Non-local behavior for an ocean-atmosphere boundary layer problem

Advisors : Eric Blayo (Université Grenoble-Alpes, EPC Airsea - Laboratoire Jean Kuntzmann, Grenoble)
Contact : Eric.Blayo@univ-grenoble-alpes.fr
Didier Bresch (CNRS, LAMA Université Savoie Mont-Blanc, Chambery)
Contact : didier.bresch@univ-smb.fr
Florian Lemarié (Inria, EPC Airsea - Laboratoire Jean Kuntzmann, Grenoble)
Contact : florian.lemarie@inria.fr

Keywords : ocean-atmosphere coupling ; turbulent boundary layers ; parameterization ; mathematical analysis

Subject

This internship concerns the modeling of ocean-atmosphere coupling phenomena, taking into account the physical parameters of boundary layers. At the mathematical level, this corresponds to the coupling of two partial differential equations (one governing a turbulent oceanic boundary layer and the other governing a turbulent atmospheric boundary layer) with an intermediate zone modeling the exchange processes at the interface. The diffusion terms of the considered systems as well as the boundary conditions between the interface zone and the oceanic and atmospheric layers involve the jump of oceanic and atmospheric velocities across the interface zone in a non-linear manner. Vertical exchanges being largely dominant, we can restrict ourselves to the study of 1-D systems.

During this internship, we will focus on the well-posedness of the coupled system for a model coupling two Ekman layers (i.e. essentially taking into account the turbulent diffusion, the large-scale pressure gradient and the Coriolis force, see Klein et al. (2004)). Starting from the stationary case treated in the thesis of S. Théry (2021) (chapter 5), we will try to reformulate these results in a more general way, in particular by trying to characterize the diffusion models and the regimes leading to this property. Numerical tests could be carried out with an existing model. A particularly interesting extension would be to add within the model the effects of fluid density stratification (see for example Chacon et al. (2014) in the case of the ocean).

It is therefore a subject mixing modeling, mathematical analysis and numerical illustrations, on the problem of ocean-atmosphere exchanges.

References

• Chacon Rebollo T., M. Gómez-Mármol, & S. Rubino (2014) *On the existence and asymptotic stability of solutions for unsteady mixing-layer models.* Discrete & Continuous Dynamical Systems

• Klein R., E. Mikusky, & A. Owinoh (2004) *Multiple Scales Asymptotics for Atmospheric Flows.* Proceedings of 4th European Conference on Mathematics

• Thery S. (2021) *Etude numérique des algorithmes de couplage océan-atmosphère avec prise en compte des paramétrisations physiques des couches limites.* Université Grenoble Alpes