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Estimation of the vertical velocities associated with coastal upwelling using models and observations

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Apart from some exceptions (e.g. certain convection movements, small scale turbulence, or surface gravity wave), vertical velocities in the ocean are generally too weak to be measured. In particular, that is the case of the vertical movements associated to the coastal upwelling dynamics. This prevents any accurate assessment of the vertical fluxes (mass, heat, oxygen and carbon) which are of particular importance when it comes to quantify the nutrient enrichment. As a result, questions related to the source, position, and debit of a coastal upwelling are still largely opened.

In a first part, we analyze the vertical velocity field in a series of models of increasing complexity : from Ekman theory (unstratified theory in which the upwelling structure is controlled by the interaction of the surface and bottom boundary layers) to the primitive equation of a realistic simulation of the Senegalese coastal upwelling (ROMS). Then in the second part, we present preliminary results from the Upsen cruise (9-18 march 2012) in which we will seek to measure horizontal flows associated with the South Senegal upwelling in order to estimate the corresponding vertical velocities.