A minimal adiabatic example of sudden stratospheric warming

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Abstract

We present a new idealized test case of a Sudden Stratospheric Warming (SSW) event implemented in GFDL's FV3 dynamical core. The initial condition features a wintertime stratospheric circulation with a westerly jet in the Northern Hemisphere and an easterly jet in the Southern Hemisphere. In the absence of tropospheric wave forcing, the model preserves the stratospheric circulation for approximately 200 days. To induce SSW, we introduce a moving mountain to generate planetary waves. Wavenumber-1 forcing led to a vortex displacement SSW, while wavenumber-2 forcing produced a vortex split SSW, consistent with observational data and litterature. This minimal test case highlights the robustness of the model in simulating stratospheric processes and provides a framework for further investigations into the initiation mechanisms of SSW. It can serve as a benchmark for assessing the performance of dynamical cores in simulating stratospheric phenomena and troposphere-stratosphere interaction.

Keywords: CFD, dynamical core, modeling, test cases

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