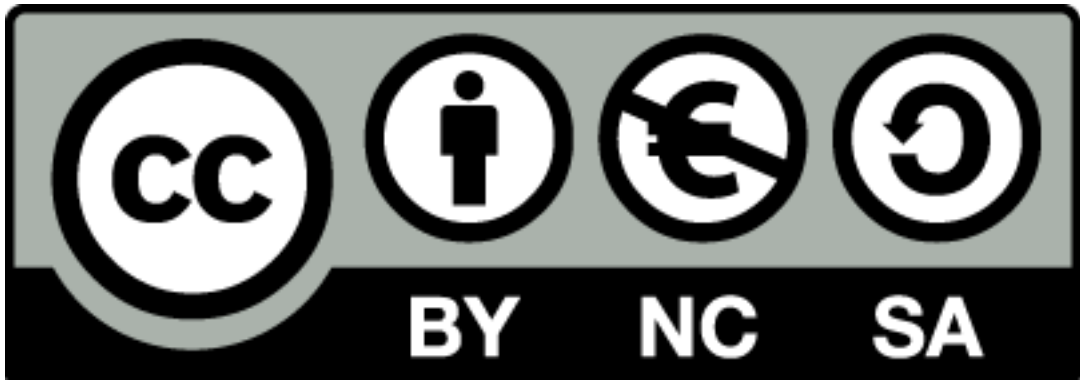
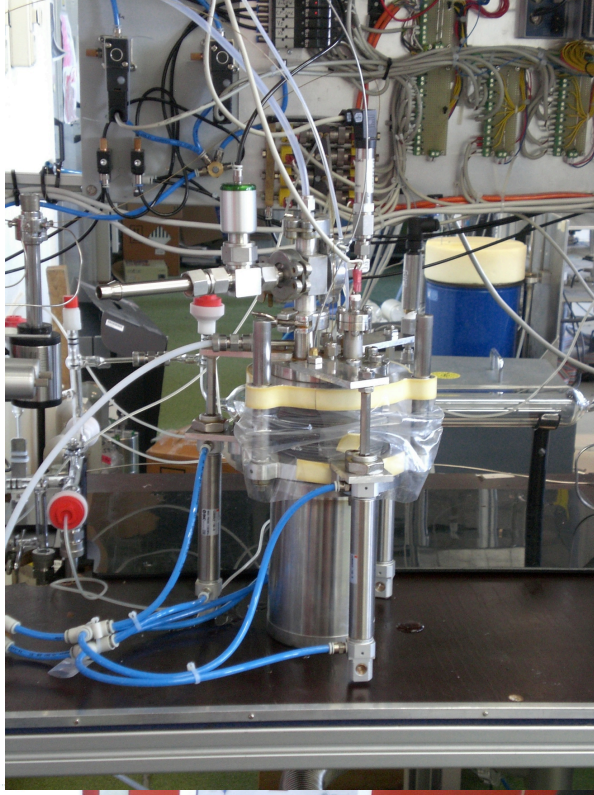
The material that was presented in this presentation was later published in a discussion paper in ACPD, that can be found on:
http://www.atmos-chem-phys-discuss.net/12/589/2012/acpd-12-589-2012.html



The stable isotopic composition of atmospheric H_2; *at the ground and in the lowermost stratosphere (LMS)*



A.M. Batenburg

and

T.J. Schuck, A.K. Baker, A. Zahn, C.A.M. Brenninkmeijer of the CARIBIC project

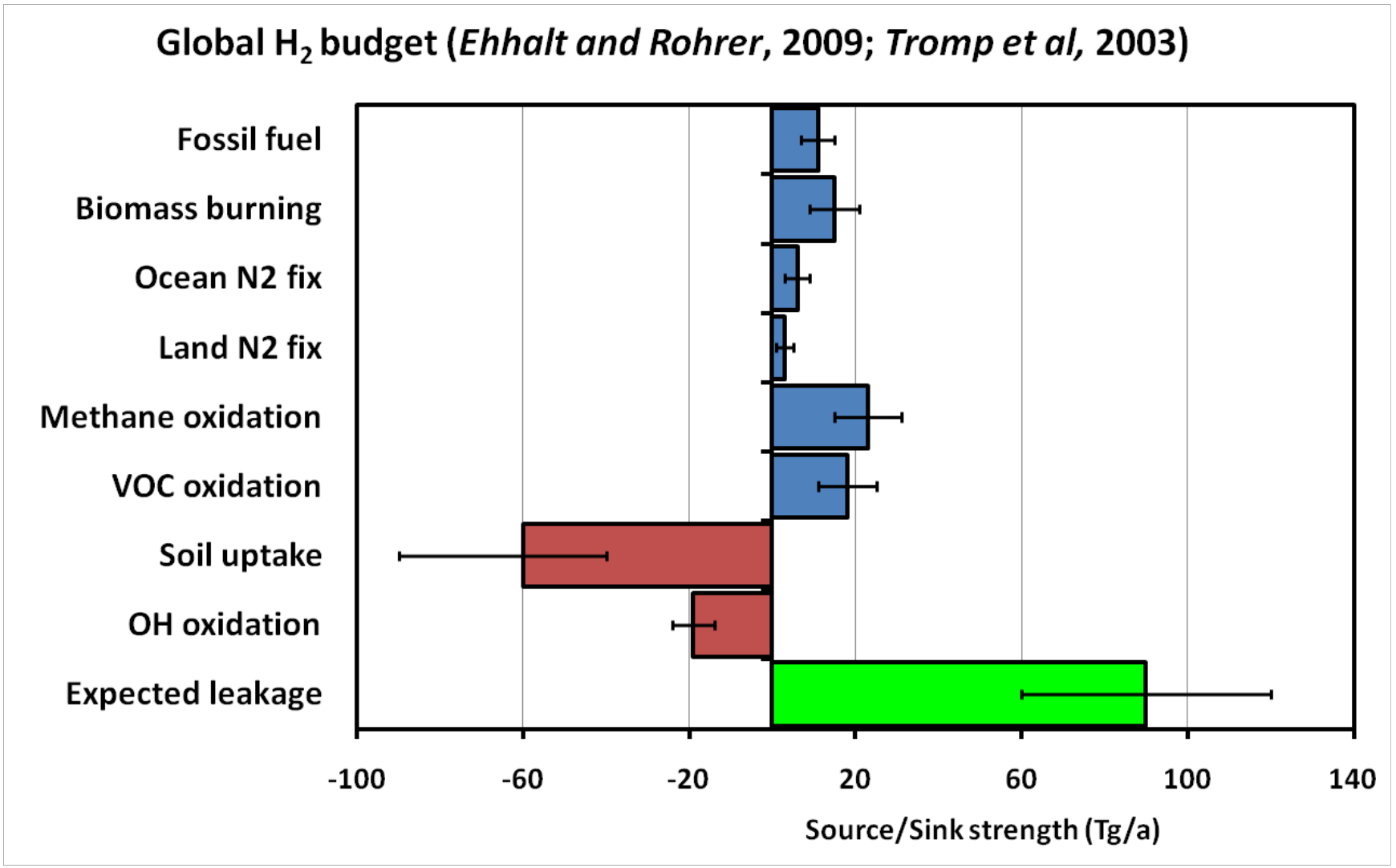
and

S. Walter, G. Pieterse, T. Röckmann of IMAU

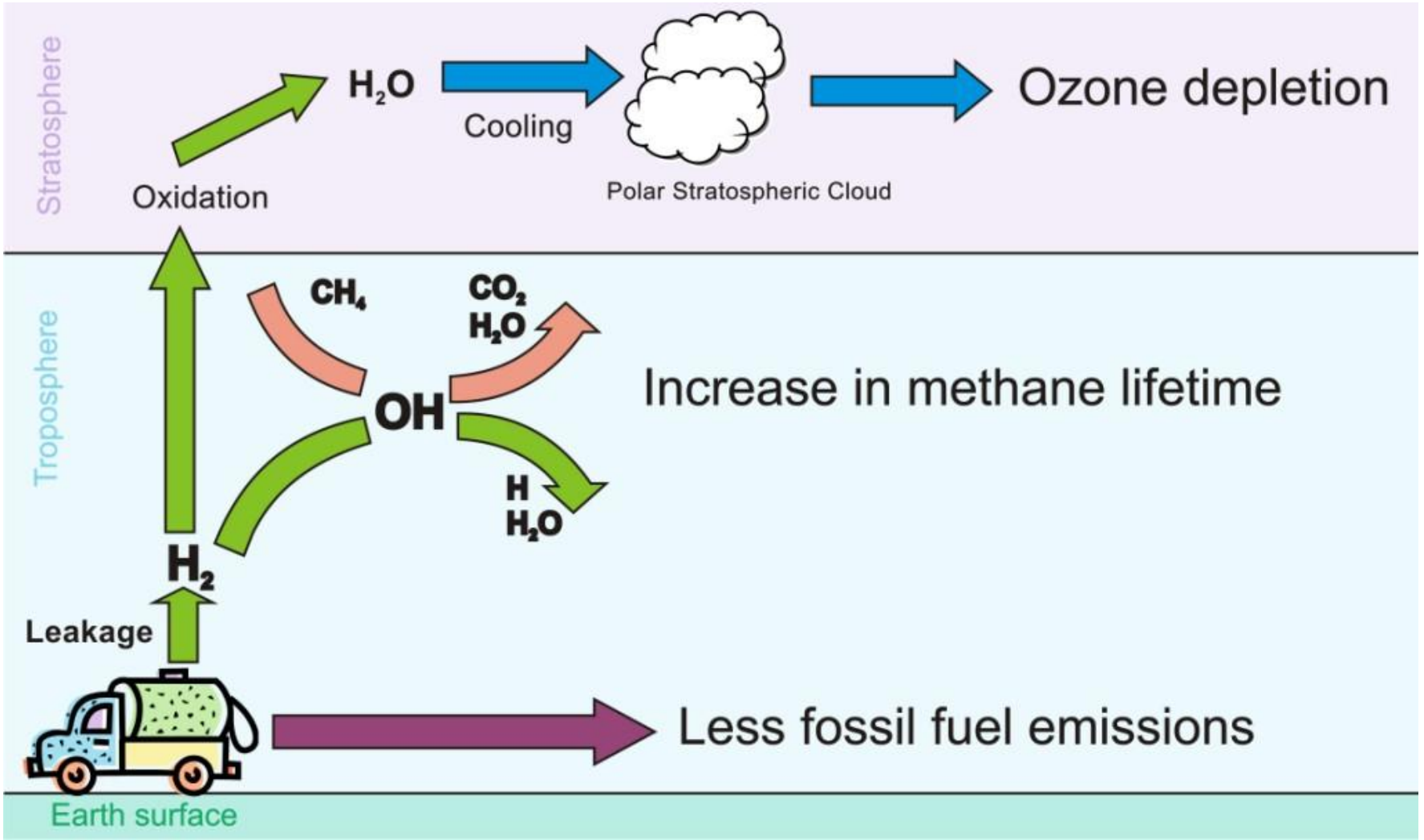
Presentation overview

- **Introduction**
  - * Hydrogen (H_2)
  - * H_2 isotopic composition (δD)
- **Results**
  - * Ground stations
  - * Lowermost stratosphere (LMS)
- **Summary**

The atmospheric H_2 budget



Effects of a Hydrogen Economy

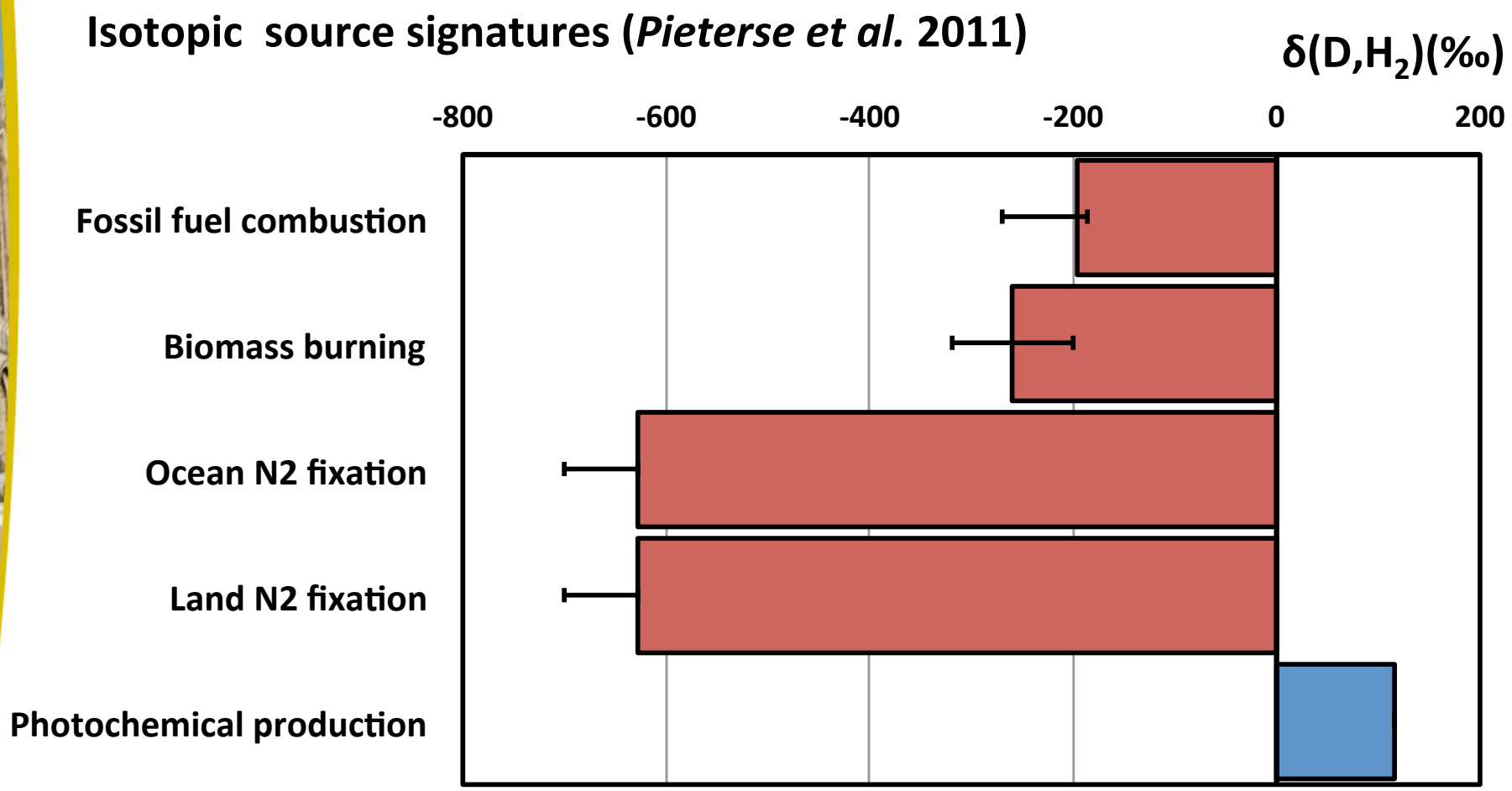


Isotope δ-notation

$$\delta(\mathrm{D},\mathrm{H_2}) = \left(\frac{\left(\frac{\mathrm{D}}{\mathrm{H}}\right)_{\mathrm{Sample}}}{\left(\frac{\mathrm{D}}{\mathrm{H}}\right)_{\mathrm{VSMOW}}} - 1 \right) \cdot 1000‰$$

The $\delta(\mathrm{D},\mathrm{H_2})$ value represents the deuterium-to-hydrogen ratio in the $\mathrm{H_2}$ relative to a standard (Vienna Standard Mean Ocean Water (VSMOW))

Isotopic source signatures



Isotopes can be used to gain information about different sources and sinks.

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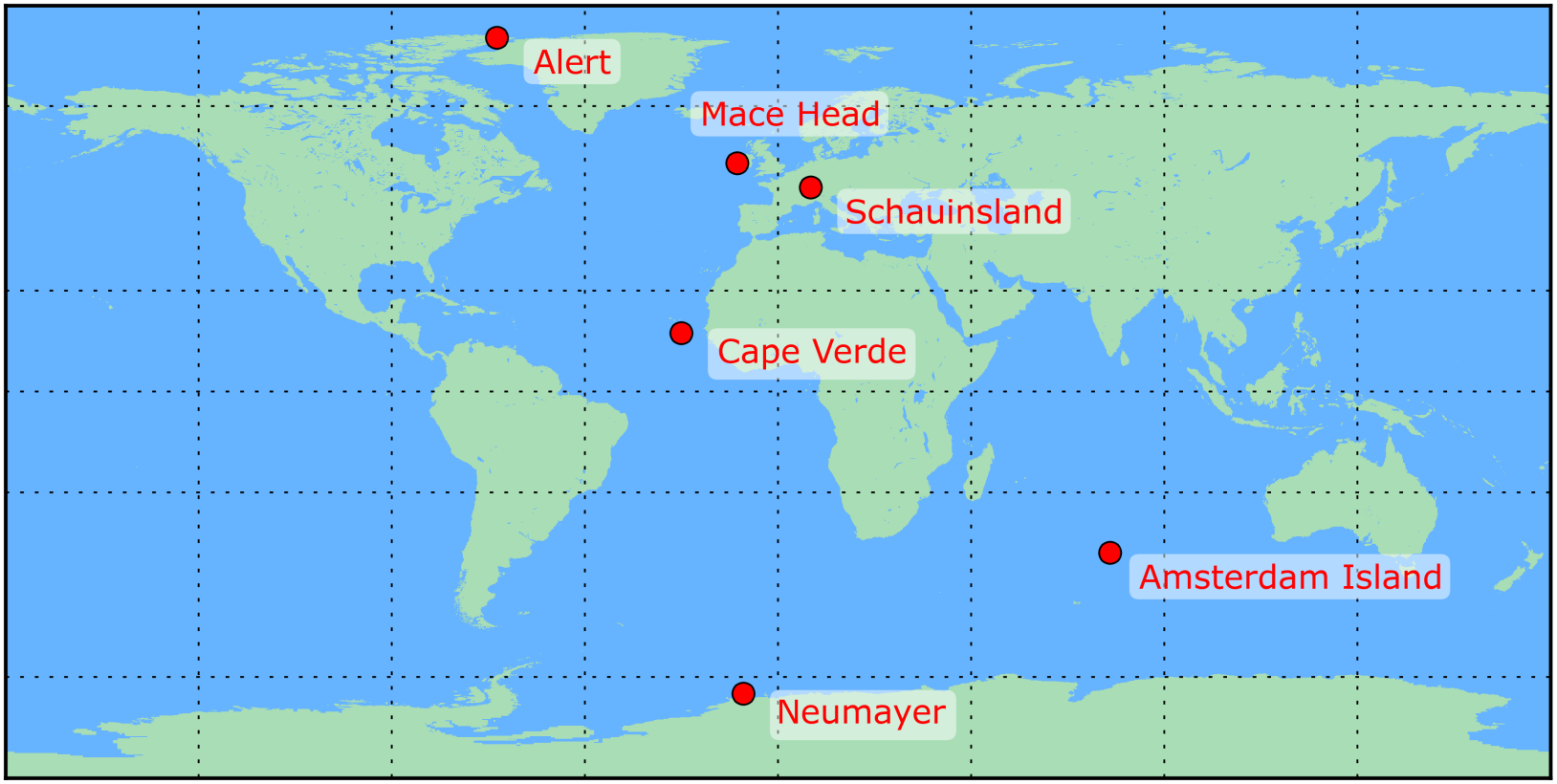
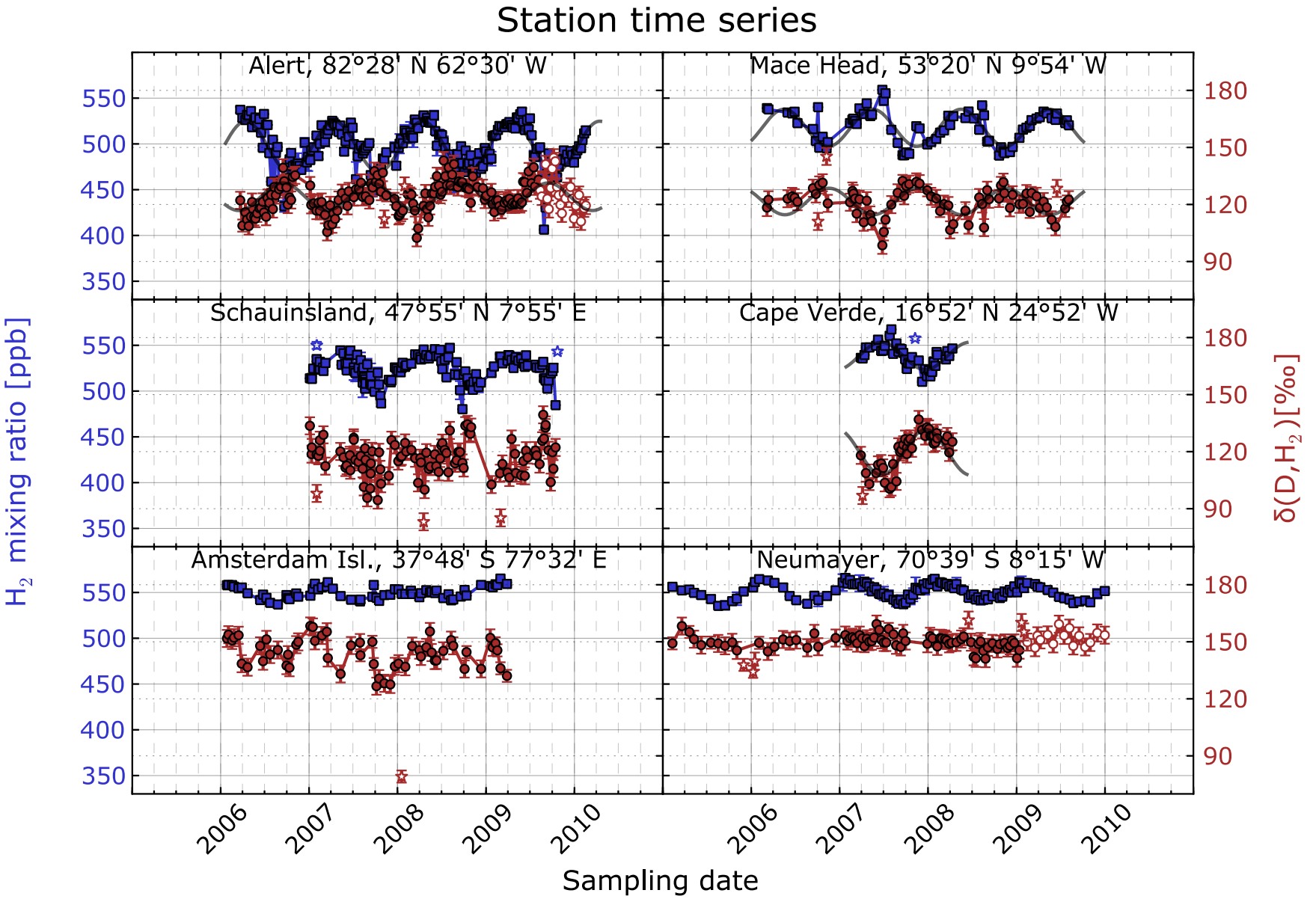
The EUROHYDROS network

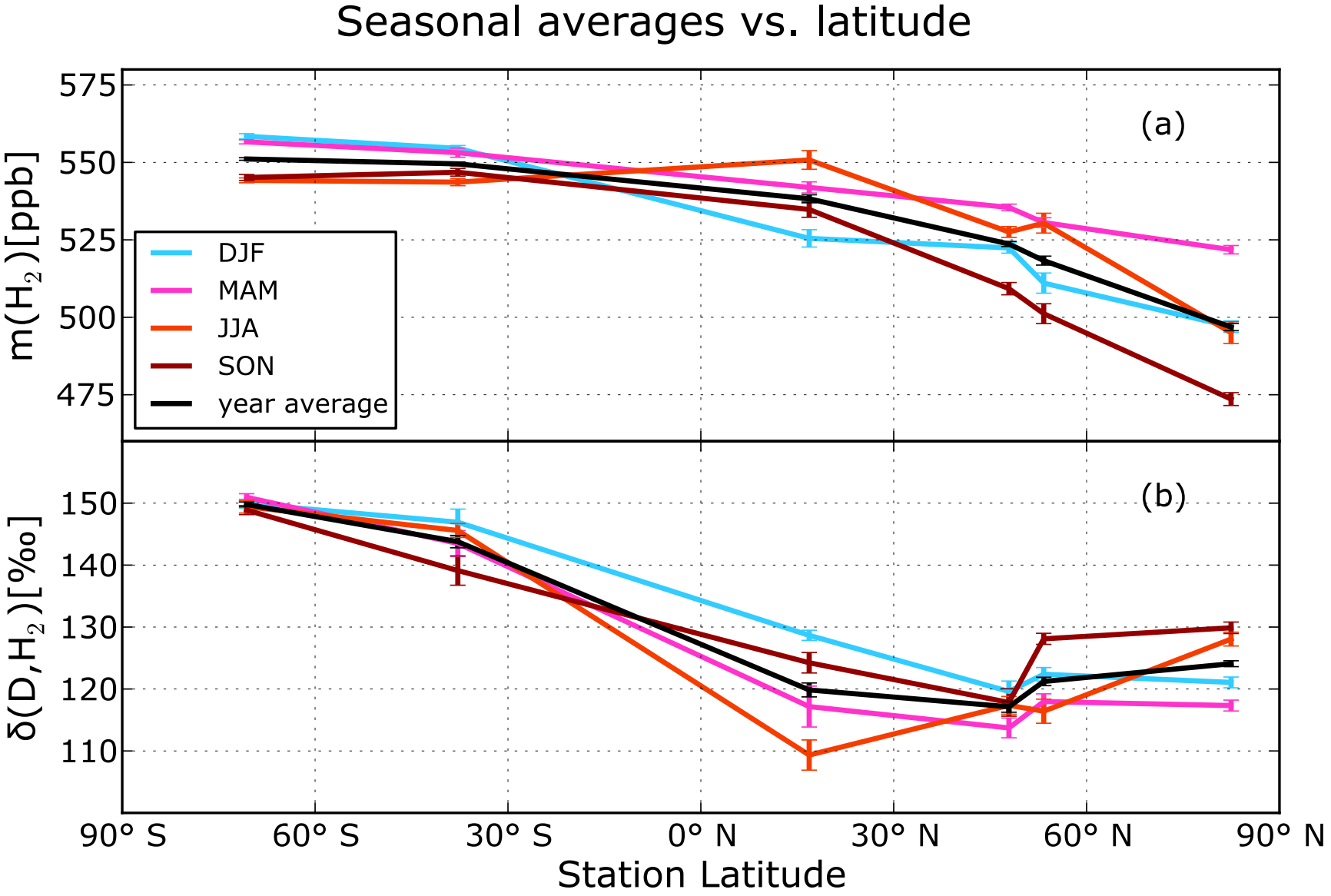


Batenburg et al., 2011
http://www.atmos-chem-phys.net/11/6985/2011/acp-11-6985-2011.html

EUROHYDROS data



EUROHYDROS data



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Stratospheric H_2 cycle

CH_4

Source: Hydrocarbon oxidation

Enriched in D

H_2

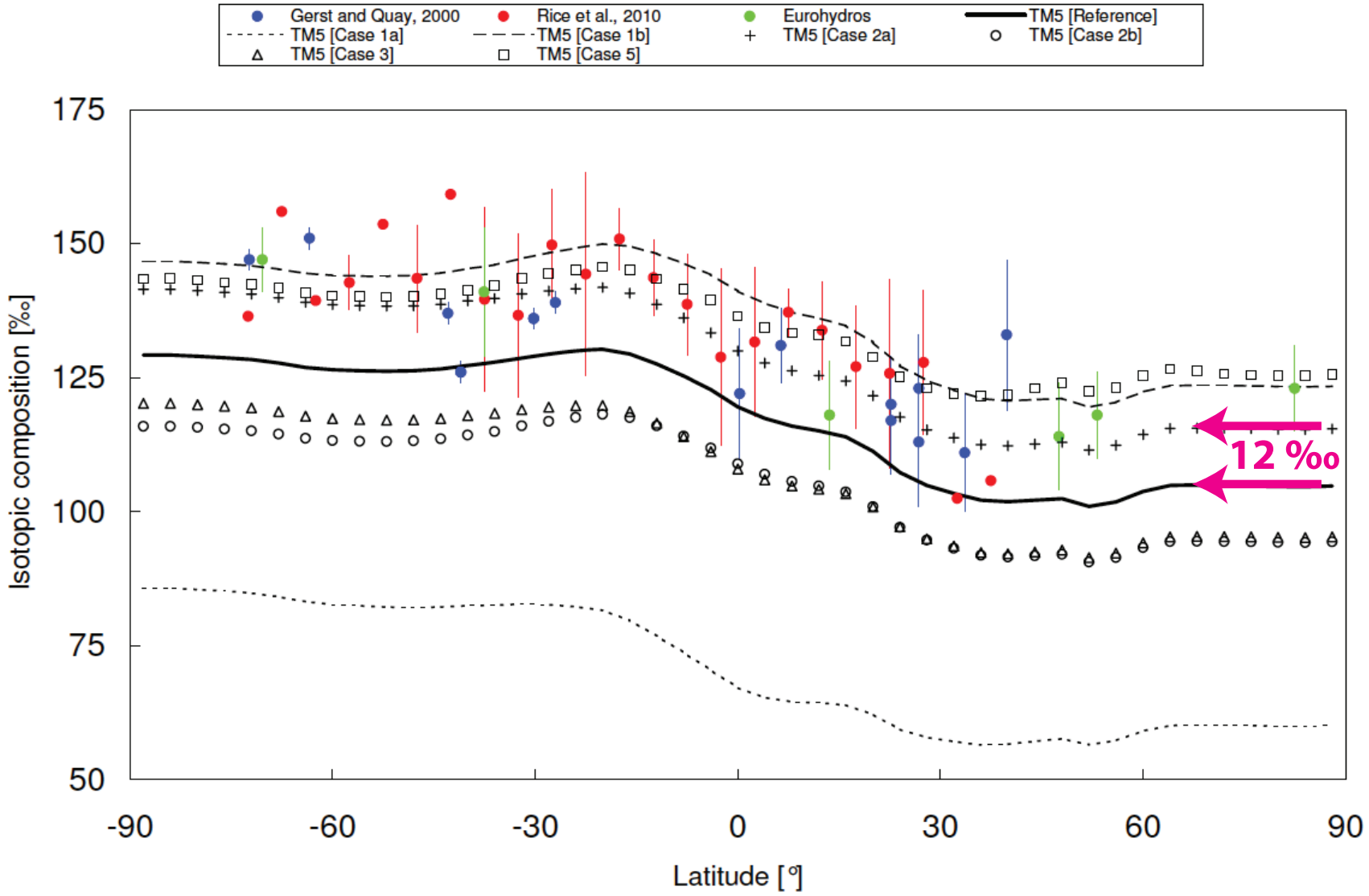
Sink: Oxidation by OH

Preferentially removes H

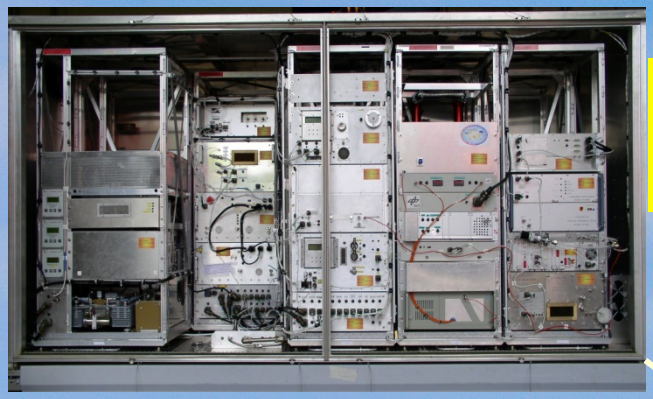
H_2O

Result of stratospheric processing: H_2 mixing ratio changes little, while δD increases dramatically.

Stratospheric input



Pieterse et al., 2011
http://www.atmos-chem-phys.net/11/7001/2011/acp-11-7001-2011.html



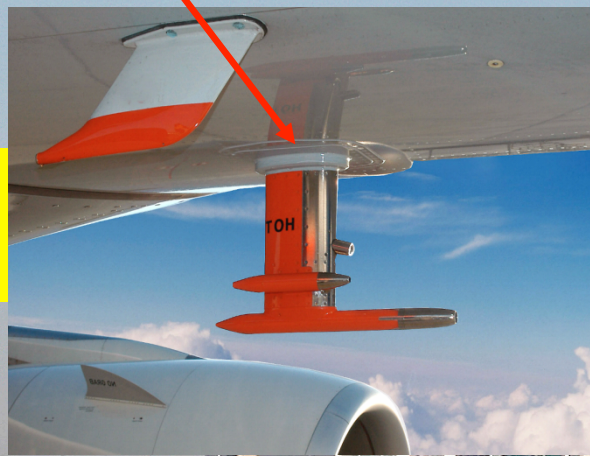
CARIBIC measurement container

Mass 1.5 ton Deployment monthly

Cargo door

Airbus
A 340-600

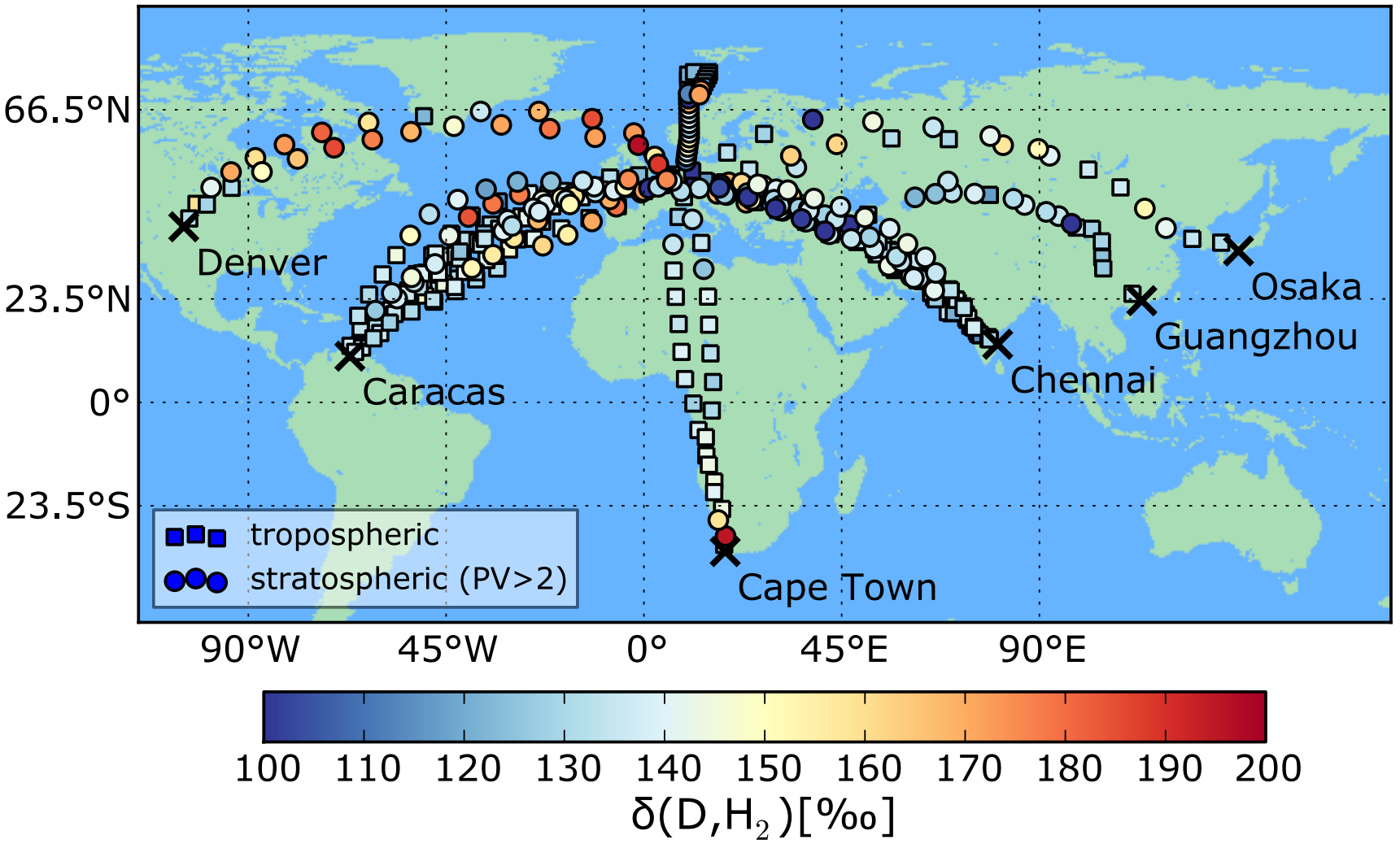
D-AIHE



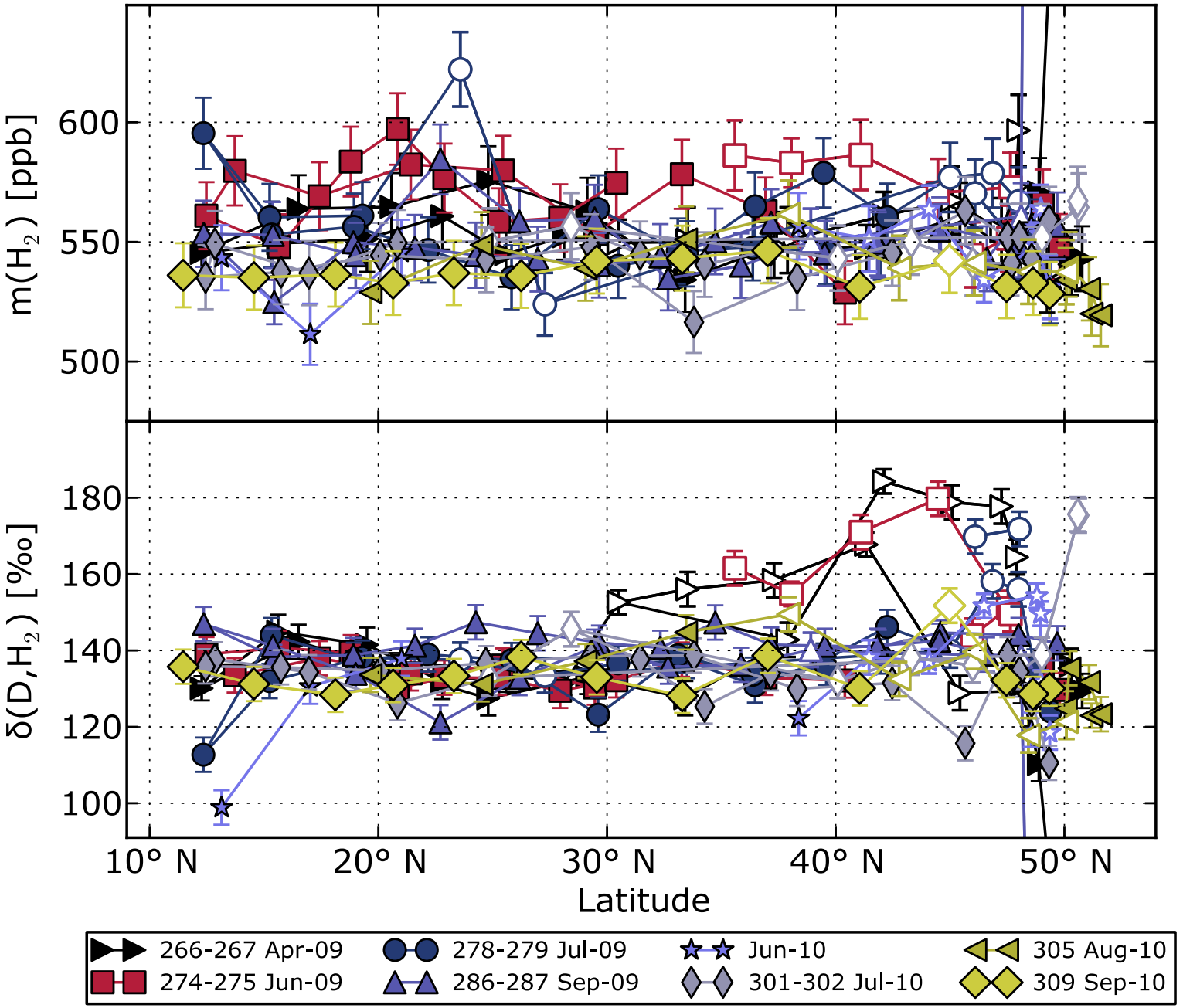
Air inlet system

Permanent part

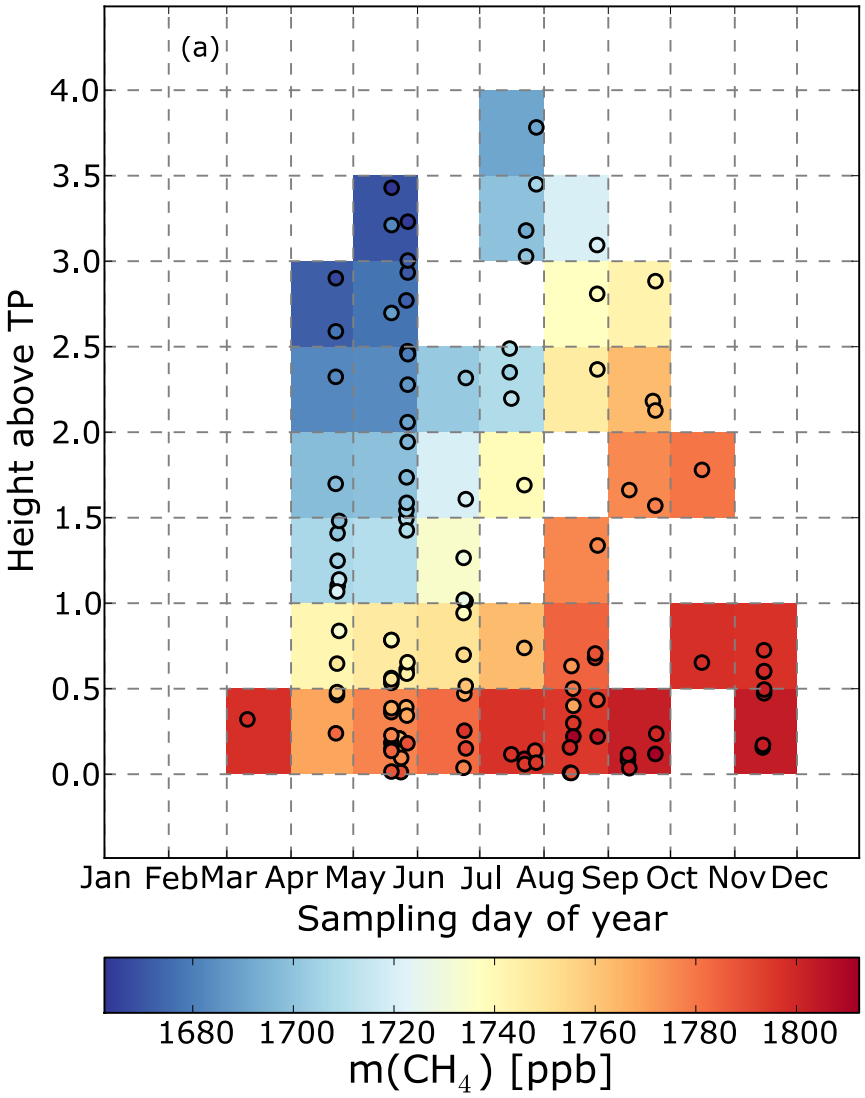
Sampling locations

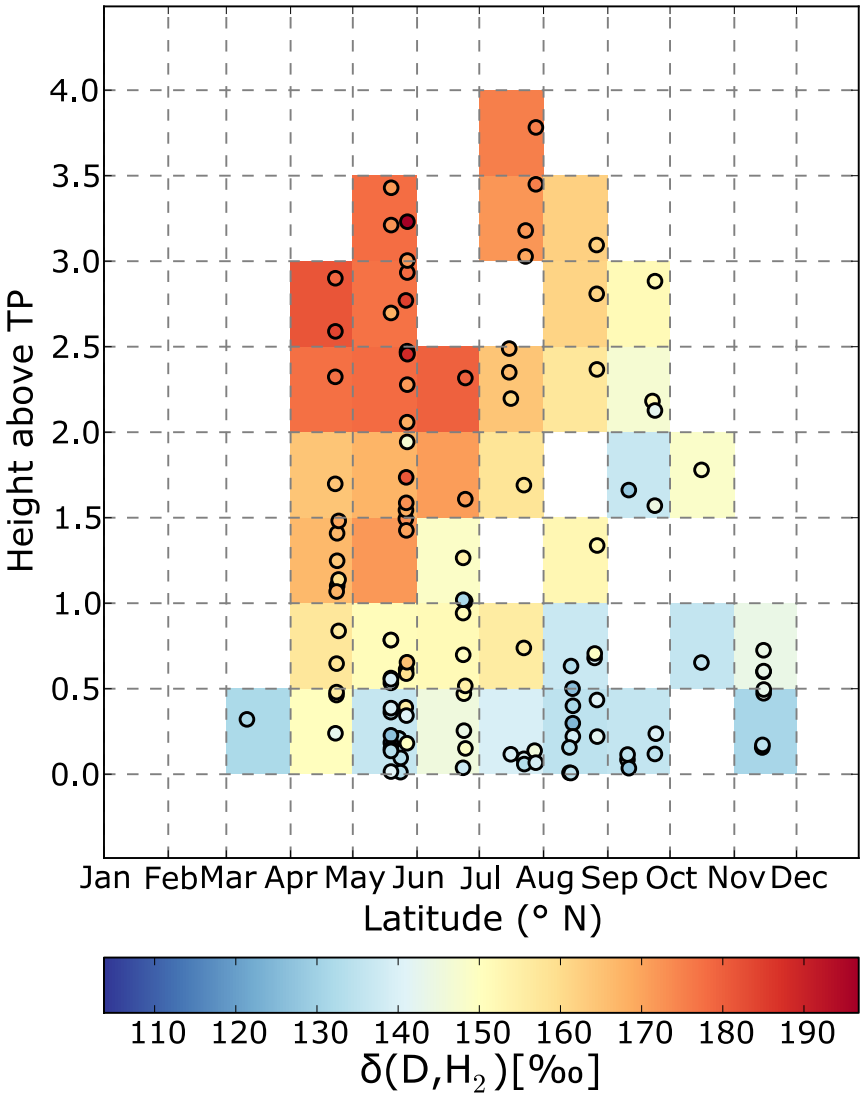


Example: Caracas flights



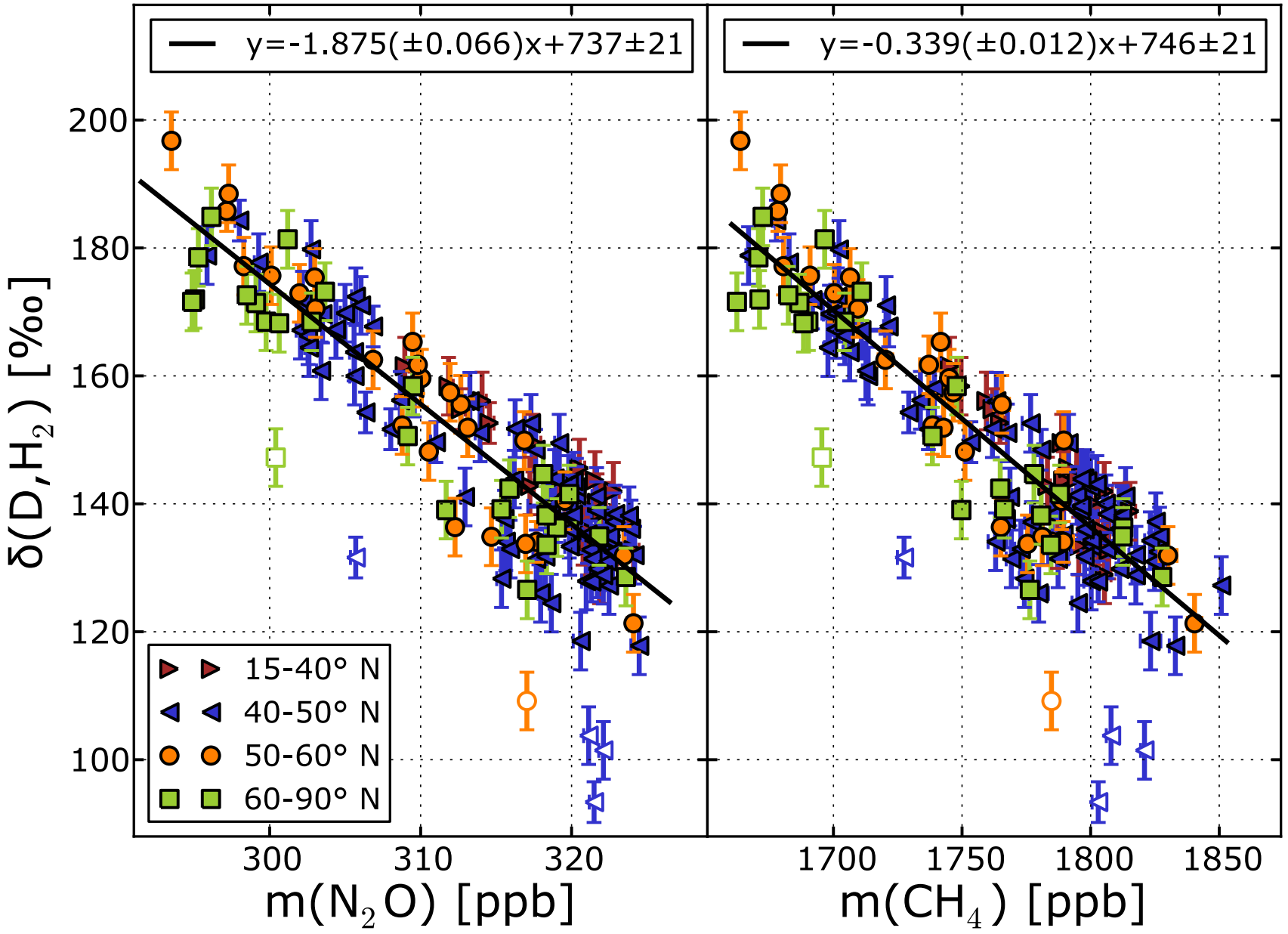
Stratospheric samples





$\delta D(H_2)$ `mirrors' methane

Stratospheric correlations



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Summary

We've collected δD data from the **ground** and **around the tropopause**

Ground:

- Information obtained on seasonal cycles and latitudinal variation

LMS:

- No change in m(H_2)
- *δ*D increases with stratospheric age
- Tight correlations with other species that can improve models