Geophysical Research Abstracts
Vol. 14, EGU2012-10815, 2012
EGU General Assembly 2012

CO-based examination of the Arctic middle atmosphere dynamics in the Specified Dynamics version of the Whole Atmosphere Community Climate Model (SD-WACCM) using ground-based CO observations from Kiruna

C. G. Hoffmann (1), D. E. Kinnison (2), R. R. Garcia (2), M. Palm (1), J. Notholt (1), U. Raffalski (3), and J. Groß (4)

(1) University of Bremen, Institute of Environmental Physics, Germany, (2) National Center for Atmospheric Research, Boulder, Colorado, USA, (3) Swedish Institute of Space Physics, Kiruna, Sweden, (4) Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology, Germany

We compare Arctic middle atmosphere CO for the Arctic winters 2008/2009 and 2009/2010 measured by ground-based microwave radiometry against simulations made with the Whole Atmosphere Community Climate Model driven with specified dynamical fields (SD-WACCM4). The representation of polar dynamics in the model is examined indirectly with this approach, since CO is a tracer for dynamics in this region during polar winter. Measurements were taken with the Kiruna Microwave Radiometer (KIMRA). The instrument, which is located in Kiruna, northern Sweden (67.8°,N, 20.4° E), provides CO profiles between 40 and 80 km altitude.

SD-WACCM4 is nudged with analyzed meteorological data below approximately 50 km altitude. Model output is therefore directly comparable to a specific set of measurements, in contrast to output of the free-running model WACCM4. The presented comparison is one of the first, which makes use of this particular feature of SD-WACCM4. The global model is evaluated daily at the particular model grid-point closest to the measurement location, so that the comparison is performed on the smallest space and time scales currently simulated by the model. As a guide to what can generally be expected from such a comparison, the same analysis is repeated for the spatially distributed observations of CO from the Microwave Limb Sounder (MLS), onboard the Aura satellite. The time evolution of CO is compared for the complete time series, as well as for the slowly and rapidly evolving parts alone.

Overall, the agreement among the datasets is very good. The model is almost as consistent with the measurements as the measurements are with each other. Mutual correlation coefficients of the slowly varying part of the CO time series are ≥ 0.9 over a wide altitude range. This demonstrates that the polar winter middle atmosphere dynamics is very well represented in SD-WACCM4. In particular, this comparison reveals that the relaxation to analyzed meteorological fields below 50 km altitude constrains the behavior of the simulation sufficiently such that the simulation in the free-running part above 50 km is also close to the measurements. However, above 50 km, the model-measurement correlation for the rapidly varying part of the CO time series is lower (0.3) than the measurement-measurement correlation (0.6). This is attributed to the fact that the gravity wave parametrization in SD-WACCM4 is based on a generic gravity wave spectrum and cannot be expected to capture the instantaneous behavior of the actual gravity wave field present in the atmosphere.