Geophysical Research Abstracts
Vol. 15, EGU2013-9818, 2013
EGU General Assembly 2013

Inferring Source and Sink of Atmospheric CO_2 at High-resolution from Space: a Mesoscale Modeling Approach using Inverse Technique

Dhanyalekshmi Pillai (1), Michael Buchwitz (1), Christoph Gerbig (2), Thomas Koch (2), Heinrich Bovensmann (1), Maximilian Reuter (1), and John Burrows (1)

(1) Institute of Environmental Physics, University of Bremen, Germany, (2) Max Planck Institute for Biogeochemistry, Jena, Germany

Satellite observations providing column-averaged atmospheric CO_2 mixing ratios with adequate temporal and spatial sampling as well as high precision can offer valuable additional information on the regional distribution of the sources and sinks of CO_2. The proposed satellite mission Carbon Monitoring Satellite (CarbonSat) has been selected by the European Space Agency (ESA) to be one of two candidate mission for Earth Explorer 8 (EE-8) to be launched around 2019. CarbonSat will measure dry-air column-averaged mixing ratios of CO_2 and CH_4, denoted as XCO_2 and XCH_4 respectively, with a high spatial resolution of 2 x 2 $km^2$and very good spatial coverage (goal: 500 km swath width). CarbonSat will produce atmospheric XCO_2 images from which the CO_2 emission pattern of moderate to strong localized emission sources can be derived and hence has the capability to monitor emissions of major cities and other strong localized emission sources. In order to effectively utilize these measurements and to estimate surface fluxes at the required spatio-temporal resolution and with significant uncertainty reduction, a high-resolution coupled biosphere-atmosphere modeling framework using inverse technique is required.

The goal of this study is to assess CarbonSat's capability to quantify the CO_2 emissions of large cities, taking into account a realistic description of the XCO_2 retrieval errors, the spatio-temporal distributions of CO_2 emissions as well as atmospheric transport and mixing. The study proposes to use a modeling framework consisting of the following models: the Weather Research Forecasting (WRF) model which enables passive tracer transport simulations of greenhouse gases (WRF Greenhouse Gas Model, WRF-GHG) and the Stochastic Time-Inverted Lagrangian Transport model (STILT) to derive biosphere-atmosphere exchange at high spatio-temporal resolution. The initial focus of the study is to perform forward simulations of atmospheric CO_2 concentrations for a domain centered on Berlin in Germany (as a case study for a typical mid-scale city) with a horizontal resolution of 10 x 10 km^2. An analysis will be carried out for all CarbonSat Berlin overpasses using simulated CarbonSat data for one reference year. Preliminary results will be presented along with the modeling approach.