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River runoff influences on the Central Mediterranean Overturning Circulation

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The role of riverine freshwater inflow on the Central Mediterranean Overturning Circulation (CMOC) was studied using a high-resolution ocean model with a complete distribution of rivers in the Adriatic and Ionian catchment areas. The impact of river runoff on the Adriatic and Ionian Sea basins was assessed by a twin experiment, with and without runoff, from 1999 to 2012. This study tries to show the connection between the Adriatic as a marginal Sea containing the downwelling branch of the anti-estuarine CMOC and the large runoff occurring there.
It is found that the multiannual CMOC is a persistent anti-estuarine structure with secondary estuarine cells that strengthen in years of large realistic river runoff. The CMOC is demonstrated to be controlled by wind forcing at least as much as by buoyancy fluxes. It is found that river runoff affects the CMOC strength, enhancing the amplitude of the secondary estuarine cells and reducing the intensity of the dominant anti-estuarine cell. A large river runoff can produce a positive buoyancy flux without switching off the antiestuarine CMOC cell, but a particularly low heat flux and wind work with normal river runoff can reverse it. Overall by comparing experiments with, without and with unrealistically augmented runoff we demonstrate that rivers affect the CMOC strength but they can never represent its dominant forcing mechanism and the potential role of river runoff has to be considered jointly with wind work and heat flux, as they largely contribute to the energy budget of the basin.
Looking at the downwelling branch of the CMOC in the Adriatic basin, rivers are demonstrated to locally reduce the volume of Adriatic dense water formed in the Southern Adriatic Sea as a result of increased water stratification. The spreading of the Adriatic dense water into the Ionian abyss is affected as well: dense waters overflowing the Otranto Strait are less dense in a realistic runoff regime, with respect to no runoff experiment, and confined to a narrower band against the Italian shelf with less lateral spreading toward the Ionian Sea center.