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Terrain-induced Rotor Experiment: Final plans

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The Terrain-induced Rotor Experiment (T-REX) is the second phase of a coordinated effort to explore the structure and evolution of atmospheric rotors and associated phenomena in complex terrain. Rotors are intense low-level horizontal vortices that form along an axis parallel to, and downstream of, a mountain ridge crest that can pose a great hazard to aviation. The initial, exploratory phase of this effort is the Sierra Rotors experiment, which completed its Special Observation Period (SOP) in early spring 2004 in Owens Valley in the lee of the Sierra Nevada in California.

The main scientific objectives of T-REX are focused on improving the understanding and predictability of the coupled mountain-wave/rotor/boundary-layer system. In addition, complementary scientific objectives include understanding the role of mountain waves in stratospheric-tropospheric exchange, structure and evolution of the complex terrain boundary layer in the absence of rotors, and wave cloud phase transitions and layering. In order to achieve its scientific objectives, the T-REX program has two main observational thrusts: 1) Comprehensive ground-based and airborne, in situ and remote sensing measurements during strongly perturbed conditions favoring rotor formation, and 2) Comprehensive observations of complex-terrain boundary layer structure and evolution from undisturbed to strongly perturbed conditions.

T-REX field activities will take place in Owens Valley in March and April 2006. Owens Valley lies to the east of the southern Sierra Nevada, which is the tallest, steepest, quasi two-dimensional topographic barrier in the contiguous United States. Mountain waves and attendant rotors are known to reach particularly striking amplitude and strength there. Climatological studies show that the months of March and April have the highest frequency of rotor events, including many days with conditions favorable for generation of mountain waves and rotors, and also many days when it will be possible to document terrain-induced boundary-layer circulations in Owens Valley under more quiescent conditions. The field operations will be supported by real-time mesoscale model forecasts, and ensuing field research will be tightly coupled with numerical modeling studies.

Ground-based and airborne, in situ and remote-sensing measurements will be conducted both upwind and within Owens Valley. Some of the planned measurements will be met through intensive observational periods (IOP) (e.g. aircraft and manually-operated instrumentation), whereas others will be met through continuous operation. Our plans include three aircraft (NSF/NCAR HIAPER, University of Wyoming King Air, UK BAe146), two equipped with aerosol lidars, atmospheric chemistry instruments and microphysics probes (HIAPER and UK BAe146), and all three equipped with dropsonde systems to document the mesoscale structure and evolution of the upper parts of the rotor coupled system over Owens Valley as well as the kinematic and thermodynamic structure of airflow up- and downstream of the valley centerline. An array of fixed and mobile ground-based instruments, including lidars, wind profilers, sodars, sounding systems, dense networks of automatic weather stations, microbarographs, and temperature data loggers, flux towers, and an instrumented car, will be used to document the lower portions of the rotor coupled system under strongly perturbed conditions favoring rotor formation as well as the flow and thermodynamic structure of the boundary layer in absence of rotors.