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# The Mean Sea Level Equation and its application to the Mediterranean Sea

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We construct a formalism to obtain the Mean Sea Level (MSL) evolution by considering the fundamental mass conservation equation with compressible effects and a linear equation of state. The MSL Equation (MSLE) can be constructed for any limited region of the world ocean, as well the global ocean, and it consists of an ordinary differential equation including surface water and buoyancy fluxes, as well as lateral volume and density fluxes. The new equation contains buoyancy fluxes terms representing the steric effects whereas the water and volume transport terms describe the mass flux contributions. The MSLE is studied for the Mediterranean Sea case using a simulation experiment for the decade 1999-2008. It is found that the Mediterranean MSL tendency is made of steric contribution that is periodic in time superimposed to a stochastic signal due to the mass balance, the latter dominating the MSL tendency. The stochastic term of the MSL tendency arise from the unbalance between the volume flux at Gibraltar and the area average surface water flux. The time integration of the MSLE for the Mediterranean Sea allows an accurate reconstruction of the MSL if compared to satellite altimetry.