A simple modification that could significantly improve ocean models

Paul Williams

Department of Meteorology, University of Reading, Reading, United Kingdom (p.d.williams@reading.ac.uk)

Many ocean models use the Robert–Asselin filter to suppress the spurious computational mode of the leapfrog scheme. Unfortunately, whilst successfully eliminating the unwanted mode, the Robert–Asselin filter also weakly suppresses the physical solution and severely degrades the numerical accuracy. These two concomitant problems are shown to occur because the filter does not conserve the mean state, averaged over the three time slices on which it operates.

This presentation proposes a simple modification to the Robert–Asselin filter, which does conserve the three-time-level mean state. When used in conjunction with the leapfrog scheme, the modification vastly reduces the artificial damping of the physical solution. Correspondingly, the modification increases the numerical accuracy for amplitude errors by two orders, yielding third-order accuracy.

The modified filter may easily be incorporated into existing ocean general circulation models, via the addition of only a few lines of code that are computationally very inexpensive. As an example, results will be shown from a recent implementation of the modified filter in the UK Met Office Hadley Centre's ocean model. The modification is shown to significantly alter the simulated mean ocean state.

Reference
Williams, PD (2009) A proposed modification to the Robert-Asselin time filter. *Monthly Weather Review*, **137**(8), pp 2538-2546, 2009. doi:10.1175/2009MWR2724.1