Current activities and projects of water vapour measurements in the UTLS in France

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NDAC H2O Workshop
Bern 5-7 July 2006

Currently Existing Instrumentation

- Balloon borne ELHYSA Frost point hygrometer J. Ovarlez, LMD now transferred to G. Berthet, LPCE
- Balloon borne SDLA and micro-SDLA tuneable diode laser G. Durry, SA and University of Reims
- Balloon borne SAOZ spectrometer J.P. Pommereau
- Raman lidar, LACY, Reunion Island, J. Leveau, P. Keckhut

Satellite instrumentation

- ODIN-SMR P. Ricaud (Urban's presentation)
- ENVISAT-GOMOS A. Hauchecorne
- METOP/IASI (EUMETSAT, CNES, retrievals SA/ LPMA etc..)
  Launch planned 17 July 2006

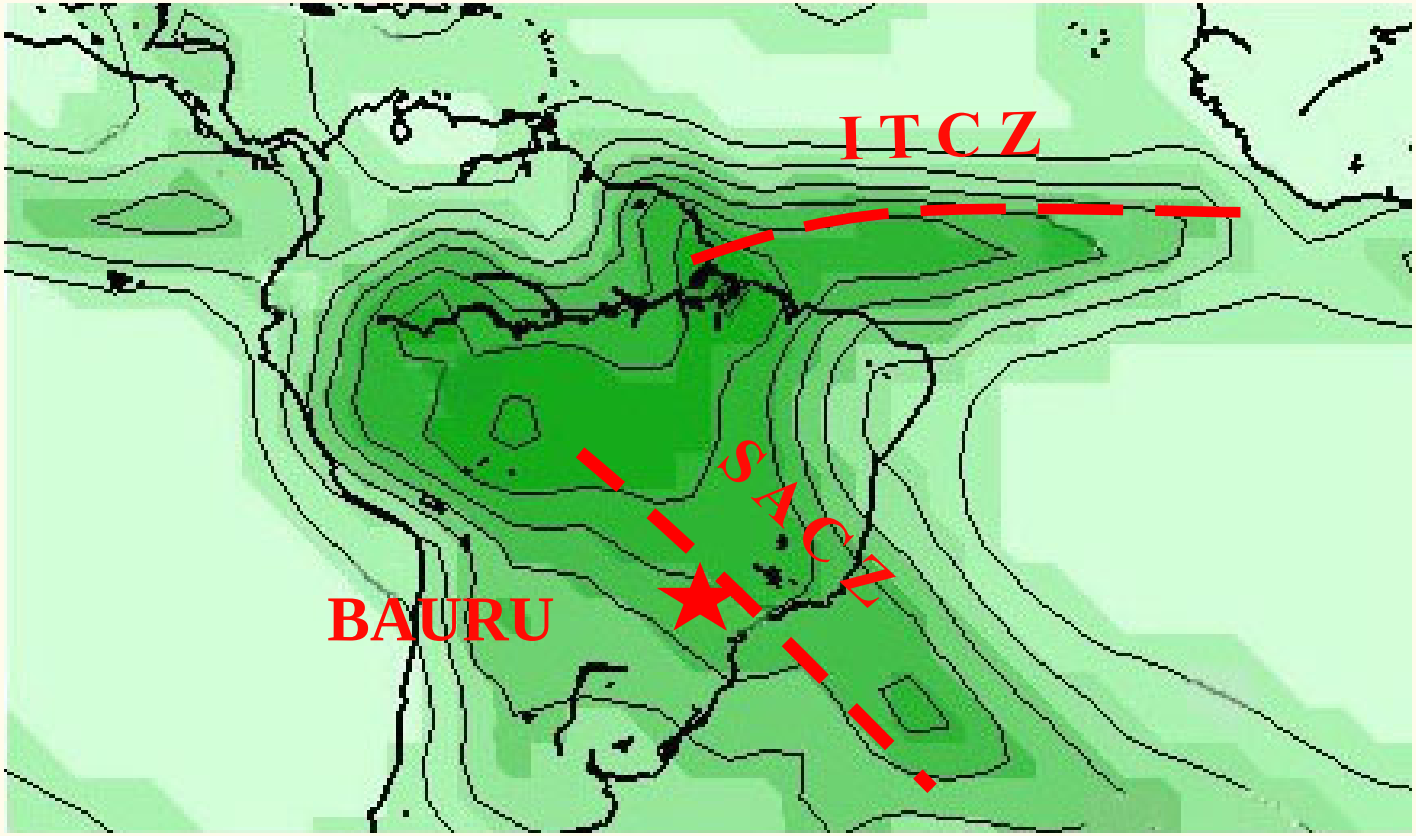
Projected instrumentation

- Balloon borne Pico-SDLA (lightweight 2 kg sonde version of μSDLA) G. Durry SA/ Reims. First flight planned Oct 2006

- G-B Microwave radiometer, P. Ricaud, Laboratoire d'Aérologie
  Under development, tests at Bern
  Project: Lanemezan, Reunion Island 2007, Concordia 2008

Recent Field Measurements (1)

Tropics HIBISCUS European project, Brazil 2001-2004



HIBISCUS Small balloons and sondes

- 6 Small balloons : several instruments on the same flight
  - Lightweight (10 to 40 kg), low consuming, small size, robust instruments
  - **Combination of meteorology, GPS location, clouds, tracers, chemistry, H2O, electric field**

- 2 x 10ZL (10 000 m3), 120 kg at hook, ascent/descent up to 30 km

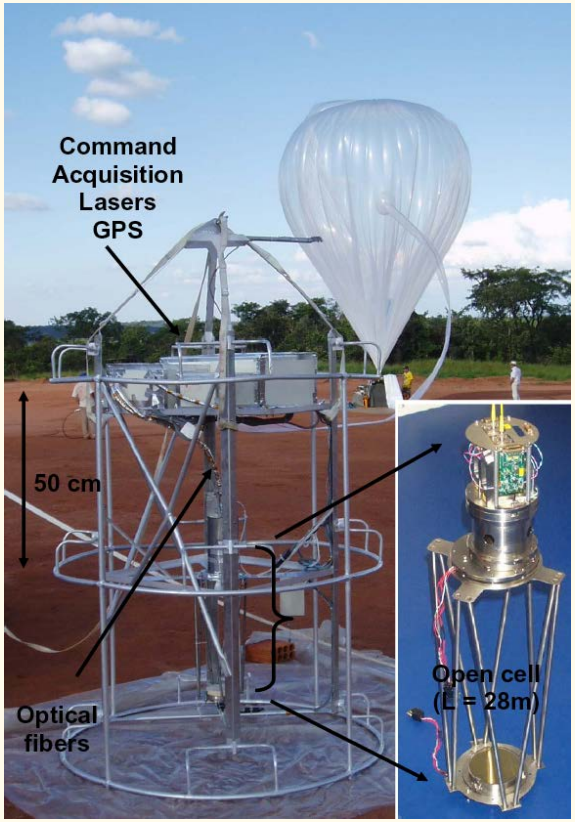
- 4 x 3SF (3000 m3), 170 kg at hook, daytime ascent and natural night-time descent through the TTL (22km => 14km)

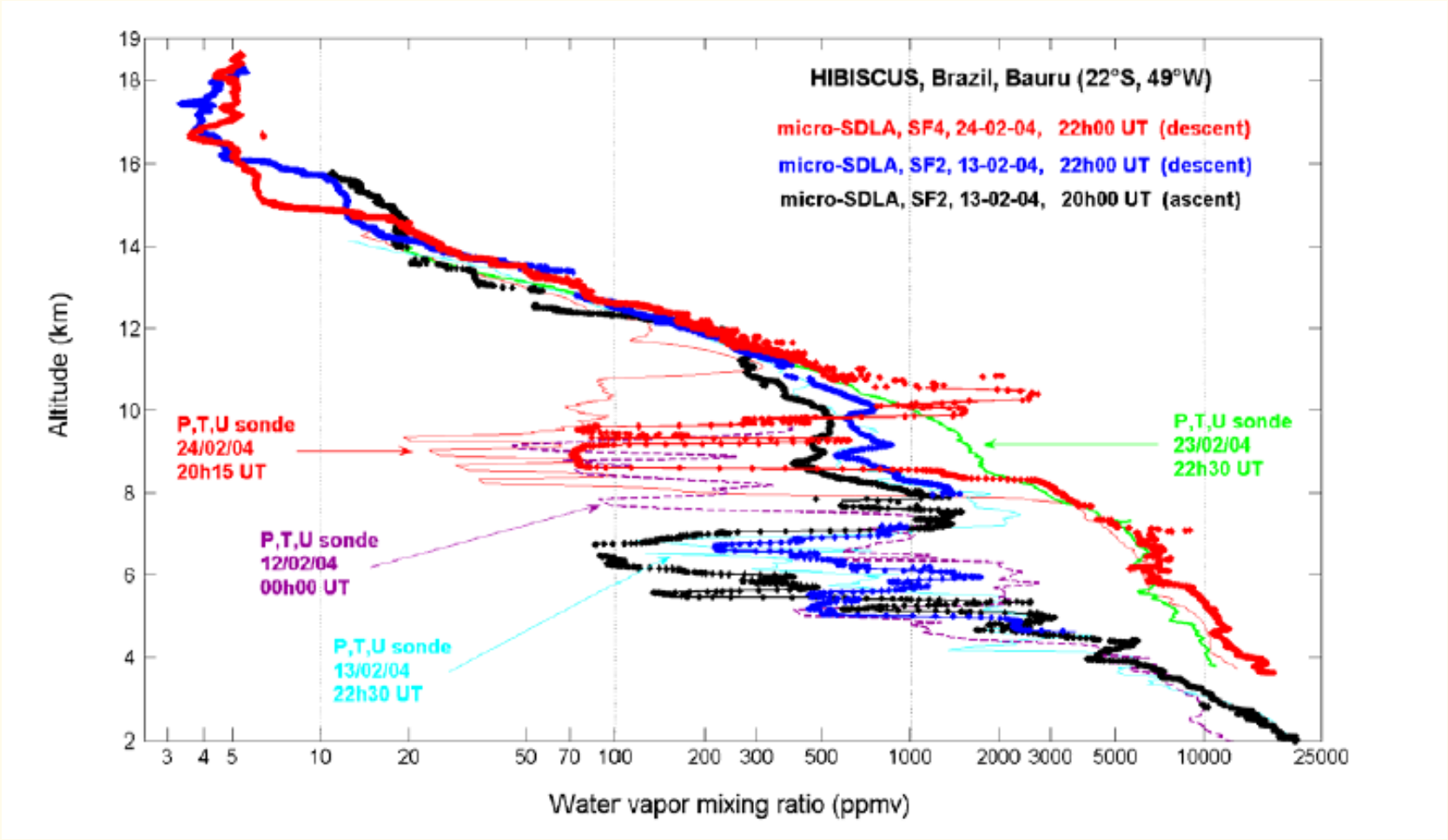
- 10 backscatter, 12 ozone and 2 UV radiation sondes

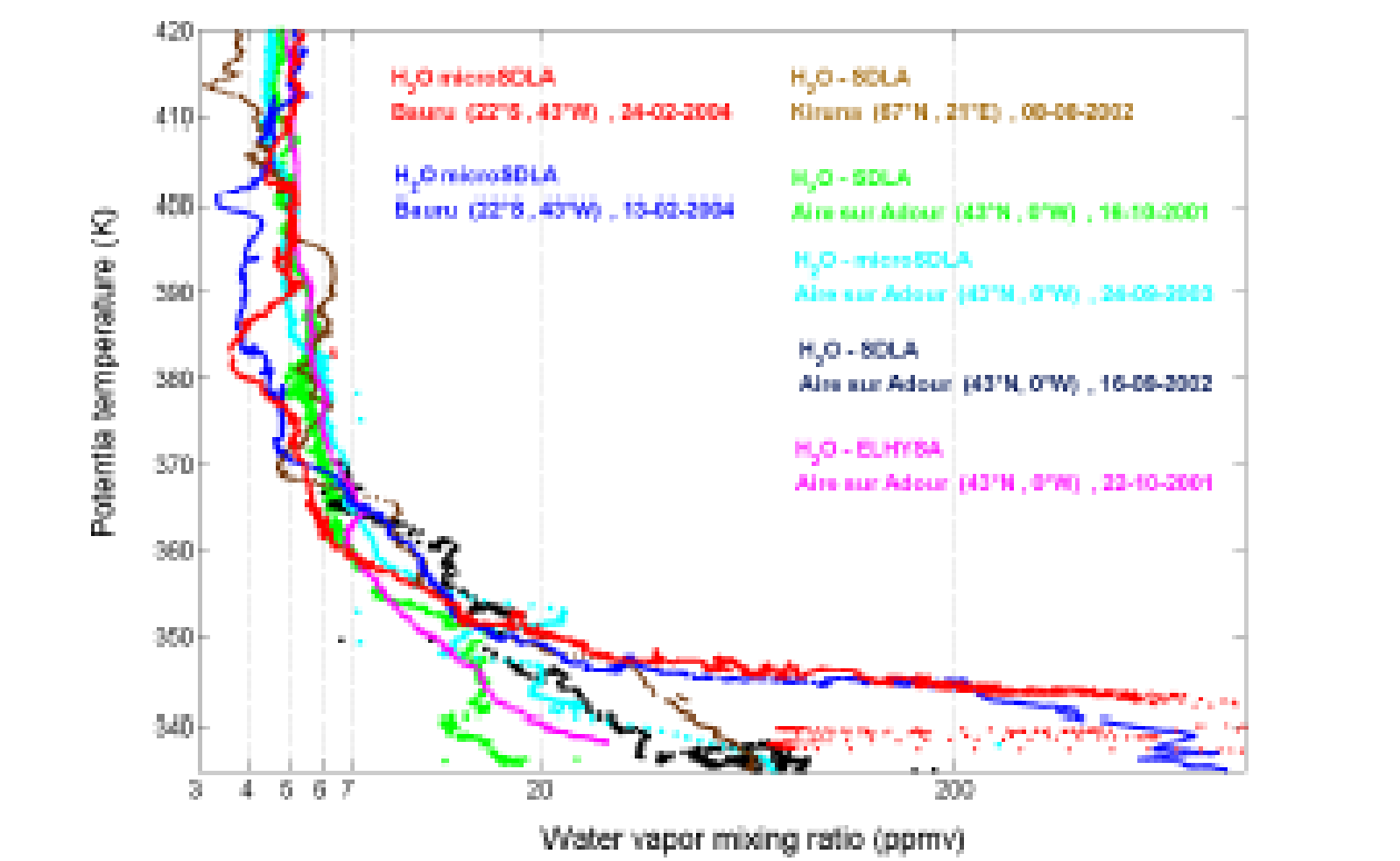
SF2, Feb 13th 2004

Micro-SDLA tuneable diode laser H2O and CH4

SF2 13 February




HIBISCUS, Brazil, Bauru (22°S, 49°W)
micro-SDLA, SF4, 24-02-04, 22h00 UT (descent)
micro-SDLA, SF2, 13-02-04, 22h00 UT (descent)
micro-SDLA, SF2, 13-02-04, 20h00 UT (ascent)
P,T,U sonde 24/02/04 20h15 UT
P,T,U sonde 23/02/04 22h30 UT
P,T,U sonde 12/02/04 00h00 UT
P,T,U sonde 13/02/04 22h30 UT
Altitude (km)
Water vapor mixing ratio (ppmv)


Potential temperature (K)
420
410
400
390
380
370
360
350
340
3
4
5
6
7
20
200
Water vapor mixing ratio (ppmv)
H2O microSDLA
Bauru (22°S , 43°W) , 24-02-2004
H2O microSDLA
Bauru (22°S , 43°W) , 13-02-2004
H2O - SDLA
Kiruna (67°N , 21°E) , 09-09-2002
H2O - SDLA
Aire sur Adour (43°N , 0°W) , 16-10-2001
H2O - microSDLA
Aire sur Adour (43°N , 0°W) , 26-09-2003
H2O - SDLA
Aire sur Adour (43°N, 0°W) , 16-09-2002
H2O - ELHYSA
Aire sur Adour (43°N , 0°W) , 22-10-2001

Tropics HIBISCUS European project, Brazil 2001-2004

Summary short duration flights

- Micro-SDLA H2O, CH4, O3, T, 2 flights, high convection no dehydration, dry (3.5 ppm) layers in the UT related to horizontal exchange, High H2O/CH4 layer at altitude of cold point due to convection

- TDLAS tuneable laser, T. Gardiner, National Physical Laboratory UK, 2 flights, dry conditions

Summary Water vapour sondes

- Test of Surface Acoustic wave (SAW) instrument of the University of Cambridge. R.L. Jones .Fine in UT, not enough sensitivity yet in LS
- Comparisons sondes instrumentation SAW, Snow White, RS 80, RS90 R L Jones / L. Eden

  Best results RS90

  But still no reliable measurements above 15 km

Tropics HIBISCUS European project in Brazil 2001-2004

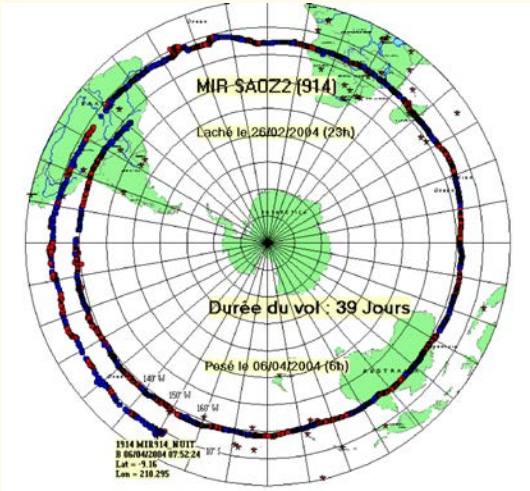
Long duration balloons and satellites

- Attempt of SAW on constant level balloons (UCAM / LMD) (not enough H2O deposited on sensors, transmission pb)
- SAOZ MIR long duration balloon: Zonal distribution of H2O between 6 and 25 km J. P. Pommereau
- GOMOS still pb with detector noise in near IR, work in progress A. Hauchecorne

Infra-Red Montgolfier (MIR)

- 45 000 m3
- ~ 60kg at hook
- Day/night excursion : 28 km/20-22 km
- Remote sensing in the UT/LS
- SA SAOZ Vis-near IR spectrometer : chemistry, clouds, H2O (x 2)
- ENEA Micro-lidar : clouds (x 1)
- IR radiometer
- CNES Inmarsat gondola (TM,TC)

MIR-SAOZ #2
Launch : Feb 26th, 2004
39 days
70 profiles



SAOZ UV-Vis spectrometer payload

- 400-1000 nm spectral range
- Solar Occultation at sunset and sunrise
- Altitude : GPS (3D Loc ± 10m, Time ± 0.1s).
- Retrieval: Onion peeling, ray tracing
- Vertical resolution 1.4 km
- Altitude registration ± 50 m
- Measured species: O3, NO2, Temp (O2), H20 (5[illegible] nm) and cloud extinction from 25 km down to 6 km or cloud top

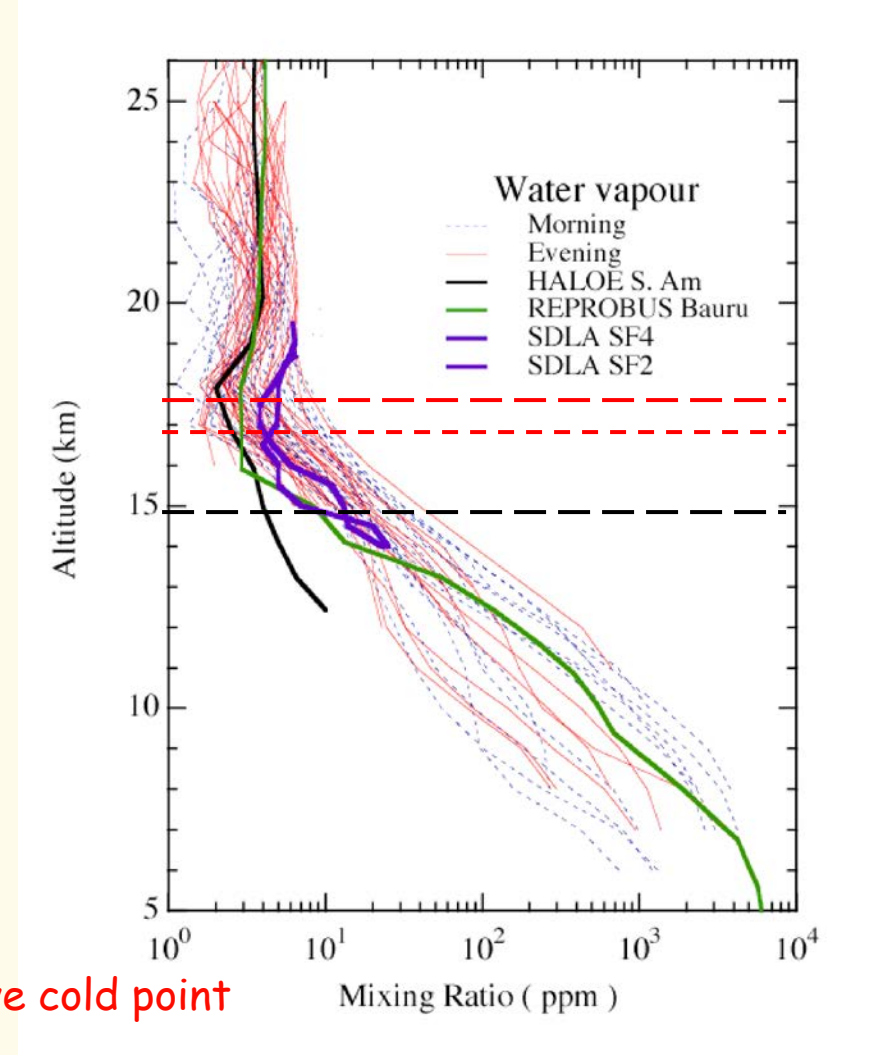
MIR-SAOZ H2O measurements

Z>15 km
λ = 940 nm

Precision:
0.2 ppm at 17 km
0.4 ppm at 23 km
Accuracy 2 ppm

12>Z>16 km
λ=760nm

Z<12km
λ=590 nm



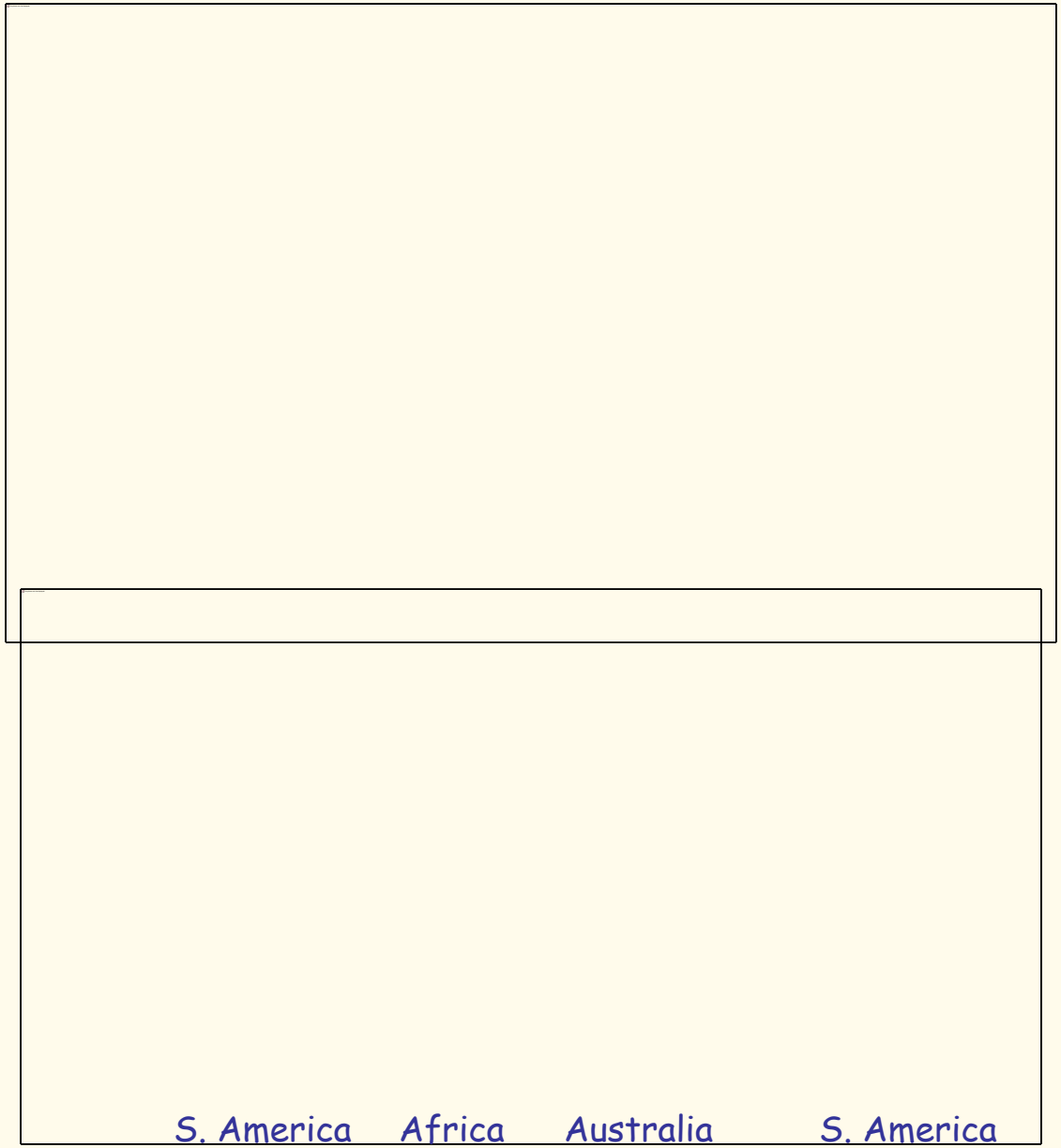
Hygropause
Cold Point
Tropopause

Hygropause at or above cold point

Zonal variation of water vapour in TTL at 10°-20°S

Max (4.5-5 ppm) above convergence zones and continents

Minima (2.5-3 ppm) above oceanic areas



More moisture above land convective areas

Minima over warm subsident oceanic regions

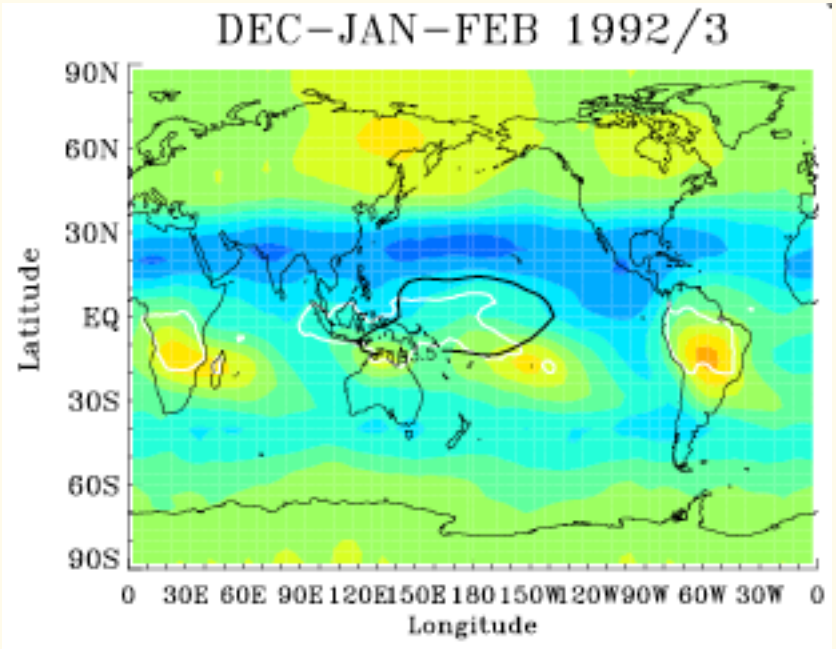
Very consistent with

UARS MLS

But not very much with

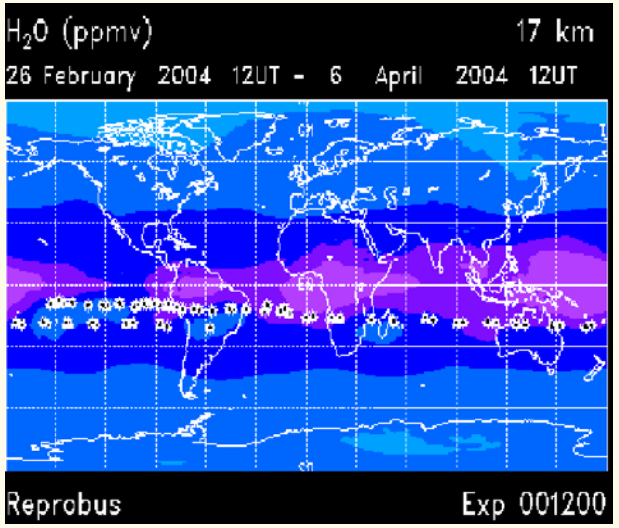
ECMWF / REPROBUS 3D CTM

100 hPa



Read et al. 2004

17km, Feb-March 2004



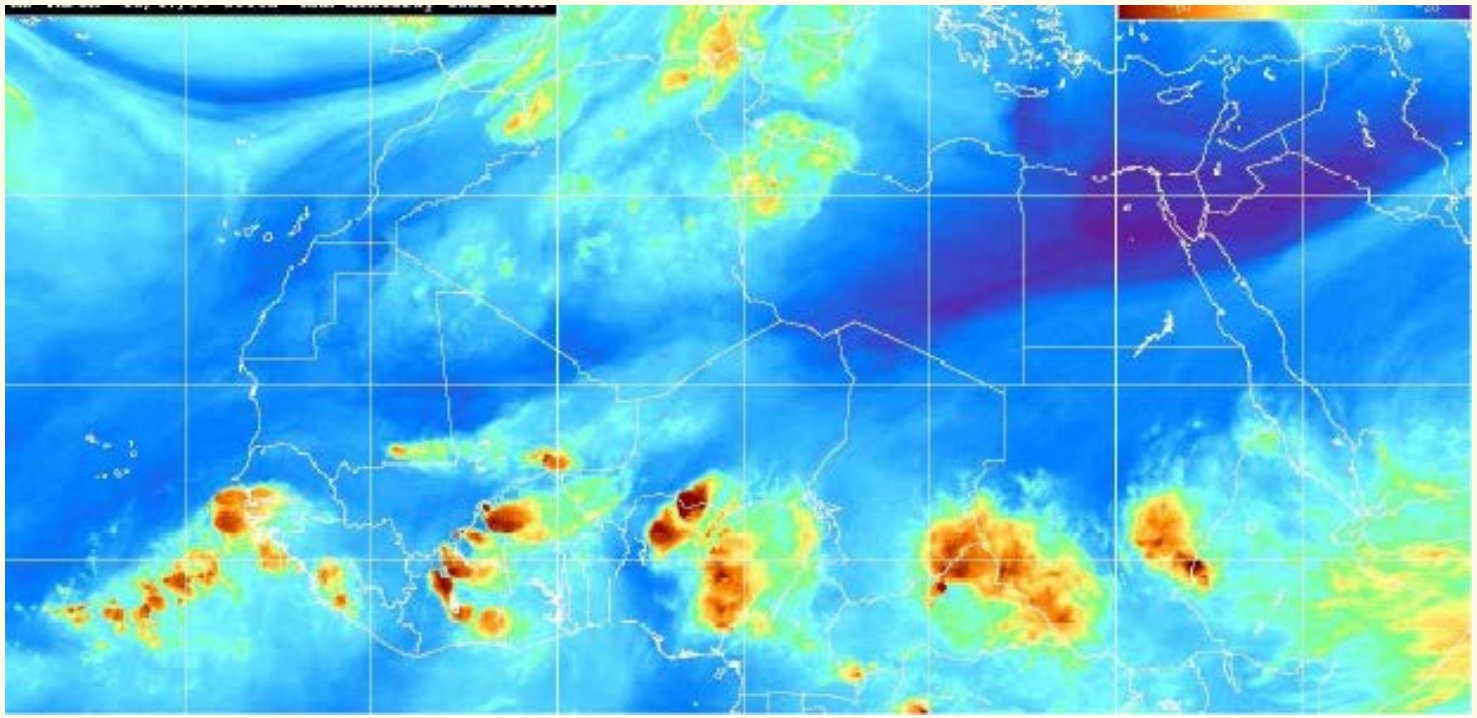
Courtesy F. Lefèvre

Recent Field Measurements (4)

- Tropics Reunion Island (H Bencherif)
  - Raman lidar not above 11-12 km
  - Attempts CFH frost point hygrometer, Limited results (rain, technical), see Vömel presentation

Projects (1) SCOUT-AMMA 26 July-29 Aug 2006

Land convection during the African Monsoon



Meso-scale Systems developping at the limit between SW wet monsoon wind and dry NE Harmattan (Meteosat IR channel)

H2O measurements

- 10 Small balloon flights operated by CNES from Niamey
  incl: 3 µSDLA, 3 SAOZ H2O
- 15 BKS/O3/H2O sondes by DMI / CNRS / CAO at Niamey
  Lyman alpha FLASH + **recovery with GPS ARGOS**
- Daily RS92
- GEOPHYSICA M-55 from Ouagadougou
  Lyman alpha FLASH (CAO) and FISH (FZJ)
- GOMOS and ODIN-SMR reinforced observations

Project (2)

- Mid-Latitude Aire sur l'Adour October 2006

  Tropical intrusions G. Durry, G. Berthet,

  SDLA, μSDLA and ELHYSA, 3-4 flights

Project (3)

SCOUT-EQUATORIAL Autumn 2007

Long duration MIR balloons :
2 SAOZ Flights from Teresina, 5°S, Brazil
One flight = 50-80 profiles

- IASI H2O statistical comparison at Equator between 6-25 km
- If successful use of IASI for extending the results in latitude

- Also, MIPAS, Fish, μSDLA ?, ELHYSA ? Tests of Pico-SDLA

Project (4)

Year-round H2O sondes from Bauru, 22°S in 2008,

Ascents during METOP overpass of:

- FLASH Lyman alpha,
- PicoSDLA if ready
- RS92

* Payload recovered with ARGOS/GPS

Operated by Instituto de Pesquisas Meteorologicas (IPMET)

- Date of start, frequency of soundings and total number to be optimized with METOP/IASI project

- Test of possible system for long term stratospheric water vapour monitoring system for NDSC / NDACC network