On how turbulent mountain stress influences sudden stratospheric warming ocurrence in WACCM

Froila M. PALMEIRO[1], Rolando R. GARCIA[2], Natalia CALVO[3], and David BARRIOPEDRO[4]

[1] *Barcelona Supercomputing Center, Barcelona, Spain*

[2] *Atmospheric Chemistry Division NCAR, Boulder CO, USA*

[3] *Dpto. Fisica de la Tierra y Astrofisica UCM, Madrid, Spain*

[4] *Instituto de Geociencias IGEO-CSIC, Madrid, Spain*

The implementation of the Turbulent Mountain Stress (TMS) parametrization in the Whole Atmospheric Community Climate Model (WACCM) is found to be critical to obtain a realistic Sudden Stratospheric Warming (SSW) frequency in the Northern Hemisphere. Comparing two 50-year simluations, one with TMS (TMS-on) and one without (TMS-off) reveals lower than observed SSW frequency in TMS-off from December to February, while in March both simulations show SSW frequencies comparable to reanalysis. Meridional eddy heat fluxes in the lower stratosphere are stronger in TMS-on than in TMS-off, except in March. These differences are accompanied by increased orographic gravity wave drag (OGWD) in TMS-off that comes mainly from the Himalayas and the Rocky Mountains in response to stronger surface winds. Two different mechanisms of how planetary and GWs interact are identified in the simulations. In the lower stratosphere, enhanced dissipation of GWs in TMS-off modifies the subtropical jet and thus the conditions for refraction of planetary waves, which then propagate preferentially towards the equator instead of towards the pole. In the middle and upper stratosphere, compensation between resolved and parametrized GWs leads to weaker Eliassen-Palm flux divergence (EPFD) in response to stronger OGWD in TMS-off. While the former mechanism persists for the entire winter, the OGWD in TMS-off decreases in March and is compensated by enhanced EPFD, which might explain the reduced TMS-off bias in the frequency of March SSWs.

Key words: S-T coupling, SSW, wave dynamics