The SPARC Data Assimilation Working Group (DAWG)

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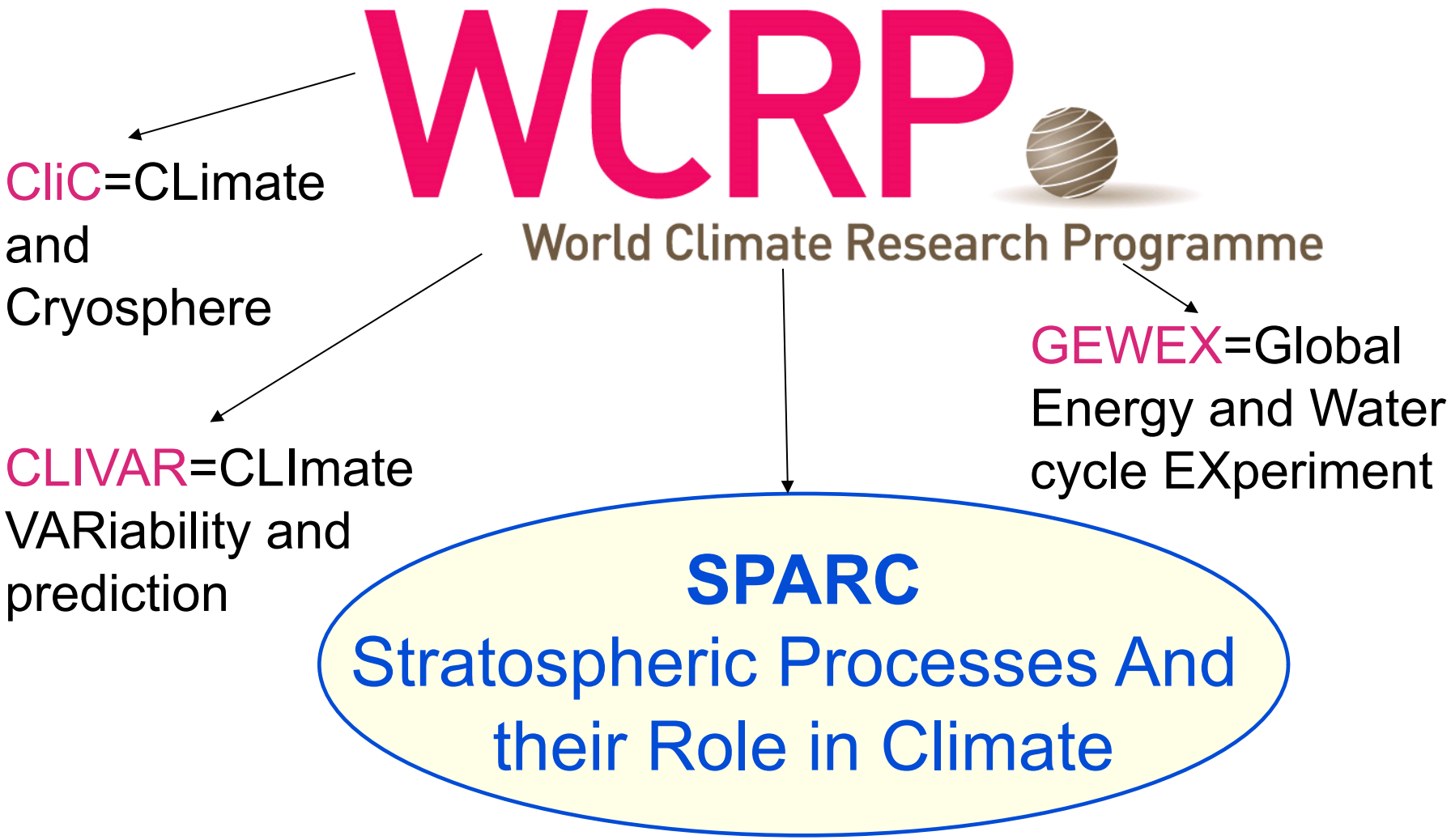
SPARC-DA workshop, Exeter, 21 June 2010

The two overarching objectives of the WCRP are:

- ***to determine the predictability of climate***
- ***to determine the effect of human activities on climate***

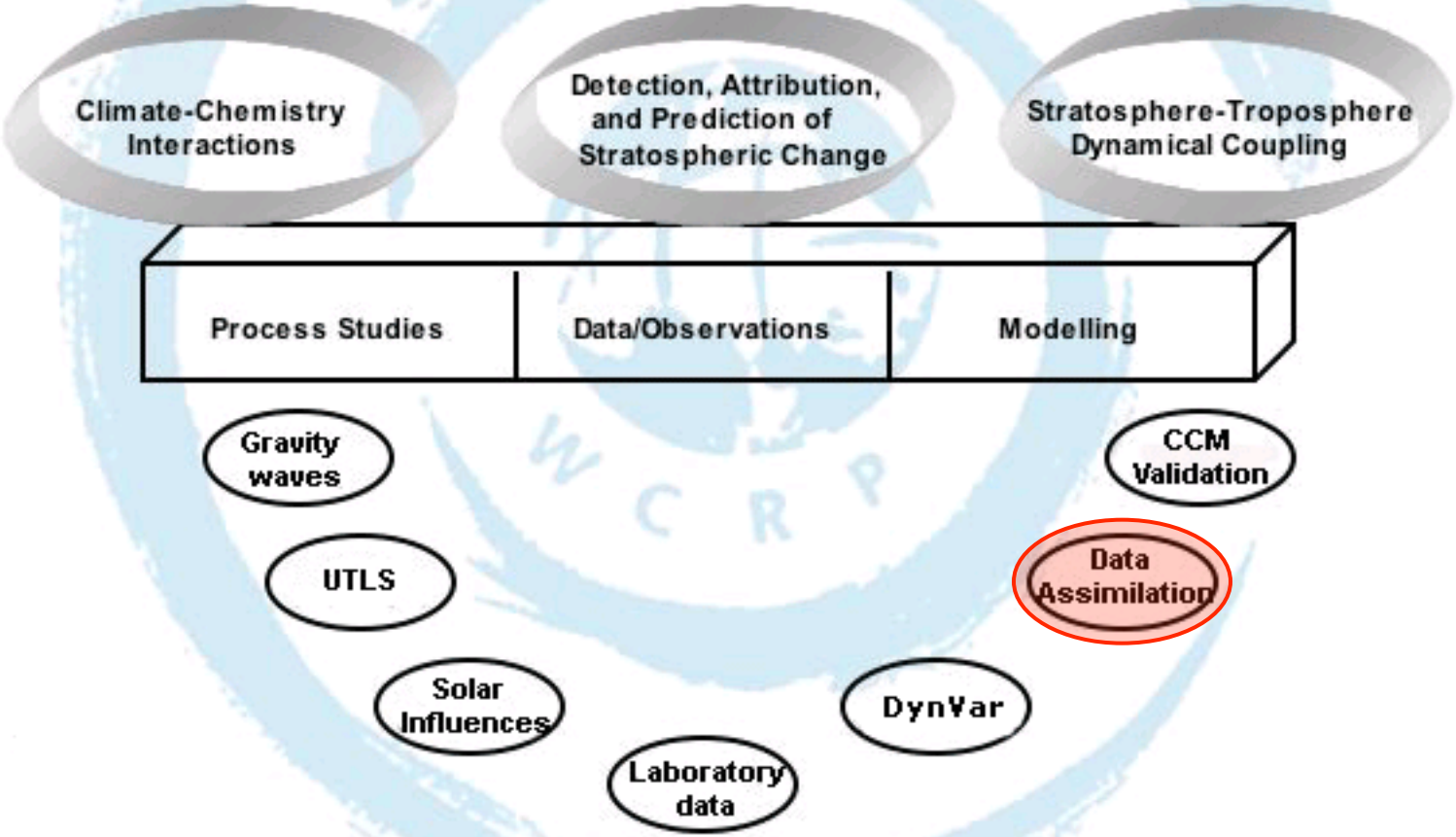


SPARC

Stratospheric Processes And their Role in Climate

http://www.atmosp.physics.utoronto.ca/SPARC/

- is a project of the WCRP
- Is led by a Scientific Steering Group, augmented by theme and project leaders
- does not conduct research, or provide any funding
- facilitates research through focused activities with clear outcomes
  - The activity should not duplicate an existing activity
  - The activity can benefit from international coordination
  - Explicitly bringing together different research communities to work on a specific problem is particularly encouraged
- Vehicles: SPARC General Assembly, Workshops, Newsletter, Data Center
- Products: SPARC reports (e.g. water vapour assessment) and review articles


Climate-Chemistry Interactions
Detection, Attribution, and Prediction of Stratospheric Change
Stratosphere-Troposphere Dynamical Coupling
Process Studies
Data/Observations
Modelling
Gravity waves
CCM Validation
UTLS
Data Assimilation
Solar Influences
DynVar
Laboratory data

Why is SPARC interested in DA?

- Long term, global data sets for the troposphere and stratosphere, free of artificial trends.
- Guidance for reanalysis efforts e.g. analyses should come with diabatic heating rates from the model
- 3-D velocity fields with reduced data assimilation “noise” (giving spurious transport)
- Improved parameterizations, e.g. gravity-wave drag
- Ozone, tracers and aerosols.
- Improved understanding of UT/LS region.
- Polar processes

SPARC Data Assimilation Working Group: goals

Created in 2002 to coordinate and promote data assimilation work relevant to SPARC

- 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 (e.g. GCOS) on SPARC data needs.

How can we achieve these goals?

- Workshops with a theme
  - Invite experts in related areas who normally don't attend SPARC-DA workshops. Connect with user community.
  - Dedicated workshops, special sessions of EGU, etc.
- Preparation of report or review article
  - For SPARC newsletter
  - For general audience, i.e. BAMS
- Intercomparison, or collaborative projects
  - Ozone, e.g. ASSET
  - Transport (age of air, trajectory calc'ns)
  - Water vapour
  - GW body force
  - SPARC-IPY (International Polar Year)
  - GEOSS and GMES projects (PROMOTE II, GEMS, .

What has happened?

- Data Assimilation Working Group meeting – UMBC, USA, June 2002
- ASSET/SPARC workshop – Florence, June 2003
- ECMWF/SPARC workshop – ECMWF, June 2003
- Joint DA/winds workshop – Banff, Sept. 2005
- DA workshop – Noordwijk, Sept. 2006
- Joint DA/IPY workshop – Toronto, Sept. 2007
- No separate workshop in Sept. 2008 due to SPARC General Assembly in Bologna
- MOCA-09: M01 (Middle Atmosphere), J21 (Data Assimilation) and this session July 2009
- Workshop Exeter, England, June 2010

Format of SPARC DA Workshop

- Invited speakers in SPARC science to invigorate and broaden discussion and to keep physical perspective
- Long talks with room for discussion
- Scheduled discussions to focus on SPARC science and DA interactions
- Meeting report to identify accomplishments and new goals

This year's themes

- Seamless prediction
- Stratosphere-troposphere-mesosphere coupling
- Tropospheric/environmental prediction

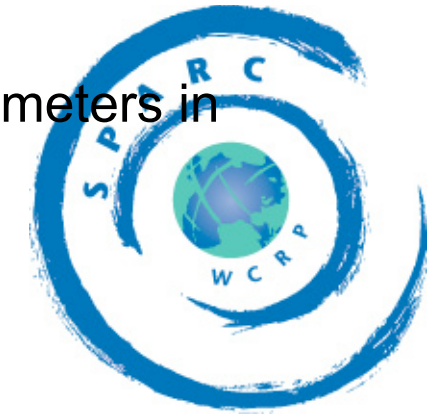
Seamless prediction and model error

Seamless Prediction

- Is a broad term, generally referring to a unified framework for research on prediction in weather and climate
- is a major theme of the WCRP Coordinated Observation and Prediction of the Earth System (COPES) strategic framework.
- Climate models need to describe processes on time scales from years to seasons to weeks to one day (Palmer et al. 2008)
- implies validating models on a variety of time scales

Data assimilation is a tool for learning about models

- indirect information about model error is contained in analysis increments
- methodology can be used to estimate uncertain parameters in climate models (instead of initial conditions).



Stratosphere-troposphere-mesosphere coupling

- Impact of stratosphere on troposphere for weather and climate prediction
- Mesospheric coupling: new frontier, argument for whole atm system?

Tropospheric/environmental prediction

- General trend at weather centers (e.g. ECMWF GEMS project)
- Link tropospheric and stratospheric chemical DA communities

GOALS of SPARC DA Discussion

- After 8 years, is SPARC-DA still relevant? If so, how? Is SPARC DAWG currently serving SPARC needs?
- Should it morph into an activity focused on seamless prediction?
- What trends, themes do we see coming out of this workshop, or in general?
- Consider how to interact with and influence the rest of the WCRP programme (WOAP, WGNE, GCOS) and thereby the space agencies.
- Location, date of next workshop

End

What was IPY?

- Internationally coordinated periods of intensive, interdisciplinary scientific research focused on the **Earth's Polar Regions**
- IPY 2007-08 was the fourth International Polar Year
- It ran from March 2007 to March 2009

What was the SPARC-IPY about?

- During the IPY period document dynamics, chemistry and microphysical processes within the polar vortices
  - focusing on coupling between
    - the stratosphere and troposphere
    - the stratosphere and mesosphere
  - using satellite observations, aircraft and balloon campaigns as well as ground-based observations to study the state of the polar atmosphere
- Facilitate and coordinate (SPARC IPO)
  - coordinate the SPARC-IPY programme
  - promote new initiatives in the context of the SPARC core themes
    - climate-chemistry interactions
    - detection, attribution and prediction of stratospheric change
    - stratosphere-troposphere dynamical coupling

What has been achieved?

- SPARC Data Assimilation

  enhancing observational data set by filling gaps in the data during polar night, or inconsistent spatial and temporal coverage

- SPARC-IPY Data Archive

  providing a complete consistent data archive intensely focused on the IPY period

- Other IPY Activities

  disseminating scientific results for the IPY period

  coordinating with related IPY activities

  managing wrap-up activities at the SPARC-IPO

  promoting new initiatives

  outreach

SPARC Data Assimilation

- Data assimilation groups participated in SPARC-IPY:
  - the Canadian Middle Atmosphere Model - Data Assimilation System (CMAM-DAS; formerly CMAM-FDAM)
  - the European Centre for Medium-Range Weather Forecasting (ECMWF)
  - the Global Environmental Multi-scale – BIRA Atmospheric Chemistry module (GEM-BACH; formerly GEM-STRATO) from Environment Canada
  - the National Center for Environmental Prediction (NCEP)
  - the Global Modeling and Assimilation Office (GMAO) from NASA Goddard Space Flight Center
  - the UK MetOffice - Stratospheric Assimilated Data (UKMO & UKMO-UARS)
- Data collection almost complete

  the analyses were collected through May 31, 2009 where possible
- Also hoping to include BASCOE/PROMOTE (PROtocol MOniToring for the GMES Service Element)

SPARC Data Center

- IPY data publicly available for non-commercial purposes through the SPARC Data Center:

http://www.sparc.sunysb.edu/

- Register at http://www.sparc.sunysb.edu/html/user_ipy.html
- Subsequently will receive a user id for the web interface

Model	Horizontal Grid	Vertical Grid	Dynamical Fields	Chemistry and Microphysics	Time Period and Sampling
CMAM-DAS (formerly CMAM-FDAM)	3.75x3.75 97 longitudes 48 latitudes	71 model levels	Temperature, u velocity, v velocity, geopotential height, vorticity, divergence, log surface pressure	Q, specific humidity, cloud liquid water content, cloud ice water content, cloud cover Odd oxygen, NOx, ClOx, BrOx, HNO3, H2O, CH4, HCl, CO, N2O,O3, NO2, ClO, BrO, ClONO2, NO3, N2O5, O3c	1 November 2005 to 31 March 2009 every 6 hours
ECMWF	0.25x0.25 1440 longitudes 721 latitudes	92 model levels	Temperature, u velocity, v velocity, geopotential height, divergence, log surface pressure	Q, specfic humidity, cloud liquid water content, cloud ice water content, cloud cover, O3	1 June 2007 to 31 May 2009 every 6 hours
GEM-BACH (formerly GEM-STRATO)	1.5x1.5 240 longitudes 120 latitudes	80 model levels	Temperature, u velocity, v velocity, geopotential height, log surface pressure	specific humidity, CH4, HCl, CO, N2O, NO, N2O5, O3, NO2, ClO, NO3, HNO3, HOCl, HF, ClONO2	1 March 2007 to 28 February 2009 every 6 hours
GMAO	0.667 x0.5 540 longitudes 361 latitudes	72 model levels	Temperature, u velocity, v velocity, geopotential height, potential, vorticity, divergence, surface pressure, pressure thickness, temperature tendency	relative humidity, cloud ice water mixing ratio, cloud liquid water mixing ratio, total cloud fraction, optical thickness of all clouds, O3	1 March 2007 to 31 May 2009 every 6 hours
NCEP	0.313x0.313 1152 longitudes 576 latitudes	64 model levels	Temperature, u velocity, v velocity, geopotential height	specific humidity, cloud water vapour, O3	1 March 2007 to 31 May 2009 every 6 hours
UKMO	0.5625x0.375 640 longitudes 480 latitudes	27 pressure levels	Temperature, u velocity, v velocity, geopotential height, vertical velocity		1 March 2007 to 31 May 2009 every 24 hours
UKMO-UARS	3.75x2.5 96 longitudes 73 latitudes	24 pressure levels	Temperature, u velocity, v velocity, geopotential		1 March 2007 to 31 May 2009 every 24 hours

Other IPY Activities

- Disseminating scientific results via coordination & facilitation with related IPY activities

  two review articles in the July-edition of the SPARC newsletter mainly within the SPARC, Oracle-O3, and IASOA frameworks and via collaboration with MLS, ACE, Eureka data analysis groups and Pan-Arctic Study group

  1. "Features of the Arctic Stratosphere during IPY" provides a broad overview of the observations and highlights some of these features in the Arctic during the IPY period
  2. "Studies of the Antarctic Stratosphere During IPY" broadly reports on significant topics for the Antarctic stratosphere during IPY including characteristics of the Antarctic stratosphere during IPY, the polar vortex, stratospheric ozone and polar stratospheric clouds

- Outreach activities

  "Have We Forgotten about Ozone in the Climate Change Era? Maybe Not!" to be published in the North of Ordinary in-flight magazine in fall

Outstanding Issues

- Observational data management

  consortium members providing SPARC-IPO with

  meta data statements

  links to "actual" data depositories

  to be included in SPARC-IPY homepage

- Observational data access

  guiding and providing users with data sets

- Asking for help from consortium members

  in process of updating the SPARC-IPY website & its maintenance in **future**

  in reporting any related-IPY publications in **future**