Grégoire
Broquet
Laboratoire des Sciences du Climat et de l’Environnement, LSCE/IPSL, CEA-CNRS-UVSQ, Université Paris-Saclay, 91198 Gif-sur-Yvette, France
Elise Potier, Laboratoire des Sciences du Climat et de l’Environnement, LSCE/IPSL, CEA-CNRS-UVSQ, Université Paris-Saclay, 91198 Gif-sur-Yvette, France/Université Paris Cité and Univ Paris Est Créteil, CNRS, LISA, F-75013 Paris, France/Science Partners, Quai de Jemmapes, 75010 Paris, France
Erik Koene, Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland
Tia Scarpelli, School of GeoSciences, University of Edinburgh, UK
Paul Palmer, School of GeoSciences, University of Edinburgh, UK
Antoine Berchet, Laboratoire des Sciences du Climat et de l’Environnement, LSCE/IPSL, CEA-CNRS-UVSQ, Université Paris-Saclay, 91198 Gif-sur-Yvette, France
Audrey Fortems-Cheiney, Laboratoire des Sciences du Climat et de l’Environnement, LSCE/IPSL, CEA-CNRS-UVSQ, Université Paris-Saclay, 91198 Gif-sur-Yvette, France/Science Partners, Quai de Jemmapes, 75010 Paris, France
Ingrid Super, Department of Climate, Air and Sustainability, TNO, P.O. Box 80015, 3508 TA Utrecht, the Netherlands
Julia Marshall, Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Weßling, Germany
Dominik Brunner, Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland
Poster
NASA's OCO-2 total column CO2 mixing ratio (XCO2) observations have been used extensively for large-scale mapping of biospheric CO2 fluxes and for quantifying CO2 emission hotspots (e.g., industrial plants, cities) using local transects of the corresponding plumes. However, there is a lack of inverse modelling experiments assessing the potential of OCO-2 data for the regular monitoring of biospheric and anthropogenic CO2 fluxes at the scale of individual countries. Such a capability would be critical to support the national greenhouse gas emission reporting and reduction policies in the frame of the Paris Agreement. This presentation summarizes the results of three national scale inversions carried out in the framework of the European H2020 CoCO2 project, which supports the development of the operational global and multi-scale Copernicus CO2 monitoring service. These three inversion systems include the CHIMERE chemistry transport model at 10 km resolution over France coupled to the Community Inversion Framework (CIF), the ICON-ART model at 13 km resolution over Western Europe coupled to the Carbon Tracker Data Assimilation Shell (CTDAS), and the GEOS-Chem at ~25 km for the whole Europe coupled to an Ensemble Kalman Filter. The three models assimilated surface CO2 and/or OCO-2 XCO2 observations from the year 2018 and separately controlled the anthropogenic emissions and biospheric fluxes. GEOS-Chem also assimilated TROPOMI CO observations to assess the potential of this species that is co-emitted with CO2 during combustion to simultaneously estimate biospheric and anthropogenic fluxes of CO2. The presentation will highlight various challenges associated with the joint estimation of anthropogenic and natural fluxes of CO2, the co-assimilation of co-emitted species, the co-assimilation of surface and satellite CO2 observations, and the representation of uncertainties in the inventories of the anthropogenic emissions of CO2 and co-emitted species used as prior estimates for the inversions. We found large differences in biogenic CO2 flux estimates across the different systems, particularly for the annual budgets, but also when assimilating surface versus satellite observations in the same assimilation system. This has not improved on previous studies that used coarser-scale models. We also found that all three models lack of robust control of national-scale anthropogenic CO2 emissions on monthly to annual timescales when using the existing in-situ and satellite observations. The co-assimilation of CO data did not significantly increase this constraint. There is a stronger and more robust impact of the satellite data assimilation locally. The results obtained here provide guidance for the improvement of current modeling capabilities to monitor the CO2 anthropogenic emissions. Such an improvement and CO2M with the associated step-change in XCO2 data over Europe should radically change our ability to quantify regional anthropogenic emissions of CO2.

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