WAVEWATCH III SMC grid update for multi-resolution winds and hybrid parallelisation

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Abstract

The spherical multiple-cell (SMC) grid (Li 2011, 2012) package in WAVEWATCH III has been updated for using sea-point only wind and current forcing in the latest V6.07 public release. Instead of using regular grid wind in previous versions, mixed multi-resolution winds could now be interpolated to the multi-resolution grid sea points in the wind input. This configuration is particularly useful for regional forecasting as regional high resolution winds could be merged with large scale or global coarse resolution winds for a unified multi-resolution wind input.

The sea-point wind option is tested with the Met Office SMC36125 global wave forecasting model (Li & Saulter 2014) and compared with the regular 25 km wind input case. As our raw global wind is at 16 km, it is first interpolated to the 25 km regular grid for the regular grid wind input. Inside the wave model, the 25 km wind is further interpolated to the refined grid points at 12, 6 and 3 km resolutions. For the sea point only option, the 16 km global wind is interpolated directly to the multi-resolution grid for the 25, 12, 6 and 3 km sea points. So differences between the two methods are actually caused by the different interpolation procedures, which is not very large. Further tests will mix together our local high resolution winds with the global one.

Another update of the SMC grid module is for MPI-OpenMP hybrid parallelisation. The SMC grid space propagation for a single wave spectral component is now parallelised with OpenMP for multiple threads within one rank. Theoretically, a whole shared memory node (total 36 threads on our Cray XC40 computer) could be configured for a single spectral component propagation but experiments showed that the model scalability flattened out quickly after 6 threads and the most economical configuration is 3-thread one on our Cray X40 machine, which could reduce the elapsed time by about 60% in comparison with the single-thread or pure MPI case. Using more than 9 threads will not yield further reduction but may make the run even slower! The scalability may depend on computers so users may need to work out the best configuration on your machines. Nevertheless, this hybrid configuration has made it possible to run even higher resolution models as the memory demand on a single node will be reduced when multiple threads are used because the number of ranks per node is reduced.

References

Li, JG 2011: Global transport on a spherical multiple-cell grid. *Mon. Wea. Rev.*, **139**, 1536-55.

Li, J.G. 2012: Propagation of ocean surface waves on a spherical multiple-cell grid. *J. Comput. Phys.*, **231**, 8262-8277.

Li, J. G., A. Saulter 2014: Unified global and regional wave model on a multi-resolution grid. *Ocean Dynamics*, **64**, 1657-1670.

SMC36125 Grid
NC=592970
NA=1321
NB=256

SMC36125
2016090518
SWHmx = 10.54
SWHmn = 0.000E+00