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Possible impact of QBO and upwelling on satellite measurements of N_2O in the tropical lower stratosphere

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A modified form of tracer-tracer correlations of N_2O and O_3 has been used as a tool for the evaluation of atmospheric photochemical models. Thereby, the data is organized monthly for both hemispheres by partitioning the data into altitude (or potential temperature) bins and then averaged over a fixed interval of N_2O. In our recent model evaluation study we applied satellite observations from the Odin-Sub Millimeter Radiometer (Odin/SMR) and found large differences between model simulations and Odin/SMR observations in the tropics. At 500 K these differences are probably partly caused by the large vertical O_3 gradients occuring in the tropics which cannot entirely be resolved by the rather coarse vertical resolution of Odin/SMR of 3 km and partly by inaccuracies in the model simulations of transport in the tropical stratosphere. The N_2O averages we derived from Odin/SMR observations at potential temperature levels at 650 K were much higher than the N_2O values we derived from the model simulations. Further, these values are much higher than the highly accurate ground-based observations of N_2O derived in the troposphere which is the only source region of this trace gas. Furthermore, these values occur with a seasonal dependence showing a maximum in winter and a minimum in summer. By comparing several years of Odin/SMR measurements we found that these values also occur with an interannual variability. We applied our method to other satellite data sets as Aura/MLS, MIPAS/ENVISAT and CRISTA and model simulations of WACCM. We found that the exceptionally high values of N_2O found in the monthly averages by Odin/SMR are also found in the monthly averages derived from CRISTA and MIPAS which as Odin/SMR provide N_2O measurements with a high vertical resolution. Thus, the exceptionally high absolute values of N_2O found in the data of instruments with high vertical resolution might be related to some (partly well-known) bias problems or instrument noise which needs further assessment. However, the seasonal and interannual variability of these values is most probably caused by local dynamical processes in the tropics as e.g. the seasonal cycle of tropical upwelling and the QBO, the latter of which is usually not well represented in model simulations.