SACH4

Source attribution of methane using satellite observations, isotopic measurements and GEOS-Chem simulations

DURATION
15/12/2016 - 15/03/2019

BUDGET
149 780 €

PROJECT DESCRIPTION

There is now a widespread scientific consensus on the profound influence of human activities on the global climate system, particularly through increased emissions of greenhouse gases like carbon dioxide (CO_2) and methane (CH_4) since the preindustrial era. Although CH_4 is roughly 200 times less abundant in the atmosphere than CO_2, it is a more potent greenhouse gas. The comparative impact of CH_4 on climate change is more than 86 times greater than CO_2 over a 20-year period. However, due to its relatively short lifetime of ~9 years, it is now recognized that one of the most efficient methods to mitigate warming due to greenhouse gases on decadal time frames is to cut CH_4 emissions.

Atmospheric CH_4 concentrations have more than doubled since the pre-industrial period. Although its main sources and sinks have been identified, there still remain large uncertainties regarding the balance between those sources and sinks. Furthermore, CH_4 is a challenging atmospheric component to study as its non-monotonous changes in the last decades and its interannual variability are not yet fully understood.

With the SACH4 project we want to reduce these uncertainties and increase our knowledge on how the different sources and sinks influence the atmospheric abundance of CH_4. The Royal Belgian Institute for Space Aeronomy (BIRA-IASB) has developed a global CH_4 product from IASI/METOP satellite observations. In collaboration with the University of Liège (ULiège) we will compare this dataset to tagged simulations of CH_4 from the GEOS-Chem 3-D model to study the CH_4 source allocation.

In addition, we will investigate the possibility of retrieving isotopic concentrations of CH_4 from ground-based Fourier Transform InfraRed (FTIR) measurements. Isotope analysis is an important tool in atmospheric chemistry, as it gives additional information about sources and reaction pathways.

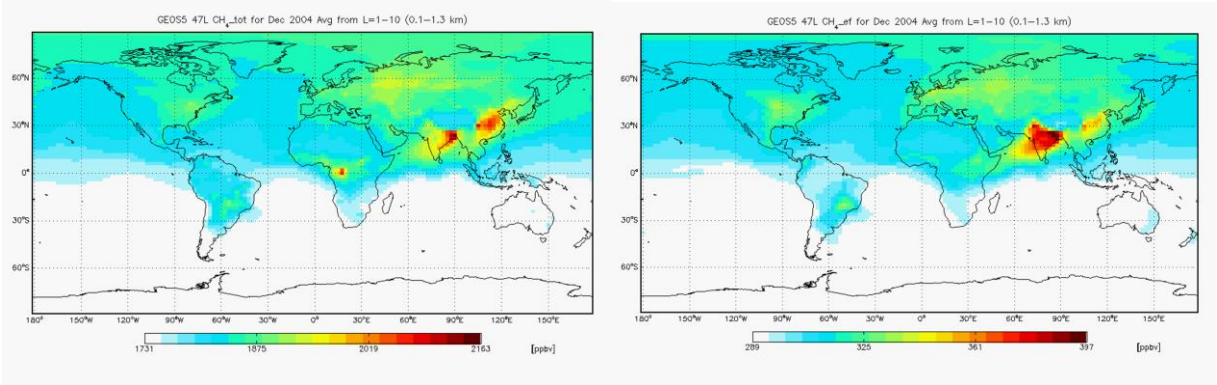

Figure 1: GEOS-Chem CH_4 product (resolution of 2° x 2.5°) in December 2004. [left] Monthly mean volume mixing ratio of CH_4 between 0.1 and 1.3 km is given in parts per billion volume (ppbv). [right] Monthly mean volume mixing ratio (in ppbv) global distribution issued from livestock emissions.

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GEOS-Chem (www.geos-chem.org) is a global 3-D Chemical Transport Model capable of simulating global trace gas and aerosol distributions. Since 2011, the GIRPAS team from ULiège has implemented and intensively used the GEOS-Chem model to support data interpretation. The GEOS-Chem tagged simulations of CH_4 account for the contribution of each emission source and one sink to the total methane column. With this study we want to identify the contribution of the different sources to the observed CH_4 concentrations. In addition, a novel isotopic product will become available with the development of $^{13}CH_4$ and CH_3D products from ground-based FTIR measurements. These products will provide otherwise unavailable information on the emission sources of CH_4 and additional constraints on the source distribution. With this work we want to improve our current understanding of the balance between the sources and sinks that shape the global CH_4 distribution and its evolution. This knowledge can help target the pertinent sources for reducing CH_4 emissions and its associated impact on the climate system. The project results will be disseminated through scientific papers, conferences, and public communication.

This collaboration between BIRA-IASB and ULiège will demonstrate how Belgian expertise relative to observing, modelling and analysis methods can be combined. The imbalance between sources and sinks of CH_4 being at the forefront of climate change matters, combining global analysis of satellite and model data along with local ground-based measurements offers an innovative angle of the question. This project brings new and original elements that will help solve this issue. In a context where climate change and air quality play a major role in every European's everyday life, it is of great importance to inform the society at large on the widespread impact of methane emissions. Indeed, by combining global and local observations, the project provides a point of view on the matter that will illustrate how the question needs to be dealt with not only on a national level but also on a global scale.

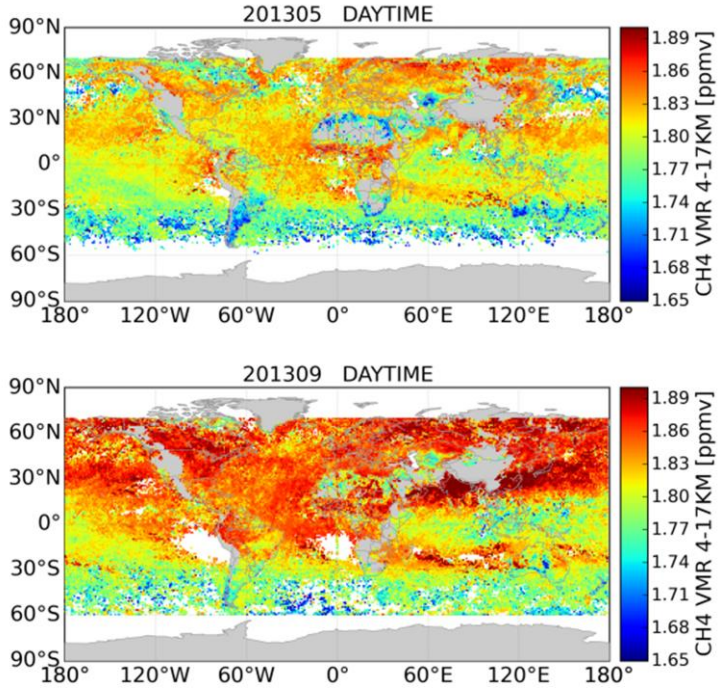

Figure 2: BIRA-IASB CH_4 product. Monthly mean volume mixing ratio of CH_4 between 4 and 17 km is given in parts per million volume (ppmv) for May and September 2013.

CONTACT INFORMATION

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