Project: **1238**

Project title: **Middle atmosphere localized gravity wave forcing: Formation, impact and long-term evolution**

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Text: Maximum of two pages incuding figures. Reports for joint projects may be longer.

We utilize the ICON version 2.6.3 with upper-atmosphere extension (UA-ICON) as distributed by the German weather service (DWD). So far, we have conducted a set of 30-year long (excluding the spin-up periods) time-slice experiments with the UA-ICON model by employing repeated annual cycles of SST, SIC, and greenhouse gases of the year 1985. This year is appointed as both El-Nino southern oscillation and Pacific decadal oscillation were in their neutral phase and no major volcano eruption has occurred, hence conditions in this year can serve as a useful proxy for the multi-year mean conditions and an estimate of their internal variability. First, a control (CTL) run is carried out where both the sub-grid scale orography (SSO) scheme and non-orographic GW scheme are used and two sensitivity tests where a) the SSO scheme is disabled (noSSO) and b) the non-orographic gravity wave (GW) scheme is disabled (noGWD).

So far, we have studied the interaction between the resolved waves and parameterized gravity wave drag in the UA-ICON model [1]. The stratospheric polar vortex accelerates, cools and shifts poleward in both sensitivity runs. The frequency of sudden stratospheric warmings in the CTL simulation is 5.7 events per decade and drops to 1.7 and 4 events per decade in the noSSO and noGWD, respectively. In both sensitivity runs (particularly in noGWD), an enhancement in the resolved wave amplitude is found in the high latitude stratosphere and in the mesosphere and lower thermosphere (MLT) region in all latitudes. The magnitudes of the resolved waves responses are generally larger for noGWD than noSSO. Our results confirm the compensation mechanism in the UA-ICON model, whereby the perturbed forcings in the GW parameterization drag are often cancelled or compensated by a resolved large-scale wave driving of opposite sign.

In addition, we have studied the climatology of the stratopause height and temperature in the UA-ICON model and have examined them by comparing to a 11-year Microwave Limb Sounder (MLS) climatology. In addition, the elevated stratopause events occurrence, their main characteristics, and driving mechanisms in the UA-ICON model are examined in the above-mentioned sensitivity runs [2].

References:

[1]: Karami, Kh., Mehrdad, S., Jacobi, C: Response of the resolved planetary wave activity and amplitude to turned off gravity waves in the UA-ICON general circulation model, *submitted to JASTP*.

[2]: Karami, Kh., Borchert, S., Eichinger, R., Jacobi, C., Kuchar, A., Mehrdad, S., Pisoft, P, Sacha, P: The climatology of elevated stratopause events in the UA-ICON model and the contribution of gravity waves, *submitted to JGR-Atmosphere.*