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# *Stratospheric Processes and their Role in Climate (SPARC)*

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## SPARC: Overall Aim & Modus Operandi



- To bring knowledge of the stratosphere to bear on relevant issues in climate variability and climate prediction
- To identify gaps and define “bite sized” deliverables, bringing in relevant partners, in a well-defined strategic plan for evolution

SPARC resources:

- WCRP allocation to support travel
- SPARC Office
- **Its participating scientists**

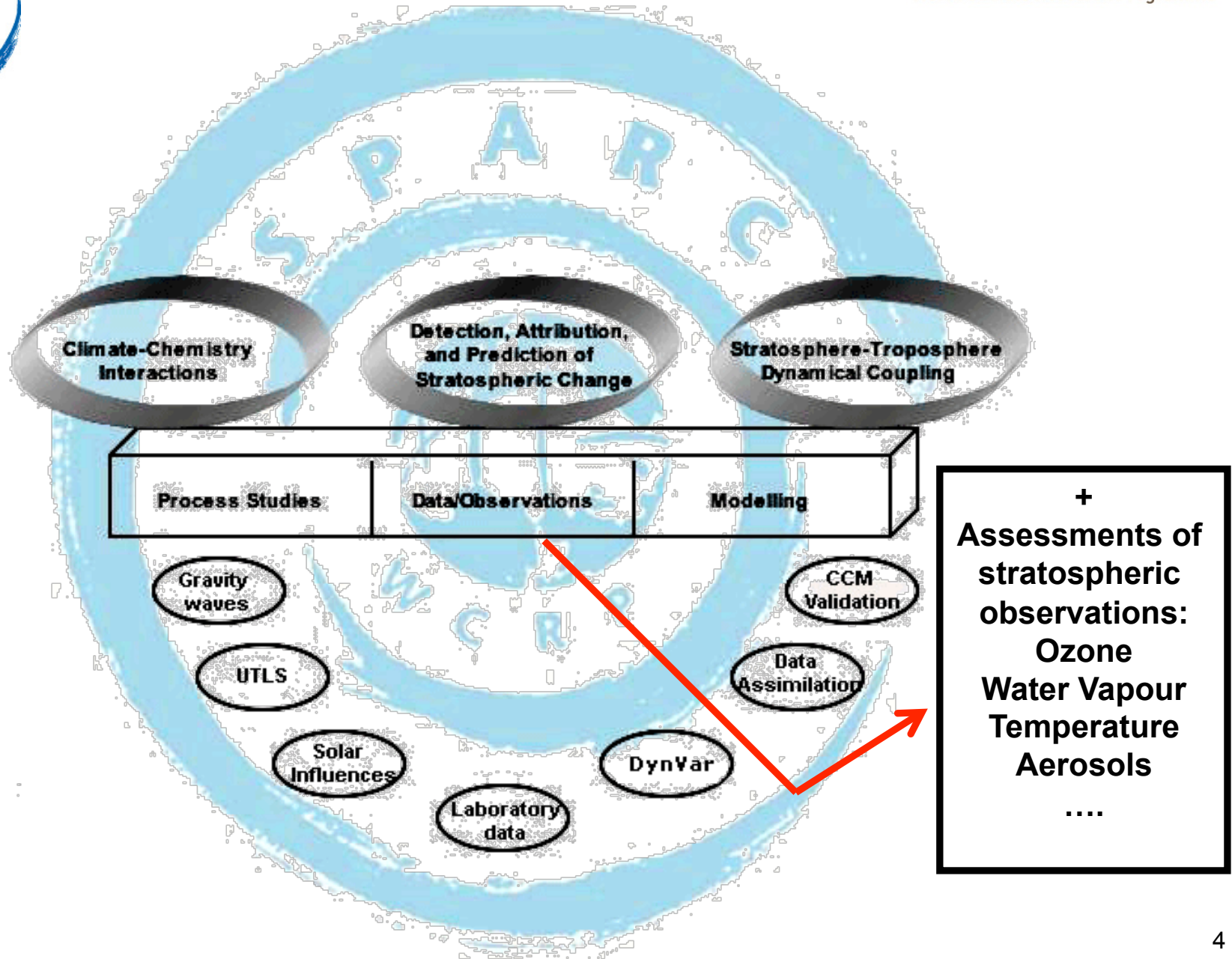
If we are successful in promoting useful activities, then we leverage other resources (e.g. ISSI)



- SPARC vehicles include
  - SPARC Newsletter (279 citations in the WoS)
  - SPARC Reports (174 citations in the WoS)
  - Refereed review papers
  - Papers from SPARC activities (e.g. CCMVal)
  - Interdisciplinary workshops to cross boundaries
  - Working groups, e.g. data assimilation
  - General Assemblies (normally every 4 years)
    - *Last one was in Bologna in 2008, next will be in 2014*
    - *The WCRP Open Science Meeting will replace the SPARC GA for the intervening (2008-2014) period*



# Current SPARC Structure

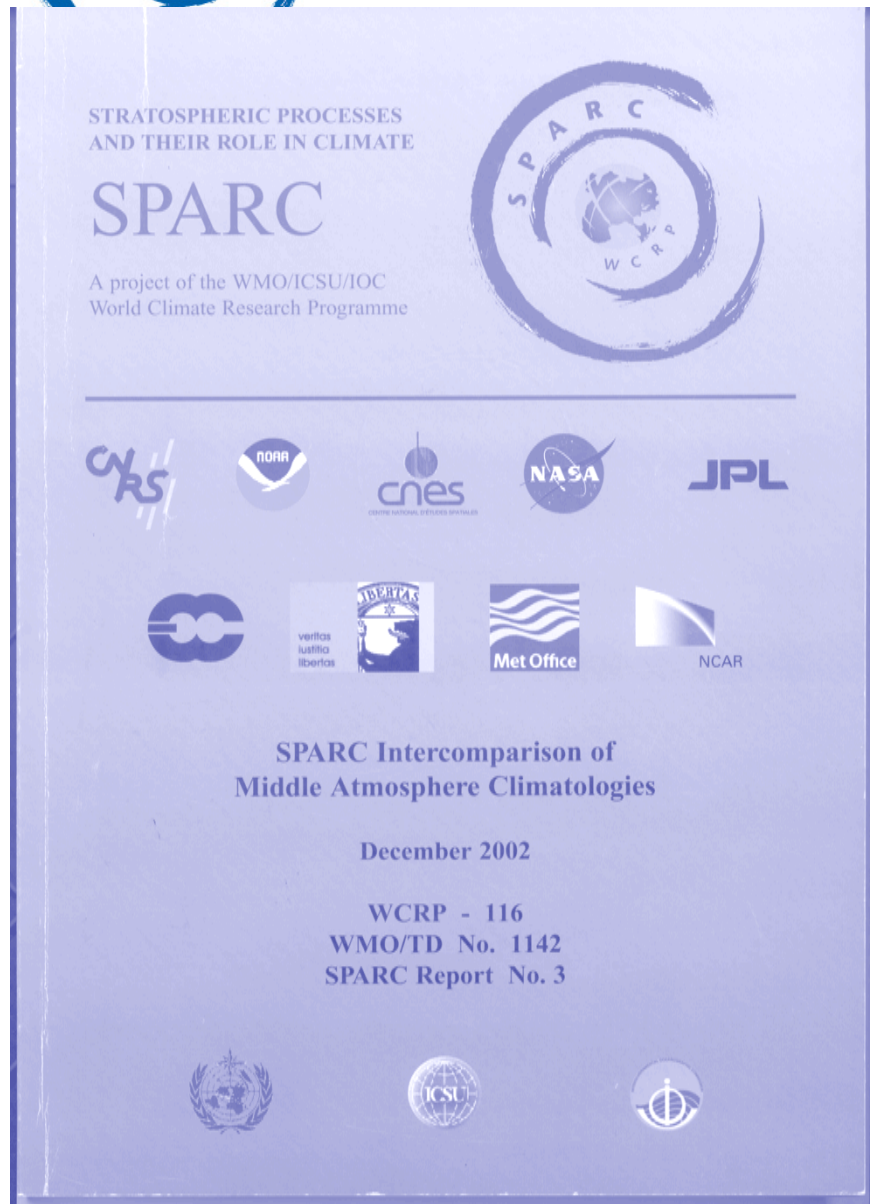




- SPARC science relies heavily on high-quality observational data sets for understanding atmospheric processes, variability, and long-term changes
- Our peer-reviewed SPARC Reports concerning stratospheric observations have had an important role in ozone and climate assessments
  - Ozone profile trends (1998)
  - Water vapour trends (2000)
  - Stratospheric temperature trends (2001)
  - Middle atmosphere climatologies (2002)
  - Aerosol assessment (2006)
- Provided direct input into the 1998, 2002 and 2006 WMO/UNEP Ozone Assessments  
(14 citations in WMO/UNEP 2006; 7 citations in AR4)



# SPARC Intercomparison of Middle Atmosphere Climatologies



- Was *not* a new climatology
- Provided a “users’ guide” to existing climatologies (observations and analyses)
  - All climatologies had some weaknesses somewhere
- Motivated by the SPARC GRIPS model intercomparison
  - Focused on winds and temperatures
- Also led to a J. Clim. Paper
- Highlighted areas where observational knowledge is poor (e.g. tropical winds)



- Observations are again becoming a major SPARC focus
- GCOS and CEOS are responsible for observations, but are coming to WCRP bodies such as SPARC for advice on science priorities and how to best exploit existing data
  - CEOS ACC sought SPARC input for its “gap report”
  - ESA is asking SPARC to define science needs which will be met through STSE funding
  - SPARC represents WCRP on the GCOS AOPC
- The growing emphasis on ECVs/CDRs is a big part of this, as well as the need to support model validation
- Arguments for reprocessing or for new measurements are more far compelling for the agencies if they come from data users such as SPARC

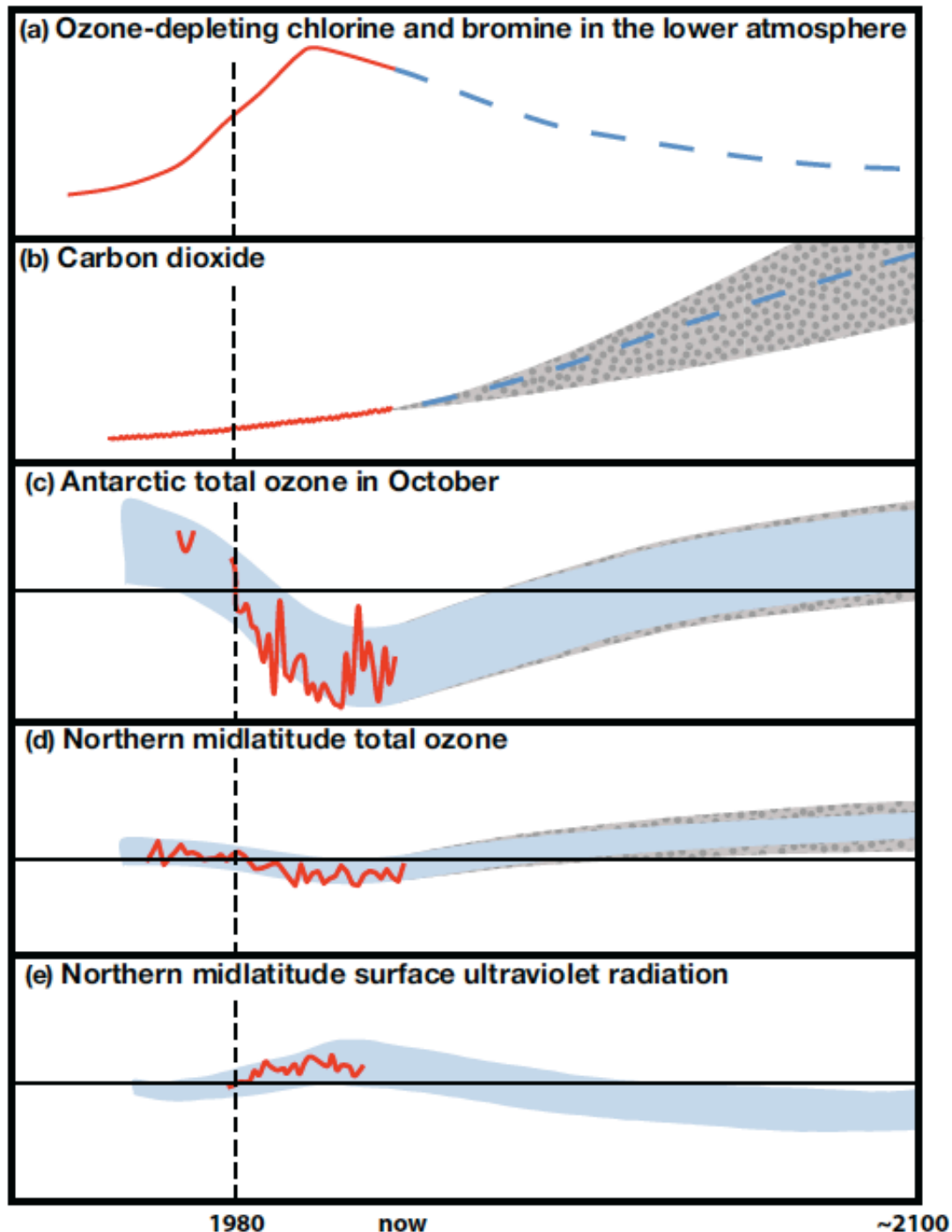


# ***Chemistry-Climate Model Validation Activity (CCMVal)***



- The largest and highest-profile SPARC activity over the last few years
- Just completed a comprehensive peer-reviewed SPARC Report, involving 18 CCM groups and over a hundred scientists as authors and reviewers
  - Process-oriented validation of models
  - Detailed evaluation of radiative and chemical schemes
  - Statistical evaluation of ozone projections
  - Effect of stratosphere on troposphere
- Provided critical input into the 2010 WMO/UNEP Ozone Assessment





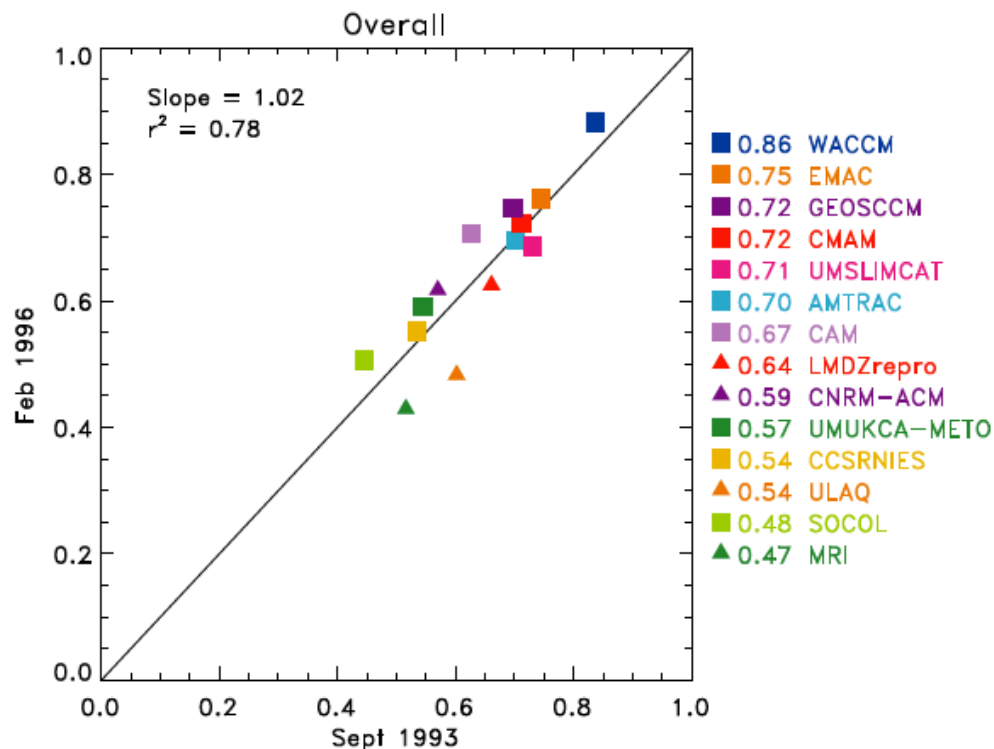
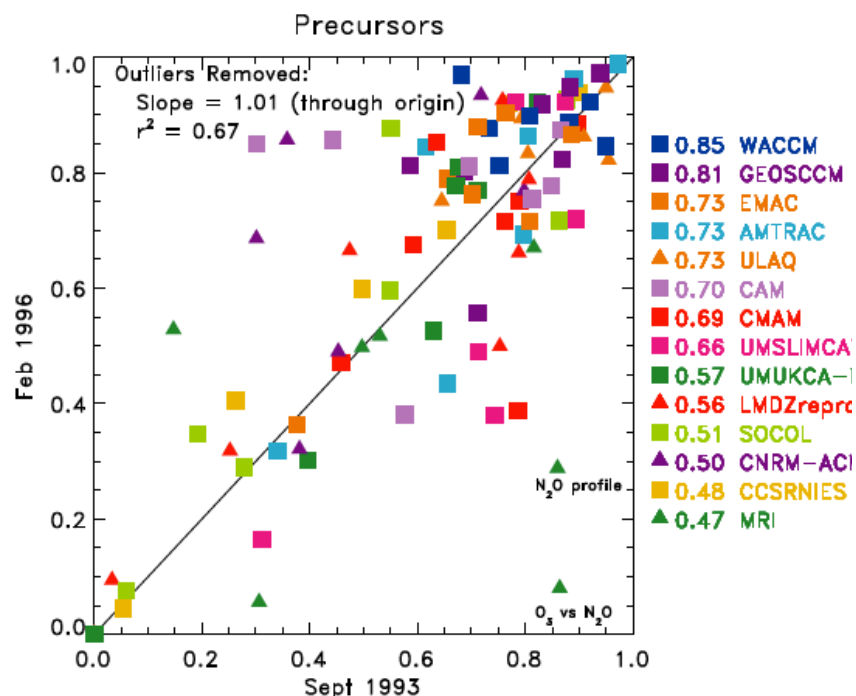
## From the Executive Summary of the 2010 UNEP/WMO Assessment

- The shaded areas in panels (c)-(e) came from CCMVal based on sophisticated statistical analysis of model variability and trends
- In past Assessments, estimates of model ranges had been pure guesswork



## Chemistry chapter: Diagnostics testing precursors and radicals

Fast Chemistry Evaluation

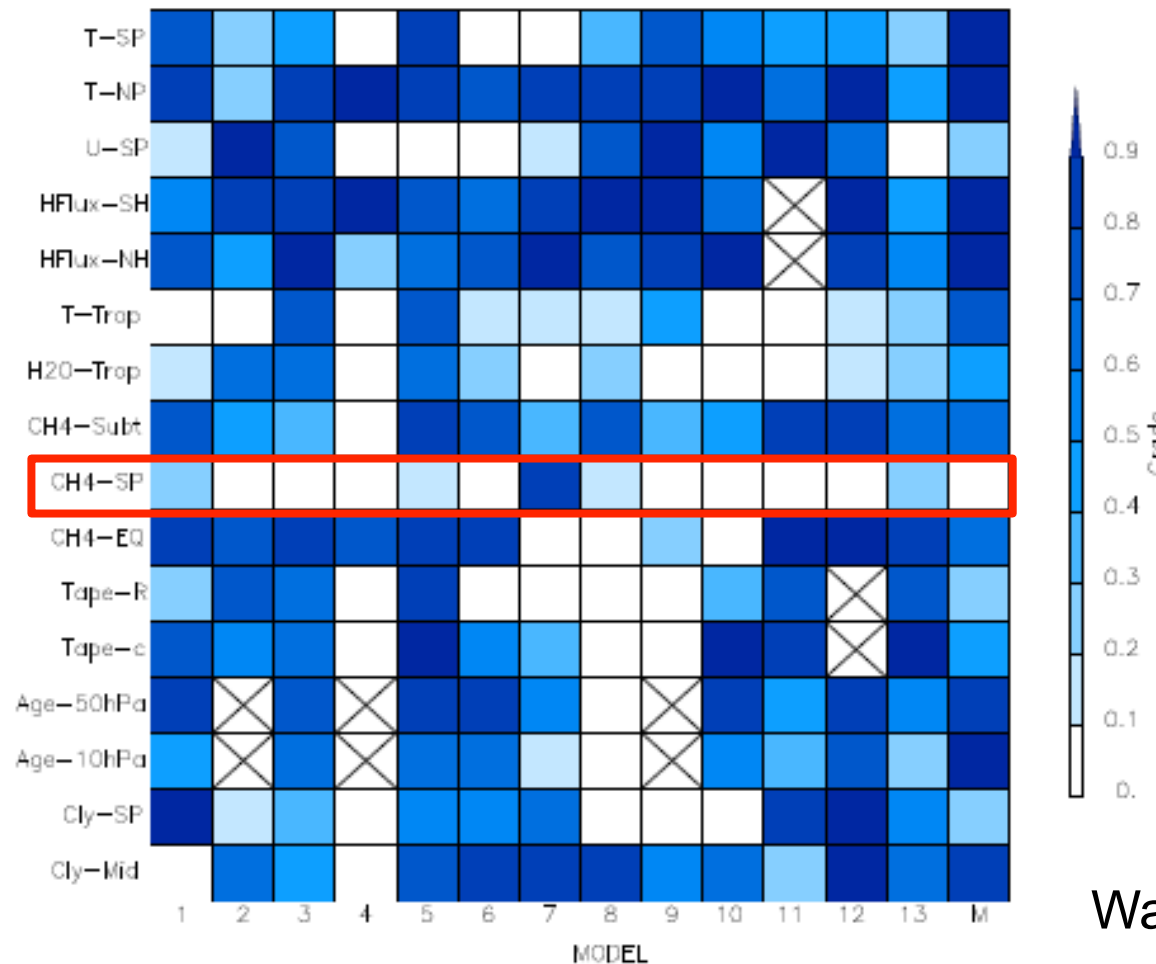


Grading of model performance in simulating precursors and radicals on the basis of ACE-FTS observations during two different time periods. Models performing best exhibit a more sophisticated chemistry scheme: AMTRAC, CMAM, EMAC, GEOSCCM, UMSLIMCAT, and WACCM.



## A first attempt at quantitative performance metrics

- Grading table: dark blue indicates good, white bad model performance
- The fidelity of the grading relies on the accuracy of the observations!



- Chemical observations for CCMVal-1 mostly from HALOE

- CH<sub>4</sub> diagnostic in the SH polar region: even the best performing models do a bad job

- Indication that the quality of the observations may be questionable?

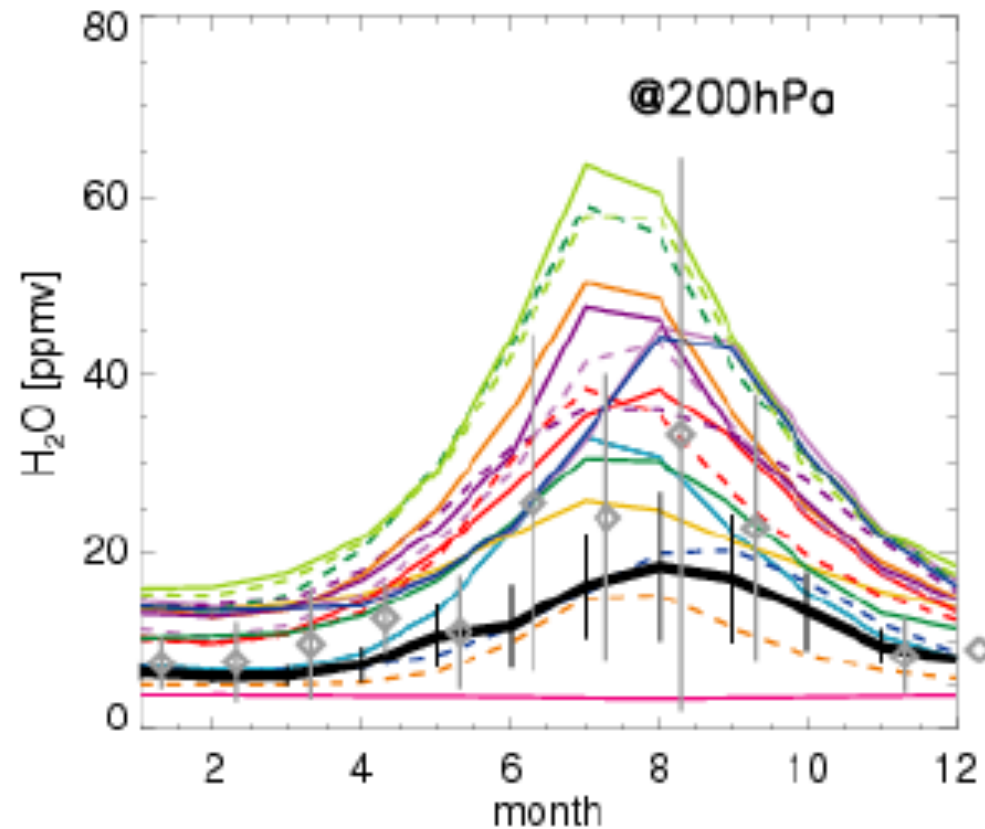
Waugh & Eyring (2008 ACP)



## UTLS chapter: Seasonal cycles in chemical trace gas species at different pressure levels

Seasonal cycle of H<sub>2</sub>O 40°N-60°N: models coloured, MIPAS observations in black, ACE-FTS in grey

- MIPAS shows likely a too low amplitude at 200 hPa (pers. Communication, G. Stiller, IMK, Karlsruhe)
- ACE-FTS, despite potentially higher accuracy, shows very large std deviations, largely due to its highly restricted sampling
- Comparison between models and the two data sets yield different conclusions



Hegglin et al. (2010 JGR)



## ***Recommendations from the SPARC CCMVal Report***



- Long-term vertically resolved data sets of constituent observations in the stratosphere are required to assess model behaviour and test model predictions. This includes ozone, but also other species that can be used to diagnose transport and chemistry. The current set of GCOS Essential Climate Variables is not sufficient for process-oriented validation of CCMs.
- More global vertically resolved observations are required, particularly in the UTLS. As CCMs evolve towards including tropospheric chemistry, lack of observations in this region will become a major limitation on model validation.
- A systematic comparison of existing observations is required in order to underpin future model evaluation efforts, by providing a more accurate assessment of measurement uncertainties.



## *How a SPARC Report works*



- Report gets commissioned by the SPARC SSG, with designated Lead Authors and a well-defined scope
- Lead Authors develop an author team and outline
- First draft gets reviewed internally and by “friends”
- Second draft gets reviewed externally (coordinated by the SPARC Office)
- Normally, there is a final review meeting to accept the Report (there may be an Executive Summary)
- Report gets edited by the SPARC Office and published as a WCRP Technical Report, both physically and on-line
- It is good for elements of the Report to be published in journal articles, but these should be submitted before the Report is published



## *Other issues*

- There are currently two related SPARC activities
  - A second water vapour assessment (WAVAS-2), which seems to have got stalled
  - A second ozone profile trends assessment, which will start up with a workshop in January 2011 in Geneva
- Both of these are focusing on long-term trends, rather than on climatologies
  - WAVAS-2 is also focusing on supersaturation and discrepancies between in-situ measurements
- It makes sense to include water vapour and ozone here
- For practical reasons, SPARC would like this Report to be finalized by late 2011, if possible