

IEM Update: From pollen to rivers to pavements to soils and a whole lot more

Daryl Herzmann
ISU Meteorology Seminar
10 Oct 2006

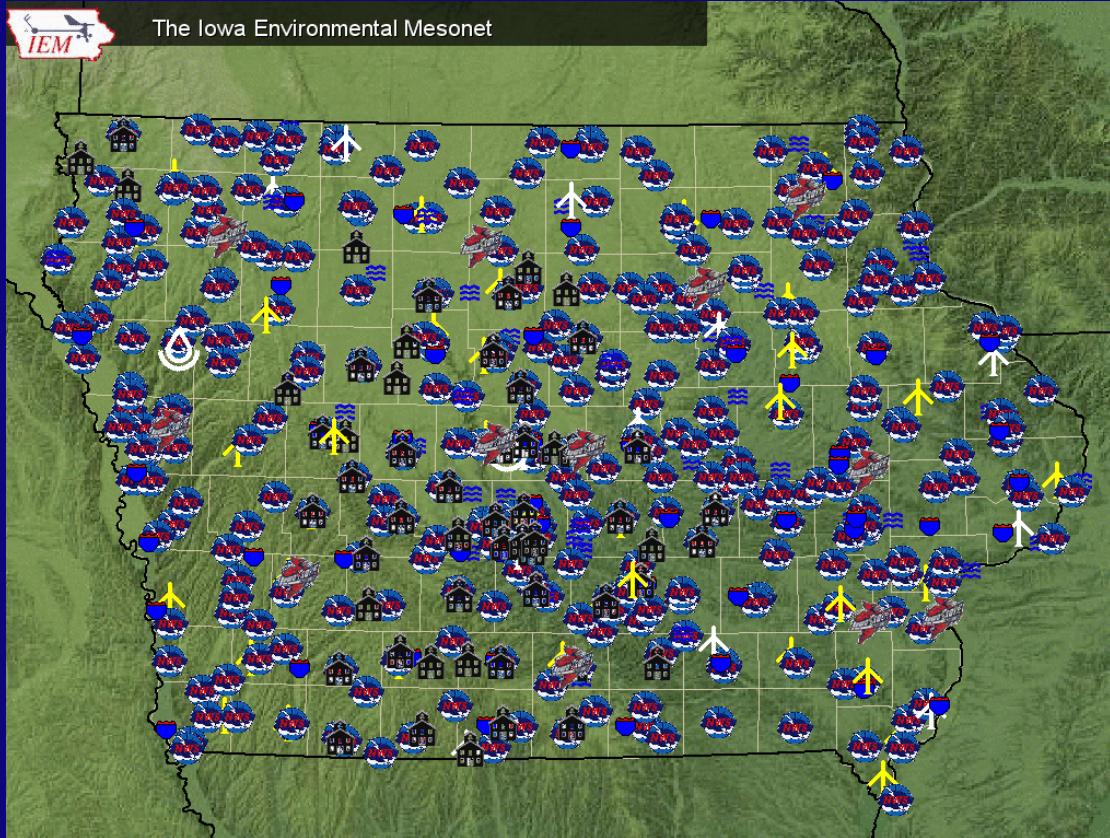


Motivation for the IEM

- Spring 2001: To build a centralized clearing house for environmental data in the state
 - Collect, process and archive data from pre-existing networks
 - Build two-way partnerships with data providers and data consumers
 - Foster multi-disciplinary collaboration and research
- Fall 2006: I'm still at it, so we must be doing something right!



Sensor Locations



Build a mesonet like how daryl cooks, throw it all in a pot and hope it tastes good.



Nearest Neighbor Index

The NNI is a simple ratio between the mean minimum distance and expected distance by chance of sampling points over some sampling area.

Tier 1 is a combination of the ASOS and AWOS networks.

Network	Sites	NNI	Z	Avg Min Distance [km]	Expected Min Distance [km]
ASOS	38	1.05	0.76	38.3	36.5
AWOS	76	1.14	2.12	40.9	36.0
RWIS	101	1.10	1.88	34.2	31.0
SchoolNet	102	0.69	5.54	21.4	31.0
ISUAG	12	0.76	1.44	74.7	98.8
Tier 1	114	0.82	3.83	20.6	25.2
Tier 2	215	0.72	7.57	13.9	19.2
Tier 3	329	0.76	7.98	12.0	15.7

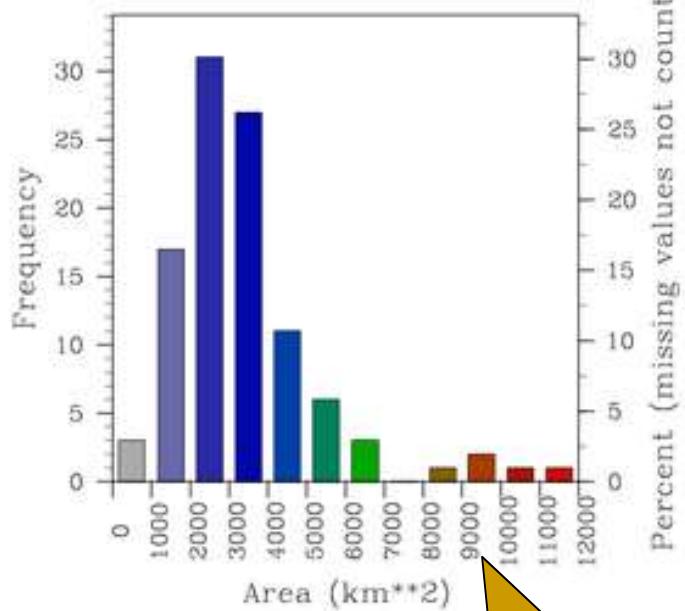
NNI Value	Details
> 1	increasing values greater than 1 indicate more dispersion
= 1	indicates sampling points have a uniform distribution
< 1	decreasing values less than 1 indicate more clustering



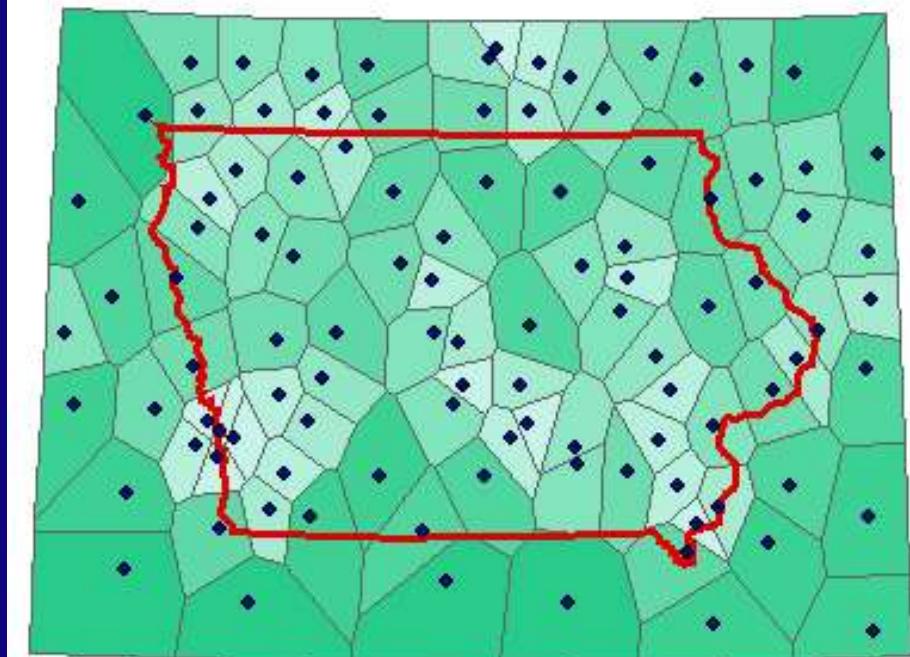
Thiessen Polygons

- Polygons represent optimized areas closest to an observation point
- This and further analysis allows design of a representative data grid for Iowa

Tier 1 Frequency Histogram



Tier 1 Thiessen Polygons



Skew in polygon size indicates opportunity for improvement of regional representativity



Representativity Results

- The IEM is spatially representative at a scale of roughly 30 km.
- Arbitrary combination of all data sources leads to clustering and degradation of data quality at finer scales.
- <http://mesonet.agron.iastate.edu/info/nni.phtml> or Google “IEM Representativity”



Daily Data Processing

- On 4 October, the IEM ingested 304,121 observations (~111 million per year)
- SchoolNet data is sampled once per minute, the IEM ingests 1+ million obs per day to produce the sub-sample.
- 20 GB of compressed Level2 NEXRAD data is processed.
- 10,000+ Level3 NEXRAD radar attribute files are ingested into the spatial database
- Thousands of NWS issued text products are processed to extract data and information.
- 99% of processing done in real-time.



Observation Archive

	Begins	Current Stations	Obs Stored
ASOS	1945	17	1,323,570
IA AWOS	1995	37	191,017,657
IA RWIS	1994	53	15,015,105
SchoolNet	2002	131	166,626,011
NWS COOP	1893	185	3,107,343
Ag Climate	1998	14	1,003,436
Other		Lots	~20,000,000
			<i>~400 million</i>

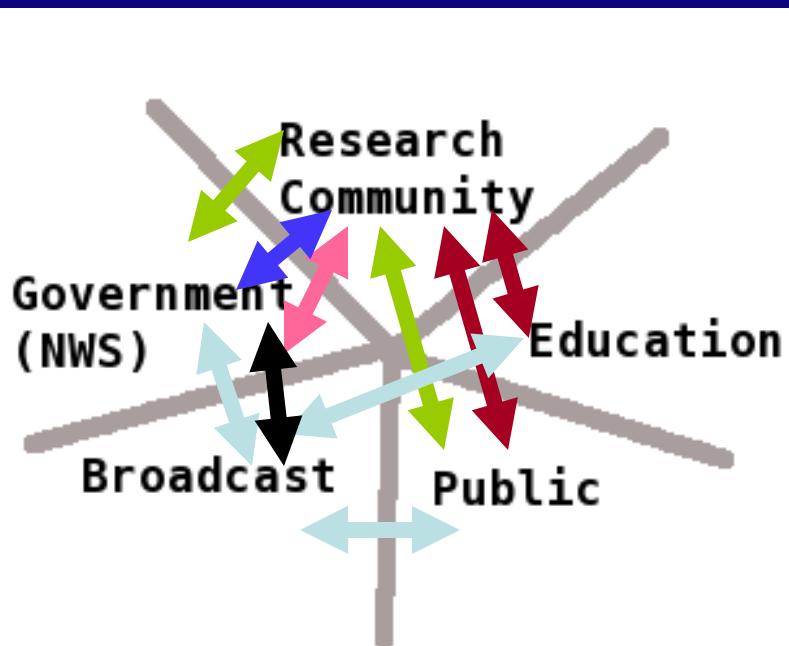


With all those observations, lets just sit on it or perhaps swim in it....



- Observations collected are freely distributed.
- Developed numerous applications to visualize the data to save the user time and potential errors
- Gridded analysis is coming soon.

IEM Projects fostering collaborations



- Daily Erosion Project
- Pollen Dispersion
- Squaw Creek Flood Model
- Pavement Project
- SchoolNet8
- IEM Chat



Iowa Daily Erosion Project

Rick Cruse, ISU

Dennis Flanagan, USDA-ARS

Jim Frankenberger, USDA-ARS

Brian Gelder, ISU

David James, NSTL

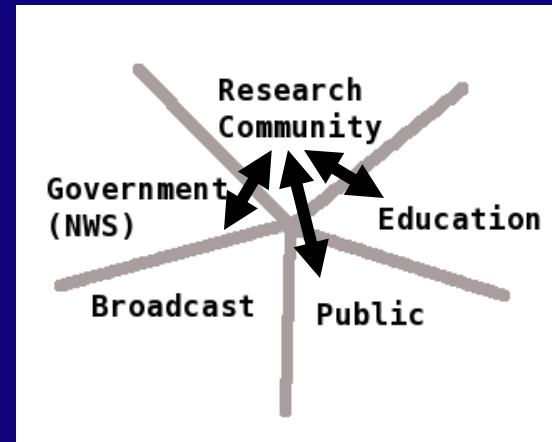
Witold Krajewski, IIHR U-Iowa

Michal Kraszewski, IIHR U-Iowa

John Laflen, USDA-ARS retired

Jean Opsomer, ISU

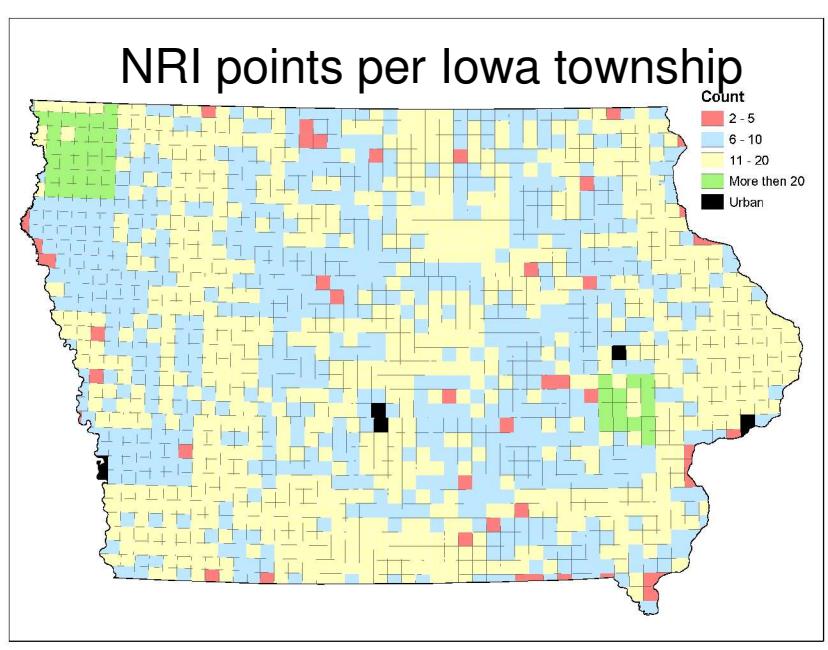
Dennis Todey, SDSU



Cruse, 2006: Daily estimates of rainfall, water runoff, and soil erosion in Iowa. *Journal of Soil and Water Conservation*. Volume 61, Number 4. p 191-200.



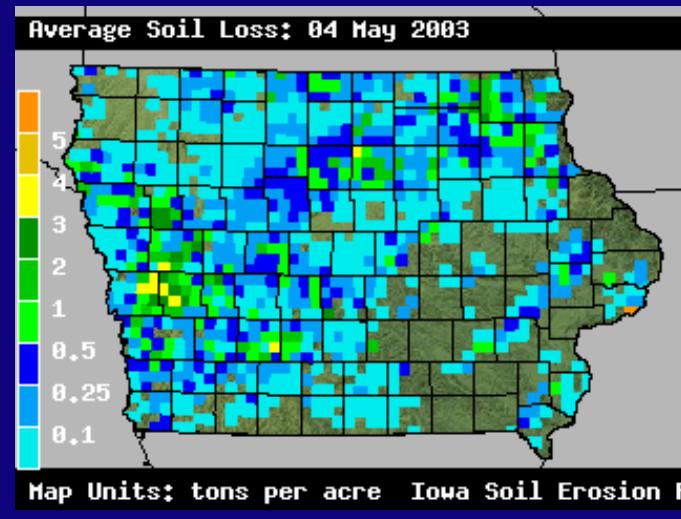
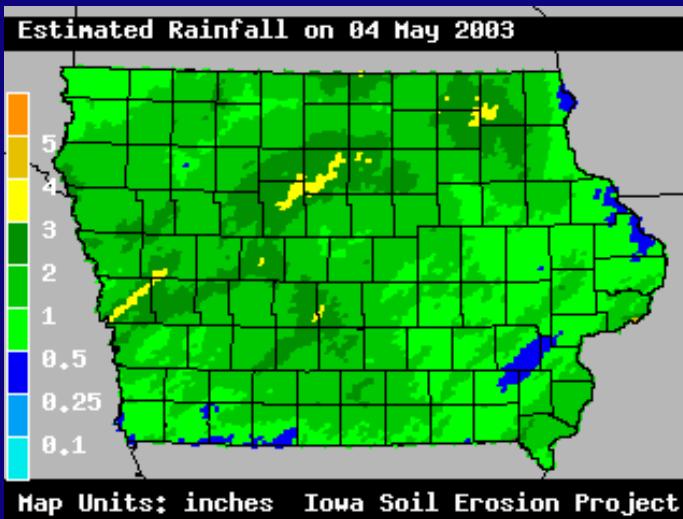
Inputs to drive WEPP model



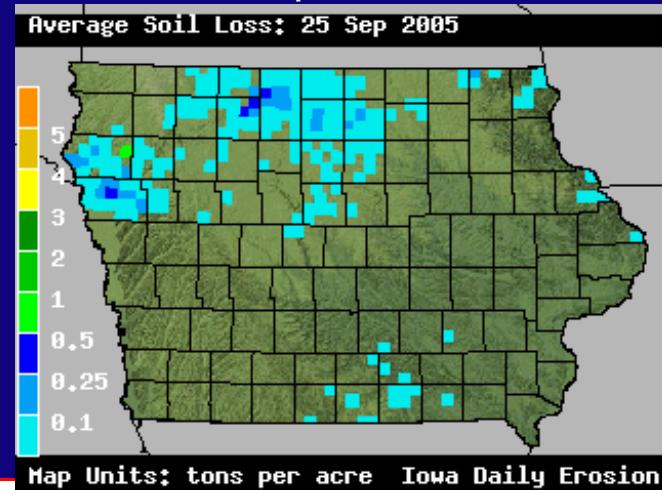
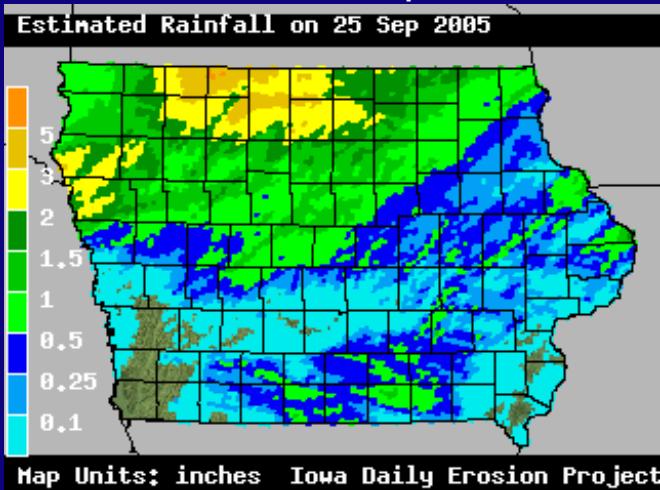
- Natural Resources Inventory (NRI) provides a majority of the inputs used.
- Local expertise used to build out representative land management data.
- IEM provides 15 minute rainfall and daily climate information.
- 90,000 WEPP model runs are executed daily producing results at roughly noon-thirty.
- Results are displayed on the township scale



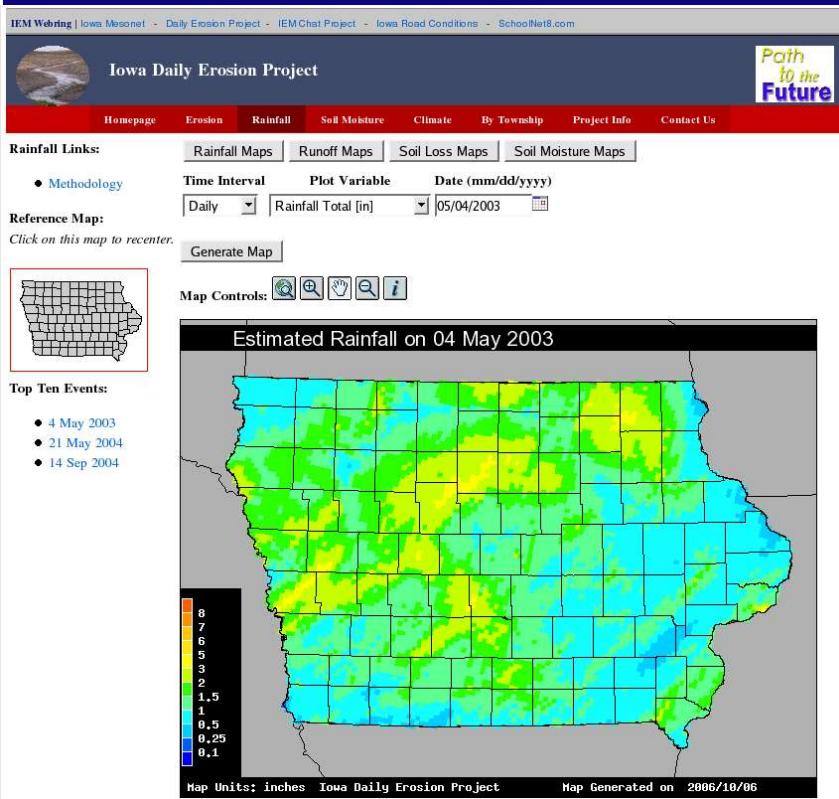
4 May 2003, heavy rains on freshly tilled soils



25 Sep 2005, heavy rains on mature crops



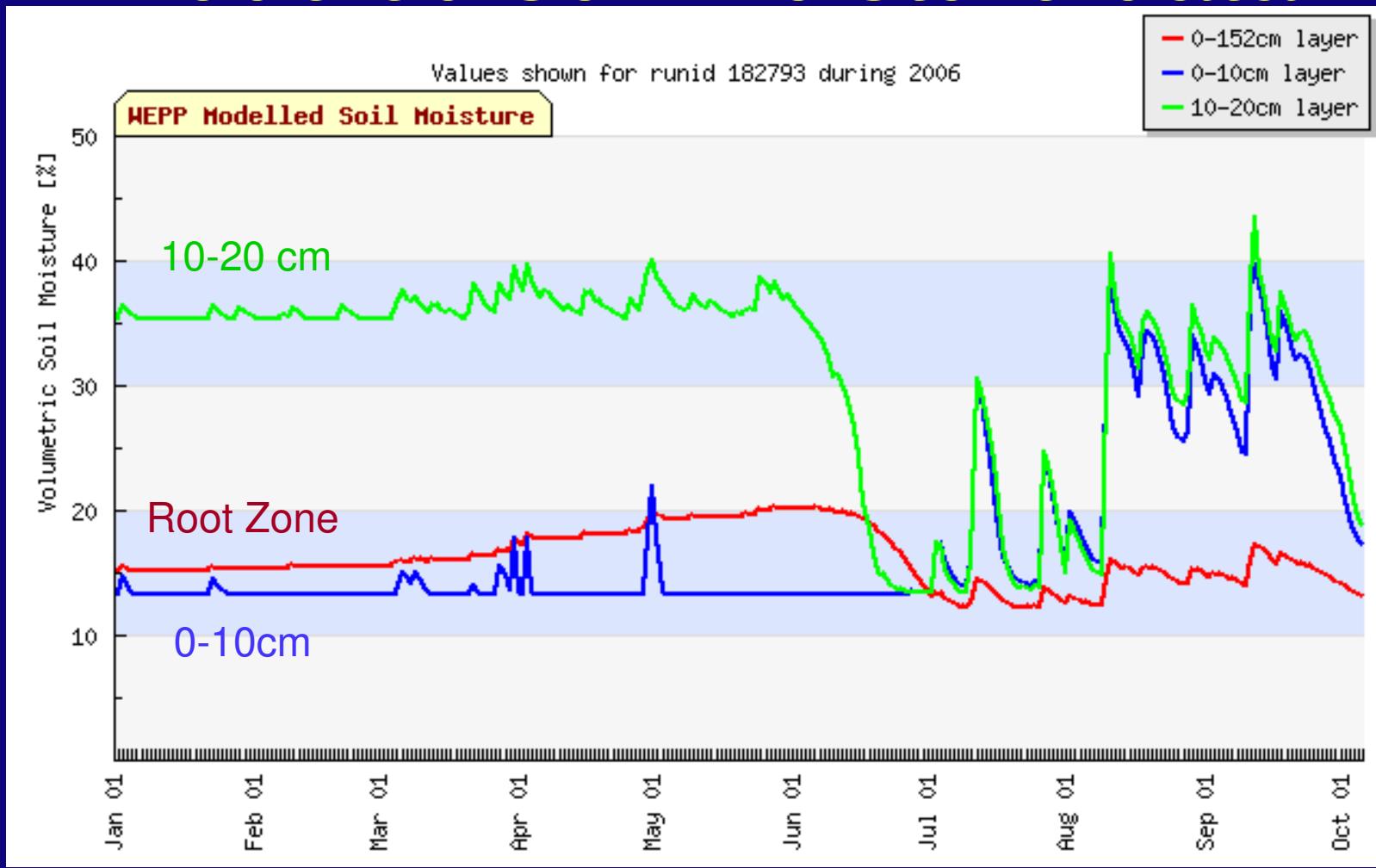
Interactive Website



- Pan, zoom, and query to your heart's content
- Need to add download features, (lazy daryl)
- Could use more user feedback for features to be added



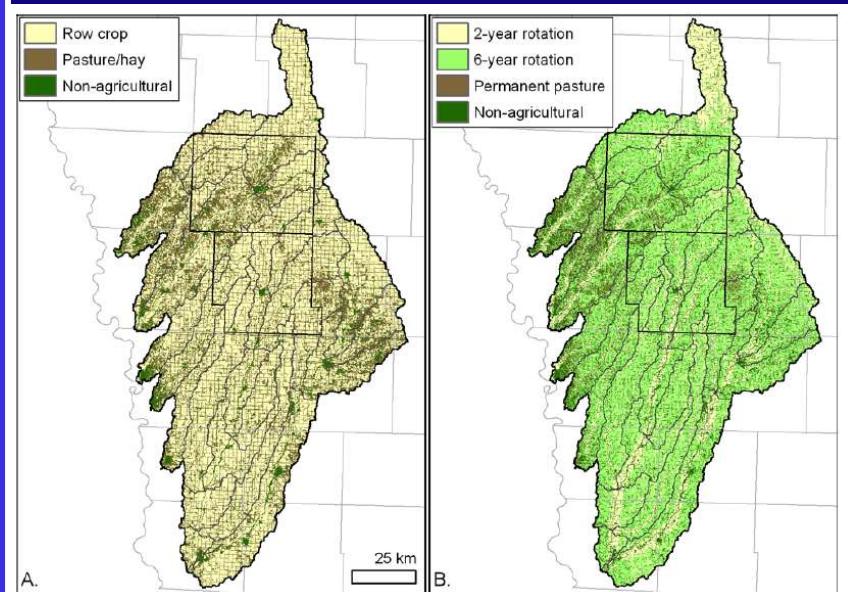
Modeled soil moisture data



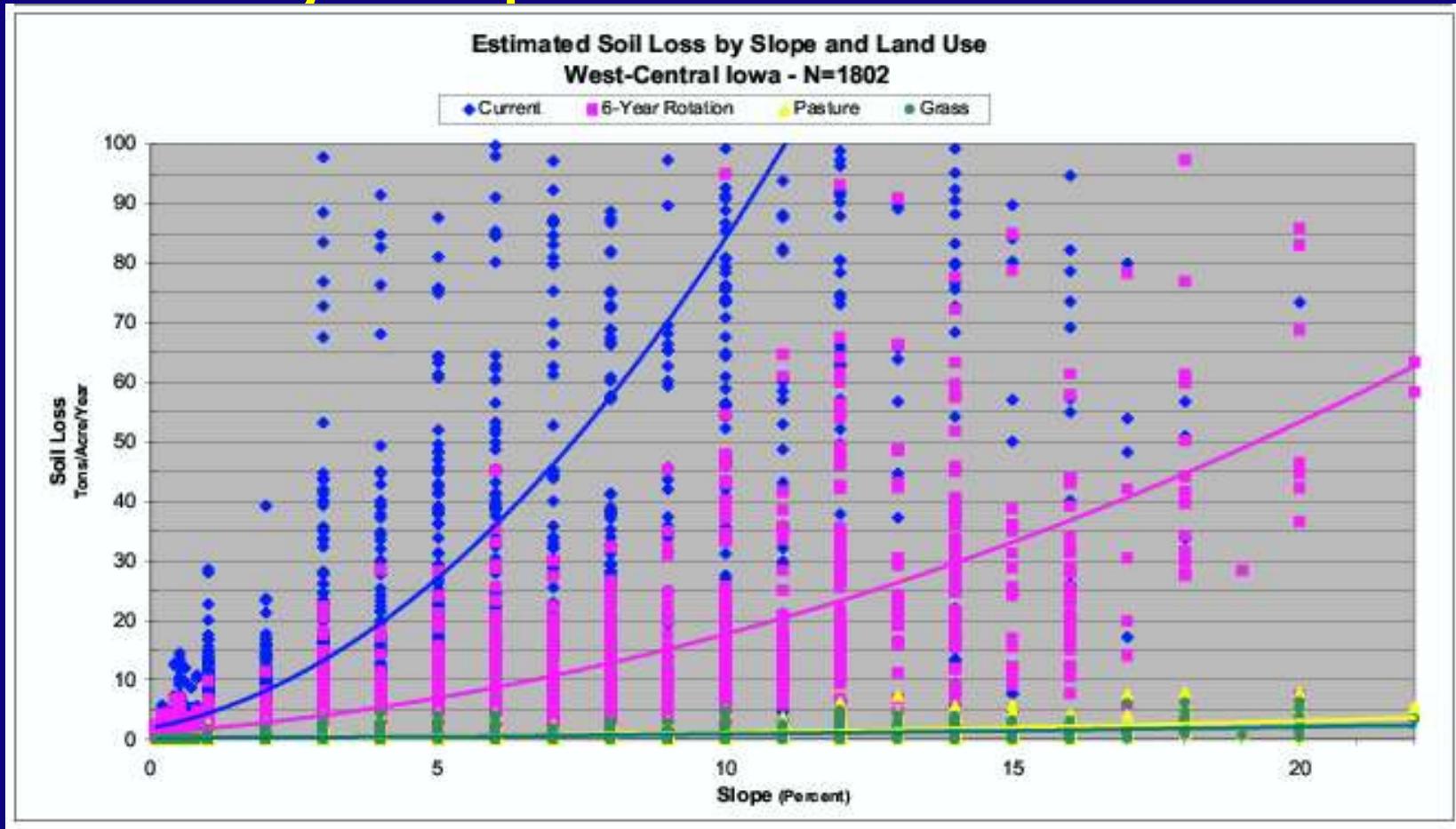
Alternative land use over Western Iowa

- Lets do something different than intensive row cropping over the Loess Hills.

Burkart, M., D. James, M. Liebman, and C. Herndl (2005), Impacts of integrated crop-livestock systems on nitrogen dynamics and soil erosion in western Iowa watersheds, *J. Geophys. Res.*, 110, G010009.



Estimated Soil Loss by Slope and Land Use



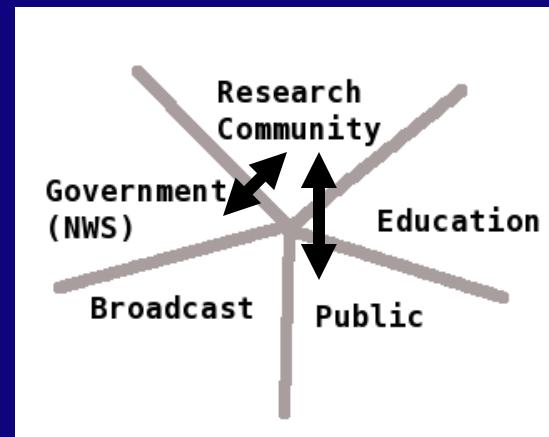
Coupling Lagrangian Stochastics and Large Eddy Simulation to Predict Long Distance Dispersal of Pollen

Mark Westgate

Raymond Arritt

Susana Goggi

Jeff Wolt



Developing maize out crossing (OC) knowledge

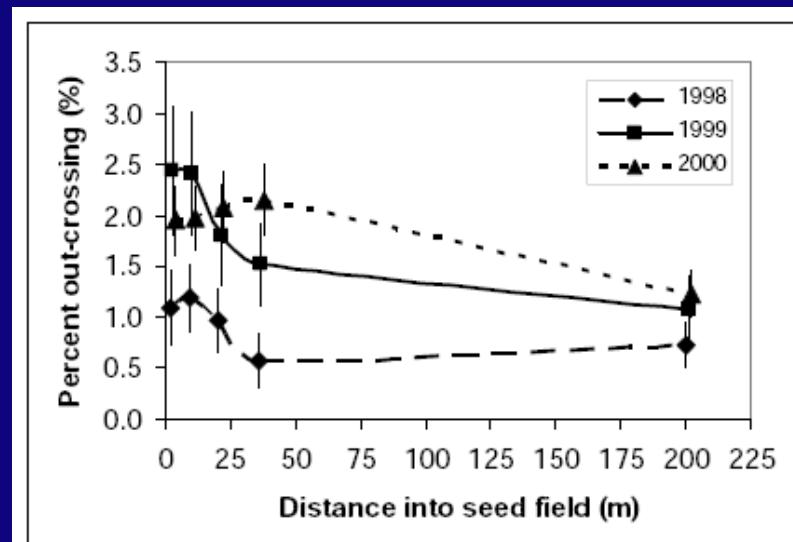
- 1 Measure OC for seed production in Iowa
- 2 Model OC with a regulatory compliant model (AERMOD) and validate result
- 3 Interface model with a regional weather monitoring network (IEM)
- 4 Develop retrospective and prospective tools for regionally based OC monitoring & Prediction



Measure OC for Seed Production

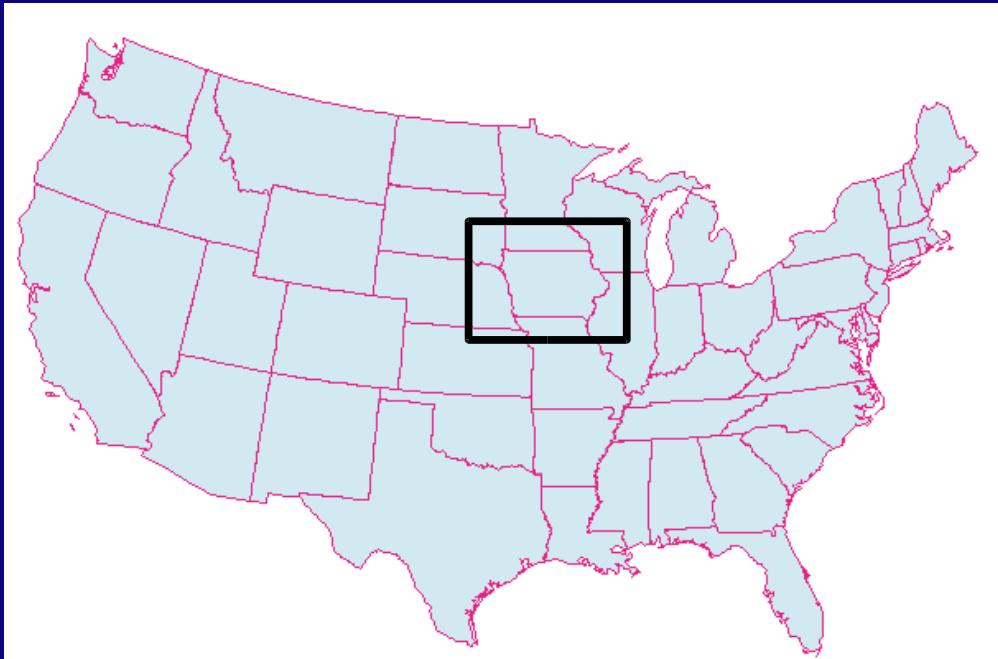
- Data collected during a 3 year monitoring of commercial seed production fields
- Out-crossing observations along in-field transects

Ireland, D.S., et al: 2006. Managing Reproductive Isolation in Hybrid Seed Corn Production. Crop Science, **46**, 1445-1455.



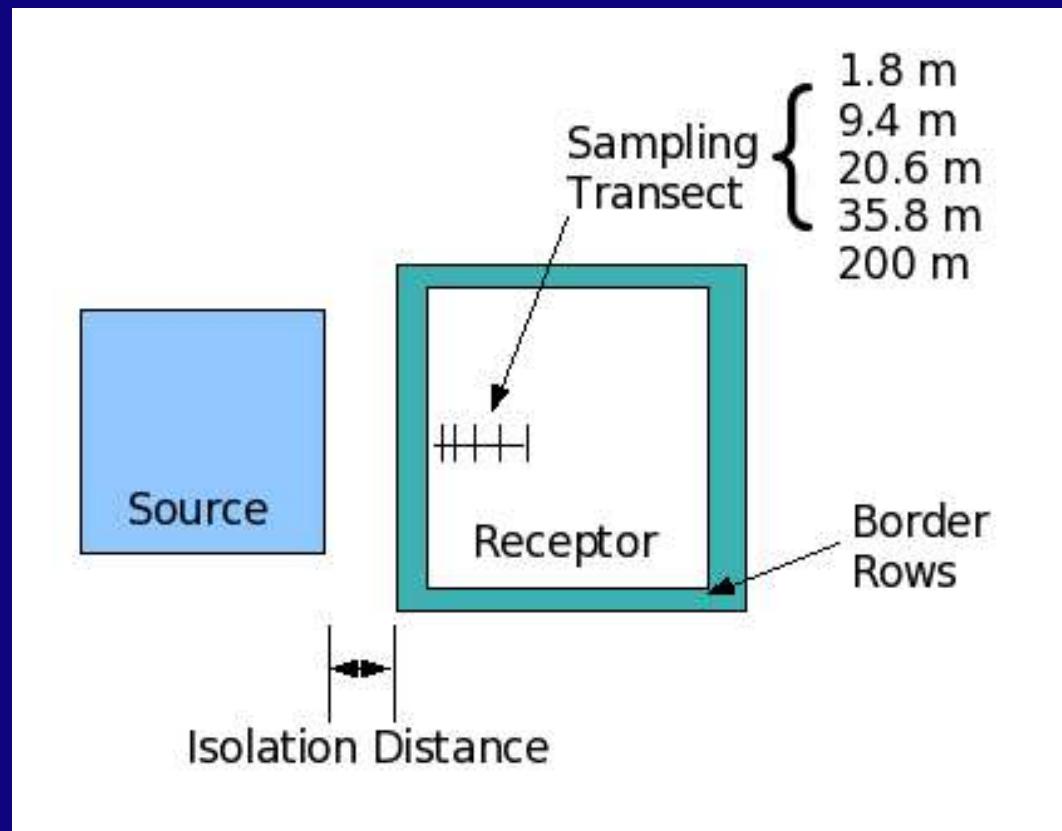
Model validation fields

Validate modelling approach using AERMOD and IEM data against an observed pollen out crossing dataset.
Selected 8 sites in Iowa from datasets with adequate meta-data

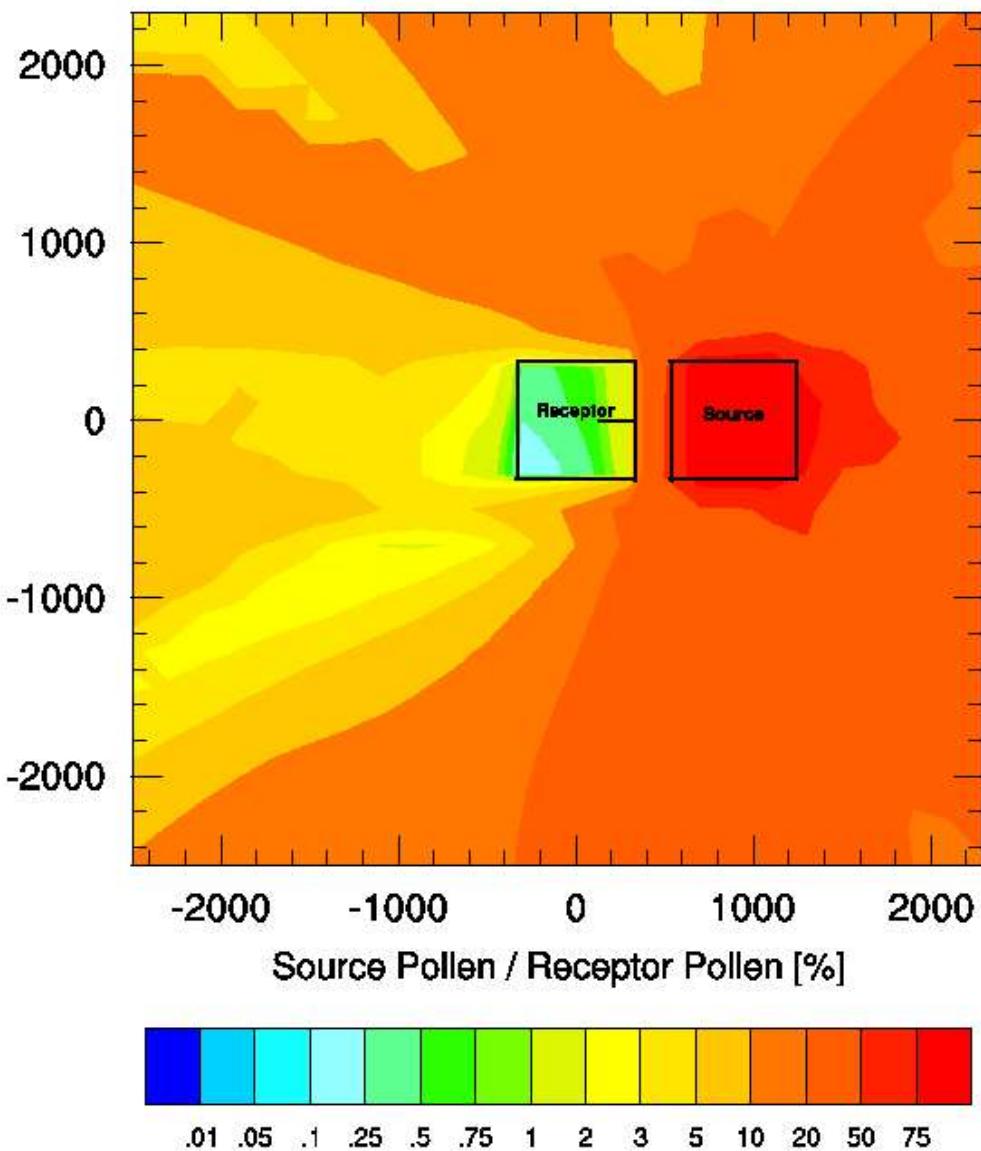


AERMOD “Field” Setup

- Develop idealized representation of OC field studies
- Use IEM weather for a uniform domain of 49km^2



AERMOD output for Field 14-15



Presented is a simple ratio of pollen from source (adventitious) versus receptor fields. The line in the receptor field is the transect used for validation.

Validation – A work in progress

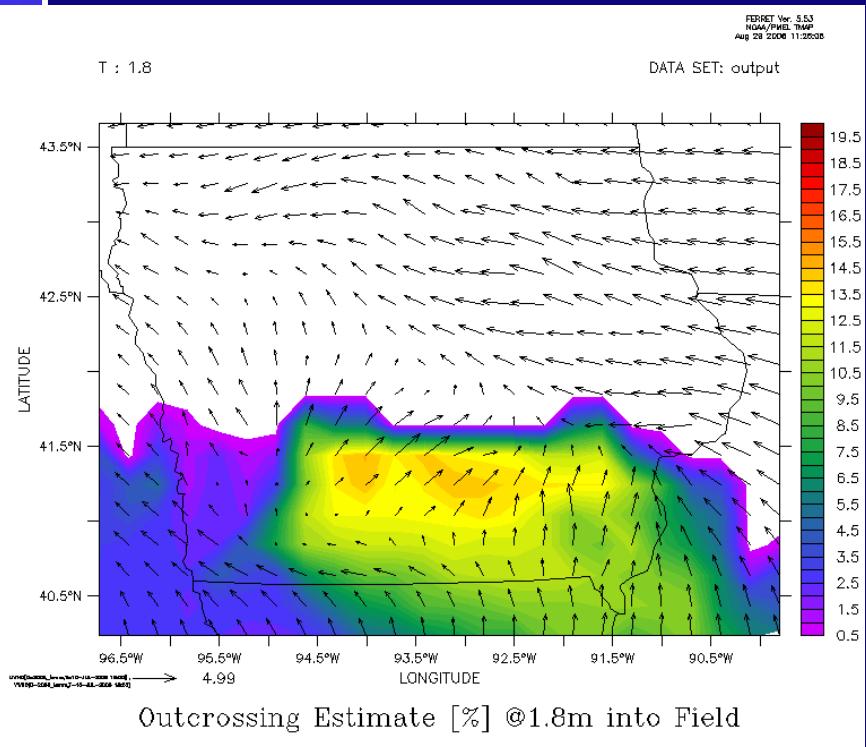
Field “14-29” – 130 m isolation distance

Distance within receptor field (m)	Outcrossing (%)	
	Observation	Model
1.8	3.1	6.5
9.4	5.2	5.9
20.6	1.0	5.3
35.8	4.2	4.9

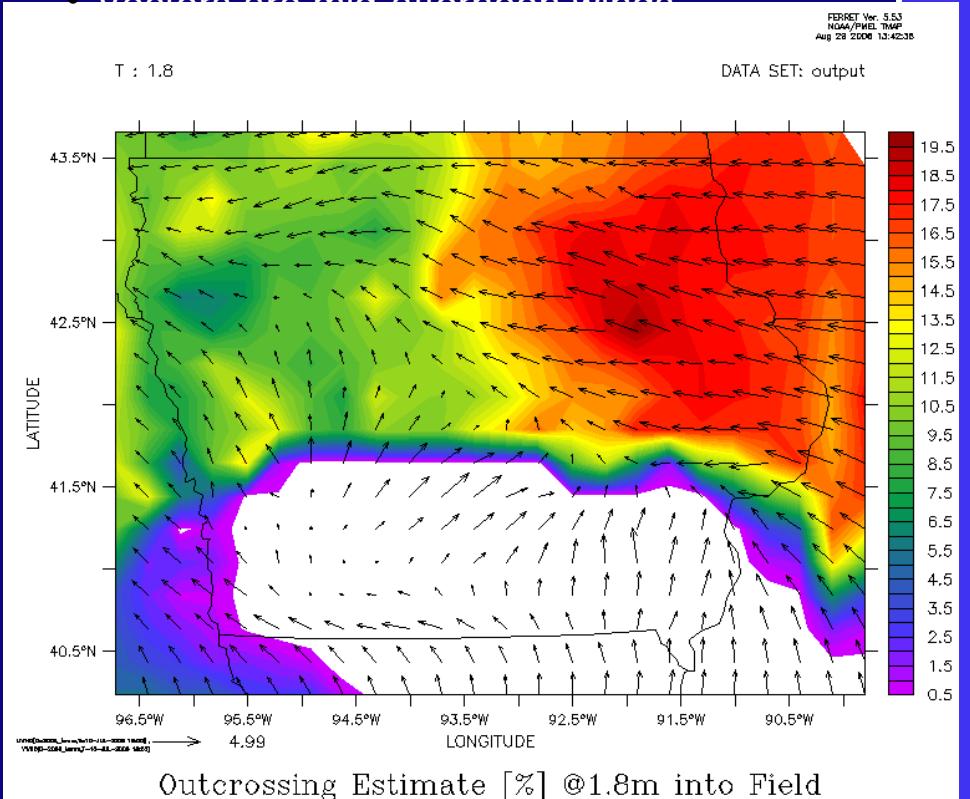
With no major modification AERMOD predicts directionally correct, order of magnitude correspondence to field observations – Thus, with further calibration AERMOD can be adapted as a first tier model



Regional modelling



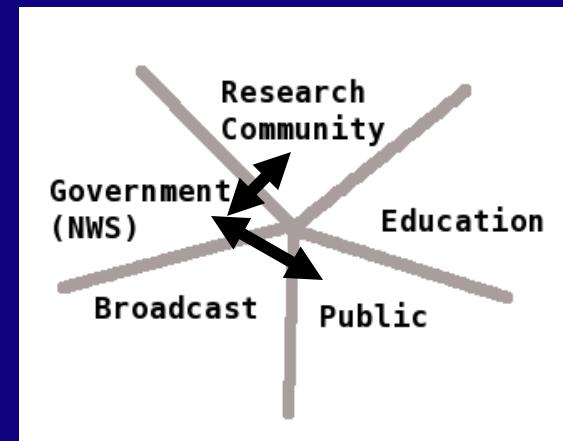
- Outcrossing estimated at 1.8 meters into receptor field with 130 m isolation
- Vectors are mid afternoon winds



Squaw Creek river stage model

Michael Hamilton, ISU FP&M

David Miller, ISU FP&M



Motivation



Photo by Paul Thomas

- Update a river stage model from the 1970s to run on the web with IEM data
- Provide City of Ames and ISU with 0-48 hour predictions of Squaw Creek river stage.
- Small flood events have impacts that need to be mitigated.



Flood model runs from website

Squaw Creek Flood Prediction System

Homepage Run Model Scenario Editor Storm Editor

Run the Model!

This form allows you to set up the model with the necessary parameters to run. Any relevant storms are pulled into the run based on your specification for time. Please fill out the following items and then click the *Run Model* button at the bottom of the page.

1. Model Initialization Time:

The model will start running from this time out to 60 hours.

Month:	Day:	Year:	Hour:
September	6	2006	01 AM

2. Configure Recession Curve:

The model needs to have two points along the recession curve of the Squaw Creek. These two points must be after the *Model Initialization Time* chosen in #1 and the flow must be receding.

Time Index:	Hour:	Flow:
1.	03 AM	
2.	04 AM	

3. Select optional scenarios to run with:

You can select from these scenarios to run with as well.

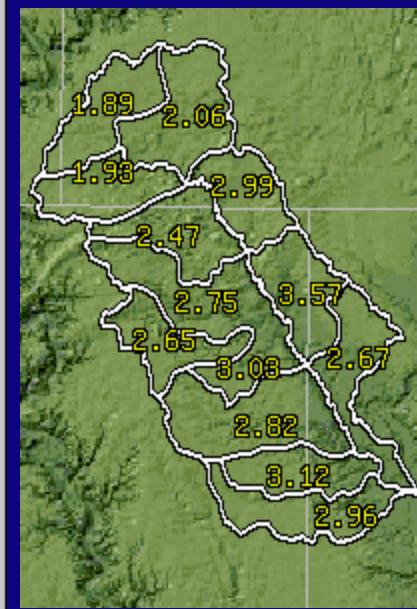
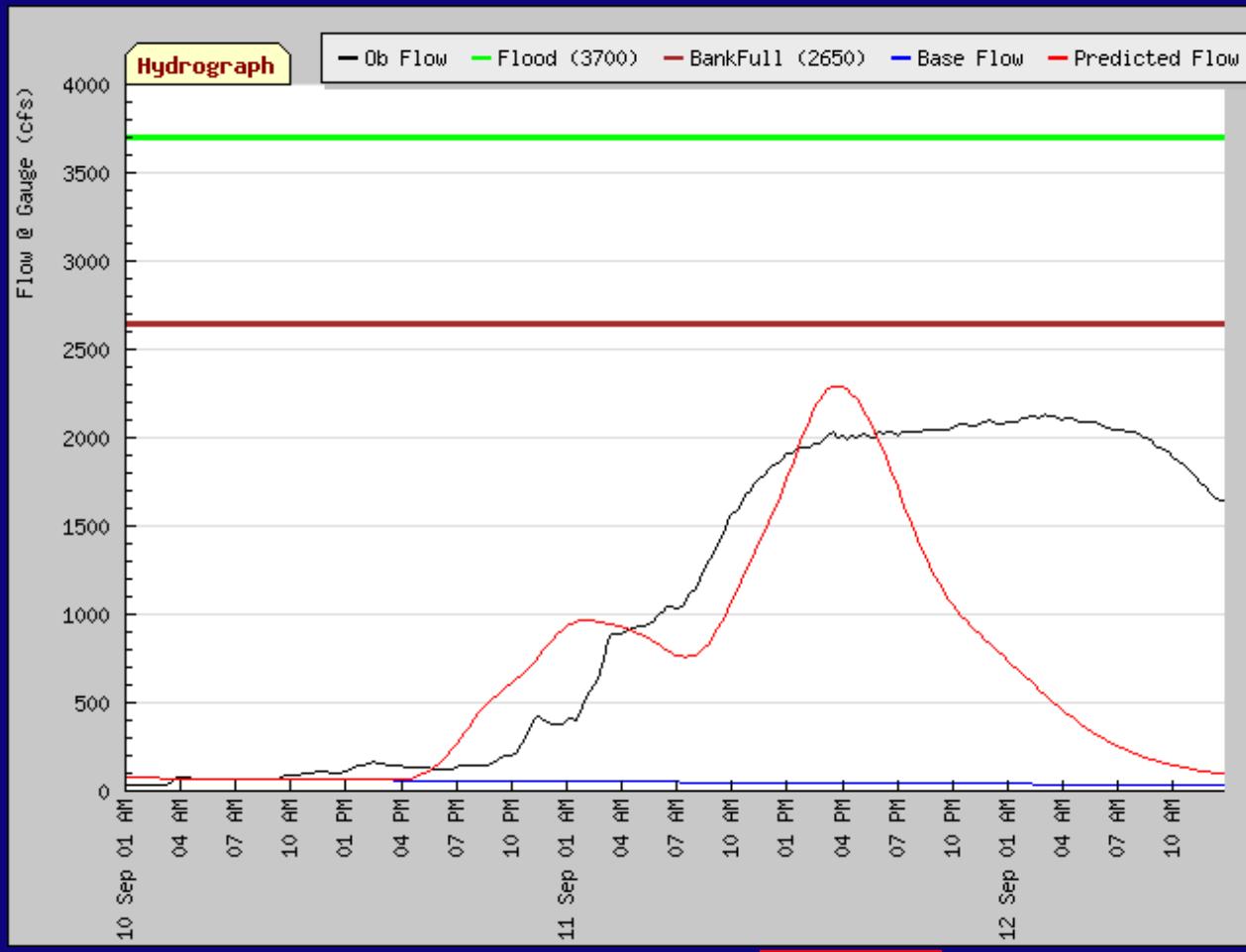
2 AM NextDay 2 inch
 April 6
 1-inch rain across basin @ 6 am
 Fig5 4inch test
 Fig5 2 inch test
 March 30 2006

4. Run The Model:

- User can select date to run for (current or historical).
- Model runs from IEM rainfall data, initial river stage, and antecedent soil moisture.
- Unfortunately, only works for 1 location.



10-12 Sept 2006: Not perfect



Working with Television weather data networks (schoolnets)

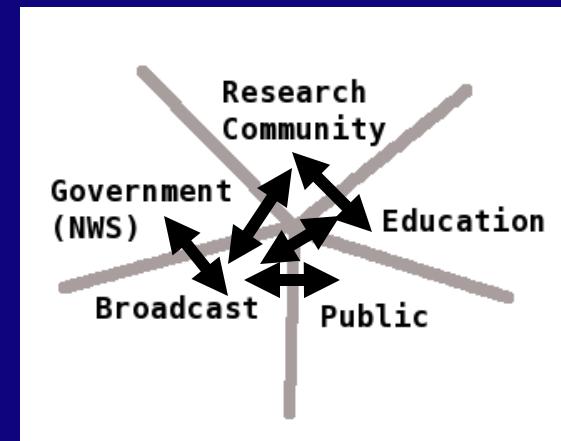
KCCI-TV Des Moines

KELO-TV Sioux Falls, SD

KIMT-TV Mason City, IA

CIPCO Cooperatives

Corn Belt Power
Cooperatives



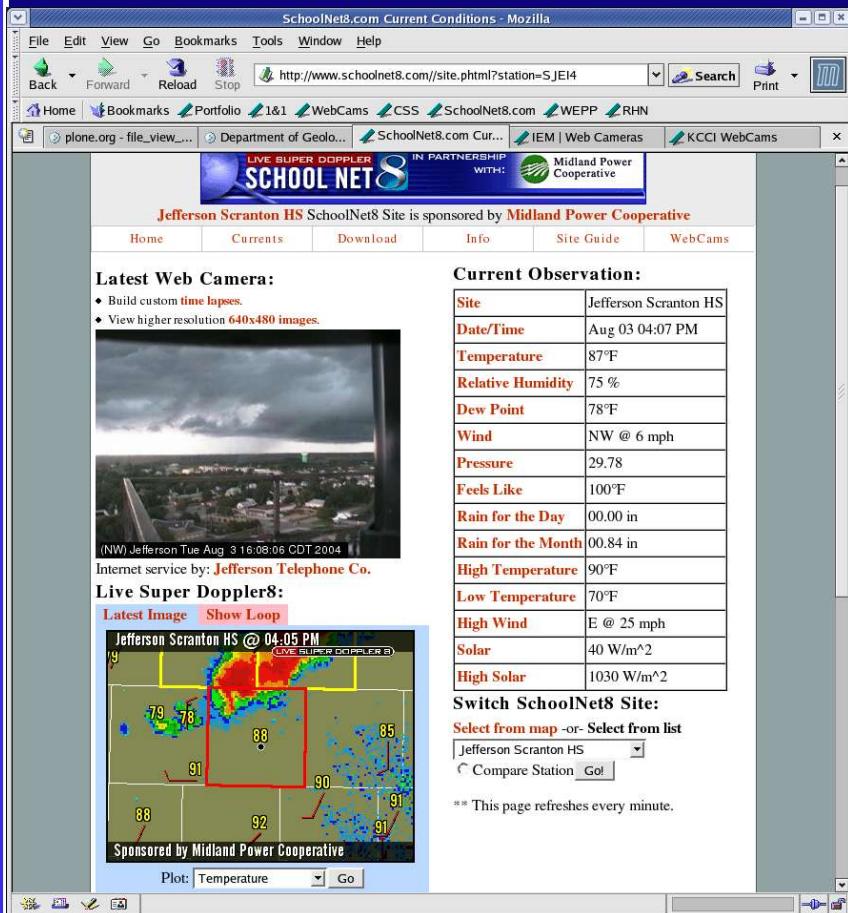
Collaborating with Schools



- Yearly workshop taught for educators in KCCI-TV network (Agron 206 taught in 3 hours).
- Routine email communications with every school.
- Over 4,000 emails exchanged with various schools since 2002.



Interactive Website



- Combines RADAR, NWS warnings, cameras, current weather, and climatology in one page.
- Has thousands of routine daily users.
- Two educational guides, one authored by the IEM and collaborators.



IEMChat

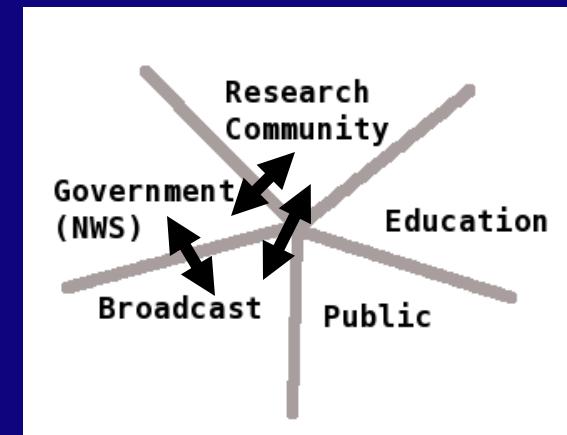
Jason Burks, NWS Huntsville

Darone Jones, NWS Birmingham

John McLaughlin, KCCI-TV Des Moines

Shane Searcy, NWS Des Moines

Brad Small, NWS Des Moines



IEMChat: Built to support the collaboration of operational meteorologists

Since 2000, some NWS weather offices have used Instant Messaging as a way to communicate with media and emergency management partners. We developed IEMChat as a platform to eliminate many of the deficiencies found with commercial chat solutions.

Previously:

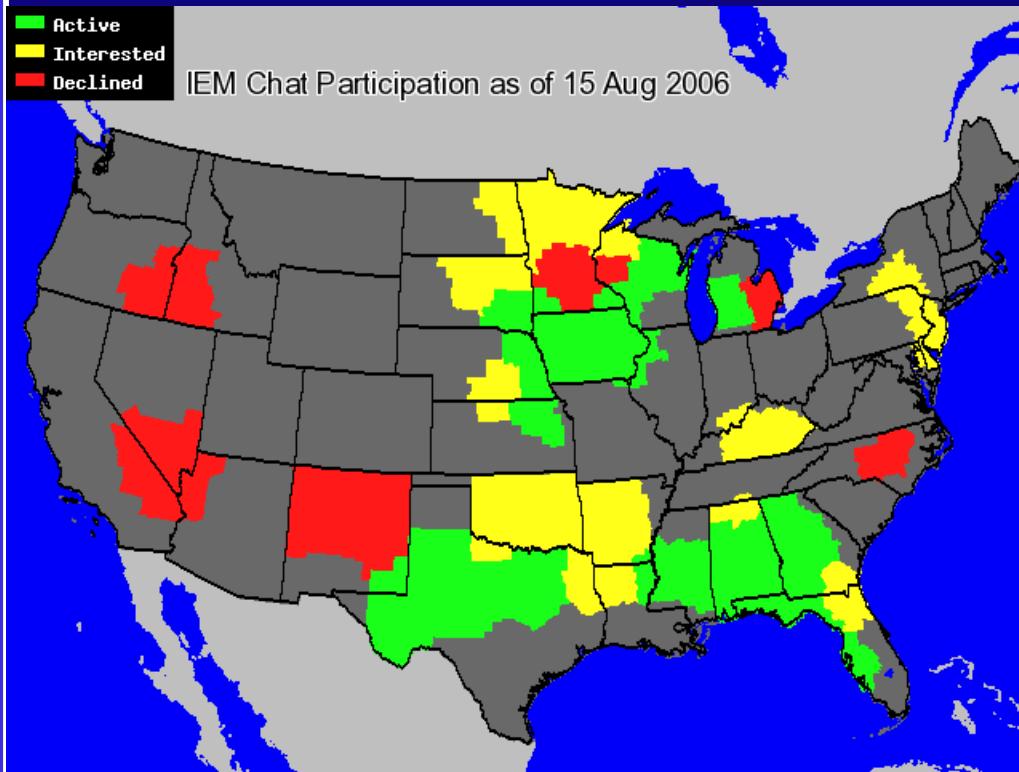
- Commerical chat solutions (Yahoo, AIM, MSN) offer nice features, but are not extensible
- Adware/IM worm concerns prevent a number of organizations from participating
- Lack of standards makes regional scalability impossible.
- Management of chatroom and users was time consuming

Now with IEMChat:

- Open Source client and server software offers max flexibility
- Control of the chat server and accounts removes a majority of the IM attack vectors for worms.
- User accounts, room names, organization is standard and consistent nationwide.
- Almost no chat management required by the local weather office after it is setup.



Status and Future



- ~20 offices now use iemchat to collaborate with their chat partners
- Over 200 entities have IM chat accounts, 500+ users
- NWS Management evaluating as a possible “standard” for collaboration with dissemination partners.



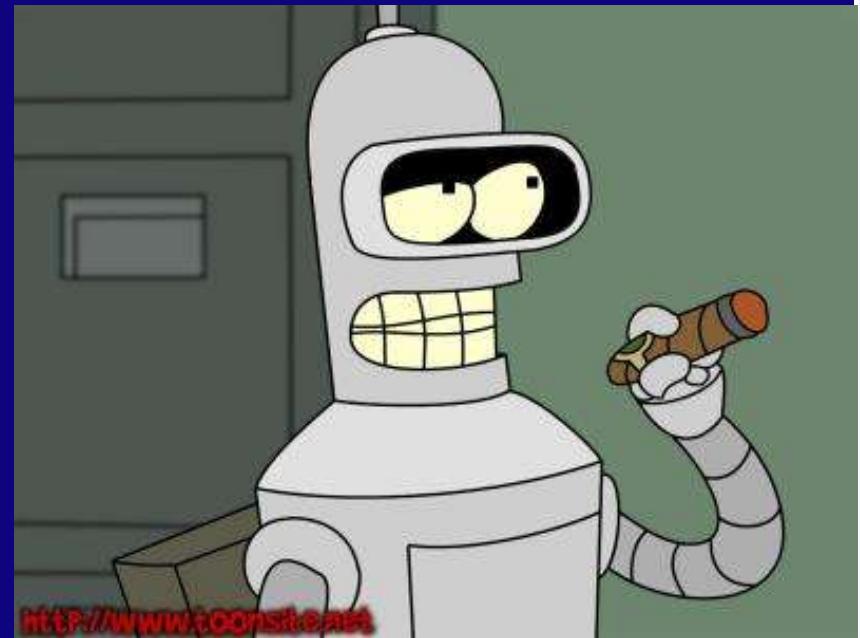
IEMChat Response

- “Our forecast staff love the fact of how much time is being saved by the ‘bot’. The bot rules! On average, from the time the product is issued to the time the ‘bot’ reports it to the room is about 15 seconds. All we do now is talk about the storm trends.” – Darone Jones NWS
- “With this new client I have had no such problems to date. The icing on the cake is the ‘bot’ and the speed the information gets to me. In some cases, I receive notification through this before all of the other equipment in my office. Simply stated, this could very well transfer into saving a life.” – David Neal WBRC-TV
- “...it's the best thing since NEXRAD!” - KJTV

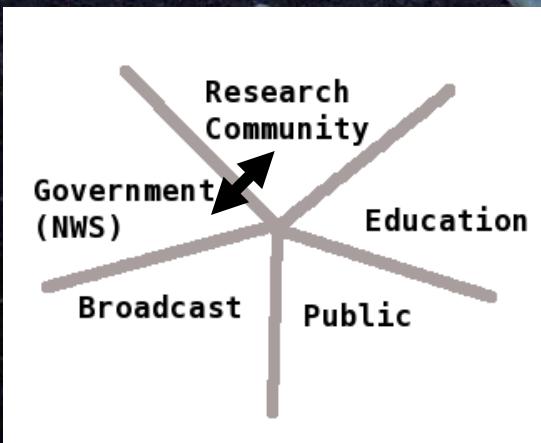


My name is ... iembot!

- lembot is the code name for a chat “bot”
- A bot is a program that participates in chats and acts like just another user
- lembot is a good bot! He reduces the work load of the NWS to participate in the chat by automatically relaying products into the chatroom.



IEM Cow

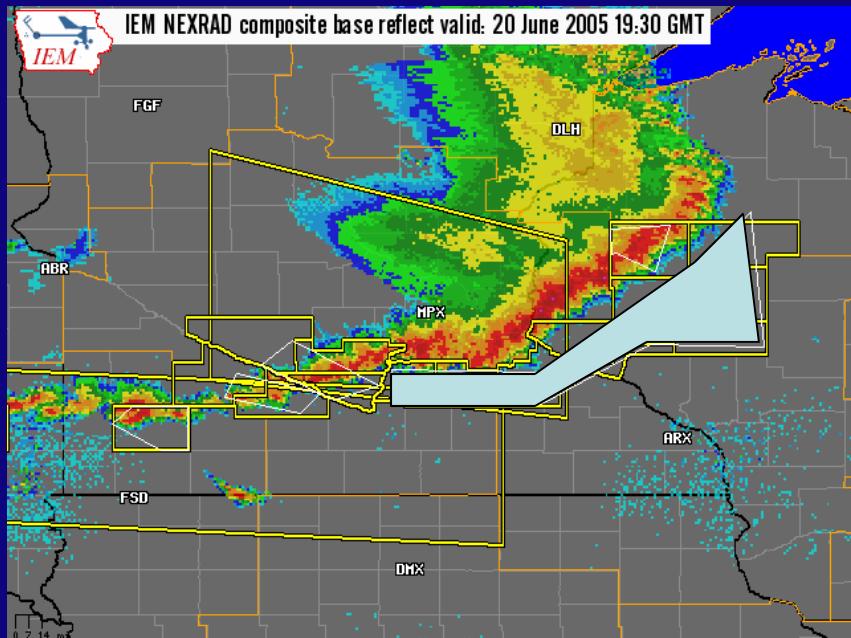


Collaborators names
omitted to protect the
innocent ☺



Motivation

- NWS is transitioning to polygon based warnings.
- One of the reasons for polygons is more accurate warnings, so lets compute polygon warning verification.
 - *Not* official data



Start: 2006 May 5 0 Z End: 2006 May 5 23 Z

WFO: [SJT] SAN_ANGELO

Warning Type: Tornado Srv T'storm

Hail Size: 0.75

LSR Type: Tornado Srv T'storm

Go Cow Go

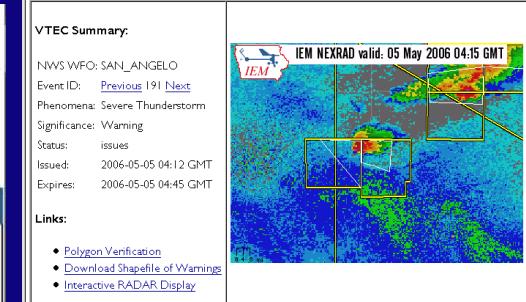
Begin Date: 05/05/2006 00:00 End Date: 05/05/2006 23:00

Summary:

Observation	Warning		Listed Warnings: 36		Reports		51
	Y	N	Verified: (A _w)	13	Warned Events (A _e)	45	
Y	13 45	5 B	% Verified	36	Unwarned Events (B)	5	
N	23	NA	Non TOR LSRs during TOR warning		17		
FAR == C / (A _w + C) = 0.64		POD == A _e / (A _e + B) = 0.9	CSI == ((POD) ⁻¹ + (1-FAR) ⁻¹ - 1) ⁻¹ = 0.35				
Avg Lead Time for 1st Event	11.7	Avg Lead Time for all Events	15.8	Max Lead Time	38	Min Lead Time	1

Warnings Issued & Verifying LSRs:

	Issued:	Expired:	County:		Final Status:	Poly Area:	
Isr	Valid	Lead Time:	County	City	Type	Magnitude	
SV	05/05/2006 00:09	05/05/2006 00:45	Concho,TX	McCulloch,TX	NEW	2098 km^2	
Isr	05/05/2006 00:17	8 minutes	Mcculloch,TX	Melvin	Hail	1	
Isr	05/05/2006 00:32	23 minutes	Concho,TX	1 Nw Doole	Hail	1.75	
SV	05/05/2006 00:14	05/05/2006 00:45	McCulloch,TX	Mason,TX	San Saba,TX	NEW	3157 km^2
Isr	05/05/2006 00:26	12 minutes	Mcculloch,TX	Voca	Hail	0.75	
Isr	05/05/2006 00:32	18 minutes	Mason,TX	2 Ese Mason	Wind Gust	62	
Isr	05/05/2006 00:35	21 minutes	Mason,TX	8 N Mason	Hail	1.75	
SV	05/05/2006 00:29	05/05/2006 01:15	Tom Green,TX	Sterling,TX	NEW	1413 km^2	
Isr	05/05/2006 00:35	6 minutes	Sterling,TX	10 S Sterling City	Hail	2.75	
Isr	05/05/2006 00:55	26 minutes	Tom Green,TX	17 Wnw Arden	Hail	4	
SV	05/05/2006 00:31	05/05/2006 01:00	Concho,TX	Coleman,TX	McCulloch,TX	NEW	1155 km^2
TO	05/05/2006 00:42	05/05/2006 01:15	Mason,TX		NEW	794 km^2	

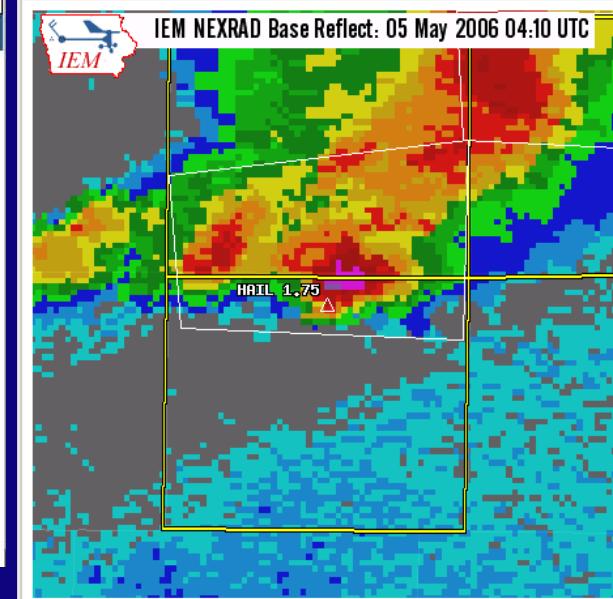


Text Product:

317
W050504 KSJT 050412
SVR317
TXC431-050445-
/0.NEW.KSJ.T.SV.W.0191.060505T0412Z-060505T0445Z/

BULLETIN - EAS ACTIVATION REQUESTED
SEVERE THUNDERSTORM WARNING
NATIONAL WEATHER SERVICE SAN ANGELO TX
1112 PM CDT THU MAY 4 2006

THE NATIONAL WEATHER SERVICE IN SAN ANGELO HAS ISSUED A
* SEVERE THUNDERSTORM WARNING FOR...
NORTHWESTERN STERLING COUNTY IN WEST CENTRAL TEXAS



IEM Website



IEM Climodat:

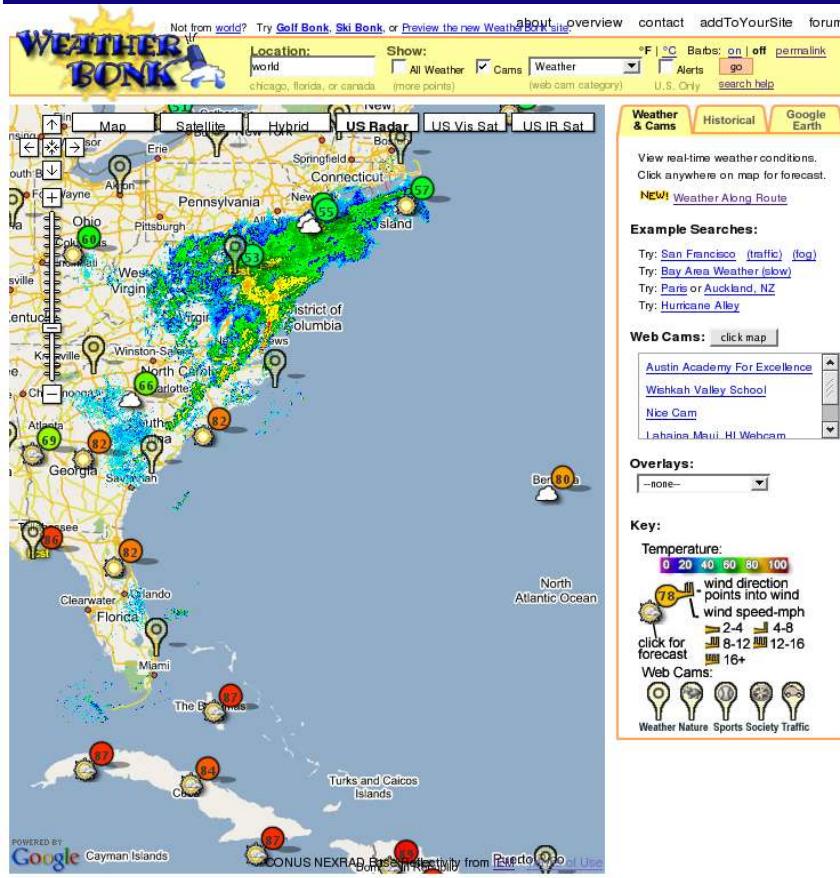
Answering the most common data questions

- Precipitation Events per Climate Week
- Twelve Significant Rainfall Events
- Growing Degree Days
- Daily Record Highs and Lows
- Daily Maximum Precipitation
- Daily Record Hi and Low Ranges
- Daily Mean Highs and Lows
- Number of Days Each Year Min ≥ 32
- Last Spring/First Fall/Length of Season
Base=32
- Last Spring/First Fall/Length of Season
Base=30
- Last Spring/First Fall/Length of Season
Base=28
- Last Spring/First Fall/Length of Season
Base=26
- Last Spring/First Fall/Length of Season
Base=24
- Monthly Average Maximum Temperatures
- Monthly Average Minimum Temperatures
- Monthly Average Mean Temperatures
- Monthly Precipitation Totals + Averages
- Monthly Heating Degree Days
- Monthly Cooling Degree Days
- Heat Stress Variables
- Monthly Rainy Days
- First Fall Freeze Probabilities
- Last Spring Freeze Probabilities

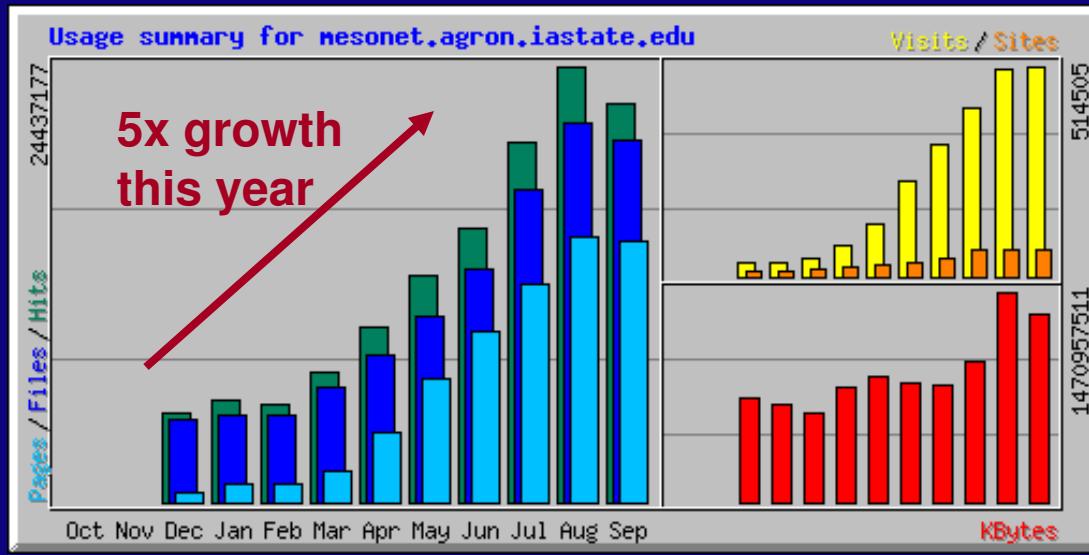


GIS Efforts

- Web services power apps like Google Maps mashups
- IEM Rainfall provides GIS ready rainfall products
- Easy to download climate normals
- Link to Oregon State PRISM data



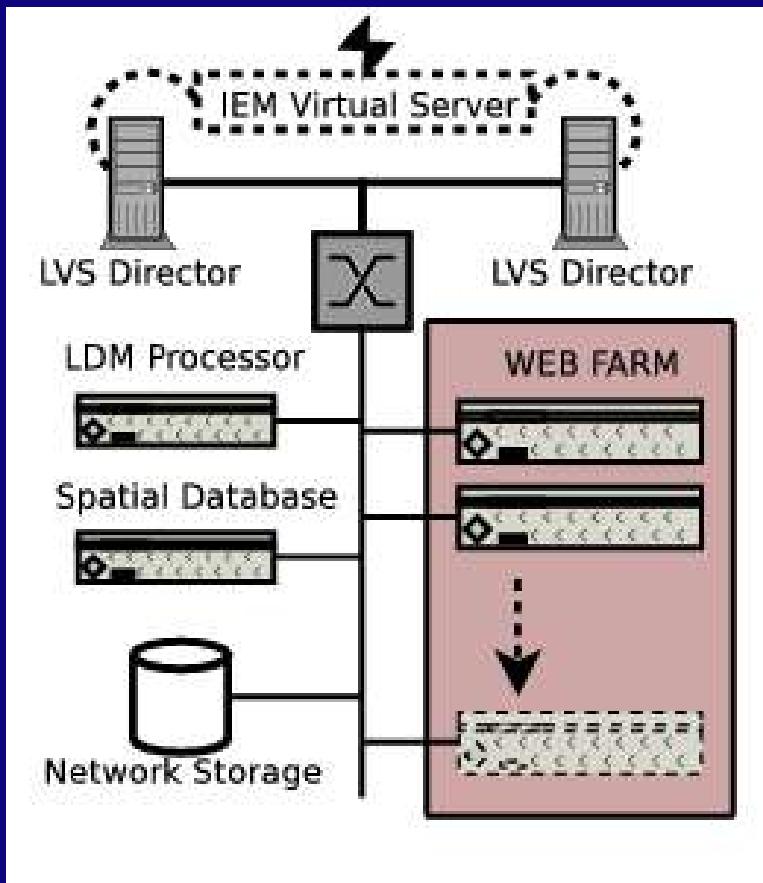
Traffic / Hits



- Average 800,000 hits per day!
- Estimated 5,000 people per day view IEM delivered content.
- #1 website on ISU campus for bandwidth



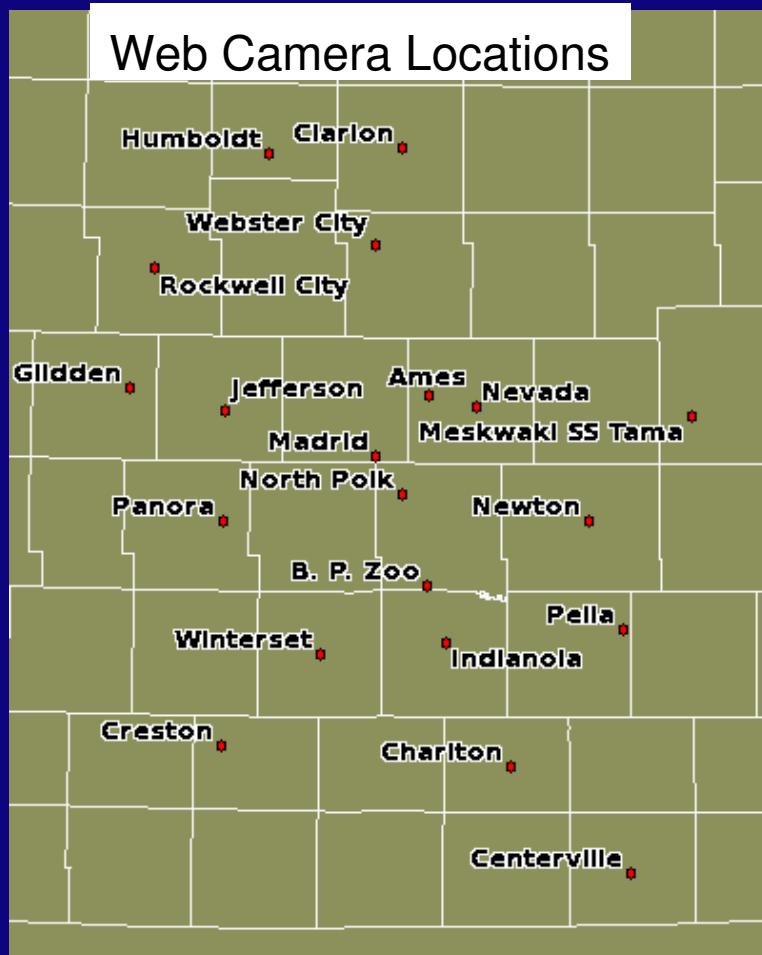
Unidata Equipment Grant



- Funding to increase IEM web service capacity
- Specifically to add a number of GIS web services (remote data access)
- Many thanks to Unidata for supporting our efforts.



Webcam Stuff



- KCCI-TV gives the IEM access to their network of 20+ web cameras

- Webcams are environmental data and actually have educational value

IEM Monkeys ensuring that their tower is actually vertical.



Who will forget 12 Nov 2005?

- Webcams captures 2.5 tornadoes live
- Recent article in BAMS on the event



Lots of educational value here:



Just showing off now....



IEM developed software to have the cameras automatically track the sun and the moon. Can track NEXRAD identified storms as well!



Honorable mention

- Pavement design project, ISU & DOT
 - Modeling pavement conditions using IEM climate data
- Iowa Agro-Ecozones
 - Carol Williams, ISU
- XML databases
 - Shashi Gadia et al, ISU
- IEM delivered Road Conditions
 - Shameless display of IEM logo on local TV stations



All done, any questions?

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