Geophysical Research Abstracts,
Vol. 11, EGU2009-5743, 2009
EGU General Assembly 2009

Wave-induced turbulence in the lee of the Medicine Bow Mountains

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The Medicine Bow Mountains is a mountain range in the Rocky Mountains that extend for 160 km in the SSW to NNE direction from northern Colorado into southern Wyoming. During the NASA06 orographic precipitation field campaign in Jan/Feb 2006, the University of Wyoming King Air (UWKA), highly instrumented for collecting both in situ and remote sensing measurements, the latter with the airborne Wyoming Cloud Radar, flew repeated passes over the Medicine Bow Mountains in SE Wyoming at a range of altitudes as low as 700 m above the highest terrain. The highest portion of the Medicine Bow Mountains in SE Wyoming rises 1000 m above the surrounding terrain to the maximum altitude of 3661 m MSL. Precipitation as well as lofting of snow from the surface provided ample scatterers for the WCR measurements, and the multiple antenna configuration allowed for dual-Doppler synthesis and corresponding retrieval of the two-dimensional flow field in the vertical plane beneath the aircraft.

This study focuses on two events (Jan 26 and Feb 5) during which strong vertical motions were measured at the aircraft flight level (with respective maximum vertical velocity amplitudes of 20 ms1 and 10 ms-1) and strong downslope winds in excess of 30 ms-1 were measured within 200 m above the ground. High-resolution numerical simulations of these two events were performed with the NRL COAMPS model using multiple nested domains to obtain horizontal resolution of $\tilde{3}00$ m over the Medicine Bow Peak and the adjoining area. The simulation results show presence of terrain-generated lee waves that were stronger and more rapidly evolving in the Jan 26 case, and the boundary-layer separation occurring over the lee slopes. While at this horizontal resolution the simulated flow is in good agreement with the overall features of the retrieved flow from the dual-Doppler analysis, the much finer resolution attainable from the WCR data (on the order of 40x40 m2 for two-dimensional velocity fields) allows identification of fine-scale coherent vorticical features within a rotor zone, where instead of a larger rotor circulation indicated by the simulation results, a more turbulent dynamics and smaller-scale vortices appear to be more prevalent. The numerically simulated and retrieved flow fields from the dual-Doppler analysis will be compared at different model and dual-Doppler horizontal grid resolutions to ascertain the degree of quantitative agreement and the effects of subgrid-scale averaging and turbulence parameterization on the representation of rotors.