

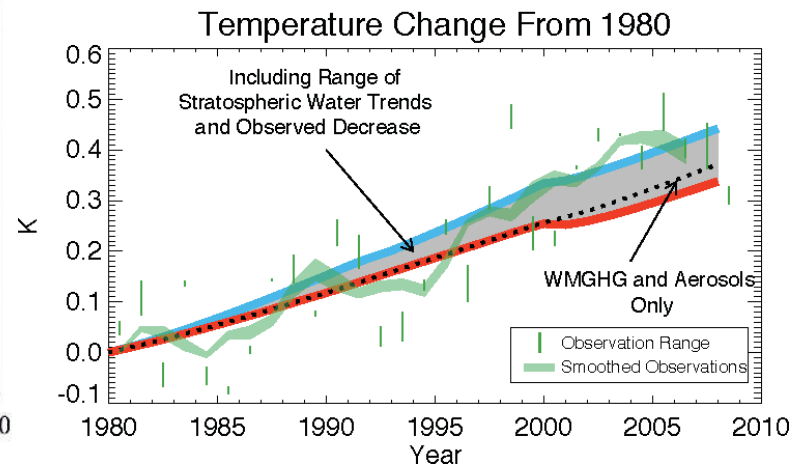
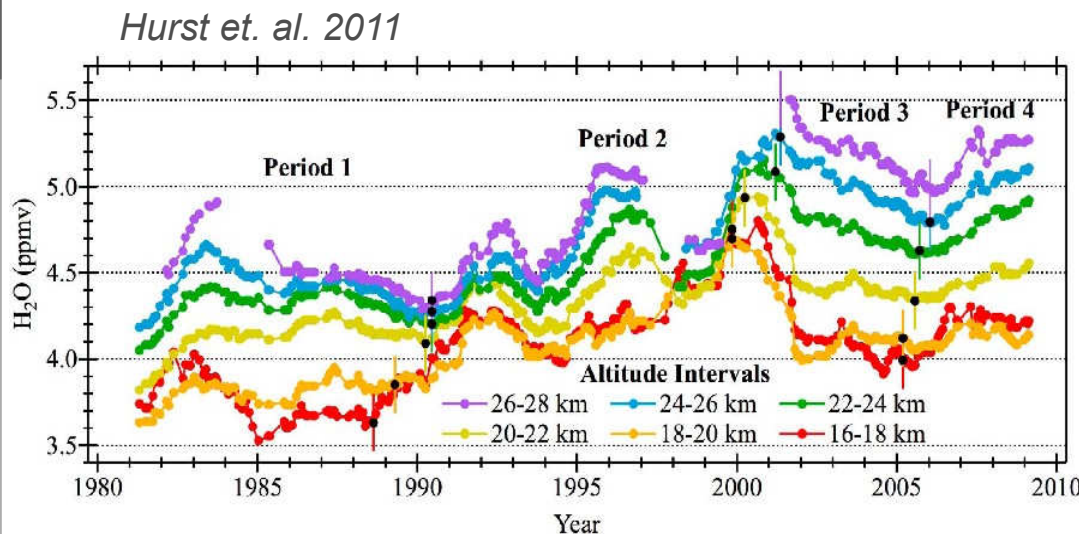
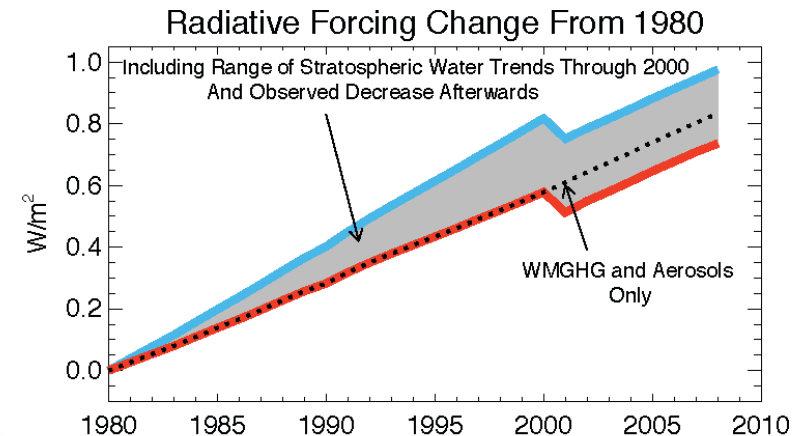
Comparison of FISH total water measurements with other hygrometers

Tim Klostermann, Cornelius Schiller, Martina Krämer, Nicole Spelten,
D. Fahey, J. Smith, R. Herman, D. Hurst, H. Vömel

Climatological impact of water vapour

- annual increase of 0.7%
- year 2000 decrease of 10%
- bottom line 0.5ppmv matters
(for both short and long term changes)

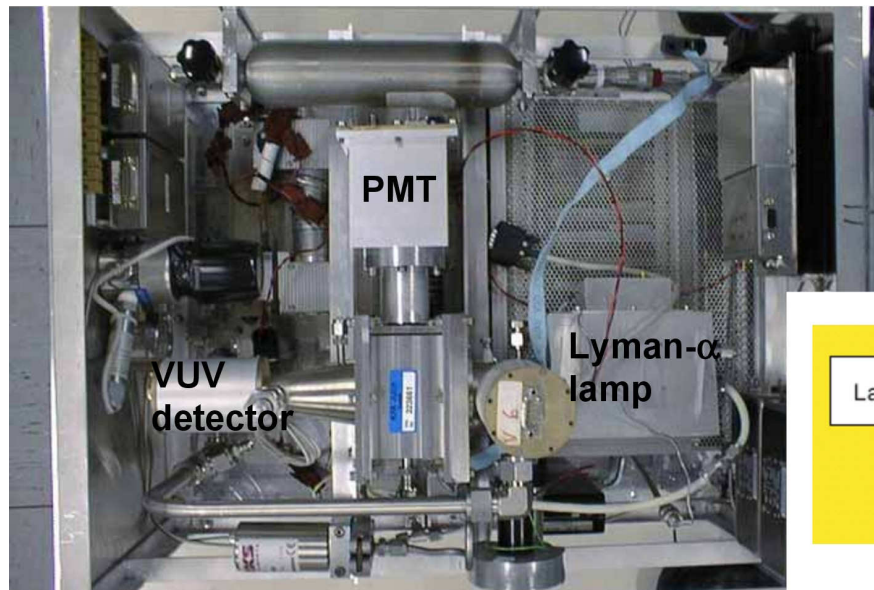
Solomon et. al. 2010



Measurements of UT/LS Water Vapour

- **Platforms: satellites, balloons, aircrafts**
- **In-situ techniques:**
 - Frostpoint hygrometers (FPH, CFH)
 - Lyman-Alpha (**FISH**, HWV)
 - TDLAS (JLH, DLH, CLH, ALIAS, HAI)
 - Mass spectrometer: CIMS
- **Remote sensing:**
 - MLS on AURA, HALOE on UARS, SCIAMACHY on EnviSat

FISH – Fast In-situ Stratospheric Hygrometer



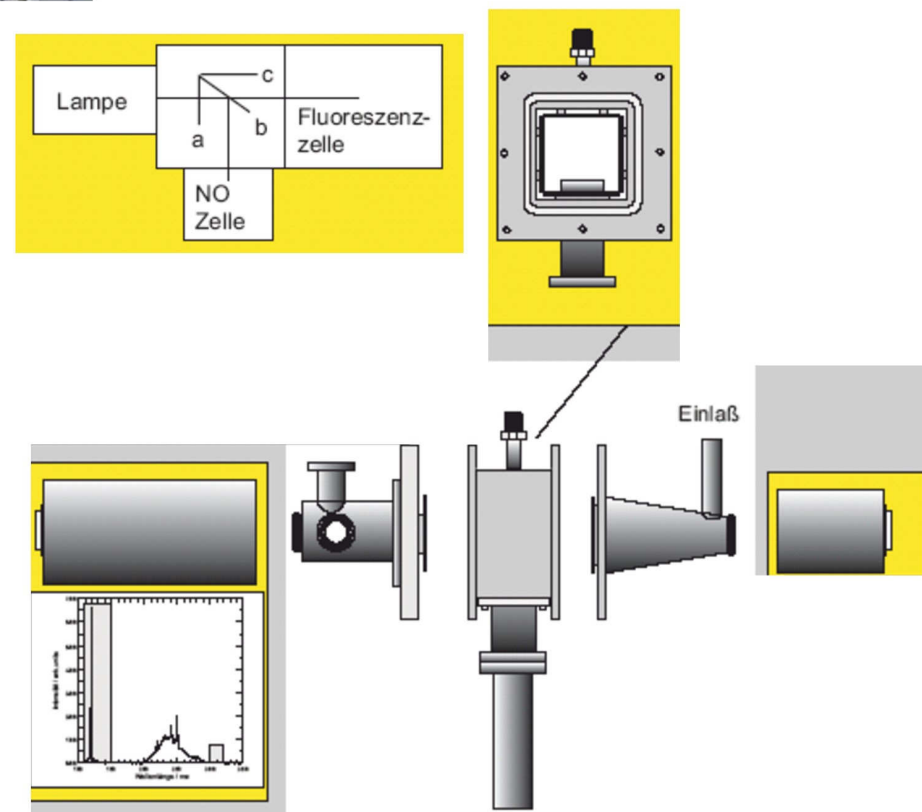
$$H_2O = c_k \frac{\text{fluorescence} - f_u \text{ background}}{\text{intensity}}$$

principle:

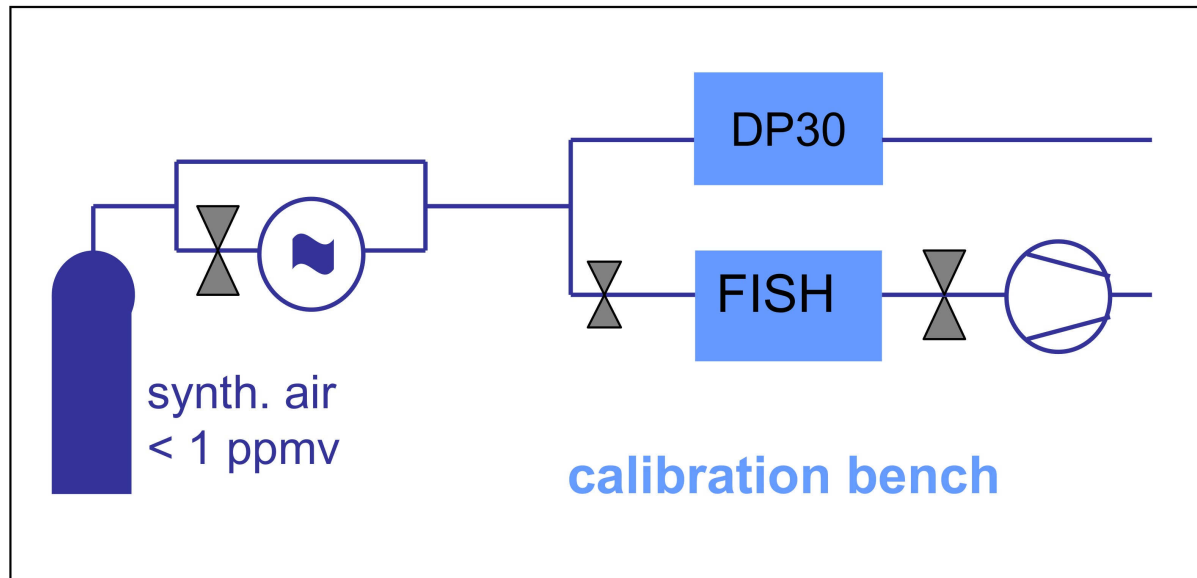
Ly- α photofragment fuorescence



Zöger et al., J . Geophys. Res., 1999



FISH - Jülich calibration bench



- reference: MBW frost point hygrometer
- 1-500 ppmv in 5-8 steps
- 35-350 hPa
- repeated before and after each flight

Water Vapour and Reference Instruments

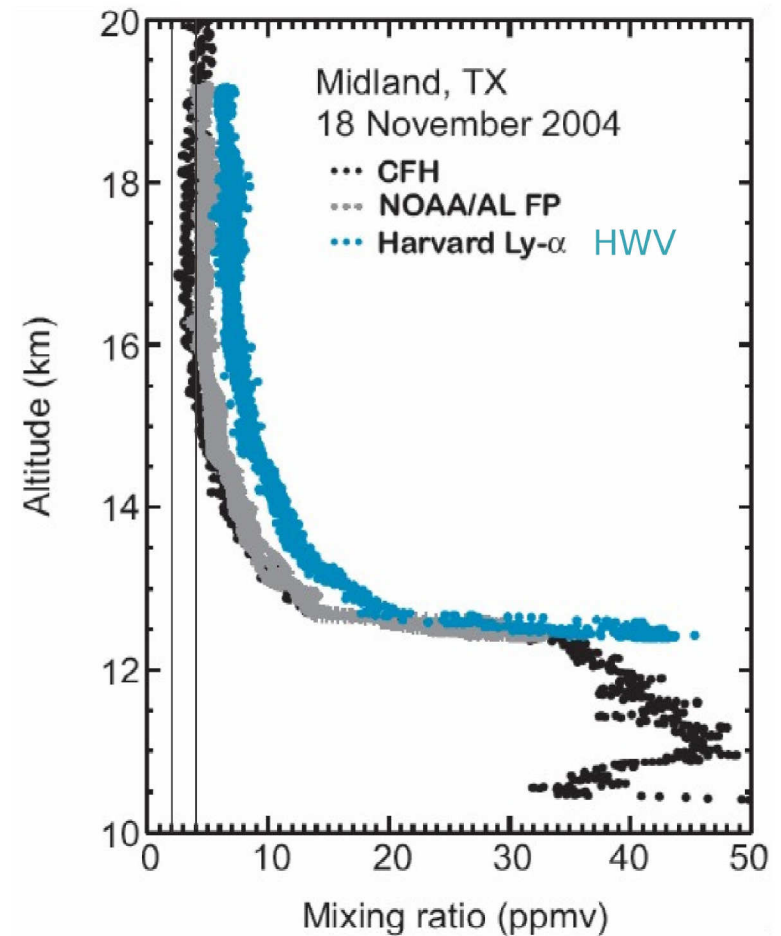
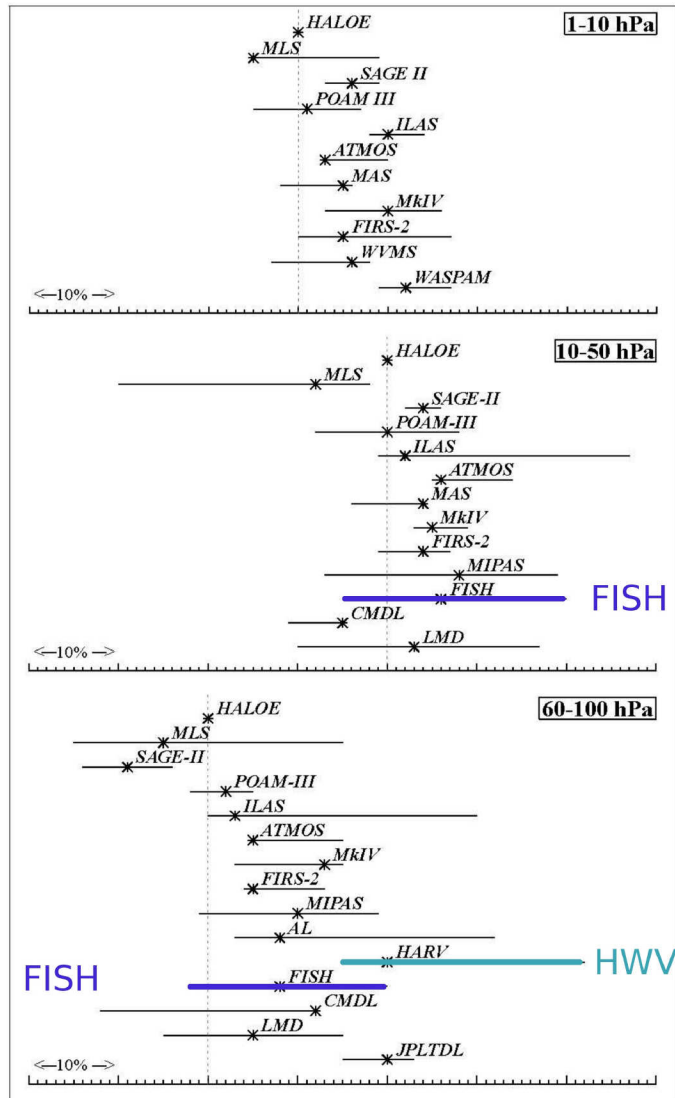
- **FISH**
2x MBW DP30, MBW373,
Thunder humidity generator,
PTB permeation source
- **CIMS**
in-flight (catalytic H₂ conversion),
MBW373,
Elkins standard (gravimetric)
- **HWV**
bubbler,
UV absorption

They seem to agree within 5% or 0.15 ppmv at 3-4 ppmv.

SPARC activities

SPARC/WRCP:

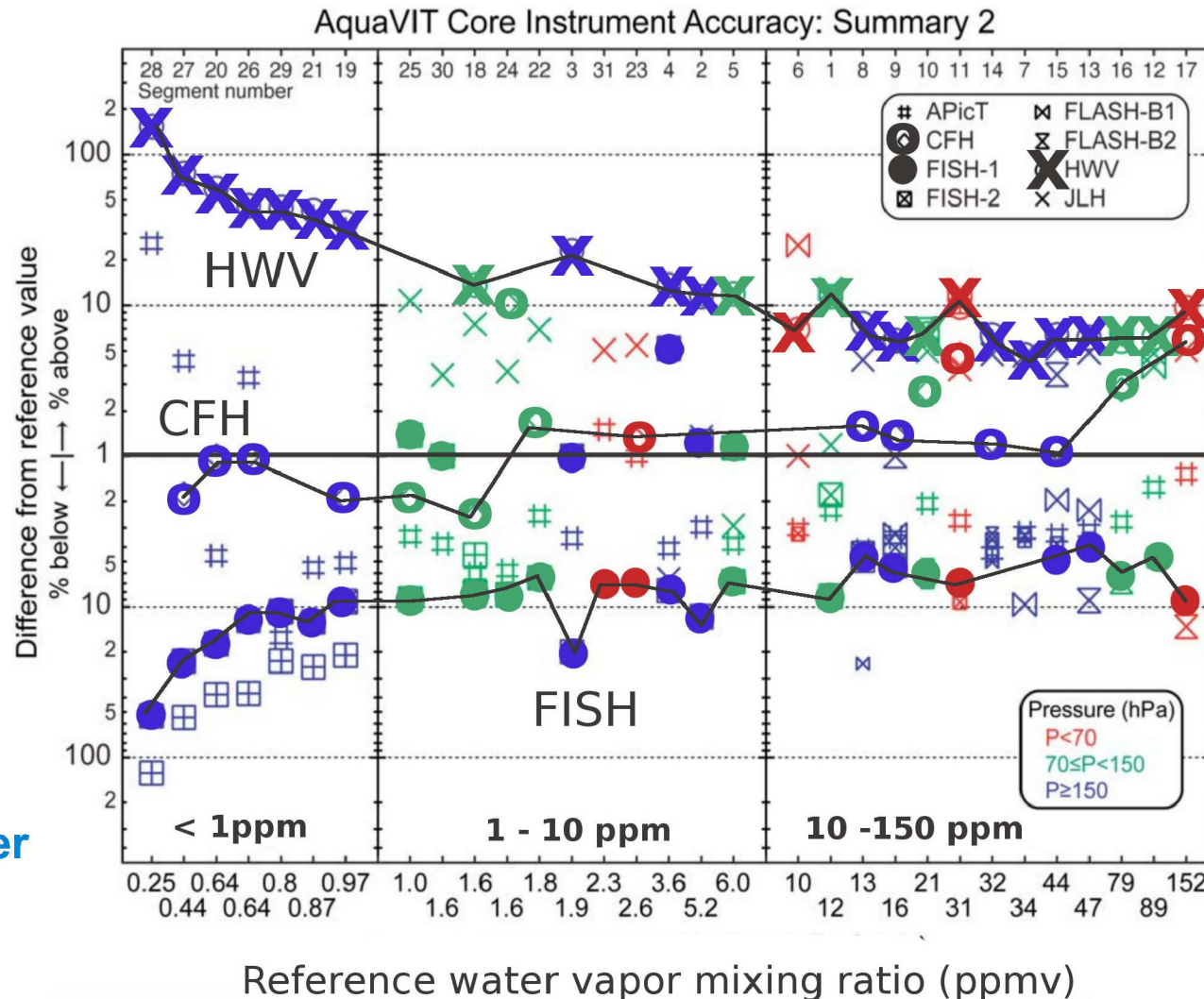
Stratospheric Processes And their Role in Climate/
 World Climate Research Programme



Peter et al., SPARC Newsletter, 2008

SPARC Water Vapour Assessment 2002

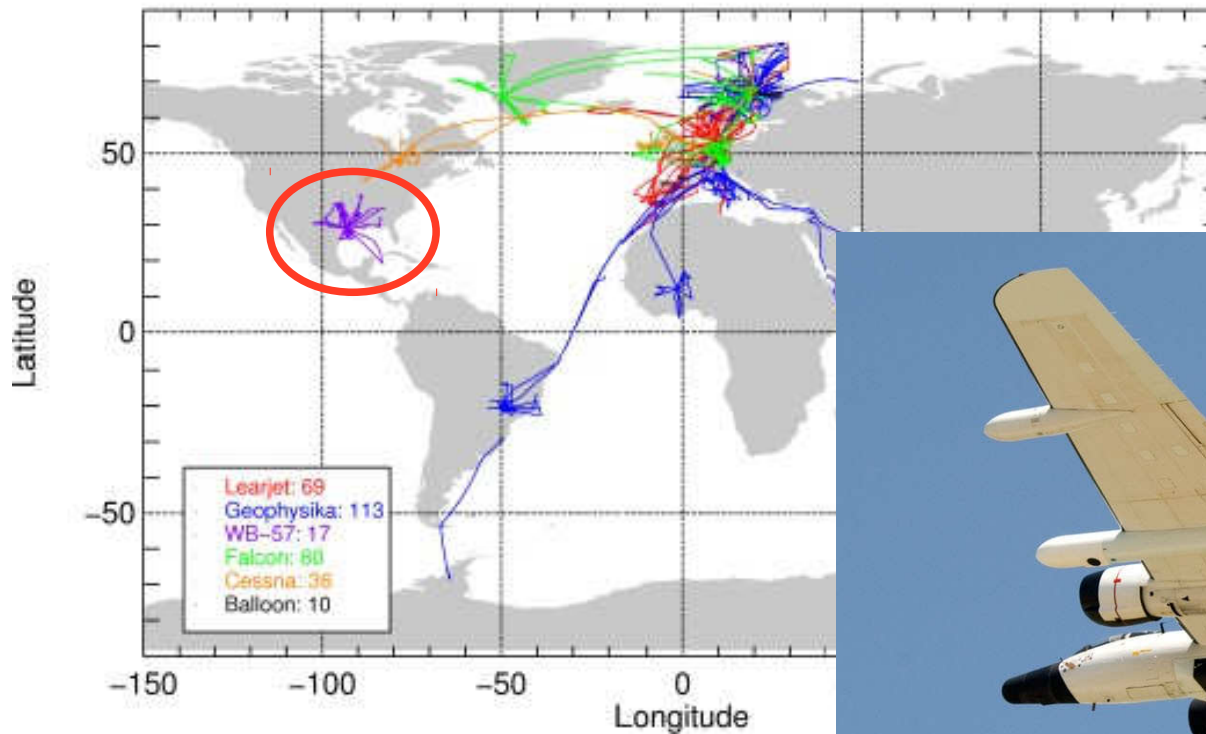
AquaVIT: Aqua Validation and Instrument Tests



Campaign
2007 at
AIDA chamber

MACPEX

FISH: Flightpath of all Flights



NASA: WB-57



**H₂O - comparison flights
around Houston/Tx in 2011**

MACPEX

<10 ppmv:

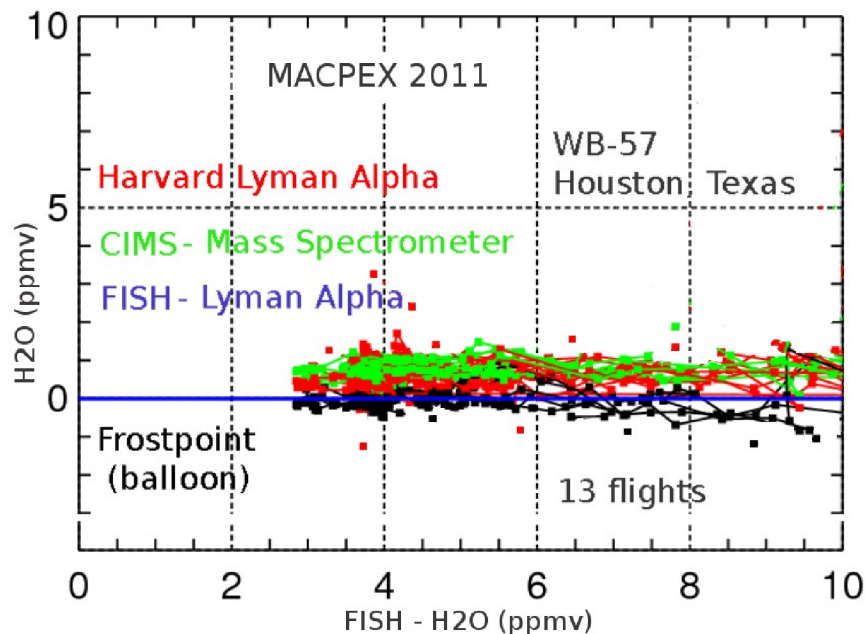
HWV > FISH

CIMS > FISH, HWV

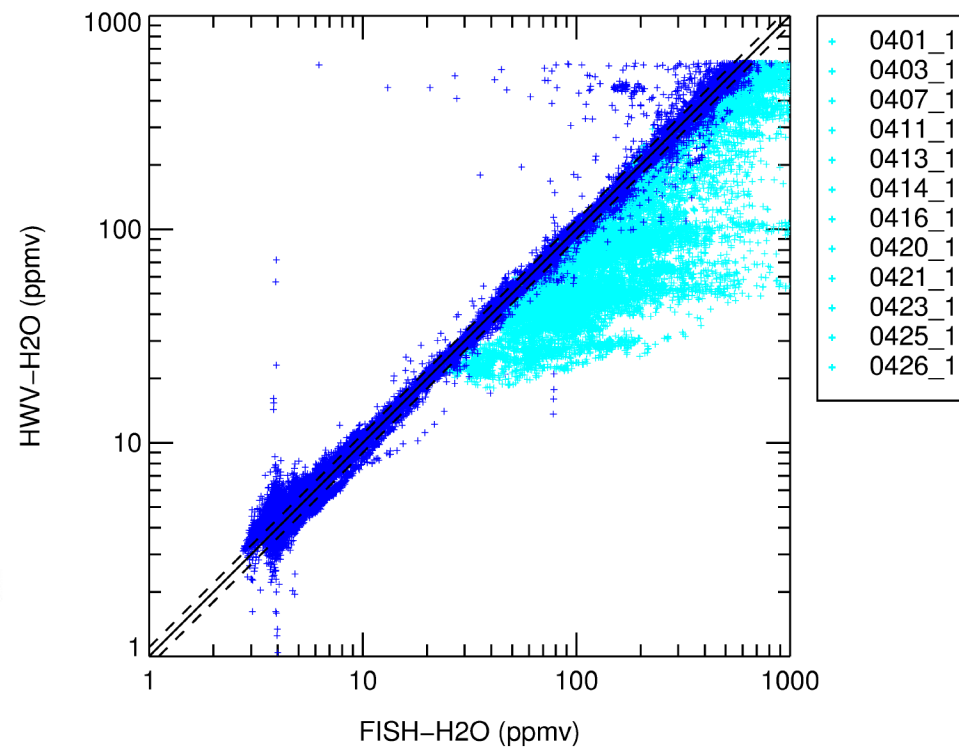
FPH ~ FISH

>10 ppmv:

HWV ~ FISH



idx = FISHrh/HWVrh > 1.3, FISHrh > 100%



Comparison of UT/LS water measurements

Summary

- 0.5 ppmv uncertainties matter: e.g. radiative climate forcing
- **2002** SPARC Water Vapour Assessment:
advanced hygrometers with 12% accuracy
- **2007** AquaVIT laboratory comparison:
same tendency, but lower discrepancies around 10%
- **2011** MACPEX in-flight comparison:
same tendencies, but again discrepancies around 10%
- The discrepancies are platform independent.

Further need to improve H₂O measurements!