Tide induced vorticity shedding in the strait of Rio-Antirio (Greece), a numerical experiment

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Rio-Antirio a 2200m wide and 60m deep strait, lies in the northern side of Peloponnese (Greece), connecting Patraikos gulf with Corinthiakos gulf. The axis of the channel has a NE-SW orientation of about 60° and the line connecting the tips of the headlands show a departure from 90° from the axis of the channel. The bathymetry shows that the offshore coastal region, in both headland tips, drops quickly in the first 200m at a depth of 50m (fig 1a). The geometry of the area and the measured current velocities are favouring to produce alternating jet flow and separation phenomena behind the headlands. These kinds of flow patterns effect the long term transport rates of pollutants, nutrients and also the erosion and deposition mechanisms. Knowledge of the details of the flow field and of the mechanisms that participate in vorticity shedding and dissipation is increasingly interesting.

The strait presents interesting flow phenomena behind its headlands during the cycle of the M2 tide, which is the driving circulation forcing for this area. Plans for the construction of a bridge across the strait, in conjunction with the interesting vortices observed during field experiments, a two dimensional finite difference numerical model was examined, to study the flow field and also to provide technical parameters for the bridge design.

The two dimensional finite difference numerical model developed uses the depth integrated shallow water momentum and continuity equations. The model was verified from experimental data taken from current meters, tide gauges, drogues and air photos.

Numerical experiments performed for the different tide heights and a number of the approximately geometries. The results analysed lead to conclusions about the threshold for the flow to be separated and vortices to make their appearance in the flow field (fig 1b). The analysis of the calculated vorticity distribution patterns shows the life time of these vortices within a tide cycle as also the way the vorticity is advected by the background flow. These vorticity distribution maps reveal the interaction of the vortices generated in the first half of the tide cycle with those of the second one. The last thing that is examined with the aid of the model results is the bottom stress distribution and the regions with maximum shear are established.

These regions coincide with the region of active seabed erosion as mapped during a survey using a high resolution subbottom profiling system.

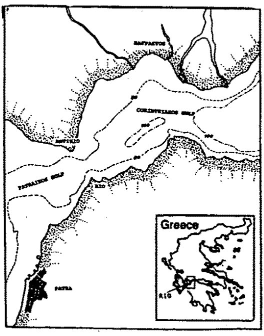

fig 1.a

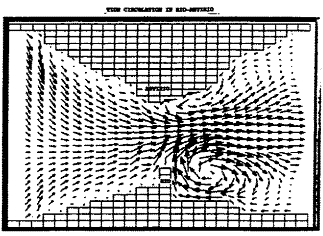

fig 1.b