Geophysical Research Abstracts
Vol. 21, EGU2019-15598, 2019
EGU General Assembly 2019

Nested inverse modelling of methane fluxes based on remote sensing and in-situ atmospheric measurements: case studies over Europe and Africa

Amir Hossein Abdi, Julia Marshall, Christian Rödenbeck, Frank-Thomas Koch, and Christoph Gerbig
Max Planck Institute for Biogeochemistry, Jena, Germany (abdi@@bgc-jena.mpg.de)

Methane (CH_4), an important greenhouse gas with more powerful specific warming potential than carbon dioxide, has a significant contribution to global warming and climate change. Despite the important role of this atmospheric tracer, considerable uncertainties still exist in its budget.

In order to decrease these uncertainties, atmospheric transport models in combination with atmospheric observations can be employed as a tool to constrain the sources and sinks. This is known as top-down or inverse modeling. Improving the methods and the tools used in inverse modelling is an essential step toward reducing the uncertainties originating from diverse diffusive CH_4 sources which are intermingled geographically.

Due to the lack of surface-based measurements in some regions such as Africa, Greenhouse Gases Observing Satellite (GOSAT) retrievals - which are only available over limited time periods but comparatively dense in space - are used as a constraint in the inversion system. For this aim, the high-resolution regional Stochastic Time-Inverted Lagrangian Transport model STILT is modified to represent the atmospheric methane column measurements and coupled to the global 3-dimensional transport model TM3 to spatially resolve the regional emissions in Europe and Africa. The global inversion is performed for 2009-2015 on a coarse resolution $\sim 3.83^{\circ}$ x 5°. The nominal spatial resolution of the regional inversion is up to 0.25° x 0.25° for 2011-2012. Prior fluxes are based on Emission Database for Global Atmospheric Research (EDGAR), a global wetland methane emissions and uncertainty dataset for atmospheric chemical transport models (WetCHARTs), the Global Fire Assimilation System (GFAS), Sanderson's global database of termite methane emissions, and the soil Methanotrophy Model (MeMo). A set of concentration data from a large number of atmospheric measurement sites, as well as satellite soundings, are applied to constrain the sources and the sinks in both the global and the nested domains.

Sensitivity tests to examine the robustness of the STILT realisation of the column operator are carried out using several different receptor/particle and inversion parameter setups. The sensitivity analyses and comparisons are presented and discussed.