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An Adiabatic Foehn Mechanism

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Atmospheric mountain flows produced when the incoming wind is small near the surface and continuously increases with altitude are evaluated with models of increasing complexity. All models confirm that foehn can be produced by a mountain gravity wave critical level mechanism, where the critical level is located below the surface. This mechanism does not involve humidity, upper level wave breaking, upstream blocking, downward wave reflections or hydraulic control as often suggested by popular theories. The first model used is a theoretical model which combines linear gravity wave dynamics with a nonlinear boundary condition: in this model the wave breaking does not feedback onto the dynamics by construction. Partial linear waves reflections are also minimized by using smooth profiles of the incident wind and a uniform stratification N^2 =cte, and can even be suppressed when the incident wind shear is also constant, U_z=cst. The second model is WRF, and we show that it predicts mountain wave fields that can be reproduced by the theoretical model, providing that we specify adequate boundary layer depth in the theoretical model.

Lott, F., 2016: A New Theory for Downslope Windstorms and Trapped Mountain Waves.J. Atmos. Sci.,73, 3585–3597, doi: 10.1175/JAS-D-15-0342.1.