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On the influence of tidal variability on the mean exhange through the Strait of Gibraltar

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The Strait of Gibraltar is the only dynamically relevant connection of the Mediterranean Sea to the Atlantic Ocean. A small net inflow of fresh water through the Strait is necessary to balance the buoyancy losses and the excess of evaporation minus precipitation over the Mediterranean. Mass and salt conservation force this net inflow to be achieved as a density driven baroclinic exchange that can be usefully approximated as a two-layer system with reduced gravity g' $\simeq 0.02$ m/s^2, layer fluxes Q$_1$ $\simeq Q_2 \simeq 1$ Sv and net flow Q$_0$ $\simeq 0.05$ Sv.

At the main sill, located at Camarinal section, the mean exchange is hydraulically controlled, meaning that that the Froude number is G^2=1. However, a baroclinic tide is forced by the strong (amplitude of more than 4 Sv for the net flow) barotropic tide that is able to reverse the flow at both layer at Camarinal, deeply modifying the exchange conditions: It has been recognized that half of the mean exchanged flows at Camarinal are accounted by non-linear correlations between tidal currents and interface depth fluctuations, called "eddy fluxes".

A six months current data set has been analyzed to study the influence of tidal variability on the exchange and its associated hydraulics at the Strait. The data show a strong time-dependence on hydraulic conditions at Camarinal. During a great part of the tidal cycle, the strong (amplitude larger than 50 m) internal fluctuations are able to compensate the effect of flow fluctuations on the composite Froude number G^2, so that G^2 $\simeq 1$. However, as far as the net flow exceed an absolute value of around 2.5 Sv, the control is lost at Camarinal and supercritical conditions are found. These su-

percritical events are observed at springs and may take place both during the flood or the ebb part of the tidal cycle. The observations support the hypothesis that the “eddy fluxes” are related to occurrence of these events.