Geophysical Research Abstracts
Vol. 21, EGU2019-1015, 2019
EGU General Assembly 2019

Global Mapping of CO_2 Concentration of OCO-2 by Statistical Modeling of Anthropogenic Emission Dataset

Shrutilipi Bhattacharjee and Jia Chen

Environmental Sensing and Modeling (ESM), Department of Electrical and Computer Engineering, Germany, Technical University of Munich (TUM), Munich, Germany (shrutilipi.bhattacharjee@tum.de, jia.chen@tum.de)

Atmospheric carbon dioxide (CO_2) is one of the greenhouse gases (GHG) that triggers the climate degradation and other environmental threats most severely. Many satellite missions are initiated in last few decades, such as, NASA's Orbiting Carbon Observatory-2 (OCO-2), Japanese Greenhouse gases Observing SATellite (GOSAT), SCanning Imaging Absorption Spectrometer for Atmospheric CHartographY (SCIAMACHY), etc., for the remote sensing of CO_2 and other GHG. The OCO-2 is offering unprecedented accuracy for the space-based measurements of atmospheric CO_2, but as a Level-2 retrieval, which is irregular in space and time. It provides near-global coverage in its 16 days repeat cycle. Further, during the retrieval also, a huge portion of the Earth's surface remains unmeasured due to several factors, such as, cloud covers, surface reflectance, etc.

On the other hand, few global high-resolution anthropogenic CO_2 emission datasets are already available with us which could play an important role for different interpretations and applications of the remotely sensed CO_2 concentration data of the OCO-2 satellite, supporting carbon cycle science. For example, the Open-source Data Inventory for Anthropogenic CO_2 (ODIAC) is one such popular emission data product which provides monthly emission data from 2000 to 2016, considering fuel combustion, cement production, gas flaring, etc. Similarly, the Emissions Database for Global Atmospheric Research (EDGAR) also offers time-series fossil CO_2 emission data from 1970 to 2016, including all anthropogenic emissions from fossil fuel combustion and production, industrial processes.

This work focuses on the validation and application of the OCO-2 satellite-based CO_2 measurement with respect to ODIAC and EDGAR emission datasets. From the application perspective, we aim to spatially interpolate the daily concentration of CO_2 in local scale, and subsequently to a global mapping. This is a data fusion approach to increase the spatial and temporal coverage by modeling the additional emission measures through a multivariate spatial interpolation method, namely Semantic CoKriging (SemCK). Here, one of the major pre-processing criteria is to ensure that the primary CO_2 concentration of OCO-2 and the secondary emission measures are correlated within the study regions. The SemCK based correlation (within concentration measures) and cross-correlation (between concentration and emission measures) analyses validate the OCO-2 observations and interpolates the unmeasured points of the study regions.

The interpolation results of CO_2 concentration are further validated for those locations which are unmeasured by OCO-2 but by the ground based TCCON stations. The results show that the incorporation of external emission data sources for the prediction of missing OCO-2 measures enhances the prediction accuracy and coverage, compared to the approaches which do not consider emission as auxiliary information. This process is also capable to identify and predict the high and low emission hotspots in the predicted surface of the CO_2 concentration that are external to the OCO-2 measurement locations. This approach is one of the initial attempts to integrate the anthropogenic emission data for the validation and the prediction of OCO-2 measures towards its global mapping.