Results from the Jordan Narrows Gap Ammonia Transport Study: Inter-basin Airmass and Pollutant Exchange Estimates using Doppler Wind LiDAR

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The Salt Lake Valley (SLV) and other densely populated topographic basins in northern Utah and throughout the world suffer from prolonged pollution episodes during wintertime that are associated with persistent cold air pools (PCAPs). PCAPs develop when high-pressure systems and subsidence temperature inversions trap colder air and anthropogenic pollutants in topographic basins. The feedback between meteorological and chemical processes in PCAPs has received increasing attention in recent years.

While atmospheric mixing and transport processes are generally suppressed under the statically stable atmospheric conditions of PCAPs, some thermally and synoptically driven processes still work to modulate pollutant and pollutant precursor concentrations within and along the edges of the PCAPs. For the SLV, these processes include canyon circulations through tributaries, lake breeze circulations from the Great Salt Lake (GSL), and synoptically forced or thermally driven inter-basin air-mass exchanges between the Utah Valley and Salt Lake Valley.

In this presentation, we summarize observational evidence for and quantitative estimates of inter-basin air mass exchange from a 2018-2019 field study conducted in the Jordan Narrows, an approximately five-km wide topographic gap separating the Utah and Salt Lake Valley basins. We used Doppler wind LiDAR and automatic weather station observations to estimate the volume flux through the topographic gap. By combining this volume flux with observations of surface ammonia (NH_3) concentrations from the Wasatch Front Ammonia and Chloride Observations Study, we derive estimates of ammonia transport between the two basins, one of the key precursors for the particulate pollutant dominating Utah's wintertime pollution episodes.

Our findings are based on a limited 14-day period but suggest that inter-basin transport may be a significant term in the wintertime ammonia budgets for both basins. Based on our estimates for this short time period, Utah County exported on average about 20% of its daily NH_3 emission through the Jordan Narrows into the Salt Lake Basin. In turn, Salt Lake County, on average, imported an additional 45% of its own emission by means of this inter-basin exchange.