A New Ground-Based Carbon Monoxide Radiometer for Observing the Dynamics of the Arctic Middle Atmosphere

Niall Ryan, Mathias Palm, and Justus Notholt
Institute for Environmental Physics, University of Bremen, Bremen, Germany (n_ryan@iup.physik.uni-bremen.de)

The dynamical properties of the middle atmosphere must largely be derived from interpretation of observed chemical tracer data, predominantly from measurements by ground-based or satellite-borne instruments. Carbon monoxide (CO) is a well-suited tracer for polar middle atmosphere dynamics: during polar winter, the chemical reactions involving the gas are negligible due to lack of sunlight and the gas exhibits strong vertical and horizontal gradients. Ground-based measurements of the atmosphere are increasingly important for making long-term records of atmospheric composition and, because of the likely upcoming gap in satellite measurements, are needed to intercompare past and future satellite instruments.

This contribution presents a new ground-based millimeter wave radiometer, CORAM, that is designed to measure radiation, at \( \sim 230 \) GHz, emitted during rotational transitions of CO. CORAM will be housed at the APIWEV station in Ny Alesund, Spitsbergen (79° N), an ideal location for observing middle atmosphere dynamics from inside and outside the polar vortex, and make continuous CO observations in the High-Arctic. The observations from CORAM will be used for validation of the polar dynamics in atmospheric models, and to investigate the short-term variability of polar middle atmosphere dynamics. Used in combination with measurements in Kiruna, Sweden (68° N), information about the CO gradient across the polar vortex edge can also be recovered.

I will describe the new instrument and inversion technique, and present the ability of the observation system operating in a High-Arctic location. I will show the sensitivity of the system to CO concentrations in the altitude range of approximately 40-80 km with a preliminary error analysis using optimal estimation, and the effect of inversion nonlinearities on CO trend analysis.