EMS Annual Meeting Abstracts
Vol. 7, EMS2010-338, 2010
10th EMS / 8th ECAC

Trapped lee wave interference over double ridges

I. Stiperski (1) and V. Grubišić (2)

(1) Meteorological and Hydrological Service, Zagreb, Croatia (stiperski@cirus.dhz.hr), (2) University of Vienna, Vienna, Austria

Trapped lee waves form downwind of a mountain ridge under conditions conducive to wave energy confinement within the lower troposphere. Placing a secondary ridge downwind of the first leads to constructive and destructive interference of lee waves. Idealized high-resolution two-dimensional simulations with the NRL COAMPS model are used to investigate the trapped lee wave interference over a double ridge in the linear and nonlinear flow regimes as well as in the presence and absence of surface friction. The upstream atmospheric structure and terrain profiles derive from observations obtained in the Terrain-induced Rotor Experiment (T-REX).

The results show that the interference pattern is described well by linear interference theory for all mountain heights. The pattern is determined by the ratio of the intrinsic trapped lee wave wavelength and the ridge separation distance. On the contrary, the wave amplitude is not predicted well by linear interference theory. For the double ridge, the primary horizontal lee wave wavelength is determined by the upstream wind shear profile and modulated by the ridge separation distance.

In the presence of surface friction, boundary-layer separation develops and rotors form for mountain heights exceeding a certain critical value. For a double ridge this critical mountain height is strongly dependent on interference. In the lee of the downstream ridge, changes in the wave amplitude due to interference affect the rotor strength most significantly. Only for the strongest nonlinear regime examined is the rotor strength amplified by constructive interference beyond that obtained in the lee of a single ridge, while destructive interference significantly diminishes the rotor strength. The strength of rotors in the valley attains a constant value for highly nonlinear regimes and is significantly diminished compared to their strength in the lee of a single ridge. Destructive interference is seen to be highly nonlinear even for cases of very low mountain heights in absence of surface friction. Total destructive interference, in which waves almost completely cancel out in the lee of the downstream ridge, develops for certain ridge separation distances but only for the height of the downstream ridge being less than the upstream one.