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Are column measurements of GHGs better suited for inverse modeling than in-situ measurements?

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Remote sensing of GHGs is promising in that it provides global coverage, but it also provides observations that are different from in-situ observations in that they are column averaged mixing ratios. Data assimilation involving atmospheric transport models are commonly used in combination with GHG observations to derive the relevant information on regional distribution of sources and sinks and on processes affecting GHG fluxes. As those transport models rely on subgrid parameterizations for vertical transport, there is considerable uncertainty associated with turbulent mixing within the planetary boundary layer as well as with moist convection by cloud processes. Column observations such as made by ground based FTS or by satellite based instruments are currently believed to be more adapted for use in combination with transport models, as uncertainties related to modeled vertical transport are thought to not strongly affect vertically integrated quantities.

We use the WRF-VPRM modeling system, combining the weather research and forecasting model WRF-chem, the vegetation photosynthesis and respiration model VPRM, and high resolution emission inventory data, to investigate the impact of different physics parameterizations on the vertical distribution of CO2. Simulations where done for a domain covering most of Europe at a spatial resolution of 10 km for a full summer month, when surface-atmosphere exchange fluxes are strongest during the growing period. Mixing ratio differences are largest within the boundary layer with values reaching several ppm during daytime, related to differences in simulated mixing heights resulting from the choice of PBL scheme. Differences in simulated column averaged dry air mixing ratios (X_CO2) of several tens of ppm indicate a reduced sensitivity of columns to vertical mixing. However larger differences are associated with frontal systems involving convective transport. The presentation will assess those transport model related uncertainties against requirements resulting from the necessity to detect changes in GHG fluxes.