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Heat budget for enclosed water bodies: case study of the Thau lagoon (South of France)

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Because of the multiplicity of sources of error, unknown sources of heat and uncertainties of surface heat fluxes, it is often difficult to close the heat budgets of enclosed water bodies. The literature provides closure up to 200%. In this study, we use two 1D models to simulate the Thau lagoon, a shallow, brackish water lagoon (75 km^2) located along the Mediterranean coast in the South of France. To force the models at the surface, an extended data set collected in the middle of the lagoon between February and December 2009 is used. After tuning and selection of the best surface heat flux parameterization, the two models successfully simulate the amplitude of the temperature seasonal cycle, the intra-seasonal cooling events and the diurnal cycle of surface temperature. They also correctly reconstruct the spring/summer salinity increase.

The energy balance of the lagoon is then calculated using the surface heat flux data set obtained from the best model simulation. This leads to a closure of 116% for the lagoon. Statistical errors are then considered on each term of the heat budget in order to evaluate the errors and compare them to the residue representing the unknown terms of the budget. It is shown that the largest errors are supported by the latent heat flux, at a level of the same order of magnitude as the residue itself. This means that inaccuracies for closing the energy balance of an enclosed water body are mostly due to incompressible errors affecting surface forcing, i.e. random errors due to instrument measurements and to the parameterizations used.