Wind Erosion Prediction System Introduction

NRCS Train the Trainer Session

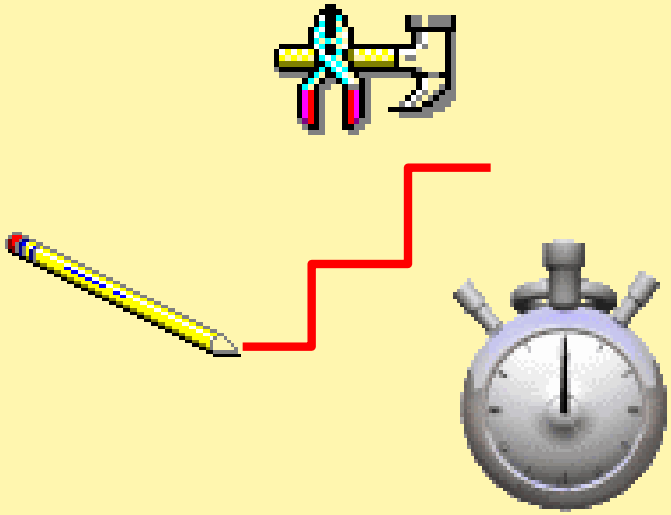
WEPS

Wind Erosion Prediction System

Process-based

Daily time-step

Wind erosion model



Why was WEPS Developed?

- **Wind Erosion Equation (WEQ) does not predict wind erosion where erosion is observed in some areas.**
- **There is a need for more information about wind erosion than just rotational average tons/acre/year we get now.**
- **There is a need for an easier to use and a faster model.**

Who was Involved?

Multi-agency Government Commitment

ARS

BLM

NRCS

EPA

Wind Erosion Equation WEQ

1965

- E = f (I, K, C, L, V)
  - I = soil erodibility
  - K = soil ridge roughness
  - C = climatic factor
  - L = field length
  - V = vegetative factor

Where are the Factors in WEPS?

Soil Erodibility - I Factor

- Surface Aggregation
  - Size Distribution
  - Dry stability
- Crusted Surface
  - Cover fraction
  - Stability and thickness
  - Loose, erodible material on crust

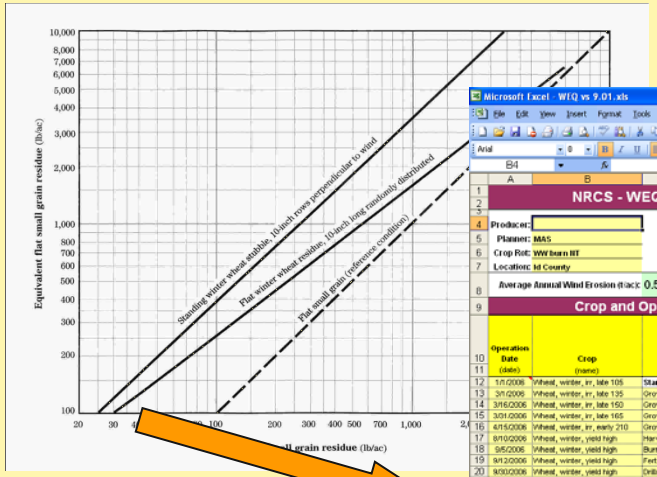
Where are the Factors in WEPS?

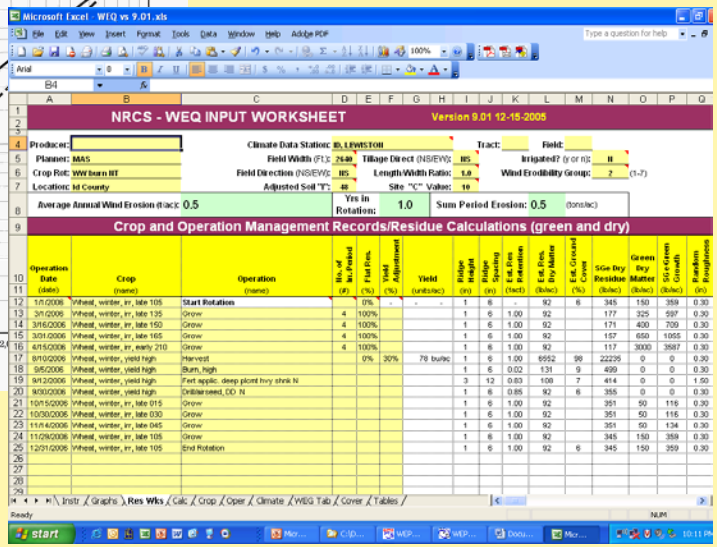
Soil Ridge Roughness - K Factor

- **Surface Roughness**
  - **Random**
  - **Oriented (Ridges & Dikes)**
  - **Ridge Direction**

Why is WEPS Needed?

From Charts and Spreadsheets to





To replace the older (1965) technology of WEQ

A modern process based model

Why is WEPS Needed?

Provide more accurate assessments of soil loss from agricultural fields

Why is WEPS Needed?

Better tool for designing efficient, cost-effective erosion control systems

Why is WEPS Needed?

Provide additional quantitative information besides just average annual soil loss

Why is WEPS Needed?

Provide additional prediction capabilities not available with current technology

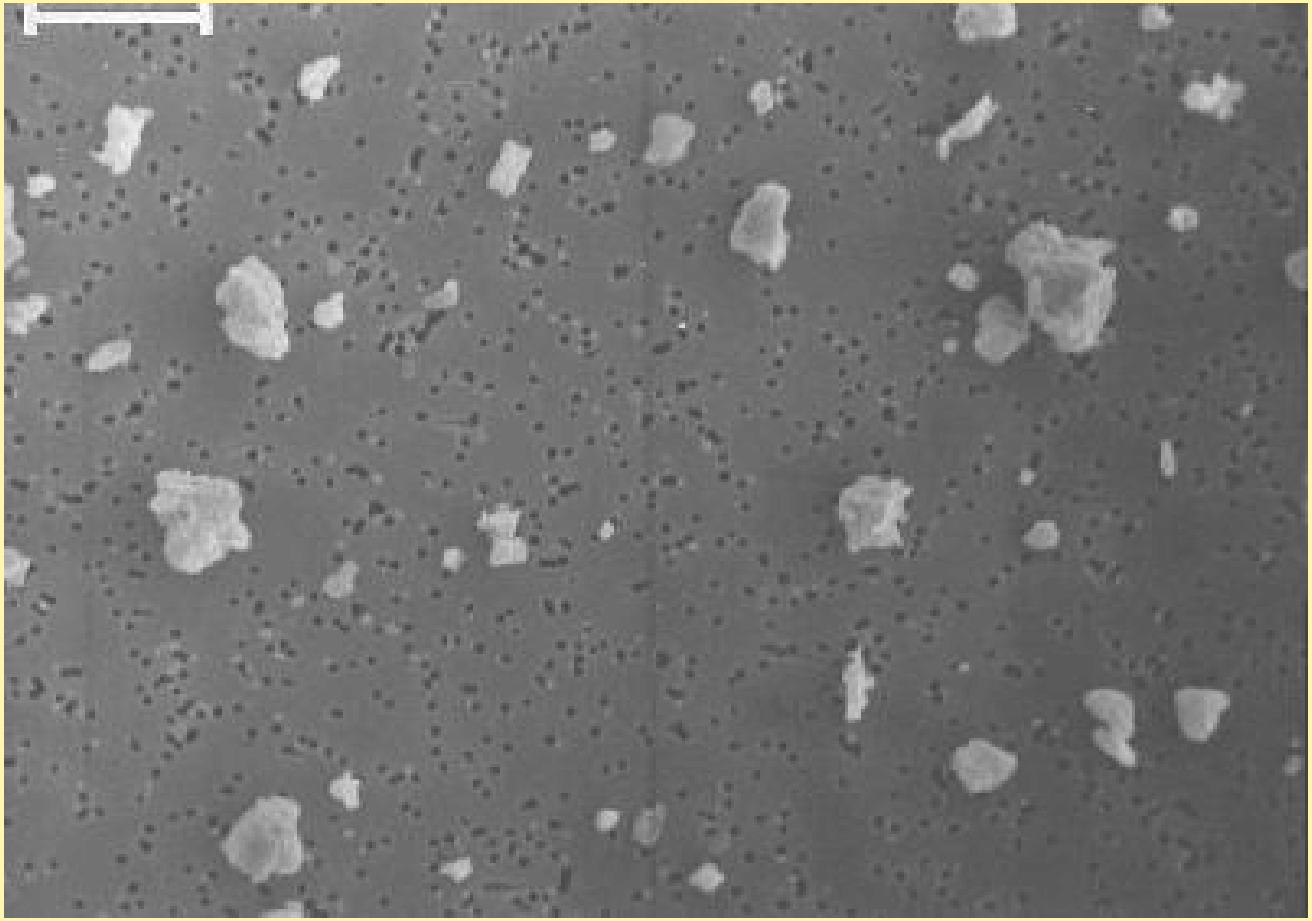
Why is WEPS Needed?

Estimate soil loss by wind across individual field boundaries

Why is WEPS Needed?

Estimate suspension soil losses and their direction

Why is WEPS Needed?



- Estimate PM-10 emissions
- In the future, (with funding), PM-2.5 and Operation Dust

Why is WEPS Needed?

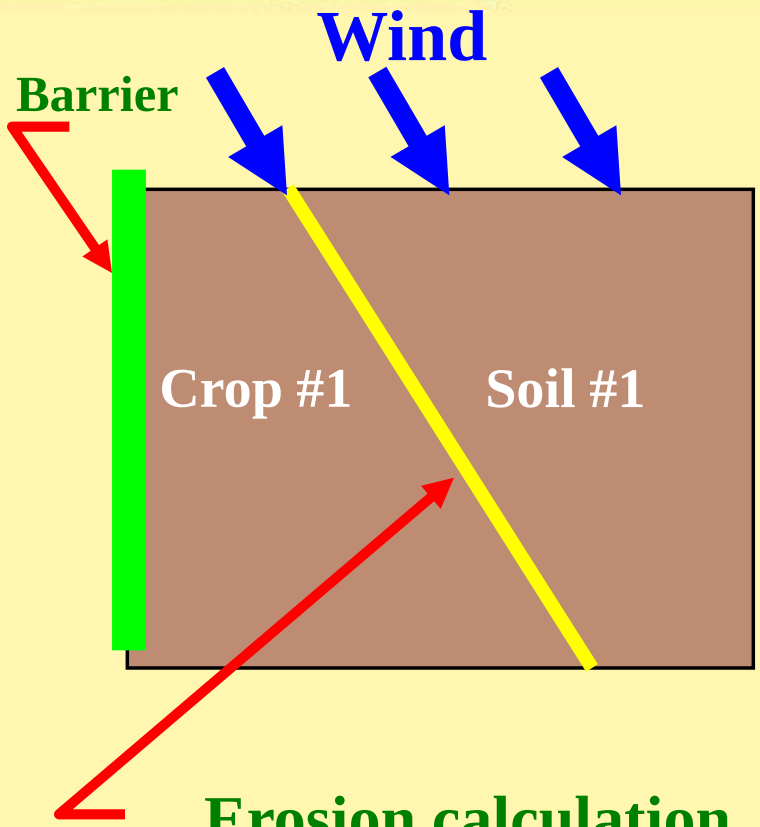
Determine offsite impacts

What is the Purpose of WEPS?

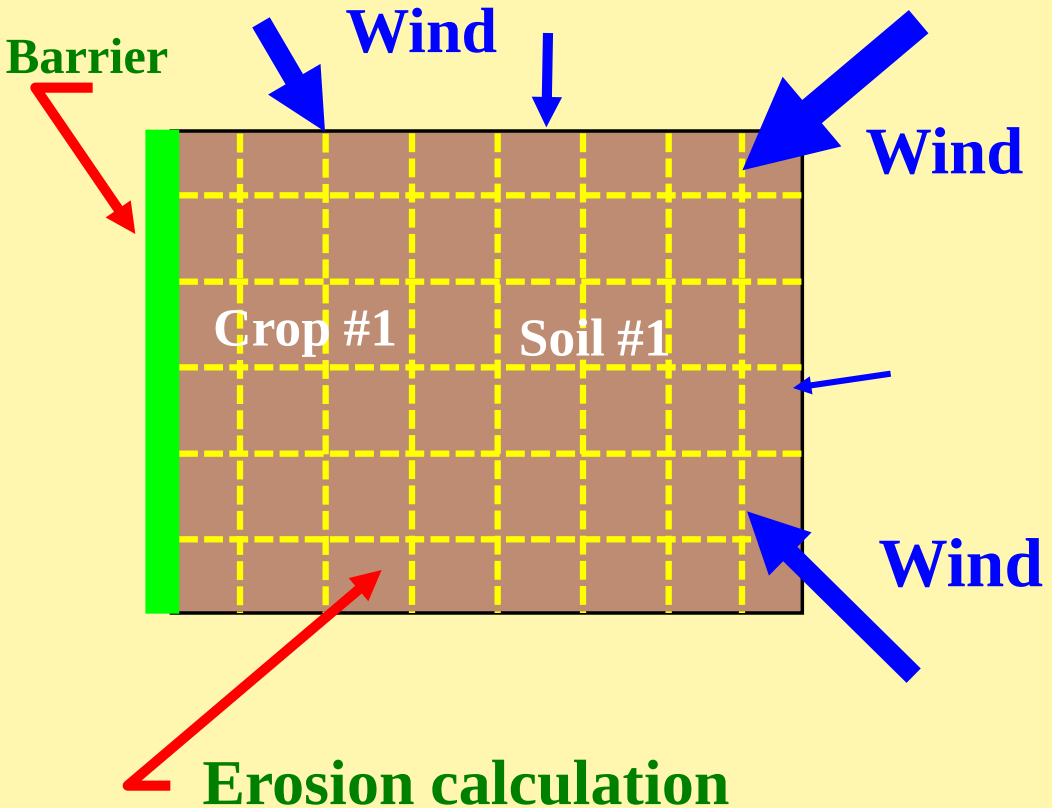
- Planning soil conservation systems
- Aid in environmental planning and assessment evaluations
- To estimate offsite impacts of wind erosion

WEQ

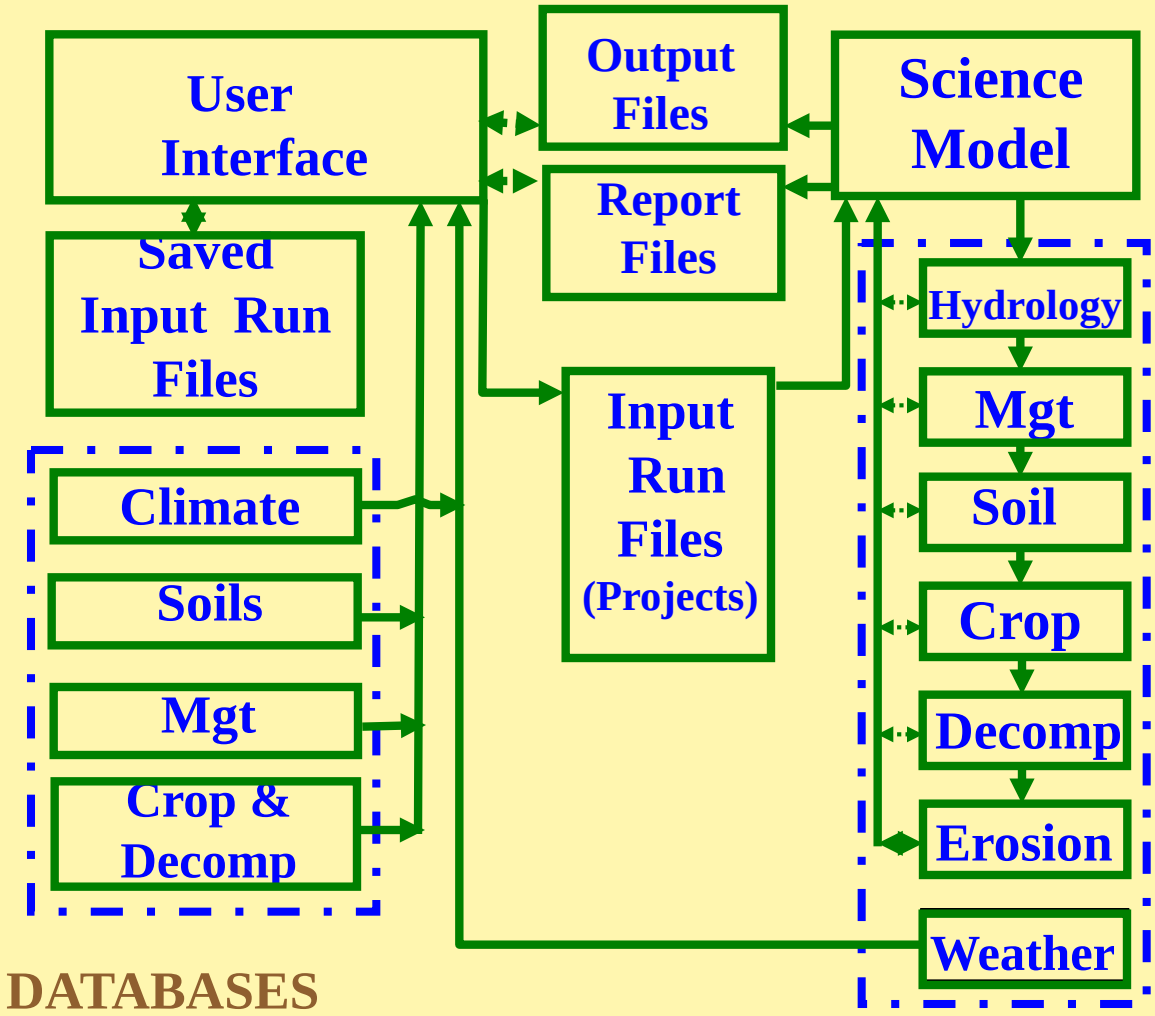
WEPS



Erosion calculation made along a ***Linear Transect***



Erosion calculation made for ***Grid Areas***


User Interface
Output Files
Science Model
Report Files
Saved Input Run Files
Input Run Files (Projects)
Hydrology
Mgt
Soil
Crop
Decomp
Erosion
Weather
Climate
Soils
Mgt
Crop & Decomp
SUBMODELS
DATABASES

WEPS Weather

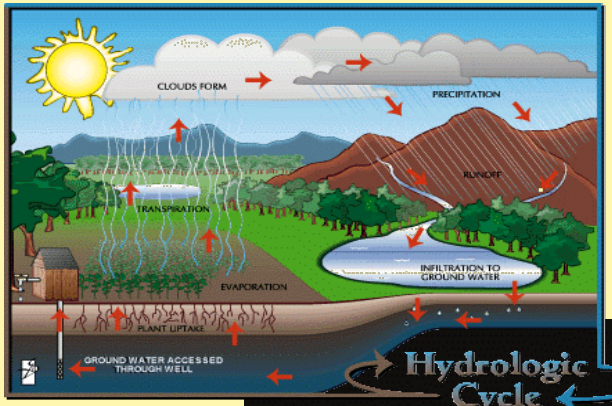
Purpose

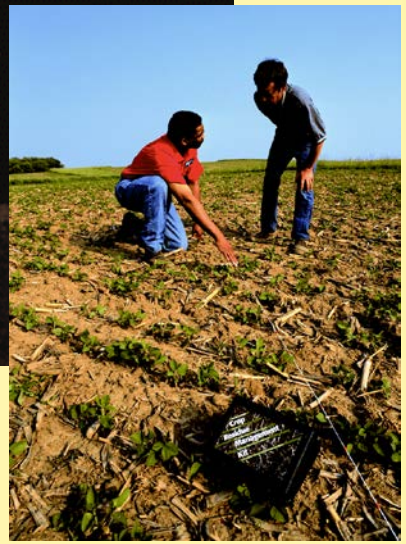
Drives the fundamental physical processes simulated by WEPS

WEPS Simulates Daily Changes in Field Conditions

- Soil aggregation
- Surface wetness
- Surface roughness
- Residue status (standing/flat)

WEPS Simulates Processes Driven by Daily Weather





- Water Balance
- Crop Growth
- Residue Decomposition

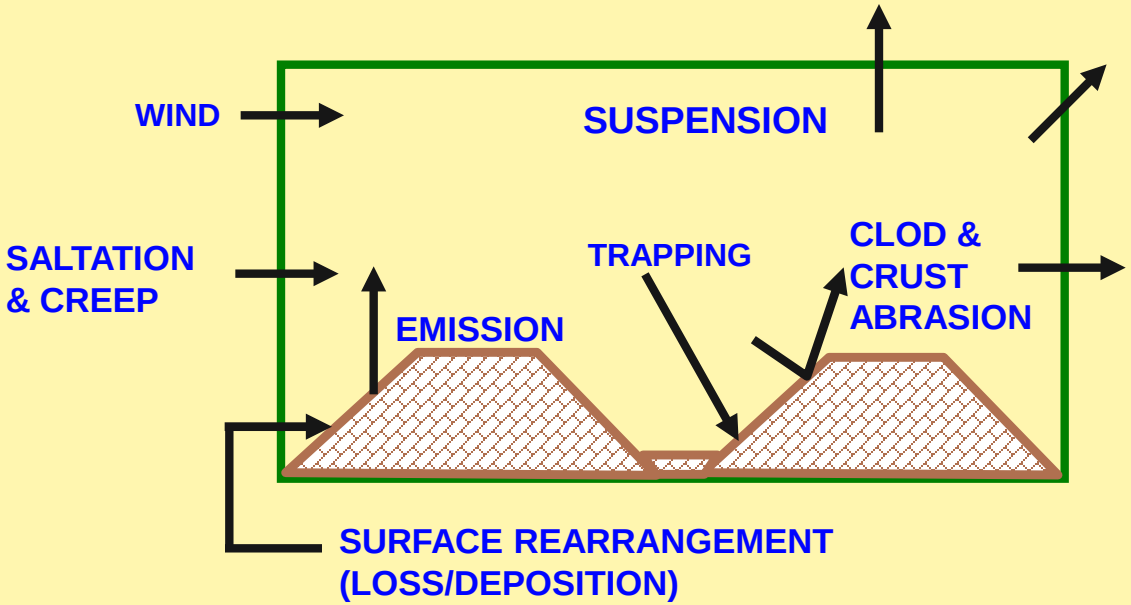
WEPS Simulates Common Management Practices

- Tillage
- Planting
- Irrigation
- Harvesting
- Burning
- Mulching
- Manure App.





WEPS Simulates Wind Erosion Processes

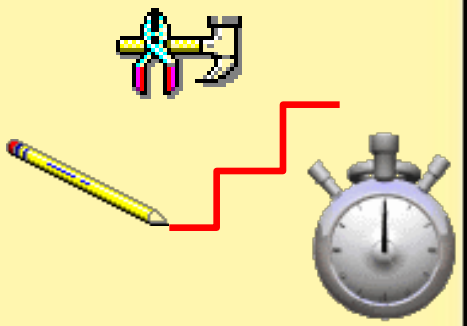


- **Detachment**
- **Transport**
- **Deposition**

WEPS Output Flexibility

	WEPS	WEQ
Annual soil loss	✔	✔
Period soil loss	✔	✔
Saltation/Creep	✔	
Suspension	✔	
PM-10	✔	
Surface conditions	✔	✔ Limited
Wind energy	✔	
Boundary loss	✔	

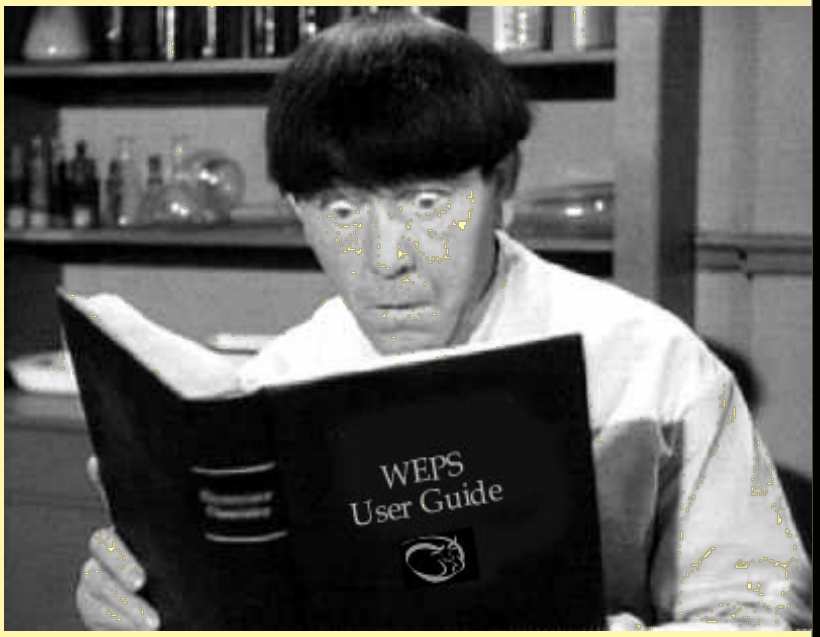
What is WEPS 1.0?



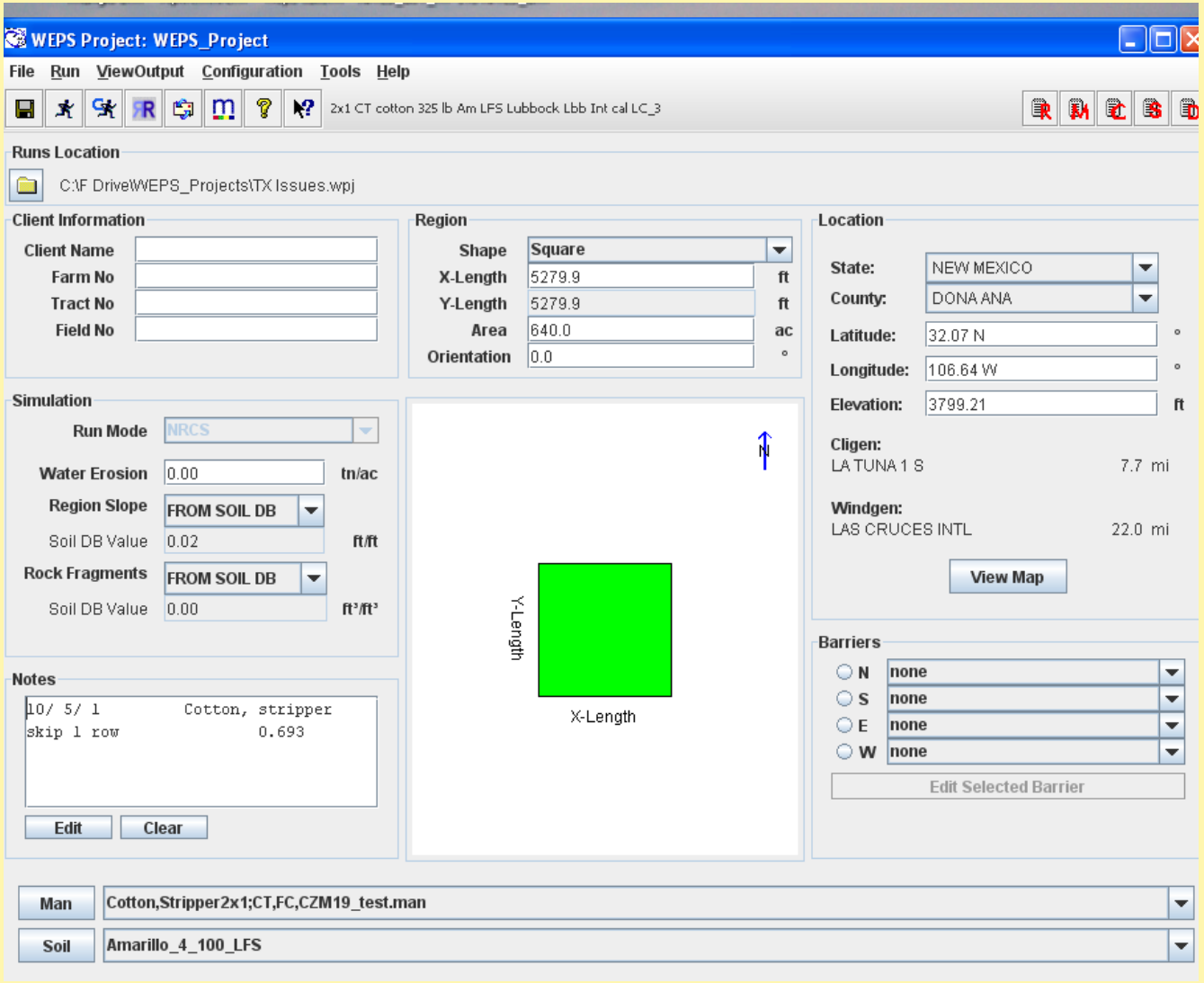
First Version of processed-based daily time-step Wind Erosion Science Model

WITH

A Simplified Graphical User Interface and Sample Databases



WEPS 1.0 Interface

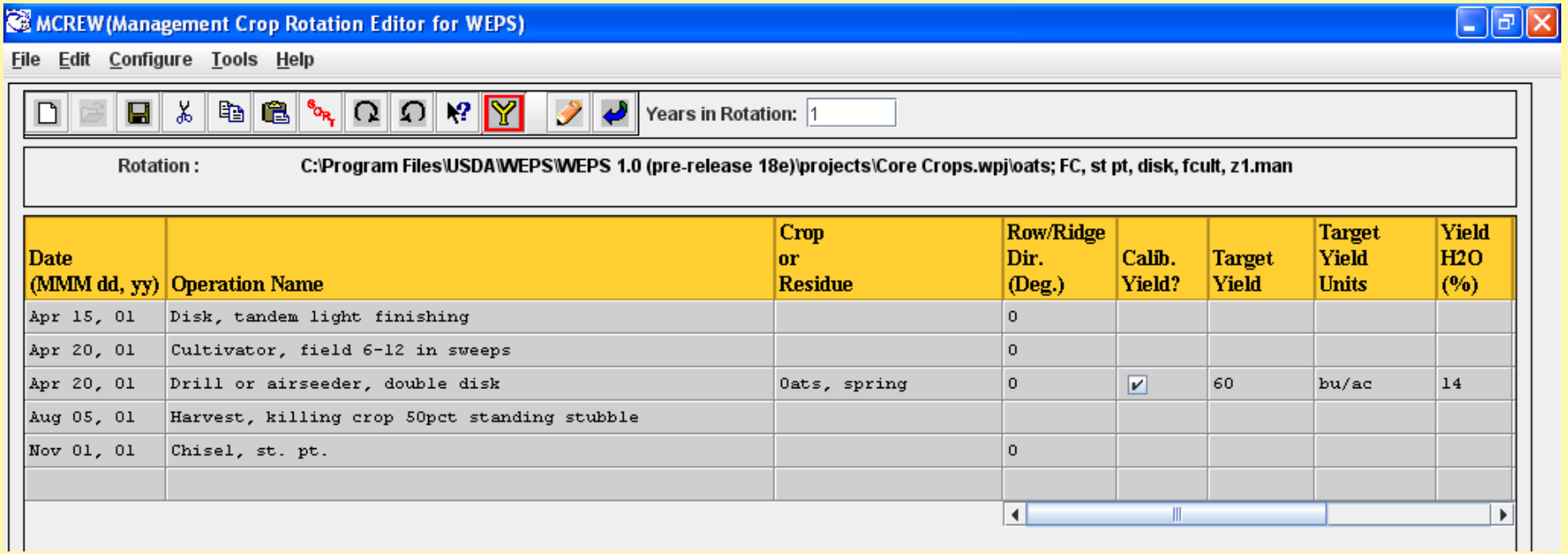


Specify:

- **Region**
- **Location**
- **Soil**
- **Mgt**
- **Barriers**
  (if used)

WEPS 1.0 Interface

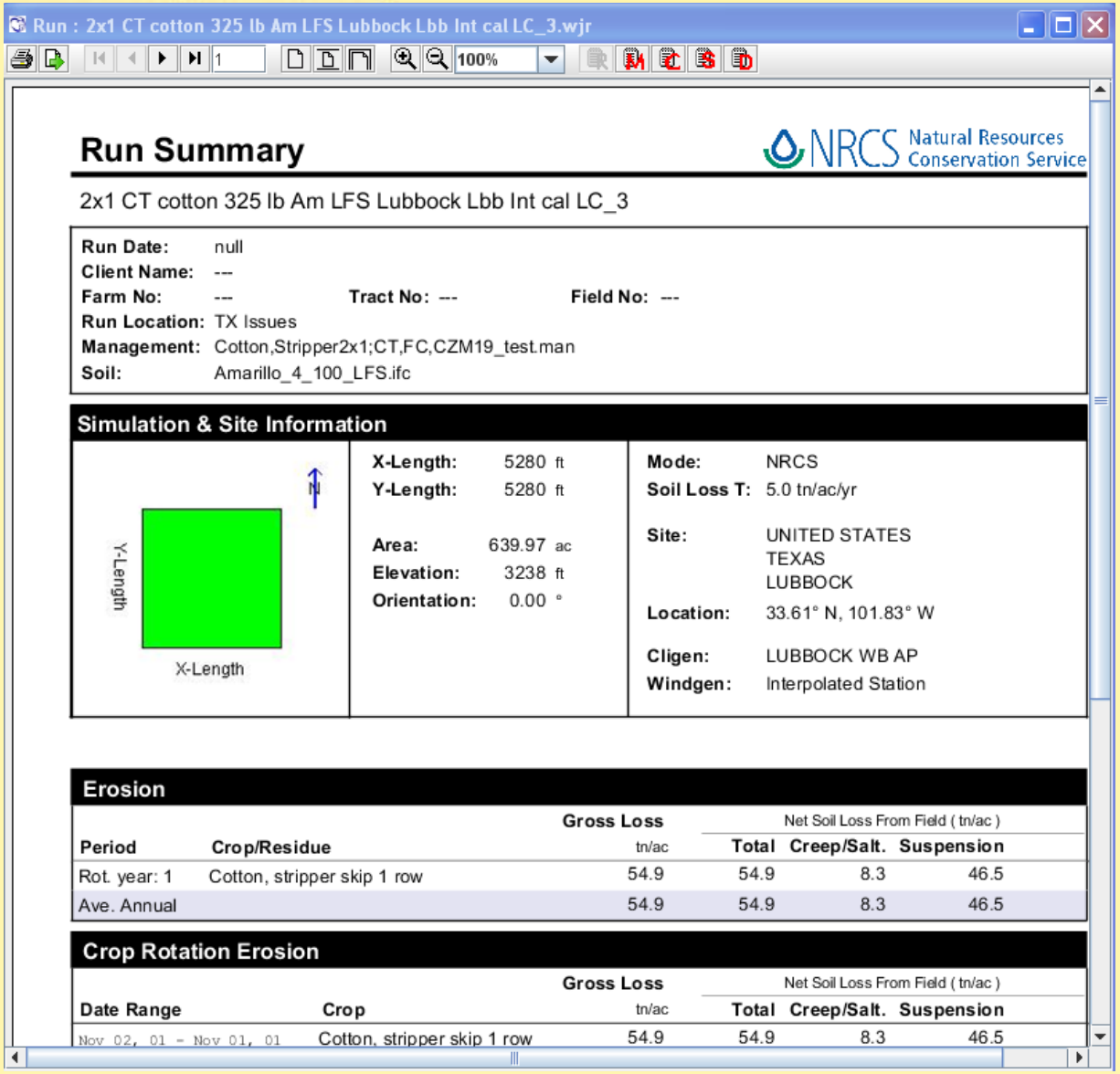
Management/Crop Rotation Editor for WEPS (MCREW)



Date (MMM dd, yy)	Operation Name	Crop or Residue	Row/Ridge Dir. (Deg.)	Calib. Yield?	Target Yield	Target Yield Units	Yield H2O (%)
Apr 15, 01	Disk, tandem light finishing		0				
Apr 20, 01	Cultivator, field 6-12 in sweeps		0				
Apr 20, 01	Drill or airseeder, double disk	Oats, spring	0	☑	60	bu/ac	14
Aug 05, 01	Harvest, killing crop 50pct standing stubble						
Nov 01, 01	Chisel, st. pt.		0				

Dates, Operations, & Crops

WEPS 1.0 Outputs


Run : 2x1 CT cotton 325 lb Am LFS Lubbock Lbb Int cal LC_3.wjr

Run Summary

NRCS Natural Resources Conservation Service

2x1 CT cotton 325 lb Am LFS Lubbock Lbb Int cal LC_3

Run Date: null
Client Name: ---
Farm No: --- **Tract No:** --- **Field No:** ---
Run Location: TX Issues
Management: Cotton,Stripper2x1;CT,FC,CZM19_test.man
Soil: Amarillo_4_100_LFS.ifc

Simulation & Site Information

X-Length:	5280 ft	Mode:	NRCS
Y-Length:	5280 ft	Soil Loss T:	5.0 tn/ac/yr
Area:	639.97 ac	Site:	UNITED STATES TEXAS LUBBOCK
Elevation:	3238 ft	Location:	33.61° N, 101.83° W
Orientation:	0.00 °	Cligen:	LUBBOCK WB AP
		Windgen:	Interpolated Station

Erosion

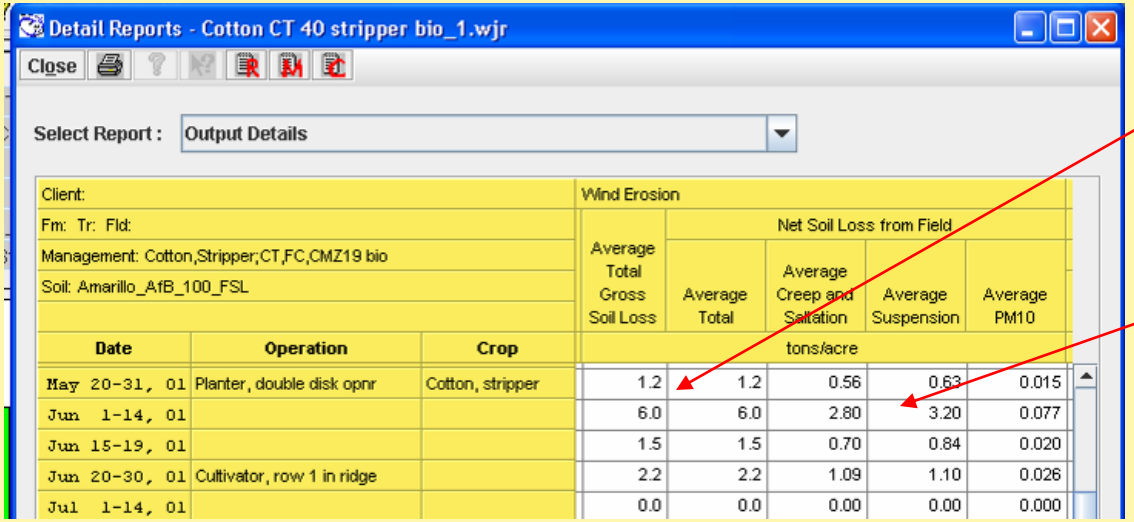
Period	Crop/Residue	Gross Loss tn/ac	Net Soil Loss From Field (tn/ac) Total	Creep/Salt.	Suspension
Rot. year: 1	Cotton, stripper skip 1 row	54.9	54.9	8.3	46.5
Ave. Annual		54.9	54.9	8.3	46.5

Crop Rotation Erosion

Date Range	Crop	Gross Loss tn/ac	Net Soil Loss From Field (tn/ac) Total	Creep/Salt.	Suspension
Nov 02, 01 - Nov 01, 01	Cotton, stripper skip 1 row	54.9	54.9	8.3	46.5

- **Run Summary**
  - **Simulation & Site Infor**
  - **Erosion**
  - **Crop Rot. Erosion**
  - **Harvest**
  - **SCI Summary**
  - **Rot. Stir Energy**
  - **Crop Rot. Stir Energy**

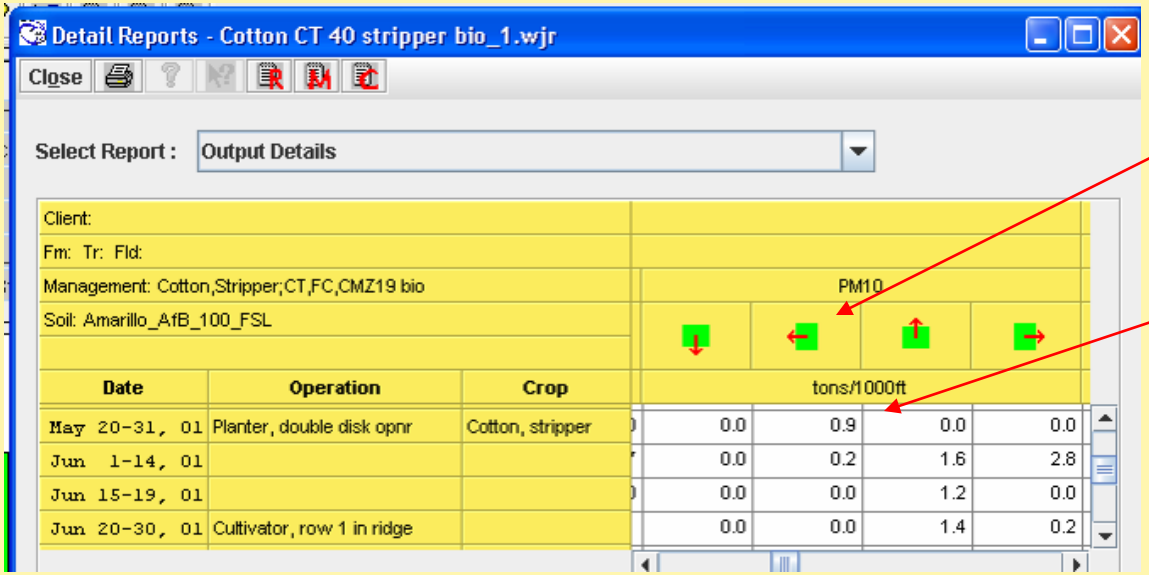
WEPS 1.0 Outputs (cont.)



- **Detail Output**

Net soil loss by period

Net soil loss by type
Creep & Saltation, Suspension, and PM10

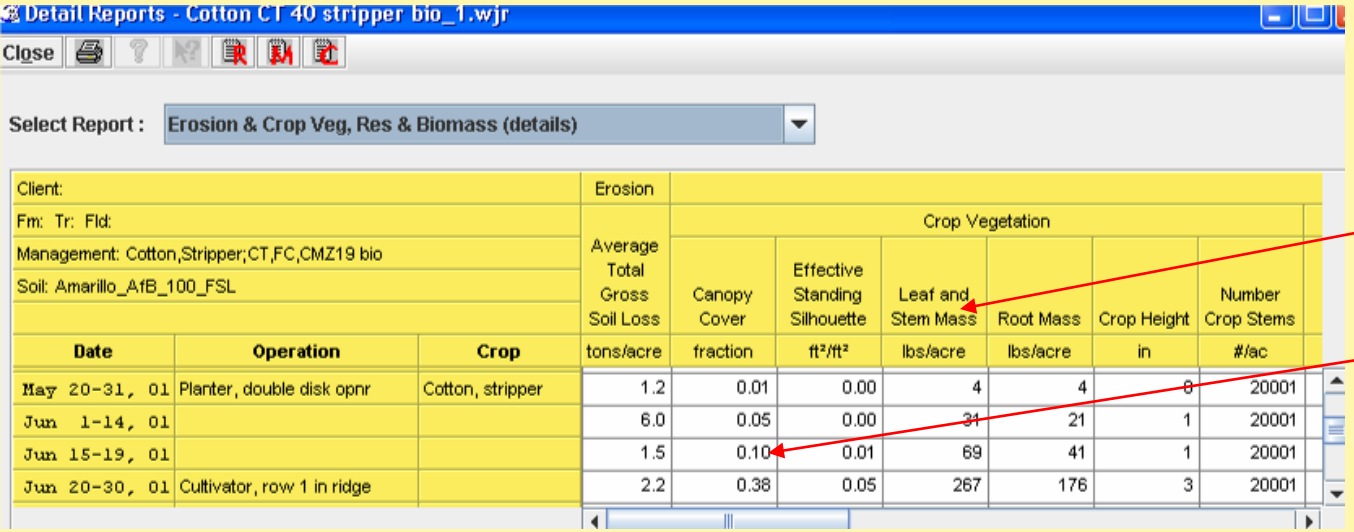


- **Detail Output**

PM10 loss each side of the field

PM10 loss by period per 1000 ft of field edge

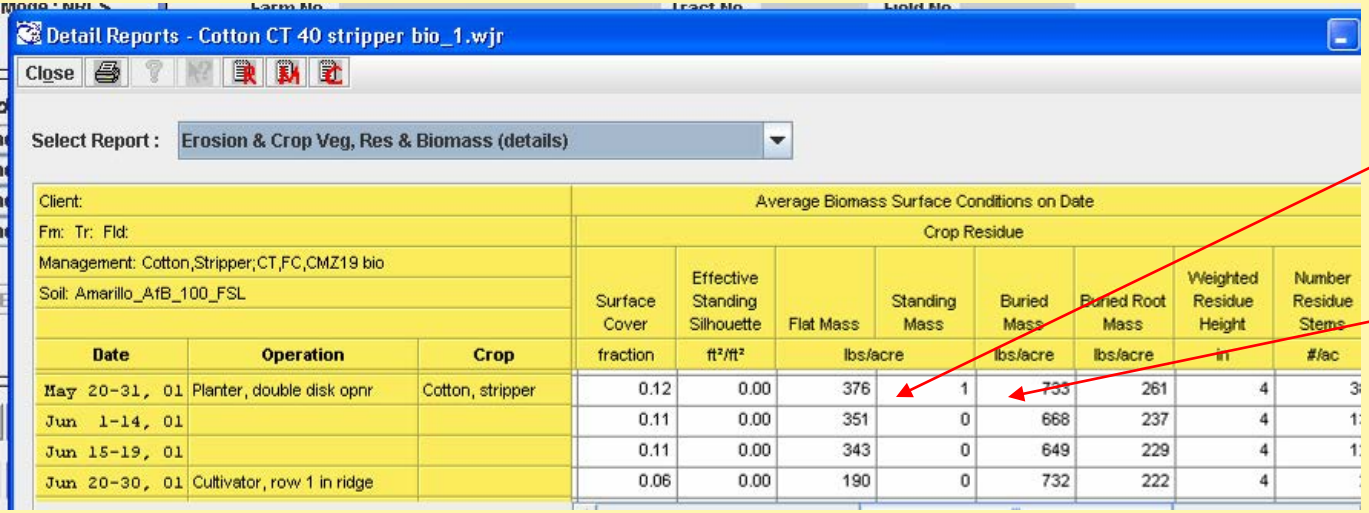
WEPS 1.0 Outputs (cont.)



- **Detail Output**

Crop Growth

Canopy Cover



- **Detail Output**

Crop Residue Flat Mass

Crop Residue Standing

WEPS Database Needs

- Climate Data
  - Wind (Windgen)
  - Weather (Cligen)
- Management Practices Data
  - Management
  - Operations
  - Crop
  - Wind Barrier Data
- Soils Data

WEPS 1.0 Databases

Climate Data (Windgen & Cligen)

- **Databases**
  - Compact & national in coverage
- **Generators**
  - Hourly speed and daily direction from Windgen
  - Daily weather data from Cligen
- **More information**
  - Windgen - http://www.weru.ksu.edu/weps
  - Cligen - http://www.ars.usda.gov/Research/docs.htm?docid=18094

WEPS 1.0 Databases

Management Practices Data

- **Crop and Operation Databases**
  - **The WEPS User Manual has a "How to" section**
  - **NRCS has matched all crop and operation files with RUSLE files**
- **Wind Barrier Database**
  - **The WEPS User Manual has a "How to" section**
  - **Bruce Wight, NRCS has revised the Barrier data**
- **Management Database**
  - **"How to" Power Point explains file conversions from RUSLE files**

WEPS 1.0 Databases

Management Practices Data

- **Management Database**
  - **23000 RUSLE files are available on the WEB by Conservation Management Zones (CMZs)**
  - **Each FO will only download the zones they need**

WEPS 1.0 Databases

Soils Data

- **NRCS "SSURGO" database**
  - **National soil database (MS Access format)**
    - **http://soildatamart.nrcs.usda.gov**
  - **Populated from NRCS "NASIS" database**
    - **http://soils.usda.gov/**
    - **WEPS will run on the same file as Toolkit does in the FO**
- **WEPS soils data input requirements**
  - **"IFC" file format (WEPS User Manual)**
    - **http://www.weru.ksu.edu/weps**

WEPS 1.0

Current Status and Work

- **April 4, 2005**
  - **Released to NRCS for Testing/Evaluation**
- **NRCS Testing/Implementation**
  - **Testing has been completed in 10 regional locations**
  - **Train the trainer sessions scheduled for June-August, 2010**
  - **NRCS Ver 1.0 released May 2010**

Benefits of WEPS 1.0

- **Allows for future WEPS releases that will:**
  - **Use the same erosion technology**
  - **Use same databases**
  - **Use compatible inputs**
  - **Build upon user's current knowledge and experience with WEPS 1.0**
  - **Provide additional capabilities**

Future Versions of WEPS will include

- Plant damage
- Integration with WEPP
- Non-cropped lands
- Visibility & PM2.5
- “DEPAWS”
- Complex fields
- Barrier Growth
- Multiple soils

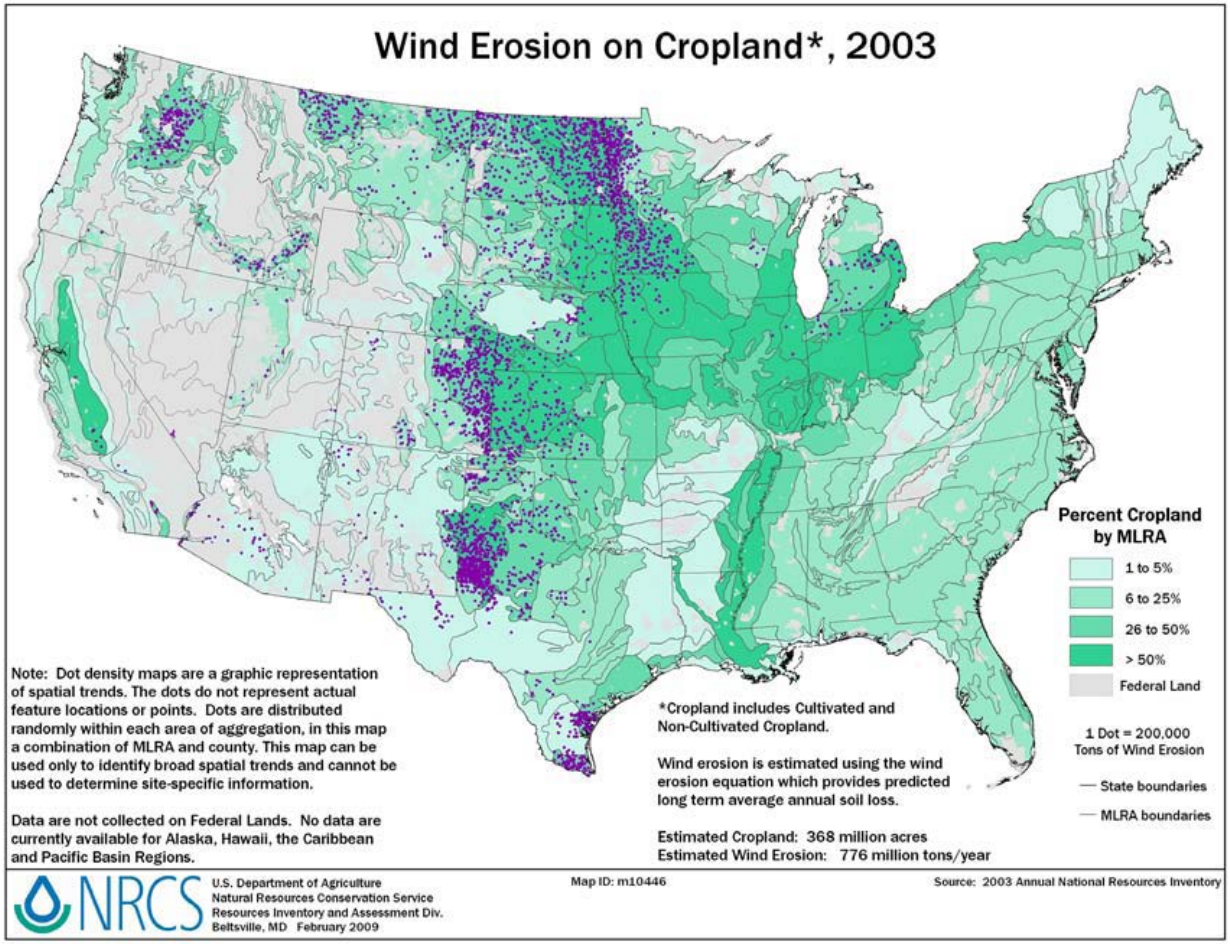
WEPS Summary

Providing needed erosion prediction technology

- Process based model
- Weather/database driven
- Simulation on a daily time step
- Reflects effects of cultural practices
- Computes erosion in 2-D space
- Estimates soil loss by direction and size

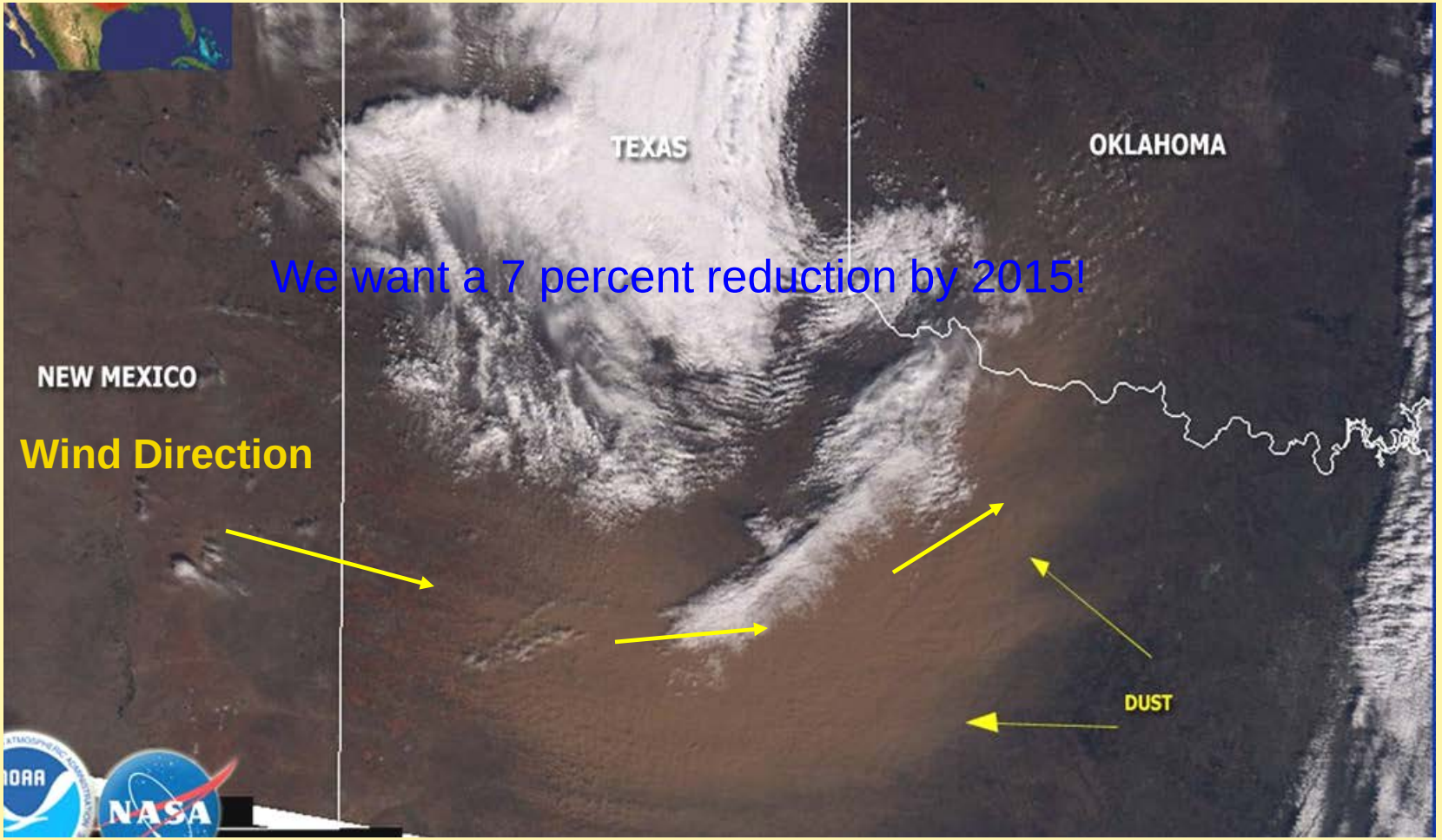
The Problem

- NRI has identified wind erosion as a problem on more acres than water erosion.
- In 2003, wind erosion accounted for more than 776 million tons of soil loss from cropland



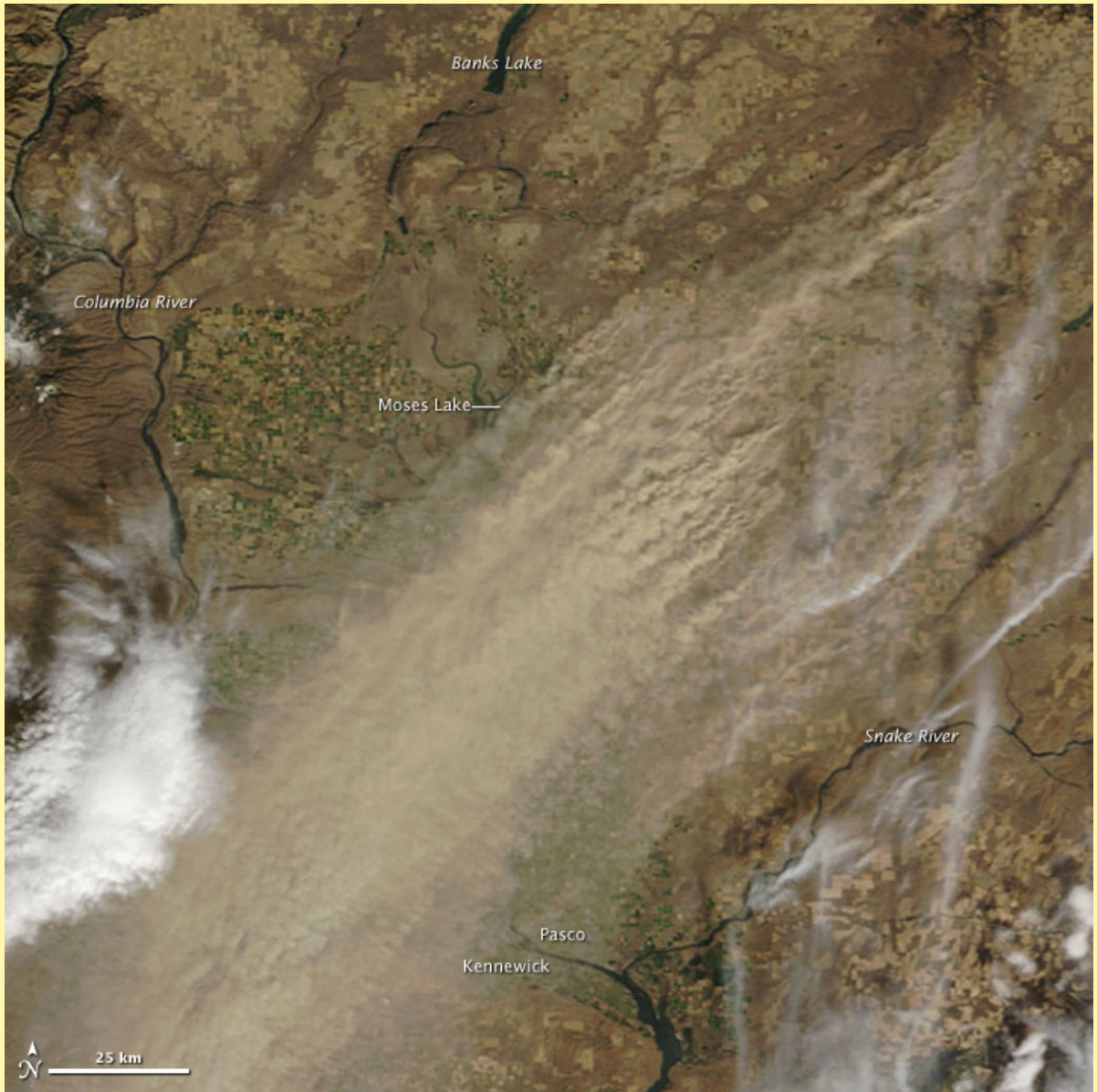
West Texas 2-24-07

Major problems still occur.
This was mostly Cotton cropland with residue shredded



This is Eastern WA 10/3/09

- 40+ mph blowing from the NE (not normal)
- SE Lincoln and Adams Co.
- WW-SF
- The WW was just planted and had not come up yet.



Resource Evaluation is People

"If we don't continue spending as much time in the field as possible, face to face with the people and the resources, then our databases are as good as they are ever going to be."

Larry Butler 3/1/07
Retired TX State Conservationist

Wind Erosion Prediction