Great Salt Lake Dust Plume Study

By Dr. Kevin Perry, Department Chair

Despite the healthy snowpack in Utah this year, the Great Salt Lake (GSL) remains near historic low levels with more than 550 square miles of lakebed exposed (see the satellite image taken on 07/24/2017). The lake level has dropped significantly over the last decade due to a combination of water diversions for agriculture and less-than-average annual snowfall. A white paper describing the impacts that water development projects have had on the GSL was jointly published by scientists at Utah State University, the Utah Division of Water Resources, Salt Lake Community College, and the Utah Division of Wildlife Resources in February 2016. (https://qcnr.usu.edu/pdfs/publications/Great%20Salt%20Lake%20Water%20Level_Feb%2024%202016.pdf). One of the consequences of a low lake level is that the exposed lakebed has begun to act as a source of dust to the atmosphere. Dust plumes from the GSL can significantly reduce horizontal visibility and temporarily increase particulate matter (i.e. PM10 and PM2.5) concentrations to unhealthy levels for Wasatch Front residents living downwind of the GSL.

MODIS image of GSL

I am currently half way through a two-year study to identify the portions of the GSL lakebed that are active dust sources and determine if the PM10 mineral dust contains elevated concentrations of potentially dangerous heavy metals. I will also be collaborating with the Department of Geography to determine the elevation of each identified dust hot spot. This information will provide the Utah Department of Natural Resources with vital information on how fluctuating lake levels may impact future dust production.

To accomplish these goals, I am collecting soil samples from all 550 square miles of the exposed lakebed of the GSL. I am using a bicycle instead of an ATV to minimize damage to the fragile surface crust. Traveling at this slower pace also allows me to observe interesting surface features along the way which could easily be missed while zooming by on an ATV. I call the bicycle/trailer system that I am using for this study the Ute Dust Devil (see photo). To minimize selection bias, I map out a grid of GPS coordinates prior to each day's sampling. At each sampling location, I document the surface crust characteristics and collect three soil samples (2 surface crust samples and 1 subsurface sample). To minimize information bias (i.e., misclassification due to observational differences), I decided that it was important to collect all of the samples myself. Although it has been a physically challenging endeavor at times, it has been a fascinating experience. My preconceived notion that the exposed lakebed would be a vast, featureless, and somewhat uniform environment couldn't be further from the truth.

Once the soil samples are returned to the lab, they are dried and sieved to measure the particle size distribution and determine the fraction of sand, clay, and silt. The clay and silt fractions are then placed into a resuspension chamber where they are aerosolized, passed through a PM10 impaction inlet, and then collected onto filters for subsequent chemical analysis by Inductively-Coupled Plasma Mass Spectrometry (ICP-MS) and Synchrotron X-ray Fluorescence (S-XRF). Together, these analytical techniques provide quantitative measurements of 53 elements including most of the heavy metals.

Ute Dust Devil Bike

To date, I have bicycled 749 miles and have completed sampling of 40% of the GSL lakebed. I have documented the surface crust characteristics at 1825 locations and have collected more than one ton of soil. If you are interested in following my progress on this project and learning more about the interesting things I have observed along the way you can follow me on Instagram at "GreatSaltLakeDust". I would also like to take this opportunity to kick off a fundraising activity to support undergraduate scholarships and air quality research projects. I am seeking donors willing to pledge a certain amount of money for each mile I ride as part of this project. I estimate that the total mileage will be 2250 miles. Thus, a pledge of 10 cents per mile would end up being about $225 at the conclusion of the project (summer 2018). We will, of course, accept pledges no matter how large or small as all proceeds will be used for undergraduate scholarships and air quality research activities. The students and I thank you in advance for your support!