Mathematics of the Weather 2024



Contribution ID: 18

Type: Contributed Talk

## Time-parallel integration and phase averaging for the rotating shallow-water equations on the sphere

Wednesday 9 October 2024 09:15 (15 minutes)

We present a phase-averaging framework for the rotating shallow-water equations and a time-integration methodology for it. Phase averaging consists of averaging the nonlinearity over phase shifts in the exponential of the linear wave operator. Phase averaging aims to capture the slow dynamics in a solution that is smoother in time (in transformed variables), so that larger timesteps may be taken. In our numerical implementation, the averaging integral is replaced by a Riemann sum, where each term can be evaluated in parallel. This creates an opportunity for parallelism in the timestepping method.

In this talk, we will show proof-of-concept results and analyse their errors in order to examine the impact of the phase averaging on the rotating shallow-water solution. We will also examine how the averaging allows us to use larger timesteps and where the optimal averaging window is at a chosen timestep size.

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Session Classification: Time-Scale Interactions & Balancing