SPARC and S-RIP update
WDAC meeting 2019

Susann Tegtmeier

SPARC
Stratosphere-troposphere
Processes And their Role in Climate

Themes

Atmospheric Dynamics + Predictability

Chemistry + Climate

Long-term Records for Climate Understanding

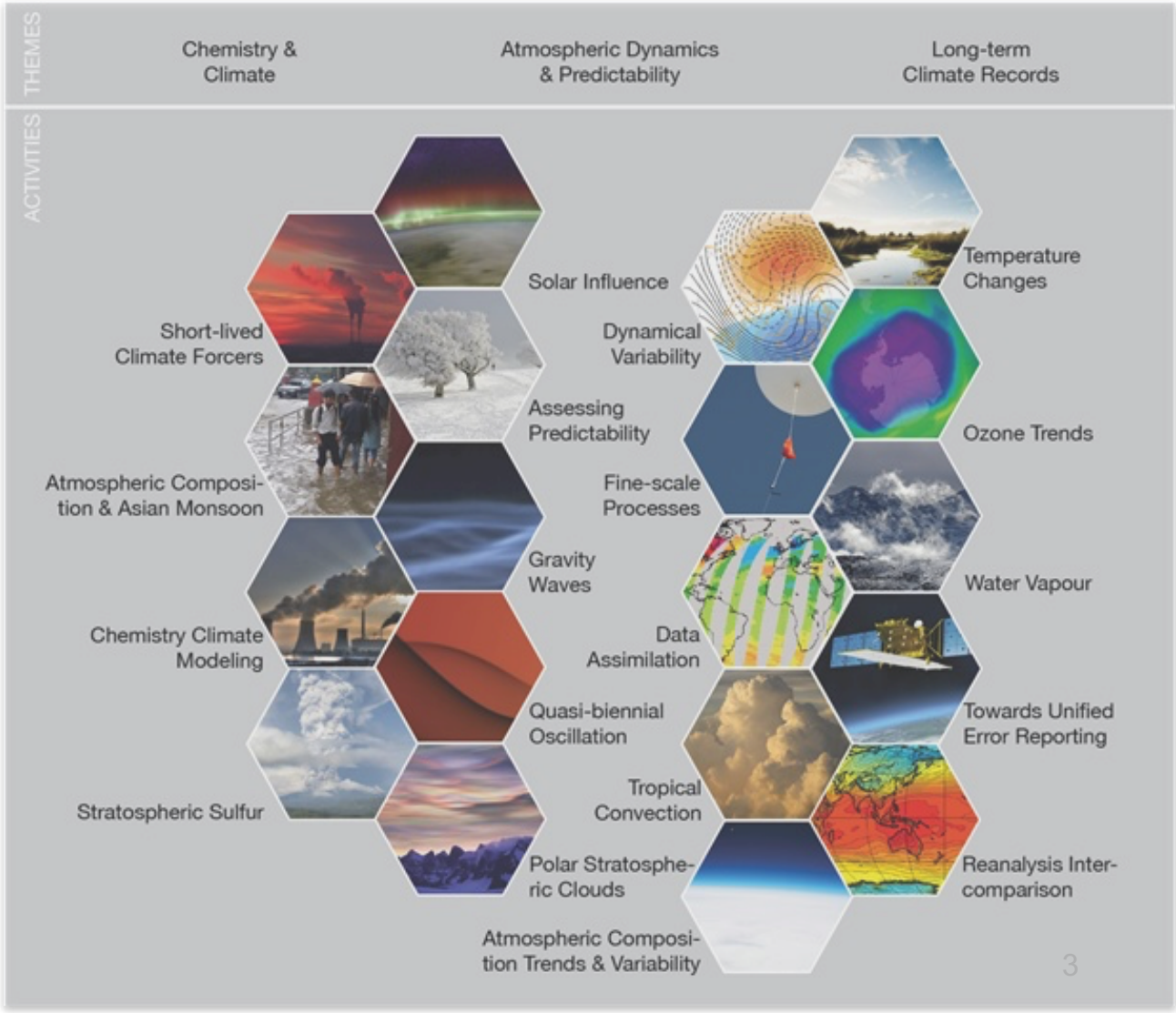
SPARC Activities

SPARC
Stratosphere-troposphere
Processes And their Role in Climate

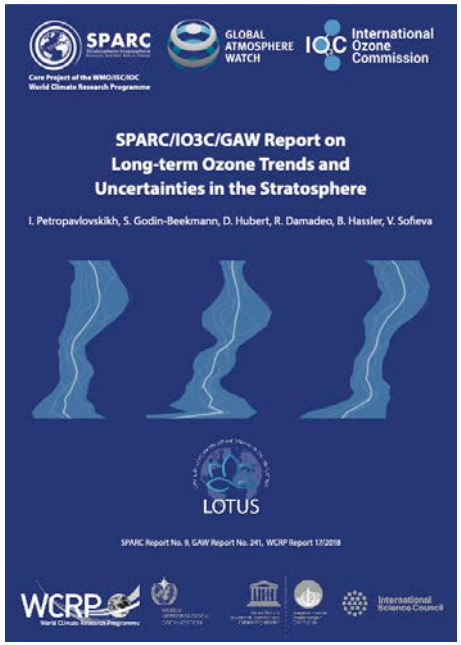
WCRP
World Climate Research Programme

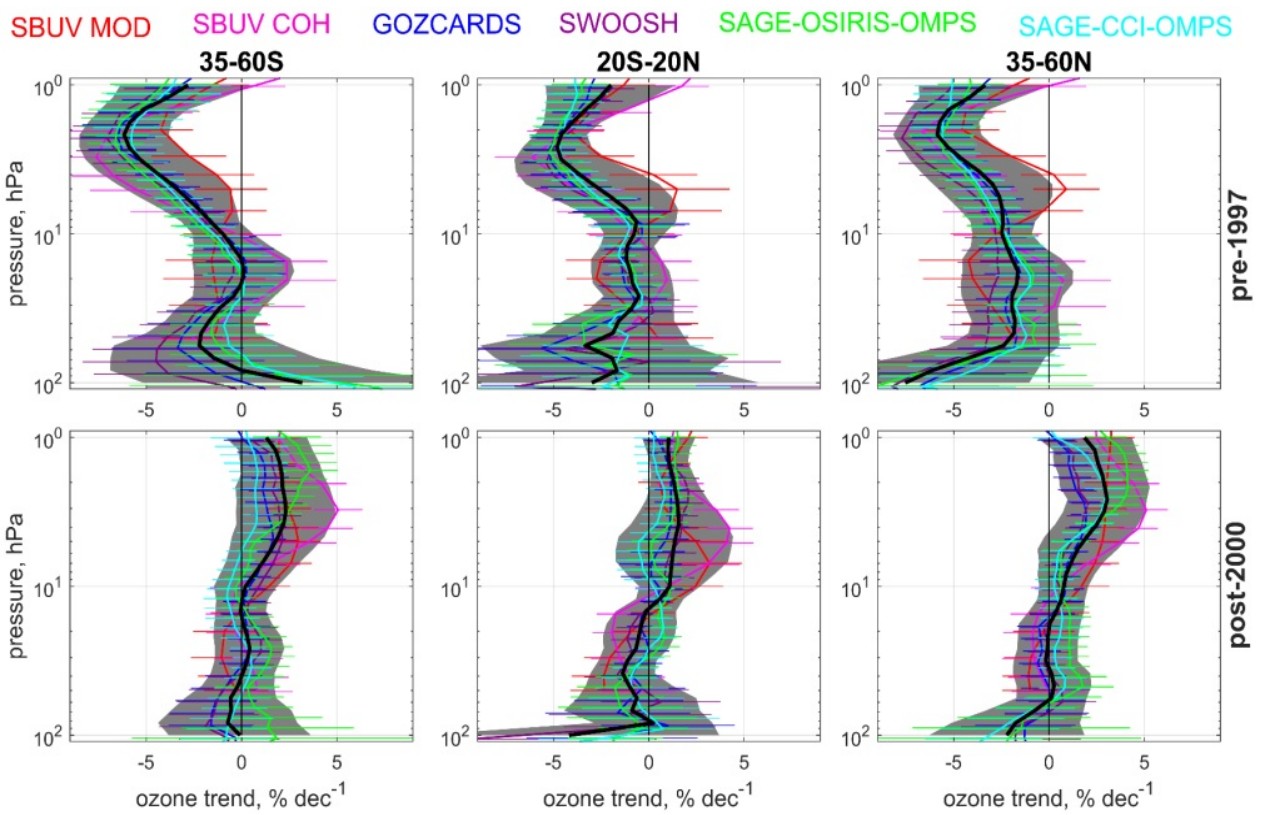
SPARC activities:

- **Bottom-up approach: the community proposes new activities**
- **Activities extended only if new science questions arise.**
- **Activities can produce reports, published by SPARC.**



Long-term Ozone Trends and Uncertainties in the Stratosphere (LOTUS)





- Simple merging of trends but uncertainties need to be carefully considered
- Post-2000 show significant +2-3%/dec trends in upper strat at NH mid-latitudes

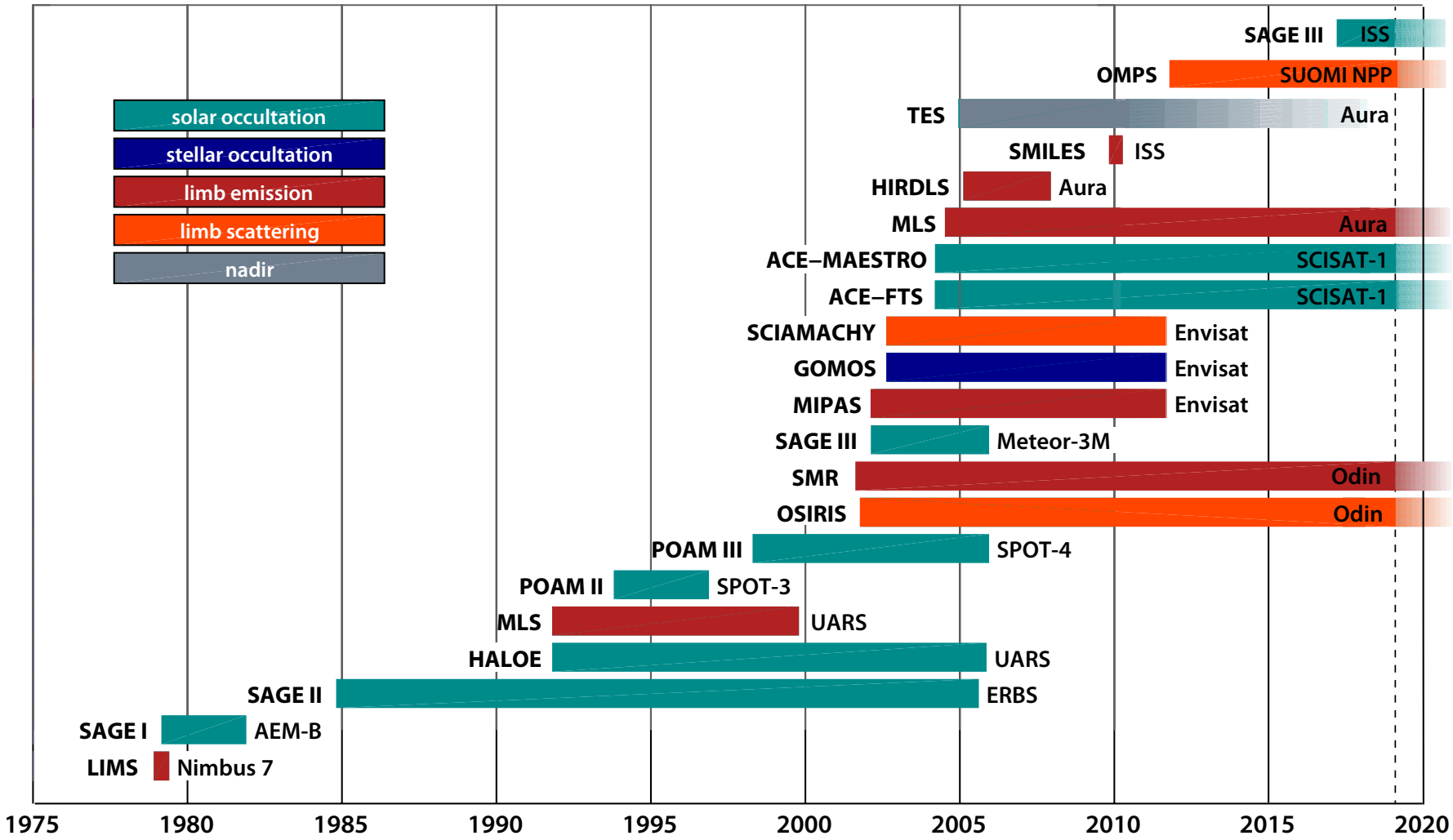
Ozone recovery

- Ozone is recovering in the **upper stratosphere**
  - Magnitude and patterns are consistent in different datasets and in model simulations.
  - recovery trends (2-3 % per decade) in NH are the most significant.
- Lower stratosphere
  - Large uncertainties and discrepancies between models and observations.
  - Complicated ozone variability due to dynamical effects or ODS replacements (Ball et al., 2018).
  - Further analyses are needed

a) Satellite limb measurements of ozone need to continue

b) Long-term composition measurements need to continue

Satellite limb measurements



SPARC Reanalysis Intercomparison Project (S-RIP)

Communication platform between researchers and the reanalysis centres

Better understanding of differences among reanalyses and their underlying causes

Guidance to users by documenting the intercomparison in peer reviewed papers and the SPARC S-RIP report (2019).

Reanalysis Centre (Contacts for S-RIP)	**Name of the Reanalysis Products**
ECMWF (**R. Dragani**)	ERA-40, **ERA-Interim**, (ERA-20C, ERA-20CM), (CERA-20C), [ERA5]
JMA (**Y. Harada, C. Kobayashi**)	JRA-25, **JRA-55** (and JRA-55C, JRA-55AMIP)
NASA (**K. Wargan**)	**MERRA**, **MERRA-2**
NOAA/NCEP (**C. Long, W. Ebisuzaki**)	NCEP-NCAR R-1, NCEP-DOE R-2, **CFSR**
NOAA & Univ. Colorado (**G. Compo, J. Whitaker**)	(20CR)

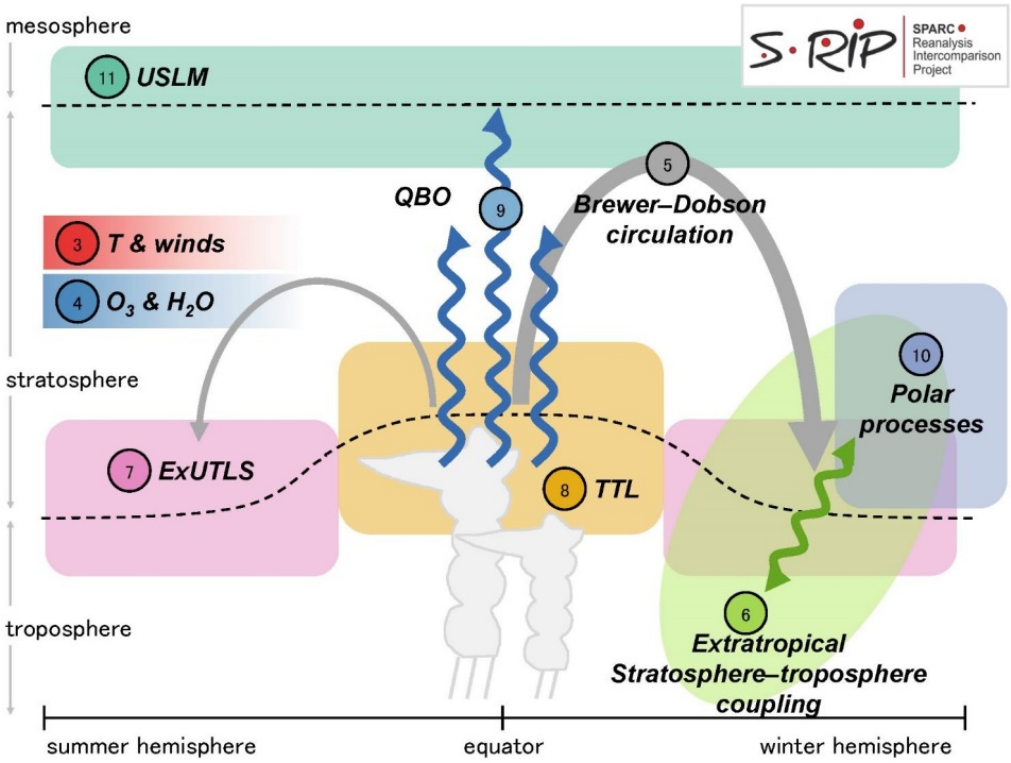
SPARC Reanalysis Intercomparison Project (S-RIP)

Interim report published as journal publications:

1) Overview of the S-RIP project
2) Climatology and interannual variability of dynamic variables
3) Assessment of upper tropospheric and stratospheric water vapour and ozone

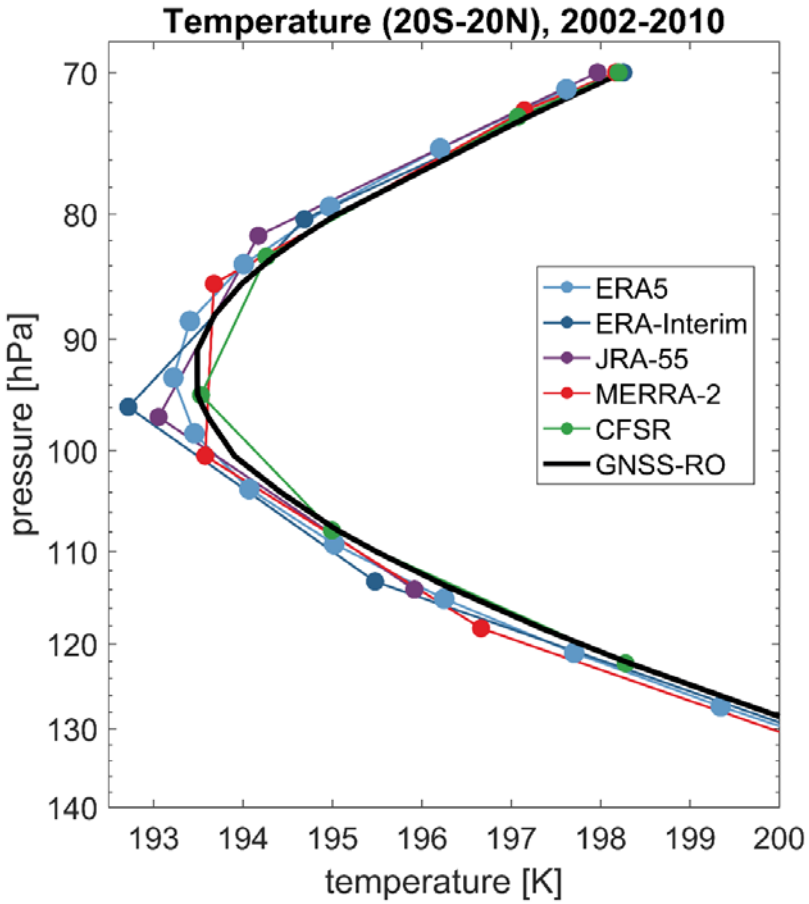
Final report to be submitted for review, soon (end of March 2019)

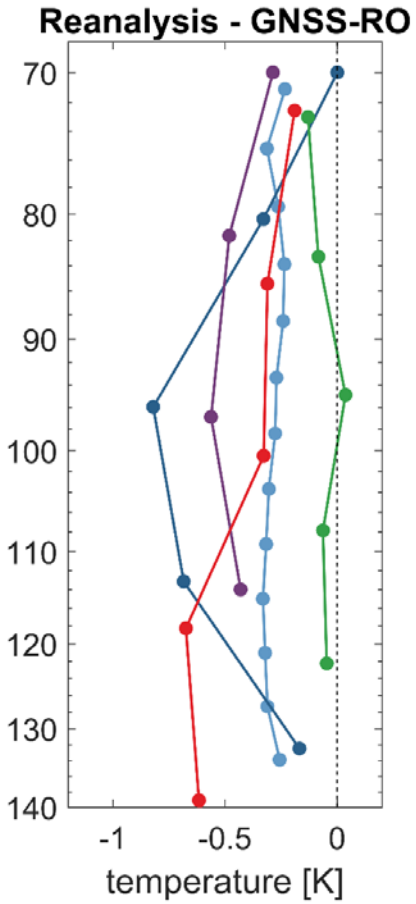
Publication planned for end of 2019



Example: Temperature profile

Vertical profiles of reanalyses and GNSS-RO* temperature, 20°S-20°N, 2002-2010





Cold bias

Up to -0.5 K for

CFSR

ERA5

JRA-55

Up to -1 K for

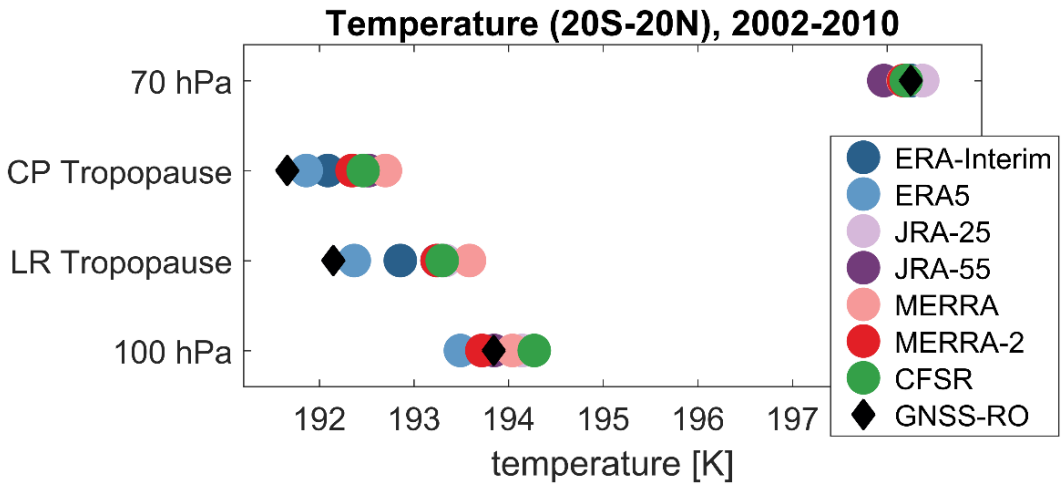
MERRA-2

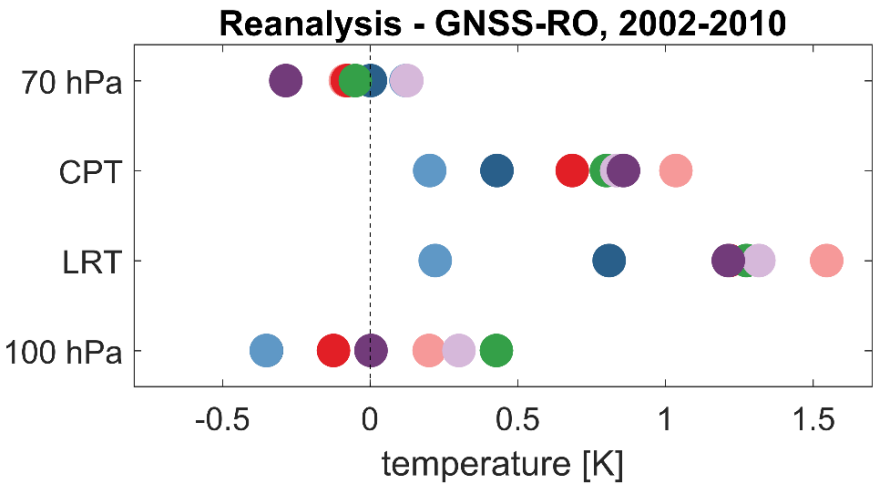
ERA-Interim

*Global Navigation Satellite System - Radio Occultation (GNSS-RO)

Tropopause temperatures

Temperature at 100 hPa, 70 hPa, cold point and lapse rate tropopause (20°S-20°N) for reanalyses and GNSS radio occultation



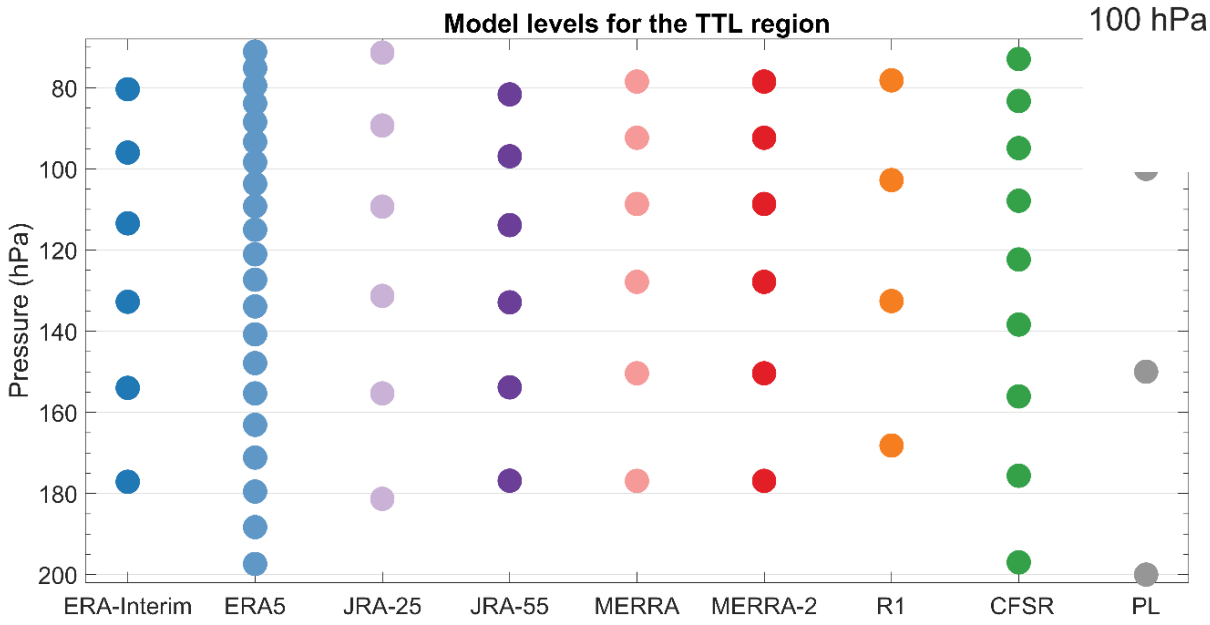


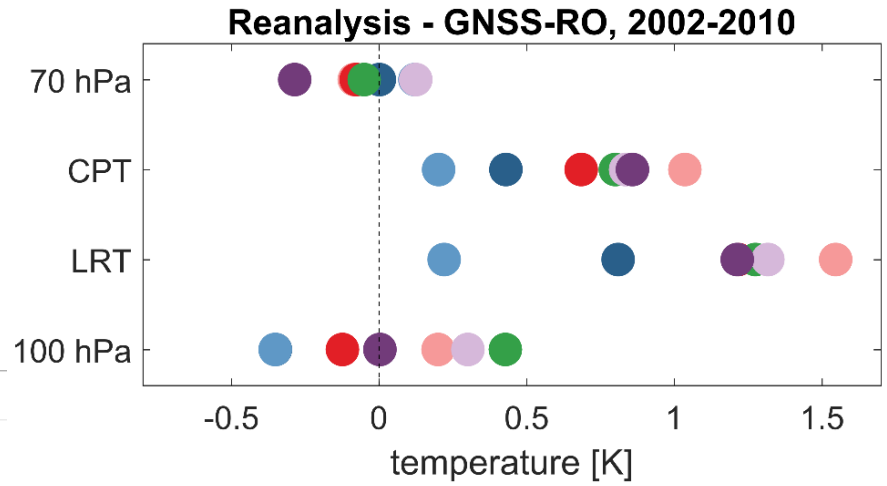
Good agreement at the two pressure levels (70 hPa and 100 hPa)

Reanalyses 0.2 – 1.5 K too warm at the cold point and lapse rate tropopause

Tropopause temperatures

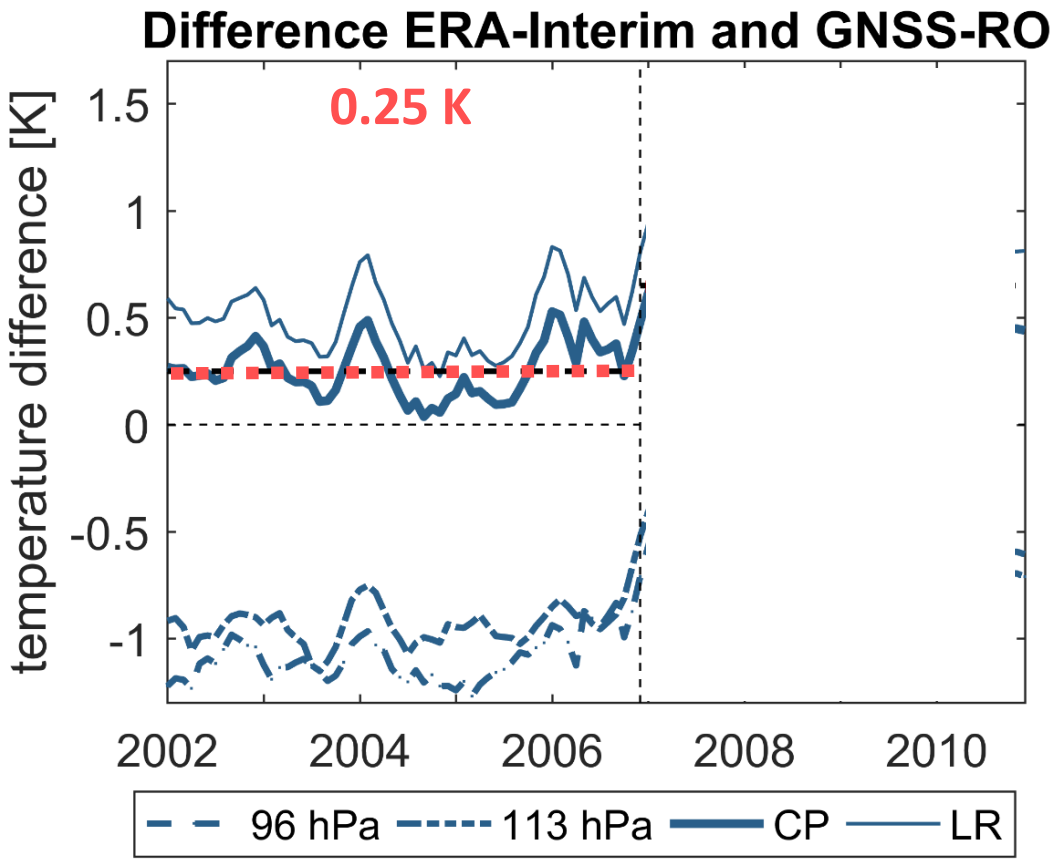
Reanalyses system with the highest vertical resolution (ERA5) shows the best agreement for the tropopause temperatures





Impact of COSMIC on tropopause temperature

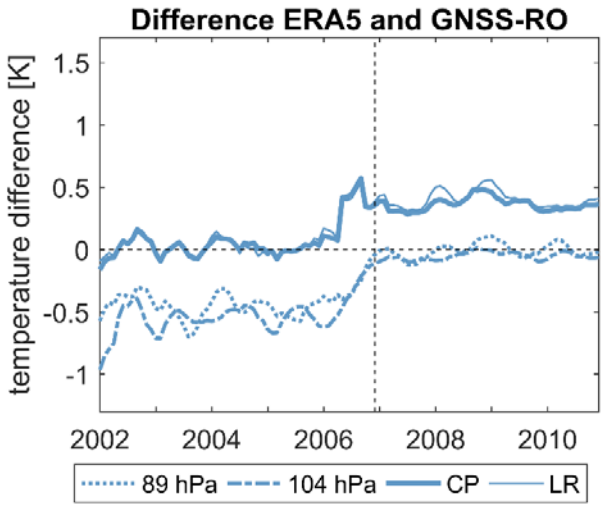
Time series of differences between ERA-Interim and GNSS radio occultation temperature 20°S-20°N

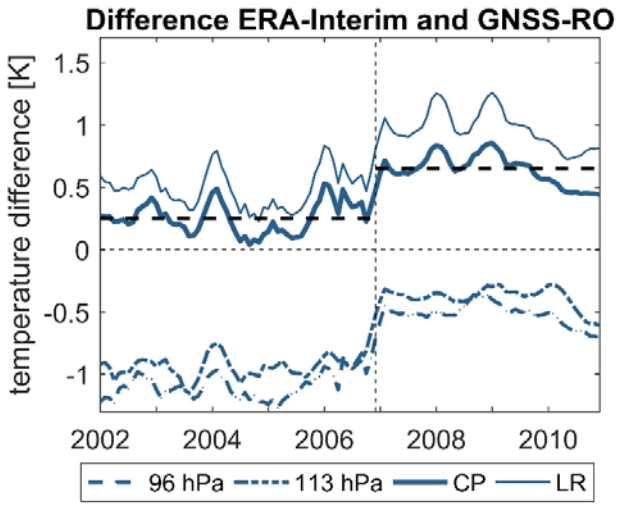


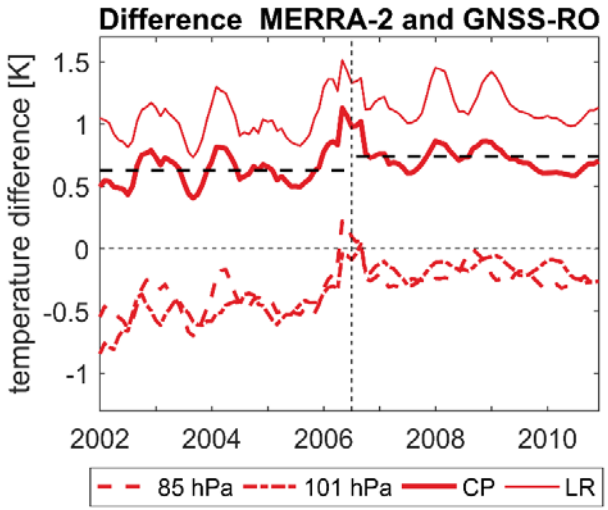
Better agreement of temperature at model levels after 2007 when COSMIC became available* but larger warm biases at cold point and lapse rate

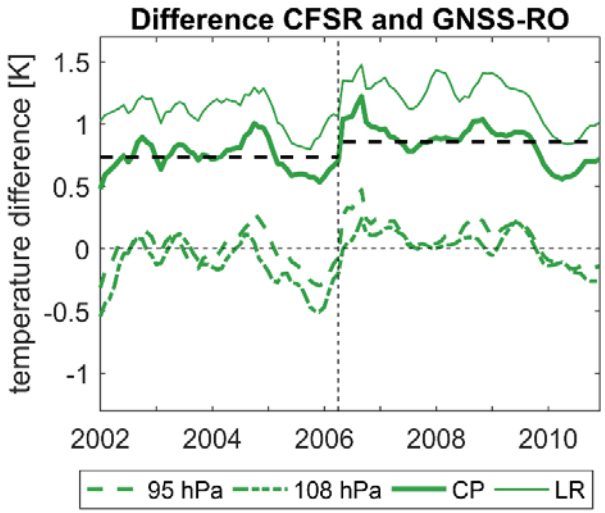
* Number of GNSS-RO data assimilated increased by an order of magnitude

Vertical resolution versus realistic temperatures









Bias increase between model levels and tropopause reflects resolution (best for ERA5, second best CFSR)

Most realistic tropopause depends on how ‚resolution bias (+)' and ‚temperature bias (-)' cancel each other out

SPARC Reanalysis Intercomparison Project (S-RIP)

Future plans:

- TIRA
- Add-ons and updates with new focus areas: MJO

The SPARC Data Assimilation Working Group (DAWG)

DAWG has been redesigned with a new overarching goal:

Using state-of-the-art data assimilation to address climate issues on a range of timescales.

Science-related themes and desired outcomes for 2019-2020

Theme 1: Chemical Reanalysis

Theme 2: Dynamical Reanalysis

Theme 3: Future of Limb Sounder

Theme 1: Chemical Reanalyses

- **Objectives:**

  Evaluation of existing chemical reanalyses and intercomparion; based on the S-RIP experience

  Added value of chemical reanalyses vs climatologies (e.g. SWOOSH, GOZCARD, …)?

  Use of chemical reanalyses for instrument intercomparison, drift analysis and bias corrections?

- **Outcomes:**

  Peer-reviewed papers

  Increased awareness and use of chemical reanalyses by the SPARC community (CCMi, ACAM, …)

Theme 2: Dynamical Reanalysis

- **This theme will address questions not treated by SRIP:**

  Evaluation of reanalysis in the upper stratosphere and mesosphere

  Evaluate trends in reanalysis

  Estimating the uncertainties in reanalyses

- **Outcomes:**

  Peer-reviewed publications

Theme 3: Future Limb Sounder Missions in Support of SPARC

Objectives:

1. Act as a forum within SPARC and identify scientific questions that need a limb sounder. Also compile scientific questions available in international reports (e.g. GCOS) that need satellite observations. Identify questions that would not be tackled by any proposed mission.
2. Define set of OSSEs or denial experiments to quantify the added value of a newly proposed instrument.
    - e.g. in terms of vertical/horizontal/time coverage and resolution, in terms of observed parameters, …


Thank You!
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