WEPS NRCS Implementation Issues: Resolved

Larry Wagner

USDA- ARS

Engineering and Wind Erosion Research Unit

Manhattan, Kansas

ISELE, Anchorage, AK
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Engineering and Wind Erosion Research Unit

WEPS History

- 1984 - Conceived as a replacement for WEQ due to customer requests for improved wind erosion technology
- Under development ever since
  - 2005 - Delivered WEPS to NRCS for testing
  - 2008 - Delivered WEPS to NRCS database population
  - 2010 - Accepted by NRCS for implementation
  - 2011 - Installed on computers in 2200 field offices

WEPS Desired Features

- 1991 – NRCS User Requirements Document
  - Process based (as opposed to empirical WEQ)
  - Simple to use interface (ease of use)
  - Quick results (computational runtime)
  - Use NRCS national databases (soil)
  - Applicable to broad range of cropland conditions
  - Provide additional output beyond average T/ac/yr

WEPS Handoffs to NRCS

- April 4, 2005 – Testing and Evaluation
  - Science code complete
  - Interface fully usable
  - Tested by NRCS (6 regions nationwide)
- Feb 26, 2008 – Training & Database Population
  - Databases required populating for national use
  - Additional testing

NRCS Testing Evaluations

- Runtime too slow
- Desired to“specify” yield before WEPS run
- Wanted known yield to harvest residue ratios
- Interface too “cluttered”
- Databases needed vetting and populating
- Add Energy Calculator and SCI to WEPS

WEPS Runtime Constraints

- Original "WEPS Requirements Document" runtime specification was "30 minutes"
  - Time to plan & complete manual WEQ calculation
  - Typical PC at the time
    - 8088 processor
    - Floppy drive system
    - No standard hardware floating point support ($200)
- NRCS continually revised runtime requirement
    - 5 minutes for obtaining and selecting inputs
    - 30 seconds per rotation year simulation

WEPS Runtime Constraints

- 2006 – WEPS could not meet desired runtime
  - number of simulation years reduced to 15 years per management rotation year
  - 80-90% of runtime was consumed in Hydrology
    - "Darcy" water balance routines
- Current NRCS WEPS Release
  - Number of simulation years set to 50 yrs/rot yr

WEPS Runtime Constraints

- Decided to use WEPP hydrology
  - Computationally faster (tipping bucket approach)
  - Introduced lots of side effects within model
    - No simulation of upward water movement due to evapotranspiration in upper layers
    - No diurnal “rewetting” and drying of soil surface
  - Took about a year to modify other WEPS components to compensate for WEPP hydrology differences (Soil and Plant growth submodels)

Yield as an Input

- WEPS designed to reflect variability in yield and biomass production from year to year
  - Average weather/crop yield conditions DO NOT produce average wind erosion soil loss
  - WEPS "grows" crop based upon water availability
  - Therefore, it cannot inherently know the actual longterm average yield prior to a WEPS run
    - Climate variability
    - Management effects on water conservation
    - Soil water holding capacity differences

Yield as an Input

- To address this issue, a “Yield Calibration” option was added to the WEPS interface
  - Iteratively makes WEPS runs until the average yield is within 5% of the specified crop yield
  - Increases runtime for “calibration” runs due to multiple runs normally getting executed for the iterative solution
  - If used incorrectly, one can defeat WEPS ability to reflect differences in soils, climate and management practices

Fixed relationship for yield to biomass ratio

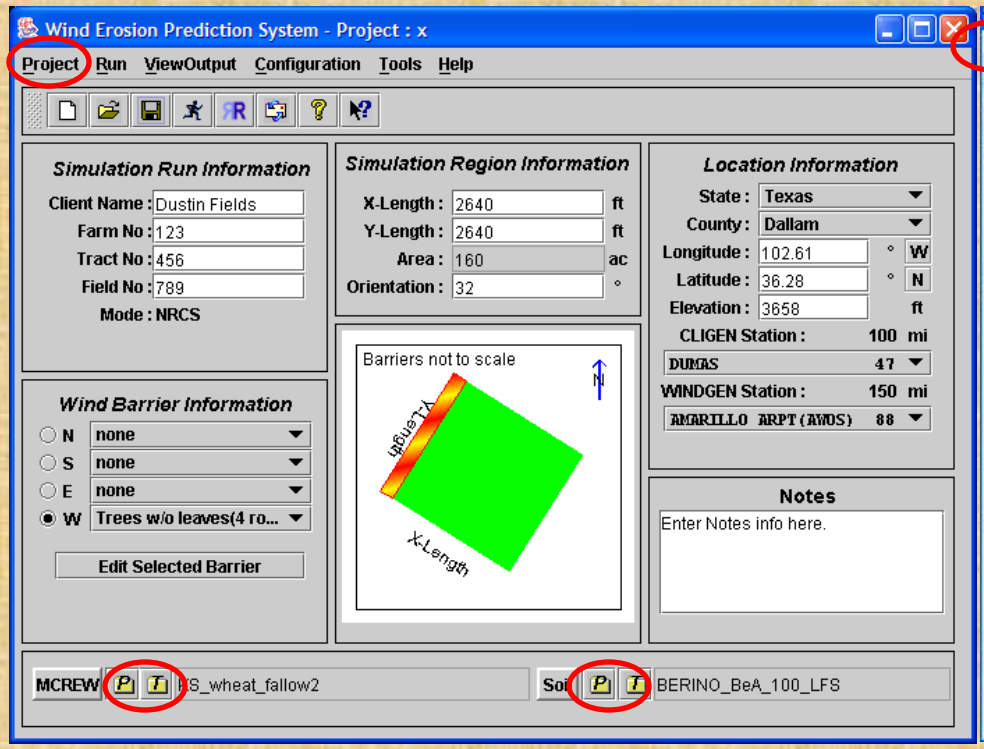
- In addition, NRCS also wanted the yield to follow a fixed relationship with the above ground biomass produced
  - Previously, WEPS only "grew" above ground biomass (stem/leaves) independent of reproductive "yield"
  - Ability to configure an individual plant growth record to not use a fixed relationship yield:harvest ratio, if desired
  - Ability to override this feature for all plant growth records as a cmdline option is available in WEPS

WEPS NRCS Interface Issues

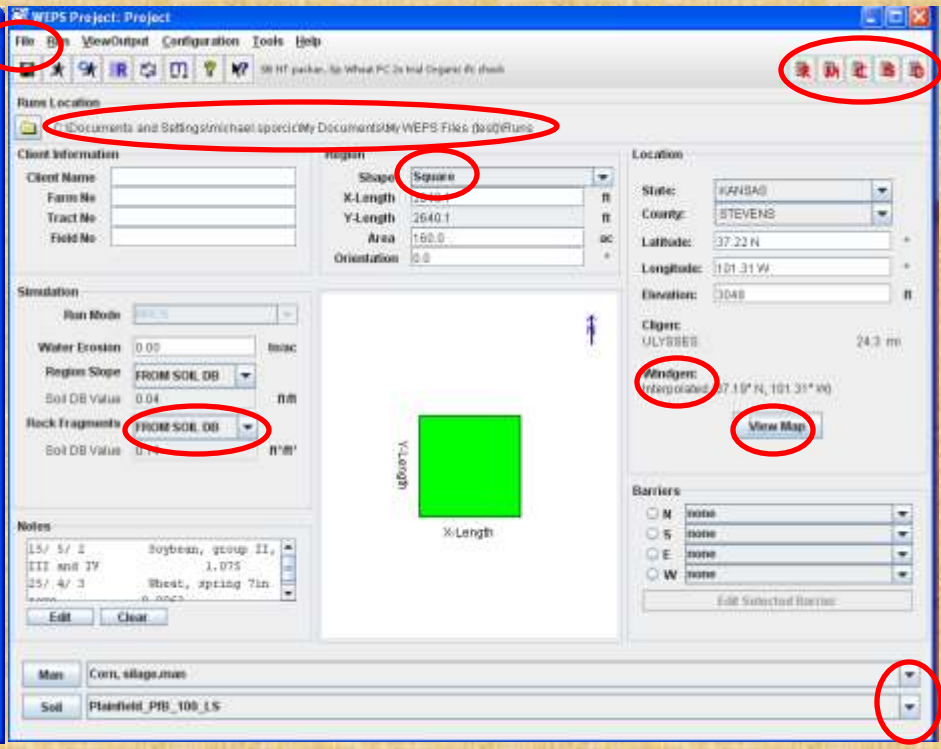
- Interface too complicated
  - Extra functionality built into interface caused confusion for NRCS WEPS trainees
  - Removed features deemed unnecessary by NRCS
    - Hid or disabled by default numerous interface features
    - WEPS only requires 4 inputs
      - Field Information (size, shape and orientation)
      - Location (automatically determines climate files)
      - Management
      - Soil

WEPS Main Interface Improvements

Old Interface



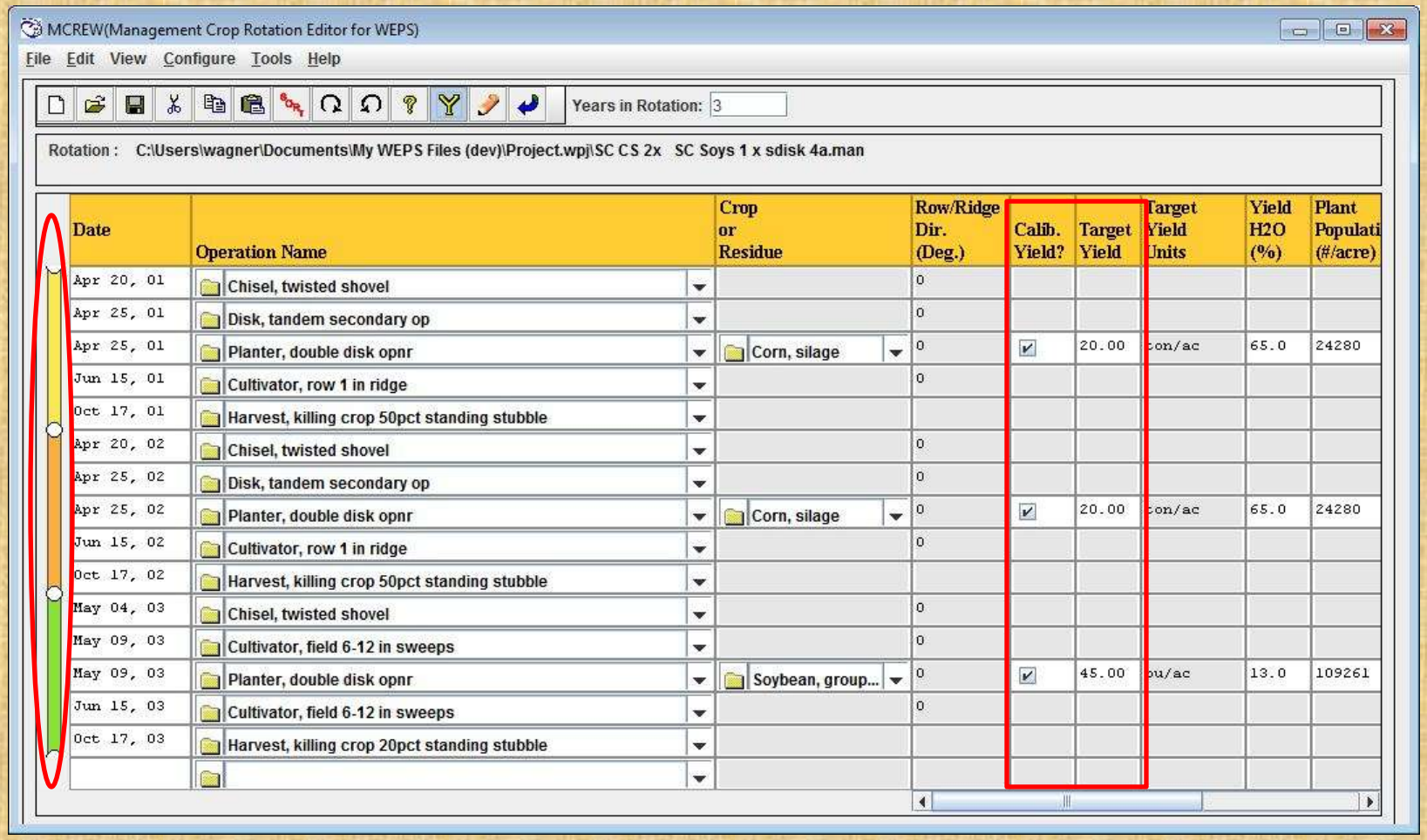
Current Interface



MCREW Interface Complaints

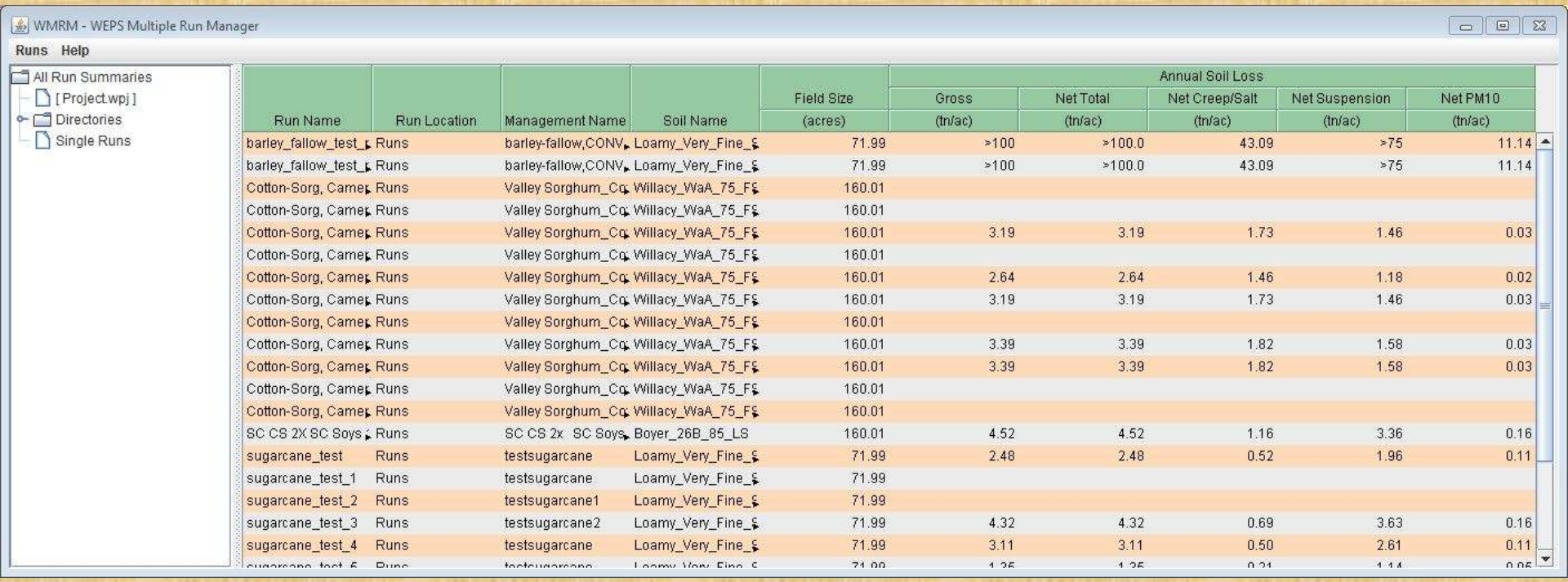
- Enhanced MCREW functionality to better serve NRCS needs
  - Provided ability to hide or make read-only specific drilldown accessible management operation, crop growth and decomposition rate parameters
  - Provided ability to convert RUSLE2 “Crop Management Zone” rotation files for use with WEPS
  - Visually displays “crop rotation segments”

MCREW Interface Enhancements



WEPS Output Reviewing Enhancements

- Display results summary of multiple WEPS Runs



Run Name	Run Location	Management Name	Soil Name	Field Size (acres)	Annual Soil Loss Gross (tn/ac)	Net Total (tn/ac)	Net Creep/Salt (tn/ac)	Net Suspension (tn/ac)	Net PM10 (tn/ac)
barley_fallow_test_	Runs	barley-fallow,CONV	Loamy_Very_Fine_S	71.99	>100	>100.0	43.09	>75	11.14
barley_fallow_test_	Runs	barley-fallow,CONV	Loamy_Very_Fine_S	71.99	>100	>100.0	43.09	>75	11.14
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01					
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01					
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01	3.19	3.19	1.73	1.46	0.03
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01					
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01	2.64	2.64	1.46	1.18	0.02
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01	3.19	3.19	1.73	1.46	0.03
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01					
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01	3.39	3.39	1.82	1.58	0.03
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01	3.39	3.39	1.82	1.58	0.03
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01					
Cotton-Sorg, Camel	Runs	Valley Sorghum_Co	Willacy_WaA_75_FS	160.01					
SC CS 2X SC Soys	Runs	SC CS 2x SC Soys	Boyer_26B_85_LS	160.01	4.52	4.52	1.16	3.36	0.16
sugarcane_test	Runs	testsugarcane	Loamy_Very_Fine_S	71.99	2.48	2.48	0.52	1.96	0.11
sugarcane_test_1	Runs	testsugarcane	Loamy_Very_Fine_S	71.99					
sugarcane_test_2	Runs	testsugarcane1	Loamy_Very_Fine_S	71.99					
sugarcane_test_3	Runs	testsugarcane2	Loamy_Very_Fine_S	71.99	4.32	4.32	0.69	3.63	0.16
sugarcane_test_4	Runs	testsugarcane	Loamy_Very_Fine_S	71.99	3.11	3.11	0.50	2.61	0.11

WEPS Output Report Changes

- Revised WEPS default “Summary Report” per NRCS requests to include additional information
  - Included management report detail
  - Included crop summary report
  - Included Energy Calculator and SCI reports
- Auto-generate PDF files of all reports
- Provide capability to print any WEPS reports

WEPS Database Deficiencies

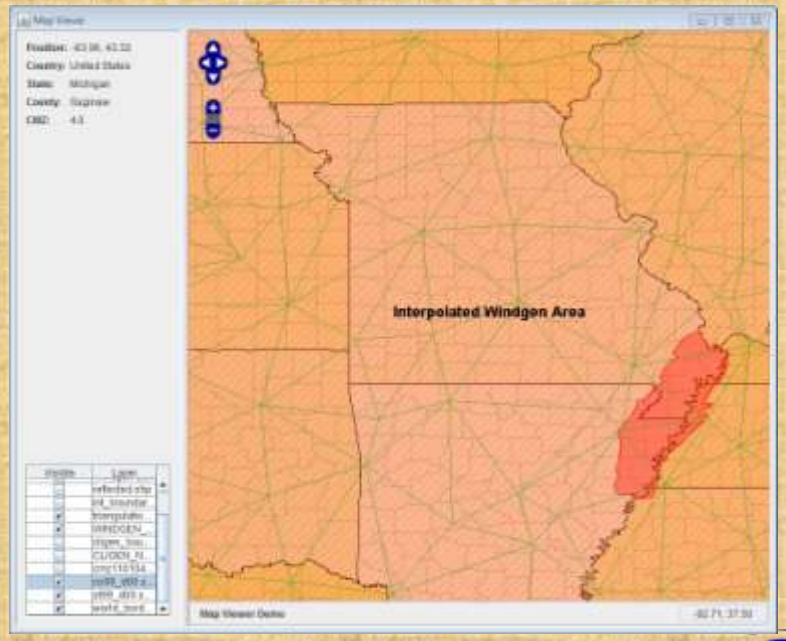
- Updated the Windgen station data using "NOAA quality control vetted" records
- Regenerated Cligen station data from newer historical meteorological data and corrected deficiencies in the station generation code
- Fully populated the wind barrier database
- Provided a station "interpolation" method for generating windgen station records in sparsely populated regions

WEPS Database Deficiencies

- Provided a method for NRCS to define "polygon" regions with assigned climate stations for use where the nearest station and interpolated station approaches were not adequate
- Provided a full GIS compatible viewing package to visually see the extent of and where these polygon regions were located

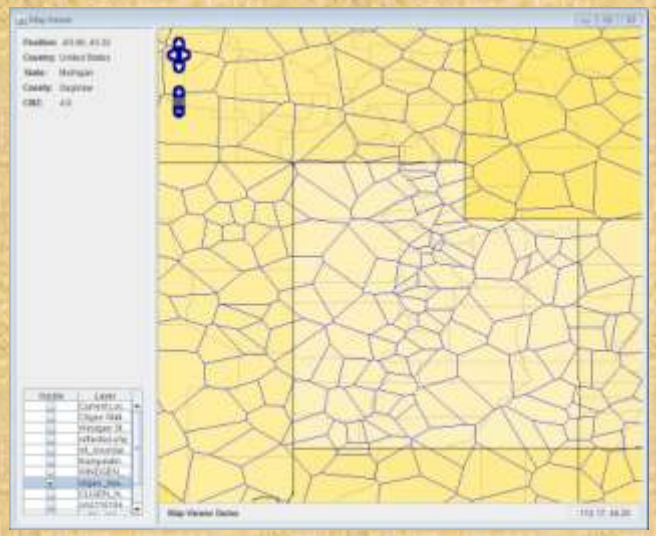
Windgen

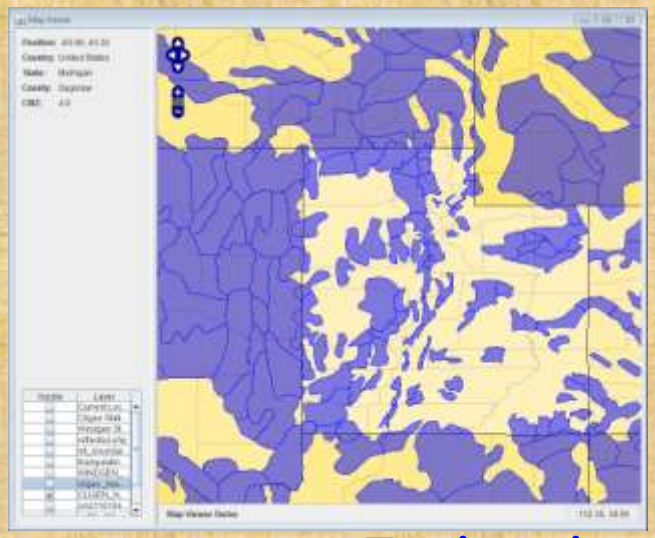
- Started with 1051 wind stations (Windgen) and NRCS rejected 302
- 23 new Windgen stations developed from NARR data for western states



Cligen

- Started with 2658 climate stations (Cligen) for temperature and precipitation and added 68 in the western states using Rock:Clim from FS
- Quality checked the original Cligen data sources and rebuilt the Cligen database





WEPS Databases

- 308 Operations – To simulate tillage, harvest, grazing, spraying and manure application
- 235 Crops – To simulate growing crops in all of the US including HI and AK
- 25,000 Management – Template files originally developed for RUSLE2 by Crop Management Zone region
- Soil – Obtained over Internet from NRCS SoilDataMart website

Summary

- Lots of work went into the science behind WEPS and the development of the simulation model code
- An equivalent effort has gone into the WEPS interface and database development and population of them