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Título: A general approach for studying vertical effects in shallow fluids

Abstract: The modeling and numerical simulation of geophysical flows is currently a very active topic of research. A usual approach in shallow areas, where characteristic length of the domain is assumed to be much longer than the vertical one, is to use the well-known shallow water or Saint Venant system. One of the advantage of such model is that its complexity is limited and allows to have good results with less computational efforts. Nevertheless, one of the main drawbacks of shallow water system is that the the vertical information is neglected because vertical effects are assumed to be small when compared to the horizontal ones, so that a vertical average process is perform. This leads us to lose important information for many practical applications. We will see here several ways to overcome this limitation.

A first approach is the so-called multilayer decomposition, which considers a vertical division of the fluid into M given layers. Within each layer, a depth-average process is performed, leading to a layerwise constant solution for the horizontal velocity. This technique has been successfully applied to many situations.

Another different approach, that we shall exploit here,corresponds to the shallow water moment models. In the moment approach, rather than dividing the vertical direction into layers, one single layer is considered, but now the variables are supposed to follow a polynomial profile, with an arbitrary degree of approximation, in the vertical direction. This allows us to obtain vertical effects, as now the horizontal velocity is not just a constant for the whole column of the fluid, but a polynomial on the vertical variable. An advantage of this approach with respect to the multilayer one is its lower computational cost.

Finally, both techniques could be merged, obtaining multilayer moment-models that efficiently and accurately reproduce the vertical structure of the fluid.