Using Observations to Understand Regional Methane Budgets

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There is a growing need for comparisons between emission estimates produced using bottom-up and top-down techniques at high spatial resolution. In response to this, a proof of concept study has been performed in which developed an inversion approach to estimate methane (CH_4) emissions for a region (East Anglia) in the South East of the UK (~100 x 150 km) at high spatial resolution. We present results covering a 1-year period (June 2013 - May 2014) in which atmospheric CH_4 concentrations were recorded at 1-2 minute time-steps at four locations within the region of interest. Precise measurements were obtained using gas chromatography with flame ionisation detection (GC-FID) at three of the sites; the fourth used a PICARRO Cavity Ring-Down Spectrometer (CRDS). These observations, coupled with the UK Met Office's Lagrangian particle dispersion model, NAME, were used within the InTEM inversion system to produce the CH_4 emission fields. Realistic county emissions estimates in East Anglia were produced, which compare well with those of the UK National Atmospheric Emissions Inventory (NAEI).

In parallel a study of hot-spot emissions from a landfill near Cambridge was conducted with reasonable agreement being found emission estimates using the WindTrax dispersion model, a Gaussian Plume model and the NAME InTEM approach described above. We conclude that while the regional NAME InTEM approach provides real information about the location of hot-spot emissions, more work is needed to improve the uncertainties associated with the emission estimates. Bayesian approaches in which hot-spot locations are included in the prior show potential in this regard.

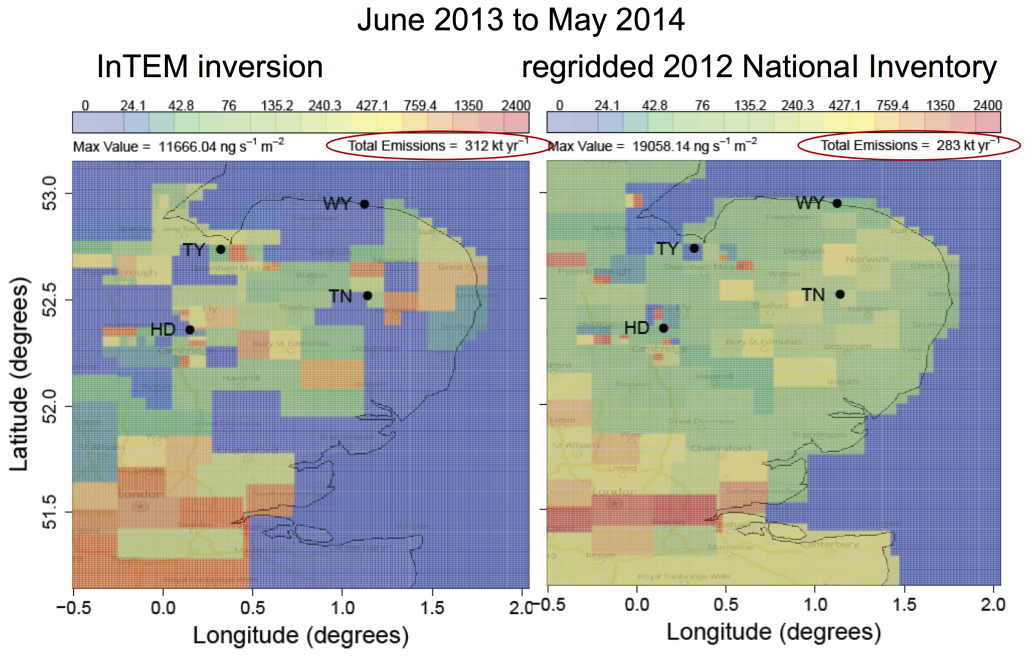

Figure 1. Estimated emissions of CH_4 in East Anglia from: (left) InTEM inversion of CH_4 measurements at marked sites; and (right) UK NAEI for 2012.