

# Report from the Third SPARC SSG Session

Geneva, October 17-20, 1995

The focal point of the session was the review of the progress made within the SPARC Initiatives. Addition of specific topics has been proposed within some of the existing initiatives. They concern mostly the role of aerosols and ozone changes in the Lower Stratosphere-Upper Troposphere (LS/UT) Chemistry.

## GRIPS (GCM-Reality Intercomparison Project for SPARC)

GRIPS provides a coordinated framework for : the intercomparison of Troposphere-Stratosphere General Circulation Models (TSM-GCMs) and the parameterisations included in them, the understanding of the effects of physical processes on (middle) atmospheric circulation, the studies of middle atmospheric structure and variability, including its relationships with the troposphere, the prediction and understanding of stratospheric change and its effects on climate. Also GRIPS helps to establish regular contact between members of the middle atmospheric modelling community and with the tropospheric modellers.

**Tasks for Phase 1.** This Preliminary Intercomparison Phase includes : documentation of the participating TSM-GCMs groups wor-

king in a common format ; validation of the TSM-GCM climatologies, including the identification of common systematic errors in the location and strength of specific climatic features and budget studies of the physical mechanisms at work ; examination of the ability of the GCMs to develop sudden warmings and the two-way interactions between the stratosphere and troposphere during these events ; examination of the modes of variability in the GCMs, including the statistical links between the stratosphere and troposphere on seasonal timescales ; assessment of the sensitivity of the TSM-GCMs to the parameterised physical processes, investigations of the accuracy of the parameterisations, especially the radiative transfer schemes.

### Present status of GRIPS :

- First chance for international discussion : IUGG, MW5 meeting, 10 July 1995 (a report is published in this Newsletter)
- New letter of invitation to participate in GRIPS : October 1995. At present, 10 groups are participating, and the number may increase to about 15.
- Commencement of Euro-GRIPS : January 1996. EuroGRIPS was submitted to the Framework IV (Environment and Climate Programme) of the European Community. It is now in the «negotiation phase» after successful scientific review.

The participants in «EuroGRIPS» include S. Pawson (Berlin), W. Lahoz (Reading), P. Simon (Météo-France), and R. Swinbank (Bracknell).

- First GRIPS workshop : 4-7 March 1996 (tentative), Victoria, BC, Canada, with the participation of 1-3 members of each modelling group and several prominent modellers invited as observers.
- Organisation, during the SPARC Assembly in Melbourne, possibly, of another GRIPS workshop.
- Completion of the intercomparisons for phase 1 (limited intercomparisons, documentation, long-term means).
- Completion of phase 1 and definition of phase 2 : late 1996 or 1997.

**Phase 2.** The exact goals of Phase 2 need careful definition so that useful scientific problems are addressed and allow the participation of as many groups as possible. All participants should obtain positive feedback for their own work, in the sense of yielding useful research results, as well as contributing to the whole intercomparison.

Some of the many ideas put forward are : AMIP-type project (i.e. long integrations using identical boundary conditions and other imposed quantities) ; case studies (but the initialisation will pose problems) ; predictability studies (including sensitivity to initial

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conditions) ; perturbation studies (e.g., sensitivity to ozone distribution) ; routine swapping (e.g. compare results from one model with two different radiation or convection schemes).

The **discussion** focused on the introduction of chemistry into the models involved in GRIPS. It was stated that most groups intend to put chemistry sooner or later and the question was raised on whether SPARC has a role to play in putting together the information for chemistry. This could, in fact, be an output of the UT/LS Chemistry SPARC Project (see below).

The possibility of enlarging EuroGRIPS to non-European groups was also discussed, and a proposal could be submitted to the next EC Call of Opportunity.

## SPARC Reference climatology

The **aim** of this work is to construct a comprehensive climatology of means and variabilities of observed data, primarily for comparison with TSM-GCM simulations. The overall goal is to provide the atmospheric variables of most use to the research community, in a simple to use and easily accessible format (available via anonymous ftp from NCAR).

Primary **data sources** should be the National Meteorological Center (NMC) operational stratospheric and tropospheric analyses (1000-1 hPa, October 1978 - present). **Analysis products** are temperature and geopotential height, from which balanced winds are derived. Tropical winds can also be obtained from radiosondes. The ECMWF and Berlin analyses will be useful for comparison at selected altitudes. The ECMWF extends up to 10 hPa. The Berlin analyses contain temperature and height data available over the Northern Hemisphere (100-10 hPa, 1958 - present, for some levels). Shorter data sets could also be quite useful for examining future GCM simulations of stratospheric constituents, i.e., the United Kingdom Meteorological Office (UKMO) tropospheric-stratospheric assimilation (covering 1000-0.3 hPa for October 1991 - present),

which includes winds and temperatures, and Goddard STRATAN assimilation (1000-10 hPa for 1985-1993, 1979 - present, by the end of this year ; their 1000-0.4 hPa analyses span January 1991 - present).

The question of the **mesospheric** temperature/wind climatology is still unclear : Two possible data sets are the Pressure Modulated Radiometer (PMR) data (low vertical resolution, extending to 85 km, 1975-1978) and Microwave Limb Sounder (MLS) data (high vertical resolution, 20-70 km, 1992-1994). As for the HRDI stratosphere-mesosphere wind data, these are still a research topic and may not be adequate to be included in the reference climatology at this time. There were also suggestions to use lidar or rocketsonde data to get «ground truth».

The proposed **spatial sampling** is  $5^\circ \times 10^\circ$  on NMC 17 pressure levels (1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 10, 5, 2, 1 hPa).

The **quantities to be included** in this climatology are monthly means, together with daily and interannual variability estimates. Results will include :

- Zonal averaged values of temperature, zonal wind, components of the residual mean meridional circulation (derived from a thermodynamic balance - continuity equation analysis), poleward heat and momentum fluxes, Eliassen-Palm flux divergence, rms planetary wave amplitudes (stationary plus transient waves).
- Fourier analysis of observed fields and uncertainties.
- Space-time power spectra to complement the stationary wave and transient wave concept.
- Latitude-longitude fields at selected pressure levels, e. g., 500, 200, 100, 50, 10 and 1 hPa. A suggestion was also made to include extreme temperatures or temperature probabilities in the lower stratosphere (for chemistry modelling) and to include statistics on isentropic potential vorticity on a couple of standard surfaces, in the lower and middle stratosphere.
- A sample of stratospheric constituent data : zonal mean ozone, methane, and water vapour (possible from SBUV, MLS or HALOE data).

As a conclusion of the discussion, it appeared clearly that Phase 1 of the Project is well defined, but more work is needed for defining Phase 2. Cooperation with the revised CIRA activity was considered desirable.

## Gravity wave processes and their parameterisation (GWPP)

**Actions on the High-Resolution data Archiving Issue.** The US National Weather Service started, on April 1 1995, archiving 6-second data at 95 stations in the continental US, Alaska, Caribbean and tropical Pacific. Data will be available through U.S. NODC. The Canadian Atmospheric Environment Service was also contacted as well as the German (Neisser at Observatorium Lindenberg) and the New Zealand Met. services. A larger number of countries should be contacted through the WMO. An article was prepared for EOS : Hamilton & Vincent «High Vertical Resolution Radiosonde Wind and Temperature Data : New Prospect for Widespread Availability and Some Important Research Applications».

A closely related issue has been raised during discussions at the IUGG in Boulder : the archiving of meteorological data associated with ozonesondes.

**Scientific progress.** Numerous results were presented during the IUGG in Boulder during the Middle Atmosphere Symposium, IAGA session on tropical aeronomy, SPARC sessions, Gravity Wave Workshop. It showed tremendous interest in the problem of GW parameterisation. Initial experience with sophisticated GW-drag schemes has been obtained by some 3D modelling groups (NCAR, MPI Hamburg, GSFC). Interesting developments in observational techniques were presented, e. g. airglow imaging (Swenson), the applications of native-resolution radiosonde data (Karoly), etc. Results from the coordinated ALOHA campaign led to a discussion on the need of a massive observational GW campaign in 1998.

**A NATO Advanced Research Workshop** on «Gravity Wave Processes and Their Para-



meterisation in Global Climate Models» is being organised by K. Hamilton (director), M.L. Chanin and N.A. McFarlane (April 1-5, 1996, Santa Fe, U.S.A). Funding has been approved from NATO. WCRP will also sponsor the workshop and provide support for non-NATO participants.

The ARW will be an ideal forum for debating and making decisions concerning the need of archiving high-resolution ozone-sondes, the need of a large observational campaign in the line of ALOHA, and the constitution of a GW climatology.

### Stratosphere-Troposphere Exchange (STE)

A SPARC Workshop on STE took place at La Pointe-du-Lac, Québec from June 13 to 15, 1995 (an extended report is given in this issue of the Newsletter). This workshop, following the NATO/ARM held in Cambridge in 1993 on the same topic, has changed our perception of the way to approach the issue (cf the review paper on STE by Holton et al. in Reviews of Geophysics, 33, 4, 403-439, 1995).

The SSG discussed at length the need to elaborate a global measurement strategy to help plan future campaigns. There seems to be an agreement on the fact that the traditional local approach is limited when trying to quantify the global STE, or, as T. Shepherd phrased it, «making spot measurements to study STE is like looking at each eddy to study turbulence». The need for chemical air mass characterisation to document the transport implies the use of chemical tracers of different lifetimes, in addition to physical quantities. Availability of global measurements of these parameters from satellite platforms is for an unforeseeable future.

It was decided by the SSG that a **small group should be appointed** to meet for a few days within the next few months with the following charge : «Proceeding from the previous international workshops that were held in Cambridge, UK, and in Québec, Canada, on this topic, the

group is to work to develop **combined measurement and modelling strategies** to progress in gaining the necessary understanding of these processes that are needed for better assessments. These strategies should consider the newly developed paradigms for stratosphere-troposphere exchange and be delivered for consideration at the next SPARC SSG meeting. The group should hold a meeting at which they may invite presentation of ideas by experts in measurement, models, and theory. They should then develop «straw-man» strategies. Further development of the concepts may take place through electronic communications and meetings of opportunity.»

In this context, two presentations were made on future stratospheric aircraft : D. Ehhalt presented the status of the **STRATO 2C** project. The plane in the present configuration can fly one hour at 20 km, but existing plans to modify the design could help increase the ceiling (up to 23 km) and the duration of flight. V. Khatatov presented the Airborne Polar Experiment on board the **M-55 Geophysika** Stratospheric Research Aircraft (see SPARC Newsletter N° 5) and announced the success of the proposal submitted for support to the CEE, ESF and the Italian Antarctica programme and the offer by NILU to archive the data. The use of this aircraft is open for international cooperation, and 8 countries are planned to participate so far.

### Water vapour Instrumentation and Climatology

Presently there is a poor knowledge of mean distribution/variability of H<sub>2</sub>O and of processes that maintain mean distribution ; there is also a controversy over future changes of distribution. The **main tasks** being undertaken are to review the present data base and available instrumentation, to explore plans for future measurements and suggest the monitoring programme that could lead to a climatology of LS/UT water vapour.

Local and global measuring **techniques** should be evaluated (i.e. **locally** : improved radiosondes, frost point instruments, Lyman- $\alpha$  hygro-

meters, tunable laser diode instruments, Raman lidar techniques and differential absorption lidar (dial) ; and **globally** : nadir-viewing sounders, occultation sounders : SAGE II & III, HALOE, microwave limb emission sounders and infrared limb emission sounders : LIMS, CLAES, ISAMS, HIRDLS).

The climatology requires a **global monitoring effort** with continuous validation ; it should provide the seasonal evolution of global means and the measurement of the variations with «sufficient» vertical resolution. Also, **measurement and theoretical campaigns** are required to understand the mechanisms that control water vapour and its variability, having as a goal a predictive capability to include in climate models. It will require measurements of several variables beyond water vapour.

During the GEWEX Water Vapour Project (GVaP) phase II planning meeting on 12 July 1995, the SPARC activities and goals were presented, and the plans for LS/UT water vapour measurements received a strong support. As a conclusion, the tentative plan now is to hold an international workshop to develop a Science/Implementation Plan for a **broadened water vapour project** which would be designed to meet the needs of cooperating and cosponsoring projects : GEWEX/GVaP, CLIVAR/GOALS, and SPARC. It could take place in winter 1995/early spring 1996.

The SPARC Water vapour Initiative plans are to complete the draft report and to hold a **workshop** early in 1996 in order to develop statement of measurement requirements, to review and refine the report on measurement capabilities present status, to develop plans for measurement campaigns needed for validation and climatology, and to develop a strategy of how SPARC could have best interactions with GVaP.

The SPARC SSG stressed the need of **cooperation** with GVaP. Vital interest was shown in connection with some evidence of a H<sub>2</sub>O **trend** in the stratosphere. It was also noted that the vertical distribution of H<sub>2</sub>O should be studied with reference to the tropopause level.



## Stratospheric Temperature Trends Assessment (STTA)

Two meetings of STTA already took place : in Reading (UK.) in March 1995 and during IUGG in July 1995. The next one is planned in Berlin on 18-19 December 95. It will be concerned with the following questions : base time period for viewing anomalies ; time intervals over which trends have to be determined ; statistics regarding the time series : correlations, standard deviations, attempt to understand the differences ; how to 'weight' instrumental record vs 'analysed' field ; trend determinations ; optimal choices to account for solar cycle, QBO, ... ; merits/limitations of different data sets.

The results already obtained were presented by V. Ramaswamy, essentially the zonal mean temperature between 100 and 2 hPa from MSU, SSU (UKMO and Nash) and radiosondes (Labitzke, Angell and Oort) as well as the NMC analysis. The study of the **upper stratosphere** will need to be completed later on a more local aspect by using rocket and lidar data.

As for model predictions, in the lower stratosphere the model uncertainties are due to the incomplete knowledge of the vertical profile of the O<sub>3</sub> loss, the forcing of the surface-troposphere system and the role of changes of O<sub>3</sub> versus changes in well-mixed GHGs ; in the upper/middle stratosphere, the question is still open whether the CO<sub>2</sub> signal is visible or not and, if not, if the absence of signal is due to the O<sub>3</sub> decrease ; there is large dynamical variability on the time scale of interest, and the understanding of the sources of the variability should be done in parallel.

## Lower Stratosphere-Upper Troposphere (LS/UT) Chemistry

Ivar Isaksen reported on numerous on-going activities in this field and referred to the recent Halkidiki (cf SPARC Newsletter N° 5) and Schliersee (cf this issue) meetings.

Close SPARC/IGAC cooperation is needed to avoid that some key issues fall in between both programmes. This is of utmost importance as the vertical distribution of the perturbations in this altitude domain are key issues in the climate change detection.

A list of possible activities were discussed including : review of LS/UT chemistry, parameterisation of heterogeneous chemistry in the models, comparison of chemical models, the role of convective processes for the upper troposphere, modelling the impact of aircraft emissions, the use of aircraft and satellite data, modelling long term O<sub>3</sub> loss, parameterisation of climate-chemistry interactions, UV radiation in relation to LS/UT chemistry.

The idea of a joint workshop with IGAC/GIM/GLOCHEM (i.e. the Global Chemical Modelling Issue) was suggested and should be discussed with IGAC.

Several suggestions were made by the SPARC SSG : to organise the use of the numerous data sets recently available in the LS/UT domain, to test the sensitivity of models to perturbations in order to force models to extreme mode, set up perturbation experiments and have 5-6 or so models run, to look at the coupling between O<sub>3</sub>, H<sub>2</sub>O, aerosols in the LS/UT, to look at chemical-radiative-dynamical interactions at different time-scales.

The SSG recognised the need to better define the main focus of this initiative. Finally, three foci were identified : effect of perturbation, aerosol chemistry and chemistry-climate coupling. With the addition of these thematics, it was suggested, that in the title of the Study Group, the term «Chemistry» is replaced by «O<sub>3</sub>, Aerosols and Climate» to reflect more precisely the content of its activity, and A. R. Ravishankara was invited to co-chair the group with I. Isaksen.

## Ozone trends

The group met first in Halkidiki in May 1995 and in Boulder in July 1995. The next meeting is scheduled in France at the Observatory of Haute-Provence for July 1996 (together with the WMO/IOC group).

The goals of this group are mainly (cf Newsletter N° 5) : to advance understanding of the O<sub>3</sub> trends in the lower stratosphere, to look at the likely quality of the O<sub>3</sub> measurements to be made in the coming years, to help develop a validation and intercomparison programme, and to keep an eye on the developments of total O<sub>3</sub> data quality or trends especially in the tropics.

The available data sets are the key long-term data sets : ozonesondes, SAGE, SBUV and SBUV/2, and the Umkehr data set (as a second class product).

The work is planned to include : a comparison of O<sub>3</sub> profiles (SAGE, MLS, HALOE), a full description of the SAGE algorithm, a study of the August 1995 Mauna Loa/SAGE O<sub>3</sub> profile intercomparison, an analysis of the SME/correlative measurements with the European Brewer-Mast O<sub>3</sub> sondes.

Two suggestions were made by the SSG : to include the upper troposphere in the analysis (the emphasis will stay on the lower stratosphere), and to add a statistician to the group in order to improve the statistical approach.

J. Kaye presented the present schedule of space-based O<sub>3</sub> measuring systems from 1990 to 2002, and gave some ideas on how to deal with the large number of satellite data and in particular how to ensure that the data quality would be as high as possible. He insisted that SPARC should have an important role to play in ensuring coordination in treating this large variety of data. This issue concerns not only O<sub>3</sub> measurements, but also other parameters. For this reason, it was decided to create a «group of coordination of space-based observations of the stratosphere». J. Gille, at the request of the SSG, defined the charge of the group as follows :

«...Every effort should be made to ensure the highest quality of the data sets and consistency among them. This means, at least, that attention must be paid to ensuring consistent approaches to instrument calibration and characterisation, development of data reduction algorithms, and validation of the geophysical products. This group is



charged with bringing together the appropriate people responsible for various aspects of data quality, and their funding agencies, in order to foster agreement on common approaches to these problems».

### Report on the WMO/GAW UV-B programme

P. Simon as chairman of the «WMO ad hoc Scientific Steering Committee on UV monitoring» reported on the activities of this group for which the terms of reference and composition were given in the SPARC Newsletter N° 5. The plans and priorities of the different working groups were presented and the contact with SPARC identified : S. Madronich, in charge of the modelling working group will be asked to report to SPARC.

### Preparation of a SPARC Implementation Plan

6 It was agreed that SPARC is sufficiently advanced in the definition of its scientific priorities, and has even already implemented some actions. Therefore it was thought timely to prepare an Implementation Plan. The draft of such a document was outlined and the responsibilities defined.

### The EC contribution to SPARC

The EC contribution to SPARC was presented by G. Amanatidis. The point of general agreement was to increase cooperation between the EC Environment and Climate Programme and SPARC.

### Organisation of the 1st SPARC General Assembly

The Organisation of the 1st SPARC General Assembly in Melbourne was discussed at length including : list of invited speakers, preparation and distribution of the Second Circular, publication of extended abstracts, list of sponsoring agencies, etc. The second Circular and Call for Papers are included in this issue.

### Activities of the SPARC Office

The SPARC Office has been until now suffering from lack of permanent scientific staff. However support for a new position has now been offered by CNRS for a young scientist, and Céline Phillips, the new appointee, was warmly welcomed. Also, M-C. Torre whose contract expired was thanked by the members of the SSG for her contribution in the last three

years to the success of SPARC. The part-time contribution of Yuri Koshelkov, detached from the Central Aerological Observatory of Russia, will continue in 1996. Candidates which might be assigned to the Office by their own organisation for a one-year stay should let themselves be known by writing to the SPARC Office.

The SPARC Office produces a biannual SPARC Newsletter, which is being distributed to a mailing list of 2000 persons. The SSG congratulated the Office with the high quality of the SPARC Newsletters. It was proposed to have a SPARC Web page containing up-to-date information.

One of the charges of the SPARC Office has been the organisation of SPARC meetings, whether they were closed SPARC Study group meetings or symposia and workshops in international meetings. This load should even increase in the next years.

The next meeting of the SPARC SSG will be taking place in Adelaide, Australia, on December 9-12, 1996.

## SPARC Workshop on Stratosphere-Troposphere Exchange

Pointe-du-Lac, Québec, Canada, 13-15 June 1995.  
Convener : Ted G. Shepherd.

### Background

The subject of Stratosphere-Troposphere Exchange (STE) is crucial to many areas of atmospheric science, and lies at the heart of present concerns about the impact of aircraft emissions on the ozone layer. This last issue is a prime motivation behind the considerable research funds that are currently being invested around the world (particularly in Europe and the USA) in measure-

ment campaigns and in the development of research aircraft. In light of this activity, the SPARC SSG decided at its meeting of September 1994 that it would be useful to bring together a cross-section of experts from the various scientific communities concerned with STE, in order to provide improved coordination between the different national research activities and to work towards a comprehensive measurement and modelling strategy.

The resulting workshop was sponsored jointly by the Atmospheric Environment Service of Canada and the WCRP. Participants were invited from the following scientific communities : theory, global modelling, mesoscale modelling, airborne measurement, ground-based measurements, satellite measurements, stratospheric chemistry, diagnostics, and assessment studies. There was also representation from funding agencies. A total of 37 scientists participated, from eight different countries.