

# The SPARC Water Vapour Assessment-II

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SPARC (core project of the WCRP) is organized under 3 themes:

- 1) Atmospheric Dynamics and Predictability
- 2) Chemistry and Climate
- 3) Long-term records for Understanding  
**Water Vapor Assessment (WAVAS)-II**

## Background:

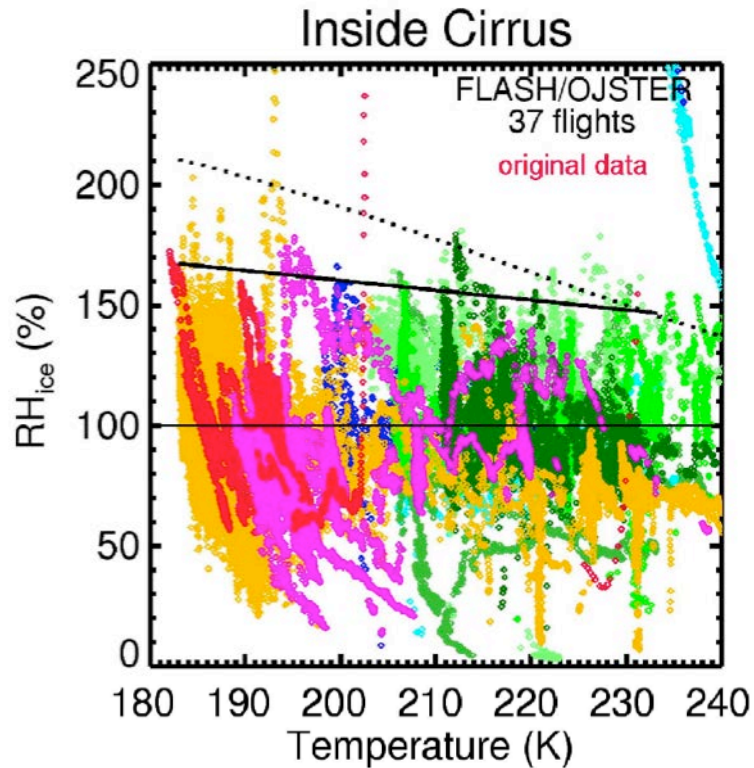
In 2000 SPARC published an assessment of stratospheric water vapor, led by James M. Russell and Deiter Kley to provide information for the IPCC Working Group 2. The ultimate goal was to understand trends and variability.

Since then, there has been a change in the satellite data available, questions on accuracy of *in situ* measurements & questions on trends, so a new effort was launched in 2008 by Cornelius Schiller and Thomas Peter.

## Fundamental questions addressed by WAVAS-II

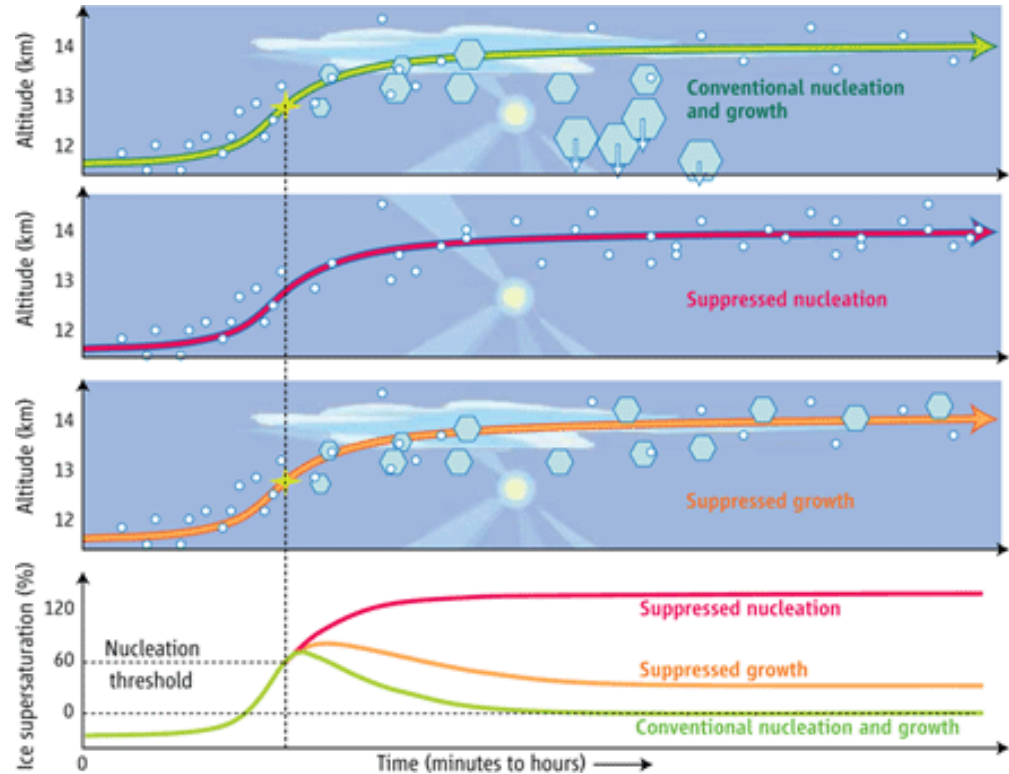
- 1) Accuracy (in particular in regards to *in situ* measurements)
- 2) Stability (for trends and variability) this includes considering discontinuities between measurement systems.

# Where accuracy matters: A super saturation puzzle



Dotted line: water saturation  
Thick black line: homogeneous freezing  
threshold 0.5μm

*Kraemer et al., ACP, 2009*

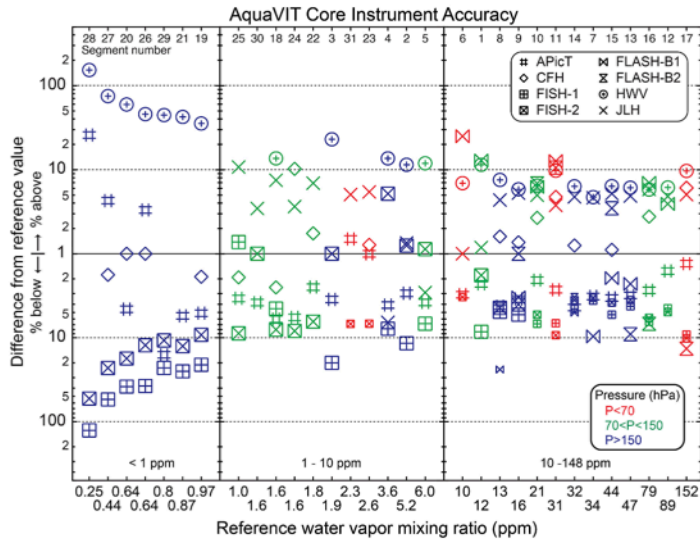


*Peter et al. Science, 2006*

Brought into question fundamental  
understanding of microphysics.

The *in situ* accuracy issue was addressed through laboratory and field measurements and extensive evaluation of existing *in situ* measurements

## Aquavit I and II (Aida, KIT)

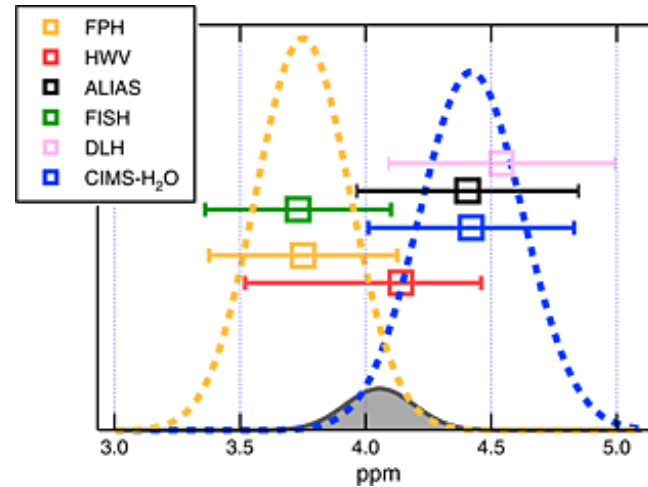


Fahey et al., AMT, 2015

## WAVAS-II

workshops/discussions/collaborations inspired these activities and facilitated international collaborations.

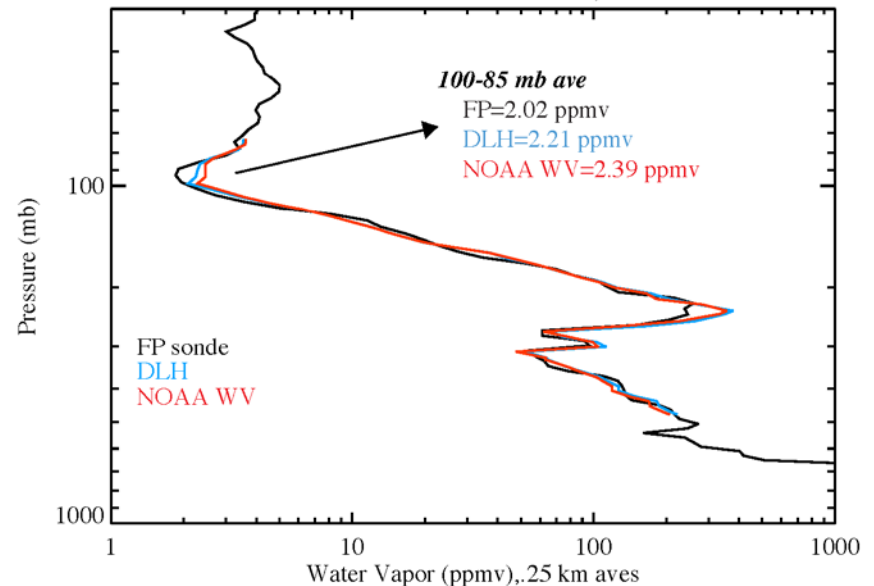
## MACPEX (WB57, Houston)



Rollins et al., 2014, JGR

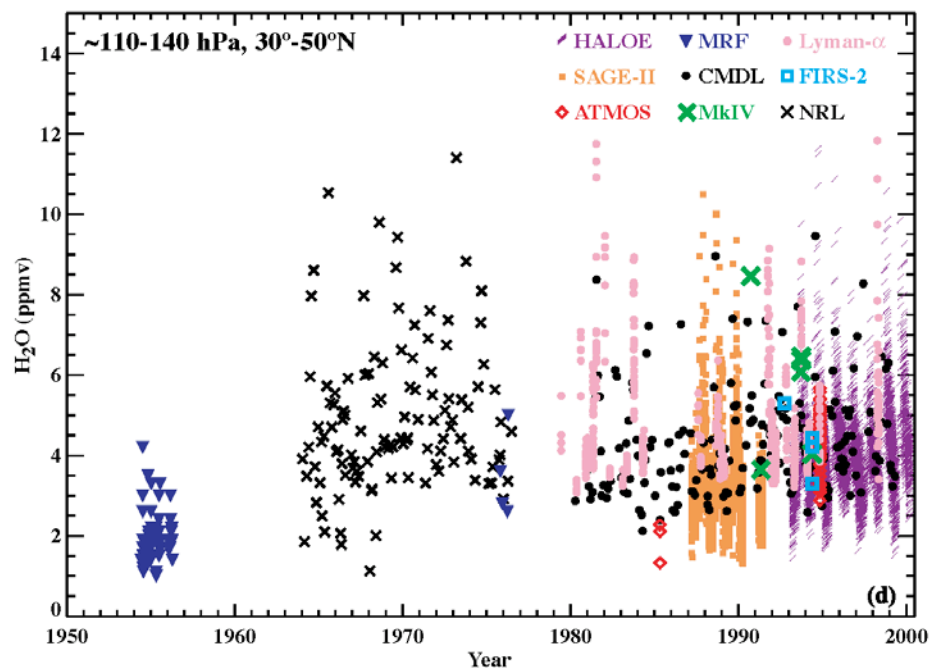
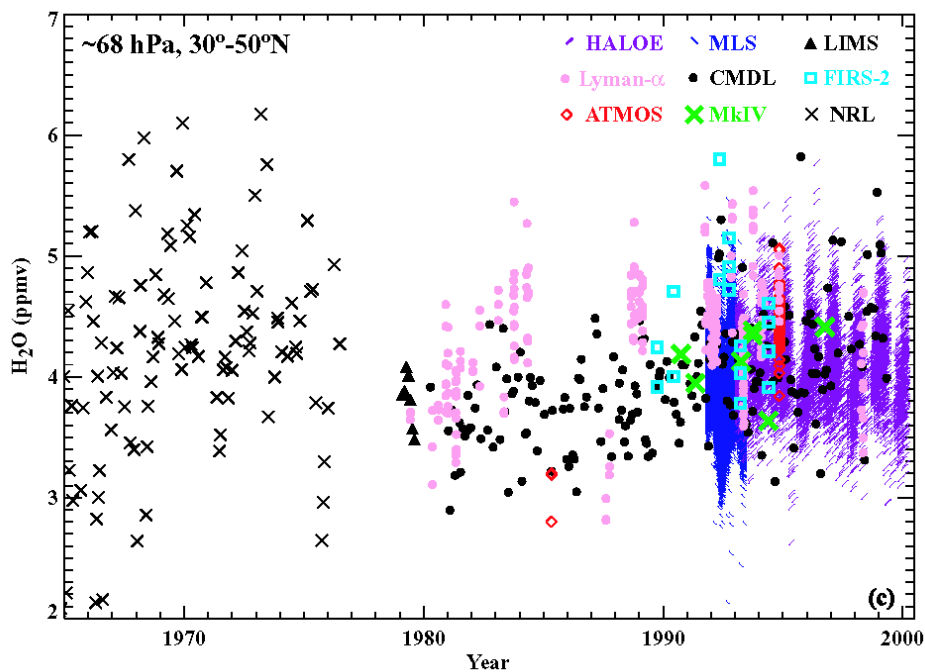
## ATTREX (Global Hawk, Guam)

ATTREX GUAM Feb 17, 2014



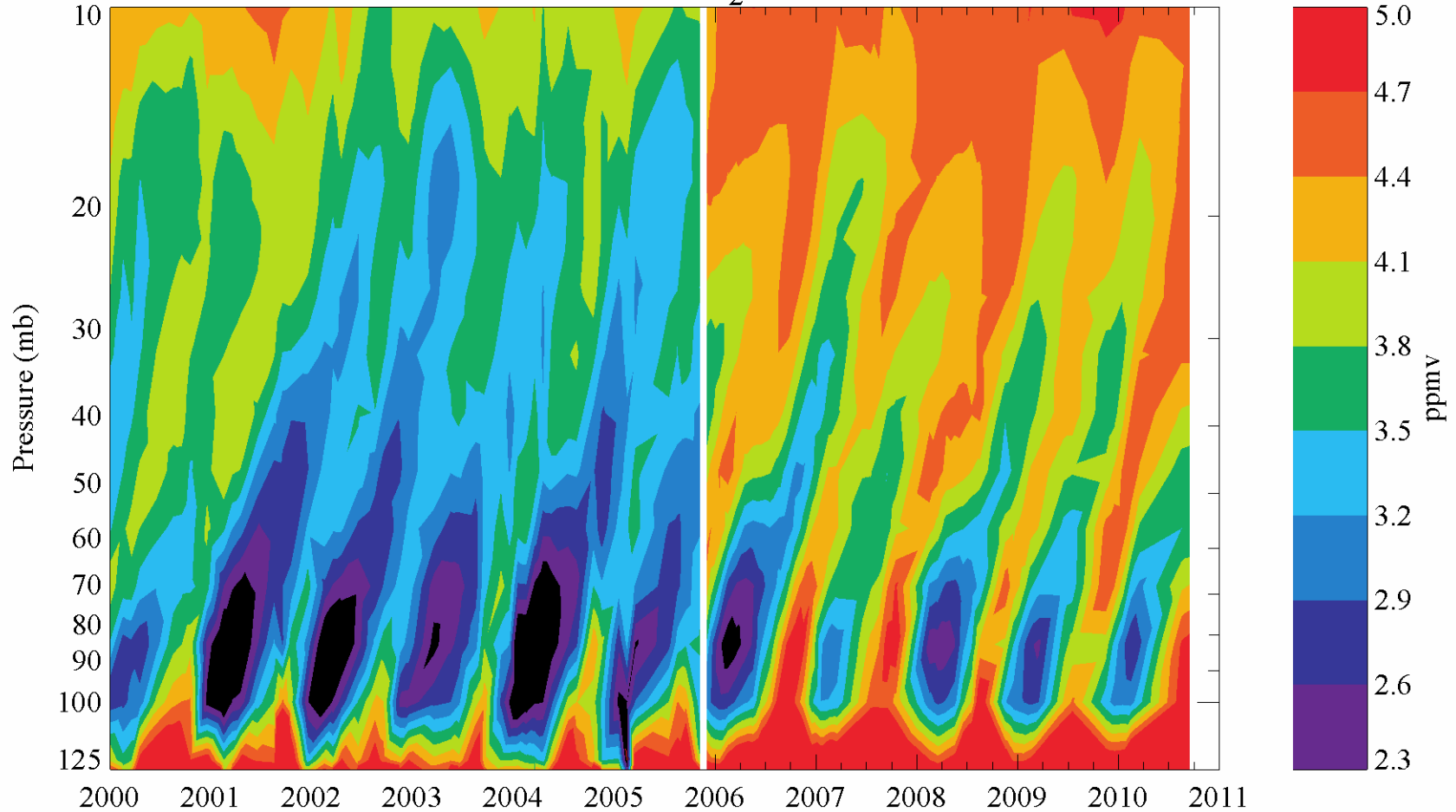
# Stability issue: Stratospheric water vapor observations are not consistent in time

Stratospheric water vapor measurements have not been taken continuously at any one location or with any one technique for an extended period of time. Jumps exist.



From SPARC WAVAS 2000 report

MLS+HALOE 10N-10S H<sub>2</sub>O, no corrections



There can be continuity problems when a instrument ceases operation.



# WAVAS II Part II: Quality assessment of UTS satellite data records

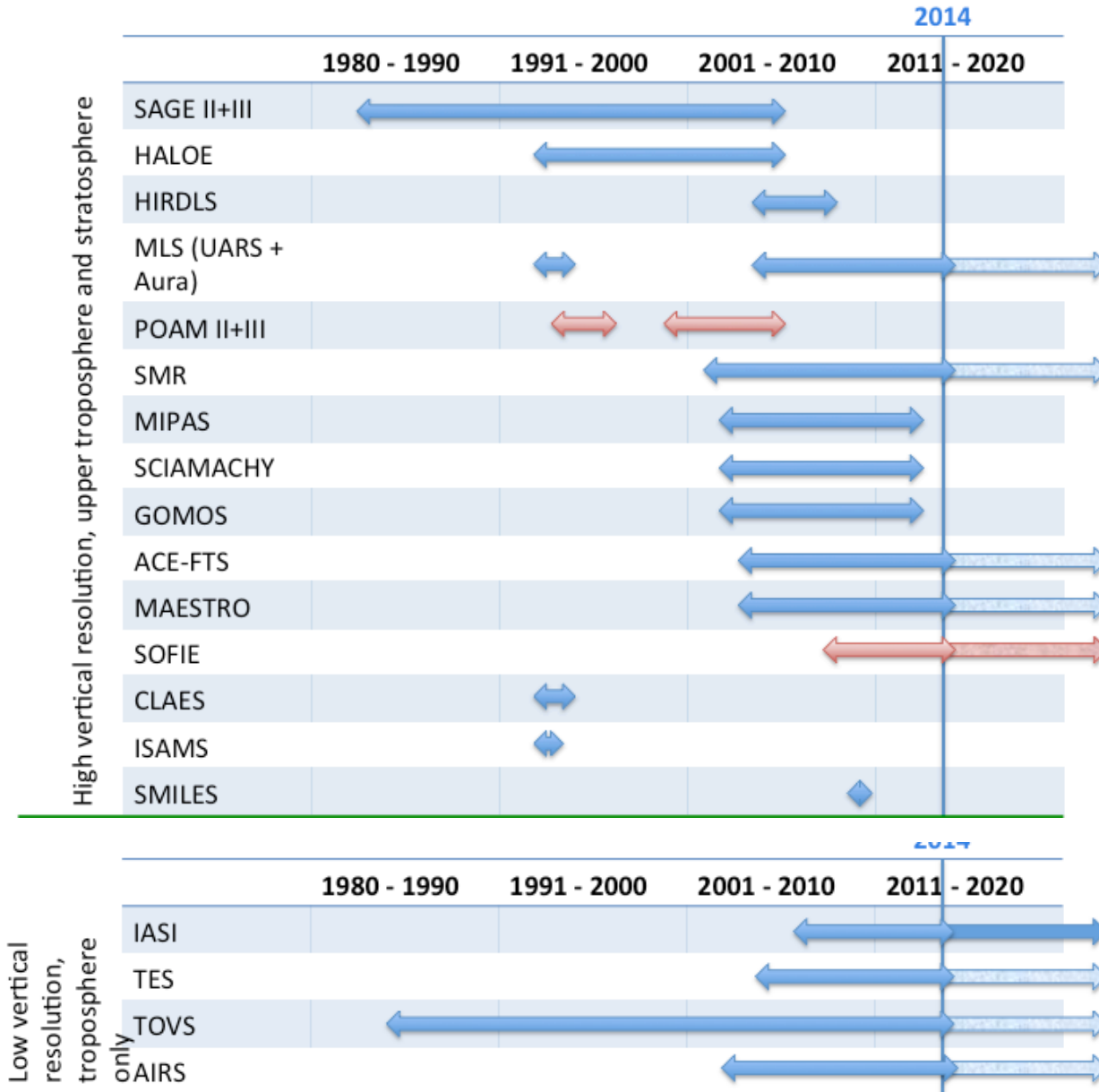
Leads: Gabi Stiller, Karen Rosenlof, Bill Read

## Goals:

- 1) Provide quality assessment of upper tropospheric to lower mesospheric satellite records since the early 1990s
- 2) Provide, as far as possible, absolute validation against ground-truth instruments
- 3) Assess inter-instrument biases, depending on altitude, location, and season
- 4) Assess representation of temporal variations on various scales
- 5) Include data records on isotopologues
- 6) Provide recommendations for usage of available data records and for future observation systems

Final result will be journal articles and then a report. Papers will be submitted to an ACP/AMT Inter-journal special issue: **Water vapour in the upper troposphere and middle atmosphere: a satellite data quality assessment including biases, variability, and drifts** ([http://www.atmospheric-measurement-techniques.net/special\\_issues/schedule.html#43](http://www.atmospheric-measurement-techniques.net/special_issues/schedule.html#43))

# Satellites in WAVAS-II



A few have isotope measurements, and those are being compared as well.

## WAVAS Satellite Report structure

01-introduction

02-characterisation

03-fph

04-groundbased

05-satellite

06-timeseries

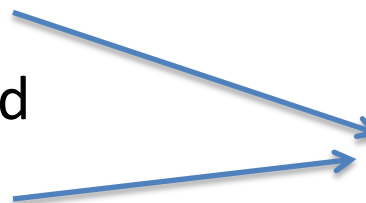
07-derived quantities

08-uth (nadir and limb measurements)

09-isotopologues

10-discussion

11-summary



*Dale will address drifts between frost point and satellite measurements in his talk today.*

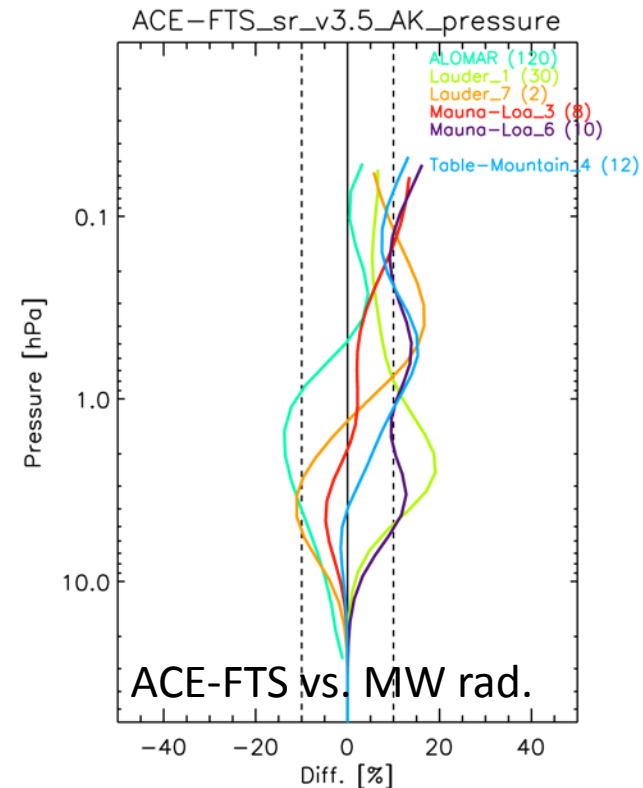
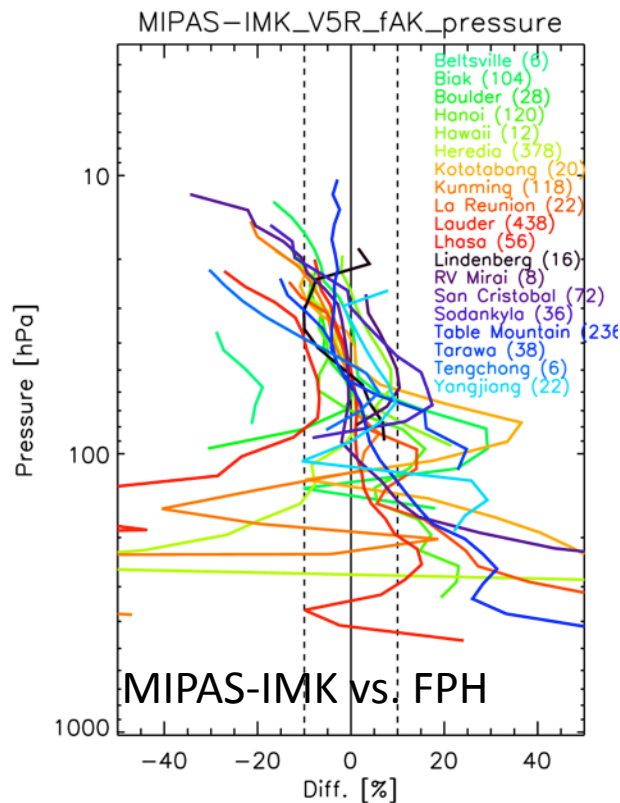
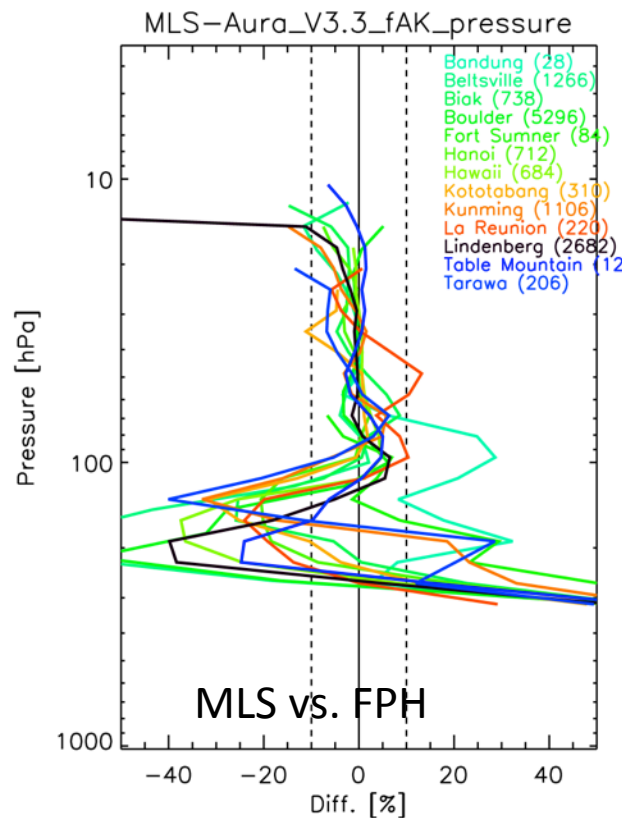
# A significant part is comparison of satellite and ground based data

Balloon-borne frost point hygrometers (up to ~ 30 km)

Ground-based microwave radiometers (from ~ 30 km to lower mesosphere)

Appropriate averaging kernels applied

*A systematic comparison like this with ground based measurements has not been done before.*



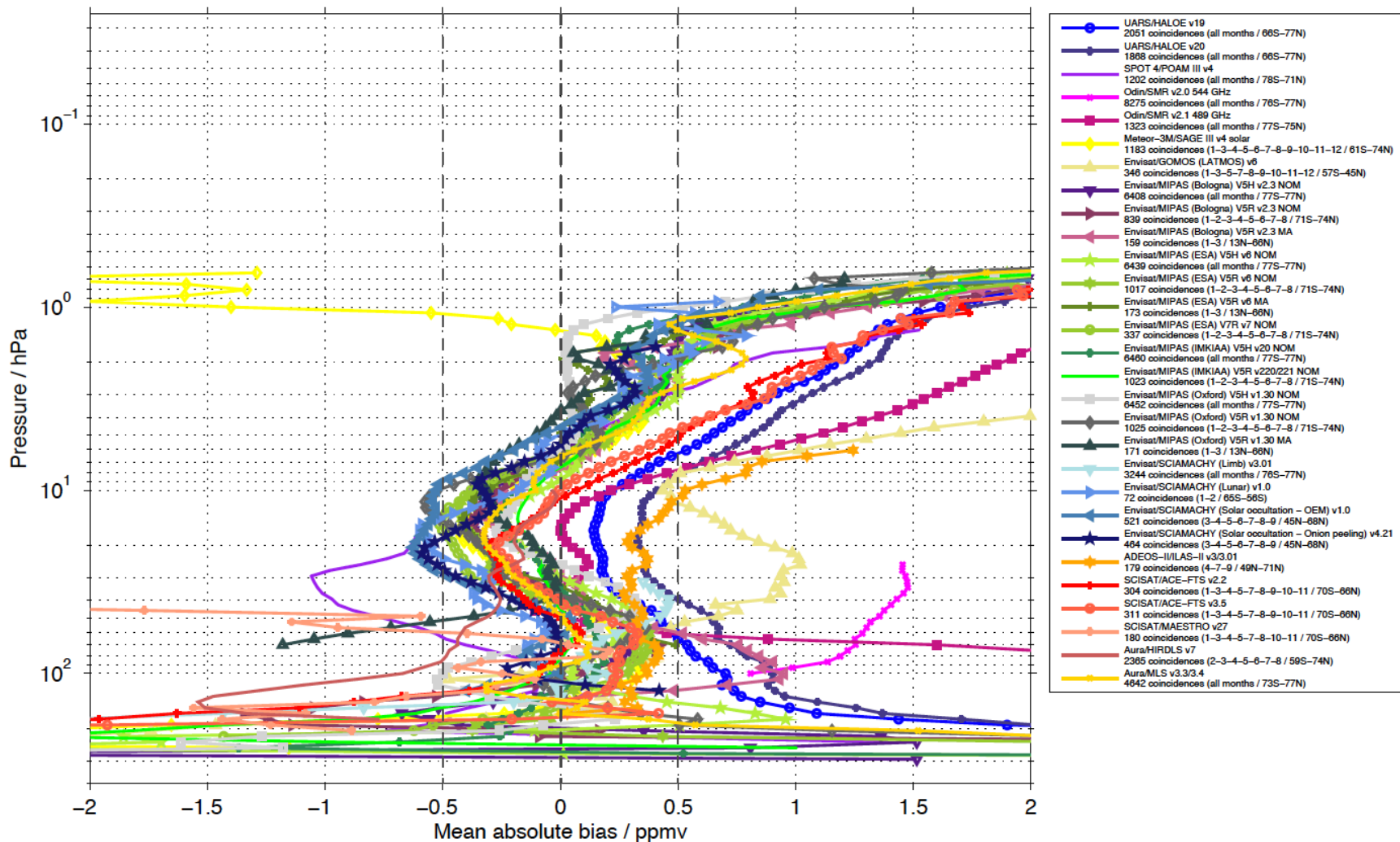
# Comparison of co-located satellite measurements

*A systematic comparison like this between satellites has not been done before.*

Water vapour comparisons with ERBS/SAGE II v7.00 as reference – mean absolute bias

Creation Time:  
18-05-2015  
22:52:33 LT

Considered: Day of year: entire year Latitude: global Longitude: 180 W – 180 E Obs: at least 20



# Comparison of derived quantities

## 1.5. ASCENT RATES OF THE TROPICAL TAPE RECORDER

131

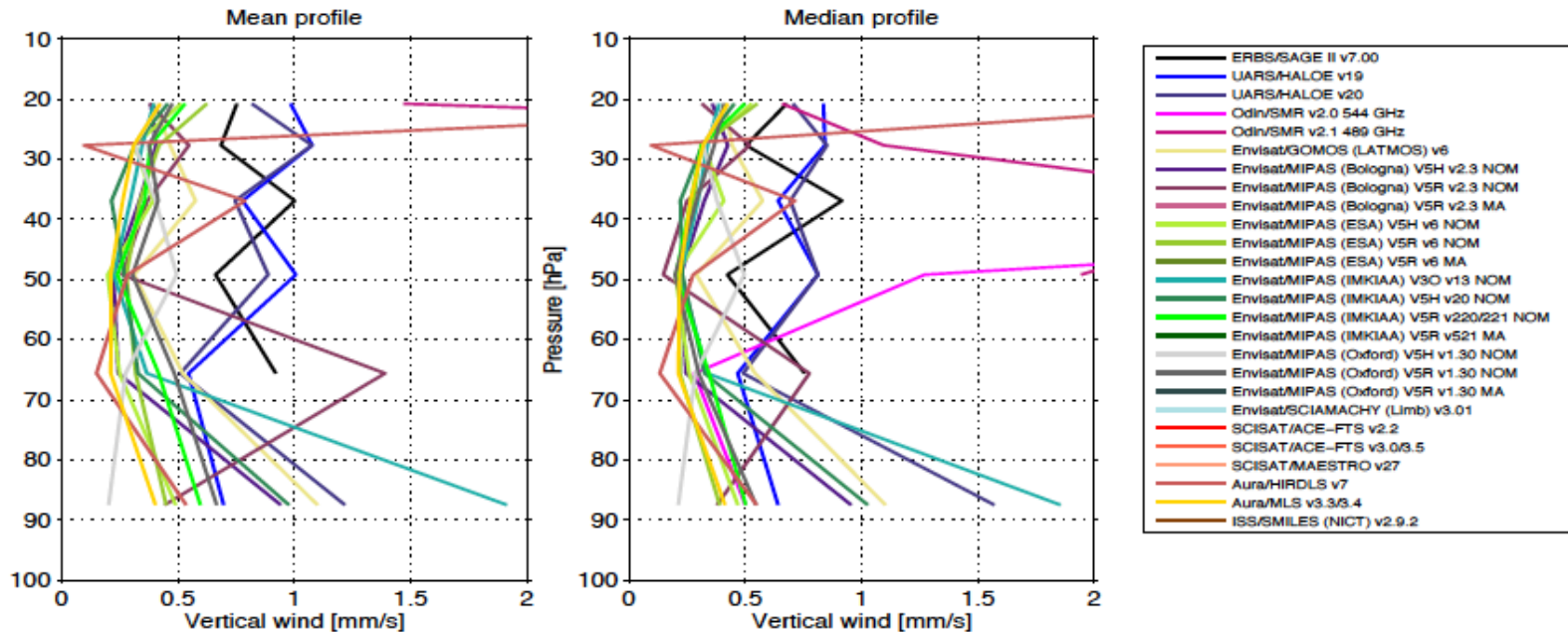
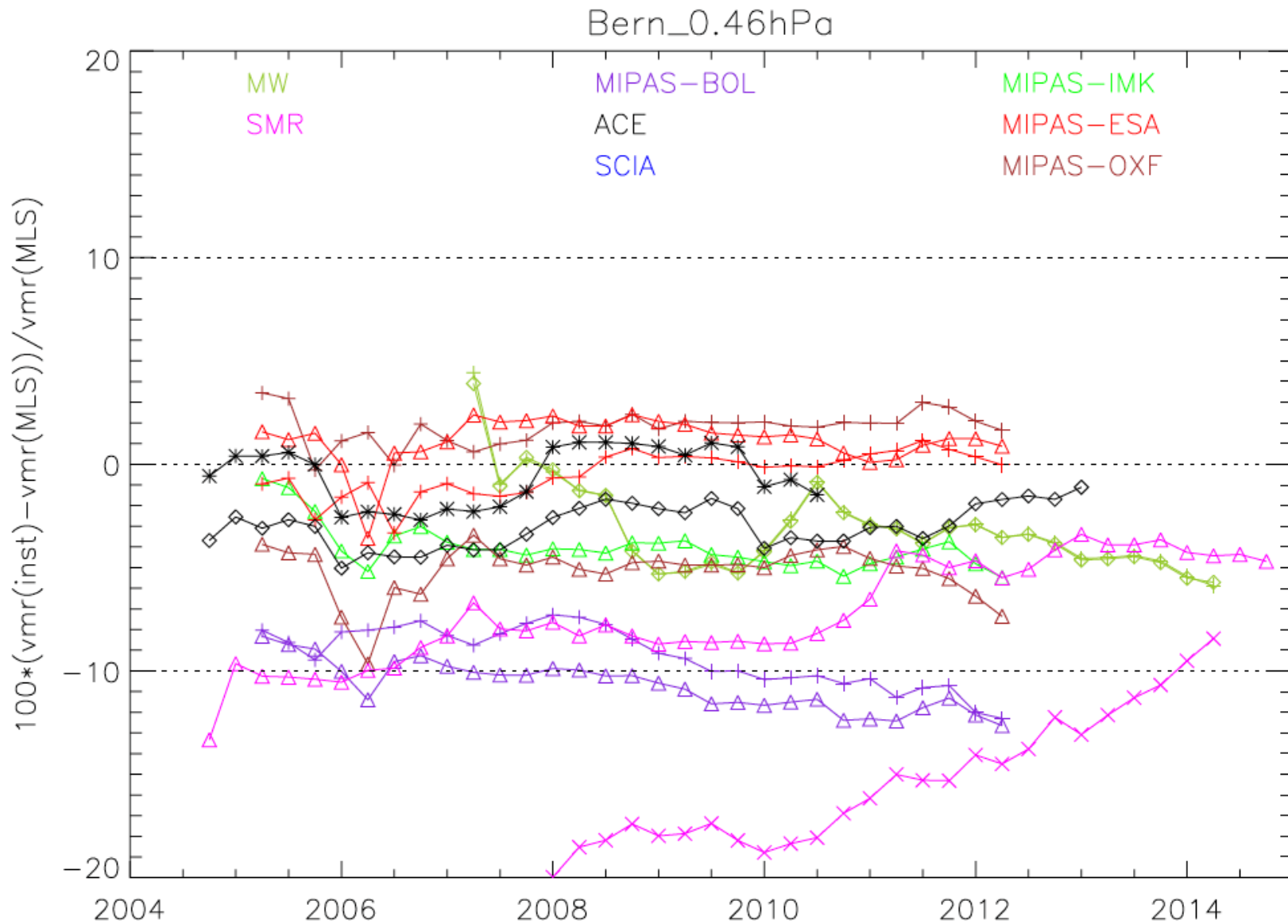


Figure 1.44: Mean (left panel) and median (right panel) tape recorder ascent rates derived from the different data sets.

Also seasonal cycles, QBO, trends, variability and drift analysis

# High altitude comparisons also included



## Most work should be complete by the end of 2016

**Key point:** This will be the last stratospheric water vapor assessment for the foreseeable future. After ISS SAGE-III, no stratospheric vertically resolved satellite water instruments are currently funded. Existing operating missions are relatively old, and will not continue indefinitely.

If new satellites are not forthcoming, then more support is needed for extensive ballooning (better spatial and temporal coverage than currently exists). See Müller et al. 2016, **The need for accurate long-term measurements of water vapor in the upper troposphere and lower stratosphere with global coverage** in Earth's Future, DOI: [10.1002/2015EF000321](https://doi.org/10.1002/2015EF000321)