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Understanding CO2 Fluxes with Southern Hemisphere TCCON column and surface measurements and tagged tracer modeling

Nicholas Deutscher (1,2), Vanessa Sherlock (3), Sara Mikaloff-Fletcher (3), David Griffth (2), Ronald Macatangay (2), John Robinson (4), Dan Smale (4), Brian Connor (5), and Justus Notholt (1)

(1) University of Bremen, Institute of Environmental Physics, Bremen, Germany (n_deutscher@iup.physik.uni-bremen.de), (2) University of Wollongong, Centre for Atmospheric Chemistry, Wollongong, Australia, (3) National Institute for Water and Atmospheric Research, Wellington, New Zealand, (4) National Institute for Water and Atmospheric Research, Lauder, New Zealand, (5) BC Consulting, Alexandra, New Zealand

The Total Carbon Column Observing Network currently consists of 16 operational ground based remote sensing stations measuring total column CO2, CH4 and other gases by solar Fourier Transform spectrometry in the near infrared. TCCON aims to provide column averaged dry air mole fractions (Xy) of sufficient accuracy and precision to resolve small spatial and temporal gradients for inverse modelling studies, and is the basis for validation of satellite measurements of greenhouse gases such as those from GOSAT, SCIAMACHY and OCO-2. TCCON currently achieves $\sim$0.1% repeatability and $\sim$0.3% accuracy for measurements of XCO2. At present there are three operational TCCON sites in the Southern hemisphere: Darwin (12°S), Wollongong (34°S) and Lauder (45°S). The relatively quiescent nature of the southern hemisphere with respect to carbon fluxes means that temporal and spatial variations in southern hemispheric column measurements are small. This makes using SH column measurements especially demanding for both satellite validation and inferring fluxes.

In this presentation, we focus on comparing xCO2 measured and modelled at the three SH sites. We use tagged regional and process-based tracers to understand the processes driving observed seasonal and interannual variability and investigate how differences between observed and modelled XCO2 can be used to diagnose errors in the analysed fluxes assumed in the forward model simulations. In addition, we look at how correlations with other measured species, such as CH4 and CO, aid in this process. Further, we will investigate how differences between the columns and co-located surface measurements can be also used in understanding model-measurement mismatches.