A Gridded Version of the EPA Greenhouse Gas Inventory

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2012 US EPA anthropogenic methane emissions

Available only as national totals
We can estimate emissions based on concentrations.
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Process based emissions

Observed Concentrations
We can estimate emissions based on concentrations

Turner et al. (2015)
The ultimate goal of inverse analyses is to improve bottom-up inventories. Atmospheric observations (top-down) provide a prior estimate for inversions, which in turn guides improvements in the bottom-up process-based emission inventory (bottom-up).
An evaluable gridded EPA inventory for 2012

Region-specific EPA emission factors

Spatial allocation on $0.1^\circ \times 0.1^\circ$ grid using national & high resolution datasets with facility-level information from the Greenhouse Gas Reporting Program

22 layers of data for emissions from different processes

Monthly time resolution

Scale-dependent error characterization
4.4 Tg Production
0.9 Tg Processing
1.1 Tg Transmission
0.5 Tg Distribution

Allocating Natural Gas Emissions
The allocation accounts or nonconventional wells and well completions

Emissions from Natural Gas Production - 4.4 Tg

CH₄ emissions ($10^{12}$ molec s⁻¹ cm⁻²)
Processing emissions are only allocated to processing plants.
Transmission emissions are related to a large set of activity data.

Emissions from Natural Gas Production, Processing, and Transmission - 6.4 Tg

CH₄ emissions (10^{12} molec s\(^{-1}\) cm\(^{-2}\))
Distribution emissions take into account local differences in infrastructure.
Total emissions
Gridded EPA anthropogenic methane emissions for 2012
EDGAR v4.2 anthropogenic methane emissions for 2008

CH₄ emissions (Mg a⁻¹ km⁻²)
Differences in spatial allocation will impact inversion results.
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We can use the detailed local EDF Barnett Shale inventory to estimate our errors.
Estimated errors vary as a function of resolution.
Emissions and the paper are available at: epa.gov/ghgemissions/gridded-2012-methane-emissions
We are finalizing an inversion using GOSAT Methane for 2009 - 2015
Smith et al. find consistency over Four Corners

Emissions estimated from aircraft mass balance at Four Corners are now consistent with Gridded EPA inventory.

No significant decadal change, emissions do not seem to scale with natural gas produced.
Ren et al. find higher oil & gas emissions in the Marcellus

Emissions estimated from aircraft mass balance point at a larger source from oil & gas operations (Comparing 2015 with 2012).

Low ethane emissions may point at a larger coalbed methane.
Some other studies

Barkley et al. (2017) use some emissions fields to allow comparison of aircraft data with their local inventory.

Cui et al. (2017) found consistency with aircraft estimates for the San Joaquin Valley.

Jeong et al. (2017) used the landfill estimate as an independent check on their study of California emissions.
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