Applied Climatology and the Role of NOAAs Regional Climate Centers -

Partners in the emerging National Climate Services

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NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Powered by ACIS NOAA Regional Climate Centers

The face(s) of the NOAA RCC Program

High Plains
Dr. Dennis Todey
http://www.hprcc.unl.edu/

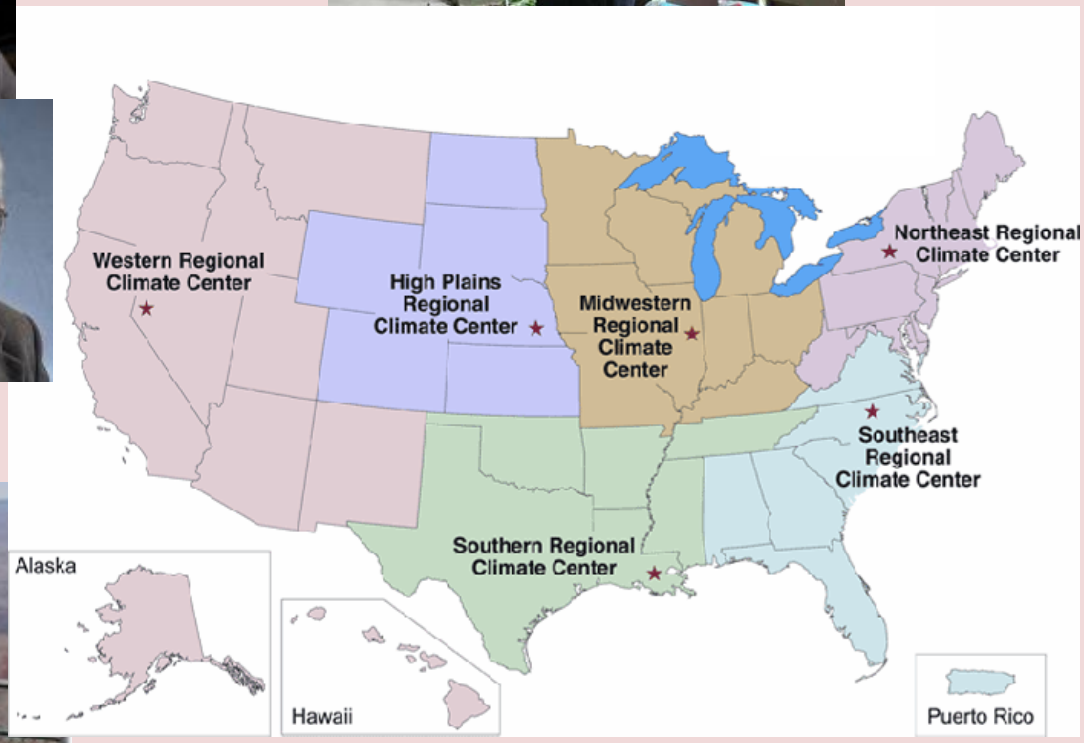
Midwestern
Mr. Steve Hilberg
http://mrcc.sws.uiuc.edu/

Northeast
Dr. Art DeGaetano
http://www.nrcc.cornell.edu

Southeast
Dr. Peter Robinson
http://www.sercc.com/

Southern
Dr. Kevin Robbins
http://www.srcc.lsu.edu

Western
Dr. Tim Brown
Dr. Kelly Redmond
http://www.wrcc.dri.edu/



OneNOAA Science S

NOAA

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NOAA Regional Climate Centers

A Brief History

- 1978 National Climate Program Act
- 1981-86 Demo Projects (NRCC WRCC MRCC)
- 1986 Congressionally Directed Funds
- 1990 Six RCCs Nat. Climate Prog. Office
- 1991-97 National Weather Service
- 1997 National Climatic Data Center
- 2006 Nationally Competed (transfer of SERCC)

What are RCCs?

Regional **hubs** for user-centric climate services, interdisciplinary climate research, applications and education that provide a regional focus to addressing societal needs.

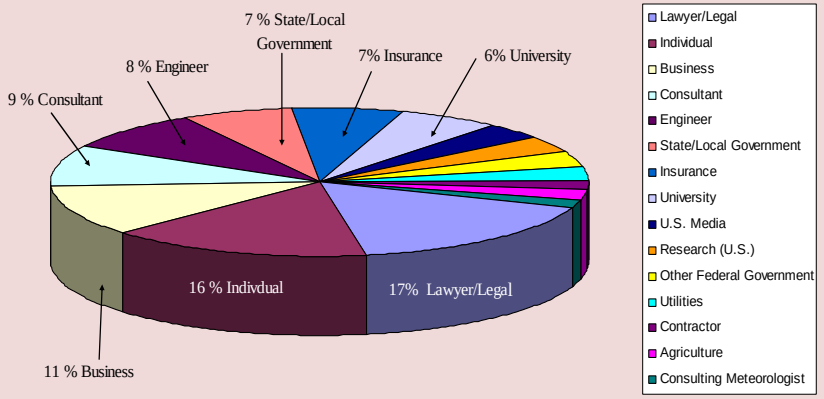
Evolving RCC Functions

- Contractual obligations
  Data systems, user service and monitoring
- Near-real time data delivery system,
  Web-based information resources.
- Infrastructure capabilities grow from user and partner interests and needs (e.g. Northrop Grumman)
- Efficiency and robustness
  - Program versus individual centers
- Leverage infrastructure for decision support and applied research

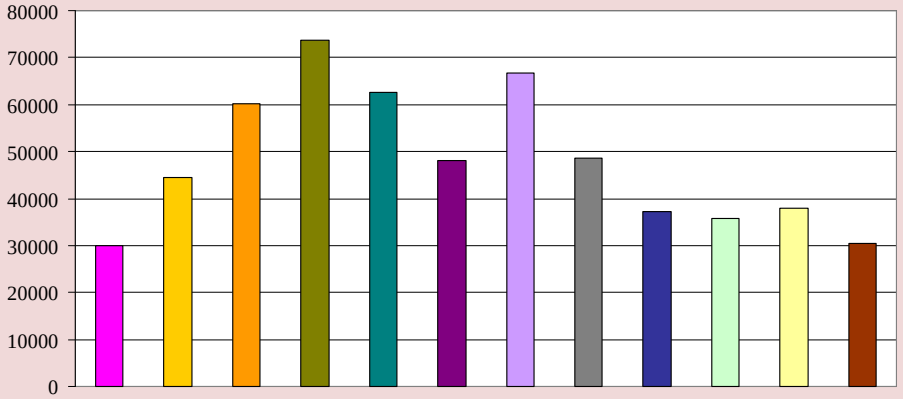
User Service

- Conduct outreach to regional and local decision makers on the use of climate products.
  - Building design (snow loads, soil freezing),
  - Flood management,
  - Irrigation,
  - Pest management
  - Coastal erosion
  - Water management
  - Agriculture
  - Climate change
  - Energy
  - Environment
  - Risk management
  - Transportation
  - Natural hazards

Regional Climate Centers' Customers



Regional Climate Centers Customers Served On-line

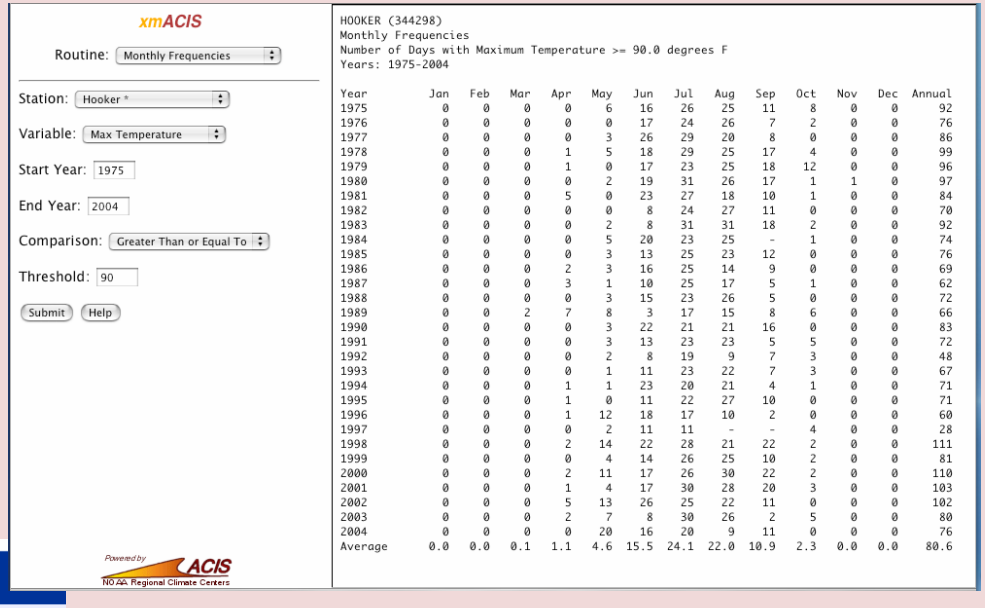


Monthy Services July 2006 - June 2007

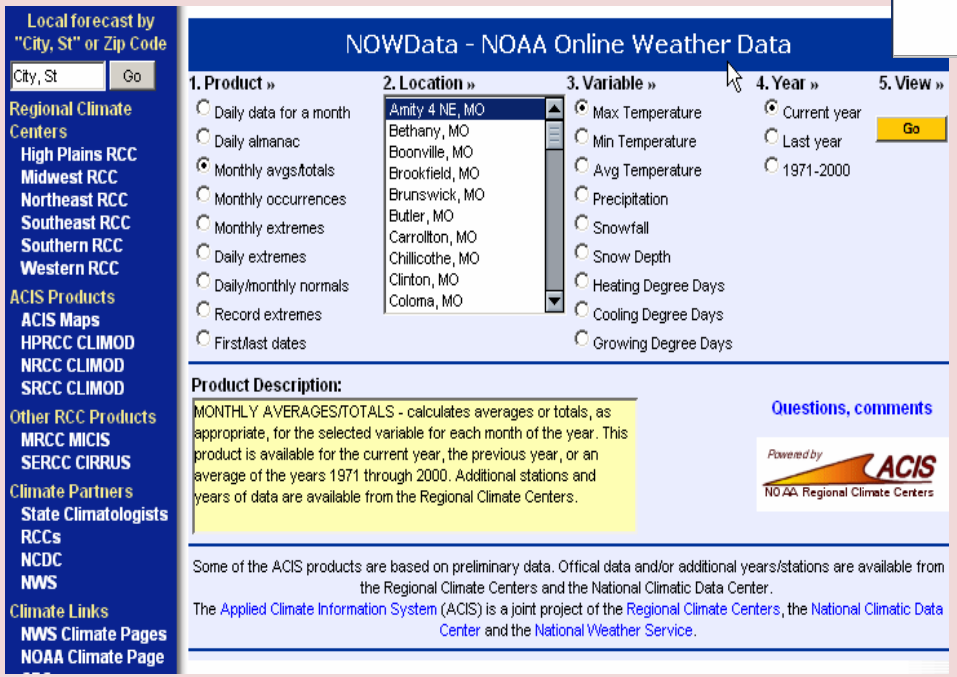
Partnering with NWS

- xmACIS *(NWS Field Office Use)*

- **Applied Climate Information System**
- **Data query tool for NWS local climate research / local product development, and to answer customer climate record inquiries**
- **Complete historical climate database with near real-time update**



Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1975	0	0	0	0	6	16	26	25	11	8	0	0	92
1976	0	0	0	0	0	17	24	26	7	2	0	0	76
1977	0	0	0	0	3	26	29	20	8	0	0	0	86
1978	0	0	0	1	5	18	29	25	17	4	0	0	99
1979	0	0	0	1	0	17	23	25	18	12	0	0	96
1980	0	0	0	0	2	19	31	26	17	1	1	0	97
1981	0	0	0	5	0	23	27	18	10	1	0	0	84
1982	0	0	0	0	0	8	24	27	11	0	0	0	70
1983	0	0	0	0	2	8	31	31	18	2	0	0	92
1984	0	0	0	0	5	20	23	25	-	1	0	0	74
1985	0	0	0	0	3	13	25	23	12	0	0	0	76
1986	0	0	0	2	3	16	25	14	9	0	0	0	69
1987	0	0	0	3	1	10	25	17	5	1	0	0	62
1988	0	0	0	0	3	15	23	26	5	0	0	0	72
1989	0	0	2	7	8	3	17	15	8	6	0	0	66
1990	0	0	0	0	3	22	21	21	16	0	0	0	83
1991	0	0	0	0	3	13	23	23	5	5	0	0	72
1992	0	0	0	0	2	8	19	9	7	3	0	0	48
1993	0	0	0	0	1	11	23	22	7	3	0	0	67
1994	0	0	0	1	1	23	20	21	4	1	0	0	71
1995	0	0	0	1	0	11	22	27	10	0	0	0	71
1996	0	0	0	1	12	18	17	10	2	0	0	0	60
1997	0	0	0	0	2	11	11	-	-	4	0	0	28
1998	0	0	0	2	14	22	28	21	22	2	0	0	111
1999	0	0	0	0	4	14	26	25	10	2	0	0	81
2000	0	0	0	2	11	17	26	30	22	2	0	0	110
2001	0	0	0	1	4	17	30	28	20	3	0	0	103
2002	0	0	0	5	13	26	25	22	11	0	0	0	102
2003	0	0	0	2	7	8	30	26	2	5	0	0	80
2004	0	0	0	0	20	16	20	9	11	0	0	0	76
Average	0.0	0.0	0.1	1.1	4.6	15.5	24.1	22.0	10.9	2.3	0.0	0.0	80.6



- NOWData (Public Use)

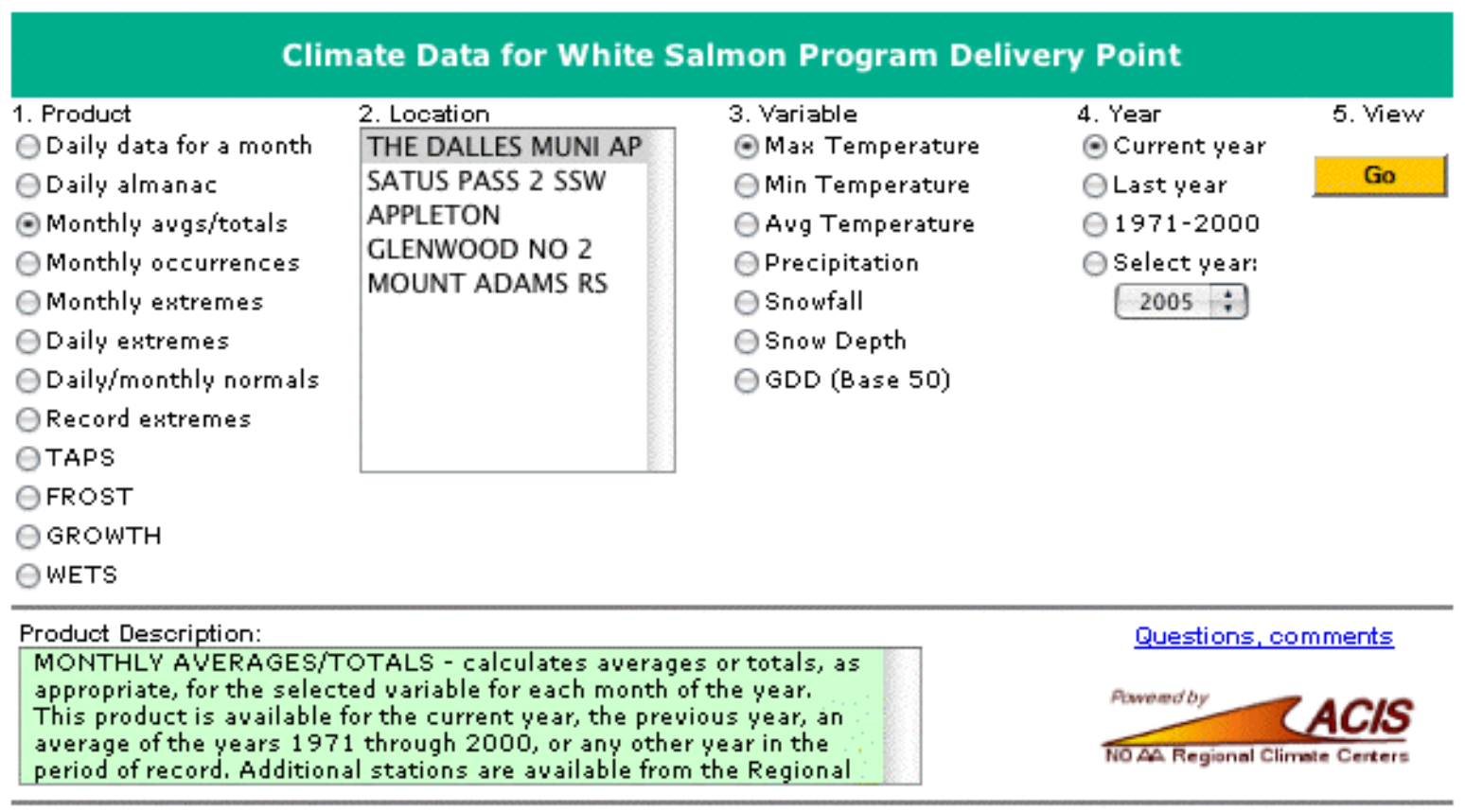
http://www.weather.gov/climate/xmacis.php?wfo=btv

- **Self-service tool**
- **Subset of xmACIS**
- **Free, limited access**
- **Current year and Normals**
- **Portal for ACIS and NCDC information**

Powered by ACIS NOAA Regional Climate Centers

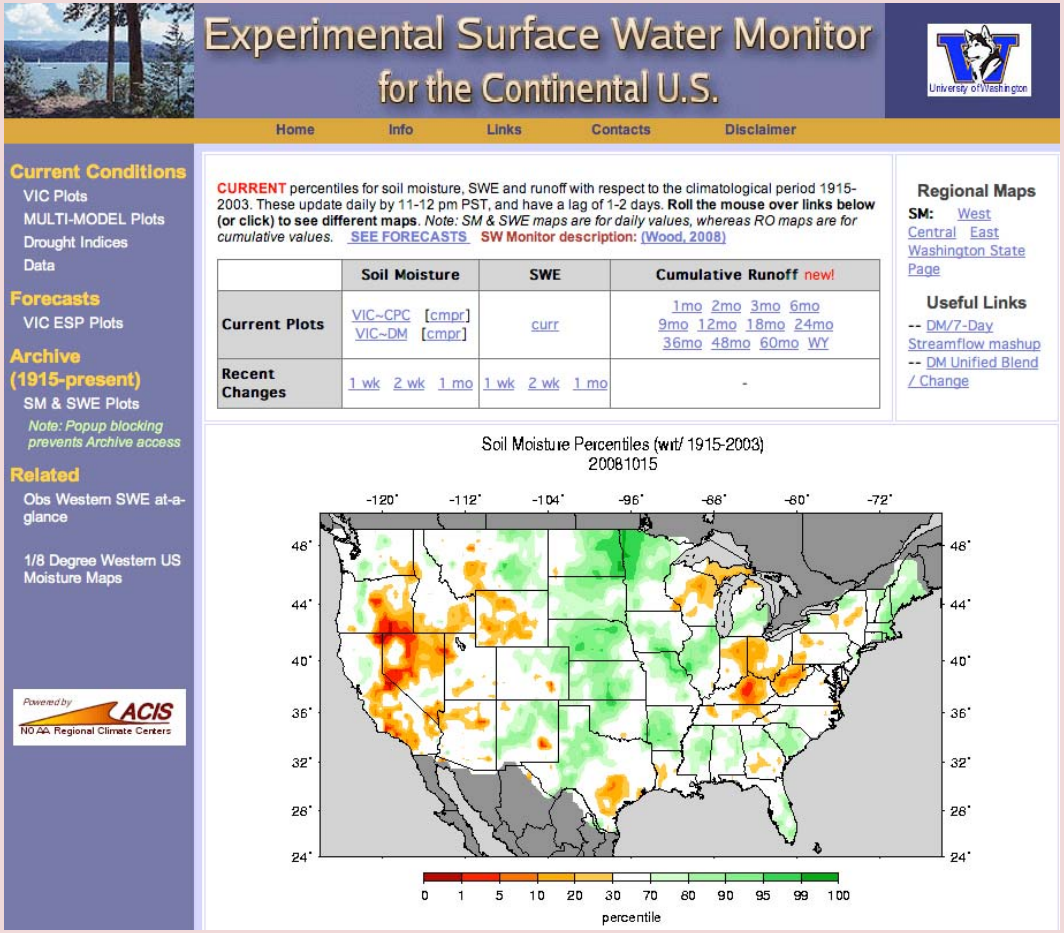
Partnering with Federal Agencies

- AgACIS *(Custom NRCS data and products)*



http://agacis.rcc-acis.org/

Partnering with RISAs



http://www.hydro.washington.edu/forecast/monitor/index.shtml

Partnering with NWS/NCDC/Private Industry

- ThreadEx *(Open Use)*
  - **Consistent daily temperature and precipitation extremes**

http://threadex.rcc-acis.org/

ThreadEx
Long-Term Station Extremes for America

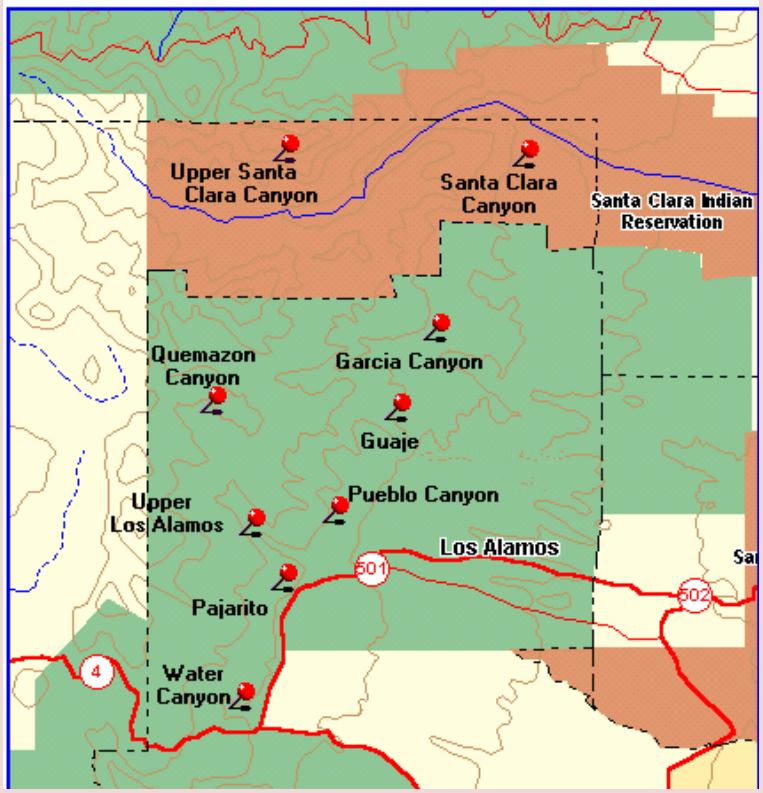
Threaded Climate Extremes for Burlington Area, VT

Period of record: 1883 - 2007

Date	Highest Maximum Temperatures (degrees F)		
	Top Record	2nd Record	3rd Record
1/1	56 in 1966	50 in 1979	48 in 2005+
1/2	59 in 1890	51 in 2000	51 in 1979
1/3	55 in 2000	52 in 1950	52 in 1913+
1/4	63 in 1950	57 in 1897	53 in 2000
1/5	57 in 1950	56 in 2007	55 in 1993
1/6	62 in 2007	56 in 1890	52 in 1946
1/7	54 in 1946	51 in 1915	49 in 1932+
1/8	51 in 1930	50 in 1937	48 in 1935
1/9	57 in 1937	55 in 1978	48 in 1965
1/10	49 in 1939	47 in 1983	45 in 1935
1/11	56 in 1980	52 in 1975	51 in 1983+
1/12	55 in 1980	54 in 1885	45 in 1932
1/13	60 in 1932	55 in 2005	55 in 1995

Likely to be a several different sites

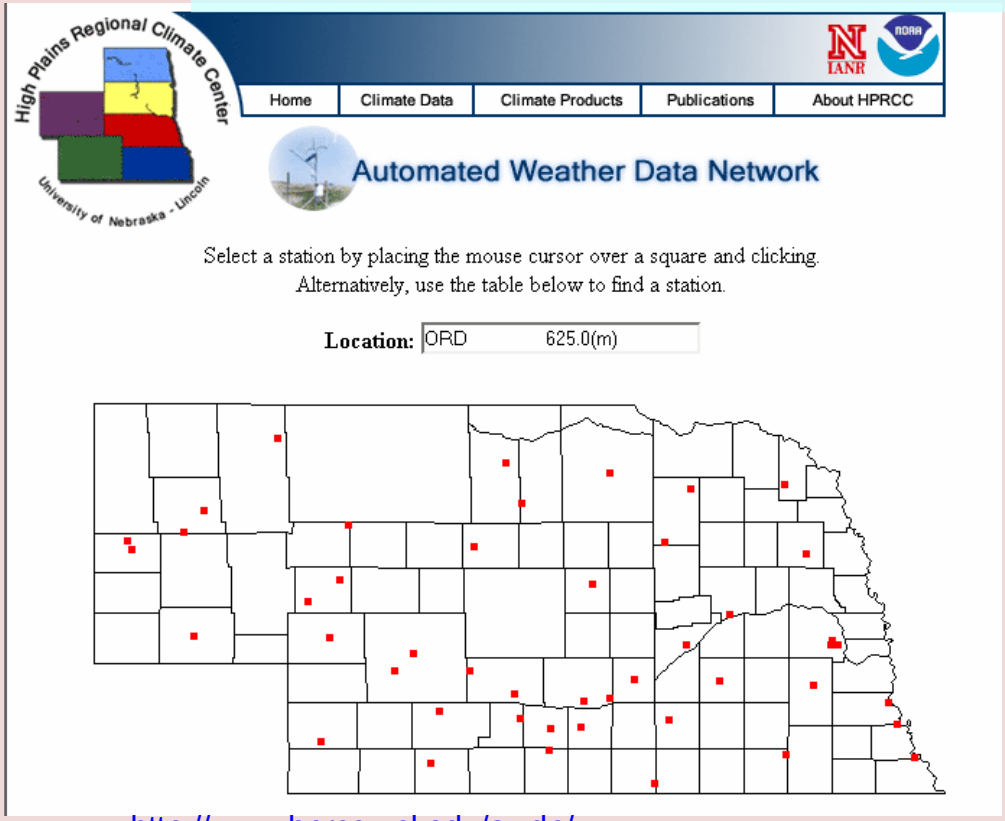
Partnering in Data



Fire Season Stations in AZ from the Western RCC

http://www.wrcc.dri.edu/fpa/

Regional Data Network from the High Plains RCC

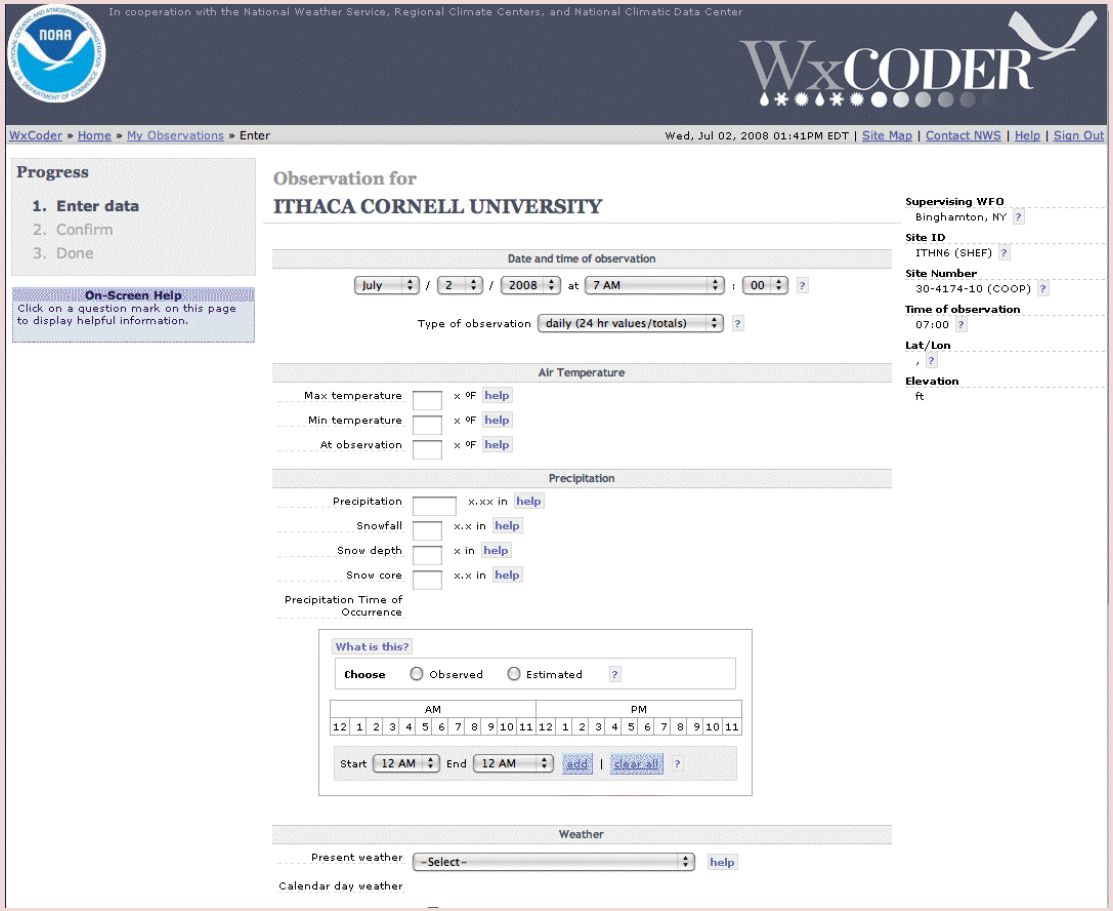


http://www.hprcc.unl.edu/awdn/

Partnering with NWS/NCDC

- WxCoder III *(COOP Use)*
  - **Internet observation entry system**

http://acis.dri.edu/wxcoder/



Serving as Centers of Data

- **Historical climate data essential but not sufficient**
  - Past to present to future
  - Expand thinking beyond climate …. ecological, social and economic data
- **Data encompass more than observations**
  - **Quality, quantity, scale, uncertainty**
- **Climate to weather and back again**
  - **Decisions do not obey arbitrary time bounds**
- **Decision Support instead of raw values**

Enhanced Consistency

State Climate Office

2007	01	01	53	36	44.5	0.08
2007	01	02	39	31	35	0.00
2007	01	03	49	35	42	0.00
2007	01	04	57	44	50.5	0.02
2007	01	05	57	50	53.5	0.95
2007	01	06	56	41	48.5	0.29
2007	01	07	43	32	37.5	0.13
2007	01	08	44	30	37	0.15
2007	01	09	34	28	31	0.05
2007	01	10	29	22	25.5	T

NWS LCD

DY	MAX	MIN	AVG	WTR
1	53	36	45	0.08
2	39	31	35	0.00
3	49	35	42	0.00
4	57	44	51	0.03
5	57	50	54	0.95
6	56	41	49	0.28
7	43	32	38	0.13
8	44	30	37	0.15
9	34	28	31	0.05
10	29	21	25	0.02

CLIMOD product: Daily Data

Month: January 2007

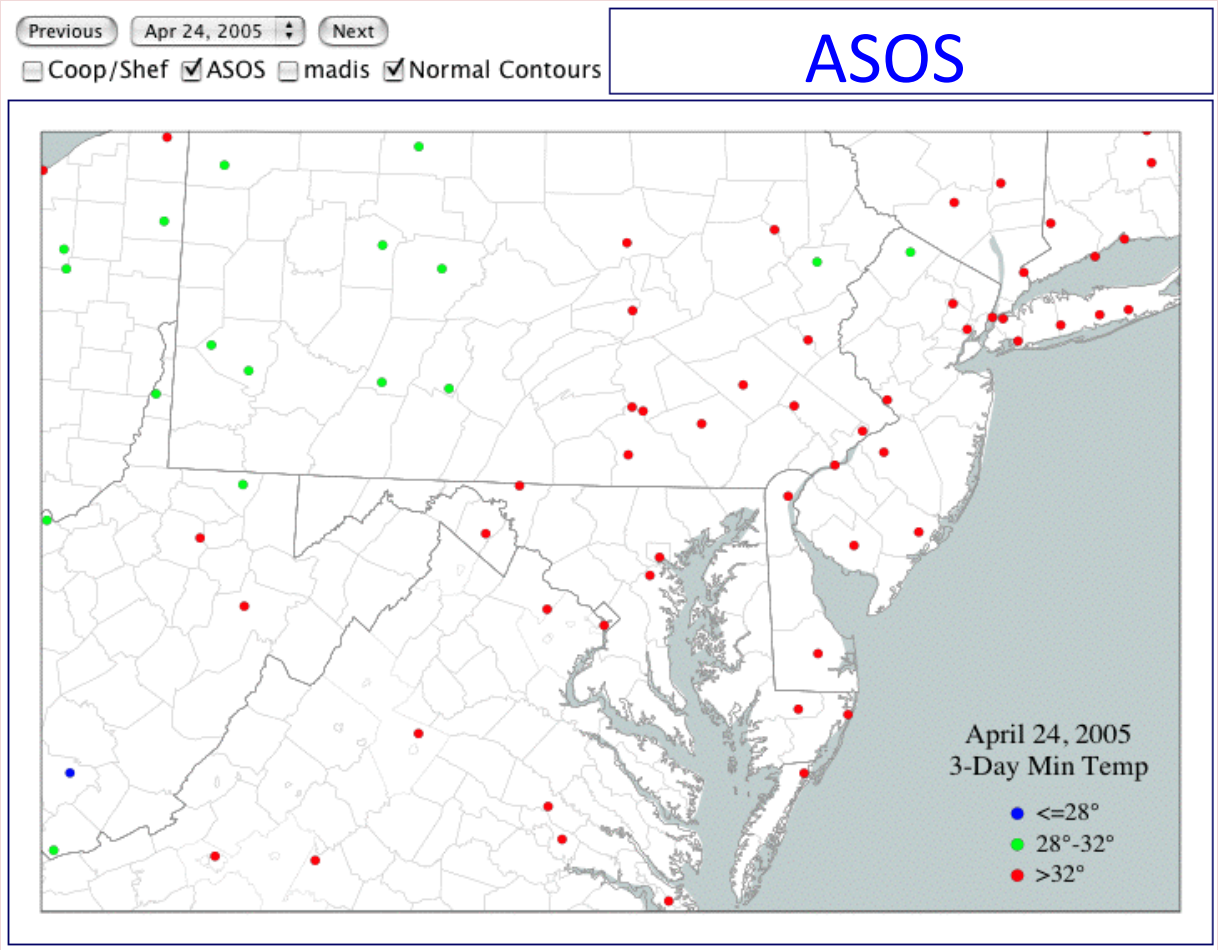
Day	Max	Min	Avg	Precip
1	53	36	45	0.00
2	39	31	35	0.00
3	49	35	42	0.00
4	57	44	51	0.03
5	57	50	54	0.95
6	56	41	49	0.28
7	43	32	38	0.13
8	44	30	37	0.15
9	34	28	31	0.05
10	29	21	25	0.02

Partnering with NWS/NCDC

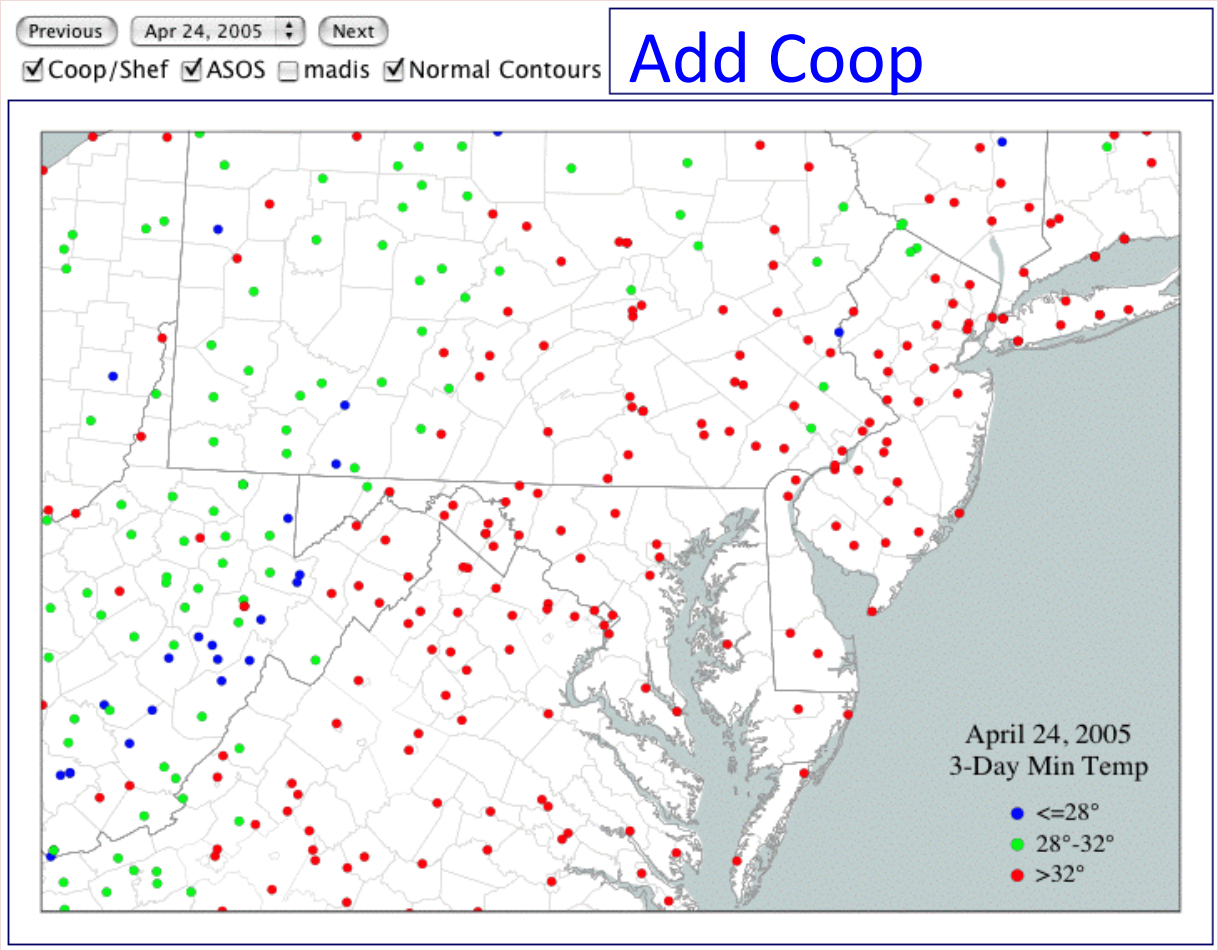
- Datzilla *(Partner Use)*
  - **Data discrepancy reporting**
  - **400 registered NOAA users**

http://datzilla.srcc.lsu.edu/datzilla/

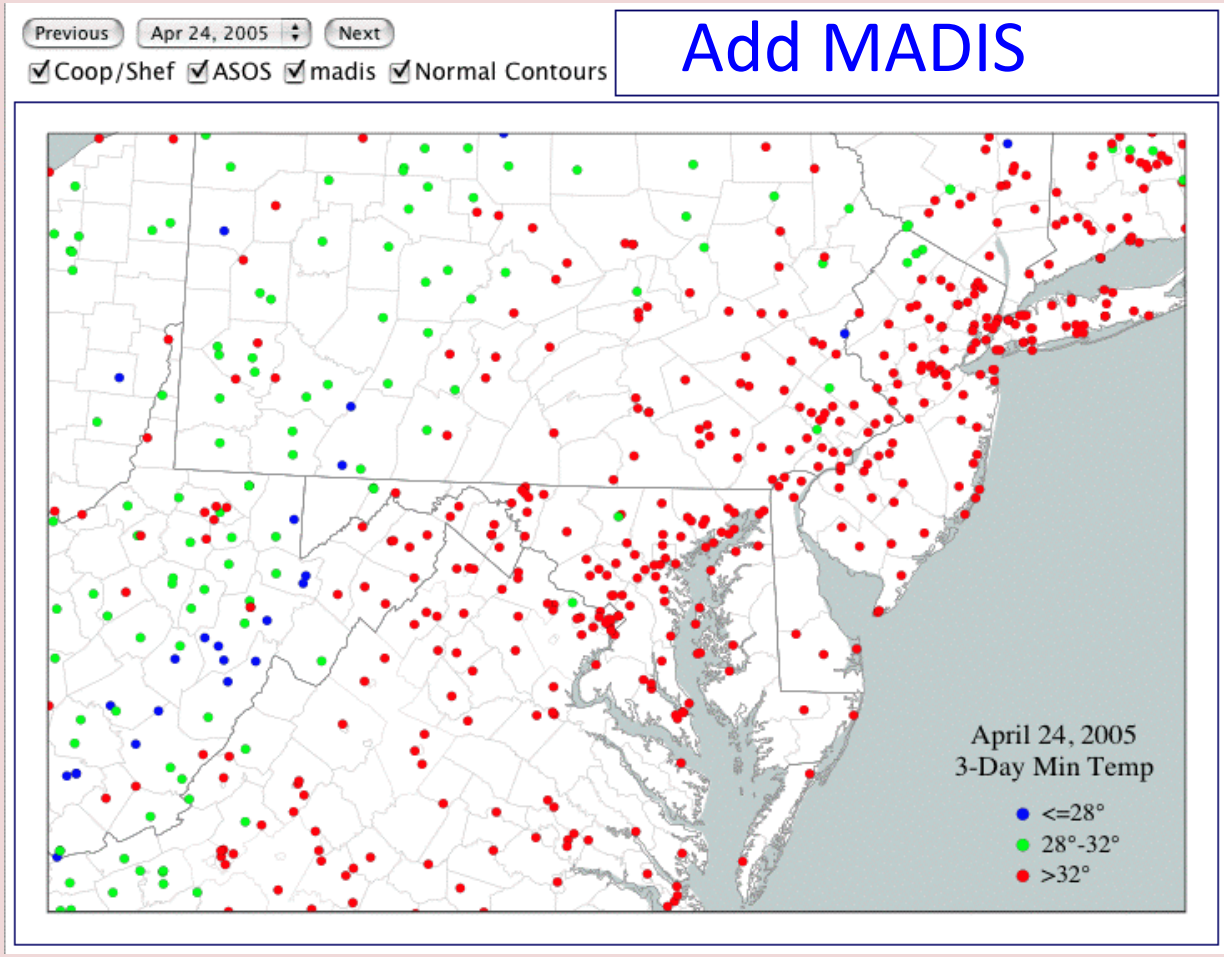
Enhanced Integration of Networks



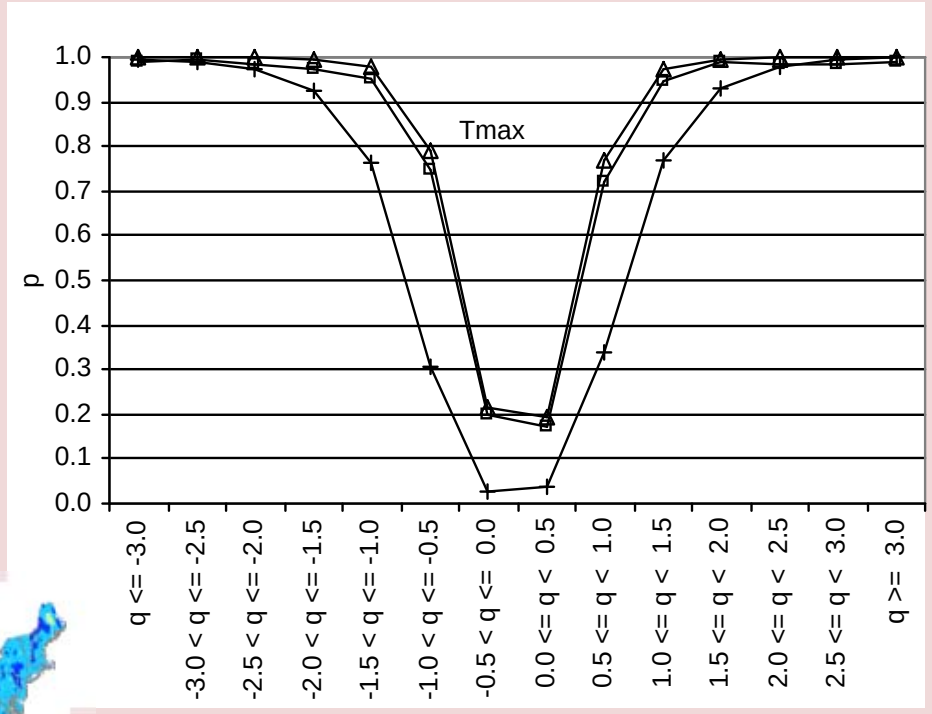
Enhanced Integration of Networks



Enhanced Integration of Networks

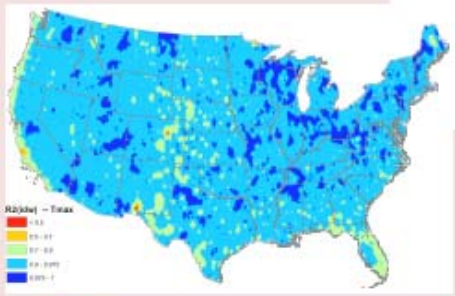


Enhanced Data Quality



HPRCC SRT

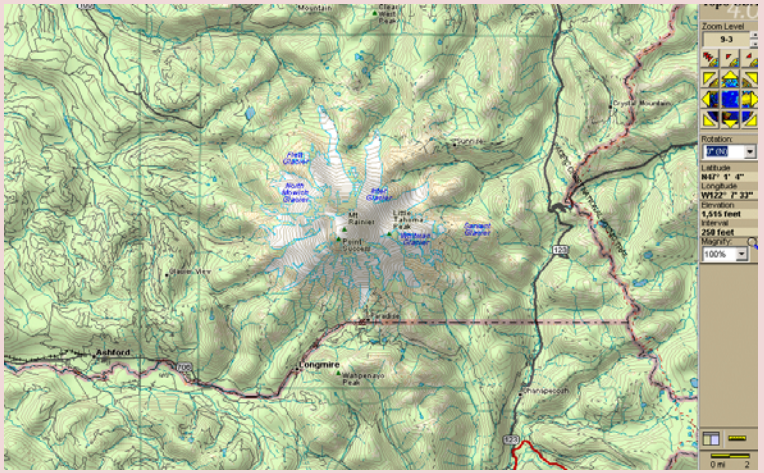
IDW

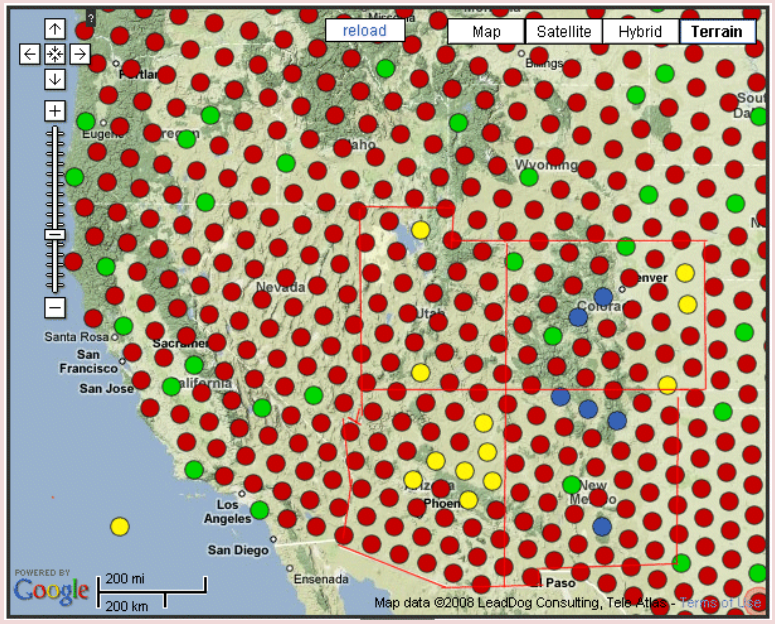


TMax

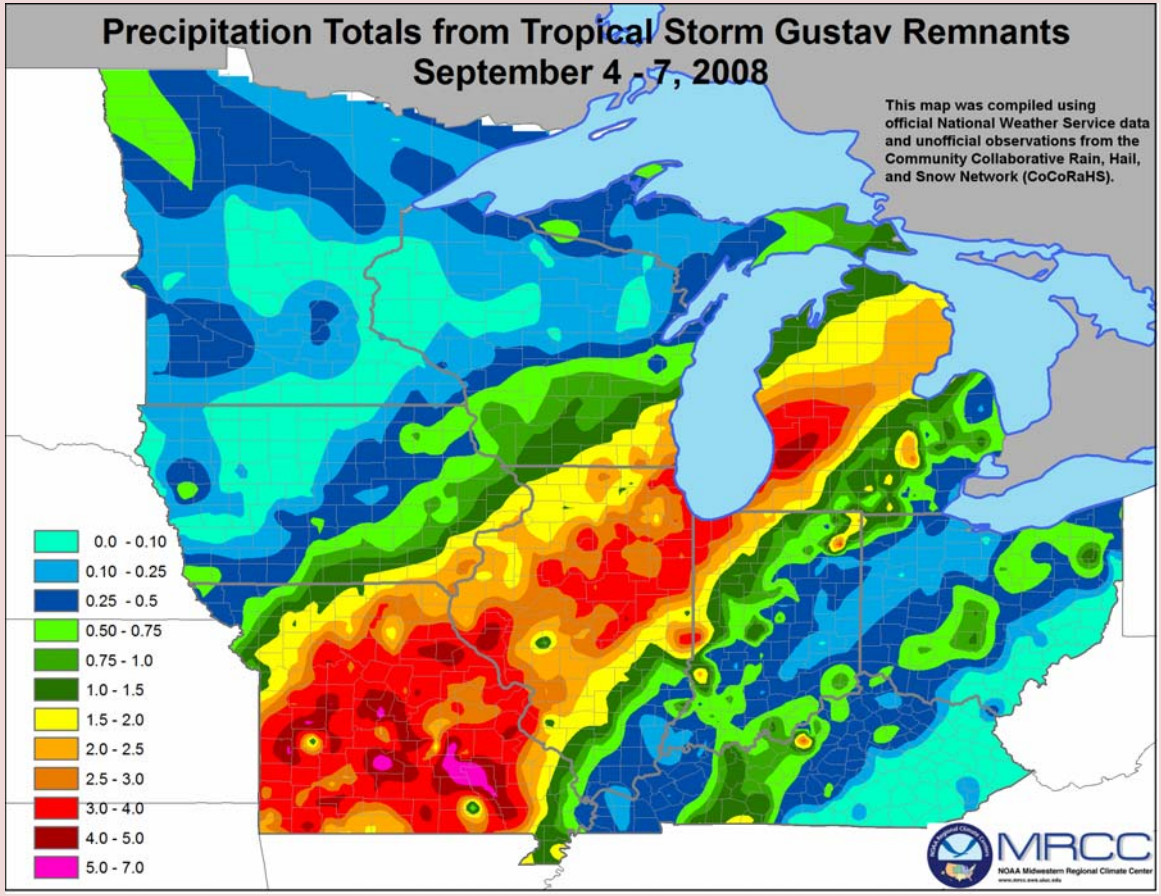
TMin

Partnering in support of HCN-M



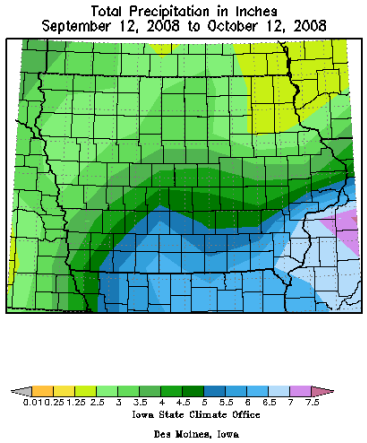


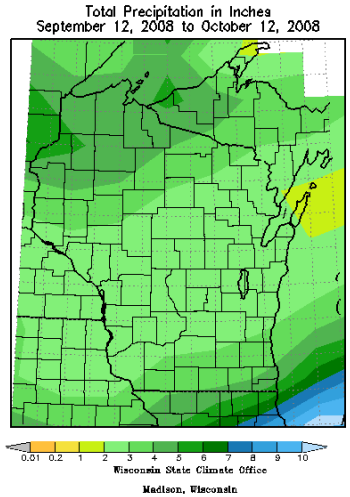
Partnering with State Climatologists



Hybrid Coop-CoCoRaHS Precip Map

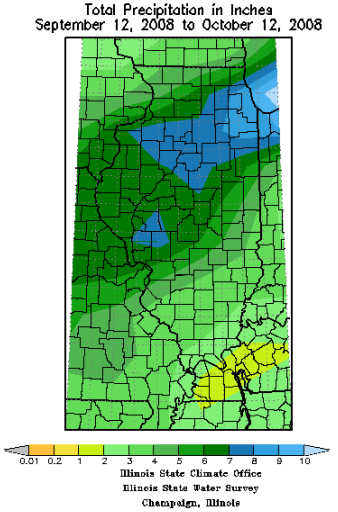
Partnering with State Climatologists

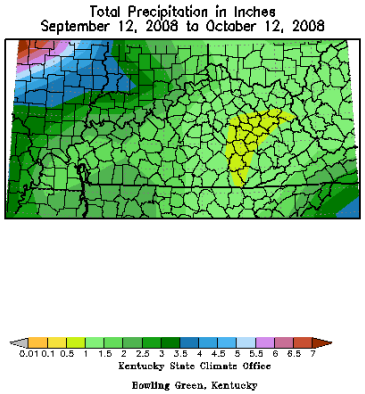




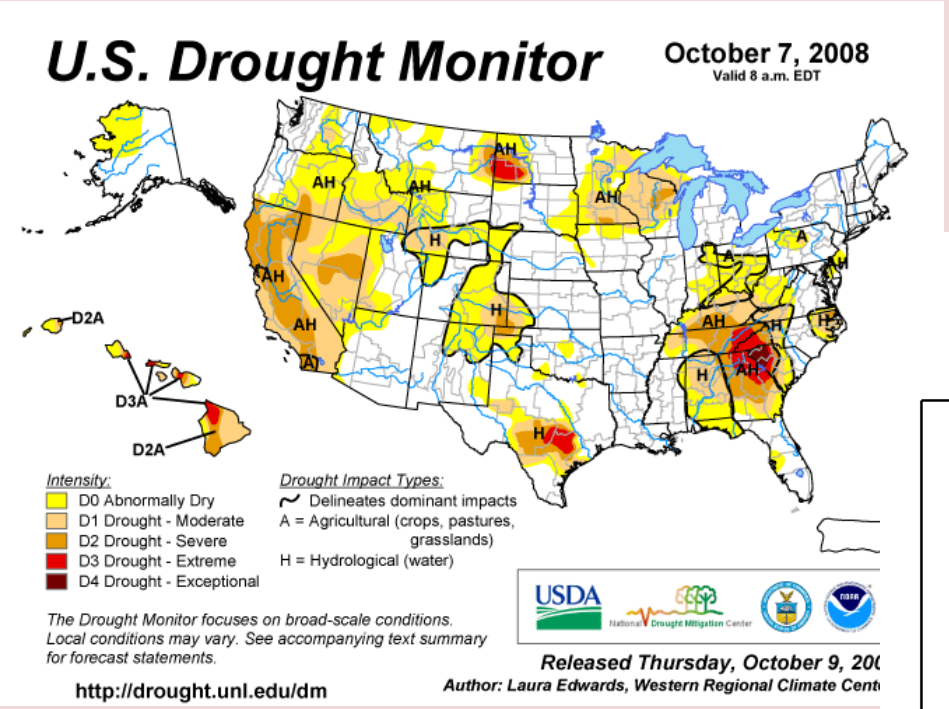
- Infrastructure
- Data
- Stakeholders
- Local expertise

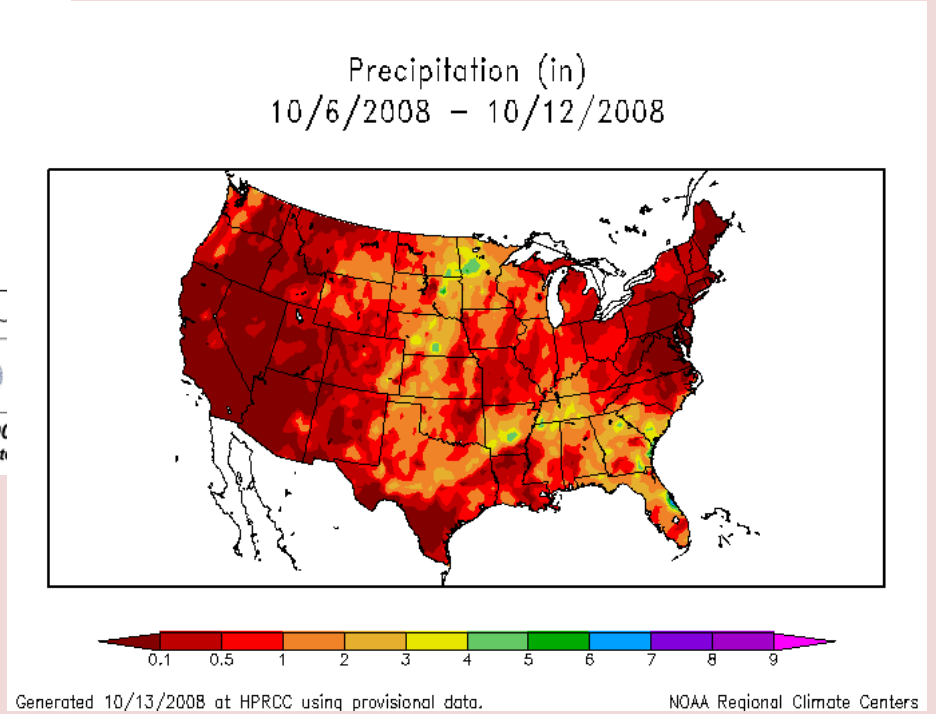
  NCDC/AASC Grant
  State Climatologists working with RCCs to explore Reference Climate Networks - CRN & HCN-M





Partners with NIDIS





“Getting information off the Internet is like taking a drink from a fire hydrant.”

- Mitchell Kapor, founder of Lotus Development Corp.

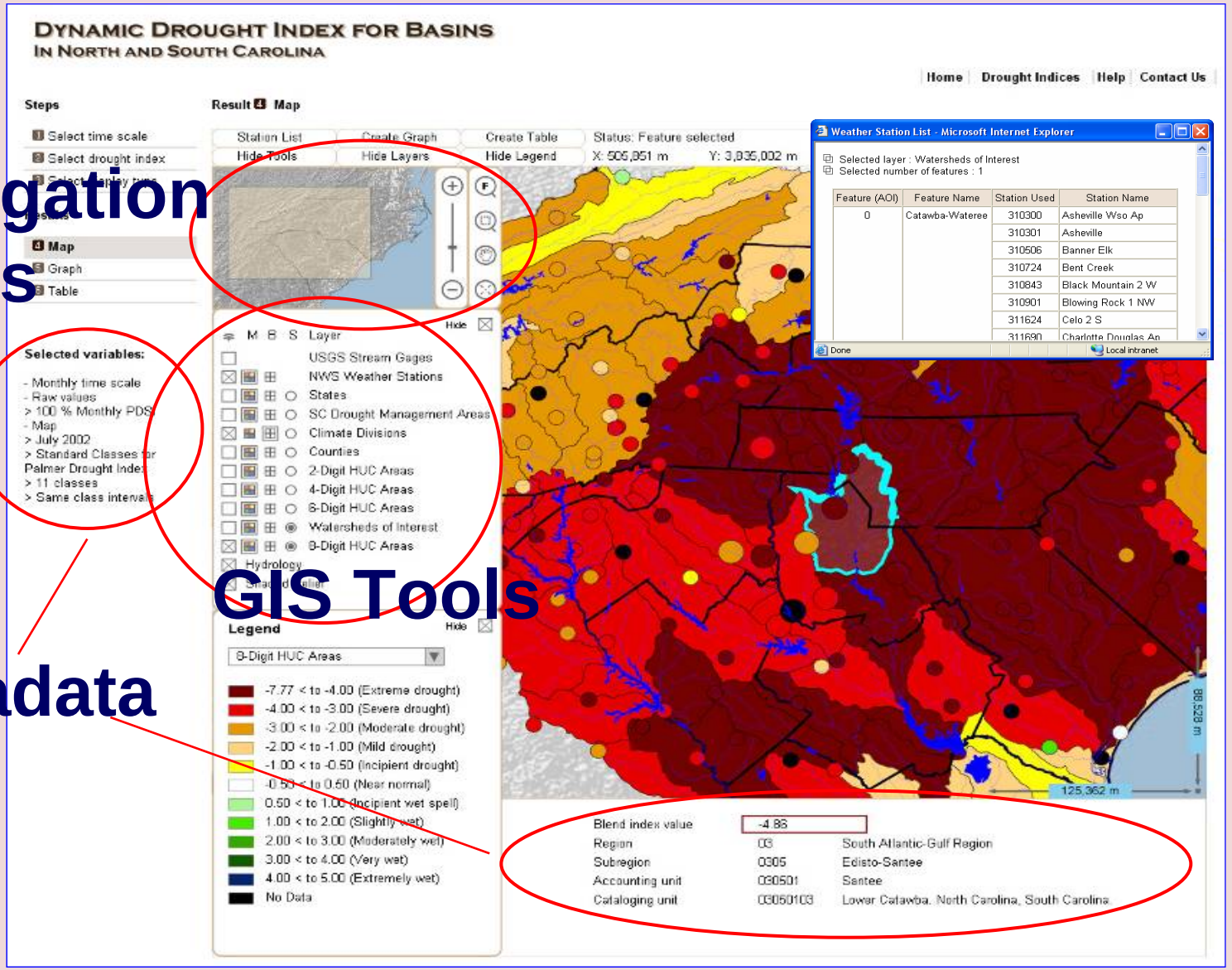
On the forefront of climate to decision making

- **Build upon acquired stakeholder trust**
  - Trust the team not a particular player
- **Shared information, tools and solutions**
  - **Funding will continue to be at a premium**
- **Proactive, evolutionary approaches**
  - **Grounded in tried and true methods**
- **Understand changing hazards, consequences, adaptations and assets**
  - **challenges *and* opportunities**

Map Navigation Tools

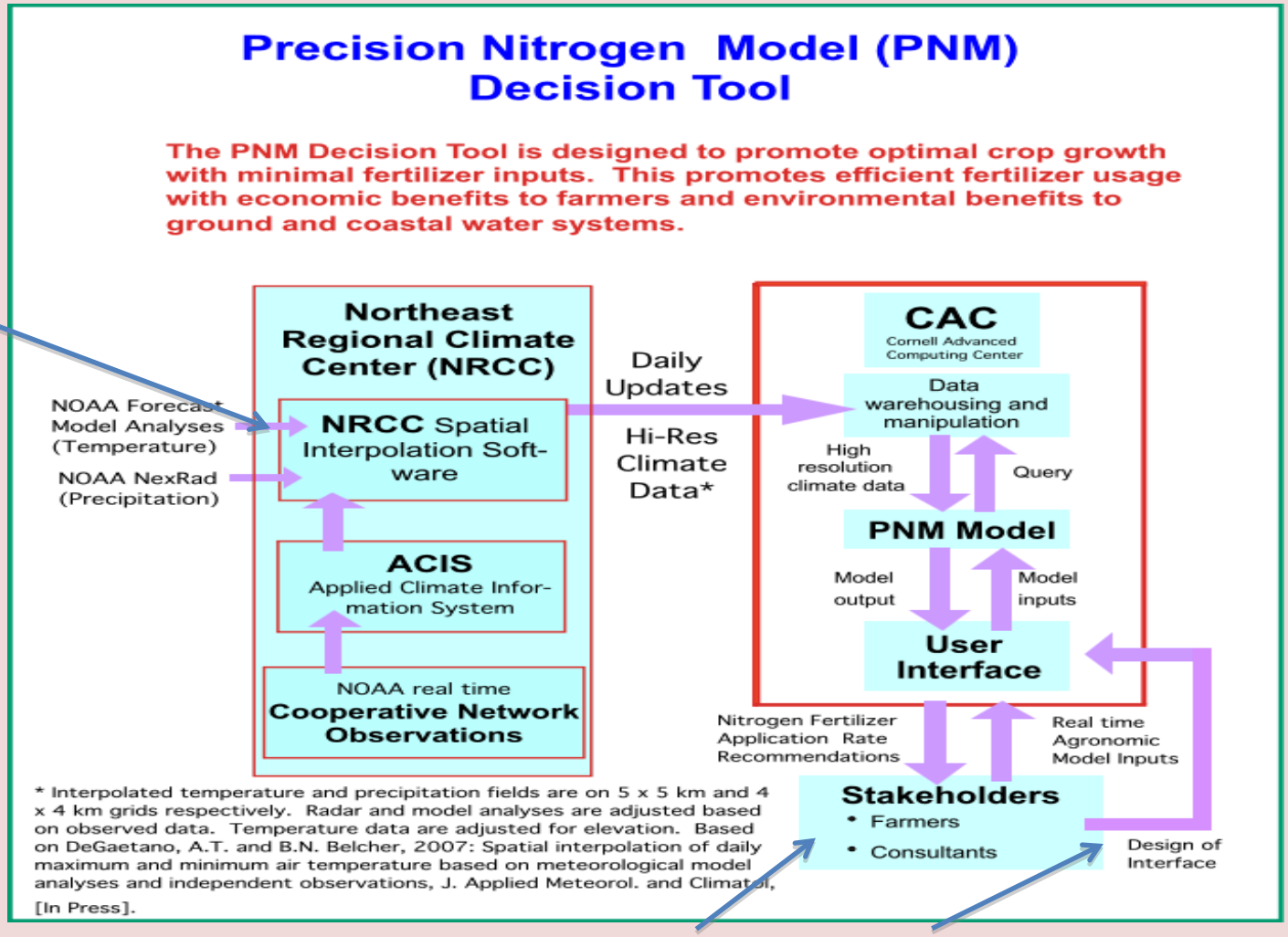
GIS Tools

Metadata

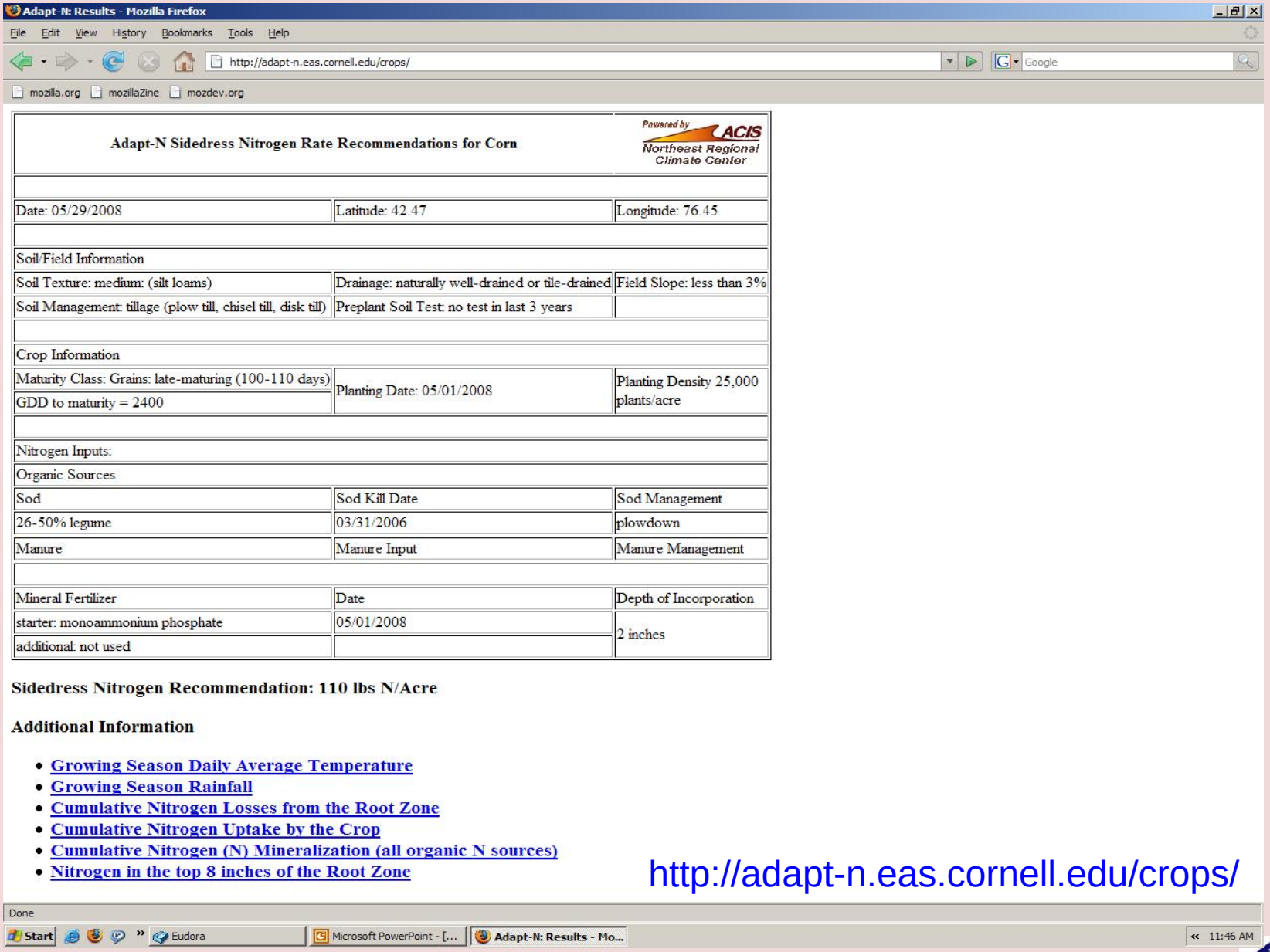


A "Dynamic" Tool Example

Potential for expansion to go from climate to weather and back again!



Potential utility for climate change impact assessment on ground and estuary water quality



Adapt-N Sidedress Nitrogen Rate Recommendations for Corn		Powered by ACIS Northeast Regional Climate Center
Date: 05/29/2008	Latitude: 42.47	Longitude: 76.45
Soil/Field Information		
Soil Texture: medium: (silt loams)	Drainage: naturally well-drained or tile-drained	Field Slope: less than 3%
Soil Management: tillage (plow till, chisel till, disk till)	Preplant Soil Test: no test in last 3 years	
Crop Information		
Maturity Class: Grains: late-maturing (100-110 days)	Planting Date: 05/01/2008	Planting Density 25,000 plants/acre
GDD to maturity = 2400		
Nitrogen Inputs:		
Organic Sources		
Sod	Sod Kill Date	Sod Management
26-50% legume	03/31/2006	plowdown
Manure	Manure Input	Manure Management
Mineral Fertilizer	Date	Depth of Incorporation
starter: monoammonium phosphate	05/01/2008	2 inches
additional: not used		

Sidedress Nitrogen Recommendation: 110 lbs N/Acre

Additional Information

- Growing Season Daily Average Temperature
- Growing Season Rainfall
- Cumulative Nitrogen Losses from the Root Zone
- Cumulative Nitrogen Uptake by the Crop
- Cumulative Nitrogen (N) Mineralization (all organic N sources)
- Nitrogen in the top 8 inches of the Root Zone

http://adapt-n.eas.cornell.edu/crops/

Partnering in Applied Research

RCC-AASC -NCDC

Trend Identification in Twentieth-Century U.S. Snowfall: The Challenges Kenneth E. Kunkel, Michael A. Palecki, Kenneth G. Hubbard, David A. Robinson, Kelly T. Redmond, and David R. Easterling *Journal of Atmospheric and Oceanic Technology*

RCC-RCC

SERVICES: A Modern Applied Climate Information System Kenneth G. Hubbard, Arthur T. DeGaetano, and Kevin D. Robbins *Bulletin of the American Meteorological Society*

RCC-RISA

Winter Orographic Precipitation Ratios in the Sierra Nevada—Large-Scale Atmospheric Circulations and Hydrologic Consequences Michael Dettinger, Kelly Redmond, and Daniel Cayan *Journal of Hydrometeorology*

HPRCC

Quality Control of Weather Data during Extreme Events Jinsheng You and Kenneth G. Hubbard *Journal of Atmospheric and Oceanic Technology*

NRCC

Spatial Interpolation of Daily Maximum and Minimum Air Temperature Based on Meteorological Model Analyses and Independent Observations Arthur T. DeGaetano and Brian N. Belcher *Journal Applied Meteorology and Climatology*

WRCC

Methodology and Results of Calculating Central California Surface Temperature Trends: Evidence of Human-Induced Climate Change?John R. Christy, William B. Norris, Kelly Redmond, and Kevin P. Gallo *J. Climate*

MRCC

Storm Precipitation in the United States. Part I: Meteorological Characteristics Michael A. Palecki, James R. Angel, and Steven E. Hollinger *Journal of Applied Meteorology*

SRCC

Hurricane Ivan's Impact Along the Northern Gulf of Mexico B. Keim et al. EOS, Trans American Geophysical Union.

SERCC

Atmospheric Circulation and Inland Flooding in Twentieth Century North Carolina, USA: Implications for Climate Change Impacts? P. Robinson, Natural Hazards

The Tag

A preliminary: Applications as forecasts

An implicit assumption that has pervaded much of applied climatology

Past is Prologue

Past statistics = Future statistics

The decision that uses the information is about the future

Therefore, past values often de facto forecasts

Not explicitly recognized as such

Past is considered reliable guide to the future

Climate stationarity is implicit in this assumption

Huge societal investments ($B, $$B, $$$B)

What is changing?

Many of the underlying issues remain the same,
but what is changing is the context.

1) **Changes in climate (the physical system)**

2) **Changes in the understanding of climate**

3) **Changes in needs for climate information**

Old, familiar needs

New needs, new applications, more sophisticated applications

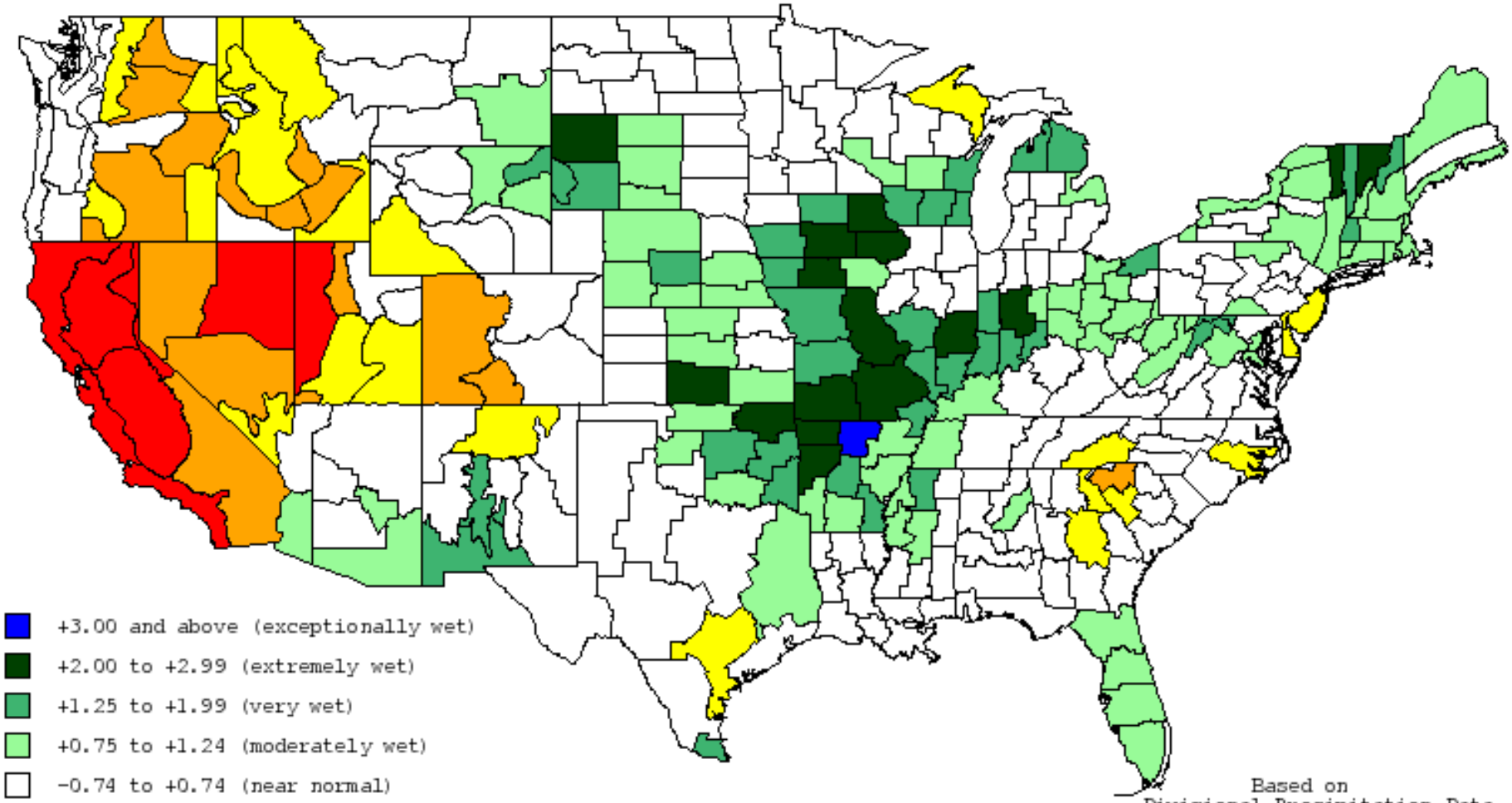
RCC Core Characteristics

- Regional climate expertise-climate has a strong regional character; RCC scientists can address not only what is happening but why
- Provision of climate information to broad user community-not focused on a narrow range of users
- Focus on understanding of interactions between climate and society/natural environment
- Interpretation of climate data and observations
- National in scope
- Mission pursued continuously for ~20 years
- Limited resources

Examples of Climate Information

National Map of Standardized Precipitation Index

6-month Standardized Precipitation Index through the end of August 2008



+3.00 and above (exceptionally wet)
+2.00 to +2.99 (extremely wet)
+1.25 to +1.99 (very wet)
+0.75 to +1.24 (moderately wet)
-0.74 to +0.74 (near normal)
-1.24 to -0.75 (moderately dry)
-1.99 to -1.25 (very dry)
-2.99 to -2.00 (extremely dry)
-3.00 and below (exceptionally dry)

Based on
Divisional Precipitation Data
1895 to present
Provisional data provided by
NOAA/NWS/CPC & NOAA/NESDIS/NCDC

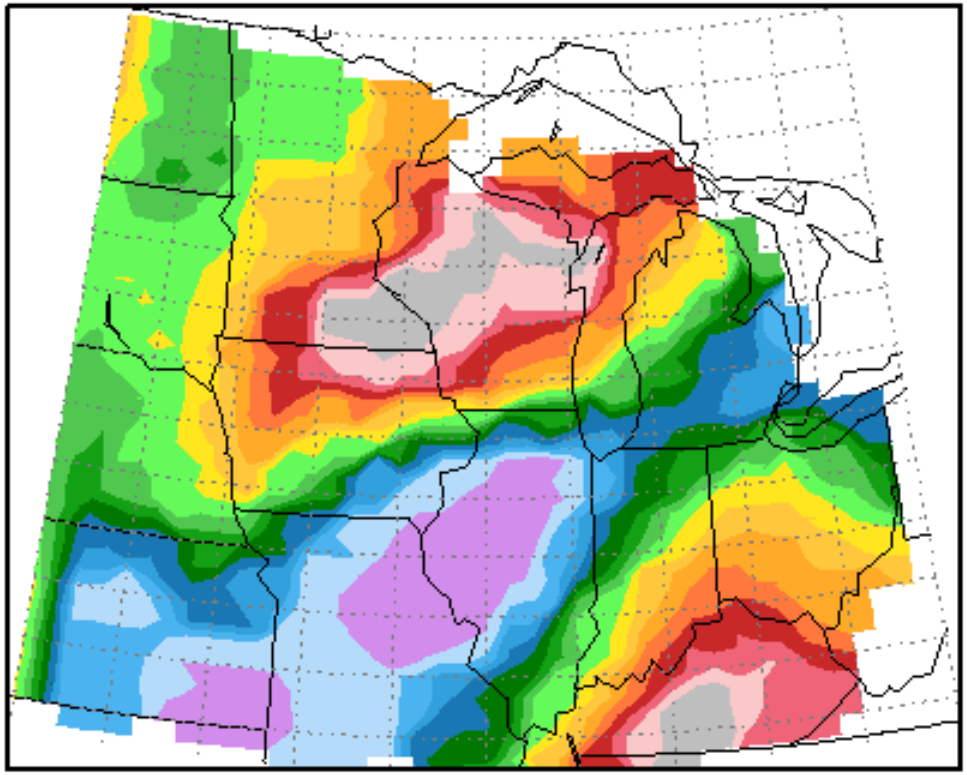
Western Regional Climate Center
Desert Research Institute
Reno, Nevada

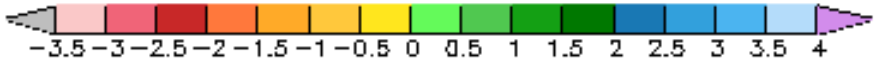
Operational Soil Moisture Monitoring in Midwest

Relevance and Challenge

- Soil moisture conditions are single most important factor affecting Midwestern crop yields
- There is no uniform soil moisture monitoring network
- Operational soil moisture model was developed in 1989 and used since then to provide daily-updated maps and tables of soil moisture status
- Uses daily precipitation and temperature data from NWS cooperative observer network
- Kunkel, K.E., 1990: Operational soil moisture estimation for the Midwestern United States. *J. Appl. Meteor.*, **29**, 1158-1166.

Current Soil Moisture Deviation (inches), Depth = 0-72
9-29-2008





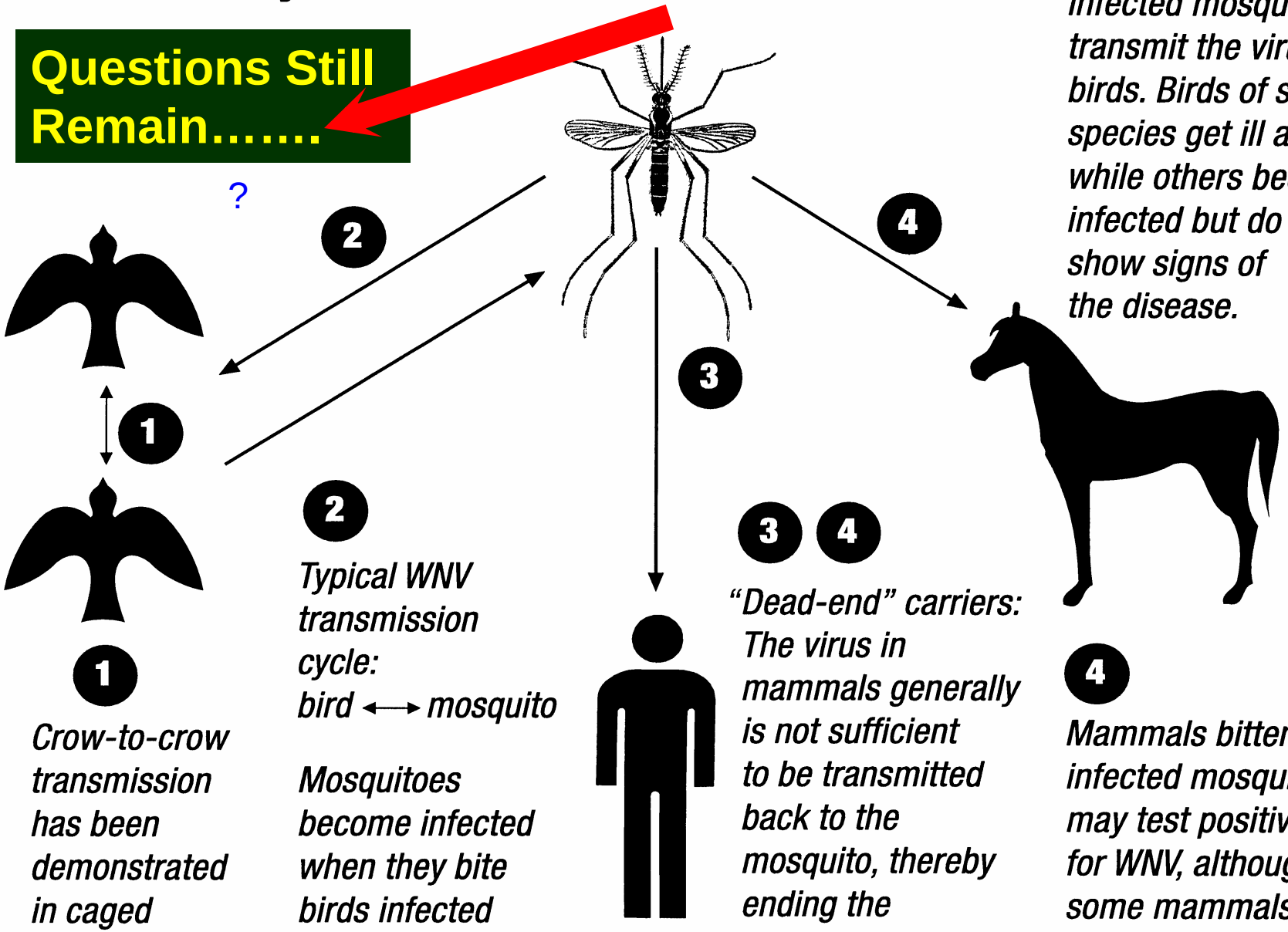
Midwestern Regional Climate Center
Illinois State Water Survey
Champaign, Illinois

Estimating Risk of West Nile Virus Infection in Illinois

Transmission Cycle of the West Nile Virus

Questions Still Remain…….

?



1

Crow-to-crow transmission has been demonstrated in caged birds.

2

Typical WNV transmission cycle: bird ⟷ mosquito

Mosquitoes become infected when they bite birds infected with WNV.

3 4

"Dead-end" carriers: The virus in mammals generally is not sufficient to be transmitted back to the mosquito, thereby ending the transmission cycle.

Infected mosquitoes transmit the virus to birds. Birds of some species get ill and die, while others become infected but do not show signs of the disease.

4

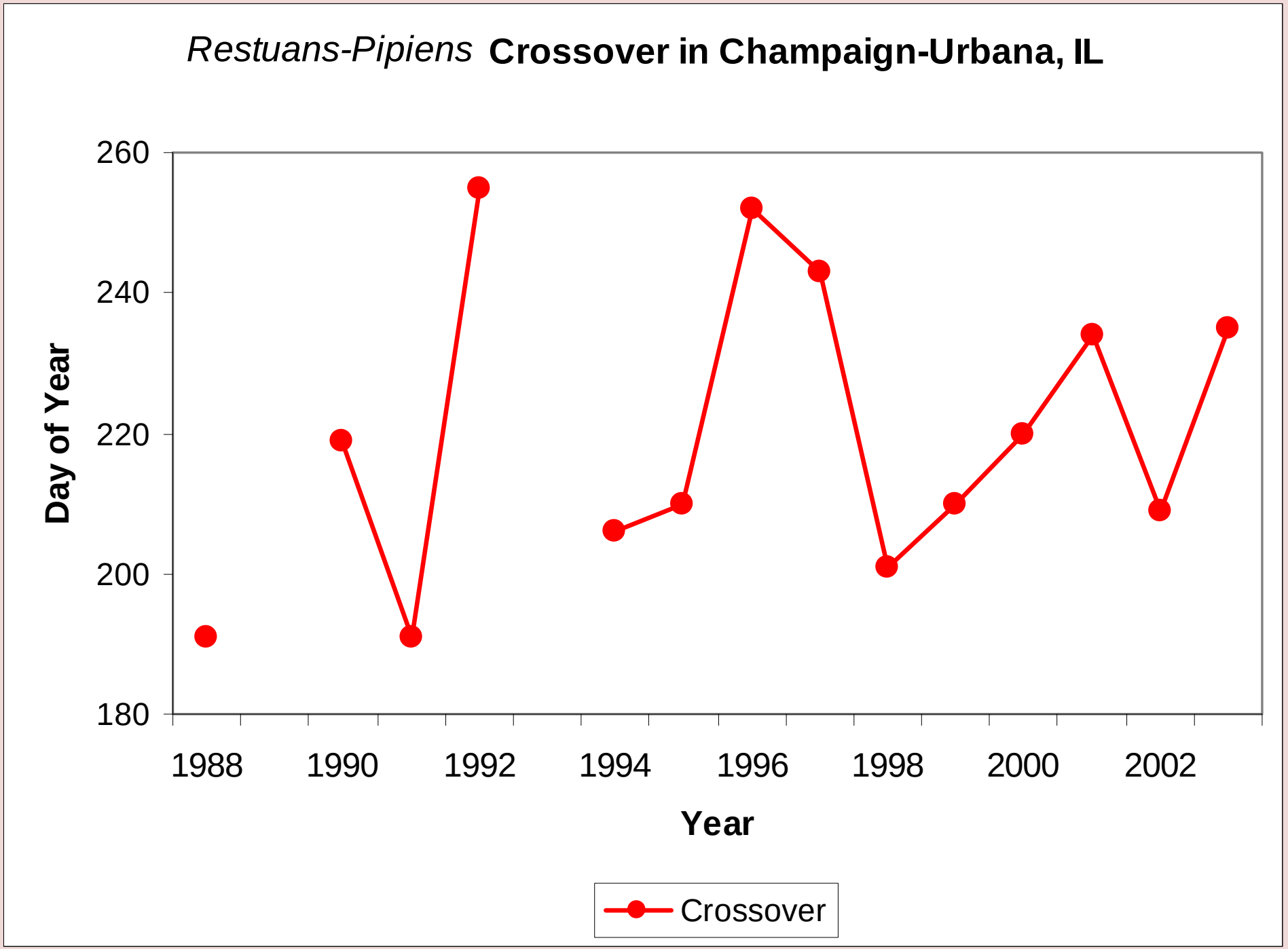
Mammals bitten by infected mosquitoes may test positive for WNV, although some mammals will not get ill.

Culex Pipiens

- In Illinois (and probably much of northern U.S.), the white-spotted (Culex restuans) and the northern house (Culex pipiens) mosquitoes appear to be primary vectors for maintaining the transmission cycle
- The white-spotted mosquito, an early season species, bites birds but not mammals
- The northern house mosquito, a late season species, will bite both birds and mammals

Crossover behavior

- What is of interest is the time when the mosquito population “crosses over” from an abundance of white-spotted to an abundance of northern house species.
- The observations indicate considerable interannual variability in the crossover date
- The following graph shows that it ranges from early July (day of year 190) to mid-September (day of year 255)


Restuans-Pipiens **Crossover in Champaign-Urbana, IL**
260
240
220
200
180
Day of Year
1988
1990
1992
1994
1996
1998
2000
2002
Year
Crossover

Crossover-Climate Indices

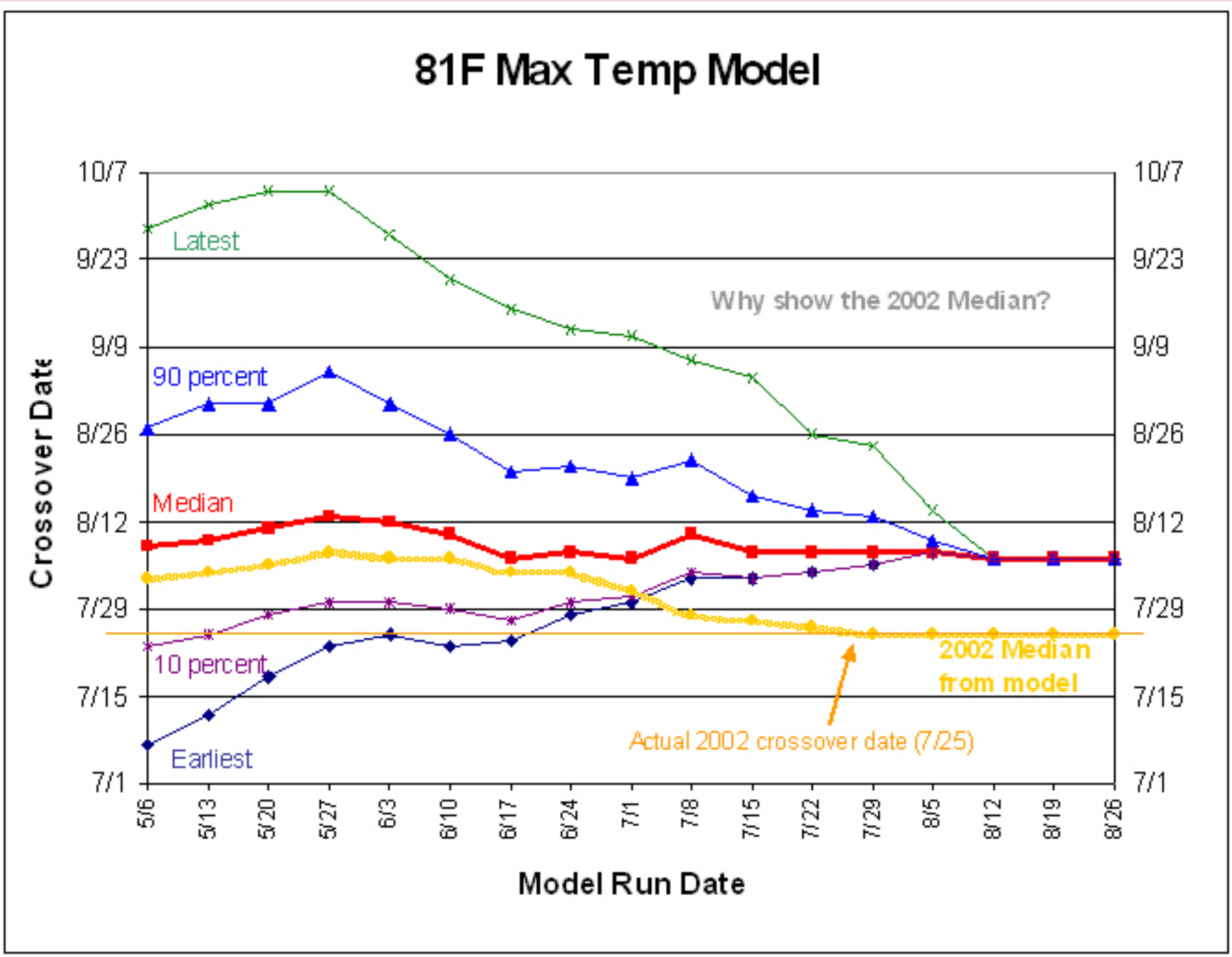
- We investigated whether climate indices could be developed to predict crossover date.
- Two simple linear models were found to have predictive value (explaining more than 60% of the variance):

  Degree day model using a base of 63°F

  T_{max} exceedance model using a threshold of 81°F

Application

- A method for producing probabilistic forecasts of crossover date was developed for use during the warm season.
- This method uses historical climate data essentially as scenarios of future conditions.
- A single forecast uses observed data up to current date and then appends data from one year of the historical record to produce a scenario of a complete year's worth of data.
- Repeat for all years from 1900 to last year
- Results disseminated on Midwestern Regional Climate Center web site


81F Max Temp Model
Crossover Date
10/7
9/23
9/9
8/26
8/12
7/29
7/15
7/1
Latest
90 percent
Median
10 percent
Earliest
Why show the 2002 Median?
2002 Median from model
Actual 2002 crossover date (7/25)
5/6
5/13
5/20
5/27
6/3
6/10
6/17
6/24
7/1
7/8
7/15
7/22
7/29
8/5
8/12
8/19
8/26
Model Run Date

RCC Central Mission

- Provision of relevant and useful climate information
- Focused on regional climate-sensitive activities
- Based on an understanding of the relationship between climate and physical and socio-economic conditions.

RCCs: A Unique Institution

- Network is national in extent – 50 states covered
- Approximate alignment with key regional climate features and sensitivities
- Scientific expertise on regional characteristics
- Repository of regional climate datasets
- Uniquely positioned to monitor and interpret regional climate anomalies
- Regional presence, credibility and trust

Future of the Regional Climate Center Program

- Historical rationale and mission still very relevant and applicable
- Climate change as a new and challenging dimension – especially adaptation
- Leveraging of resources with regional players on regional problems
- Facilitation of a continuous public dialogue on critical climate issues
  - It's not just climate: Joint identification of solution paths to address unprecedented complex multi-stressor issues
- A growth area: Ecological services and environmental constraints

A near-term leadership opportunity:

Harnessing a quarter century of experience and expertise to help shape a suite of climate services adequate for 21st Century needs

QUESTIONS?

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