Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10932, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10932
EGU General Assembly 2008

Interaction of mountain lee waves with valley flows

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T-REX (2006) and its pilot study Sierra Rotors (2004) were conducted over Owens Valley in the lee of the southern Sierra Nevada. During these projects, it has been observed that mountain wave activity frequently exists at or above the mountain ridge height, decoupled from the flow in the valley. In contrast, the strongest periods of wave and rotor events over Owens Valley are characterized by deep penetration of westerly momentum into the valley. In this study, we examine physical processes involved in the transition from the regime characterized by decoupled valley circulations to the regime with strong penetration of westerly momentum into the valley during selected T-REX wave events. Idealized two-dimensional numerical simulations using the NRL Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) are used to examine the role of two processes involved in this transition: i) changes in the amplitude and wavelength of lee waves due to upstream wind speed and stability profile changes, and ii) thermal heating within the valley that leads to the erosion of a stability profile which might prevent penetration of wave activity down the lee slopes. The idealized wind speed and stability structures are based on observed profiles collected by rawinsondes launched from the valley and upstream of the mountains. Results are presented for one of the strongest events observed during T-REX.