

GIRAFE v1: A global precipitation climate data record from satellite data including uncertainty estimates

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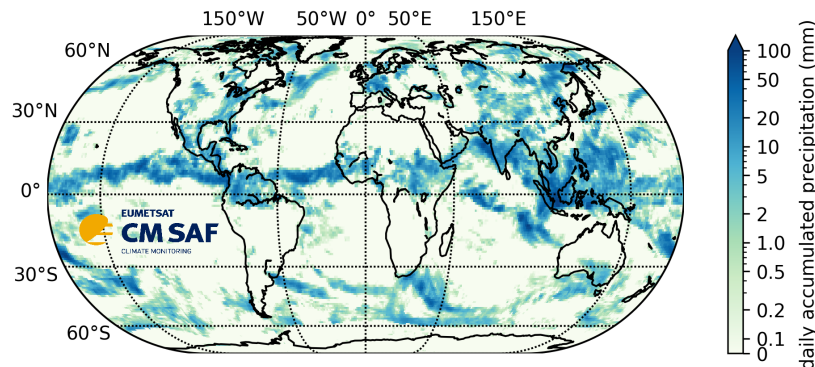
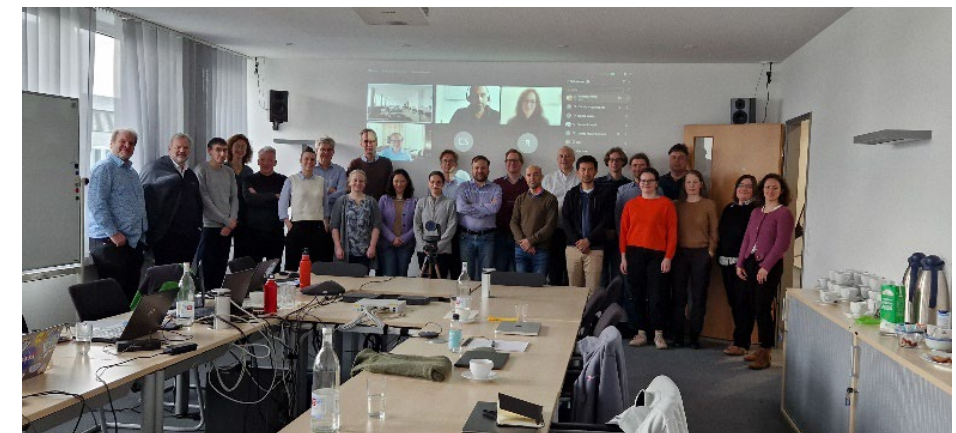
⁷Hydro Matters



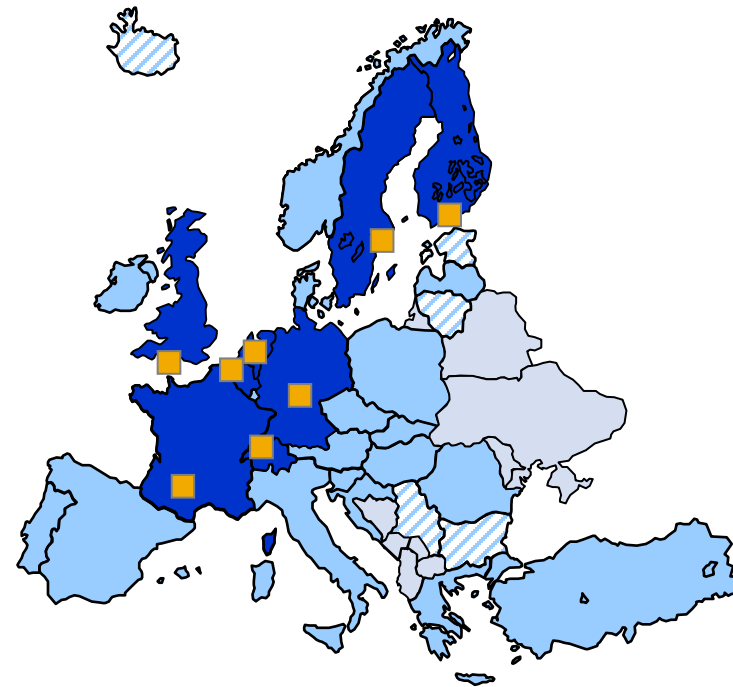
- Triggered and guided by the workshop series “Global precipitation monitoring in a joint European effort”
- **Global satellite-based precipitation climate data record (CDR) at 1° daily resolution covering the period 2002 onwards**
- Merging of IR and passive microwave observations (I & S)
- Build on previous research/development from
 - Copernicus C3S
 - The Megha-Tropiques/GPM science team
 - The HOAPS science team



Group photos from workshops



- EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF)
<https://www.cmsaf.eu>
- Operated in 5 year phases, with sustained funding.
- Hosted by DWD and with 8 partners in total.
- Various science teams, with processing centres at DWD and RMIB.
- **CM SAF covers core activities to develop and generate the global satellite-based precipitation CDR**



■ CM SAF Member States
■ Location of Partner NMHSs

70 Jahre
Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Deutscher Wetterdienst

SMHI

Swedish Meteorological and Hydrological Institute



Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Verkeer en Waterstaat



Royal Meteorological Institute of Belgium



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
**Federal Office of Meteorology and Climatology
MeteoSwiss**



Finnish Meteorological Institute



Met Office, United Kingdom



Centre National de la recherche scientifique

→ CM SAF

→ CNRS-LEGOS and –IPSL: Project lead, Scientific lead, validation and documentation

→ DWD: Development and integration, implementation, processing, validation and documentation, support to Science lead

→ External to CM SAF

→ CNR-ISAC (G. Panegrossi, P. Sanò): Provision of precipitation retrieval algorithms for MW sensors and support within the Copernicus Climate Change Service (C3S) of the European Commission

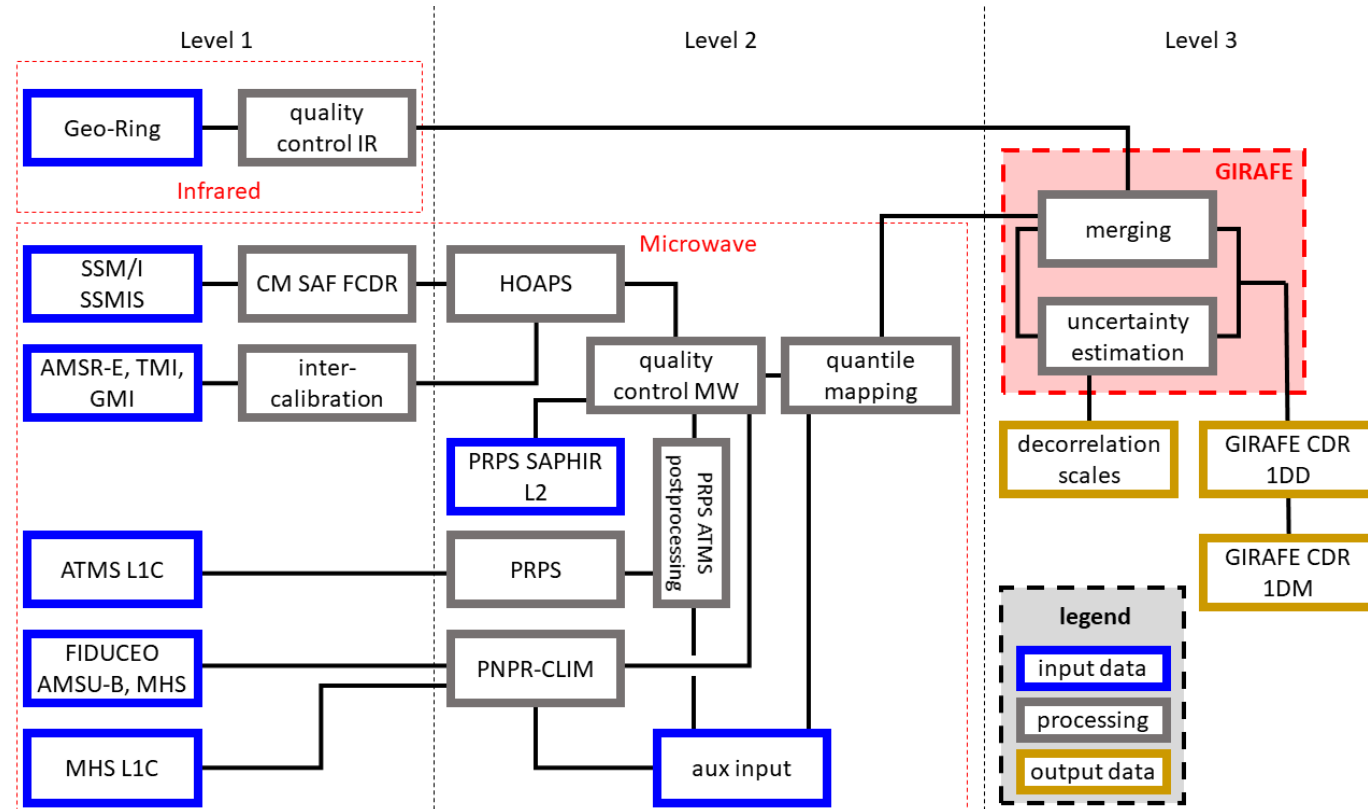
→ Copernicus Climate Change Service (C3S) of the European Commission: support via MW sounder retrieval and first quantile mapping development

→ NASA/UMD (C. Kidd): Provision of precipitation retrieval algorithms for MW sensors and support

→ ...

Technical specifications

- ➔ 2002-2022
- ➔ 1° x 1° x 1 day accumulated precipitation
- ➔ No adjustment towards rain gauge
- ➔ Sampling uncertainty for daily data
- ➔ Continuous extension with ICDR version coming in early 2025, then in a sustained operational environment *and* production.
- ➔ Fully documented and freely available
- ➔ ESSD publication in preparation

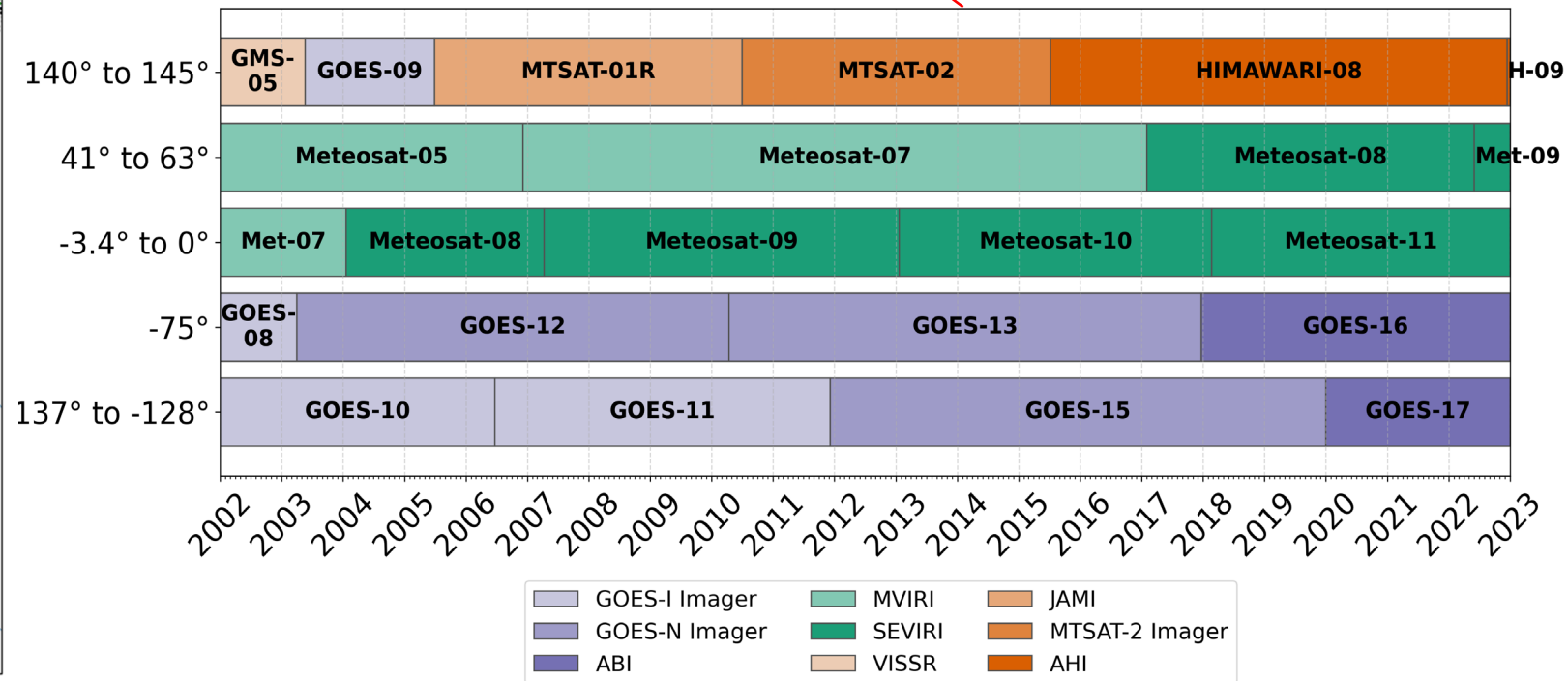
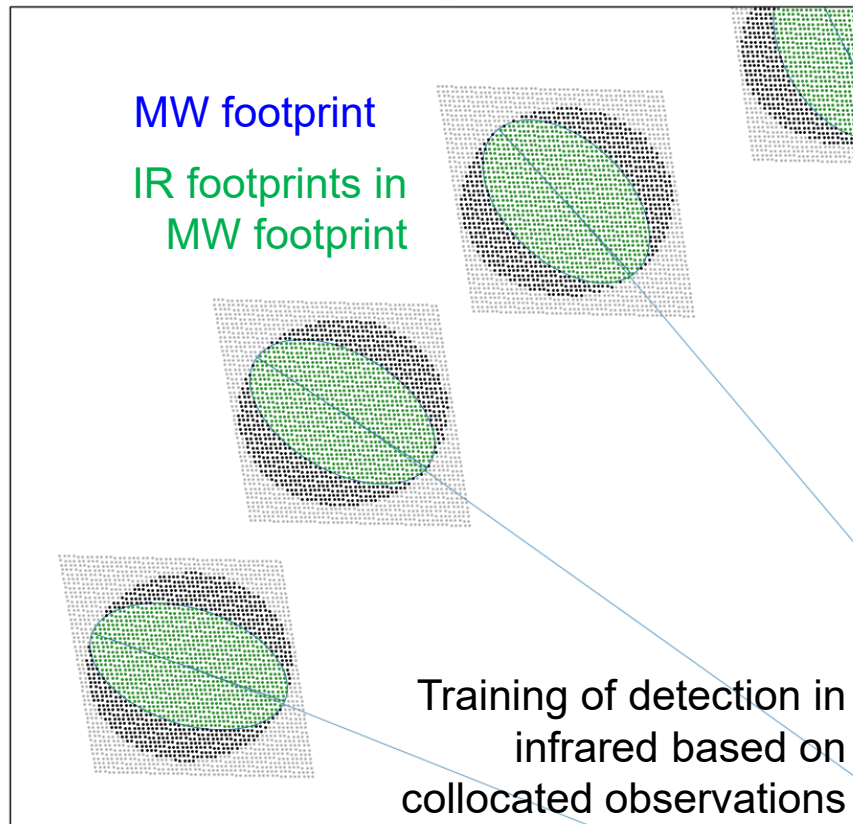


Based on TAPEER (Tropical Analysis of Precipitation with an Estimation of Errors) developments for Megha-Tropiques

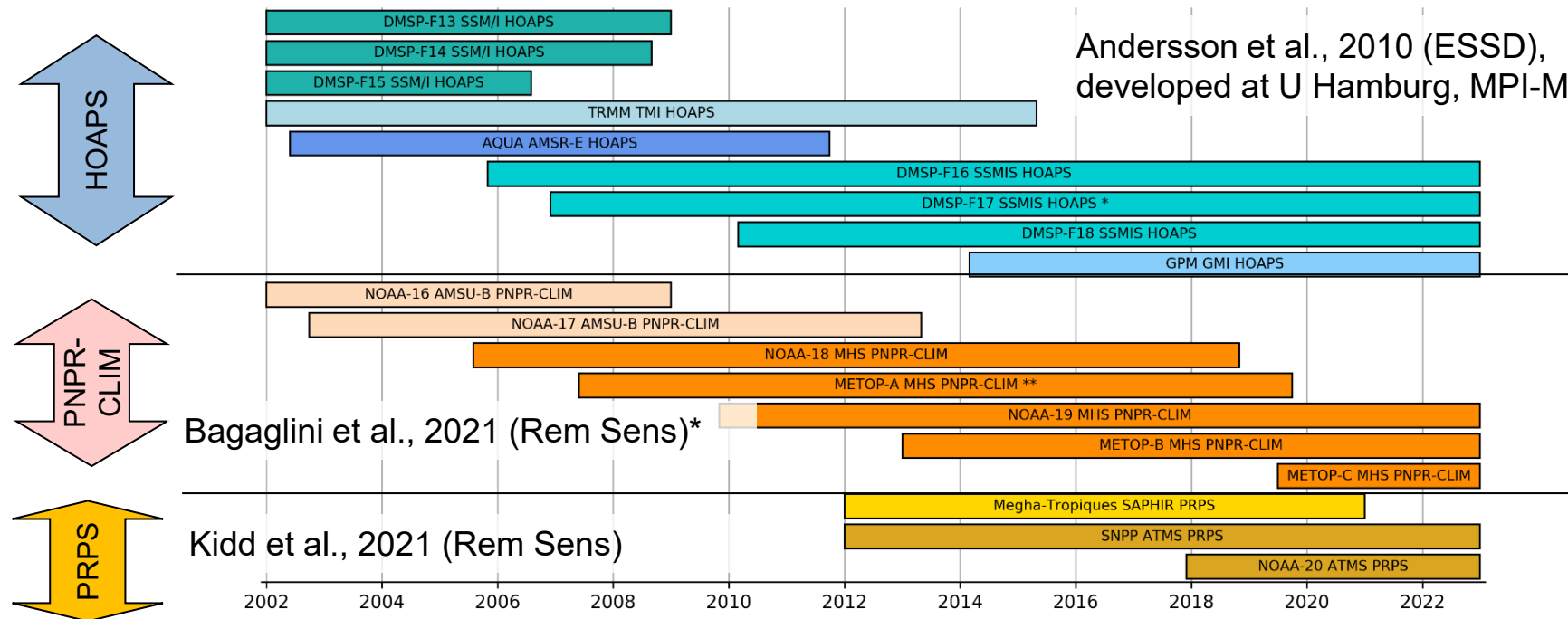
$$\text{accumulated precip} = \text{conditional precip rate} * \text{precip fraction} * 24\text{h}$$

Microwave based

Infrared-based
(trained by microwave)



- Instantaneous precipitation rate estimates (~20 km, twice daily per polar orbiting satellite)
- PMW retrievals development: PRPS by C. Kidd (NASA, U Maryland), PNPR-CLIM (CNR-ISAC), and the HOAPS team



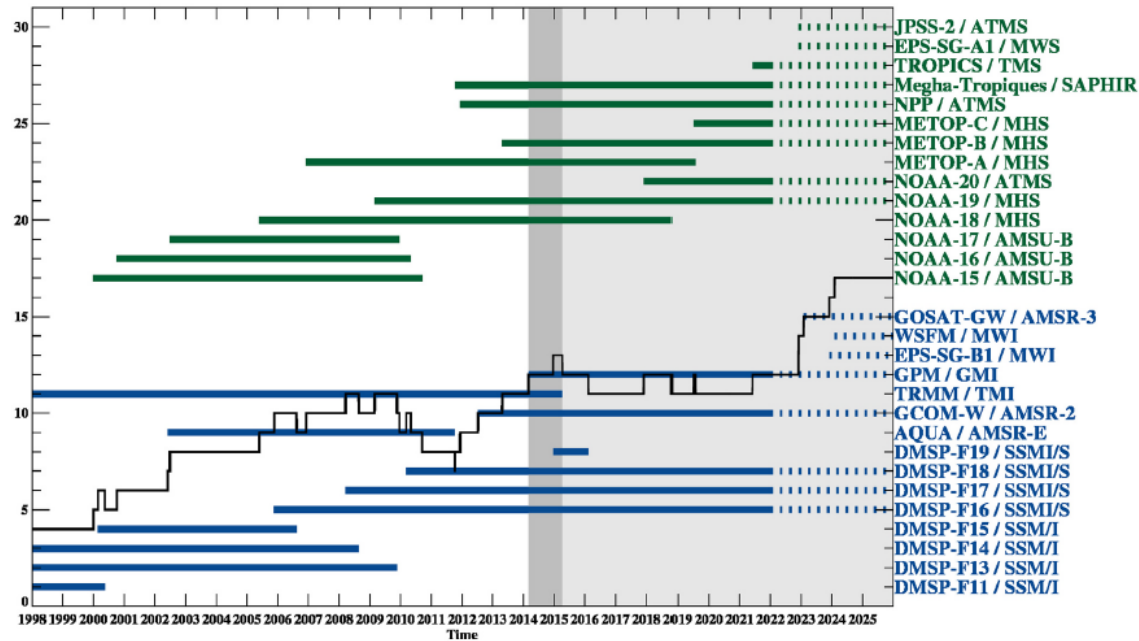
*The PNPR-CLIM algorithm has been developed by CNR-ISAC in the **C3S_312b_Lot1 Copernicus** project.

- Quantile mapping to handle differences arising from differences in retrieval sensitivity and resolutions

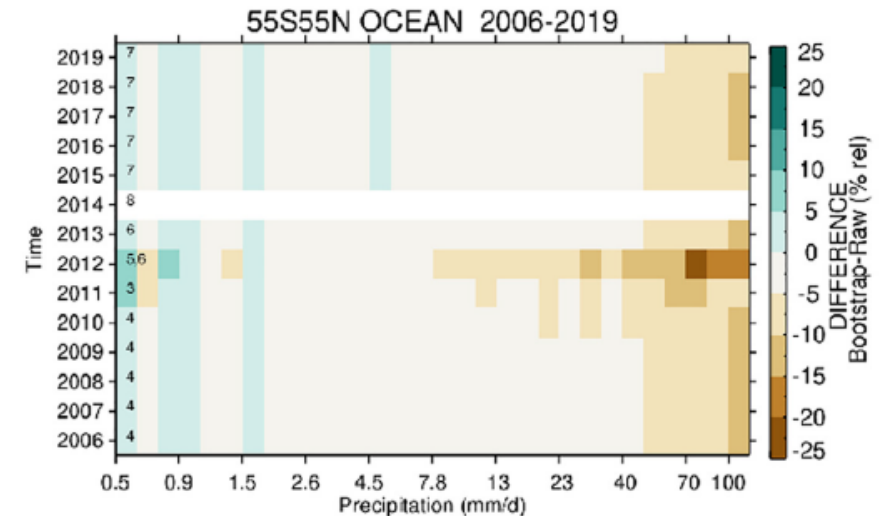
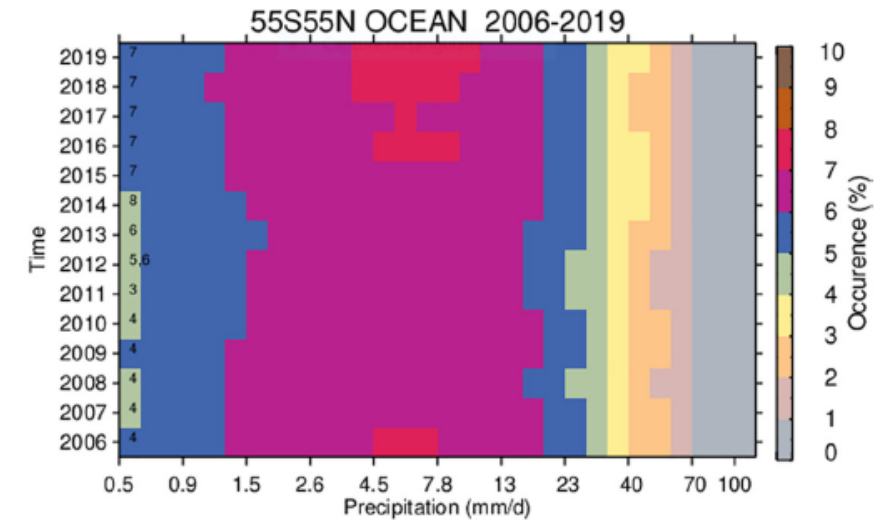
Evaluating the impact of a time-evolving constellation on multi-platform satellite based daily precipitation estimates Atmospheric Research 279 (2022) 106414

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Using a prototype version of GIRAFE v1

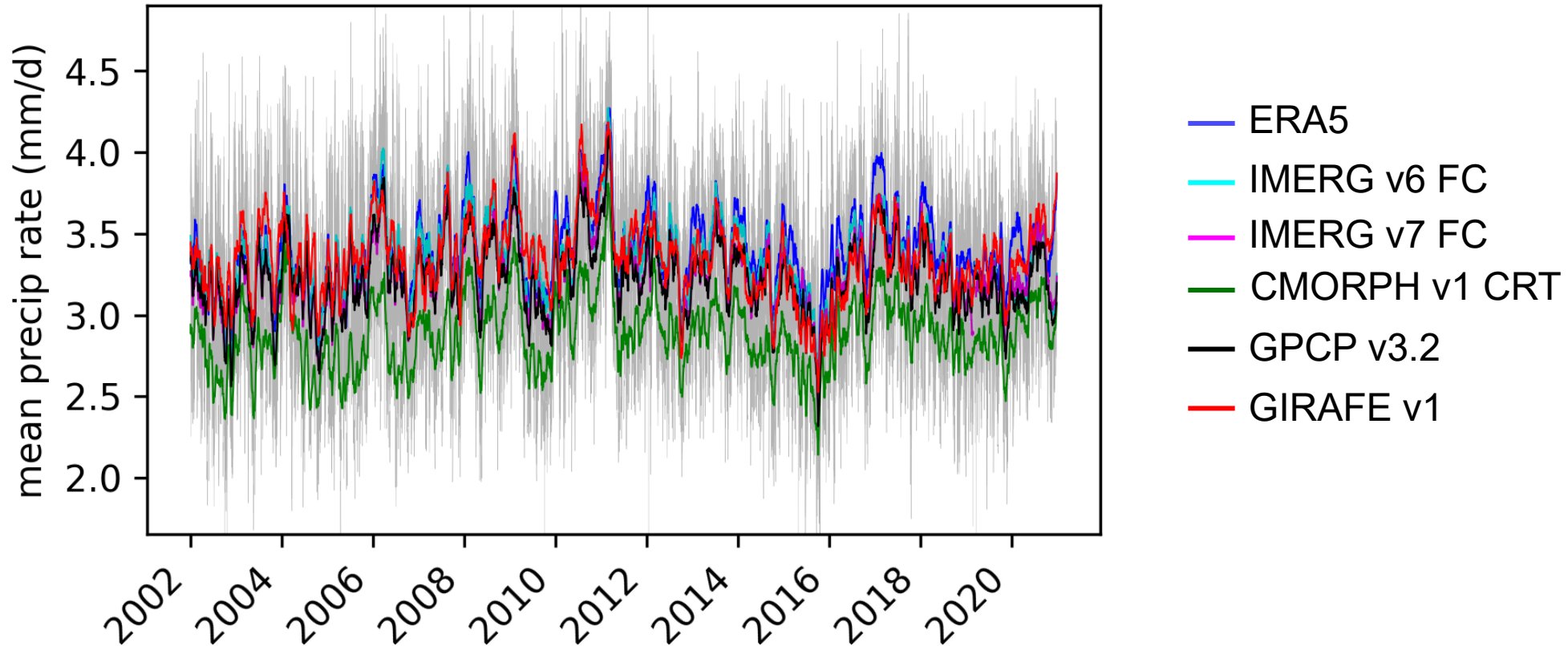


Small impact of the time-evolving constellation

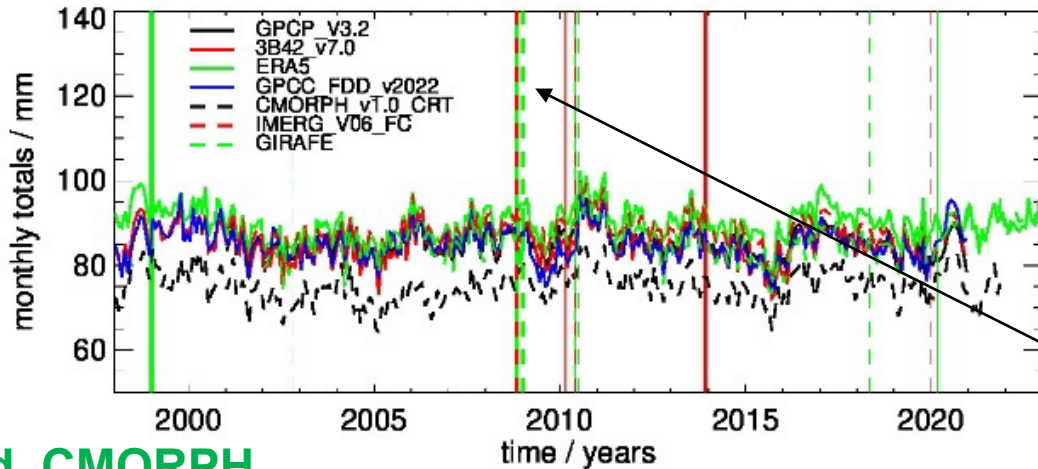


- Extensive quality assessment activity in the scope of the CM SAF release
- Intercomparison with other quasi-global datasets

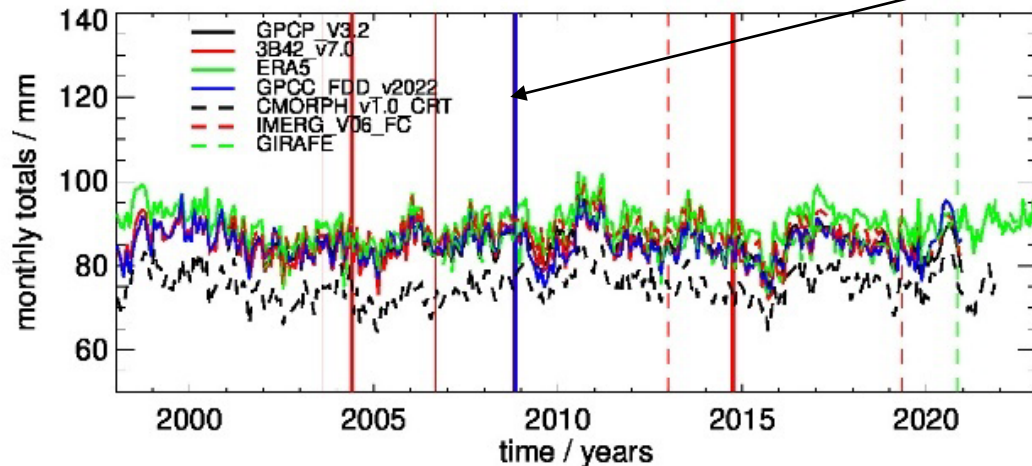
Averages over tropical land (inside 30°N/S)



Land, GPCP



Land, CMORPH



Homogeneity test after Wang 2008
Applied to monthly totals, log-scaled
Plotted are anomalies, shifted by climatology

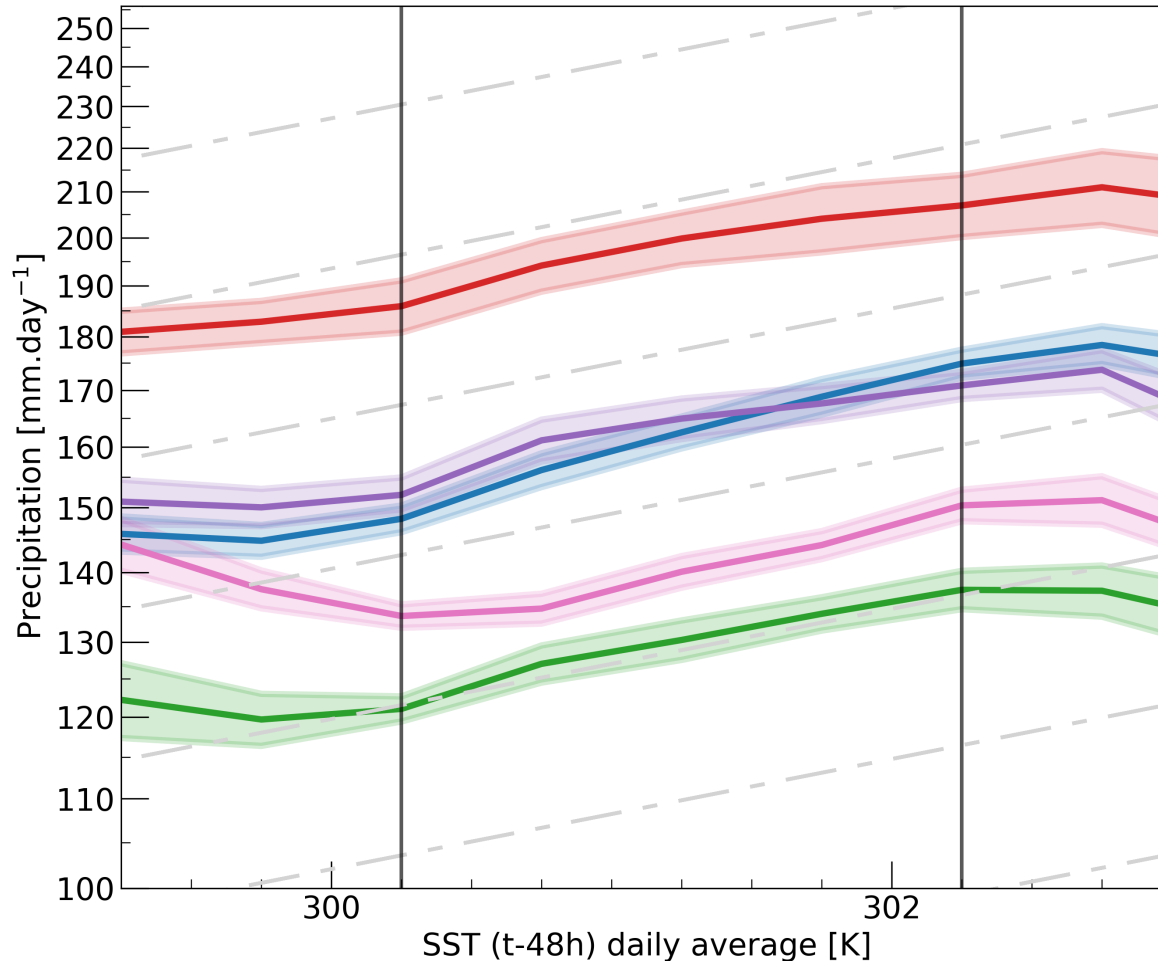
In BOLD lines, 2 tests confirmed the break.

Various confirmed breaks.

Note the differences in detected breaks between top and bottom figure.

- One example: GIRAFE in 2008-12 vs GPCP but not confirmed relative to CMORPH.
- This preliminary analysis suggests a high stability of the GIRAFE record over the 2002-2022 period.

99.9th percentile



GSMAP6 **5.43 %/K**

IMERG7 **8.52 %/K**
GPCP 3.2 **5.61 %/K**

GIRAFE **6.26 %/K**
CMORPH **6.33 %/K**

Close to theoretical expectation of
Clausius-Clapeyron scaling
(See Roca et al., 2022 GRL)

Update from De Meyer and Roca, 2021 JMSJ; Roca et al., 2021 WCRP/IPWG Precipitation Assessment



Outlook to future GIRAFE versions

- Continue the workshop series on global precipitation monitoring in a joint European effort. Next workshop: May 2025 in Paris, France.
- Bias correction to rain gauges based on user feedback from workshop series.
- Extend temporal coverage forward and backward in time.
- Continue the cooperation with C. Kidd on retrieval developments.
- Address the retrieval of snowfall at high latitudes; interest in establishing a cooperation with H SAF.
- Assess quantile mapping applicability in phase space.
- Open for additional input to GIRAFE from the community.
- ...

- GIRAFE v1 is a new global satellite-based CDR for precipitation at 1° - 1 day resolution for climate applications
- Extensive validation and intercomparison results exhibit good quality, high stability and good agreement with existing data records.
- Current record 2002-2022
- ICDR service to be operationalized in early 2025 to continuously extend the dataset
- Long-term, sustained effort (operational satellites, funding and processing environment).

- Access via https://doi.org/10.5676/EUM_SAF_CM/GIRAFE/V001
 - algorithm description, user manual, validation report
- “Expert mode” data (on request)
 - start of day from 06, 12, 18 UTC (00 UTC is the standard)
 - Variogram fitting output



GIRAFE
v1 DOI