Dust Mitigation

Wind Erosion Management

Joel Poore
USDA-NRCS:
Conservation Agronomist
Wind Erosion Specialist
Central National Technology Support Center
Fort Worth, Texas

Dust Mitigation
Wind Erosion Management

Land use management alternatives
Management: Minimize disturbance to soil surface in land use
Management: Utilize buffers for disturbed areas
Management: Maintain residue or growing cover throughout year

Land owner/manager is the one that solves the problem on a land parcel(s)
NRCS tools and planning process provide assistance to the land owner
NRCS wind erosion tools include: Wind Erosion Prediction System WEPS
A well trained conservation planner
Resource Management Systems

Where is the risk low, moderate and high? (regional)
When is the problem occurring? (regional and site specific)
When is surface condition vulnerable? (site specific)

Scottsbluff National Monument (Dome Rock): Western Nebraska
Average Annual March 16-17, 2013

Clear and dusty days at Big Spring, TX. December, 1970

NRCS technical planning assistance with landowners to solve an identified problem.

Planner: Identify the problem (amount and timing of wind erosion), generation of the 3 forms of wind erosion, then create and evaluate, with the land owner manager, alternative management systems that reduce the problem. Land owner manager selects and implements a management system.

Planner: Work with the landowner manager to evaluate the effectiveness of the management system and modifies the management as needed to improve effectiveness.

Wind erosion, suspension and blowing dust problems in AZ has unique factors that make managing the concern unique. Many other areas in the US and the world continue to experience this resource concern as well.

From a general regional perspective, the process of identifying potential solutions begins with identifying general causative factors.

Look at the jigsaw puzzle as a whole. Tools such as those used by NRCS, WEPS, is used to narrow down solutions at the jigsaw puzzle piece level. Land parcel. As assessment at the land parcel continues, certain patterns and correlation of effectiveness can be developed for regional efforts.

WEPS does not do the work for a conservation planner
WEPS helps a conservation planner do their work

Implementing a BMP:
Not what you do, how effectively you do it.

Example: Idaho – regional factor summary:
Wind Erosion and Using WEPS: Accuracy vs precision question

Answer:
"There are a lot of issues in this region:
a) First, the area has a climate (intensity and pattern) that is susceptible to wind erosion (low annual precipitation and a propensity for high winds)

b) Second, the soils are highly susceptible to wind erosion if not protected with sufficient anchored surface vegetation

c) Third, crops like potatoes do not leave much protective residue on the surface after harvest, leaving the soil in a more vulnerable state than other typical crops, like wheat, milo, etc.

d) Fourth, the historical tillage management practices exacerbate the wind erosion issues by putting the soil surface in a more vulnerable state. (Low residue and low aggregate stability)"

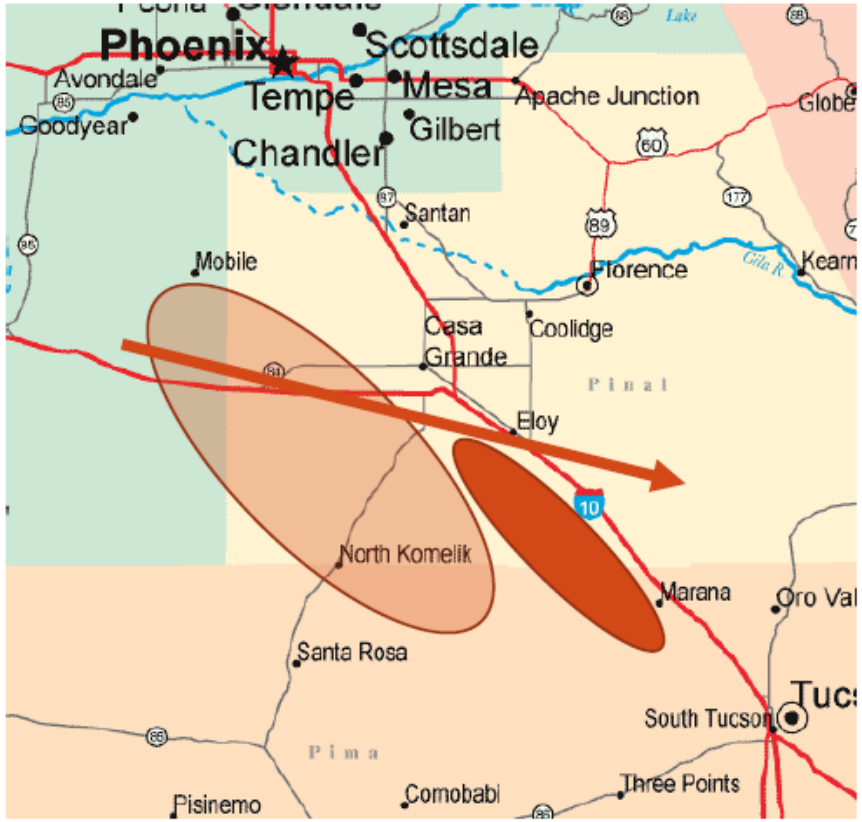
Arizona Dust Mitigation Example and Potential process and alternatives

Wind Station Data

Station: US AZ MESA/FALCON FIELD Threshold: 8.0 m/s

Elevation: 424 Avg Energy: 510

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Winds > Threshold	4.8	3.5	4.2	5.9	5.4	5.0	4.3	4.7	4.4	3.9	3.7	4.0
Energy kJ/m^2/day	658	545	418	536	363	444	696	793	457	328	418	467
Monthly Percent	11	9	7	9	6	7	11	13	7	5	7	8
Preponderance	1.9	1.7	1.4	1.6	1.6	1.4	1.3	1.4	1.9	1.8	1.7	2.4
PWED	NNE-22	NE-45	SW-225	WSW-24	SW-225	SSW-20	NNE-22	NNE-22	NNE-22	NE-45	NE-45	NNE-22

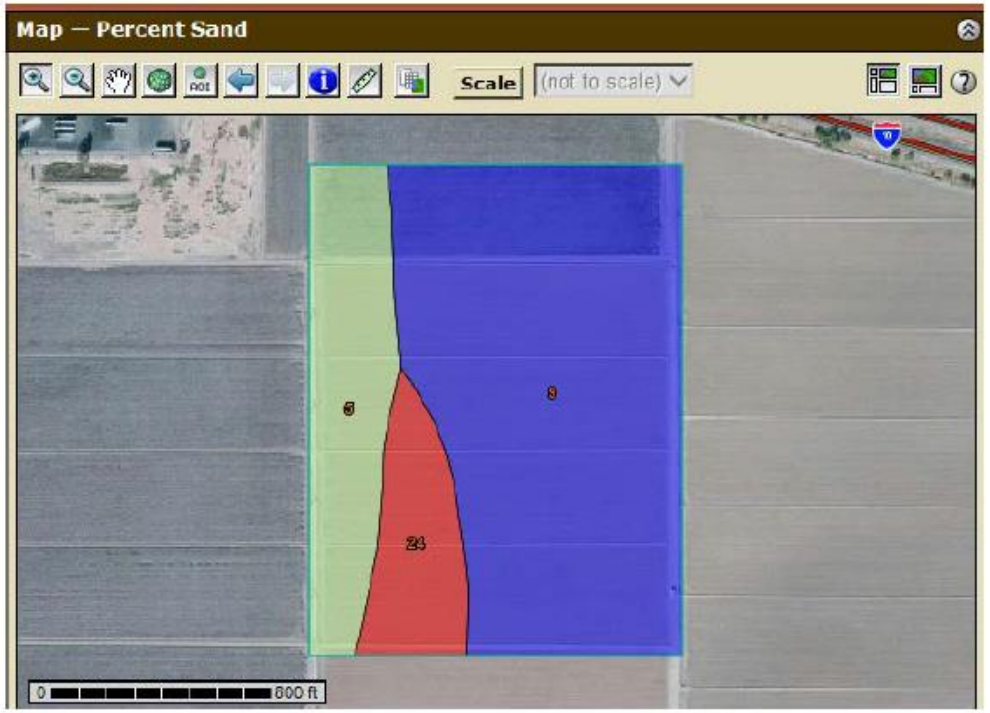


Developing Dust mitigation plans:
Focusing into the Land parcel level
Isolate regional areas and identify general land use and scenarios.

Focus in this example:
July - October
PWED = NNE direction

Along I10, begin to look for example land parcels then start the planning process

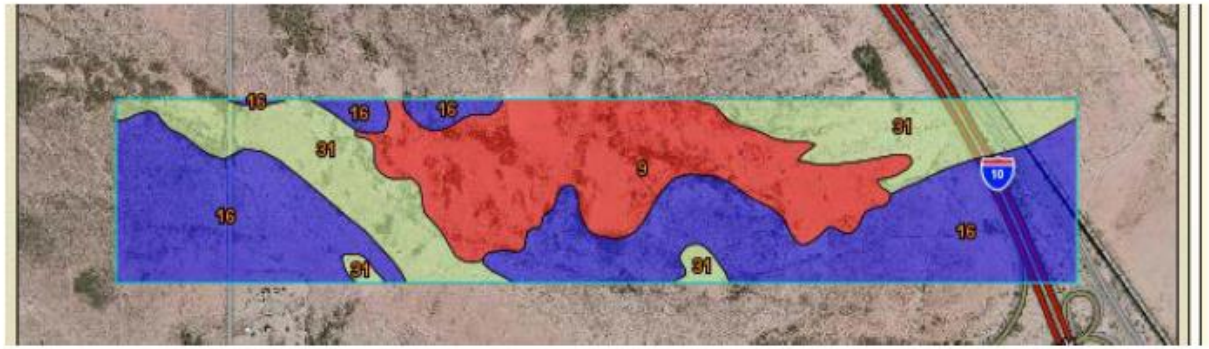
Soil map unit component to use for simulation
Several small irrigated fields examples
Using web soil survey (another useful tool)



%	Sand	Silt	Clay	CaCO3	SOM
Cashion clay	26.1	28.9	45	13	1.5
Contine clay loam	33.3	31.7	35	4	0.75
Glenbar clay loam	24.1	40.2	36	10	0.43

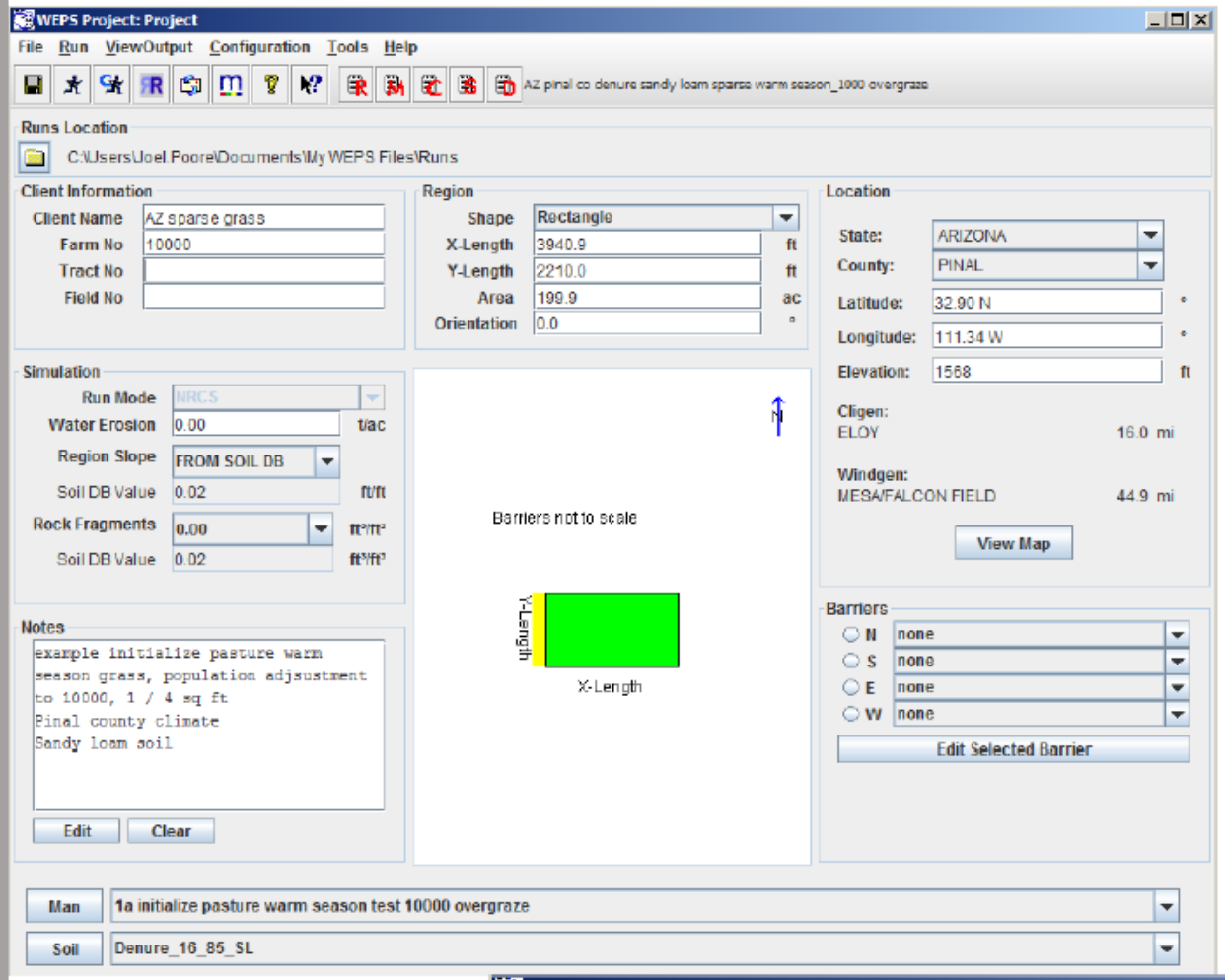
**vfs texture fraction moves as suspension

Example field 2: looks like sand dunes and range?



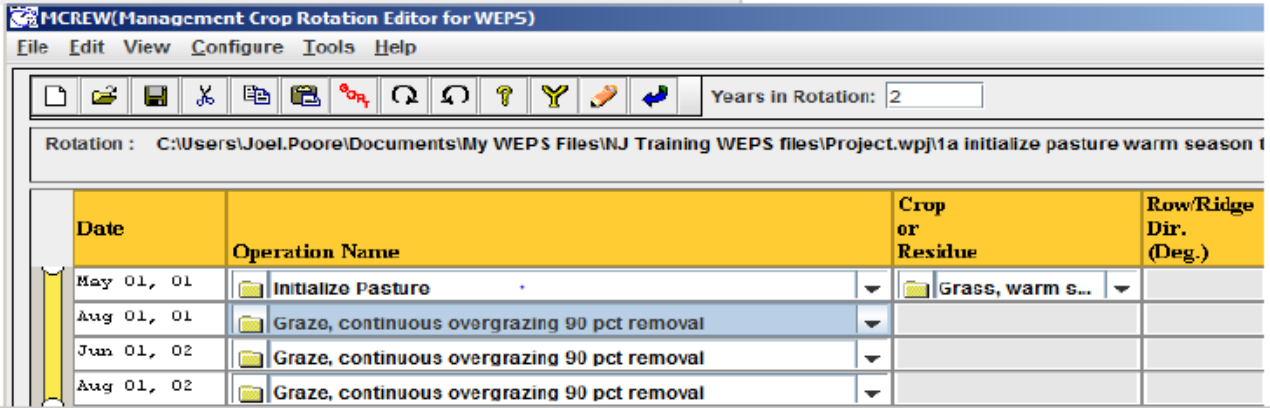
%	Sand	Clay			
Denure sandy loam	66.1	14			
Contine clay loam	33.3	35			
Mohall loam	40	23			

Wind Erosion Prediction System: WEPS user interface Building an erosion simulation:



5 main user inputs

Region:	**Rectangle 200 ac**
Location:	**Pinal CO AZ**
Barriers:	**none**
Soil:	**Denure SL**
Management:	**grazing, sparse range**

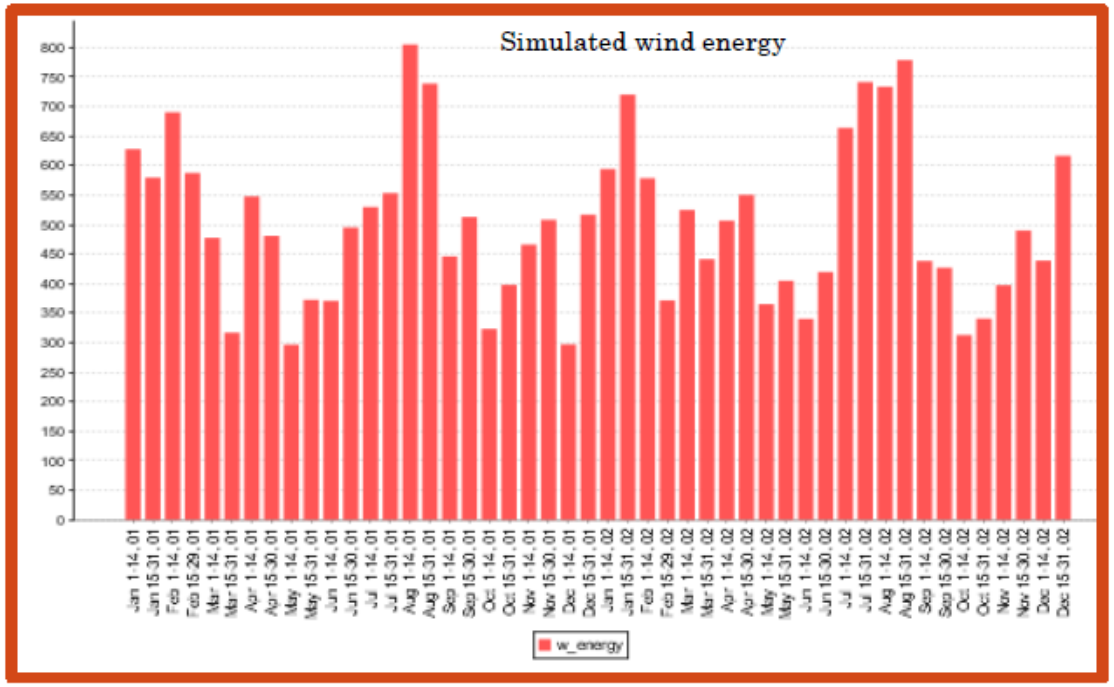


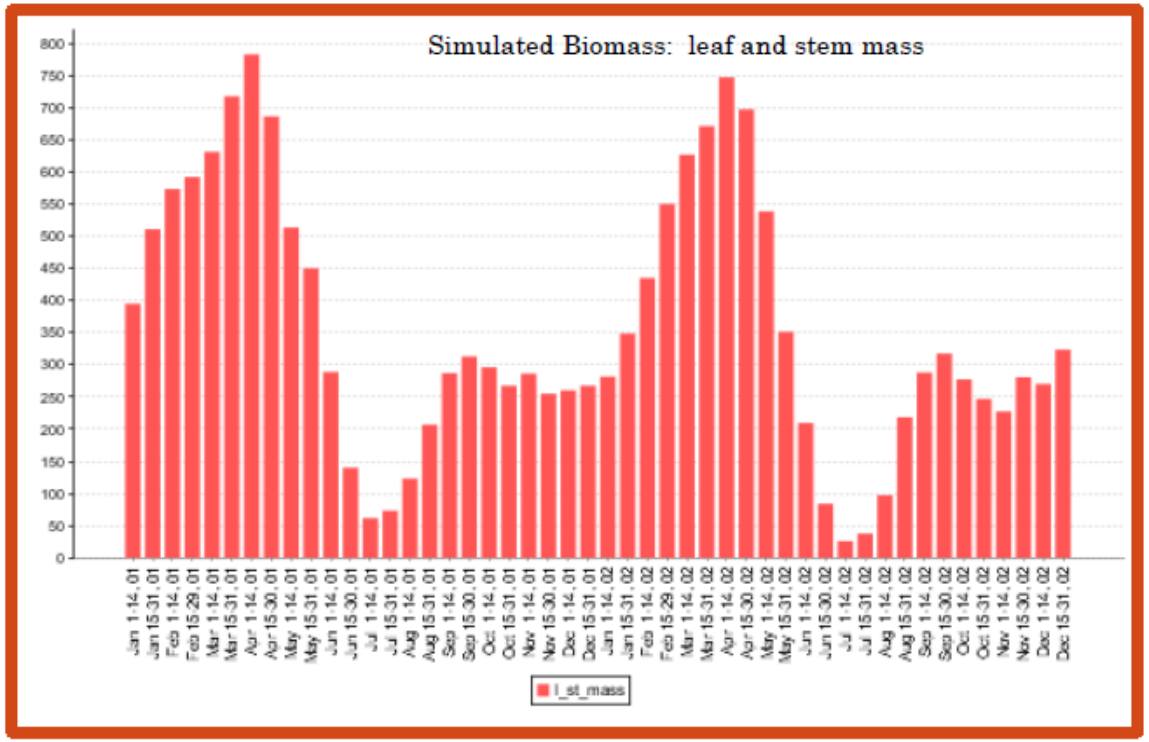
Native range example, WEPS results benchmark disturbed surface simulate: Wheel traffic or severe hoof traffic

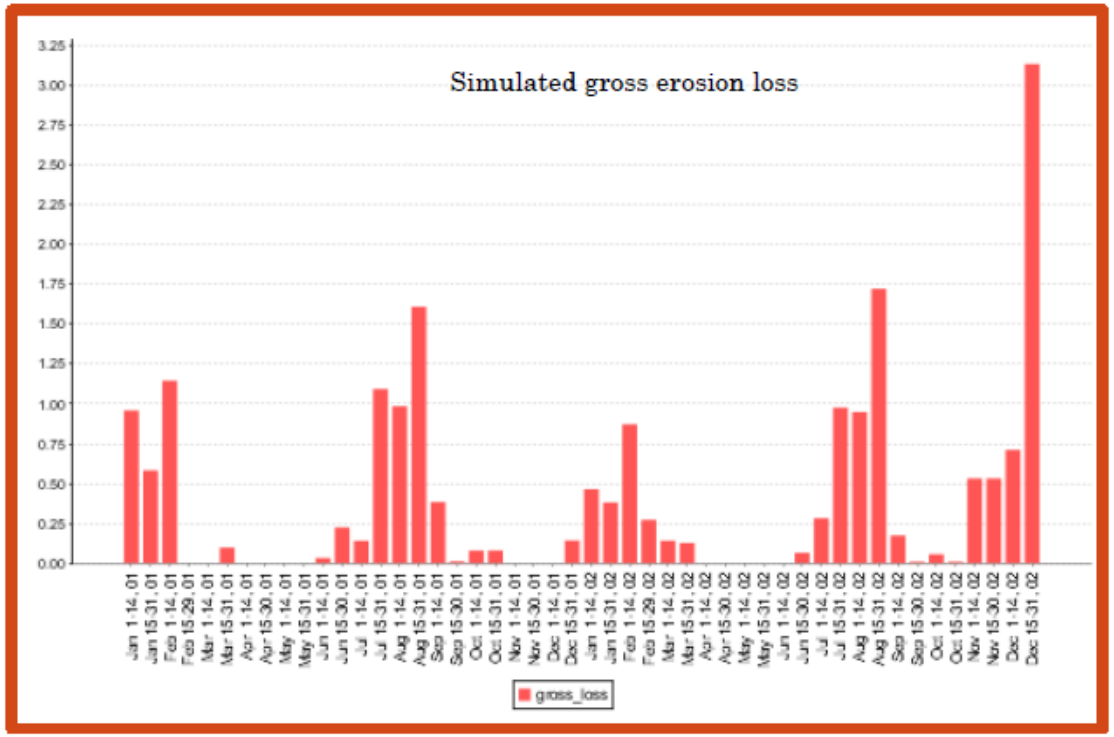
Evaluate both intensity and timing

Erosion

Period	Crop/Residue	Gross Loss t/ac	Net Soil Loss From Field (t/ac) Total	Creep/Salt.	Suspen.	PM10
Rot. year: 1		7.6	7.6	2.9	4.7	0.20
Rot. year: 2		11.4	11.4	4.7	6.7	0.29
Ave. Annual		9.5	9.5	3.8	5.7	0.25







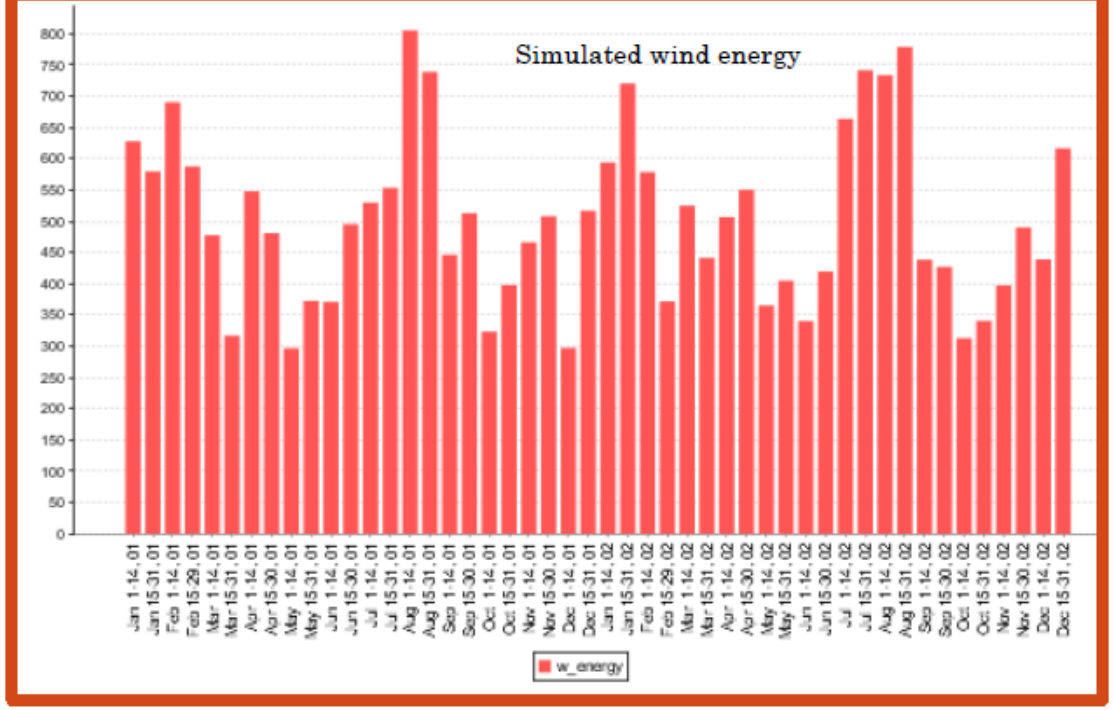
Native range example, WEPS results
Alternative undisturbed surface
Grazed with minimal hoof traffic

Evaluate both intensity and timing

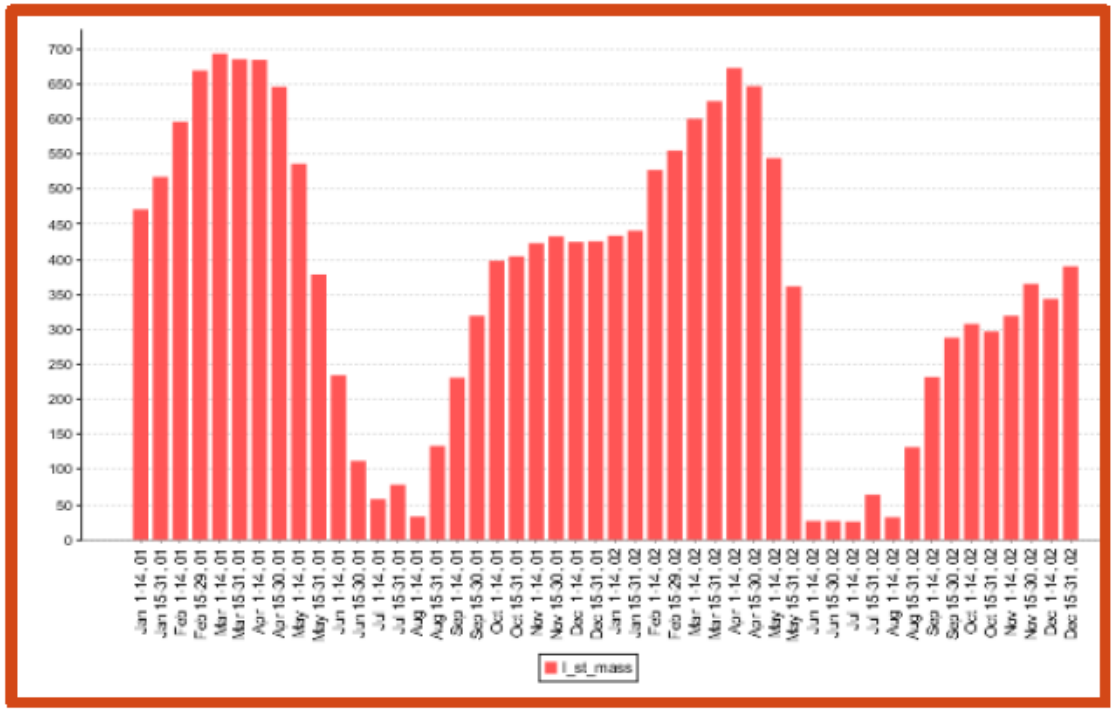
Erosion

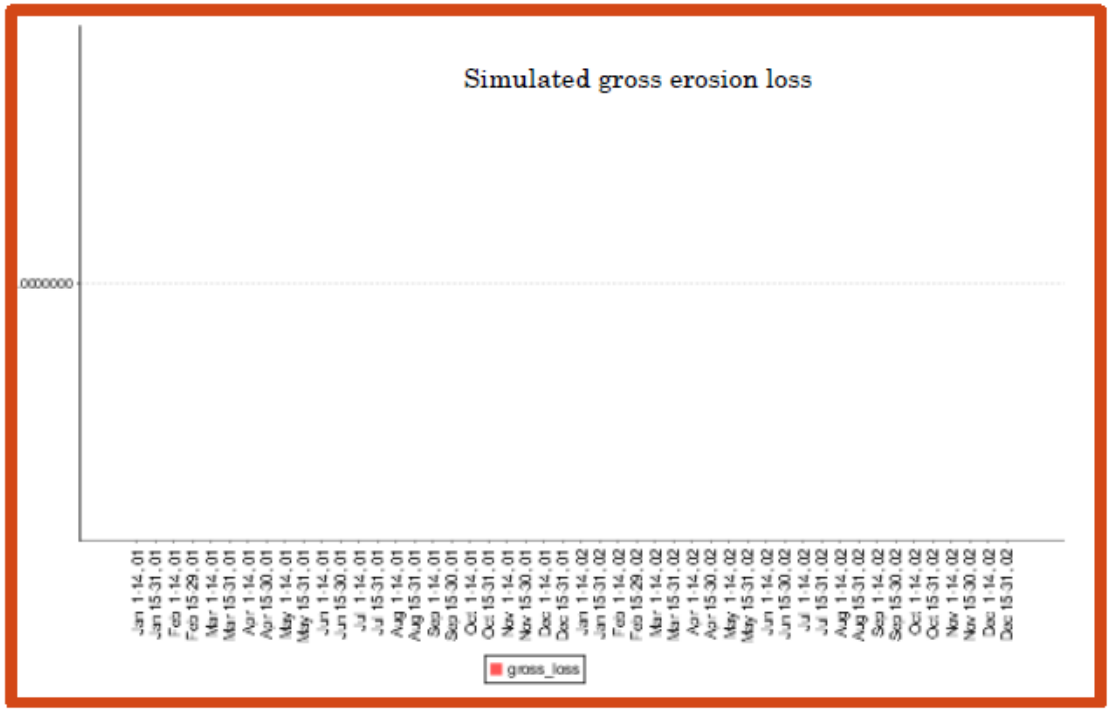
Period	Crop/Residue	Gross Loss t/ac	Net Soil Loss From Field (t/ac) Total	Creep/Salt.	Suspen.	PM10
Rot. year: 1	Grass, warm season, forage	0.0	0.0	0.0	0.0	0.00
Rot. year: 2	Grass, warm season, forage Grass, warm season, forage	0.0	0.0	0.0	0.0	0.00
Ave. Annual		0.0	0.0	0.0	0.0	0.00

Disturbance includes:
animal, human, rain impact, saltation, others



Simulated Biomass: leaf and stem mass





Benchmark: continuous cotton, irrigated

Erosion

Period	Crop/Residue	Gross Loss t/ac	Net Soil Loss From Field (t/ac) Total	Creep/Salt.	Suspen.	PM10
Rot. year: 1	Cotton, southern upland	36.6	36.6	14.8	21.9	0.91
Ave. Annual		36.6	36.6	14.8	21.9	0.91

SCI Summary

Soil Conditioning Index:	-2.8	**SCI Subfactors**	
Energy Calculator:	5.6 gal diesel/ac	**OM:**	-0.47
Average Annual STIR:	89.2	**FO:**	0.12
Wind Erosion Soil Loss:	36.6 t/ac	**ER:**	-13.43
Water Erosion Soil	0.0 t/ac		

Alternative: cotton, irrigated w/ DC small grain hay crop

Erosion

Period	Crop/Residue	Gross Loss t/ac	Net Soil Loss From Field (t/ac) Total	Creep/Salt.	Suspen.	PM10
Rot. year: 1	Wheat, winter cover Cotton, southern upland	3.3	3.3	1.6	1.7	0.07
Ave. Annual		3.3	3.3	1.6	1.7	0.07

SCI Summary

Soil Conditioning Index:	-0.2	**SCI Subfactors**	
Energy Calculator:	8.8 gal diesel/ac	**OM:**	-0.13
Average Annual STIR:	130.8	**FO:**	-0.30
Wind Erosion Soil Loss:	3.3 t/ac	**ER:**	-0.28
Water Erosion Soil	0.0 t/ac		

Dust mitigation approaches, using WEPS
Relative difference in Erosion Risk for Benchmark and Alternative crop systems

5 main user inputs
Region: Rectangle 200 ac
Location: Pinal CO AZ
Barriers: none
Soil: Denure SL
Management: Cotton
Management: Cotton, DC hay

Dust mitigation crop example
Adding a small grain hay DC to cotton, 92% reduction in average annual suspension

Alternative practices that may help mitigate wind erosion concerns: A system of practices is recommended, not 1 silver bullet. Site and farm specific plan design is called a "specification" land owners decision. A system of alternatives can be modelled with WEPS and relativce difference from benchmark evaluated.

Vegetative barriers (Herbaceous wind barriers)reduce wind velocity across fields and intercept wind-borne particles. System is designed to meet the needs and ability of the land owner/manager

Residue management practices: reduce amount and timing of disturbance and surface residue. Each field and farm must design their own system that works for them.

Alternative practices that may help mitigate wind erosion concerns: A system of practices is recommended, not 1 silver bullet. Site and farm specific plan design is called a "specification" land owners decision. A system of alternatives can be modelled with WEPS and relativce difference from benchmark evaluated.

Mulching during certial periods, veg or fabric, several benefits, watch secondary effects on other production inputs such as nutrient manasgement

Strip cropping and adjusted crop rotation might apply

Cloddiness, surface roughness, ridges can provide temporary reduced erosion, not a long term, sustainable solution. Perhaps a place.

Buffer Examples

Trap saltation and creep particles
Problem is Saltation and Creep has already occurred
reduce source of suspension and total erosion.
15-25 ft cross wind trap strip – Stable border

Prefer Herbaceous wind barriers combined with residue management

Buffer Function: Examples

Creating a "sheltered" or protected area downwind of the buffer.

Buffer Function: Examples

Be Creative

Buffer Function:
Reduce Source and Transport soil particles

Vegetation / Residue on soil surface serves the same basic functions as a well designed wind barrier. Reduces both the source and transport of erodible material.

Lack of vegetation/residue on the soil surface and soil disturbance increases risk of wind erosion.

Increased source and transport of erodible soil material - change in friction velocity

Buffer Functions: Strips of Vegetation

A Strip Crop system can provide basic wind barrier or buffer functions.
Example of Reduced Source and Transport Factors as well as deposition

Dust Mitigation:

NRCS wind erosion tools include:
- Wind Erosion Prediction System WEPS
- A well trained conservation planner
- A willing and motivated landowner/manager
- Resource Management Systems

The Wind Erosion Prediction System

WEPS 1.0
User Manual

USDA-ARS
Wind Erosion Research Unit
Manhattan, Kansas, USA

March 2010