ETL Doppler lidar backscatter and radial velocity measurements: What can they tell us about tracer behavior?

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Goals for the Vertical Transport and Mixing (VTMX) science meeting included looking at lidar backscatter measurements taken coincident with radial velocity measurements during IOP 7 (Oct. 17/18) and IOP 8 (Oct. 19/20) of the VTMX field campaign (October 2000). We were interested in how the observed patterns in the backscatter field relate to the radial velocity field, terrain irregularities, and tracer behavior.

Lidar backscattered signal intensity is affected by the size, shape, concentration, and the index of refraction of the scatterers, and the wavelength of the incident radiation. Relative humidity plays a role by influencing the size and index of refraction of aerosols. At the 10.59 μm wavelength (the wavelength of the light emitted by the Doppler lidar deployed during VTMX), most of the scattering occurs by particles 1 - 3 μm in diameter. The backscatter data shown at the science meeting were range-corrected and preliminary.

Previous success in lidar backscatter data analyses includes results from an ETL Doppler lidar deployment to the Grand Canyon (Banta, R. M., L. S. Darby, P. Kaufman, D. H. Levinson, and C. J. Zhu, 1999: Wind flow patterns in the Grand Canyon as revealed by Doppler lidar. *J. Appl. Meteor.*, **38**, 1069-1083.). It was shown that changes in backscatter occurred temporally with a change of air mass inside the canyon, and spatially at the inversion near the rim of the canyon.

At the science meeting, several samples of radial velocity and backscatter plots were presented from IOP 7 showing distinct patterns in the backscatter field. For example, higher backscatter values often occurred in the lowest 500 m of a range-height scan, coinciding with a shift in the wind direction at the same level (Fig. 1, radial velocity (top), backscatter (bottom)). A 0.5° elevation scan showed an enhancement of backscatter along the eastern edge of the gap-flow jet (Fig. 2, radial velocity (top), backscatter (bottom)). This enhanced region of backscatter coincided with the deepest part of the valley, but it is not known at this time if the terrain caused a pooling of aerosols, contributing to the backscatter enhancement. Other explanations for the enhanced backscatter may be that the jet, as well as the canyon outflows, imported lower-backscatter (cleaner) air into the basin, leaving the region of enhanced aerosols between the two regions of cleaner air. Similar plots were shown for IOP 8.

The presence of asymmetry in the backscatter was found during the initial look at contour plots of backscatter from north/south and east/west scans (for both IOP 7 and IOP 8). The causes behind the asymmetry appear to be related to the basin-scale winds (particularly along the

north/south line). For example, with southerly winds, the backscatter was often enhanced to the north of the lidar. More analysis is needed before any concrete results can be established. It was decided that relating lidar backscatter data to tracer behavior may not be a fruitful path to investigate, but with further analysis, it is expected that the horizontal variability represented in the Doppler lidar data will lead to insight on the transport of pollutants into, out of, and within the basin.

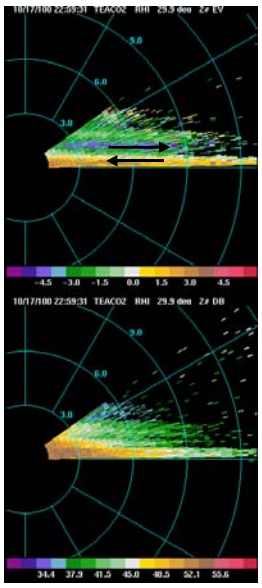

Figure 1
ETL Doppler lidar scan pointing along 30° azimuth.

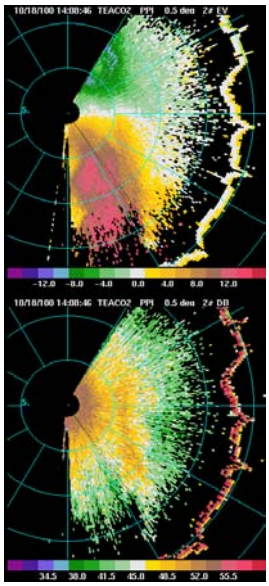

Figure 2
0.5° degree quasi-horizontal ETL Doppler lidar scan.