OBSERVATION AND MODELING OF GAP FLOW IN THE WIPP VALLEY ON 20 OCT. 1999

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Abstract: A synergistic analysis of different observational data and idealized numerical simulations of the 20 October 1999 gap flow event in the Wipp valley is presented. This was a typical shallow foehn case characterized by along-valley flow in the lower levels which was separated from the south-westerly geostrophic flow aloft. Radio soundings indicate that the flow upstream of the Brenner pass was blocked. Additional soundings inside the Wipp valley show much stronger flow (15 - 18 m/s) capped by an elevated inversion. Potential temperature of the layer below the inversion in the Wipp valley was 3 - 4 K warmer than in comparable depth layer upstream of the Brenner pass, suggesting that most of the air mass in the valley descended from aloft rather than coming through the pass. This is confirmed by estimated down-valley mass transport through vertical cross-sections at several locations along the valley. TEACO2 Doppler lidar scans show that the maximum wind (up to 21 m/s) was observed near the exit of the valley. Also, lateral asymmetry of the flow (stronger wind on the eastern side) was evident throughout the valley, but was especially pronounced downstream of the lidar location. Idealized numerical simulations of this case (simple topography with straight channel without side valleys and simplified upstream sounding) also show lateral asymmetry of the flow speed, indicating that this asymmetry can be produced in a straight channel by interaction between the lower level flow and the south-westerly flow aloft. A comparison between NOAA P3 in situ measurements and TEACO2 Doppler lidar retrieved winds in vertical cross-section along the Wipp valley showed good agreement between the two data sets. This suggests that other variables (temperature, pressure) measured by the NOAA P3 aircraft are also representative of the flow. Examination of thermo-dynamic structure of the flow (along-gap wind component and potential temperature interpolated from NOAA P3 in situ measurements) show some similarities and some inconsistencies with the reduced gravity shallow water model. Further idealized numerical simulations are presented to test the degree that inversion displacements govern the dynamics of the flow.