Masters Defense

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COPLANAR DOPPLER LIDAR RETRIEVAL OF ROTORS FROM T-REX 2006

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Abstract

Two coherent Doppler lidars were deployed during the Terrain induced Rotor EXperiment (T-REX), one by Arizona State University (ASU) and the other by the Deutsches Zentrum für Luft- und Raumfahrt (DLR). The lidars monitored the coupled Mountain Wave-Rotor-Boundary Layer (MWRBL) in Owens Valley, CA, during the spring of 2006. The overall purpose of this research is to further understanding of rotors over complex terrain and their interaction with the atmospheric boundary layer. The mechanisms and behavior of rotors are not fully understood, but initial observations show evidence of complex wind variations with height, which can be seen, for example, in photographs of cloud formations associated with rotor conditions.

Coplanar Range Height Indicator (RHI) scans by the lidars (along the same azimuthal angle) allowed retrieval of two-dimensional velocity vectors on a vertical/cross-barrier plane using the least squares method. Vortices (rotors) are shown to evolve and advect in the flow field, allowing analysis of their behavior in the MWRBL system during Intensive Observing Period 6 on March 25, 2006 from 9:04 to 11:17 am Local Time (1704 to 1917 UTC). The locations, magnitudes, and evolution of the vortices can be studied through calculated fields of velocity, vorticity, streamlines, and swirl. The latter is derived from complex eigenvalues of the local two-dimensional velocity gradients. Two classes of vortical motions are identified: rotors and sub-rotors, which differ in scale and behavior. The level of coordination of the two lidars and the nature of the output (i.e., in range-gates) creates inherent restrictions on the spatial and temporal resolution of retrieved fields.