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Estimation of methane sources and sinks by inverse modelling using GOSAT observations

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Since the nineties, inverse modeling by assimilating measurements into a chemical transport model (CTM) has been used to derive sources and sinks of atmospheric trace gases. More recently, the high global warming potential of methane (CH4) caught the attention of several research groups. Indeed, the diversity and the variability of methane sources induce high uncertainty on the
present and the future evolution of CH4 budget.

Historically, inverse problems have been limited by the lack of observations but, the increasing of available measurement data (satellite data, high frequency measurement, FTIR spectrometry,...) gradually supplements this issue. However, the use of different types of observations is a challenge for current inversions. Do these different datasets derive consistent methane fluxes using inverse modelling ?
Moreover, recent studies have highlighted the need for improvements in the accuracy of the atmospheric circulations in chemical transport model: a bad representation of the atmospheric transport may derive wrong methane fluxes.
Consequently, we investigate here these two main issues (consistency between inversions using different datasets and transport model errors) by comparing an ensemble of methane inversions using :
- different versions of the transport model used in the inverse system
- different observation data sets (GOSAT observations and surface measurements)

Moreover, these different inversions have been run for recent years, which allow us to investigate the interannual variability of methane sources and sinks. In particular, two years of strong methane emissions have been highlighted in 2007 and in 2010. These anomalies have been mainly attributed to anomalies in the Tropics and in China, where major climate events have been observed and where economic development is carrying on with a fast pace, even if emissions reported in inventories are overestimated.