



Inverse Modeling of CH₄ and its Isotopic Composition at European and Point Source Scales

Randulph Paulo Morales

Dominik Brunner

Laboratory for Air Pollution/Environmental Technology, Swiss Federal Laboratories for Materials Science and Technology, Empa, Dübendorf, Switzerland

Background

- CH₄ is the second most important anthropogenically emitted greenhouse gas after carbon dioxide.
- Since 2007, a renewed growth of atmospheric CH₄ occurred, but sources are poorly understood.

Meteorologically driven (Nisbet et. al., 2014)

Agricultural Emissions (Schaefer et.al., 2016)

Fossil fuel emissions (Hausmann et.al, 2016)

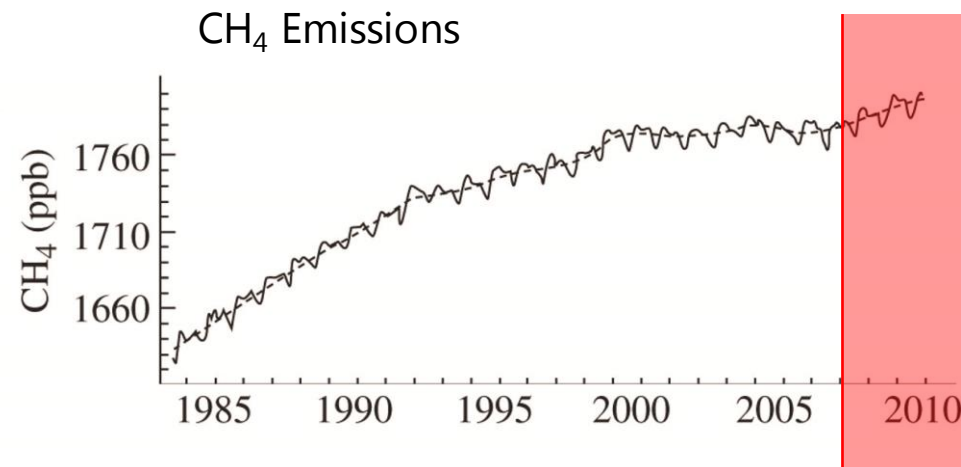
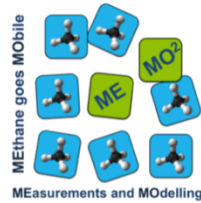


Fig. 1. Globally averaged CH₄ dry air mole fractions determined from weekly samples in the NOAA Global Cooperative Air Sampling Network (Dlugokencky et. al., 2011)

Background

- Significant uncertainties for particular sources (e.g. emissions from landfill sites) remain highly variable (Bergamaschi et al., 2005).
- Huge gap between CH₄ budgets derived from national level estimates and budgets estimated from local source observations. (Fisher et. al, 2017)



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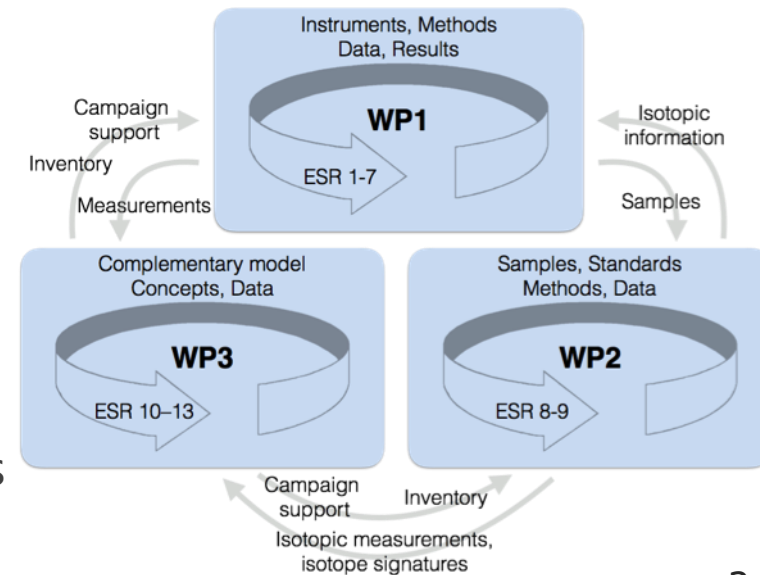
Academic Institutions:



Partner organizations:



- Measurement of CH₄ across Europe
- Perform isotope techniques to attribute observed CH₄ elevations to individual sources
- Develop tools to translate CH₄ elevations into emissions and to integrate local measurements to European scale



Plans

- Simulate CH₄ concentrations at the scale of localized sources

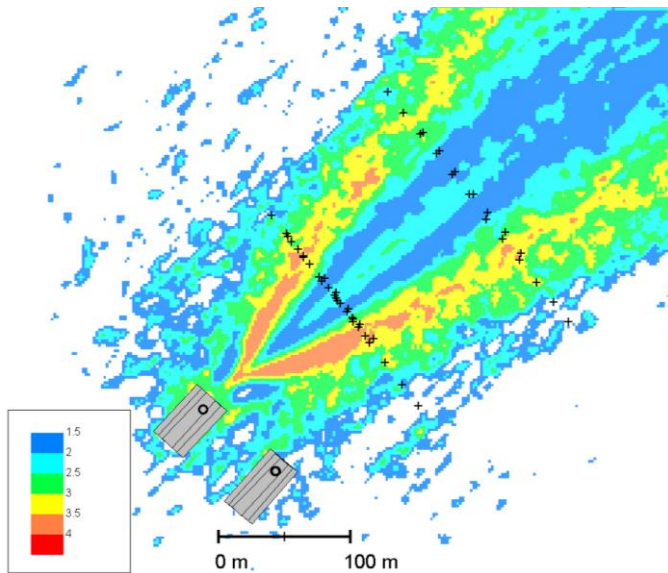


Fig 2. Modelled mean concentrations of point source release in [$\mu\text{g}/\text{m}^3$]

- Implement a transport and inverse modelling system for CH₄ and its isotopes based on a mesoscale LPDM

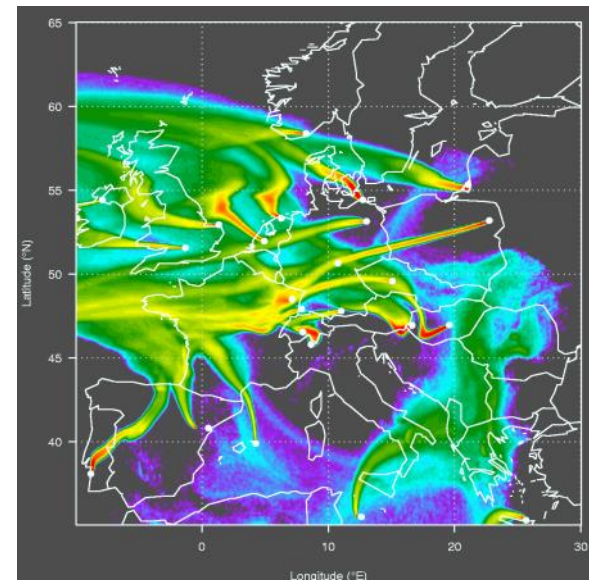


Fig. 3. Source sensitivities for different sites across Europe for a single arrival time

- Validate methane emission inventory by inverse modeling

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