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Turbulence anisotropy in katabatic flows. From Antarctica plateau to alpine slopes.

Christophe Brun (1), Sébastien Blein (1), Hélène Barral (1,2), and Christophe Genthon (2)
(1) LEGI, Grenoble University, France (christophe.brun@legi.grenoble-inp.fr), (2) LGGE, Grenoble University, France

Atmospheric boundary layers (ABL) under stable temperature stratification coupled with gravity effects along a slope induce katabatic downslope flows with non-trivial turbulent mixing properties. Such complex turbulent shear flow can be found in mountain regions where they interact with the atmospheric dynamic in the valley. They are also a specific trend for glacier in mountains or glacier in polar regions, where extreme temperature conditions contribute to enhance the turbulent properties related to the flow. The understanding of turbulence processes for ABL in such cases is a keypoint to improve boundary layer parametrizations in regional meteorology models and thus climate change predictions.
The present study focuses on the property of anisotropy of turbulence in a set of katabatic flows generated in various conditions. An open issue is to determine up to which extent turbulence is behaving in a universal way for such ABL. Especially we will determine invariants for the Reynolds stress tensor which are usually considered to quantify departure from isotropy for a given turbulent structure of the flow (Tennekes and Lumley 1972). We will study the distribution of anisotropy invariant map for a familly of katabatic flows, using both experimental measurements performed with 3D sonic anemometers and numerical results extracted from LES.
The first flow case will be a mountain slope in the french alps (Sebastien Blein PhD in LEGI Grenoble) for which measurements were performed during a stable episode in november 2012 and LES was performed with the MesoNH mesoscale model (Meteo-France) used with refined grid resolution. The second flow case will be a katabatic flow along a gentle slope in Antarctica (Hélène Barral PhD in LGGE/LEGI Grenoble). Measurements are being performed during austral summer 2014 with a sonic anemometer in the Terre Adélie coastal region, about 6 km from the french Dumont-Durville scientific station and on the way between the coast and Concordia plateau, 1000 km further inside antarctica. Numerical simulations will be available as well.
We will show how departure from isotropy is linked with the development of a relative simple shear flow with a principal streamwise flow direction along the slope and a principal shear direction in the ground normal direction.