U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory

EPA/600/C-99/003
December 1999

Mid-Atlantic Stressor Profile Atlas

U.S. ENVIRONMENTAL PROTECTION AGENCY

National Exposure Research Laboratory

Ecological Exposure Research Program

Regional Vulnerability Assessment Research Program

Begin...

Last Updated: March 27, 2000

Contact Information

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Preface

This ***Mid-Atlantic Stressor Atlas*** is being made available for informational use and comment only. It is being provided for information purposes to stimulate dialogue relevant to the science of comparative ecosystem risk assessment. Please provide any comments concerning this document or the ReVA program in general to Dr. Betsy Smith, ReVA Coordinator, via e-mail at smith.betsy@epa.gov.

The ***Atlas*** represents the first product of EPA's Regional Vulnerability Assessment (ReVA) program. This applied research is being coordinated by EPA's National Exposure Research Laboratory and builds on collaborations throughout EPA's Office of Research and Development and with other partners both inside and outside of EPA. The goal of the ReVA program is to provide predictive tools to inform regional decision-makers as to where future environmental problems are likely to occur and to illustrate the trade-offs associated with alternative environmental and economic policies. The ***Stressor Atlas*** represents a first step towards integrating information into a regional-scale comparative risk assessment that aims to allow targeting of limited resources towards environmental problems that are likely to emerge in the next 5 to 25 years.

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Final Cautionary Note

Please keep in mind that the colors on the stressor maps are based on *relative* concentrations or loadings. They are not intended to suggest that any stressor in any given county or watershed currently poses a risk to human or other ecosystem components.

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Acknowledgments for ReVA Stressor Atlas

In addition to those individuals who are recognized for contributing to particular stressor profiles (see "Contributors" at the end of each profile), EPA-ORD wants to acknowledge the individuals who helped create this Mid-Atlantic Stressor Profile Atlas. Ross Lunetta (ORD-National Exposure Research Laboratory)(ORD-NERL) was the stressor Team Lead responsible for the overall atlas development. Dean Carpenter (ManTech Environmental Technology, Inc.) (METI) was the technical editor of the atlas and author of numerous subsections. Jay Messer and Llew Williams(NERL) made significant contributions to the overview, conclusions / recommendations sections, and process, respectively. Jean Dye and Carol Legg of (ORD-National Risk Management Research Laboratory) provided an interim review of the atlas. Keith Endres (NERL) was the work assignment manager and GIS manager for stressor map development. Dick Dulaney (Lockheed- Martin) was responsible for map production. Jo Anne Tippett (METI) was the hypertext editor. Metadata editing was done by Casson Stallings (METI). Graphic design was by Thomas Dalby, Joseph Turner, and Casson Stallings (METI), and hypertext design was by Mark Henderson (METI). Janet Parsons (METI) provided editorial assistance

A special note of thanks is also extended to Betsy Smith (NERL) who organized and refereed the document, peer review, and reviewer reconciliations. ORD also recognizes the valuable contributions of peer reviewers Patricia Brewer (Southern Appalachian Mountains Initiative, Asheville, North Carolina), Michael L. Johnson (John Muir Institute of the Environment, University of California, Davis, California), and Mary W. Stoertz (Department of Geological Sciences, Ohio University, Athens, Ohio).

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Metadata Catalogue

Metadata is information that describes characteristics of data. This information documents the creation of data sets and includes such details as: purpose of the data set, lineage, distribution methods, and usage limitations. In the case of geographic data sets, metadata includes a description of the geographic coordinate system or projection.

The Metadata Catalogue provides metadata for each map coverage in the ReVA Mid-Atlantic Stressor Profile Atlas. It should be noted that the Federal Geographic Data Committee (FGDC) metadata standard was used as a general guideline, rather than an absolute framework, due to the variety in the map production methodology.

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Tables

Abbreviations

MASA Mid-Atlantic Study Area (ReVA)

MAIA Mid-Atlantic Integrated Assessment (EMAP)

EPA United States Environmental Protection Agency

ORD Office of Research and Development (EPA)

CBEP Community-Based Environmental Protection (EPA)

GIS Geographic Information System

ReVA Regional Vulnerability Assessment (ORD)

EMAP Environmental Monitoring and Assessment Program (ORD)

R-EMAP Regional Environmental Monitoring and Assessment Program (EPA)

EIMS Environmental Information Management System (ReVA)

RADM Regional Acid Deposition Model

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Introduction

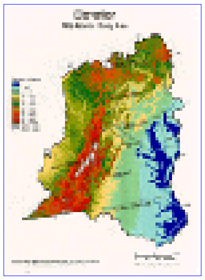
- Maps
- References

In 1990, EPA's Science Advisory Board produced a report titled "Future Risk: Strategies for the 1990's". The report called for a fundamental shift in EPA's approach to environmental protection that better addresses the impacts of multiple stressors on multiple resources. In response to this, ORD's Ecological Research Strategy outlined a core research program designed to meet the current and future needs of EPA. The four major elements of this program include: 1) Ecosystem monitoring research; 2) Ecological processes and modeling research; 3) Ecological risk assessment research; and 4) Ecosystem risk management restoration research. While primarily focusing on 3, Ecological risk assessment research, the Regional Vulnerability Assessment Program (ReVA) will contribute to each of these core research areas.

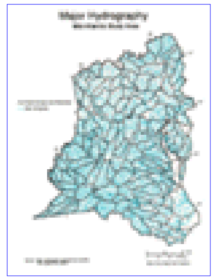
ReVA is designed to fill a gap in ORD's ecological risk assessment research by identifying, prioritizing, and forecasting risk at the regional scale with an initial pilot study in the Mid-Atlantic region. (Region is defined as a multi-state area over which broad-scale environmental policy decisions are made). Large-scale analysis is an important component of the ORD strategy because only a regional approach will prioritization of regional problems by including transboundary effects of multiple stressors and regional (to global) accounting of the associated impacts (O'Neill et al. 1997). Similarly, a regional approach is appropriate for effectively targeting risk management activities as it allows a better assessment of the true scope and magnitude of environmental problems (Hunsaker et al. 1992) as well as insight into the most cost-effective or socially acceptable ways to address the complex issues associated with multiple stresses affecting multiple resources (Graham et al. 1991). To achieve a regional scale, ReVA relies heavily on the use of Geographic Information Systems (GIS) technology to develop overlays of geospatial patterns of stressors, receptors, and ambient conditions that identify areas where exposures are likely to represent in the greatest risks. We call the spatial overlays "profiles" (exemplified by Maps 1, 2, and 3).

The initial phase of ReVA was to develop profiles based on existing information for environmental stressors across the mid-Atlantic. The objective was to place the data into a common spatial (GIS) format and make it available for ReVA analyses. This objective required a collaborative, interdisciplinary effort and resulted in the maps and descriptions in this atlas. Individual collaborators are identified in each section.

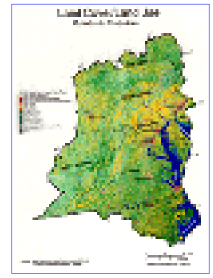
Stressor profiles were obtained by a variety of methods. In some cases, spatial data was immediately accessible, for example, census data and remote imagery for human land uses. In other cases, the information was available as point-space monitoring data. The areas between monitoring points were interpolated by several methods. In still other cases, mathematical models were used to simulate the patterns based on the distribution of their known or inferred sources. The model can be as simple as making assumptions about fertilization and runoff rates from fields, or as complicated as multimedia fate and transport models to simulate fate and transport of pollutants from monitored factory smokestacks. Specific methods are presented for each profile in the atlas.



map 1



map 2



map 3

References

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Stressor Profiles

The development of stressor profiles, or stressor characterization, is an essential element in the first phase of ecological exposure assessment. The rest of this report documents the initial efforts by ReVA staff in developing stressor profiles and their subsequent compilation as a stressor atlas. Following the publication of this document, initial efforts will begin on constructing receptor profiles to provide the other necessary elements for calculating ecosystem exposure profiles for the Mid-Atlantic study area (MASA). The publication of an exposure atlas will be the first step toward a comprehensive, knowledge-based decision support system for Mid-Atlantic risk managers, in the form of a regional information system that includes spatial and temporal distribution of ecosystem stressors, receptors, and exposures in MASA. The following sections include a discussion on how the featured stressor profiles were selected, the individual stressor profiles including metadata, and how the profiles can be accessed in electronic format.

Selection Criteria

In considering which stressor categories would be featured in this atlas, ReVA staff developed the following criteria, all of which had to be met by a candidate stressor.

- The candidate stressor appears to represent a significant hazard to regional ecosystem processes, as indicated by preliminary modeling and/or empirical (qualitative/quantitative) data.
- Its exposure pathways are known to the extent that mediating processes are sufficiently documented to support a quantitative assessment of ecological risk.
- Data, interpolation techniques, and/or models required for the development of a particular stressor profile currently exist or are technically feasible in the foreseeable future.
- A principal investigator within ORD is available with the appropriate expertise to champion the development of the stressor profile.

The specific assessment questions developed for MAIA will determine the particular metric(s) for each stressor category. The year 1992 was the designated historical base year for all stressor profiles. Given data limitations, however, the designation will be used only for guidance as the most desirable year. Future versions of this stressor atlas will include stressor forecasts for one or more target years (e.g., 2000, 2010).

Individual Stressor Profiles

Through the application of the stressor selection criteria, ReVA staff in consultation with EPA Region 3 staff have selected nine stressor categories for stressor profile development:

Acid Deposition	Landscape Pattern	Agricultural Use of Pesticides
Coal Mining	Agricultural Nitrogen	Soil Erosion/Sedimentation
Human Population	Ground-Level Ozone	Solar UV-B Radiation

This profiles of each of these stressors include the following information:

- Introduction
- Conceptual Model
- Methods
- Results
- References
- Contributors
- Profile(s)

Rather than a comprehensive model depicting all possible impacts, the conceptual models presented with each profile are designed to illustrate some of the exposure pathways to sensitive receptor types. The mapped results of each stressor are based on a quintile ranking of geographic units (e.g., counties, watersheds) whose respective colors (from low to high values) are green, green-yellow, yellow, orange, and red. Units colored gray are those with no data. Because the map colors indicate relative and not absolute measures, readers should avoid (1) making color comparisons among maps of different years for the same stressor, and (2) making assumptions of ecological impact (i.e., red does not necessarily imply high vulnerability). An accompanying equal increment histogram, whose color coding is keyed to the map, summarizes the distribution of stressor measures.

ReVA Information Database Access and Use

With the publication of this atlas, the public will have immediate access to the ReVA stressor profiles in electronic format via the Internet. The ReVA site on the World Wide Web (http://www.epa.gov/eimsreva/) includes information on the ReVA objectives, principal contacts, and the ReVA Environmental Information Management System.

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Acid Deposition

- Conceptual Models
- Methods
- Results
- References
- Contributors
- Maps

During the 1970s and 1980s, acid deposition was recognized as a cause for widespread forest decline and the disappearance of fish from many lakes in Europe and North America. It was also recognized to hasten the erosion of concrete and stone in buildings, roadways, and statues. To reduce these types of damage, Title IV of the 1990 Clean Air Act calls for the reduction of SO2 emissions by 10 million tons below 1980 levels (U.S. EPA 1998). This reduction is being accomplished by a two-phase tightening of the restrictions on fossil fuel-fired power plants. The Act also calls for a 2 million ton reduction in NOX emissions by the year 2000. This reduction is being accomplished by the implementation of new burner technologies by coal-fired power plants.

Acid deposition from the atmosphere occurs primarily in two chemical forms, sulfuric acid (H2SO4) and nitric acid (HNO3). Atmospheric emissions of sulfur compounds from fossil fuel combustion and nitrogen compounds from internal combustion engines, agriculture, and livestock production are widely recognized as the primary sources of acid deposition. Acid deposition occurs in both wet and dry forms (Fig. 3). Wet deposition of acidic sulfur and nitrogen is normally associated with rainfall and snowfall, but can also occur from suspended cloud-water droplets. Higher acidity levels have been measured in cloud and fog water than have been measured in rainfall or snowfall. Dry deposition of acidic sulfur is primarily in the form of suspended particulate matter. Dry deposition of acidic nitrogen can occur in both particulate and gaseous forms.

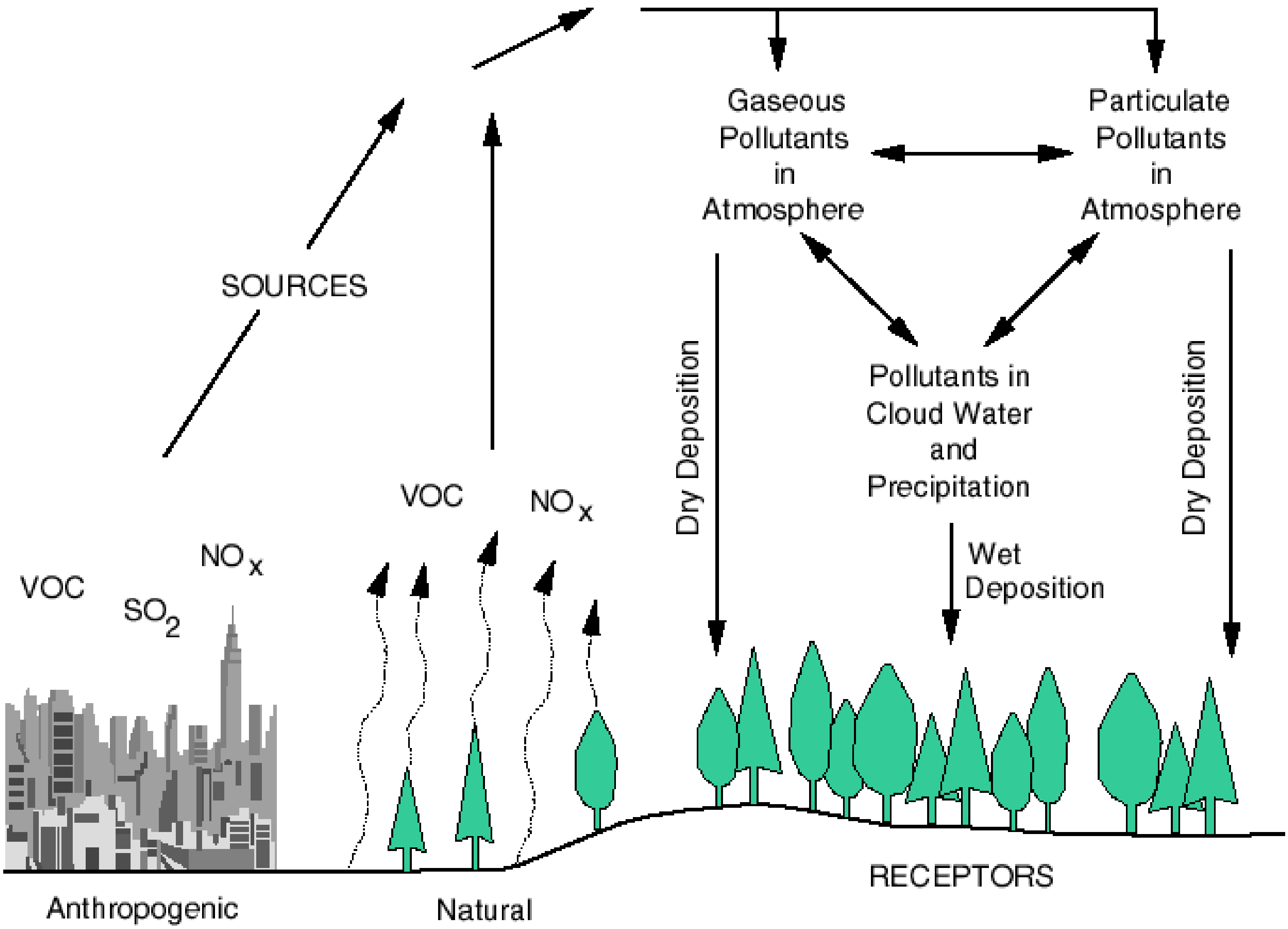


Fig. 1. Processes involved in acid deposition.

Conceptual Models

Acid deposition has a major effect on aquatic biota in areas where the geology underlying freshwaters have limited acid-neutralizing capacity. Within MASA, these areas include, but are not limited to, the mid-Appalachian highlands and the mid-Atlantic coastal plain. Obviously, the deposition of acidic contaminants directly to freshwaters is an effective acidifier, but runoff from the entire upstream watershed can also be important. While the greater exposure of aquatic ecosystems to acidic contaminants is through wet deposition, dry-deposited acidic substances can be washed from vegetation and soils by precipitation and thus contribute to the exposure. Acid deposition in both sulfuric and nitric forms can reduce the pH level of the water in lakes and streams to levels at which critical nutrient utilization is impaired at various trophic levels of the aquatic ecosystem. A further lowering of water pH can produce gross physiological damage to fish and other organisms, leaving the affected lakes and streams essentially barren in the most extreme cases. These types of ecological damage are associated mostly with chronic exposure to acid deposition, but acute effects are also observed during storms and snowmelt. The episodic events have caused large fish kills. Excess nitrogen can produce blooms of algae and bacteria, leading to hypoxic conditions deadly to fish and other large organisms.

Acid deposition can also have a major effect on forests on high mountain ridges where the canopy can intercept and accumulate acidic cloud water. Damage can occur from physiological disruption due to a higher than normal acidity and from a nutrient effect related to nitrogen deposition (Fig. 4). Exposure of coniferous canopies to nitrogen-rich rain or cloud water can delay the normal "hardening" process of the needles in preparation for harsh winter conditions. Acid deposition may also alter the chemistry of sensitive soils. As acidic water moves through the soils, vital plant nutrients can be removed.

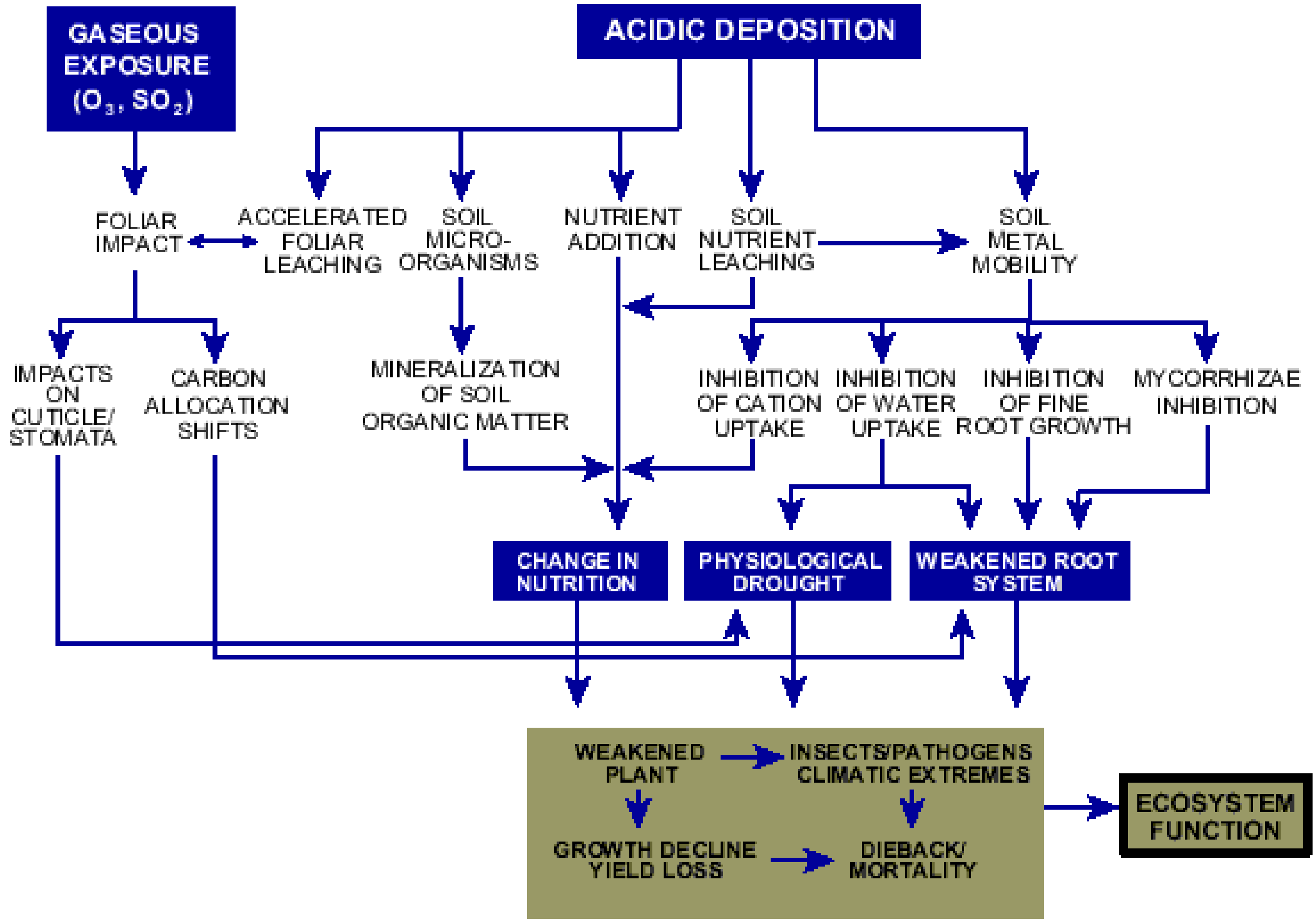


Fig. 2. Conceptual model of acid deposition.

Methods

The Regional Acid Deposition Model, or RADM (Chang et al. 1987), was developed under the auspices of the National Acid Precipitation Assessment Program to address policy and technical issues associated with acidic deposition. The model is designed to provide a scientific basis for forecasting changes in deposition and air quality resulting from changes in precursor emissions and to forecast the levels of acidic deposition in areas where receptors are sensitive. Understanding and modeling regional air quality and acidic deposition requires consideration of a complex range of physical and chemical processes and their interactions, such as (1) the emissions of precursor chemicals that produce and regulate acidity in atmospheric deposition, (2) the meteorological processes that transport and mix emitted species in space and time, (3) the physical and chemical transformations that alter the physical phases and chemical properties of emitted species, and (4) the meteorological factors and properties of the land surface that lead to deposition of acidic substances.

Given that the environmental monitoring network in MASA has a relatively low density of field sites that measure atmospheric deposition, RADM can complement these accuracy benchmarks by providing estimates of deposition rates across the topographically diverse terrain of the entire region. The version of RADM used for this analysis covers a geographic domain of 2800 by 3040 km whose boundaries range from central Texas to the Atlantic Ocean and from south of James Bay, Canada, to the southern tip of Florida. The 80-km RADM domain consists of 35 by 38 horizontal grid cells. The full 80-km RADM for sulfur, nitrogen, and oxidant studies has 15 vertical layers. The vertical layers cover the distance from ground level to 16 km in altitude, increasing in thickness with increase in altitude. For each grid cell, predictions are generated at dynamically determined time-steps of seconds to minutes and are output hourly by RADM with 41 chemical species being transported. Hourly wet and dry deposition values are also generated for each surface cell for 12 species (6 wet and 6 dry). For studies such as this one, requiring a finer horizontal resolution, a 20-km high-resolution RADM (HR-RADM) or 20-km RADM, has been defined. The

20-km RADM is nested within the domain of the 80-km RADM. The HR-RADM covers a geographic domain whose boundaries range eastward from the middle of Illinois to the Atlantic Ocean and from Sudbury, Ontario, southward to the upper section of North Carolina. The 20-km RADM domain consists of 69 by 61 horizontal grid cells. A one-way nesting method is used to provide dynamic boundary conditions from the 80-km to the 20-km model. HR-RADM has 15 layers in the vertical, the same as for the full 80-km RADM.

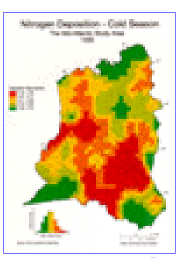
The principal acids in deposition are sulfuric (H_2SO_4) and nitric (HNO_3). Thus, emissions of compounds containing sulfur and nitrogen have received primary emphasis in acid deposition simulation. However, volatile organic compounds (VOCs) and their oxidation products are equally important because they are precursor compounds, involved in reactions that produce the oxidizing species that lead to formation of sulfuric and nitric acids in the atmosphere. Because only emissions from the year 1990 were used to represent baseline emissions, an estimate of interannual variability is unavailable. The RADM chemistry component consists of 157 reactions among 63 species, 40 of which are organic compounds. Chemical decomposition by solar radiation (photolysis) is included in the model chemistry, as are aqueous-phase reactions that occur in clouds.

The meteorological fields used to drive the RADM are from the Mesoscale Model (MM5) of the National Center for Atmospheric Research, Pennsylvania State University. The MM5 is run by using four-dimensional data assimilation (Stauffer and Seaman 1989; Stauffer et al. 1990) to produce the most accurate hindcasts (recreation of past weather) for the chemical model. Because RADM simulates atmospheric chemistry on a time scale of only a few days, an aggregation technique was used to develop annual estimates of acidic deposition. Meteorological cases with similar wind flow patterns were grouped by applying cluster analysis to classify the wind flow patterns from 1982 to 1985; this resulted in 19 sampling groups, or strata. Meteorological cases were randomly selected from each stratum; the number selected was based on the number of wind flow patterns in that stratum relative to the number of patterns in each of the other strata, to approximate proportionate sampling. A total of 30 cases are used in the current aggregation approach. Deposition results for the 30 selected cases are weighted according to the strata sampling frequencies to form annual averages. While preliminary tests of model accuracy suggest that the estimates of sulfur and nitrogen levels are generally within 25% of monitored data, no formal accuracy assessment of HR-RADM output has been conducted for MASA.

Results

Modeling results are shown in the four thematic maps that follow (Maps 4-7).

For the cold season (October-March), the two areas of highest nitrogen deposition within MASA are from central North Carolina into eastern Virginia and from extreme southeast Ohio through northern West Virginia and extreme southwest Pennsylvania into western Maryland. During the warm season (April-September), the highest nitrogen deposition in MASA is again in the upper Ohio River valley, but now extends over the entire western half of Pennsylvania and includes most of the central metropolitan areas between Washington, D.C., and New York City. The areas in North Carolina and Virginia with high nitrogen deposition for the cold season do not show similar high deposition of nitrogen for the warm season.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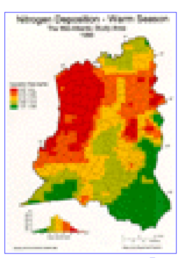
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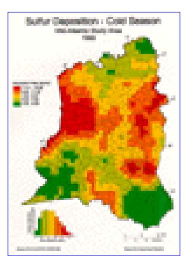
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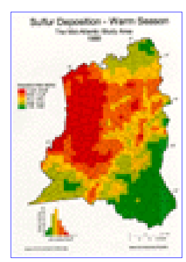
Map 7 Metadata

For the cold season, the highest sulfur deposition within MASA is in a large area of eastern Ohio, northern West Virginia, and western Pennsylvania; in a second area from the northern Chesapeake Bay to New York City; and in small isolated areas around larger cities in eastern Virginia and north-central North Carolina. For the warm season, the highest sulfur deposition in MASA is located almost entirely in a large region from eastern Ohio and northern West Virginia through most of the western half of Pennsylvania.

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Contributors

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Robin Dennis, NOAA--Air Resources Laboratory, RADM model output

Renee Jaramillo, Applied Sciences, Inc., RADM model output

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Coal Mining

The Western Allegheny and Central Appalachian Plateaus are major coal-producing regions in the United States. During the past century, coal mining in the Appalachian region has contaminated streams with acidic waters and metallic sediments (Appalachian Regional Commission 1969). Runoff and drainage from both active and inactive coal mine sites are contaminating MASA streams with acidic and metallic waters and sediments. More than 66,500 documented sources of coal mine drainage in Appalachia have polluted an estimated 17,000 km of streams (Appalachian Regional Commission 1969; Cohen and Gorman 1991). In addition to these chemical perturbations, road building, mine site construction, and strip mining have impaired the physical habitat of streams adjacent to mining sites through channelization or sedimentation (Starnes and Gaspar 1995).

In early 1995, the Office of Surface Mining (OSM) and EPA's Region 3 developed a strategic plan to implement the provisions of a Statement of Mutual Intent on improving and restoring water quality that has been degraded by mine drainage from abandoned coal mines in the states of Maryland, Pennsylvania, Virginia, and West Virginia. The objectives of this strategic plan are to cooperate as a regional clearinghouse for shared data and information related to identifying mine drainage sites, develop shared information management systems, and develop a national clearinghouse for mine drainage information. A long-term goal of this program is to develop a joint EPA/OSM spatial database of sites impacted by mine drainage.

Conceptual Models

Many potential stressors are associated with mining activities (Fig. 5). The physical and chemical stressors associated with mining are reflected by the composition of biological assemblages and the energy and material flows of the ecosystem (e.g.,Clements et al. [1992]; Starnes [1985]; Hill et al. [1997]). The principal response to physical habitat degradation is loss of biological diversity (fish, macroinvertebrates, algae) at both local (stream) and landscape (watershed) scales. Accelerated morbidity and mortality can also occur. Overall ecosystem function degrades.

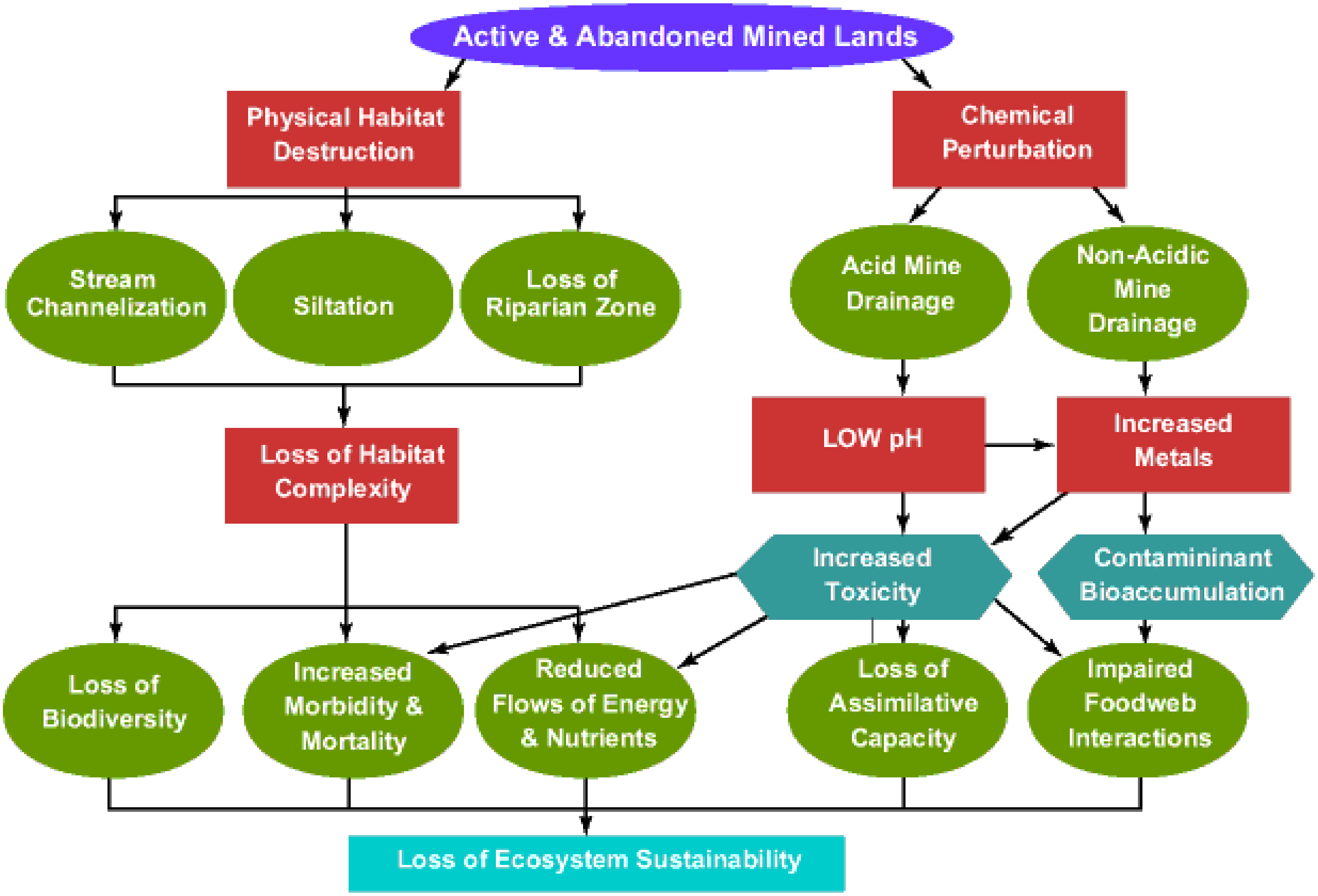


Figure 3. Conceptual model of exposure of streams to coal mining.

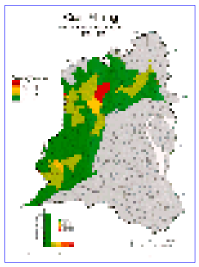
Chemical perturbations can be either a combination of acid and metal impacts, or metal impacts alone. Both types of chemical impacts increase the toxicity of sediments and overlying waters and the bioaccumulation of metals by surviving species (e.g., Burton et al. 1987). Other impacts include loss of assimilative capacity, impairment of trophic interactions, and an overall reduction of energy and nutrient flows (e.g., Carpenter et al. [1983] and Moore et al. [1991]). The combined effect of chemical and physical stressors on stream ecosystems is a decline in ecosystem health. All streams flowing through the coal-bearing areas of the MASA are potentially vulnerable to the impacts associated with mining.

Methods

The potential impact of mining on streams was assessed by determining the extent of mining activity within a U.S. Geological Survey (USGS) hydrologic unit and its proximity to streams within that hydrologic unit. Because mining impacts are limited to that portion of MASA underlaid by coal-bearing geology, only those hydrologic units in the coal-bearing region were considered. Total mining area was estimated by using spectral signatures for coal mining developed for the middle Appalachian region by EPA Region 3. This data, acquired from thematic mapper (TM) satellite imagery of years 1988-1993, can distinguish coal mines (which are spectrally dark) from other land surface disturbances. Spatial accuracy assessments of the areal estimates are unavailable. Because the data represent an initial baseline for mining area estimates and no subsequent areal estimates have been made, an estimate of interannual variability is also currently unavailable. Although there is evidence that abandoned mines contribute significantly more toxic runoff than do active mines (Appalachian Regional Commission 1969, Cohen and Gorman 1991), the distinction cannot be obtained from the TM images. The absolute area of mining within any hydrologic unit was used to score the potential severity of mining impacts. Since drainage density (cumulative stream length within a hydrologic unit per surface area of the hydrologic unit) in this region is high, all streams are assumed to be in close proximity of mining activity proportional to that stressor's presence. This impact score was then applied to all streams within that hydrologic unit, based on EPA's Reach File 3, which catalogs streams based on 1:100,000-scale USGS maps.

Results

By overlaying coal mine area onto stream drainage, the extent of MASA streams impacted by mine drainage was estimated (Map 8). Three percent of the streams are very vulnerable because of their proximity to the most intensive mining class, while 66% are in the least vulnerable categories.



Map 8 Metadata

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December 1999

Mid-Atlantic Stressor Profile Atlas

Human Population

In a now classic formulation of how aggregate societal factors impact the environment (Ehrlich and Holdren 1971), the environmental impact (I) of humans is presented as the product of their population size (P), an affluence factor (A) representing per capita resource use, and a technological or efficiency factor (T) representing the impact per unit of resource used. All other things being equal, increasing numbers of people make an increasing impact on the environment and the U.S. population continues to increase. Middle range projections by the U.S. Bureau of the Census (USCB; Day 1996) put the U.S. population at 392 million by the year 2050--approximately a 50% increase over the current population of 266 million (Fig. 6). The high-end estimates suggest the U.S. population could double.

While MASA is projected to have a relatively low growth rate when compared to other U.S. regions, some of its states--Maryland, Virginia, New York, New Jersey, and North Carolina--are projected to gain more than 1 million persons each by the year 2025 (Campbell 1997). The growth will continue to be concentrated on the Eastern Seaboard, thereby putting increasing pressures on estuaries in the region.

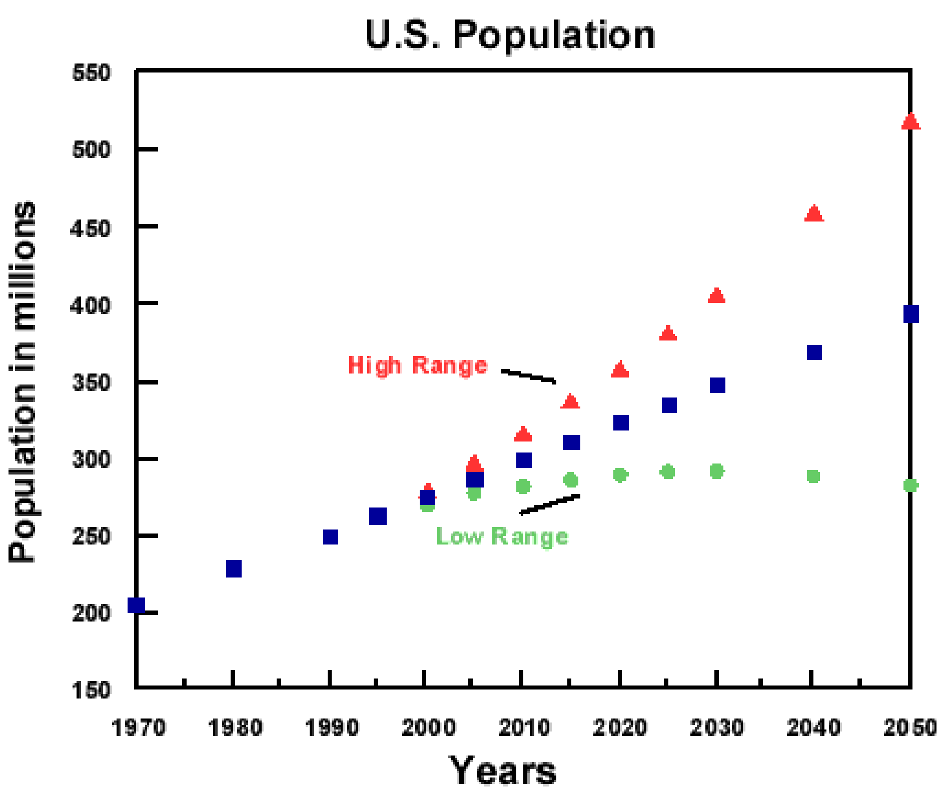


Figure 4. Projected U.S. Population Growth.

While the net interstate migration is predicted to be low and generally negative in most of the mid-Atlantic states through 2025, international immigration into the region will be substantial. Five (New York, New Jersey, Virginia, Maryland, and Pennsylvania) of the top 10 states with respect to projected net increase in immigrants are within MASA. Within the region, only North Carolina is projected to have the high net rates of interstate migration that are expected along the South Atlantic seaboard. The demographic dynamics of the Western half of the region are typified by West Virginia, the only state in the region without ocean access. The population in West Virginia is one of the oldest in the nation, and deaths are expected to exceed births through the year 2025, the only state in the union where this is expected to be the case. Net population is expected to increase in West Virginia, however, as a result of a net positive interstate migration--a reversal of trends observed since the early part of the century.

Not only are the ecological consequences of increasing populations significant, so too are other demographic trends such as the decline in the number of persons per household. Demand for many goods and associated environmental impacts, including energy use and residential land, is more closely tied to the number of households rather than the number of individuals (McKellar et al. 1995). Between 1960 and 1990, the average number of persons per U.S. household dropped from 3.35 to 2.63. This number is expected to continue dropping through the middle of the century although at a lower rate. This continuing decline in household size will be fueled in part by the aging of the U.S. population--its age structure is projected to shift dramatically in the next 30 years as the number of citizens older than 65 doubles. Overall, the populations of Virginia and Maryland tend to be younger than the other states in the region, but all of the states will have a significant increase in the percentage of elderly.

In addition to population size and structure, the spatial distribution of the population continues to evolve. The increase of land in developed use has significantly exceeded the growth rate of the population itself. Across the United States, central cities have lost population following the proliferation of automobile use. The population of both Baltimore City and Washington, DC, declined by more than 20% between 1970 and 1995 while the surrounding counties had a very rapid growth rate--in many cases more than doubling within 25 years. Population has sprawled in a leapfrog pattern of development, consuming both agricultural and forest lands. This has reduced the amount of available faunal habitat as well as fragmenting that which remains.

Until recently, the most rural areas across the United States and in the mid-Atlantic have lost population. Between 1990 and 1995, however, the trend has reversed, and rural counties across the United States have experienced a net growth. Although the net growth is very small, this phenomenon may be the beginning of a long-term trend as changing communication technologies allow businesses to relocate to rural communities and individuals to telecommute. Since land-use change per additional household is much greater in rural than urbanized counties (Vesterby and Heimlich 1991) this trend could further accelerate habitat destruction in the region.

Conceptual Models

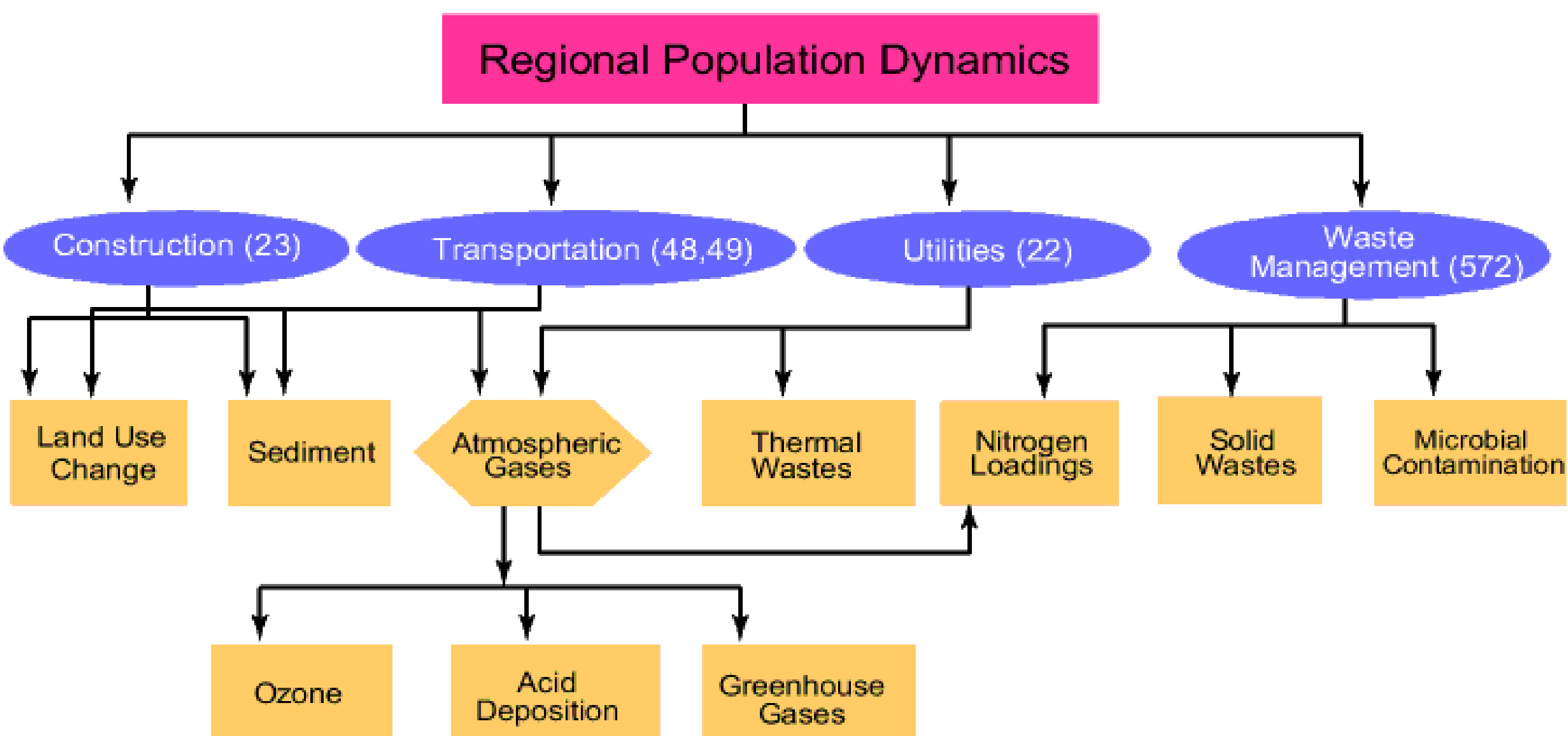


Figure 5. Conceptual model of human population dynamics.

(Numbers on the diagram for the economic sectors refer to the North American Industrial Classification System categories)

Regional populations have a direct impact on certain economic sectors, including construction, transportation, utilities, and waste management. Increased sectoral activity produces specific stressors (Fig. 7). Although global increases in population would be expected to increase demand in the resource sectors (agriculture, forestry, mining), the production in these sectors on a regional scale may in fact be displaced, and activity in these sectors may subsequently decrease as the population increases. Population growth can be thought of as a master stressor that increases the production of many of the stressors described elsewhere in this atlas. Examples include sediment production, ozone, and acid deposition.

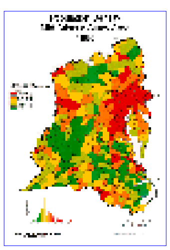
Three population indicators are included to describe the population stress across MASA: 1995 population density, growth rate from 1990 to 1995, and change in annual growth rate from 1980-1990 to 1990-1995.

Methods

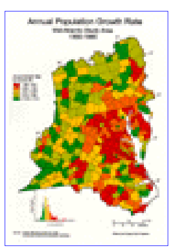
The first indicator, population density, was calculated as number of individuals per square mile in 1995. Data are based on USCB county-level intercensus population estimates (USCB 1996). Data for Virginia's small independent cities were merged with the surrounding county prior to construction of this map (Map 9). The second indicator, annual population growth rate from 1990 to 1995, was calculated by county. Values were calculated from the USCB 1990 census data and 1995 county-scale intercensus population estimates (USCB 1996). The third indicator, change in the annual growth rate from the 1980-1990 to 1990-1995, was also calculated by county. Values were calculated from the USCB 1980 and 1990 census data and 1995 county-scale intercensus population estimates (USCB 1996).

Results

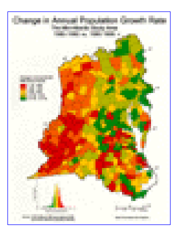
Regarding population density (Map 9), the resultant county areas coded in red represent areas which are primarily urban and suburban in nature. The majority of these counties are located in the east coast megalopolis extending from Philadelphia, Baltimore, and Washington, DC, and surrounding suburban counties. Other metropolitan areas in this upper quintile of the region highlighted here include Pittsburgh, PA; Richmond, Roanoke, and Norfolk/Newport News, VA; and Raleigh/Durham, NC. The green areas are low-density rural areas.



Map 9



Map 10



Map 11

Metadata

Regarding annual population growth rate from 1990 to 1995 (Map 10), the highest growth rates (coded in red) represent a doubling time from 10 to 45 years. High-growth areas are located predominantly in the eastern half of the region in suburban fringes or newer boom areas such as Raleigh/Durham, NC. This is in contrast to those counties where population growth is negligible or on the decline, including both urban centers and low-density rural counties. The pattern of a declining urban center surrounded by a rapidly growing circle of suburban counties is repeated throughout the region. In several locations, such as surrounding Washington, DC, the declining urban center is surrounded by a moderating first ring of growth and a rapidly growing secondary ring.

Regarding change in annual growth rate (Map 11), while growth may still be high in some of these areas, a significant decline in growth rate has occurred since the 1980s. Counties with declining growth rates are shown as dark green. Growth rates are accelerating in much of the western half of the region, however. Although growth rates are low through most of West Virginia, western Pennsylvania, and western Virginia, the trend is upward. For example, during the 1980s, West Virginia suffered an annual average decline of 0.8%, but during the 1990-1995 period has had an estimated average annual increase of 0.4%. This pattern reflects a national trend where rural counties overall experience a decline in population through the 1980s but have increased during the 1990s.

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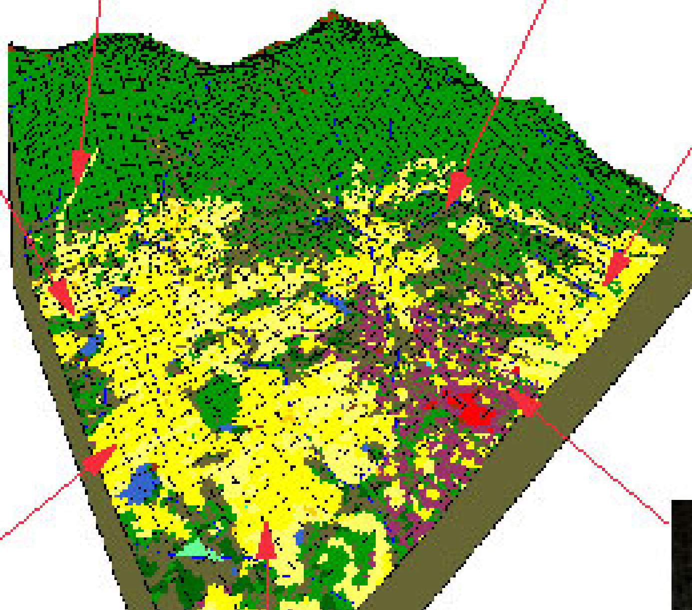
Agriculture on steep slopes increases soil loss and loadings to streams

Forest Practices Influence Patch Sizes and Connectivity

Dams alter habitats and the hydrology of streams



Roads near streams increase sediment and pollution loadings

Agriculture near streams increases stream sediment and chemical loadings and reduces riparian filtering capacity

Population growth results in loss of forest and change in overall watershed conditions

The type, amount and location of agriculture in a watershed influences overall watershed conditions

The mountains, valleys, and coastal plains form the backdrop for all of the physical and ecological processes shaping landscape patterns across the Mid-Atlantic region. Topographical variation in the mid-Atlantic states creates one of the most diverse physical and ecological regions in the nation. In the western section of MASA, the Appalachian Mountains rise thousands of feet to dominate the landscape for hundreds of miles in any direction. Landscapes in the Appalachians tend to be dominated by large blocks of continuous forest because the topography precludes any large scale development (except mines). Here one would expect to find streams with the cleanest water. The great valley of the Appalachians, stretching from Pennsylvania to Alabama, provides fertile agricultural lands and gently sloping areas for human development. These valley areas tend to be dominated by large blocks of farmland. Here we might expect to find losses of riparian zones, increased sediment loads to streams, and direct agricultural chemical input to streams, especially where patches of agricultural lands are adjacent to streams or are on steep slopes (> 3%). To the east of the Appalachians, the Mid-Atlantic coastal plain stretches to the Chesapeake Bay and coastal areas of Delaware, Maryland, Virginia, and northern North Carolina. Human communities (urban, residential, and agricultural lands) in these areas tend to be more complex and of finer scale than patterns in the ridge and valley areas to the west. This pattern results from fewer biophysical constraints (e.g., slopes) on development. MASA contains several estuaries, including the Chesapeake Bay, one of the most important natural resources in North America. The estuarine and wetland habitats surrounding this and other bays are associated with lowland areas and slowly draining soils that have been washed from the western mountains.

Conceptual Models

One indicator of this conversion to human dominance is simply the proportion of a landscape in anthropogenic cover. The proportion of a watershedís total area in anthropogenic land cover (urban and agricultural) is termed the U-Index. This stressor can lead to impacted freshwater biota as a result of (1) management practices and infrastructure that increase the probability of soil loss, erosion, and accelerated sediment transport, (2) loss or fragmentation of vegetation that lowers the energy dissipation potential of the watershed and increases erosion, and (3) loss of riparian areas that reduces the sediment- and contaminant-filtering capacity of the watershed (Fig. 8).

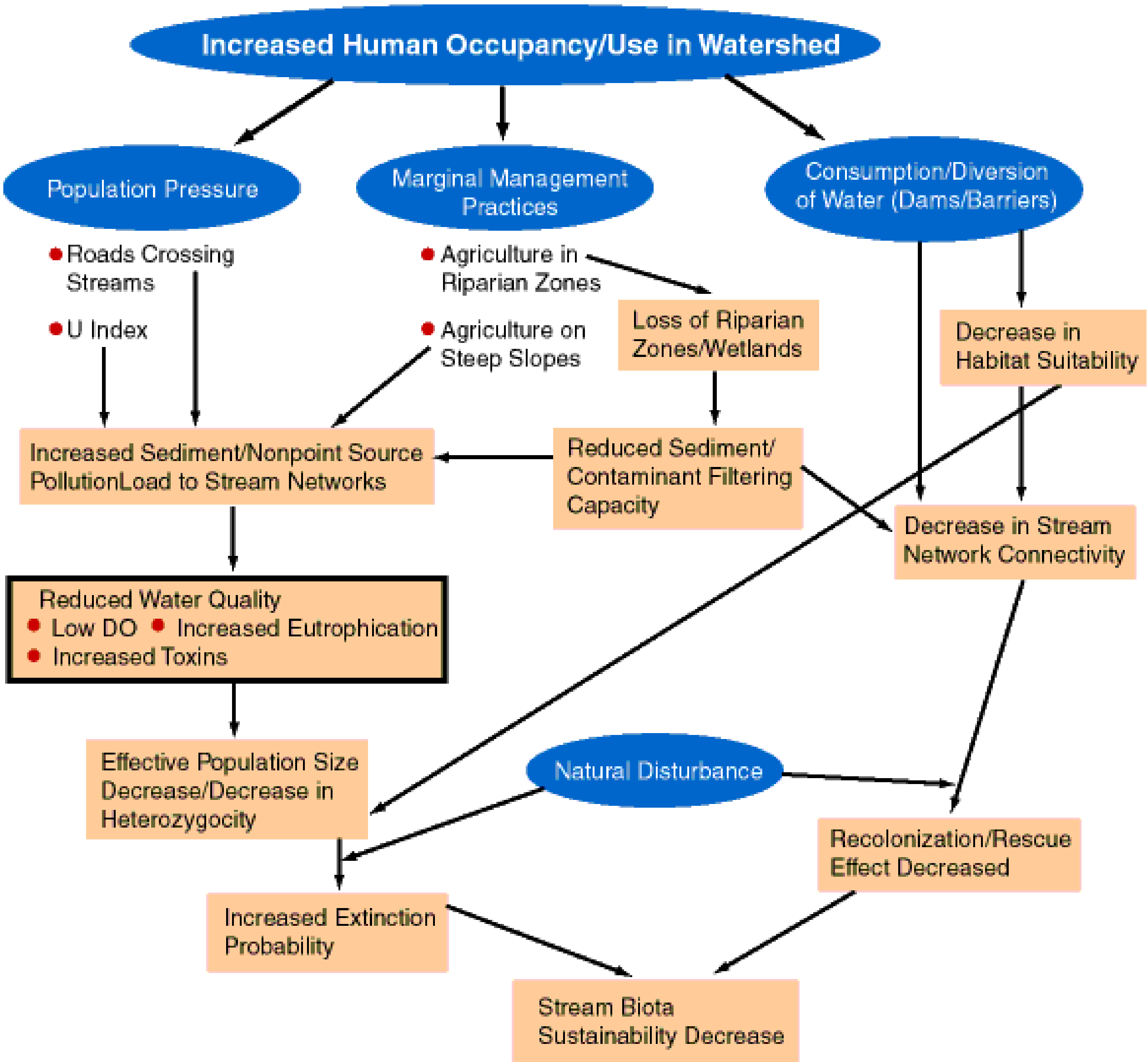


Fig. 6. Conceptual model of the exposure of the landscape to stressors.

Two additional stress indicators of landscape pattern are management practices and infrastructure that result in reduced soil stability and increased erosion: (1) agriculture on steep slopes and (2) roads that cross or are near streams (Riitters et al. 1996). Agriculture on steep slopes is an indicator of marginal agricultural practices that often result in soil loss and increased sedimentation to streams. Agricultural lands on steep slopes are quite vulnerable to soil loss, especially in areas with intense precipitation events, because the soils are often exposed to direct rainfall that breaks up the soil surface, and because steep slopes enhance water movement across the surface (through gravity [Wilson 1986]). Sediments and agricultural chemicals lost from agricultural lands end up in streams through run-off, decreasing the water quality, habitat quality, and habitat amount in streams (Fig 8). Roads that cross or that are near streams act as conduits for water, sediment, and chemical input into streams (Fig. 8).

A fourth indicator of landscape pattern, agriculture near streams, represents the potential loss of riparian buffers and direct sediment and toxic loadings to streams. Whereas the distribution of riparian forests is an indicator of natural buffering capacity, the distribution of agricultural land cover in riparian zones is an indicator of potential problems. Loss of riparian vegetation reduces the riparian zoneís ability to filter sediments coming into a stream from overland flow (Lowrance et al. 1984, 1985; U.S. EPA 1995; Fig. 8). The result is increased sediment loadings to streams. Moreover, agricultural lands near or in the riparian zone are direct sources of pesticide and other toxic chemical loadings into streams (Fig. 8).

Negative effects of human-induced landscape changes on stream condition may not be immediately apparent because of fundamentally different temporal and spatial scales in which local stream segments and watersheds operate (Hunsaker and Levine 1995; Sparks 1995). Stream segment conditions can reflect near-site disturbances and watershed-level disturbances. The "noise" introduced by near-site factors can camouflage the effects of ongoing watershed-level changes. Therefore, it is important to understand explicit hierarchical relationships of various aspects of stream condition (e.g., water chemistry, physical habitat, fish population sizes) with various landscape and watershed-scale properties (Sparks 1995; Frenzel and Swanson 1996). Moreover, broad-scale and intensive precipitation events that occur on the order of years to decades may be necessary to overcome an energy threshold to move large amounts of sediment across a degraded or partially degraded watershed (as described above [Junk et al. 1989; Sparks 1995]). It is during these events that human-induced landscape changes may manifest their greatest negative impact.

Methods

To analyze the four landscape stressor indicators described aboveóU-Index, roads crossing streams, agriculture on steep slopes, and agriculture near streams, four sources of data were used: (1) 1:100,000-scale Digital Line Graph data for roads from the U.S. Geological Survey (USGS), (2) U.S. EPA River Reach File 3 data, (3) 90-m Digital Elevation Model data from the USGS, and (4) 30-m land cover data from the Multi-Resolution Land Characteristics (MRLC) Consortium (Jones et al. 1997). Digital coverages of these data were obtained from the USGS EROS Data Center, or via EPA Region 3. The data were imported into a geographic information system using Arc/Info software and combined and analyzed in various ways to produce each of the four indicators (discussed below). Spatial accuracy of areal estimates from the MRLC coverage are unavailable. Because the data represent an initial baseline for landscape pattern estimates, an estimate of interannual variability is also currently unavailable. EPA Region 3 versions (mosaics) of each of these data sets were used rather than the available Mid-Atlantic-wide mosaics because of problems in data accuracy in the Mid-Atlantic-wide coverages.

Indicators were summarized by USGS Hydrologic Unit Codes (8-digit HUCs) for only those watersheds within the EPA Region 3 boundary because only EPA Region 3 mosaics were used (as stated above). The indicators will be recalculated for all HUCs when the data accuracy problems are resolved.

U-Index. This map was produced by using a "cookie-cutter" procedure to extract the land cover information for each watershed separately. The number of pixels with agricultural or urban land cover was then counted in each watershed, and the total was divided by the total number of pixels for a given watershed to yield the watershed-specific index measure.

Roads Crossing Streams. This indicator represents the proportion of stream length within 30 m of roads by 8-digit USGS watersheds. The occurrences of roads within 30 m of streams were tabulated from USGS stream and road maps. Road and stream coverages (Arc/Info) were converted to a raster format with 30-m pixels and then overlaid. Individual watersheds were then cookie-cut out of the base grid. The number of pixels where both a road and a stream occurred was divided by the total number of stream pixels to obtain a watershed-specific measure.

Agriculture on Steep Slopes. This map was produced by overlaying a slope coverage and the land cover coverage. Percent slope was calculated from the digital elevation model as the vertical rise in elevation per horizontal distance traveled. After the two coverages were overlaid, the cookie-cutting technique previously described was used to determine the proportion of watershed area that was crop or agriculture on slopes of greater than 3%.

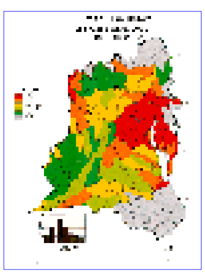
Agriculture Near Streams. This map was created by converting the stream coverage to a raster format with 30-m pixels. This raster version was overlaid on the land cover coverage to determine the stream length that flowed through agricultural land cover. The length of streams flowing through agricultural land cover was divided by the total length of streams in each watershed to arrive at the index measure. A 30-m pixel size was used because it was consistent with the pixel size of the land cover map.

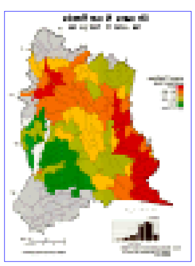
Results

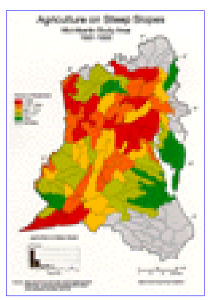
Analytical results are presented in the subsections that follow and in the four accompanying maps and charts.

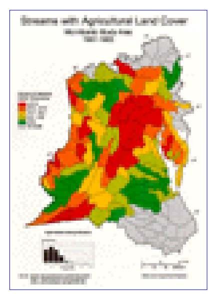
U-Index. The regional pattern of human use is reflected in the watershed rankings over the region (Map 12). The accompanying bar chart shows that the highest U-Index value for a watershed is about 70%, which means that 70% of that watershed has agricultural or urban land cover. The lowest value is about 3%, and the median value is about 30%. The proportion of area with urban or agricultural land cover exceeds 50% in about 15 watersheds, and about the same number of watersheds have U values of less than 10%. The greatest levels of human use are in watersheds around the Washington-Baltimore and Pittsburgh metropolitan areas, and the lowest values are in northwestern Pennsylvania and West Virginia.

Roads Near Streams. The regional pattern of roads along streams (Map 13) is somewhat unexpected because many of the watersheds with a high incidence of roads along streams are located in relatively remote areas that have fewer roads. The explanation lies in the topography of the region. Road construction is more difficult in steeper topography, and as a result, the roads are often located in the relatively flat areas along stream beds. Furthermore, the highly dissected topography that is characteristic of the Appalachian Plateau often forces the roads to cross streams several times in a short distance. So while there may be fewer roads, most are located adjacent to streams and hence have relatively high values for the indicator.


Map 12


Map 13


Map 14


Map 15

Metadata

Agriculture on Steep Slopes. Every watershed in MASA has some agriculture on steep slopes (Map 14). The proportions are lower in remote mountainous areas, where less agriculture exists, and in some predominantly agricultural regions such as the Delmarva peninsula, where steep slopes are rare. The combination of steep slopes and agriculture occurs most often on the foothill margins of the great valleys in the Mid-Atlantic region, where agriculture is a dominant local land use.

Agriculture Near Streams. Although only a few watersheds have more than 30% of their stream length with agricultural land cover (Map 15), every watershed has at least some agriculture in the riparian zone. The watersheds with the highest potential for negative impacts are in eastern Pennsylvania, Maryland, and northern Virginia.

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U.S. Environmental Protection Agency
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December 1999

Mid-Atlantic Stressor Profile Atlas

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Agricultural Nitrogen

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- Methods
- Results
- References
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Nitrogen is an essential nutrient used in natural and synthetic compounds to enhance plant growth. Agricultural use, such as for crops and pasture, accounts for the majority of nitrogen application nationwide. Agricultural operations are not only important receptors of nitrogen, but are large sources of the nutrient as well. For example, annual U.S. production of manure by farm animals contains an estimated 6.5 million tons of nitrogen (Nolan et al. 1997). When unused by plants, excess nitrogen can seep into groundwater and cause adverse environmental impacts when subsequently discharged into streams (Ator and Denis 1997). National discharges of nitrogen have increased almost 20-fold since 1940 (Turner and Rabalais 1991). Those lands where agriculture dominates tend to have the highest discharges nationwide (Hill 1978); an estimated 39% of nutrients in the Chesapeake Bay are derived from agriculture (Chesapeake Bay Program 1995).

EPA is responsible for protecting aquatic ecosystems from excessive nitrogen contamination, including that from the inorganic (e.g., fertilizer) and organic (e.g., manure) constituents of agricultural applications (U.S. EPA 1998). Agency responsibility comes from a mandate through the Clean Water Act to establish regulations for evaluating the loading of particular chemicals. One such regulation involves the development of Total Maximum Daily Loads (TMDLs), which identify the total amount of any pollutant that a particular water body can receive and still meet water quality goals. EPA also sets the minimum regulations for livestock facilities. Large livestock production units are incorporated in the National Pollutant Discharge Elimination System (NPDES), which requires a permit under certain circumstances. The trend toward consolidation of animal production to large, confinement-type operations has steadily increased in the past 20 years, and they are not fully encompassed in the 20-year old NPDES standards. These "factory farms" are largely unregulated because they are not required to show how they will meet Clean Water Act standards for waste management. Despite past regulatory efforts surrounding agricultural operations, agricultural nonpoint pollution is a major source of quality impairment for waters assessed in all 50 states (U.S. GAO 1995).

Recognizing that water protection policies of the past have failed to concentrate on animal waste and agricultural runoff, a new federal "Clean Water Action Plan" forges a new era for our nationís water protection policies. The plan outlines more than 100 specific federal actions and goals forging a partnership between several agencies. One of the objectives of the plan is to target runoff from farms, suburbs, and cities, including a new strategy for regulating wastes from large animal feeding operations. Because most water quality problems are caused by runoff largely from agriculture, under this plan EPA will work with the U.S. Department of Agriculture (USDA) to help implement TMDLs. Water quality criteria for nitrogen will be established, thus leading to enforceable water quality standards (Blankenship 1998). Another initiative in part designed to contribute to improvement in agriculture practices is the "Know Your Watershed" campaign, a national partnership of 50 corporations, conservation groups, commodity growersí associations, and federal agencies. Nutrient management has become a collective effort by federal, state, and local governments and industries in association with farmers and ranchers.

To help ensure the effectiveness of near-term regulatory strategies, a regular evaluation of regional vulnerability from the introduction or continued use of particular chemical applications is required. Much of the attention to nitrogen has focused on the stress from surface and subsurface runoff and exposure to surface waters. Aquatic impacts from nitrogen exposure include algae blooms, depletion of oxygen levels, and subsequent loss of aquatic biota. Additionally, excessive nitrogen can impact human health when groundwater containing elevated concentrations contaminates well water (e.g., blue baby syndrome).

While natural sources of nitrogen exist, elevated concentrations are typically caused by human activities. Anthropogenic (human) sources of nitrogen are classified into two types: (1) point sources from atmospheric deposition (fossil fuel combustion, e.g., gasoline-powered vehicles, coal- and oil-burning electric utilities) and wastewater and septic systems and (2) nonpoint sources, such as animal wastes from confined areas and applied manure and commercial fertilizers (Ator and Denis 1997).

Once dispersed in the air, point sources from coal- and oil-burning electric utilities, automobiles, and other forms of transportation become nonpoint sources deposited regionally on the land in wet and dry forms. Although only agricultural nitrogen sources in the Mid-Atlantic are addressed here (see "Methods"), other major sources of nitrogen pollution in this region include the aforementioned industrial and transportation sectors, as well as the high population segments and urban sources. Specific examples of the latter are septic tanks, wastewater, and fertilizer use on lawns and golf courses.

Conceptual Models

Excess nitrogen in waste, fertilizer, and precipitation can leach to the subsurface as organic N, ammonium (NH_4) or nitrate (NO_3^-). Organic N and nitrate leave the landscape via surface water runoff. The mobile form of nitrogen in the subsurface is as nitrate, and several chemical and biological reactions transform the nitrogen to this form. Nitrate is also the major form of nitrogen that plants take up and convert back into organic nitrogen as plant tissue, thus completing the cycle. Nitrate moves via groundwater and leaves the subsurface as base flow to the streams. Denitrification in the subsurface can transform the nitrogen to gaseous form, which then diffuses into the atmosphere (Fig.10).

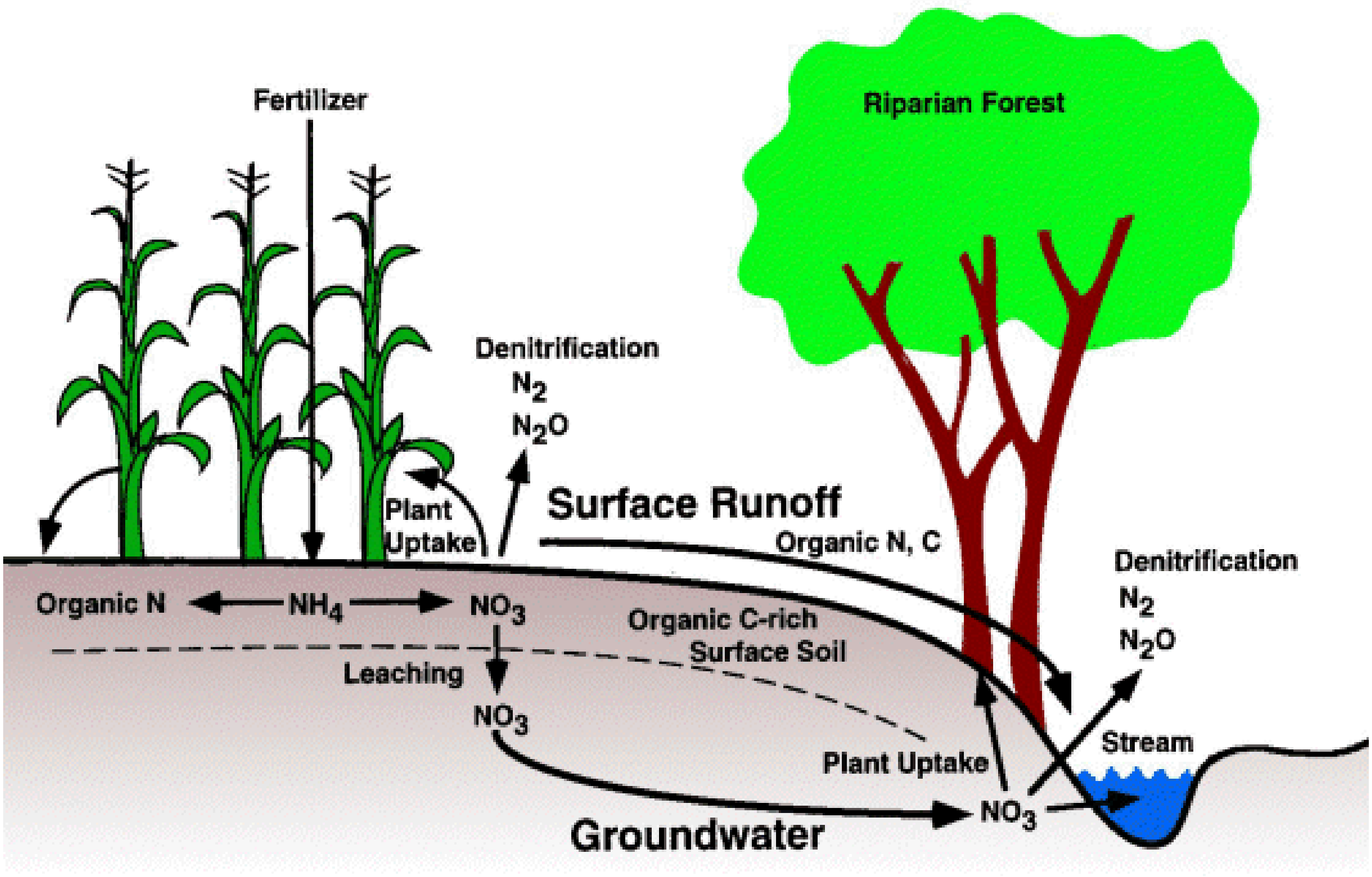


Fig. 7. Conceptual model of nitrogen transport. (after Jordan et al. [1997]).

The amount of agricultural nitrogen becoming a pollutant to ground and surface waters in the Mid-Atlantic depends on farming practices across the whole region, whether the soils are well drained, and the woodland-to-cropland ratio. Further, nitrate concentration in groundwater is affected by local land use, aquifer type, rainfall and irrigation amounts, and the timing of rainfall in relation to fertilizer and manure applications (Nolan et al. 1997). Because of the generally well-drained soils and high nitrogen input from fertilizer, manure, and atmospheric deposition, some of MASA (portions of Pennsylvania, Maryland, Delaware, Virginia, and North Carolina in particular) has high *potential* for contamination of shallow groundwater by nitrate (USGS 1996). About half the high nitrate concentrations that contribute to the decline of fish populations in nontidal streams and rivers flowing into the Chesapeake comes from groundwater (USGS 1997). The average travel time of underground water (groundwater) from when it enters the water table to when it discharges to a stream or river is 10 to 20 years, with the longest measured travel time at 50 years; it will take decades for all the nitrate to be flushed from the underground reservoirs or aquifers (USGS 1997).

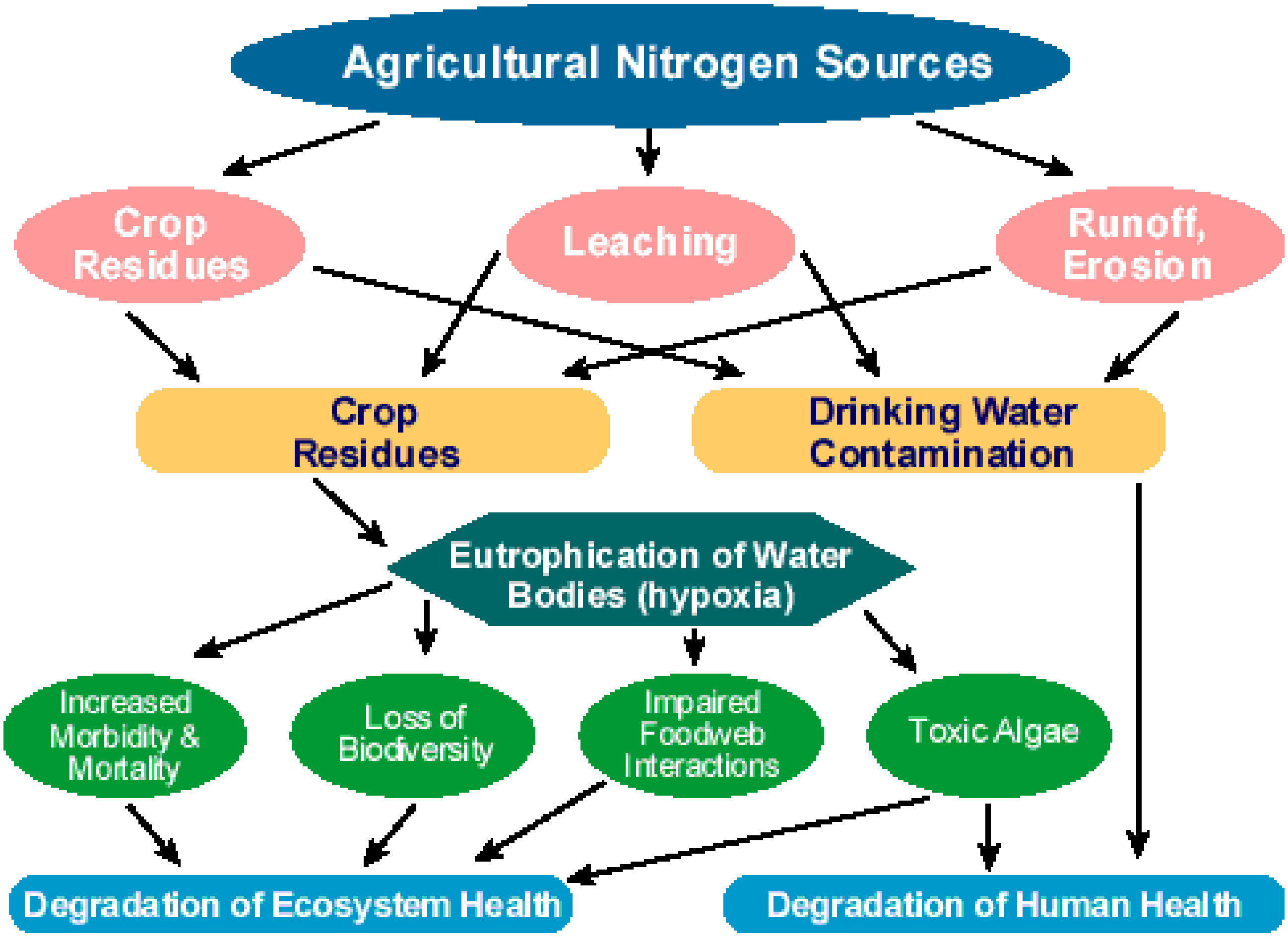


Fig 8. Conceptual model of exposure to nitrogen stressors.

Possible aquatic impacts of nitrogen contamination are many (Fig. 10). The discharge of nitrate to water bodies such as lakes, estuaries, and coastal waters is the major cause of eutrophication (Nixon 1995). As discussed above, groundwater can also contribute to much of the nitrate discharges to surface water (Jordan et al. 1997). Upon reaching aquatic systems, nitrogen may have many different effects on phytoplankton and rooted aquatic macrophytes (Kemp et al. 1983) and may increase the extent of waters with low concentrations of dissolved oxygen (Taft et al. 1980). Excessive nitrogen inputs can also lead to seasonal depletion of dissolved silica and altered phytoplankton (DíElia et al. 1983).

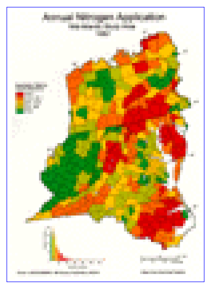
Methods

Total agricultural nitrogen use for each county was estimated as the sum of inorganic and organic applications. Inorganic use was derived from state fertilizer statistics (USDA 1995; 1996a,b) if available. These estimates are the result of data collected from a sample survey conducted for a crop year. If a MASA state was not a major producer of the product of interest, the average value of 1992 major producing states in the United States was used. State-level inorganic nitrogen use estimates are based on the product of the following: (1) fraction of crop area receiving nitrogen applications, (2) the number of applications, and (3) the application rate (pounds per acre per application). State-level nitrogen application by crop was allocated to individual counties according to relative crop acreage (1992 Census of Agriculture). Summing all crop-specific applications provided county-level total inorganic agricultural nitrogen.

Animal sources of nitrogen were based on average excretion rates for livestock. State-level organic nitrogen estimates are based on the product of (1) state-level populations for each animal category (chickens, cows and swine) (1992 Census of Agriculture database [U.S. Department of Commerce 1995]) and (2) the daily excretion of nitrogen per 1000 lb of animal unit (Georgia Soil and Water Commission 1994). To perform this calculation, all animal categories were converted to a common animal unit (Georgia Soil and Water Commission 1994). State-level applications by animal category were allocated to individual counties according to relative livestock acreage. Summing all animal-specific use provided county-level total organic agricultural nitrogen. The databases containing the inorganic and organic nitrogen by MASA county were summed to obtain total nitrogen application estimates.

Results

Many of the Mid-Atlantic counties, particularly those that border the Chesapeake or Pamlico estuaries, are meaningful sources of agricultural nitrogen (Map 16). Areas in the western MASA are less significant sources of agricultural nitrogen. The dominant sources of agricultural nitrogen MASA are from animals. The mean annual potential application of agricultural nitrogen in MASA is about 775,000 tons, of which more than 67% comes from animal wastes.



Map 16 Metadata

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Mid-Atlantic Stressor Profile Atlas

EPA/600/C-99/003
December 1999

Ground-Level Ozone

Ozone is a naturally occurring chemical in the background atmosphere, but its concentrations can be increased manyfold in the lower atmosphere (troposphere) by anthropogenic emissions of atmospheric contaminants. Increases in tropospheric ozone concentrations are widespread, and the corresponding elevated ozone at ground level can enhance the regional vulnerability of vegetation and humans to injury (U.S. EPA 1996). Unlike many other atmospheric contaminants, ozone is not emitted directly, but is formed through a complex series of chemical reactions (FinlaysonñPitts and Pitts 1986) involving volatile organic compounds (VOCs) and nitrogen oxides (NOX). VOCs and NOX are emitted directly into the atmosphere from diverse sources including automobiles, fossil fuel combustion, and use of industrial solvents, as well as from biogenic sources, including trees and crops. Meteorological factors such as sunlight and wind speed determine the speed of ozone-producing reactions, and the distance that ozone and its precursors are transported from their original sources and mixed in the atmosphere. This long-range transport means that industrial and urban sources of VOCs and NOX can affect distant rural areas (National Research Council 1991), and their impact can vary greatly from year to year as the meteorology varies. Because ground-level ozone is one of six criteria pollutants under the 1990 Clean Air Act, EPA is mandated to regulate its precursors (U.S. EPA 1998a). The agency revised its National Ambient Air Quality Standard for ozone in July 1997 to increase protection to both human and ecosystem health.

Conceptual Model

Figure 11 outlines the processes that can occur when plants are exposed to elevated levels of ozone and some of the subsequent short-term and long-term effects of the exposure (U.S. EPA 1996). In order to cause damage to plants, ozone must first diffuse into the leaf through the stomata. Any factors that affect the stomatal openings, such as moisture availability, will affect the amount of ozone that is absorbed and its subsequent damage. If the absorbed ozone is not destroyed by the plantís natural biochemical antioxidants, it impairs normal plant cell functioning. The plant may partially compensate for cell damage by repairing or replacing the cells, which draws energy resources away from other plant activities. Primary short-term effects of ozone damage in leaves include a decrease in net photosynthesis and premature leaf loss, as well as discoloration or stippling of the leaves.

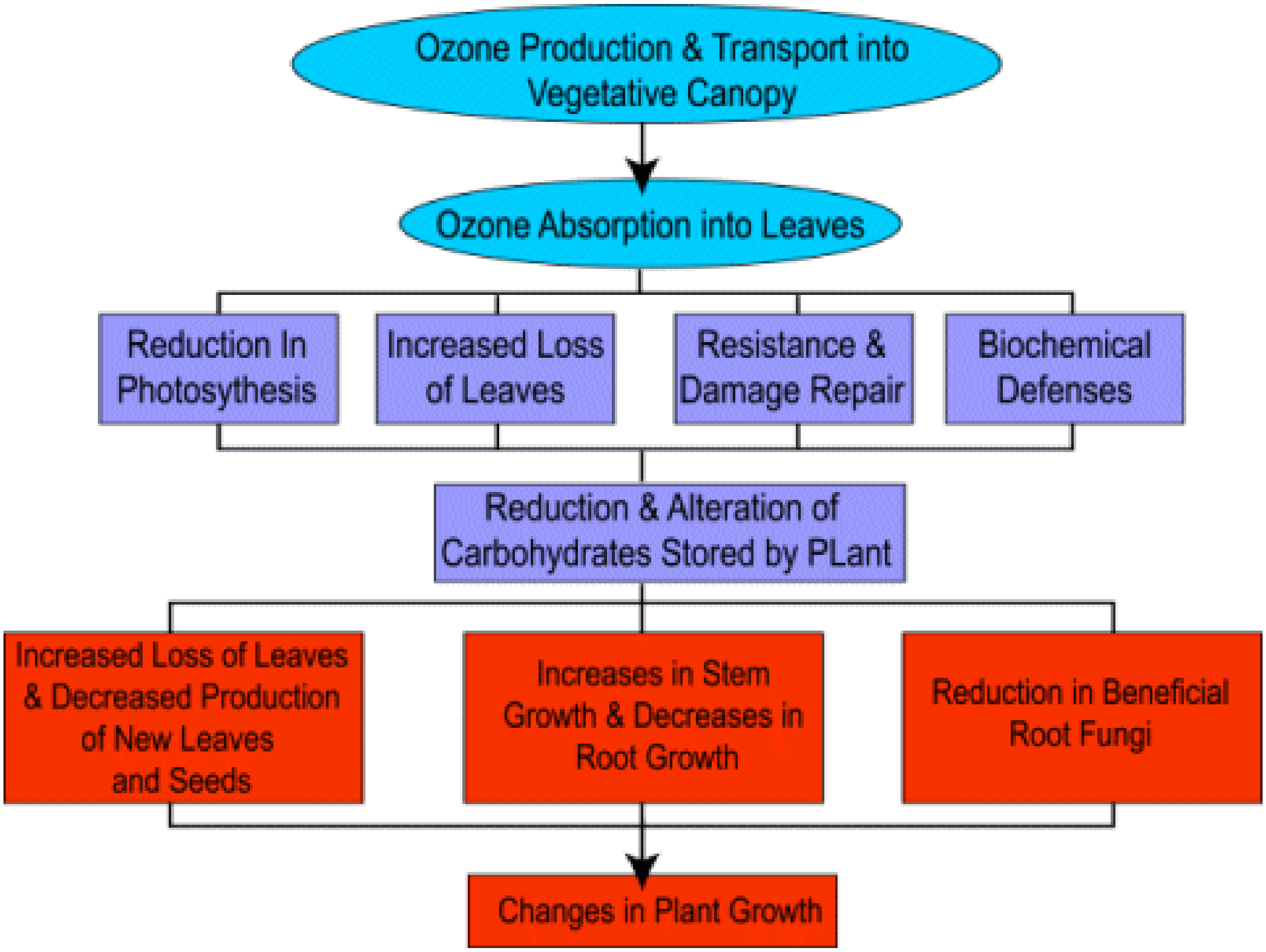


Fig 9. Conceptual model of exposure of plants to ozone.

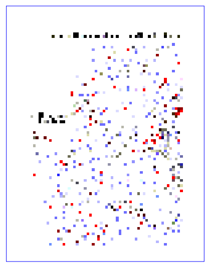
Decreases in carbohydrate production from reduced photosynthesis, as well as the reallocation of carbohydrates in response to the ozone stress, affect the long-term growth of the entire plant. A common effect is a change in the amount and distribution of foliage, which can decrease the plantís storage of carbohydrates and make the plant more susceptible to other environmental stressors, such as drought, nutrient limitation, or cold weather. Plants can experience a reduction in seeds, flowers, and other reproductive functioning. Ozone damage may also alter stem growth or increase new shoot growth at the expense of roots, which can weaken the plant and decrease its cold hardiness. The reduction in carbohydrates decreases the growth of roots and beneficial mycorrhizal fungi, which decreases the long-term storage of food reserves and increases the susceptibility of the tree to root disease. Another symptom of ozone exposure is discolored vegetation from damaged leaves which, if widespread, could lead to aesthetic concerns.

Ozone damage starts with individual plants, but can affect the composition of entire ecosystems. Different plant species, and even individuals within a family, have different sensitivities to ozone. Ozone damage thus will selectively eliminate sensitive plants and can thereby decrease the diversity of an ecosystem.

Methods

Vegetation can be damaged by ozone when exposed to sufficiently high concentrations for a sufficiently long duration. To determine the relationship between ambient air quality and the potential for damage to vegetation, biologically meaningful exposure indices were defined. The development of exposure indices based on ambient measurements that can be used as a surrogate for dose is an area of ongoing research and controversy, and many different forms have been proposed and used (U.S. EPA 1996). While individual hourly ozone concentrations are commonly used to evaluate human health effects, plant exposure indices must represent long-term impacts of ozone. These long-term impacts can be better represented by a cumulative sum of all hourly ozone concentrations during an exposure period, multiplied by a weighting factor that is often 0, 1, or a function of the concentration (Lee et al. 1989). The W126 exposure index, for example, which was used in this analysis, weights all hourly values using a sigmoidal weighting function. This function overweights higher ozone values, which are thought to cause a higher proportion of plant damage, and essentially excludes ozone background values less than 40 ppb (Lefohn and Runeckles 1987).

Hourly ozone measurements were obtained from the Aerometric Information Retrieval System (AIRS) database (U.S. EPA 1998b) for monitors located both within MASA (100ñ109 monitors per year) and immediately outside its boundaries. Values for all 24 hours per day are used in the analysis, and the W126 exposure index is calculated by weighting these data and summing them over a seven-month period, April through October, to cover the growing season of trees. To get regionally distributed ozone values, the point data were interpolated spatially by kriging via the use of a nested spherical variogram model with a maximum search radius of 1100 km and search parameters from 3 to 20 cells (Lefohn et al. 1987). The resulting data is distributed on a ½ degree by ½ degree grid resolution over the Mid-Atlantic region, and it was produced for each year from 1990 through 1995. Map 17 shows the location of the AIRS monitors, along with the grid resolution of the kriged data.

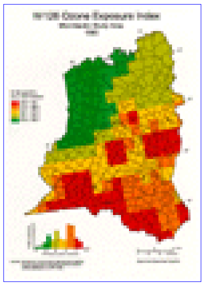


Map 17 Metadata

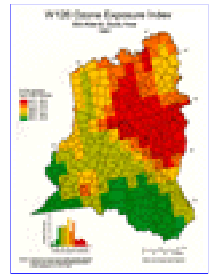
The accuracy of the spatial interpolation depends on many factors such as the distribution of the monitors, as well as on the interpolation technique itself. The kriging process tends to smooth out the data and is useful for identifying large-scale spatial trends in the data, although sometimes at the expense of hiding extremes in the dataset. For the majority of the grids, with the exception of those on the edges of the domain, the standard deviation of the interpolated value using this kriging technique is less than 40% of the W126 value.

Results

The W126 form of the ozone exposure index is presented for the years 1990 (Map 18) and 1991 (Map 19). These two years are used to demonstrate the interannual variability in both the magnitude and the distribution of index values. Although the urban areas tend to have higher ozone concentrations, ozone throughout MASA is heavily influenced by sources of NOx and VOC, and by daily meteorology, which affects the rates of chemical reactions that form ozone and transport of ozone and its precursors across the region. Because of variations in meteorology, the ozone patterns can vary substantially from year to year, as shown in Maps 18 and 19. In 1991, for example, the northern part of MASA had higher average temperatures and daily sunlight than during 1990, which might have contributed to the higher ozone values in 1991. There was no clear difference in these parameters in the southern part of MASA, but the higher ozone values found in 1990 might be caused by differences in wind directions or contributions of extreme episodes. Different areas of the region may experience biologically damaging levels of ozone during different years, although some areas (such as in Maryland, Delaware, and New Jersey) may also be repeatedly exposed to high ozone levels. Both the magnitude and the spatial distribution of ozone are important in determining potential vegetation damage because the distribution of sensitive plant species varies around a region. Crops, for example, which are highly sensitive to ozone damage, occur largely in the eastern half of MASA, where ozone levels are generally higher. Sensitive tree species occur in the more rural western areas of the region, where the exposure index varies from low to high values, depending on the year.



Map 18 Metadata



Map 19 Metadata

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U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory
EPA/600/C-99/003
December 1999

Mid-Atlantic Stressor Profile Atlas

Agricultural Use of Pesticides

Pesticides are used for a variety of purposes, including control of household, lawn, and garden pests; for control of mosquitoes and other insect vectors of animal and human diseases; for control of brush in rangelands, on roadsides, and along power line rights-of-way; as wood preservatives; as disinfectants; and in golf courses, parks and forest lands. The toxicity that makes pesticides useful in agriculture, silviculture, disease vector, and nuisance control can, however, also endanger humans, nontarget wildlife, and ecosystems. EPA carries the mandated responsibility for solving this policy and regulatory dilemma, first through registering pesticides so that their labels explain how to avoid unreasonable risks when using them, and second by setting allowable levels of pesticide residues to ensure the safety of drinking water and the food supply (Schierow 1996).

EPA accumulates data for both agricultural and nonagricultural uses of pesticidal materials. Estimates of pesticide industry sales and pesticide use for the years 1992 and 1993 (Aspelin 1994) provide a national perspective on the relative importance of agricultural uses as compared to pest control activities for ornamental plants, turf, aquatic pests, rights-of-way, industrial and institutional uses, and by public health agencies. The average application rate for planted crops remained at 2.2ñ2.3 lb per treated acre nationally from 1976 through 1993, increasing to 2.5 lb per treated acre in 1994 and 1995 (USDA 1997). This is much less than typical use rates in some other settings. Suburban lawns, for example, typically receive about 8 lb per treated acre. Thus, although the more extensive ecological vulnerabilities arise through agricultural operations, there remains the potential for significant local risks in more urbanized settings. For example, in Delaware during 1989, urban pest control consumed 35 tons of chlorpyrifos, or 88% of the state total (Chandler et al. 1990). The frequency of detection of chlorpyrifos residues >0.01 µg/L in urban streams nationwide (26.5%) is nearly twice that seen (14.6%) in the much more extensive rural setting (USGS 1997). Nevertheless, because it accounts for the bulk (about 75%) of pesticide use nationwide (Aspelin 1994), agriculture can usually be assumed to be of first concern in evaluating regional vulnerabilities to pesticides. MASA is no exception. Agricultural uses (total use of insecticides and herbicides for turf grasses, vector control, forests, and agriculture) account for 86% of the total mass applied (L Burns, unpublished data). Uses of insecticides, herbicides, fungicides, and growth control chemicals (excluding sulfur used to control fungi and foliar oil sprays for insect control) on croplands and pastures during 1992 amounted to about 26,000 tons in the Mid-Atlantic region (Gianessi and Anderson 1995).

This section presents cartography describing the agricultural uses of the herbicide atrazine, and of the combined use of 25 organo-phosphorus (OP) insecticidal active ingredients (AIs) during the 1992 base year (Table 1) . These compounds were selected because of their significant use volume: In the major producing states during the period 1990ñ1993, nine herbicidal AIs accounted for about 85% of the total herbicide used on field crops. Atrazine was the most heavily used of these, accounting for 19% of the full total (22% of the 85%) in 1992 (USDA 1994). Use data for the OP insecticides, because they have a common mode of action, can for a preliminary assessment of vulnerability, be summed despite their considerable differences in chemical, environmental, and toxicological properties. The proportion of OP compounds in total insecticide use has steadily increased since their introduction in the late 1960s, reaching 65% by the late 1980s (Gianessi and Puffer [1992], cited by Larson et al. [1997]). Over the six-year period from 1990 to 1995, 13 insecticidal AIs accounted for 72% of the total insecticide use (as mass applied) on corn, cotton, wheat, fall potatoes, and soybeans in major producing states (USDA 1997); seven of these (chlorpyrifos, dimethoate, fonofos, methyl parathion, phorate, profenofos, and terbufos) are OP compounds, accounting for 68% of the full total (94% of the 72%).

Atrazine is used as a pre-emergence herbicide on corn and sorghum. It is relatively mobile, readily leaching into shallow groundwater in lighter soils and flowing in overland runoff to streams. It produces a reversible inhibition of photosynthesis, causing little ecological damage as long as exposure of aquatic ecosystems is limited to brief runoff episodes (Solomon et al. 1996). Effects on ecosystem productivity appear to be unlikely if sustained concentrations do not exceed 20 ppb, which is rarely the case. Because the human health standard (the "Maximum Contaminant Level," or "MCL"), is only 3 ppb (USEPA 1995), the peak levels of atrazine observed in some shallow groundwaters are of concern for evaluating human exposure from drinking water wells. In addition, more than 5% of stream concentrations in agricultural areas nationwide exceed the 3-ppb MCL (USGS [1997] data).

OP insecticides inhibit the enzyme cholinesterase, leading to tetanic paralysis and death of the target organism. Potential non-target exposure pathways include ingestion of poisoned insects by birds and mammals foraging in treated fields, and from transport of the materials to downstream ecosystems. The use pattern of the 25 OP insecticides (Table 1; data from Gianessi and Anderson [1995]) is dominated by five field crops in the United States as a whole (62%). This is not the case in MASA states, where these crops contribute only 38% of total use. In Mid-Atlantic surface waters sampled from October 1973 through March 1997, chlorpyrifos was detected at 15.7% of 375 sampled sites, with four samples greater than the (chronic) ambient water quality guideline of 0.041 g/L. Diazinon was detected at 19.4% of 391 sampled sites. Azinphos-methyl concentrations exceeded the (chronic) ambient water quality guideline of 0.1 g/L in 34 instances (Ferrari et al. 1997). Little is known of the toxicological significance of these observations, of the combined effects of multiple AIs, or of potential effects in aquatic ecosystems.

Conceptual Models

Pesticides migrate away from their immediate target by drift of spray material during application, followed by evaporation, wind erosion of contaminated particles, and by seepage into the groundwater (Fig.12). Pesticides move to natural water courses via groundwater discharges and surface runoff, and once in the regional atmosphere, are redeposited by dry fall and with rain.

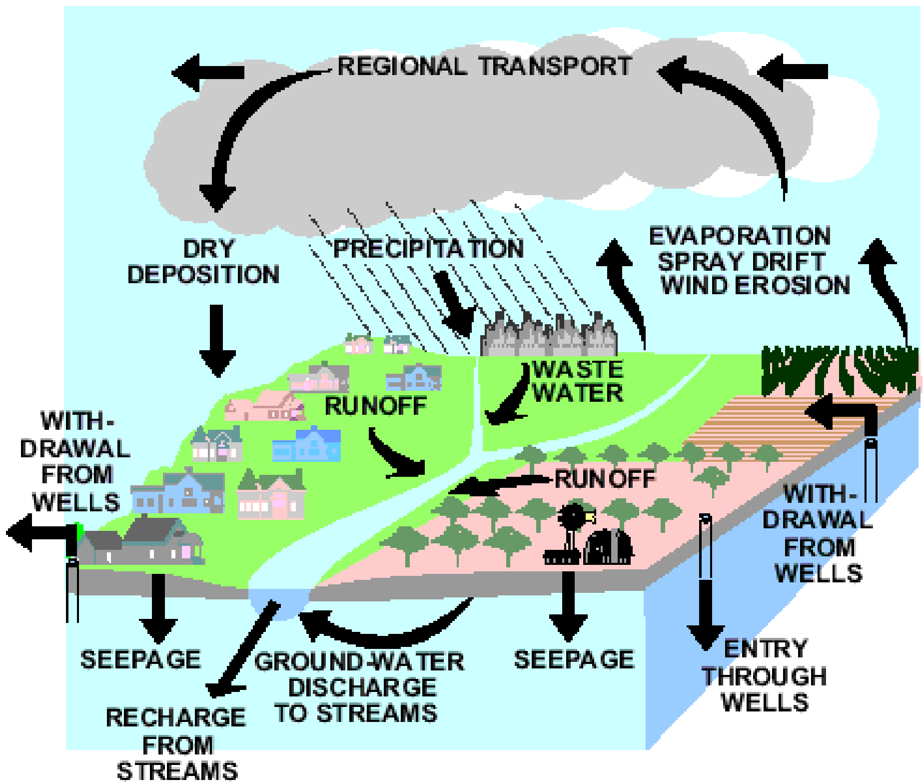


Fig 10. Conceptual model of pesticide transport.

Pesticides may have a variety of unintended impacts (Fig. 13). Beneficial insects, including pollinators and natural predators of pest species, may be present in the field during treatment. If treatment is too close to harvest time, unacceptable residues may remain on vegetation and enter the human food chain either directly or via contaminated animal feedstocks. Runoff and leaching can move pesticides to surface water and groundwater, where they may contaminate the drinking water of humans or wildlife. Pesticides may enter terrestrial food chains by airborne drift off-site and via wildlife scavenging within treated fields.

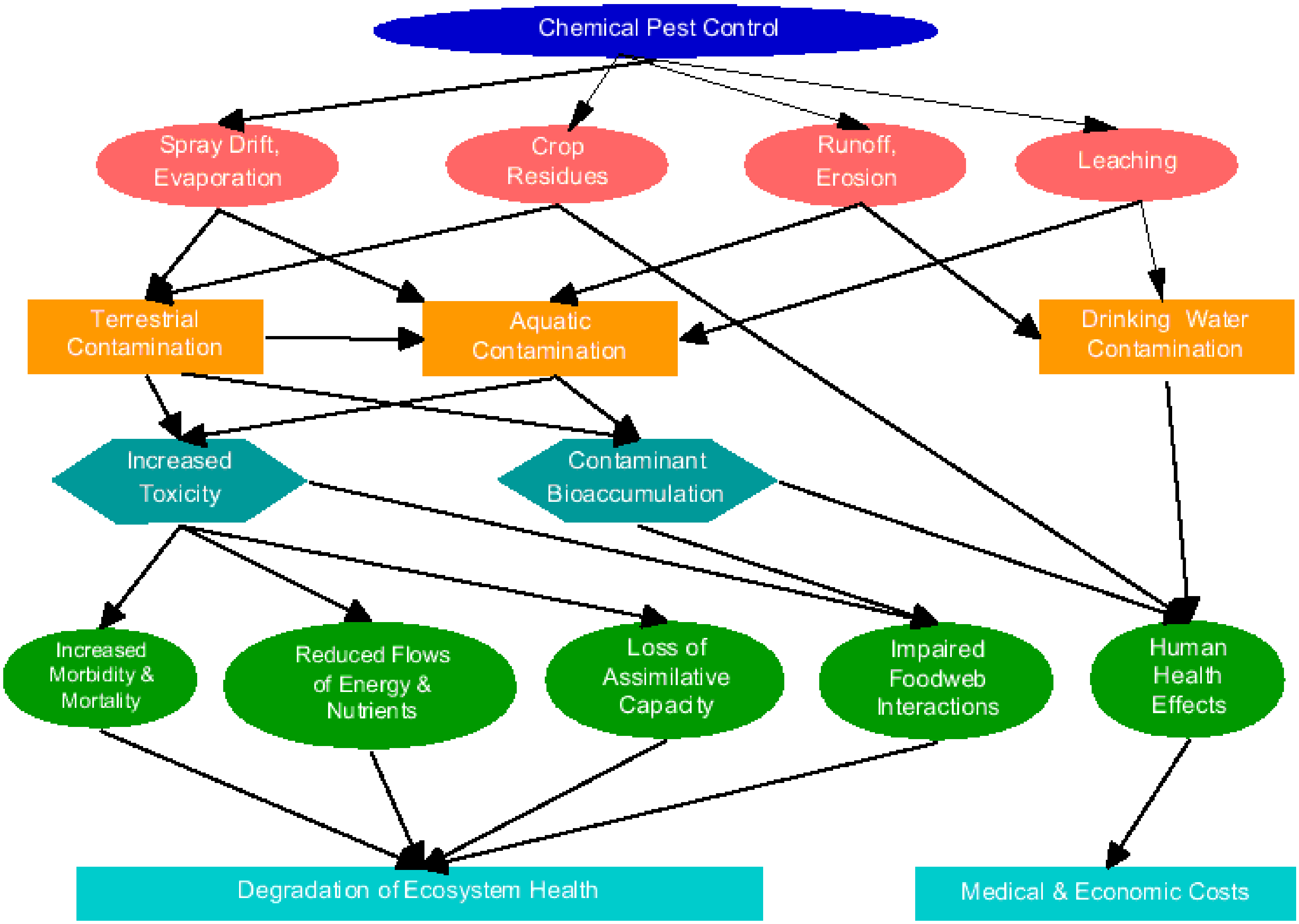


Fig. 11. Conceptual model of pesticide impacts.

Upon reaching aquatic ecosystems, pesticides have a variable lifetime, depending on the speed of transport and transformation processes in that system. Herbicides may have a direct impact on phytoplankton and rooted aquatic macrophytes. Hydrophobic compounds can be sequestered in benthic sediments and can contaminate both the planktonic and benthic food chains. Benthic organisms are also exposed to contaminants in the water column by burrow irrigation and, in the case of filter-feeding molluscs, by direct ingestion of food items. Piscivoresówhich may include birds such as kingfishers, herons, and eagles, as well as mammals from mink to manófeed on the nektonic fishes and the game fish often found as top carnivores. During insect emergence, pesticide is transferred from the benthic zone to predatory fishes, and to insectivorous birds, including many passerines. Waterfowl (e.g., swans, geese, dabbling ducks) are exposed to pesticides in the aquatic vegetation and associated sediments.

Methods

Both EPA (Aspelin 1994, 1997) and USDA accumulate data on the sale and use of pesticides. USDA pesticide use surveys include eight benchmark years (1964, 1966, 1971, 1976, 1982, 1990, 1991, and 1992; USDA 1994). However, consistent information over time is available for only 11 crops: corn, cotton, soybeans, wheat, rice, grain sorghum, peanuts, fall potatoes, other vegetables, citrus, and apples. Under the sponsorship of EPA, USDA, and the Water Resources Division of USGS, the National Center for Food and Agricultural Policy (NCFAP) has assembled a comprehensive database of pesticide use in American agriculture (Gianessi and Anderson 1995). The NCFAP database is not specific to any particular year. It is a summary compilation of studies conducted by public agencies during the four-year period 1990ñ1993 and includes the following.

- National Agricultural Statistics Service (NASS) surveys of pesticide use in field crops, vegetable crops, and fruit and nut crops
- Reports funded by the USDA Cooperative Extension Service
- Pesticide benefit assessments from the USDA National Agricultural Pesticide Impact Assessment Program
- State of California compilations of farmersí pesticide use records

The study data were supplemented by the following information.

- NCFAP surveys of extension service specialists
- Where necessary, imputations developed from the assumption that neighboring statesí pesticide use profiles are similar

The 15,740 individual use records in the databaseócovering 200 AIs and 87 cropsóare state-level estimates focused on two use coefficients: (1) the percent of a cropís acreage in a state treated with an individual AI and (2) the average annual application rate of the AI per treated acre.

These data represent average application and treatment rates by state, and thus, given the local variability of cropping and management practices, cannot yield precise county-scale estimates. The extrapolation of state averages to county-scale estimates produces an irreducible uncertainty not readily amenable to quantification. The reliability of state-level NCFAP estimates can, however, be evaluated from NASS assessments of the coefficient of variation (CV) or percentage relative standard error (%RSE), of data in the NASS chemical use reports (Table 2) . The variability due to sampling error (expressed as a percentage of the estimate) is calculated for all chemical and acreage variables in the NASS surveys. Table 2 shows the entire range of sampling variability for percent of acres treated and application rate for the crop class (field crops, fruits, vegetables) across all crops and states surveyed. Selection of a specific variability estimate is controlled by the number of reports used to develop an estimate for the particular crop in a particular state. For combined totals (e.g., all field crops within MASA, or combined use of OP insecticides on all crops within an entire state), the aggregate sample size can be used to select the appropriate %RSE.

These data were used to calculate approximate confidence limits, and to evaluate the significance of interannual variability in the source data underlying the NCFAP database. In general the %RSE can be interpreted by imagining that the surveys are repeated many times by using the same sample size: In two out of three cases, the outcome would not differ from the database value by more than the stated sampling variability. Approximate confidence bands for state-level application rates were calculated by applying values from Table 2 to NCFAP data elements. For example, if a tabulated value is 20% of a field crop treated with a specific pesticide, the (66%) confidence band for a state with few reports would be 20 ± (20 × 0.35), or 20 ± 7% of the crop acreage. For a state with a large sample size, the confidence interval would be 20 ± (20 × 0.10), or 20 ± 2% of the crop acreage. For comparison of application rates, an overlap of confidence bands at twice the %RSE (i.e., 2 standard errors) indicates that the estimates have only a 1-in-20 chance of being genuinely different.

Applying these concepts to NASS data for the use of atrazine in field corn (Table 3) , we see that the areal fraction of corn treated during a three-year period (encompassing the 1992 base year) varies from 76% to 85% in Pennsylvania, and from 72% to 78% in North Carolina. Because these states have substantial sample sizes, we apply a mid-range %RSE from Table 2, arriving at 95% confidence intervals for total atrazine use of 1.01 ± 0.16 (1991), 1.24 ± 0.20 (1992), and 0.92 ± 0.44 (1993) million pounds in North Carolina: That these intervals overlap suggests that interannual variability in these data is largely due to sampling variability rather than genuine differences in atrazine use among years. For the "major states" (16 states encompassing 90% of U.S. corn acreage), the corresponding values (calculated with the minimum %RSE from Table 2 because of the large aggregate sample size) are 52.1 ± 9.7 (1991), 54.9 ± 11.7 (1992), and 49.6 ± 5.7 (1993), which leads to the conclusion that NCFAP entries for corn in the Mid-Atlantic states derived from the 1990ñ1993 period should be valid for 1992, or indeed for any other year within the base set.

Use in each county must be estimated by extrapolation of these state-level pesticide data. County acreage data from the 1992 Census of Agriculture database (USDC 1995a) were assembled for field corn (as a combined total of corn for grain [3,129,800 acres in the Mid-Atlantic region] and corn for silage and green chop [719,300 acres]), sweet corn (82,100 acres), and sorghum (60,717 acres). County-level use of atrazine was weighted by total county area to present comparable loading rates among counties. State-level statistical summaries were developed by using the reliability figures of Table 2.

For the OP insecticides, the number of acres treated with insecticides by state was extracted from Census of Agriculture data to estimate use by individual counties. An aggregation across multiple AIs was necessary to improve the statistical reliability of the results, and because most crops are treated with multiple AIs during the growing season. For example, during 1992, that acreage of corn treated with insecticides received on average 1.09 AIs; cotton received 1.77; and corn, soybeans, cotton, and wheat as a group received 1.24 ingredients (ERS 1993). During 1994, cotton received on average 3.5 AIs; 19% of the acreage received at least 5 AIs (ERS 1995). State-level application rates of the OP insecticides were calculated by summing over applications to all crops in the NCFAP database and then dividing by the total acres treated for insecticides in the state. This aggregated crop treatment rate was then applied to the county-level data for acres treated for insect control and then weighted by a countyís land area to permit comparability among county estimates. For calculation of state-level statistics, the %RSE for treated acres was extracted from the relevant published state reports of %RSE of acres treated with "agricultural chemicals" (USDC 1993, 1994añg). These data are specific to the use of commercial fertilizer, but were used in the absence of data specific to pesticide use. For comparability with NASS data on the percent of acres treated with atrazine, the percent of acres treated with insecticides was developed from the values for acres treated with insecticides and total harvested cropland acreages (census item 060047, which includes harvested hay, vegetable crops, orchards, berries, small grains, and row crops). Lands on which all crops failed were omitted from the analysis. Although undoubtedly they received some pesticide treatment, they amounted to only 0.18 million acres within MASA; in contrast, 13.7 million acres of land produced a harvestable crop.

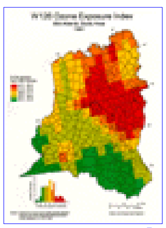
The county-level acreage data may not represent all crop acreage because of Census of Agriculture nondisclosure rules. The impact of nondisclosure rules on analytical results could be evaluated, however, because the Census database allocates nondisclosed data to an artificial county (FIPS code 998). A comparison of state-level to county-level totals and evaluation of "998" data for MASA entries indicated that nondisclosed data did not constitute a significant perturbation on the county estimates. Estimates of pesticides applied to pasture represent only the pastureland reported in the Census of Agriculture and not pastures used for other purposes (federally owned land used for pasture or grazing), again not a factor of major significance in the Mid-Atlantic region.

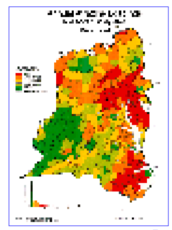
Census data were developed from electronic databases published as part of the 1992 Census of Agriculture (USDC 1995a). The Bureau of the Census has collected data every five years at a county scale from farms in each state, Puerto Rico, Guam, and the U.S. Virgin Islands, where a "farm" was defined as "any place from which $1000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year" (USDC 1995b). The bureau conducts an independent coverage evaluation program for each census to measure accuracy and completeness of farm counts and selected characteristics. The 1992 Census of Agriculture used two types of statistical procedures to estimate accuracy and completeness to account first for nonresponse to the data collection form and then for the sample data collection itself.

Some data elements have been collected from only a sample of farms and thus are subject to sampling error. The sample form was mailed to approximately 29% of all farms in 1992, including all large and specialized farms (based on expected sales, acres, or standard industrial classification); all farms in Alaska, Hawaii, and Rhode Island; and a sample of all other farms. Estimates of the reliability of state and county totals for selected items are shown in "reliability" (statistical) tables not included in the electronic database. Required %RSE values were extracted for this study from the published census reports for each of the Mid-Atlantic states (USDC 1993, 1994añg).

Results

Corn is the dominant field crop in the region, comprising more than 30% of the 13.7 million acres of harvested farmland. About 75% of the corn acreage is treated with atrazine as a pre-emergence herbicide (Table 4) . A 95% confidence interval (CI) for 1992 use in the MASA region encompasses a total of 2166 ± 442 tons. (The crop estimates [± their standard errors] were 2116 ± 217 tons used on field corn, 30.4 ± 1.8 tons on sweet corn, and 20 ± 2 tons on sorghum [not shown].) Pennsylvania received more than 30% of the total, and the Mid-Atlantic section of North Carolina was second highest at about 20%. Ranking of atrazine use by county indicates that the top 20% of counties cluster in eastern North Carolina and the northern Chesapeake watershed (Map 19).


Map 19 Metadata


Map 20 Metadata

The totals for the 25 OP insecticidal AIs enumerated for MASA crops are shown in Table 5 . The OP insecticides accounted for 63% of total insecticide use in the Mid-Atlantic states (Gianessi and Anderson 1995), excluding the use of oil as a foliar spray in orchards to control insect infestation. The 3.6 million acres of land in the Mid-Atlantic counties treated with insecticides constitute 26% of harvested acreage in the region, suggesting a mid-range 15%RSE for the region-wide application rate. (The mid-range datum was used for all values in Table 5 [including the MASA totals] to allow for uncertainties, both in treated acreages and in application rates contributing to total-use figures summed from the NCFAP database.) In 1992, these 3.6 ± 0.7 million acres received a total of 2199 ± 736 (95% CI) tons of OP AIs, with an average use of about 1.23 ± 0.37 lb per treated acre region-wide. The AlbemarleñPamlico Drainage of North Carolina was the heaviest user of OP insecticides, receiving half the total tonnage in the region, followed by Virginia and Pennsylvania with about 15% each. The geographic profile (Map 20) indicates that use of OP insecticides is heaviest in the counties of eastern North Carolina and southern Virginia, with a secondary cluster in the northern Chesapeake region.

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Mid-Atlantic Stressor Profile Atlas

Soil Redistribution

Erosion is a complex natural process that is strongly modified, usually increased, by human activities. Soils nationwide are eroding at an average rate that is 17 times higher than the rate of soil formation. Within MASA, soil erosion rates and per-unit-stream sediment yields in the Piedmont are generally 2-20 times higher than in the Coastal Plain. Thus a large proportion of sedimentation in the region's coastal areas has its origins in the uplands.

Investigations of the influence of land use on stream water quality and aquatic communities indicate that sediment yields and impacts are greater in urban and agricultural watersheds than in forested drainage areas. In a recent study, annual suspended sediment yields from forested, agricultural, and urban catchments of the North Carolina Piedmont region were 291 kg/ha, 695 kg/ha, and 1320 kg/ha, respectively (Lenat and Crawford 1994). During base-flow conditions, however, the agricultural site produced the highest suspended sediment concentrations in associated streams. Sediments from the agricultural area were associated with higher nutrient levels, whereas the levels of metals and other toxics were highest in streams draining urban watersheds. An Index of Biological Integrity (IBI) detected only minor differences in fish communities between agricultural and forested catchments, although fish biomass was slightly higher in the agricultural watersheds. The fish community within the urban watershed was characterized by low number (richness) of species, low biomass, and the absence of intolerant species. Similarly, the richness of the benthic invertebrate taxa indicated that the agricultural catchment was moderately stressed and the urban catchment was severely stressed. In stressed sites the most intolerant invertebrate groups, the Ephemeroptera (mayflies), Plecoptera (stone flies), and Trichoptera, (caddis flies) decreased while tolerant Oligochaeta (worms) increased in richness, indicating that the impact of land use on stream sediment regimes is an important factor in controlling the structure of aquatic communities.

The impacts of suspended sediments and siltation on coastal areas, large lakes, and estuaries are more difficult to isolate because of the co-occurrence of sedimentation with eutrophication and toxic pollution. Physical habitat, including suspended sediments and substrate texture, can be more important than water quality in influencing an IBI in coastal plain streams (Hall et al.,1996). In estuarine areas, however, a multi-metric Benthic IBI (B-IBI) distinguished between impacted and nonimpacted sites more than 90% of the time, although the metric was less effective in assessing the response to individual stressors (Weisberg et al. 1997).

Conceptual Model

Soil erosion occurs when wind or rainfall dislodges soil particles on the landscape. This phenomenon increases the vulnerability of regional ecosystems via two principal routes (Fig. 14): (1) decreased vegetation growth rates with the removal of soil from its original location and (2) the subsequent impacts to aquatic ecosystems when some fraction of the eroded soil enters surface waters. Vegetation is the prime deterrent to erosion. The aboveground plant structure (cover) mitigates the shear force of wind or water at the soil surface, and plant roots maintain the cohesiveness of the top soil layer. Thus, erosion occurs predominantly in denuded soils, such as soils in agricultural areas. Nonagricultural activities that also produce soil erosion include forestry, road and building construction (Ward 1986; Kuo 1975), and mining (McIntosh and Barnhisel 1993). The extent of soil disruption produced by these activities is mediated by the soil type (e.g., mineralogy, particle size, and organic matter), which influences soil cohesiveness and ability to absorb and retain water.

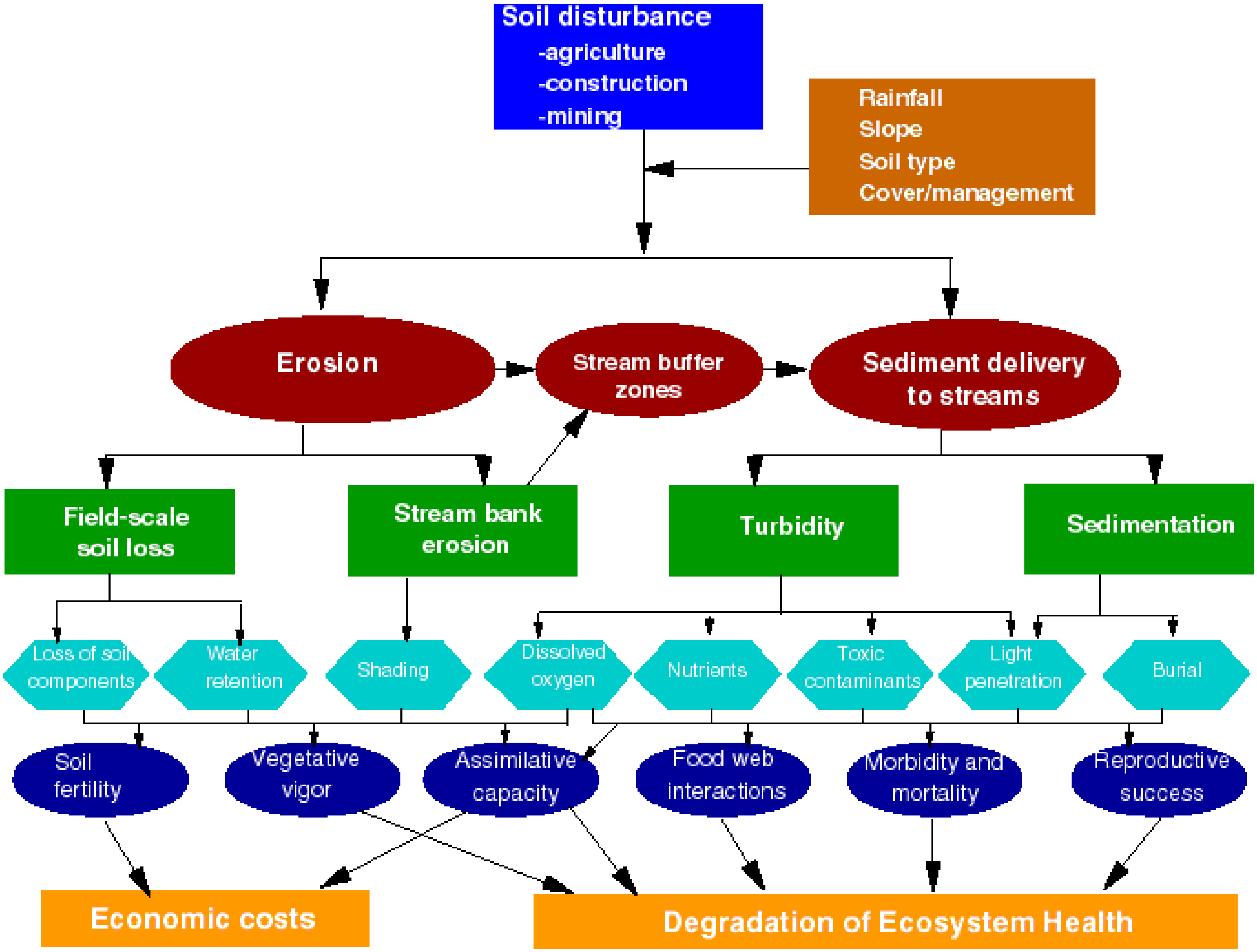


Fig. 12. Conceptual model of the impacts of soil erosion.

Finer soil particles (sediment) eroded from a hillside may be deposited further downslope or may be transported to a stream channel. The effectiveness of rainfall and runoff in transporting soil particles is mediated by soil cohesiveness and factors that affect entrapment and reattachment of particles, such as surface roughness and vegetation. Thus, sediment yield to the receiving stream depends on slope length to the stream and the sediment capture efficiency of intervening terrain, indicating the importance of stream buffer zones. Once in the stream, sediments may be stored as alluvium in the channel or carried out of the drainage basin; this will depend on stream power and the location of intervening low-energy zones low energy. In the MASA Piedmont, about 76% of mean annual erosion is stored on hillsides, 14% is stored within streams, and 10% results in sediment yield (Phillips 1991).

Sediments entering surface waters may have multiple, compound impacts on aquatic receptors: Suspended particles in the water column diminish the penetration of light for photosynthesis; the biological or chemical oxygen demand associated with the particles depletes the water column of oxygen; and the particles may physically clog fish gills, filtering benthos, and gravel spawning areas (Wohl and Carline 1996). Stream turbidity decreases productivity of plankton and periphyton and also contributes nonpoint source pollution in the form of nutrients or toxic chemicals adsorbed on suspended sediment particles. For example, streams draining urban watersheds are characterized by high levels of metals associated with sediments, and agricultural drainage basins contribute nutrient and pesticide loadings.

Thus, the physical and chemical processes through which sedimentation impacts stream biology can act at the level of the organism (mortality), population (reproductive success), or community (assimilative capacity), with no absolute values or thresholds for effects levels. Rather, possible effects depend upon the types and quantity of sediment delivered and the existing physical and biological characteristics of the receiving water body. As a general rule, stream order is a good predictor for sediment effects, with streams decreasing in functional order with increasing sediment loads. The extent to which those changes manifest themselves as economic costs and/or degradation of ecosystem health depends in part on the intended use of the water body and the resilience of the resource.

Methods

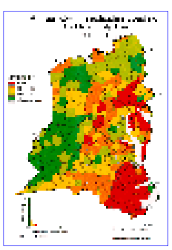
Because only under extreme circumstances can soil erosion be measured directly, the susceptibility of a landscape to erosion is estimated by semi-empirical models such as the Universal Soil Loss Equation (USLE). The USLE has been widely used to estimate average annual soil loss (mass per unit area) according to known erosion mechanisms: rainfall, soil type, slope, vegetative cover, and agricultural management practices. The model uses regional erosion factors based on multivariate analyses of soils and weather. Given the historical interest in agricultural erosion, the factors contributing to erosion have been calibrated for agricultural cropping systems, with the vegetation term taking the form of crop cover and management practices. Other agricultural practices that contribute to soil erosion but are less well quantified by the USLE include grazing, especially disturbance of riparian buffer zones by livestock (Trimble and Mendel 1995). Nonagricultural activities may be represented in USLE-based models by values for bare soil or modifications of the vegetative cover and management terms. Soil data for soil erosion estimates are derived from soil surveys and are catalogued in the nationwide STATSGO database. Soil and crop summary statistics, regional rainfall intensity and length of slope for STATSGO soil polygons are factored into the USLE in the Natural Resources Inventory (NRCS 1998).

Limitations of the USLE include the static nature of the data, the bias toward agricultural land uses, and lack of adequate calibration in regions of steep slope (largely because such areas are excluded from agriculture). Modifications of the USLE such as the RUSLE (Revised USLE) make use of actual meteorologic data to estimate soil erosion with temporal responses for specific time periods or rainfall events. Although many soil transport mechanisms have been characterized for small watersheds, existing models for estimating sediment delivery to surface waters are too dependent on calibration to have utility at scales suitable for regional assessments.

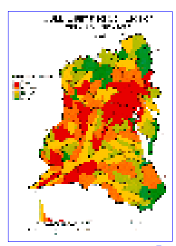
The values for total suspended solids (TSS, as mg/L) are derived from EPAís STORET database (OWOW 1998), which in turn is a compilation of measurements from a number of sources, governmental and nongovernmental. To adequately represent the large sedimentation events, which deliver a disproportionate fraction of the stream sediment load, the 85th percentile value was calculated for each sampling location. Average values for each hydrologic unit (see Results) were derived from frequency weighted averages for all measurements from locations within the unit boundaries. Thus values may be derived from streams of different order.

Potential problems when interpreting the TSS data include variability in the quantity of data available for each hydrologic unit, and the nonsystematic sampling regime, which results in higher spatial and temporal variabilities of data collection. Temporal variability may be extremely important because of the intermittent nature of rainfall, and hence, erosion events, and the nonlinear response of sediment transport and resuspension to stream flow.

Results



Map 21 Metadata



Map 22 Metadata

An areally weighted average value of USLE calculations for eight-digit hydrologic units (HUCs) was calculated for MASA for 1992. The resulting quintile classification map (Map 21) indicates higher potential for soil erosion in the agricultural counties of southeastern Pennsylvania and in the mountainous areas of West Virginia, Virginia, and Pennsylvania. The TSS in streams for eight-digit HUCs were calculated for the period 1990ñ1995. The resulting quintile classification map (Map 22) indicates that areas of highest suspended sediments in streams include parts of the Susquehanna drainage, the mountainous areas of West Virginia and Virginia, and the farming areas of southeastern Pennsylvania.

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EPA/600/C-99/003
December 1999

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Solar UV-B Radiation

Ultraviolet-B (UV-B) radiation is the most energetic part of sunlight reaching the Earth's surface (wavelength region is 280 to 315 nm), and it has been shown to have important effects on ecosystem health. Decreases in total-column ozone, which have been observed over temperate and high-latitude regions during the past two decades, tend to cause enhanced solar UV-B exposure. More than 90% of the atmospheric ozone is located in the stratosphere, miles above the Earth's surface. EPA is mandated in Title IV of the 1990 Clean Air Act to protect stratospheric ozone (U.S. EPA 1998). In this section estimates are provided of changes in the distribution of UV-B radiation reaching the surface in MASA, and conceptual models that describe UV-B exposure are presented.

Concerns over the effects of UV-B have prompted EPA and other U.S. agencies and companies to initiate the development of networks of UV-B measurement sites in U.S. cities, national parks, and agricultural locations. Some of these sites are located within MASA. Field measurements of UV radiation in the Mid-Atlantic region are sparse at present, but a combination of satellite measurements of total ozone, cloud distributions, and other UV-attenuating components of the atmosphere can be used to estimate UV-B exposure for various times and locations. Current data indicate that there have been significant decreases in stratospheric ozone, the main component of the atmosphere that filters out UV-B, and increases in UV-B over this region since 1979. Climate changes and acid deposition also may have caused increases in the penetration of UV-B into the region's lakes and streams during this period.

Conceptual Models

The exposure (or dose rate) of organisms to UV-B radiation depends upon the UV-B irradiance reaching the organism weighted according to the wavelength dependence of the biological effect, that is, the action spectrum. Factors that affect the exposure are depicted in Fig. 15. The UV-B irradiance reaching the Earth's surface is influenced by UV-absorbing and UV-scattering components in the atmosphere, of which ozone is dominant. Chemical depletion of stratospheric ozone, which can be caused by reactions involving halogenated compounds (chlorofluorocarbons, methyl bromide, etc.) and nitrogen oxides that are being released by human activities into the atmosphere, is likely to persist well into the next century. Ozone depletion is being enhanced through stratospheric cooling by increasing inputs of carbon dioxide and other radiatively important gases derived from human activities. In the lower atmosphere, or troposphere, clouds and aerosols also can have important effects on the transmission of UV-B irradiance, as well as the geometry of radiation that reaches the ground. Solar UV-B radiation comes predominantly from the sky on a clear day, and so significant exposure can occur even in the shade of a tree. Scattering by aerosols and clouds makes UV-B even more diffuse.

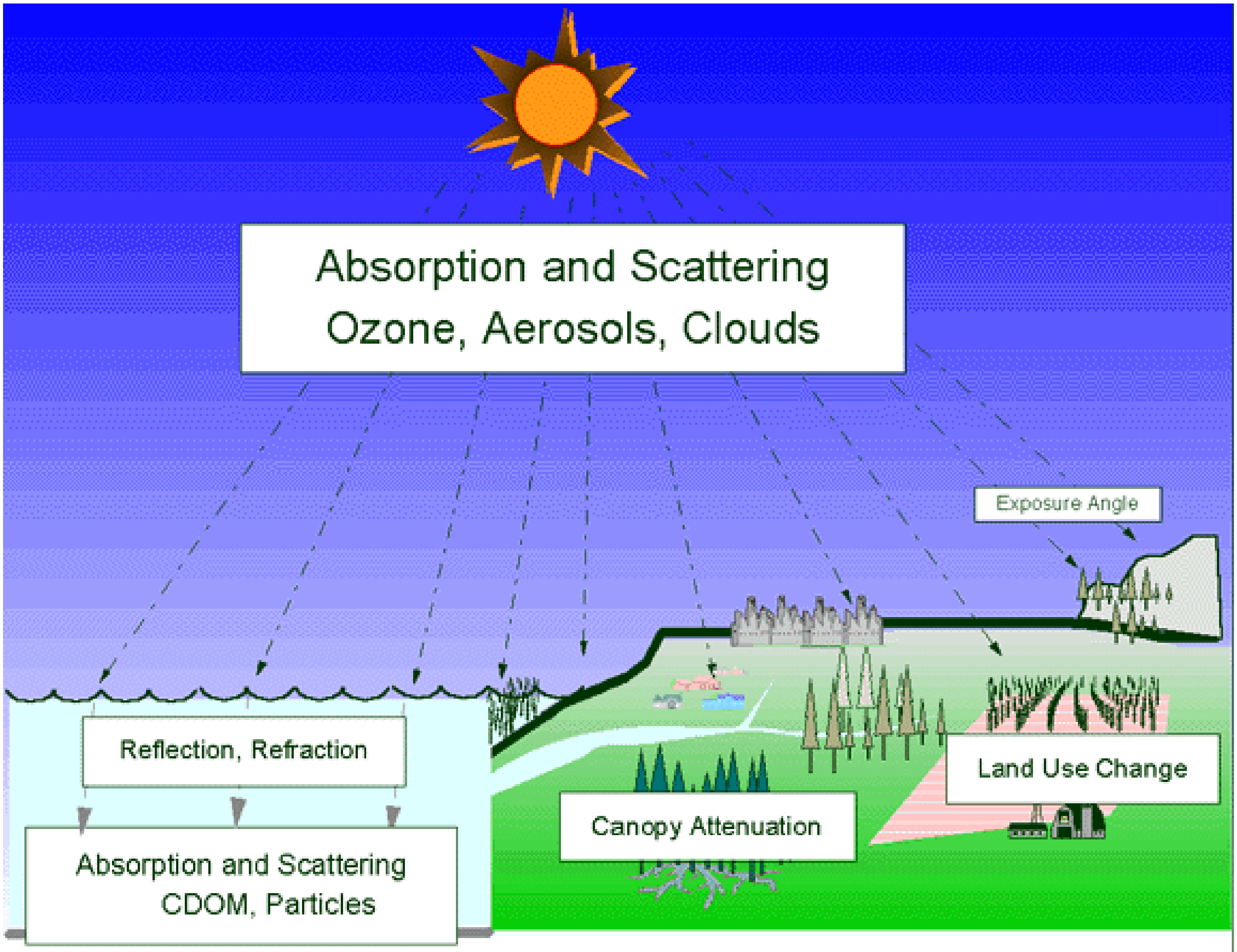


Fig. 13. Factors affecting UV-B exposure in the Mid-Atlantic region.

At the Earth's surface, other important, but less understood, factors control exposure. In aquatic environments, UV-absorbing dissolved and particulate substances control the UV-B penetration into the water; of these substances, the colored dissolved organic matter (CDOM) is generally most important, although suspended sediments can be dominant in rivers and streams. UV-B attenuation by algae is less important. UV-B attenuation by overhanging forest canopy can control exposure in streams and small rivers during the growing season. In terrestrial ecosystems, the angle of exposure (perspective), as influenced by factors such terrain or position under canopy, can affect exposure. Vegetation covers a large part of the Mid-Atlantic region, and UV-B is attenuated as it passes through the canopy. Thus, plant leaves on the lower part of the canopy and on understory plants in MASA forests receive less exposure, as do organisms that generally live in shaded environments. Land-use changes, such as conversion of forests to cropland, or removal of riparian vegetation for development, can open up the landscape and thus affect UV-B exposure.

The evaluation of the biological effects of UV-B exposure also requires action spectra. Action spectra have been measured for a variety of effects, ranging from skin cancer, ocular effects, and immunological effects on human beings to physiological and biogeochemical effects (photosynthesis, nutrient cycling, etc.) on aquatic and terrestrial ecosystems (Madronich et al. 1995). Exposures computed with different action spectra result in different responses to ozone depletion. The radiation amplification factor (RAF) is a commonly used measure of the dependence of the responses on ozone depletion. For small ozone changes, the RAF is the percent change in exposure ratioed to the percent change in the ozone column. For estimates within the Mid-Atlantic region, the standard action spectrum for erythema (sunburning) was used (McKinlay and Diffey 1987). This action spectrum is being used to report biologically weighted irradiances for data measured by the EPA UV-B monitoring network. The RAF values for this action spectrum fall in the 1.1-1.2 range. This RAF is lower than the RAF computed for directly exposed DNA (2.2), but it does fall in the mid-range of RAF values that have been determined for a variety of aquatic and terrestrial organisms (Madronich et al. 1995).

The ecological effects of UV-B are not well understood. Past research programs in this area have emphasized the atmospheric reactions that cause ozone depletion. Nonetheless, recent work indicates that UV-B radiation has profound effects on human health, animals, plants, and microorganisms (Fig. 16). These effects are not all detrimental, and they can be complex, involving for example, photorepair of damage, interactions with other large-scale changes such as increasing atmospheric CO2 concentrations and temperatures or phototoxic interactions between UV and widespread aquatic pollutants such as polycyclic aromatic hydrocarbons. Moreover, the most important effects on ecosystems may involve longer term changes in the competitive balance of species, productivity, and biogeochemical cycles (Zepp et al. 1995). Thus, the exposure estimates presented here are not intended to reflect the ultimate response of plants and animals in MASA to increased UV-B irradiance.

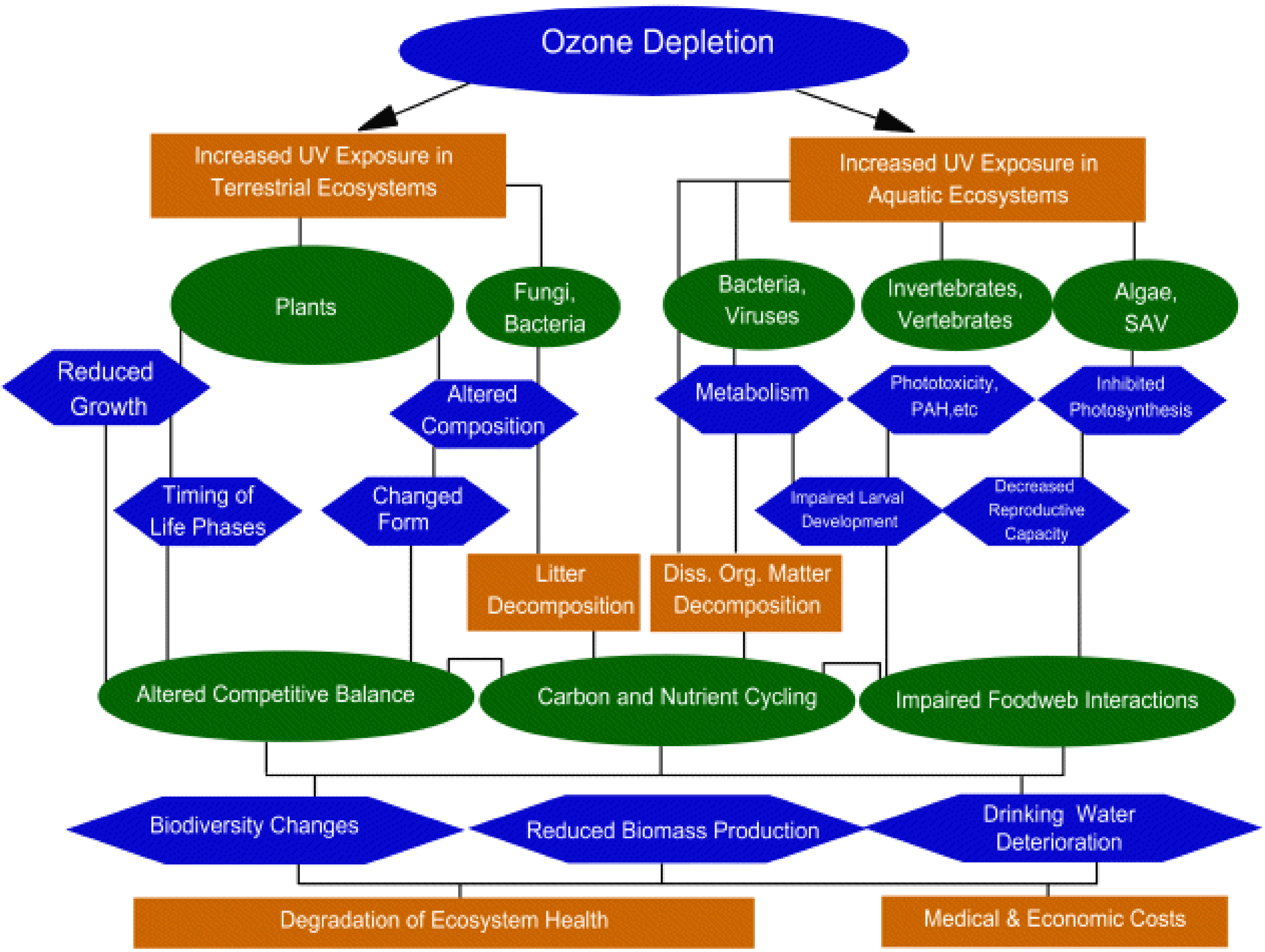


Fig. 14. Conceptual model of solar UV-B irradiation exposure.

A variety of short-term responses to increased UV-B have been identified in aquatic systems (Häder et al. 1995). Photosynthesis of primary producers such as phytoplankton and submerged aquatic vegetation can be inhibited, and food web relationships can be altered. Both invertebrates and vertebrates experience a variety of detrimental effects when exposed to enhanced UV-B, ranging from impaired growth and survival to skin injury and immune system suppression. Larval stages are generally most susceptible to damage. Aquatic carbon and nutrient cycles also may be strongly affected. Many microbial species are effectively killed on direct exposure to solar UV-B radiation (Herndl et al. 1993). UV-B-induced photodegradation of the CDOM results in increased UV-B penetration into MASA lakes and coastal waters

(Morris and Hargreaves 1997; Degrandpre et al. 1996). But UV-B radiation also tends to stimulate bacterial and algal growth by increasing the biological availability of the polymeric organic carbon and nitrogen in aquatic ecosystems (Moran and Zepp 1997). These effects presumably alter carbon and nitrogen cycling in upper layers of lakes and sea. Indeed, current evidence suggests that decline in North American lake productivity that was attributed to acid rain in the 1980s may be partly attributable to increased UV-B irradiance. UV radiation also enhances the toxicity of pollutants that have been taken up by aquatic biota.

Terrestrial ecosystems also may be affected (Caldwell et al. 1995; Rozema et al. 1997). Much of what is known about UV-B interactions with plants relates to agriculturally important species, although new data concerning nonagricultural mid- and high-latitude species are now becoming available. Plant growth can be affected through UV-B effects on gene activity, photosynthesis, and metabolism. Biological effects such as reductions in photosynthesis have been observed with soybeans, oats, and loblolly pines, and soybean seed yields can be reduced. Seedling growth can be reduced with sunflowers, corn, and rye. Changes in the form of wheat, soybeans, and mosses also are caused by UV-B exposure. Plant composition also can be altered by enhanced UV-B; this in part involves changes in leaf composition that help protect plants by increasing UV-absorbing compounds and antioxidants. In addition, the litter from plants grown under enhanced UV-B is more resistant to degradation by soil microorganisms.

Again we emphasize that these increases in UV-B irradiation, which are partly due to decreases in total column ozone over MASA, are influenced by the action spectrum used to make the estimates. Factors such as canopy attenuation, moreover, can greatly affect exposure of certain organisms, for example, invertebrates and vertebrates in streams. Moreover, solar UV radiation is known to enhance the toxicity of widely distributed aquatic pollutants in the Mid-Atlantic region such as polycyclic aromatic hydrocarbons. Geographic and temporal variations in such pollutants also can affect the biological effects of UV-B radiation.

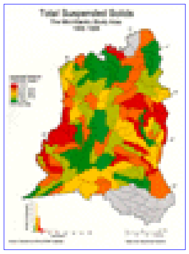
Methods

Map compilations for surface UV-B irradiance in the Mid-Atlantic region were developed by using estimates of erythemally weighted UV-B irradiances that were taken from a global data set developed at NASA-Goddard Space Flight Center (Herman et al. 1996; JR Herman and EA Celarier, personal communication). The daily data was expressed in units of joules per square meter. The estimates were computed by using a semispherical radiation transfer model that generates solar UV spectral irradiance at Earth's surface with inputs of total ozone, local terrain height, and cloud distributions. Daily values for total column ozone and cloud cover over 1o × 1o grids of the Mid-Atlantic region were based on observations by the Total Ozone Mapping Spectrometer (TOMS) that was mounted on the Nimbus 7 satellite from November 1978 to May 1993. The Version 7 algorithm and calibration were used to retrieve the ozone data. The current TOMS, which is mounted on the Earth Probe satellite, has a more highly resolved field of view of 39 × 39 km. (NASA 1998). Terrain heights are based on a U.S. Department of Defense geographical database and were spatially aggregated to the grid resolution.

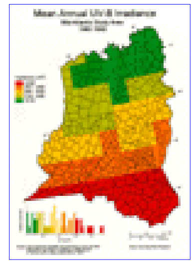
The daily irradiance values were integrated over monthly, yearly, and triennial periods to examine longer term changes. No attempts were made to represent the effects of exposure angle, canopy attenuation, and attenuation by scattering and absorption in the streams, rivers, lakes, and estuaries. Triennial means were used to help smooth the considerable noise caused by year-to-year variations in cloud cover.

Results

The surface UV-B generally increases from south to north and, to a lesser extent, from west to east over MASA; the southeastern part receives the greatest exposure. The greatest north-south geographic differences were observed during the winter months, and the least variation was observed during the summer. The magnitude of seasonal variations increased with higher latitudes. The southern Chesapeake Bay and eastern Virginia croplands are located in the region that receives the greatest UV-B exposure. Changes in surface UV-B irradiance were determined by comparing mean values of two three-year periods: 1979-1981 versus 1990-1992. The results further show that surface UV-B increased throughout MASA during the 1980s. The change in UV-B was greatest in the northwestern part of MASA, including the mountainous regions, where increases of 8-10% were estimated.



Map 23 Metadata



Map 24 Metadata

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Mid-Atlantic Stressor Profile Atlas

Conclusions and Recommendations

Development of this atlas has allowed us to identify limitations and gaps in selected coverages, to anticipate problems that may arise as we transfer this technology to other users, and to suggest approaches to address these shortfalls. Some of the lessons learned in creating the stressor profiles include the following:

- Integration of data from administrative units (e.g., counties), ecological units (e.g., watersheds), points (e.g., field stations), and grids (e.g., remotely sensed data) is not straightforward. Considerable thought and effort is required to provide a consistent approach for converting various data to a common spatial reference.
- Entering data estimated from models into other models may result in compounded errors. For example, use of digital elevation data with data for another parameter that incorporates an elevation component in its estimation may be problematic. These errors could become important if the researcher considers the mapped profiles as 'data' rather than model outputs.
- The local data readily available for most stressors is too limited to confidently estimate the variability for points within the distributions. Good local data (benchmarks) are needed to improve or verify the accuracy of the distributions presented.
- When overlaying stressor profiles, the inconsistencies in determining the frames of spatial reference often give rise to "sliver polygons" (areas of incomplete information that are an artifact of the process). The user cannot assume that there is a valid data point for every pixel on the map unless this artifact has been dealt with.
- Although we may select a metric as guided by our current knowledge, for example, our use of the erythemal wavelengths of UV-B, it may not represent the optimal parameter for estimating vulnerability of critical receptors in the ecosystem.
- Gradients of stressor concentrations or loadings may be inadequate to draw strong correlations with either other stressors or with critical receptor information as exposure estimates are developed. Interpolations are not the same as ground measurements at a point in space.
- Spatial aggregations, e.g., those made by various organizations to meet the specific needs of their studies, frequently are not identified and resolved early on. As a result, data provided by counties, for example, may have slightly different meanings across the Region.
- The temporal scale of stressor distributions may not be appropriate for specific receptors (e.g., to match seasonal life-cycle sensitivities).

- Databases vary in their handling of missing data points; failure to resolve this difference may result in misleading or inaccurate estimates.

As a general caveat, the profiles in this document should be viewed as coarse overviews of stressor levels across the Mid-Atlantic region. The profiles provide a general picture and can be used to prioritize research efforts between sub-regions. But just as the local TV weather report is not a substitute for an on-site rain gauge, the profiles are not a substitute for accurate ground-level measurements at a spatial point, e.g., small watershed, of particular concern.

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Glossary

For interdisciplinary programs such as ReVA, a glossary is warranted to minimize possible miscommunication among program participants. The following terms in particular require definition to assist in the discussion of technical issues.

Ambient condition Environmental factors other than the stressor that modify the exposure field of the response to the stressor; these can include natural stressors, or stressors that are held constant in order to isolate the effects of a particular stressor for purposes of analysis.

Agent Any physical, chemical, or biological entity that can induce an adverse response (synonymous with stressor).

Ambient condition characterization A portion of exposure characterization where ambient condition profiles are developed.

Ambient condition profile An estimate of the spatial and temporal distribution of ambient condition.

Assessment endpoint An explicit expression of the environmental value that is to be protected. An assessment endpoint includes both an ecological entity and specific attributes of that entity. For example, salmon are a valued ecological entity; reproduction and population maintenance of salmon form an assessment endpoint.

Conceptual model The conceptual model describes a series of working hypotheses of how the stressor might affect ecological entities. It also describes the ecosystem potentially at risk, the relationship between measures of effect and assessment endpoints, and exposure scenarios.

Ecological indicator A measure or index of measures that can be used to describe the condition of an ecosystem or one of its critical components or processes.

Ecological integrity The degree to which an ecosystem demonstrates resiliency, biological diversity, species composition, structural redundancy, and functional processes comparable to that of the natural habitats of a region.

Ecological risk assessment The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors.

Ecological sustainability The ability of an ecosystem to maintain ecological integrity over time.

Ecosystem The biotic community and abiotic environment within a specified location in space and time.

Exposure The co-occurrence or contact of a stressor and one or more receptors in both space and time.

Exposure characterization A portion of the analysis phase of ecological risk assessment that evaluates the interaction of the stressor with one or more ecological entities. Exposure can be expressed as co-occurrence or contact, depending on the stressor and ecological component involved.

Exposure profile The product of exposure characterization in the analysis phase of ecological risk assessment. It summarizes the magnitude and spatial and temporal patterns of exposure for the scenarios described in the conceptual model.

Exposure scenario A set of assumptions concerning how an exposure may take place, including assumptions about the exposure setting, stressor characteristics, and activities that may lead to exposure.

Hazard Pollutant or activity and its disruptive influence on the ecosystem.

Measure of effect A measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint.

Measure of exposure A measurable stressor characteristic that is used to help quantify exposure.

Measurement endpoint See "Measure of effect."

Receptor An ecological component that is at risk of exposure to a particular stressor.

Receptor characterization A portion of exposure characterization where receptor profiles are developed.

Receptor profile An estimate of the spatial and temporal distribution and condition of an individual receptor.

Regional vulnerability The likelihood that exposure to stressors, acting alone or in combination, directly or indirectly, will cause regional ecosystem structures and functions to vary beyond their range of natural variability, such that their ability to provide the ecological goods, services, and values that the public has come to expect and desire is reduced.

Risk characterization A phase of ecological risk assessment that integrates the exposure and stressor-response profiles to evaluate the likelihood of adverse ecological effects associated with exposure to a stressor. The adversity of effects is discussed, including consideration of the nature and intensity of the effects, the spatial and temporal scales, and the potential for recovery.

Source An entity or action that releases to the environment or imposes on the environment a chemical, physical, or biological stressor or stressors (synonymous with agent).

Stressor Any physical, chemical, or biological entity that can induce an adverse response.

Stressor characterization A portion of exposure characterization where stressor profiles are developed.

Stressor profile An estimate of the spatial and temporal distribution of an individual stressor.

Stressor-response profile The product of characterization of ecological effects in the analysis phase of ecological risk assessment. The stressor-response profile summarizes the data on the effects of a stressor and the relationship of the data to the assessment endpoint.

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Appendix A

Tables for Agricultural Pesticides Profile

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Table 1. Total Organo-Phosphorus Insecticide Use (short tons)

	Major Field Crops**		All Crops	
Common Name	USA	Mid-Atlantic States	USA	Mid-Atlantic States
Acephate	605.2	40.7	1,694.9	436.9
Azinphos-methyl	385.5	11.8	1,209.6	123
Chlorpyrifos	4,370.80	306.2	7,382.3	866.2
Diazinon	41.5	0.6	632.9	44.5
Dicrotophos	330.6	0.2	333.1	0.2
Dimethoate	577	12.5	1,309.7	152
Disulfoton	655.1	16.3	903.3	53.2
Ethion	0	0	495.4	0.3
Ethoprop	329.6	20.4	724.9	120.9
Ethyl Parathion	470	10.5	1,159.10	10.5
Fenamiphos	61.8	1.9	307.5	53.1
Fonofos	1,312.30	47.3	1,616.9	125.4
Malathion	772.7	50.9	1,688.8	82
Methamidophos	347.2	12.9	544.2	15.9
Methidathion	5.7	0	186.5	2
Methyl Parathion	2,331.20	13.9	2,980.9	57.1
Mevinphos	0.4	0.3	141.9	4

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Naled	16.6	0	115.1	0.2
Oxydemeton-methyl	51.1	0	120.6	0.2
Phorate	1,867.80	51.1	2,226.3	78.1
Phosmet	33.1	5.9	470.6	53.4
Profenofos	1,031.40	1.4	1,031.4	1.4
Sulprofos	426.2	0	426.2	0
Terbufos	3,978.50	411.8	4,345.2	413.3
Trichlorfon	0.8	0.3	7.0	0.3
Total	**20,002.2**	**1,016.8**	**32,054.2**	**2,694.2**

*NY, NJ, and NC data for entire state rather than Mid-Atlantic portion only.

**Corn, cotton, potatoes, soybeans, wheat.

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Table 2. Reliability Statement* of 1992 Pesticide Data# in NASS Agricultural Chemical Usage Reports, Range of %RSE Encountered in the Data Sets

Percent Acres Treated	Field Crops (1992 Crop Year)		Fruits (1993 Crop Year)		Vegetables (1992 Crop Year)	
	Acres Treated	Appl. Rate	Acres Treated	Appl. Rate	Acres Treated	Appl. Rate
< 10	40 - 100	1 - 60	25 - 90	1 - 30	35 - 85	1 - 10
10 - 24	10 - 35	5 - 35	15 - 65	1 - 20	20 - 70	1 - 10
25 - 49	5 - 15	1 - 30	10 - 35	1 - 20	10 - 40	1 - 10
50 - 75	5 - 15	5 - 25	5 - 20	1 - 15	5 - 20	1 - 10
> 75	1 - 5	1 - 10	1 - 10	1 - 5	1 - 5	1 - 10

*Sampling variability expressed as percentage relative standard error (%RSE) of the estimate. The %RSE to be applied to a specific datum depends on the size of the sample (N) used to develop the item (NASS 1993a,b, 1994b).

#Fruits survey conducted in 1993 crop year.

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Table 3. Interannual Variability in Atrazine Use on Field Corn

				Treated Area		Application Rate*		Total Applied	
State**	Acres Planted (x1000)	Number of Reports	Percent Acres Treated	Acres (x1000)	%RSE	Pounds per Acre	%RSE	Pounds (x1 million)	SE

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1991									
NC	1,050	138	76	798	2.5	1.27	5.0	1.01	0.08
PA	1,400	173	78	1,092	2.5	1.22	5.0	1.33	0.1
Major States	68,580	5,759	66	45,263	5.0	1.14	5.0	52.06	4.83
1992									
NC	1,150	127	78	897	2.5	1.39	5.0	1.24	0.1
PA	1,380	174	76	1,049	2.5	1.23	5.0	1.3	0.09
Major States	71,375	5,628	69	49,249	5.0	1.12	5.0	54.94	5.87
1993									
NC	1,000	136	72	720	10.0	1.28	12.5	0.92	0.22
PA	1,370	173	85	1,165	2.5	1.16	5.0	1.36	0.09
Major States	65,690	5,469	69	45,326	5.0	1.09	1.0	49.55	2.84

*Application rate expressed as rate per crop year, that is, as the product of the number of applications and the rate per application (NASS 1992, 1993a, 1994a).

**The 16 major states (GA, IL, IN, IA, KS, KY, MI, MN, MO, NE, NC, OH, PA, SD, TX, WI) total includes 90% of the field corn planted in the United States for each year reported. For each crop year, a mid-range percentage %RSE from that year's report was used for individual states; the minimum value was used for Major States totals.

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Table 4. Atrazine Use on Field Corn and Sweet Corn in the Mid-Atlantic Region During the 1992 Crop Year

1992 Field Corn (Sum of Corn for Grain + Corn for Silage and Green Chop)

			Treated Area		Application Rate#		Total Applied	
State	Harvested Acres* (×1000)	% Acres Treated#	Acres (×1000)	%RSEÜ	Pounds per Acre	%RSEÜ	Tons	SE
DE	164	84	137	2.5	1.43	5.0	98	7
MD	527	71	374	10.0	1.6	15.0	299	79
NJß	93	84	78	2.5	1.43	5.0	56	4
NYß	559	70	391	10.0	1.63	15.0	319	85
NCß	779	78	608	2.5	1.39	5.0	422	32
PA	1,401	76	1,065	2.5	1.23	5.0	655	50
VA	515	73	376	10.0	1.2	15.0	226	60
WV	72	71	51	10.0	1.6	15.0	41	11
Mid-Atlantic	4,111	99	4,081	5.0	1.04	5.0	2,116	217

1992 Sweet Corn

State	Harvested Acres* (×1000)	% Acres Treated#	Treated Area Acres (×1000)	%RSEÜ	Application Rate# Pounds per Acre	%RSEÜ	Total Applied Tons	SE
DE	9.3	10	0.9	45.0	2.39	5.0	1.1	0.6
MD	11.9	54	6.4	12.5	1.26	5.0	4.0	0.7
NJß	10.9	56	6.1	12.5	1.37	5.0	4.2	0.8
NYß	23.7	78	18.5	2.5	1.16	5.0	10.7	0.8
NCß	2.7	19	0.5	45	1.29	5.0	0.3	0.2
PA	19.8	78	15.4	2.5	1.16	5.0	8.9	0.7
VA	2.2	54	1.2	12.5	1.26	5.0	0.8	0.1
WV	0.9	54	0.5	10	1.26	5.0	0.31	0.05
Mid-Atlantic	81.4	61	49.5	5.0	1.23	1.0	30.4	1.8

*Harvested areas from 1992 Census of Agriculture (USDC 1995a,b).

#Percent of crop treated and application rates for individual states from Gianessi and Anderson (1995).

ÜCoefficient of variation (%RSE) from NASS (1993a). Mid-range %RSE used for individual states; minimum value used for Mid-Atlantic total.

áCoefficient of variation (%RSE) from NASS (1993b). Mid-range %RSE used for individual states; minimum value used for Mid-Atlantic total.

ß NJ, NY, and NC data are sums for those counties wholly or partially within the Mid-Atlantic area.

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Table 5. Organo-Phosphorus Insecticide Use in the Mid-Atlantic Region During the 1992 Crop Year*

State	Harvested Acres (x1000)	% Acres Treated	Treated Area Acres (×1000)	%RSE	Application Rate# Pounds per Acre	%RSEÜ	Total Applied Tons	SE
DE	470	29	136	1.5	1.18	15.0	80	13
MD	1,397	28	395	1.7	0.34	15.0	67	11
NJá	450	25	114	1.6	0.81	15.0	46	8
NYá	1,837	14	261	0.7	1.29	20.0	168	35
NCá	2,725	44	1,208	0.9	1.80	15.0	1,087	174
PA	3,860	20	771	0.9	0.81	20.0	312	66
VA	2,449	26	628	0.9	1.28	15.0	402	64
WV	556	13	74	1.9	0.97	20.0	36	8
Mid-Atlantic	13,744	33	4,587	1.0	0.96	15.0	2,199	368

pestable

*Harvested area, area treated with insecticides and its coefficient of variation (%RSE, assumed equal to that for other agricultural chemicals) from 1992 Census of Agriculture (USDC 1995a,b).

#Application rates from Gianessi and Anderson (1995).

ÜPercentage relative standard error (%RSE) for application rates from NASS (1993a), mid-range value.

áNJ, NY, and NC data are sums for those counties wholly or partially within the Mid-Atlantic area.

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Contact Information

U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory

EPA/600/C-99/003
December 1999

Mid-Atlantic Stressor Profile Atlas

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You have been reading the

Mid-Atlantic Stressor Profile Atlas

Publication produced for the

Ecological Exposure Research Program

Regional Vulnerability Assessment Research Program

U.S. Environmental Protection Agency

Under contract by

ManTech Environmental Technology, Inc.

Research Triangle Park, North Carolina

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Contact Information

Contact Information

For further information about the ReVA Mid-Atlantic Stressor Profile Atlas, please contact:

Betsy R. Smith

ReVA Coordinator

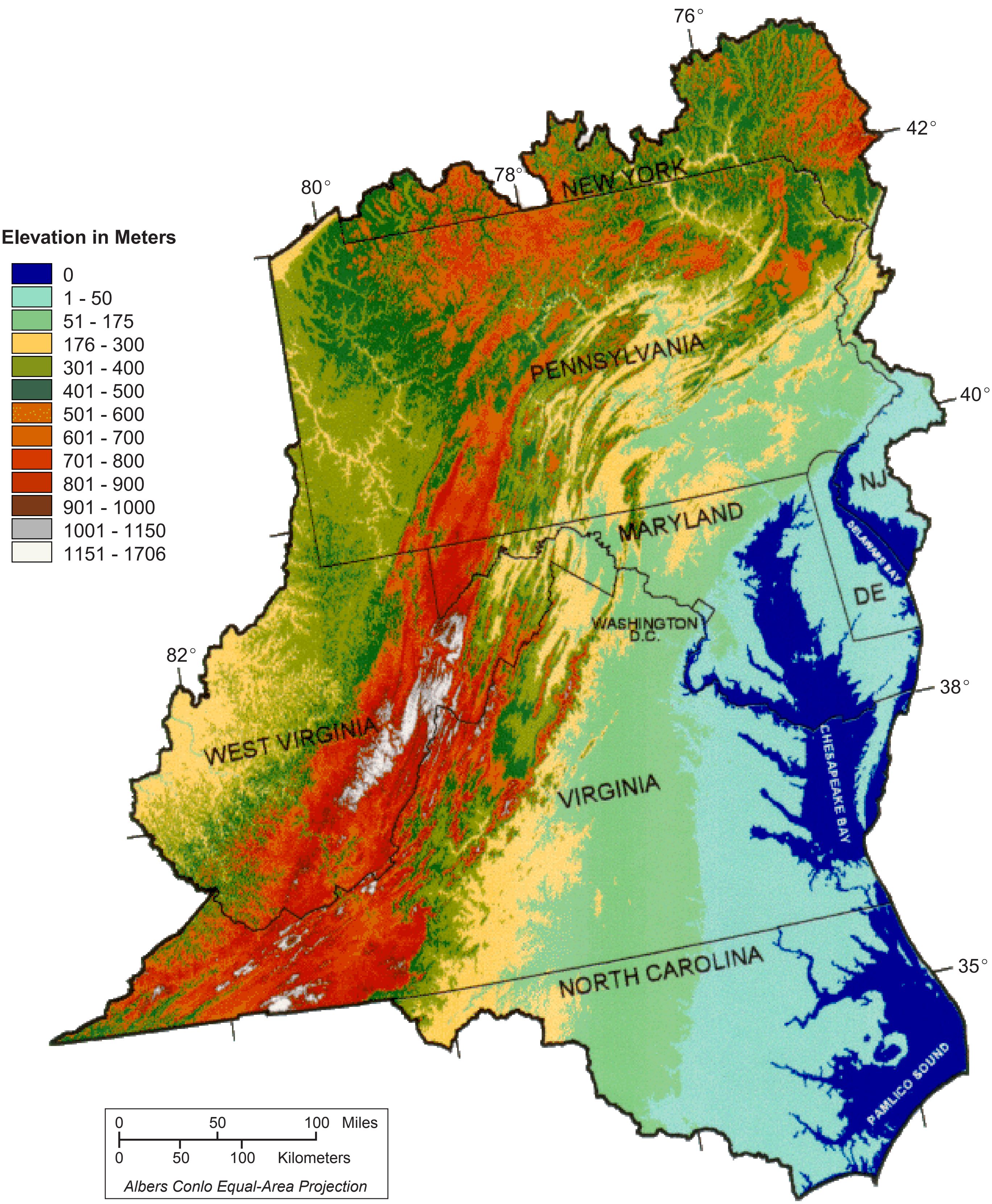
U.S. Environmental Protection Agency

MD-75

Research Triangle Park, NC 27709

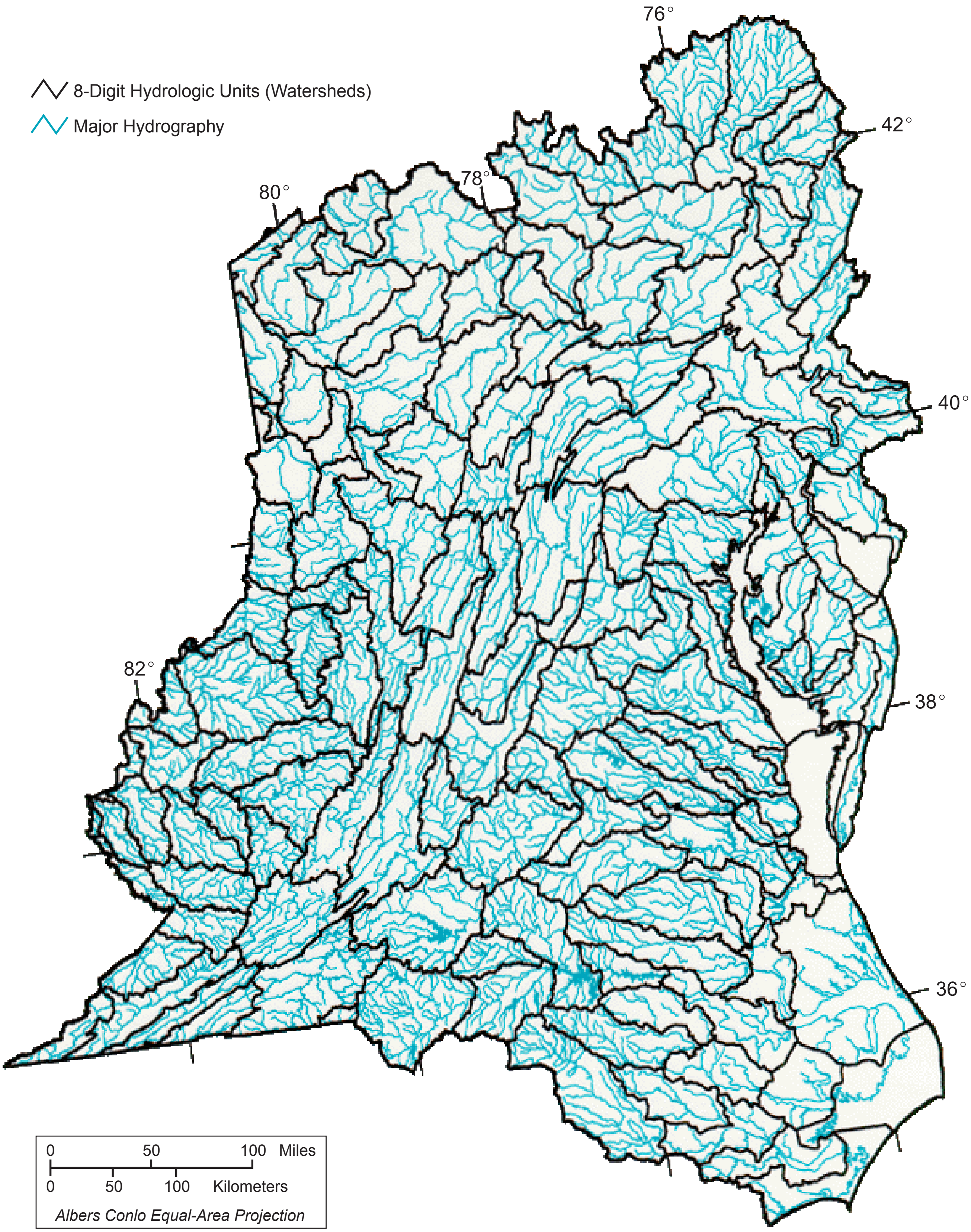
smith.betsy@epamail.epa.gov

Elevation
Mid-Atlantic Study Area



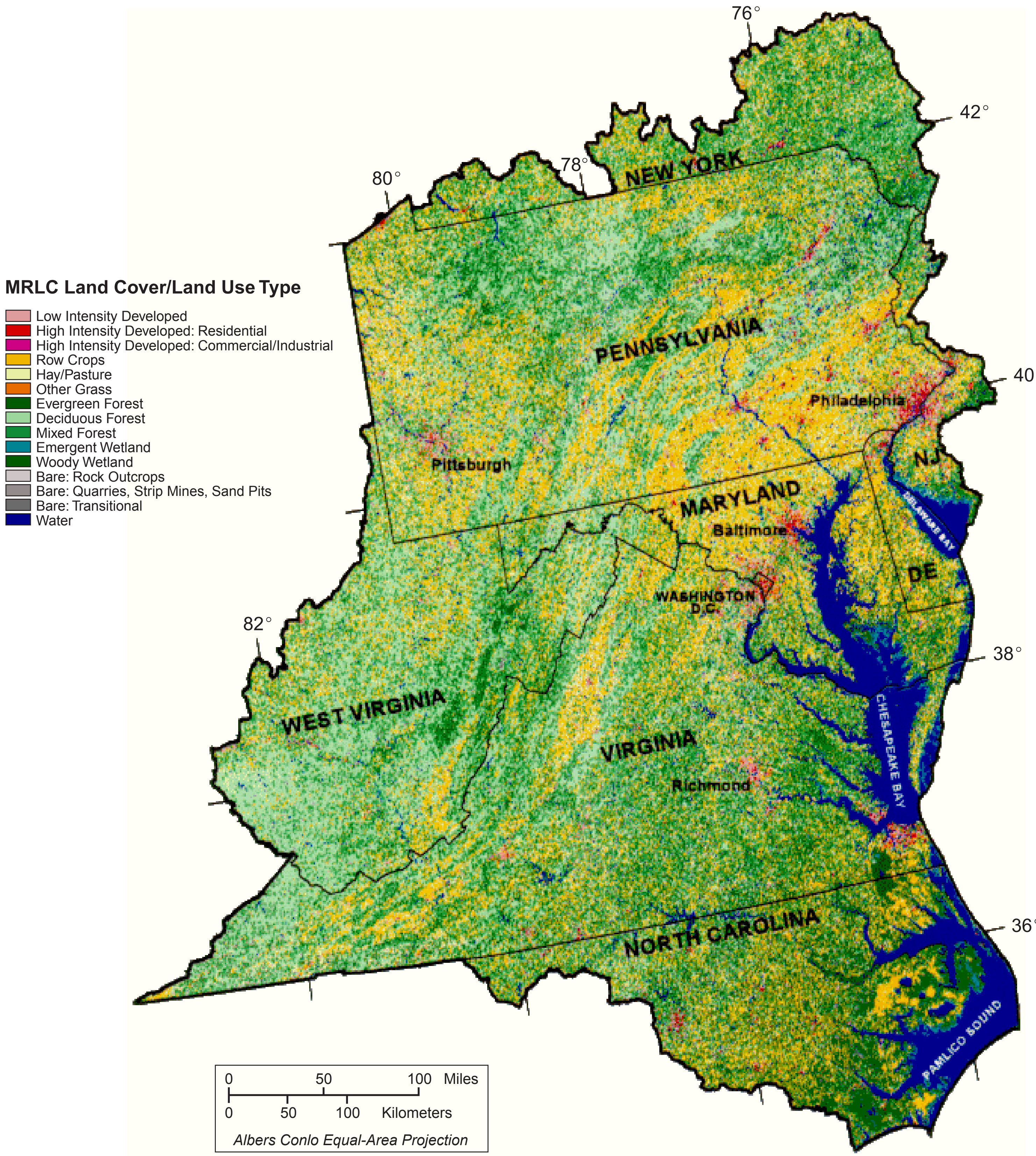
Source: USGS Digital Elevation Model (DEM) 7.5 minute, 2 arc-second and 3 arc-second data resampled to 90 meter cells

Major Hydrography
Mid-Atlantic Study Area



Source: Major hydrography extracted from the EPA River Reach File 3 (RF3).

Land Cover/Land Use
Mid-Atlantic Study Area

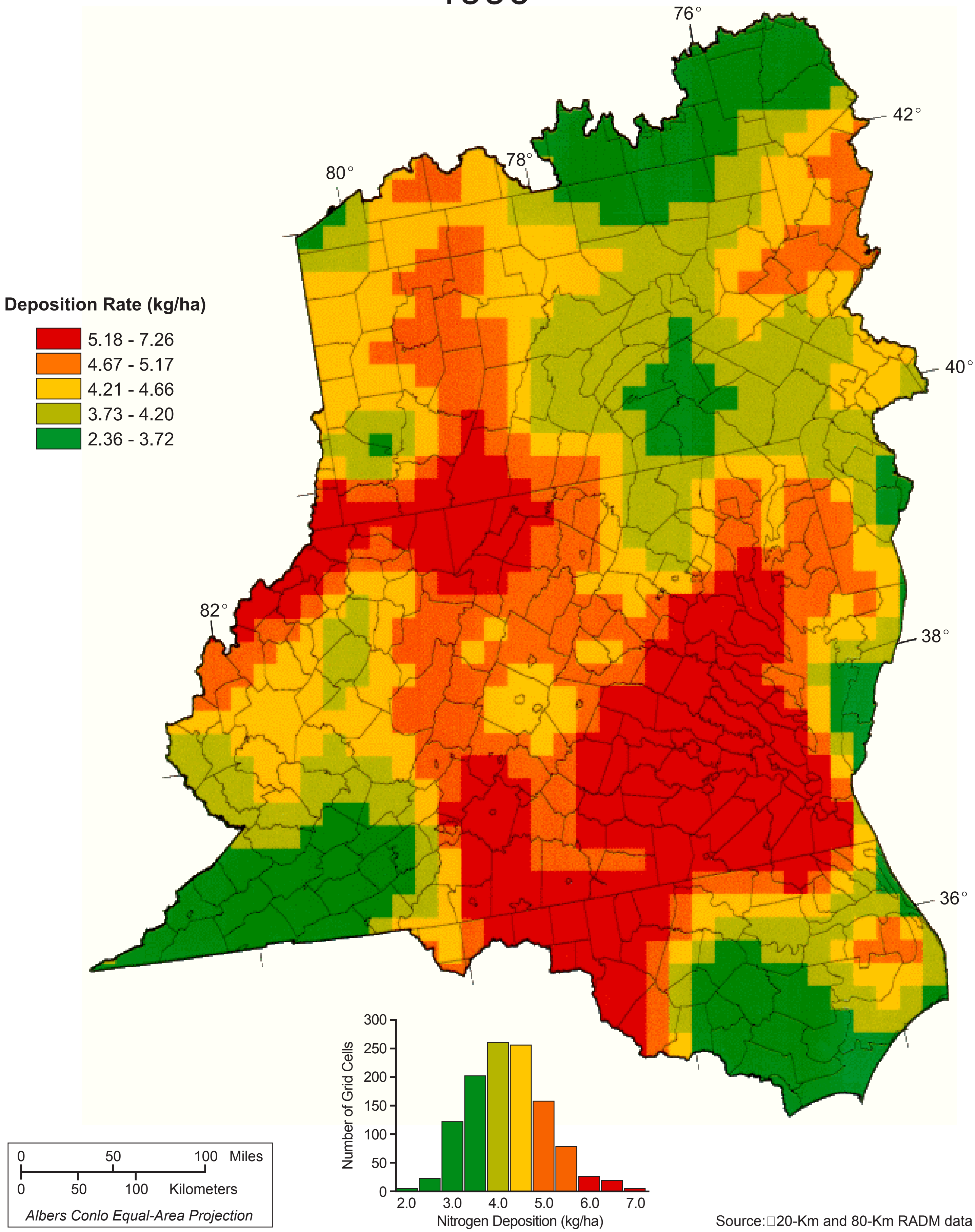


Source: Multi Resolution Land Characteristics (MRLC) Landsat Thematic Mapper data, 1991-93.

Nitrogen Deposition - Cold Season

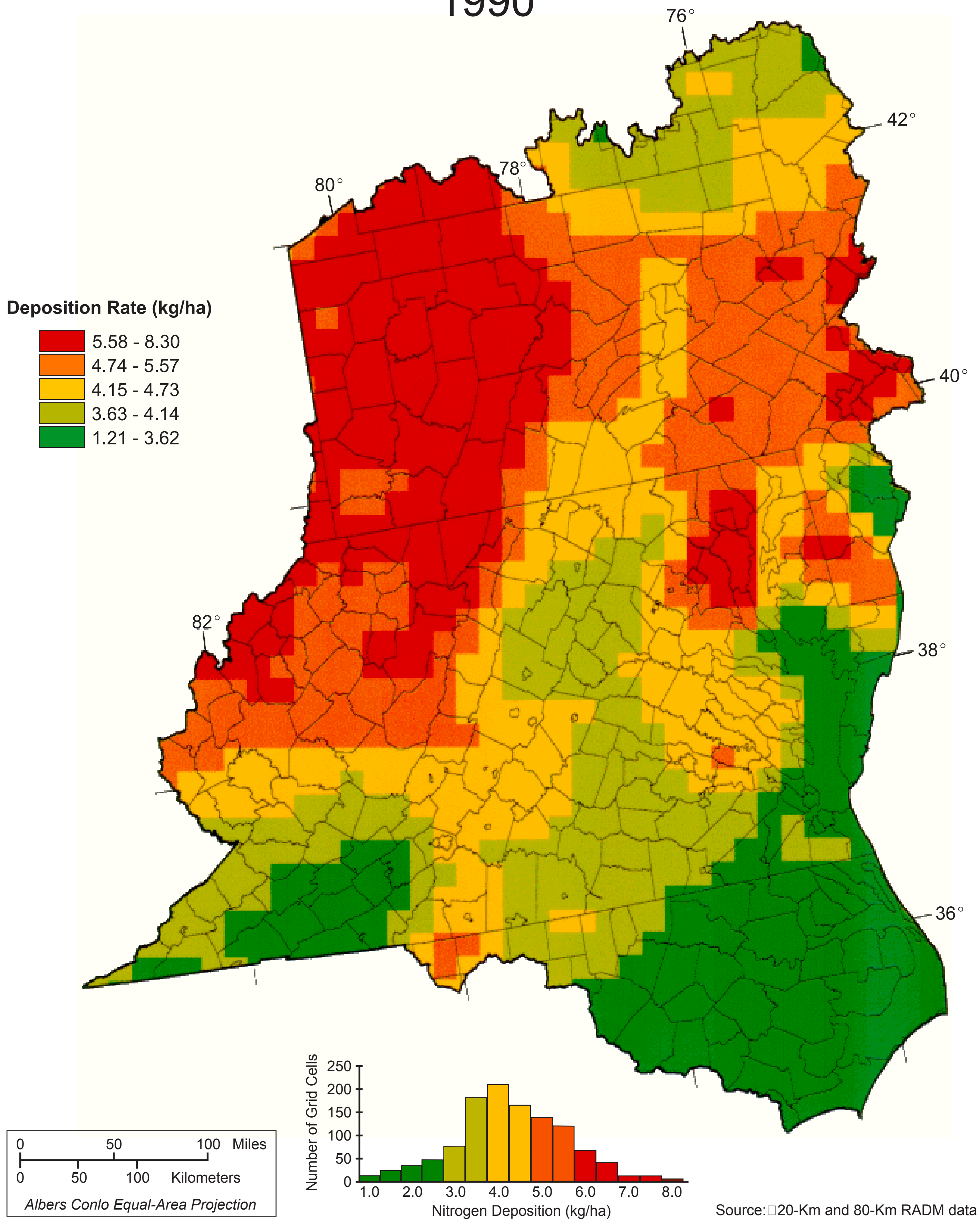
Mid-Atlantic Study Area

1990

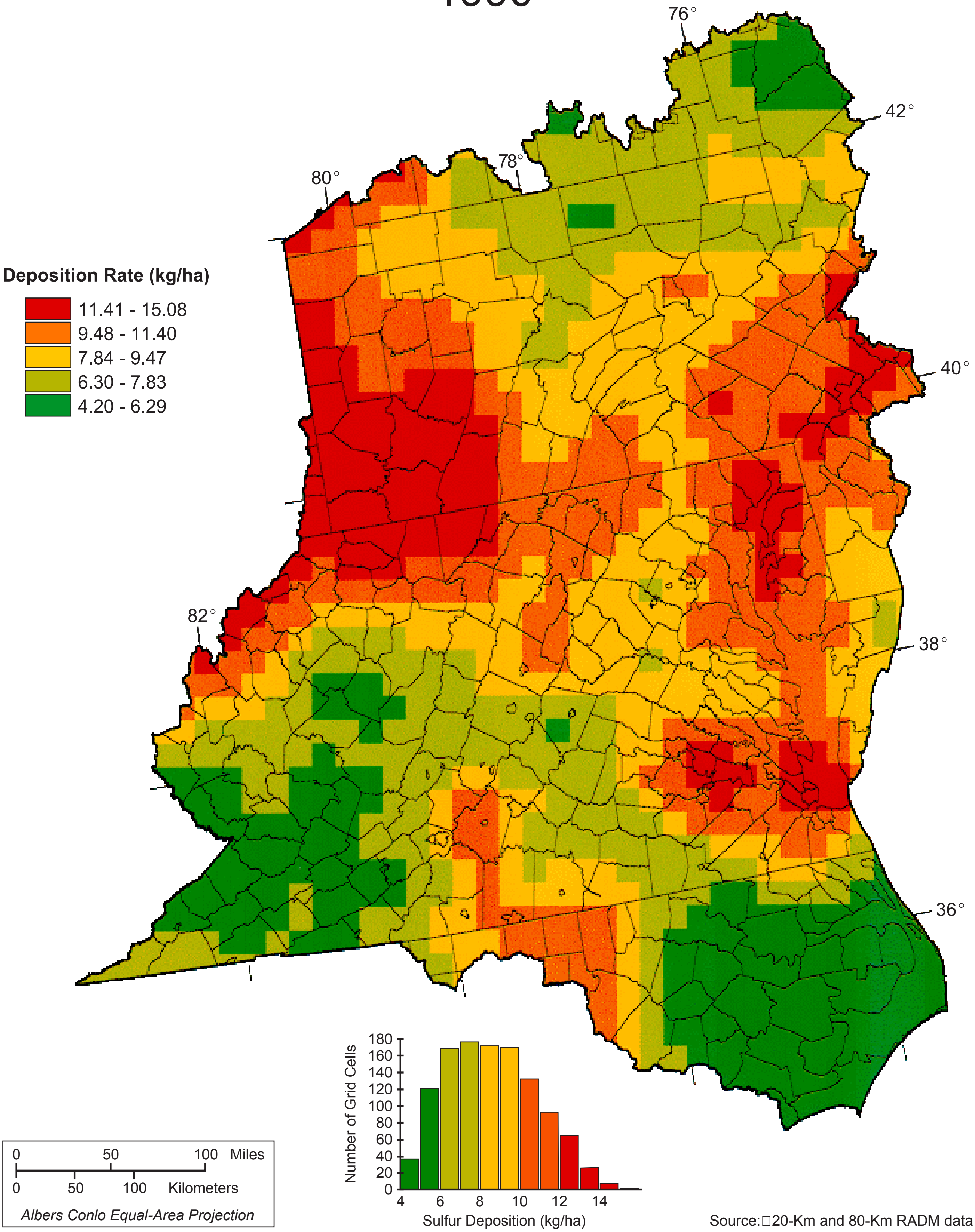


Source: 20-Km and 80-Km RADM data

Nitrogen Deposition - Warm Season
Mid-Atlantic Study Area
1990



Sulfur Deposition - Cold Season
Mid-Atlantic Study Area
1990

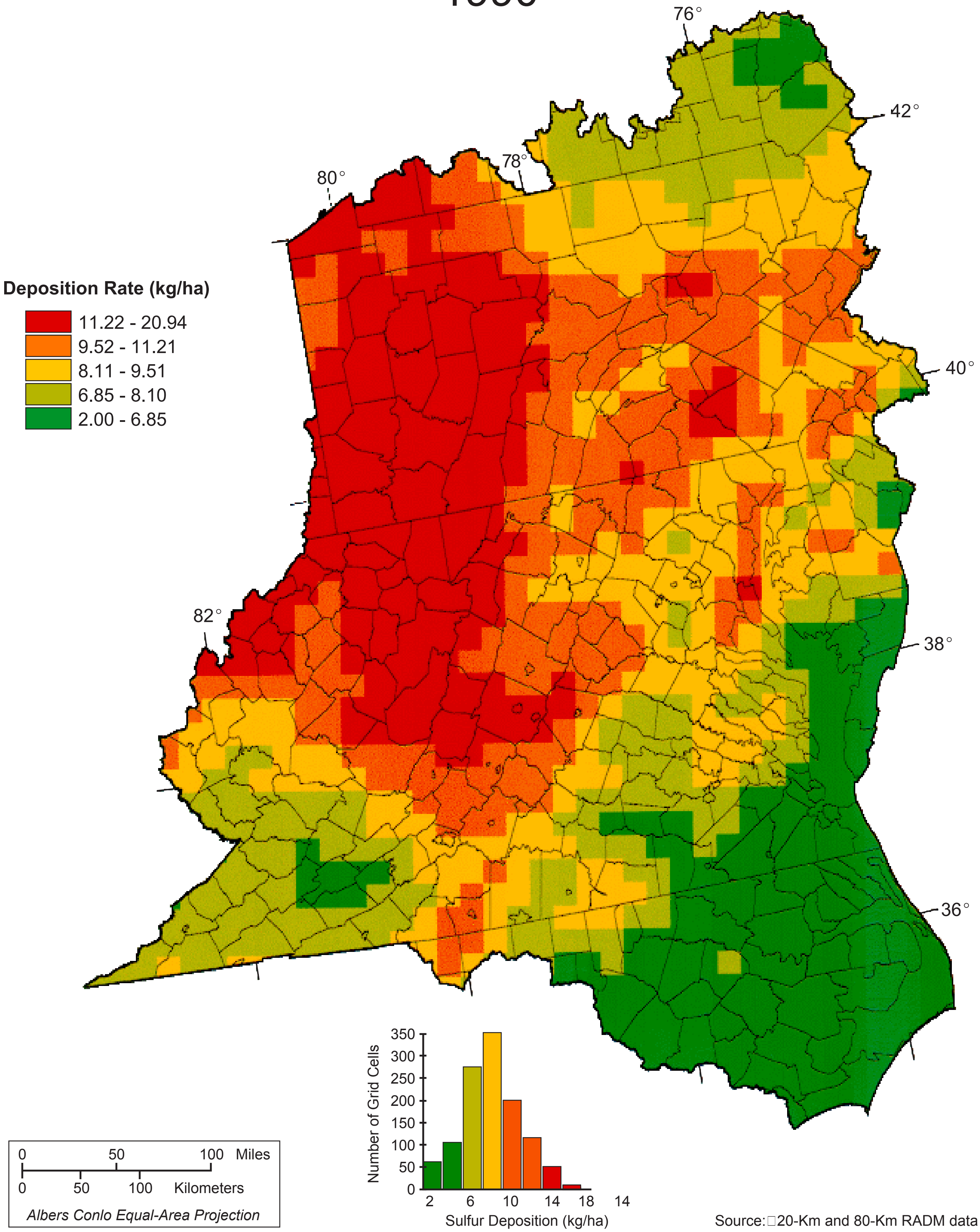


Source: 20-Km and 80-Km RADM data

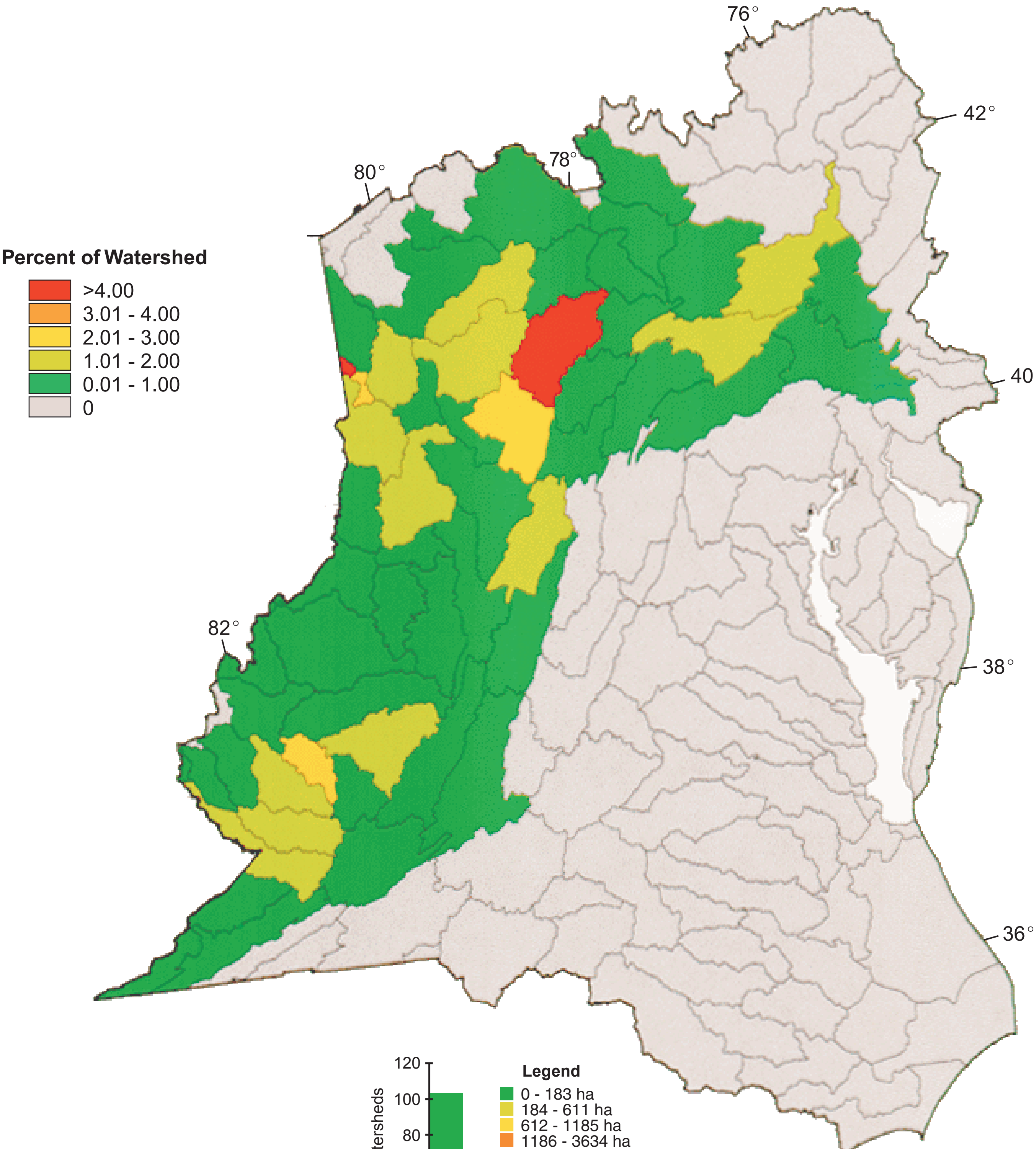
Sulfur Deposition - Warm Season

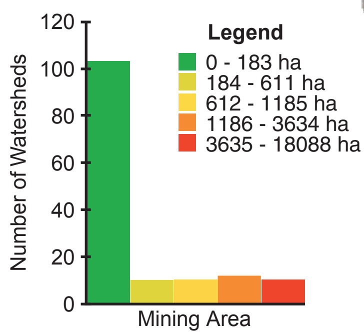
Mid-Atlantic Study Area

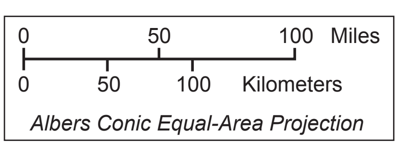
1990



Coal Mining
Mid-Atlantic Study Area
1988-1993



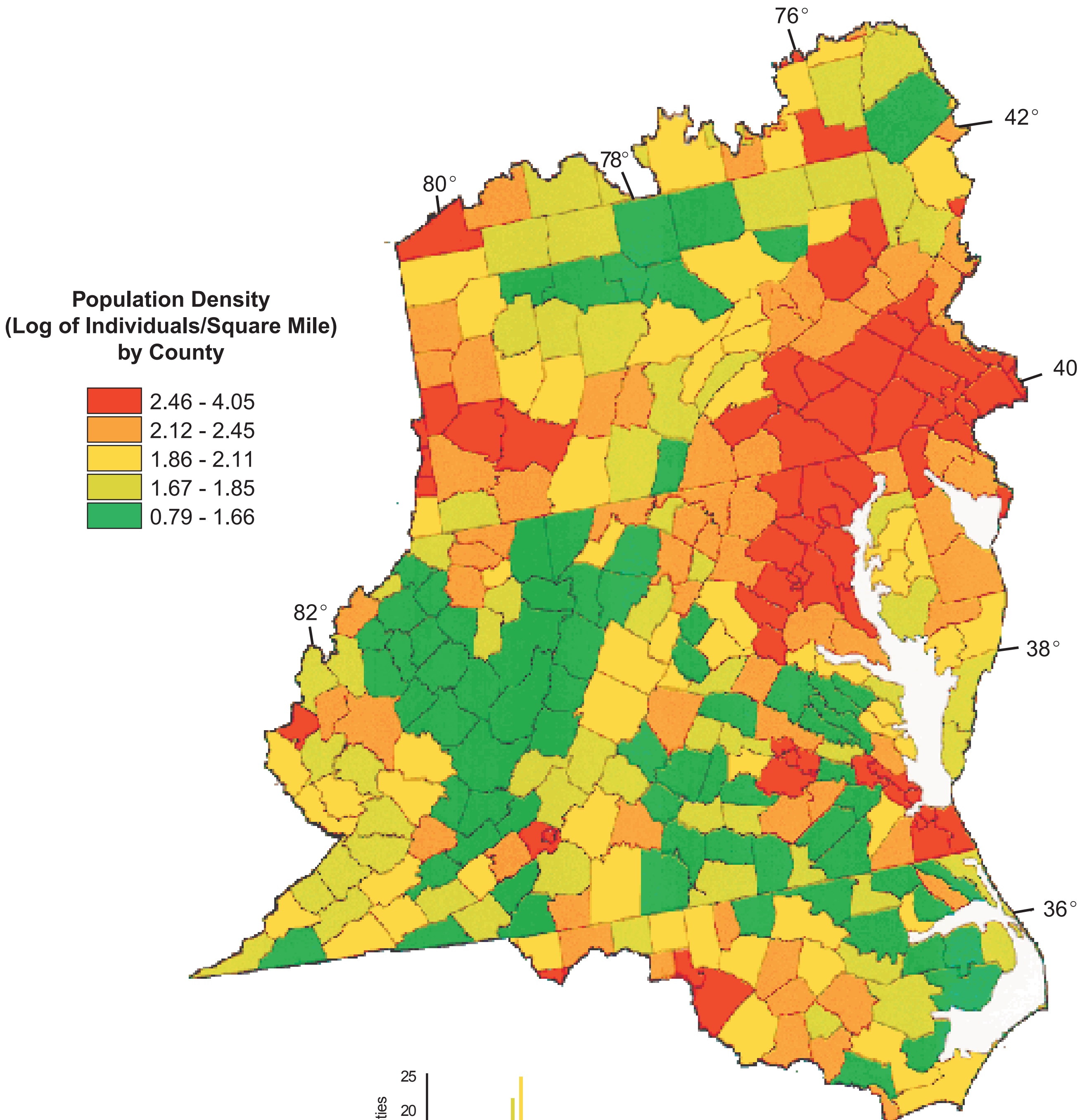


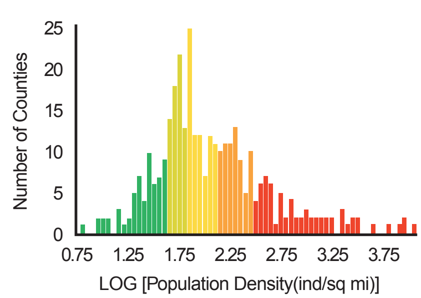


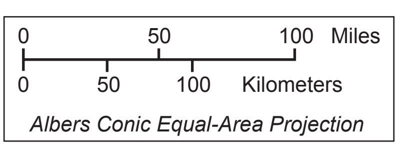
Source: Coal mining areas derived from remote sensing data

Map 8

Population Density
Mid-Atlantic Study Area
1995







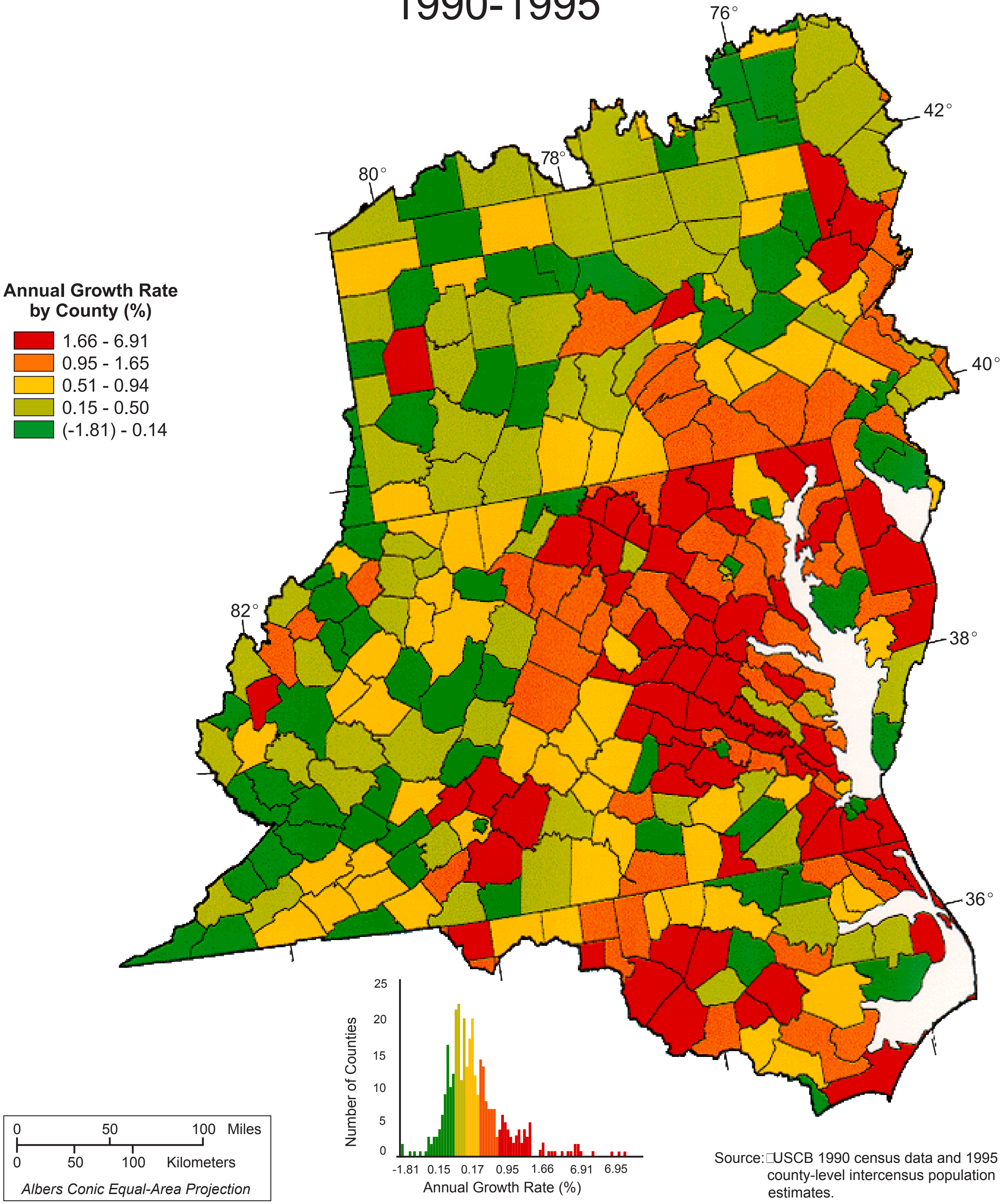
Source: USCB 1995 county-level intercensus population estimates

Map 9

Annual Population Growth Rate

Mid-Atlantic Study Area

1990-1995



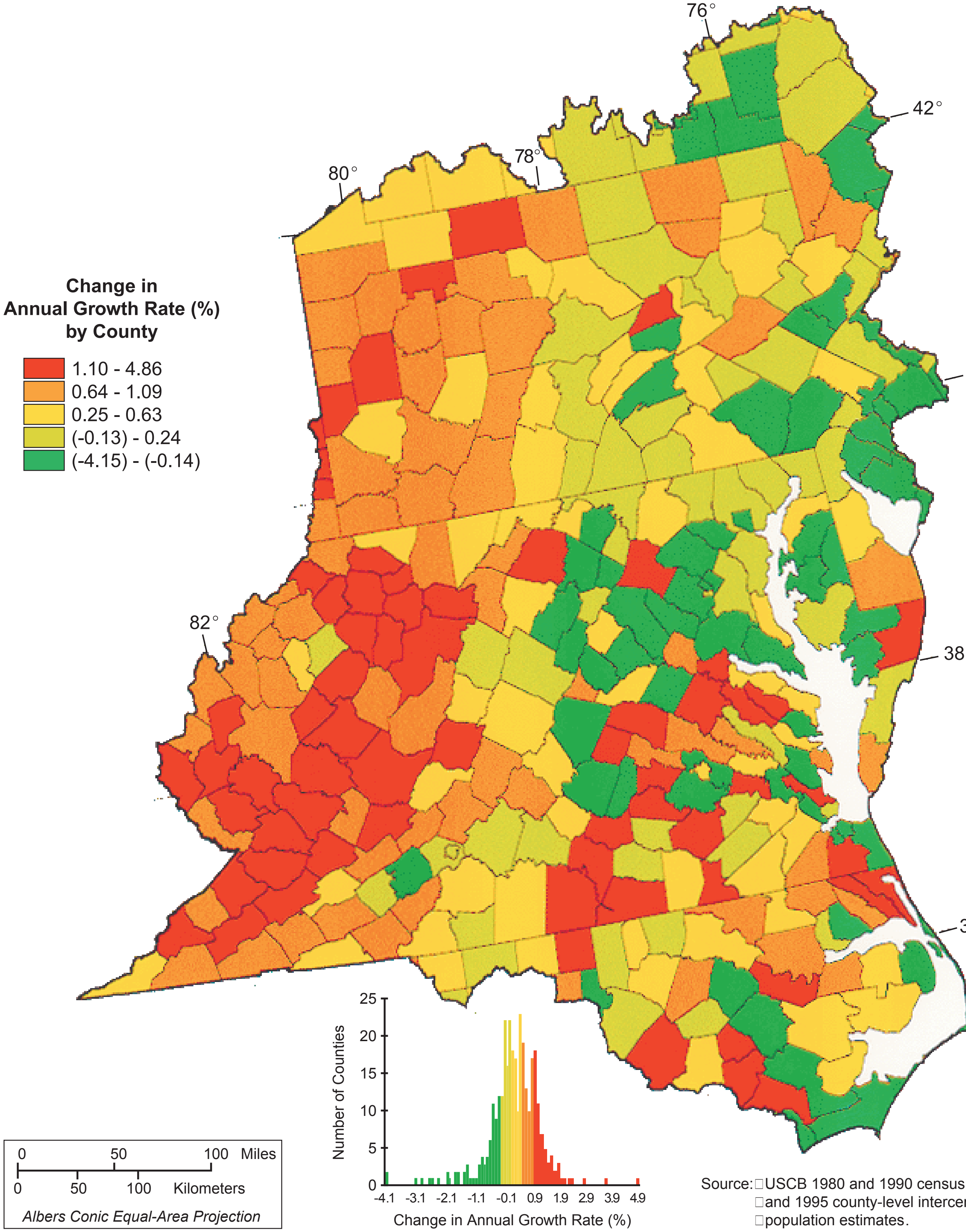
Source: USCB 1990 census data and 1995 county-level intercensus population estimates.

Map 10

Change in Annual Population Growth Rate

Mid-Atlantic Study Area

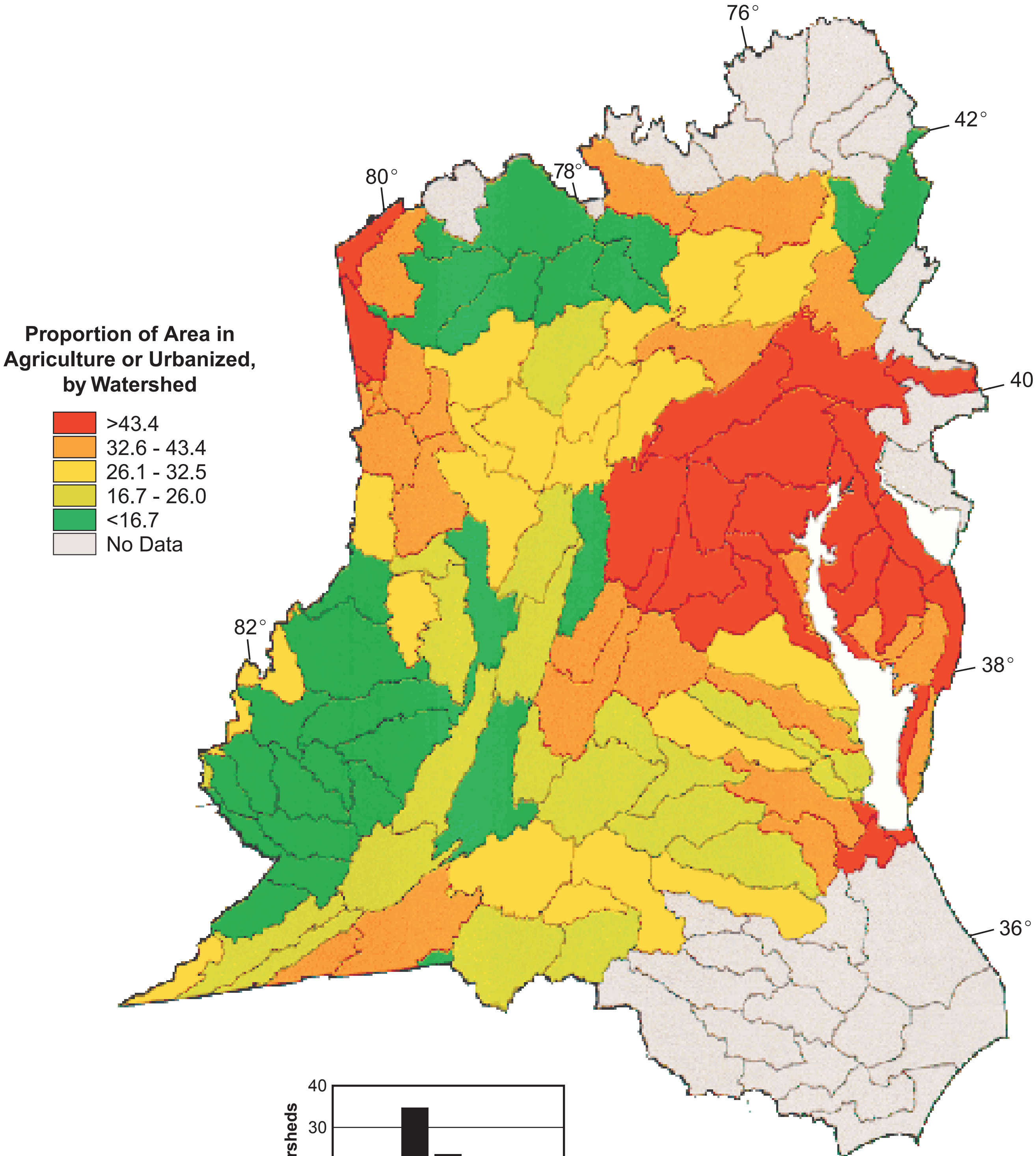
1980-1990 vs. 1990-1995

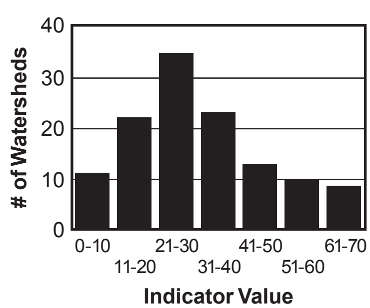


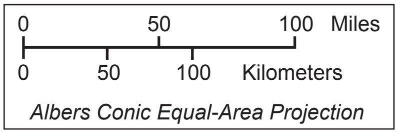
Source: USCB 1980 and 1990 census data and 1995 county-level intercensus population estimates.

Map 11

Human Use Index
Mid-Atlantic Study Area
1991-1993



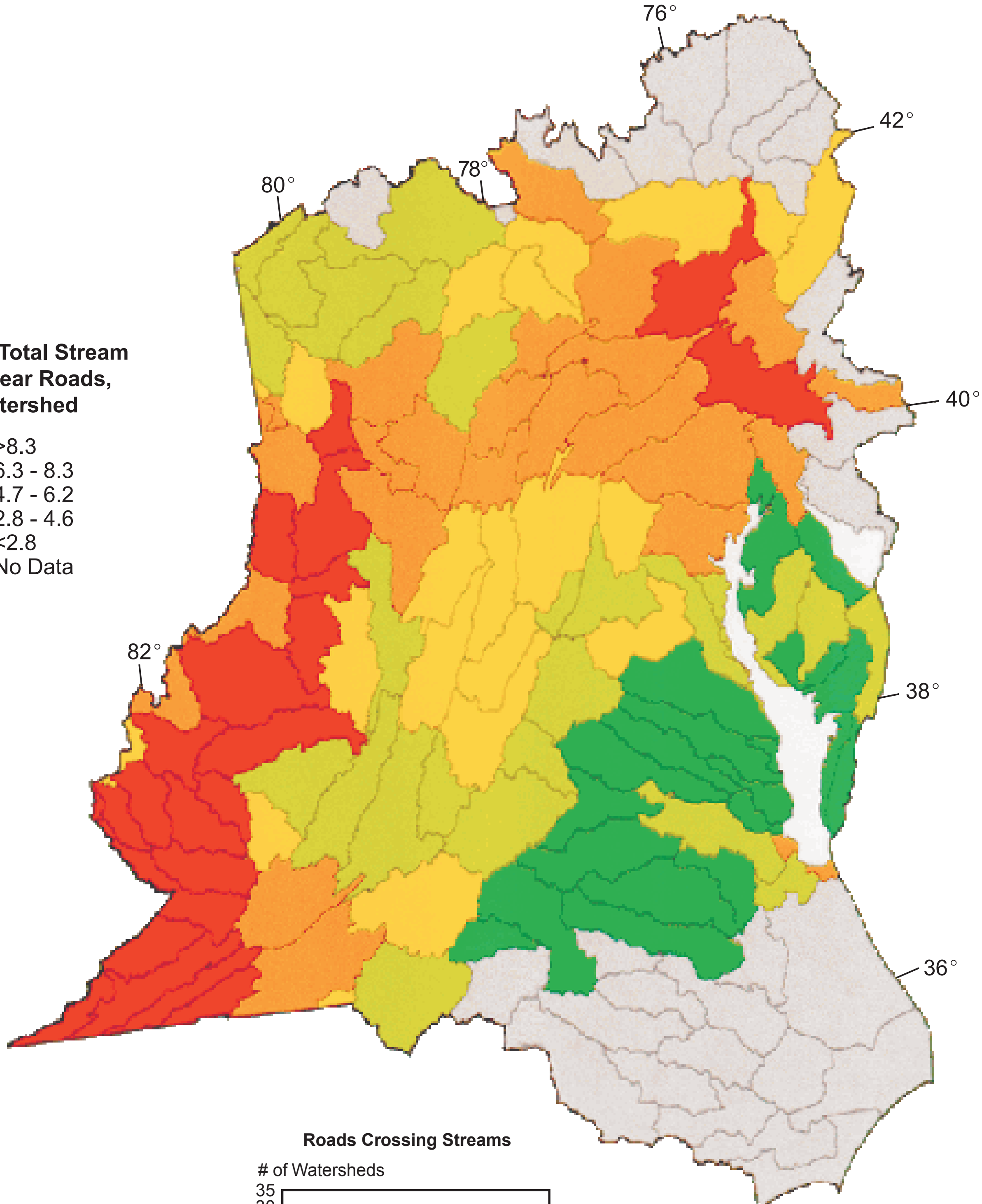




Source: Agricultural and urban land within each watershed were derived from MRLC 30-meter land cover/land use data (1991-93).

Map 12

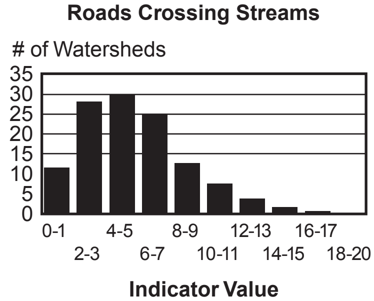
Streams Near Roads
Mid-Atlantic Study Area



Percent of Total Stream Length Near Roads, by Watershed

- >8.3
- 6.3 - 8.3
- 4.7 - 6.2
- 2.8 - 4.6
- <2.8
- No Data

Roads Crossing Streams



0 50 100 Miles

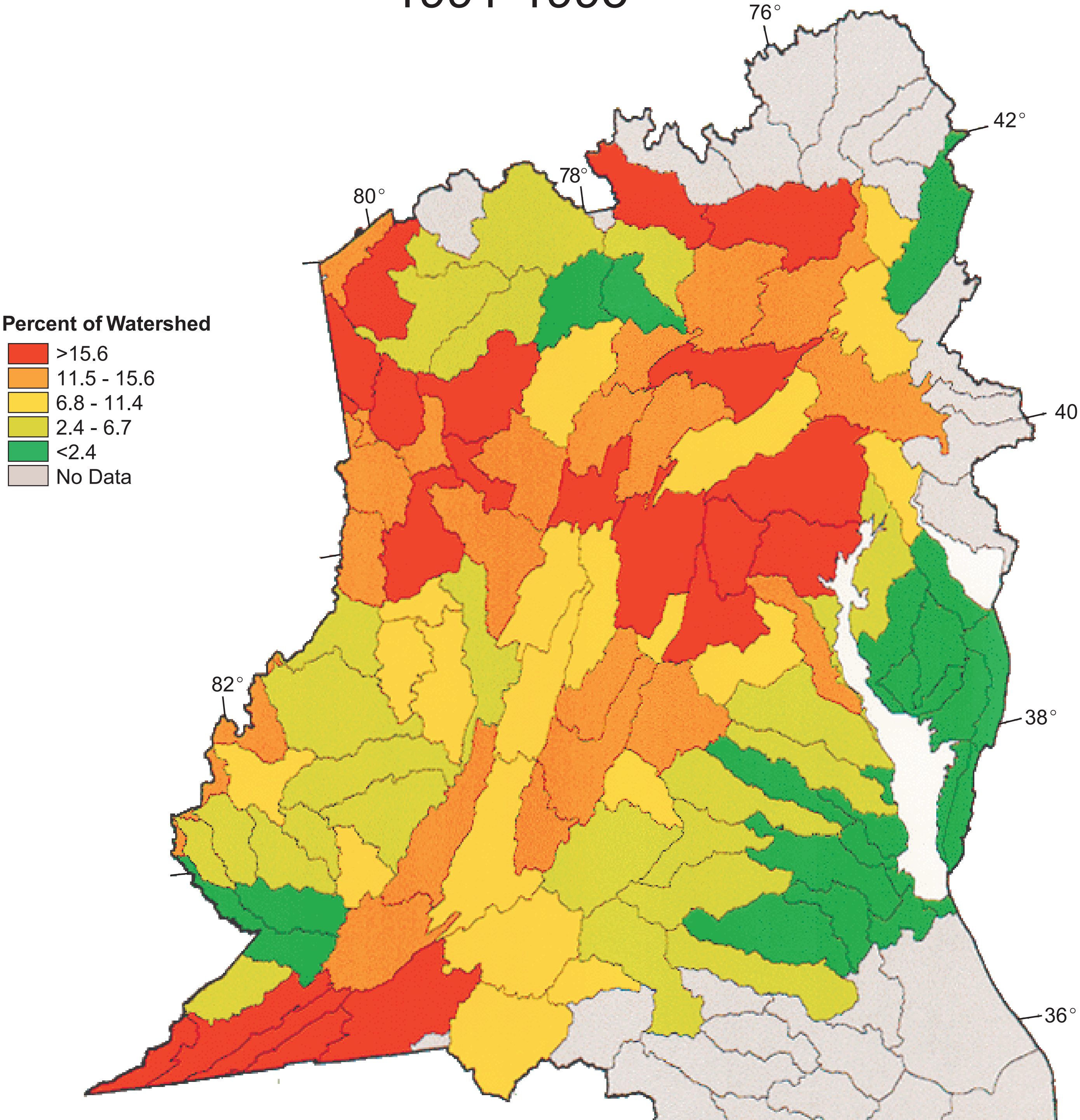
0 50 100 Kilometers

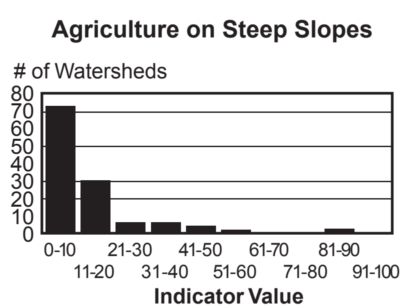
Albers Conic Equal-Area Projection

Source: Road data derived from USGS 1:100,000 Scale DLG data. Stream data from EPA Reach File 3.

Map 13

Agriculture on Steep Slopes
Mid-Atlantic Study Area
1991-1993





0 50 100 Miles
0 50 100 Kilometers
Albers Conic Equal-Area Projection

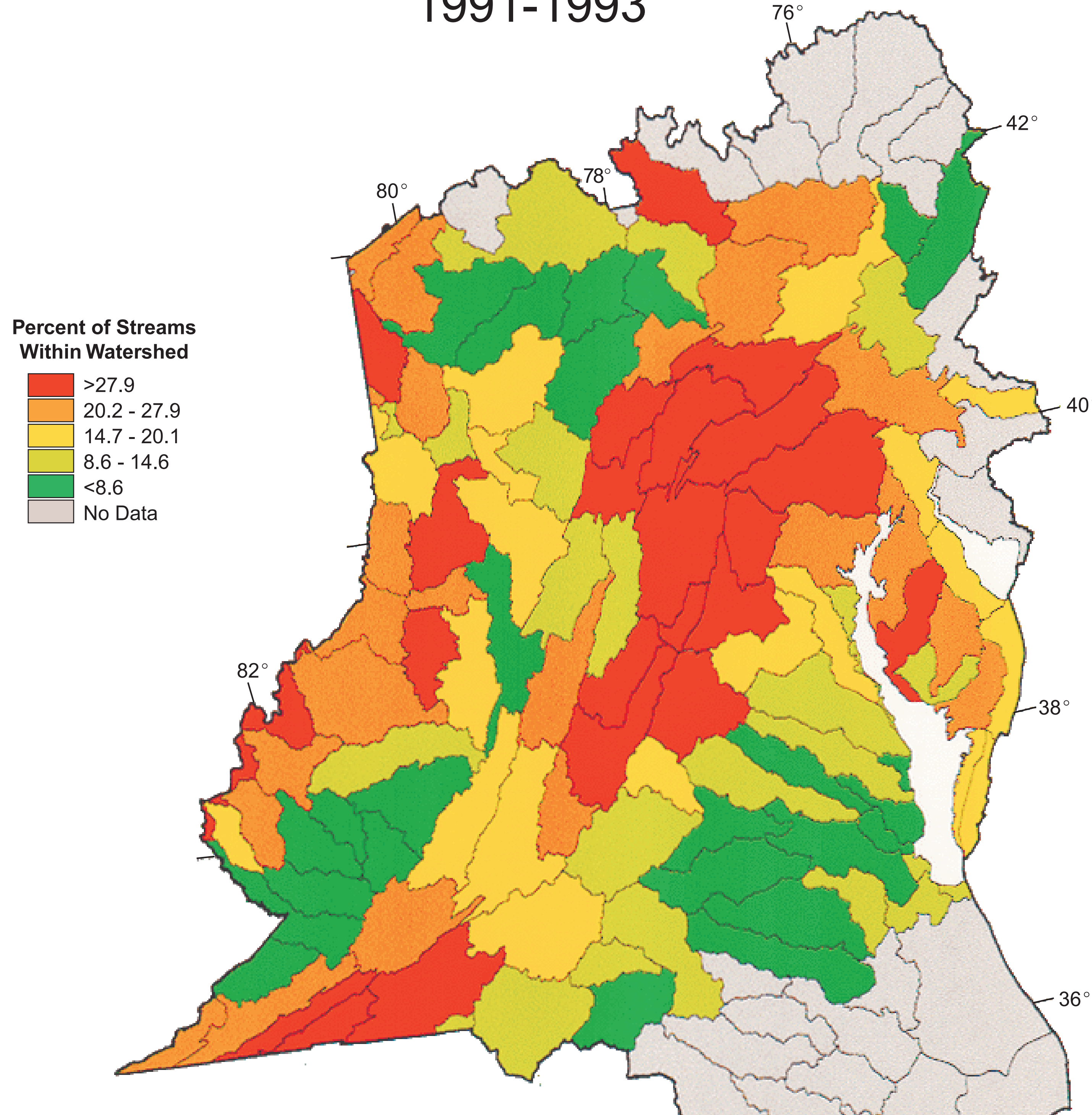
Source: Slope derived from 90-meter USGS Digital Elevation Model data. Agricultural land derived from MRLC land cover/land use data (1991-93).

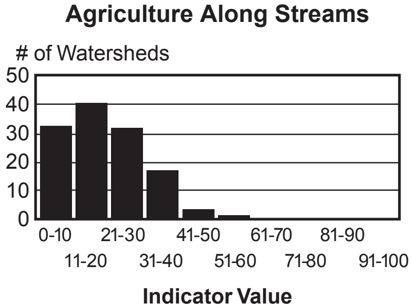
Map 14

Streams with Agricultural Land Cover

Mid-Atlantic Study Area

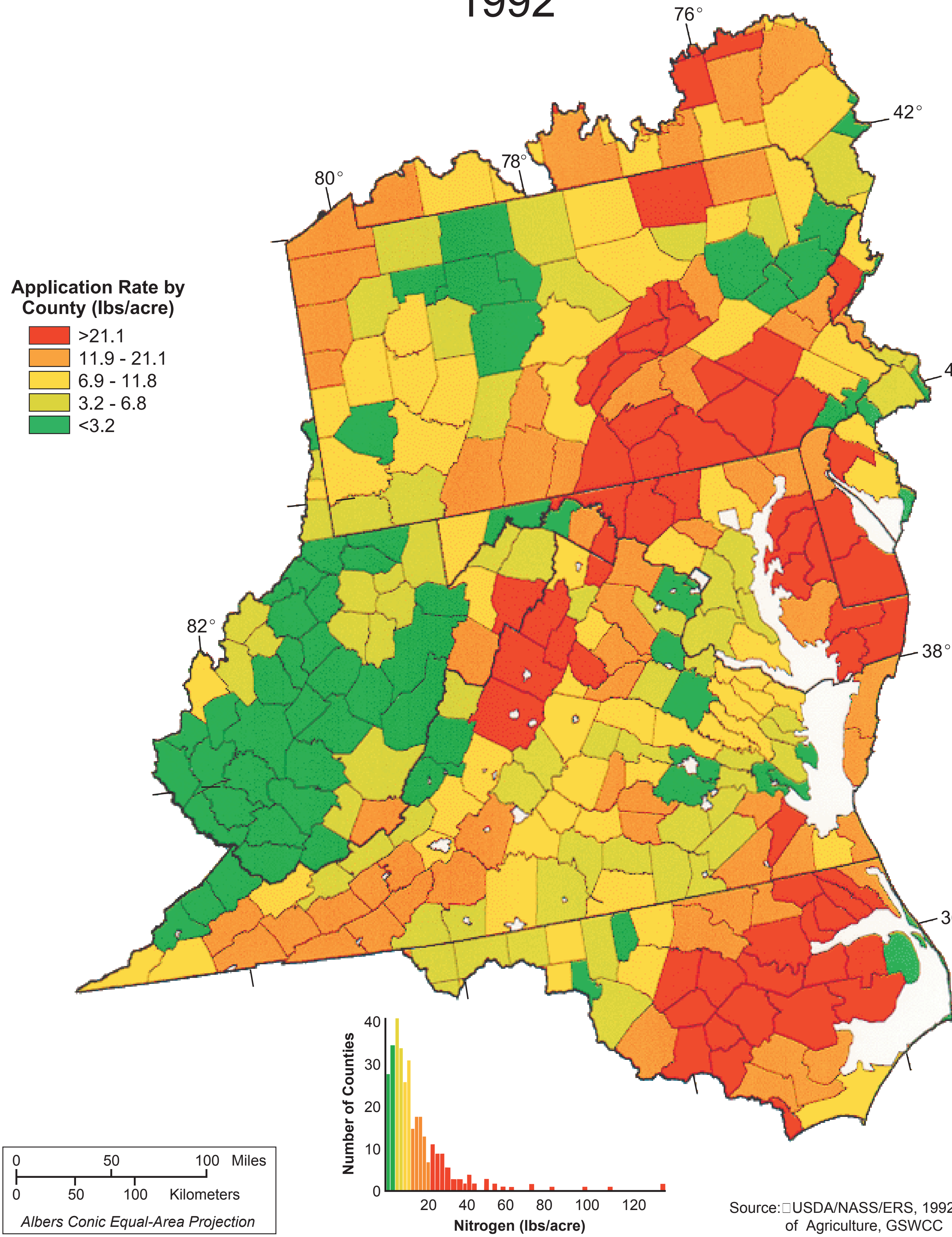
1991-1993





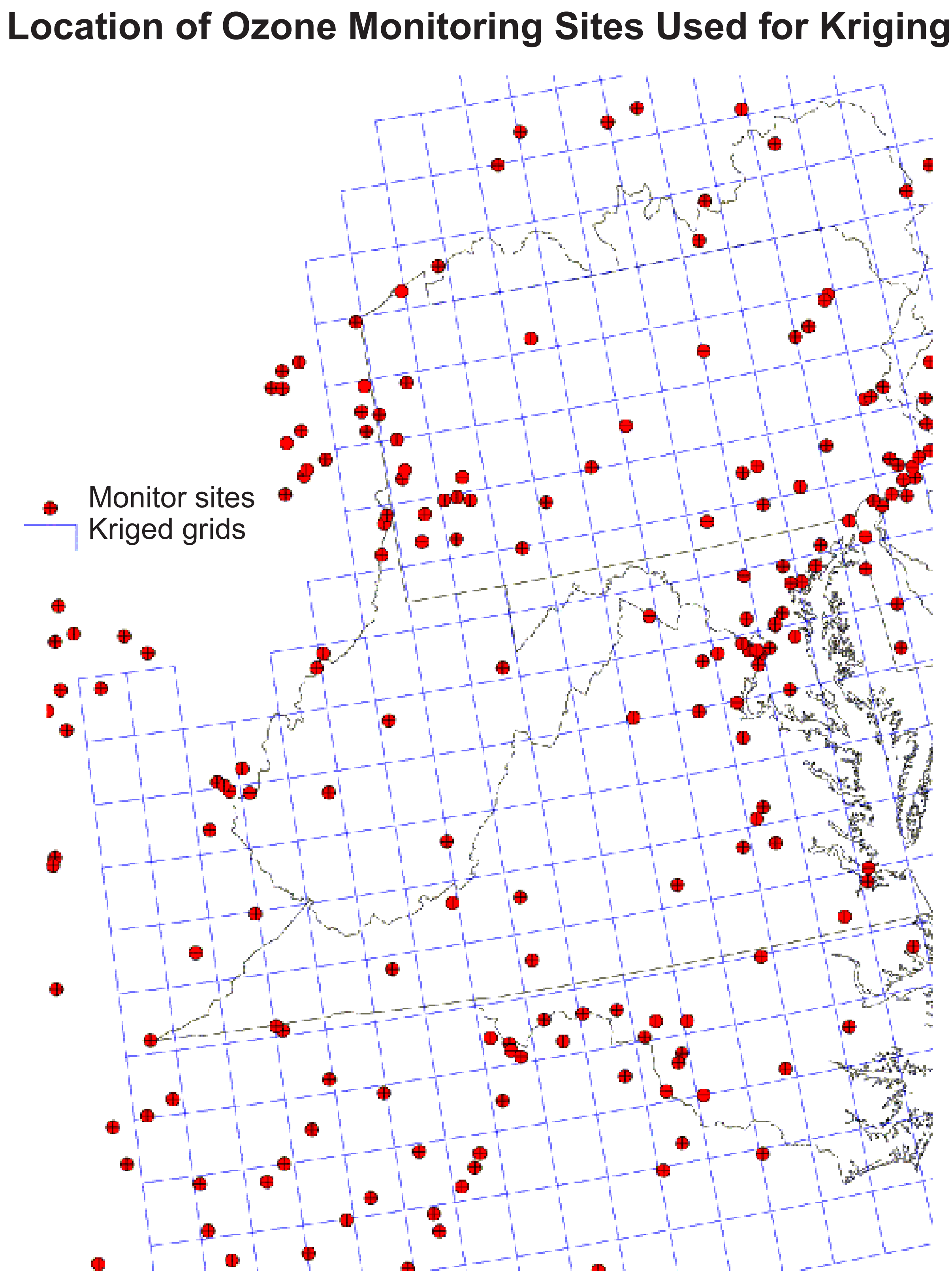
Source: Stream data derived from the EPA River Reach File 3. Agricultural land cover derived from MRLC land cover/land use data (1991-93).

Annual Nitrogen Application
Mid-Atlantic Study Area
1992

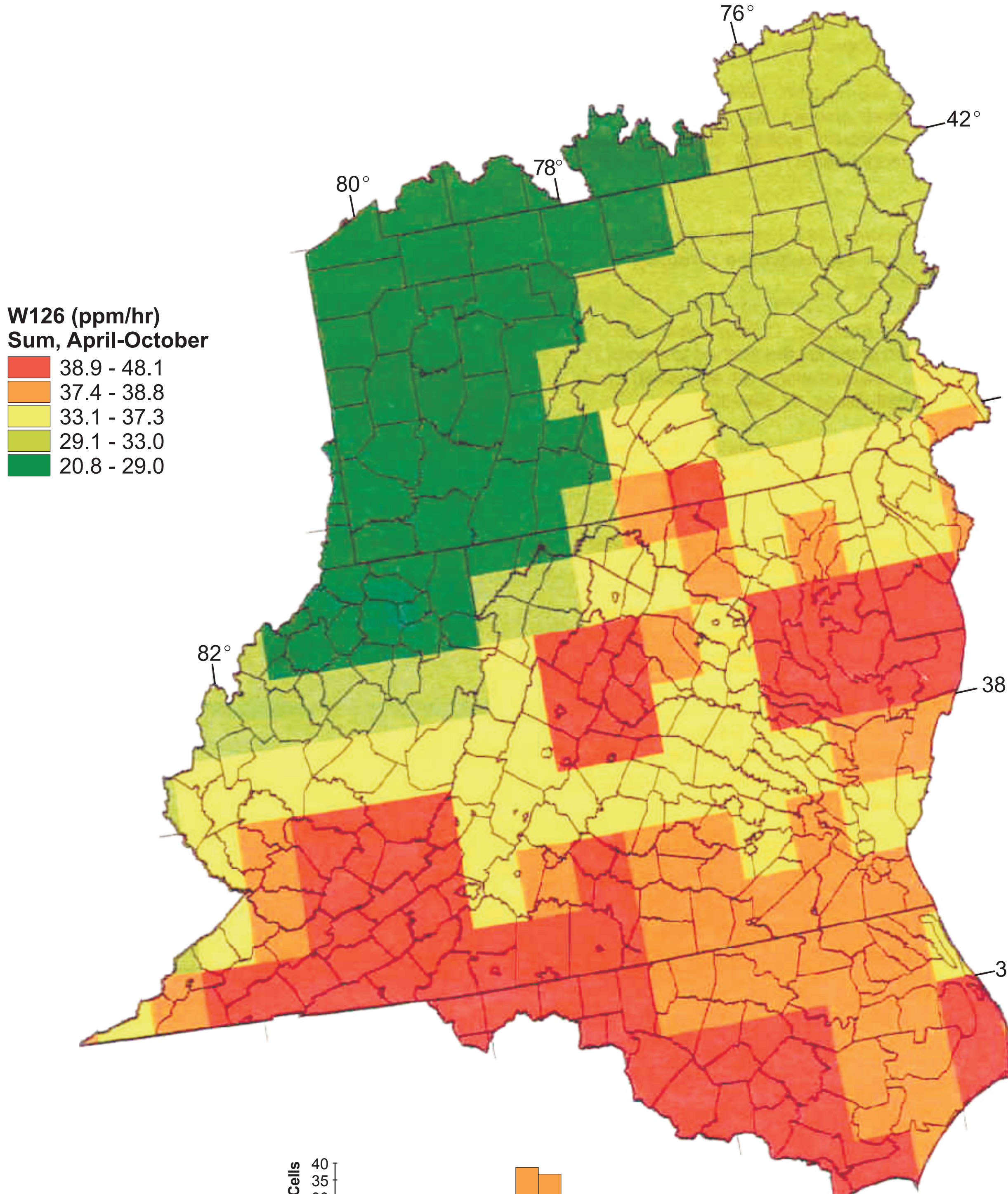


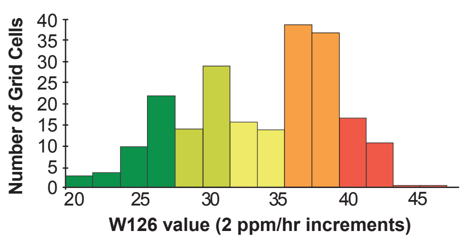
Source: USDA/NASS/ERS, 1992 Census of Agriculture, GSWCC

Map 16


Location of Ozone Monitoring Sites Used for Kriging
Monitor sites
Kriged grids

W126 Ozone Exposure Index
Mid-Atlantic Study Area
1990





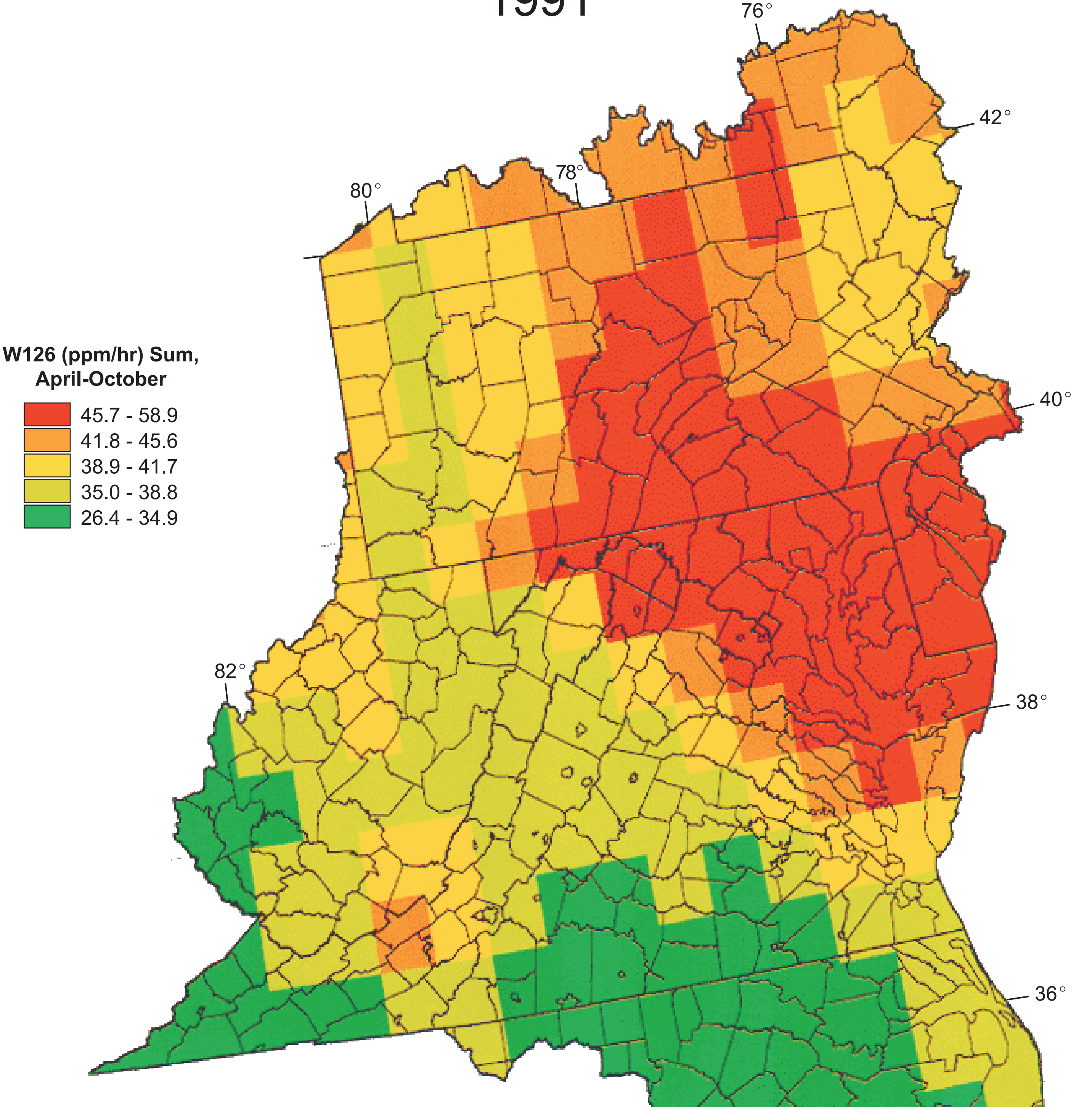
0 50 100 Miles
0 50 100 Kilometers
Albers Conic Equal-Area Projection

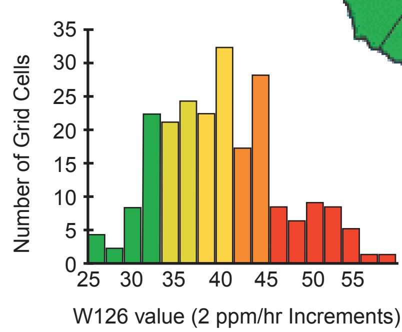
Source: Derived from hourly ozone measurements obtained from the Aerometric Information Retrieval System (AIRS) database(U.S. EPA 1998).

W126 Ozone Exposure Index

Mid-Atlantic Study Area

1991

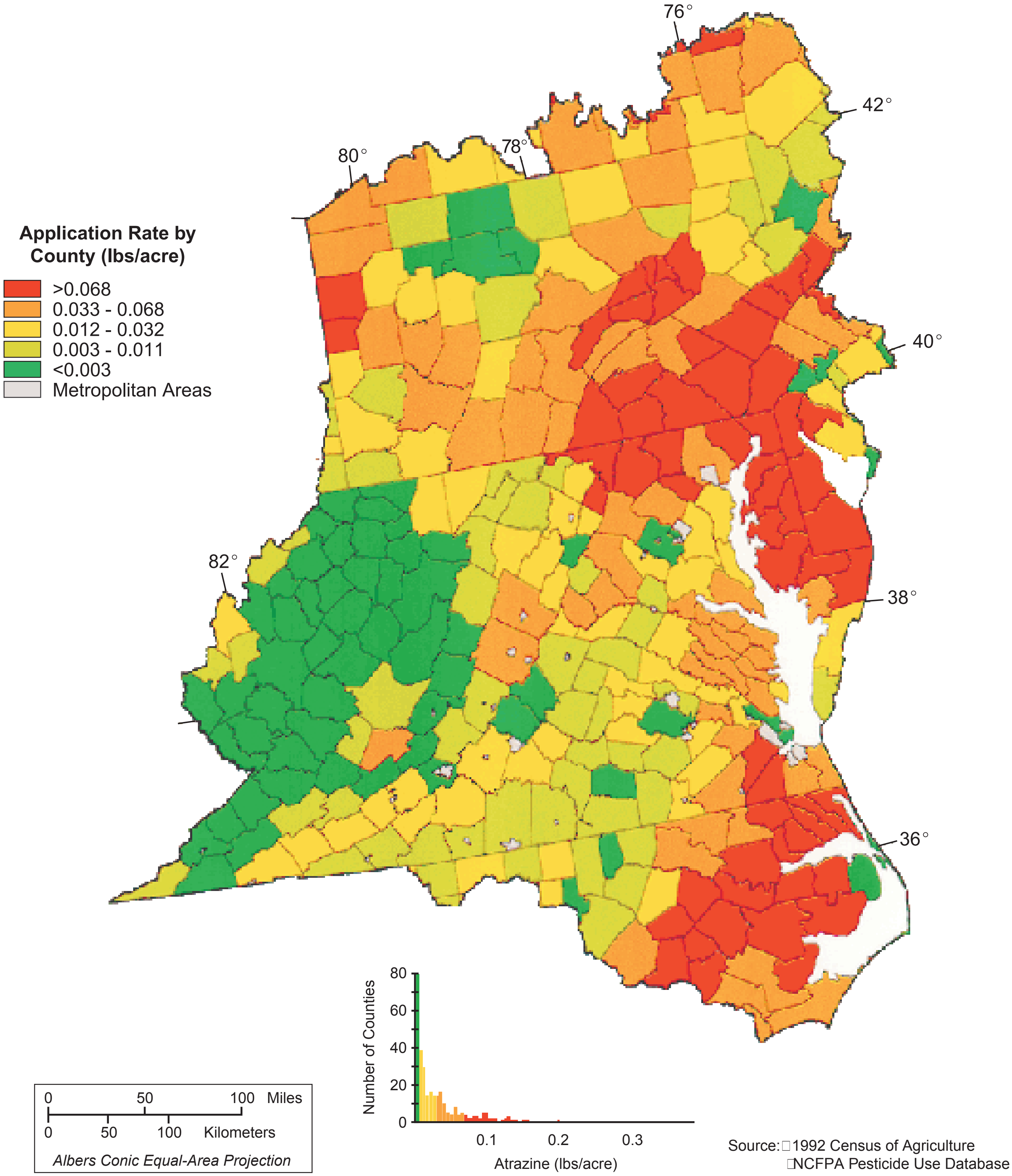




Source: Derived from hourly ozone measurements obtained from the Aerometric Information Retrieval System (AIRS) database (U.S .EPA 1998)

Map 19

Annual Atrazine Loadings
Mid-Atlantic Study Area
1992



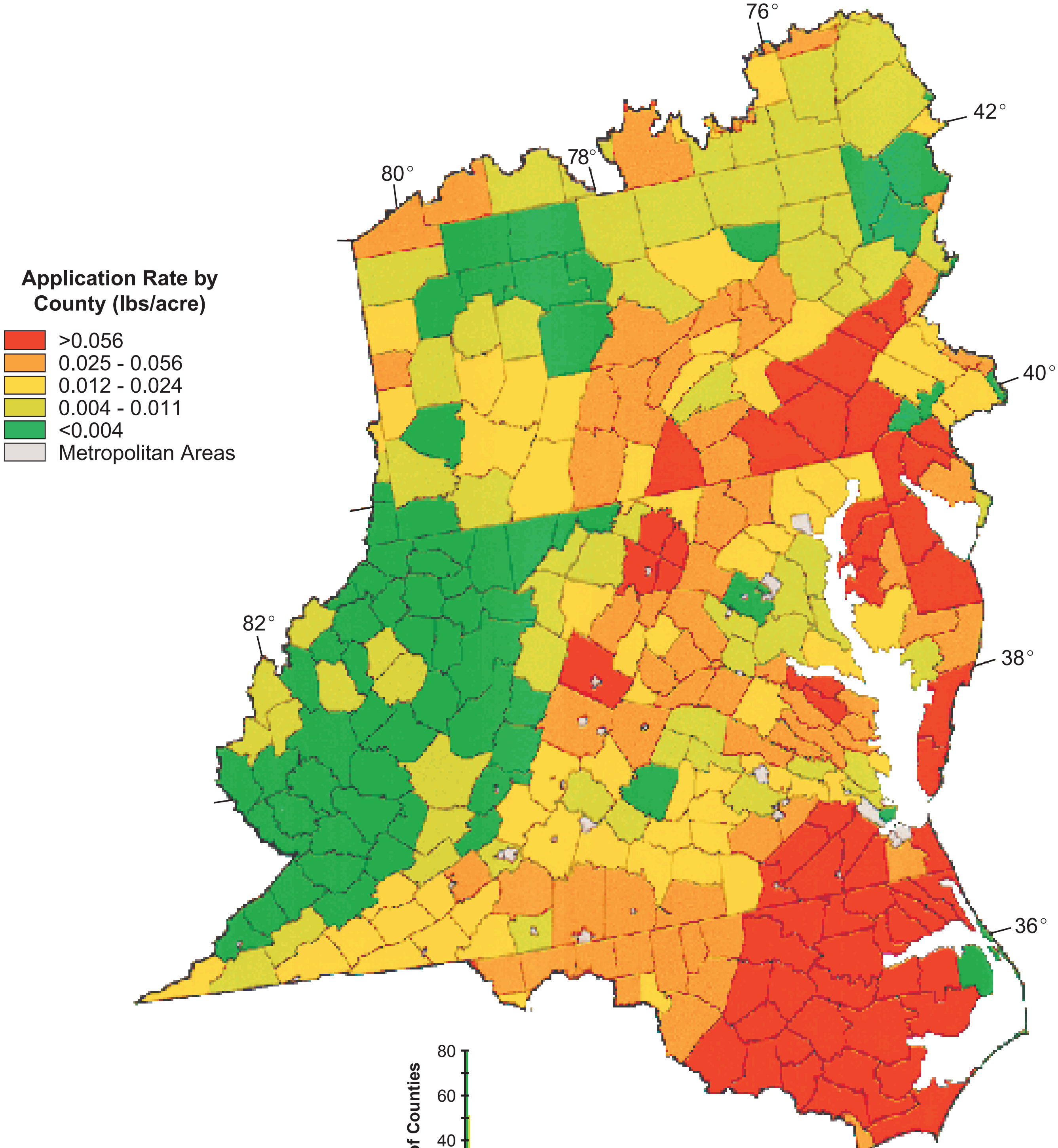
Source: 1992 Census of Agriculture
NCFPA Pesticide Use Database

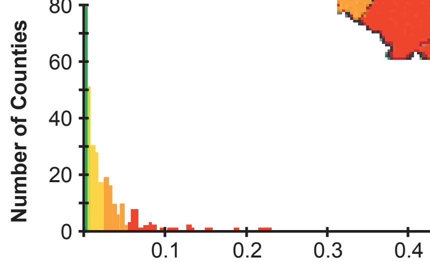
Map 20

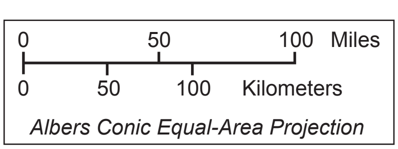
Annual O-P Insecticides Loadings

Mid-Atlantic Study Area

1992



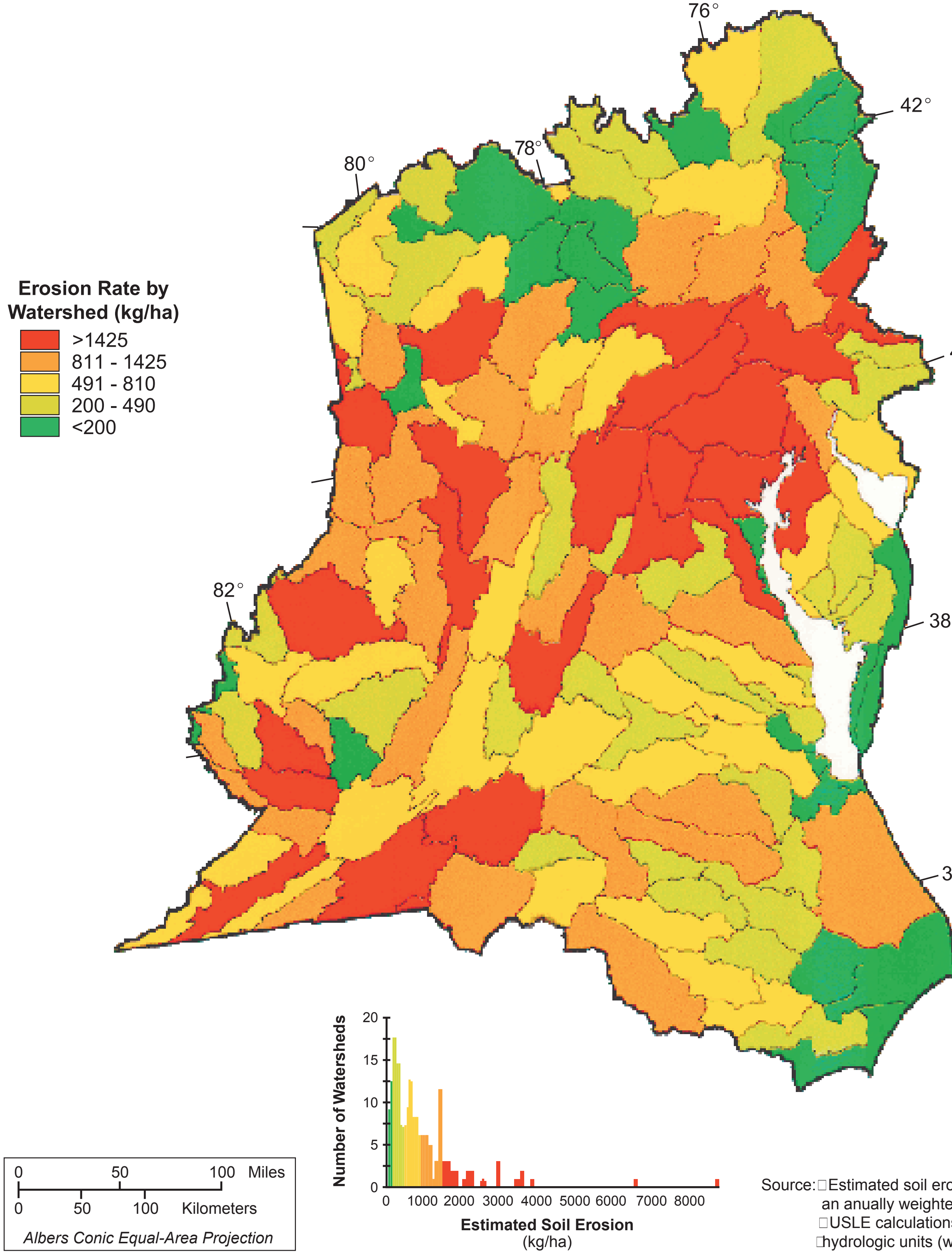




Source: 1992 Census of Agriculture
NCFAPPesticide Use Database

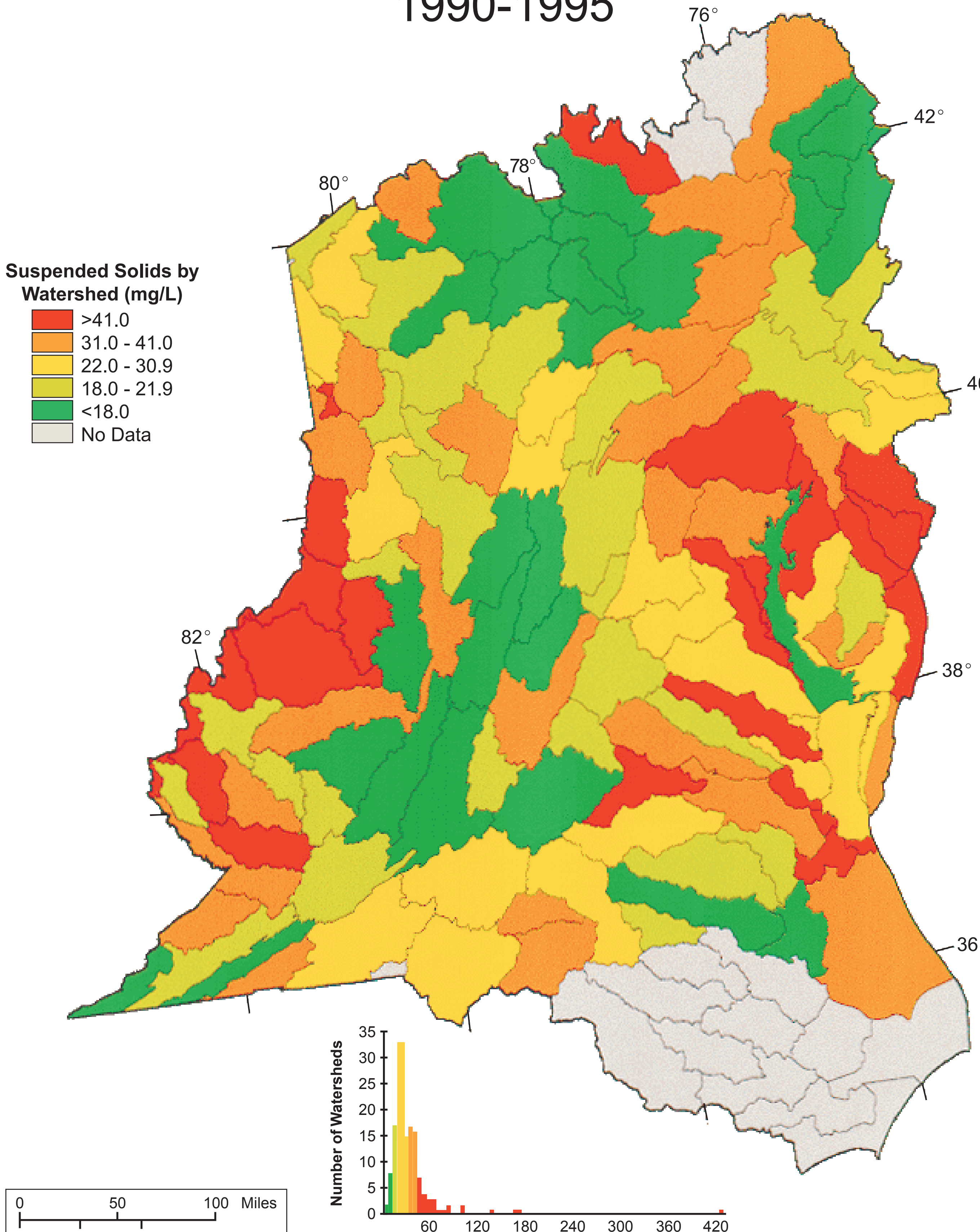
Map 21

USLE Estimated Soil Erosion
Mid-Atlantic Study Area
1992



Source: Estimated soil erosion derived from an anually weighted average of USLE calculations for 8-digit hydrologic units (watersheds).

Total Suspended Solids
Mid-Atlantic Study Area
1990-1995



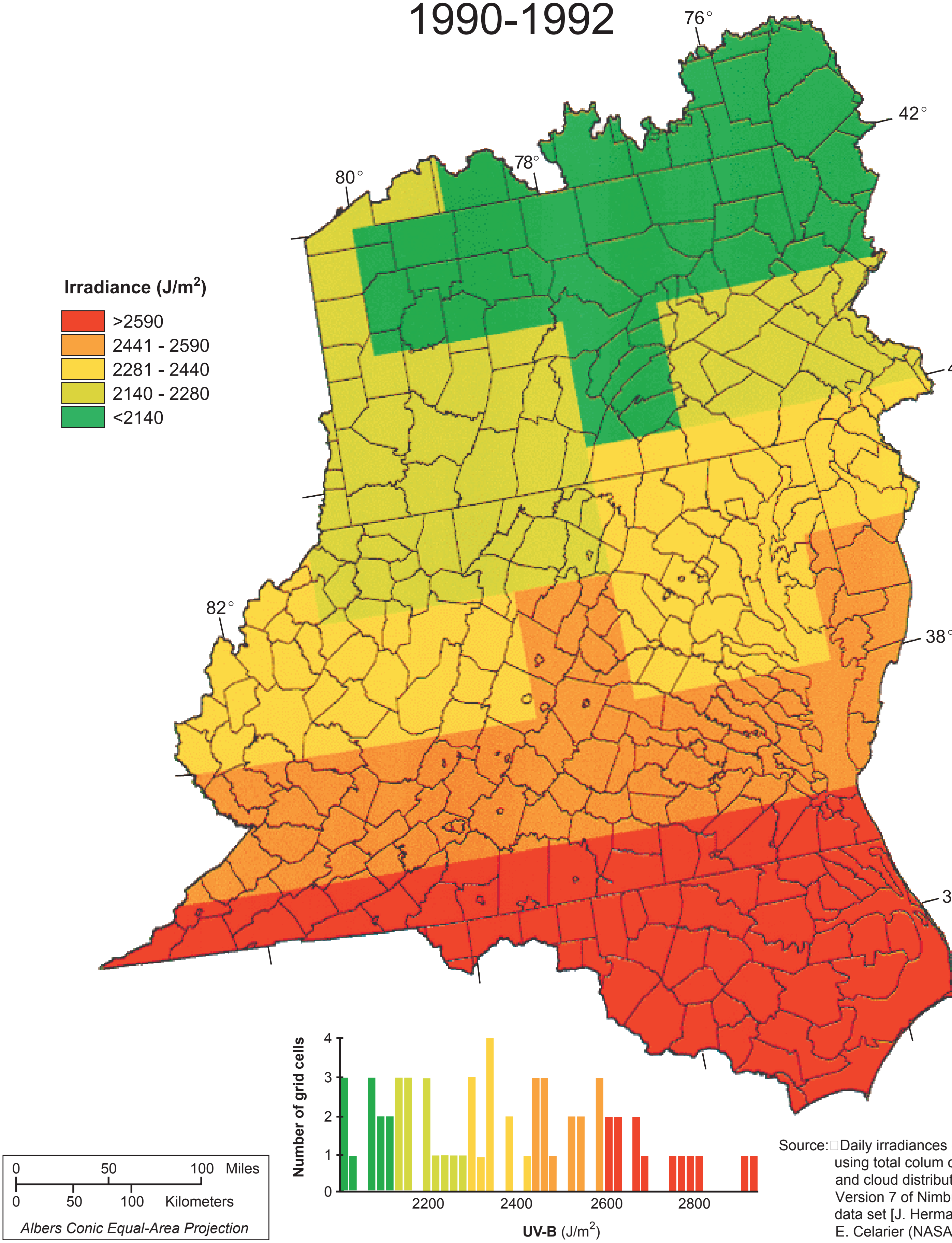
Source: Derived from EPA's STORET database.

Map 23

Mean Annual UV-B Irradiance

Mid-Atlantic Study Area

1990-1992



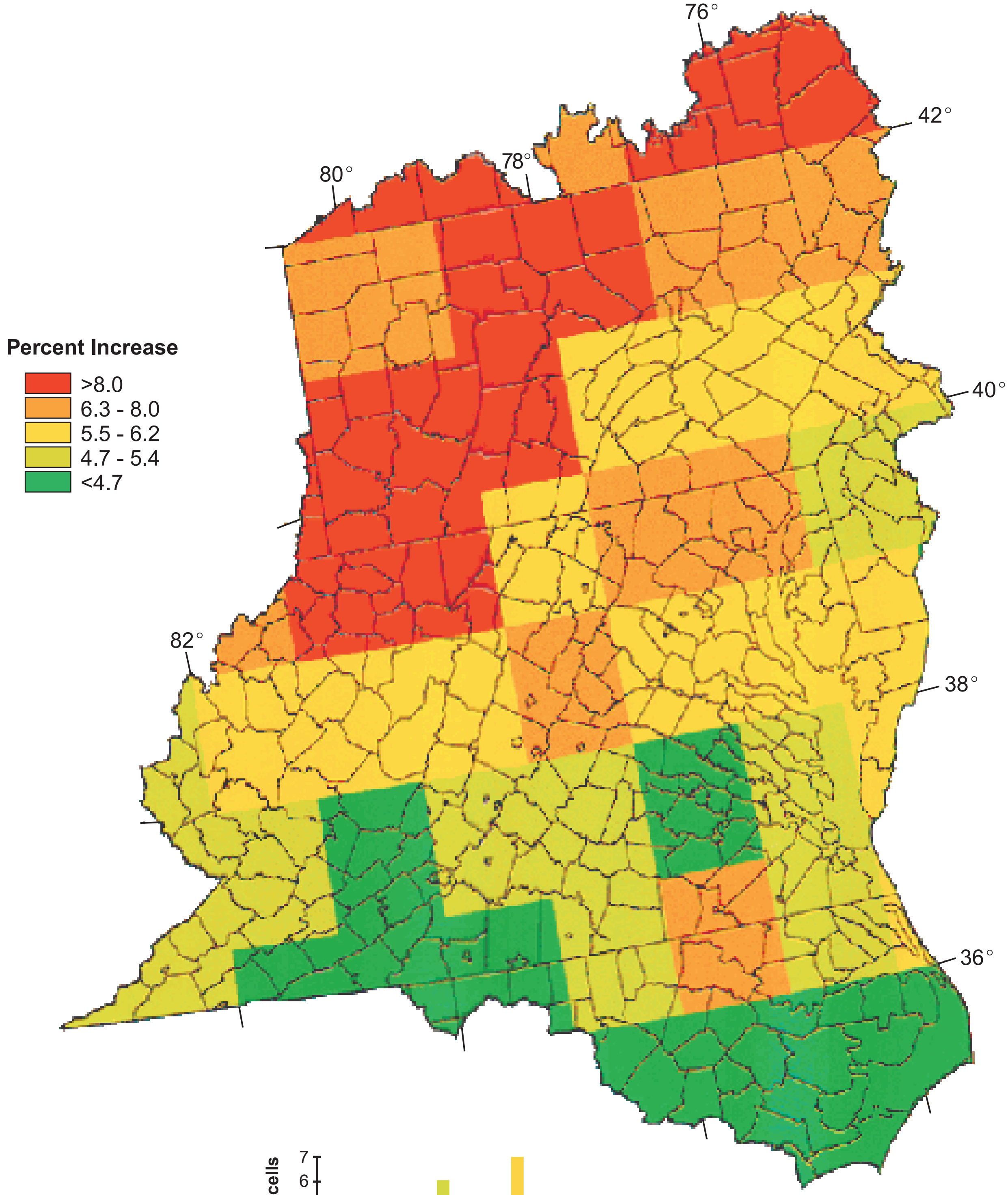
Source: Daily irradiances estimated using total colum ozone and cloud distributions from Version 7 of Nimbus 7 TOMS data set [J. Herman and E. Celarier (NASA-GSFC). 1997]

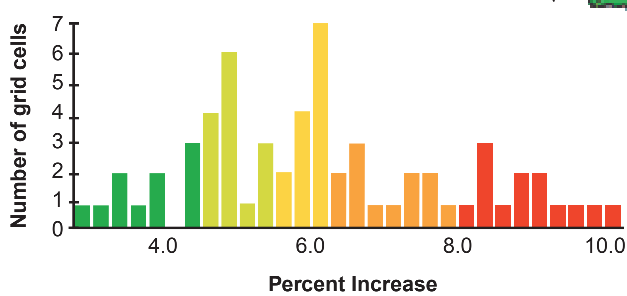
Map 24

Average Increase in Mean Annual UV-B Irradiance

Mid-Atlantic Study Area

1992





Source: Daily irradiances estimated using total colum ozone and cloud distributions from Version 7 of Nimbus 7 TOMS data set [J. Herman and E. Celarier (NASA-GSFC). 1997].

Map 25

REVA MAIA Reach File version 3 Alpha (RF3)

Metadata:

Identification_Information:
  Citation:
    Citation_Information:
      Originator: US EPA(ed.)
      Publication_Date: 19970000
      Publication_Time: Unknown
      Title: REVA MAIA Reach File version 3 Alpha (RF3)
      Geospatial_Data_Presentation_Form: map
  Description:
    Abstract:
      USEPA Reach File Version 3.0 Alpha (RF3-Alpha) for the ReVA MAIA study area.
    Purpose:
      To define RF3 streams in the MAIA study area for the regional vulnerability (REVA) study.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 19970000
    Currentness_Reference: Publication Date
  Status:

Progress: In work
Maintenance_and_Update_Frequency: Unknown
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East_Bounding_Coordinate: -74.18644541
North_Bounding_Coordinate: 42.29408165
South_Bounding_Coordinate: 34.39608158
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Theme_Keyword: Rivers
Theme_Keyword: Reach Files
Theme_Keyword: RF3
Place:
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Place_Keyword: Eastern US
Place_Keyword: Mid-atlantic Integrated Assessment
Place_Keyword: MAIA
Place_Keyword: New York
Place_Keyword: New Jersey
Place_Keyword: D.C.
Place_Keyword: West Virginia
Place_Keyword: Virginia
Place_Keyword: North Carolina
Place_Keyword: Pennsylvania
Place_Keyword: Mayland
Access_Constraints: None
Use_Constraints:
100,000, the clip cover (250,000 data.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Dr. Tom Mace
Contact_Organization: US EPA

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Reasearch Triangle Park

State_or_Province: NC

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: mace_tom@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment: ARC/INFO

Cross_Reference:

Citation_Information:

Originator: USEPA(comp.)

Publication_Date: 19970000

Publication_Time: Unknown

Title: US EPA Reach File Version 1 (RF1) and Version 3 Alpha (RF3)

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: EPA in D.C.

Publisher: US EPA

Online_Linkage: <http://nsdi.epa.gov/nsdi/projects/rf1_meta.html>

Online_Linkage: <http://www.epa.gov/OWOW/NPS/rf/techref.html>

Data_Quality_Information:

Logical_Consistency_Report: Line topology was created with ARC/INFO and is present.

Completeness_Report: None

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: National map accuracy standards for 1:100,000 scale map.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None

Lineage:

Source_Information:
Source_Citation:
Citation_Information:
Originator: USEPA(comp.)
Publication_Date: Unknown
Publication_Time: Unknown
Title: USEPA Reach Files Version 3.0 Alpha (RF3)
Edition: USEPA
Geospatial_Data_Presentation_Form: map
Publication_Information:
Publication_Place: Unknown
Publisher: USEPA
Online_Linkage: <http://www.epa.gov/OWOW/NPS/rf/techref.html>
Source_Scale_Denominator: 100000
Type_of_Source_Media: Electronic
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 19940000
Source_Currentness_Reference: Publication Date
Source_Citation_Abbreviation: EPA_RF3
Source_Contribution: Rivers and Streams
Source_Information:
Source_Citation:
Citation_Information:
Originator: USEPA(comp.)
Publication_Date: Unknown
Publication_Time: Unknown
Title: ReVA MAIA Cataloging Units
Geospatial_Data_Presentation_Form: map
Publication_Information:
Publication_Place: Unknown
Publisher: USEPA
Source_Scale_Denominator: 250,000
Type_of_Source_Media: Electronic
Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: Unknown

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: MAIA_HUC8

Source_Contribution:

Used as a clip coverage to clip the RF3 data to the MAIA boundaries.

Process_Step:

Process_Description:

USEPA Reach Files Version 3.0 (RF3) (EPA_RF3) for the US were obtained, appended, reprojected, and clipped by ReVA hucs (MAIA_HUC).

Source_Used_Citation_Abbreviation: EPA_RF3

Source_Used_Citation_Abbreviation: MAIA_HUC8

Process_Date: Unknown

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

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SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Complete chain

Point_and_Vector_Object_Count: -1

SDTS_Point_and_Vector_Object_Type: Node, planar graph

Point_and_Vector_Object_Count: -1

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0

False_Northing: 0

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

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Abscissa_Resolution: 1

Ordinate_Resolution: 1

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137

Denominator_of_Flattening_Ratio: 0.003364089

Entity_and_Attribute_Information:

Overview_Description:

Entity_and_Attribute_Overview:

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Entity_and_Attribute_Detail_Citation: GIRAS DATA

Entity_and_Attribute_Detail_Citation: USEPA Reach File Version 3.0 technical reference

---

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Reasearch Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

  Metadata_Security_Handling_Description: None

  Metadata_Security_Classification: Unclassified

  Metadata_Security_Classification_System: Unknown

Generated by mp on Wed Sep 30 22:13:08 1998

MASA: Mean Annual UV-B Irradiance (1990-1992)

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Richard Zepp(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MASA: Mean Annual UV-B Irradiance (1990-1992)

Geospatial_Data_Presentation_Form: map

Description:

Abstract: Estimated mean annual UV-B Irradiance for MASA.

Purpose:

Identify regions and ecosystems which may be impacted by the amount of or increases in UV-B irradiance.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details on the geographic sources or on the methodology used to create the shape file are not available. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000

Ending_Date: 19920000

Currentness_Reference: Ground Condition

Status:
  Progress: Complete
  Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
  Bounding_Coordinates:
    West_Bounding_Coordinate: -84.16709622
    East_Bounding_Coordinate: -74.18644541
    North_Bounding_Coordinate: 42.29408165
    South_Bounding_Coordinate: 34.39608158
Keywords:
  Theme:
    Theme_Keyword_Thesaurus: None
    Theme_Keyword: Ecological Risk
    Theme_Keyword: UV-B Irradiance
    Theme_Keyword: Ozone Depletion
  Place:
    Place_Keyword_Thesaurus: None
    Place_Keyword: US
    Place_Keyword: Eastern US
    Place_Keyword: Mid-atlantic Integrated Assessment
    Place_Keyword: MAIA
    Place_Keyword: New York
    Place_Keyword: New Jersey
    Place_Keyword: D.C.
    Place_Keyword: West Virginia
    Place_Keyword: Virginia
    Place_Keyword: North Carolina
    Place_Keyword: Pennsylvania
    Place_Keyword: Maryland
    Place_Keyword: US EPA Region 3
    Place_Keyword: MASA
    Place_Keyword: Mid-Atlantic Study Area
Access_Constraints: None
Use_Constraints: The spatial accuracy of the data is unknown.
Point_of_Contact:
  Contact_Information:
    Contact_Person_Primary:

Contact_Person: Richard Zepp

Contact_Organization: USEPA NERL Athens

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Athens

State_or_Province: GA

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Zepp_Richard@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the attributes in the shape file, it appears to have been created in ARC/INFO and converted to an ArcView shape file.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 151

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0

False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Betsy Smith
Contact_Organization: U.S. Environmental Protection Agency
Contact_Position: ReVA Coordinator
Contact_Address:
Address_Type: mailing address
Address: MD-75
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: 919-541-0620
Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov
Distribution_Liability:
EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:
Metadata_Date: 19980930
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 15:40:04 1998

MASA: Change in UV-B Irradiance (1979-1982 vs.1990-1992)

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Richard Zepp(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MASA: Change in UV-B Irradiance (1979-1982 vs.1990-1992)

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Estimated change in mean annual UV-B Irradiance for MASA. The average annual irradiance during the three year periods 1979-1982 and 1990-1992 are compared to estimate the change in UV-B irradiance.

Purpose:

Identify regions and ecosystems which may be impacted by the amount of or increases in UV-B irradiance.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details on the geographic sources or on the methodology used to create the shape file are not available. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19790000
Ending_Date: 19920000
Currentness_Reference: Ground Condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -84.16709622
East_Bounding_Coordinate: -74.18644541
North_Bounding_Coordinate: 42.29408165
South_Bounding_Coordinate: 34.39608158
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Ecological Risk
Theme_Keyword: UV-B Irradiance
Theme_Keyword: Ozone Depletion
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: US
Place_Keyword: Eastern US
Place_Keyword: Mid-atlantic Integrated Assessment
Place_Keyword: MAIA
Place_Keyword: New York
Place_Keyword: New Jersey
Place_Keyword: D.C.
Place_Keyword: West Virginia
Place_Keyword: Virginia
Place_Keyword: North Carolina
Place_Keyword: Pennsylvania
Place_Keyword: Maryland
Place_Keyword: US EPA Region 3
Place_Keyword: MASA
Place_Keyword: Mid-Atlantic Study Area
Access_Constraints: None
Use_Constraints: The spatial accuracy of the data is unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Richard Zepp

Contact_Organization: USEPA NERL Athens

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Athens

State_or_Province: GA

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Zepp_Richard@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the attributes in the shape file, it appears to have been created in ARC/INFO and converted to an ArcView shape file.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 151

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0

False_Northing: 0

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: 1

Ordinate_Resolution: 1

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137

Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Casson Stallings
Contact_Organization: ManTech Environmental Technologies, Inc.
Contact_Position: GIS Specialist
Contact_Address:
Address_Type: mailing address
Address: PO Box 12313
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: (919) 549-0611
Contact_Electronic_Mail_Address: cstallings@man-env.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: Unknown
Metadata_Time_Convention: Local time
Metadata_Access_Constraints: None
Metadata_Use_Constraints: None
Metadata_Security_Information:
Metadata_Security_Handling_Description: None
Metadata_Security_Classification: Unclassified
Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 15:50:39 1998

MAIA Soil Erosion: Soil Erosion

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Rochelle Araujo(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Soil Erosion: Soil Erosion

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Estimated average annual soil erosion, based on USLE, within each eight-digit huc in MASA.

Purpose:

Identify regions and ecosystems which may be impacted by soil erosion and the sedimentation it causes.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details on the geographic sources or on the methodology used to create the shape file are not available. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19920000

Currentness_Reference: Ground Condition

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -84.16709622
East_Bounding_Coordinate: -74.18644541
North_Bounding_Coordinate: 42.29408165
South_Bounding_Coordinate: 34.39608158
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Ecological Risk
Theme_Keyword: Total Suspended Solids
Theme_Keyword: Water Quality
Theme_Keyword: Sedimentation
Theme_Keyword: Soil Erosion
Theme_Keyword: USLE
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: US
Place_Keyword: Eastern US
Place_Keyword: Mid-atlantic Integrated Assessment
Place_Keyword: MAIA
Place_Keyword: New York
Place_Keyword: New Jersey
Place_Keyword: D.C.
Place_Keyword: West Virginia
Place_Keyword: Virginia
Place_Keyword: North Carolina
Place_Keyword: Pennsylvania
Place_Keyword: Maryland
Place_Keyword: US EPA Region 3
Place_Keyword: MASA
Place_Keyword: Mid-Atlantic Study Area
Access_Constraints: None
Use_Constraints:
The spatial accuracy of the data is unknown, however ti is 100,000 scale data.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Rochelle Araujo

Contact_Organization: USEPA NERL Athens

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Athens

State_or_Province: GA

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Araujo_Rochelle@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the attributes in the shape file, it appears to have been created in ARC/INFO and converted to an ArcView shape file.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 151

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000
Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Betsy Smith
Contact_Organization: U.S. Environmental Protection Agency
Contact_Position: ReVA Coordinator
Contact_Address:
Address_Type: mailing address
Address: MD-75
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: 919-541-0620
Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov
Distribution_Liability:
EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:
Metadata_Date: 19980930

Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Casson Stallings
Contact_Organization: ManTech Environmental Technologies, Inc.
Contact_Position: GIS Specialist
Contact_Address:
Address_Type: mailing address
Address: PO Box 12313
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: (919) 549-0611
Contact_Electronic_Mail_Address: cstallings@man-env.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: Unknown
Metadata_Time_Convention: Local time
Metadata_Access_Constraints: None
Metadata_Use_Constraints: None
Metadata_Security_Information:
Metadata_Security_Handling_Description: None
Metadata_Security_Classification: Unclassified
Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 15:44:23 1998

MAIA Soil Erosion: Suspended Solids

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Rochelle Araujo(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Soil Erosion: Suspended Solids

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Estimated average suspended solids in streams for eight-digit hucs. The average for each watershed in MASA was calculated based on data for individual streams.

Purpose:

Identify regions and ecosystems which may be impacted by suspended solids in the water.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details on the geographic sources or on the methodology used to create the shape file are not available. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000

Ending_Date: 19950000

Currentness_Reference: Ground Condition

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Ecological Risk

Theme_Keyword: Total Suspended Solids

Theme_Keyword: STORET

Theme_Keyword: Water Quality

Theme_Keyword: Sedimentation

Theme_Keyword: Soil Erosion

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Place_Keyword: Mid-Atlantic Study Area

Access_Constraints: None

Use_Constraints:

The spatial accuracy of the data is unknown, however ti is probably equivilant to 1:100,000 scale data.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Rochelle Araujo

Contact_Organization: USEPA NERL Athens

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Athens

State_or_Province: GA

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Araujo_Rochelle@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the attributes in the shape file, it appears to have been created in ARC/INFO and converted to an ArcView shape file.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 151

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5
Standard_Parallel: 45.5
Longitude_of_Central_Meridian: -096.000000
Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Betsy Smith
Contact_Organization: U.S. Environmental Protection Agency
Contact_Position: ReVA Coordinator
Contact_Address:
Address_Type: mailing address
Address: MD-75
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: 919-541-0620
Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov
Distribution_Liability:
EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 15:13:26 1998

MAIA Agricultural Atrazine Applications

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Lawrence A Burns(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Agricultural Atrazine Applications

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Estimated annual Atrazine applications for the MAIA region.

Purpose: Identify regions which may be at risk due to pesticides.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details on the geographic sources or on the methodology used to create the shape file are not available. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000

Ending_Date: 19930000

Currentness_Reference: Ground Condition

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Ecological Risk

Theme_Keyword: Non-Point Source Pollution

Theme_Keyword: Pesticides

Theme_Keyword: Organo-Phosphorous

Theme_Keyword: Agriculture

Theme_Keyword: Herbicides

Theme_Keyword: Atrazine

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-Atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Temporal:

Temporal_Keyword_Thesaurus: None

Temporal_Keyword: 1991

Temporal_Keyword: 1990

Temporal_Keyword: 1992

Temporal_Keyword: 1993

Access_Constraints: None

Use_Constraints:

250,000 scale data. The spatial accuracy of areal estiamtes based on the land cover data are unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Lawrence A Burns

Contact_Organization: USEPA NERL Athens

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Athens

State_or_Province: GA

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Burns_Lawrence@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the fields contained in the shape file, it appears that the coverage was originally created in ARC/INFO and later converted to an ArcView shapefile.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 409

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0

False_Northing: 0

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: 1

Ordinate_Resolution: 1

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137

Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 14:00:09 1998

AIRS Ozone Monitoring Sites (1990)

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Deborah Luecken(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: AIRS Ozone Monitoring Sites (1990)

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

This coverage contains the AIRS ozone monitoring sites for the years 1990-1995.

Purpose:

This coverage contains the location of the ozone monitoring sites given by the Aerometric Information and Retreival system (AIRS). This was used in conjunction with the hourly ozone data for each site to produce kriged surfaces of ozone concentration in the MASA region for 1990 through 1995.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details were not given on the geographic sources or on the methodology used to create the coverage. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000

Ending_Date: 19950000

Currentness_Reference: Ground Condition

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -106.767

East_Bounding_Coordinate: -70.016

North_Bounding_Coordinate: 44.528

South_Bounding_Coordinate: 25.596

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Non-Point Source Pollution

Theme_Keyword: Ozone

Theme_Keyword: W126

Theme_Keyword: Air Pollution

Theme_Keyword: Ground-Level Ozone

Theme_Keyword: AIRS

Theme_Keyword: Aerometric Information and Retreival System

Theme_Keyword: Ozone Monitors

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Access_Constraints: None

Use_Constraints:

The locational data is of unknown accuracy and should not be used except in the context of regional studies.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Deborah Luecken

Contact_Organization: USEPA NERL RTP

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Reseach Triangle Park

State_or_Province: NC

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Luecken_Deborah@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handling required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

It appears that the coverage was originally created in ARC/INFO.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 0.003390378

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Tom Mace
Contact_Organization: USEPA
Contact_Position: Unknown
Contact_Address:
Address_Type: mailing address
Address: Unknown
City: Research Triangle Park
State_or_Province: NC
Postal_Code: Unknown
Country: USA
Contact_Voice_Telephone: Unknown
Contact_Electronic_Mail_Address: Mace_Tom@epamail.epa.gov
Distribution_Liability:
EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:
Metadata_Date: 19991126
Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: Casson.Stallings@mantech.com

Metadata_Standard_Name:

Does not follow the FGDC Content Standards for Geospatial Metadata

Metadata_Standard_Version: FGDC-STD-001-1998

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp version 2.4.35 on Fri Nov 26 15:30:26 1999

MAIA Ground-Level Ozone (1990)

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Deborah Luecken(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Ground-Level Ozone (1990)

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

This shapefile contains estimated growing-season ozone W126 indices for 1990.

Purpose:

This will assist in identifying regions in which the vegetation may be at risk for ozone damage.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details were not given on the geographic sources or on the methodology used to create the coverage. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19900000

Currentness_Reference: Ground Condition

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Ecological Risk

Theme_Keyword: Non-Point Source Pollution

Theme_Keyword: Ozone

Theme_Keyword: W126

Theme_Keyword: Vegetation

Theme_Keyword: Air Pollution

Theme_Keyword: Ground-Level Ozone

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Access_Constraints: None

Use_Constraints:

250,000 scale data. The spatial accuracy of areal estiamtes based on the land cover data are unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Deborah Luecken

Contact_Organization: USEPA NERL RTP

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Reseach Triangle Park

State_or_Province: NC

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Luecken_Deborah@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the fields contained in the shape file, it appears that the coverage was originally created in ARC/INFO and later converted to an ArcView shapefile.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 235

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000
Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Betsy Smith
Contact_Organization: U.S. Environmental Protection Agency
Contact_Position: ReVA Coordinator
Contact_Address:
Address_Type: mailing address
Address: MD-75
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: 919-541-0620
Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov
Distribution_Liability:
EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:
Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 13:24:04 1998

MAIA Ground-Level Ozone (1991)

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Deborah Luecken(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Ground-Level Ozone (1991)

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

This shapefile contains estimated growing-season ozone W126 indices for 1991.

Purpose:

This will assist in identifying regions in which the vegetation may be at risk for ozone damage.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details were not given on the geographic sources or on the methodology used to create the coverage. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19910000

Currentness_Reference: Ground Condition

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Ecological Risk

Theme_Keyword: Non-Point Source Pollution

Theme_Keyword: Ozone

Theme_Keyword: W126

Theme_Keyword: Vegetation

Theme_Keyword: Air Pollution

Theme_Keyword: Ground-Level Ozone

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Temporal:

Temporal_Keyword_Thesaurus: None

Temporal_Keyword: 1991

Access_Constraints: None

Use_Constraints:

250,000 scale data. The spatial accuracy of areal estiamtes based on the land cover data are unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Deborah Luecken

Contact_Organization: USEPA NERL RTP

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Reseach Triangle Park

State_or_Province: NC

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Luecken_Deborah@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the fields contained in the shape file, it appears that the coverage was originally created in ARC/INFO and later converted to an ArcView shapefile.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 235

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5
Standard_Parallel: 45.5
Longitude_of_Central_Meridian: -096.000000
Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Betsy Smith
Contact_Organization: U.S. Environmental Protection Agency
Contact_Position: ReVA Coordinator
Contact_Address:
Address_Type: mailing address
Address: MD-75
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: 919-541-0620
Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov
Distribution_Liability:
EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 13:28:22 1998

MAIA Coal Mining

Metadata:

- Identification_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Distribution_Information
- Metadata_Reference_Information

Identification_Information:

Citation:

Citation_Information:

Originator: Brian H Hill(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Coal Mining

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

This data describes the percentage of streams within each hydrologic unit (watershed) that are at risk from coal mining operations.

Purpose:

Provide estiamtes of coal mining and regions where it potentially impacts streams. This will be used in the ReVA project to assess coal mining as an ecosystem stressor and identify regions that are more likely to be at risk.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details were not given on the geographic sources or on the methodology used to create the coverage.

THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19880000

Ending_Date: 19960000
Currentness_Reference: Ground Condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -84.16709622
East_Bounding_Coordinate: -74.18644541
North_Bounding_Coordinate: 42.29408165
South_Bounding_Coordinate: 34.39608158
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Water Quality
Theme_Keyword: Ecological Risk
Theme_Keyword: Non-Point Source Pollution
Theme_Keyword: Mining
Theme_Keyword: Coal Mining
Theme_Keyword: Runoff
Theme_Keyword: Acidic Water
Theme_Keyword: Metals
Theme_Keyword: Sediment
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: US
Place_Keyword: Eastern US
Place_Keyword: Mid-atlantic Integrated Assessment
Place_Keyword: MAIA
Place_Keyword: New York
Place_Keyword: New Jersey
Place_Keyword: D.C.
Place_Keyword: West Virginia
Place_Keyword: Virginia
Place_Keyword: North Carolina
Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Access_Constraints: None

Use_Constraints:

100,000 and 1:250,000 scale data. The spatial accuracy of areal estiamtes based on the land cover data are unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Brian H Hill

Contact_Organization: USEPA NERL Cinncinatti

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Cincinnati

State_or_Province: Ohio

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Hill_Brian@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the fields contained in the shape file, it appears that the coverage was originally created in ARC/INFO and later converted to an ArcView shapefile.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 264

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0

False_Northing: 0

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: 1

Ordinate_Resolution: 1

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137

Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 12:37:47 1998

MAIA Landscape Pattern

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Bruce Jones(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Landscape Pattern

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

This geographic data contains several indicators of human use in the MAIA region. The indicators were calculated and summarized by the eight digit hucs within EPA region 3--a subset of the MAIA region. The indicators measure human use of the land, agriculture on steep slopes and near streams, and the length of road near streams.

Purpose:

Provide indicators of human use within the MAIA region for the ReVA study and to identify regions that are potentially at risk.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Full details were not given on the sources used. The sources cited are either the EROS or USGS source that the data was likely derived from, or the ReVA equivilant--already clipped to the MAIA region. In some cases equivilant data was used which covered only EPA

Region 3.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19970000

Currentness_Reference: Publication Date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Landscape Pattern

Theme_Keyword: agriculture

Theme_Keyword: Sediment

Theme_Keyword: Water Quality

Theme_Keyword: Nitrogen Application

Theme_Keyword: U-Index

Theme_Keyword: Road Density

Theme_Keyword: Land Use

Theme_Keyword: Ecological Risk

Theme_Keyword: Population Pressure

Theme_Keyword: Roads Crossing Streams

Theme_Keyword: Agriculture on Steep Slopes

Theme_Keyword: Agriculture near Streams

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Access_Constraints: None

Use_Constraints:

The indices are based on 1:100,000 and 1:250,000 scale data. The spatial accuracy of areal estiamtes based on the land cover data are unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Dr. Bruce Jones

Contact_Organization: USEPA NERL-LV

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Las Vegas

State_or_Province: Nevada

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Jones_Bruce@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the fields contained in the shape file, it appears that the coverage was originally created in ARC/INFO and later converted to an ArcView shapefile.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: None available

Logical_Consistency_Report:

It appears that polygon topology was created with ARC/INFO. In its current form some of this information may have been lost.

Completeness_Report: None

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: None

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: USEPA(comp.)

Publication_Date: 19940000

Publication_Time: Unknown

Title: USEPA Reach Files Version 3.0 Alpha (RF3)

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Unknown

Publisher: USEPA

Online_Linkage: <http://www.epa.gov/OWOW/NPS/rf/techref.html>

Source_Scale_Denominator: 100000

Type_of_Source_Media: Electronic

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19940000

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: EPA_RF3

Source_Contribution: Rivers and Streams

Source_Information:

Source_Citation:

Citation_Information:

Originator: USEPA (Comp.)(comp.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: ReVA MAIA Cataloging Units

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Unknown

Publisher: USEPA

Source_Scale_Denominator: 250000

Type_of_Source_Media: Electronic

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: Unknown

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: MAIA_HUC8

Source_Contribution:

Used as a clip coverage to clip the RF3 data to the MAIA boundaries.

Source_Information:

Source_Citation:

Citation_Information:

Originator: USGS(comp.)

Publication_Date: 19890000

Publication_Time: Unknown

Title: USGS Digital Line Graphs 1:100,000 (Roads)

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: <ftp://mapping.usgs.gov/pub/ti/DLG/100kdlgguide/dug-2.txt>

Publisher: USGS

Online_Linkage: <http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html>

Source_Scale_Denominator: 100000

Type_of_Source_Media: online

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19890000

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: USGS_ROADS

Source_Contribution: Roads

Source_Information:

Source_Citation:

Citation_Information:

Originator: EROS(comp.)

Publication_Date: 19970900

Publication_Time: Unknown

Title: Federal Region III Land Cover Data Set

Geospatial_Data_Presentation_Form: remote-sensing image

Publication_Information:

Publication_Place: Unknown

Publisher: USEPA

Online_Linkage: <http://www.epa.gov/nwapsurf/eimssur2/indexold.html>

Online_Linkage: Version 3alb

Type_of_Source_Media: Unknown

Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19860000

Ending_Date: 19940000

Source_Currentness_Reference: Ground Condition

Source_Citation_Abbreviation: EPA3_MRLC

Source_Contribution: Land Cover and Land Use

Source_Information:

Source_Citation:

Citation_Information:

Originator: USGS(comp.)

Publication_Date: 19930000

Publication_Time: Unknown

Title: DIGITAL ELEVATION MODELS: Data Users Guide 5

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Reston, VA

Publisher: USGS

Online_Linkage:

<http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html>

Source_Scale_Denominator: 250000

Type_of_Source_Media: Unknown

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19930000

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: USGS_DEM250

Source_Contribution: Elevation and indirectly slope

Process_Step:

Process_Description:

To analyze the four landscape stressor indicators escribed above--U-Index, roads crossing streams, agriculture on steep slopes, and agriculture near streams--five sources of data were used (1) USGS_Roads--1/100,000-scale Digital Line Graph data for roads from theUSGS, (2) EPA_RF3--USEPA River Reach File 3 data, (3) USGS_DEM250--90m Digital Elevation Model data, (4) EPA3_MRLC--30m land cover data from the Multi-Resolution Land Characteristics (MRLC) Consortium, and (5) MAIA_HUC8--the 8 digit hucs for the MAIA region. Digital coverages of these data were obtained from the USGS EROS Data Center, or via EPA Region 3. The data were imported into ARC/INFO and combined and analyzed in various ways to produce each of the four indicators (discussed below). Because the data represent an initial baseline for landscape pattern estimates, an estimate of interannual variability is currently unavailable. Indicators were summarized by USGS Hydrologic Unit Codes (8-digit HUCs) for only those watersheds within the EPA Region 3 boundary because only EPA Region 3 mosaics were used. The indicators will be recalculated for all HUCs when the data accuracy problems are resolved.

U-Index.This map was produced by using a "cookie-cutter" procedure to extract the land cover information (EPA3_MRLC) for each watershed (MAIA_HUC8) separately. The number of pixels with agricultural or urban land cover was then counted in each watershed, and the total was divided by the total number of pixels for a given watershed to yield the watershed-specific index measure.

Roads Crossing Streams. This indicator represents the proportion of stream length (EPA_RF3) within 30 m of roads by 8-digit USGS watersheds (MAIA_HUC8). The occurrences of roads within 30 m of streams were tabulated from USGS stream and road (USGS_ROADS) maps. Road and stream coverages (Arc/Info) were converted to a raster format with 30-m pixels and then overlaid. Individual watersheds were then cookie-cut out of the base grid. The number of pixels where both a road and a stream occurred was divided by the total number of stream pixels to obtain a watershed-specific measure.

Agriculture on Steep Slopes. This map was produced by overlaying a slope coverage (derived from USGS_DEM250) and the land cover coverage (EPA3_MRLC). Percent slope was calculated from the digital elevation model as the vertical rise in elevation per horizontal distance traveled. After the two coverages were overlaid, the cookie-cutting technique previously described was used to determine the proportion of watershed area that was crop or agriculture on slopes of greater than 3% . Agriculture Near Streams. This map was created by converting the stream coverage (MAIA_RF3)to a raster format with 30-m pixels. This raster version was overlaid on the land cover coverage (EPA3_MRLC) to determine the stream length that flowed through agricultural land cover. The length of streams flowing through agricultural land cover was divided by the total length of streams in each watershed to arrive at the index measure. A 30-m pixel size was used because it was consistent with the pixel size of the land cover map.

Source_Used_Citation_Abbreviation: MAIA_HUC8

Source_Used_Citation_Abbreviation: EPA_RF3

Source_Used_Citation_Abbreviation: USGS_ROADS

Source_Used_Citation_Abbreviation: EPA3_MRLC

Source_Used_Citation_Abbreviation: USGS_DEM250

Process_Date: Unknown

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 141

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: lscape.shp
Entity_Type_Definition: ArcView shape file
Entity_Type_Definition_Source: ESRI
Attribute:
Attribute_Label: Shape
Attribute_Definition: Field holding reference to the geographic feature
Attribute_Definition_Source: Generated by ArcView
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Unknown
Codeset_Source: ESRI
Attribute:
Attribute_Label: Area
Attribute_Definition: The area of each polygon
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0.0
Range_Domain_Maximum: 1200000000
Attribute_Units_of_Measure: meters

Attribute:

Attribute_Label: Perimeter

Attribute_Definition: Length of bounding arcs

Attribute_Definition_Source: Calculated by ARC/INFO

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 160000

Attribute_Units_of_Measure: meters

Attribute:

Attribute_Label: maiaross_

Attribute_Definition: The unique ID calculated by ARC/INFO

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Unique Positive Integers

Codeset_Source: Unknown

Attribute:

Attribute_Label: maiaross_id

Attribute_Definition: The user-supplied ID for each polygon

Attribute_Definition_Source: Initially set by ARC/INFO, can be changed by user

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: Unknown

Attribute:

Attribute_Label: Huc

Attribute_Definition:

The 8 digit USGS watershed codes which are also the MAIA cataloging usits

Attribute_Definition_Source: USGS or EPA

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 01010101

Range_Domain_Maximum: 99999999

Attribute:

Attribute_Label: Uindex

Attribute_Definition:

Percentages of area used by humans (e.g., agriculture, urban)

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 100

Attribute_Units_of_Measure: Percent

Attribute:

Attribute_Label: Rdstr

Attribute_Definition:

Percentage of stream length within 30m of a road for each watershed

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 100

Attribute_Units_of_Measure: Percent

Attribute:

Attribute_Label: Crop3

Attribute_Definition:

Percent of watershed containing agriculture on slopes steeper than 3%

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 100

Attribute_Units_of_Measure: Percent

Attribute:

Attribute_Label: Cstr

Attribute_Definition:

The proportion of streams in a watershed that flow within 30m of an agricultural area

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 100

Distribution_Information:

- *Distributor:*
  - *Contact_Information:*
    - *Contact_Person_Primary:*
      - *Contact_Person:* Betsy Smith
      - *Contact_Organization:* U.S. Environmental Protection Agency
    - *Contact_Position:* ReVA Coordinator
    - *Contact_Address:*
      - *Address_Type:* mailing address
      - *Address:* MD-75
      - *City:* Research Triangle Park
      - *State_or_Province:* NC
      - *Postal_Code:* 27709
      - *Country:* USA
    - *Contact_Voice_Telephone:* 919-541-0620
    - *Contact_Electronic_Mail_Address:* smith.betsy@epamail.epa.gov
- *Distribution_Liability:*
  - EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

- *Metadata_Date:* 19980930
- *Metadata_Contact:*
  - *Contact_Information:*
    - *Contact_Person_Primary:*
      - *Contact_Person:* Casson Stallings
      - *Contact_Organization:* ManTech Environmental Technologies, Inc.
    - *Contact_Position:* GIS Specialist
    - *Contact_Address:*
      - *Address_Type:* mailing address
      - *Address:* PO Box 12313
      - *City:* Research Triangle Park
      - *State_or_Province:* NC
      - *Postal_Code:* 27709
      - *Country:* USA
    - *Contact_Voice_Telephone:* (919) 549-0611
    - *Contact_Electronic_Mail_Address:* cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Wed Sep 30 22:14:43 1998

MAIA Human Population

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Sandra Bird(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Human Population

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Estimated population density, population growth, and change in population growth for the MAIA region.

Purpose:

Identify regions and ecosystems which may be impacted by population changes.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details on the geographic sources or on the methodology used to create the shape file are not available. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19800000

Ending_Date: 19900000

Currentness_Reference: Ground Condition

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Ecological Risk

Theme_Keyword: Population

Theme_Keyword: Population Density

Theme_Keyword: Population Pressure

Theme_Keyword: Population Growth

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Access_Constraints: None

Use_Constraints:

250,000 scale data. The spatial accuracy of areal estiamtes based on the land cover data are unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Sandra Bird

Contact_Organization: USEPA NERL Athens

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Athens

State_or_Province: GA

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Bird_Sandra@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment: An ArcView shapefile

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 342

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0

False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Betsy Smith
Contact_Organization: U.S. Environmental Protection Agency
Contact_Position: ReVA Coordinator
Contact_Address:
Address_Type: mailing address
Address: MD-75
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: 919-541-0620
Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov
Distribution_Liability:
EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:
Metadata_Date: 19980930
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:

Contact_Person: Casson Stallings
Contact_Organization: ManTech Environmental Technologies, Inc.
Contact_Position: GIS Specialist
Contact_Address:
Address_Type: mailing address
Address: PO Box 12313
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: (919) 549-0611
Contact_Electronic_Mail_Address: cstallings@man-env.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: Unknown
Metadata_Time_Convention: Local time
Metadata_Access_Constraints: None
Metadata_Use_Constraints: None
Metadata_Security_Information:
Metadata_Security_Handling_Description: None
Metadata_Security_Classification: Unclassified
Metadata_Security_Classification_System: Unknown

Generated by mp on Thu Oct 01 14:17:52 1998

MAIA Nitrogen Deposition: Cold Season

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Russ Bullock (ed.)(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Nitrogen Deposition: Cold Season

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Cold season nitrogen deposition over the MAIA region. This was generated based on RADM model output for a "typical" year.

Purpose:

For use in assessing acid rain as an ecosystem stressor for the ReVA project.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19980000

Currentness_Reference: Publication Date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -84.16709622
East_Bounding_Coordinate: -74.18644541
North_Bounding_Coordinate: 42.29408165
South_Bounding_Coordinate: 34.39608158
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Acid Rain
Theme_Keyword: Deposition
Theme_Keyword: Nitorgen
Theme_Keyword: Sulfur
Theme_Keyword: NOX
Theme_Keyword: SO2
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: US
Place_Keyword: Eastern US
Place_Keyword: Mid-atlantic Integrated Assessment
Place_Keyword: MAIA
Place_Keyword: New York
Place_Keyword: New Jersey
Place_Keyword: D.C.
Place_Keyword: West Virginia
Place_Keyword: Virginia
Place_Keyword: North Carolina
Place_Keyword: Pennsylvania
Place_Keyword: Maryland
Access_Constraints: None
Use_Constraints:
The coverage is based on modeled values for a "typical" year and does not represent the any specific year. No formal error analysis has been carried out on the modeled deposition values.
Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Dr. Russel O. Bullock

Contact_Organization: USEPA NERL

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Reasearch Triangle Park

State_or_Province: NC

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: bullock_russ@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

It appears that the coverage was originally created in ARC/INFO and later converted to ArcView's shapefile format. There is no written or verbal record of this, however.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

No formal accuracy assessment was done to compare the modeled deposition values to the measured values. Informal comparisons show the values to agree within about 25%.

Logical_Consistency_Report:

It appears that polygon topology was created with ARC/INFO. In its current form some of this information may have been lost.

Completeness_Report: None

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: None

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: USEPA (Comp.)(comp.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: ReVA MAIA Cataloging Units

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Unknown

Publisher: USEPA

Source_Scale_Denominator: 250,000

Type_of_Source_Media: Electronic

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: Unknown

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: MAIA_HUC8

Source_Contribution:

Used as a clip coverage to clip the RF3 data to the MAIA boundaries.

Process_Step:

Process_Description:

The metadata author had no access to any description of how this coverage was produced. He did have a opy of very similar RADM output. This discription is based on previous work done creating coverages from RADM outputs and the attributes in the dataset. The RADM outputs contain a list of xy values representing the coordinates of each RADM grid cell's center. Each of these also has one or more model outputs associated with it. Most likely, a point coverage was created from the list of xy coordinates and their values. A grid could be generated from this using the GRID POINTGRID command. At some time the real values representing the deposition were multiplied by 100 and converted to integers. A vecctor coverage representing the RADM grid was created by using the GRID GRIDPOLY command, the real values for deposition were restored and the coverage clipped by MAIA_HUC or a similar coverage. Finally, the grid was converted to a shape file.

Source_Used_Citation_Abbreviation: MAIA_HUC8

Process_Date: 19980000

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 1169

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 29.5
Standard_Parallel: 45.5
Longitude_of_Central_Meridian: -096.000000
Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: aciddep_cn.shp
Entity_Type_Definition: ArcView shape file
Entity_Type_Definition_Source: ESRI
Attribute:

Attribute_Label: Shape
Attribute_Definition: Field holding reference to the geographic feature
Attribute_Definition_Source: Generated by ArcView
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Unknown
Codeset_Source: ESRI
Attribute:
Attribute_Label: Area
Attribute_Definition: The area of each polygon
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0.0
Range_Domain_Maximum: 1200000000
Attribute_Units_of_Measure: meters
Attribute:
Attribute_Label: Perimeter
Attribute_Definition: Length of bounding arcs
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 160000
Attribute_Units_of_Measure: meters
Attribute:
Attribute_Label: Cn_
Attribute_Definition: The unique ID calculated by ARC/INFO
Attribute_Definition_Source: Calculated
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 1
Range_Domain_Maximum: 1169
Attribute:
Attribute_Label: Cn_id
Attribute_Definition: The user-supplied ID for each polygon
Attribute_Definition_Source: Initially set by ARC/INFO, can be changed by user

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: Unknown

Attribute:

Attribute_Label: Grid_Code

Attribute_Definition:

The value of a grid cell that the polygon was created from. This value is 100 times the deposition value for that grid cell.

Attribute_Definition_Source: Created by processor

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: Unknown

Attribute:

Attribute_Label: Cn

Attribute_Definition: Cold season nitrogen deposition

Attribute_Definition_Source: RADM

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive real values

Codeset_Source: Unknown

Attribute_Units_of_Measure: kg/ha

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Wed Sep 30 19:46:51 1998

MAIA Nitrogen Deposition: Warm Season

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Russ Bullock(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Nitrogen Deposition: Warm Season

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Warm season nitrogen deposition over the MAIA region. This was generated based on RADM model output for a "typical" year.

Purpose:

For use in assessing acid rain as an ecosystem stressor for the ReVA project.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19980000

Currentness_Reference: Publication Date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Acid Rain

Theme_Keyword: Deposition

Theme_Keyword: Nitorgen

Theme_Keyword: Sulfur

Theme_Keyword: NOX

Theme_Keyword: SO2

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Access_Constraints: None

Use_Constraints:

The coverage is based on modeled values for a "typical" year and does not represent the any specific year. No formal error analysis has been carried out on the modeled deposition values.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Dr. Russel O. Bullock

Contact_Organization: USEPA NERL

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Reasearch Triangle Park

State_or_Province: NC

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: bullock_russ@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

It appears that the coverage was originally created in ARC/INFO and later converted to ArcView's shapefile format. There is no written or verbal record of this, however.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

No formal accuracy assessment was done to compare the modeled deposition values to the measured values. Informal comparisons show the values to agree within about 25%.

Logical_Consistency_Report:

It appears that polygon topology was created with ARC/INFO. In its current form some of this information may have been lost.

Completeness_Report: None

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: None

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: USEPA (Comp.)(comp.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: ReVA MAIA Cataloging Units

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Unknown

Publisher: USEPA

Source_Scale_Denominator: 250000

Type_of_Source_Media: Electronic

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: Unknown

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: MAIA_HUC8

Source_Contribution:

Used as a clip coverage to clip the RF3 data to the MAIA boundaries.

Process_Step:

Process_Description:

The metadata author had no access to any description of how this coverage was produced. He did have a opy of very similar RADM output. This discription is based on previous work done creating coverages from RADM outputs and the attibutes of the dataset itself. The RADM outputs contain a list of xy values representing the coordinates of each RADM grid cell's center. Each of these also has one or more model outputs associated with it. Most likely, a grid representing the RADM cell centers was created using GRID POINTGRID and a cell size equivilant to the RADM simulation (20km). This grid contained the deposition values. At some point the values were converted to integers by multiplying by 100 and rounding or truncating the resulting values. The grid was converted to a vector grid with GRIDPOLY. The grid was clipped by the ReVA hucs (MAIA_HUC) or a similar coverage describing the MAIA boundary. Finally, the coverage was converted to a shape file.

Source_Used_Citation_Abbreviation: MAIA_HUC8

Process_Date: 19980000

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 1166

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 29.5
Standard_Parallel: 45.5
Longitude_of_Central_Meridian: -096.000000
Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: aciddep_wn.shp
Entity_Type_Definition: ArcView shape file
Entity_Type_Definition_Source: ESRI
Attribute:

Attribute_Label: Shape
Attribute_Definition: Field holding reference to the geographic feature
Attribute_Definition_Source: Generated by ArcView
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Unknown
Codeset_Source: ESRI

Attribute:
Attribute_Label: Area
Attribute_Definition: The area of each polygon
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0.0
Range_Domain_Maximum: 1200000000
Attribute_Units_of_Measure: meters

Attribute:
Attribute_Label: Perimeter
Attribute_Definition: Length of bounding arcs
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 160000
Attribute_Units_of_Measure: meters

Attribute:
Attribute_Label: wn_
Attribute_Definition: The unique ID calculated by ARC/INFO
Attribute_Definition_Source: Calculated
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 1
Range_Domain_Maximum: 1169

Attribute:
Attribute_Label: wn_id
Attribute_Definition: The user-supplied ID for each polygon
Attribute_Definition_Source: Initially set by ARC/INFO, can be changed by user

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: Unknown

Attribute:

Attribute_Label: Grid_Code

Attribute_Definition:

The value of a grid cell that the polygon was created from. This value is 100 times the deposition value for that grid cell.

Attribute_Definition_Source: Created by processor

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: None

Attribute:

Attribute_Label: wn

Attribute_Definition: Warm season nitrogen deposition (kg/ha)

Attribute_Definition_Source: RADM

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive real values

Codeset_Source: Unknown

Attribute_Units_of_Measure: kg/ha

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Reasearch Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Wed Sep 30 19:48:37 1998

MAIA Sulfur Deposition: Cold Season

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Russ Bullock (ed.)(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Sulfur Deposition: Cold Season

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Cold season sulfer deposition over the MAIA region. This was generated based on RADM model output for a "typical" year.

Purpose:

For use in assessing acid rain as an ecosystem stressor for the ReVA project.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19980000

Currentness_Reference: Publication Date

Status:

Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -84.16709622
East_Bounding_Coordinate: -74.18644541
North_Bounding_Coordinate: 42.29408165
South_Bounding_Coordinate: 34.39608158
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Acid Rain
Theme_Keyword: Deposition
Theme_Keyword: Nitorgen
Theme_Keyword: Sulfur
Theme_Keyword: NOX
Theme_Keyword: SO2
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: US
Place_Keyword: Eastern US
Place_Keyword: Mid-atlantic Integrated Assessment
Place_Keyword: MAIA
Place_Keyword: New York
Place_Keyword: New Jersey
Place_Keyword: D.C.
Place_Keyword: West Virginia
Place_Keyword: Virginia
Place_Keyword: North Carolina
Place_Keyword: Pennsylvania
Place_Keyword: Maryland
Access_Constraints: None
Use_Constraints:
The coverage is based on modeled values for a "typical" year and does not represent the any specific year. No formal error analysis has been carried out on the modeled deposition values.
Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Dr. Russel O. Bullock

Contact_Organization: USEPA NERL

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Reasearch Triangle Park

State_or_Province: NC

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: bullock_russ@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

It appears that the coverage was originally created in ARC/INFO and later converted to ArcView's shapefile format. There is no written or verbal record of this, however.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

No formal accuracy assessment was done to compare the modeled deposition values to the measured values. Informal comparisons show the values to agree within about 25%.

Logical_Consistency_Report:

It appears that polygon topology was created with ARC/INFO. In its current form some of this information may have been lost.

Completeness_Report: None

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: None

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: USEPA (Comp.)(comp.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: ReVA MAIA Cataloging Units

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Unknown

Publisher: USEPA

Source_Scale_Denominator: 250,000

Type_of_Source_Media: Electronic

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: Unknown

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: MAIA_HUC8

Source_Contribution:

Used as a clip coverage to clip the RF3 data to the MAIA boundaries.

Process_Step:

Process_Description:

The metadata author had no access to any description of how this coverage was produced. He did have a opy of very similar RADM output. This discription is based on previous work done creating coverages from RADM outputs and the attibutes of the dataset itself. The RADM outputs contain a list of xy values representing the coordinates of each RADM grid cell's center. Each of these also has one or more model outputs associated with it. Most likely, a grid representing the RADM cell centers was created using GRID POINTGRID and a cell size equivilant to the RADM simulation (20km). This grid contained the deposition values. At some point the values were converted to integers by multiplying by 100 and rounding or truncating the resulting values. The grid was converted to a vector grid with GRIDPOLY. The grid was clipped by the ReVA hucs (MAIA_HUC) or a similar coverage describing the MAIA boundary. Finally, the coverage was converted to a shape file.

Source_Used_Citation_Abbreviation: MAIA_HUC8

Process_Date: 19980000

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 1166

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 29.5
Standard_Parallel: 45.5
Longitude_of_Central_Meridian: -096.000000
Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: aciddep_cs.shp
Entity_Type_Definition: ArcView shape file
Entity_Type_Definition_Source: ESRI
Attribute:

Attribute_Label: Shape
Attribute_Definition: Field holding reference to the geographic feature
Attribute_Definition_Source: Generated by ArcView
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Unknown
Codeset_Source: ESRI

Attribute:
Attribute_Label: Area
Attribute_Definition: The area of each polygon
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0.0
Range_Domain_Maximum: 1200000000
Attribute_Units_of_Measure: meters

Attribute:
Attribute_Label: Perimeter
Attribute_Definition: Length of bounding arcs
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 160000
Attribute_Units_of_Measure: meters

Attribute:
Attribute_Label: Cs_
Attribute_Definition: The unique ID calculated by ARC/INFO
Attribute_Definition_Source: Calculated
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 1
Range_Domain_Maximum: 1169

Attribute:
Attribute_Label: Cs_id
Attribute_Definition: The user-supplied ID for each polygon
Attribute_Definition_Source: Initially set by ARC/INFO, can be changed by user

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: Unknown

Attribute:

Attribute_Label: Grid_Code

Attribute_Definition:

The value of a grid cell that the polygon was created from. This value is 100 times the deposition value for that grid cell.

Attribute_Definition_Source: Created by processor

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: Unknown

Attribute:

Attribute_Label: Cs

Attribute_Definition: Cold seasonsulfer deposition

Attribute_Definition_Source: RADM

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive real values

Codeset_Source: Unknown

Attribute_Units_of_Measure: kg/ha

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Reasearch Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Wed Sep 30 19:43:22 1998

MAIA Sulfur Deposition: Warm Season

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Russ Bullock(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Sulfur Deposition: Warm Season

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

Warm season sulfer deposition over the MAIA region. This was generated based on RADM model output for a "typical" year.

Purpose:

For use in assessing acid rain as an ecosystem stressor for the ReVA project.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 19980000

Currentness_Reference: Publication Date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Acid Rain

Theme_Keyword: Deposition

Theme_Keyword: Nitorgen

Theme_Keyword: Sulfur

Theme_Keyword: NOX

Theme_Keyword: SO2

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Access_Constraints: None

Use_Constraints:

The coverage is based on modeled values for a "typical" year and does not represent the any specific year. No formal error analysis has been carried out on the modeled deposition values.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Dr. Russel O. Bullock

Contact_Organization: USEPA NERL

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Reasearch Triangle Park

State_or_Province: NC

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: bullock_russ@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

It appears that the coverage was originally created in ARC/INFO and later converted to ArcView's shapefile format. There is no written or verbal record of this, however.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

No formal accuracy assessment was done to compare the modeled deposition values to the measured values. Informal comparisons show the values to agree within about 25%.

Logical_Consistency_Report:

It appears that polygon topology was created with ARC/INFO. In its current form some of this information may have been lost.

Completeness_Report: None

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report: None

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report: None

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: USEPA (Comp.)(comp.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: ReVA MAIA Cataloging Units

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Unknown

Publisher: USEPA

Source_Scale_Denominator: 250,000

Type_of_Source_Media: Electronic

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: Unknown

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: MAIA_HUC8

Source_Contribution:

Used as a clip coverage to clip the RF3 data to the MAIA boundaries.

Process_Step:

Process_Description:

The metadata author had no access to any description of how this coverage was produced. He did have a opy of very similar RADM output. This discription is based on previous work done creating coverages from RADM outputs and the attibutes of the dataset itself. The RADM outputs contain a list of xy values representing the coordinates of each RADM grid cell's center. Each of these also has one or more model outputs associated with it. Most likely, a grid representing the RADM cell centers was created using GRID POINTGRID and a cell size equivilant to the RADM simulation (20km). This grid contained the deposition values. At some point the values were converted to integers by multiplying by 100 and rounding or truncating the resulting values. The grid was converted to a vector grid with GRIDPOLY. The grid was clipped by the ReVA hucs (MAIA_HUC) or a similar coverage describing the MAIA boundary. Finally, the coverage was converted to a shape file.

Source_Used_Citation_Abbreviation: MAIA_HUC8

Process_Date: 19980000

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 1170

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0

False_Northing: 0

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: 1

Ordinate_Resolution: 1

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137

Denominator_of_Flattening_Ratio: 0.003364089

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: aciddep_ws.shp

Entity_Type_Definition: ArcView shape file

Entity_Type_Definition_Source: ESRI

Attribute:

Attribute_Label: Shape
Attribute_Definition: Field holding reference to the geographic feature
Attribute_Definition_Source: Generated by ArcView
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Unknown
Codeset_Source: ESRI

Attribute:
Attribute_Label: Area
Attribute_Definition: The area of each polygon
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0.0
Range_Domain_Maximum: 1200000000
Attribute_Units_of_Measure: meters

Attribute:
Attribute_Label: Perimeter
Attribute_Definition: Length of bounding arcs
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 160000
Attribute_Units_of_Measure: meters

Attribute:
Attribute_Label: ws_
Attribute_Definition: The unique ID calculated by ARC/INFO
Attribute_Definition_Source: Calculated
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 1
Range_Domain_Maximum: 1169

Attribute:
Attribute_Label: ws_id
Attribute_Definition: The user-supplied ID for each polygon
Attribute_Definition_Source: Initially set by ARC/INFO, can be changed by user

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: Unknown

Attribute:

Attribute_Label: Grid_Code

Attribute_Definition:

The value of a grid cell that the polygon was created from. This value is 100 times the deposition value for that grid cell.

Attribute_Definition_Source: Created by processor

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: None

Attribute:

Attribute_Label: ws

Attribute_Definition: Warm season sulfer deposition

Attribute_Definition_Source: RADM

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive real values

Codeset_Source: Unknown

Attribute_Units_of_Measure: kg/ha

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

Metadata_Security_Information:

Metadata_Security_Handling_Description: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

Generated by mp on Wed Sep 30 19:44:11 1998

Metadata for MAIA_DEM90

Abstract:
90-meter digital elevation model (DEM) from USGS 250,000-scale
DEMs (1-degree DEMs) for ReVA MAIA study area.

Purpose:
To define 90-meter DEM in MAIA study area for regional
vulnerability study.

Limitations_of_Data:
Data scale is 1:250,000.

Procedures_Used:
(1)DEM data sets in USGS format of 1:250,000-scale 36 quadrangle
maps in ReVA MAIA were downloaded from USGS DLG FTP site:
http://edcftp.cr.usgs.gov/pub/data/DEM/250/
(2)Delimiters were added by using the following UNIX command for the
Optional format:
dd if=inputfile of=outputfile ibs=4096 cbs=1024 conv=unblock
(3)Delimited Data files were imported into ARC/INFO by using DEMLATTICE.
Lattice coverages were appended into a DEM lattice by using
LATTICEMERGE.
(4)Merged coverage was projected into ReVA MAIA standard Albers
projection with BILINEAR option. Projected coverage was resampled
into 90-meter resolution with BILINEAR option and clipped by 90-meter
ReVA MAIA boundary grid.
Online linkage to the USGS 250,000-scale DEM metadata data is:
http://nsdi.usgs.gov/nsdi/wais/maps/dem1deg.HTML

Revisions:

Reviews_Applied_to_Data:
Very Little.

Related_Spatial_and_Tabular_Data_Sets:

References_Cited:

Notes:

Currentness_Reference:
ReVA MAIA boundary was derived from the best available national data.

Maintenance_and_Update_Frequency:

Time_Period_Information:
Single_Date/Time:
Calendar_Date: 1997

Projection Information:
Projection: ALBERS
Datum: NAD83
Units: METERS Spheroid GRS1980
Parameters:
1st standard parallel: 29 30 0.000
2nd standard parallel: 45 30 0.000
central meridian: -96 0 0.000
latitude of projection's origin: 23 0 0.000
false easting (meters) 0.00000
false northing (meters) 0.00000

Bounding_Coordinates:
West_Bounding_Coordinate: 1089283.375
East_Bounding_Coordinate: 1833583.375
North_Bounding_Coordinate: 2405252.750
South_Bounding_Coordinate: 1449542.750

Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Digital Elevation Models (DEM)

Access_Constraints:
None

Use_Constraints:
None

Point_of_Contact:
MACE.TOM@EPAMAIL.EPA.GOV or LUNETTA.ROSS@EPAMAIL.EPA.GOV

Security_Information:
Security_Classification: UNCLASSIFIED

Native_Data_Set_Environment:
ARC/INFO

Data_Quality_Information:

Logical_Consistency_Report:

Completeness_Report:

Completed

Horizontal_Positional_Accuracy_Report:
National Map Accuray Standards 1:250,000 scale map.

Vertical_Positional_Accuracy_Report:
National Map Accuray Standards 1:250,000 scale map.

Cloud_Cover:

Entity_and_Attribute_Information:

Entity_Type:
Entity_Type_label: MAIA_DEM90.VAT
Entity_Type_Definition: Arc attribute table
Number_of_Attributes_in_Entity: 2
Attribute:
Attribute_Label: VALUE
Attribute_Definition: Elevation in meters relative to NGVD 29
Attribute_Definition_Source: USGS 1:250,000-scale DEM data
Attribute_Domain_Values: Integer
Attribute:
Attribute_Label: COUNT
Attribute_Definition: Frequency of elevation number
Attribute_Definition_Source: Computed
Attribute_Domain_Values: Integer

Federal Region III Land Cover Data Set
Do Not Cite or Duplicate

VERSION 3alb

INTRODUCTION

The main objective of this project was to generate a generalized and consistent (i.e. seamless) land cover data layer for EPA Region III, which includes the states of Pennsylvania, Maryland, Delaware, Virginia, and West Virginia. This data set was developed by personnel at the EROS Data Center (EDC), Sioux Falls, SD. The project was initiated during the summer of 1995, and a first draft product was completed in February, 1996 (Version 1), and the second draft was completed several months later (Version 2). The write-up that follows pertains to Version 3b (February, 1997), which has fifteen classes.
Main differences from Version 2 are that (1) the hay/pasture/grass class (Version 2) was split into hay/pasture and "other grass" (parks/lawns/golf courses) classes, and (2) the high intensity developed class (Version 2) was split into high intensity residential and high intensity commercial/industrial classes.
In addition, the data set has been edge-matched with a Region 2 land cover data set, which eliminates some minor problems we had at the northeastern margins of the previous versions of the data set. Questions about the data set can be directed to Jim Vogelmann (EDC; email vogel@edcmail.cr.usgs.gov; telephone 605-594-6062). This data set is in the Albers Equal Area projection, with the 1st standard parallel value of 29 30 00, the 2nd standard parallel 45 30 00, the central meridian -96 00 00, the latitude of the projection's origin of 23 00 00, and 0's for false easting and northing values, and the spheroid being GRS1980. The data set is 24500 rows and 24701 columns.

GENERAL PROCEDURES

Data sources:

The primary source of data for this project was leaves-on (summer) Landsat TM data, acquired in 1991, 1992 and 1993. These data sets were referenced to Lambert Azimuthal coordinates. (The entire process was done using the Lambert Azimuthal projection; once a final land cover data set was generated, the data set was re-projected into Albers Equal Area projection by popular demand.) Additionally, leaves-off TM data sets were acquired and referenced. While most of the leaves-off data sets were acquired in spring, a few were from late autumn due to the difficulties in acquiring cloud-free TM data. A wider seasonal range of dates, covering a wider span of years, characterize the leaves-off data. In total, 48 TM scenes were analyzed. Data sets used are provided in Table 1. In addition, other intermediate scale spatial data were acquired and utilized. These included 3-arc second Digital Terrain Elevation Dataset (DTED) and derivative DTED products (including slope, aspect and shaded relief), population density data (both block and block group level data were used), Defense Meteorological Satellite Program (DMSP) city lights data, LUDA, and National Wetlands Inventory (NWI) data. In addition census block level data were used. It is anticipated that National Biological Service Gap Analysis Program (GAP) data may be incorporated at a future date.

Methods

The general procedure of this project was to (1) mosaic multiple summer TM scenes and classify them using an unsupervised classification algorithm, (2) interpret and label classes into fifteen land cover categories using aerial photographs as reference data, (3) resolve confused classes using the appropriate ancillary data source(s), and (4) incorporate land cover information from leaves-off TM data and NWI data to refine and augment the "basic" classification developed above.

The entire region was divided into two halves, which were analyzed separately. This was done in part to keep amounts of analyzed data reasonable, and in part because scenes from the west half of the region were acquired during late summer and early autumn, whereas scenes from the east half of the region were acquired during early summer. It was felt that the mosaicking of early summer and late summer scenes might create difficulties due to phenological differences in the vegetation. For mosaicking purposes, a base scene was selected, and other scenes were normalized to mimic spectral properties of the base scene following histogram equalization using pixels in regions of spatial overlap.

Following mosaicking, mosaicked scenes were clustered into 100 spectrally distinct classes using the Cluster algorithm developed by Los Alamos [1]. Clusters were assigned into Anderson level 1 and 2 land cover classes using National High Altitude Photography program (NHAP) aerial photographs as reference information. Almost invariably, individual spectral classes were confused between/among two or more "targeted" land cover classes. Separation of spectral classes into meaningful land cover units was accomplished using ancillary data. Briefly, for a given confused spectral class, digital values of the various ancillary data layers were compared to determine: (1) which data layers were the most effective for splitting the confused class into the appropriate land cover units, and (2) the appropriate thresholds for splitting the classes. Models were then developed using one to several data sets to split each confused class into the desired land cover categories. As an example, a spectral class might be confused between stressed deciduous forest and low density residential areas. In order to split this particular class into more meaningful land cover units, population density and city lights data were assessed to determine if they could be used to split the class into residential and forested categories, and if so, to define the appropriate thresholds to be used in the class splitting model.

Following the above class splitting steps, a "first order" classification product was constructed for each of the two halves of the study region. Leaves-off data were then clustered with the goal of discerning certain land cover features not easily discriminated using leaves-on TM data. Classes easily defined using leaves-off data included conifer vegetation and hay/pastures. Both are green in early spring and late autumn, and are readily discernable from each other and almost all other (non-green) land cover categories. This information was then incorporated into the classification product. Land cover classes that were spatially but not spectrally distinct (barren areas, clearcuts) were digitized off the screen and incorporated; wetlands information was derived from NWI data. Resultant classification products from the east and west halves of the region were then mosaicked together. After this, census block level data were used to help split high intensity developed areas into areas with few inhabitants (i.e. predominantly high intensity commercial/industrial) versus areas with high density (i.e. high intensity residential). In addition, grassy areas associated with large parks, golf courses, residential areas, and airports were separated from hay/pasture areas as a separate class (other grass).

Classes:
The resulting classification (Version 3) includes:

Class 1: Water
Class 2: Low intensity developed
Class 3: High intensity residential
Class 4: High intensity commercial/industrial
Class 5: Hay/pasture
Class 6: Row crops
Class 7: Other grass (lawns, city parks, golf courses)
Class 8: Evergreen forest
Class 9: Mixed forest
Class 10: Deciduous Forest
Class 11: Woody wetland
Class 12: Emergent herbaceous wetland
Class 13: Bare; quarries, strip mines, sand pits
Class 14: Bare; bare rock and sand
Class 15: Bare; transitional
Current definitions of the classes are as follows; percentages given must be viewed as guidelines.

A. Water (all areas of open water, generally with less than 30% cover of vegetation/land cover). Class 1 of Region III land cover data set.

B. Developed (areas characterized by high percentage (approximately 50% or greater) of construction materials (e.g. asphalt, concrete, buildings, etc.). Classes 2-4 of Region III land cover data set.

B1. Low Intensity Developed (approximately 50-80% constructed material; approximately 20-50 % vegetation cover; high percentage of residential development typifies this class). Class 2 of Region III land cover data set.

B2. High Intensity Developed (20% or less vegetation, high percentage (80-100%) building materials; typically low percentage of residential development in this class). Classes 3 and 4 of EPA Region III data set (high intensity residential and high intensity commercial/industrial, respectively).

C. Cultivated (areas that are typically planted, tilled, or harvested. Includes pastures, row crops, and hay). Classes 5, 6 and 7 in the Region III land cover data set.

C1. Grasslands (areas characterized by high percentages of grasses and other herbaceous vegetation that is regularly mowed for hay and/or grazed by livestock; predominantly hay fields and pastures, but also currently includes golf courses and city parks...) Class 5 (hay/pasture) and 7 (other grass; lawns, city parks, golf courses) of the Region III land cover data set.

C2. Row Crops (areas regularly tilled and planted, often on an annual or biennial basis; corn, cotton, sorghum, vegetable crops. . .) Class 6 of the Region III land cover data set.

D. Natural Vegetated areas. (Classes 8, 9, 10, 11 and 12 of Region III data set.

D1. Upland Forests (trees covering 40% or greater area). Includes Classes 8, 9 and 10 of Region III data set.

D1a. Conifers/Evergreens (of trees present, 70% or higher conifers). Class 8 of Region III data set.

D1b. Mixed Forest (both conifers and deciduous tree species present, with neither particularly dominant) Class 9 of Region III land cover data set.

D1c. Deciduous Forest (of trees present, 70% or higher deciduous tree species). Class 10 of Region III data set.

D2. Wetlands

D2a. Woody Wetlands (wetlands with substantial amount of woody vegetation present, either trees or shrubs). Class 11 of EPA Region III land cover data set.

D2b. Non-Woody Wetlands (wetlands without a substantial amount of woody vegetation present, usually with substantial amounts of emergent herbaceous vegetation). Class 12 of Region III land cover data set.

E. Bare areas (composed of bare rock, sand, gravel, or other earthen material with little (in the order of 20% or less) living vegetation present. Includes quarries (strip mines, sand and gravel operations), beaches, and recent clear cuts.) Classes 13 (quarries, sand/gravel pits, strip mines), 14 (bare rock and sand) and 15 (transitional bare; clear cut areas) in Region 3 data set.

CAVEATS AND CONCERNS

While we believe that the approach taken has yielded a very good general land cover classification product for a very large region, it is important to indicate to the user where there might be some potential problems. The biggest concerns are listed in bullet form below:

1) Standard quantitative accuracy checks have not been conducted. Feedback from users of the data will be greatly appreciated. Consistency checks (comparisons with other existing data layers) have been conducted; for the most part, the Region 3 land cover classification agrees favorably with these other data sources.

2) Some of the leaves-off data sets used for hay/pasture delineations were sub-optimal. In this project, leaves-off data sets were used for discriminating hay and pasture areas. The success of discriminating these areas using leaves-off data sets hinges of the greenness of the grasses during time of data acquisition. When hay/pasture areas are non-green, they are not easily distinguishable from other agricultural areas using remotely sensed data. However, there is a temporal window during which hay and pasture areas green up before most other vegetation (excluding conifers, which have different

spectral properties); during this window these areas are easily distinguishable from other crop areas.

3) The data sets used cover a range of years, and changes that have taken place across the landscape over the time period may not have been captured. While this is not viewed as a major problem for most classes, it is possible that some land cover features change more rapidly than might be expected (e.g. hay one year, row crop the next).

4) Some clear-cut areas have spectral properties similar to row crops, depending upon the times of data acquisition. Thus, there could be some confusion in areas where both clear-cuts and row crops occur in close proximity to each other.

5) NWI data were not available for some of the region, most notably western Pennsylvania. Also, the NWI data are relatively old, and wetland changes that have taken place since the NWI data were acquired will not be captured in this EPA Region III land cover data set (unless fixed manually).

6) Throughout this project, we relied heavily on the use of multi-temporal data sets (leaves-on and leaves-off). We did not have both leaves-on and leaves-off data sets for a few relatively small areas (especially along the west portion of the southern edge of Virginia and the Newport News area in southeastern Virginia). Consequently, the quality of the data product in these areas is expected to be somewhat diminished.

ACKNOWLEDGMENTS

This work was performed by the Hughes STX Corporation under U.S.Geological Survey Contract 1434-92-C-40004.

REFERENCE

[1] Kelly, P.M., and White, J.M., 1993, Preprocessing remotely sensed data for efficient analysis and classification, Applications of Artificial Intelligence 1993: Knowledge-Based Systems in Aerospace and Industry, Proceedings of SPIE, 1993, 24-30.

Table 1. MRLC Landsat thematic mapper (TM) data sets available to develop EPA Region III data set; asterisks represent data sets used to develop land cover data set.

Path/Row	Date	EOSAT-ID
14/31	05/09/93	5014031009312910*
14/32	03/17/91	5014032009107610
14/32	05/20/91	5014032009114010*
14/32	03/25/89	5014032008908610*
14/33	03/15/91	5014033009107610*
14/33	05/04/91	5014033009112410
14/33	06/10/93	5014033009316110*
14/34	03/15/91	5014034009107610*
14/34	05/04/91	5014034009112410*
14/34	08/10/92	5014034009222310

14/35 06/23/92 5014035009217510*
14/35 10/13/92 5014035009228710*
15/31 03/31/91 5015031008809110*
15/31 06/14/92 5015031009216610*
15/31 10/07/93 5015031009330410
15/32 11/14/90 5015032009032010*
15/32 06/17/93 5015032009316810*
15/32 10/20/92 5015032009229410
15/33 03/16/89 5015033008907710*
15/33 05/08/90 5015033009012810*
15/33 09/16/91 5015033009125910
15/34 04/11/92 5015034009210210*
15/34 06/17/93 5015034009316810*
15/34 10/18/91 5015034009129110
15/35 05/16/93 5015035009313610*
15/35 10/20/92 5015035009229410*
16/31 03/29/90 5016031009109010*
16/31 05/20/92 5016031009214110
16/31 06/24/93 5016031009317510*
16/32 03/29/91 5016032009109010*
16/32 06/24/93 5016032009317510*
16/32 08/24/92 5016032009223710
16/33 03/01/92 5016033009206110*
16/33 04/16/91 5016033009110610
16/33 05/20/92 5016033009214110
16/33 09/28/93 5016033009327110*
16/34 04/16/91 5016034009110610*
16/34 05/20/92 5016034009214110
16/34 09/28/93 5016034009327110*
16/35 03/01/92 5016035009206110*
16/35 09/28/93 5016035009327110
17/31 03/29/88 5017031008808910*
17/31 05/11/92 5017031009213210
17/31 10/02/92 5017031009227610*
17/32 11/12/90 5017032009031810
17/32 03/24/86 5017032008608310*
17/32 05/14/93 5017032009313410
17/32 10/02/92 5017032009227610*
17/33 03/24/86 5017033008608310*
17/33 07/17/93 5017033009319810
17/33 10/02/92 5017033009227610*
17/34 03/24/86 5017034008608310*
17/34 10/02/92 5017034009227610*
17/35 05/11/92 5017035009213210
17/35 11/03/92 5017035009230810*
18/31 04/22/94 5018031009411210*

18/31 08/09/93 5018031009322110
18/32 04/22/94 5018032009411210*
18/32 08/06/92 5018032009221910*
18/33 04/19/87 5018033008710910*
18/33 08/06/92 5018033009221910*
18/34 09/29/94 5018034009427210*
18/34 11/29/93 5018034009333310*
18/35 06/06/93 5018035009315710*
18/35 10/25/92 5018035009229910*
19/35 04/23/92 5019035009211410*
19/35 09/30/92 5019035009227410*

MAIA Agricultural Nitrogen Application

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Robert Carsel(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Agricultural Nitrogen Application

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

This geographic data contains the estimated application rate for agricultural nitrogen in the MAIA region. Additionally it contains the measures used to calculate this estimation--land area, total organic and total inorganic nitrogen applied to agricultural land. All estimates are on a county-by-county basis.

Purpose:

Provide estiamtes of total agricultural nitrogen applictions for the MAIA region. This will be used in the ReVA project to assess nitrogen as an ecosystem stressor and identify regions that are potentially at risk due to nitrogen.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Full details were not given on the geographic source for the counties data. The source cited (The ReVA counties coverage) is the most likely used. It is possible that it was derived from a sililar source.

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 19920000
Currentness_Reference: Ground Condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -84.16709622
East_Bounding_Coordinate: -74.18644541
North_Bounding_Coordinate: 42.29408165
South_Bounding_Coordinate: 34.39608158
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Water Quality
Theme_Keyword: Nitrogen Application
Theme_Keyword: Ecological Risk
Theme_Keyword: Agriculture
Theme_Keyword: Crops
Theme_Keyword: Runoff
Theme_Keyword: Nitrogen
Theme_Keyword: Fertilizer
Theme_Keyword: Non-Point Source Pollution
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: US
Place_Keyword: Eastern US
Place_Keyword: Mid-atlantic Integrated Assessment
Place_Keyword: MAIA
Place_Keyword: New York
Place_Keyword: New Jersey
Place_Keyword: D.C.
Place_Keyword: West Virginia
Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Access_Constraints: None

Use_Constraints:

100,000 and 1:250,000 scale data. The spatial accuracy of areal estiamtes based on the land cover data are unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Dr. Robert Carsel

Contact_Organization: USEPA NERL Athens

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Athens

State_or_Province: Nevada

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Carsel_Robert@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the fields contained in the shape file, it appears that the coverage was originally created in ARC/INFO and later converted to an ArcView shapefile.

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report: None available

Logical_Consistency_Report:

It appears that polygon topology was created with ARC/INFO. In its current form some of this information may have been lost.

Completeness_Report: None
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: None
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: None
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: USEPA(comp.)
Publication_Date: Unknown
Publication_Time: Unknown
Title: ReVA Counties
Geospatial_Data_Presentation_Form: map
Publication_Information:
Publication_Place: Unknown
Publisher: USEPA
Source_Scale_Denominator: 100000
Type_of_Source_Media: Electronic
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 19980000
Source_Currentness_Reference: The county boundaries should not have changed since compilation
Source_Citation_Abbreviation: EPA_RF3
Source_Contribution: Rivers and Streams
Process_Step:
Process_Description:

Total agricultural nitrogen use for each county was estimated as the sum of inorganic and organic applications. Inorganic use was derived from state fertilizer statistics if available. These estimates are the result of data collected from a sample survey conducted for a crop year. If a MASA state was not a major producer of the product of interest, the average value of 1992 major producing states in the United States was used. State-level inorganic nitrogen use estimates are based on the product of the following: (1) fraction of crop area receiving nitrogen applications, (2) the number of applications, and (3) the application rate (pounds per acre per application). State-level nitrogen application by crop was allocated to individual counties according to relative crop acreage (1992 Census of Agriculture). Summing all crop-specific applications provided county-level total inorganic agricultural nitrogen.

Animal sources of nitrogen were based on average excretion rates for livestock. State-level organic nitrogen estimates are based on the product of (1) state-level populations for each animal category (chickens, cows and swine) (1992 Census of Agriculture database [U.S. Department of Commerce 1995]) and (2) the daily excretion of nitrogen per 1000 lb of animal unit (Georgia Soil and Water Commission 1994). To perform this calculation, all animal categories were converted to a common animal unit (Georgia Soil and Water Commission 1994). State-level applications by animal category were allocated to individual counties according to relative livestock acreage. Summing all animal-specific use provided county-level total organic agricultural nitrogen. The databases containing the inorganic and organic nitrogen by MASA county were summed to obtain total nitrogen application estimates.

Before or after these calculations, the data was integrated into the counties coverage or shape file on a county-by-county basis. Additionally, the coverage was converted to a shape file at some point.

Source_Used_Citation_Abbreviation: MAIA_HUC8

Source_Used_Citation_Abbreviation: EPA_RF3

Source_Used_Citation_Abbreviation: USGS_ROADS

Source_Used_Citation_Abbreviation: EPA3_MRLC

Source_Used_Citation_Abbreviation: USGS_DEM250

Process_Date: Unknown

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 402

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5
Longitude_of_Central_Meridian: -096.000000
Latitude_of_Projection_Origin: +23.000000
False_Easting: 0
False_Northing: 0
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 1
Ordinate_Resolution: 1
Planar_Distance_Units: Meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137
Denominator_of_Flattening_Ratio: 0.003364089

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: lscape.shp
Entity_Type_Definition: ArcView shape file
Entity_Type_Definition_Source: ESRI
Attribute:
Attribute_Label: Shape
Attribute_Definition: Field holding reference to the geographic feature
Attribute_Definition_Source: Generated by ArcView
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Unknown
Codeset_Source: ESRI
Attribute:
Attribute_Label: Area
Attribute_Definition: The area of each polygon
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:

Range_Domain_Minimum: 0.0
Range_Domain_Maximum: 1200000000
Attribute_Units_of_Measure: meters
Attribute:
Attribute_Label: Perimeter
Attribute_Definition: Length of bounding arcs
Attribute_Definition_Source: Calculated by ARC/INFO
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 0
Range_Domain_Maximum: 160000
Attribute_Units_of_Measure: meters
Attribute:
Attribute_Label: maia_ctyco
Attribute_Definition: The unique ID calculated by ARC/INFO
Attribute_Definition_Source: Calculated
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Unique Positive Integers
Codeset_Source: Unknown
Attribute:
Attribute_Label: maia_ctyco
Attribute_Definition: The user-supplied ID for each polygon
Attribute_Definition_Source: Initially set by ARC/INFO, can be changed by user
Attribute_Domain_Values:
Codeset_Domain:
Codeset_Name: Positive integers
Codeset_Source: Unknown
Attribute:
Attribute_Label: statecty
Attribute_Definition: The five-digit FIPS code
Attribute_Definition_Source: USGS or EPA
Attribute_Domain_Values:
Range_Domain:
Range_Domain_Minimum: 01001
Range_Domain_Maximum: 99999

Attribute:

Attribute_Label: st

Attribute_Definition: The two-digit state abbreviations

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Unknown

Codeset_Source: Unknown

Attribute:

Attribute_Label: cntyname

Attribute_Definition: The county names

Attribute_Definition_Source: State and federal government

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Unknown

Codeset_Source: Unknown

Attribute:

Attribute_Label: fips_st

Attribute_Definition: The state fips code

Attribute_Definition_Source: Federal Government

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 01

Range_Domain_Maximum: 99

Attribute:

Attribute_Label: fips_co

Attribute_Definition: The couty FIPS codes

Attribute_Definition_Source: Federal Government

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 001

Range_Domain_Maximum: 999

Attribute:

Attribute_Label: FIPS

Attribute_Definition: The five-digit FIPS code

Attribute_Definition_Source: Federal Government

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 01001

Range_Domain_Maximum: 99999

Attribute:

Attribute_Label: Ranknew

Attribute_Definition: Unknown

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1

Range_Domain_Maximum: 5

Attribute:

Attribute_Label: totcrop

Attribute_Definition: Total nitrogen (inorganic) applied to crops

Attribute_Definition_Source: Unknown

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive real numbers

Codeset_Source: Unknown

Attribute_Units_of_Measure: Probably total pounds in each county

Attribute:

Attribute_Label: totaniml

Attribute_Definition: Total nitrogen (organic) in the form of animal waste

Attribute_Definition_Source: Unknown

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive real numbers

Codeset_Source: Unknown

Attribute_Units_of_Measure: Probably total pounds in each county

Attribute:

Attribute_Label: land_area

Attribute_Definition: Total land area (in each county)

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive integers

Codeset_Source: Unknown

Attribute_Units_of_Measure: Probably acres

Attribute:

Attribute_Label: totnitbc

Attribute_Definition:

Total agricultural nitrogen application (organic and inorganic)

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Codeset_Domain:

Codeset_Name: Positive real numbers

Codeset_Source: Unknown

Attribute_Units_of_Measure: lbs/acre (per year)

Attribute:

Attribute_Label: Rank

Attribute_Definition: Unknown

Attribute_Definition_Source: Calculated

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 1

Range_Domain_Maximum: 5

Attribute:

Attribute_Label: histo66

Attribute_Definition: Unknown

Attribute_Definition_Source: Unknown

Attribute_Domain_Values:

Range_Domain:

Range_Domain_Minimum: 0

Range_Domain_Maximum: 68

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: 919-541-0620
Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov
Distribution_Liability:
EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:
Metadata_Date: 19980930
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Casson Stallings
Contact_Organization: ManTech Environmental Technologies, Inc.
Contact_Position: GIS Specialist
Contact_Address:
Address_Type: mailing address
Address: PO Box 12313
City: Research Triangle Park
State_or_Province: NC
Postal_Code: 27709
Country: USA
Contact_Voice_Telephone: (919) 549-0611
Contact_Electronic_Mail_Address: cstallings@man-env.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: Unknown
Metadata_Time_Convention: Local time
Metadata_Access_Constraints: None
Metadata_Use_Constraints: None
Metadata_Security_Information:
Metadata_Security_Handling_Description: None
Metadata_Security_Classification: Unclassified
Metadata_Security_Classification_System: Unknown

MAIA Agricultural Organo-Phosphorus Pesticide Applications

Metadata:

Identification_Information:

Citation:

Citation_Information:

Originator: Lawrence A Burns(ed.)

Publication_Date: Unknown

Publication_Time: Unknown

Title: MAIA Agricultural Organo-Phosphorus Pesticide Applications

Geospatial_Data_Presentation_Form: map

Description:

Abstract:

This shapefile contains estimated annual organo-phosphrous pesticide applications for the MAIA region.

Purpose: Identify regions which may be at risk due to pesticides.

Supplemental_Information:

See the ReVA Mid-Atlantic Stressor Profile Atlas for additional details. Details on the geographic sources or on the methodology used are not available. THIS METADATA IS NOT FGDC COMPLIENT.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19900000

Ending_Date: 19930000

Currentness_Reference: Ground Condition

Status:

Progress: Complete

Maintenance_and_Update_Frequency: Unknown

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -84.16709622

East_Bounding_Coordinate: -74.18644541

North_Bounding_Coordinate: 42.29408165

South_Bounding_Coordinate: 34.39608158

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: Ecological Risk

Theme_Keyword: Non-Point Source Pollution

Theme_Keyword: Pesticides

Theme_Keyword: Organo-Phosphorous

Theme_Keyword: Agriculture

Theme_Keyword: Herbicides

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: US

Place_Keyword: Eastern US

Place_Keyword: Mid-atlantic Integrated Assessment

Place_Keyword: MAIA

Place_Keyword: New York

Place_Keyword: New Jersey

Place_Keyword: D.C.

Place_Keyword: West Virginia

Place_Keyword: Virginia

Place_Keyword: North Carolina

Place_Keyword: Pennsylvania

Place_Keyword: Maryland

Place_Keyword: US EPA Region 3

Place_Keyword: MASA

Temporal:

Temporal_Keyword_Thesaurus: None

Temporal_Keyword: 1991

Temporal_Keyword: 1990

Temporal_Keyword: 1992

Temporal_Keyword: 1993

Access_Constraints: None

Use_Constraints:

250,000 scale data. The spatial accuracy of areal estiamtes based on the land cover data are unknown.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Lawrence A Burns

Contact_Organization: USEPA NERL Athens

Contact_Address:

Address_Type: mailing and physical address

Address: Unknown

City: Athens

State_or_Province: GA

Postal_Code: Unknown

Country: US

Contact_Voice_Telephone: Unknown

Contact_Electronic_Mail_Address: Burns_Lawrence@epamail.epa.gov

Security_Information:

Security_Handling_Description: No special handleing required.

Security_Classification: Unclassified

Security_Classification_System: Unknown

Native_Data_Set_Environment:

Based on the fields contained in the shape file, it appears that the coverage was originally created in ARC/INFO and later converted to an ArcView shapefile.

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 409

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Map_Projection:

Map_Projection_Name: Albers Conical Equal Area

Albers_Conical_Equal_Area:

Standard_Parallel: 29.5

Standard_Parallel: 45.5

Longitude_of_Central_Meridian: -096.000000

Latitude_of_Projection_Origin: +23.000000

False_Easting: 0

False_Northing: 0

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: 1

Ordinate_Resolution: 1

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137

Denominator_of_Flattening_Ratio: 0.003364089

Distribution_Information:

Distributor:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Betsy Smith

Contact_Organization: U.S. Environmental Protection Agency

Contact_Position: ReVA Coordinator

Contact_Address:

Address_Type: mailing address

Address: MD-75

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: 919-541-0620

Contact_Electronic_Mail_Address: smith.betsy@epamail.epa.gov

Distribution_Liability:

EPA assumes no liability for the data or for products produced using the data.

Metadata_Reference_Information:

Metadata_Date: 19980930

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Casson Stallings

Contact_Organization: ManTech Environmental Technologies, Inc.

Contact_Position: GIS Specialist

Contact_Address:

Address_Type: mailing address

Address: PO Box 12313

City: Research Triangle Park

State_or_Province: NC

Postal_Code: 27709

Country: USA

Contact_Voice_Telephone: (919) 549-0611

Contact_Electronic_Mail_Address: cstallings@man-env.com

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: Unknown

Metadata_Time_Convention: Local time

Metadata_Access_Constraints: None

Metadata_Use_Constraints: None

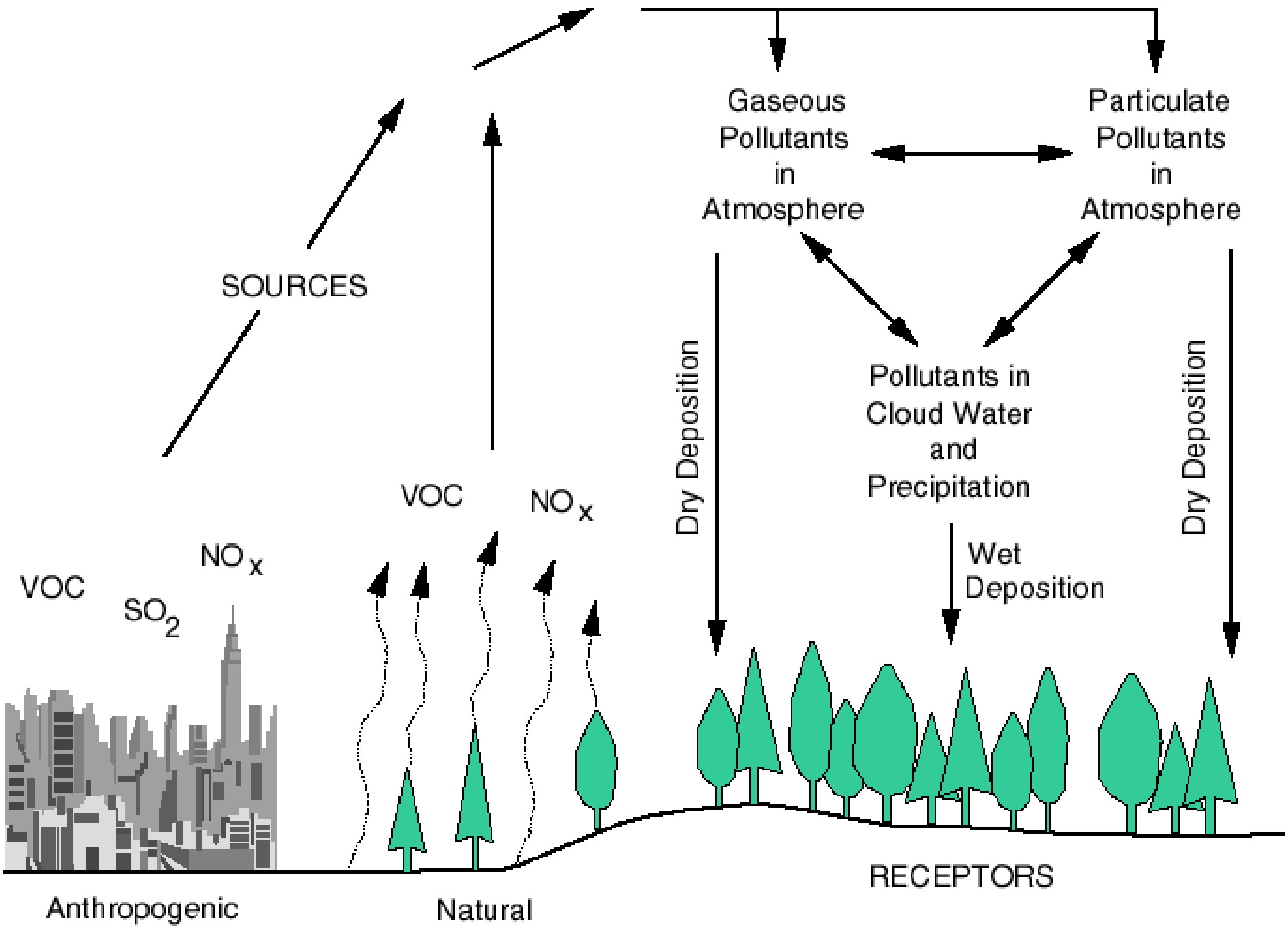
Metadata_Security_Information:

Metadata_Security_Handling_Description: None

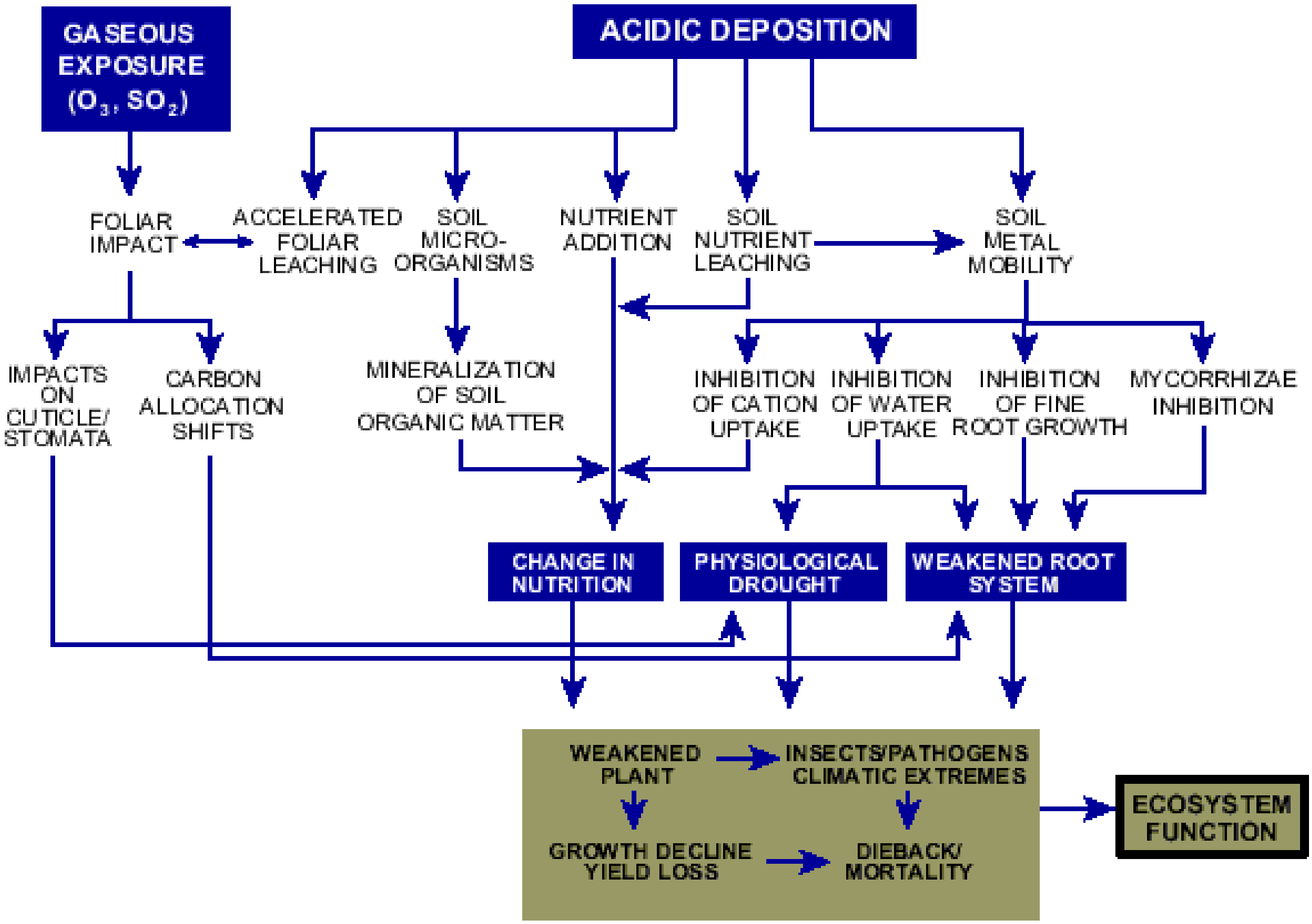
Metadata_Security_Classification: Unclassified

Metadata_Security_Classification_System: Unknown

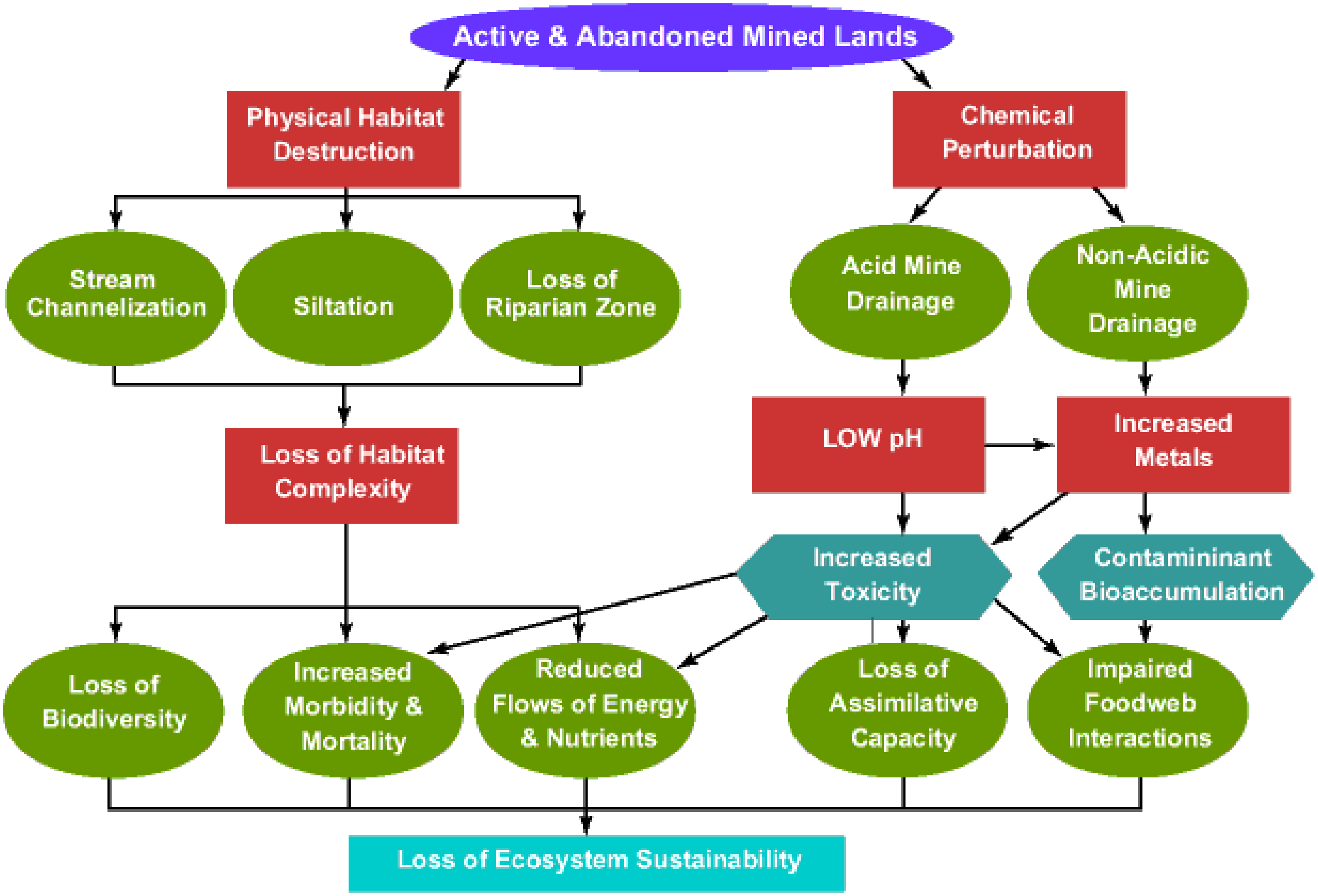
Generated by mp on Thu Oct 01 13:54:27 1998



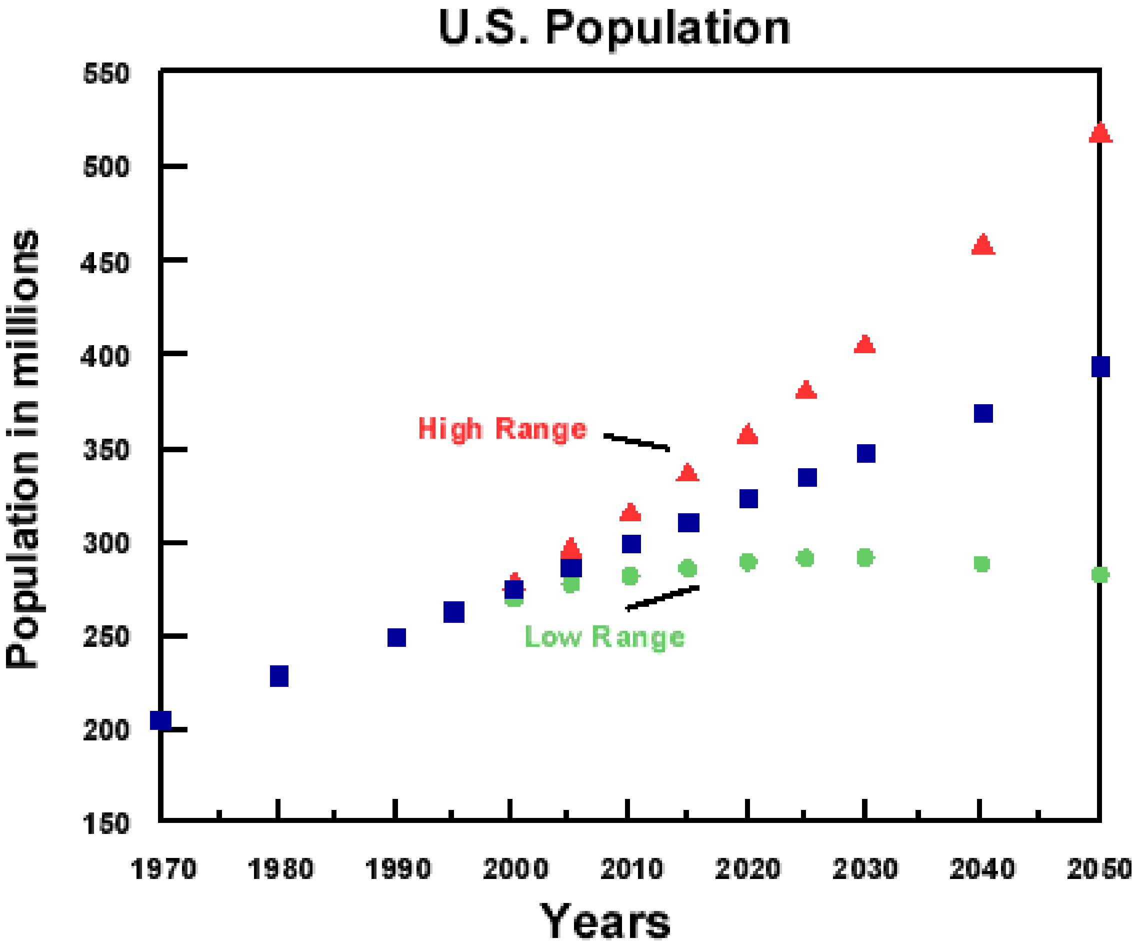
SOURCES
Gaseous Pollutants in Atmosphere
Particulate Pollutants in Atmosphere
Pollutants in Cloud Water and Precipitation
Dry Deposition
Wet Deposition
Dry Deposition
VOC
SO_2
NO_x
VOC
NO_x
Anthropogenic
Natural
RECEPTORS

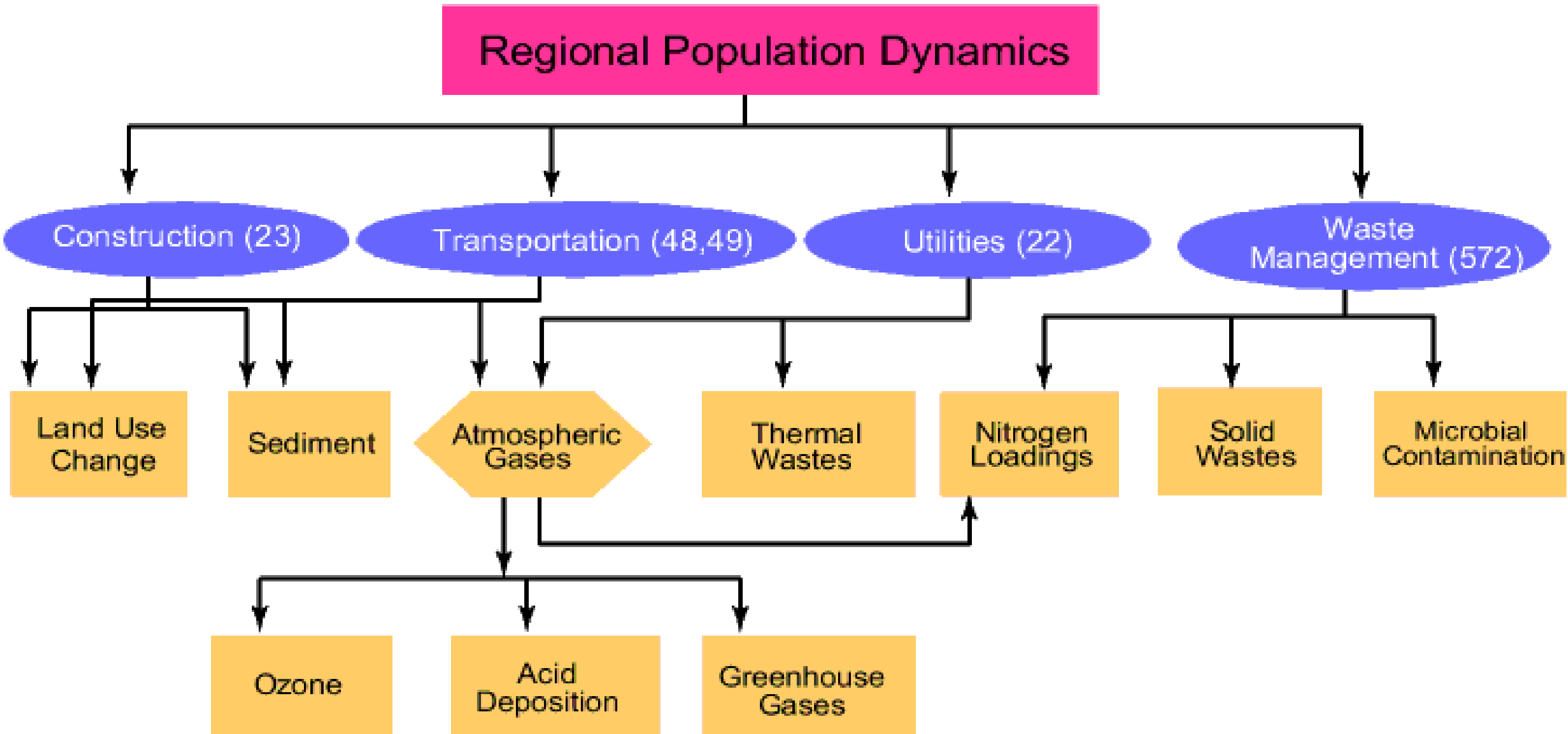


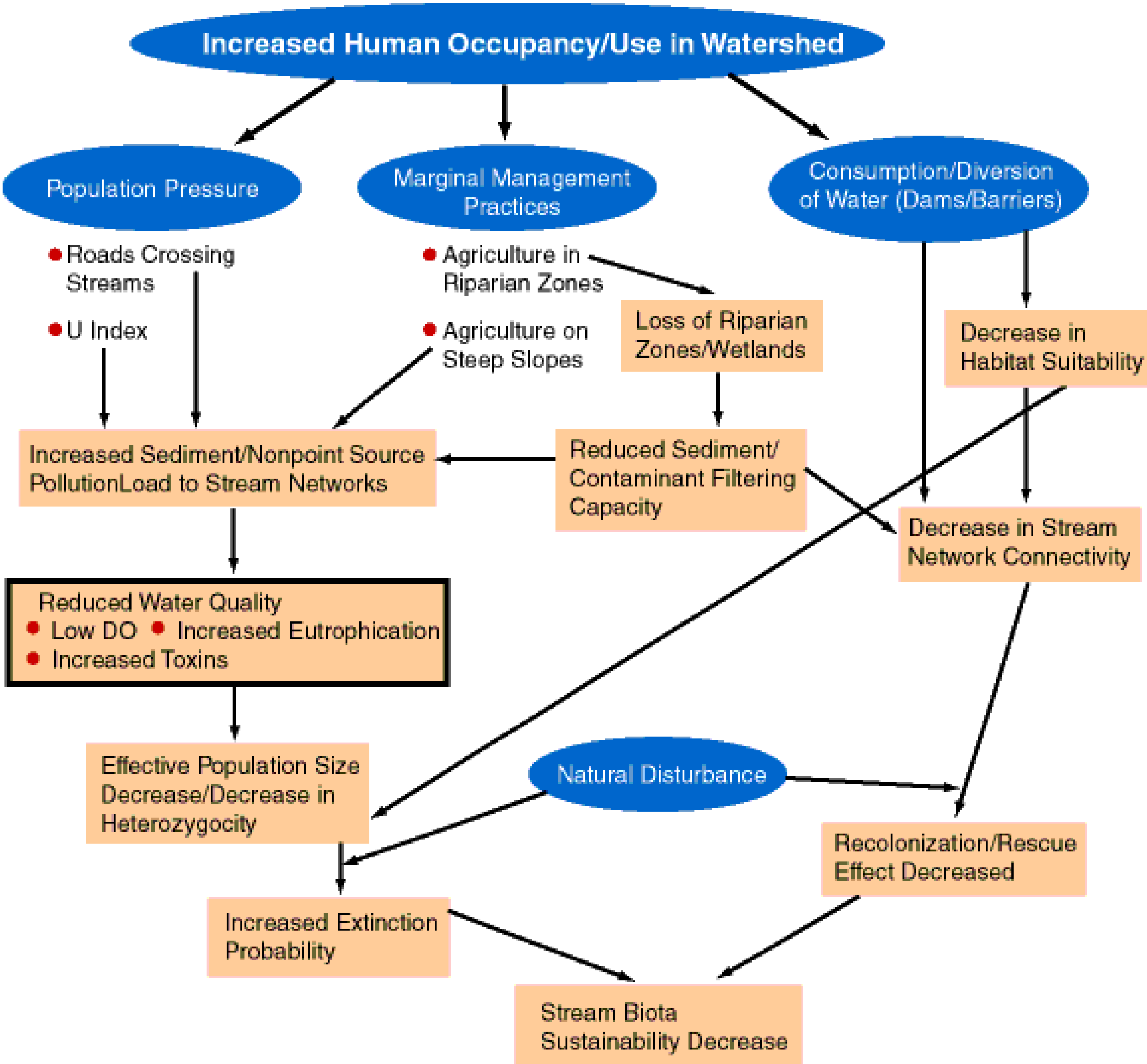
GASEOUS EXPOSURE (O_3, SO_2)
ACIDIC DEPOSITION
FOLIAR IMPACT
ACCELERATED FOLIAR LEACHING
SOIL MICRO-ORGANISMS
NUTRIENT ADDITION
SOIL NUTRIENT LEACHING
SOIL METAL MOBILITY
IMPACTS ON CUTICLE/ STOMATA
CARBON ALLOCATION SHIFTS
MINERALIZATION OF SOIL ORGANIC MATTER
INHIBITION OF CATION UPTAKE
INHIBITION OF WATER UPTAKE
INHIBITION OF FINE ROOT GROWTH
MYCORRHIZAE INHIBITION
CHANGE IN NUTRITION
PHYSIOLOGICAL DROUGHT
WEAKENED ROOT SYSTEM
WEAKENED PLANT
INSECTS/PATHOGENS CLIMATIC EXTREMES
GROWTH DECLINE YIELD LOSS
DIEBACK/ MORTALITY
ECOSYSTEM FUNCTION



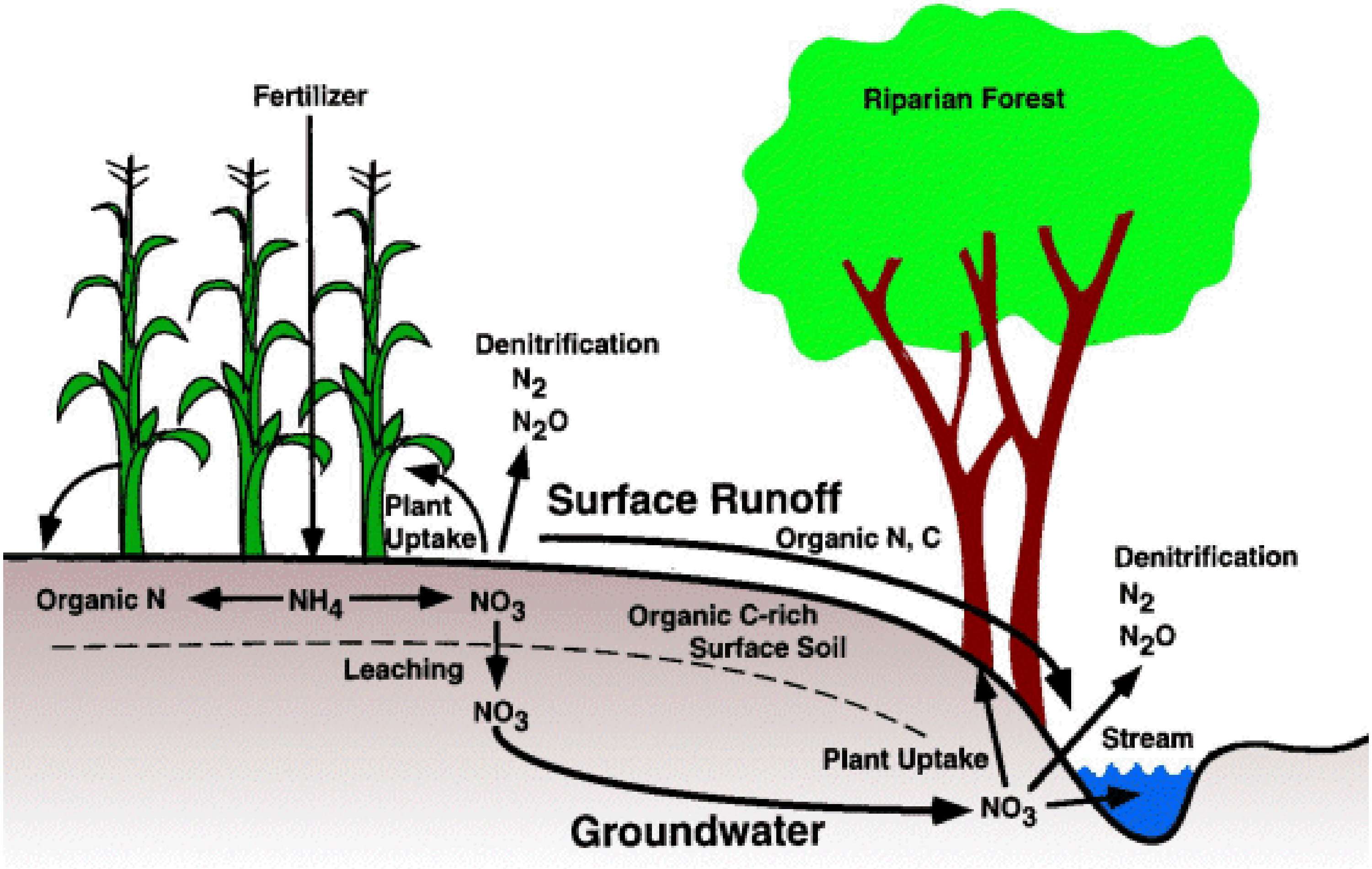
Active & Abandoned Mined Lands
Physical Habitat Destruction
Chemical Perturbation
Stream Channelization
Siltation
Loss of Riparian Zone
Acid Mine Drainage
Non-Acidic Mine Drainage
LOW pH
Increased Metals
Loss of Habitat Complexity
Increased Toxicity
Contamininant Bioaccumulation
Loss of Biodiversity
Increased Morbidity & Mortality
Reduced Flows of Energy & Nutrients
Loss of Assimilative Capacity
Impaired Foodweb Interactions
Loss of Ecosystem Sustainability

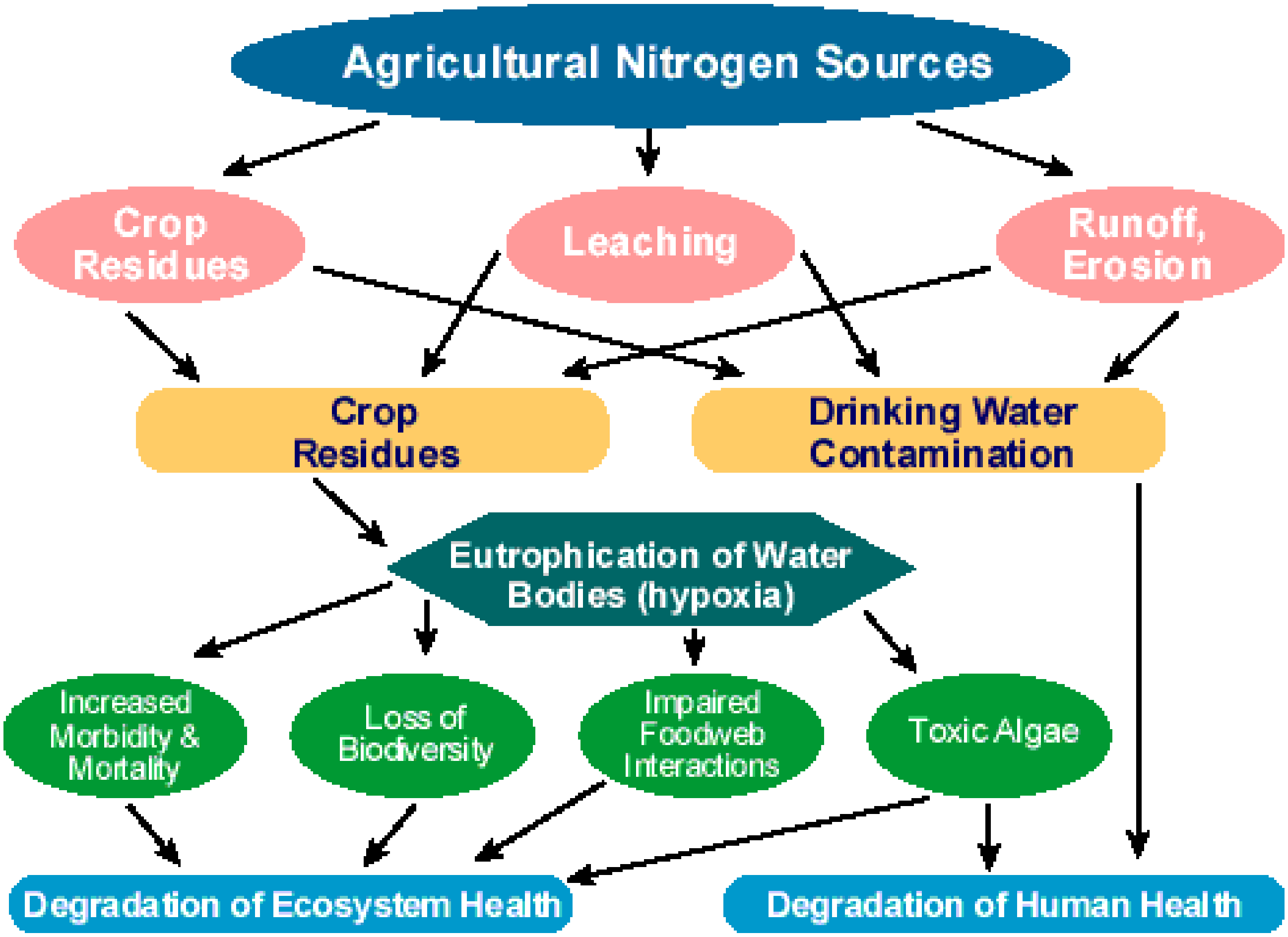

U.S. Population
Population in millions
550
500
450
400
350
300
250
200
150
High Range
Low Range
1970
1980
1990
2000
2010
2020
2030
2040
2050
Years

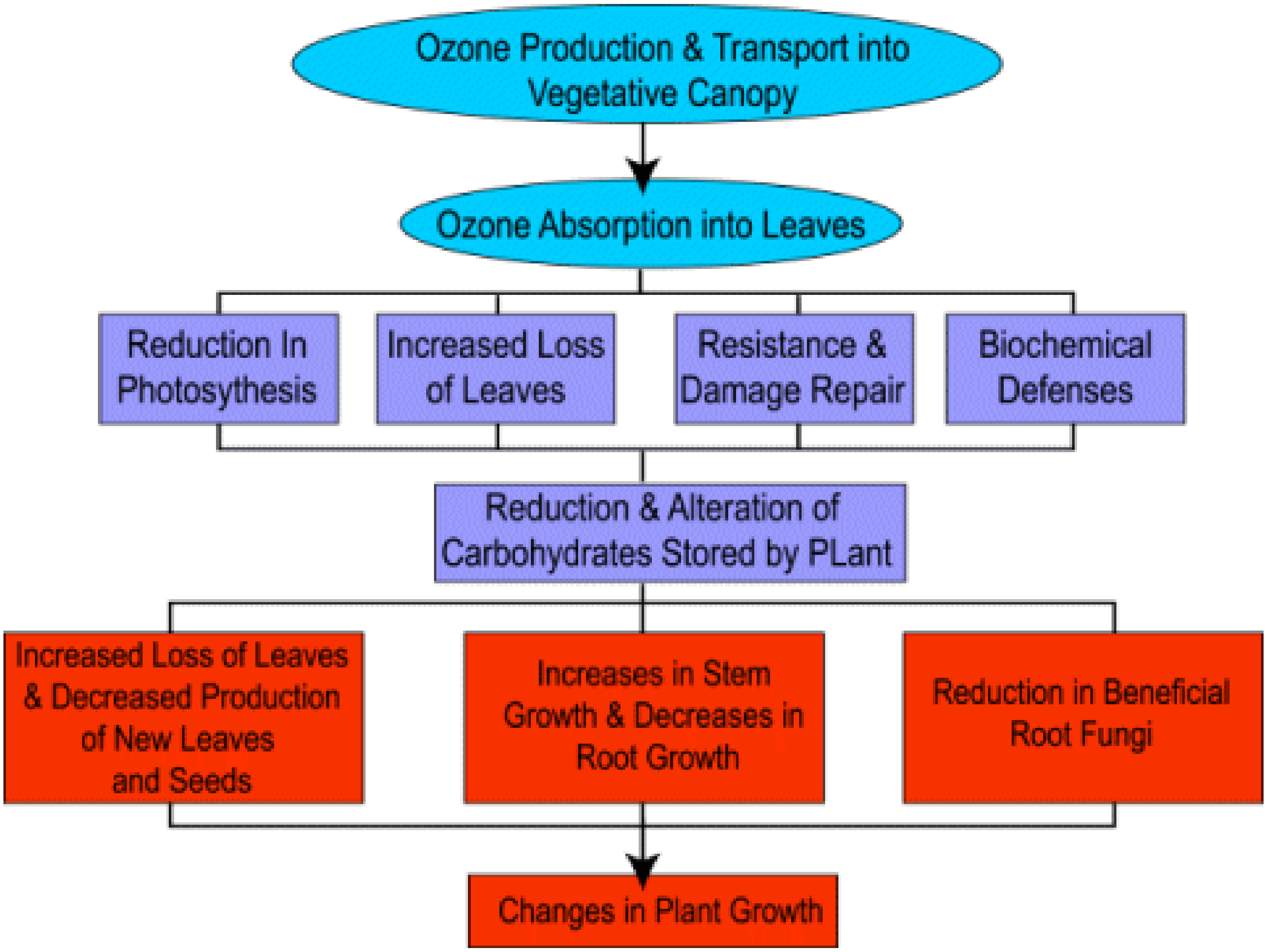

Regional Population Dynamics
Construction (23)
Transportation (48,49)
Utilities (22)
Waste Management (572)
Land Use Change
Sediment
Atmospheric Gases
Thermal Wastes
Nitrogen Loadings
Solid Wastes
Microbial Contamination
Ozone
Acid Deposition
Greenhouse Gases



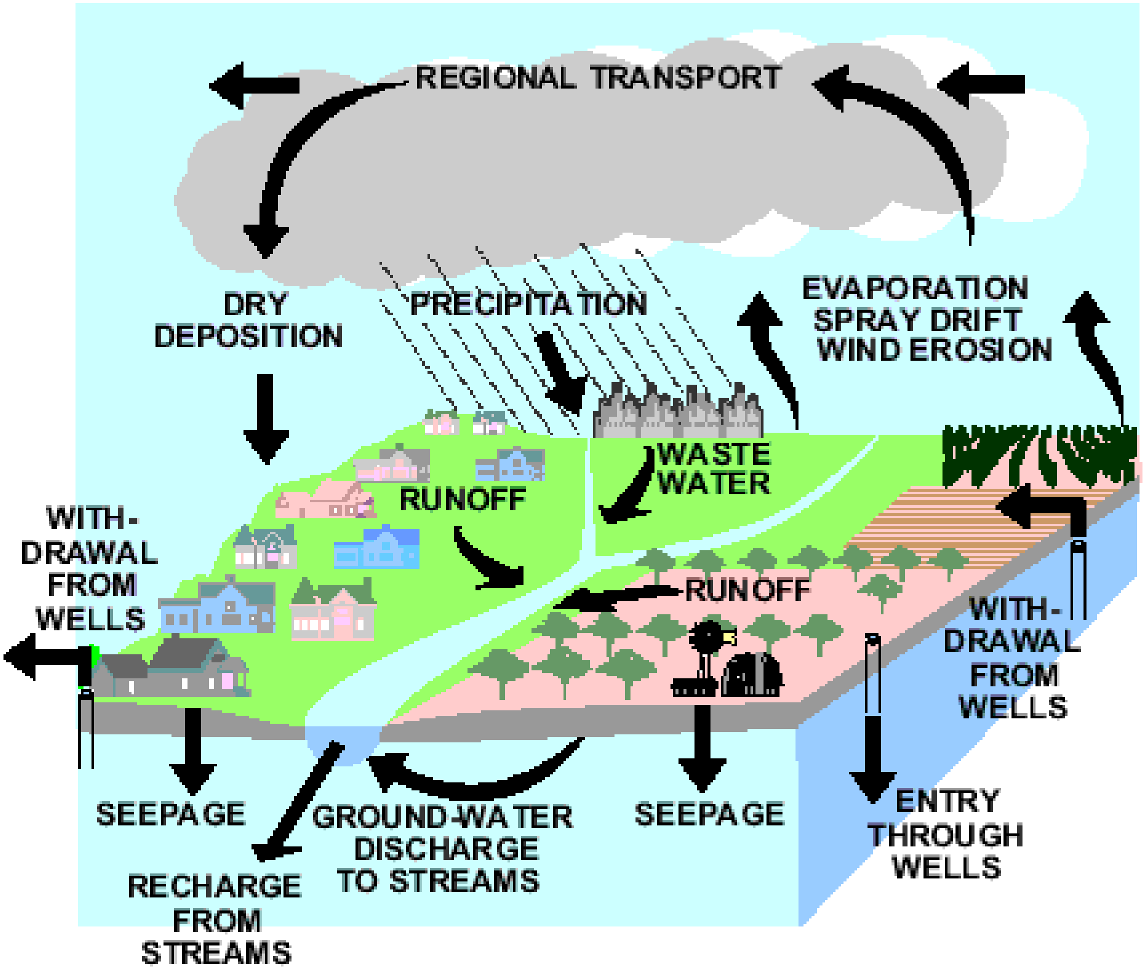
Increased Human Occupancy/Use in Watershed
Population Pressure
Marginal Management Practices
Consumption/Diversion of Water (Dams/Barriers)
Roads Crossing Streams
U Index
Agriculture in Riparian Zones
Agriculture on Steep Slopes
Loss of Riparian Zones/Wetlands
Decrease in Habitat Suitability
Increased Sediment/Nonpoint Source PollutionLoad to Stream Networks
Reduced Sediment/ Contaminant Filtering Capacity
Decrease in Stream Network Connectivity
Reduced Water Quality
Low DO
Increased Eutrophication
Increased Toxins
Effective Population Size Decrease/Decrease in Heterozygocity
Natural Disturbance
Recolonization/Rescue Effect Decreased
Increased Extinction Probability
Stream Biota Sustainability Decrease

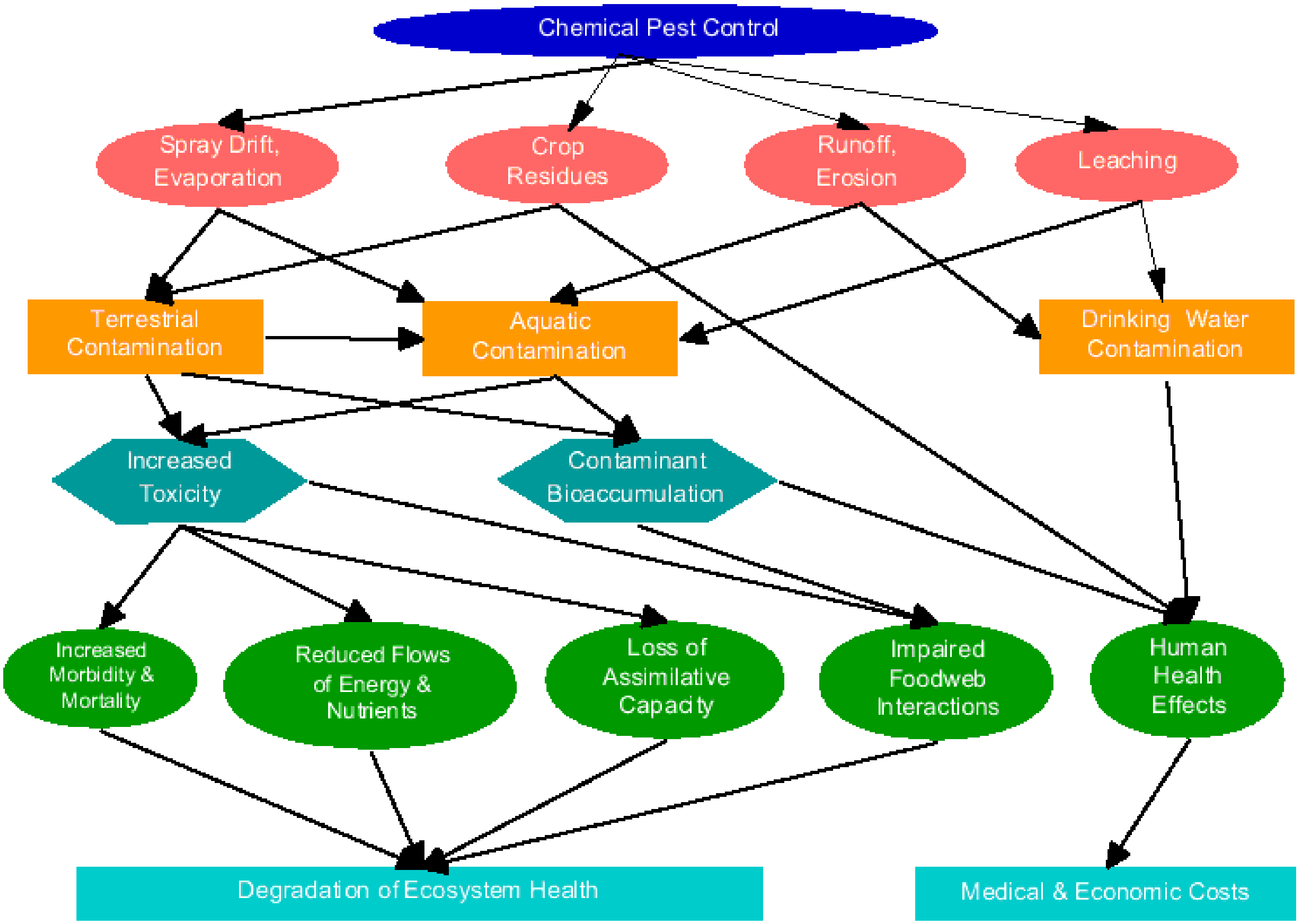

Fertilizer
Riparian Forest
Denitrification
N_2
N_2O
Plant
Uptake
Surface Runoff
Organic N, C
Denitrification
N_2
N_2O
Organic N
NH_4
NO_3
Organic C-rich
Surface Soil
Leaching
NO_3
Stream
Plant Uptake
NO_3
Groundwater

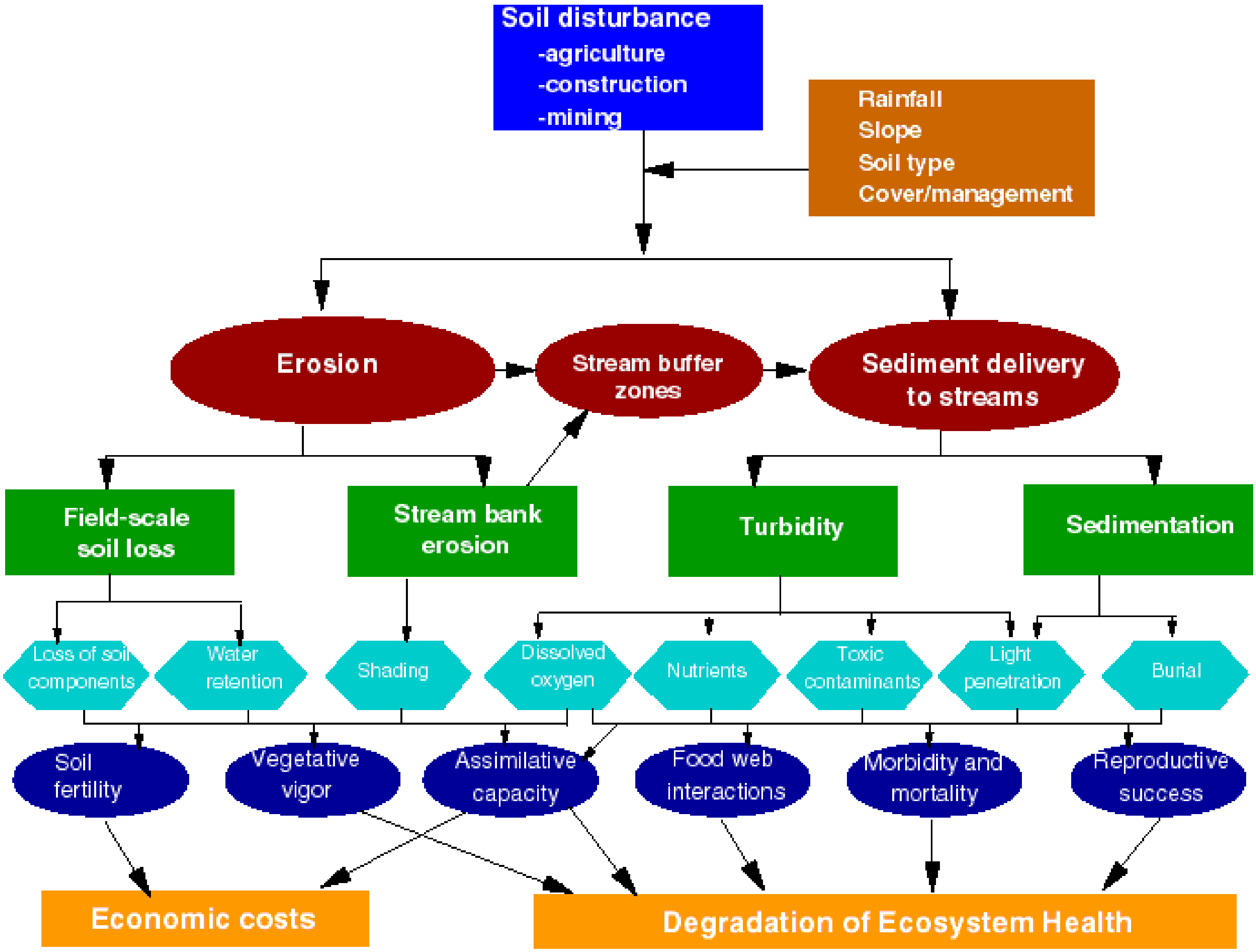

Agricultural Nitrogen Sources
Crop Residues
Leaching
Runoff, Erosion
Crop Residues
Drinking Water Contamination
Eutrophication of Water Bodies (hypoxia)
Increased Morbidity & Mortality
Loss of Biodiversity
Impaired Foodweb Interactions
Toxic Algae
Degradation of Ecosystem Health
Degradation of Human Health

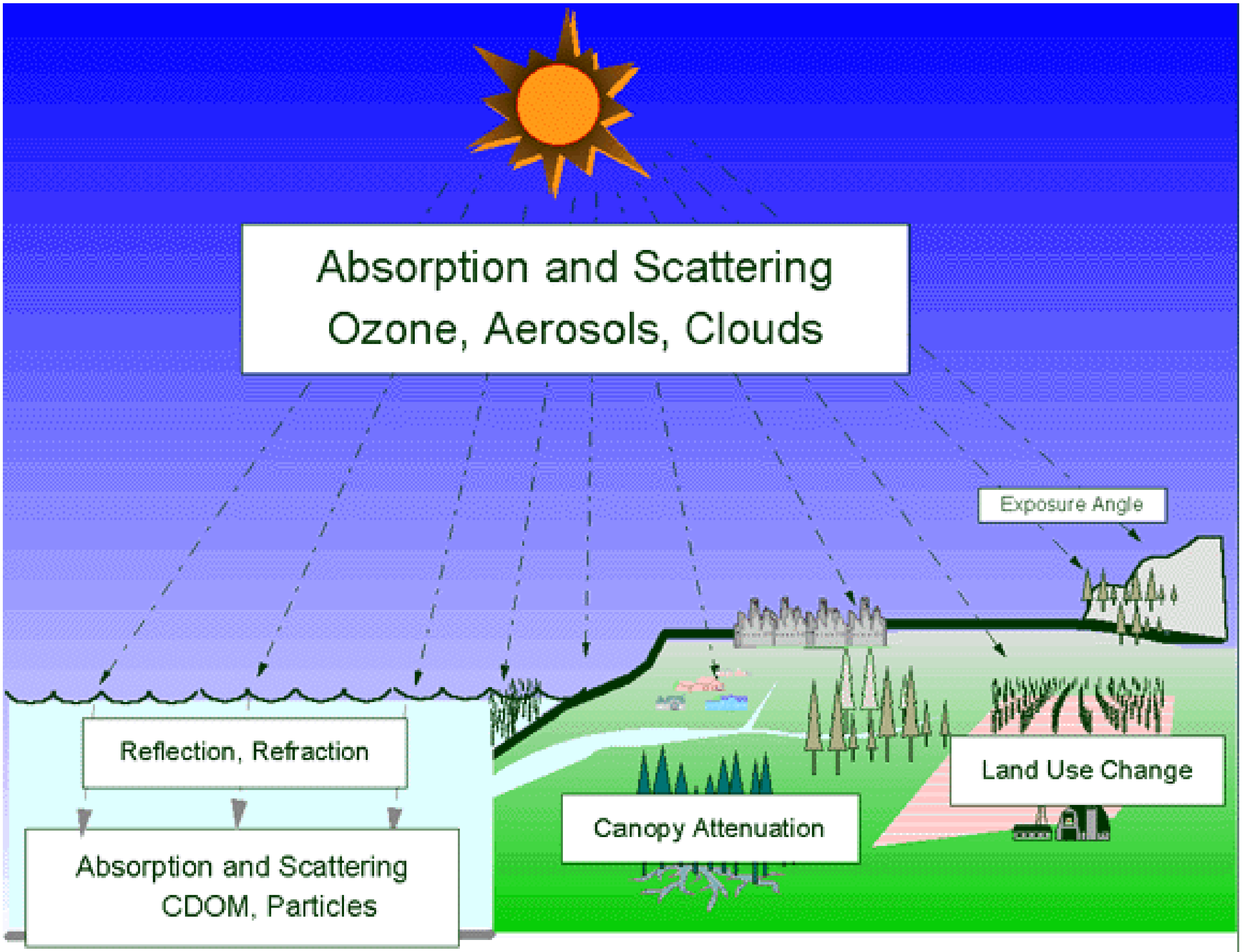


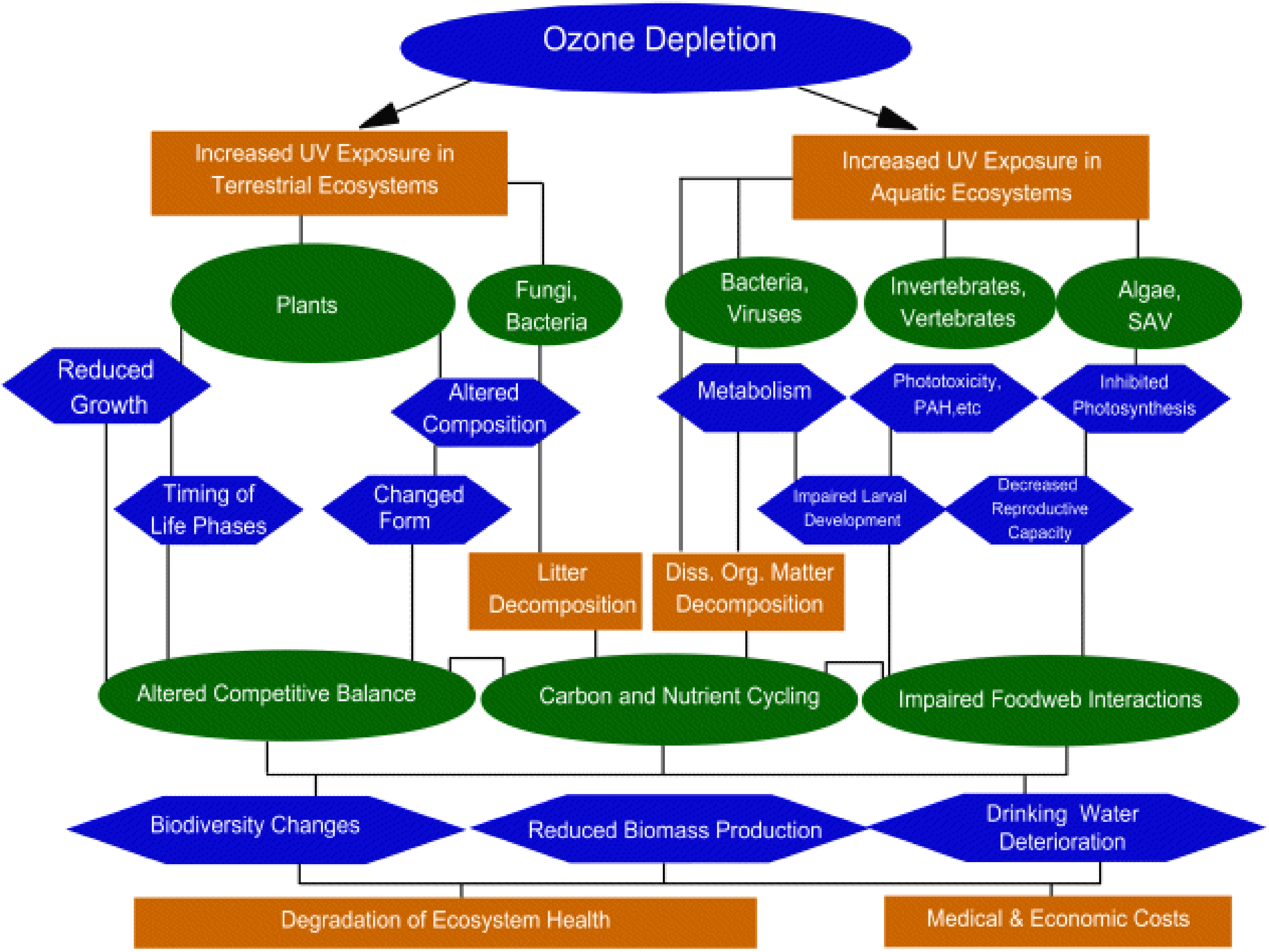
Ozone Production & Transport into Vegetative Canopy
Ozone Absorption into Leaves
Reduction In Photosythesis
Increased Loss of Leaves
Resistance & Damage Repair
Biochemical Defenses
Reduction & Alteration of Carbohydrates Stored by PLant
Increased Loss of Leaves & Decreased Production of New Leaves and Seeds
Increases in Stem Growth & Decreases in Root Growth
Reduction in Beneficial Root Fungi
Changes in Plant Growth


REGIONAL TRANSPORT
DRY DEPOSITION
PRECIPITATION
EVAPORATION SPRAY DRIFT WIND EROSION
WASTE WATER
RUNOFF
WITH-DRAWAL FROM WELLS
RUNOFF
WITH-DRAWAL FROM WELLS
SEEPAGE
GROUND-WATER DISCHARGE TO STREAMS
SEEPAGE
ENTRY THROUGH WELLS
RECHARGE FROM STREAMS


Chemical Pest Control
Spray Drift, Evaporation
Crop Residues
Runoff, Erosion
Leaching
Terrestrial Contamination
Aquatic Contamination
Drinking Water Contamination
Increased Toxicity
Contaminant Bioaccumulation
Increased Morbidity & Mortality
Reduced Flows of Energy & Nutrients
Loss of Assimilative Capacity
Impaired Foodweb Interactions
Human Health Effects
Degradation of Ecosystem Health
Medical & Economic Costs


Soil disturbance
-agriculture
-construction
-mining
Rainfall
Slope
Soil type
Cover/management
Erosion
Stream buffer zones
Sediment delivery to streams
Field-scale soil loss
Stream bank erosion
Turbidity
Sedimentation
Loss of soil components
Water retention
Shading
Dissolved oxygen
Nutrients
Toxic contaminants
Light penetration
Burial
Soil fertility
Vegetative vigor
Assimilative capacity
Food web interactions
Morbidity and mortality
Reproductive success
Economic costs
Degradation of Ecosystem Health


Absorption and Scattering
Ozone, Aerosols, Clouds
Exposure Angle
Reflection, Refraction
Land Use Change
Canopy Attenuation
Absorption and Scattering
CDOM, Particles



Ozone Depletion
Increased UV Exposure in Terrestrial Ecosystems
Increased UV Exposure in Aquatic Ecosystems
Plants
Fungi, Bacteria
Bacteria, Viruses
Invertebrates, Vertebrates
Algae, SAV
Reduced Growth
Altered Composition
Metabolism
Phototoxicity, PAH,etc
Inhibited Photosynthesis
Timing of Life Phases
Changed Form
Impaired Larval Development
Decreased Reproductive Capacity
Litter Decomposition
Diss. Org. Matter Decomposition
Altered Competitive Balance
Carbon and Nutrient Cycling
Impaired Foodweb Interactions
Biodiversity Changes
Reduced Biomass Production
Drinking Water Deterioration
Degradation of Ecosystem Health
Medical & Economic Costs