The 17-year ROM SAF radio occultation climate data record

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Contact and access and download of data:

ROM SAF helpdesk: helpdesk.romsaf.org

ROM SAF website: www.romsaf.org

Take home points

1) Data from GNSS Radio Occultation (RO) instruments on board a series of satellites in low-Earth orbit since 2001, have been reprocessed by the ROM SAF in order to generate long-term stable Climate Data Records of atmospheric geophysical variables.

2) We demonstrate that between 8-30 km the data quality and the inter-mission differences are small enough to allow for the generation of multi-mission data records starting in 2001 and now spanning 18 years.

3) We learn that GNSS RO data records have the required long-term stability, and are now becoming long enough, to be used in climate studies.

4) The long-term stability, global coverage, and high vertical resolution make RO measurements well positioned to contribute to studies of upper tropospheric and stratospheric phenomena, e.g., temperature trends, the tropical QBO phenomenon, Sudden Stratospheric Warming events in the polar stratosphere. An RO contribution to the next IPCC assessment report is foreseen.

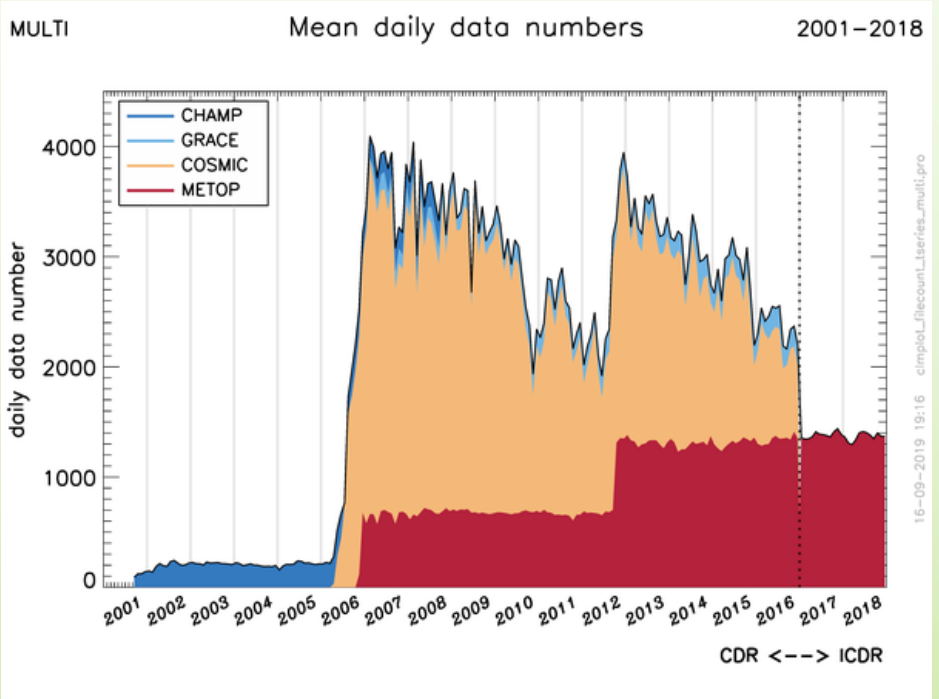
ROM SAF Climate Data Records

Climate Data Records (CDR v1.0):

GRM-29-R1: **Metop** (2006–2016)
GRM-30-R1: **COSMIC** (2006–2016)
GRM-32-R1: **CHAMP** (2001–2008)
GRM-33-R1: **GRACE** (2007–2016)
GRM-28-R1: **Multi-mission** (2001–2016)

Interim Climate Data Records (ICDR v1.0, v1.1):

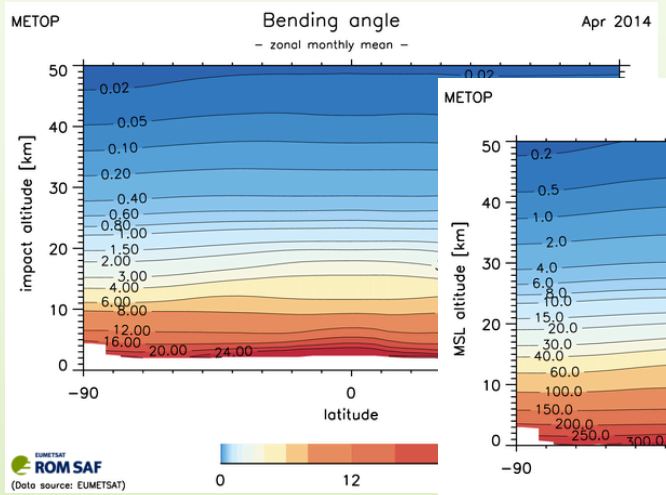
GRM-29-I1: **Metop** (2017 – present)

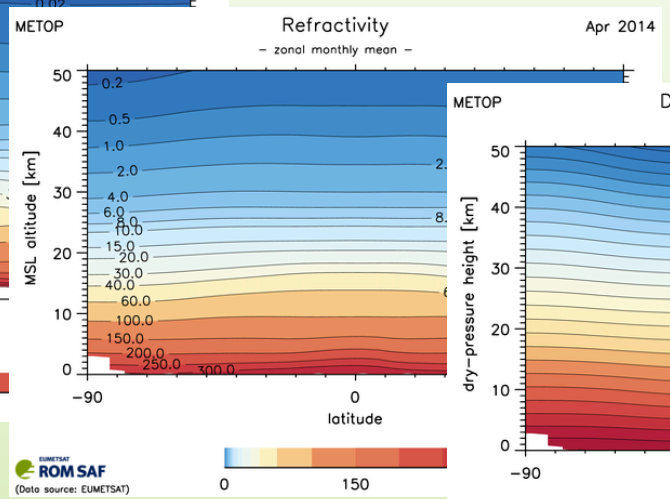


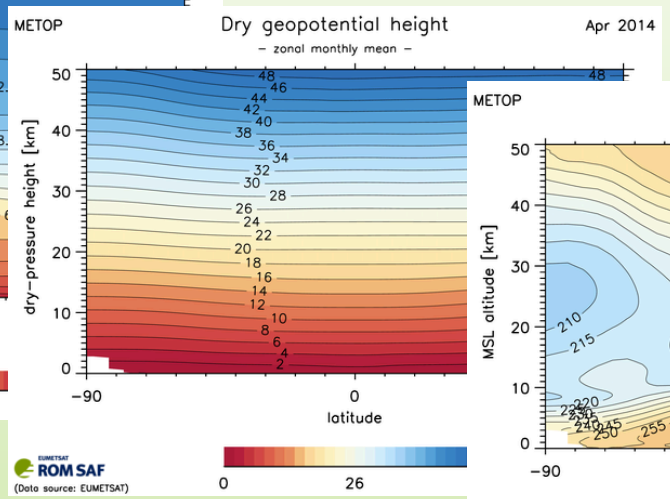
Contents:

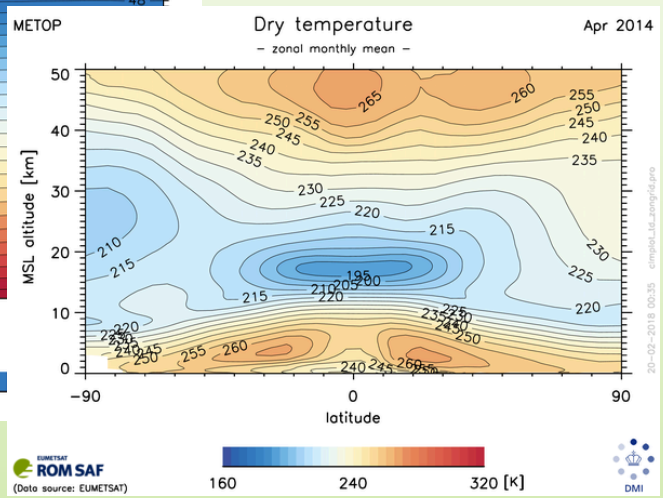
- Radio occultation bending angles, atmospheric refractivity, and dry temperature
- Temperature, humidity, pressure, surface pressure, and tropopause height
- Monthly mean gridded data of all variables, including geopotential height
- In total: **16 RO data records per satellite mission**

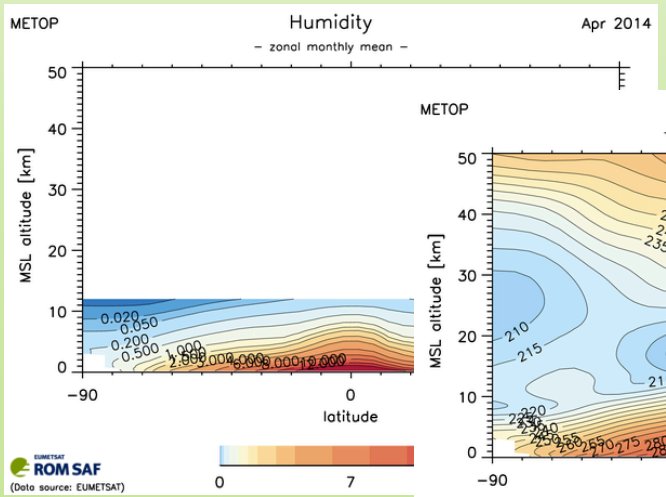
Geophysical variables available

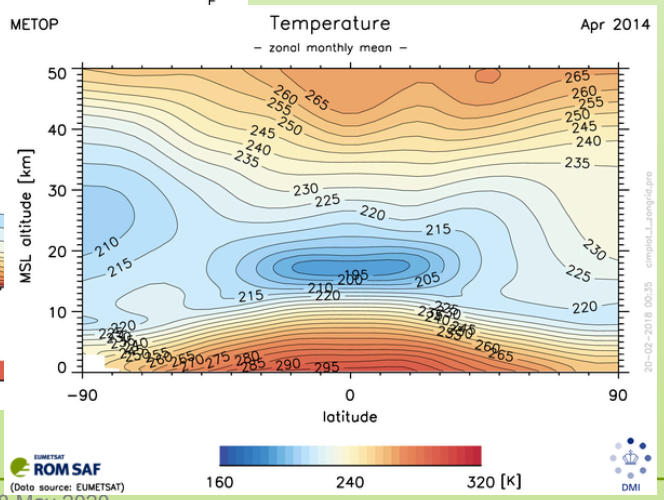


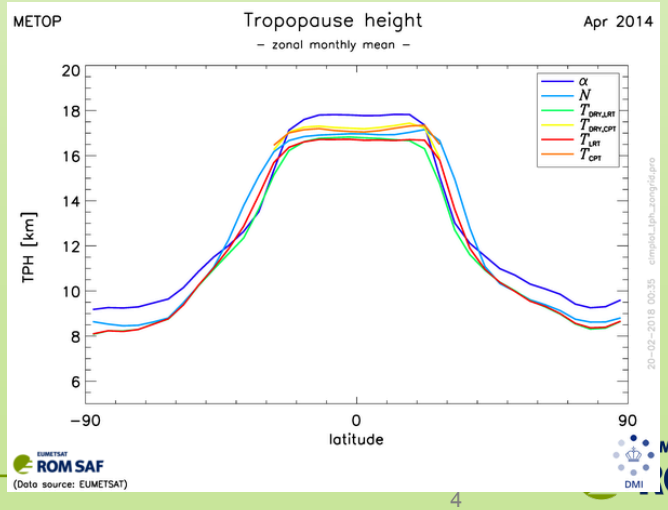






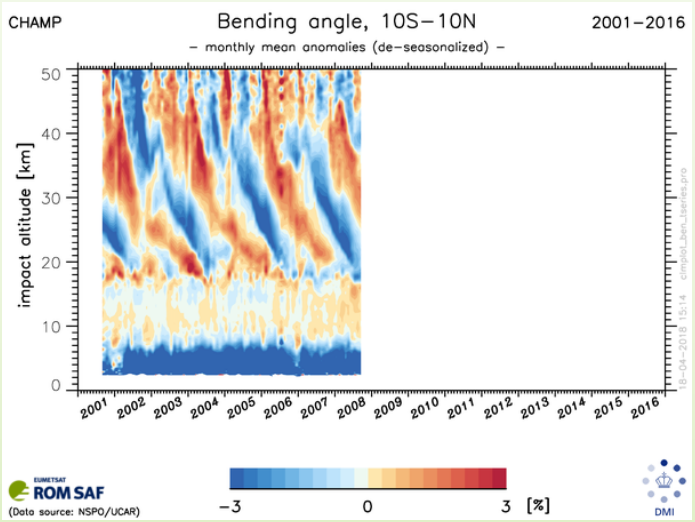




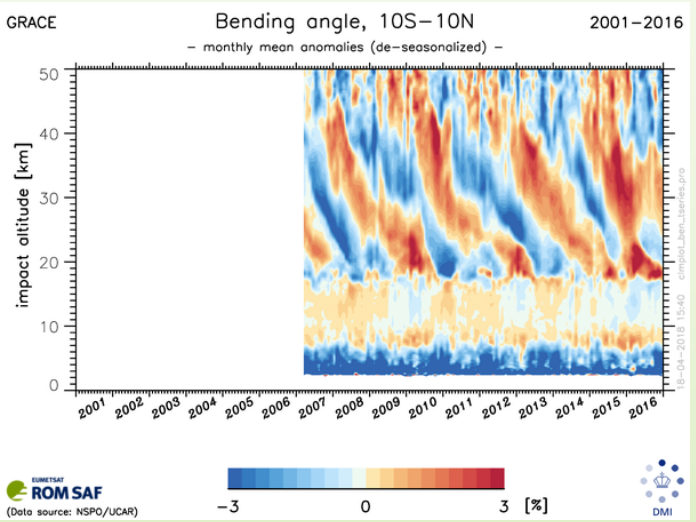


Monthly mean bending-angle anomalies

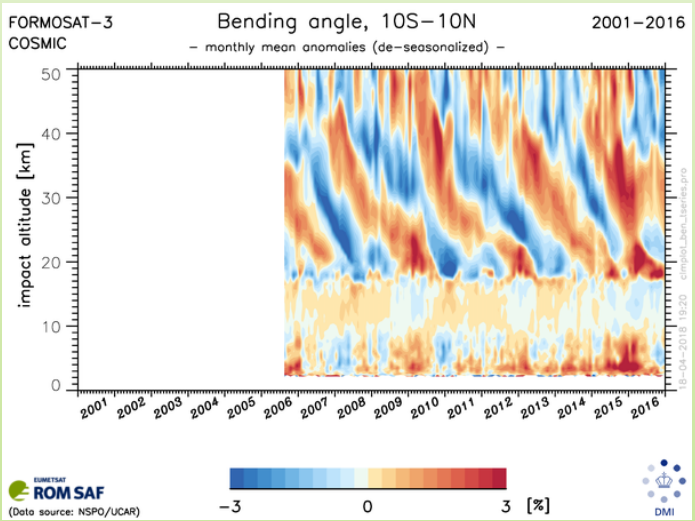
CHAMP



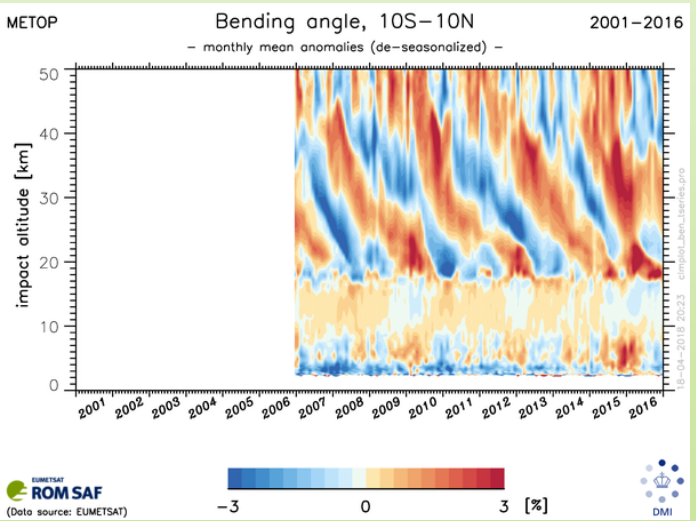
GRACE



COSMIC



Metop



Tropical bending angle anomalies retrieved from four different RO satellite missions. Very small inter-mission differences in the 8-30 km altitude range allow for the generation of long multi-mission data records

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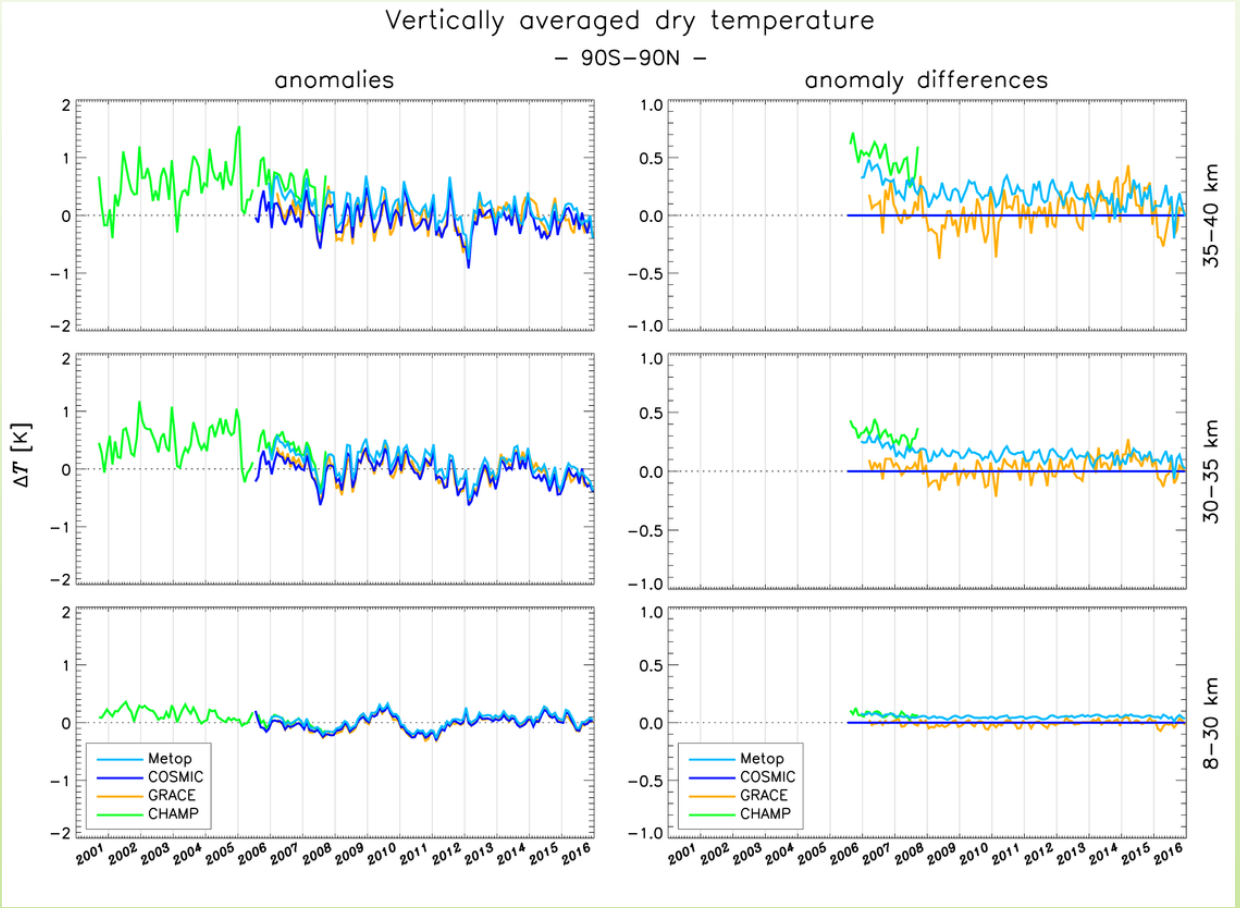
Monthly mean temperature anomalies

35-40 km

30-35 km

8-30 km

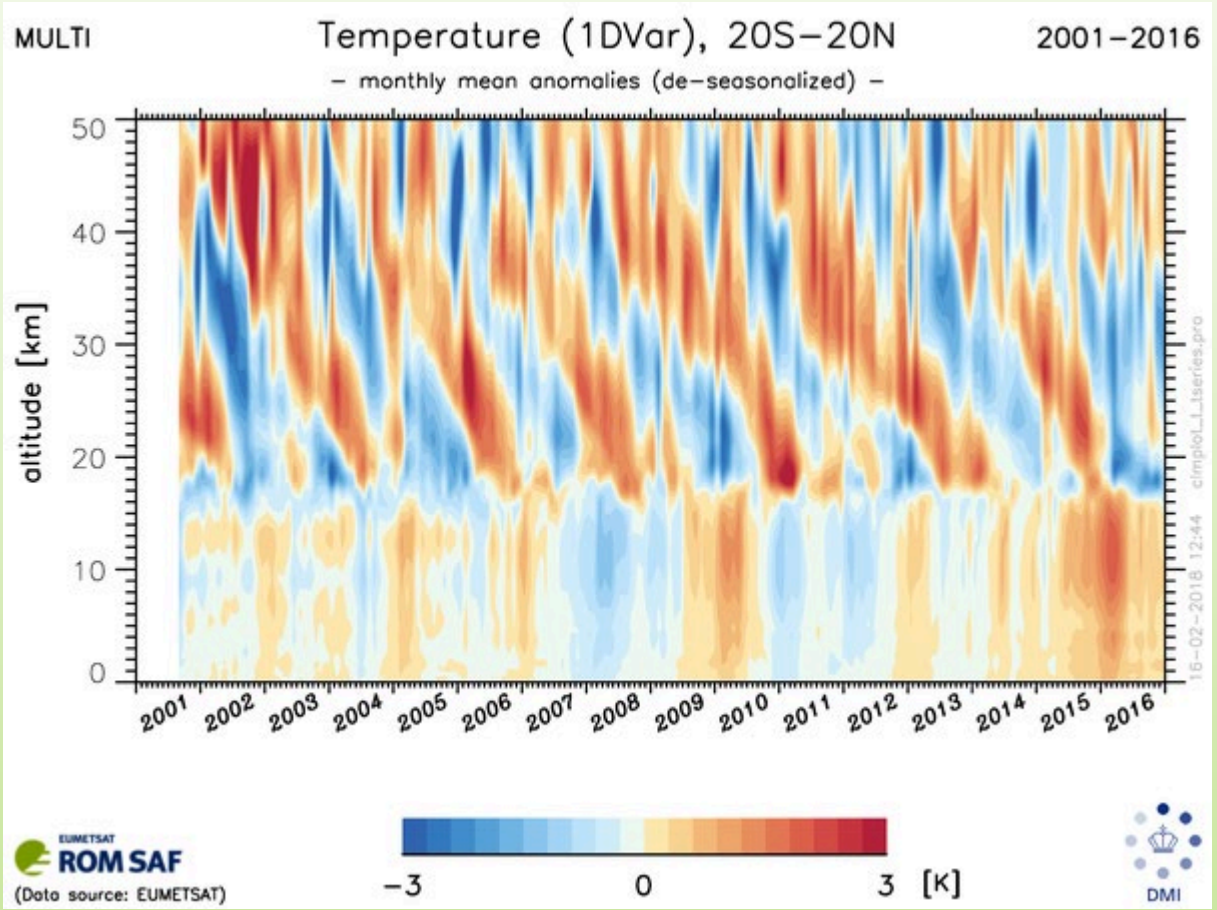


A closer look at the temperature anomalies (left hand column) and the differences between the anomalies (right hand panel) reveals the excellent consistency between the RO satellite missions, particularly in the 8-30 km altitude range.

EUMETSAT ROM SAF

Monthly mean temperature anomalies

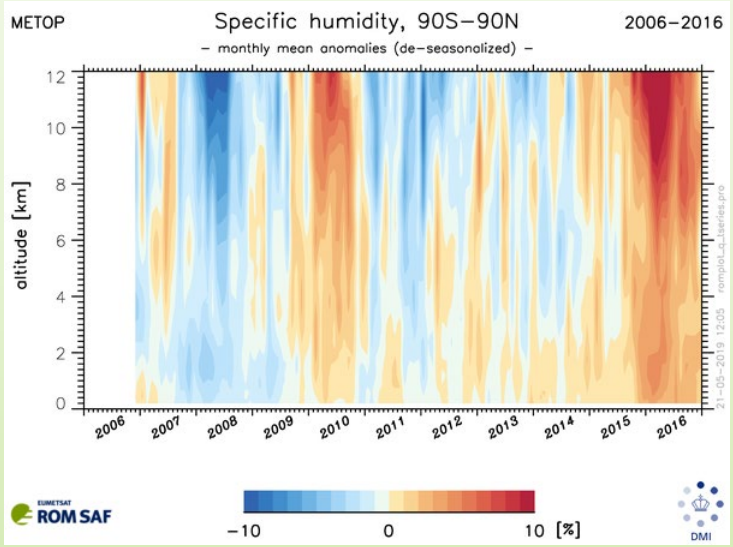
MULTI

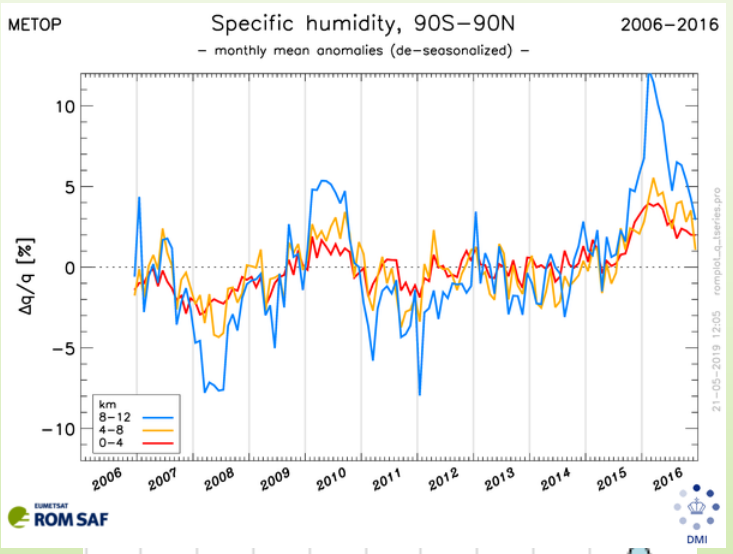


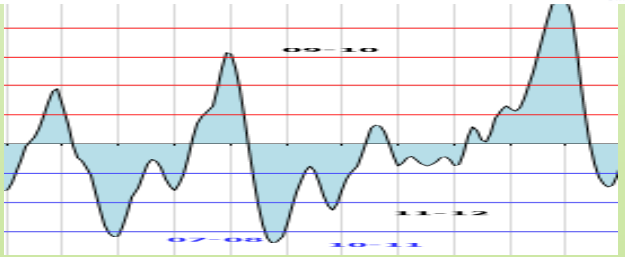
Here we have combined data from the four RO missions into a single multi-mission data set. The Quasi-Biennial Oscillation (QBO) is the dominant mode of inter-annual variability in the tropical stratosphere. Below the tropopause the ENSO phenomenon is more important.

EUMETSAT ROM SAF

Monthly mean humidity anomalies







Here we show globally averaged humidity as observed by the RO instruments on board the Metop satellites. To the right we compare the observed globally averaged humidity with an ENSO index derived from tropical Pacific sea-surface temperatures.

Differences between the Metop and COSMIC missions

	Bending angle	Refractivity	Dry temp
40-50 km	0.10 %	0.15 %	0.25 K
35-40 km	0.07 %	0.10 %	0.16 K
30-35 km	0.05 %	0.07 %	0.12 K
25-30km	0.04 %	0.06 %	0.08 K
20-25 km	0.02 %	0.04 %	0.06 K
12-20 km	0.01 %	0.02 %	0.04 K
8-12 km	0.01 %	0.02 %	0.02 K

These differences reflect both errors propagated from the profiles, and residual sampling errors.