Influence of the turbulence closure scheme on the finite-element simulation of the tidal circulation around a shallow-water island

Sébastien Blaise[1], Laurent White[1,2], Jean-François Remacle[1], Eric Deleersnijder[2,1]

[1] Centre for Systems Engineering and Applied Mechanics (CESAME),
Université catholique de Louvain, Louvain-la-Neuve, Belgium.

[2] G. Lemaître Institute of Astronomy and Geophysics (ASTR),
Université catholique de Louvain, Louvain-la-Neuve, Belgium.

September 12, 2006

Oral presentation

Abstract

The subject of this study is the modelization of the upwelling speed around Rattray Island (Great Barrier Reef, Australia). Field measurements and visual observations show that stable eddies develop in the wake of the island at rising and falling tides. The water turbidity downstream of the island suggests the existence of a strong upwelling that would be responsible for carrying bed sediments up to the sea surface. A three-dimensional finite element model with a simple turbulent closure was recently used to investigate shallow-water eddies in the wake of Rattray Island (*White and Deleersnijder*, 2006). However, the upwelling speed predicted by this model was not suffisciently intense to explain the rise of sediments to the sea surface during the life span of the eddies. In this work, we study the influence of a more sophisticated turbulent closure on the upwelling speed. In this aim, a Mellor and Yamada level 2.5 turbulent closure was implemented in the three-dimensional model. Theses results show an increase of the upwelling speed when using this turbulent closure.

Another question is the influence of advection of turbulent variables on model results. When averaged over a large horizontal area, it is often assumed that there is little horizontal variations in the turbulent variables, thereby making this term negligible. On smaller scale, this term could be relevant, particularly for complex bathymetries. Simulation were performed on Rattray Island with and without horizontal advection of turbulent variables, in order to estimate its effect.

References

White, L. and Deleernijder, E. (2006), Diagnoses of vertical transport in a three-dimensional finite-element model of the tidal circulation around an island. *Estuarine, Coastal and Shelf Science*, in press.