Evidence of Görtler vortices in a katabatic jet along a convexly curved slope.

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Abstract

A numerical study of a katabatic jet along a convexly curved slope with a maximum angle of about 35° is considered. The katabatic flow is artificialy generated by ground surface cooling and a stable atmospheric boundary layer with constant stratification is considered as a reference state. Large Eddy Simulation is performed with a special focus on the outer-layer shear of the katabatic jet. A statistical quantitative analysis as well as a qualitative description of vortical structures are used to study the present turbulent flow. It is shown that Görtler vortices oriented in the streamwise downslope direction and with a vertical mushroom shape develop in the shear layer. They play a specific role with respect to local turbulent mixing in the ground surface boundary layer. Prandtl model for katabatic jet is applied to the present results and a revisited version from the litterature is discussed, with an account for specific momentum and heat turbulent diffusion. The vertical and downslope variability of turbulent kinetic energy budget is discussed as well and it is shown that downslope advection and production are far to be negligible in katabatic flows along nonlinear slopes. Such curved slope constitutes a realistic model for alpine orography. The present contribution provides a procedure based on local turbulent anisotropy to track Görtler vortices for in situ measurements, which has never been proposed in the litterature.

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