

Comparison of reanalyses and CM SAF satellite-based CDRs

Marc Schröder, Jörg Trentmann, Martin Stengel, Rainer
Hollmann

on behalf of CM SAF

CM SAF: EUMETSAT's Satellite Application Facility on Climate Monitoring

CDR: Climate Data Record

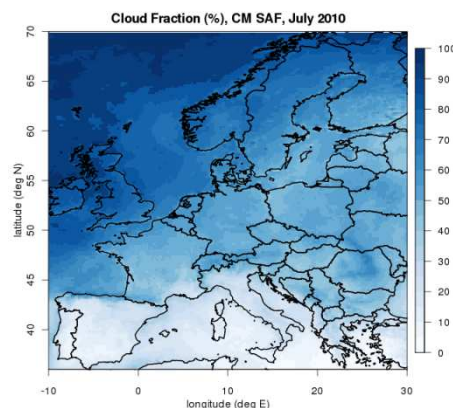


Overview

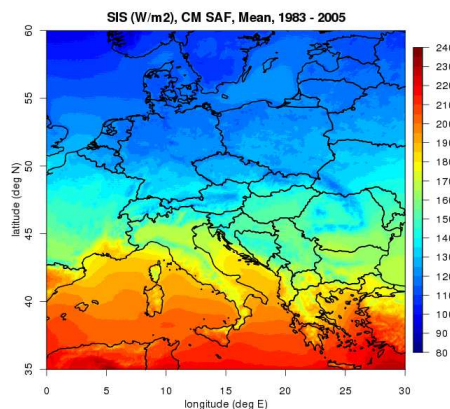
- Introduction.
- SSM/I FCDR.
- Comparison of reanalyses and:
 - HOAPS,
 - CLARA-A1.
- Results from EURO4M.
- Results from the GEWEX water vapour assessment (G-VAP).
- Conclusions.

CM SAF products

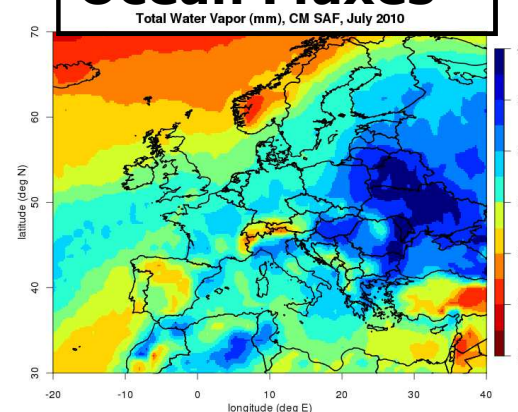
Clouds



Radiation



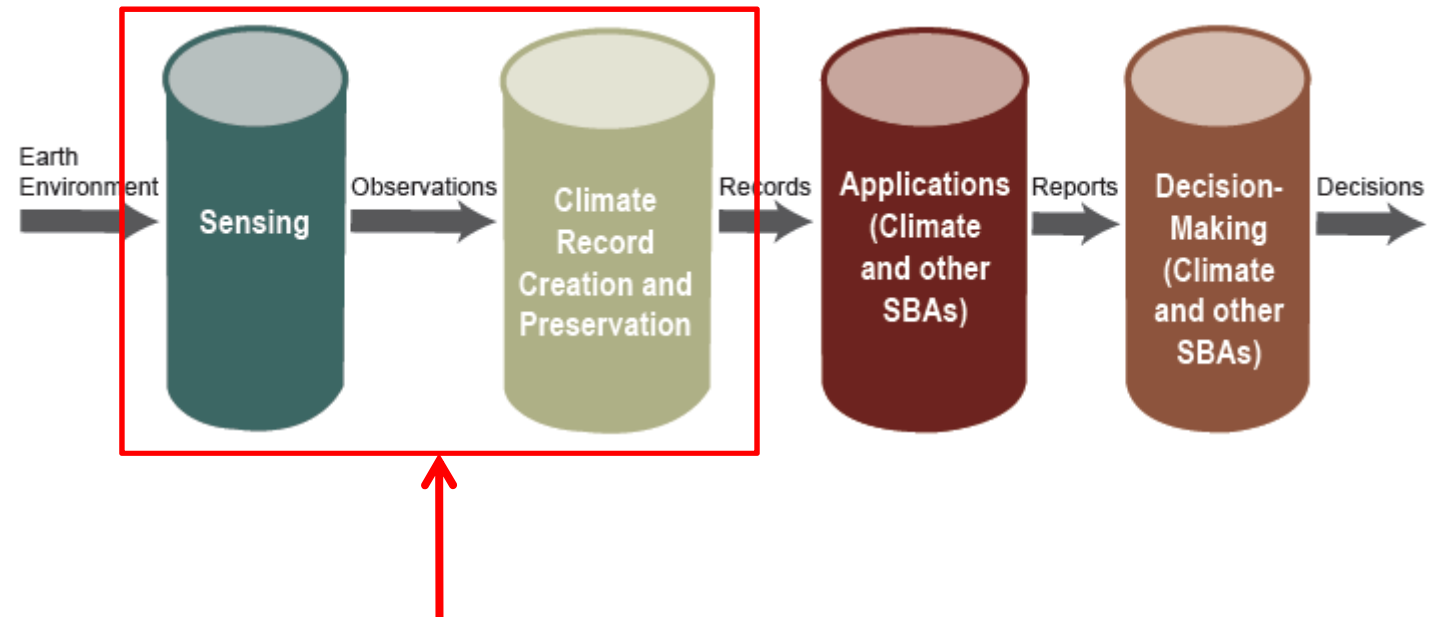
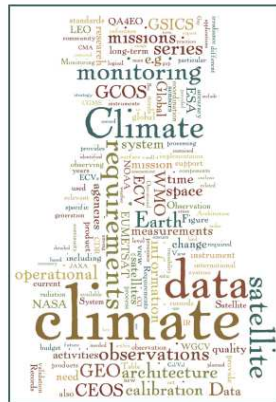
Water Vapour Precipitation Ocean Fluxes



- *EUMETSAT Satellite Application Facility on Climate Monitoring*
www.cmsaf.eu
- Provides satellite-derived climate data of geophysical variables
- Regional, up to global coverage
- Currently, data available from Jan 1982 to Oct 2013
- Spatial resolution from 0.03° - 1°

- Data freely available in netcdf-format
- User-friendly data access via the Web User Interface:
www.cmsaf.eu/wui
- Toolkit (example data + software):
www.cmsaf.eu/tools
- CM SAF Community Site available via EUMETSAT: training.eumetsat.int

Strategy Towards an Architecture for Climate Monitoring from Space



Important pillars are:

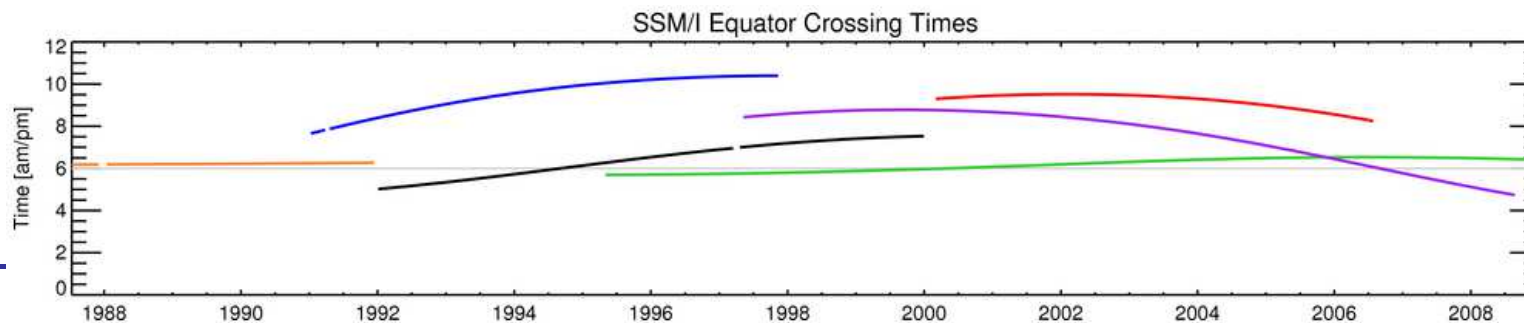
- Satellites
- In-situ / ground-based
- Reanalysis

Carefully calibrated, geolocated, intercalibrated SSM/I (SSMIS, SMMR) data.
Freely available from www.cmsaf.eu/wui. More information at www.cmsaf.eu/docs.

doi: 10.5676/EUM_SAF_CM/FCDR_SSMI/V001.

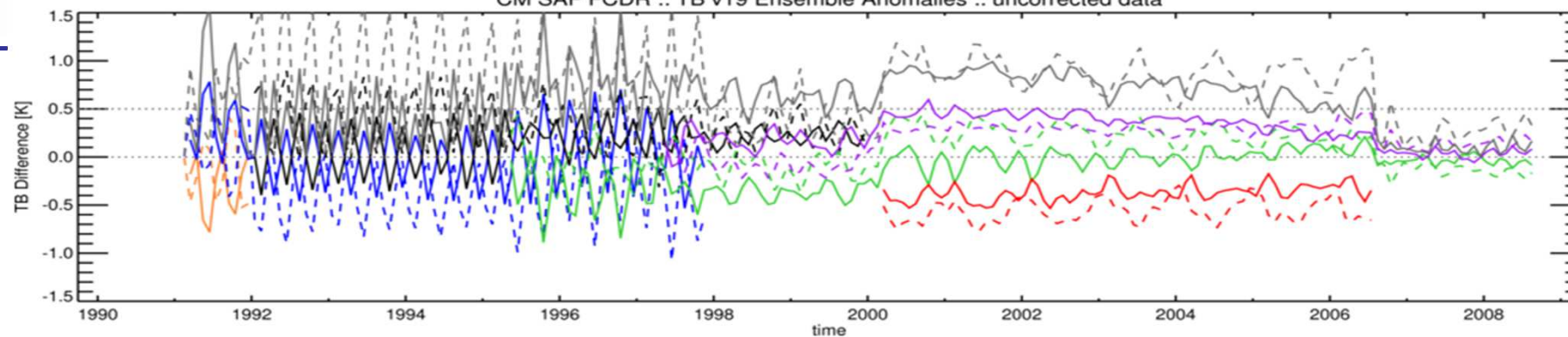
Data in sensor resolution for F08, F10, F11, F13, F14, F15:

- Sampling varies between ~15 to ~50 km,
- *Global* coverage,
- July 1987 – Dec 2008,
- Data collected in daily collections, together with NE Δ T,
- Corrections e.g. for EIA correction and inter-calibration are provided as information layers.

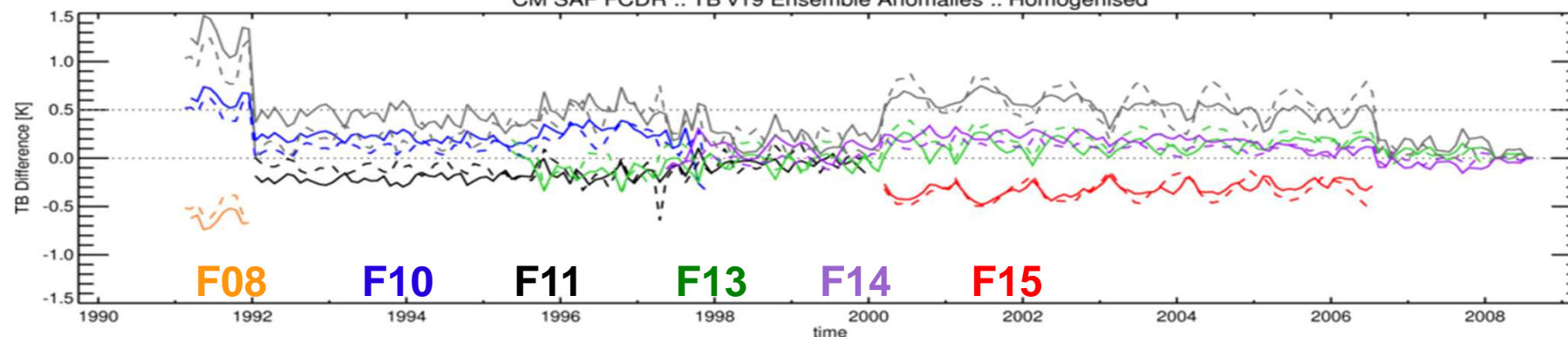




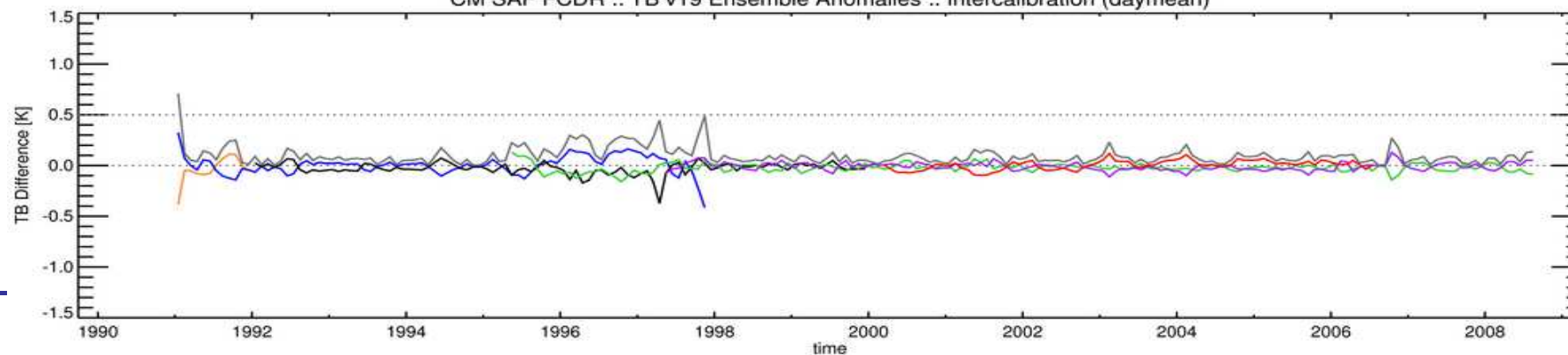
CM SAF FCDR :: TB v19 Ensemble Anomalies :: uncorrected data



CM SAF FCDR :: TB v19 Ensemble Anomalies :: Homogenised



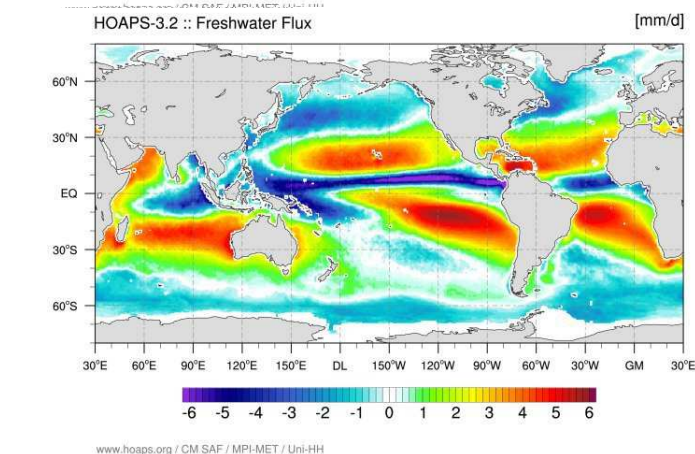
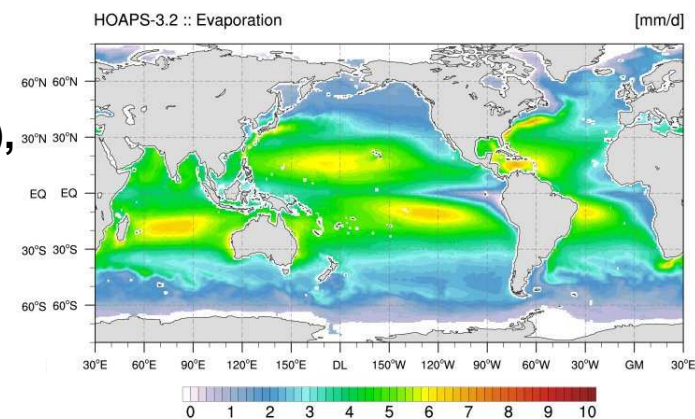
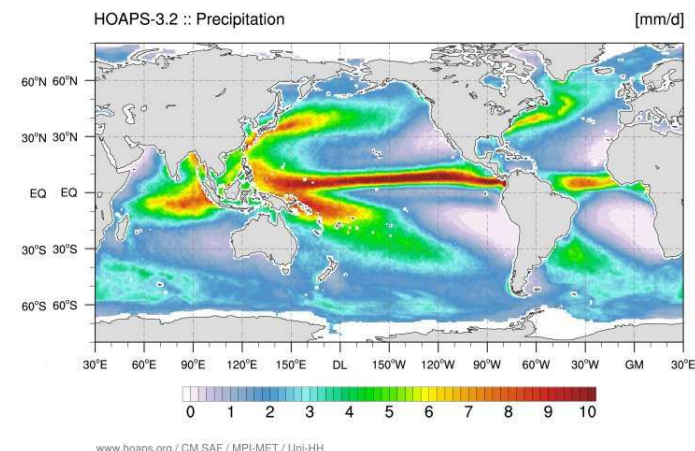
CM SAF FCDR :: TB v19 Ensemble Anomalies :: Intercalibration (daymean)



HOAPS

CM SAF products

- The Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite (HOAPS) was developed at UHH/MPI-M and successfully transferred to CM SAF.
- V3.1 – doi:10.5676/EUM_SAF_CM/HTW_SSMI/V001
V3.2 – doi:10.5676/EUM_SAF_CM/HOAPS/V001
- Global ice-free ocean in 0.5°, monthly averages, 6-hourly composites, July 1987 – Dec 2008, externally reviewed, documented (ATBD, PUM, Validation Report), doi-ed.
 - Integrated water vapour.
 - Near surface humidity,
 - Near surface wind speed,
 - Latent heat flux,
 - Precipitation,
 - Evaporation,
 - Freshwater flux,
 - SST (auxiliary)



Evaluation:

ERA-Interim,

TRMM,

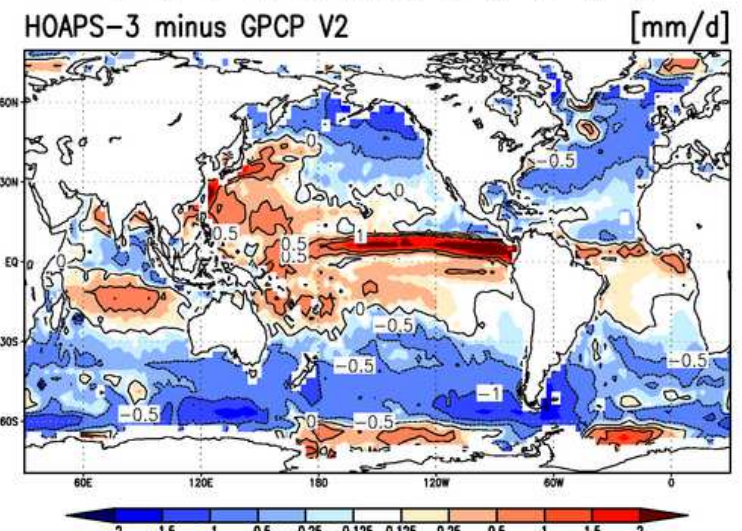
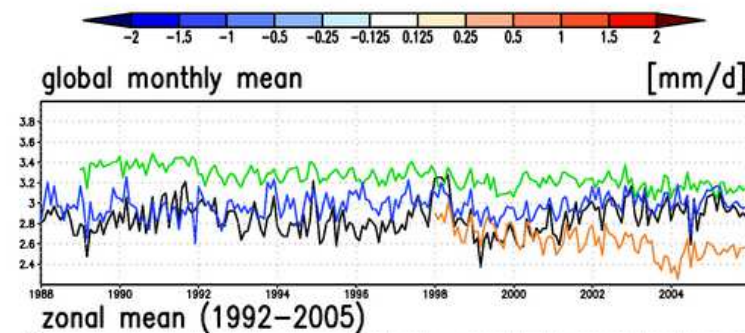
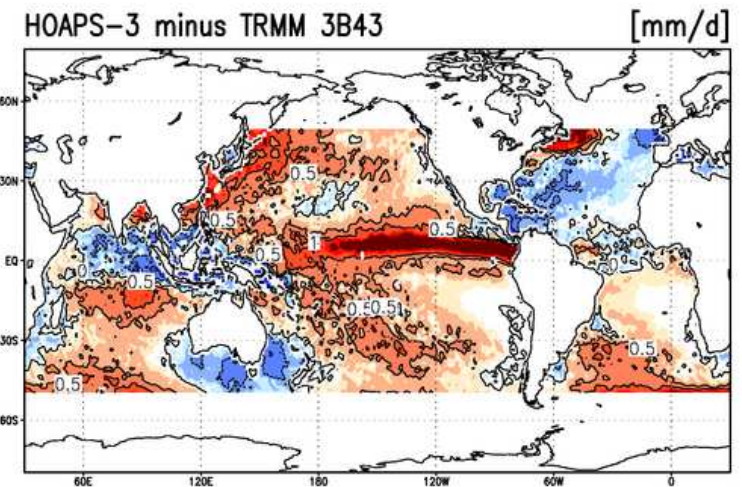
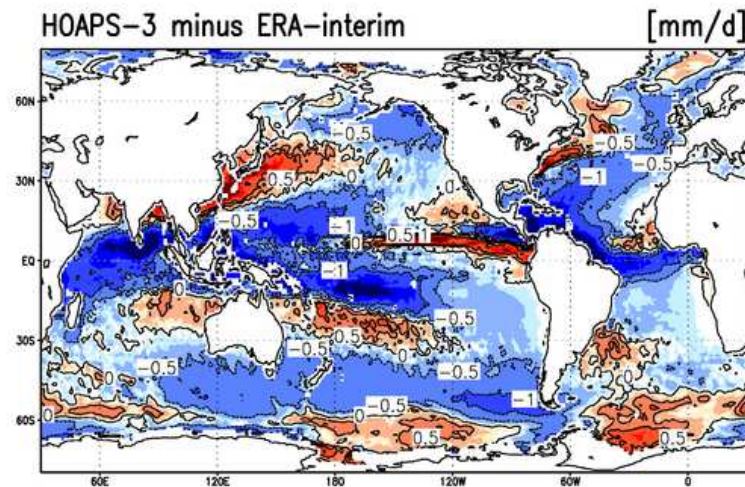
NOCS,

IFREMER,

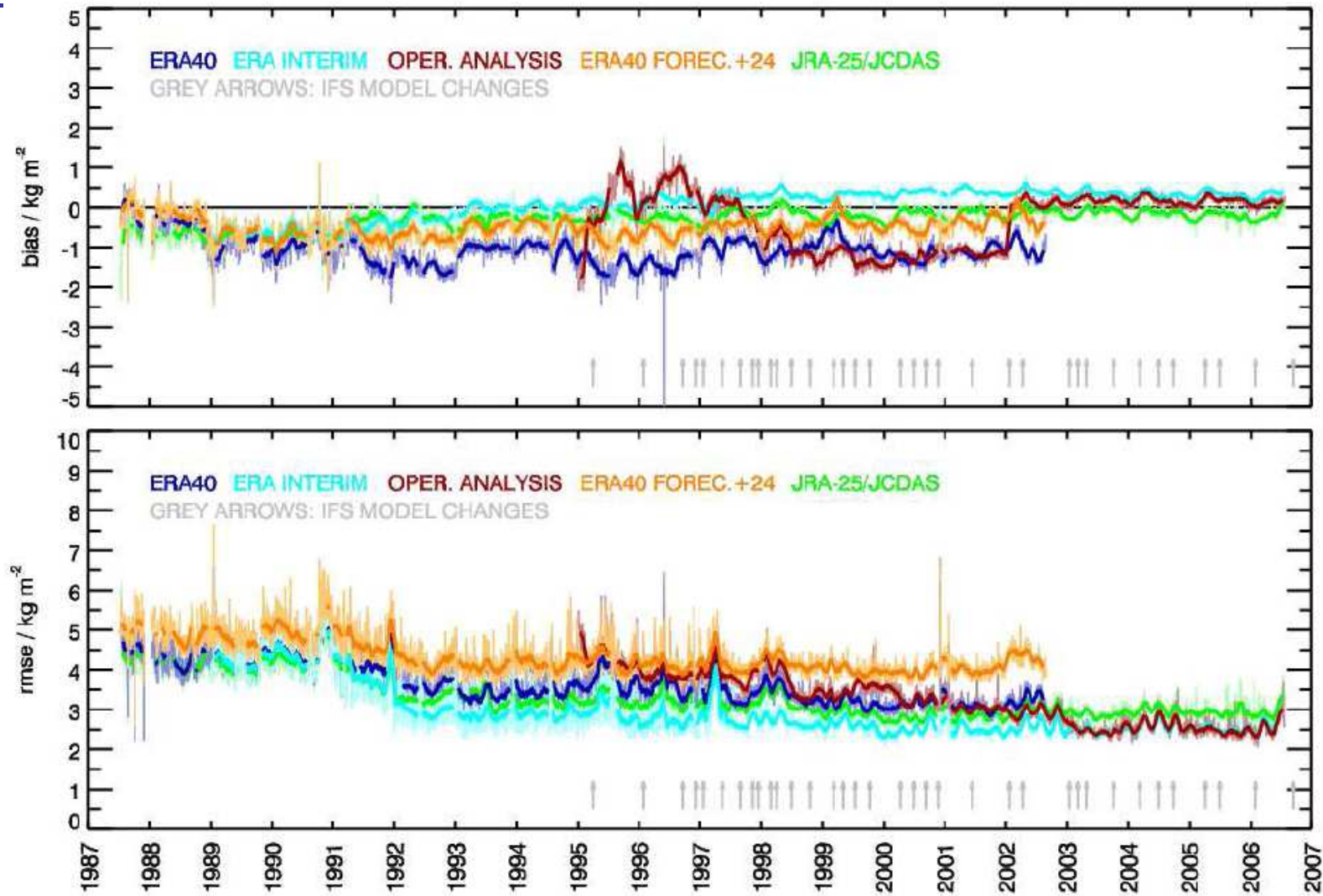
GPCP,

Buoys+ships.

Andersson et al. (2010)

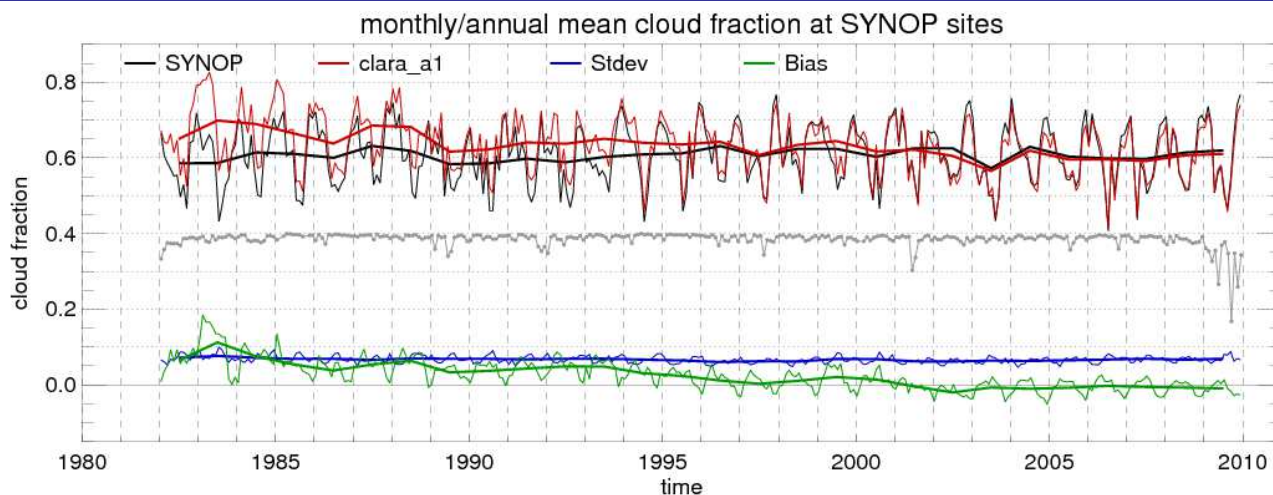


Integrated water vapour



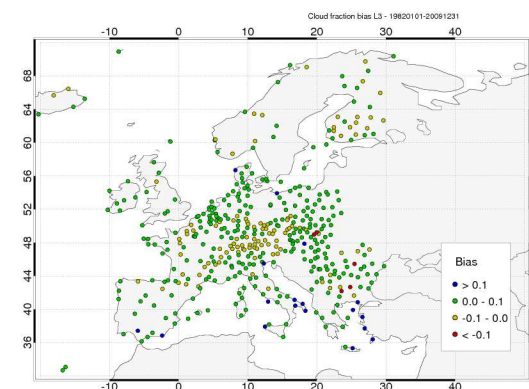
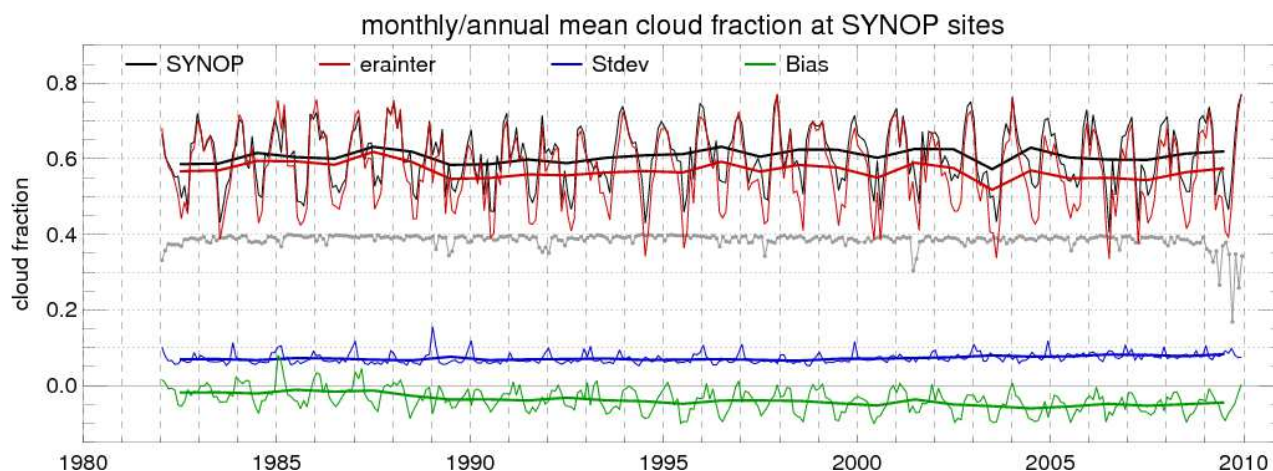
CFC monitoring Europe

CLARA-A1



- **CLARA-A1 data based on AVHRR, provided by CM SAF.**
- **CFC: cloud fractional coverage**

ERA-Interim



Shown is the monthly (thin) and annual (thick) mean cloud fraction of CLARA-A1 (Karlsson et al., 2013, ACP) and ERA-Interim at European SYNOP sites, compared with SYNOP observations. Shown is also bias and standard deviation against SYNOP.

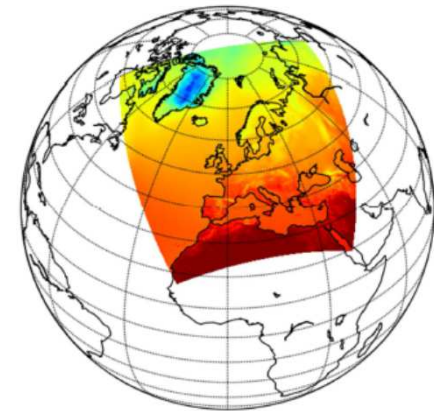
Validation of Regional Reanalysis

Two regional reanalysis data sets have been generated within the EURO4M project (www.euro4m.eu):



- SMHI: HIRLAM, 3D VAR, $\sim 0.2^\circ$, 1990 to 2009
- MetOffice: UM, 4D VAR, $\sim 0.1^\circ$, 2007 / 2008

Both reanalysis systems use ERA-Interim as boundary condition and cover Europe.

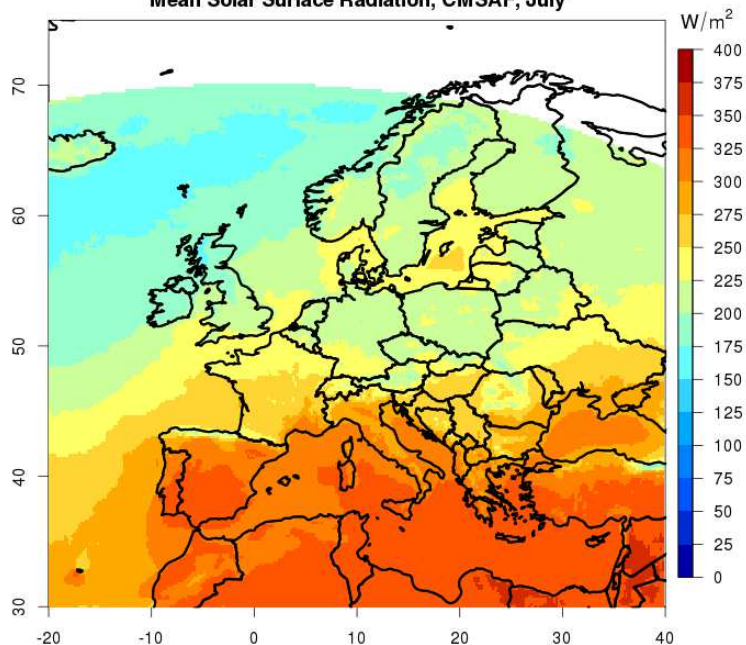


Independent, high-quality satellite-derived data sets are excellently suited for the validation of the reanalysis data sets. Within EURO4M the quality of the solar surface radiation, cloud coverage, precipitation, and integrated water vapor has been assessed using CM SAF data.

Solar Radiation July

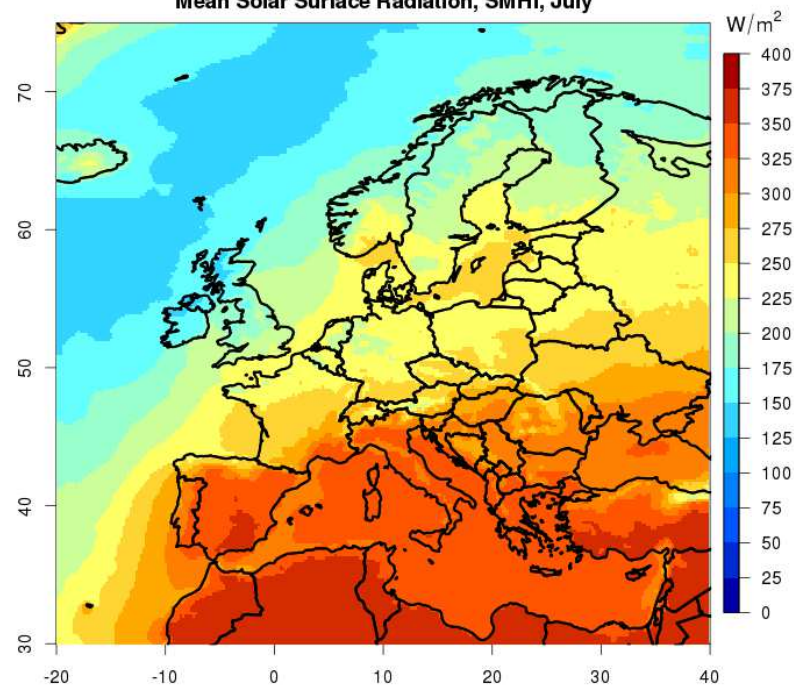
CM SAF

Mean Solar Surface Radiation, CMSAF, July



SMHI Reanalysis

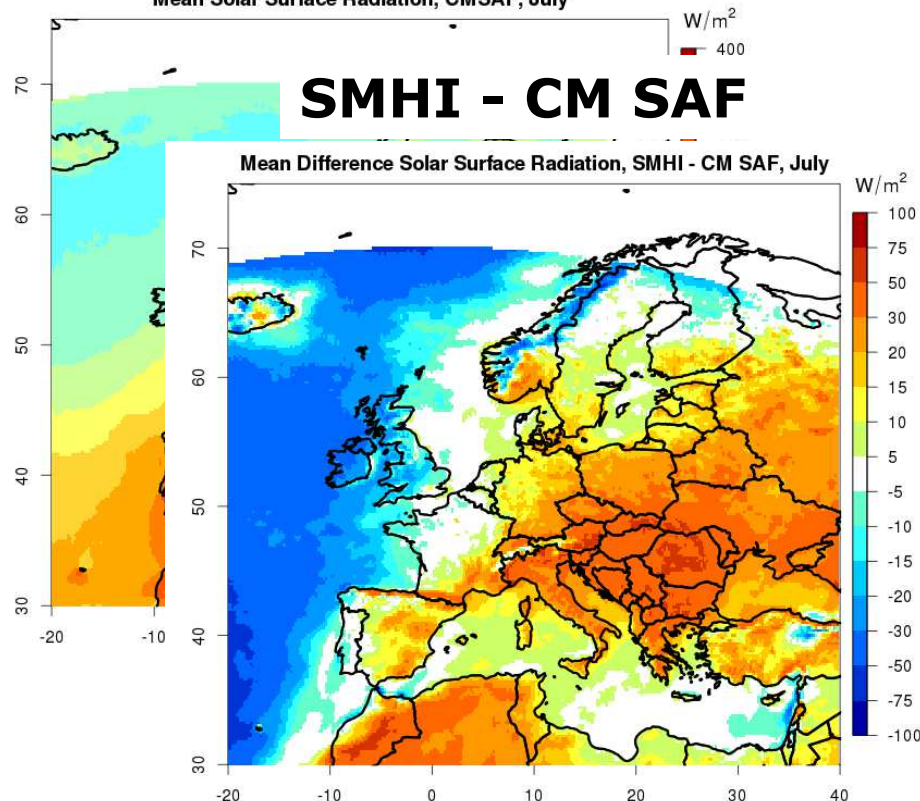
Mean Solar Surface Radiation, SMHI, July



Solar Radiation July

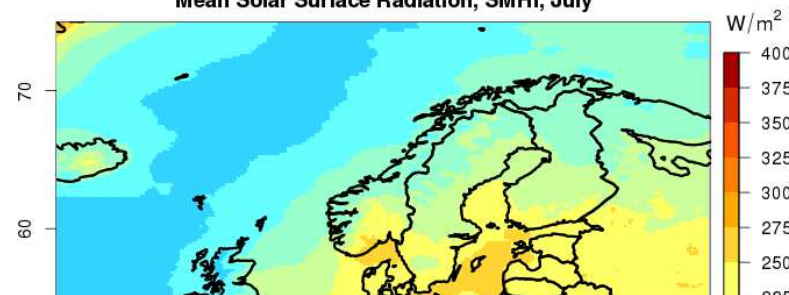
CM SAF

Mean Solar Surface Radiation, CMSAF, July



SMHI Reanalysis

Mean Solar Surface Radiation, SMHI, July

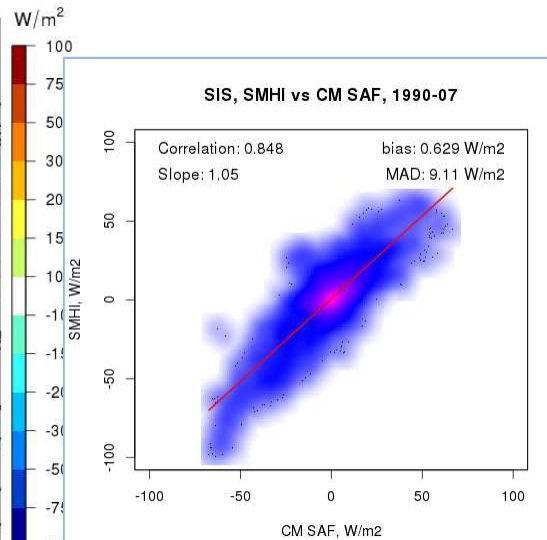
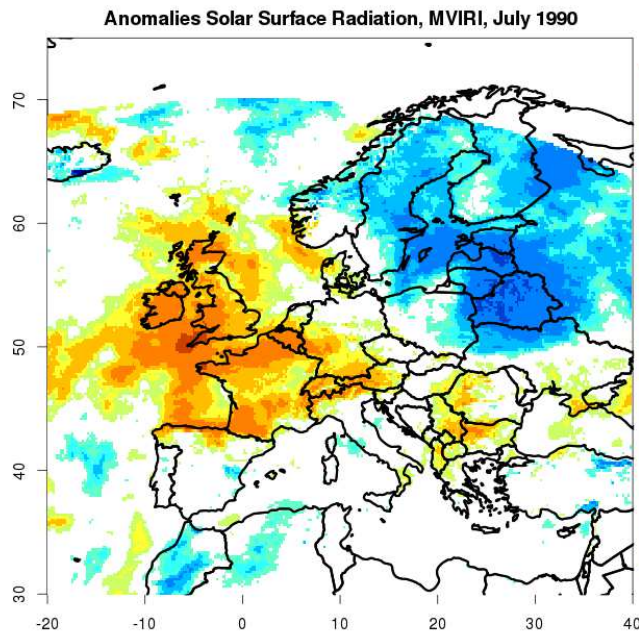


- SMHI Reanalysis tends to underestimate solar radiation in July over the Atlantic
- Overestimation over the continent, in particular South East Europe

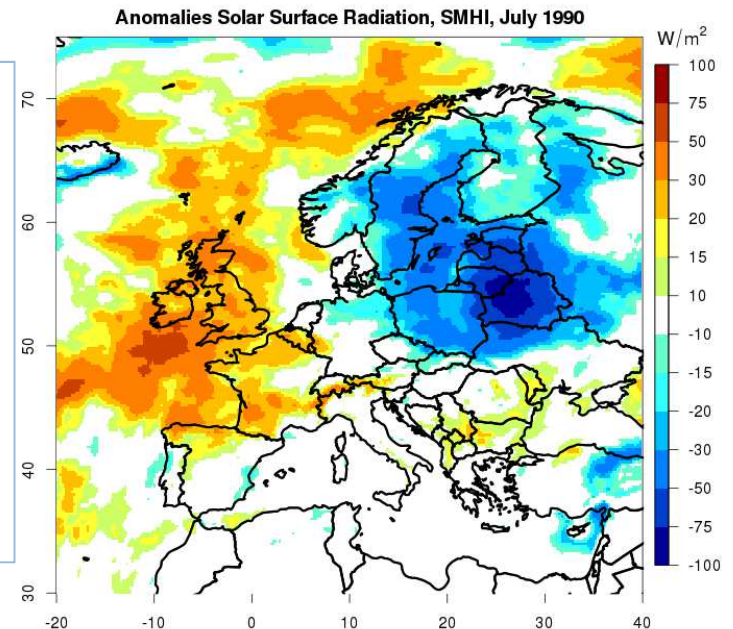


Solar Radiation July 1990, Anomalies

CM SAF



SMHI Reanalysis



- SMHI Reanalysis reproduces the spatial structure of monthly anomalies of the surface radiation
- Large correlation with the reference satellite data



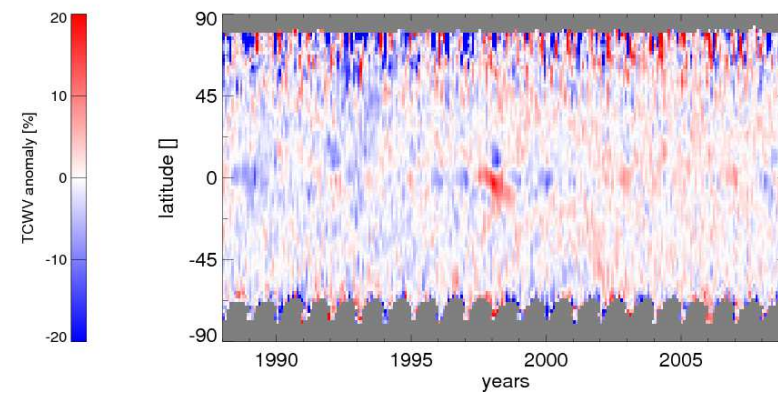
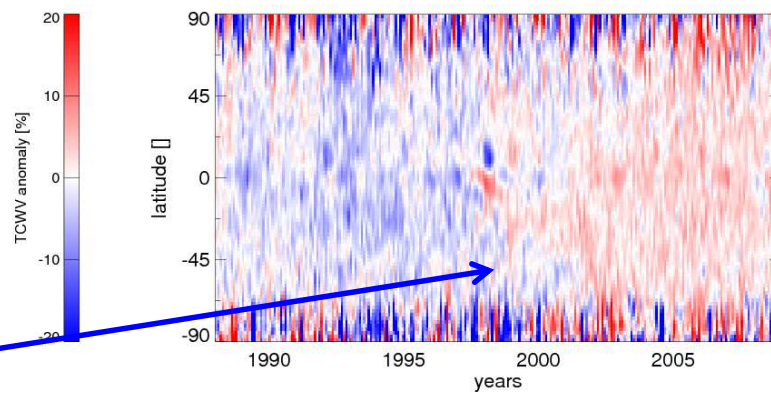
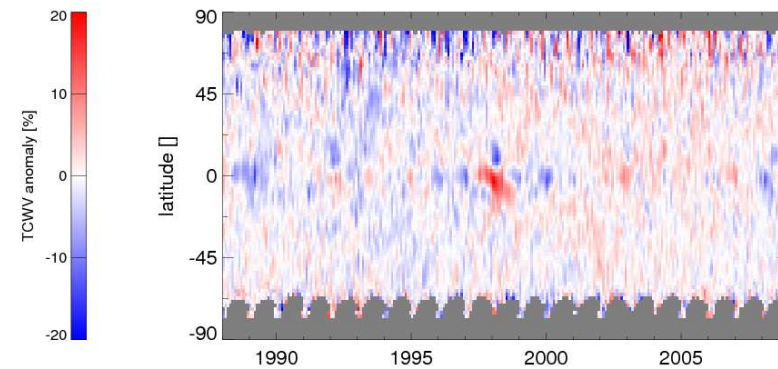
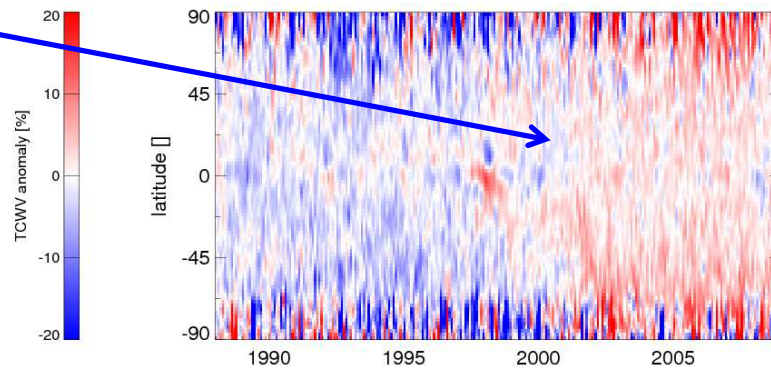
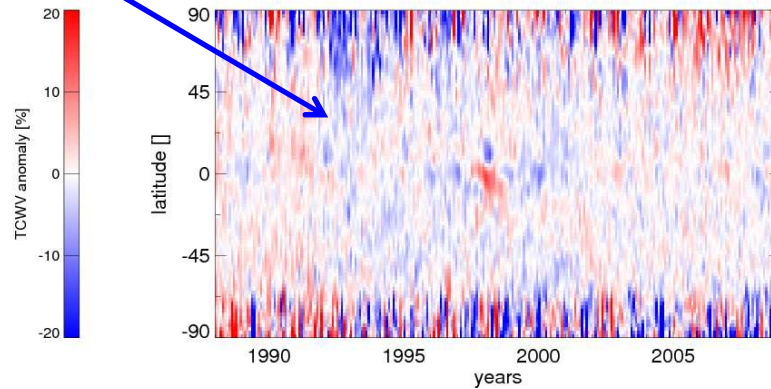
GEWEX water vapour assessment: **G-VAP**

- Overall **scope**:
 - Quantify the state of the art in water vapour products being constructed for climate applications, and by this;
 - Support for the selection process of suitable water vapour products by GDAP for its production of globally consistent water and energy cycle products.
- **Reanalyses data is also used!**
- Main **approach**: consistent inter-comparison and comparison to ground-based and in-situ observations, providing comparable evaluation results with focus on troposphere, profiles and stability/variability. No ranking!
- Considered **ECVs**: Total column water vapour (**TCWV**), upper tropospheric humidity (**UTH**), tropospheric temperature and water vapour profiles (**WV**).



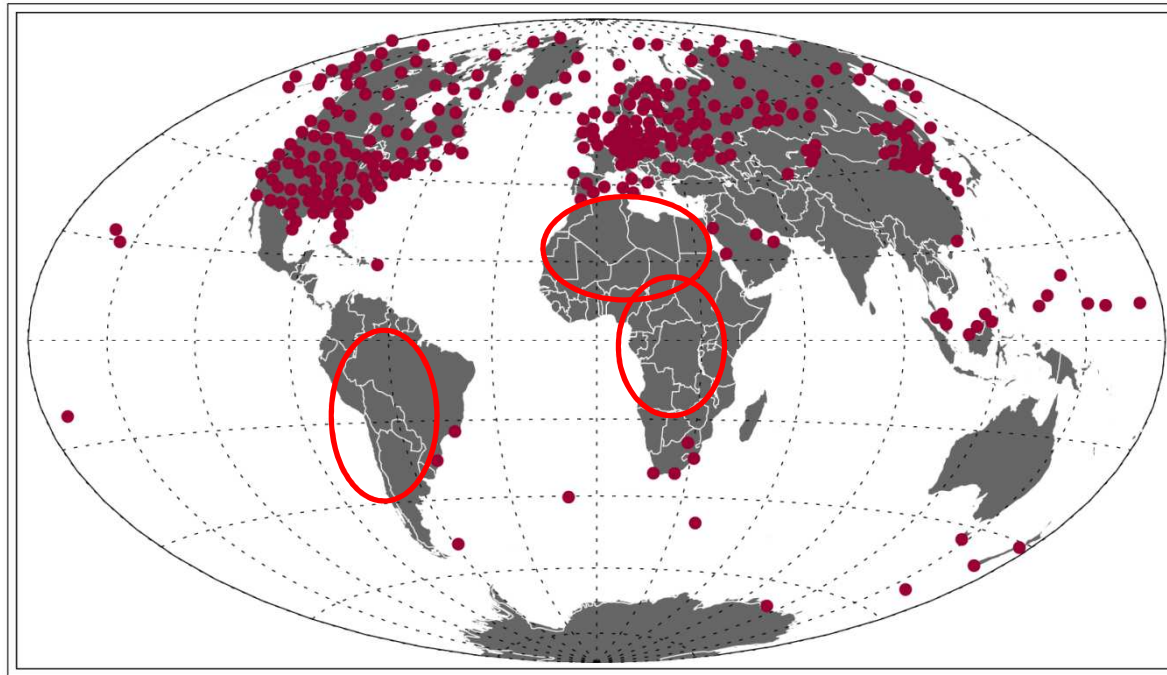
- Common features: El Nino, Arctic/Antarctic

Hovmoeller Plots



Comparison to long-term RS data record

Monthly means are calculated for those months having at least 20 days with min. of two measurements per day: basis – Dai et al. (2011). Other currently available options: Analysed Radiosounding Archive (ARSA, ARA/LMD) and GNSS (NCAR).

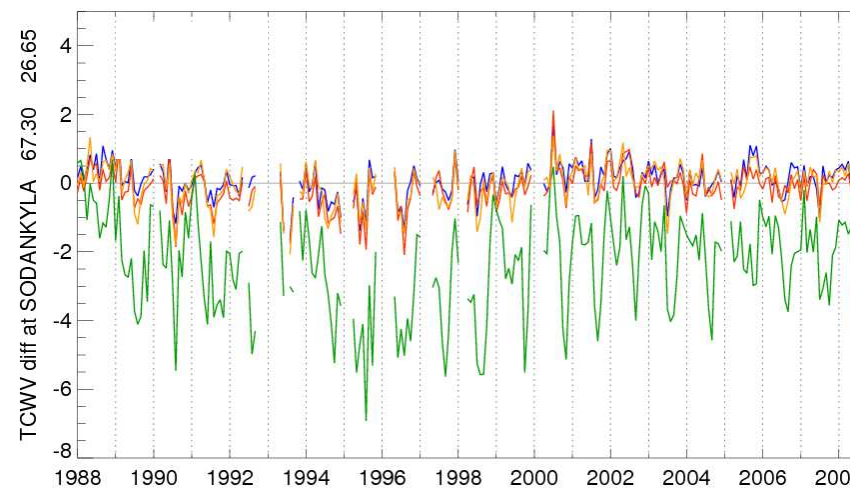
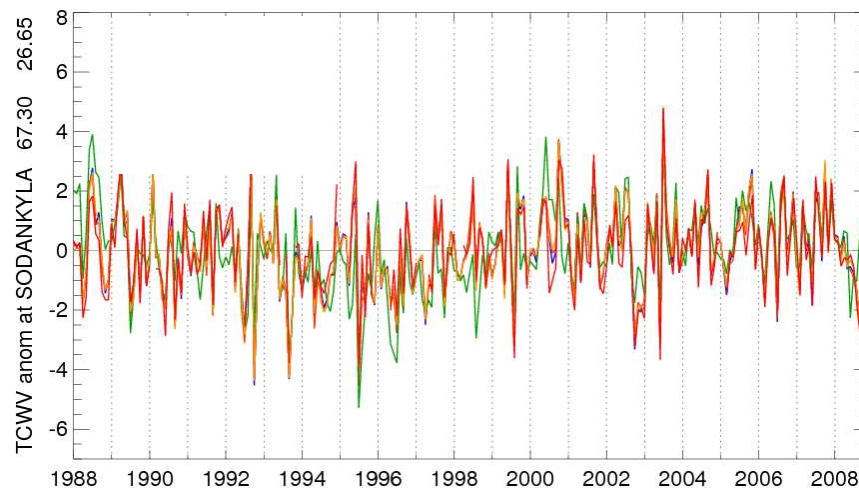
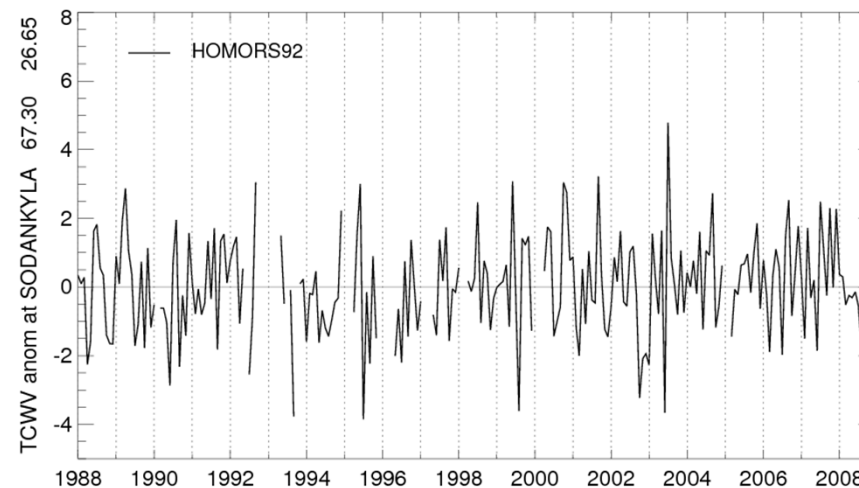
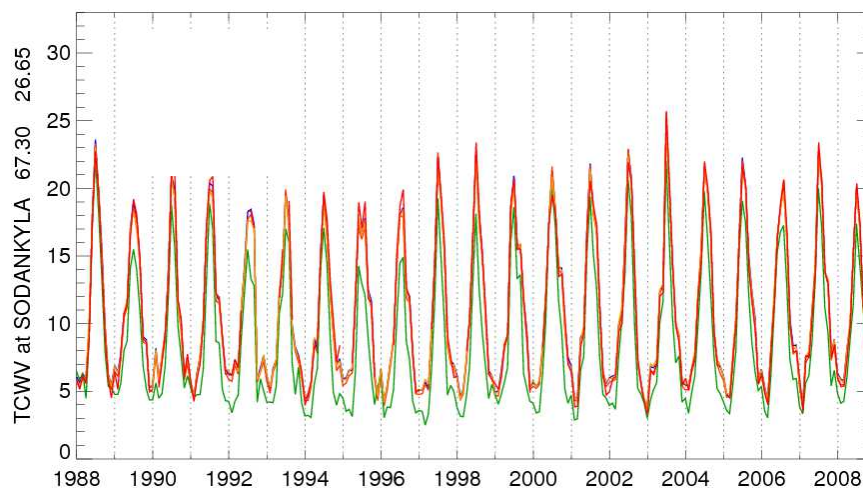


Assess stability (several records for comparison will be considered)

- global/regional averages
- per station (GRUAN/ARM/NDACC stations)
- Link between stability/Level 3 and Level 2 analysis.

Comparison vs. HomoRS92

Sodankylä, Finland (67°N, 26°E)



Conclusions

- We have shown various intercomparisons among various systems. The main conclusion is that there is no reference observation with near global and long-term coverage. However, the joint analysis is helpful in finding solid conclusions.
- The various ground-based, in-situ, satellite and reanalyses data are an enormous asset with a large variety of applications.
- The combined (of different systems) and joint (of different teams) analysis of this wealth of data turns out to be highly beneficial.
- Such efforts across systems and teams should be intensified.



Thank you for your attention!

