

Scoping paper for a SPARC data initiative on chemical observations

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Rationale

About 10 years ago, the SPARC GRIPS model intercomparison activity — the forerunner to CCMVal, focusing only on dynamics and radiation — found that there was considerable uncertainty in the model intercomparison arising from the fact that different observed data sets often gave conflicting results. Accordingly, a middle atmosphere climatology study was initiated by SPARC which compared the various available meteorological data products in terms of various aspects including mean biases, seasonal cycle, variability, and long-term changes. No data sets were problem-free, and all data sets were found to have both strengths and weaknesses. The findings were published as a SPARC Report (SPARC Report No. 3, 2002, edited by Bill Randel et al.), which provided something of a “user’s guide” to the data. The Report was of course of value to scientists analyzing the data directly, as well as to the modelers. A side effect of the assessment was that it identified measurement needs (e.g. tropical winds) and triggered improvements in the data sets.

We now face the same sort of situation in CCMVal for chemical trace gas measurements. While ozone and water vapour measurements are the subject of specific SPARC activities, there is no equivalent activity for other chemical trace gases. Yet these gases play an essential role in the ozone budget and (together with age of air, a derived product) provide tracers of atmospheric transport, and so are extensively analysed in the current CCMVal Report. However, there are a variety of data sets available and the user cannot easily determine which is the most reliable for any particular application. While comparison of different measurements is often done as part of validation studies, this information is not readily available to users. Moreover, the data sets are not always available in a standard form, or with appropriate documentation. The result is that in CCMVal, different observed data sets are used by different people, and the scores obtained on model metrics can depend on the observational data set employed. We therefore see the need for an assessment of the available data sets for these gases analogous to what was done in SPARC Report No. 3 for the meteorological data sets.

This initiative is timely since the last few decades represent something of a “golden age” of stratospheric composition measurements, and it is likely that the future stratosphere will not be as well measured as it is now. It is therefore important to capture existing knowledge on current and recent instruments before this knowledge is lost. In particular, the proposed report should help to identify priorities for reprocessing existing data or enhanced validation efforts with the active support of the measurement groups. In addition, the report would identify measurement gaps which could motivate and provide support for future missions.

Objectives

1. To assess the current state of data availability, and work together with the space agencies to establish a data portal including metadata.
2. To compare existing climatologies of chemical trace gas species, identifying differences between the data sets — taking full account of sampling limitations and biases — and, where possible, providing an expert judgment on the source of those differences.
3. To recommend future studies that would enhance the quality and usefulness of existing data, as well as identify key gaps in observed quantities.

Scope

Vertically resolved measurements of chemical trace gas species from the upper troposphere to the middle mesosphere (approximately 5-65 km), with a focus on satellite measurements but, where helpful, enhanced through aircraft and balloon measurements. Ozone and water vapour are currently being assessed through separate SPARC initiatives, so would be only briefly treated here, drawing heavily on the results of those initiatives. The main focus is expected to be on CH₄, N₂O, HNO₃, NO_y, NO_x, NO₂, HCl, Cl_y, Br_y, and age of air.

Partners

While this initiative is driven from a user perspective, the measurement partners will be critical to its success. These partners include the relevant instrument teams, the space agencies, and organizations such as CEOS-ACC and IGACO.

Timeline

Report outline and author teams to be defined by May 2010. Report to be completed by May 2012.

Funding needs

Funding would be required to facilitate workshops and the production of the SPARC Report. Since the report is expected to be completed beyond the mandate of the current SPARC Office in Toronto, separate funding should be identified for the completion, publication and distribution of the report.

The way ahead

This initiative will be discussed at the SPARC SSG meeting in Kyoto from October 26-30, 2009. Any comments received prior to that point should be sent to Michaela Hegglin (michaela@atmosph.physics.utoronto.ca) and Susann Tegtmeier (stegtmeier@ifm-geomar.de) and will be incorporated into the discussion.