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Remotely sensed and in-situ CO_2 concentrations: A framework for comparison

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In-situ measurements of carbon dioxide (CO_2) are performed very often and at high accuracy, but with sparse geographic coverage while remotely sensed data of CO_2 from the ground using Fourier transform infrared spectrometry (FTS) can be used to validate satellite data, which have a more global coverage. Comparing in-situ and remote sensing measurements of carbon dioxide has been a challenging process since the two techniques have different natures. In-situ being point concentration measurements and remote sensing being column concentrations. A framework has been developed to put side-by-side in situ and column measurements of CO_2. In situ tower and aircraft as well as remotely sensed FTS measurements were done during the CarboEurope Regional Experiment Strategy (CERES) from May to June 2005 in Biscarrosse, France. Carbon dioxide volume mixing ratios (VMRs) from the MetAir Dimona aircraft, the TM3 global transport model and Observations of the Middle Stratosphere (OMS) balloon based experiments were combined and integrated to compare with FTS measurements. Differences come mainly from the spatial variability of CO_2 around the FTS station. Additionally, the Stochastic Time Inverted Lagrangian Transport (STILT) model was utilized to quantify these differences. It also served as a "transfer standard" between the in-situ data measured at a co-located tower and the remotely sensed data from the FTS. Discrepancies partly come from uncertainties in the spatial variation of carbon dioxide.