Field measurements of the isotopic composition of atmospheric methane at the Cabauw tall tower

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Outline

Introduction / Motivation

The in-situ IRMS system / Cabauw tower setup

Comparison IRMS and QCLAS results

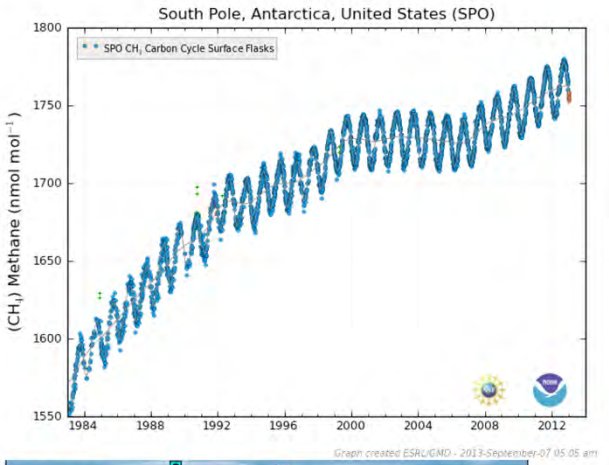
The combined dataset from Cabauw

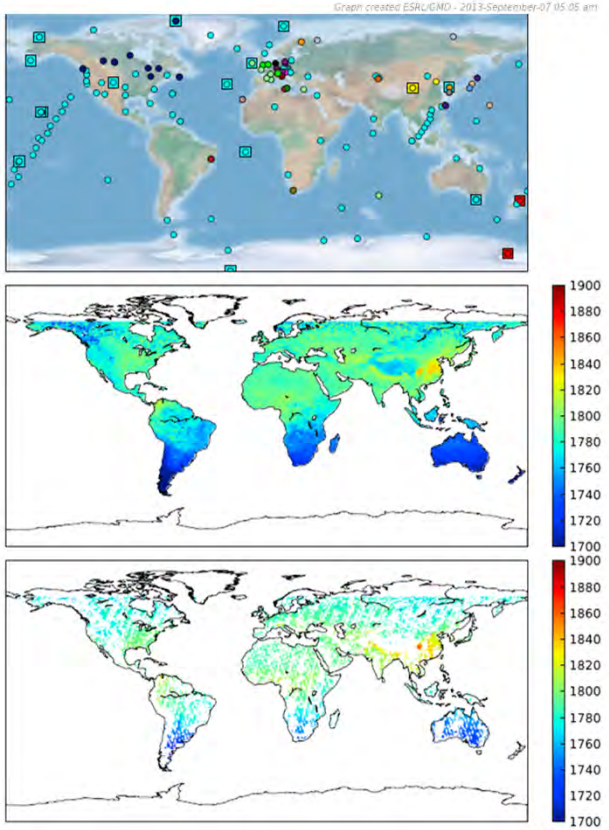
Comparison to FLEXPART model results

“Running Keeling plots”

Conclusions and outlook

Why measure CH_4 isotopologues?

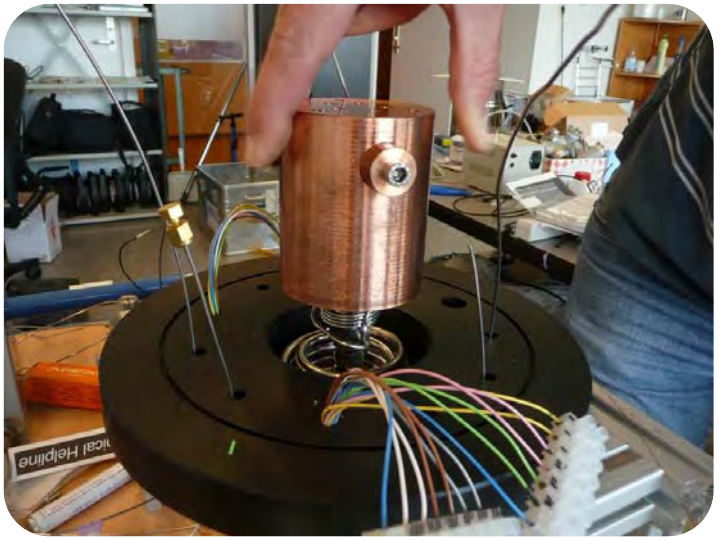




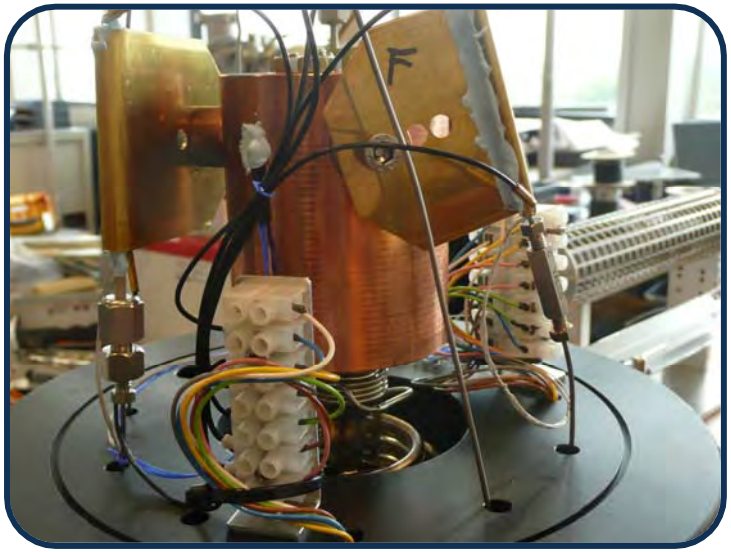
- Good observational constraint on the total CH_4 source
- Poor constraint on the source contributions

S. Houweling

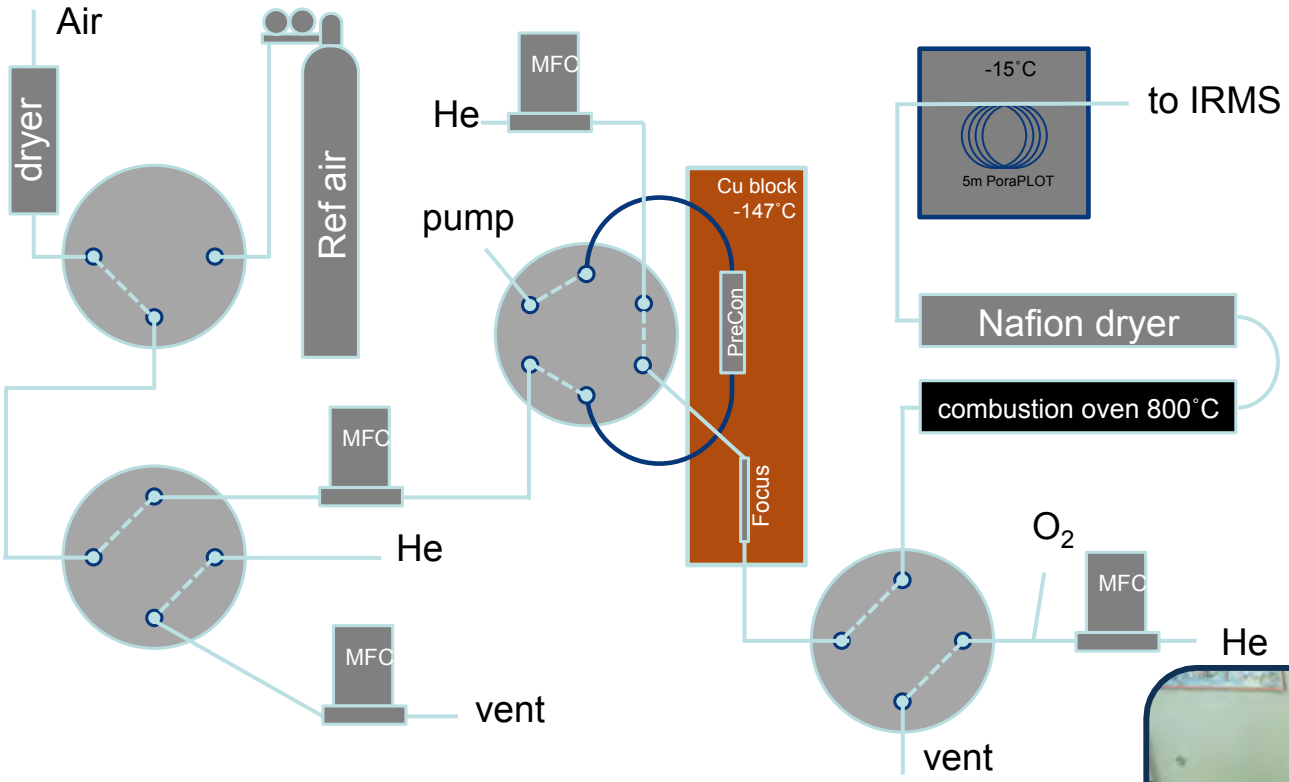
The analytical system (IRMS)

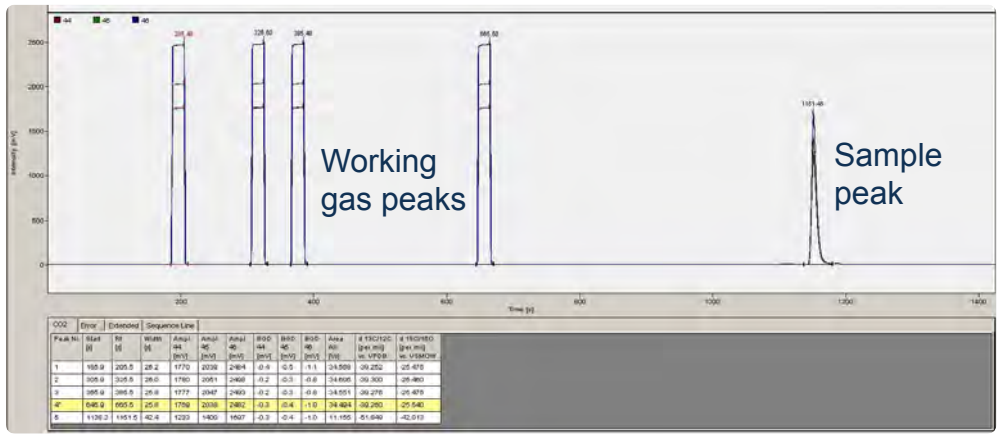


See poster Carina van der Veen



The analytical system





The main INGOS CH_4 isotope campaign

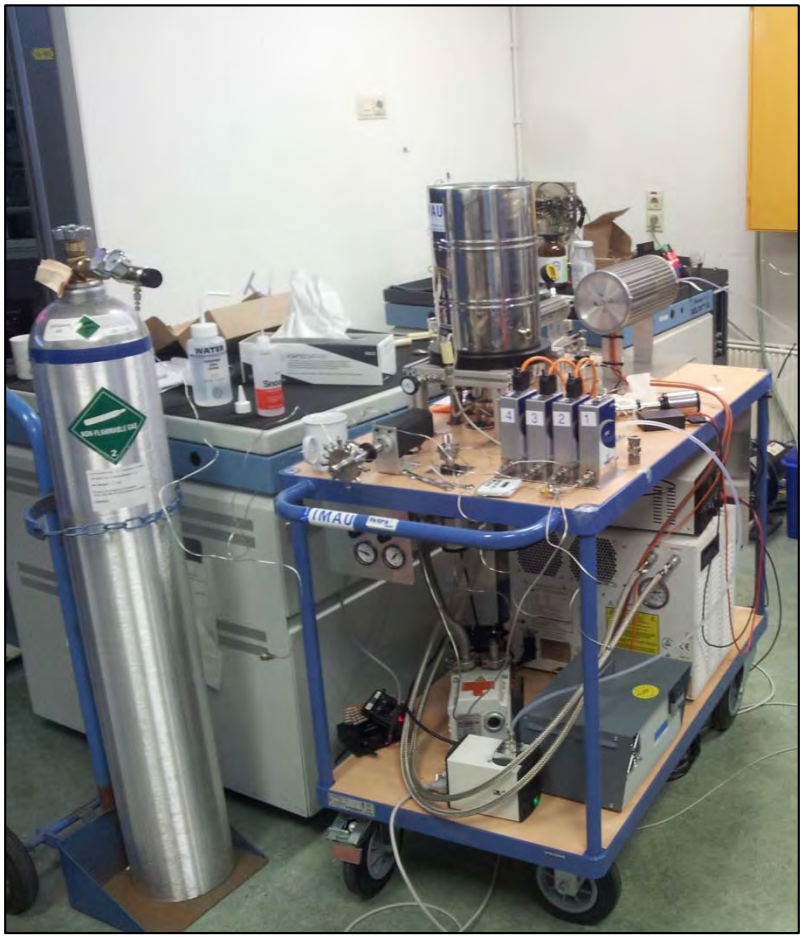
The Cabauw tall tower

Cabauw – setup

Empa

QCLAS

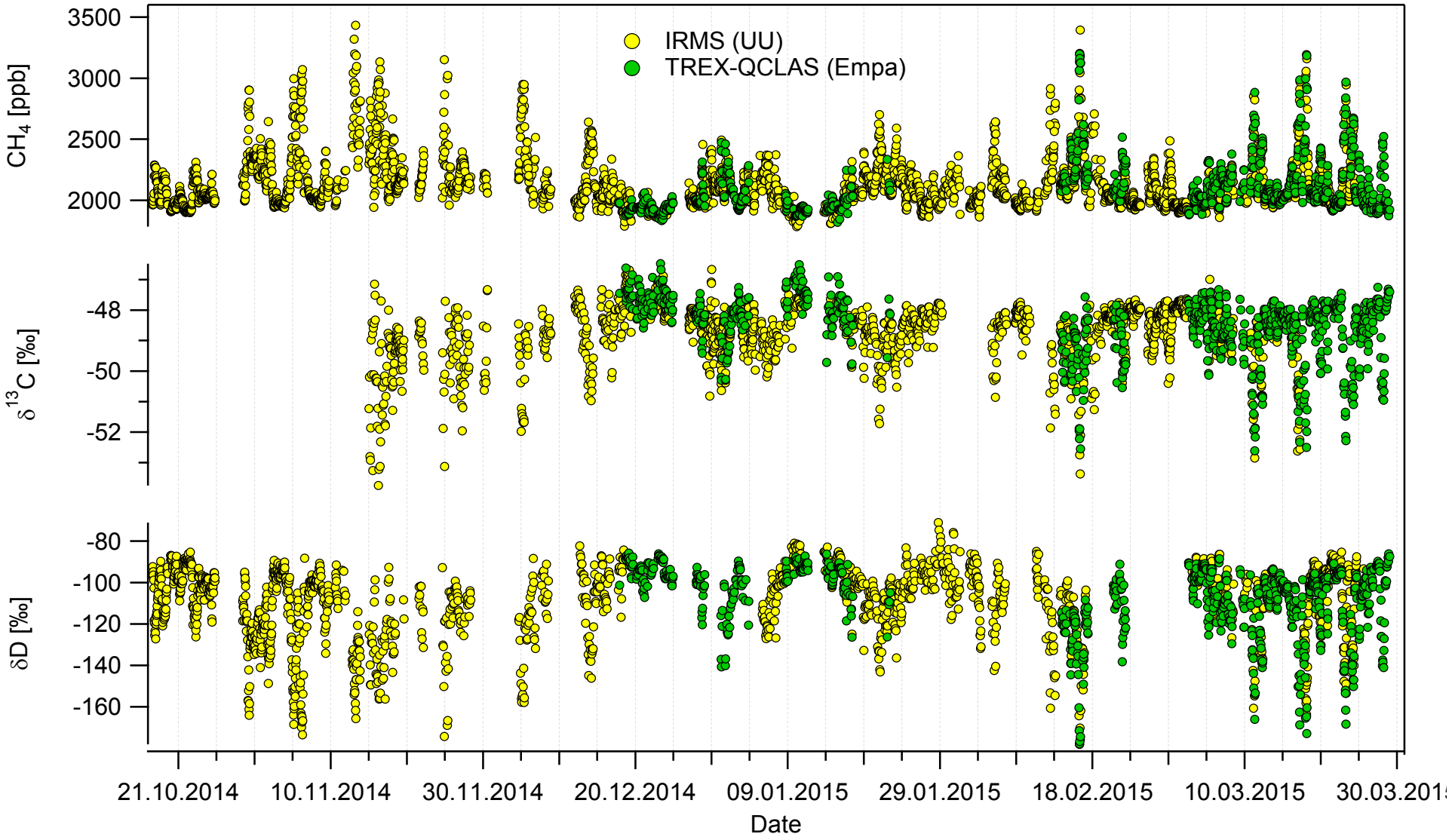
Utrecht University



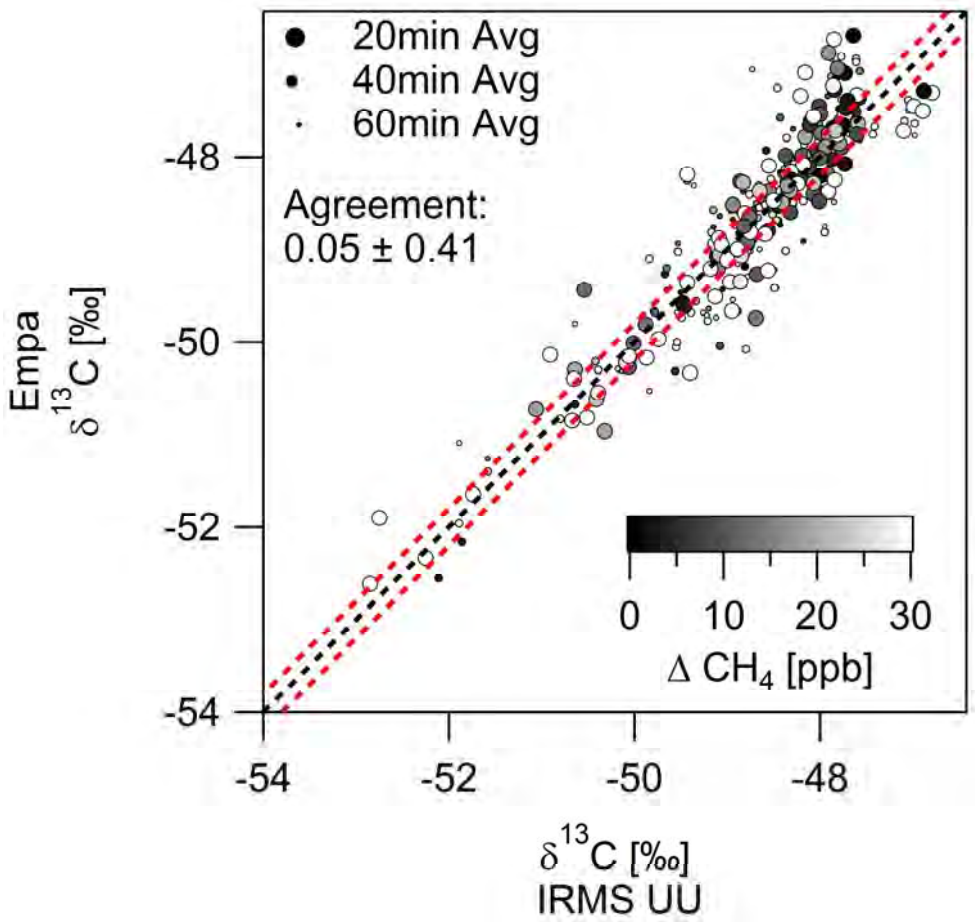
IRMS

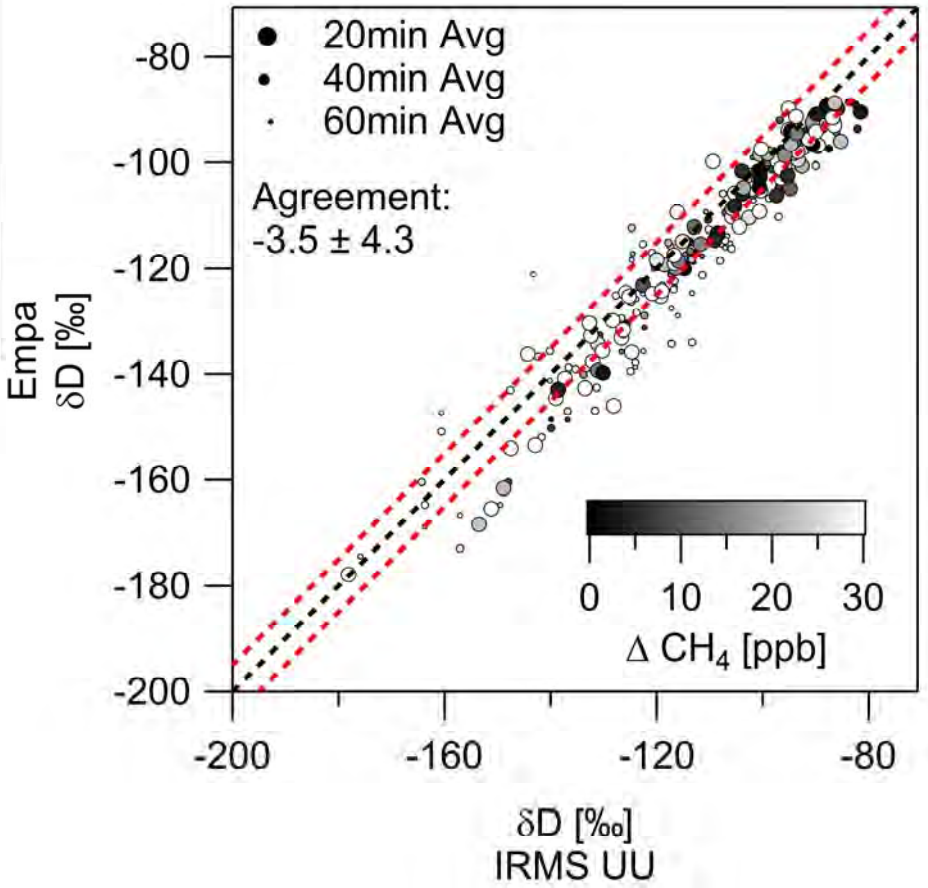
The total dataset

>2500 measurements of $\delta^{13}C$
>2500 measurements of δD



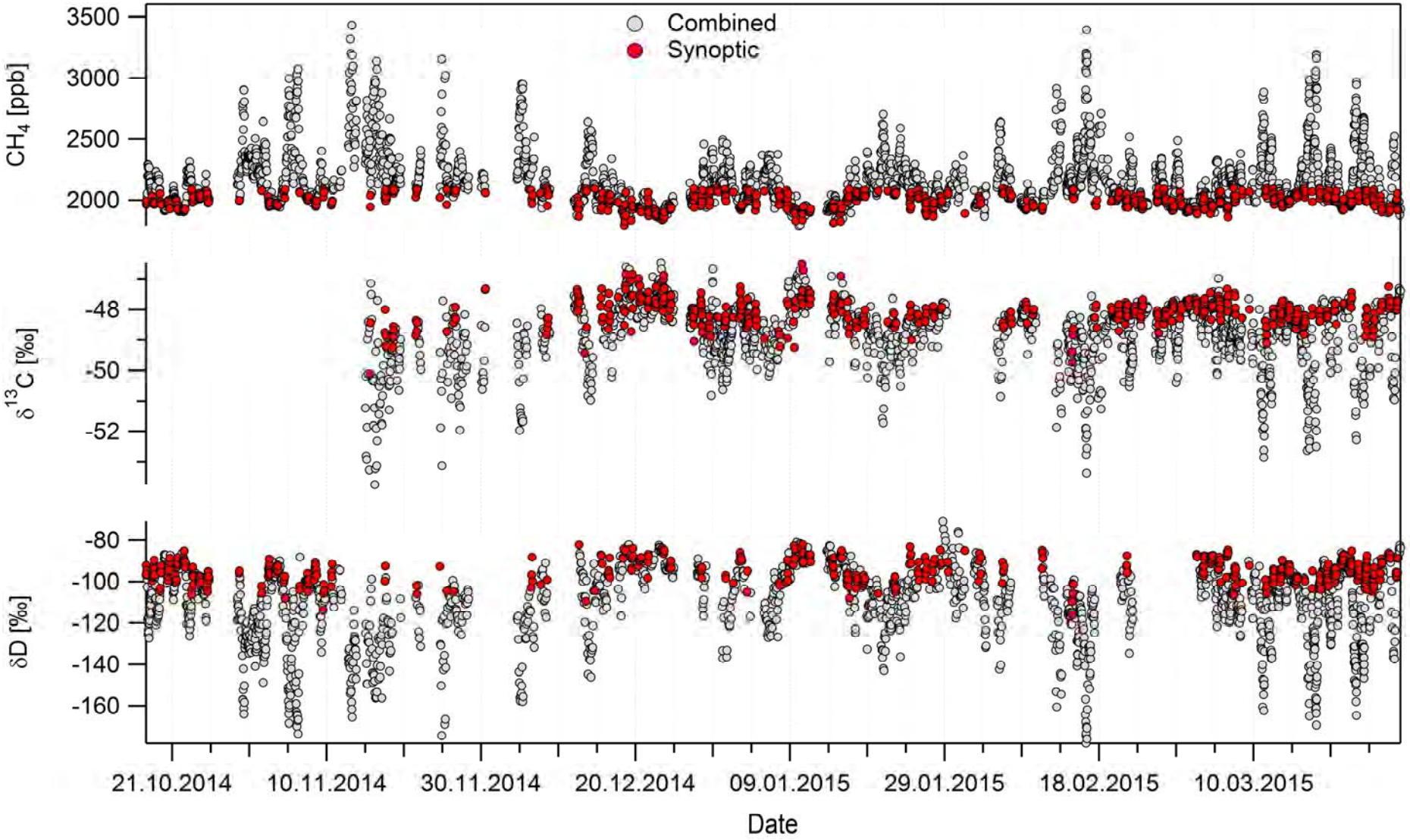
Intercomparison IRMS - QCLAS



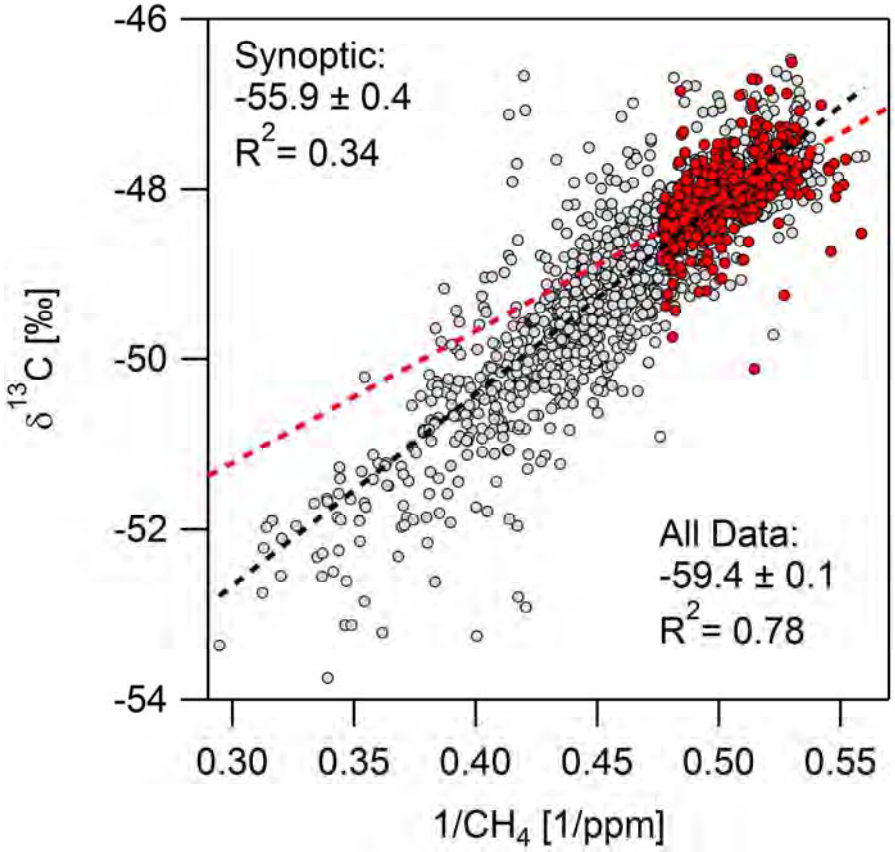


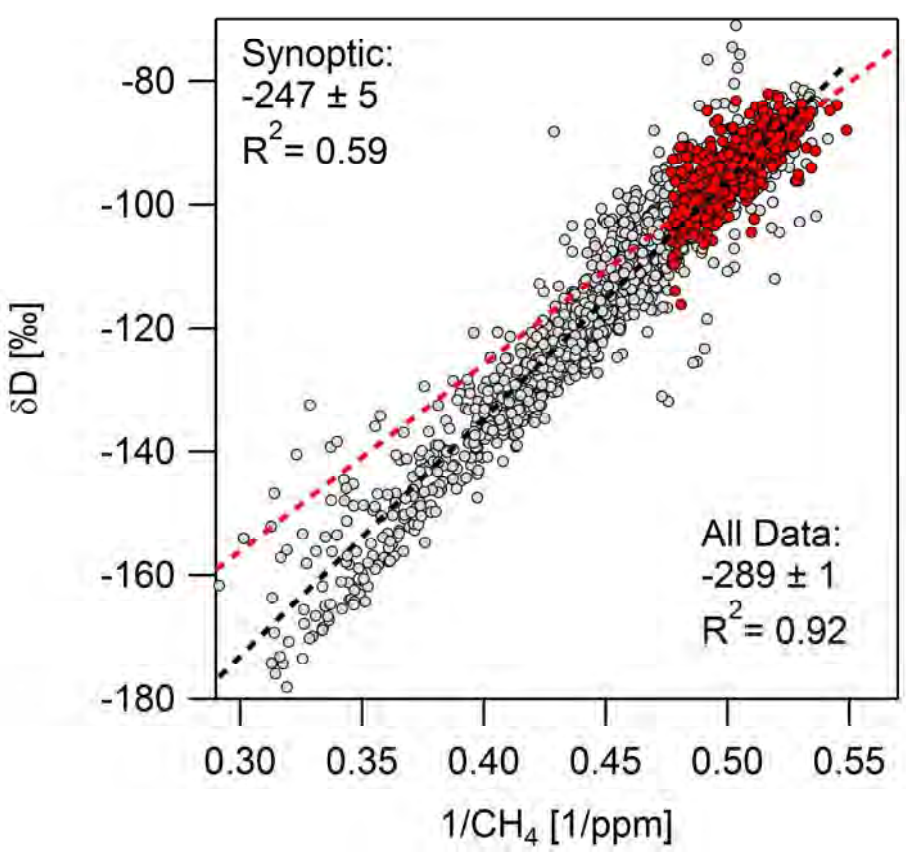
Extended WMO compatibility goals:
±0.2 ‰ for $\delta^{13}C$
±5 ‰ for δD

The combined dataset

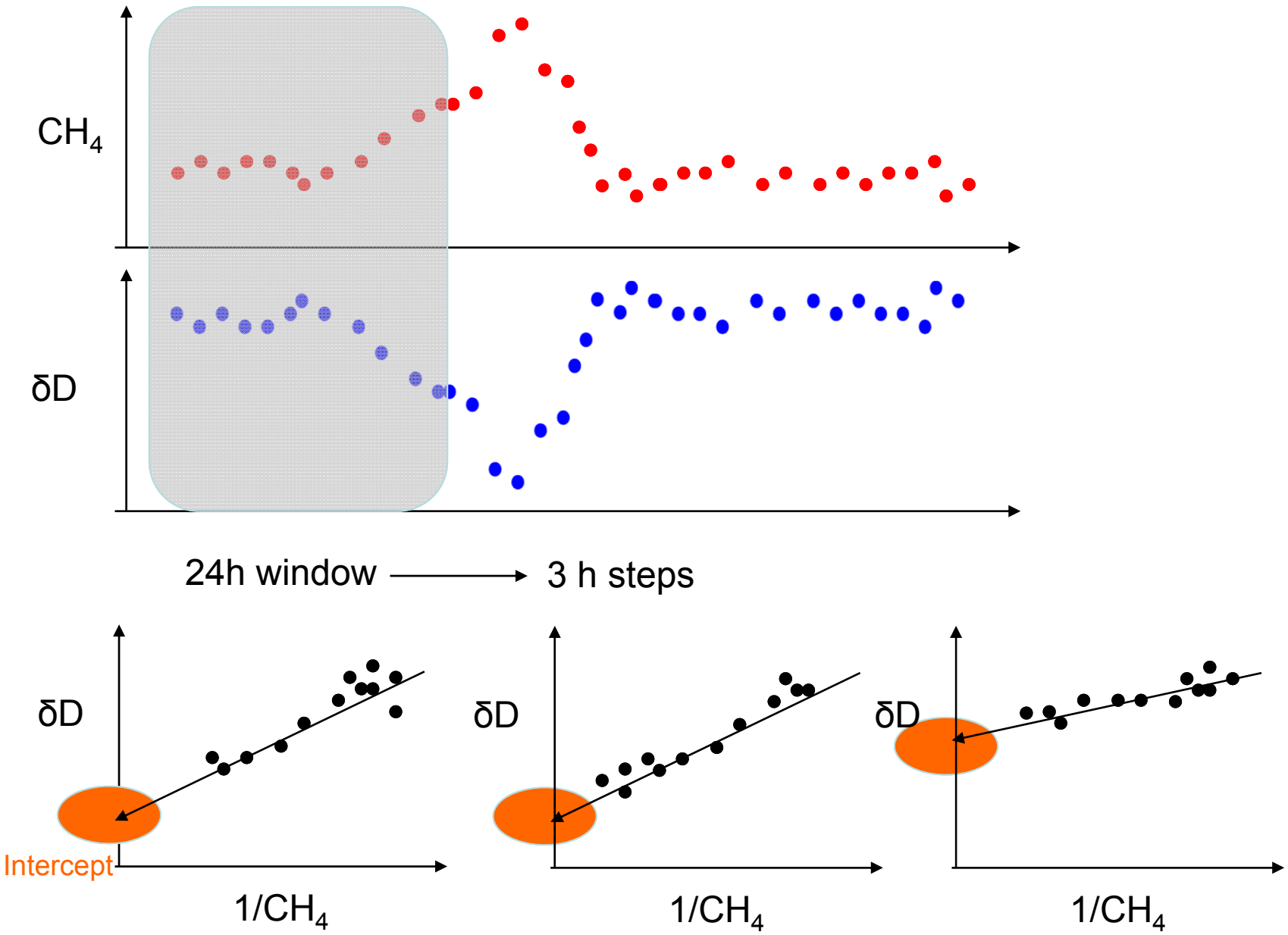


Keeling plot all data

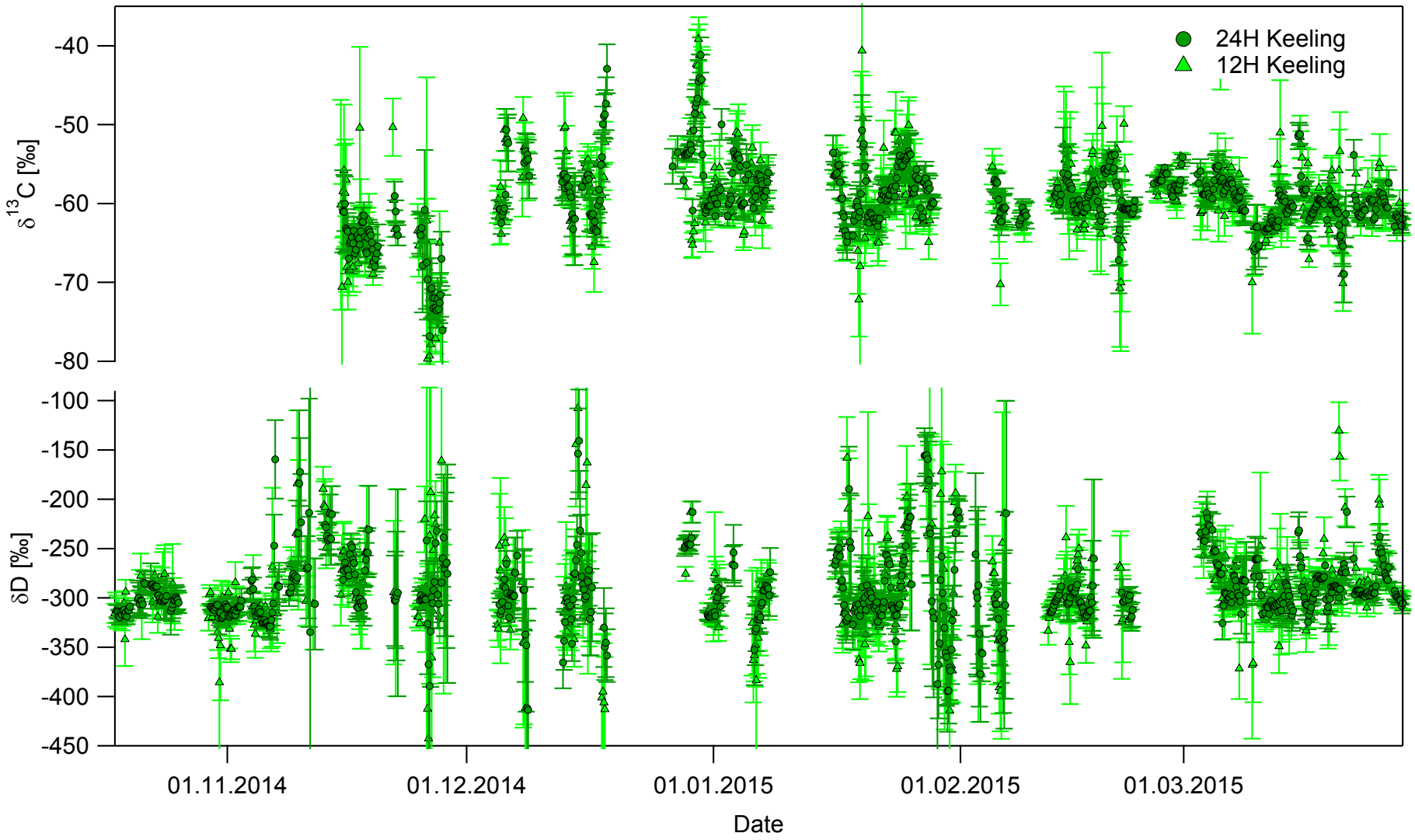




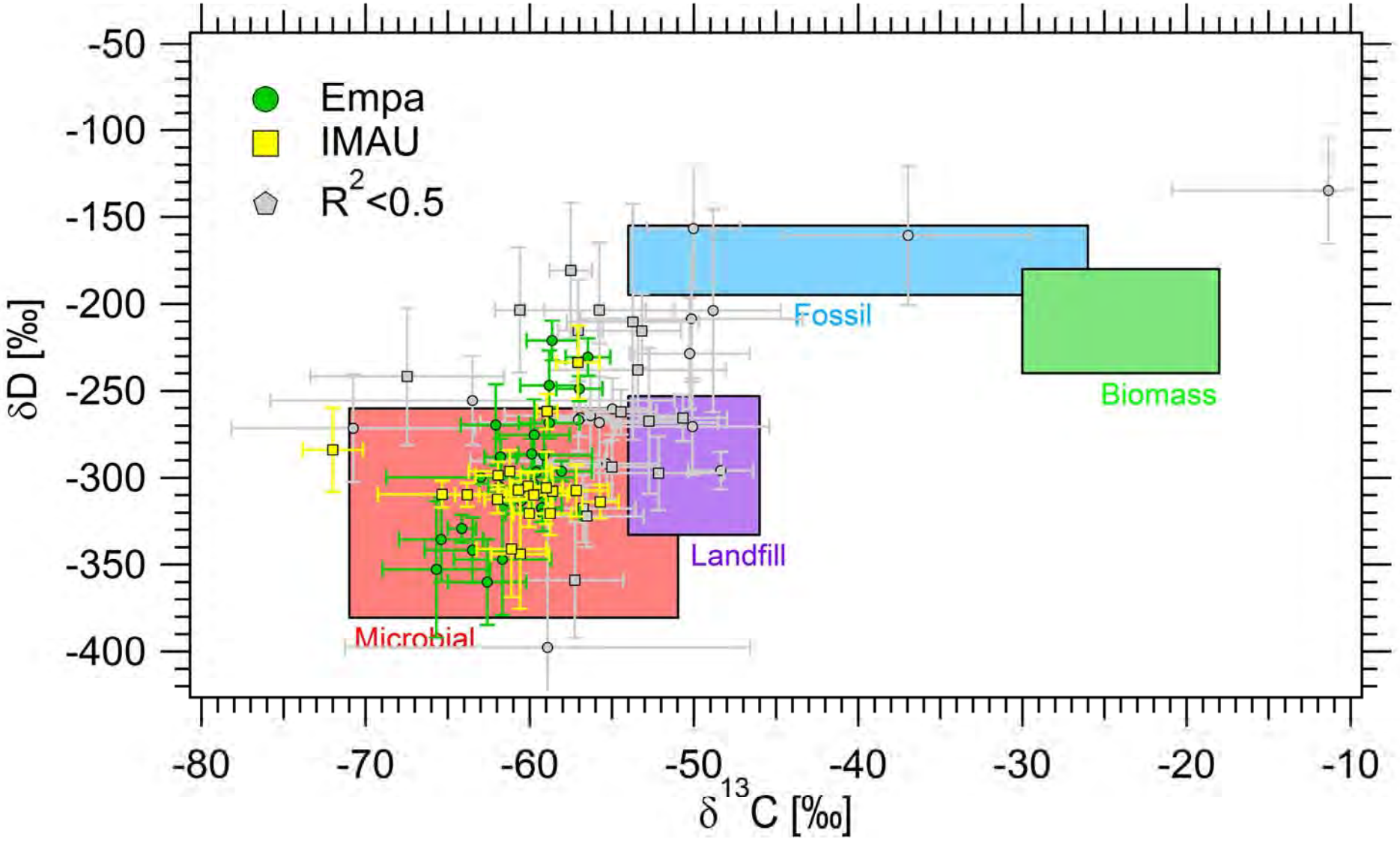
Running Keeling plot



Running Keeling plots – intercepts

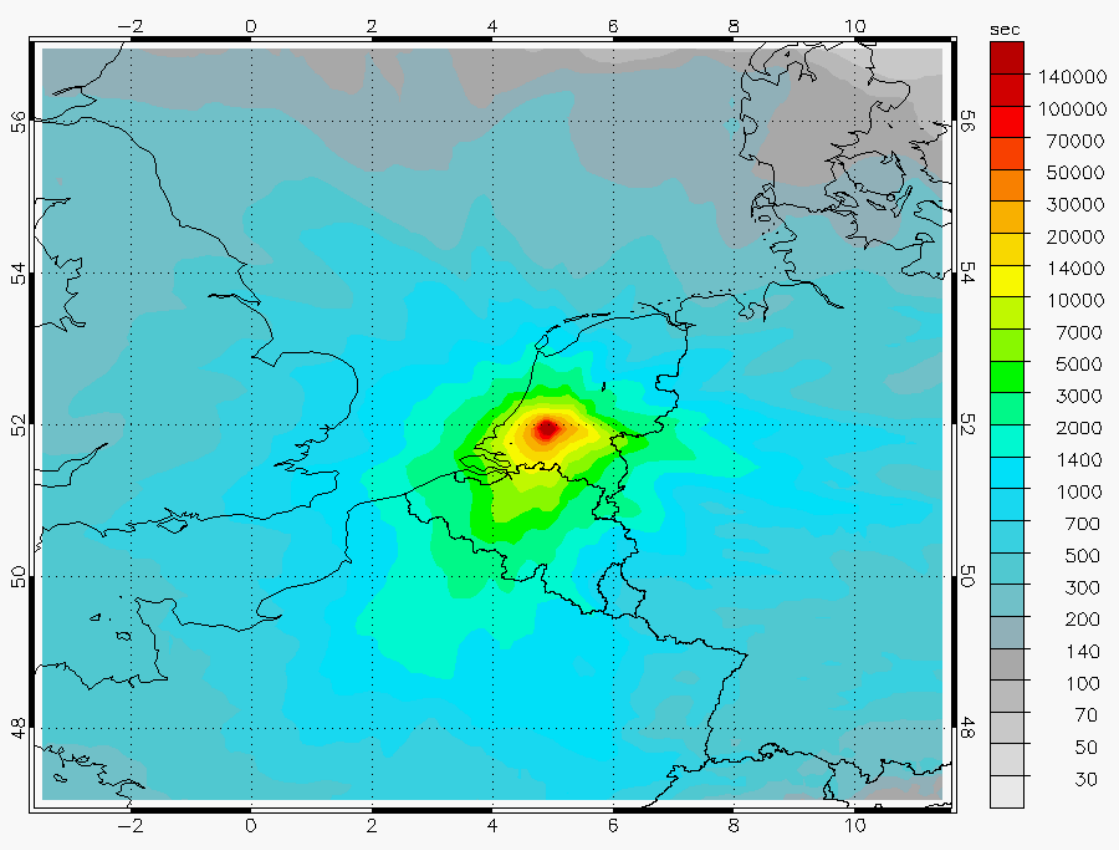


Source signatures from “running Keeling plots”

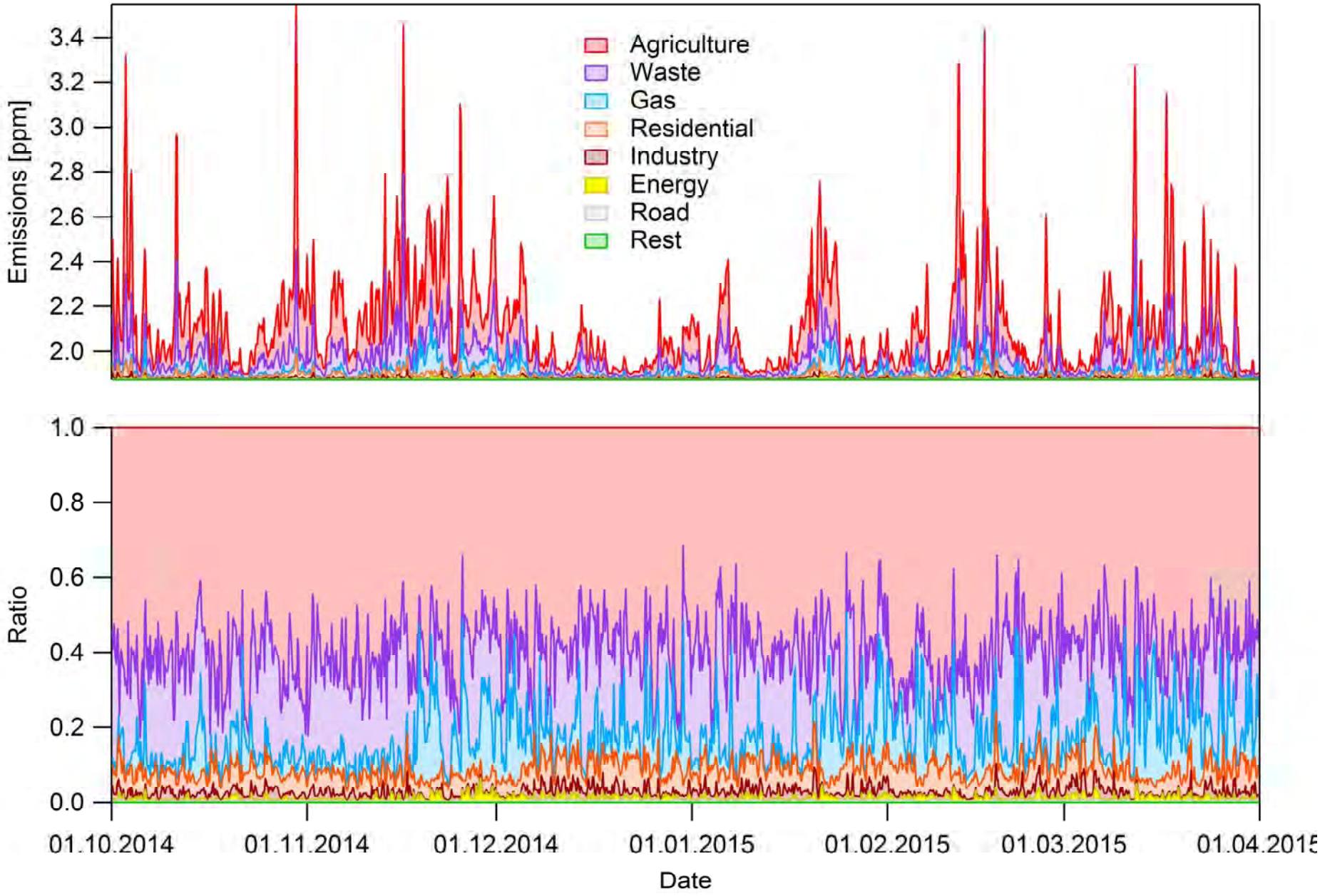


Source and isotope modeling

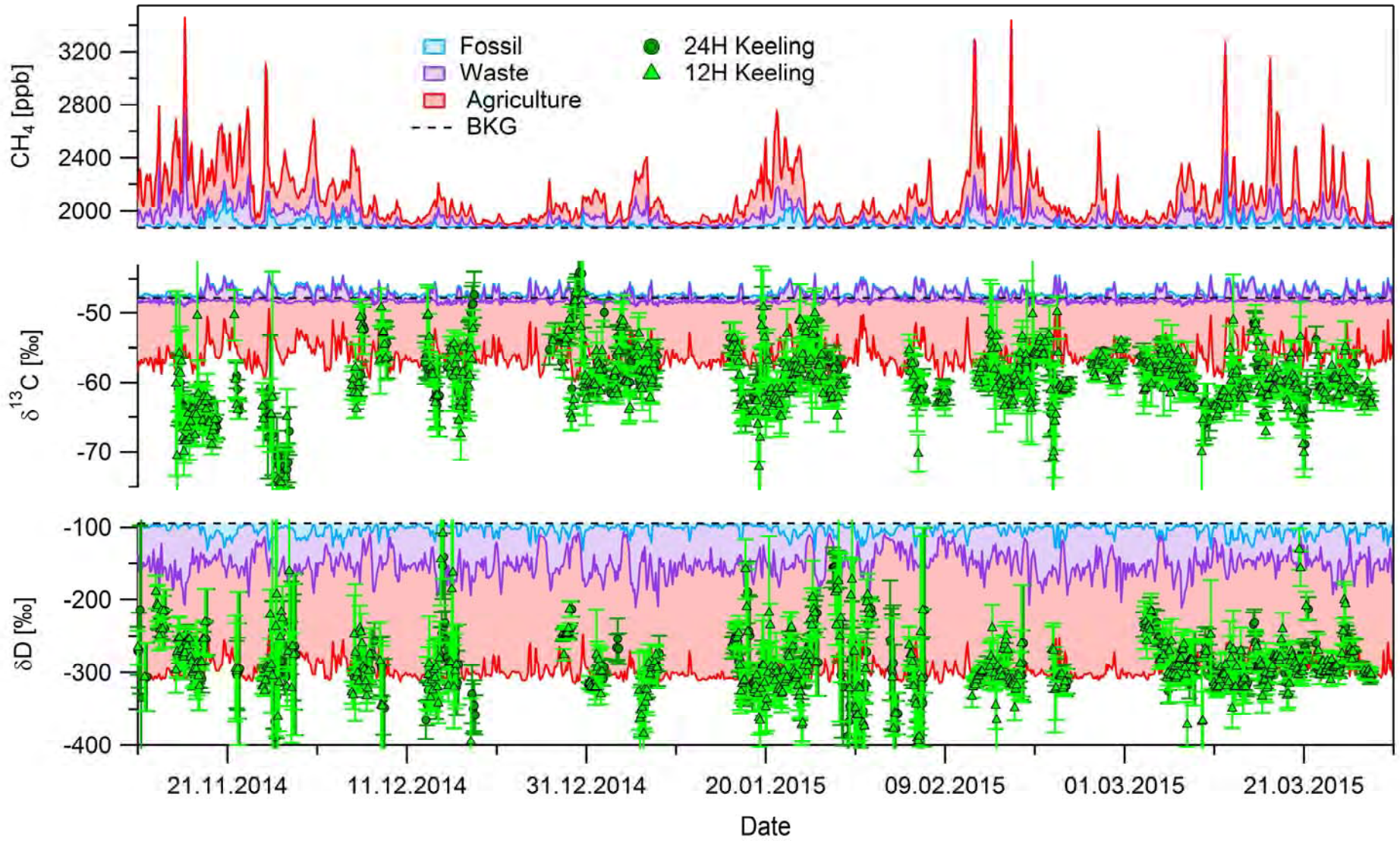
- TM5 (isotopes) see presentation Guillaume Monteil
- FLEXPART (Dominik Brunner)
  - Calculate the contribution of individual source categories using footprints and source maps



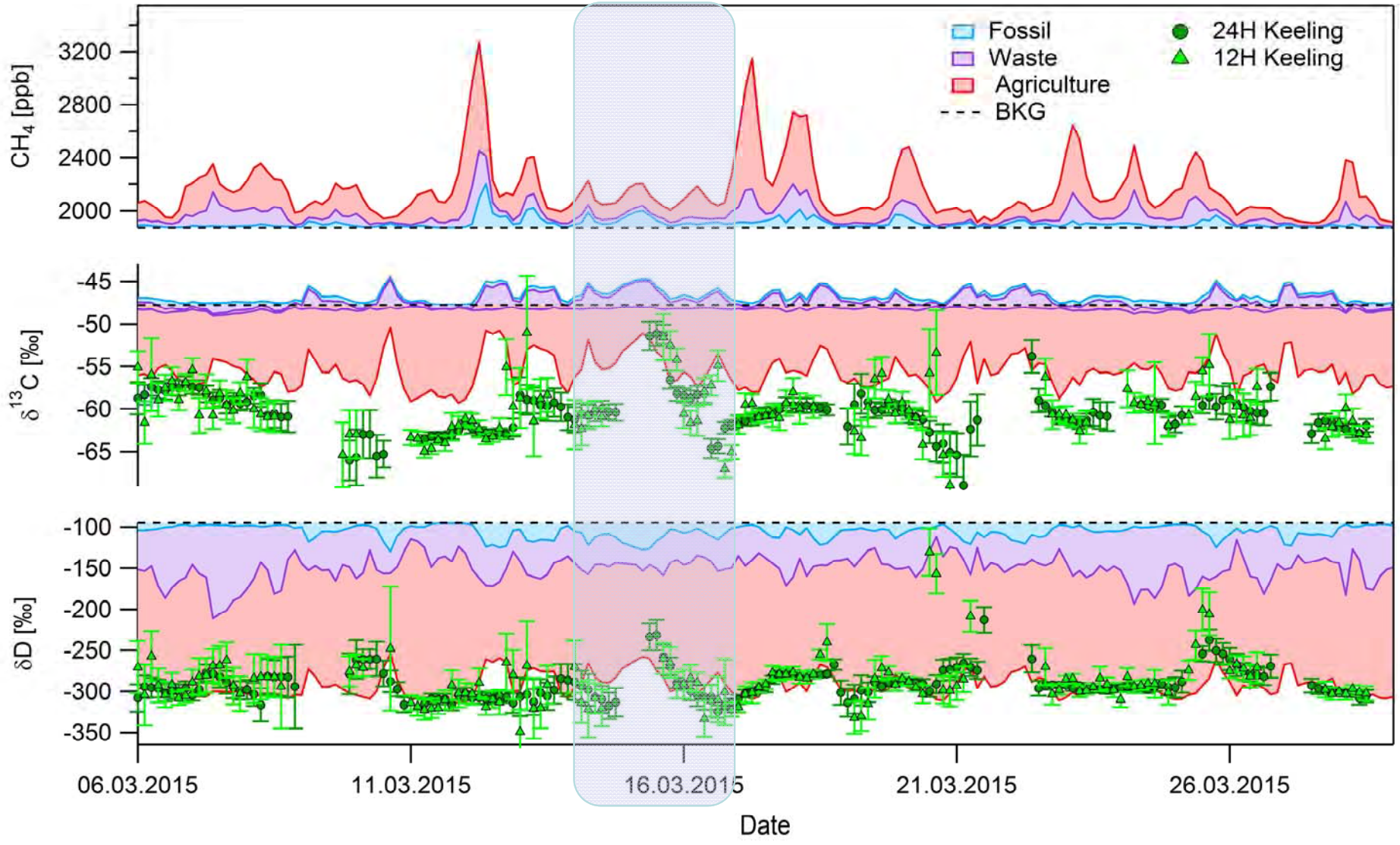
Modeling of source contributions with FLEXPART



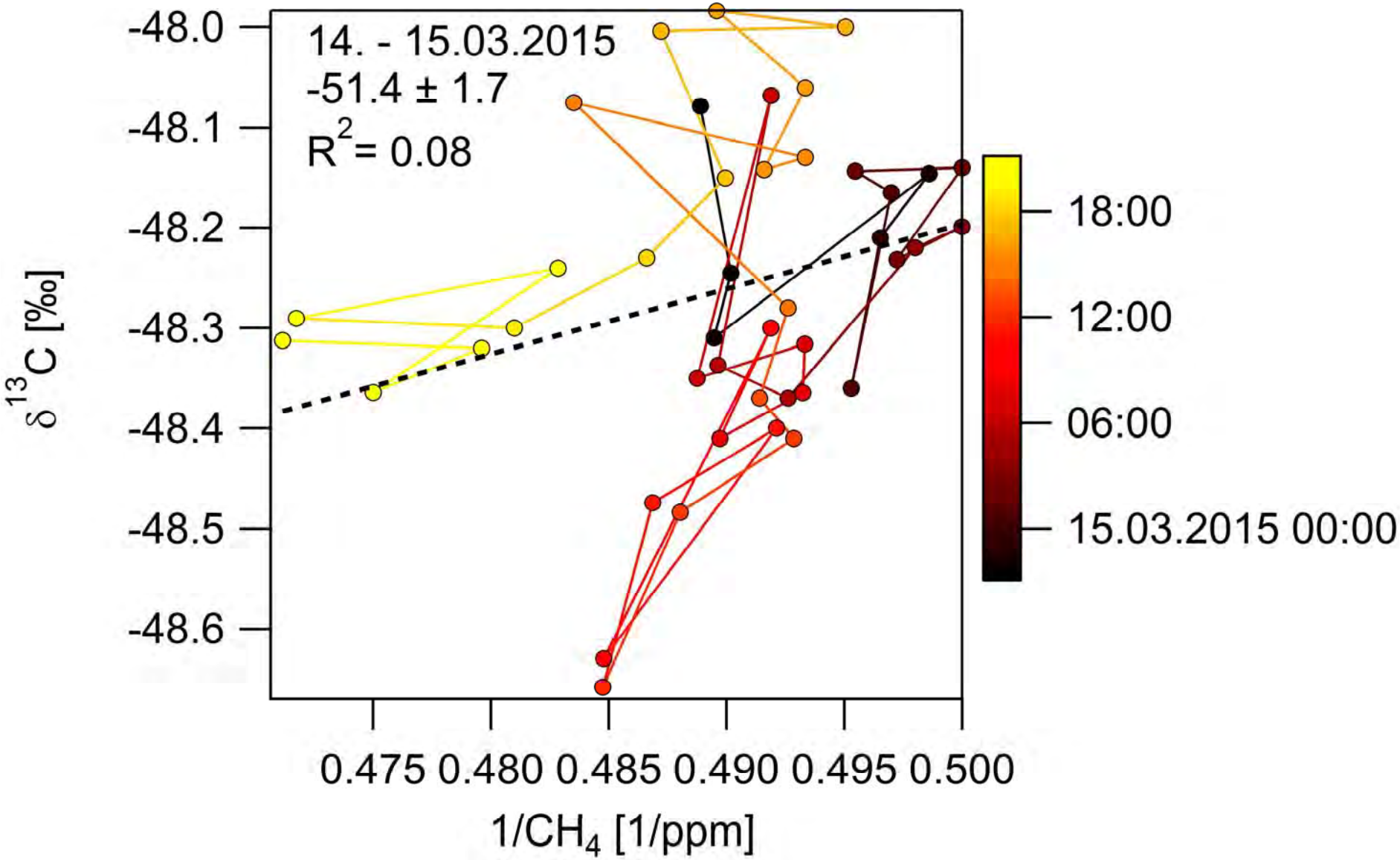
Keeling plot intercept and model source signatures



Zoom in march



Event march 15, 2015

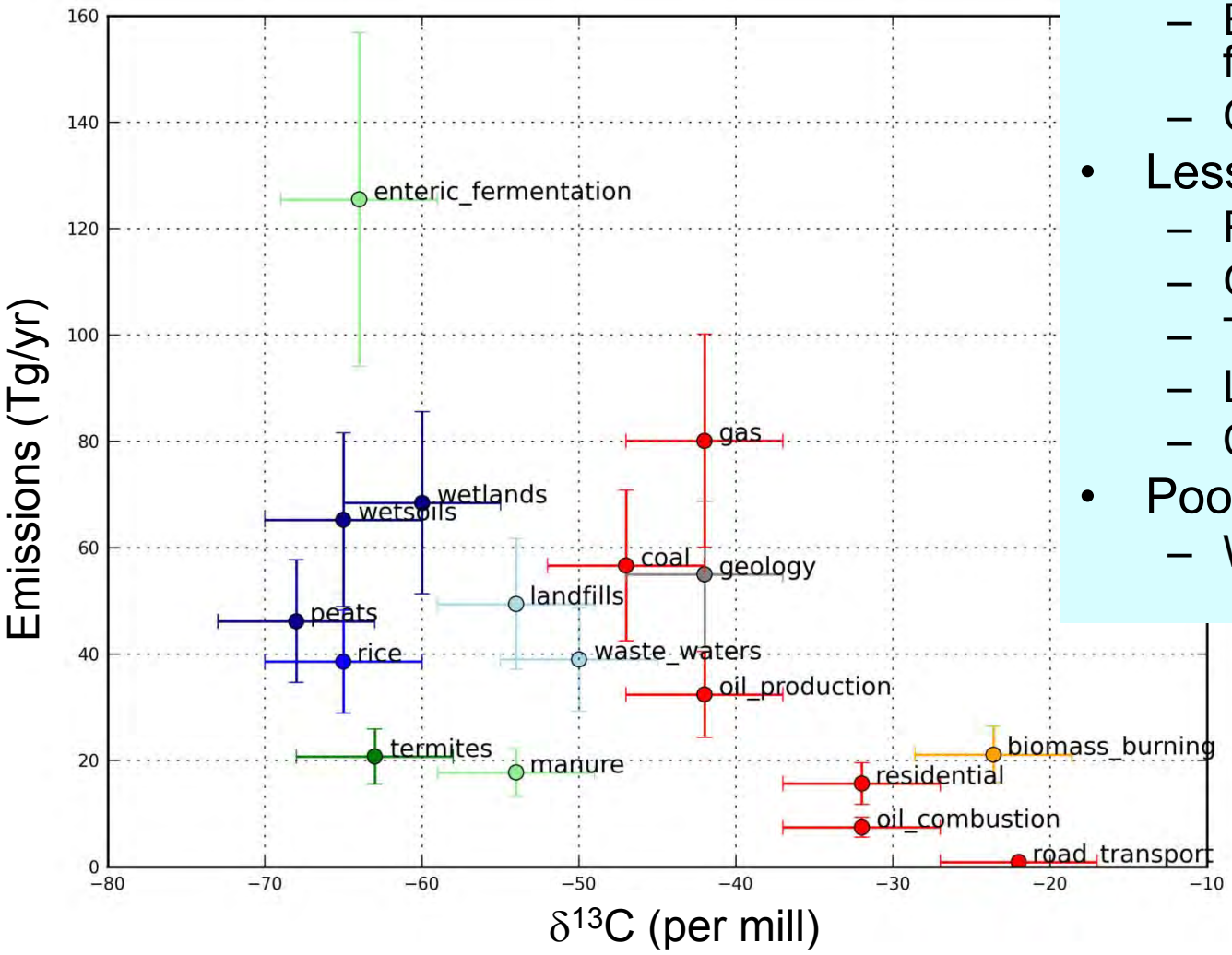


Conclusions and outlook

- Methane isotope monitoring with ~hourly time resolution is possible with IRMS and QCLAS
- “unattended operation” capability strongly improved during Cabauw campaign
- At Cabauw local and regional sources are dominated by agricultural emissions
- Occasional contributions of fossil emissions (up to 15%) are difficult to detect, still overpowered by agriculture
- Comparison to FLEXPART model results helps interpretation
- High resolution isotope interpretation needs new software tools
- IRMS system scheduled to measure in Paris (LSCE) next 1-2 months
- Picarro data to be incorporated

Look at other isotope applications on posters and on lab tour this evening (17:30!!)
Want samples analyzed → contact us!

$\delta^{13}C$ source signatures



- Well known:
  - Wetlands
  - Biomass burning
  - Enteric fermentation/manure
  - Oil and Gas
- Less well known:
  - Rice
  - Geology
  - Termites
  - Landfills
  - Coal
- Poorly known:
  - Waste water treatment

THANKS TO

Carina van der Veen

Henk Snellen

Michel Bolder

Marcel Portanger

Willi A. Brand

Michael Rothe

Peter Sperlich

Assigning isotope signatures to sources in the model