Data Integration and Modeling Framework for the Assessment of Water Quality Benefits of Conservation Practices at the National Level

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USDA ARS

USDA NRCS

Summary

Modeling is a feasible approach to evaluate the water quality benefits of conservation practices and to design improvements of new programs to more effectively and efficiently meet the goals of the 2002 Farm Bill. The United States Department of Agriculture has initiated the Conservation Effects Assessment Project (CEAP), which includes the use of models to quantify the environmental benefits of conservation practices at the national scale, termed a national assessment. This poster outlines various data, modeling components, and their linkage being used in the national assessment. A number of data sets, seamlessly covering the conterminous United States, have been developed and/or generated to feed the models. These include weather, landscape characteristics, and management practices. The models include the farm-scale model Agricultural Policy/Environmental Extender (APEX) and the Soil and Water Assessment Tool (SWAT), along with a GIS representation of the landscape. APEX simulates conservation practices for cultivated cropland. Farmer surveys conducted on a subset of National Resource Inventory sample points provide information on current farming activities and conservation practices for APEX. Output from APEX will be input into the watershed scale model, SWAT, in the HUMUS (Hydrologic Unit Modeling for the United States) system for routing the pollutants to the 8-digit watershed outlet. The system will allow comparison of alternative scenarios (e.g. with and without conservation practices) for on-site and off-site water quality benefits (e.g. reductions in in-stream concentrations and loadings of sediment, nutrients and pesticides, and reductions in the number of days that concentrations exceed human health and ecological thresholds).

The purpose of the CEAP national assessment is to provide an annual accounting of the environmental benefits obtained from USDA conservation program expenditures.

LAND USE GROUPS
Cropland, including CRP
Grazing lands, agro-forestry
Wetlands

RESOURCE CONCERNS
Water Quality
Soil Quality
Water Conservation
Air Quality
Wildlife Habitat
Ecosystem Health
Livestock Operations

Models

Agricultural Policy/Environmental eXtender (APEX) (Williams et al., 2000)

- Farm scale;
- Continuous simulation;
- Daily simulation;
- Simulates erosion, economics, water quality, soil quality, plant competition, weather, pests , land management operations including furrow diking, buffer strips, terraces, waterways.

APEX

Soil and Water Assessment Tool (SWAT) (Arnold et al., 1998)

- Basin/Watershed scale;
- Continuous simulation-daily/sub;
- Daily simulation;
- Models land management operations, crop growth, sediment, pollutant transport, channel routing.

SWAT

Cultivated Land
NRI data
(CEAP Farmers Survey)

Field level Runoff, Sediment, N and P loading from Cultivated Land

APEX

Assimilation of APEX output

Watershed level Runoff, Sediment, N and P loading from Non-Cultivated Land, and Routing

SWAT

Calibration
Calibration at each 8-digit using USGS-SPARROW annual flow, sediment, N & P loads. Additional calibration at selected USGS monitoring stations.

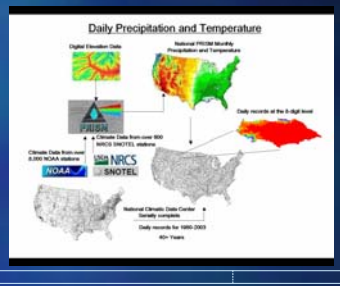
Validation
Validation using additional USGS stream flow, sediment and nutrient data at major locations along the river.

Scenarios
1. Baseline Scenario: SWAT estimates using APEX output for current conservation practices from surveys.
2. Alternative Scenario: SWAT estimates using APEX output without conservation practices

Outputs
1. Reduction in sediment and nutrient loads and concentrations at 8-digit watersheds.
2. Reductions in days exceeding standards.

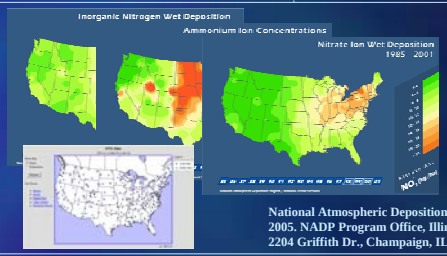
HUMUS Data Bases

- Land Use non cultivated (USGS-NLCD)
- Weather PCP and TMP
- Nitrogen Wet Atmospheric Deposition loading
- Point Source Records (USGS/USEPA)
- Management Data (AgCensus and USDA-NASS)
- Soil (NRCS-STATSGO)
- Topographic Data and Derivatives (from 3 arc seconds USGS DEMs)



Daily data developed for 8-digit watersheds combining quality controlled National Climatic Data Center (NCDC) point measurements (Eischeid et al., 1995) and monthly Parameter-elevation Regressions on Independent Slopes Model (PRISM) (Daly et al., 1994; 1997)

(Di Luzio et al., in review)



National Atmospheric Deposition Program/National Trends Network (NADP/NTN) Nitrogen Concentrations

National Atmospheric Deposition Program (NRSP-3). 2005. NADP Program Office, Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL61820

Next developments

GeoDatabases Integrating Remote Sensing Derivatives

SWAT

APEX

Integration in ESRI ArcGIS ArcHydro Framework

Output Time Series Scenarios Comparison

Simulated Time Series

Observation Time Series

Flow, Loads