An increasing trend in US methane emissions inferred from satellite observations

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Retrievals of methane from observed radiances

Satellites Observing Methane

Thermal IR
- AIRS, TES, IASI, CrIS

Shortwave IR
- SCIAMACHY
- GOSAT
- TROPOMI


(UoL v4 proxy retrievals)
Prior methane emissions from EDGARv4.2 + LPJ

Top-down studies show higher US methane emissions
Global inversion provides dynamic BCs for North America
Constraining North American methane emissions

Posterior Methane Emissions
(nmol m\(^{-2}\) s\(^{-1}\))

Total: 91.3 Tg a\(^{-1}\)

Emission Scaling Factors (Posterior / Prior)

\[ \Delta CH_4: +27.9 \text{ Tg a}^{-1} \]

US methane emissions and source attribution

- US emissions are a factor of 1.5 larger than US EPA GHGI
- Livestock + Oil/Gas are the largest underestimated sources
- Attribution is sensitive to assumption about the prior error
Top-down studies point to an increase in US methane, not seen in bottom-up estimates.
Increasing difference in NOAA/DOE observations coincides with increase in US methane emissions seen by top-down studies (data c/o S.C. Biraud & E. Dlugokencky)
Use GOSAT for regional trend analysis

- Look at trends over locations where GOSAT samples
- Compare ocean glint to contiguous US observations
Increasing difference in GOSAT observations

GOSAT and NOAA background are consistent

Contiguous US enhanced from background

Pacific background region
Mauna Loa (NOAA)
Contiguous US
Oklahoma

GOSAT trend (ppb a\(^{-1}\))

Probability (%)

RemoTeC v1.9 CH\(_4\) retrievals
(MLO data c/o E. Dlugokencky)
Where do we find regional trends?

Increases are coincident with agriculture and oil/gas.
Potential cause of the increase in US emissions

- 9-fold increase in US shale gas production from 2002–2014
- 125% increase in active drill rigs from 2002–2014

Potentially explained by oil/gas increases
Summary

- Satellite observations can be used to estimate regional methane emissions
- US methane emissions have increased more than 30% in the past decade
  - Likely due to anthropogenic (oil/gas or agriculture) sources
- Could be a contributor to the renewed methane growth

(c/o E. Dlugokencky; NOAA)