4-27-2018

Magnitude and Character of Post Fire Aeolian Deposition in the Northern Great Basin

Clayton Roehner
Boise State University

Jennifer Pierce
Boise State University

Nancy Glenn
Boise State University

Elowyn Yager
University of Idaho

Frederick Pierson
Northwest Watershed Research Center

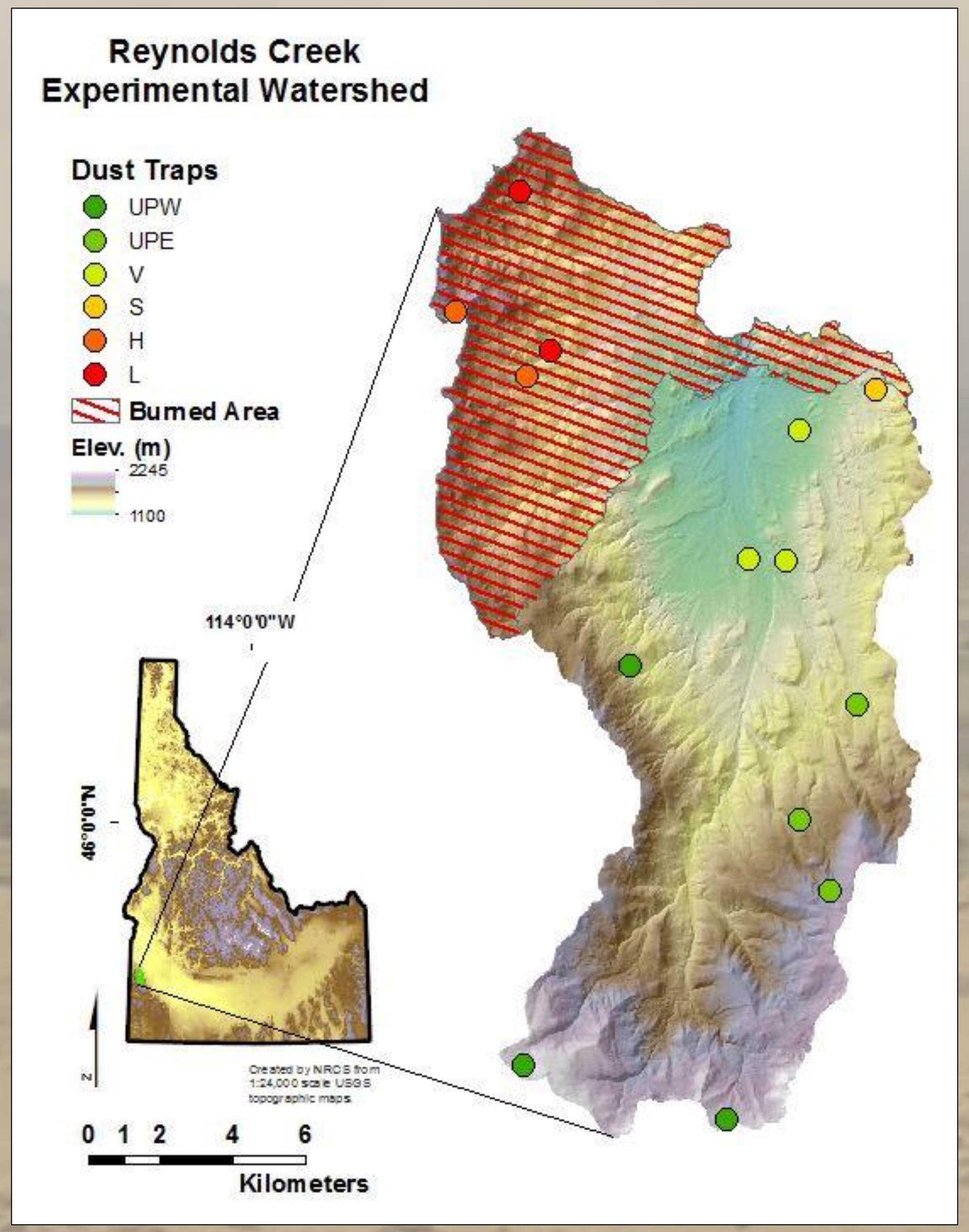
MAGNITUDE AND CHARACTER OF POST FIRE AEOLIAN DEPOSITION IN THE NORTHERN GREAT BASIN

Clay Roehner[1], Jennifer Pierce[1], Nancy Glenn[1], Elowyn Yager[2], Frederick Pierson[3]

[1]Department of Geosciences, Boise State University, Boise, ID 83725, USA, [2]Department of Civil Engineering, University of Idaho, Boise, ID 83702, USA, [3]Northwest Watershed Research Center, Agricultural Research Service, Boise, ID 83712, USA

Wind Driven Deposition and Fire in Western Rangelands

- **This study aims to characterize spatial and temporal trends in the magnitude and character of aeolian deposition in the two years following a rangeland fire.**
- Aridification, the spread of non-native plants, and anthropogenic climate change drive increased fire extent and severity (Abotzoglou, 2016).
- The Soda Fire of August, 2015 burned ~280,000 acres of eastern Oregon and SW Idaho, including 25% of the Reynolds Creek Experimental Watershed (RCEW).



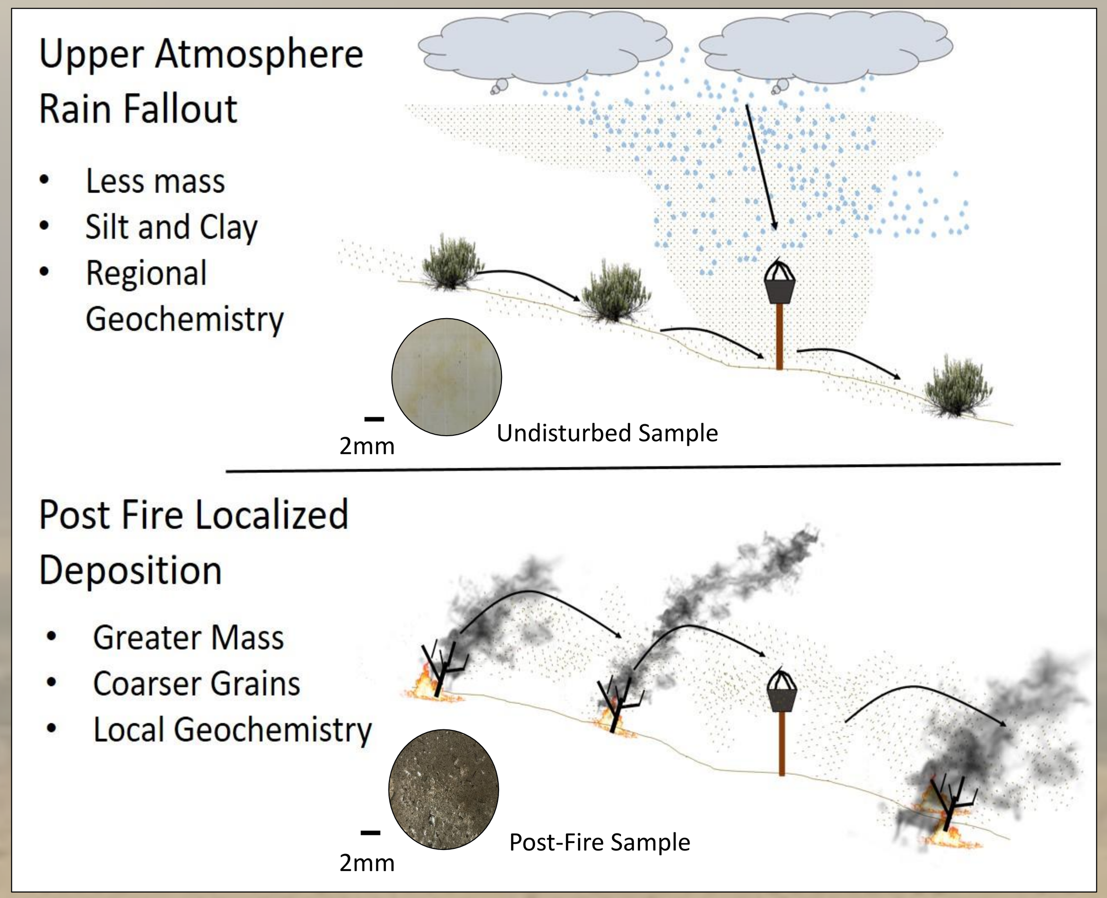
Experimental Design

- 14 passive dust collectors are distributed throughout the RCEW at well instrumented sites and sampled at seasonal intervals.
- Due to small sampling intervals and sizes, samples were combined by geographic location and season to allow for grain size and geochemical analysis.

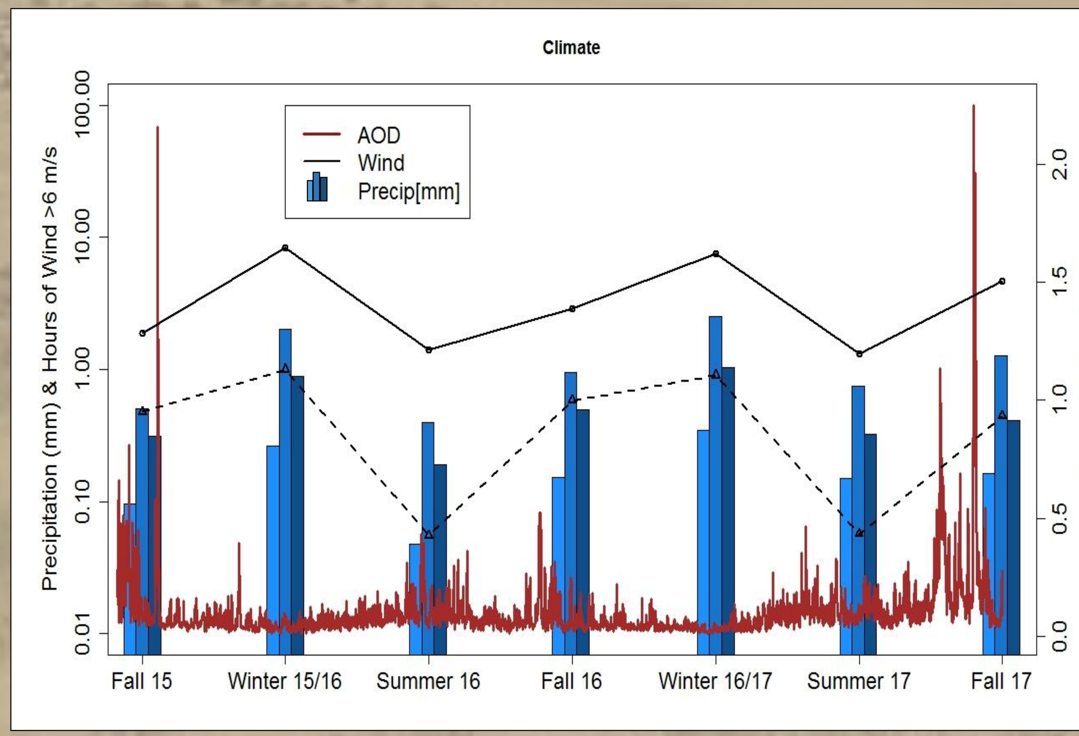
Can we trace the fingerprint of fire on a landscape using dust characteristics?

- In an undisturbed landscape, aeolian material is deposited through rainfall and dry fallout from the atmosphere;
- The atmospheric dust contains very fine silt and clay particles, soluble salts, and is very well mixed;
- Fire decreases surface roughness and increases soil erodibility, allowing for entrainment of surface particles;
- **Post-fire wind deposition of material leaves a significantly greater deposit of coarser grains and composed of locally derived geochemistry.**

Conceptual Model

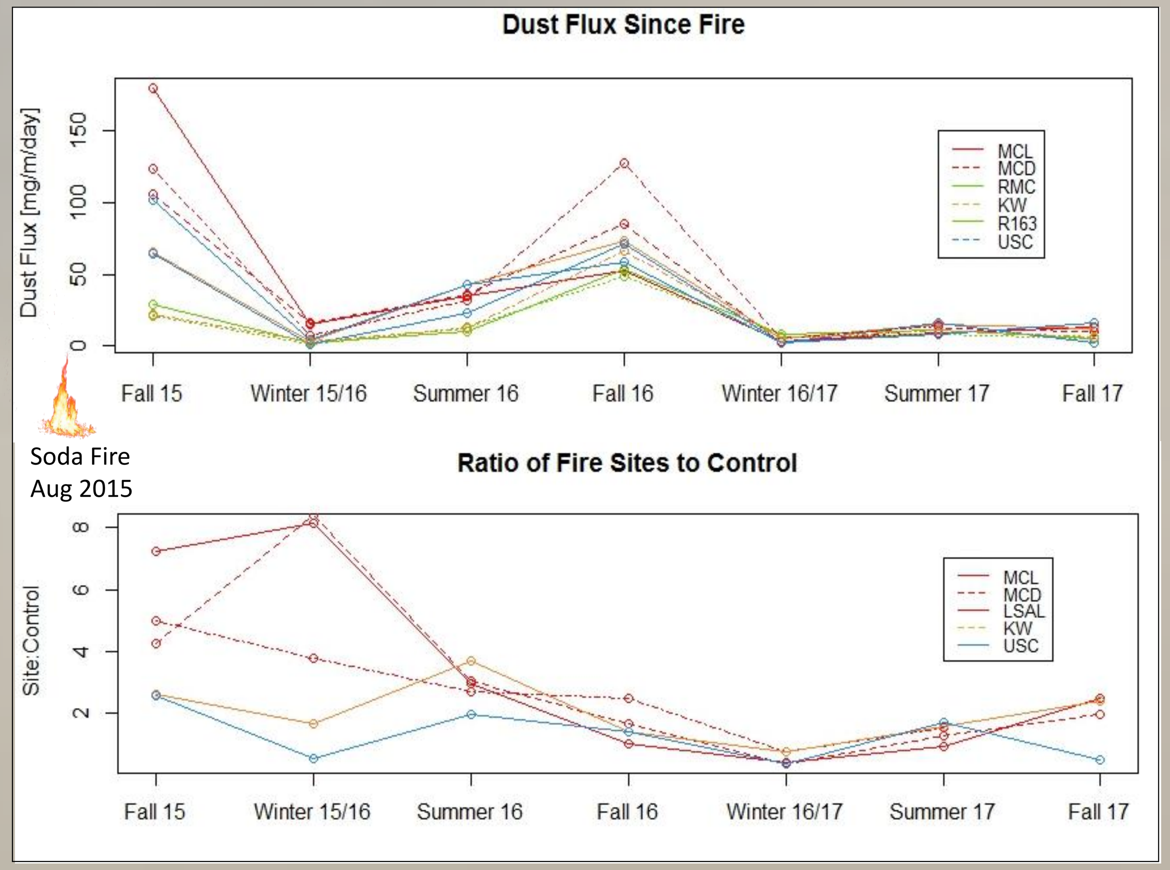


Climate Metrics



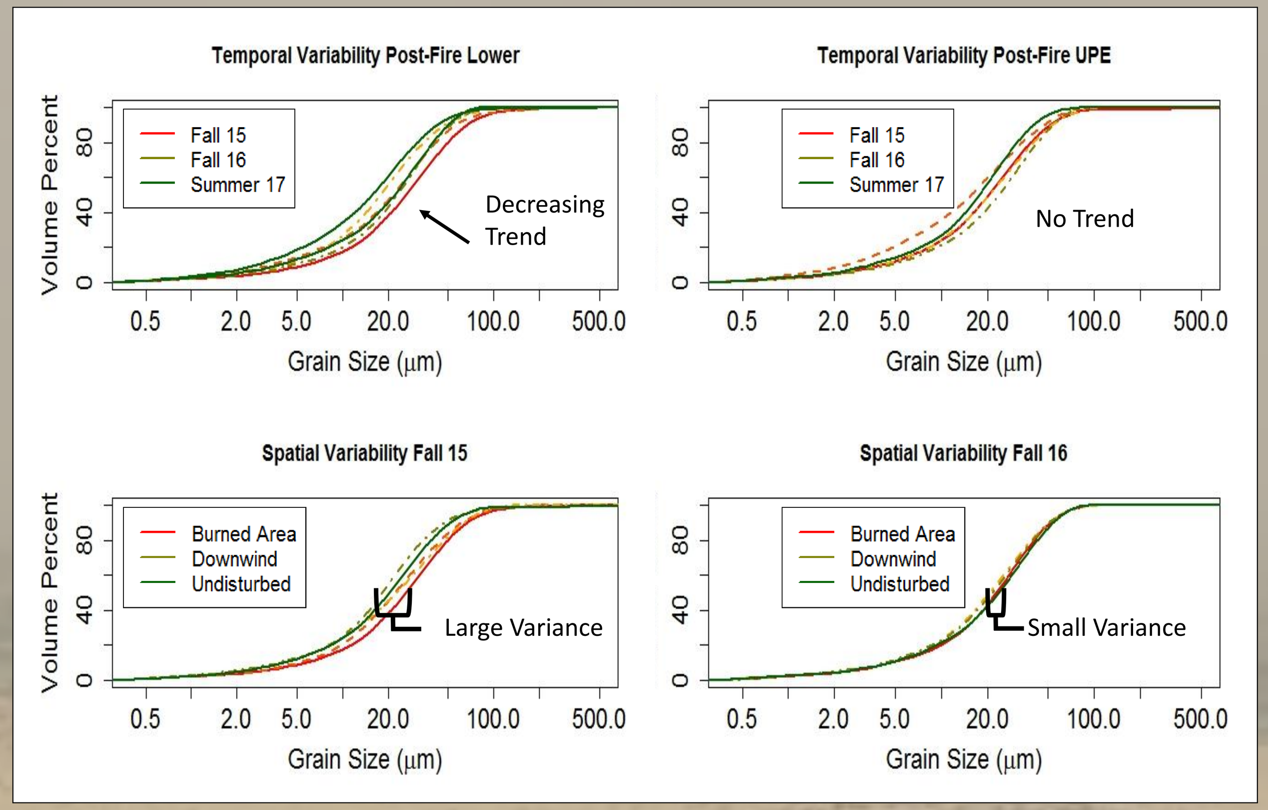
Wind above 6m/s is needed to entrain particles but precipitation is also necessary to effectively remove the particles from the atmosphere. The data above is normalized by the number of days in a sampling interval showing that the fall is both windier and wetter per day than summer.

Mass Flux



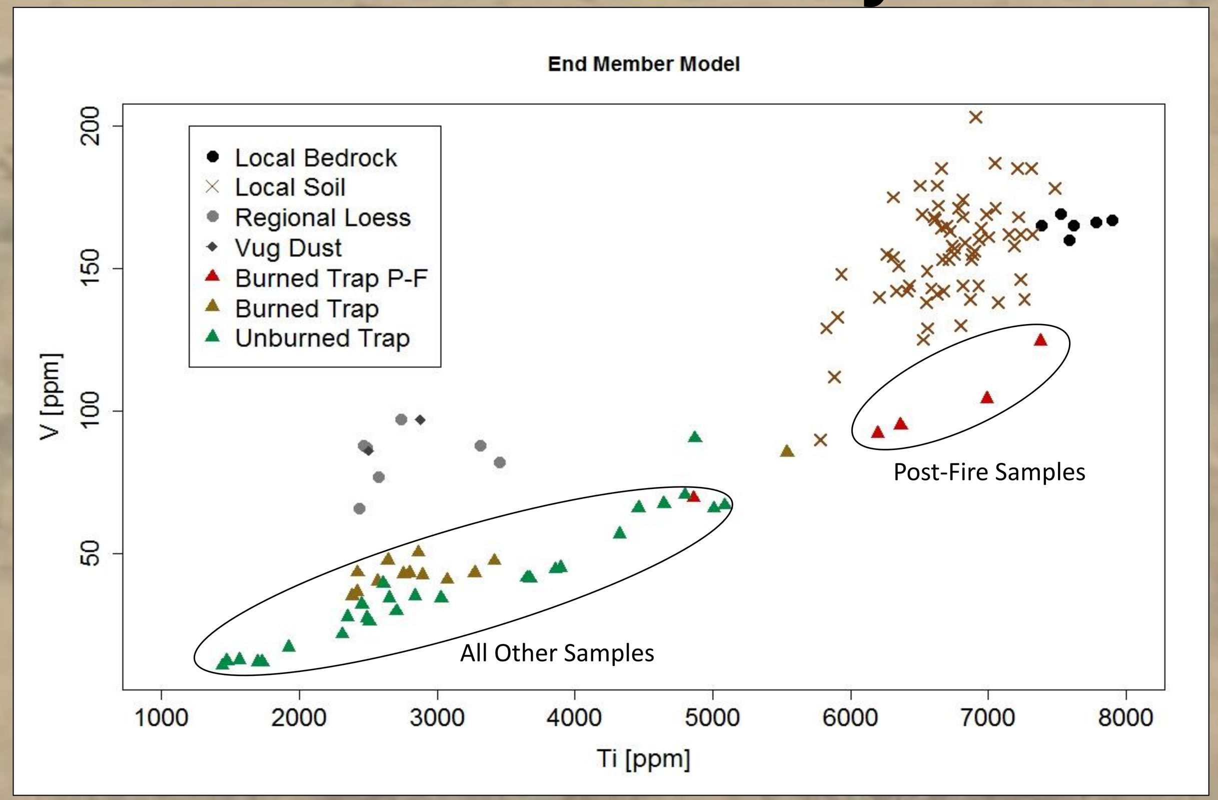
Normalizing the mass flux to the "control" site outside of the burned area, it is clear that aeolian activity was enhanced until the first growing season.

Grain Size



A trend exists in the grain size distribution over time within the burned area. While spatial variance is high following the fire, one year later the watershed has a homogenous distribution with little variance.

Geochemistry



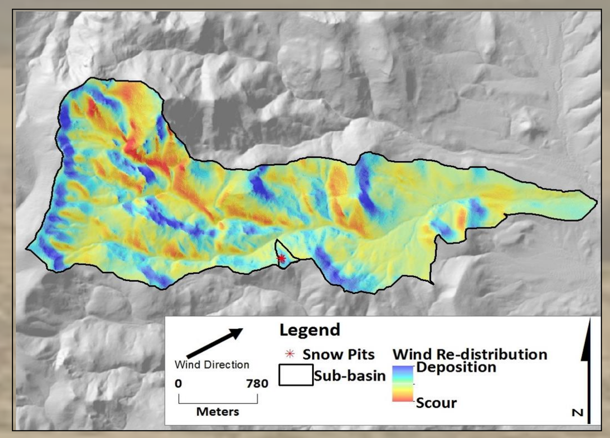
The samples collected from the burned area before the first growing season (Burned Trap P-F) plot much closer to the soils and bedrock of Reynolds Creek than the rest of the dust trap samples. The Regional Loess soil is a loess deposit that defines the regional dust signature.

Watershed Scale Results

- The trace of the fire in the form of increase **mass flux** and coarse organic material lasts up until the first growing season
  - Fall 15 produced twelve times the amount of deposition than Fall 17
  - Grasses and forbes sufficient to increase resistance and decrease mobility of burned material
- **Grain sizes** in the burned area before the first growing season are larger than unburned areas and subsequent sampling intervals.
  - Indicates an increase in the mobility of local surface sediment
- **Geochemical** V/Ti ratios indicate that material deposited in the burned area before the first growing season is similar to the soils of Reynolds Creek. After the first growing season all of the samples across the watershed plot closer to the regional loess deposit

Implications

- Anecdotal evidence of sediment drifts forming post-fire exists, but no quantitative data analyzes the process.
- Where fire and complex terrain intersect, sediment is distributed preferentially over a landscape



- Similar to snow drift formation, sediment and organic material are scoured from windward slopes and ridges and deposited in leeward hollows where deeper, more organic rich soils are found (below).
- **The spatial distribution of sediment and carbon via wind erosion (above), can influence soil hydrology, vegetation distribution and landscape evolution**

References

- Abatzoglou, J.T., and Kolden, C.A., 2011, Climate Change in Western US Deserts: Potential for Increased Wildfire and Invasive Annual Grasses: Rangeland Ecology & Management, v. 64(5): p. 471-478.
- Sankey, J.B., Germino, M.J., Glenn, N.F., 2009, Aeolian sediment transport following wildfire in sagebrush steppe: Journal of Arid Environments, v. 73, p. 912-919, http://dx.doi.org/10.2111/REM-D-09-00151.1.
- Pierson, F. B., Robichaud, P. R., & Spaeth, K. E., 2001, Spatial and temporal effects of wildfire on the hydrology of a steep rangeland watershed: Hydrological Processes. http://doi.org/10.1002/hyp.381
- Reheis, M. C., & Kihl, R. (1995). Dust deposition in southern Nevada and California, 1984-1989: Relations to climate, source area, and source lithology: Journal of Geophysical Research, v. 100(20), 8893–8918.