ROM SAF radio occultation based water vapour climate data records

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- Gridded monthly mean data based on Radio Occultation (RO)
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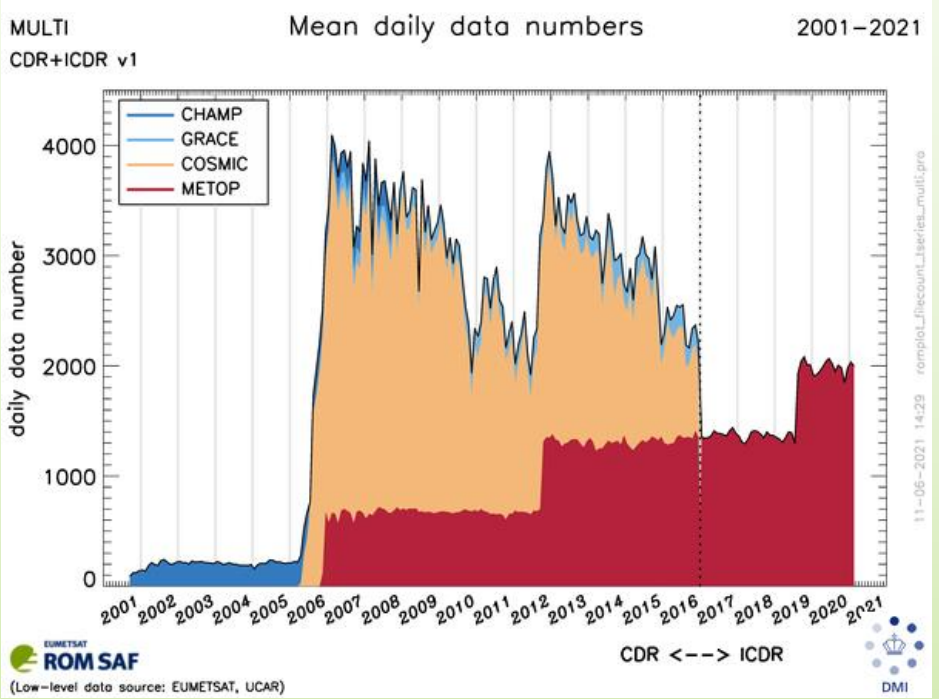
ROM SAF climate data records (CDR+ICDR)

Climate Data Records (CDR v1):

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

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

GRM-29-I1: **Metop** (2017 – present)



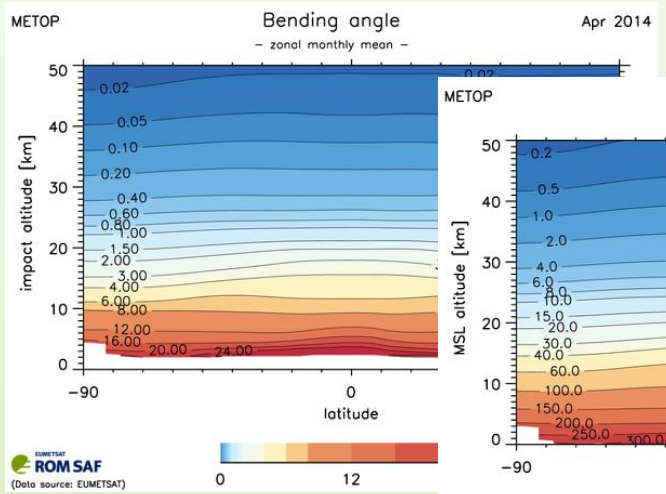
CDR/ICDR contains:

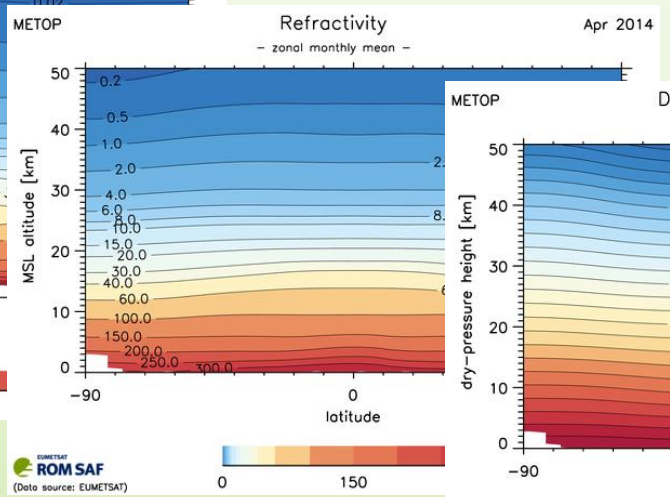
- Radio occultation bending angles, atmospheric refractivity, dry pressure and temperature
- Temperature, humidity, pressure, surface pressure, and tropopause height
- Monthly mean gridded data of all variables

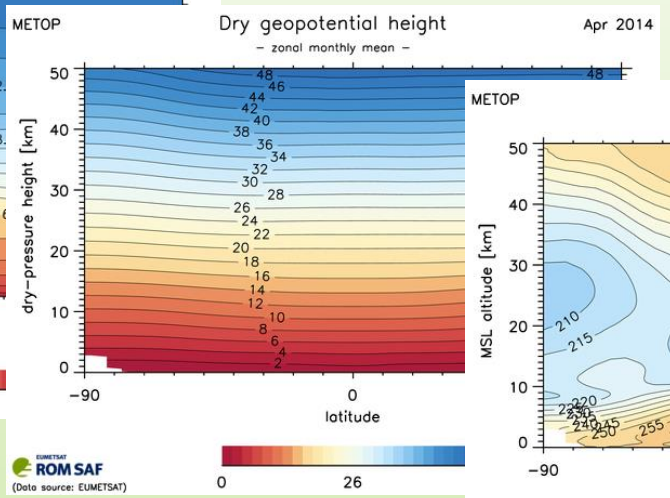
CDR v2 in the pipeline:

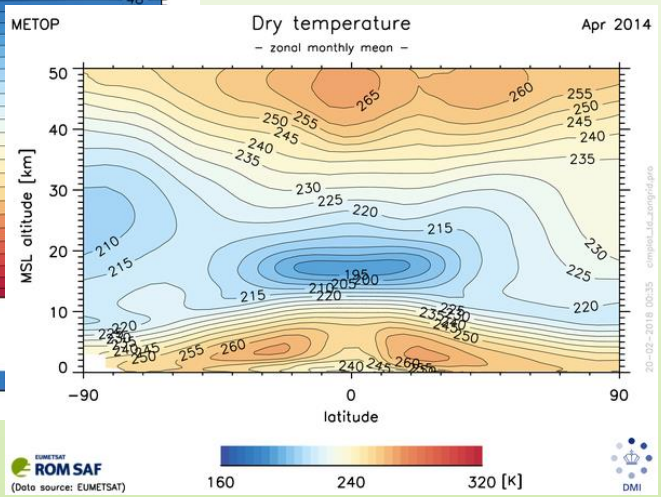
Reprocessing of RO data up to 2020 is planned for, followed by the start of a new ICDR cycle.

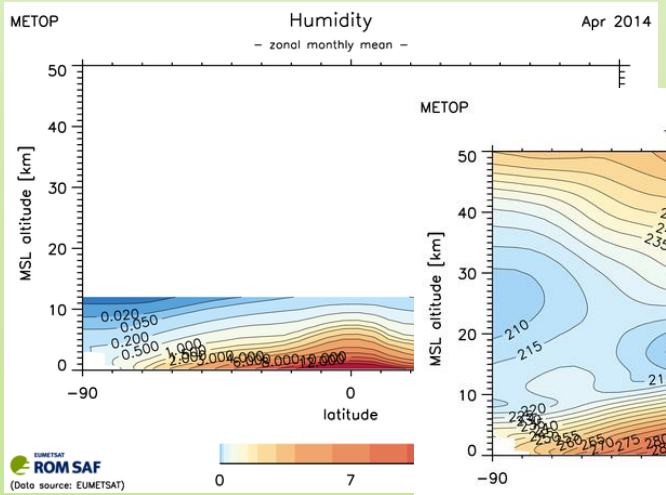
Gridded monthly mean data

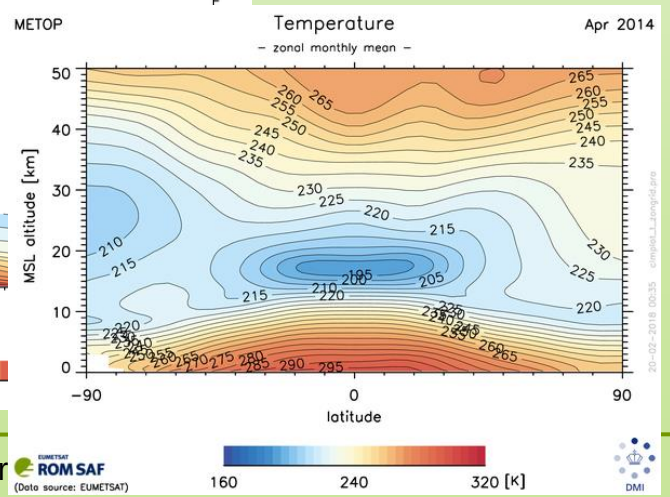


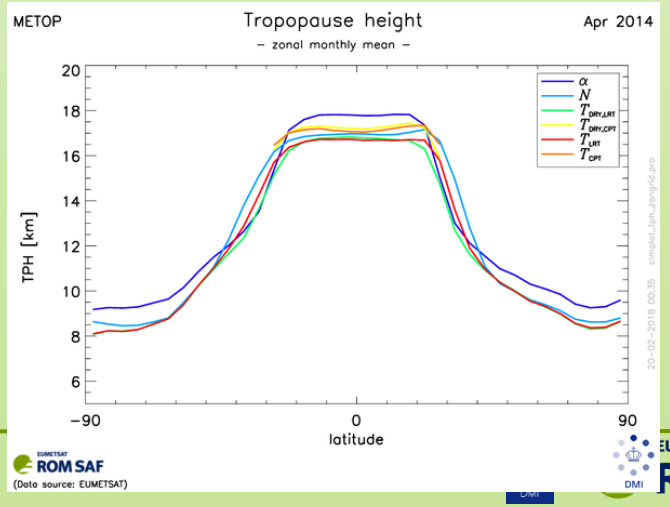




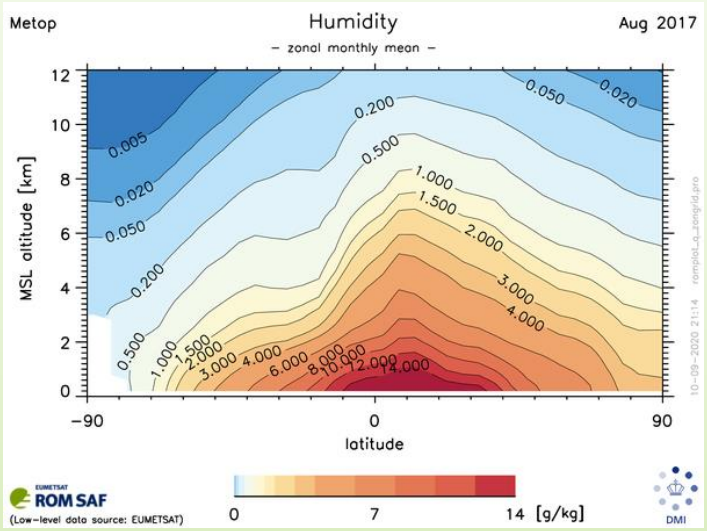


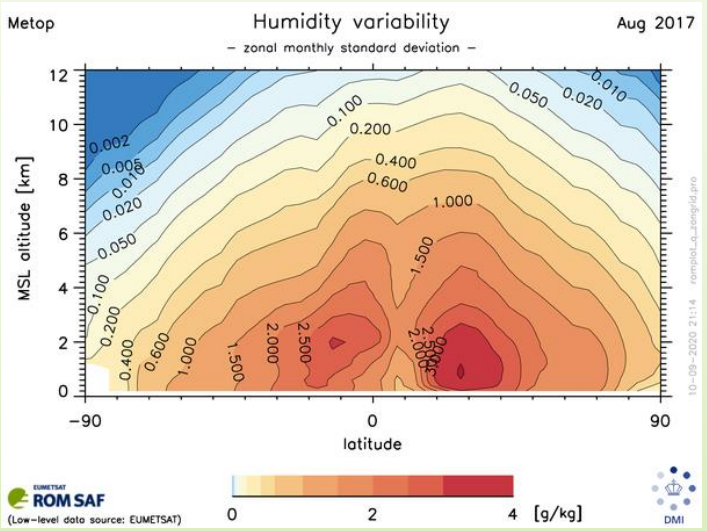


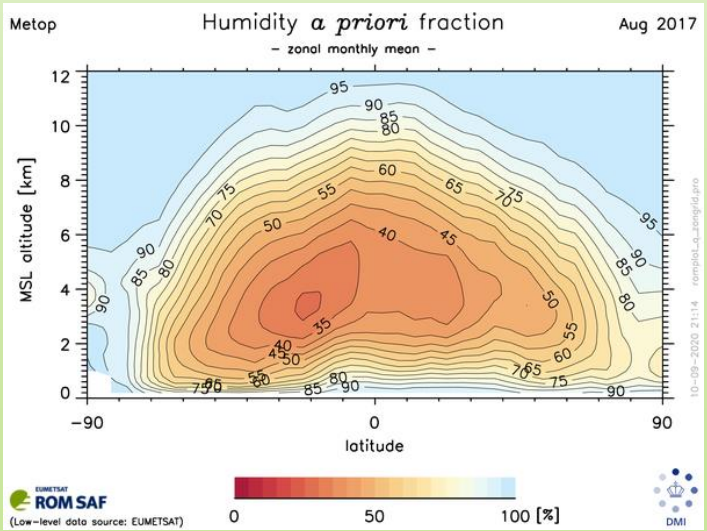


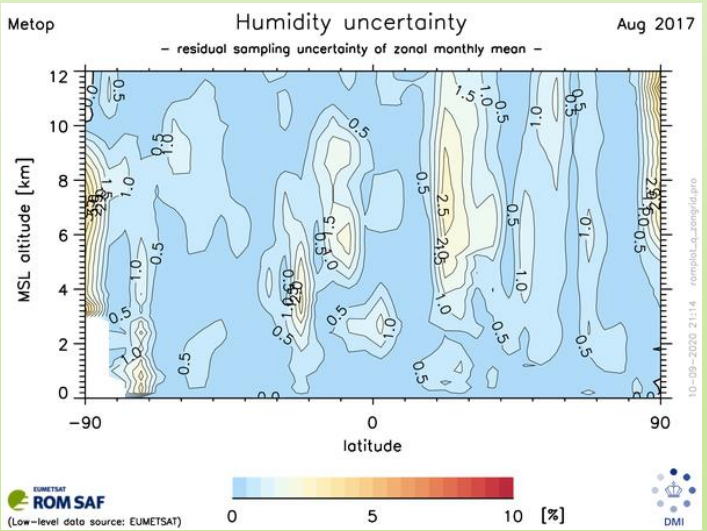


Gridded monthly mean humidity









Main characteristics:

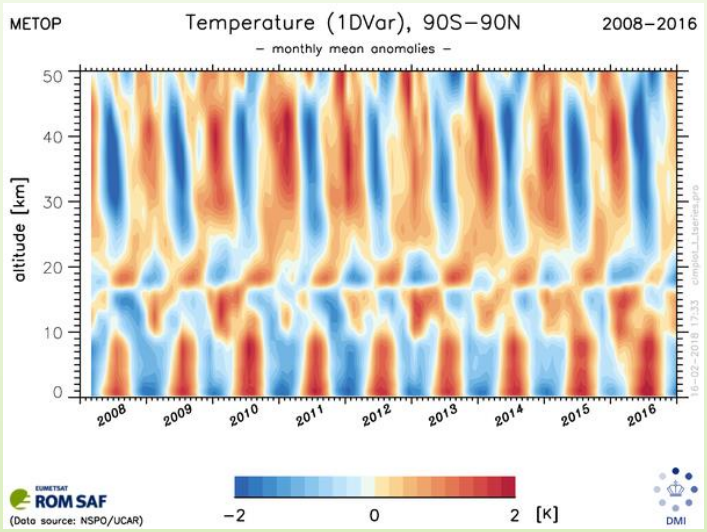
- Global coverage
- High vertical resolution
- No day-night or land-sea differences
- Maximum observational content at low- and mid-latitudes in the 2-8 km altitude region.

Data product contains:

- Monthly means
- Monthly standard deviations
- Estimate of impacts from observation (“*a priori* fraction”)
- Error/uncertainty estimates
- Data numbers

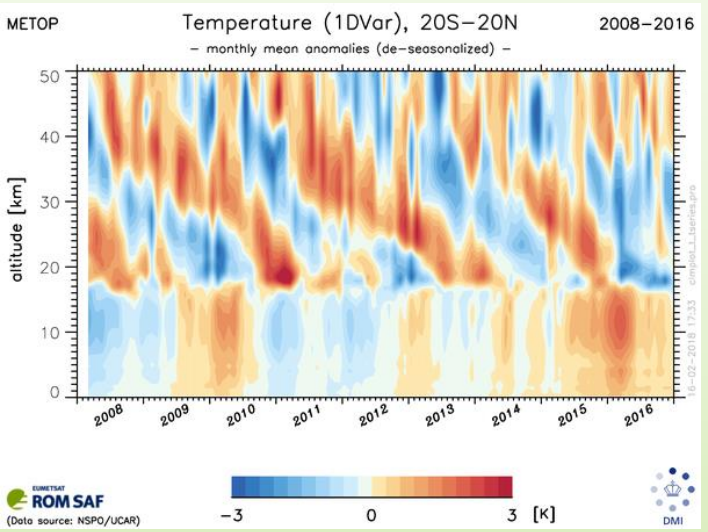
Time series of monthly mean temperature & humidity

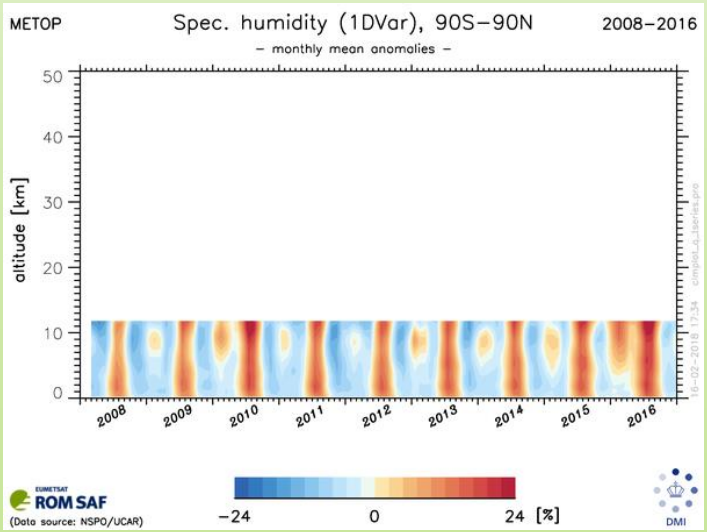
– Metop CDR –

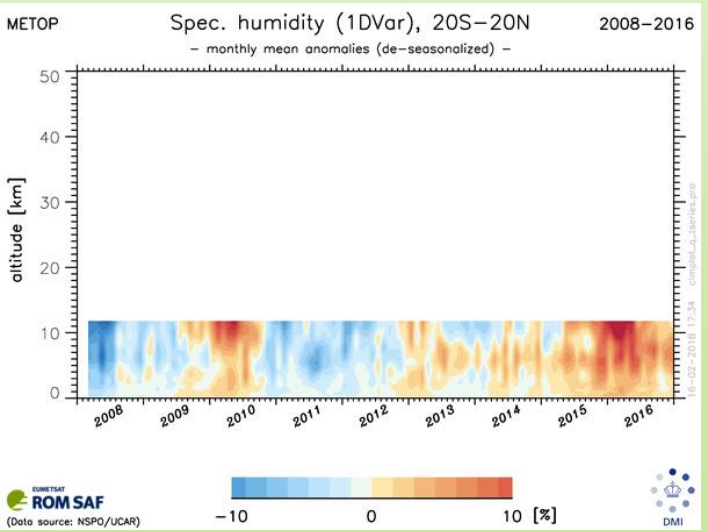


Globally,
with seasonal cycle

Tropics,
de-seasonalized

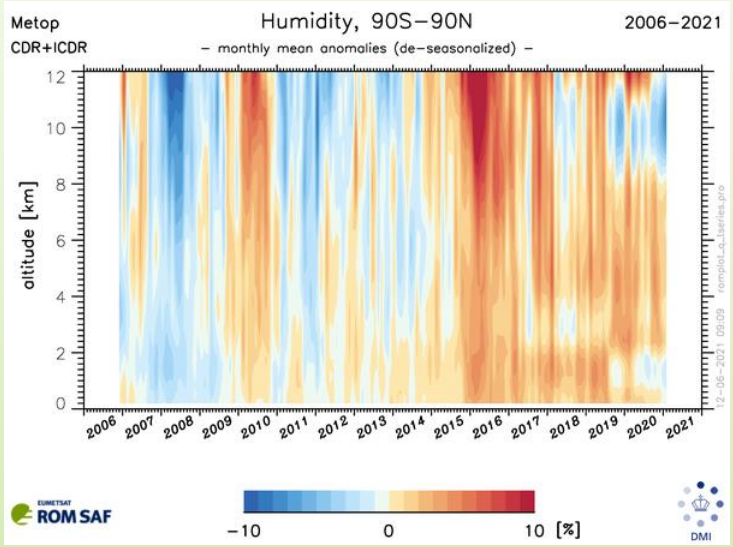


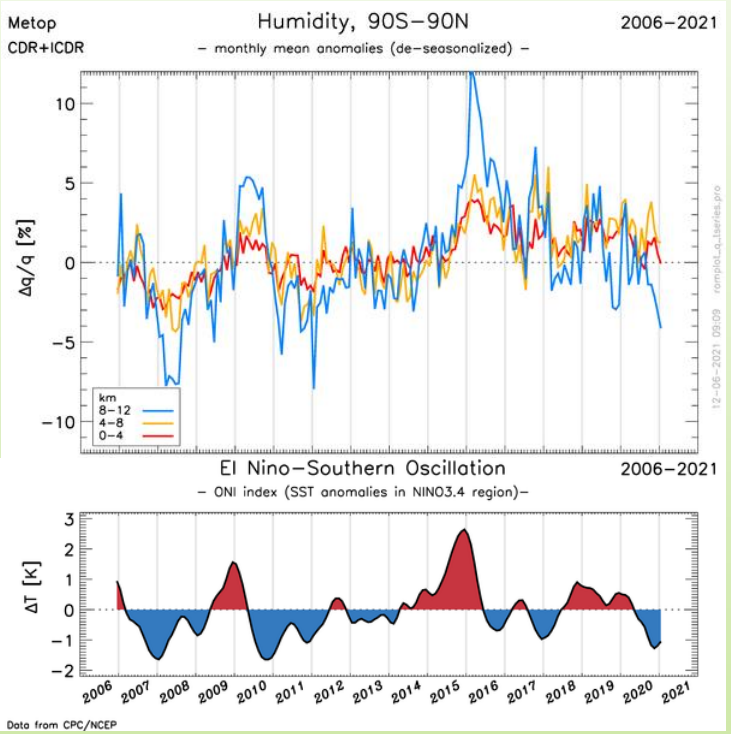




Time series of monthly mean humidity

– Metop CDR+ICDR –

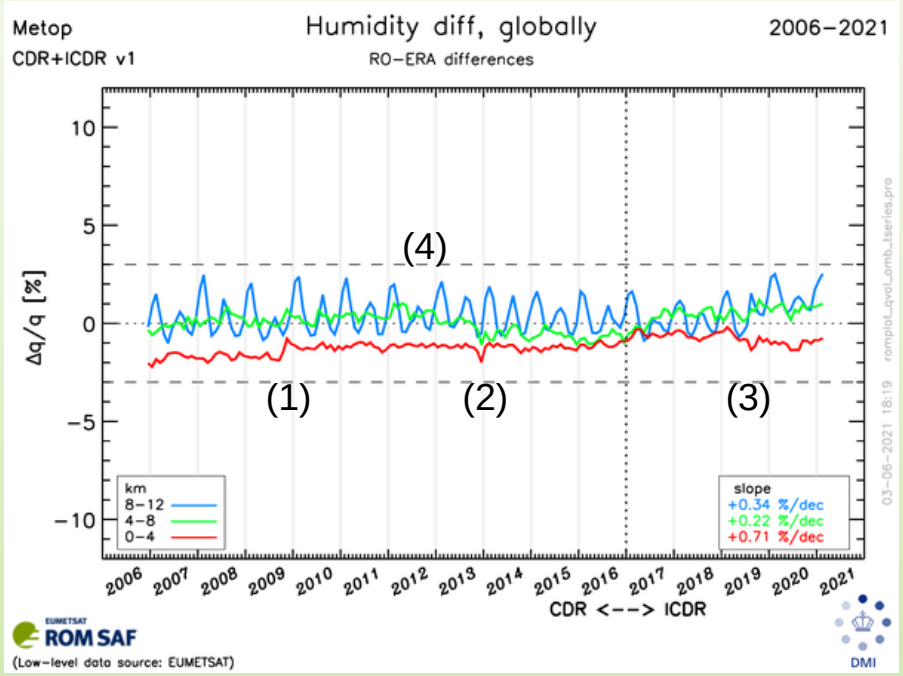




Globally averaged humidity, as observed by RO, is strongly influenced by the state of the ENSO with a certain time delay.

Time series of monthly mean humidity

– validation and monitoring of long-term stability –



(1) Stepwise change in ERA-Interim due to change in COSMIC data being assimilated in late 2009

(2) Brief bias shift in ERA-Interim in late 2013

(3) Change from ERA-Interim to ERA5 in Aug 2019

(4) Seasonal variation in RO-reanalysis differences at mid-latitudes around 10 km.

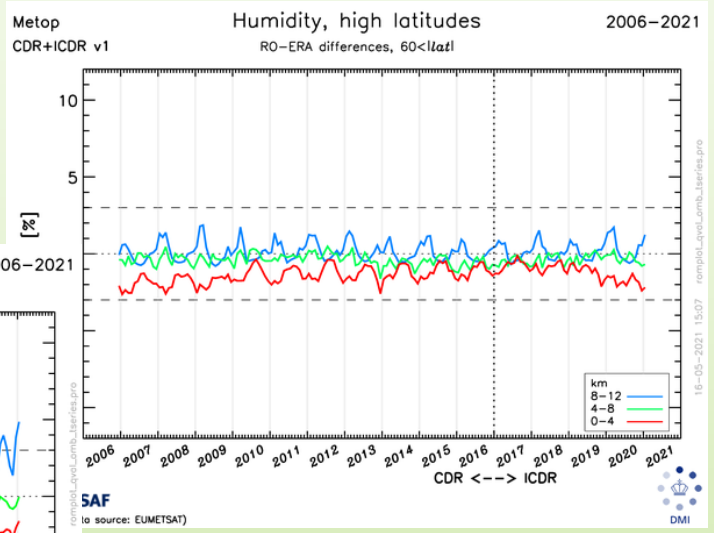
Monitoring long-term stability of RO humidity data records using ECMWF reanalyses (short-term forecasts) as a reference.

Note that the reanalysis data is not the truth. We can clearly identify biases originating in the reanalysis data used as a reference, rather than in the RO data.

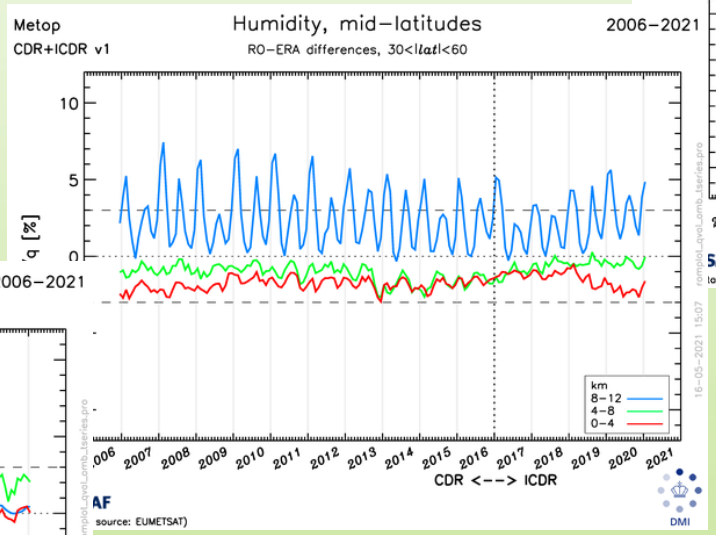
Time series of monthly mean humidity

– validation and monitoring of long-term stability –

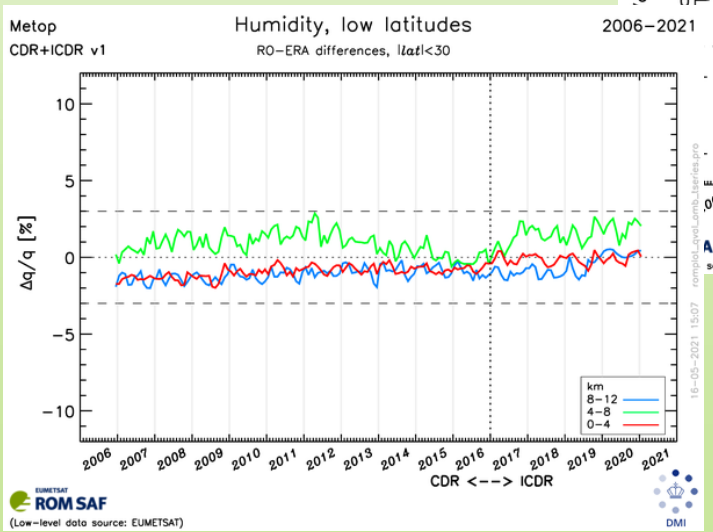
High latitudes



Mid latitudes



Low latitudes



Monitoring long-term stability of RO humidity data records using ECMWF reanalyses (short-term forecasts) as a reference.

The generation and release of ROM SAF CDR v2 is expected to reduce the RO-reanalysis differences and improve stability – due to improvements of the RO data and better stability of the reanalysis.

Summary

- Nearly 20 years of RO data available for generation of climate data records. Of these, 15 years are suitable for generation of humidity data (the COSMIC and Metop data).
- The humidity data are part of a suite of RO variables including temperature, pressure, and geopotential height in the troposphere and stratosphere, as well as tropopause height.
- RO humidity climate data records are continuously extended nearly up to present.
- Both humidity profile data and gridded monthly mean data are available as ROM SAF data products. The gridded products include mean, variability, data numbers, and estimates of uncertainty and "*a priori* fraction".
- The continuous humidity time series starting in 2006 are long enough for studies of climate variability and trends. Impacts of ENSO are clearly evident.
- Measuring long-term stability of time series using ECMWF reanalysis as reference reveal bias shifts originating in the reference itself. Expected to improve with ERA5.
- The climate quality and long-term stability of RO-based humidity CDRs are expected to improve with the next ROM SAF CDR (v2) planned for release in 2022.