**Statement of Research Interests**

Erik Crosman October 2017

**Goals and Philosophy**

My overarching goal is to conduct applied and theoretical atmospheric science research that benefits society. My research interests are wide-ranging, fostered by the many projects I have been fortunate to have been involved in at the University of Utah during my graduate and post-doctoral training. These include atmospheric processes occurring on a broad range of scales (synoptic to local scale) that impact weather forecasting, air quality, fire weather, climate, hydrology, and land use in complex terrain. I believe that scientific questions are often best answered by utilizing observational and modeling approaches concurrently whenever possible.

My future goals are to:

* Continue developing a diverse research program in mesoscale and boundary-layer meteorology in complex terrain using both observational and numerical techniques
* Develop collaborative, multi-disciplinary research projects locally and internationally
* Train undergraduate and graduate students to follow meaningful and impactful scientific career paths

**Research Focus**

My research efforts are currently focused on modeling and observing boundary-layer meteorology, transport, and associated air quality and fire weather applications within coastal and complex terrain environments. I am intrigued by the complex interactions between boundary-layer dynamics and pollutant transport and chemistry that have been observed in several wintertime air quality and meteorological studies I have participated in. I also have a deep interest in improving initialization data (surface and land use characteristics) for input into mesoscale numerical models, as well as lake temperature retrievals from satellite for use in global climate studies.

Specifically, I have conducted research in three key areas:

* Boundary-layer meteorology:

1. Improving understanding of sea and lake breeze sensitivity to an array of geophysical forcing mechanisms through idealized large-eddy simulation modeling and also from observations (Crosman and Horel 2010, 2012, 2016).

* Air quality and meteorology:

1. Understanding greenhouse gas emissions and transport in the oil and gas producing Uintah Basin (Foster et al. 2017).
2. Quantifying the impacts of lake breezes on summertime ozone and wintertime particulate matter pollution (Crosman et al. 2016; Horel et al. 2016; Blaylock et al. 2017).
3. Improving simulations of difficult-to-model wintertime cold-air pools for use in Utah Division of Air Quality State Implementation Plan modeling for particulate pollution (Neeman et al. 2015; Crosman and Horel 2017; Foster et al. 2017).
4. Basic research to understand the meteorological formation, maintenance, and decay mechanisms for cold-air pools (Silcox et al. 2012; Lareau et al. 2013; Crosman and Horel 2016).
5. Instrumentation of public transit and a news helicopter in the Salt Lake Valley to provide spatial air quality information in real-time (Crosman et al. 2017).

* Remote sensing of lakes:

1. Developing lake temperature climatology data from satellite for lakes (Crosman and Horel 2009).
2. Improving lake temperature analyses and retrievals for input in to numerical weather prediction models (Grim et al. 2013; Strong et al. 2014; Crosman et al. 2017a, b).

**Major Accomplishments**

Since beginning my current position two and a half years ago as research assistant professor at the University of Utah I have been PI or co-PI on over $X00,000 in research grants. My research efforts to date beginning with graduate work over the past 7 years have led to 21 refereed papers (7 first-author publications) and ~25 presentations at meetings at the regional, national, and international levels.

Because my current position did not come with external grant support, significant time has been spent in securing funding for research projects. These research projects have focused on mesoscale and boundary-layer meteorological observations and modeling in complex terrain. The following agencies have supported research projects that I have been funded on as either as PI or co-PI: National Science Foundation, National Aeronautics and Space Administration, National Weather Service, State of Utah, and Joint Fire Science Program. I have also been partially supported under the National Mesonet Program (NMP) grant for Mesowest (mesowest.utah.edu) led by Prof. John Horel. My tasks include overseeing the local University of Utah network of weather stations which provide data to the NMP and the National Weather Service for protection of life and property.

I have developed and taught with Prof. John Horel a hands-on atmospheric instrumentation class for undergraduate students. I have also helped lead 4 major field campaigns, and was also involved in 2 additional field campaigns. During 2 field campaigns I was in charge of organizing undergraduate and graduate student involvement. I also am the faculty representative for the University of Utah student chapter of the American Meteorological Society and lead the University of Utah local Weather Research and Forecasting (WRF) model user group.

I have helped mentor 2 PhD and 6 MS graduate students, as well as assist in overseeing several undergraduate staff members. I have experience in operating numerous observational instrument platforms including ceilometers, sodars, radiosonde systems, ozone and particulate pollution monitors, and a wide array of surface meteorological stations. I also have experience running the WRF model both for mesoscale and large-eddy simulations.

I have submitted two grants that are currently under review: The first proposal was submitted to NOAA on improving satellite remote sensing climatology of lakes, and a second proposal was submittted to NASA on improving air quality monitoring and forecasting in Mongolia. I am also in the process of writing a third grant to the National Science Foundation on the valley-exit jet phenomenon.

I plan to expand and develop my research program on applied boundary-layer and complex terrain meteorology over the next few years. The research program will have both an observational and modeling component and I will seek to increase the collaborative, multi-disciplinary research aspects of the study.

**Future Plans**

My future plans are to build additional strength in each of the research areas previously discussed, as well as develop new multi-disciplinary research projects. Currently, I have two proposals under review and a third in preparation. I also have plans to collaborate with NOAA for a major air quality and meteorology study in the Salt Lake Valley in the future. I elaborate on each of these future directions below.

1. A proposal has been submitted to work with the Environmental Protection Agency and NASA to utilize earth observations to assist air quality managers and forecasters in Mongolia in improving wintertime pollution forecasts in the second most polluted city in the world, Ulaanbaatar, Mongolia. This work would utilize experience gained from several Utah wintertime air quality studies I have participated in and apply that scientific knowledge to assist Mongolian air quality decision-makers.
2. A proposal submitted to NOAA on developing a long-term record of lake temperature derived from satellite data that is suitable for climate studies. Current lake temperature products are limited by cloud contamination, temporal representativeness and other sources of error that are not well characterized. This work would build upon the remote sensing of lake research for numerical weather prediction and climate trends I have been involved with previously.
3. A proposal is being drafted to NSF with collaborator Sebastian Hoch to conduct a modeling and observational study related to the valley-exit jet phenomenon. This study will provide insight into the fundamental flow dynamics, energy balance and turbulent processes driving these poorly-understood jets. This study will also have applications to wind energy resources, as canyon exits are potential wind energy resource regions.
4. I was involved in a research campaign entitled the “Utah Wintertime Fine Particulate Study” (UWFPS) https://www.esrl.noaa.gov/csd/groups/csd7/measurements/2017uwfps/

that was led by the Earth System Research Laboratory of NOAA in the Salt Lake Valley in January-February 2017. This study included a specially outfitted aircraft taking detailed chemistry measurements in several Utah basins to improve understanding of the complex chemistry in this area. Preliminary results indicate that complex interactions occur between the chemistry and the boundary-layer meteorology, including terrain-driven flows, gap flows, sidewall ventilation, and layering of pollutants within stable atmospheric layers. While valuable scientific results were obtained, scientific consensus that a longer, more intensive campaign with enhanced meteorological measurements to complement aircraft measurements is needed. I am in contact with NOAA investigators and discussions are ongoing about a potential large future field campaign.

**References:**

**Crosman, E.**, and J. Horel, 2009: MODIS-derived surface temperature of the Great Salt Lake.

*Remote Sensing of Environment*, **113**, 73-81.

**Crosman, E.**, and J. Horel, 2010: Sea and lake breezes: A review of numerical studies.

*Boundary-Layer Meteorology*, [**137**(1](http://www.springerlink.com/content/0006-8314/137/1/)), 1-29

Silcox, G. D., Kelly, K.E., **Crosman, E.T.,** Whiteman, C.D., Allen, B.L., 2012: Wintertime

PM2.5 concentrations in Utah's Salt Lake Valley during persistent, multi-day cold-air pools.

*Atmos. Environ*., **46**, 17-24

**Crosman, E.T**., and J.D. Horel, 2012: Idealized large-eddy simulations of sea and lake

breezes: Sensitivity to lake diameter, heat flux, and stability. *Boundary-Layer*

*Meteorology*, **144**, 309–328

Lareau, N., **Crosman, E.,** Whiteman, C.D., Horel, J.D., Hoch, S.W., Brown, W.O.J., Horst,

T.W., 2013: The Persistent Cold Air Pool Study*, Bull. Amer. Meteor. Soc*., **94**(1), 51-64.

Joseph A. Grim, Jason C. Knievel, **Crosman, E.T**., 2013: Techniques for using

MODIS data to remotely sense lake water surface temperatures. *Journal of*

*Atmospheric and Oceanic Technology* **30**(10), 2434-2451.

Strong, C., A. K. Kochanski, **Crosman, E.T**., 2014, A slab model of the Great Salt

Lake for regional climate simulation, *J. Adv. Model. Earth Syst*., **6**, 602–615.

Neemann, E. M., **Crosman, E. T**., Horel, J. D., and Avey, L, 2015: Simulations of a

cold-air pool associated with elevated wintertime ozone in the Uintah Basin, Utah,

*Atmos. Chem. Phys*., **15**, 135-151.

Crosman, E.T., Horel, J.D., 2016: Wintertime lake breezes near the Great Salt Lake.

*Boundary-Layer Meteorology.* 159(2), 439-464. doi: 10.1007/s10546-015-0117-6

Horel, J., **Crosman, E**., Jacques, A., Blaylock, B., Arens, S., Long, A., Sohl, J. and Martin, R.,

2016:, Summer ozone concentrations in the vicinity of the Great Salt Lake. *Atmos. Sci.*

*Lett*., **17**: 480–486. doi:10.1002/asl.680

Foster, C., **Crosman**, E., Horel, J., 2017: Simulations of a cold-air pool in Utah’s Salt

Lake Valley: Sensitivity to land use and snow cover. *Boundary-Layer*

*Meteorolog****y,* 164**(1), 63–87.

Blaylock, B., Horel, J., Crosman, E., 2017: Impact of lake breezes on summer

ozone concentrations in the Salt Lake Valley. *J. Appl. Meteor. Climatol.,* 56, 353–

370.

Crosman, E.T., Horel, J.D., 2017: Large eddy-simulations of a Salt Lake Valley cold-air

pool. *Atmospheric Research,* 193*,* 10-25*.*

Jacques, A. A., Horel, J. D., **Crosman, E. T**., Vernon, F., 2017: Tracking mesoscale pressure

perturbations using the USArray Transportable Array. *Mon. Wea. Rev.,* **145***,* 3119–3142*.*

Widanagamaachchi, W., Jacques, A., Wang, B., **Crosman, E**., Bremer, P., Pascucci, V., Horel,

J., 2017: Exploring the Evolution of Pressure-Perturbations to Understand Atmospheric

Phenomena. *IEEE PacificVis 2017*.

**Crosman, E.T**, Jacques, A., Horel, J. D., 2017: A Novel Approach for Monitoring Vertical

Profiles of Boundary-Layer Pollutants: Utilizing Routine News Helicopter Flights.

*Atmospheric Pollution Research*, **8(5)**, 828-835.

**Crosman, E.T.**, Vazquez, J., Chin, T.M., 2017. Evaluation of the Multi-scale Ultra-high

Resolution (MUR) analysis of lake surface temperature. *Remote Sensing,* **9(7)**, 723.

Foster, C., **Crosman**, E., Holland, L., Mallia, D., Fasoli, B., Bares, R., Horel, J., Lin, J

2017: Constraining methane emissions in Utah’s Uintah Basin with ground-based

concentration observations and a time-reversed Lagrangian transport model

(STILT). *Journal of Geophysical Research, Atmospheres*, accepted.

Tran, T., Tran, H., Mansfield, M., Lyman, S., **Crosman, E**., 2017: Four dimensional

data assimilation (FDDA) impacts on WRF performance in simulating inversion

layer structure and distributions of CMAQ-simulated winter ozone concentrations

in Uintah Basin. *Atmos. Environ.,* In review

**Crosman, E**., and co-authors, 2017: Remote sensing of lake surface temperature: A review.

In review, *J. Remote Sens. Env.*