

Scientific objectives of SPARC* and the value of data assimilation

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* Stratospheric Processes and their Role in Climate: a project of the World Climate Research Programme

Aim of SPARC

- To bring stratospheric expertise to bear on scientific issues concerned with **climate processes** and **climate prediction**;
- for the benefit of
 - World Climate Research Programme
 - WMO/UNEP Ozone Assessment
 - IPCC
 - Space Agencies



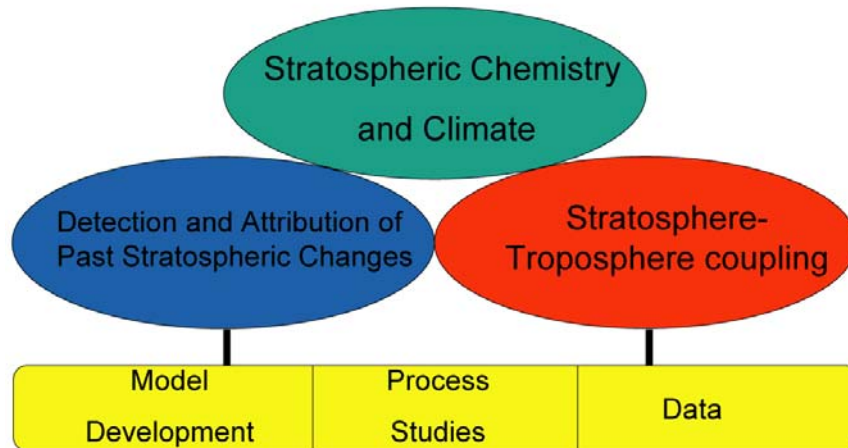
SPARC's Approach

- To focus effort on
 - **manageable** scientific tasks, with a
 - **well-defined** outcome, over a
 - **short** period of time, while seeking to
 - **anticipate** needs of the wider community



Recent Deliverables

- "Stratospheric temperature trends: observations and model simulations"
(paper by STTA group, awarded the WMO Norbert Gerbier-MUMM Award, 2003).
- Stratospheric reference climatology
- WMO/UNEP Ozone Assessment 2002
– Chap. 4 Global Ozone: past and future.



Future Themes



Stratospheric Chemistry and Climate

- How will stratospheric ozone and other constituents evolve?
- How will changes in stratospheric composition affect climate?
- What are the links between changes in stratospheric ozone, UV radiation and tropospheric chemistry?



Ozone and aerosol have multiple roles

Ozone-

Greenhouse gas UV shield Drives atmospheric chemistry
 Toxic to living things upon contact

→ Ozone is MADE in the atmosphere

Aerosols

Interacts with radiation: absorbs or scatters radiation
 Alters composition of the atmosphere (medium for reactions)
 Affects cloud formation and cloud properties
 Harmful to humans (in some cases, e.g., PM 2.5)

- Aerosols are
- made in the atmosphere from the gas phase
 - emitted into the atmosphere
 - transformed in the atmosphere



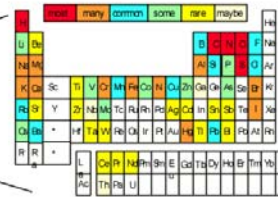
O₃ - We know what it is!



With all its properties defined

Aerosol - not a single entity!

● Composition- highly complex



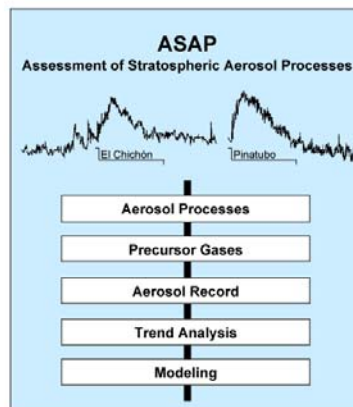
- Size distribution
- Optical properties - Absorbing vs. scattering
- Phase - liquid, solid, mixture

All these "properties" change in the atmosphere

All the properties make a difference



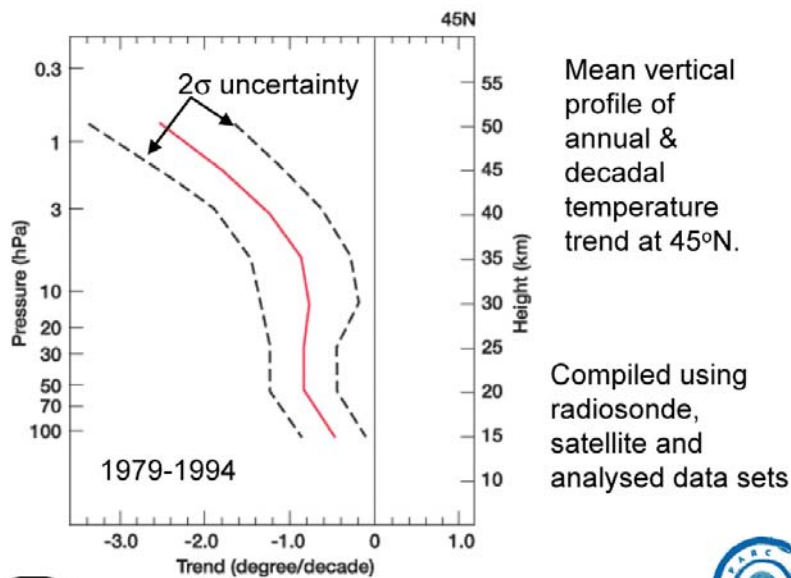
ASAP – The SPARC Aerosol Assessment



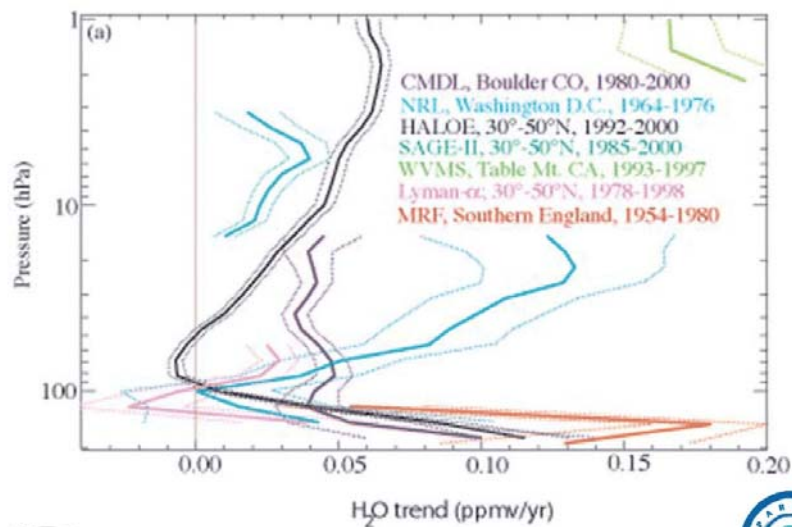
Detection and Attribution of Past Stratospheric Changes

- What *are* the past changes and variations in the stratosphere?
- How well can we explain past changes in terms of natural and anthropogenic effects.

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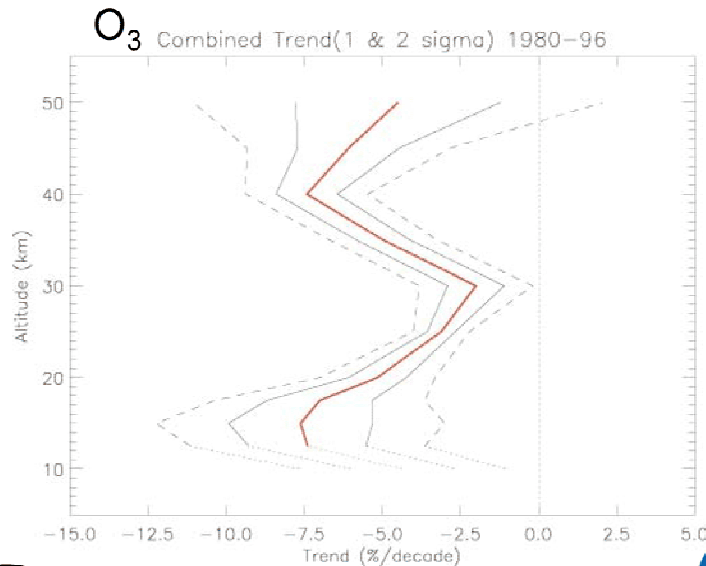


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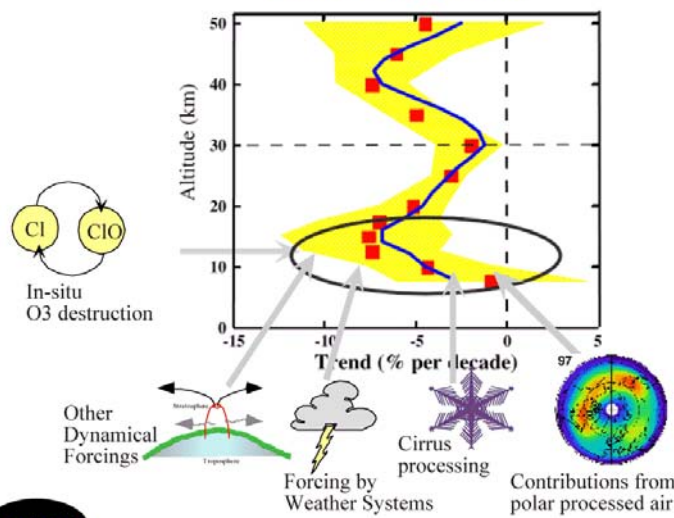


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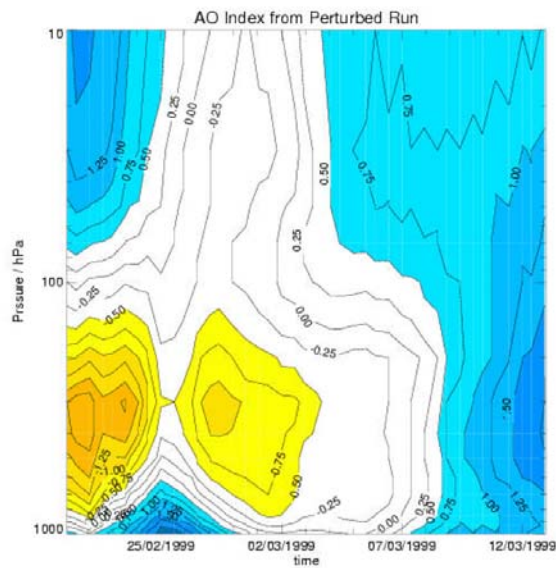
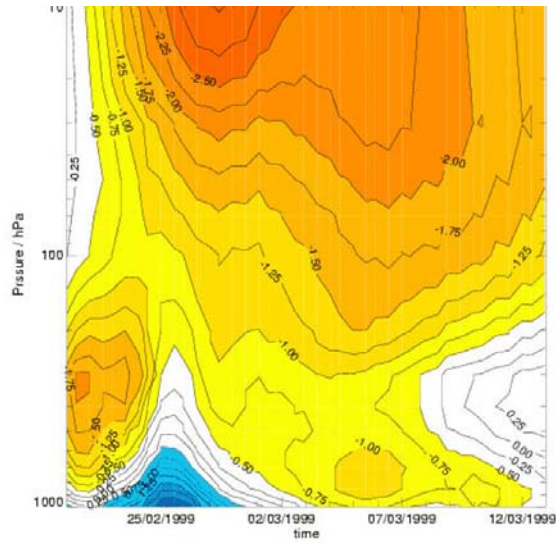
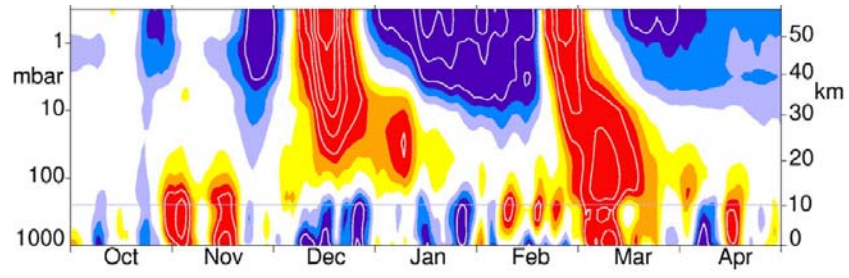
Ozone-trends and why



Stratosphere-Troposphere Coupling

- What is the role of dynamical and radiative coupling with the stratosphere in extended range tropospheric weather forecasting?
- What is the role of dynamical and radiative coupling in determining long-term trends in tropospheric climate?
- By what mechanisms do the stratosphere and troposphere act as a coupled system?





Some Data Assimilation Requirements for SPARC Science

- Long term, global data sets for the troposphere and stratosphere, free of artificial trends.
- 3-D velocity fields with reduced data assimilation "noise" at 6-hourly intervals.
- Parametrized mass fluxes.
- Diabatic heating rates.
- Ozone, tracers and aerosols.
- Attention to **B** in the UT/LS region.

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Data Assimilation Working Group

- Collect information on stratospheric data sets on meteorology and chemistry (quality, availability, software...).
- Process-focused quality assessments.
- Collect and document information in data assimilation systems.
- Liaise with space and other agencies on SPARC data needs.

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