

# Methane isotope analysis with the mobile Ruisdael system at several locations in Europe

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# Overview

Why methane matters

Isotope measurements of atmospheric CH<sub>4</sub>

Motivation

Global scale source partitioning

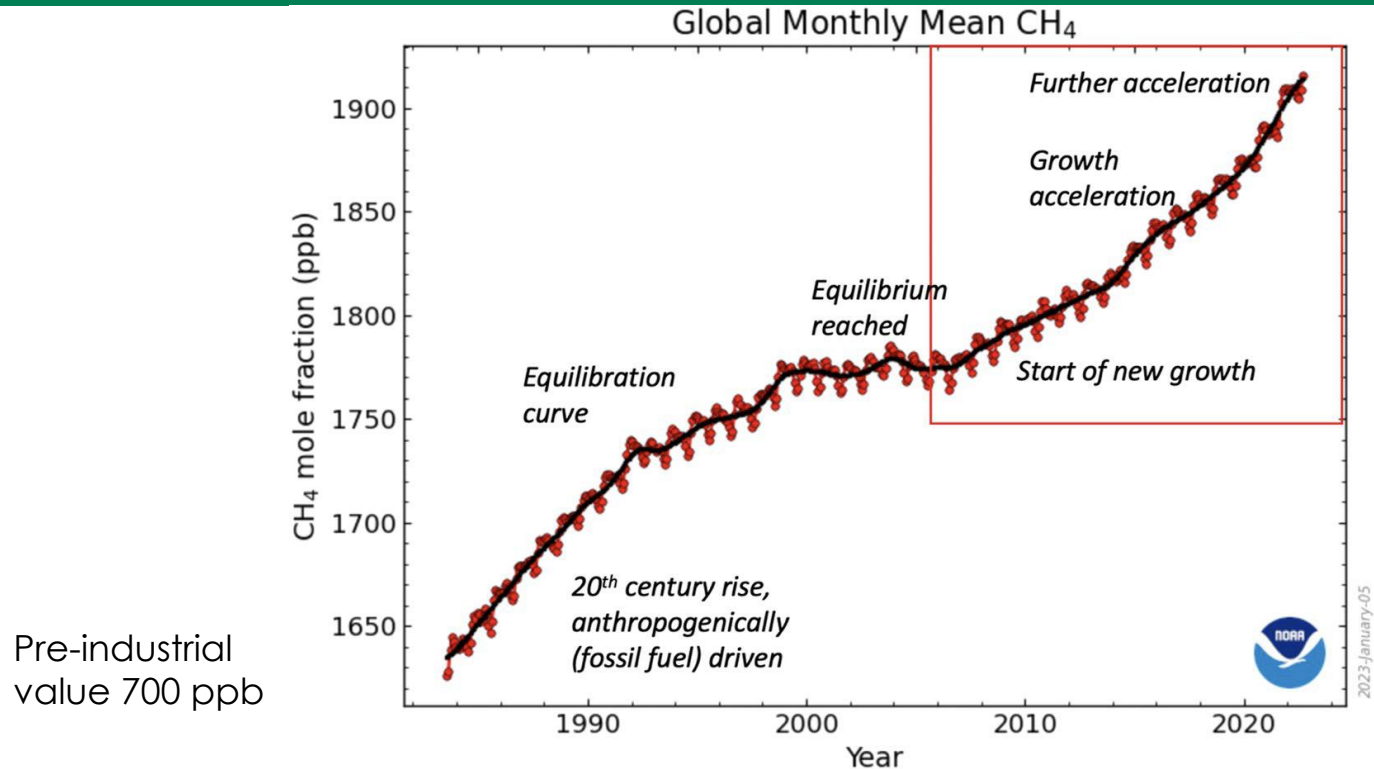
High temporal resolution measurements

Measurements & CH<sub>4</sub> sources throughout Europe

Highlight results

Conclusions

# Why is methane important?



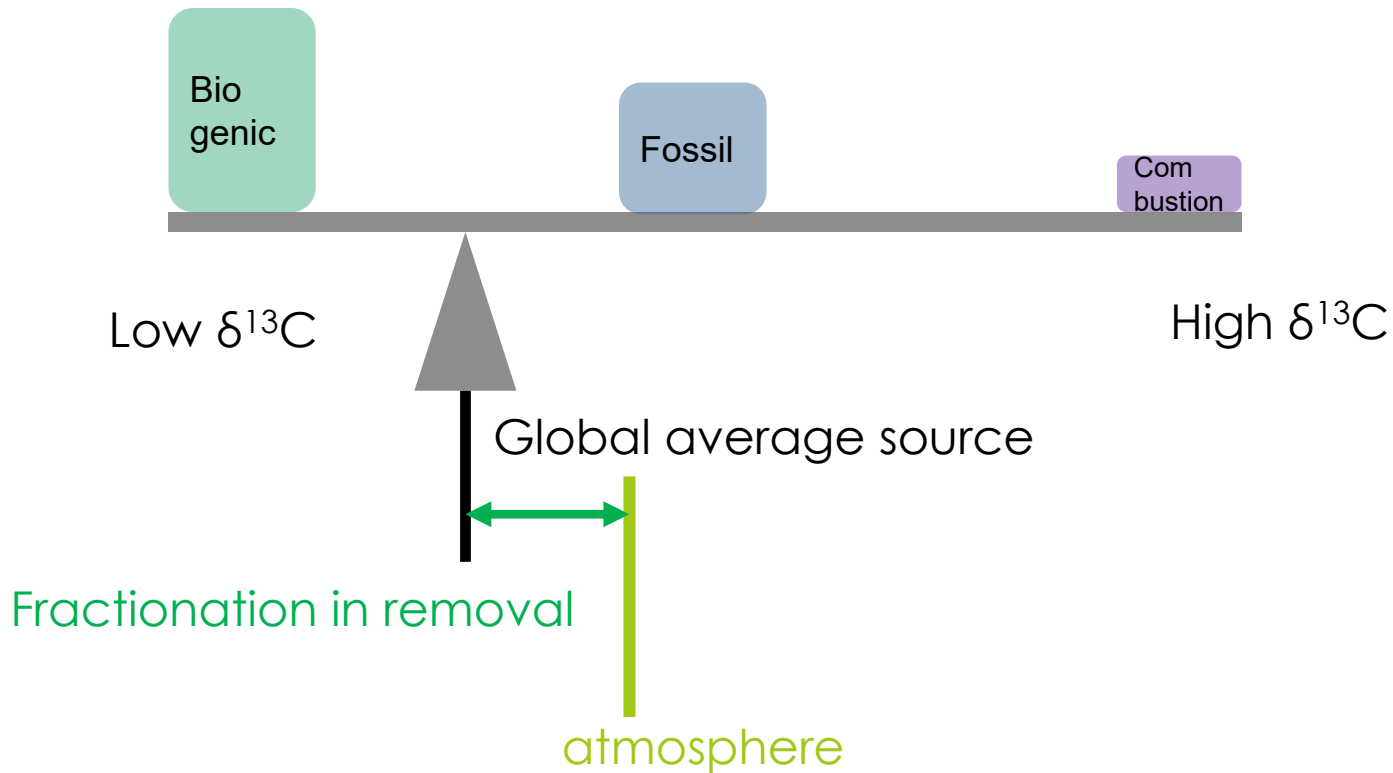
- At least 25% of current man-made warming is caused by methane
- Increase not compatible with the goal of the Paris agreement
- Global methane pledge

# Goals of isotope measurements

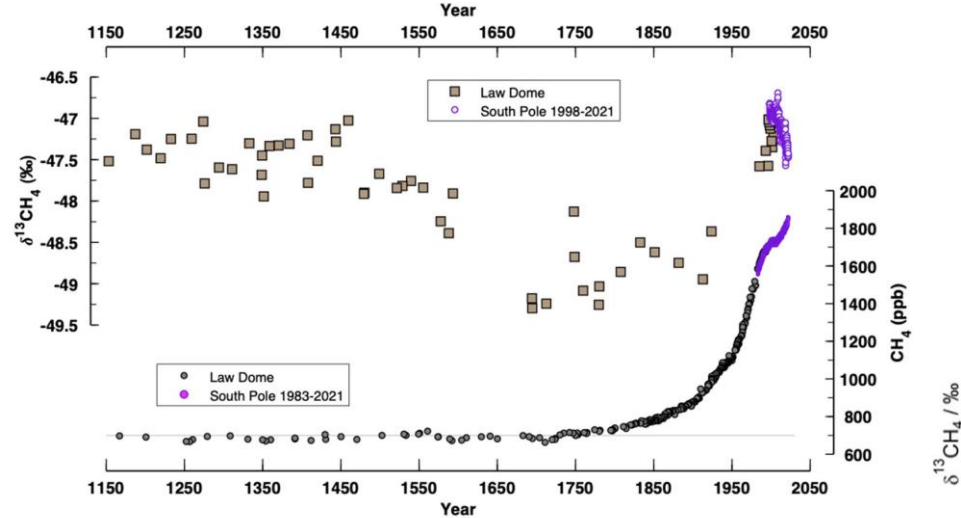
## Information on sources



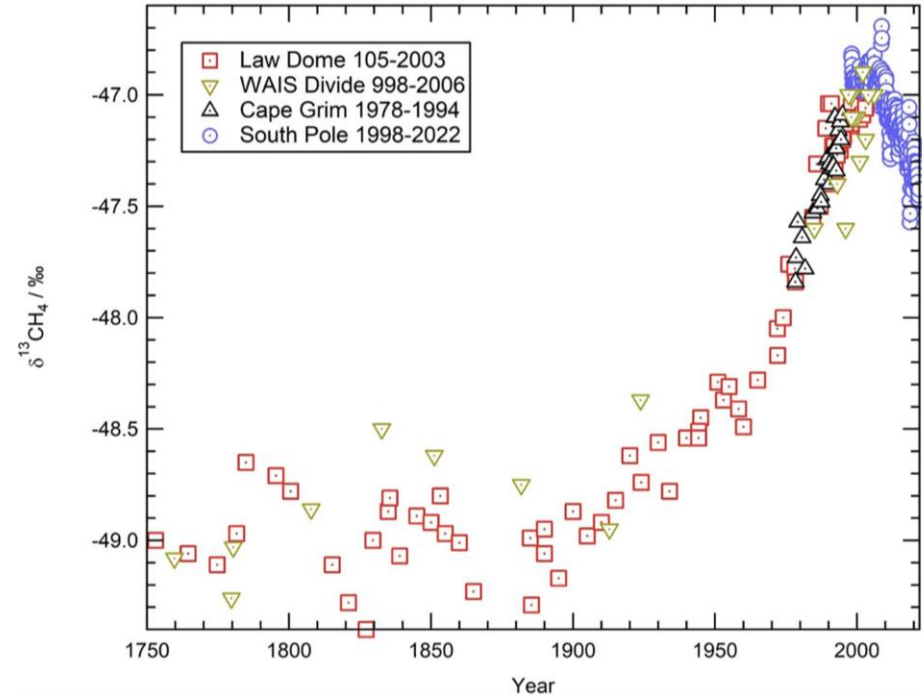
# Use of $\delta^{13}\text{C}$ for $\text{CH}_4$ source partitioning



# Use of $\delta^{13}\text{C}$ for $\text{CH}_4$ source partitioning



Before 2000:  $\delta^{13}\text{C}$  increase  
After 2007:  $\delta^{13}\text{C}$  decrease



# Why high temporal resolution measurements?

Methane mitigation happens at local scale

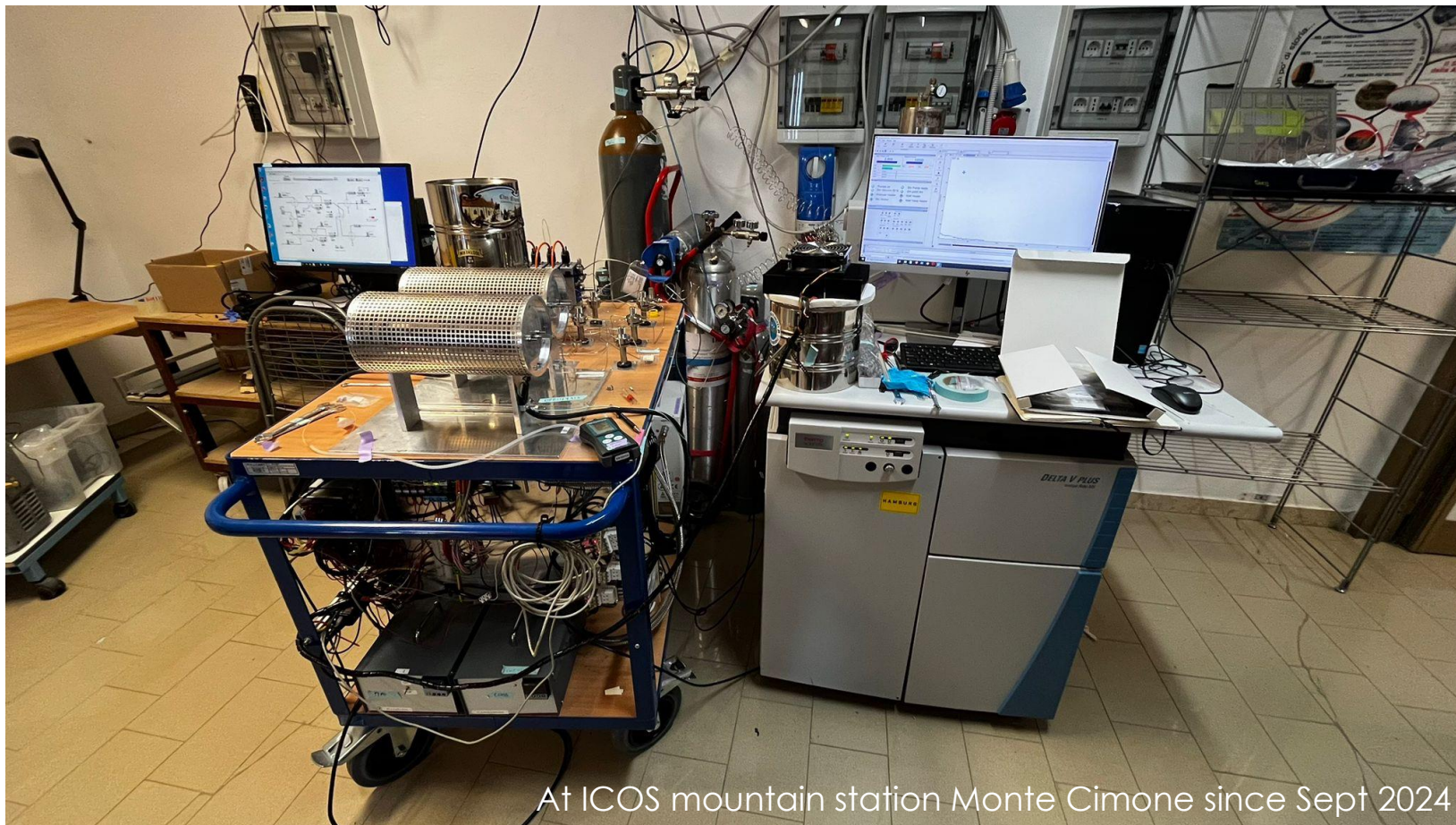
→ Attribution of “plumes” required

Improvement/verification of regional emission inventories

→ Realize continuous “isotope monitoring”



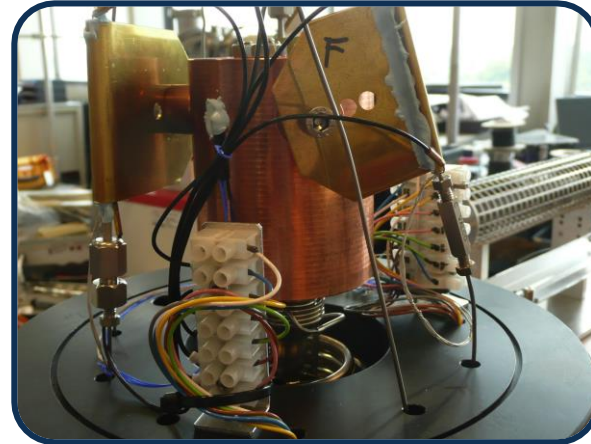
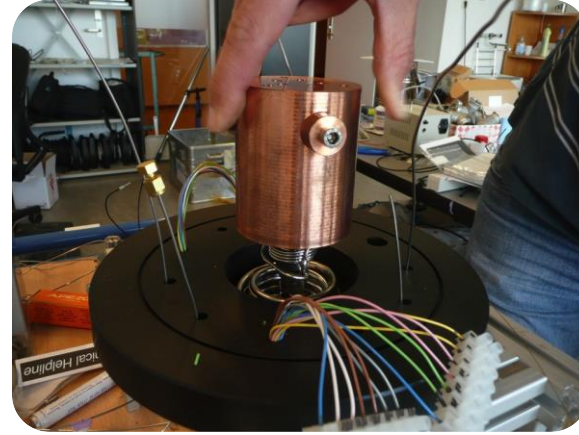
# Field IRMS system for $\delta^{13}\text{C}$ and $\delta\text{D}$ in $\text{CH}_4$



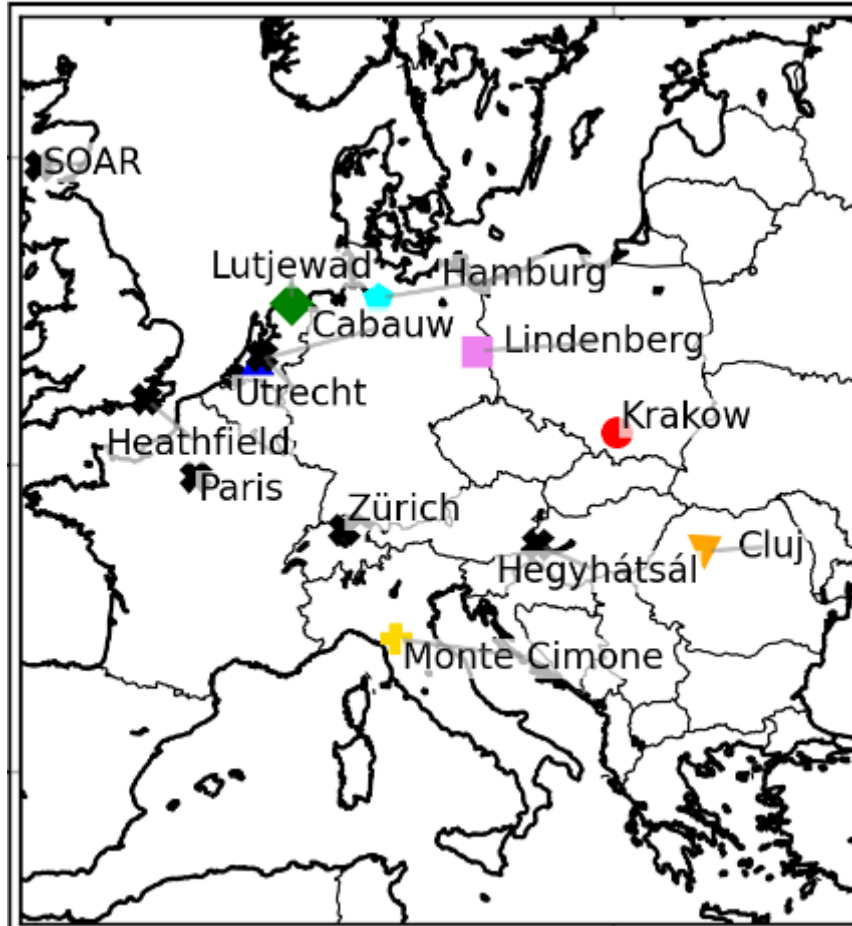
At ICOS mountain station Monte Cimone since Sept 2024



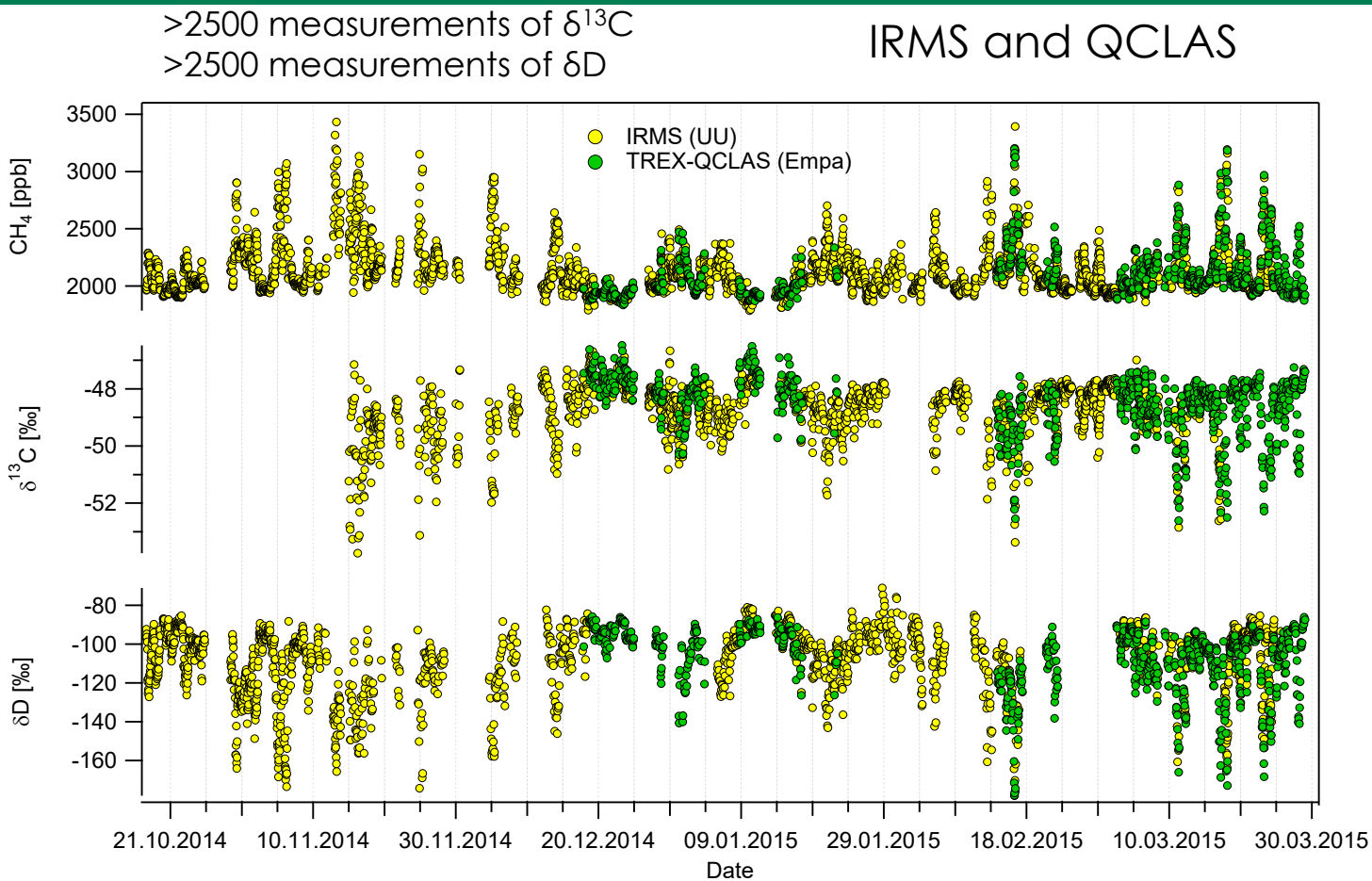
# Field IRMS system for $\delta^{13}\text{C}$ and $\delta\text{D}$ in $\text{CH}_4$



# Deployment at locations throughout Europe

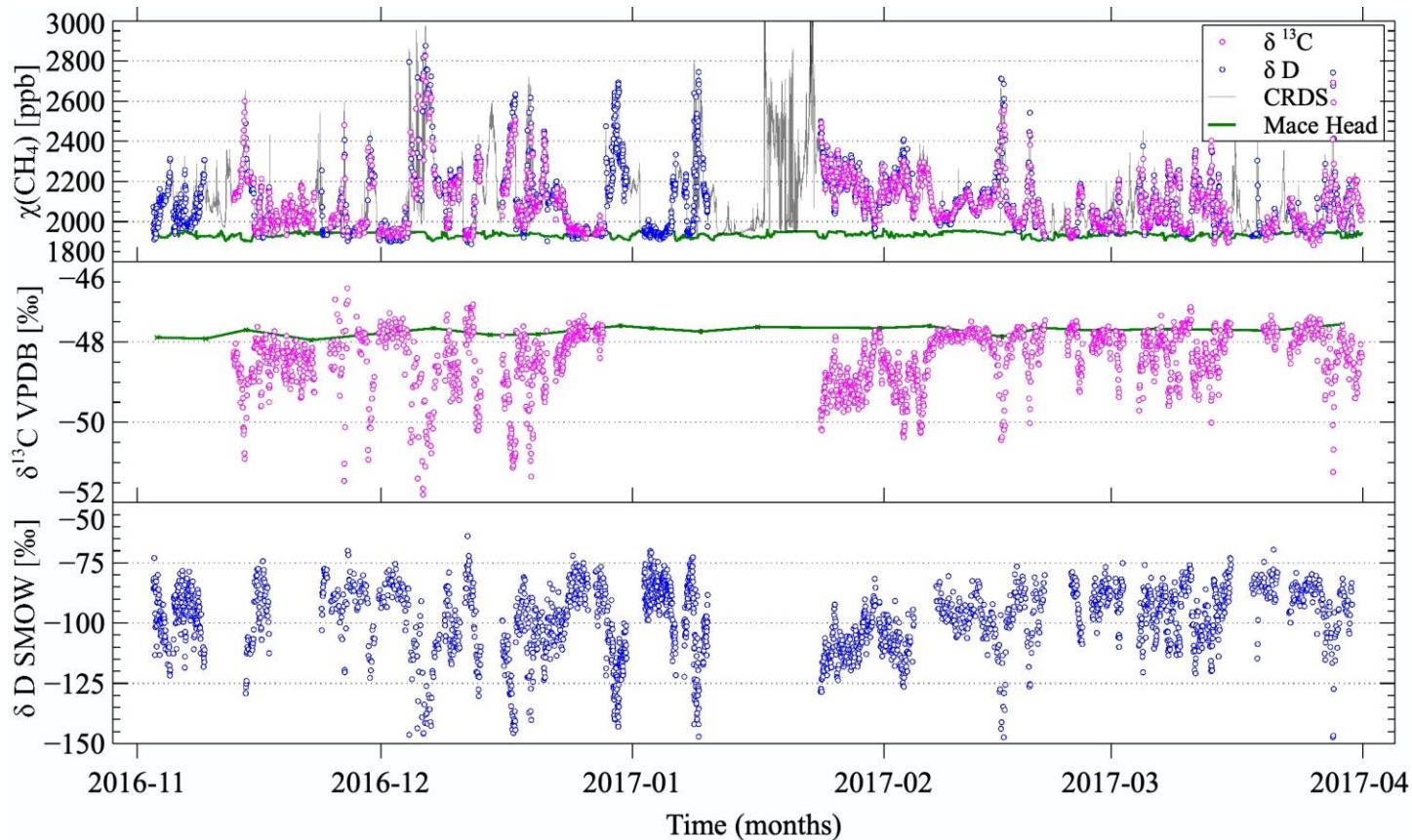


# > 5 months of measurements at Cabauw (NL)

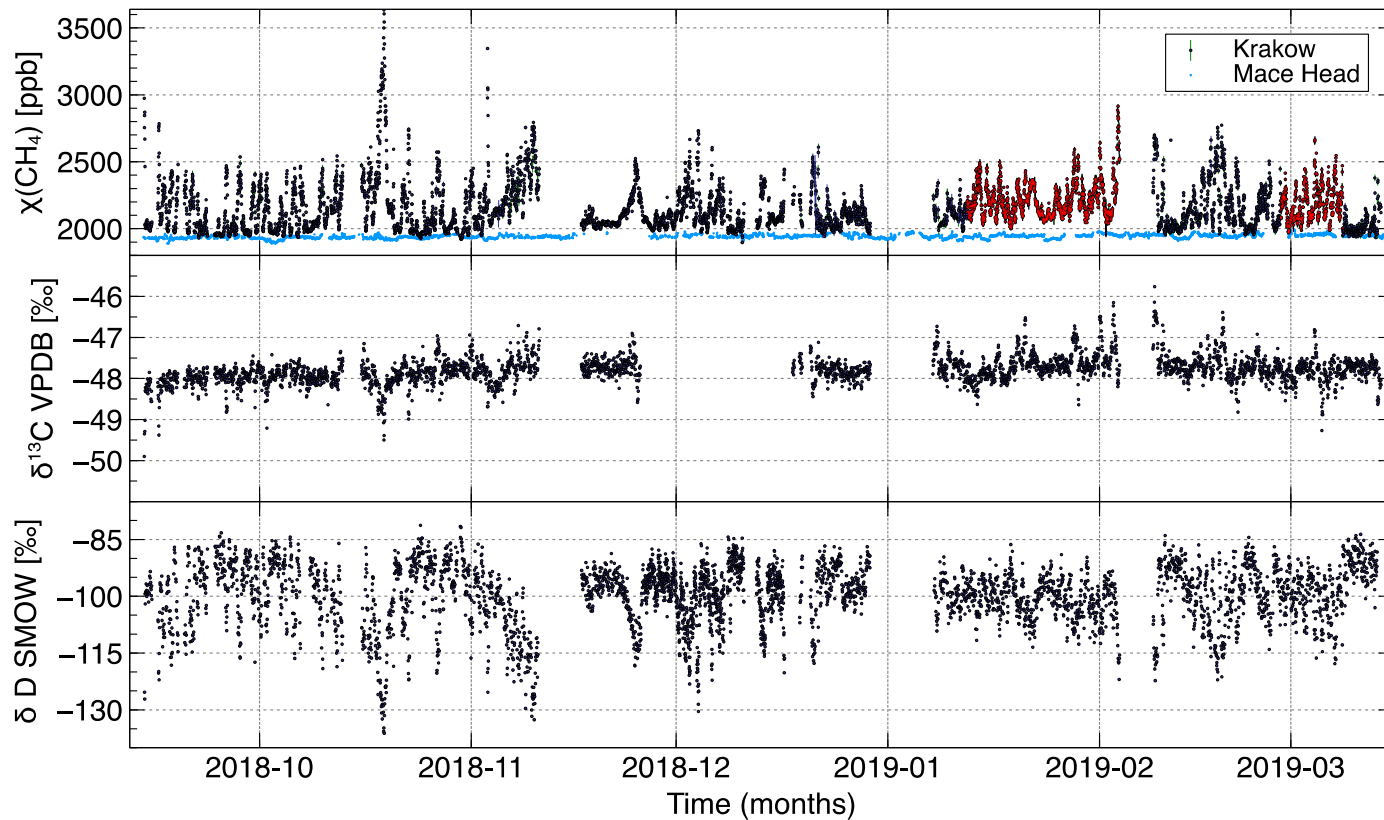




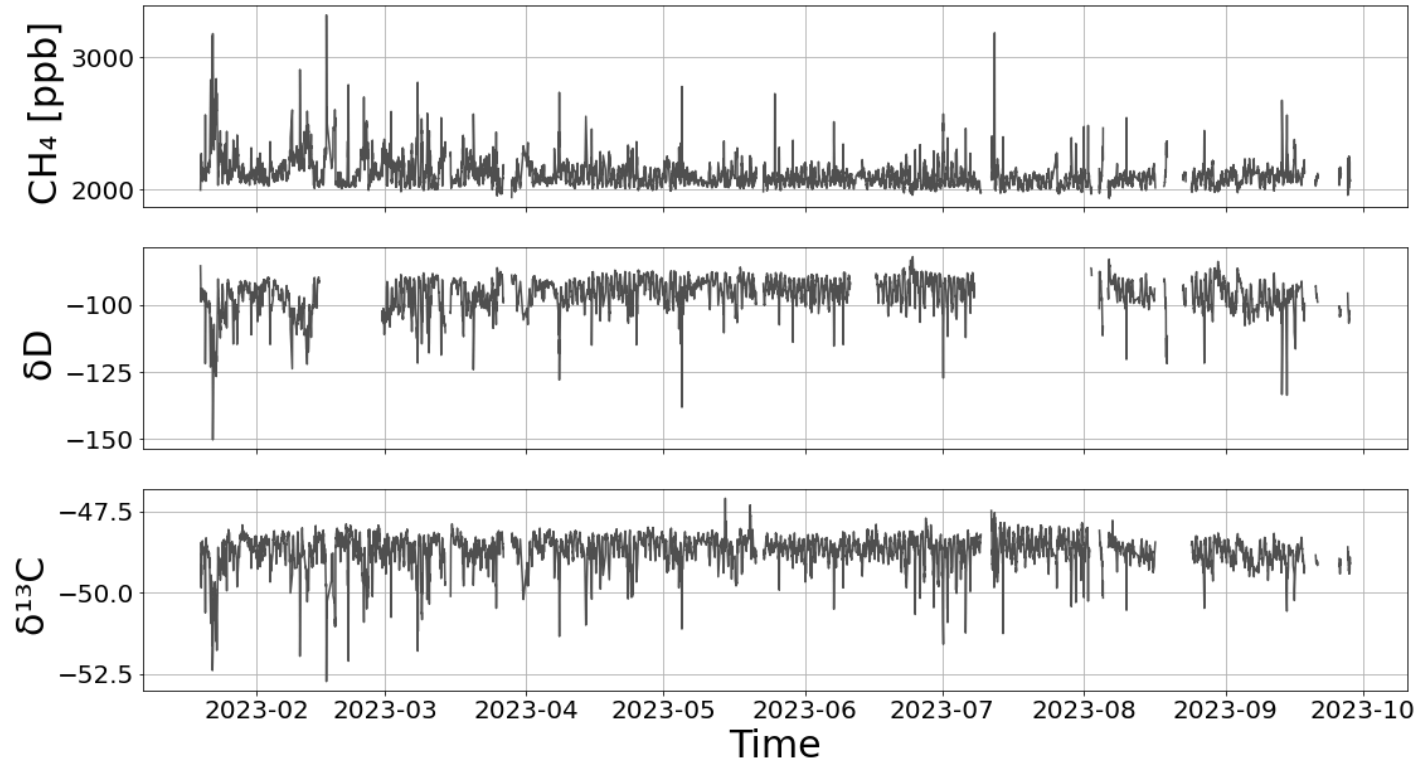
# > 5 months of measurements at Lutjewad (NL)



# > 5 months of measurements at Krakow (PL)

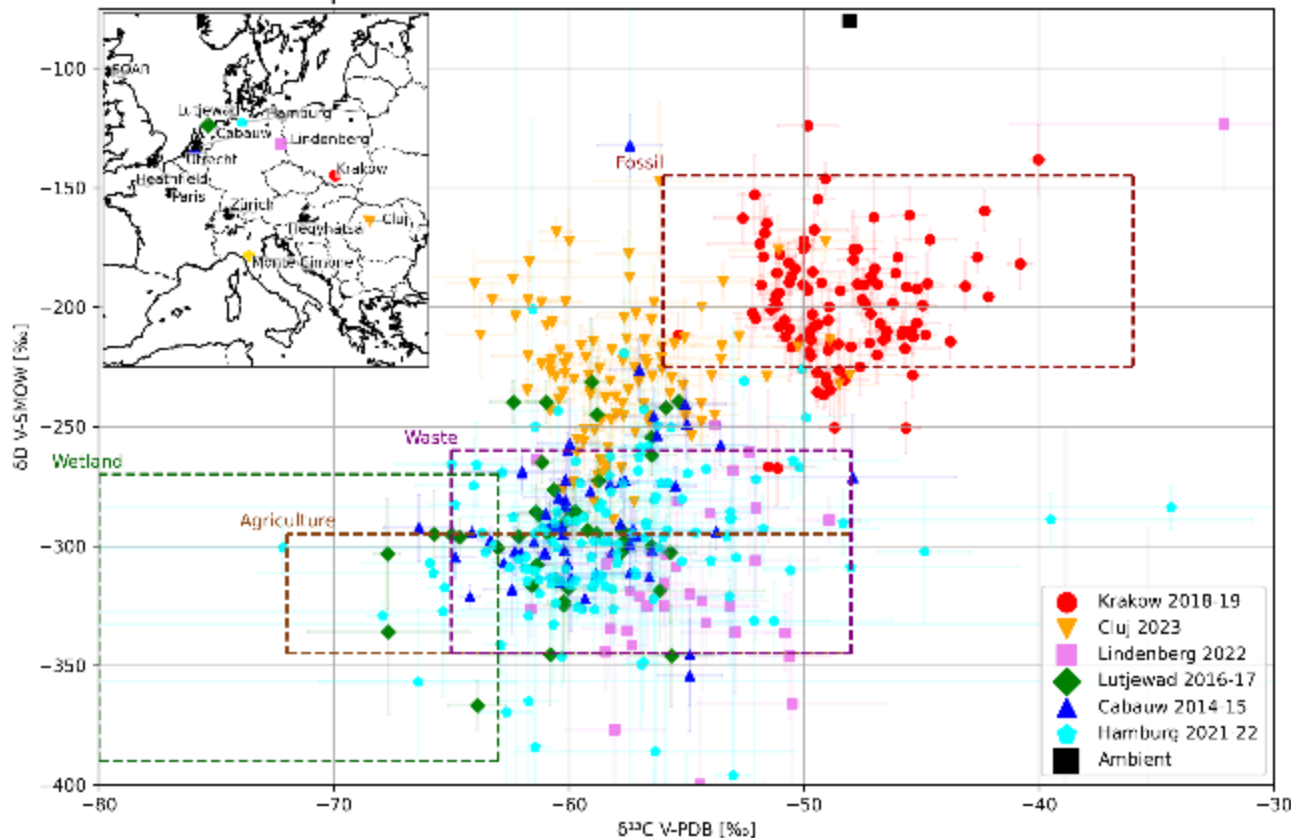


# > 8 months of measurements at Cluj-Napoca (RO)



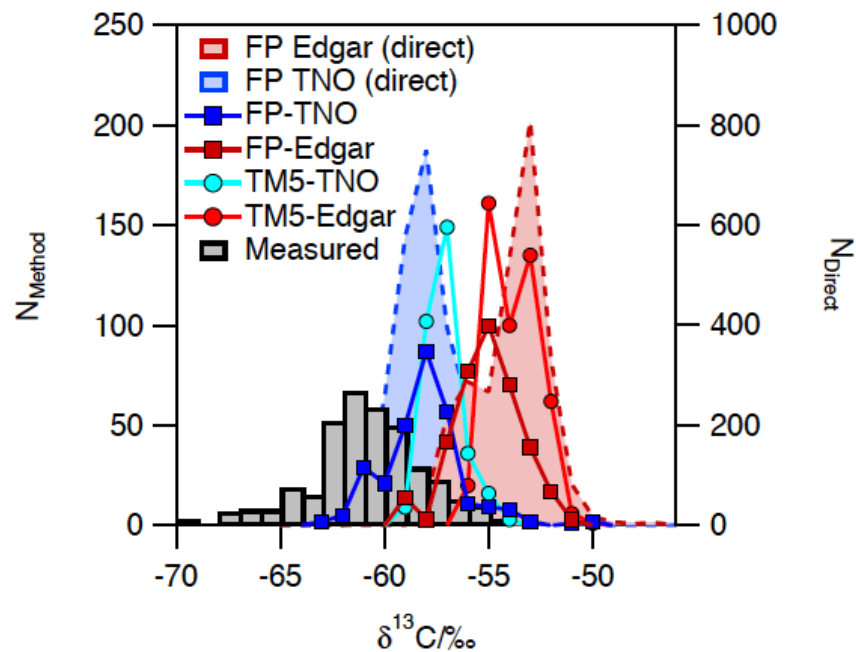
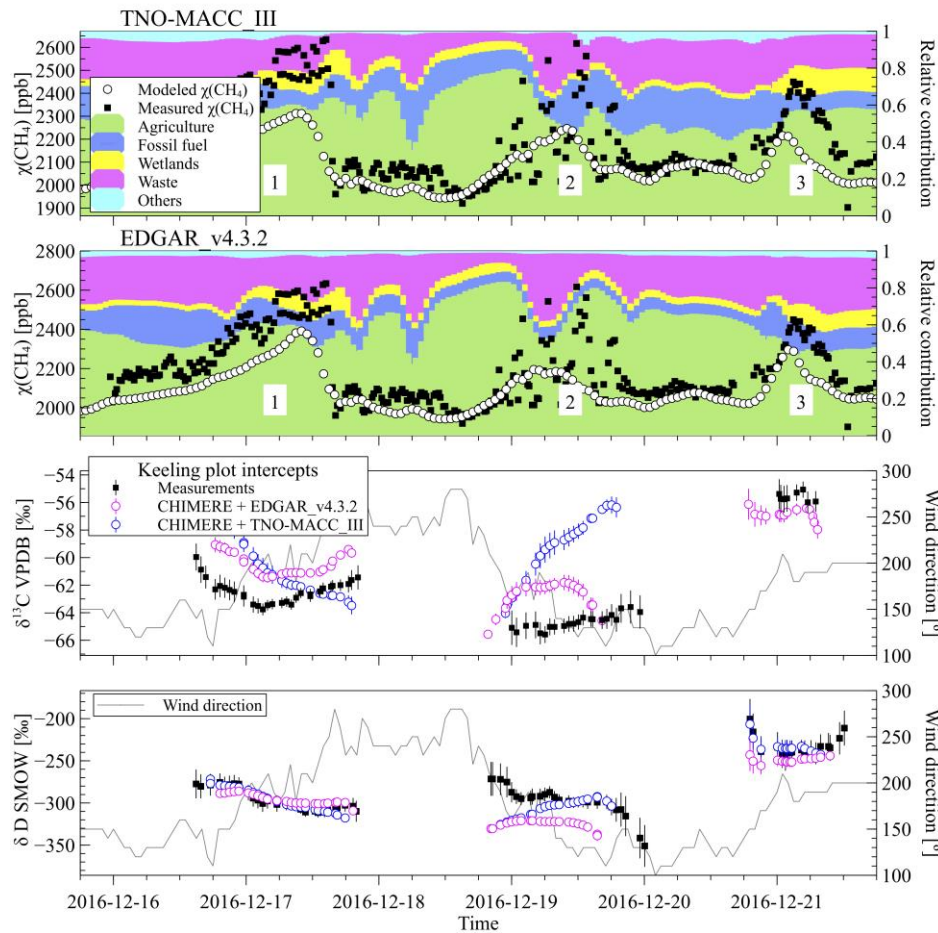
# Different origin at different locations

Dual-isotope plot of methane source signatures from locations in Europe.  
Current and past stations marked in color and future stations in black.





# Interpretation with help of models



Menoud et al., 2020

Röckmann et al., 2016

# Highlights

**Cabauw:** Fossil emissions overestimated in EDGARv4.0

**Lutjewad:** Virtually no emissions from Groningen gas fields

**Krakow:** Large emissions from coal mine “waste”

**Hamburg:** Dominant emissions are biogenic (<->street level gas leaks)

**Cluj-Napoca:** Mix of all source sectors: Model not adequate

**Lindenberg:** TODO (model comparison)

# Conclusions

Mobile IRMS system can measure  $\delta^{13}\text{C}$  and  $\delta\text{D}$  in the field

Ruisdael  $\text{CH}_4$  isotope instruments deployed at many EU locations

$\text{CH}_4$  looks isotopically different at different locations

Use isotopes to quantify regional sources

- improve emission inventories
- support mitigation action