

# ACTIVITY REPORT:

## Atmospheric Temperature Changes and their Drivers

Activity leads:

Andrea Steiner, University of Graz

Amanda Maycock, University of Leeds

28<sup>th</sup> SPARC SSG meeting

Part II: Activity reporting

February 2021

## Two Main Foci

- Atmospheric temperature variability and trends, and their uncertainty in climate data records (CDRs):
  - (i) from the troposphere to the mesosphere
  - (ii) inclusion of emerging novel observational records, e.g., limb-sounders with high vertical resolution
  - (iii) improving uncertainty information
- Attribution of atmospheric temperature changes:
  - (i) Comparison between GCMs/CCMs and CDRs
  - (ii) Attribution of temperature trends to radiative and dynamical drivers

## Major milestone – community paper Steiner et al. 2020

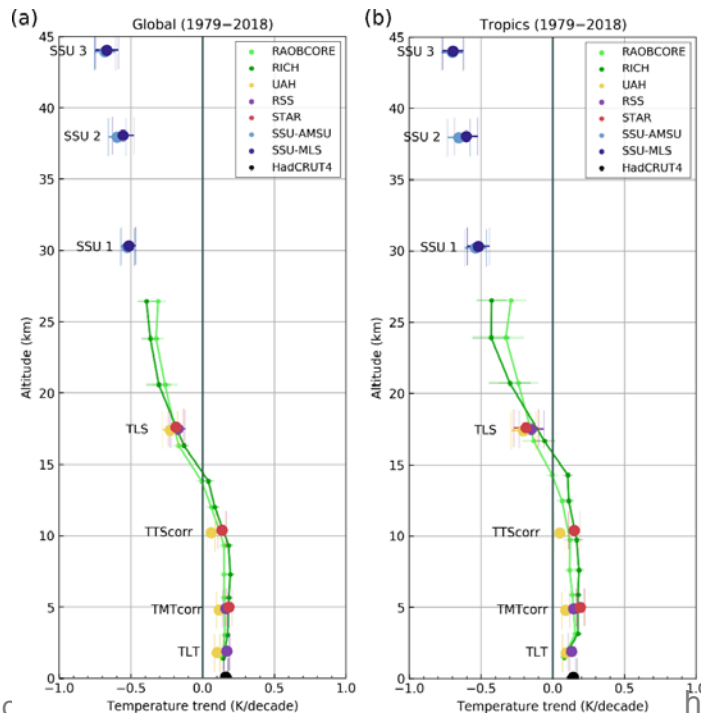


### Observed Temperature Changes in the Troposphere and Stratosphere from 1979 to 2018

A. K. Steiner; F. Ladstädter; W. J. Randel; A. C. Maycock; Q. Fu; C. Claud; H. Gleisner; L. Haimberger; S.-P. Ho; P. Keckhut; T. Leblanc; C. Mears; L. M. Polvani; B. D. Santer; T. Schmidt; V. Sofieva; R. Wing; C.-Z. Zou

*J. Climate* (2020) 33 (19): 8165–8194.

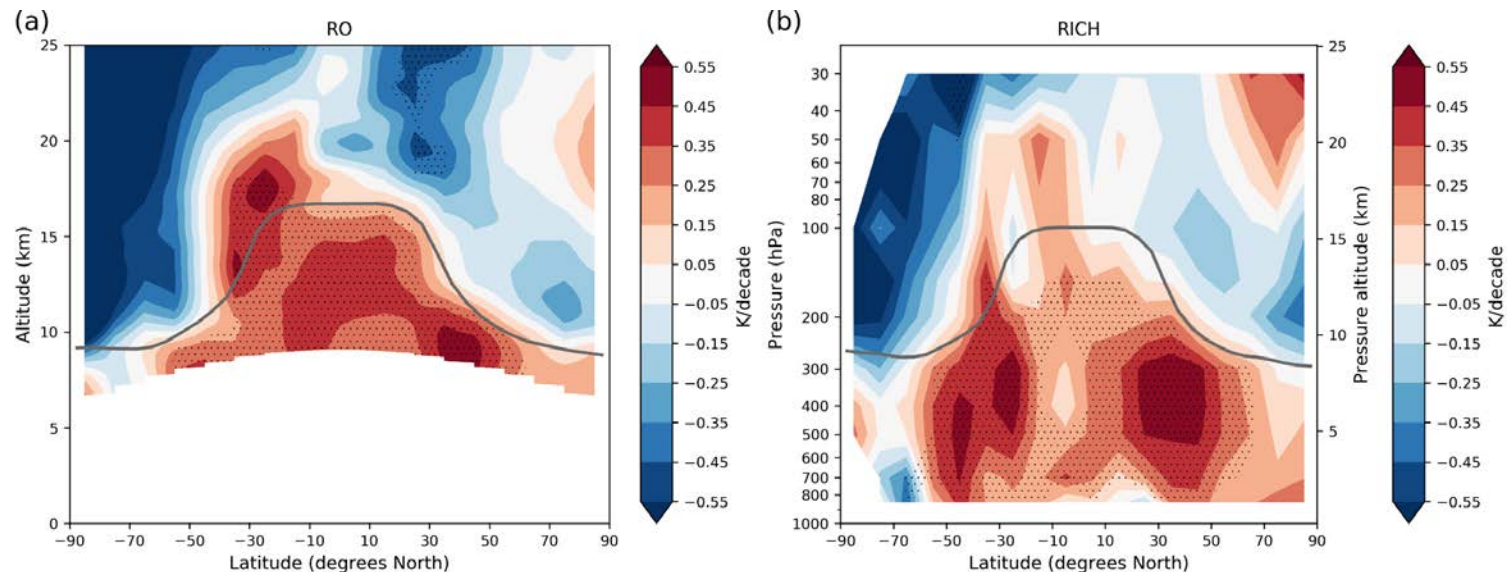
<https://doi.org/10.1175/JCLI-D-19-0998.1> Article history



## Major milestone – community paper Steiner et al. 2020

### Main results:

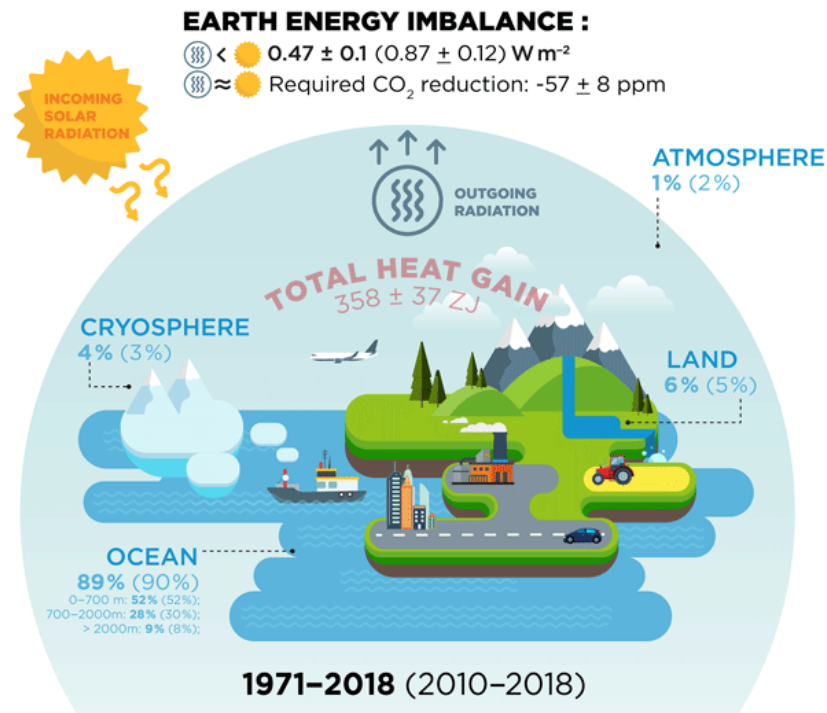
- Stratospheric cooling of 1 to 3 K over 1979–2018 from SSU & AMSU data
- Tropospheric warming of 0.6 to 0.8 K over 1979–2018 from AMSU data
- Significant tropospheric warming since 2002: 0.25 to 0.35 K/dec from RO
- Amplification of trends in tropical upper troposphere observed in RO & RS



## Highlight – joint publication CLIVAR, GEWEX, CliC, SPARC von Schuckmann et al. 2020

### Heat stored in the Earth system: where does the energy go?

- Earth energy imbalance  $0.47 \pm 0.1 \text{ W m}^{-2}$  (since the 1970s)
- 89% of heat in oceans, 6% land, 4% cryosphere melting, 1% atmosphere warming



- Further achievements
  - ATC contributions to the IPCC AR6  
WG I Chapter 2 on the changing state of the climate system  
WG I Chapter 7 on Earth's energy budget
  - Mitchell et al. (2020): Analysis of tropical temperature trends in the CMIP6 models.
  - Santer et al. (in review): Comparison of tropospheric warming trends in CMIP6 models with satellite datasets.
  - Steiner et al. (2020): RO community paper on consistency and structural uncertainty of multi-mission GPS RO records
  - RO review papers (Ho et al. 2020; Scherllin-Pirscher et al. 2021)
  - Invited presentation held at the virtual 5th International Conference on GPS Radio Occultation ICGPSRO 2020  
<https://w3.nspo.narl.org.tw/ICGPSRO2020/download/presentation/ICGPSRO2020-presentation-AB008.pdf>

- ATC-members K. Rosenlof, Q. Fu and A. Maycock are part of a new ISSI team project “Tropical Width Impacts on the Stratosphere”.
- ATC-members C. Claud, P. Keckhut, and A. Steiner are part of the ISSI team project “Synergy between satellites and ground-based observations for the study of middle atmosphere dynamics”
- Several ATC members are engaged in ongoing RO community work
- Strong opportunities for enhanced connections with different core projects and the new WCRP “model & data home”. A good example is the recent cooperation across WCRP on the EEI.
- Strong opportunities for collaborations with the newly developed Lighthouse Activities “Explaining and Predicting Earth System Change” and “Digital Earth” is particularly important for the ATC activity and we are keen to feed into the plans.



- We are planning an ATC meeting tentatively in summer 2021, which may well be a virtual meeting
- Contributions to the ISSI Teams to be continued in 2021
- Engagement of ATC co-chairs in SPARC Science Task Team (A. Maycock lead) and as WCRP Regional Focus Point (A. Steiner)
- Continued work on ATC focus topics
  - climate data records and comparison with CMIP6 models
  - reprocessed middle atmosphere records
  - attribution topics
  - next community paper