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Coupling of atmospheric model, UMO and ocean model, POM with emphasis on exact conservation of exchanged fluxes or SST and computational efficiency

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The atmospheric unified model (UMO) is a non-hydrostatic model developed by Z. Janjic and is already written as a parallel code. The Princeton ocean mode (POM), developed by G. Mellor and A. Blumberg was taken as a serial code and inserted into UMO as its subroutine (more precisely as two subroutines) and was transformed in parallel using MPICH style, same as UMO.
When atmospheric and ocean models are coupled part of the new model has on one side to “bring” atmospheric fluxes of energy and momentum to ocean and on the other to “bring” sea surface temperature to atmosphere. Usually it means interpolation between respective grids possibly with some loss of accuracy in that process. In the parallel mode there is even more important consideration of computational efficiency having in mind that we have computers with several thousands of cores and that will only increase with time.
Problem of conservation was solved by the adaptation of the POM’s grid so that each UMO’s cell is divided into four (eight, sixteen,..) cells thus granting exact conservation.
The computational efficiency was much more difficult task. In order to reduce cross processor communications to minimum during preprocessing of the coupled model two pairs of transformation matrices are created. In the case of atmospheric fluxes the first matrix has information which grid cells of POM receive information from each UMO grid cell. Since it is possible (and always happens) that the atmospheric cell partly “covers” several ocean cells the second matrix has starting and ending indices of sub-cells of atmospheric cell and corresponding ocean cells. An analogous pair of matrices is created for the transformation of the SST.