


Methane and Nitrous Oxide Stable Isotope Ratio measurements on NEEM firn air

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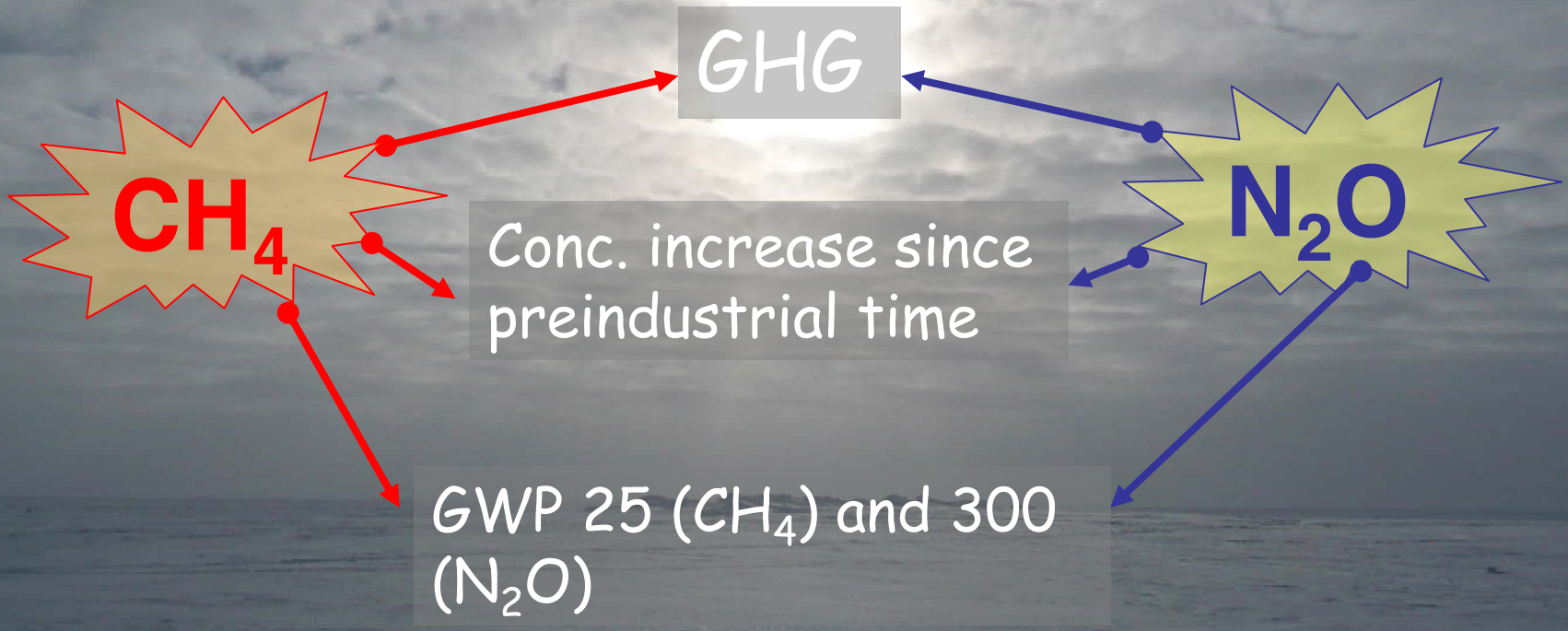
Outline

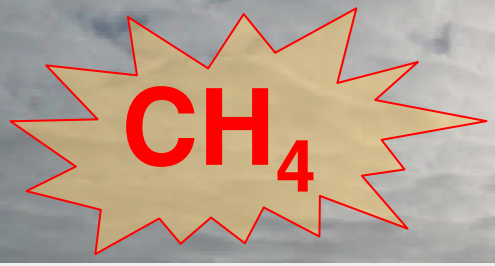
- Introduction
- Method
- Results
- Further research

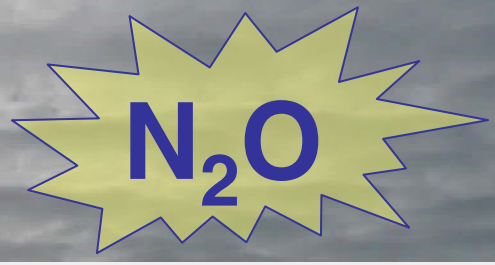
Why are we interested in CH_4 and N_2O?



Large uncertainties in their source/sink strenghts !

Why measuring CH_4 and N_2O stable isotope ratios from firn air?





To better understand the CH_4 and N_2O budget of the last 60 years with high precision isotope measurements.

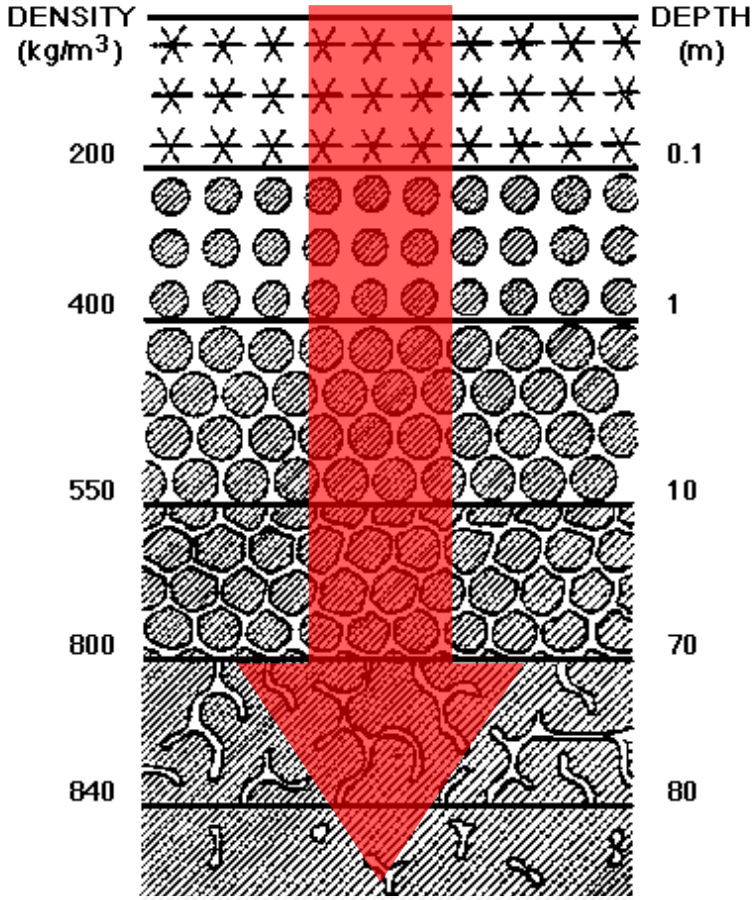
To compare firn air results with direct atmospheric measurements !

Why measuring CH_4 and N_2O stable isotope ratios from firn air?

2 crucial processes occuring in the firn:

Gravitational settling

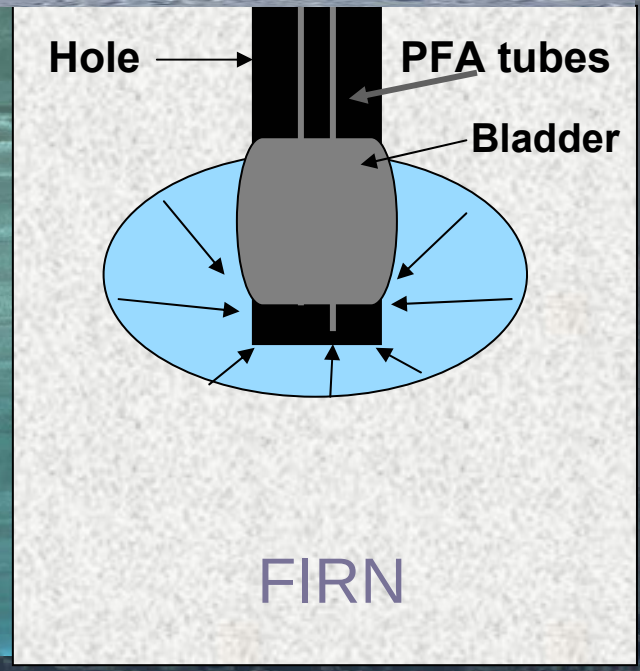
Diffusion



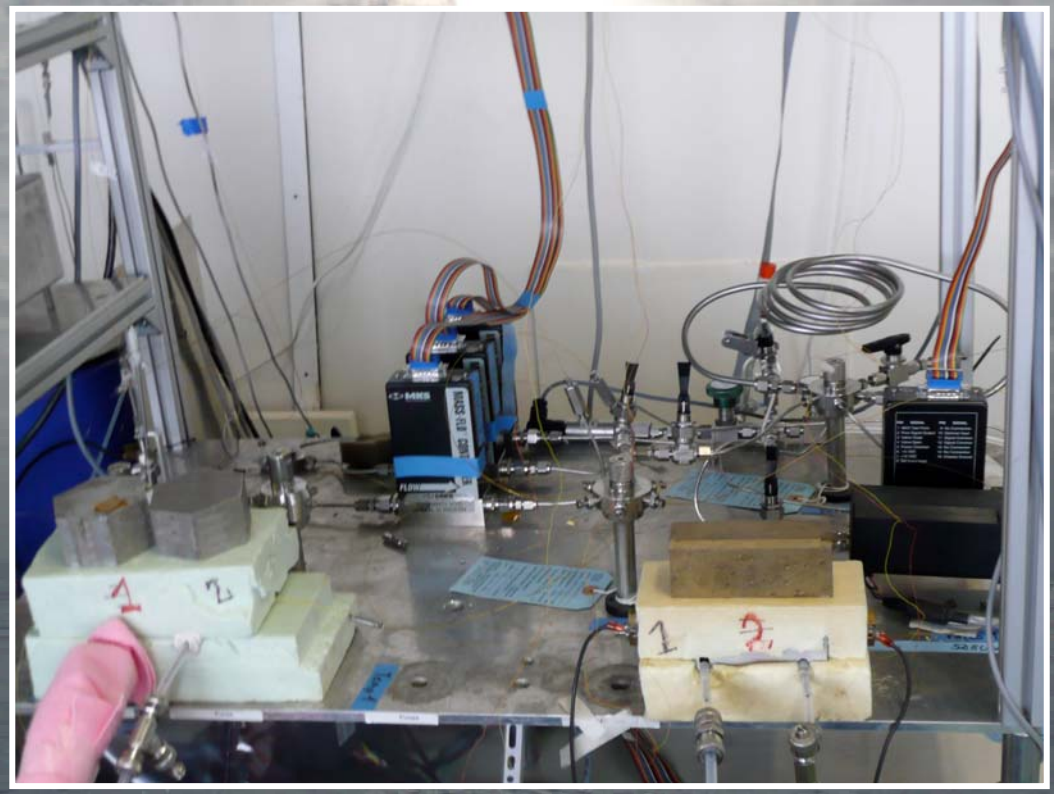
Scheme from the « Glacial World According to Wally », Broecker, 1993.

- **SNOW**
- **COMPACTED SNOW**
- **FIRN**
- **Lock-in zone**
- **Ice**

NEEM firn air sampling



Stable Isotope Ratio measurements



14 firn air bottles were analyzed at least 3 times for their isotope ratio of CH_4 ($\delta^{13}C$ and δD) and of N_2O ($\delta^{15}N$ and $\delta^{18}O$) by two high precision Isotope Ratio Mass Spectrometer systems

Results

CH_4

versus

N_2O

Mixing ratios (ppb)

$\delta^{13}C$ (‰)

δD (‰)

Depths (m)

$[CO_2]$(ppm)

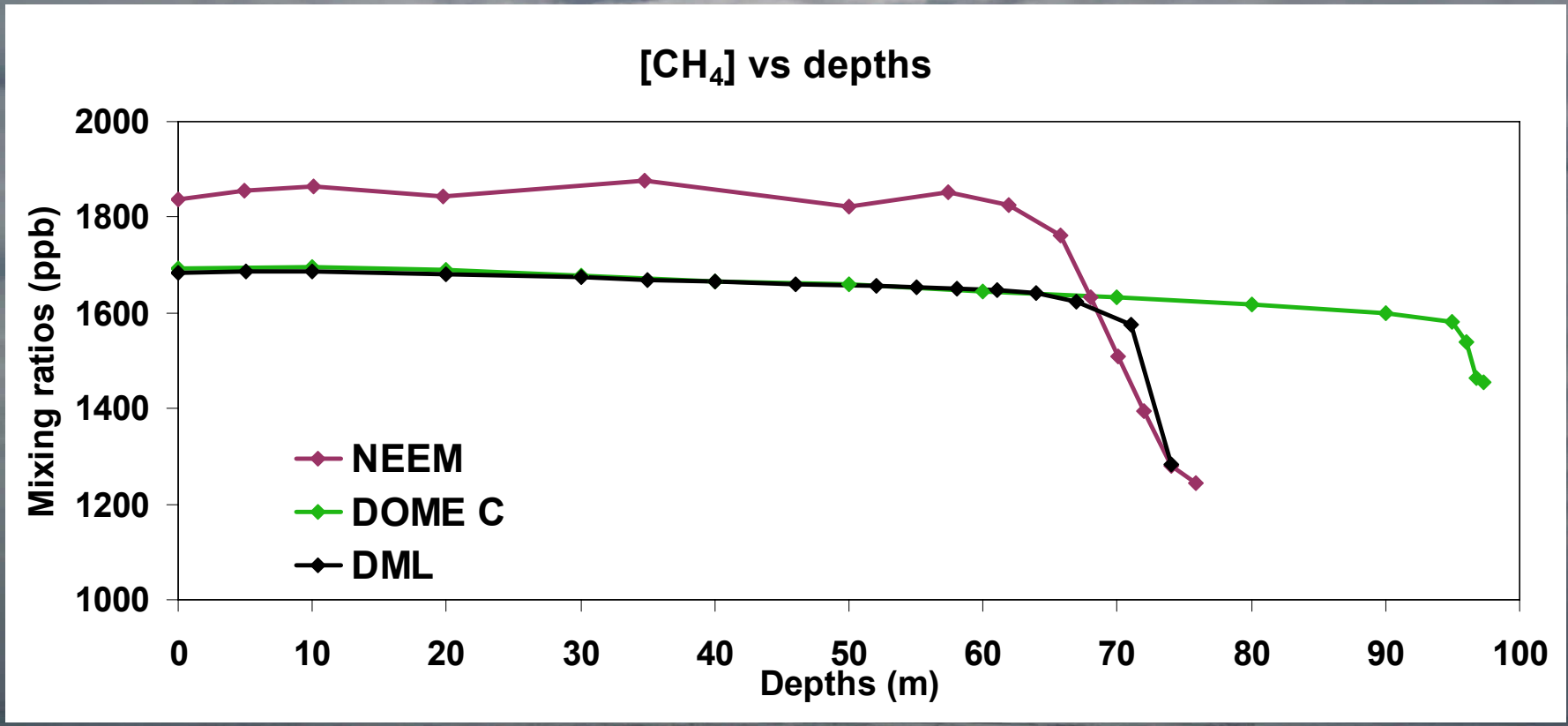
Age (AD)

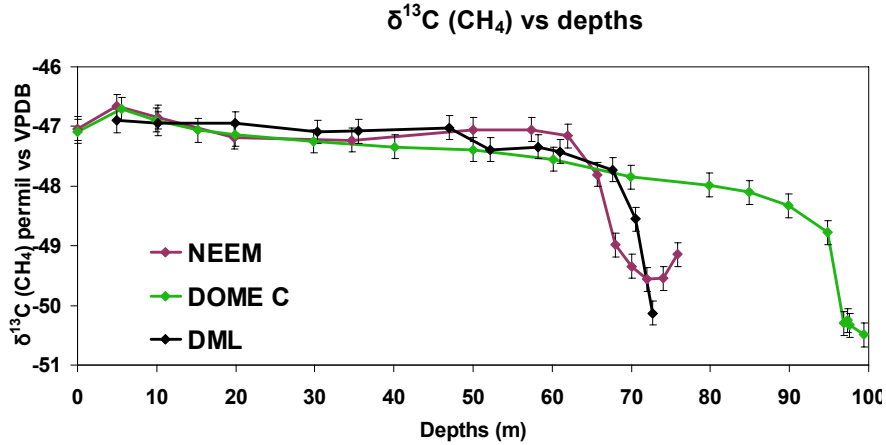
Mixing ratios (ppb)

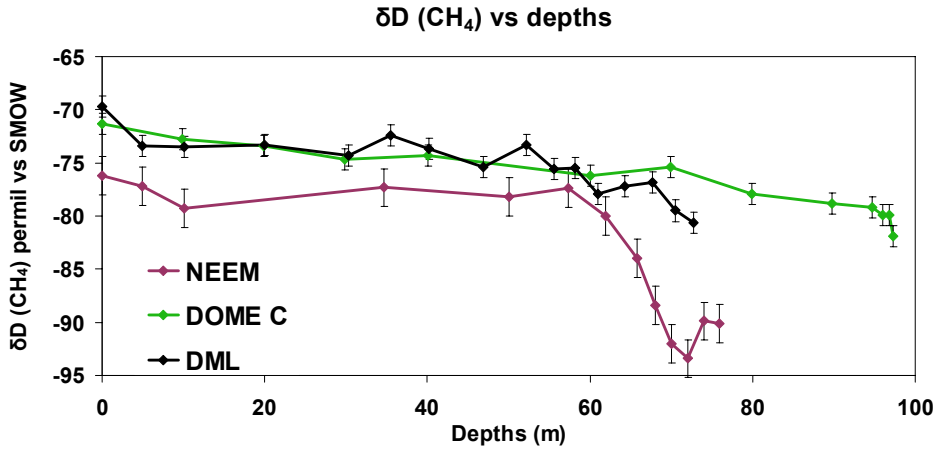
$\delta^{18}O$ (‰)

$\delta^{15}N$ (‰)

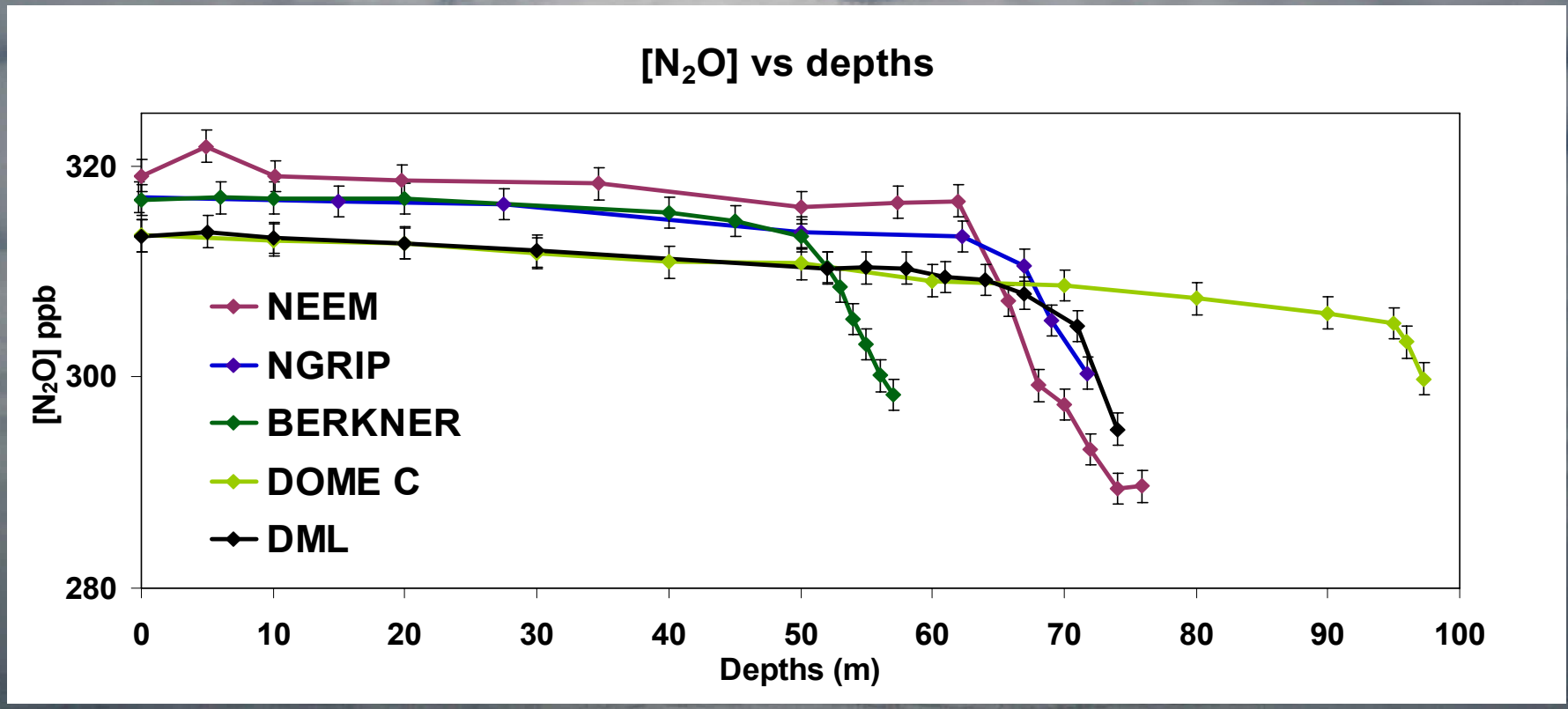
Results: CH_4 mixing and isotope ratios vs depths

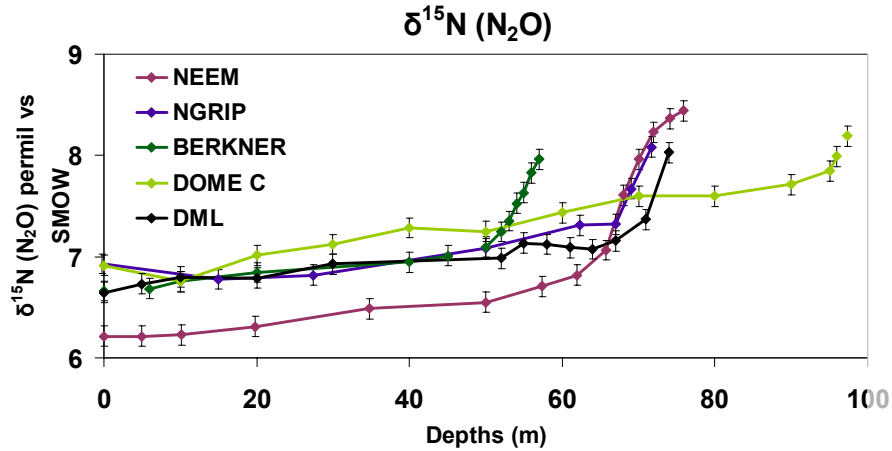


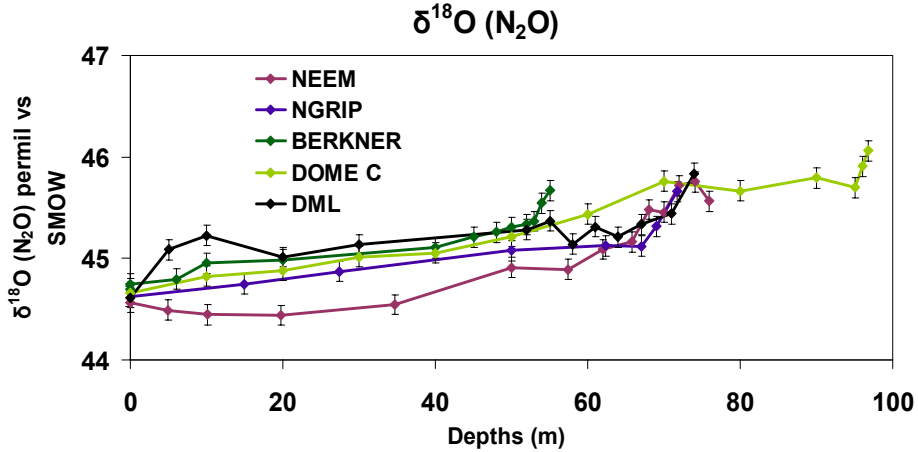




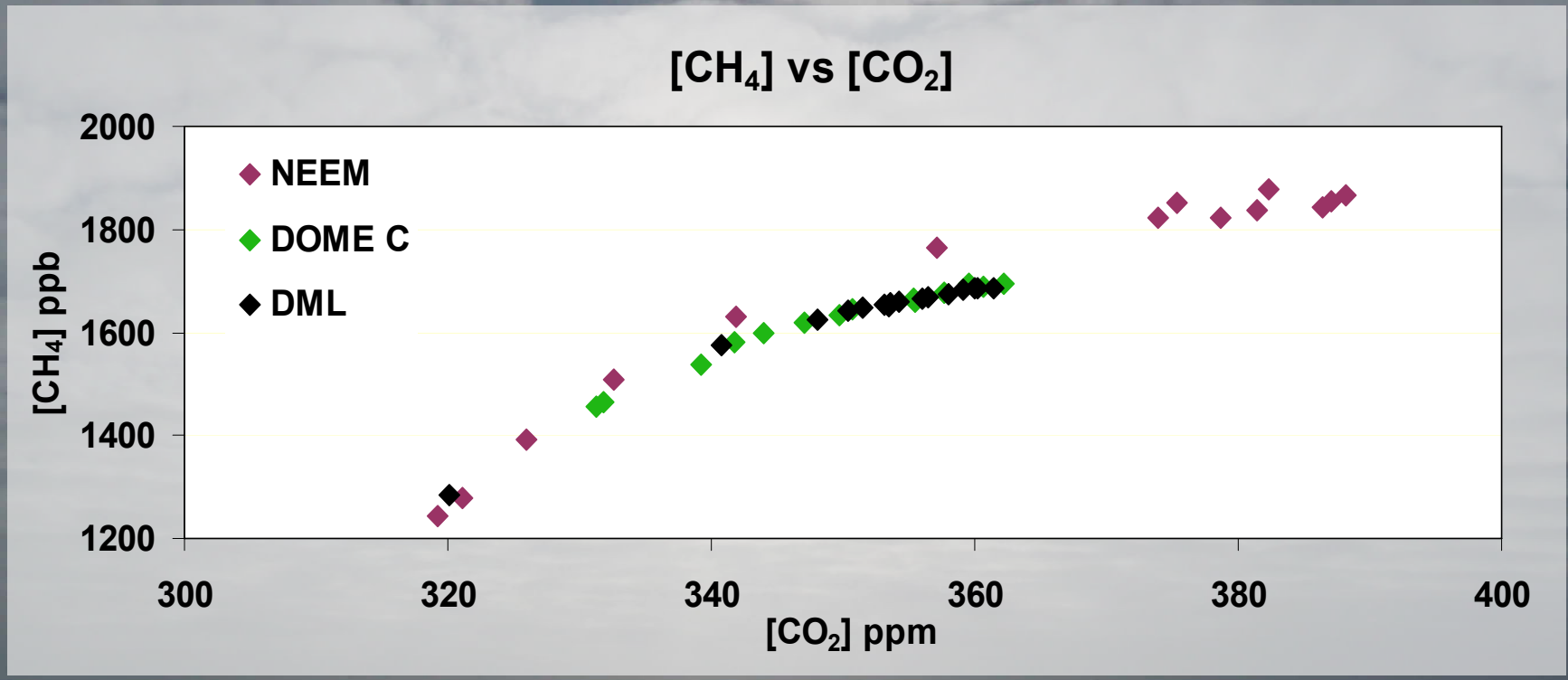
Results: N_2O mixing and isotope ratios depths

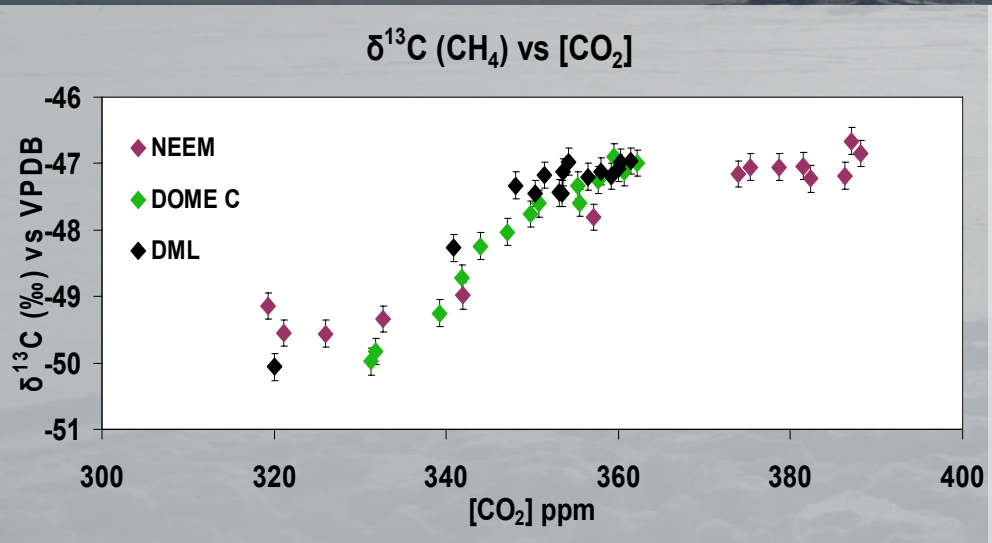


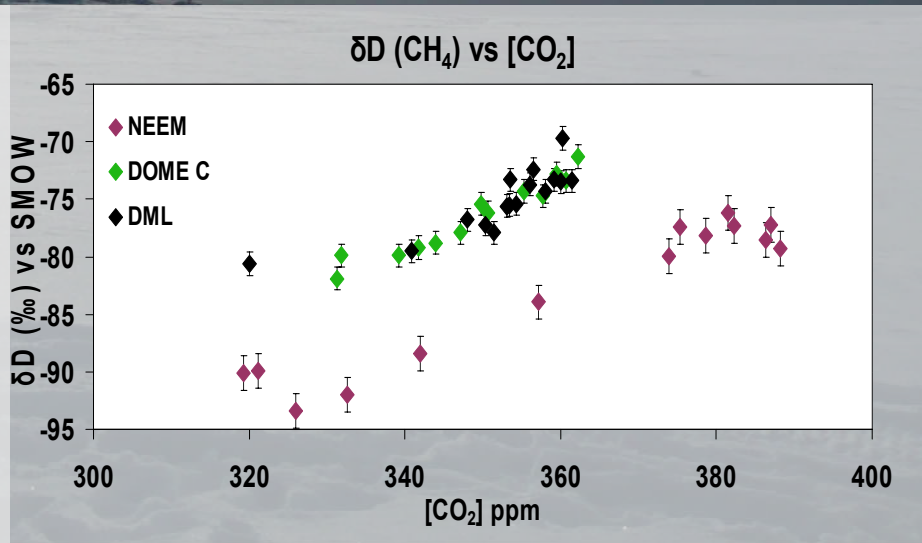




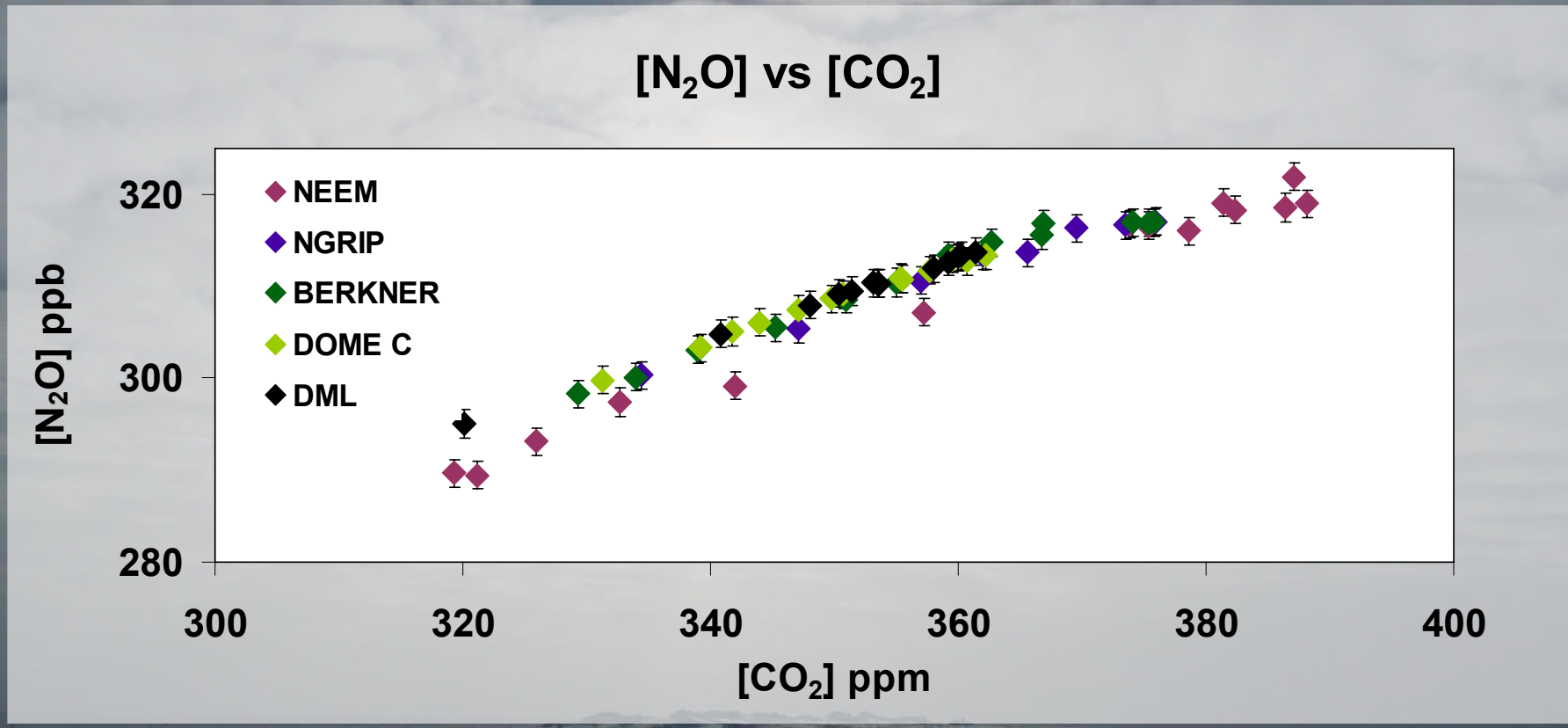
Results: CH_4 mixing and isotope ratios vs CO_2

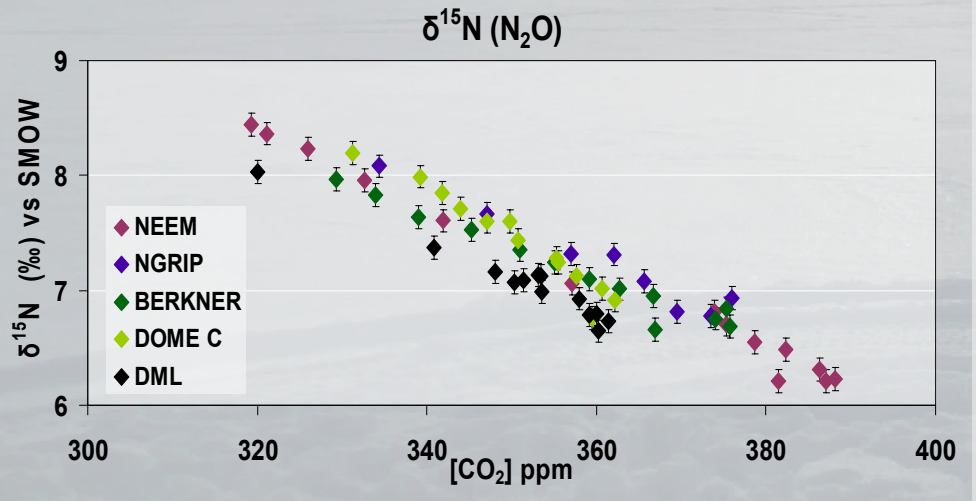


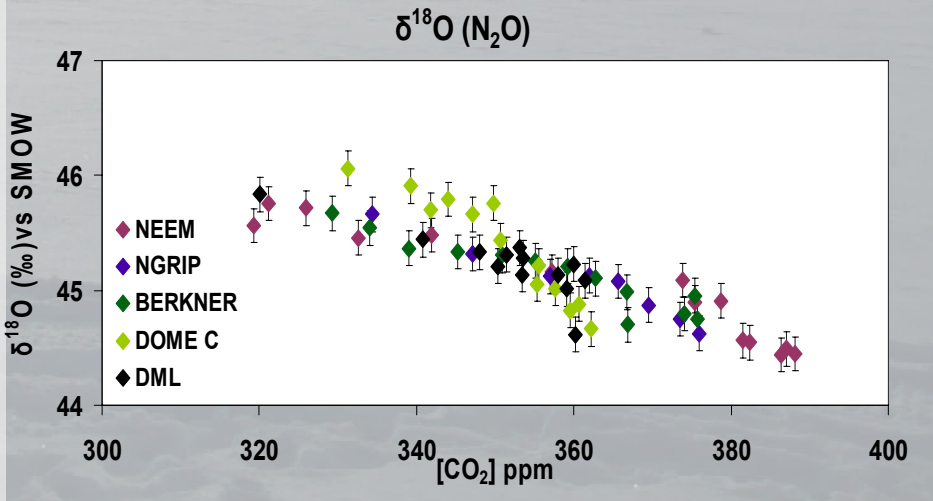




Results: N_2O mixing and isotope ratios vs CO_2





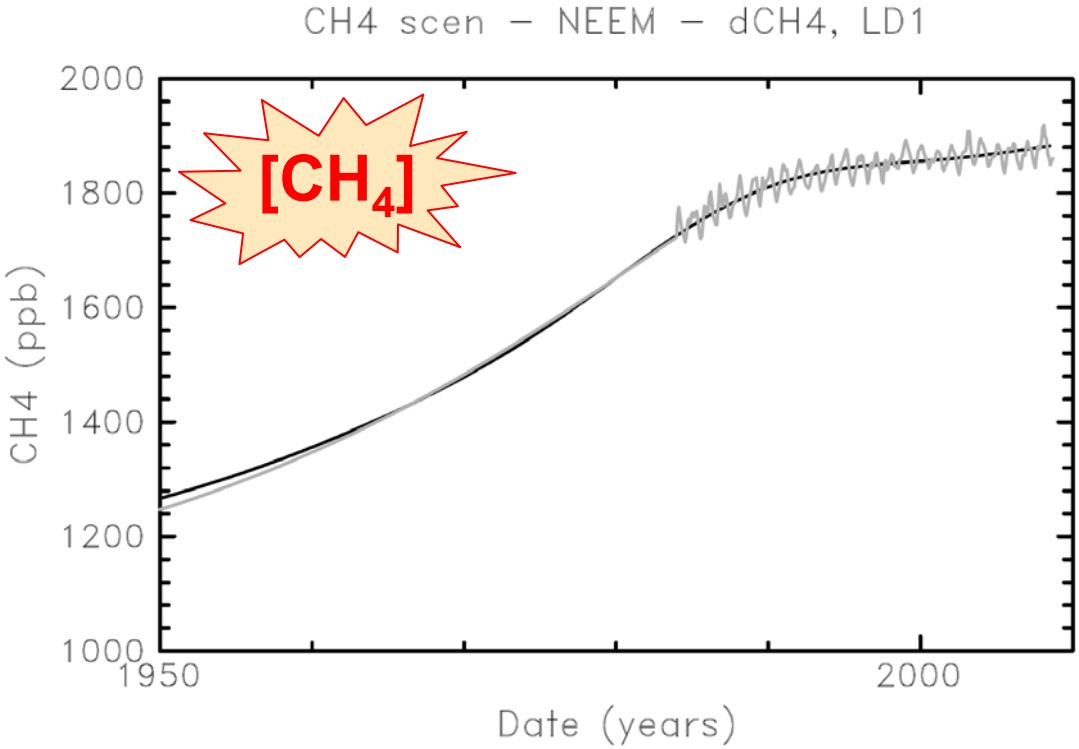


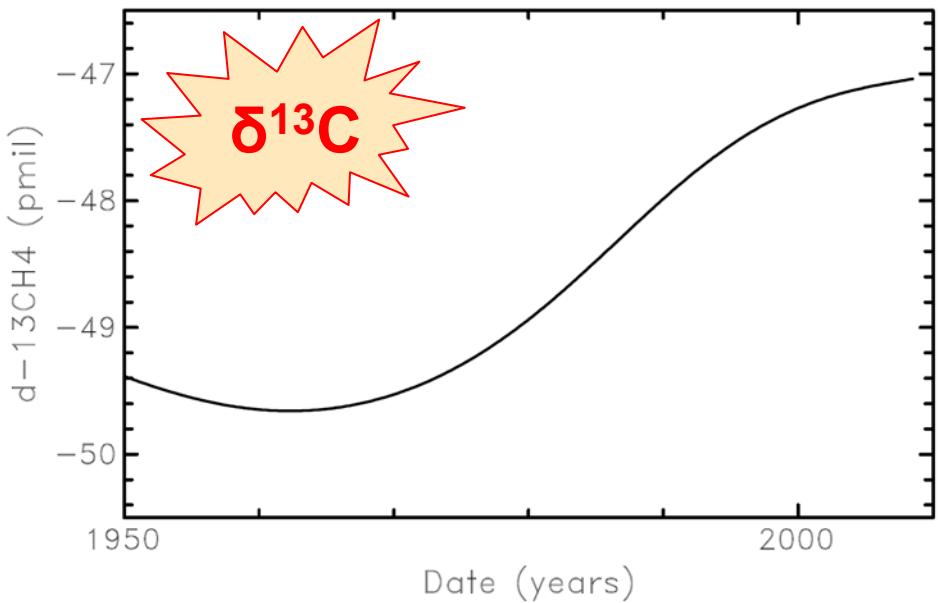
Inverse modelling

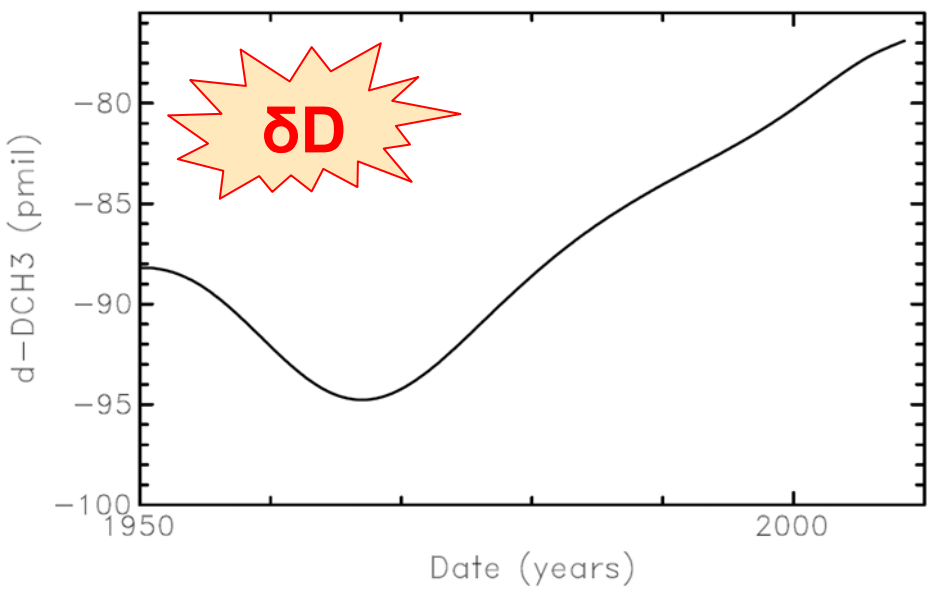
- Green function mode => probabilities of having trace gas of a given age at a given depth.
- Model parameters:
  - **Site temperature**
  - **Accumulation rate**
  - **Width of the convective layer**
  - **Firn density profile**
  - **Firn diffusivity profile**

Inverse modeling: CH_4

CH_4

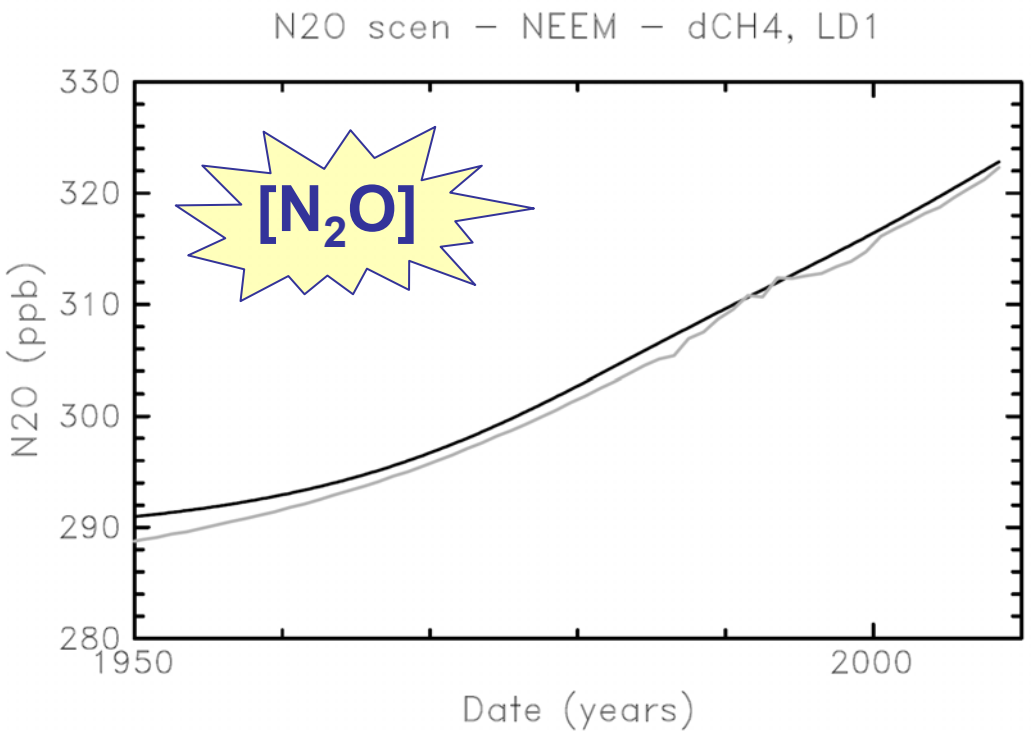


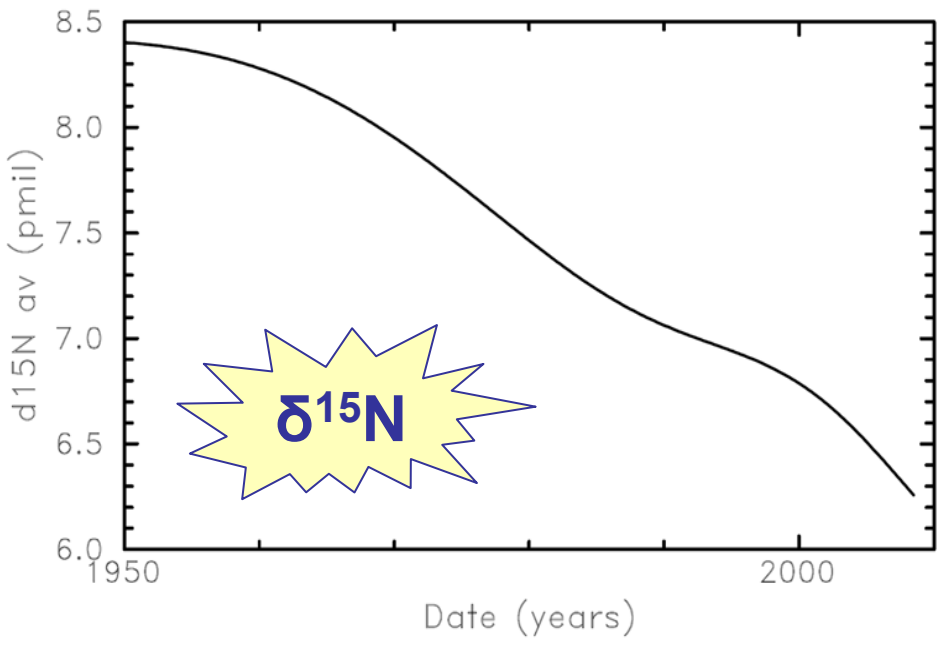


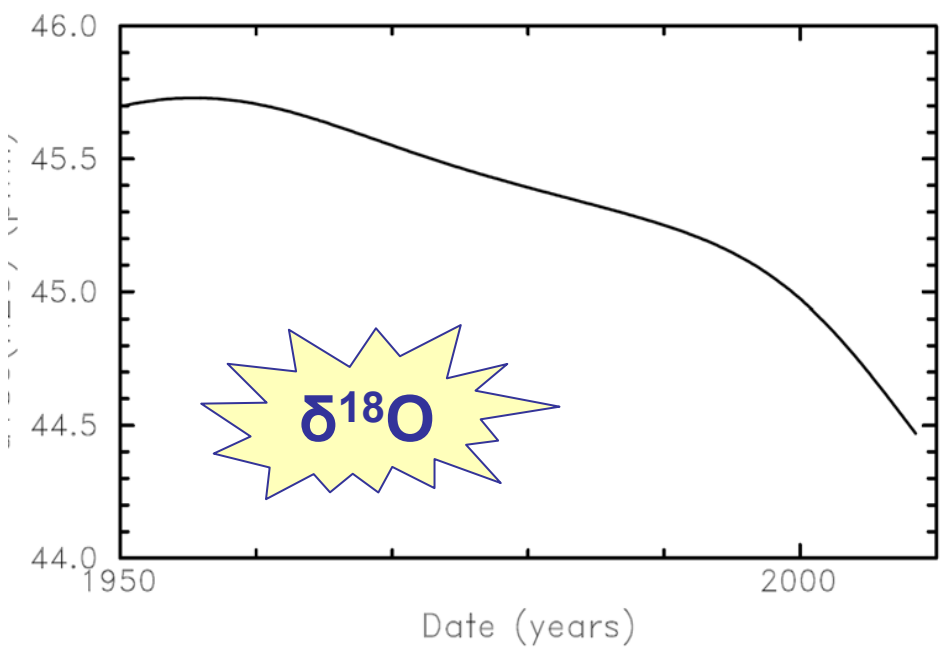


Inverse modeling: N_2O

N_2O







Further research

- Improving the the inverse modelling and comparing the different NH and SH sites.
- Splicing the firn data with ice core data.
- Measuring Holocene air trapped in NEEM ice core for N_2O and CH_4 mixing and isotope ratios.

Thank you for your attention !