## Role of sources and sinks in atmospheric greenhouse gas variability

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Current work on methane (at University of Leeds)

Methane (CH<sub>4</sub>) is the second most important long-lived anthropogenic greenhouse gas. Since 2007 the growth rate has increased noticeably, the reason for this remains unexplained (1).

We performed a model synthesis inversion to fit TOMCAT  $CH_4$  and  $\delta^{13}C$  to surface sites by varying sources and sinks (2). Results show a prolonged decrease in OH since 2007 and increasing energy sector emissions (3).



For the first time we include measurements of  $\delta^{13}$ C in our inversion, which provides improved representation of not only CH<sub>4</sub> but also  $\delta^{13}$ C variability.



(1) Global surface  $CH_4$  (ppb) from NOAA sites (black line) from 2005 to 2015. Also shown are global surface NOAA  $\delta^{13}CH_4$  (blue line).

(2) Annual average global CH<sub>4</sub> emissions by sector and region for prior (grey) and posterior (coloured) estimates.

(3)  $CH_4$  emissions from different sectors for global prior and posteriors. global OH estimates are displayed for the same period (top left). Shaded region shows posterior error.





## Representation of anthropogenic CO<sub>2</sub> emissions in IFS (Future work at ECMWF)

Future work will move from combined natural and anthropogenic  $CH_4$  to the anthropogenic component of the more abundant, less reactive greenhouse gas,  $CO_2$ .

## The work will focus on:

- Introducing mapped urban  $CO_2$  emissions on mapping and inventories (e.g. EDGAR) into the IFS (4, 5, 6).
- Developing a model to simulate anthropogenic  $CO_2$  emissions from residential heating.
- Supporting future  $CO_2$  anthropogenic emissions monitoring systems.
- Developing estimations of required perturbations of CO<sub>2</sub> fluxes as ensemble simulation input to aid uncertainty estimates in atmospheric CO2 concentrations.
- Analysing and evaluating the uncertainty within the integrated system in collaboration with CHE Project Partners.







(4) Emissions from fuel combustion in commercial and, institutional buildings and households from a 0.5° by 0.5° region of 6 major cities taken from EDGAR v4.3.2 (Janssens-Maenhout *et al.*, 2017).

Latitude

Sine

(5) Global average  $CO_2$  emissions from anthropogenic sources for 2012 taken from EDGAR v4.3.2 (Janssens-Maenhout *et al.*, 2017).

(6) Zonally averaged  $CO_2$  emissions from fuel combustion in commercial and, institutional buildings and households between 1970 and 2012 taken from EDGAR v4.3.2 (Janssens-Maenhout *et al.*, 2017).

