New Master Thesis Topic

Title: How well do we understand the uncertainties of satellite remote sensing of methane?

Short description:

Methane (CH_4) is a potent greenhouse gas, about 80 times more powerful than carbon dioxide on a 20 years timescale. Albeit decades of research, our understanding of the global methane budget is still incomplete atmospheric and there are we are still faced with major difficulties in explaining the observed variations in the atmospheric methane trend over the last 30 years. One reason is that methane is emitted by a large number of different anthropogenic and natural sources which very different spatial and temporal emission patterns which makes their quantification challenging.

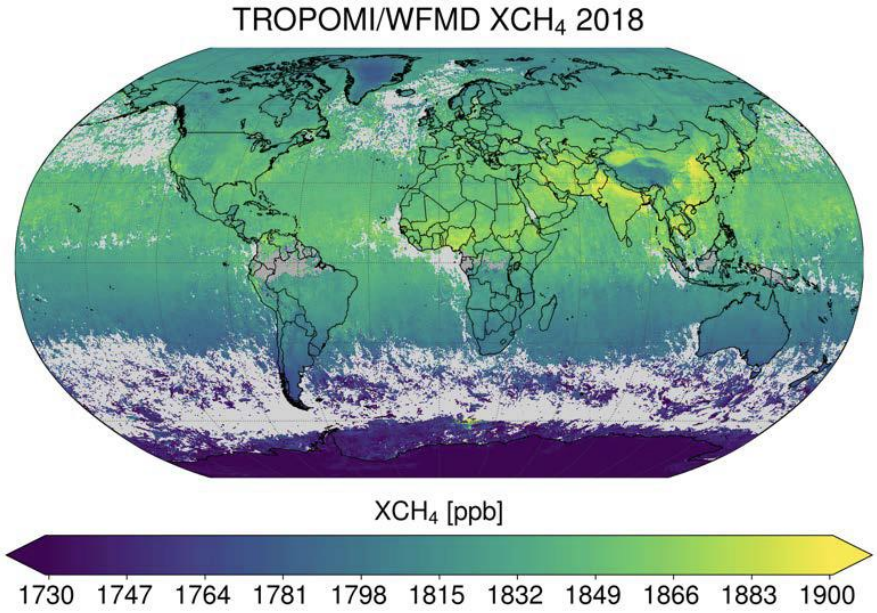

Figure: TROPOMI Methane observations obtained with the IUP WFMD retrieval averaged over the year 2018 (Schneising et al., AMT, 2019)

Space-based observations of methane can provide globally dense observations that are well suited for constraining regional surface emission and thus can

help to close gaps in our understanding of regional methane budgets. Of major interest are CH_4 column observations from the recently launched TROPOMI satellite as TROPOMI provides daily global (geometric) coverage with good spatial resolution. When combined with atmospheric transport models, these satellite data can constrain surface emissions on fine spatial resolution.

However, such surface flux inversions critical rely on realistic assumptions on errors of the satellite observations that are difficult to obtain and often not available which can then lead to false emission estimations. This is especially problematic if emission estimations are carried out with high spatial resolution but if errors are correlated in space and time.

In this project, we will the TROPOMI methane datasets generated by IUP Bremen together with the operational ESA dataset and a dataset generated by SRON. We will evaluate them by comparison to ground-based validation data from the TCCON network. In this assessment, we will apply different metrics and statistical methods to evaluate reported errors and their spatial and temporal error correlation. These results will then be used to generate guidance on the use of the satellite data for surface flux inversions and we will discuss the findings with inversion modelling groups involved the EU project EYE-CLIMA.

Skills needed:

Good Python knowledge and an understanding of Earth Observation and Remote Sensing concepts and methods

Name of the IUP research group incl. two-line description of the research area
This thesis will be hosted by the Department of Physics and Chemistry of the Atmosphere. The Department has a major focus on satellite remote sensing of atmospheric trace gases, cloud and aerosols.

Topic for students of
☒ M.Sc. Environmental Physics
☒ M.Sc. Space Sciences and Technologies

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