

Estimation of Atlantic-Mediterranean netflow variability

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The exchanges at the Strait of Gibraltar are extremely difficult to measure due to the strong temporal and across-strait variabilities; yet the Atlantic inflow into the Mediterranean is extremely important both for climate and to ecosystems. Most of the published numerical modeling studies do not resolve the Strait of Gibraltar realistically. Models that represent the strait at high resolution focus primarily in high frequency dynamics, whereas long-term dynamics are studied in low resolution model studies, and for that reason the Strait dynamics are poorly resolved. Estimating the variability of the exchanges requires long term and high-resolutions studies, thus an improved simulation with explicit and realistic representation of the Strait is necessary.

On seasonal to inter-annual timescales the flow is essentially driven by the net evaporation contribution and consequently realistic fields of precipitation and evaporation are necessary for model setup. A comparison between observations, reanalysis and combined products shows ERA-Interim Reanalysis has the most suitable product for Mediterranean Sea. Its time and space variability are in close agreement with NOC 1.1 for the common period (1980 - 1993) and also with evaporation from OAFUX (1989 – 2014).

Subinertial fluctuations, periods from days to a few months, are the second most energetic, after tides, and are the response to atmospheric pressure fluctuations and local winds. Atmospheric pressure fluctuations in the Mediterranean cause sea level oscillations that induce a barotropic flow through the Strait. Candela's analytical model has been used to quantify this response in later studies, though comparison with observations points to an underestimation of the flow at strait. An improved representation of this term contribution to the Atlantic – Mediterranean exchange must be achieved on longer time-scales.

We propose a new simulation for the last 36 years (1979 – 2014) for the Mediterranean – Atlantic domain with explicit representation of the Strait. The simulations are performed using the Regional Ocean Modeling System (ROMS) and forced with the different contributions of the freshwater budget, sea level pressure fluctuations and winds from ERA-Interim Reanalysis. The model of sea level pressure induced barotropic fluctuations simulates the barotropic variability at the Strait of Gibraltar for the last decades.