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Long Term Trends of Atmospheric Carbon Dioxide Column Concentrations in Bremen, Germany and Ny-Alesund, Spitzbergen

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Long term trends of atmospheric carbon dioxide column concentrations were analyzed from ground-based solar absorption Fourier transform infrared (FTIR) instruments in Bremen, Germany and in Ny-Alesund, Spitzbergen. The column average volume mixing ratio of the observations were then compared to the Stochastic Time Inverted Lagrangian Transport (STILT) model and CarbonTracker.

Comparisons of atmospheric carbon dioxide anomalies between the FTIR data and the models show more reasonable agreement in Bremen than in Ny-Alesund. The reasons for which come from the larger diurnal variations in Ny-Alesund as a result of smaller measured intensities and the lack of vegetation in Ny-Alesund that the model may have over estimated. With the better agreement of the models in Bremen to the measurements, a “clear sky” bias was pin pointed as models see increased carbon dioxide during frontal zone conditions – a meteorological condition when FTIRs often cannot measure.

The spatial heterogeneity of carbon dioxide was also assessed for Bremen by varying the horizontal resolutions of the STILT model from a fine to a coarse scale. The model outputs from these resolutions were then compared to STILT results with the highest resolution as well as to the FTIR data. From the standard deviation of differences among these datasets we can conclude that column concentrations are not sensitive to small-scale local carbon dioxide emission sources, although the FTIR being situated in an urban setting.