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

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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 ∼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.