A theoretical study of a simplified air-sea coupling problem including turbulent parameterizations

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ABSTRACT

The interactions between the atmosphere and the ocean play a major role in many geophysical phenomena, covering a wide range of temporal scales (e.g. diurnal cycle, tropical cyclones, global climate). Therefore the numerical simulation of such phenomena require coupled atmospheric and oceanic models, which properly represent the behaviour of the boundary layers encompassing the air-sea interface and their two-way interactions.

However, deficiencies appear in current ocean-atmosphere coupled models, both in the formulation of the physical parameterizations and in the algorithmic approach used for the coupling [1]. Sub-grid scales parameterization schemes used for representing the oceanic and atmospheric boundary layers and for computing the turbulent components of air-sea fluxes are generally developed independently, without any guarantee regarding the well-posedness of the overall coupled problem [2]. Moreover usual coupling algorithms exhibit synchrony issues [1,3].

In this talk, we address these problems from the point of view of domain decomposition methods. We show that present coupling methods used for ocean-atmosphere coupled models can be written in the formalism of Schwarz iterative algorithms, and correspond to methods that are not pushed to convergence, which may lead to imperfect coupling. We discuss the objective of achieving a mathematically and physically consistent ocean-atmosphere coupling, and we show that using improved coupling algorithms (like Schwarz methods) can impact the coupled model solution quite significantly.

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