

# GCOS Water Vapour ECV

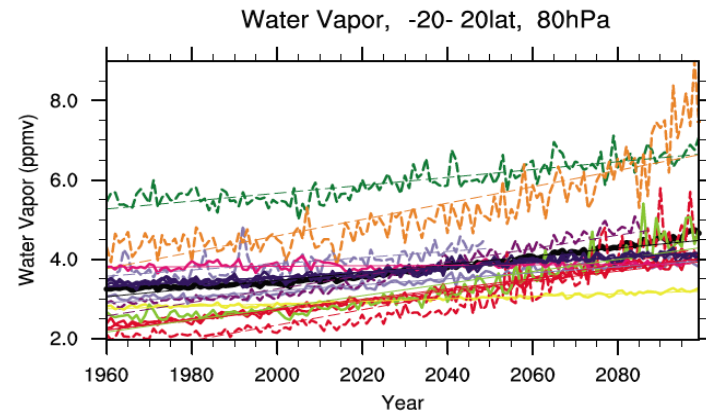


## Troposphere

- Water vapour is the most important natural GHG in the atmosphere (60% of natural greenhouse effect) and provides a positive feedback to the climate forcing from CO<sub>2</sub> (by a factor of ~ 2–3).
- Clausius-Clapeyron => over oceans, water vapour increases exponentially with temperature (~7% per K), over land: more complicated.
- Big societal impacts: intensification of storms, extreme precipitation, and flooding (highly uncertain rate)
- TCWV as indicator of strengthening of the hydrological cycle

## Upper Troposphere & Stratosphere

- UT/LS water vapour => large uncertainty on radiative forcing and temperature biases in reanalyses
- Water vapour is a source of hydroxyl radical (OH), which controls the lifetime of shorter-lived pollutants and long-lived greenhouse gases, and also plays an important role in stratospheric ozone depletion.
- Indicator of changes in the Brewer-Dobson circulation
- Chemistry-climate models do not agree on past nor future changes in stratospheric water vapour



## GCOS Requirements

	<b>Freq.</b>	<b>Resolution</b>	<b>Uncertainty</b>	<b>Stability/ decade</b>
TCWV	4h	25km	2%	0.3%
Tropospheric Profiles	4h	25km /2km	5%	0.3%
Stratospheric Profiles	daily	100-200km / 2km	5%	0.3%
Upper Trop. Humidity	hourly	25km	5%	0.3%

## Key Users of the Water Vapour ECV

European and international climate research organisations that:

- Perform climate model intercomparison and validation studies (*e.g.* CMIP6).
- Develop data assimilation for climate reanalyses (*e.g.* ERA5)
- Develop improvements to climate model radiation budgets and hydrological processes (*e.g.* land surface fluxes, precipitation, cloud processes).
- Perform process studies, such as on the impact of changes in circulation and CH<sub>4</sub> oxidation on stratospheric water vapour abundance, or on changes in extreme precipitation events under a changing climate.
- Perform studies into the long term variations in global or regional aspects of the climate system.
- Contribute research on the climate system to the IPCC scientific assessments.
- Develop or provide climate information services.

# Water Vapour: International Context



## GEWEX Water Vapour Assessment

Quantify the state of the art in water vapour products constructed for climate applications

## SPARC Data Initiative

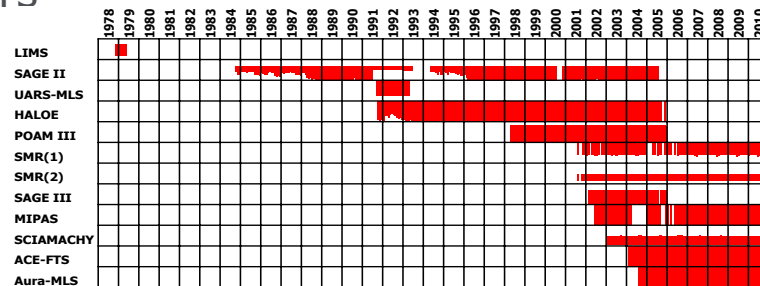
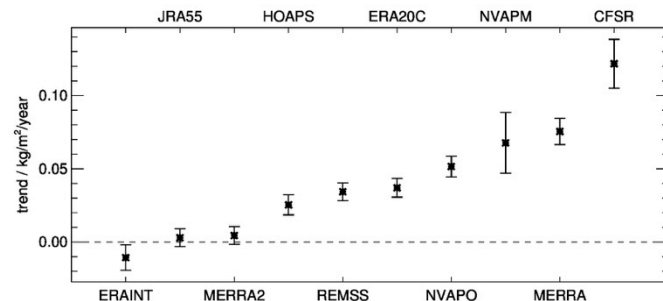
First comprehensive assessment of currently available composition measurements from an international suite of satellite limb sounders

## SPARC WAVAS

Stratospheric water vapour assessment

## SPARC OCTAV-UTLS

UTLS role in climate and impacts of stratosphere-troposphere exchanges on air quality



## SPARC

- CCMI, CCMVal, ...

## CMIP-6

- AerChemMIP, RF-MIP, DCP, ...

## EU Copernicus Climate Change Service

### Ensure Complementarity to other Water Vapour ECV activities:

- e.g. EUMETSAT, NASA, NOAA, CNES, CSA, *etc.*
- e.g. EUMETSAT's CM-SAF, ESA's GOME Evolution project, EU's Copernicus Atmosphere Monitoring Service, H2020 FIDUCEO, and the German SHARP programme, ...

# Water Vapour: Satellite Instruments



**Microwave Sounders and Imagers:** MHS, AMSU, SMMR, SSM/I, AMSR, SSMIS, ...

**TIR Imaging Spectrometers:** MVIRI, SEVIRI, ...

**High Res. IR Spectrometers:** HIRS, AIRS, IASI, CrIS

**NIR Imaging Spectrometers:** MERIS, MODIS, OLCI, ....

**UV/Vis Spectrometers:** GOME, SCIAMACHY, GOME-2, OMI, Sentinel-5P

**Limb Sounders:** SAGE, HALOE, SCIAMACHY, MIPAS, GOMOS, ACE-FTS, MLS, ALTIUS, ...

**GNSS Radio Occultation:** GRAS, COSMIC, CHAMP, ...

# Water Vapour: Key Issues for CCI+ (1)



Development of multi-mission TCWV satellite data records complementary to the well-established microwave imager time series.

- MERIS + MODIS + OLCI (and investigate addition of TIR information)
- GOME + SCIAMACHY + GOME-2 + OMI + Sentinel-5P
- Harmonisation with long-term microwave TCWV (*e.g.* GlobVapour approach)
- Investigate and improve long term stability (*i.e.* remove inter-instrument breakpoints, calibration drifts, *etc.*) and overall quality (*e.g.* cloud-clearing)
- Quantify clear-sky biases of IR products
- Exploit novel high-res (1km) TCWV over land in climate science



# Water Vapour: Key Issues for CCI+ (2)



To advance understanding of stratospheric processes governed by the interactions between multiple radiatively and chemically active constituents:

- Develop consistent harmonised set of ECV products: water vapour together with other related ECVs (temperature, ozone, aerosols,  $N_2O$ ,  $CH_4$ , *etc*). Liaise with Ozone\_cci and Aerosol\_cci projects.
- Further develop ECV harmonisation strategies for data records based on: SAGE-II, HALOE, POAM, MIPAS, SCIAMACHY, GOMOS, ACE-FTS, MLS, SMR, ...
- Intercompare nadir and limb sounder retrievals of water vapour in UT/LS, and develop a prototype harmonised product.

## CCI+ Scope:

- i. Development of new ECVs (*i.e.* ECVs that were not started in CCI so far)
- ii. New R&D on ECVs that were already started in CCI**
- iii. Cross-ECV scientific exploitation (demonstration)
- iv. Knowledge Exchange