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Influence of spatial distribution of the gravity wave activity on the middle atmospheric circulation and transport.

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Internal gravity waves (IGW) are widely recognized to contribute significantly to the energy and angular momentum transport. They play a significant role in affecting many of the middle atmospheric phenomena (like QBO or Brewer-Dobson circulation (BDC)). Using the GPS RO density profiles, we have recently (Sacha et al., 2015) pointed out a localized area of enhanced IGW activity and breaking in the lower stratosphere of the Eastern Asia/North-western Pacific (EANP) region.

With a mechanistic model for the middle atmosphere (MUAM) we performed experimental runs to study an effect of such a localized breaking region on the large-scale circulation and transport. Our results demonstrate an important role of a spatial distribution of the IGW activity (geometry of the problem) for the formation of planetary waves (PW). We show that PW created by such a localized forcing can have consequences for the polar vortex stability and the stratosphere-troposphere exchange in the tropical region of South-East Asia.

By comparing the patterns of the 3D residual circulation computed from the experimental runs with the realistic tracer distributions (N2O, CO, H2O, O3) observed by satellites, we identify the role of the IGW hotspots in longitudinal variability of the BDC (e.g. enhanced downwelling branch in the EANP region).

Finally, we discuss consequences of our research for the traditional 2D BDC concept, highlighting the uncertainty in its response to a climate change stemming from the uncertainty of future evolution of spatio-temporal distribution of IGW activity.

Sacha, P., Kuchar, A., Jacobi, C., and Pisoft, P.: Enhanced internal gravity wave activity and breaking over the Northeastern Pacific/Eastern Asian region, Atmos. Chem. Phys. Discuss., 15, 18285-18325, doi:10.5194/acpd-15-18285-2015, 2015.