SPARC DATA INITIATIVE

(Chemical Observations)

Susann Tegtmeier [1] & Michaela I. Hegglin [2]

1) IFM-GEOMAR, Kiel, Germany

1) University of Toronto, Toronto, Canada

What is SPARC?

SPARC - Stratospheric Processes And their Role in Climate

- A core project of the World Climate Research Programme (WCRP)
- Objective: help the stratospheric research community to focus on the issues of particular interest to climate
- Organization: Scientific Steering Group (SSG) and SPARC office (Toronto)
- Themes:
  - ✓Climate-Chemistry Interactions
  - ✓Detection, Attribution, and Prediction of Stratospheric Change
  - ✓ Stratosphere-Troposphere Dynamical Coupling
- SPARC reports, newsletters, meetings
- SPARC data center
- Several activities e.g., CCMVal, DynVar
- http://www.atmosp.physics.utoronto.ca/SPARC/index.html

MOTIVATION

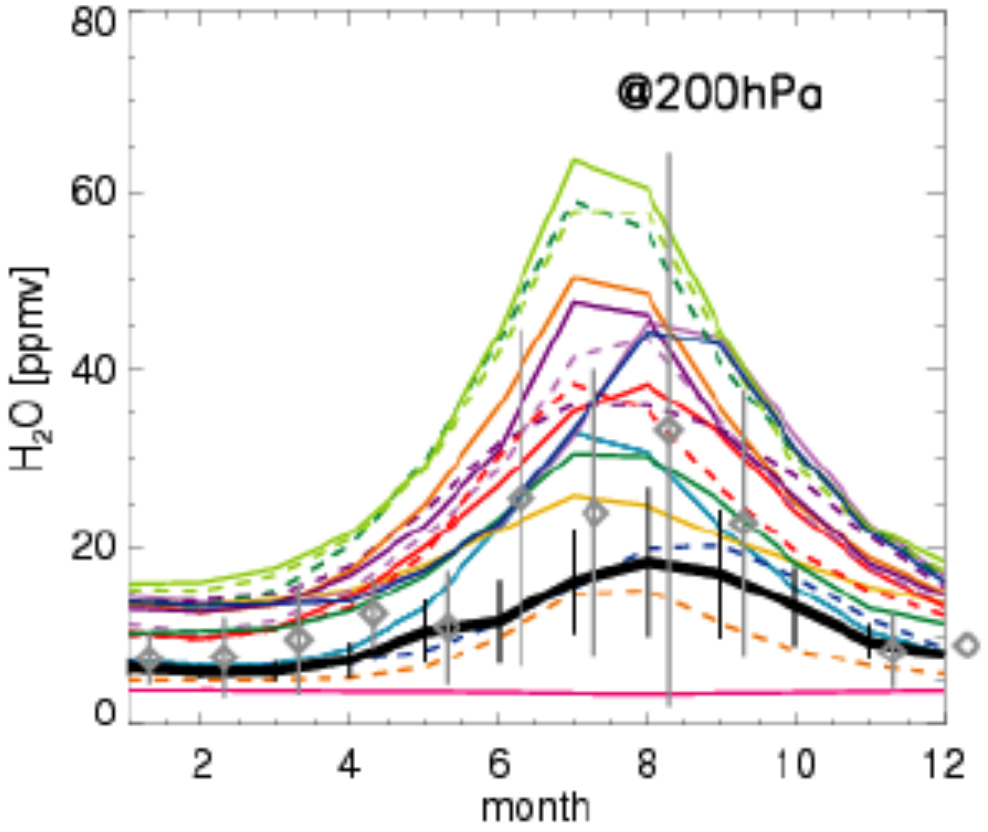
Uncertainties in model assessment

Example from the UTLS chapter of the CCMVal report:

- MIPAS shows likely a too low amplitude (pers. communication G. Stiller IMK, Karlsruhe)
- ACE-FTS, despite potentially higher accuracy, shows very large std deviations, largely due to its restricted sampling coverage
- Comparison between models and the two data sets yield different outcome.

Seasonal cycle of H_2O for 40°N-60°N

MIPAS observations in black, ACE-FTS in grey



MOTIVATION

SPARC CCMVal project (model-measurement intercomparisons):

→ variety of chemical observational data sets available

→ not necessarily known which data set is most reliable for a particular application

→ conflicting results when comparing models to different data sets

→ comparison less meaningful

Need for an assessment of the available data sets for chemical trace gases

(analogous to SPARC Report No. 3 for the meteorological data sets)

OBJECTIVES

The proposed report will offer guidance for the use of chemical trace gas observations from space based instruments.

- ✓ Establishing a data portal for chemical observations in collaboration with the space agencies and assessing state of data availability.

- ✓ Compiling climatologies of chemical trace gases (e.g. zonal means, variability, seasonal evolution, annual means) in collaboration with the instrument PIs.

- ✓ Detailed inter-comparison of these climatologies (summarizing useful information and highlighting differences between the data sets) which will be published as a SPARC report.

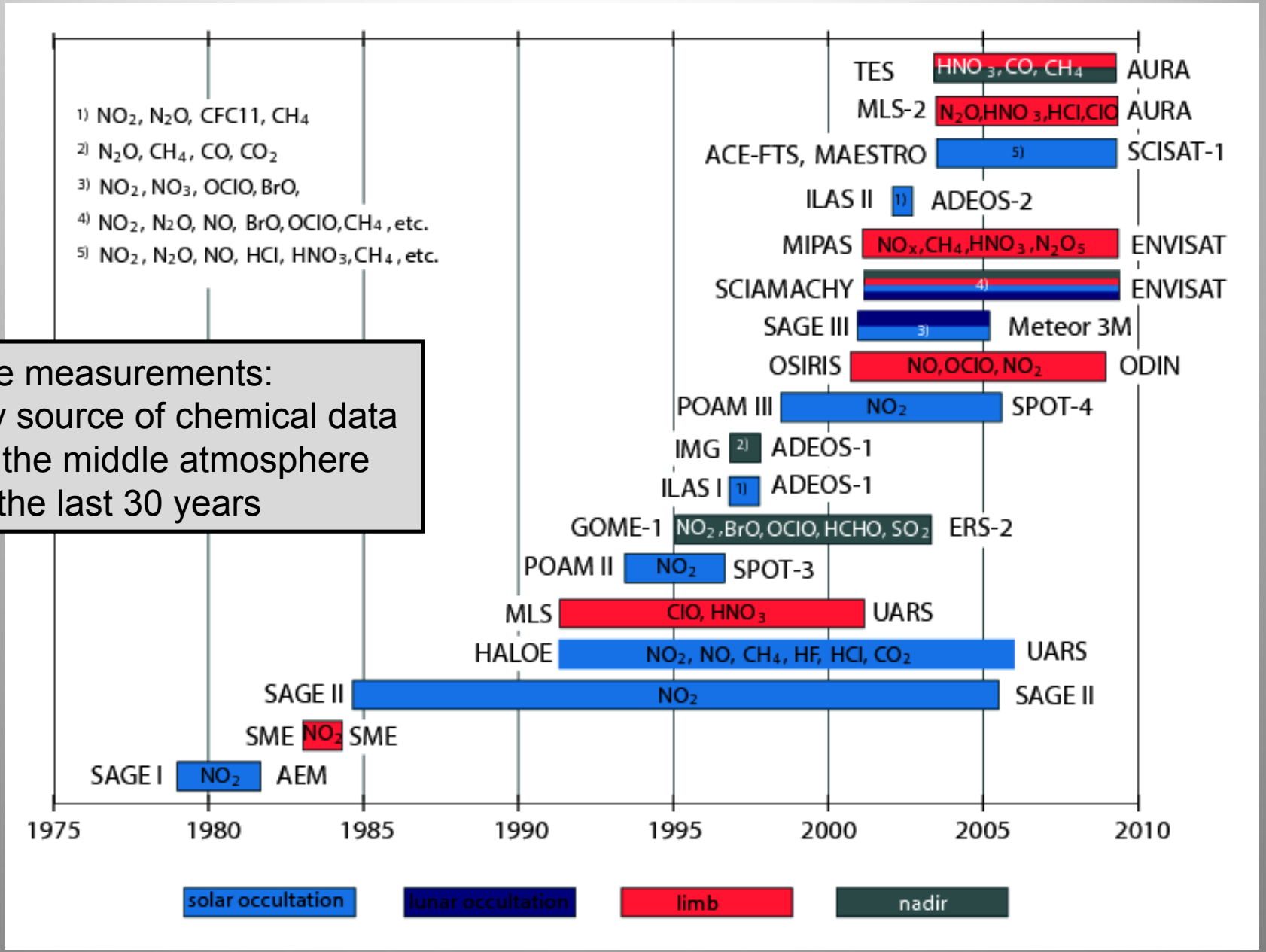
SCOPE

- ✓ Vertically resolved measurements of chemical trace gas species from the upper troposphere to the middle mesosphere (approximately 5-65 km).
- ✓ The main focus is on satellite measurements but, where helpful, the evaluation may be enhanced through aircraft and balloon measurements.
- ✓ The main species the report is targeted at are CH_4, N_2O, HNO_3, NO_y, NO_x, NO_2, HCl, Cl_y, Br_y, age of air (SF_6 and CO_2).
- ✓ Ozone and water vapor may also be treated briefly, heavily drawing from the SPARC water vapor and ozone initiatives.

DATA INITIATIVE

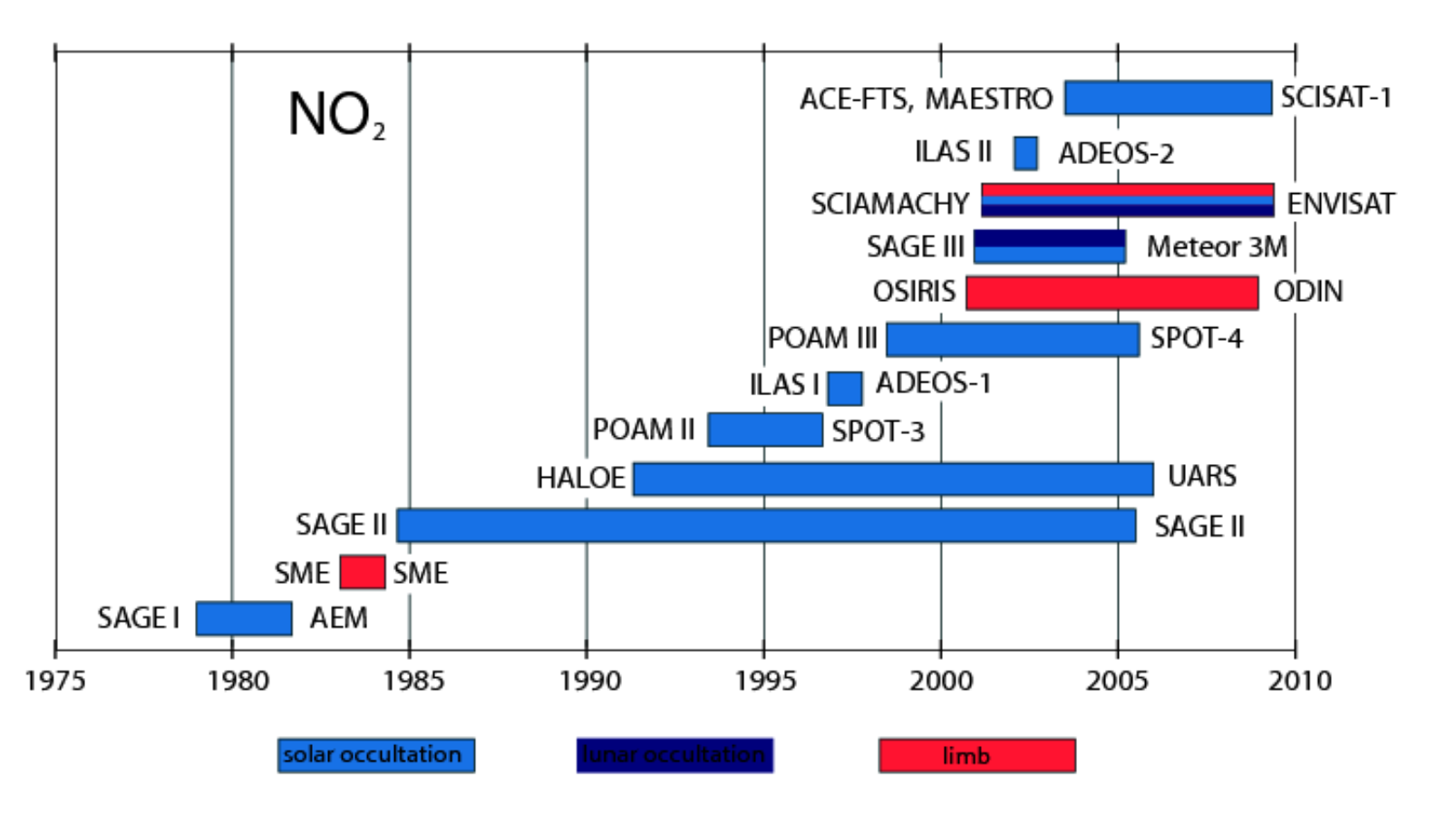
- The initiative is very timely given the fact that
  - ✓ the “golden age” of stratospheric composition measurements of the past three decades is about to come to an end,
  - ✓ it is highly likely that there will be much less measurements in the future,
  - ✓ we need to capture existing knowledge on current and recent instruments before this knowledge is lost.
- In particular the report will also help to
  - ✓ identify priorities for reprocessing data or enhanced validation efforts
  - ✓ identify measurement gaps, which could motivate and provide support for future missions.

SATELLITE MEASUREMENTS



Satellite measurements: primary source of chemical data sets of the middle atmosphere during the last 30 years

SATELLITE MEASUREMENTS



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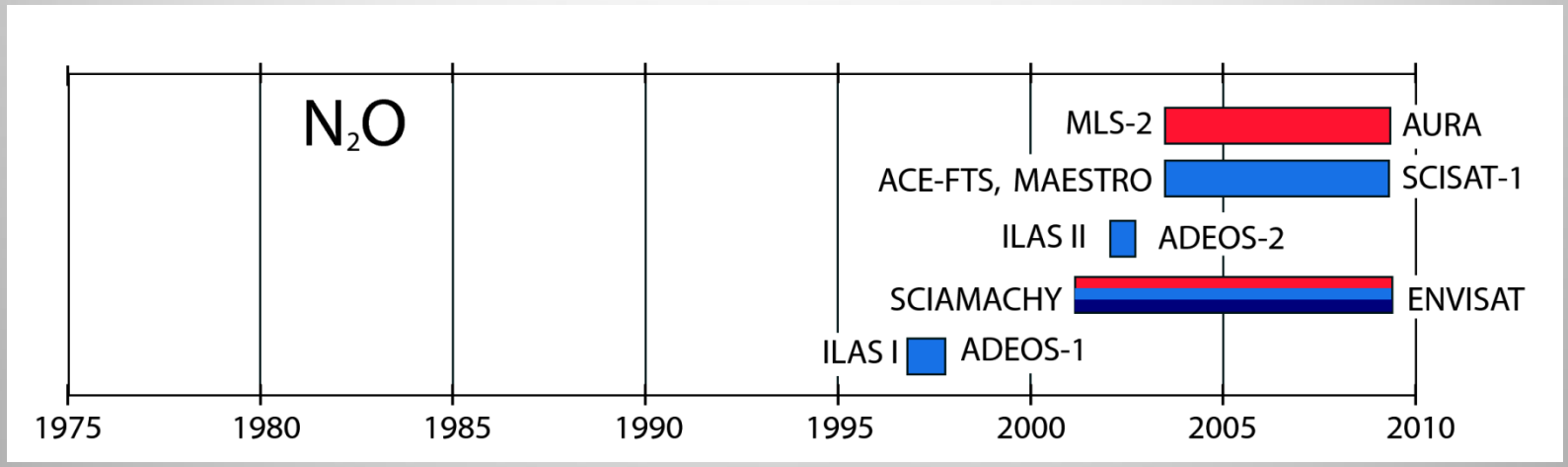
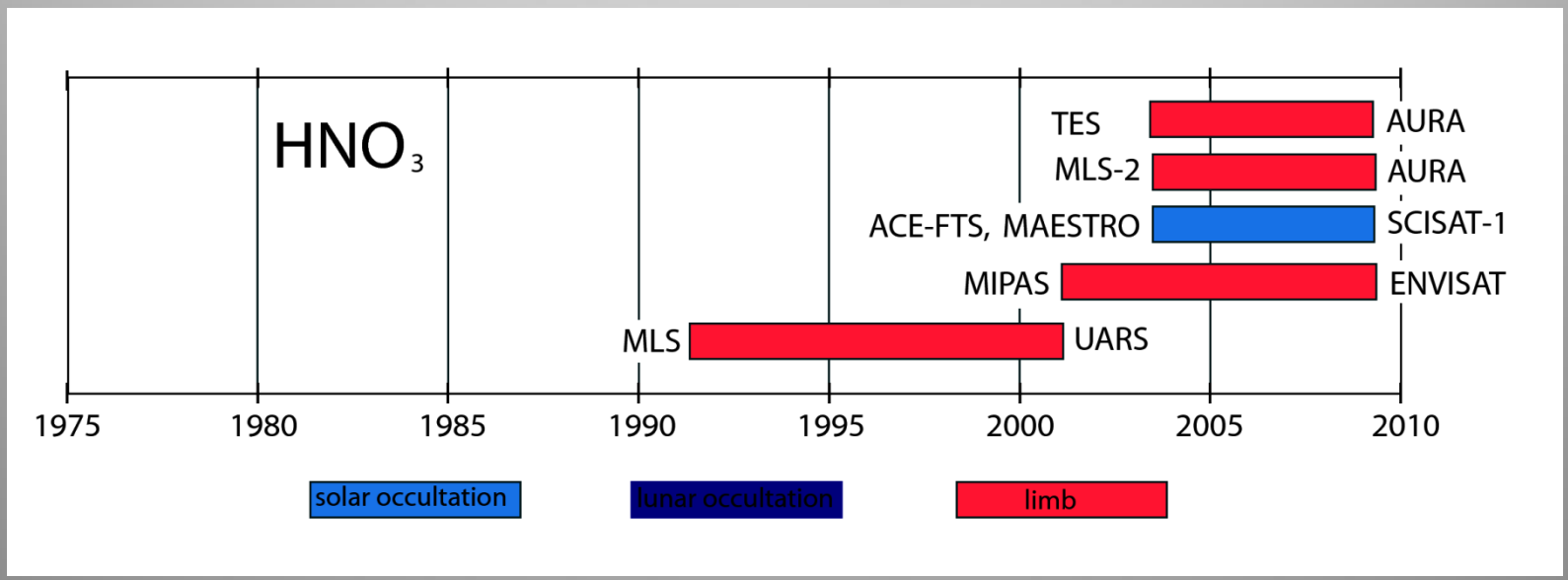
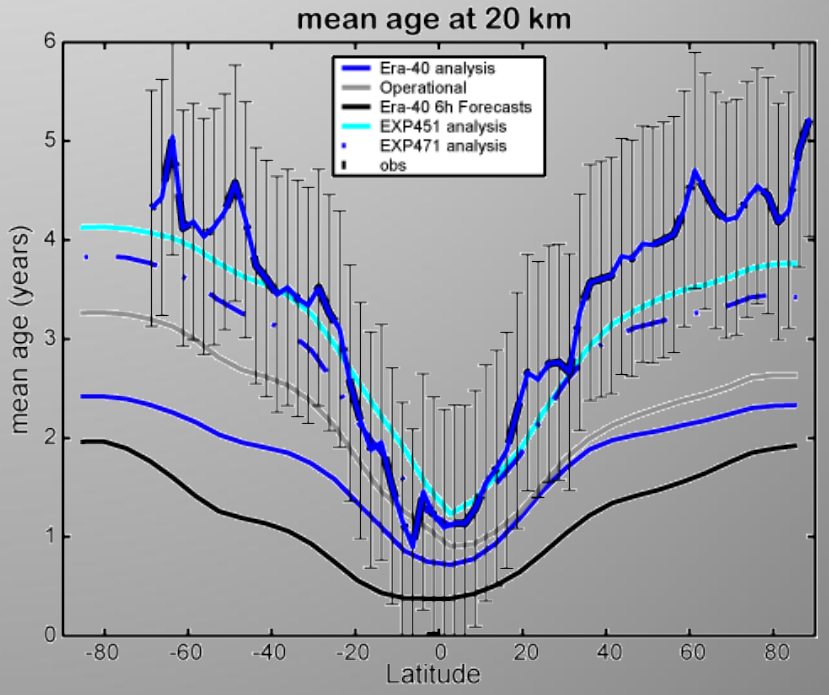




AICRAFT AND BALLOON MEASUREMENTS

Variety of aircraft and balloon campaigns available (list not complete):

- AASE I and II
- EASOE
- SESAME
- SOLVE
- EUPLEX
- CHEOPS
- POLARIS
- SPURT
- STREAM
- STRAT
- TOTE/VOTE
- POLARIS
- CR-AVE
- AVE Housten
- Polar AVE
- CRYSTAL-FACe
- AVE
- ARCTAS
- TC4
- START08
- preHIPPO
- ...



- provide high accuracy, high precision and high resolution data
- limited sampling in time and space

SPARC Newsletter No. 26 (2006)

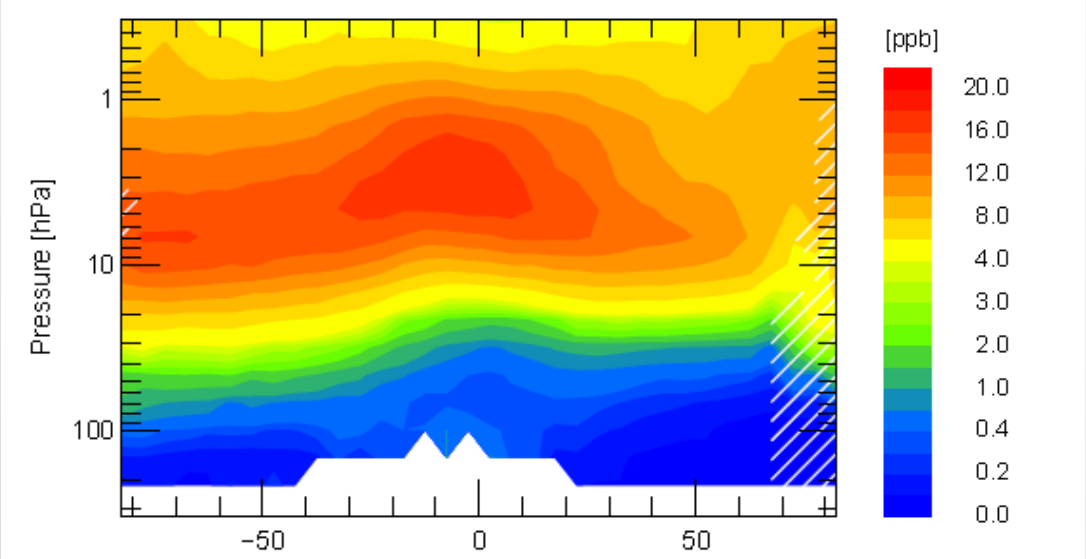
Data availability

For some atmospheric missions climatologies have been developed, e.g.

- A stratospheric climatology for O_3, H_2O, CH_4, NO_x, HCl and HF derived from HALOE measurements *(Grooß and Russell, ACP 2005).*
- Odin stratospheric proxy NO_y measurements and climatology *(Brohede et al., ACP 2008).*
- Nitric acid in the stratosphere based on Odin observations from 2001 to 2009 – Part 1: A global climatology *(Urban et al., ACP, 2009).*
- Towards a climatology of stratospheric bromine monoxide from SCIAMACHY limb observations *(Sheode et al., ACPD 2006).*
- Technical Note: A new global database of trace gases and aerosols from multiple sources of high vertical resolution measurements *(Hassler et al., ACP, 2008)* .
- BrO climatology from OSIRIS *(McLinden).*
- A Stratospheric NO_2 Climatology from Odin/OSIRIS Limb-Scatter Measurements *(Brohede at al., Can. J. Phys., 2007).*

EVALUATIONS

Zonal mean climatologies

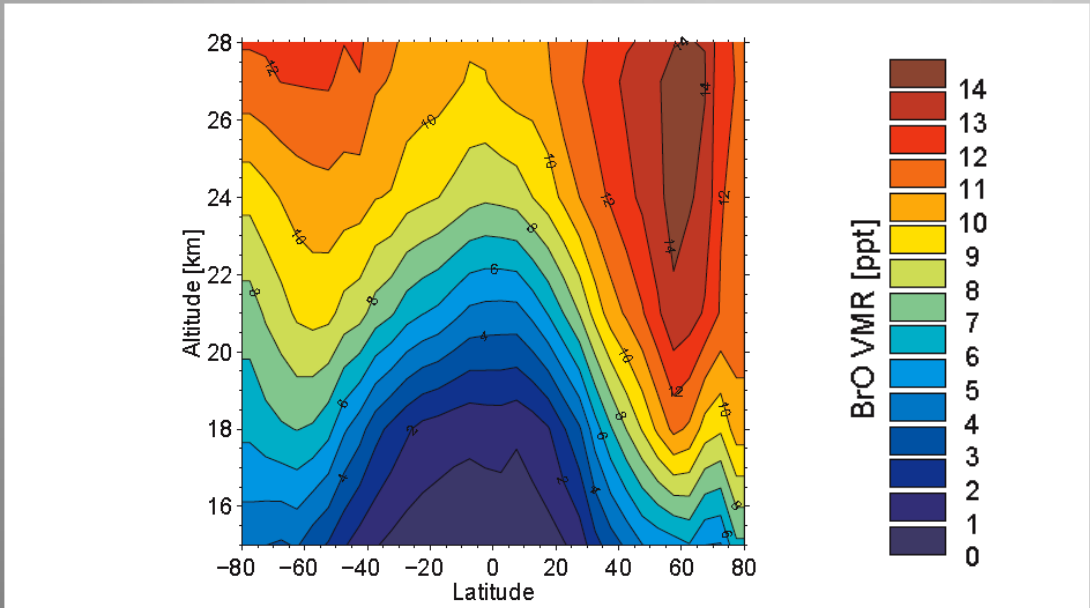


HALOE NO_x climatology

January (sunset only)

1991 - 2002

Grooß and Russell, ACP 2005



SCIAMACHY BrO climatology

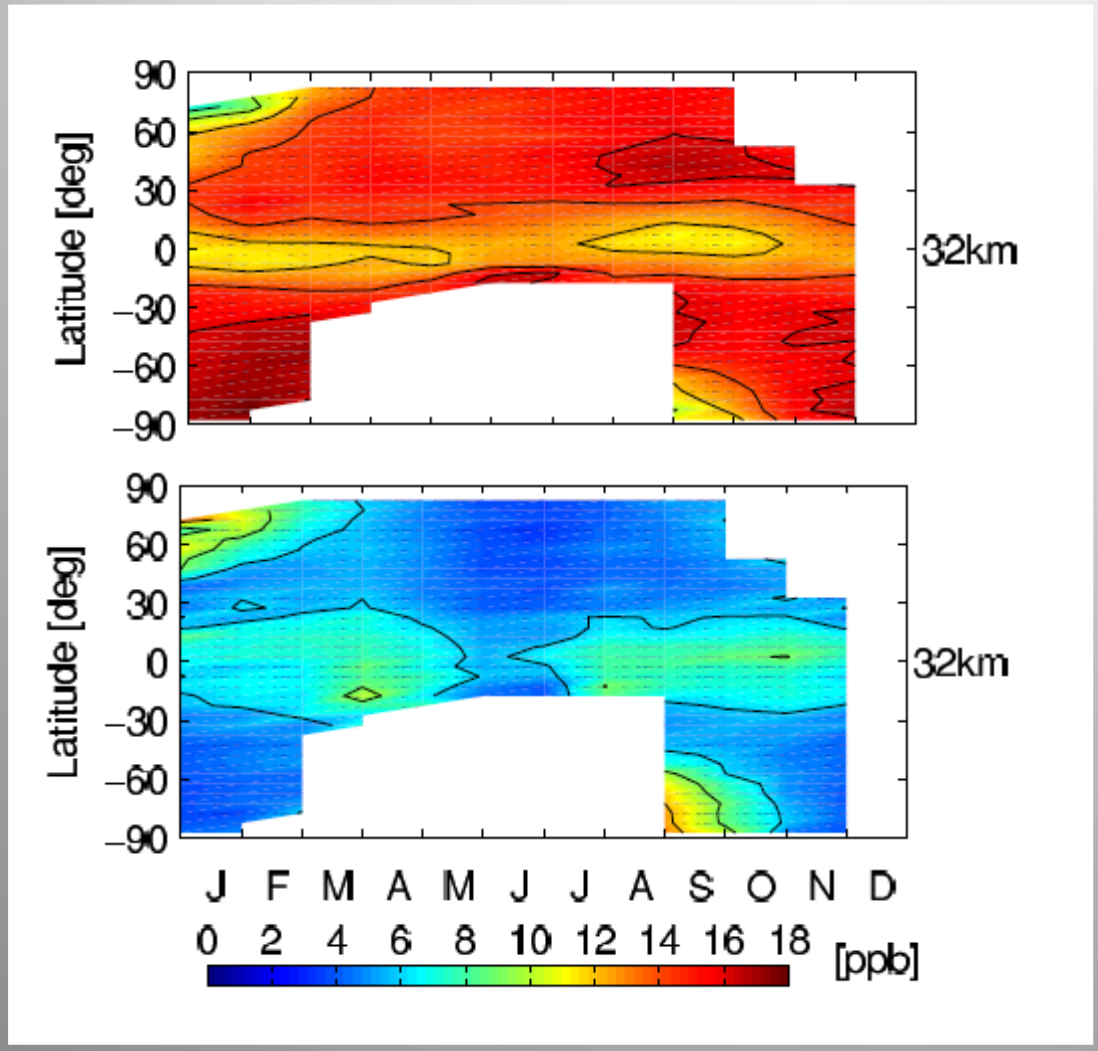
December-February

2003 - 2004

Sheode et al., ACPD 2006

EVALUATIONS

Seasonal evolution



Odin NO_y climatology

seasonal cycle of monthly mean values

Odin NO_y climatology

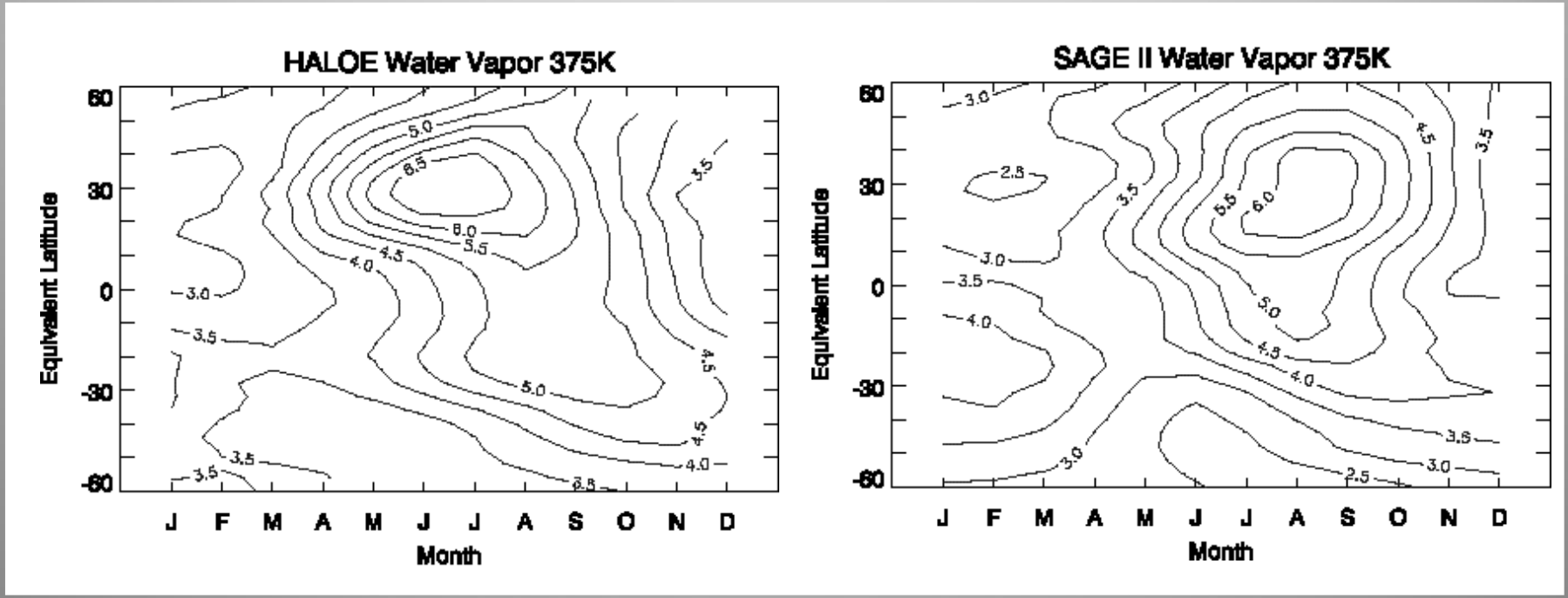
seasonal cycle of standard deviation

Brohede et al., ACP 2008

EVALUATIONS

Comparison of seasonal evolution

Seasonal cycles derived from HALOE and SAGE II (sunset) data on the 375 K isentrope. The values are mixing ratios given in ppmv.



WAVAS SPARC report n°2, 2000

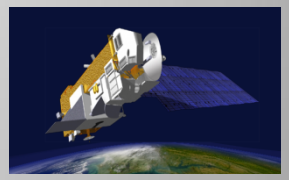
SYNERGIES

- Atmospheric Composition Portal will be developed by ACC
  - ✓ so far supported by NASA and DLR
  - ✓ no homogenized data sets, but easy access to air quality data
- NASA MEaSUREs - GOZCARDS program
  - ✓ lead: Lucien Froidevaux
  - ✓ homogenized stratospheric data sets for American missions

IDENTIFIED CONTACTS

- **Author team** (to be determined from instrument teams and analysts)
- **Space Agencies:**
  - NASA: Ernest Hilsenrath
  - CSA: Thomas Piekutowski
  - ESA: Claus Zehner, Joerg Langen
- **Experts / Advisory group** (e.g. Bill Randel, Karen Rosenlof)

- **Instrument PIs**
  - ✓ MLS (AURA/UARS): Lucien Froidevaux, Michelle Santee, Nathaniel Livesey
  - TES (AURA): Annemarie Eldering, John Worden, Reinhard Beer
  - ✓ ACE-FTS (SCISAT-1): Peter Bernath, Kaley Walker
  - MAESTRO (SCISAT-1): Tom McElroy
  - POAM II / III (SPOT-3,4): Karl Hoppel
  - ✓ HALOE (UARS): James M. Russell III, Ellis Remsberg
  - ✓ OSIRIS (ODIN): Doug Degenstein
  - ✓ SMR (ODIN): Donal Murtagh
  - ILAS I / II (ADEOS-1,2): Tatsuya Yokota, Yasuhiro Sasano
  - SAGE I / II / III: M. Patrick McCormick
  - SME: Garry Rottman
  - ✓ MIPAS (ENVISAT): Gabriele Stiller, Thomas von Clarmann
  - ✓ SCIAMACHY (ENVISAT): John Burrows
  - GOMOS: E. Kyröla, J. Tamminen
  - SABER (Timed): James M. Russell III
  - ✓ HIRDLS: John Gille
  - AIM/SOFIE: James M. Russell III, Larry Godley



DISCUSSION POINTS

- How much of aircraft, balloon, and ground-based measurements should be included, should such comparisons be done in separate papers?
- Should water vapour and ozone be included?
- What about CO, short-lived species, aerosols, PSCs?
- Technical issues like trends in data sets, sampling biases?

Feedback and comments are very welcome!

TIME LINE

- Report outline and author teams to be defined by May 2010
- **Workshop** (maybe next spring)
- Report to be completed by May 2012