A gridded (0.1°×0.1°), monthly resolved version of the EPA US GHG inventory methane emissions for use as *a priori* and reference in methane source inversions

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The present-day global emission of methane is constrained by knowledge of the global sink, but allocation by source types and regions is highly uncertain. Top-down analyses are most effective when conducted with the most accurate bottom-up emission estimates. Methane inversions have generally used EDGAR as anthropogenic prior as it provides finely gridded global data. However, EDGAR follows the relatively crude Tier 1 IPCC methods that estimate emissions using basic national or international activity data combined with default emission factors. The EPA Inventory of US Greenhouse Gas Emissions and Sinks (GHG Inventory) generally follows more complex IPCC Tier 2/3 approaches and uses more detailed country-specific activity data and emission factors. Top-down inverse analyses of atmospheric observations suggest that the results of some inventory approaches may be too low by a factor of two or more. Top-down estimates have their own errors, sometimes difficult to quantify. Evaluating and improving the bottom-up inventories on the basis of top-down analysis requires information on the spatial distribution of different source types, but the GHG Inventory methane estimates are presently only available as national totals for most and state totals for some sources.

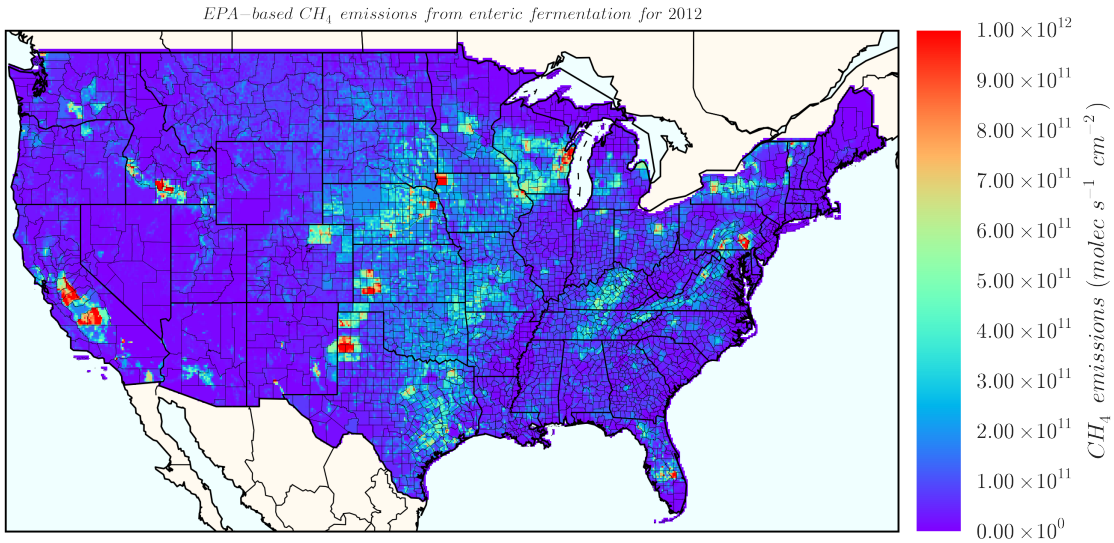

Figure 1, EPA-based methane emissions from enteric fermentation for 2012

In this research, we create a directly evaluable gridded version of the GHG Inventory for methane. We convert the GHG Inventory methane emissions into a 0.1° × 0.1° gridded monthly emission inventory for the US domain and individual years, more suitable for direct evaluation with top-down constraints. We use a wide range of source specific activity data to perform the allocation, incorporating the facility-level data reported through the EPA Greenhouse Gas Reporting Program (GHGRP) where possible. As an illustration of used gridding strategies, our gridded emission estimates from livestock are based on EPA emission data per state, capturing varying livestock management practices across the country. These emissions are then allocated on a county level by using the USDA 2012 Census of Agriculture, and finally allocated on the 0.1° × 0.1° grid by using USDA weighted land cover maps. Figures 1 and 2 show 2012 emissions from enteric fermentation and manure management, respectively. The emission maps show different spatial patterns as enteric fermentation emission are dominated by beef cattle whereas manure emissions principally originate from dairy cattle and swine. Mainly for manure management we find large differences with EDGAR v4.2, most likely related to emissions from swine.

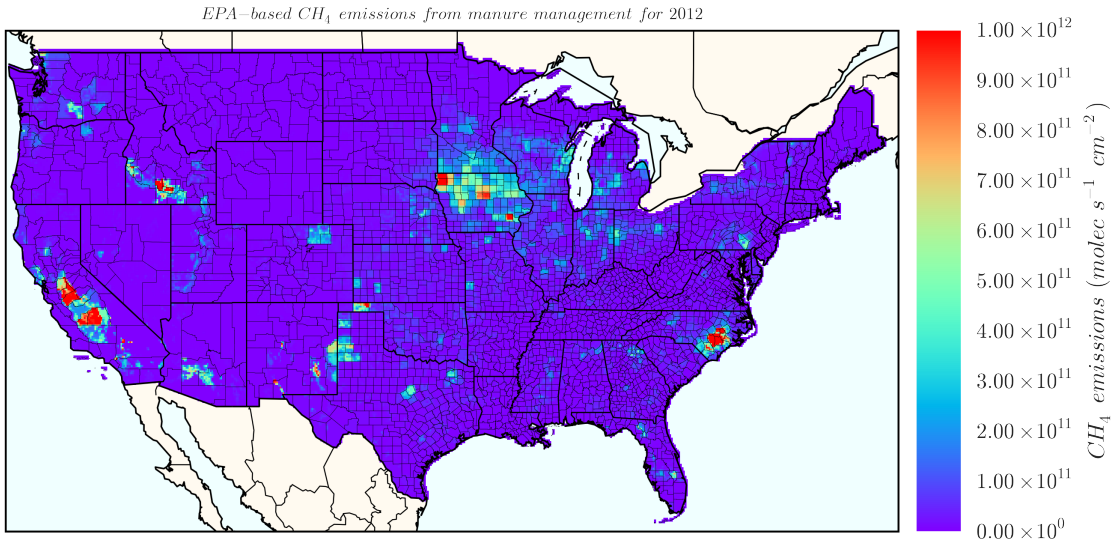

Figure 2, EPA-based methane emissions from manure management for 2012

As another example, emissions from petroleum system are allocated using a combination of DrillingInfo, EIA, and EPA data. Emissions from refineries are gridded using the relative GHGRP reported emission magnitudes to allocate the GHG Inventory emissions associated with refineries. Emissions from the production stage are gridded using DrillingInfo well-level data on well type, monthly production, and well completion. The allocation of emissions associated with natural gas systems, coal mining, rice production, and waste follows a similar strategy of using high resolution national activity data combined with GHG Inventory and GHGRP data.

The resulting inventory for 2012 will be made publicly available this summer and improves comparability between top-down methods and bottom-up inventories. It allows the achievement of a better understanding of the factors controlling methane concentrations and their trends.

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