# Climate and land use drivers of dust and investigating implications for snowmelt and water resources in the Colorado River Basin

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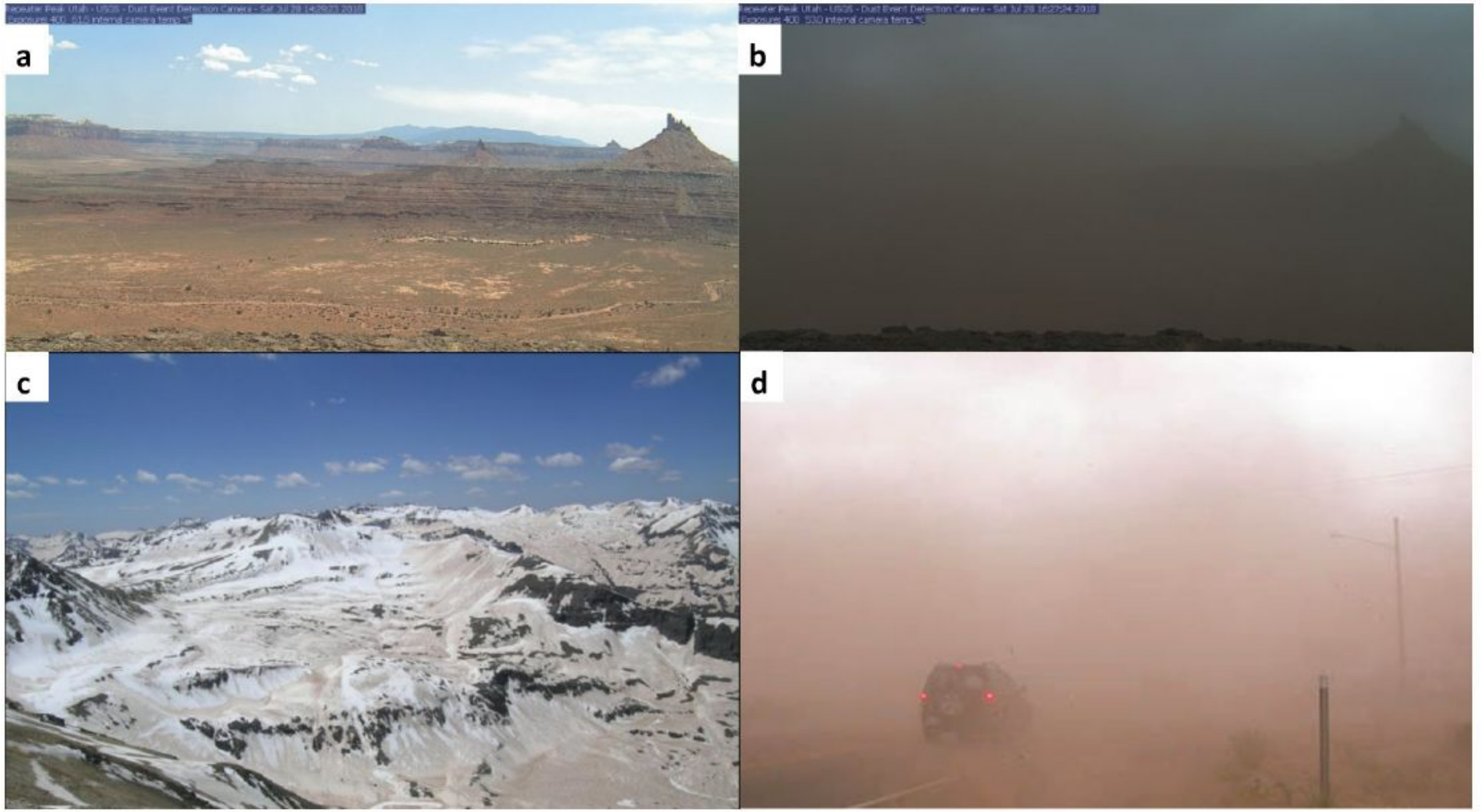


Fig. 5. Examples of dust impacts: dust storm impacting visibility near Canyonlands National Park, just prior (a) and after (b) dust event (28 July 2018); dust-on-snow event in the San Juan Mountains, Colorado (c); and low visibility on the highway near Moab, Utah (d).

Duniway et al., 2019, Ecosphere

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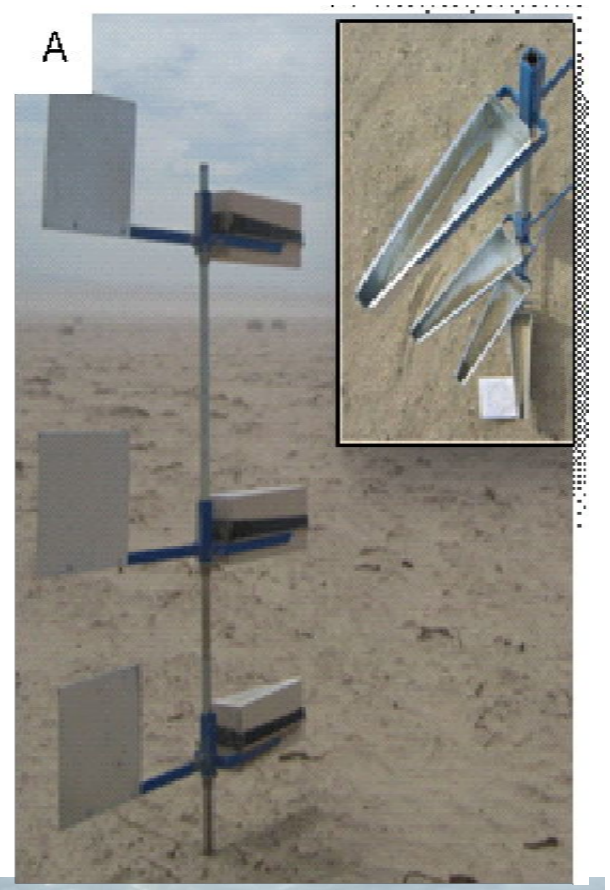
# Big Springs Number Eight (BSNE) Monitoring

**Moab Regional Network:**

- 126 Rangeland BSNE towers
  - Ongoing, sites have been added and changed since 1990s
- 33 Road BSNE towers
  - 2010-2016; sites added in 2013
- 2 OHV site BSNE towers
  - 2007-2013; near Hanksville, UT
- 29 Reclaimed Oil and Gas Well Pads
  - 2017- present
  - Sampled across range of soil, vegetation, and time since abandonment.

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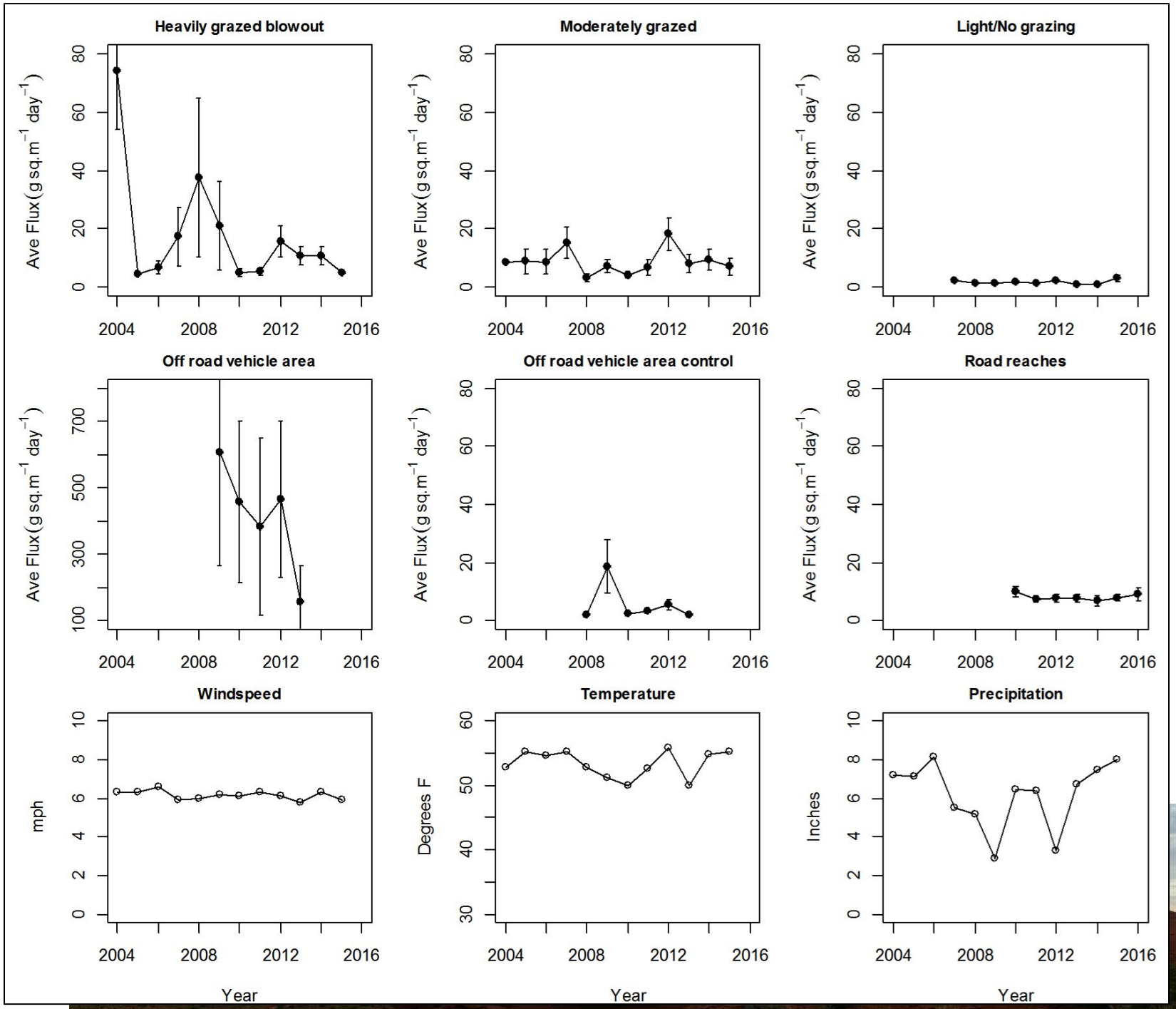
Flagg et al., 2014, Aeolian Res.; Nauman et al. 2018 ESPL; Duniway et al. 2019 Ecosphere

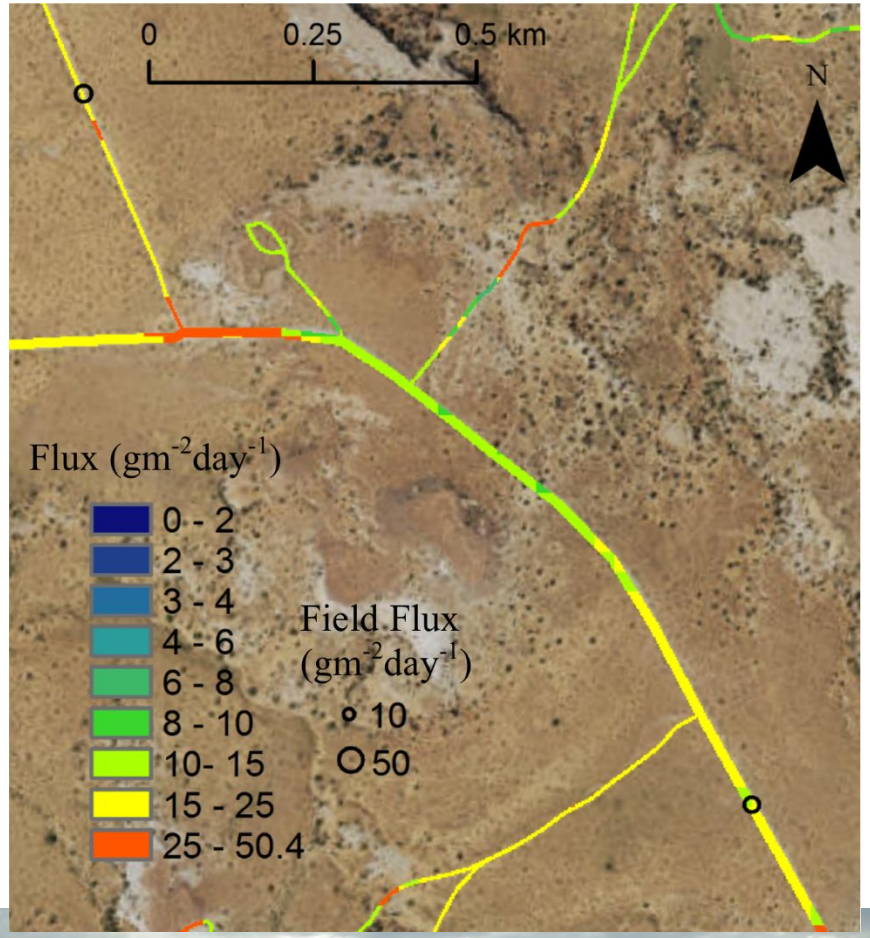



# Climate vs Disturbance

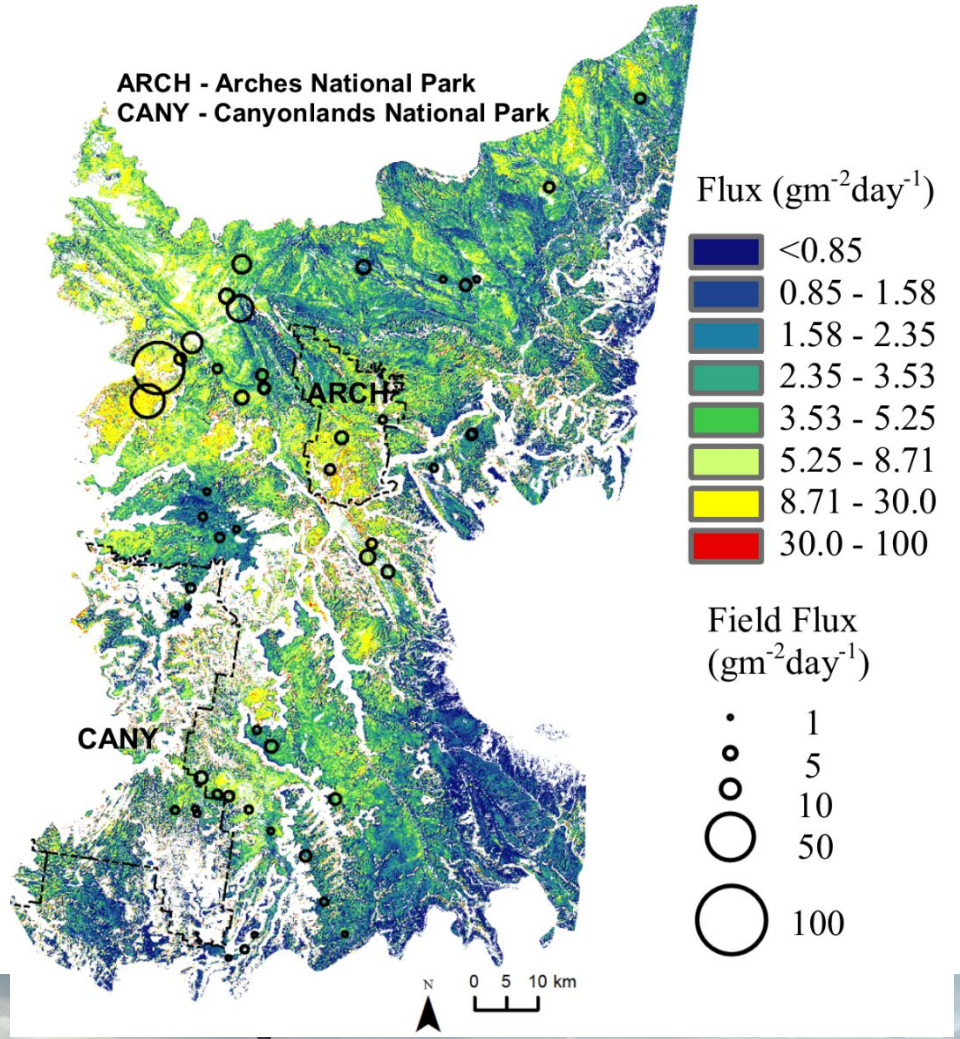
- Disturbed rangelands
  - Only had high flux on hotter, drier, windier years.
- Off road vehicle areas always had high flux, but less so on cooler, wetter, windier years
- Only unpaved roads showed no association with climate parameters

Nauman et al. 2018

# Aeolian Transport




Unpaved roads




Rangelands

Nauman et al., 2018, ESPL

# 2018 Conclusions

- Relative sediment transport
  - Rangelands: 93%
  - Unpaved Roads 7%
- Spatial controls: 1) soils 2) vegetation types 3) climate 4) topographic exposure
- Heavy grazing = 12x more sediment
- OHV use = 61x more sediment
- IT'S NOT CLIMATE OR DISTURBANCE ALONE, BUT THE SYNERGY OF THE TWO THAT DRIVES AEOLIAN TRANSPORT.
  - Hot/Dry/Windy + Disturbance = Sediment Mobilization

Nauman et al, 2018

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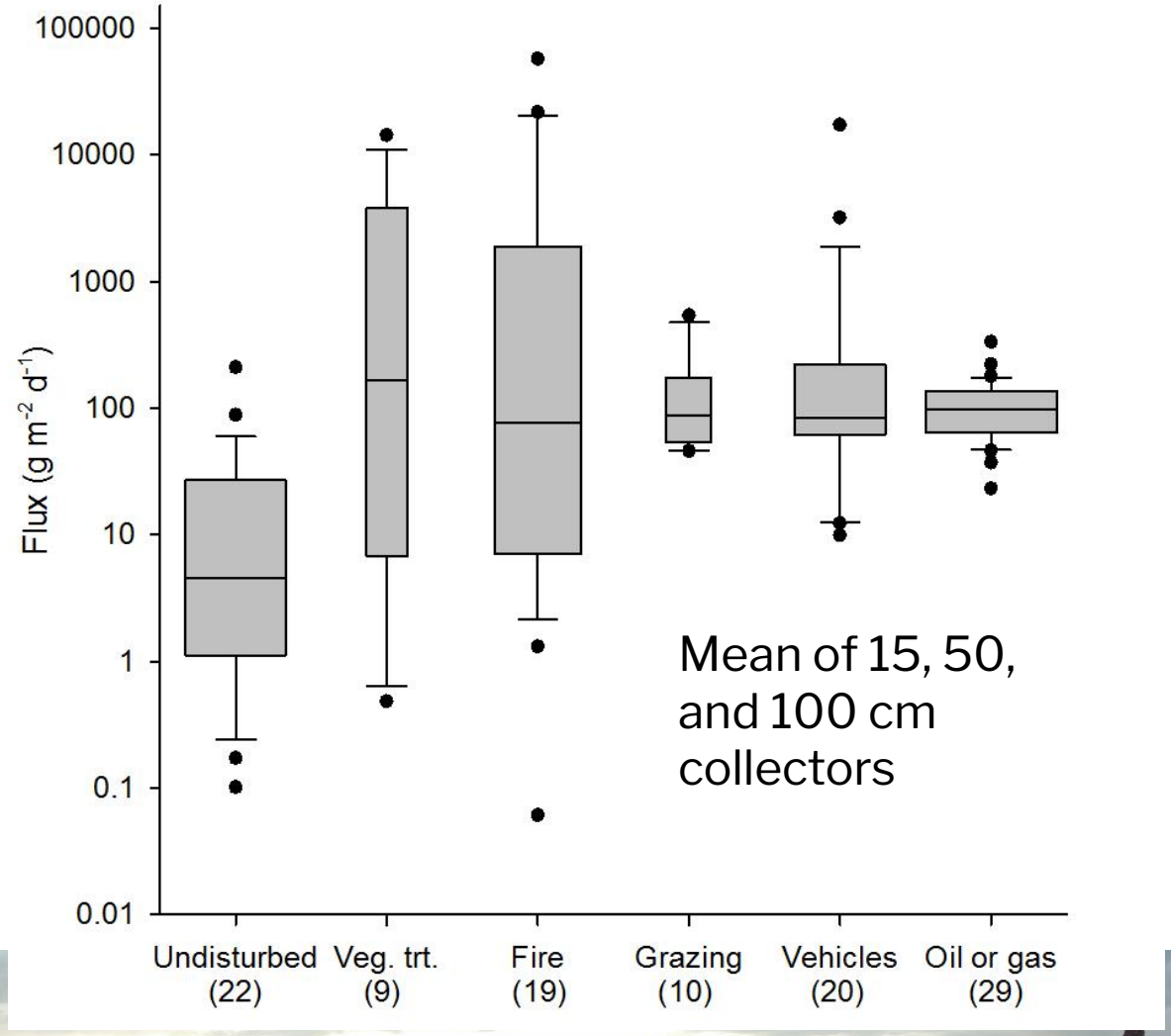
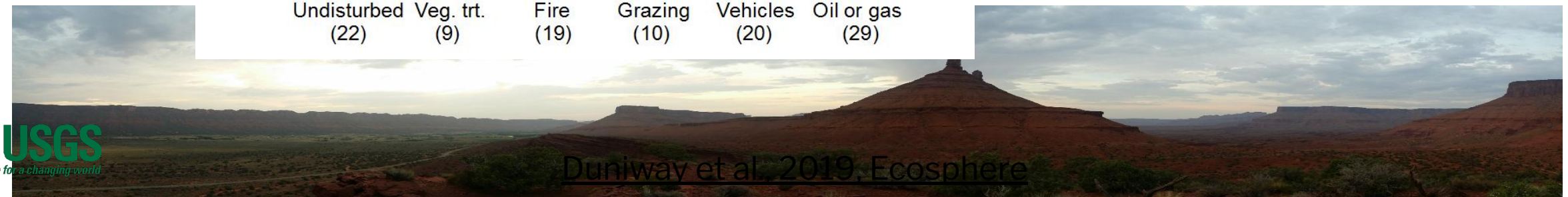
# Aeolian Flux @ Disturbances

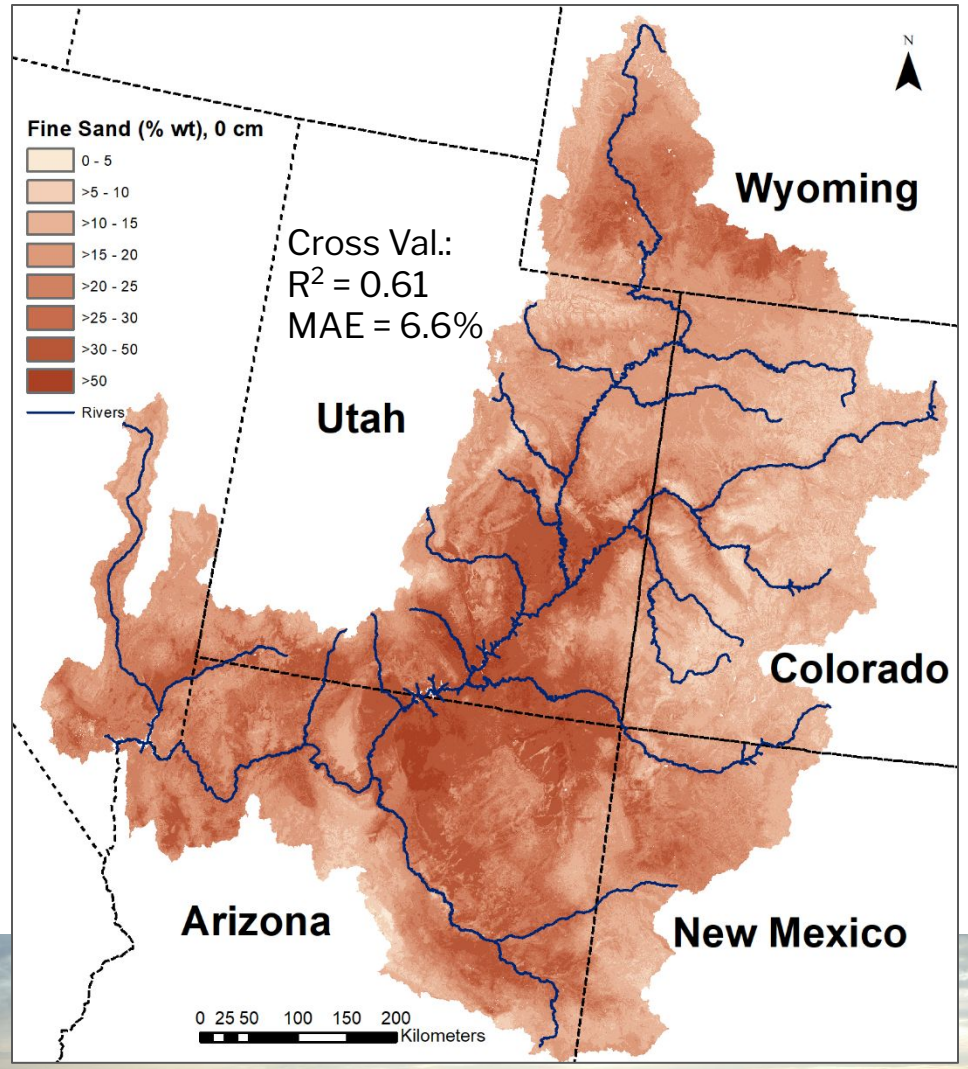



- Land disturbing practices all increase flux, but have different amounts of variability.



Duniway et al., 2019, Ecosphere

# Soil Property Maps, 30 meter grids




- Texture (sand, silt, clay, fine sand, very fine sand, rock)
- Surface rock
- Organic matter
- pH
- Erodibility
- Bulk density
- Available water capacity
- Salinity (ec, sar)
- Gypsum
- Carbonates
- Depth to restriction
- 108 Maps and associated uncertainty!

Nauman & Duniway, 2020, SSSAJ

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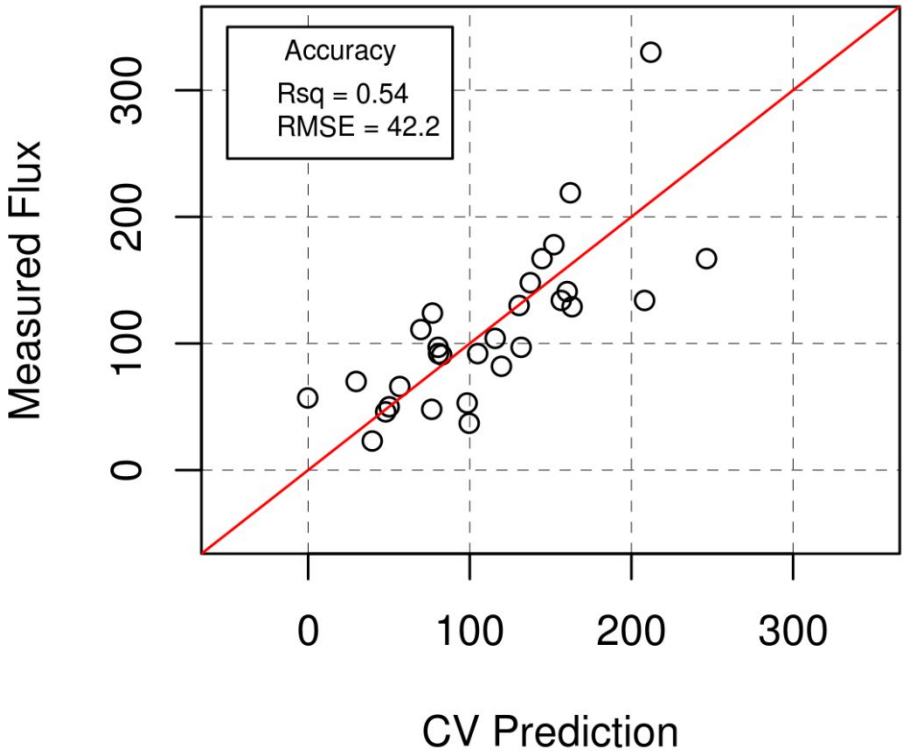
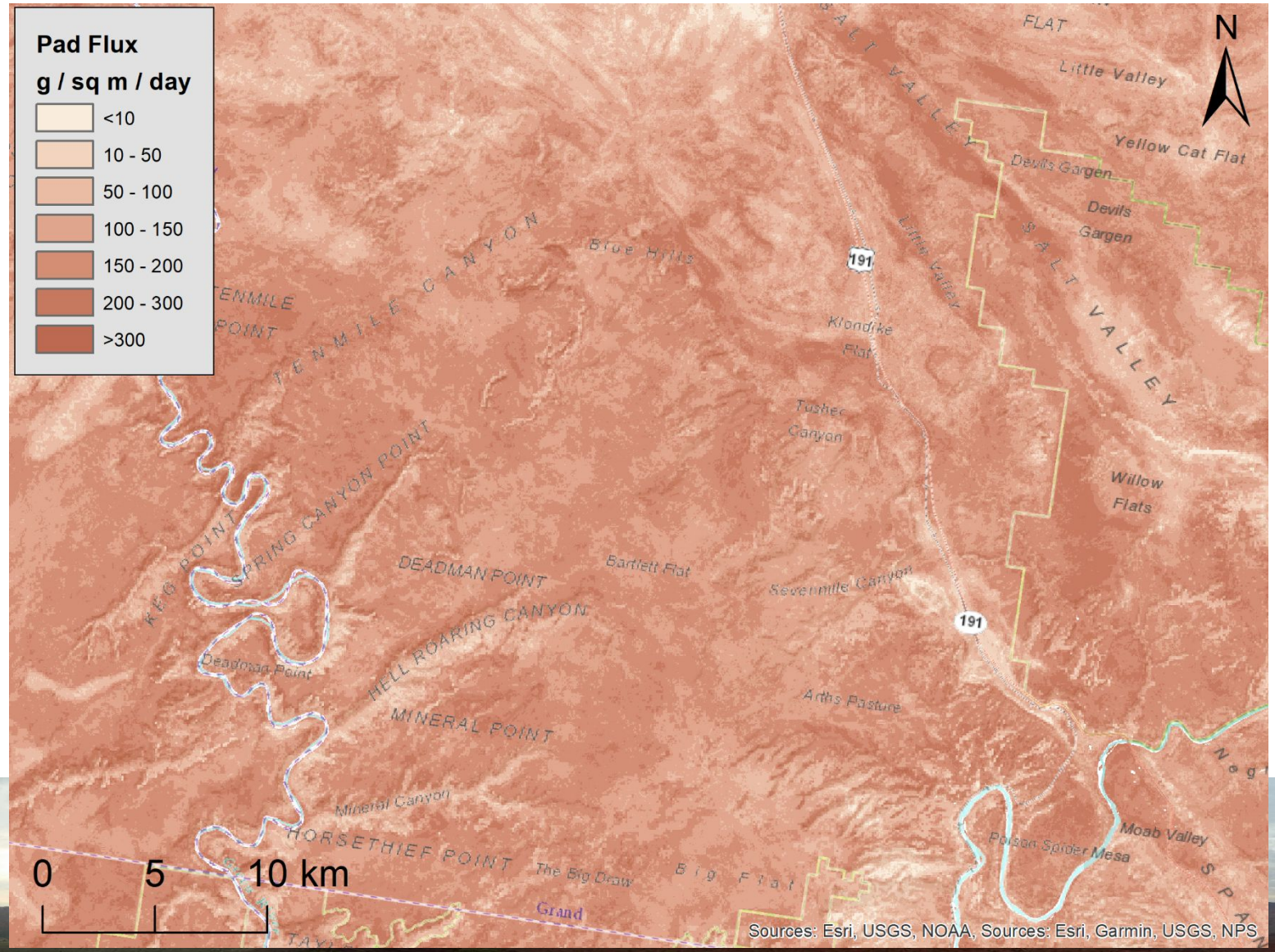
# Dust from Oil and Gas Well Pads

| Variables | Estimate | Std. Error | t value | Pr(>\|t\|) | |
|---|---|---|---|---|---|
| Sodium Adsorption Ratio (100 cm) | 48.32 | 8.82 | 5.48 | 1.30E-05 | *** |
| Fine Sand Content (5 cm) | 7.88 | 1.94 | 4.06 | 0.00045 | *** |
| Silt Content (30 cm) | 11.51 | 3.04 | 3.78 | 0.00091 | *** |
| Total Sand Content (100 cm) | 4.06 | 1.15 | 3.53 | 0.0017 | ** |
| Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 | | | | | |
| Adjusted R-squared: 0.647 | F-statistic: 13.8 on 4 and 24 DF, p-value: 5.57e-06 | | | | |

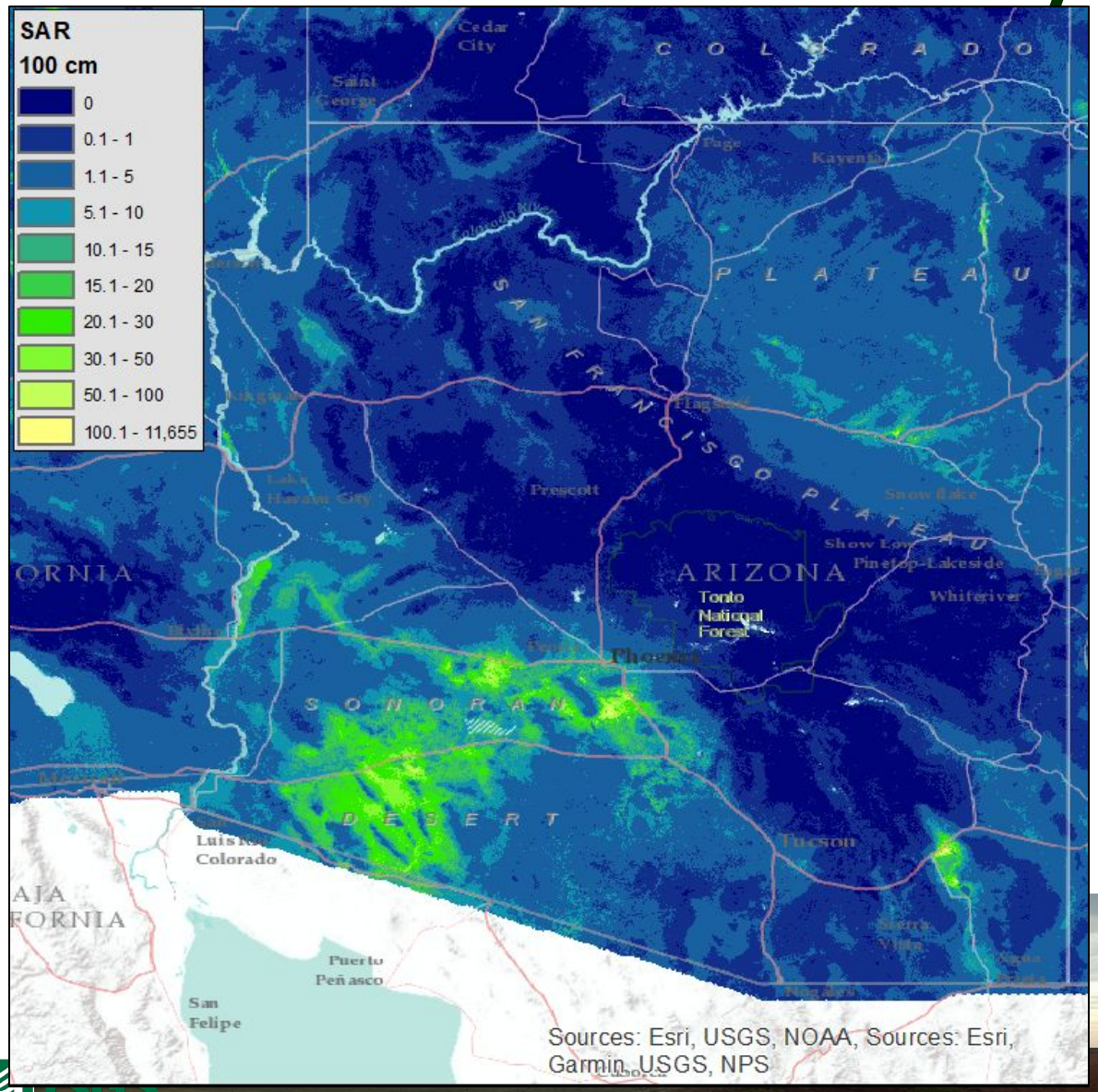
## Cross Validation

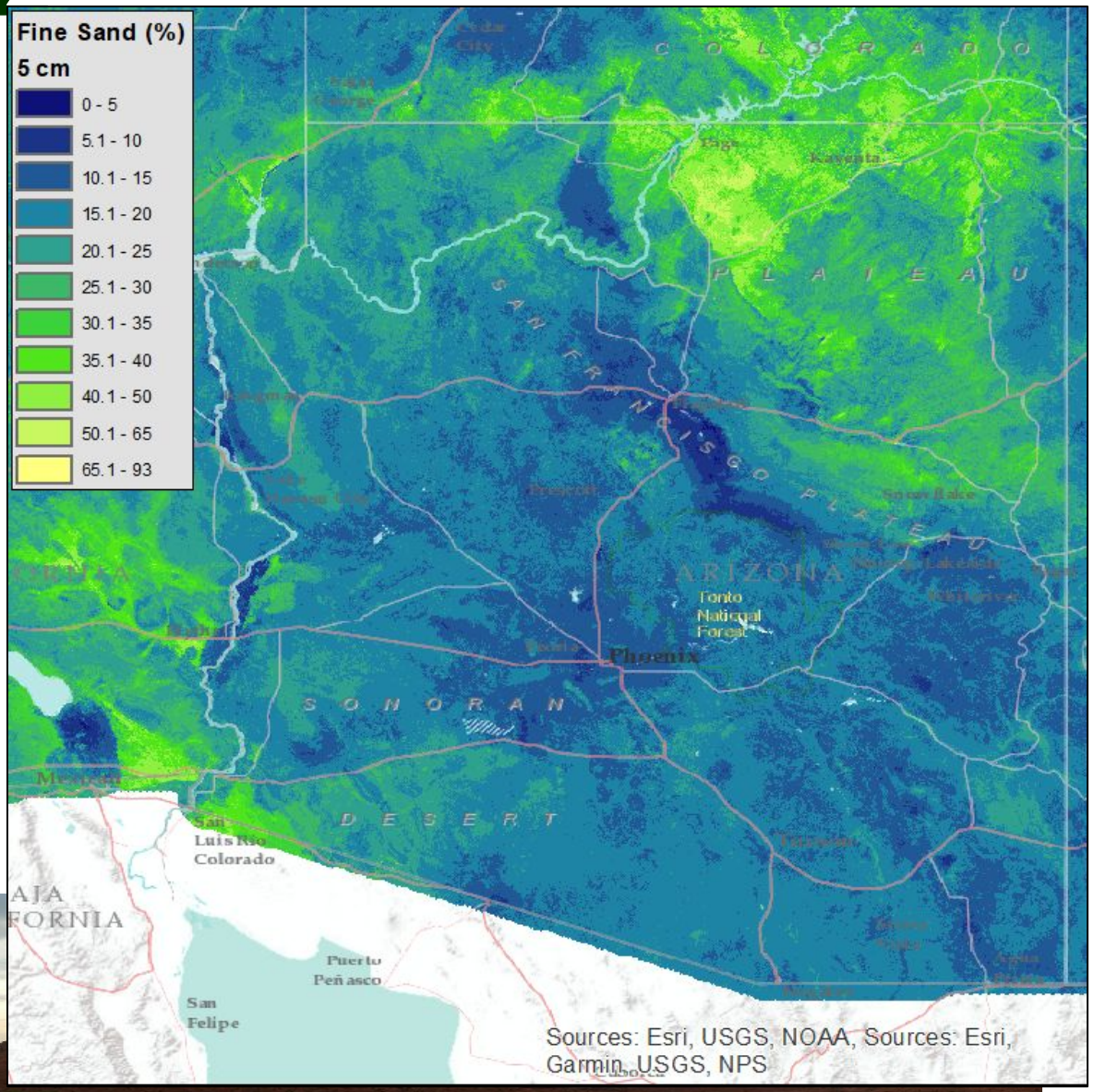



# Well pad potential flux map

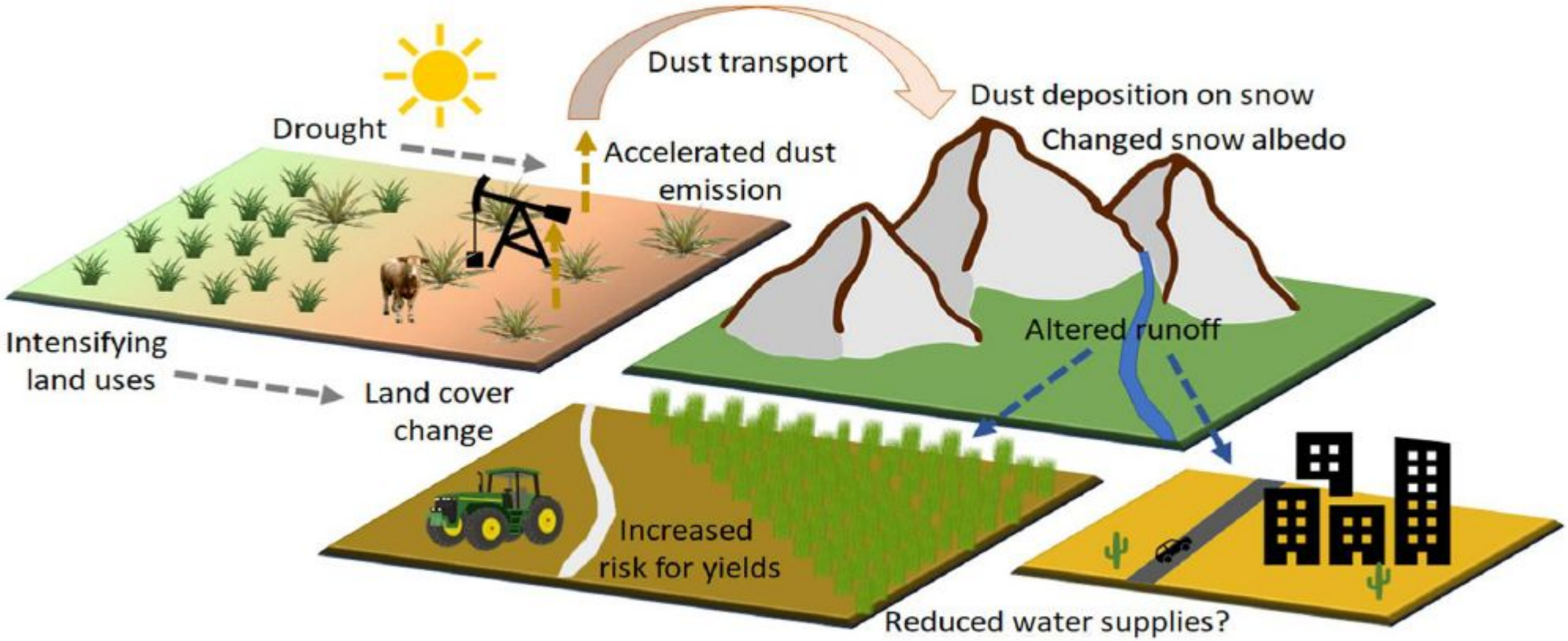


# Sodium Adsorp. Ratio and Fine Sand in AZ



# Dust, Drought, Land Use, Snow and Water

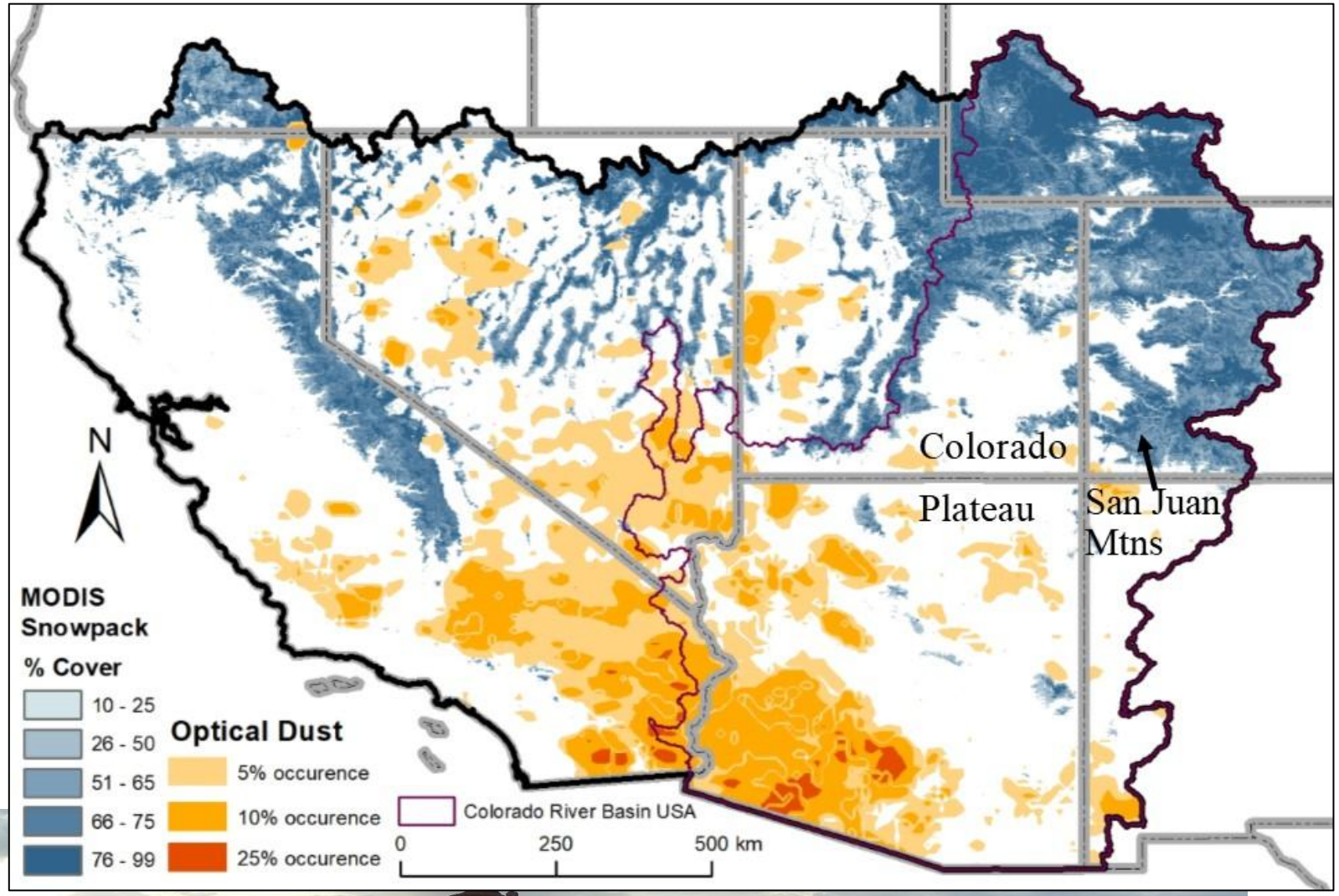



**Hypothesis**: **interaction** of surface **disturbance** and **drought** is the primary driver of dust related impacts, **as opposed to either factor alone**.

Nauman et al., 2019, NASA Roses Interdisciplinary Science proposal 19-IDS19-0020.

# Dust, Drought, Land Use, Snow and Water

- New NASA funded project
  - USGS, NMSU, U of UT, Duke
- Improving the WRF Earth System model using updated
  - Satellite albedo inputs
  - Soil inputs
  - Dust emission scheme
  - Snowmelt response to dust
  - Basin discharge response
  - Multi-faceted validation
  - Surrogate modeling hypothesis testing




Nauman et al., 2019, NASA Roses Interdisciplinary Science proposal 19-IDS19-0020.

# Thanks!

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