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S-RIP Final Report Published

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The SPARC Reanalysis Intercomparison Project (S-RIP) has published its final report in January 2022 (SPARC, 2022). Several global atmospheric reanalysis data sets (Table 1) are extensively evaluated for selected diagnostics and regions in which SPARC researchers have strong interests (Figure 9, Table 2). The report is expected to be a valuable resource for anyone using reanalysis datasets in their research.

Table 1: *Global atmospheric reanalysis data sets available as of July 2018. See SPARC (2022) for the abbreviations. (Taken from Table 1.1 of SPARC (2022).)*

Reanalysis Centre	Name of Reanalysis Product
ECMWF	ERA-40, ERA-Interim, ERA20C, CERA-20C, ERA5[1]
JMA	JRA-25/JCDAS, JRA-55
NASA	MERRA, MERRA-2
NOAA/NCEP	NCEP-NCAR R1, NCEP-DOE R2, CFSR/CFSv2[2]
NOAA and Univ. Colorado	20CR

[1] Some ERA5 data have been available since July 2018, ERA5 data from 1979 onward have been available since January 2019, and a preliminary version of ERA5 1950-1978 data have been available since November 2020. Because most of the studies in the report were finalized before ERA5 was readily available, full evaluation of ERA5 has not been made. However, Chapter 2 includes information on the ERA5 system, and some chapters show some ERA5 results.

[2] CFSR is for the period from January 1979 to December 2010, and CFSv2 is for the period from January 2011 to present. We strongly recommend explicitly referring to the combination "CFSR/CFSv2" in documenting any study that uses these products across the 2010-2011 transition.

The report has 12 chapters with a total of >600 pages, including Chapter 1 for introduction, 2 for description of the reanalysis systems evaluated, 3–11 for the actual evaluations (Figure 9), and 12 for the synthesis summary. Please see Table 2 for the list of chapter titles and co-leads. Note that one PDF file per chapter is provided.

The detailed analyses in Chapters 3–11 result in several overarching findings and recommendations, including:

- More recent reanalyses typically outperform earlier products.
- NCEP-NCAR R1 and NCEP-DOE R2 are unsuitable for many diagnostics and should generally not be used.
- Conventional-input and pre-satellite reanalyses are useful for many diagnostics but should be carefully validated against full-input satellite era products.
- Studies relying on reanalysis products should use multiple reanalyses whenever possible
- All reanalyses show discontinuities; trends and climate shifts identified in reanalysis products

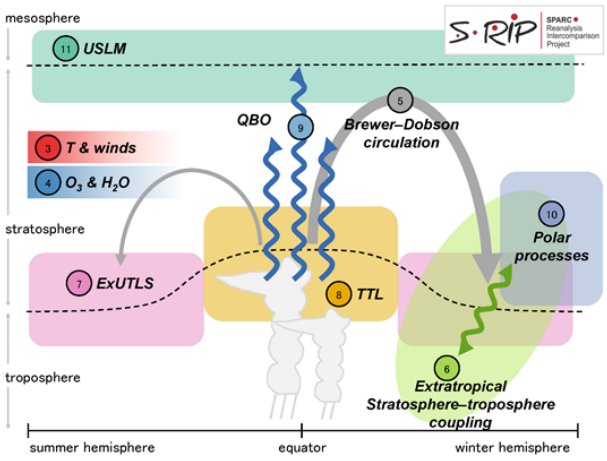

Figure 9: *Schematic illustration of the atmosphere showing the processes and regions that are covered in the report SPARC (2022). The numbers are the chapter numbers. Domains approximate the main focus areas of each chapter and should not be interpreted as strict boundaries. Chapters 3 and 4 cover the entire domain. (Taken from Figure 1.1 of SPARC (2022).)*

should be carefully validated and justified.

- Reanalysis products on model levels should be used for all studies when sharp vertical gradients or fine-scale vertical features are involved.
- Homogenized and continuing data records are essential for reanalysis production and evaluation.

Figure 10: *Photograph from the 2018 S-RIP chapter-lead meeting at NWRA at Boulder, USA. (Taken from Figure 1.5 of SPARC (2022).)*

In addition to the report there are currently over 50 associated papers published in a special inter-journal S-RIP issue of Atmospheric Chemistry and Physics (ACP) and Earth System Science Data (ESSD).

We would like to take this opportunity to say a huge 'thank you' to the many people who have contributed over the past 10 years. The Chapter Leads and Reanalysis Center Representatives were key to its success, together with the large number of contributors to individual chapters (please see S-RIP report for details of all those involved; Figure 10 shows most of the participants for the 2018 S-RIP chapter-lead meeting). We would also like to acknowledge the strong support of the reviewers, review editors, special issue editors, SPARC chairs, and the SPARC IPO without whom the report and special issue could not have been achieved.

A "Phase 2" of S-RIP is currently under discussion, to include a full evaluation of ERA5 and upcoming reanalyses such as JRA-3Q and MERRA-3. We would welcome ideas for new inter-comparison diagnostics and also proposals for new areas of interest, including those that cover tropospheric processes. New leadership at various levels will also be encouraged, so please contact us if you would like to be involved!

References

SPARC, 2022: SPARC Reanalysis Intercomparison Project (S-RIP) Final Report, edited by Masatomo Fujiwara, Gloria L. Manney, Lesley J. Gray, and Jonathon S. Wright, SPARC Report No. 10, *WCRP-6/2021*, 610 pp., doi: 10.17874/800dee57d13.

Table 2: *Chapter titles and co-leads. (Taken from Table 1.2 of SPARC, 2022.) Note that one PDF file per chapter is provided.*

	Chapter Title	Chapter Co-leads
1	Introduction	Masatomo Fujiwara, Gloria Manney, Lesley Gray, Jonathon Wright
2	Description of the Reanalysis Systems	Jonathon Wright, Masatomo Fujiwara, Craig Long
3	Overview of Temperature and Winds	Craig Long, Masatomo Fujiwara
4	Overview of Ozone and Water Vapour	Sean Davis, Michaela Hegglin
5	Brewer-Dobson Circulation	Beatriz Monge-Sanz, Thomas Birner
6	Extratropical Stratosphere-Troposphere Coupling	Edwin Gerber, Patrick Martineau
7	Extratropical Upper Troposphere and Lower Stratosphere (ExUTLS)	Cameron Homeyer, Gloria Manney
8	Tropical Tropopause Layer (TTL)	Susann Tegtmeier, Kirstin Krüger
9	Quasi-Biennial Oscillation (QBO)	James Anstey, Lesley Gray
10	Polar Processes	Michelle Santee, Alyn Lambert, Gloria Manney
11	Upper Stratosphere and Lower Mesosphere (USLM)	Lynn Harvey, John Knox
12	Synthesis Summary	Masatomo Fujiwara, Gloria Manney, Lesley Gray, Jonathon Wright