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Role of Görtler vortices on the turbulent mixing in a katabatic flow along a curved slope for stably stratified atmospheric boundary layer. Application to real mountain slopes in the Alps.

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The behaviour of the Atmospheric Boundary layer (ABL) along alpine valleys is strongly dependent on the day-night thermodynamic cycle and might impact both meteorology and air pollution prediction. At night, or during winter time, stable stratification of the ABL makes it particularly difficult to model accurately the correct mixing and dispersion properties of the fluid in comparison to neutral or convective ABL situations (Nieuwstadt & Meeder 1996). In the last decade, Large Eddy Simulation coupled with high vertical resolution has shown to be the right numerical tool to overcome such bottleneck. As a result, the simulation of katabatic flow, which consists of a downslope jet due to radiative cooling of the ground surface, is now being affordable (Skyllingstad 2003, Cuxart & Jimenez 2006, Shapiro & Fedorovich 2009). For slopes which exhibit curvature effects, Görtler instabilitiy develop and triggers transition to turbulence in the ABL (Kaimal & Finnigan 1994, Saric 1994). Strong streamwise Görtler vortices appear in the external shear layer on the convex part along the slope (Brun, Blein & Chollet 2010) and increase local mixing, a property of direct interest for scalar transport.
We will focus on the specific role played by Görtler vortices in katabatic flows which develop either on natural realistic mountain slopes or on artificialy downslope jets generated by ground surface cooling on a generic curved slope. Such Atmospheric Boundary Layer has the structure of both wall turbulence in the inner-layer zone and shear layer turbulence in the outer-layer zone. Results are analysed to show how turbulent mixing mechanism is affected by Görtler vortices eventhough stable stratification is considered. Two complementary issues are assessed in the present study:
-the statistical quantitative determination of katabatic flow driven by momentum and temperature wall shear stresses under stable stratification.
-the qualitative description of vortical structures developing in the outer part of the Atmospheric Boundary Layer subjected to a strong shear.