The 2019 Methane Budget And Uncertainties At 1 Degree Resolution And Each Country Through Bayesian Integration Of GOSAT Total Column Methane Data And A Priori Inventory Estimates

Worden et al. ACP 2022 DOI: 10.5194/acp-22-6811-2022

Science Question

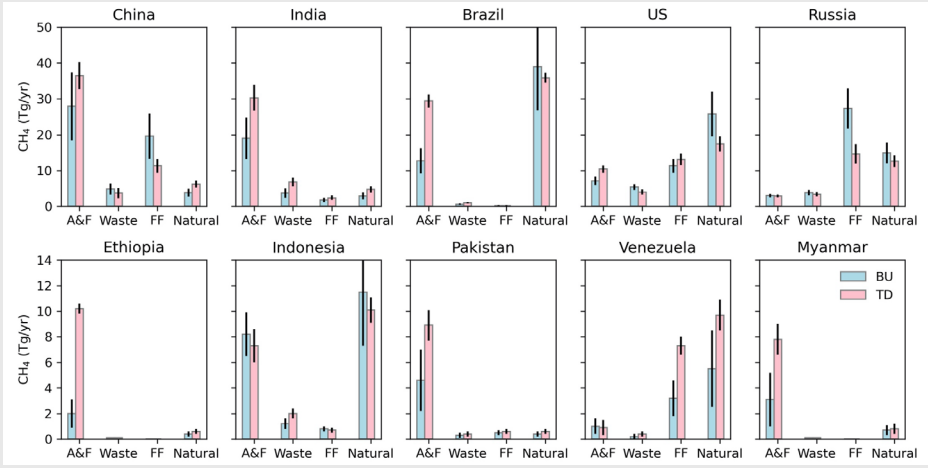
Quantifying the sectoral partitioning of methane emissions and its changes using satellite total column data is challenging because multiple emissions from different sectors and regions can affect methane in the atmospheric column.

Analysis

Here we demonstrate a Bayesian (optimal estimation) partitioning algorithm that combines satellite data with *a priori* knowledge of the emissions and their covariances, to report methane emissions by sector, and their uncertainties, at 1 degree resolution and then by country. Our results are useful for 1) the global stock-take, as a check on reported inventories or for countries without the reporting infrastructure needed to quantify methane emissions and 2) to test the partitioning of emissions by sector that is hypothesized from bottom-up inventories. For the stock-take we find that the system we use (total column data from the JAXA GOSAT satellite combined with the GEOS-Chem model), can resolve emissions from about 57 countries. Furthermore, we find that methane emissions are more likely to originate from agriculture (livestock and rice) and waste, whereas bottom-up inventories and isotopic evidence indicate larger emissions from fossil sources and wetlands; these results are statistically significant indicating that further research is needed to reconcile bottom-up and top-down estimates.

Significance

This study demonstrates a prototype algorithm for using satellite measurements to support the Global Stock Take as agreed upon by the Paris agreement. This same algorithm can robustly quantify uncertainties not just for the sectoral partitioning of emissions but their changes, which is needed to determine the efficacy of any emission reductions.



Emissions by sector for the top 10 emitters. AF represents agricultural and fires. FF represents fossil fuels or coal, oil, and gas. Natural represents wetlands, aquatic sources, and geological seeps. Bottom up (BU) inventory estimates are shown as blue bars and the remote sensing / top-down (TD) estimates are shown as the pink bars. The uncertainties in both quantities are shown as black lines.

Acknowledgements

This work was supported by the NASA Carbon Monitoring System **NNH18ZDA001N-CMS**