CHARACTERISTICS OF THE STABLY STRATIFIED ATMOSPHERIC BOUNDARY LAYER IN THE ALPS

Dr. Christophe Brun

Université Joseph Fourier, Grenoble, Francuska

Abstract

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

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.

Biosketch

Dr. Christophe Brun

Dr Christophe Brun was born in 1970 in south of France. In 1993, he got a diploma of engineer of Mechanics and Aerotechnics in Poitiers, France, and a master thesis in Aerodynamics, Fluid Mechanics, Thermics and Combustion. In 1998 he got a PhD thesis in Fluid Mechanics in Grenoble France, under the supervision of Pr E.J. Hopfinger, on the Experimental and numerical study of the strong interaction between wakes behind cylinder obstacles. From 1998 to 2001, he stayed 3 years in the Technical University of Munich, Germany, as a postdoctoral researcher, under the frame of a TMR european program. He developed a subgrid scale model for Large Eddy Simulation of turbulence with Pr R. Friedrich. Since 2002 he is assistant professor in France, first in Orl´eans university (till 2006), second in Grenoble university. He has contributed for 10 years in a Collaborative Research Projet DFG-CNRS on LES of complex flows with Pr M. Manhart (University of Munich). He is now developing a new research topic in LEGI, Grenoble, on the **simulation and modeling of atmospheric boundary layer flows**.

Recent Publications

1. Brun, C., Blein, S. and Chollet, J.P. (juin 2010) Role of the G¨ortler instability on the turbulent mixing in a katabatic flow along a curved slope for stably stratified atmospheric boundary layer. 15th **International Symposium for the Advancement of Boundary Layer Remote Sensing, Paris**
2. Brun C., Juv´e D., Manhart M., Munz C.-D. (Editors.) 2009 Numerical Simulation of Turbulent Flows and Noise Generation Results of the DFG/CNRS Research Groups FOR 507 and FOR 508. **Series : Notes on Numerical Fluid Mechanics and Multidisciplinary Design , Vol. 104.**
3. Brun, C., Haberkorn, M., Boiarciuc Petrovan, M. and Comte, P. (2008) Large Eddy Simulation of compressible channel flow. Arguments in favour of universality of compressible turbulent wall bounded flows. **Theoretical and Computational Fluid Dynamics, 22(3)**, pp. 189-212
4. Brun, C., Balarac, G., da Silva, C.B. and M´etais, O. (2008) Effects of molecular diffusion on the subgrid-scale modelling of passive scalars. **Physics of Fluids, 20(2)**, 025102.
5. Brun C., Aubrun, S., Goossens, T. and Ravier, Ph. (2008) Coherent structures and their frequency signature in the separated shear layer on the sides of a square cylinder. **Flow Turbulence and Combustion 81**, pp. 97-114