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Observations of greenhouse gases at Sodankylä during 2009-2014

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A Fourier Transform Spectrometer (FTS) was installed at the Sodankylä research station in February 2009. The system is recording direct solar spectra in the near-infrared spectral region in the spectral range between 0.7 and 2.5 μm. From the spectra column-averaged abundance of CO_2, CH_4, N_2O and other gases are retrieved. The FTS instrument is based on Bruker 125 HR and participates in the Total Carbon Column Observing Network (TCCON); the instrument has been optimized for greenhouse gas measurements. Here we first present analysis of the reprocessed data set over a six year period from 2009 until 2014. We find statistically significant increase of column amounts of carbon dioxide by 2.4 +/- 0.3 ppm per year and methane increase by 6 +/- 1 ppb per year. In addition to the FTS measurements we have started with year around AirCore measurements at Sodankylä in September 2013. AirCore is an atmospheric sampling system that is directly related to the World Meteorological Organization in situ trace gas measurement scales. AirCore provides profile information of CO_2, CH_4 and CO from troposphere and lower stratosphere. The AirCore measurements have allowed us to evaluate the accuracy of FTS retrievals. Of special interest has been the quality of the FTS retrievals of CH_4 under polar vortex conditions. Finally we present comparisons with space borne measurements by GOSAT (the Greenhouse Gases Observing Satellite) mission. We find a good agreement between the GOSAT and ground based observations. In case of CO_2 the relative difference between the two instruments has been -0.03 +/- 0.02 % and in case of CH_4 the relative difference has been -0.08 +/- 0.03 %.