A proposed modification to the Robert-Asselin time filter

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The Robert-Asselin time filter is widely used in numerical models of weather and climate. It successfully suppresses the spurious computational mode associated with the leapfrog time-stepping scheme. Unfortunately, it also weakly suppresses the physical mode 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.

The author 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 impacts on the physical mode and increases the numerical accuracy for amplitude errors by two orders, yielding third-order accuracy. The modified filter could easily be incorporated into existing general circulation models of the atmosphere and ocean. In principle, it should deliver more faithful simulations at almost no additional computational expense. Alternatively, it may permit the use of longer time steps with no loss of accuracy, reducing the computational expense of a given simulation.