P5 Improvements to polar filtering for WRF

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While WRF was designed to be a limited-area model, it can also be run globally ("Global WRF", GWRF). Global WRF requires use of a latitude-longtiude (lat-lon) projection, and since equivalent grid distances on the lat-lon grid can approach zero at the poles, GWRF must be run with a filter over these regions to ensure stability. The polar filter is applied to all fields poleward of a specified latitude, and the filtering involves forward Fourier transforms of the fields, truncation of higher-wavenumber components, and backward transforms of the fields to physical space.

In targeted testing of Global WRF (GWRF) for WRF-Chem applications, spurious signals have been seen in forecasts of tracers and chemical species. These signals appear as periodic variations in the fields in the high latitudes where the GWRF polar filter is applied, and the errors are focused on areas of complex topography. The errors have been found to stem from two sources. One is WRF's use of single-precision FTT routines in the polar filter. A fix for this has been found and consists of revising of the polar filter code to employ double-precision FFT routines and libraries. This has just been released in WRF V3.6. The second source of error is the application of the filter across terrain gradients. It is found that this can be mitigated by high-latitude terrain preprocessing, and revised WRF initialization code has been developed for this. Both issues are described and results are presented.