Atmospheric molecular Hydrogen measurements in the RAMCES network

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Outline

- Hydrogen budget
- Measurement system
  - Description
  - Quality control
  - Comparison exercices
- Data
  - Flask
  - In-situ
    - Local scale: Gif-sur-Yvette
    - Regional scale: Trainou tower
- Conclusion and work in progress

Hydrogen Budget

40 ± 10

CH4, VOC

17 ± 5

OH radical

Fossil fuel

Biomass burning

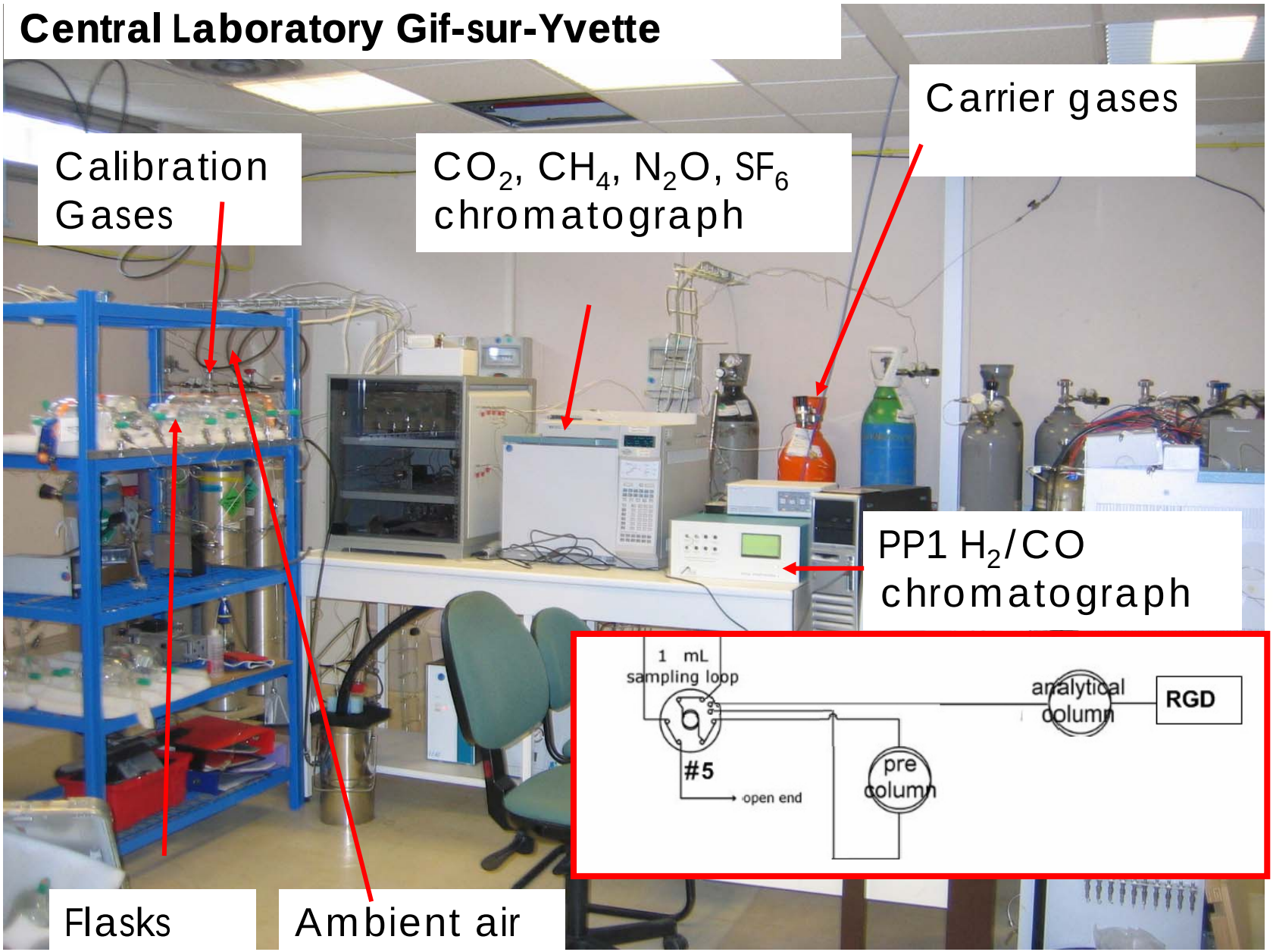
Soil sink

Ocean, vegetation

Measurement system

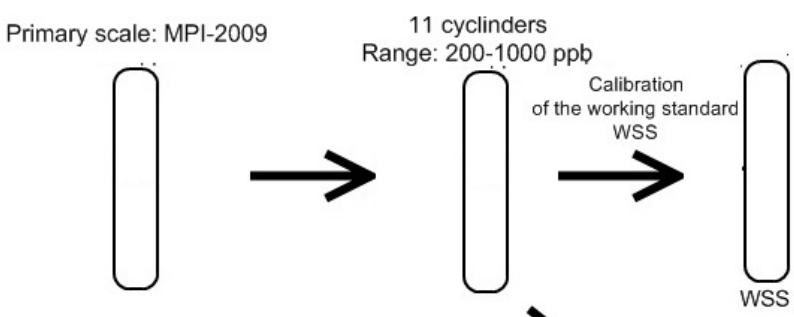
Description

Central Laboratory Gif-sur-Yvette

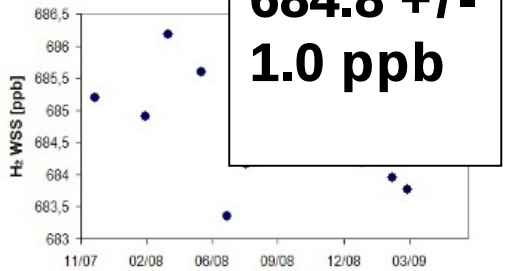


Measurement system

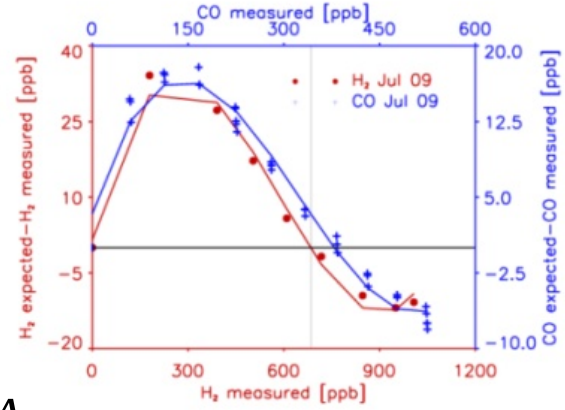
Quality control



684.8 +/- 1.0 ppb



Calibration

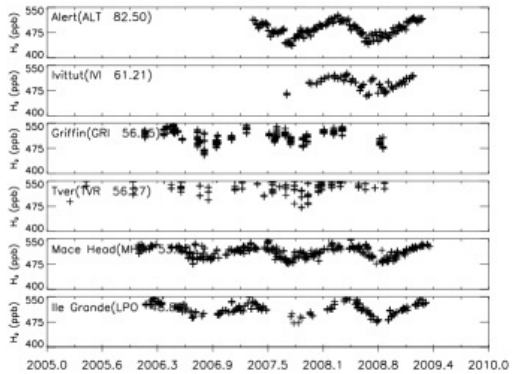


Non-linearity

$$C_{corr} = aC_{raw} + bC_{raw}^2 + cC_{raw}^3 + d$$

$$C_{sample} = C_{etalon} * \frac{A_{sample}}{A_{etalon}}$$

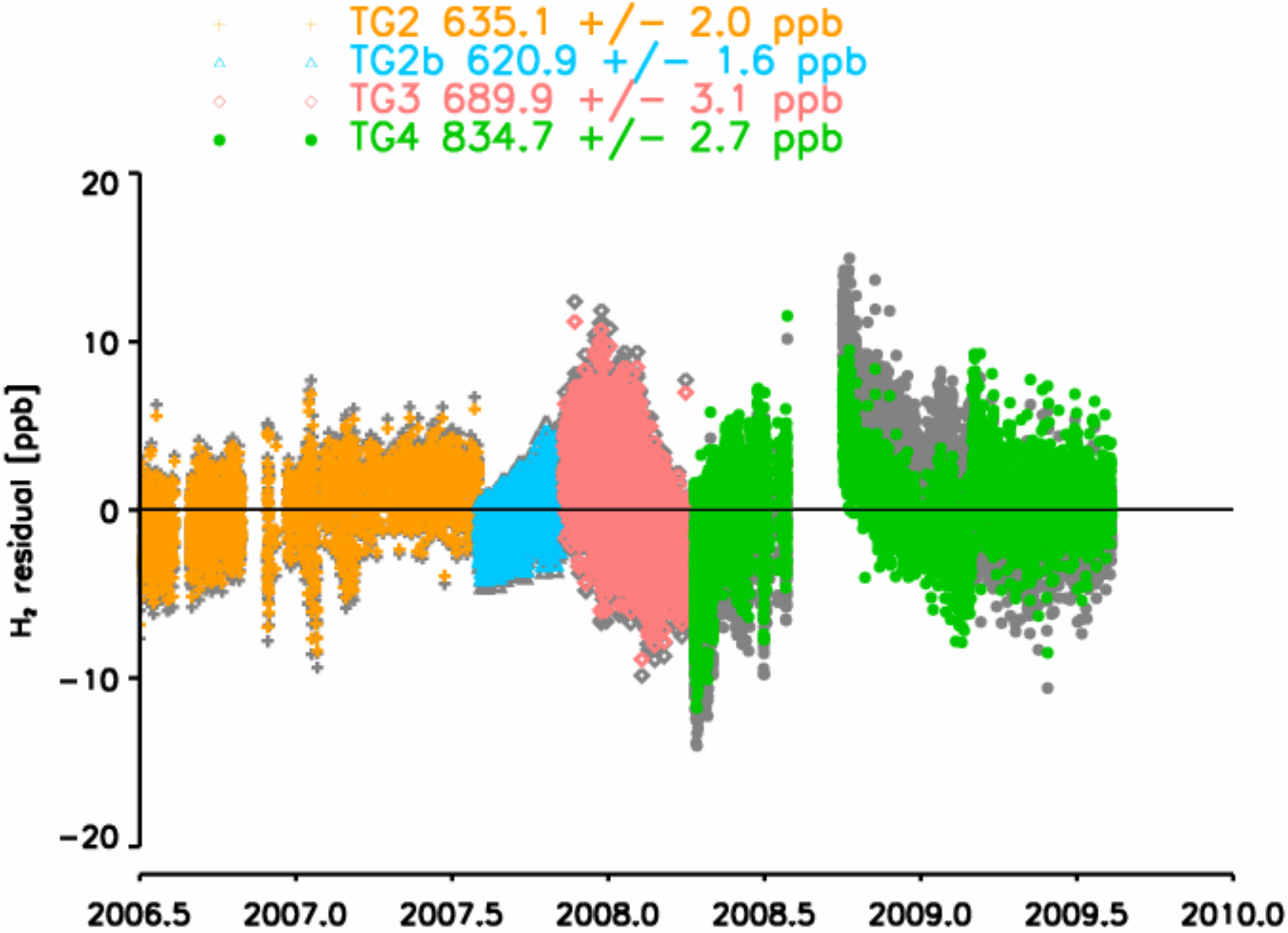
Data



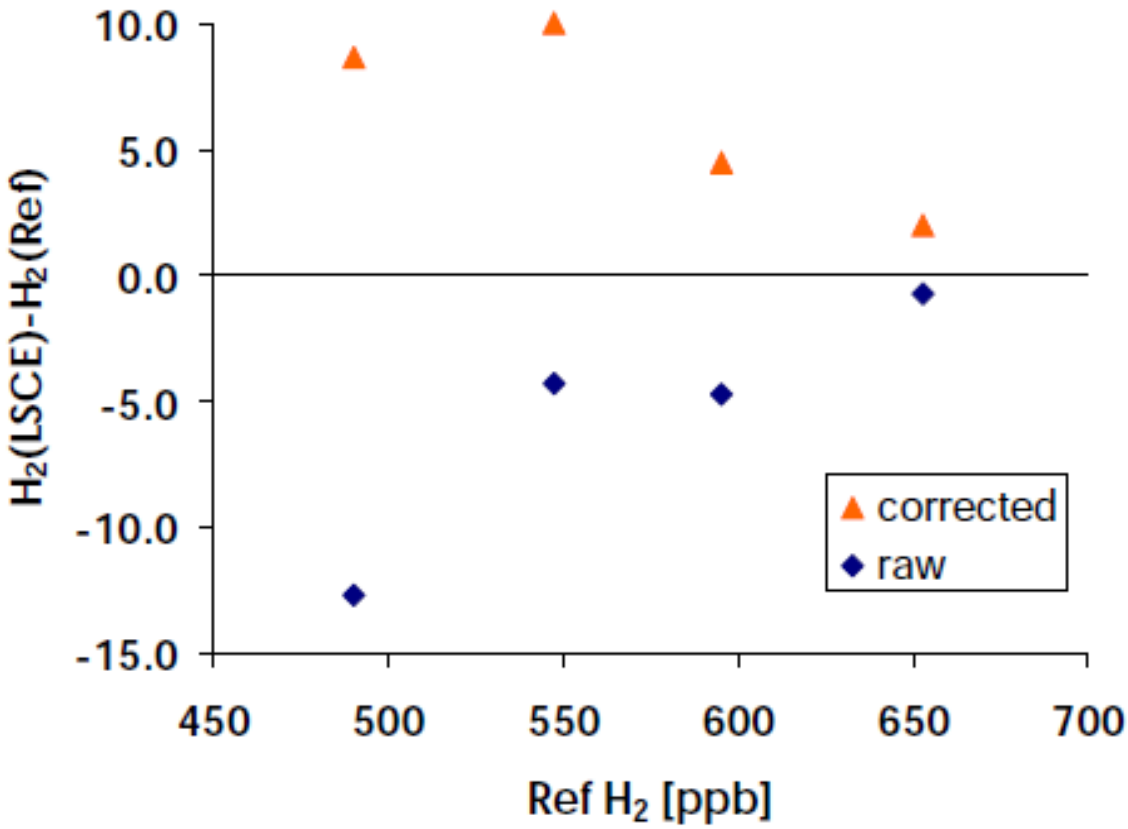
Calibration and non-linearity tests every one to two months

Measurement system

Quality control

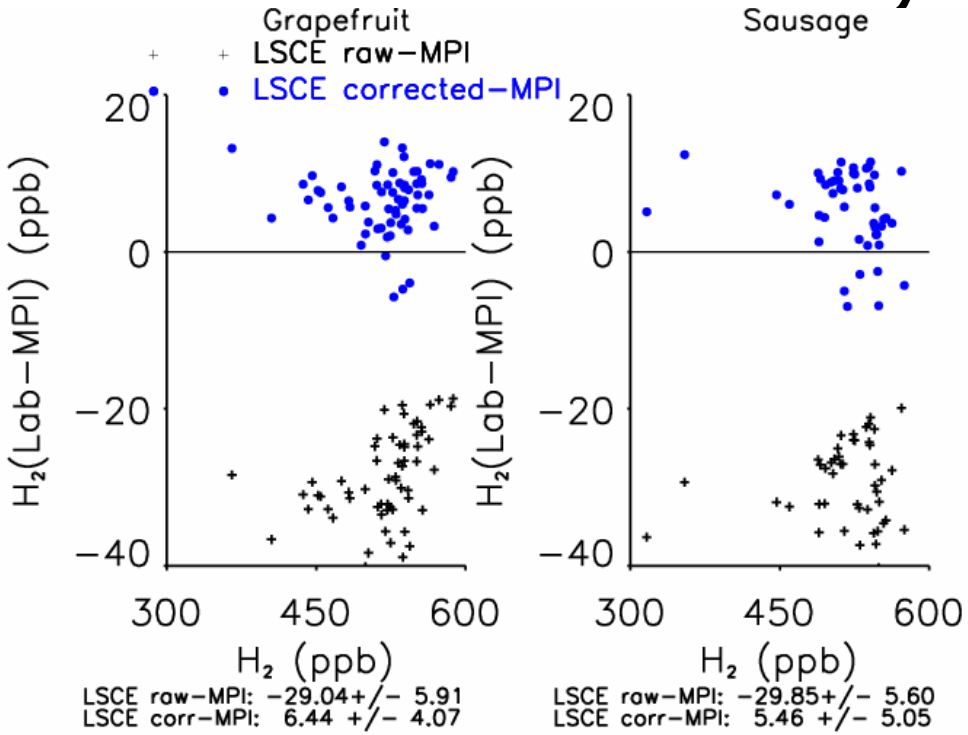


Measurement system Comparaison

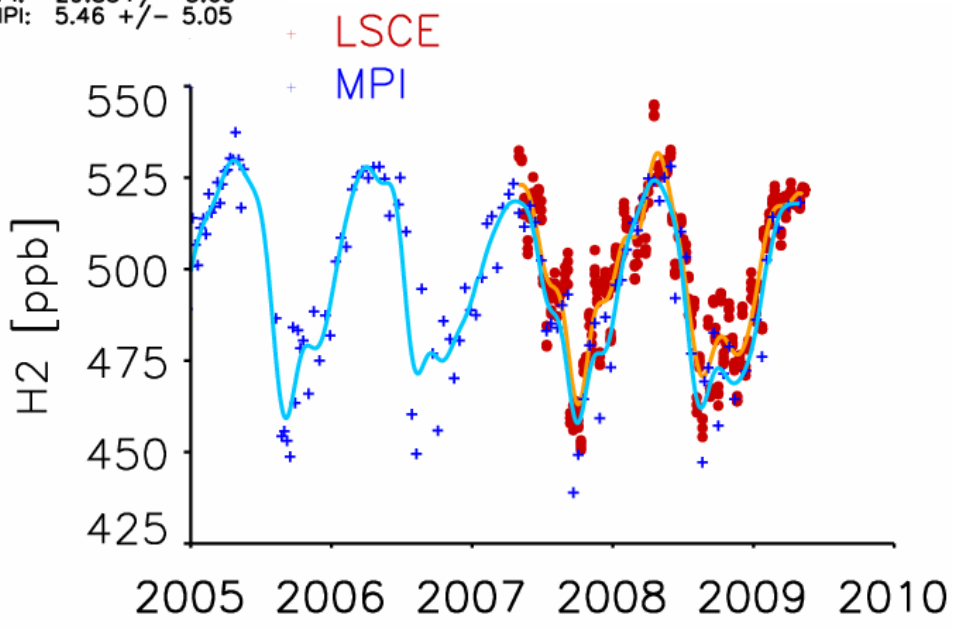


Round Robin: Comparison with MPI-BGC within EUROHYDROS project (MPI-BGC data courtesy of A. Jordan)

Measurement system Comparaison



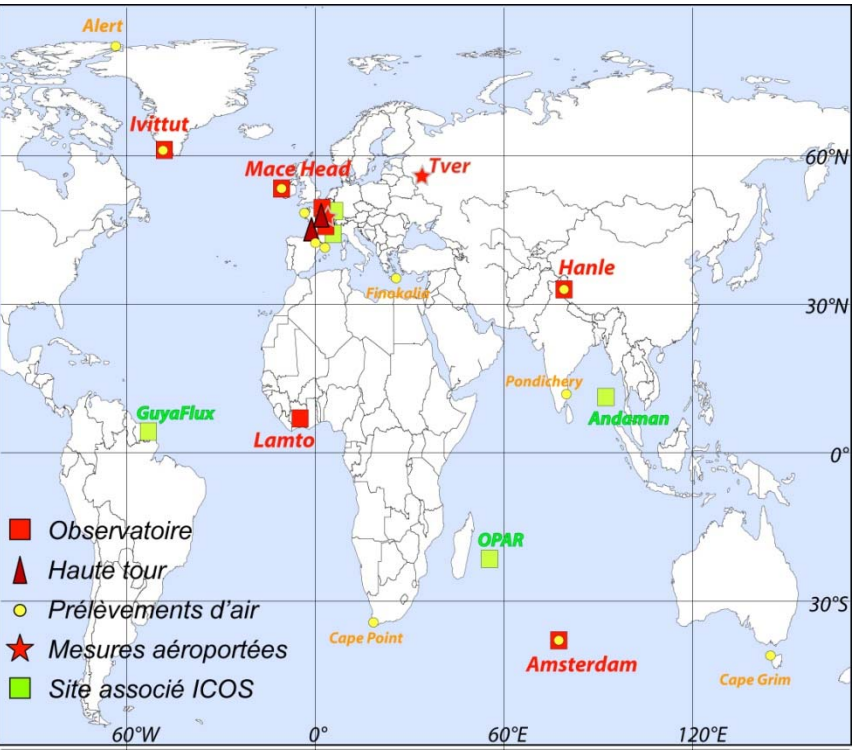
CarboEurope/IMECC Flask comparaison with MPI-BGC: mean difference around **6 ppb**

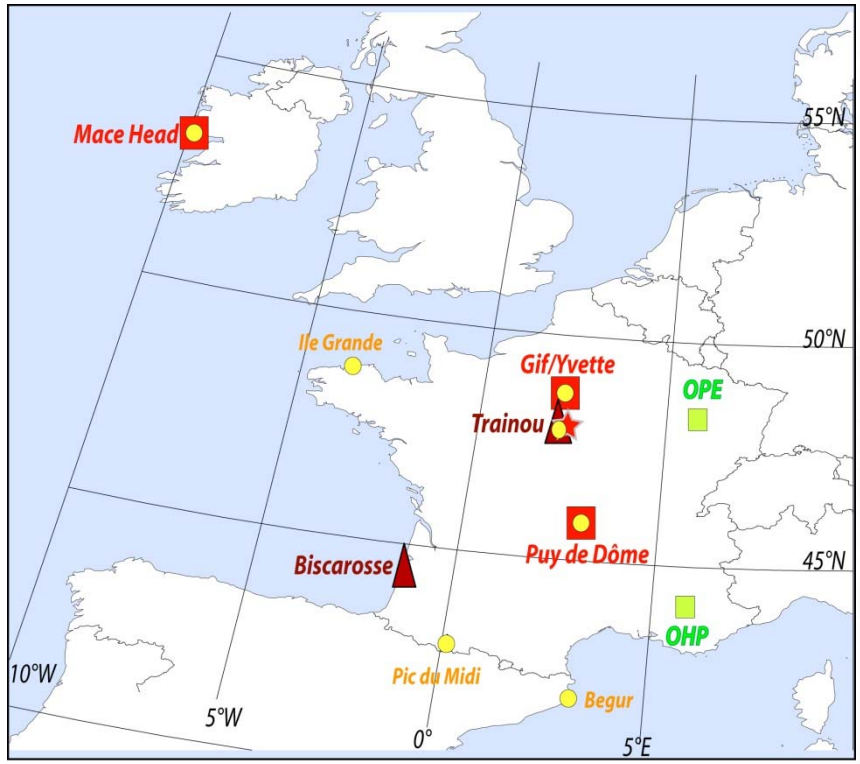


Alert: Comparison with MPI-BGC

(MPI-BGC data courtesy of A. Jordan)

Flasks data

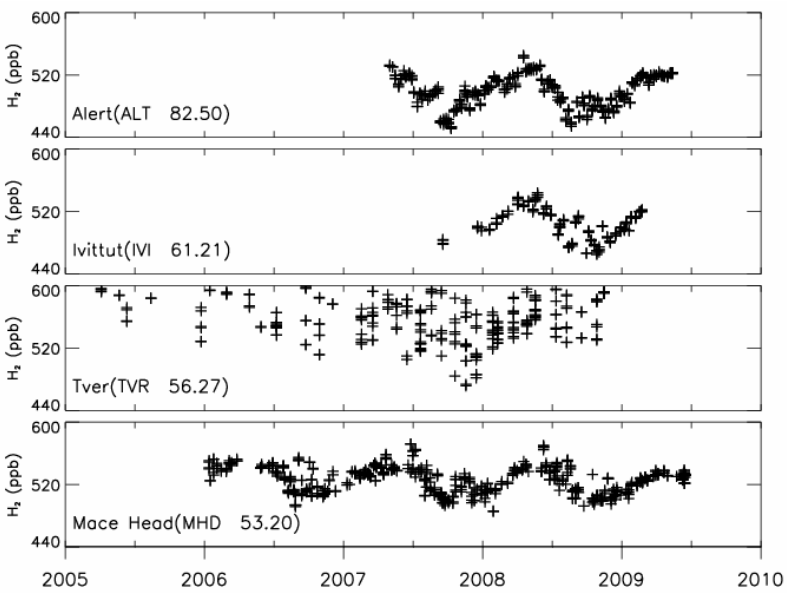


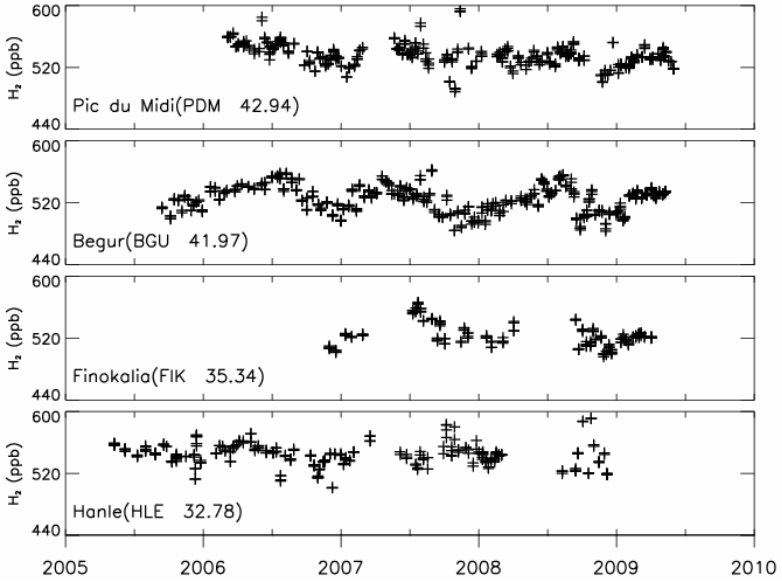


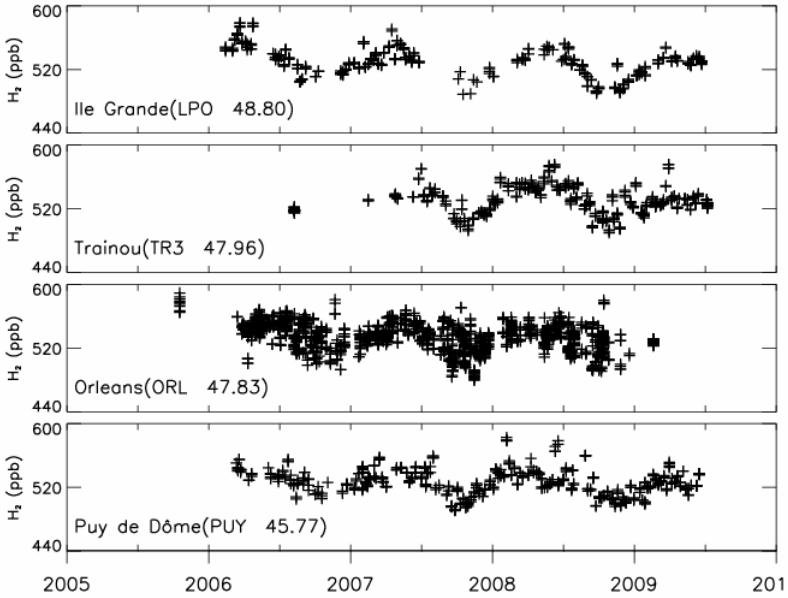
H_2 data from 15 ground sampling and 2 airborne sampling sites:

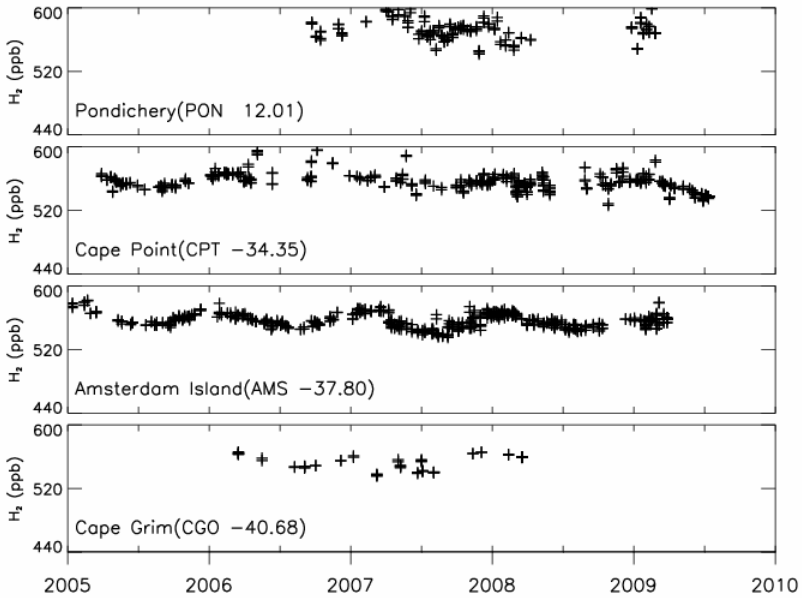
- 6 french sites
- 13 northern hemisphere sites
- 1 tropical site
- 3 southern hemisphere sites

Flasks data


H₂ (ppb)
600
520
440
Alert(ALT 82.50)
Ivittut(IVI 61.21)
Tver(TVR 56.27)
Mace Head(MHD 53.20)
2005
2006
2007
2008
2009
2010

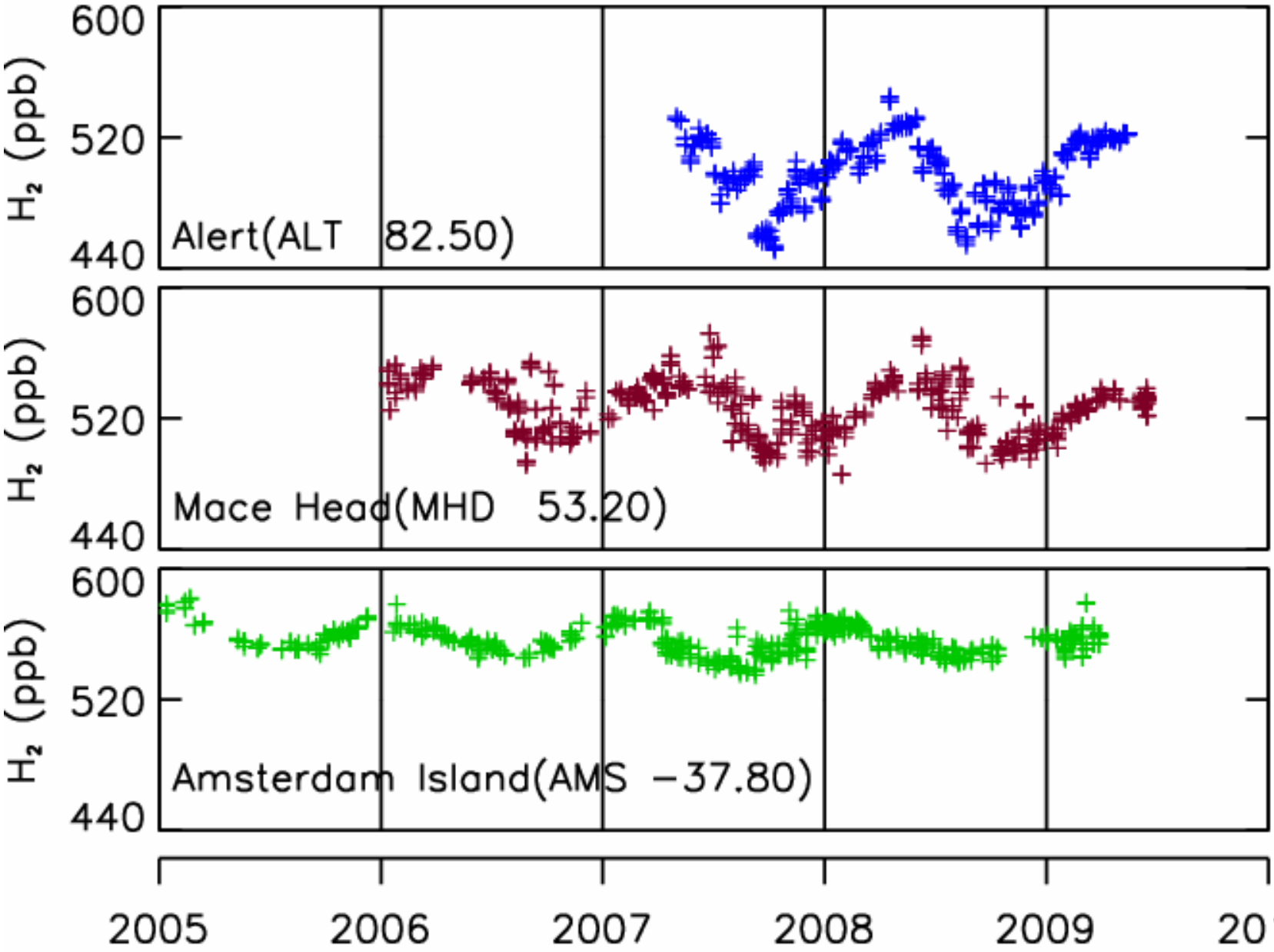

H₂ (ppb)
600
520
440
Pic du Midi(PDM 42.94)
Begur(BGU 41.97)
Finokalia(FIK 35.34)
Hanle(HLE 32.78)
2005
2006
2007
2008
2009
2010


H₂ (ppb)
600
520
440
Ile Grande(LPO 48.80)
Trainou(TR3 47.96)
Orleans(ORL 47.83)
Puy de Dôme(PUY 45.77)
2005
2006
2007
2008
2009
201

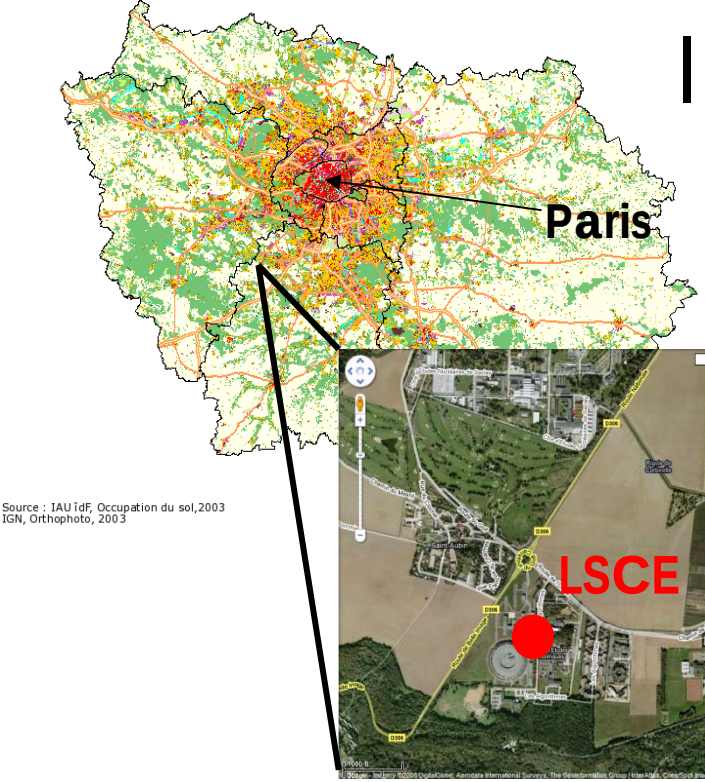

H₂ (ppb)
600
520
440
Pondichery(PON 12.01)
Cape Point(CPT −34.35)
Amsterdam Island(AMS −37.80)
Cape Grim(CGO −40.68)
2005
2006
2007
2008
2009
2010

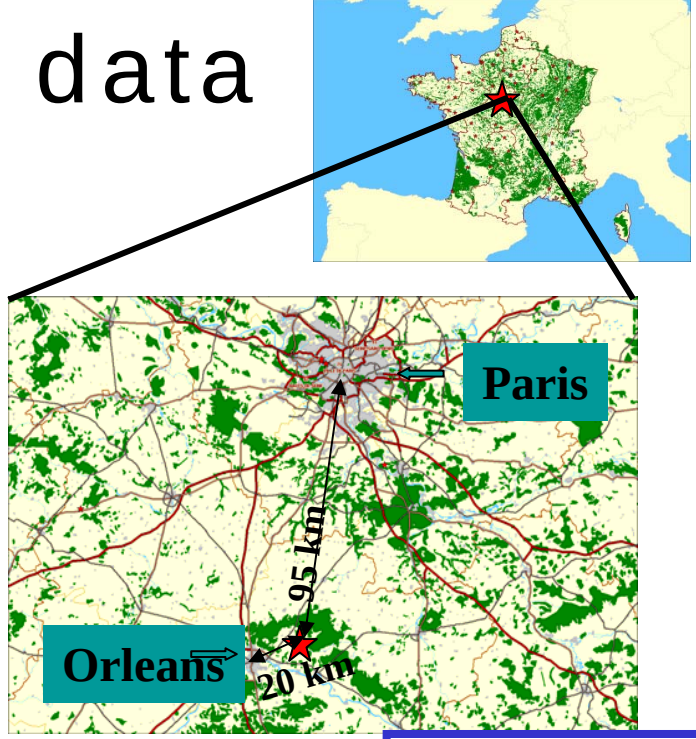

INSU
CNRS

Flasks data


600
520
440
H₂ (ppb)
Alert(ALT 82.50)
Mace Head(MHD 53.20)
Amsterdam Island(AMS −37.80)
2005
2006
2007
2008
2009
2010

In-situ data

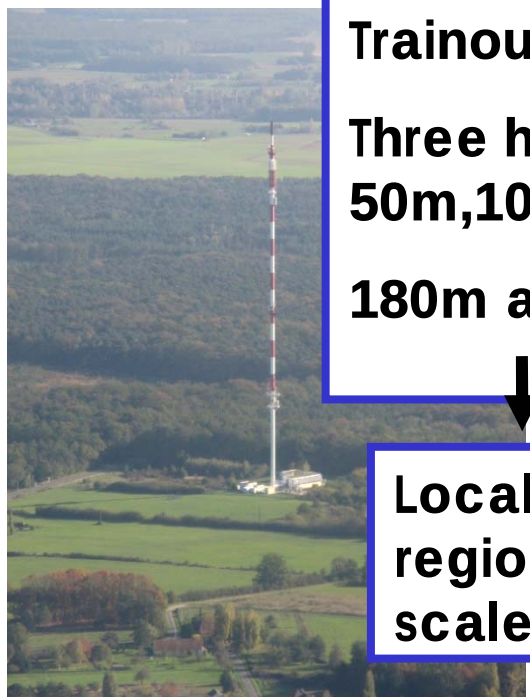




Gif-sur-Yvette

7m agl

Local scale



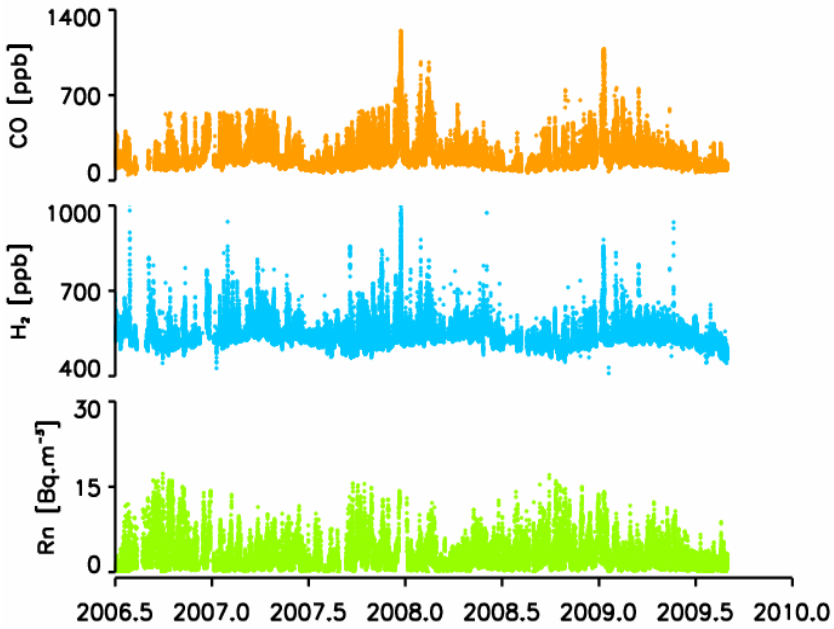
Trainou:

Three heights: 50m,100m,

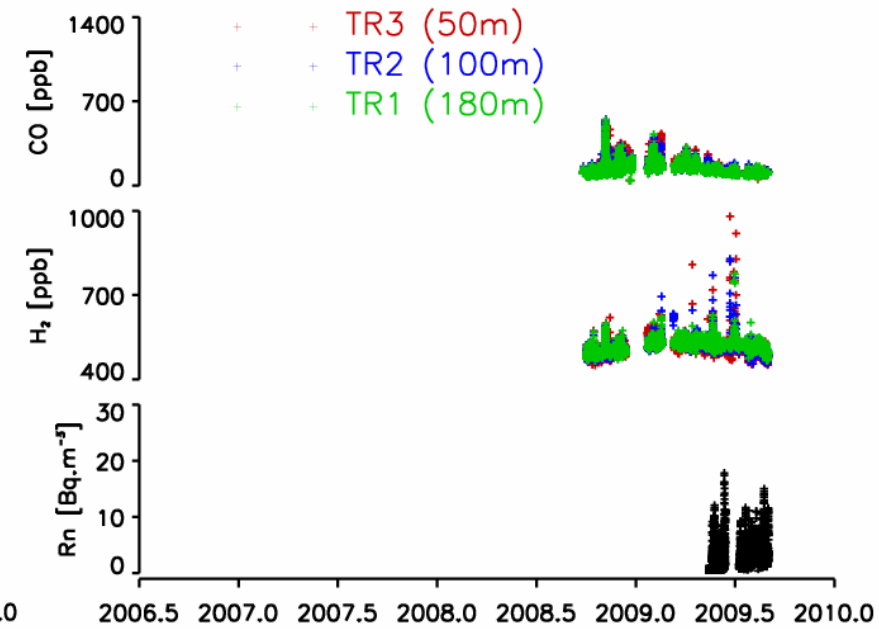
180m agl

Local to regional scale

In-situ data



Gif-sur-Yvette

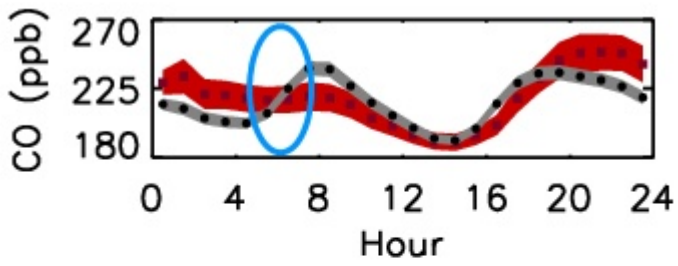


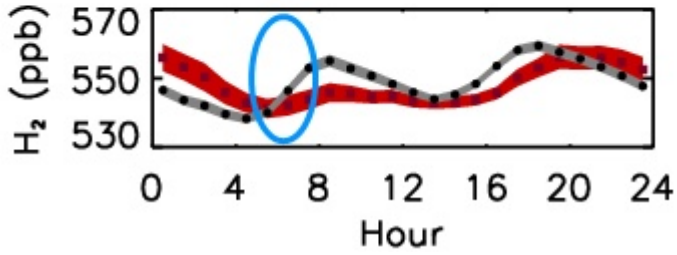
Trainou

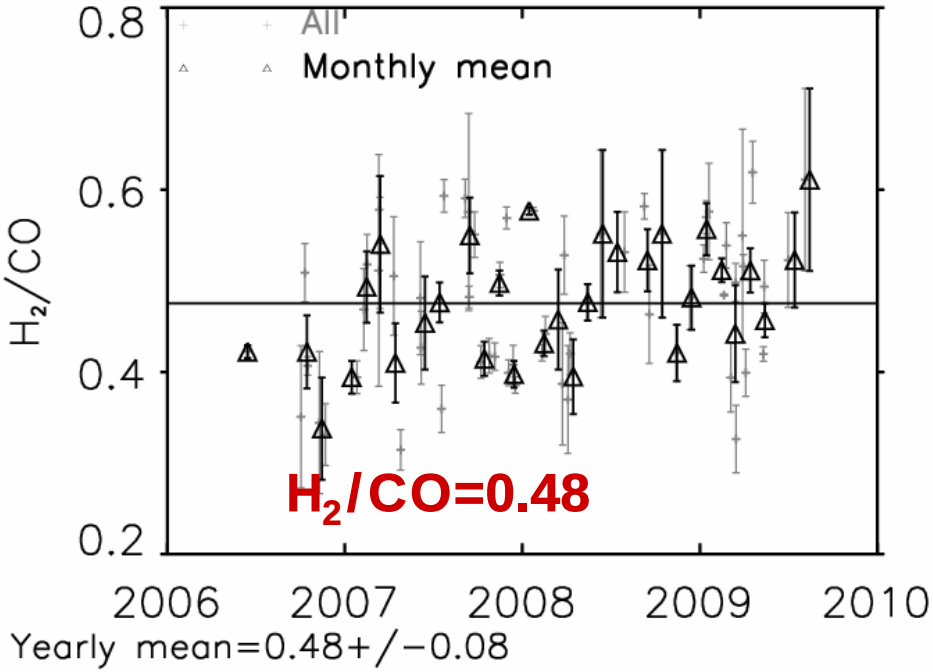
In-situ data **Gif-sur-Yvette**

* Monday to Friday

* Week-end





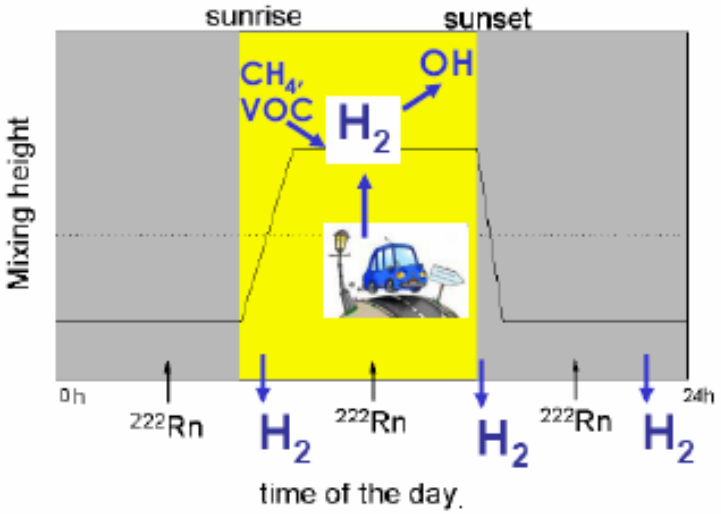


See Yver et al. JGR 2009

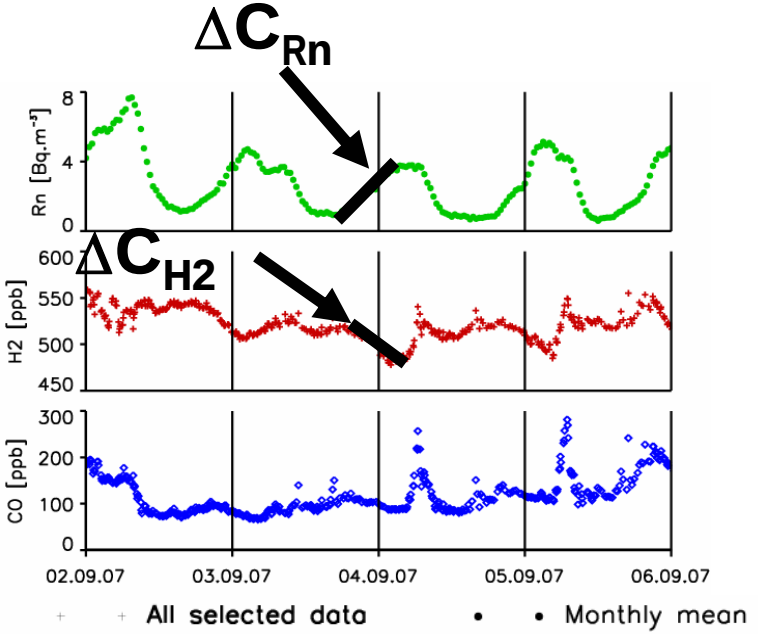
H_2/CO traffic ratio

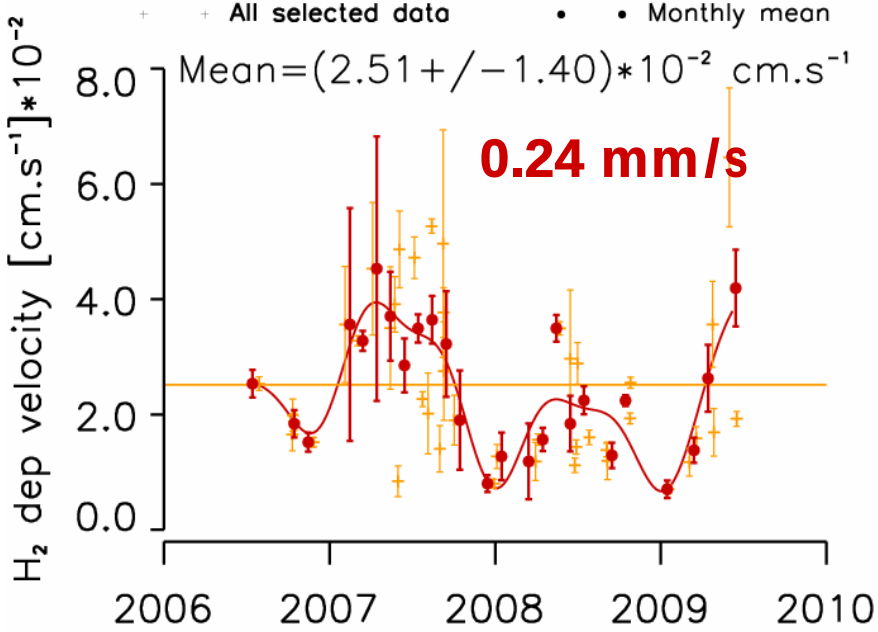
In-situ data Gif-sur-Yvette

Radon Tracer Method:



$$\bar{j}_{H2} = \bar{j}_{Rn} \frac{\Delta C_{H2}}{\Delta C_{Rn}} * \alpha$$

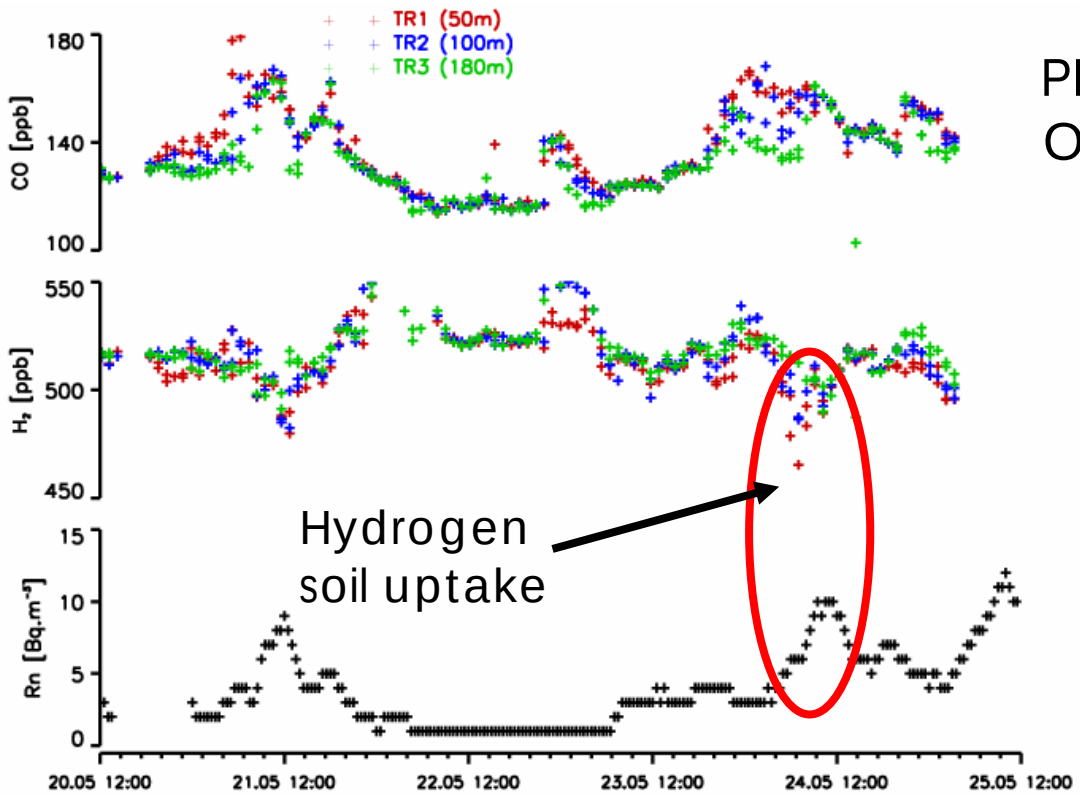




See Yver et al. JGR 2009

Hydrogen soil uptake

In-situ data Trainou



PP1 H_2/CO installed in October 2008

Radon-222 analyser installed in 05/09

Conclusion

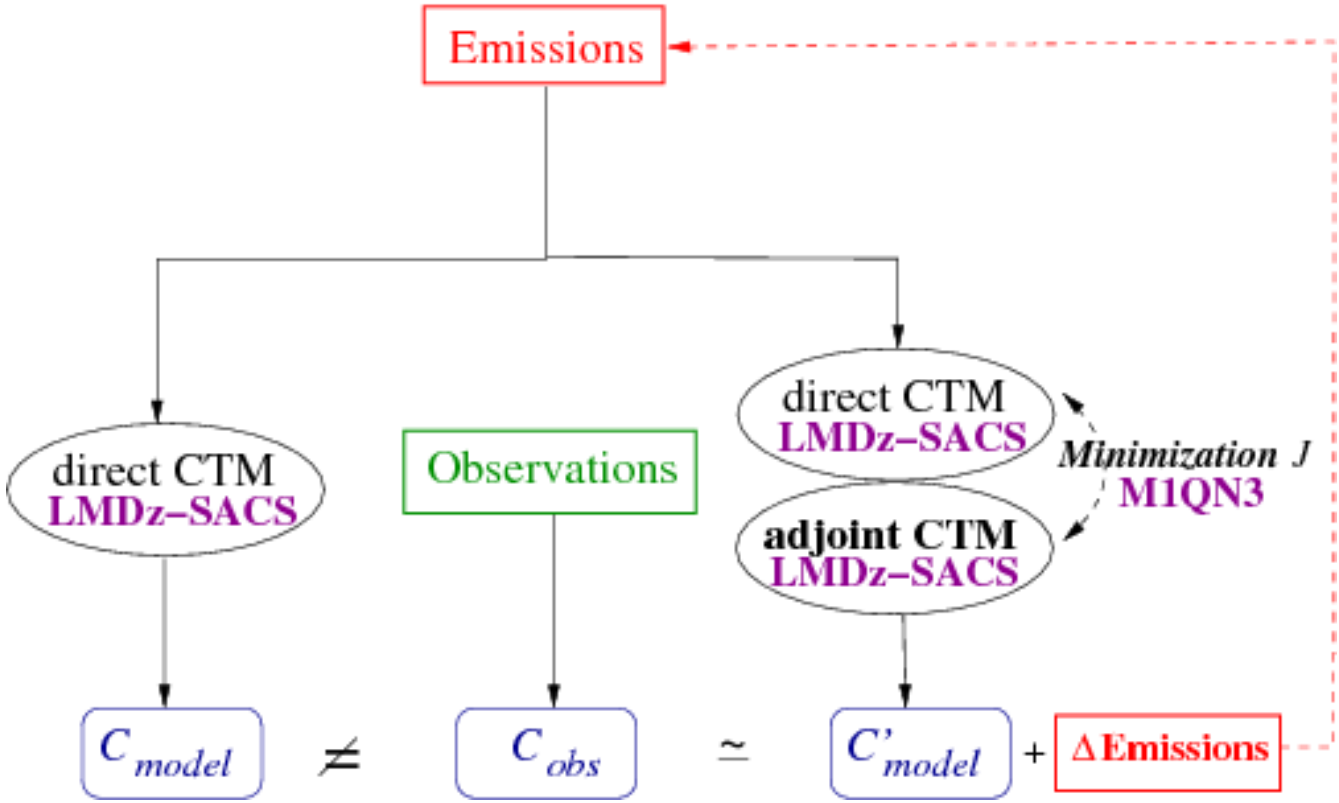
-Two H_2/CO GC (PP1) optimized and characterized to analyze atmospheric H_2 in the RAMCES network

- H_2 mixing ratios from 17 Flask sites in order to extract information of the H_2 budget on a global scale

-H_2 mixing ratio from 2 in-situ sites to estimate the local and regional H2 sources and sinks (traffic, soil sink)

Work in progress

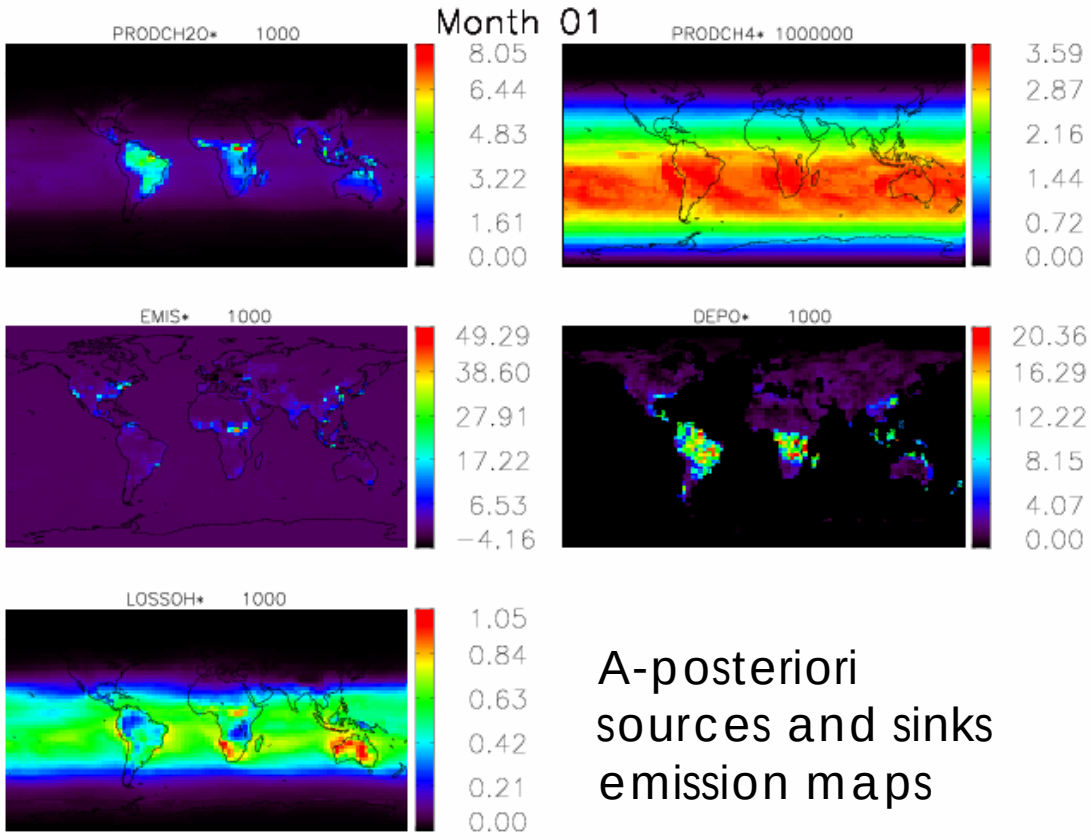
PYVAR: 4Dvar inversion with H_2 from RAMCES and EUROHYDROS networks (2007-2008)



Work in progress

Inversions :

- standard (sources and sinks optimized together)
- separated soil uptake optimization
- separated sources optimization using H_2 isotopes



A-posteriori sources and sinks emission maps

Thank you