# POST-FIRE WIND EROSION :
# Causes, consequences, and implications


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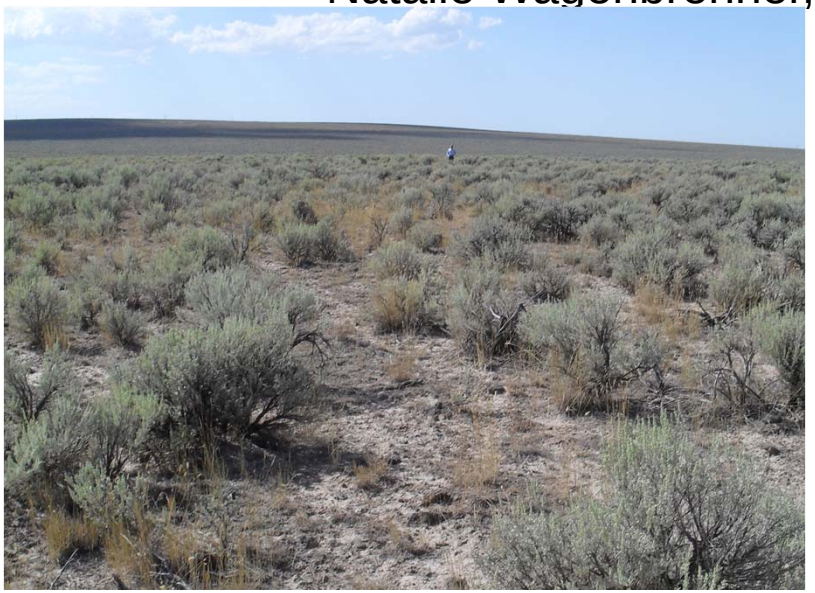


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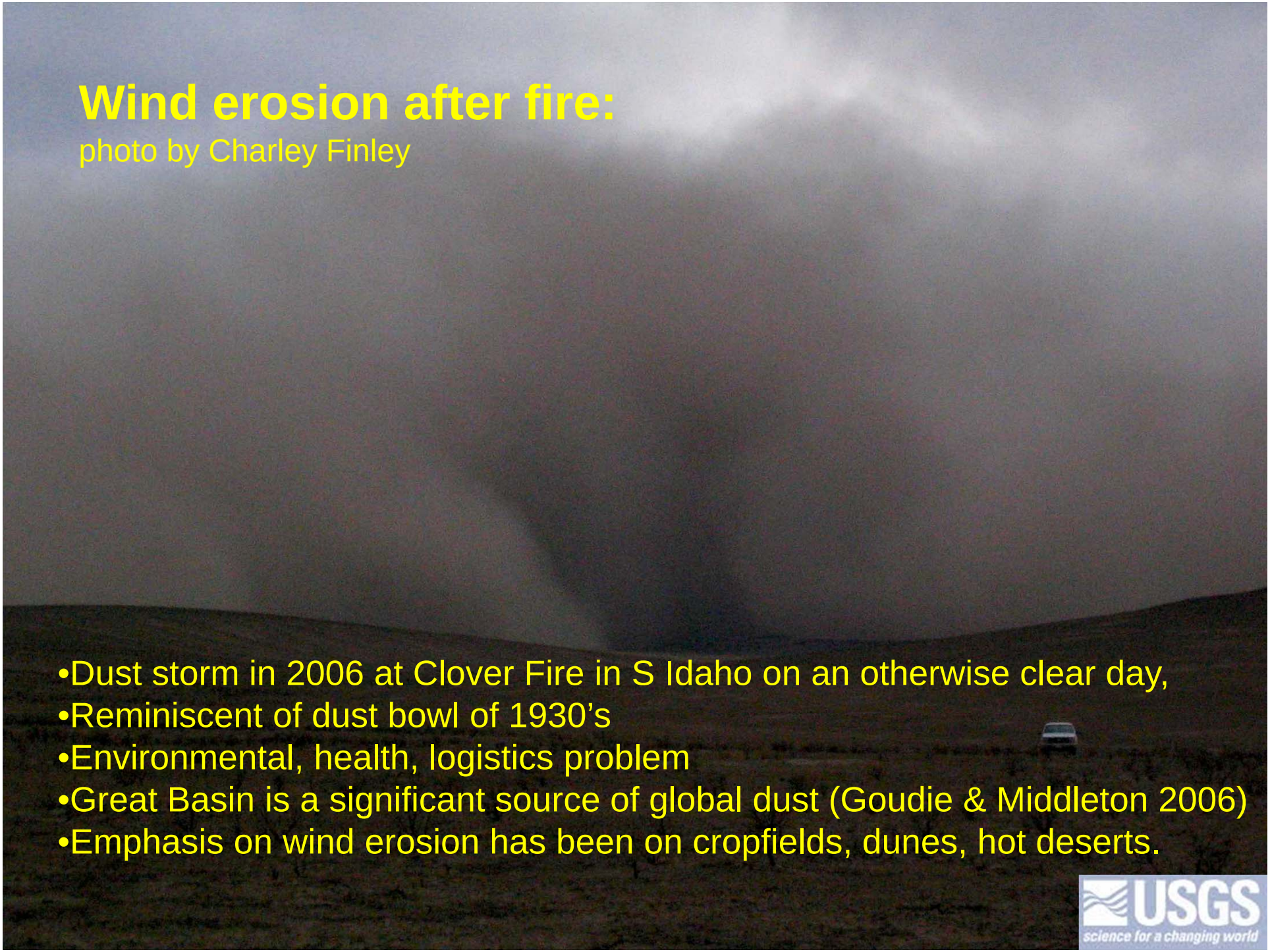

# Wind erosion after fire:

photo by Charley Finley

- Dust storm in 2006 at Clover Fire in S Idaho on an otherwise clear day,
- Reminiscent of dust bowl of 1930's
- Environmental, health, logistics problem
- Great Basin is a significant source of global dust (Goudie & Middleton 2006)
- Emphasis on wind erosion has been on cropfields, dunes, hot deserts.

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From the 2010 Jefferson Fire, near Idaho Falls

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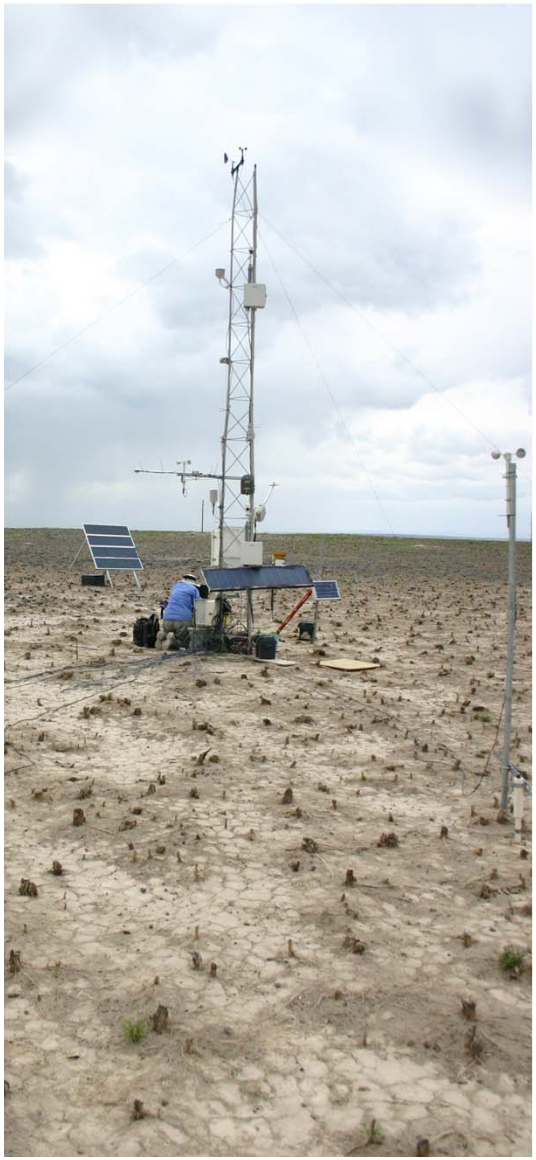
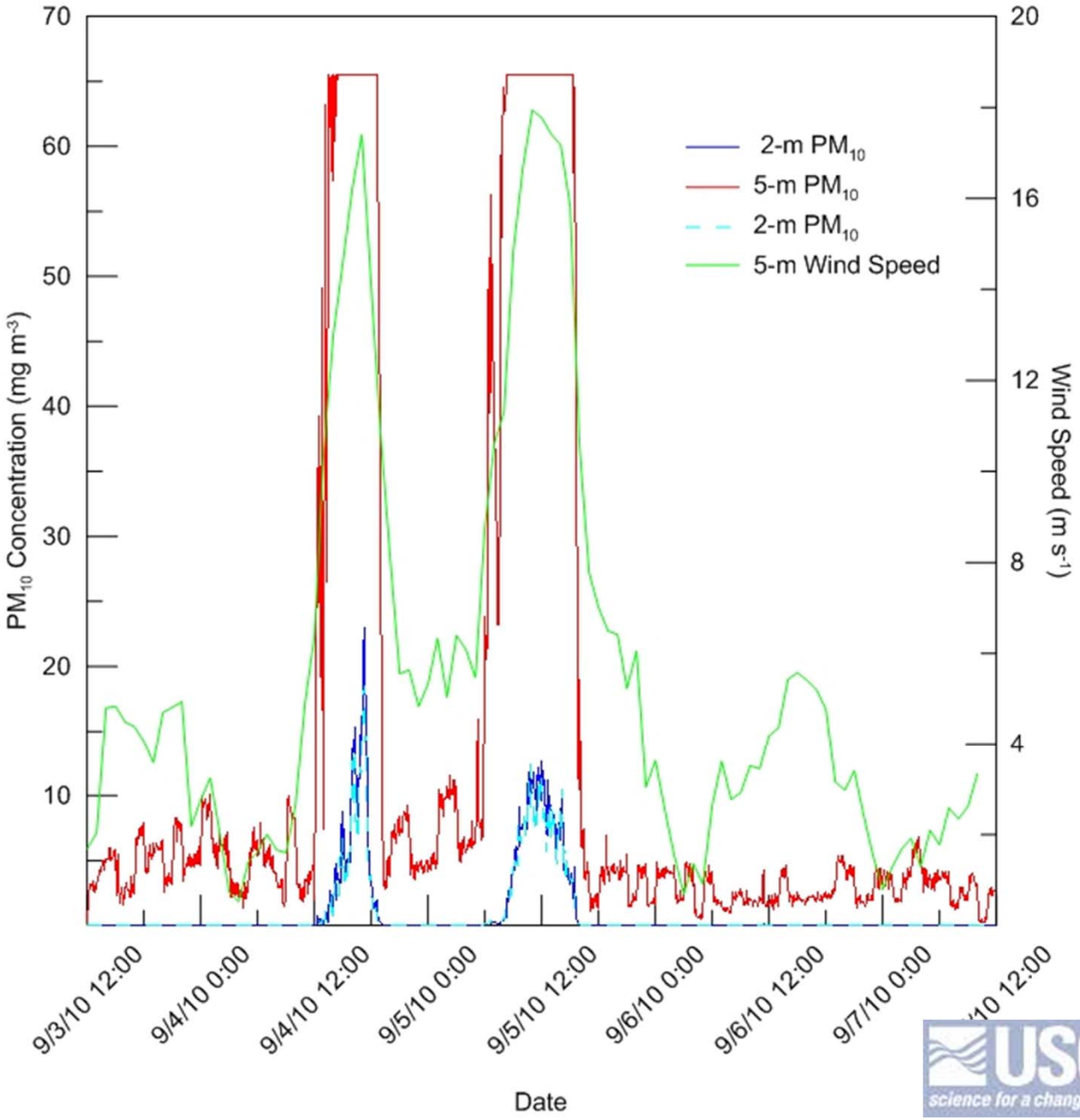
## Wagenbrenner, Germino et al., in prep, from Jefferson 2010 fire, dust flux



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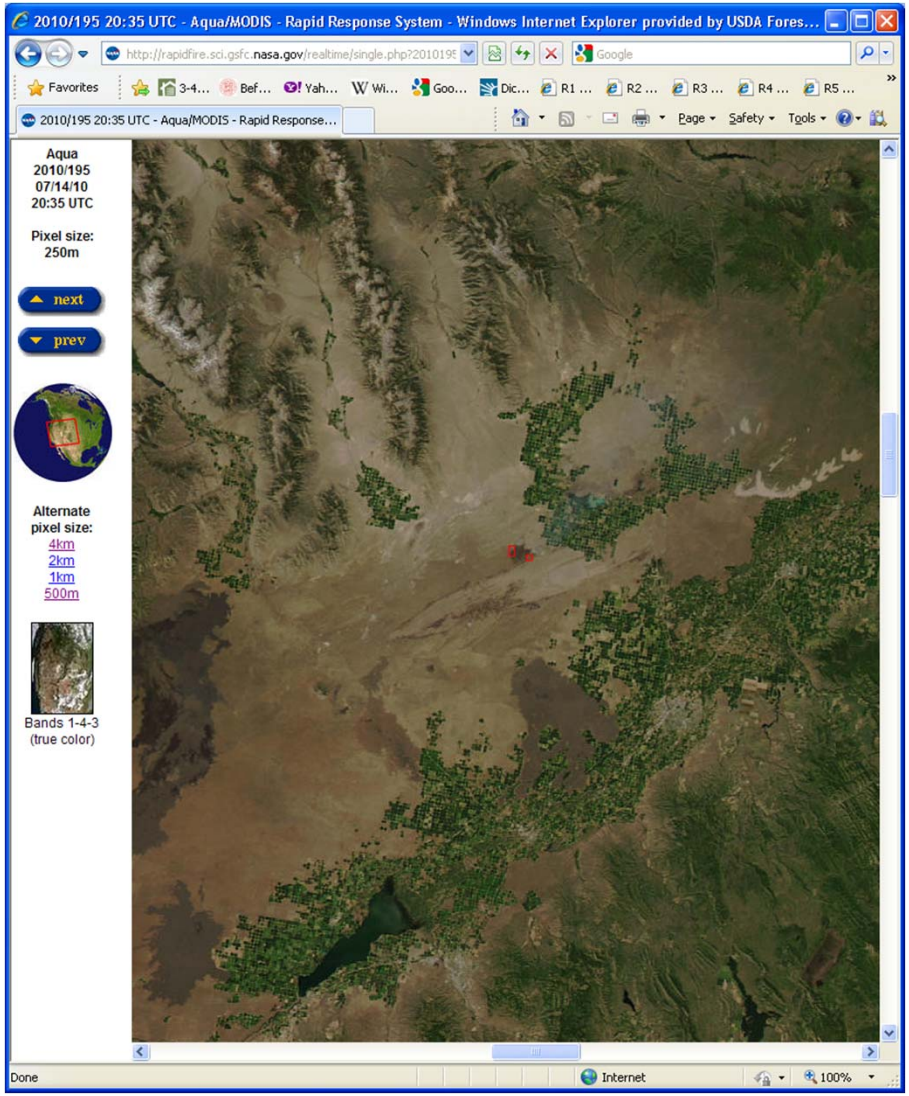
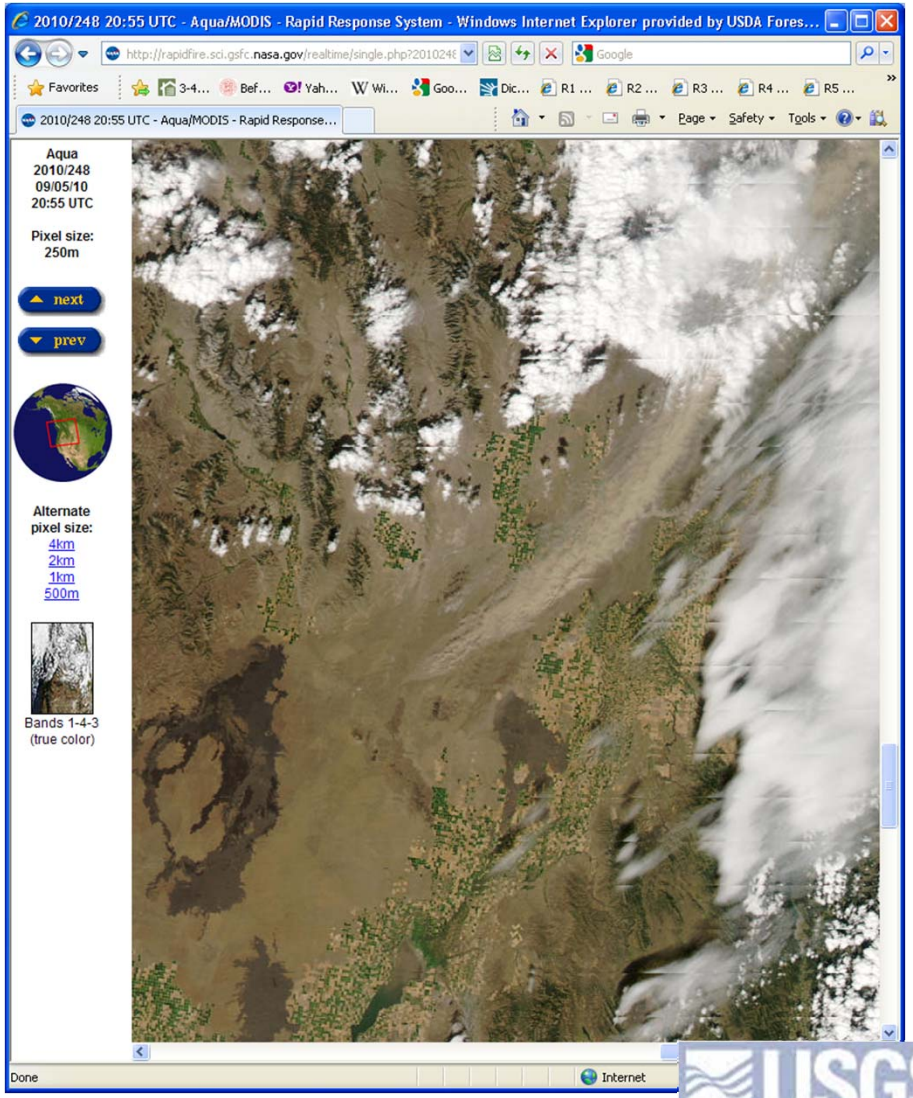
Dust can be estimated from one of its constituent particles, PM10. MODIS or other satellite imagery are key.

*From the 2010 Jefferson Fire, Idaho:*

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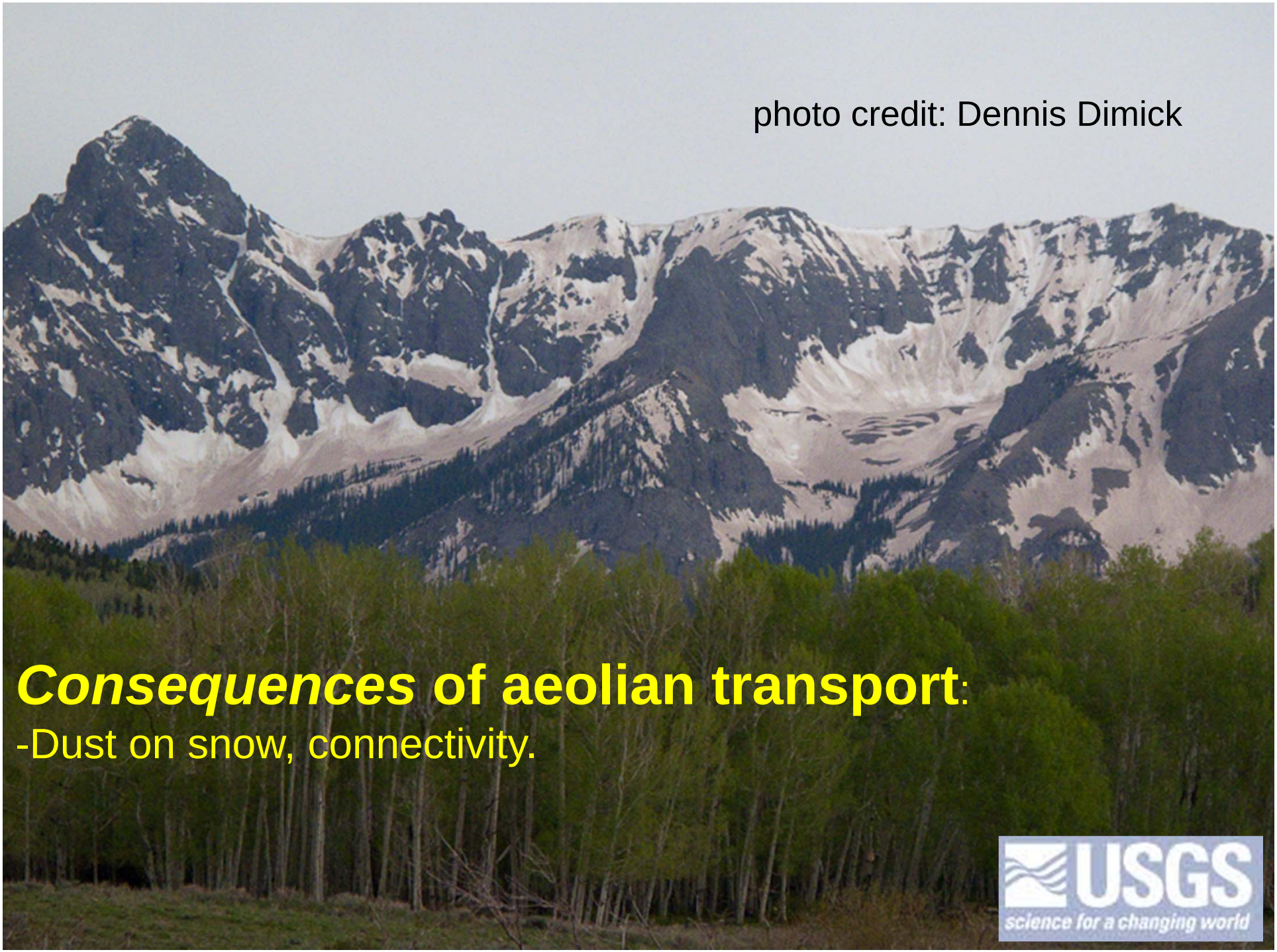


## ***Consequences*** **of aeolian transport**:

-Dust on snow, connectivity.

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- Since mid-1900's, seeding practices have been common in semiarid rangelands of Western N America.
- Seeding in emergency post-fire rehabilitation plans is aimed at **soil stabilization** and pre-emption of native species.


2003 report from US General Accounting Office notes the large cost and asks about efficiency of post-fire reseeding

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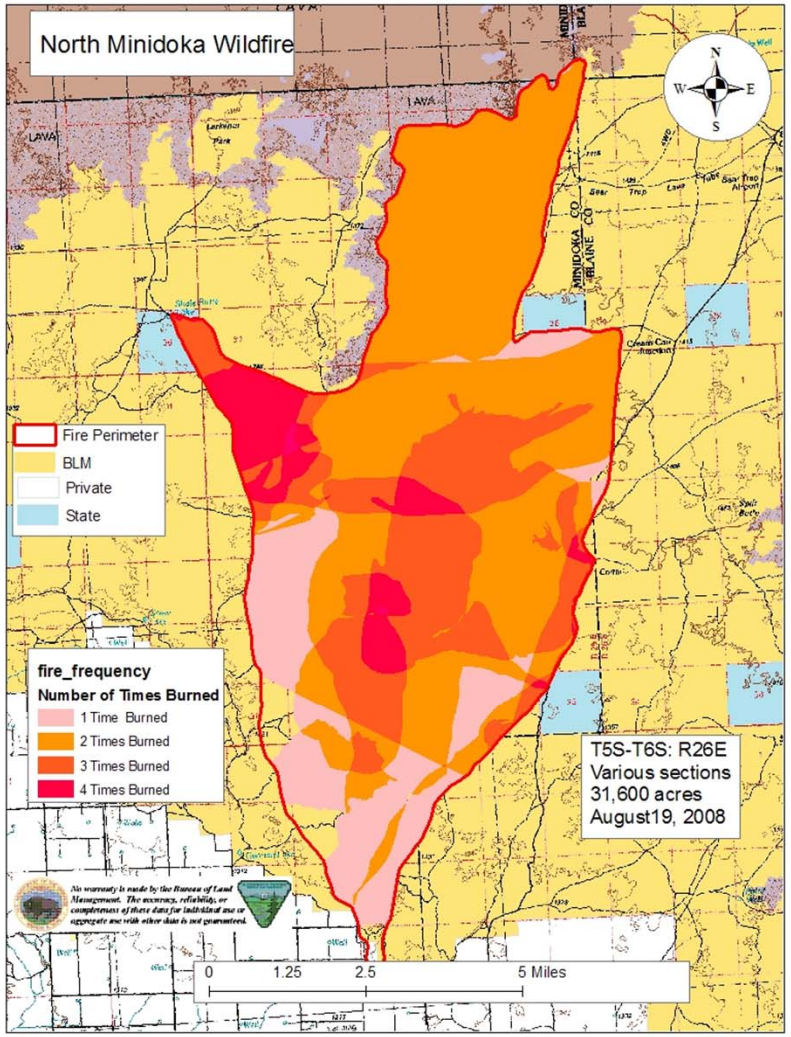
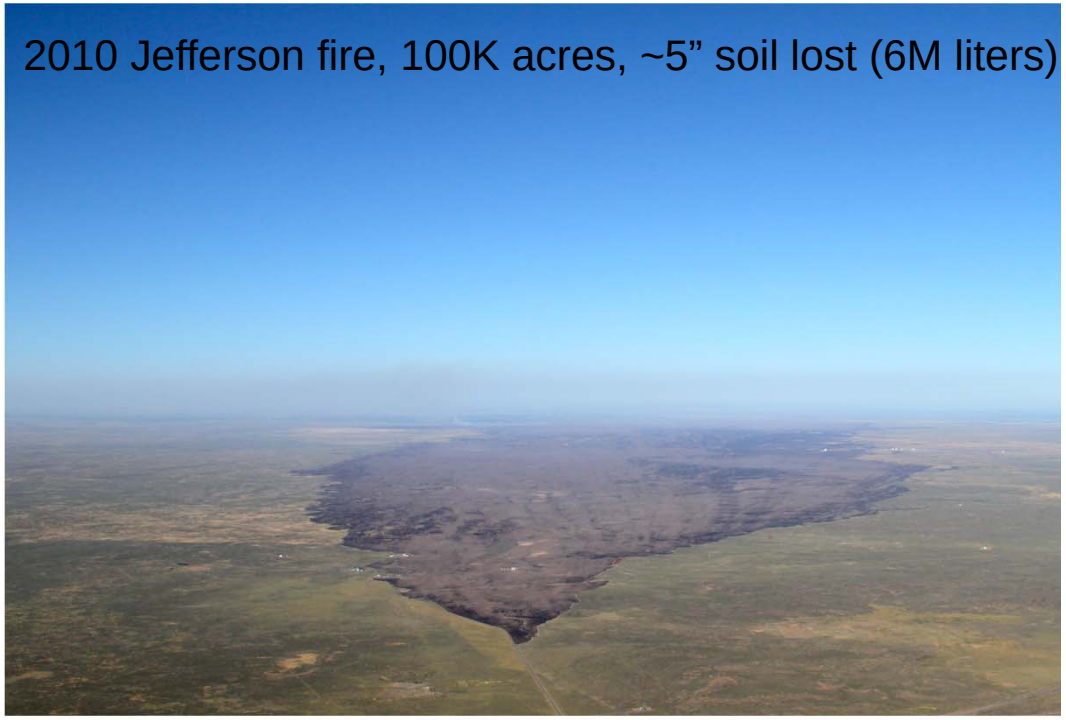
# DISTURBANCE:
# IMPACTS OF CHANGES IN FREQUENCY AND SIZE OF FIRES

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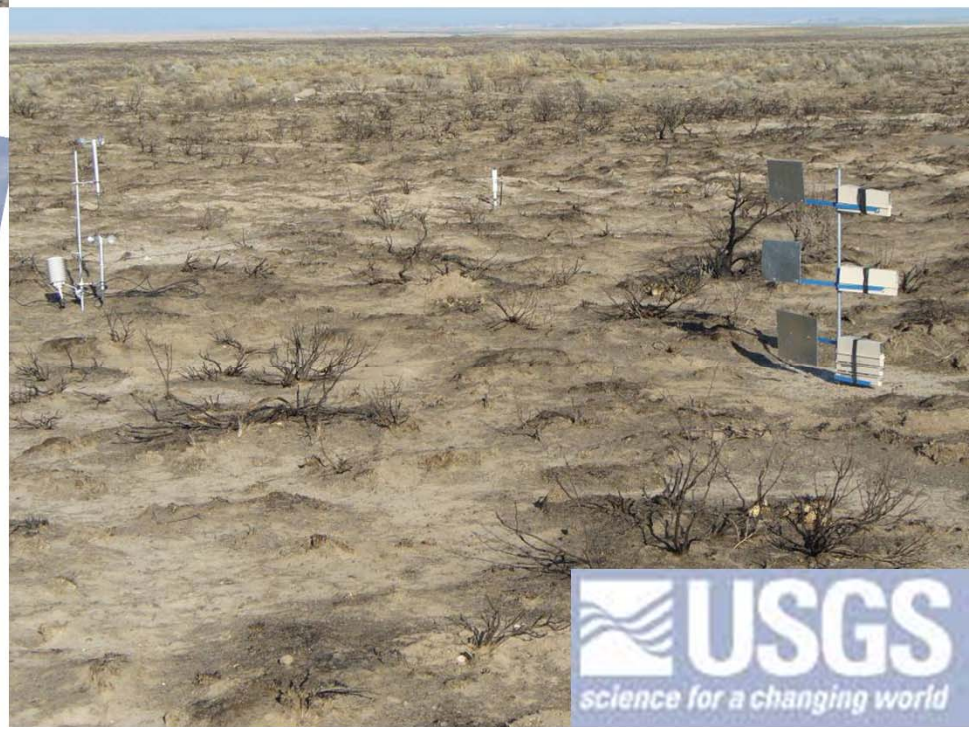
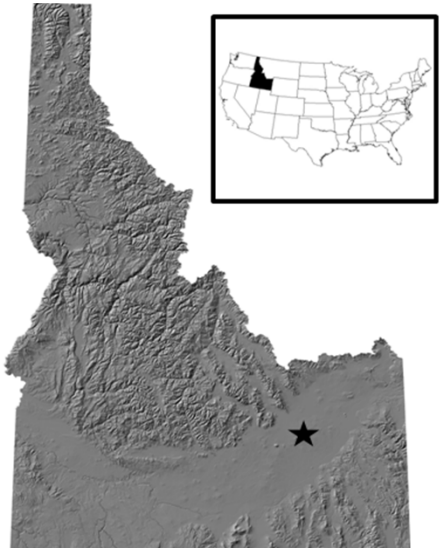
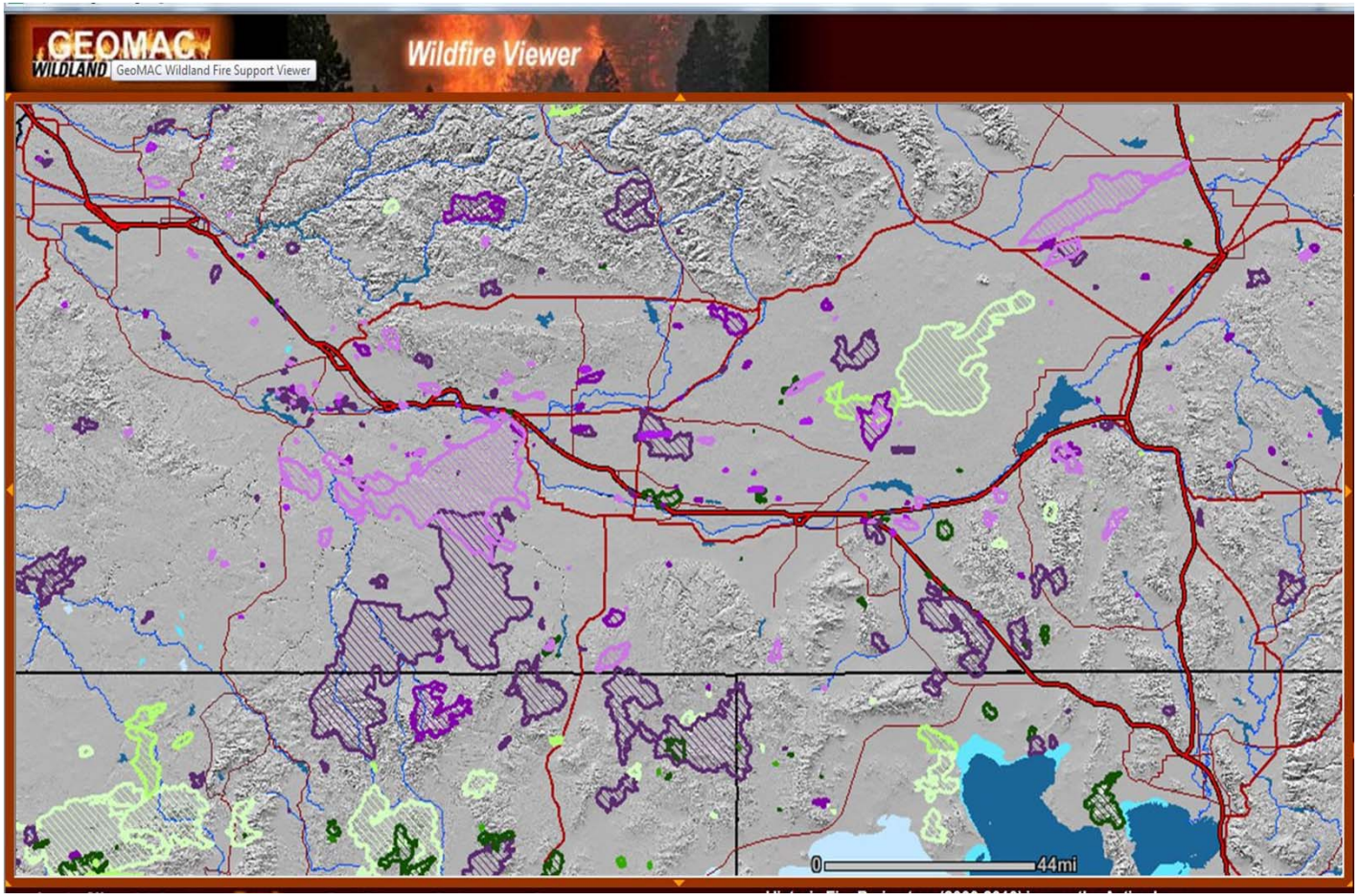
**Our research questions for Post-fire wind erosion in the Great Basin:**

**1) When, where; predictable?**
**2) How extensive?**
**3) Causes and consequences?**








**Fires we have studied:**
Clover, 2005
Crystal, 2006
Massacre Rocks, 2006
Twin Buttes, Moonshiner, 2007
Sand Hollow, 2009
Noman, 2009
Samaria, 2010
Jefferson Fire, 2010
Middle Buttes, 2010

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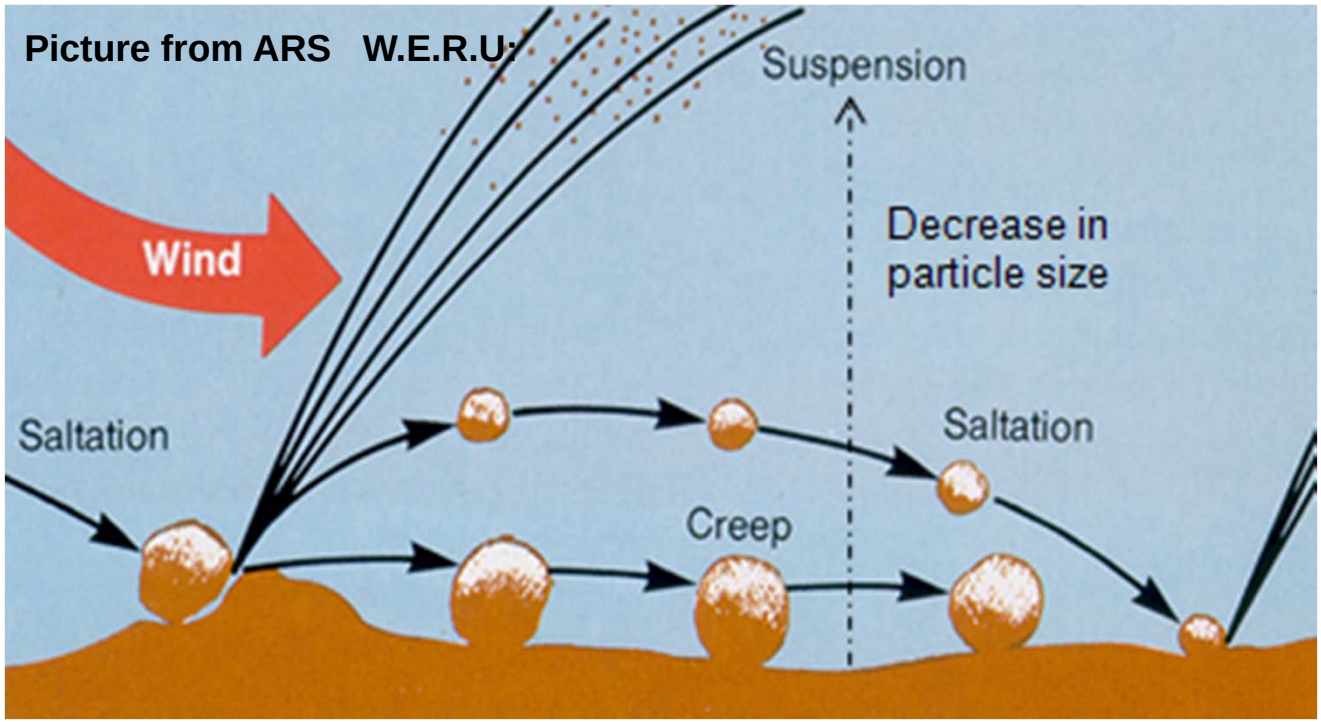
Some basic concepts of wind erosion (“aeolian transport”)




Erosion = f (erosivity, erodibility, sediment supply rate)

Our focus has been on **saltation**:
plant, climate, and ecosystem relations

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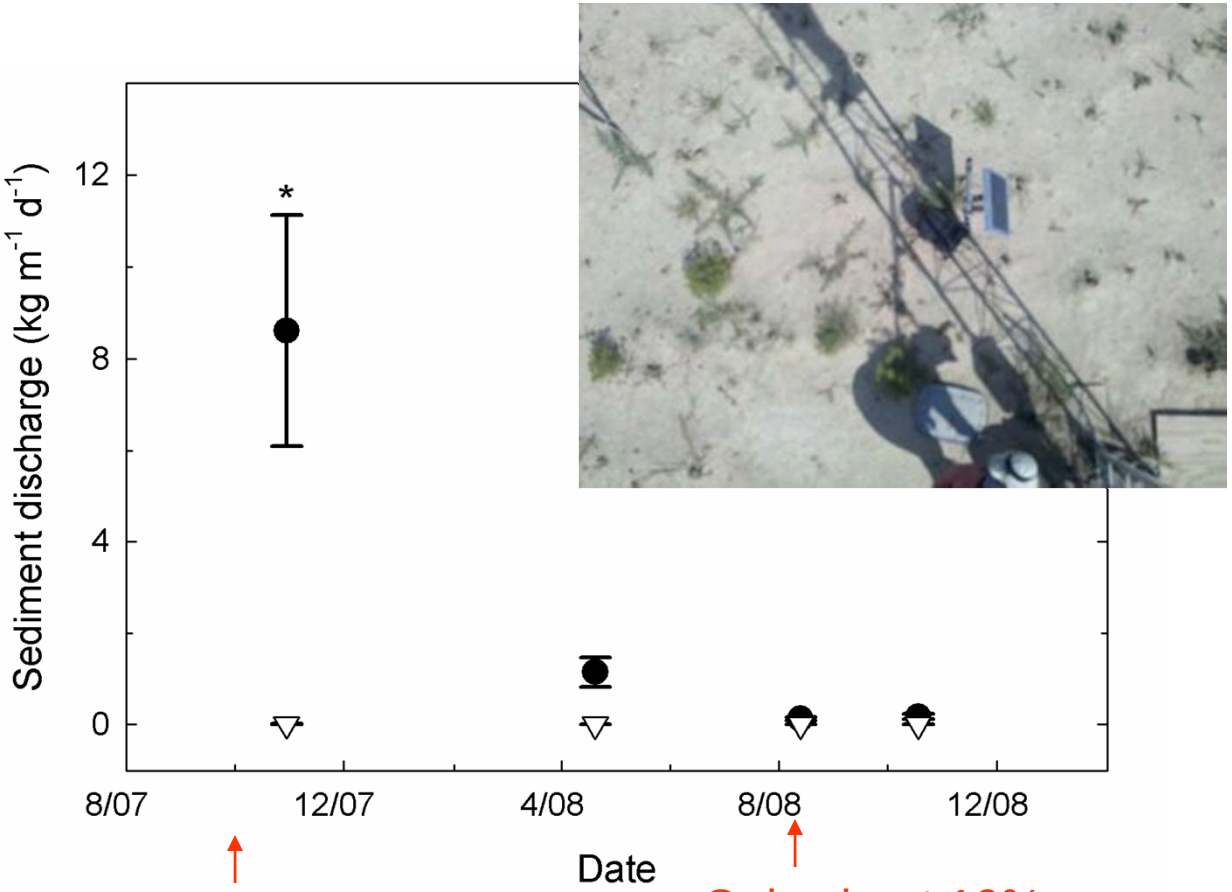
In photo: J Sankey, N Glenn




Time of Twin Buttes fire

Only about 10% vegetation cover by this time

Daily flux of sediment from 0 to 2 m height, estimated from integrating sediment mass from 5 collectors positioned on a tower, as: $\int_{height=0}^{2m} mass * area^{-1} * time^{-1}$

Sankey, Germino, Glenn 2009, in J Arid Environ; 2009b in Aeolian Research
Hasselquist, Germino 2011 et al. Biogeosciences Discussions (graph)

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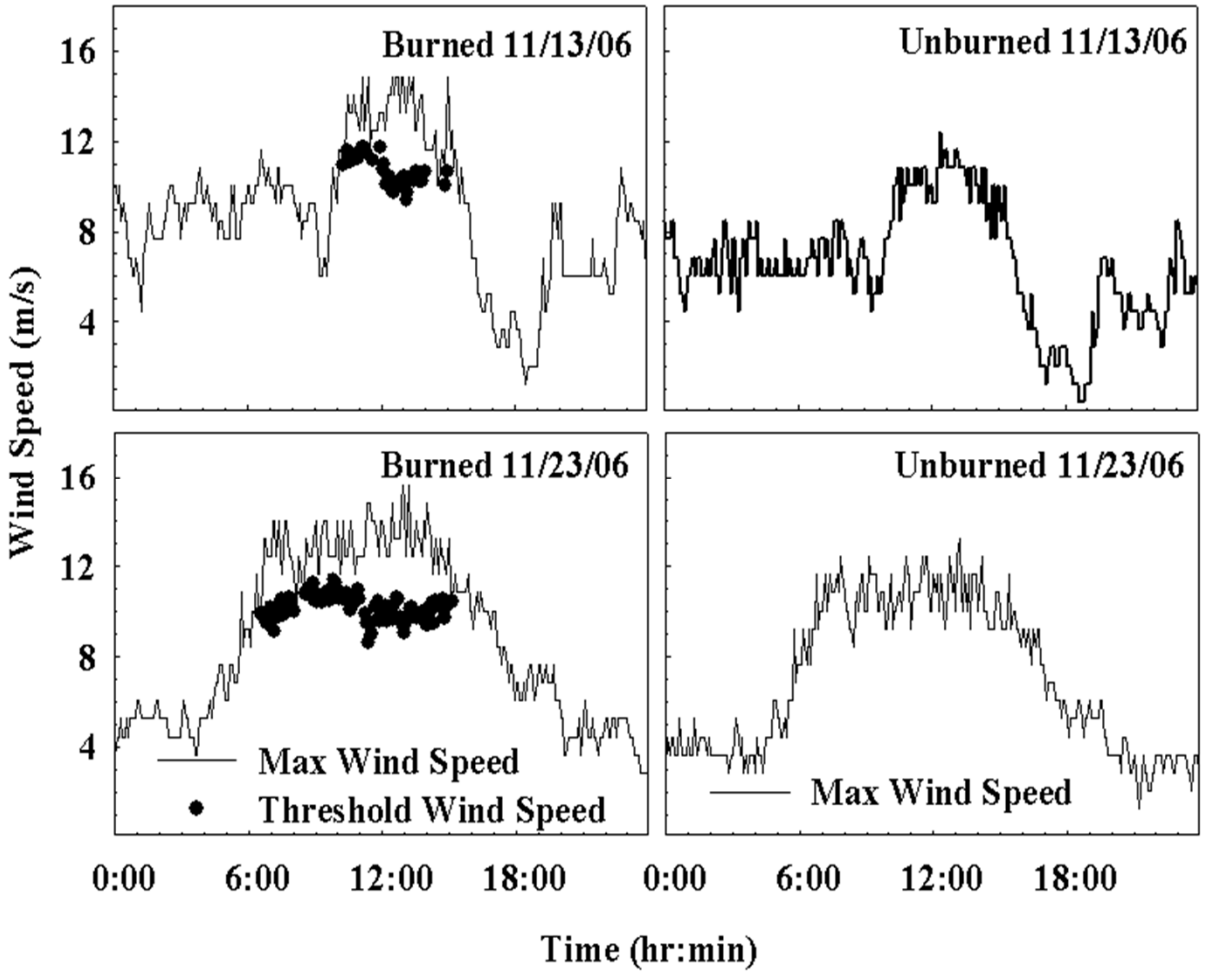
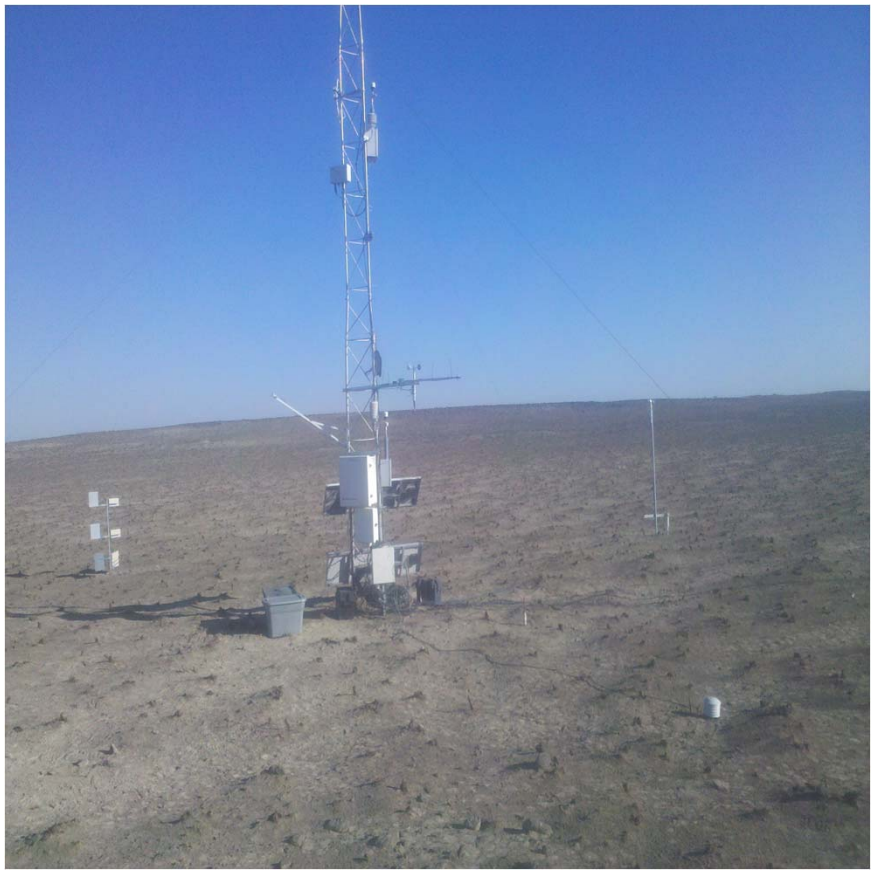
**Erodibility**: quantified through threshhold wind speeds:

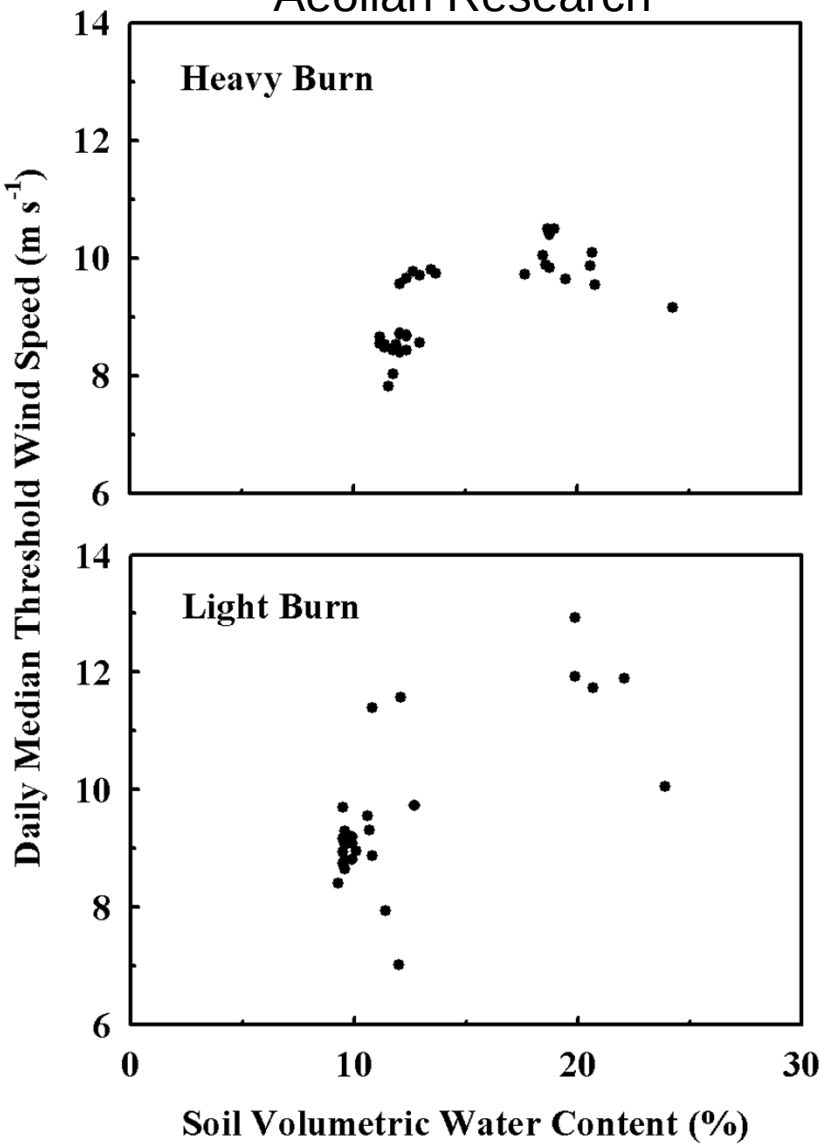
- •quite variable in time
- •Sankey, Germino, Glenn (2009, J Arid Env)
- •From the ~300K acre Crystal Fire:



High **variability in erodibility** following fire:
Why: Surface moisture variability?

Sankey et al. 2009b, in Aeolian Research



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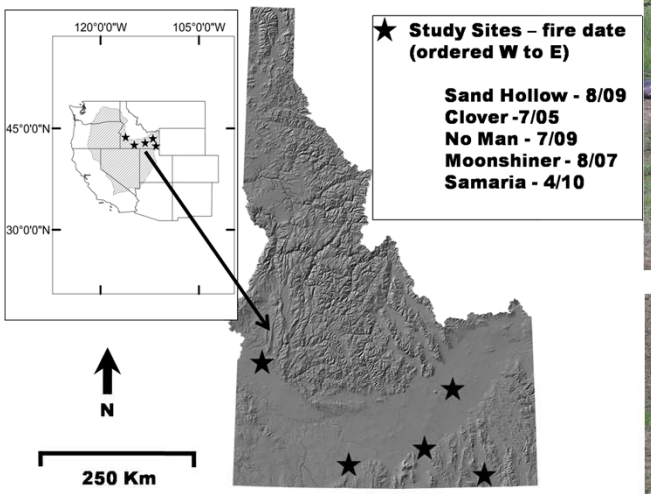
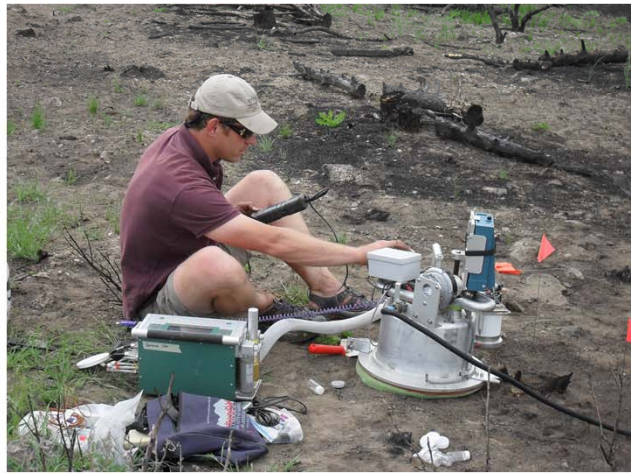
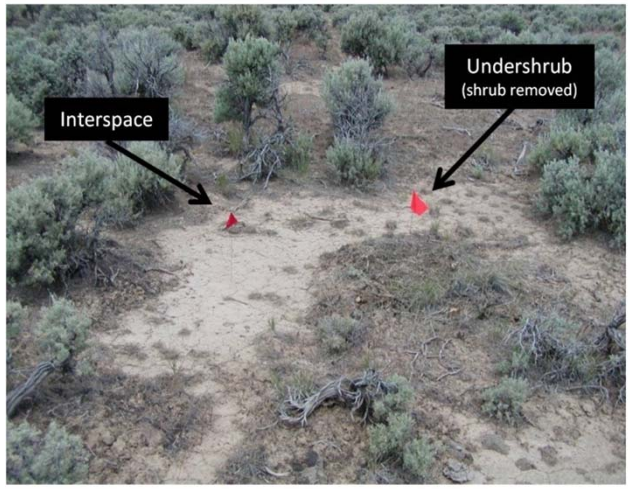
# Wind “tunnels” to help determine components of erosion



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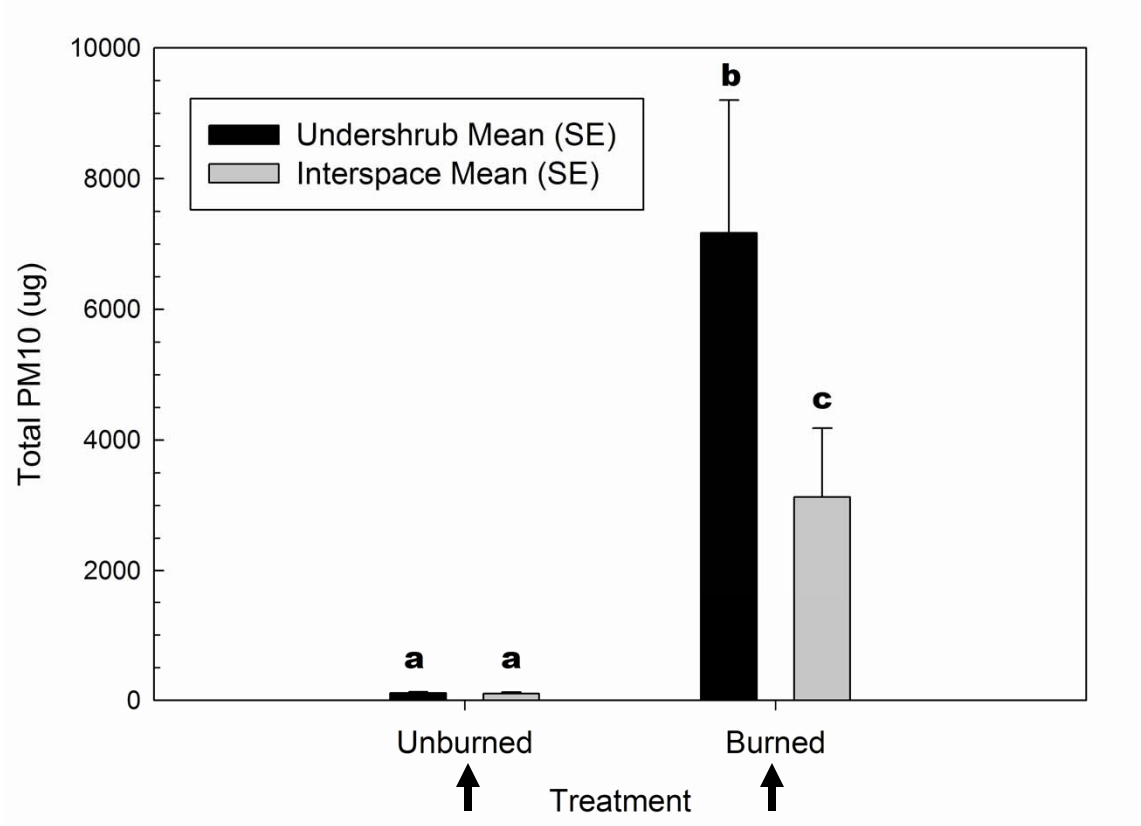
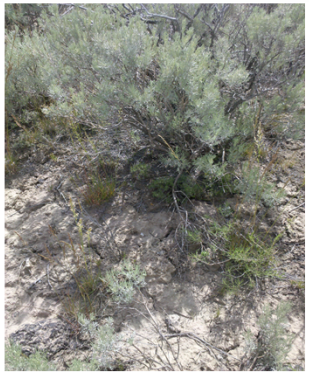
For data from 5 fires

Fire increases dust emission potential, <u>especially on microsites that had shrubs</u> (coppice mounds)

Supply of erodible sediment, but not erodibility, appears key.



From: Sankey, Germino, Glenn,
2011 J Geophysical Research and 2011 Geomorphology

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Fire effects:

EROSION = Erosivity, Erodibility, and Supply of erodible mass

++ = + no change? +

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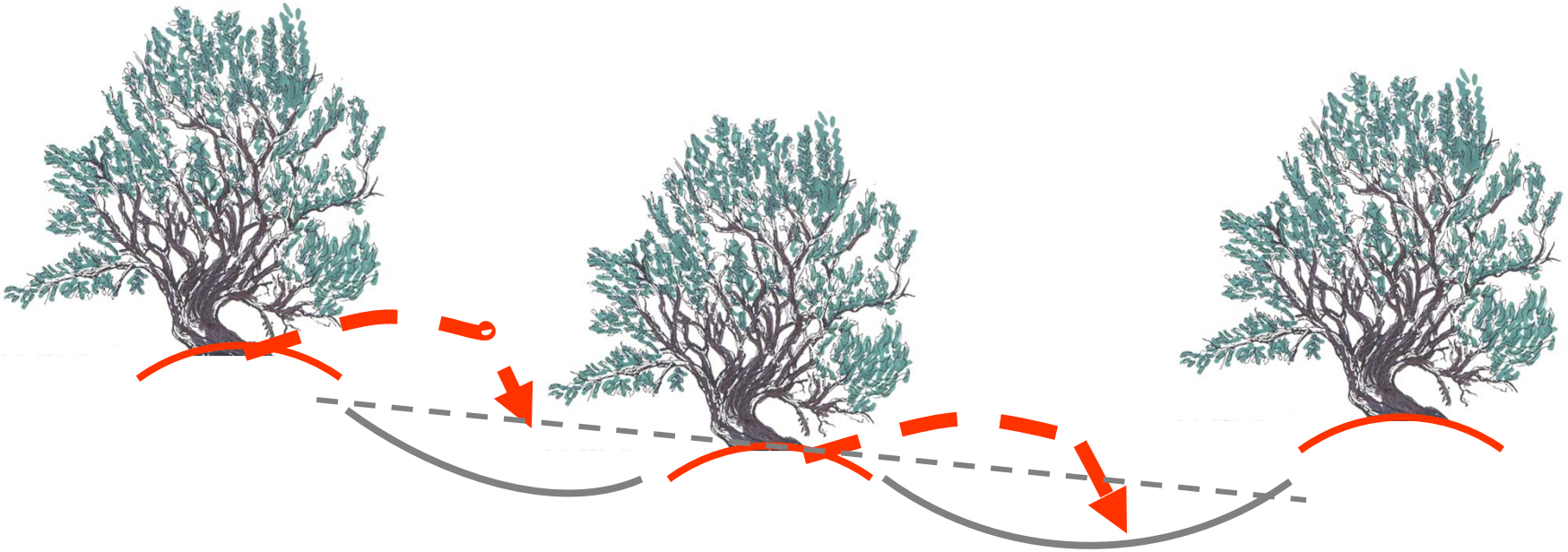
IMPACTS:

Ecosystem structure: how resistant is it to redistribution of soil by wind, after fire?



See meta-analysis for Great Basin, Sankey & Germino, International J Wildland Fire (accepted)

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CONSEQUENCES:  Site impacts of wind erosion?

-How resistant is soil-plant heterogeneity to fire + wind erosion?
-What is the ecological significance of the heterogeneity?

*Coppice-interspace heterogeneity is:*
1) fairly resistant to post-fire wind erosion where native herbs recover, and
2) is linked to landscape diversity and vulnerability to exotic annuals

*Very different from observations of mesquite-soil patterns in SW deserts

From:
Hoover and Germino, Rangeland Ecol Mgmt (accepted); and Ecol Appl, in revision.

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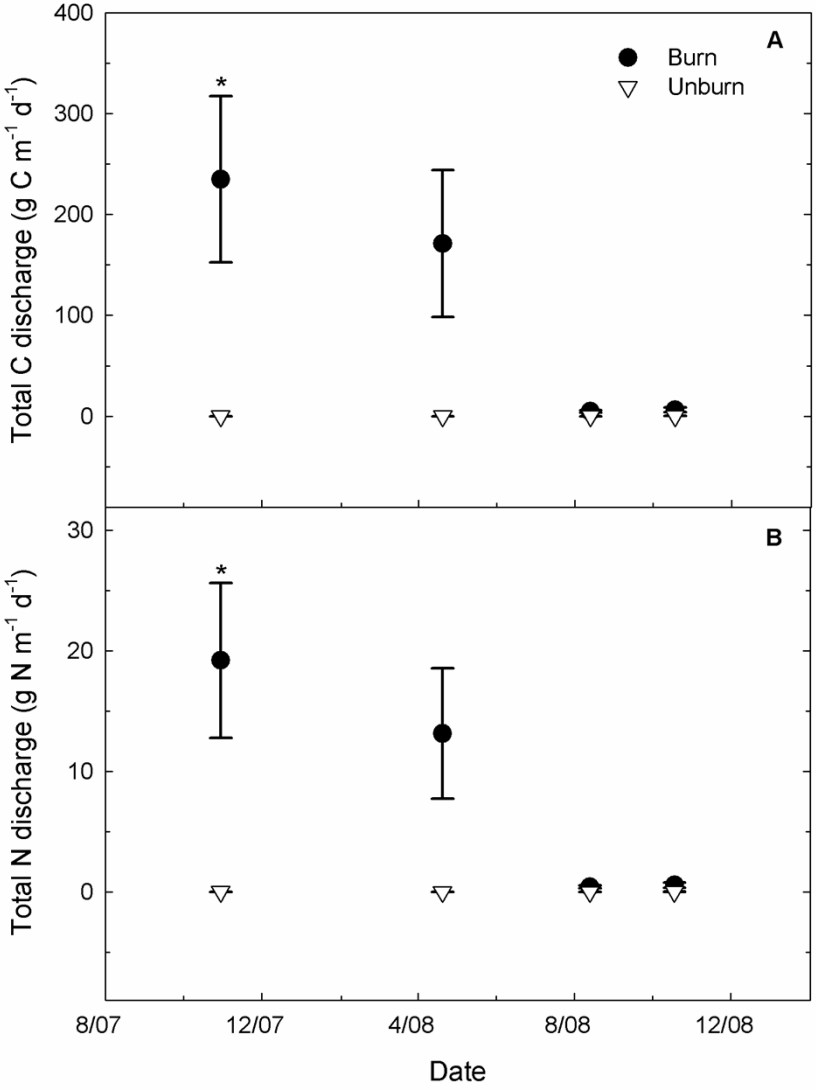
# CONSEQUENCES: *Changes in site fertility*?




Hasselquist, Germino et al., 2011
Biogeosciences Discussions

Sankey, Germino et al.
Aeolian Research 2011 (accepted)

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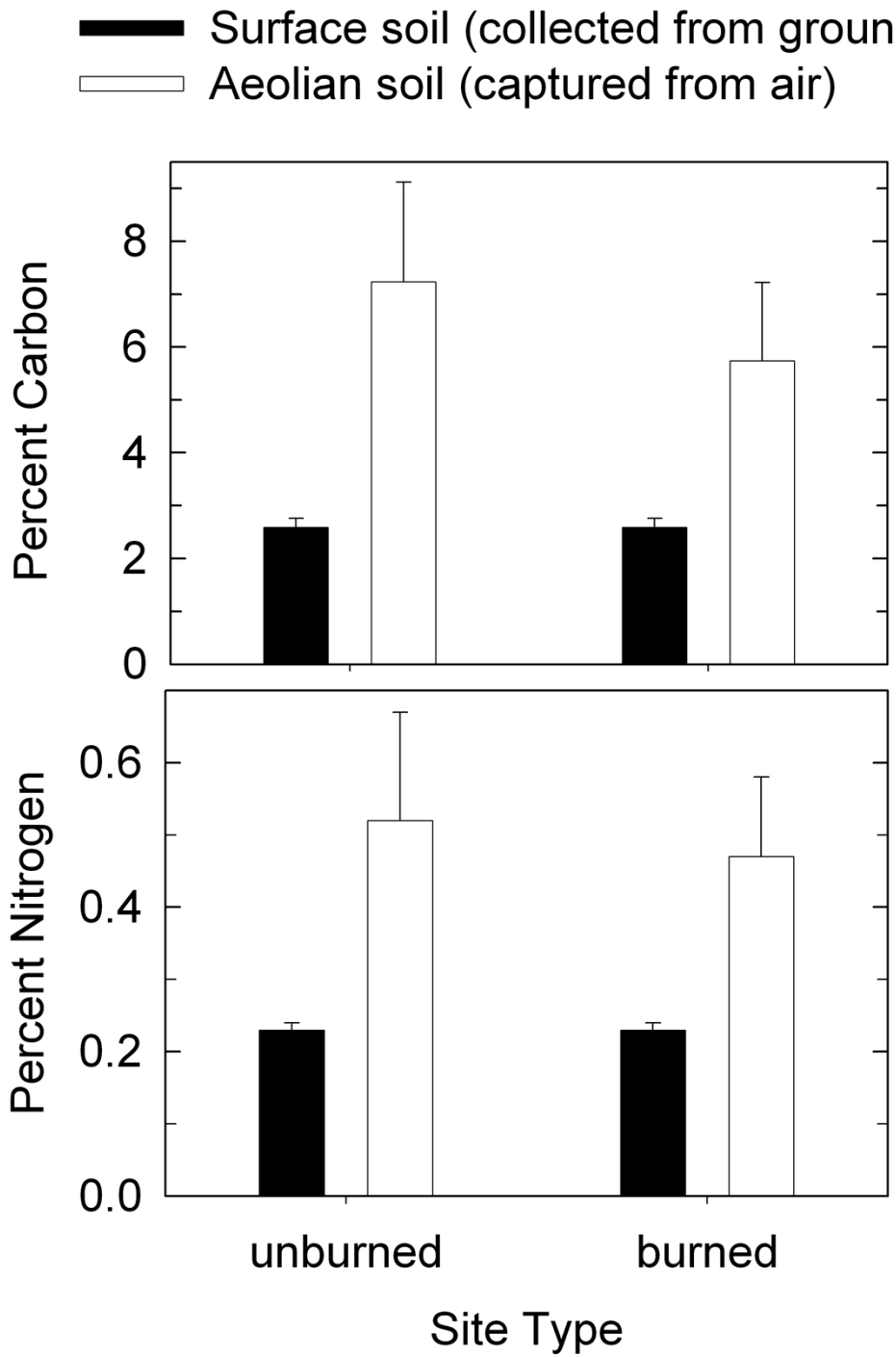
Year after fire, for the soil surface:

| | Burned, eroded | Unburned | % effect of burning and wind erosion; | P = |
|---|---|---|---|---|
| %Org. C | **2.03** ±0.12 | **2.75** ±0.31 | -26%; | 0.04 |
| %Total N | **0.21** ±0.01 | **0.26** ± 0.02 | -19%; | 0.08 |




Soils in air are 2-3 fold enriched with nutrients compared to soil on ground or eroding site

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**Summary of what we are learning about fire + erosion impacts**:

- Low-resistance of soil and nutrient loss on *large fire sites*
- High apparent resistance/resilience of healthy rangelands
- What can management do to abate the risks? Possibilities:
  - avoid large fire sizes and intense fires;
  - pre-fire control of grazing and cheatgrass;
  - rationale of seeding for soil stabilization?
  - avoid initiating saltation cascades after fire

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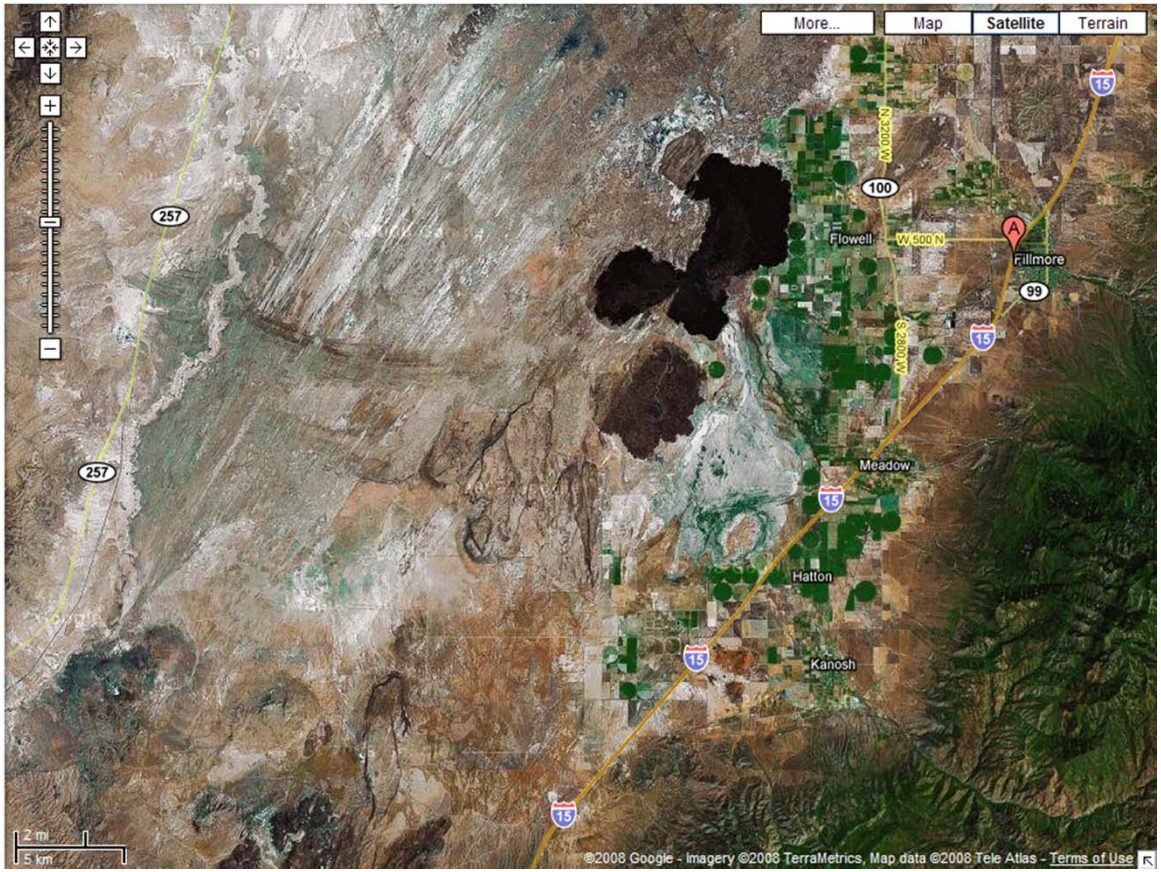
Landscape **connectivity** is unambiguous in wind erosion events, and wind erosion processes are landscape cascades (like avalanches).

From Mark Miller, for Milford Flats UT:

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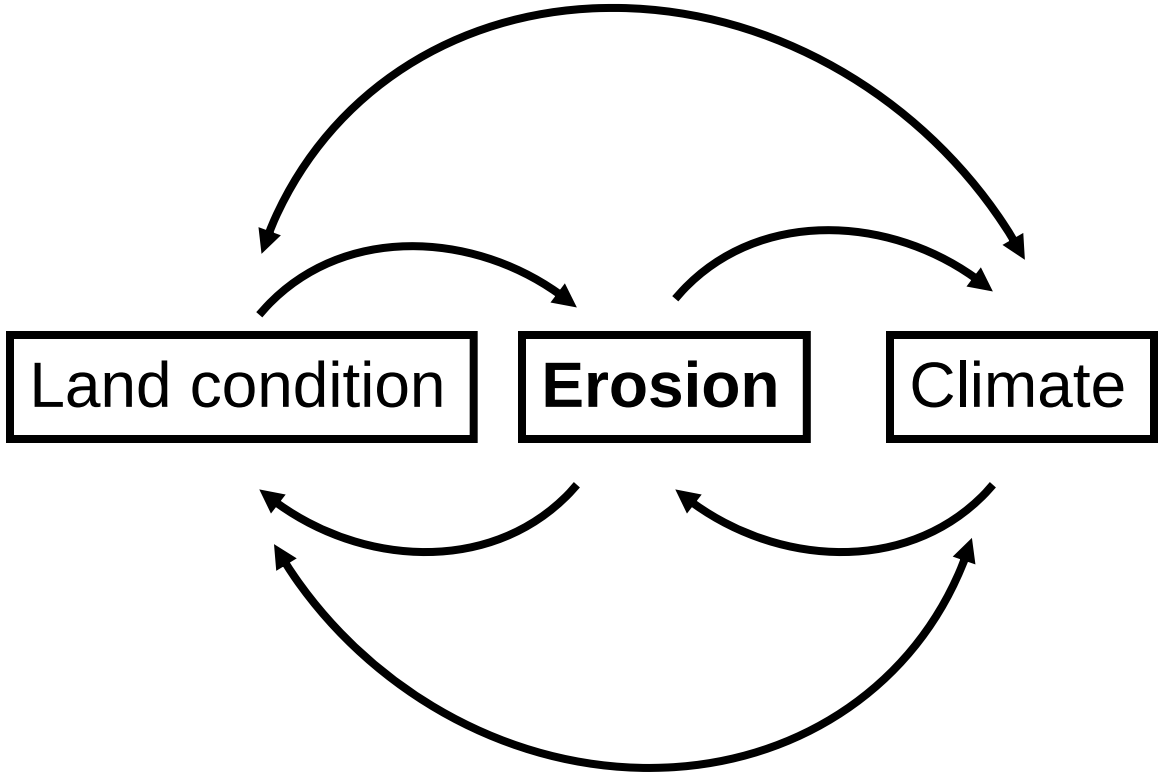
**Desertification:**

- Loss of productivity and ecosystem services
- A big concern in the specter of global change
- Is not necessary due to climate itself
- Feedbacks, connectivity are hallmarks

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-Wind erosion is a major component of environmental change

-An understanding of it requires an integrative, multidisciplinary, and landscape perspective.

# The end

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