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# Towards global and regional methane budgets estimated by high spatial resolution atmospheric inverse model with GOSAT retrievals

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**Background and aim** 

Atmospheric CH<sub>4</sub> started to increase again since 2007, after a period of near-zero growth from 1999 to 2006. Various



reasons have been discussed, but larger uncertainty still remains, especially on regional scales. In this study, we estimate global and regional  $CH_4$  fluxes for 2011 by a high resolution variational inverse model, based on **NIES-TM-FLEXPART** transport model. The atmospheric  $CH_4$ observations from both ground-based measurements and satellite-based (**GOSAT**) retrievals are assimilated. We show that the observations from GOSAT give additional view about the emissions in regions where ground-based observation network is sparse.

## Materials and methods

#### **Prior emission data**

- Anthropogenic sources: EDGAR v4.3.2<sup>[3]</sup>
- Biospheric sources (wetlands, soil sink): VISIT<sup>[2]</sup>
- Biomass burning: GFAS v1.2<sup>[4]</sup>
- Others: ocean, geological, termite

(top) Total posterior CH<sub>4</sub> fluxes from S2, i.e. both ground based and GOSAT observations are assimilated.

(right) Differences in S1 and
S2 posterior CH<sub>4</sub> flux
estimates. Positive values
indicate higher emission
estimates with GOSAT



#### **Atmospheric concentration observations**

 Ground-based: NOAA, EC, InGOS and many others
 Satellite: GOSAT SWIR Level 2 (L2) X<sub>CH4</sub> data versions 02.21-02.60<sup>[5]</sup>

#### **Inversion method**

- 4DVAR (m1qn3) follows approach by Meirink *et al.,* ACP 2008
- Optimize anthropogenic and natural fluxes biweekly on 0.1°×0.1° resolution
- Correlation length: 500 km, 15 days

#### Atmospheric transport

- NIES-TM (Eulerian, 2.5°×2.5°)
- + FLEXPART (Lagrangian, 0.1°×0.1°) <sup>[1]</sup>
- Lagrangian response = 3 days

#### I Inversion setup:

- S1: only ground-based observations assimilated
- S2: in situ and GOSAT observations assimilated



#### observations assimilated.



(top) Regional monthly anthropogenic and biospheric CH<sub>4</sub> fluxes (GCP regions). The seasonal cycles from the two inversions differ only little. The largest differences are found in anthropogenic emissions during winter.



(top) Atmospheric  $CH_4$  at Hateruma (HAT).



(top) Global mean X<sub>CH4</sub> and comparison with assimilated data. The statistics are in the unit of ppb.

#### – GOSAT "bias" subtracted from L2 data\*1

 $^{*1}$  The average  $X_{CH4}$  differences between the GOSAT and optimized forward simulation (only ground based observations assimilated) by month and  $5^\circ$ 



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