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Precipitation in CM SAF: recent GIRAFE operationalization, pre-operational anomaly service and future developments

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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

What is CM SAF?

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EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF)

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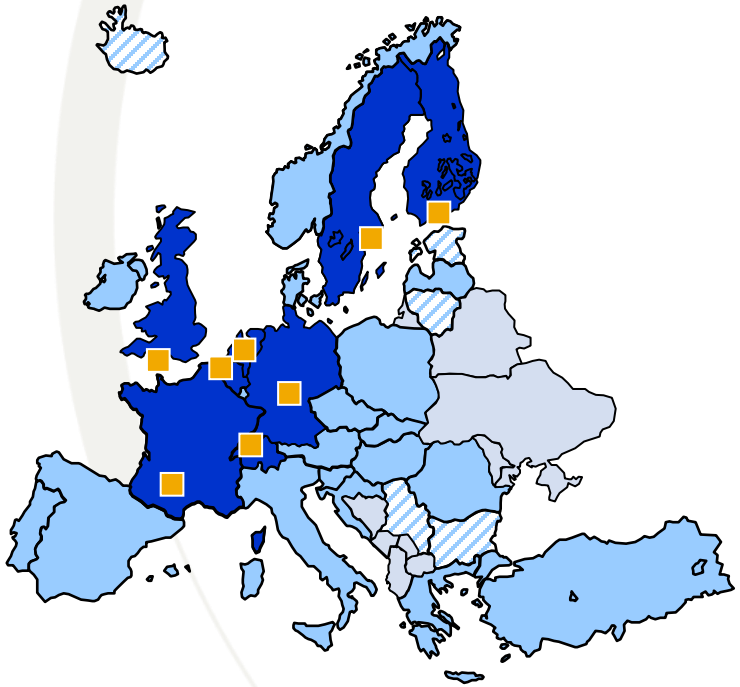

- *CM SAF Member States*
- *Location of Partner NMHSs*

CM SAF 25 1999 - 2024

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Deutscher Wetterdienst

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

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Location of Partner NMHSs

Development, production, validation, distribution of climate data records and related services for the energy and water cycle

CM SAF 25 1999 - 2024

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What is GIRAFE?

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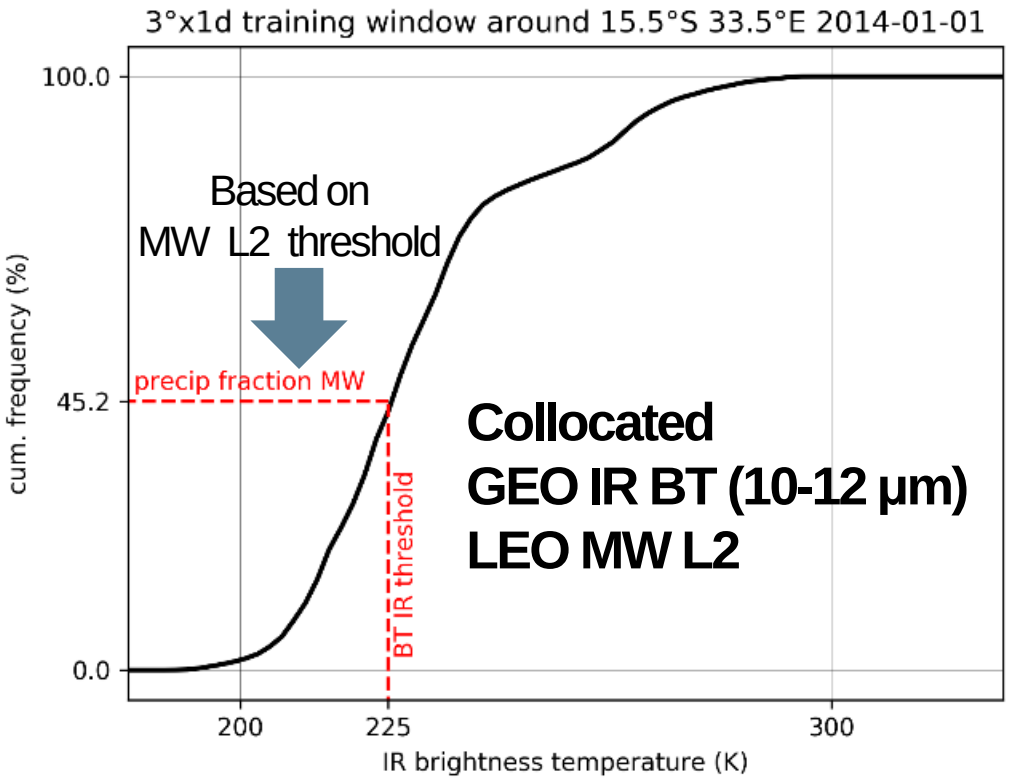
- **G**lobal **I**nterpolated **RA**in**F**all **E**stimation
- First dedicated precipitation climate data record (CDR) in CM SAF
  - CM SAF-internal and -external contributors
- Initial version 1 CDR released in 2024 (2002-2022)
  - 1 degree daily (plus sampling uncertainty) and monthly
- Based on TAPEER methods (Chambon et al, Q J R Met Soc, 2013)
  - Based in turn on UAGPI (Xu et al., JAMC, 1999)
  - geostationary infrared brightness temp. and LEO MW precipitation rate
  - P_{acc} = 24 h * cond. precip. rate * precip. fraction
  - MW-only beyond 55°N/S

What is GIRAFE?



Estimation

climate data record (CDR) in CM SAF

al contributors

d in 2024 (2002-2022)

uncertainty) and monthly

(Chambon et al, Q J R Met Soc, 2013)

al., JAMC, 1999)

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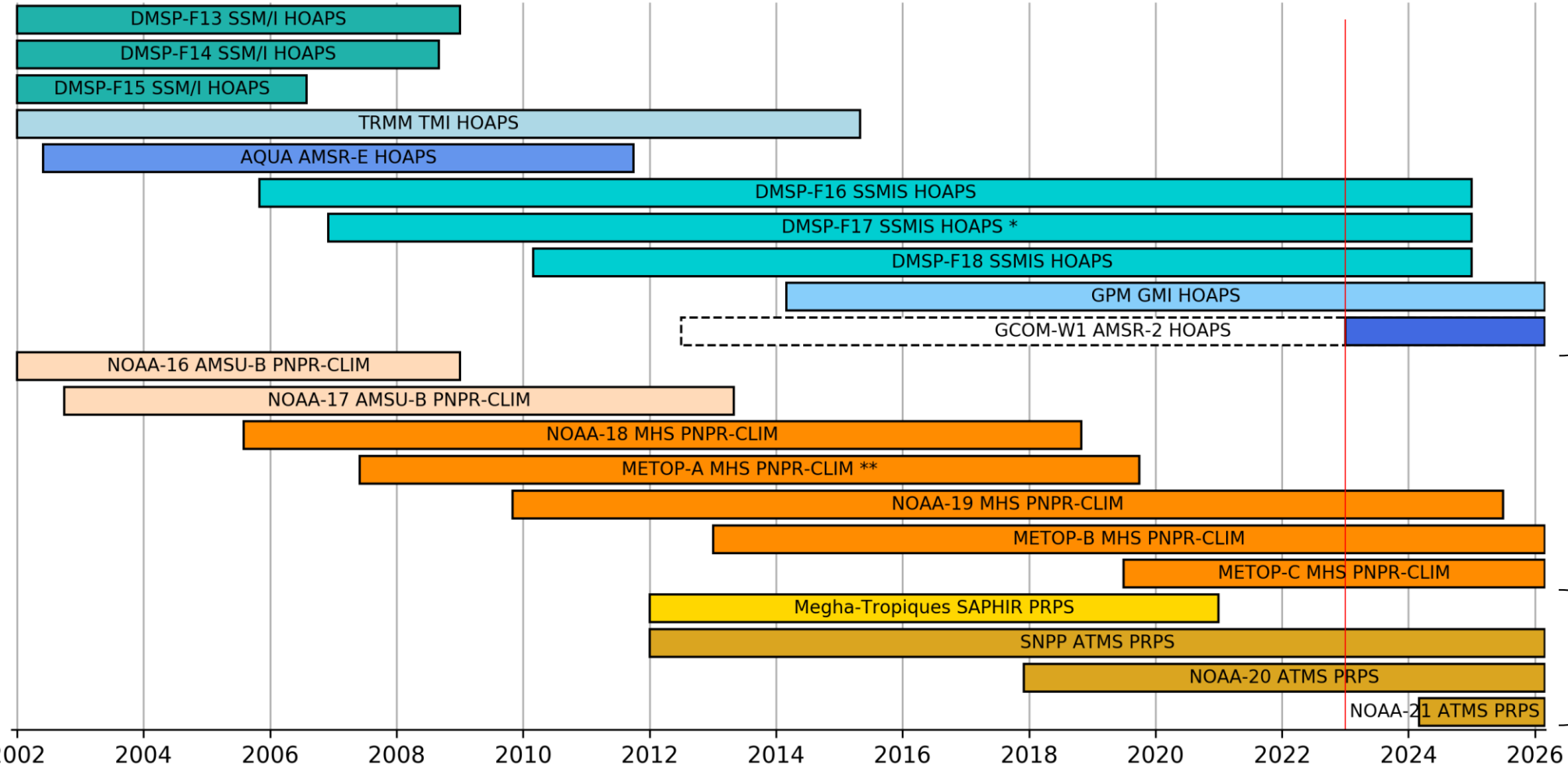
What is GIRAFE? MW constellation

21 satellites, 10 instruments, 3 retrieval algorithms, quantile mapping



HOAPS: CM SAF legacy, MW imager over open ocean, Andersson et al., ESSD, 2010

PNPR-CLIM developed at CNR-ISAC for C3S_312a_Lot1, Bagaglini et al., Remote Sens., 2021

PRPS, Kidd et al., Remote Sens., 2021

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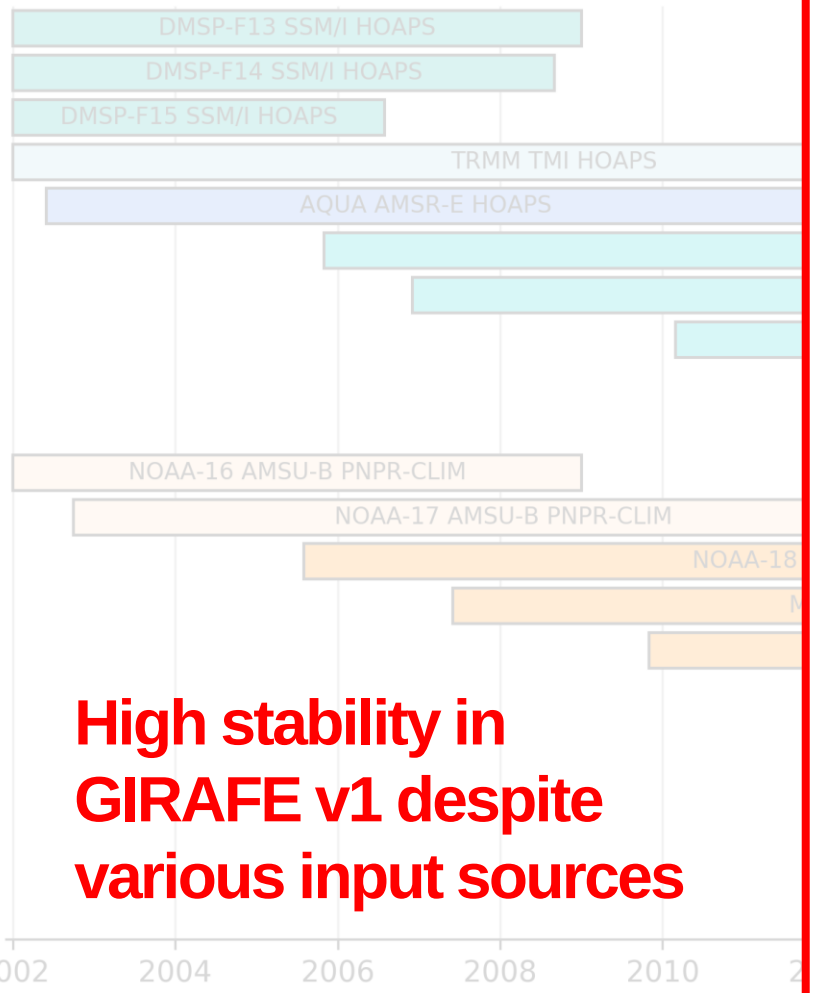

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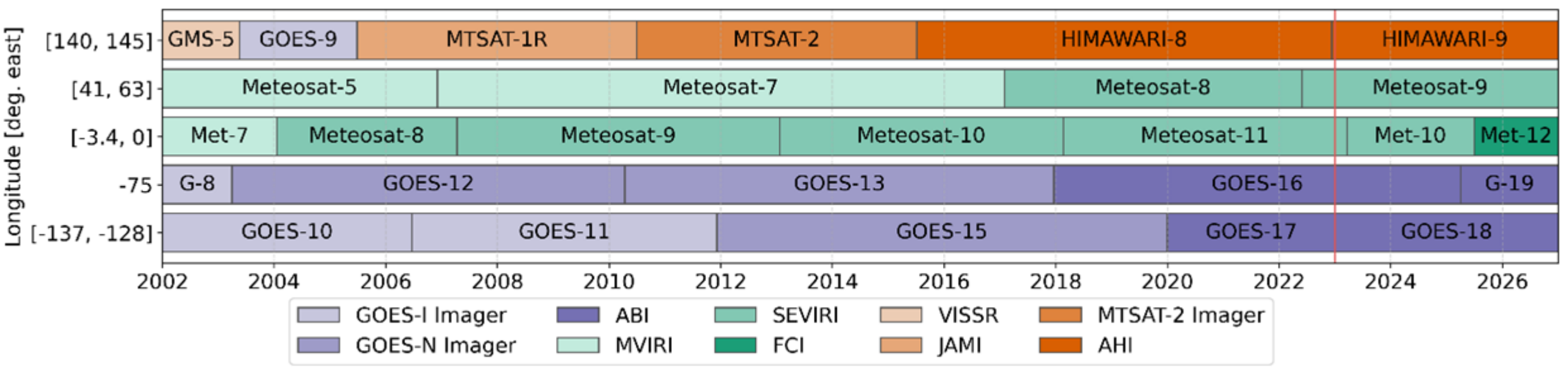
High stability in GIRAFE v1 despite various input sources

Dataset	Reference dataset 1 (RD1)	Time of breakpoint w.r.t. RD1	Reference dataset 2 (RD2)	Time of breakpoint w.r.t. RD2
Monthly totals within 50° N/S over ocean				
GIRAFE v1	GPCP v3.2	None	3B42 v7	None
3B42 v7	GPCP v3.2	September 2005 December 2007 August 2010*	3B42 v7	NA
CMORPH v1 CRT	GPCP v3.2	October 2007 October 2009	3B42 v7	July 2007* September 2010*
ERA5	GPCP v3.2	None	3B42 v7	August 2004 December 2007* September 2010*
GPCP v3.2	GPCP v3.2	NA	3B42 v7	September 2005 December 2007 August 2010*
IMERG v7 FC	GPCP v3.2	None	3B42 v7	None
Monthly totals within 50° N/S over land				
GIRAFE v1	CMORPH v1 CRT	October 2020	GPCC FDD v2022	October 2002 December 2008* June 2010 April 2018
3B42 v7	CMORPH v1 CRT	July 2003 May 2004* August 2006 October 2008* September 2014*	GPCC FDD v2022	December 1998 October 2008* February 2010 November 2013*
CMORPH v1 CRT	CMORPH v1 CRT	NA	GPCC FDD v2022	October 2008*
ERA5	CMORPH v1 CRT	None	GPCC FDD v2022	December 1998* October 2008* May 2010 February 2020
GPCP v3.2	CMORPH v1 CRT	October 2007* January 2020	GPCC FDD v2022	October 2008* June 2010* December 2019
IMERG v7 FC	CMORPH v1 CRT	None	GPCC FDD v2022	None
GPCC FDD v2022	CMORPH v1 CRT	October 2008*	GPCC FDD v2022	NA
99.9th percentile within 30° N/S over land and ocean				
GIRAFE v1	GPCP v3.2	None	3B42 v7	None
3B42 v7	GPCP v3.2	None	3B42 v7	NA
CMORPH v1 CRT	GPCP v3.2	May 2014*	3B42 v7	March 2000* September 2014*
ERA5	GPCP v3.2	March 2014*	3B42 v7	September 2014*
GPCP v3.2	GPCP v3.2	NA	3B42 v7	None
IMERG v7 FC	GPCP v3.2	July 2002 October 2018	3B42 v7	February 2009* September 2014*

What is GIRAFE? Geo-Ring



- Brightness temperatures from 10-12 µm channel
- First CM SAF service/data record to include MTG FCI
- Possible link to *the* Georing activities

GIRAFE v1 operational

- Timeline
  - 2014-2017: series of workshops („precipitation monitoring in a joint European effort“)
    - Commitment for a global precipitation CDR in CM SAF
  - 2024: Relase of the GIRAFE v1 CDR
  - **29 June 2026: Release of the GIRAFE v1 interim CDR**
    - Continously extending the GIRAFE v1 CDR
    - wui.cmsaf.eu, EUMETSAT Data Store, C3S Climate Data Store, FROGS
    - Nominal latency of three months, but aiming for ~10 days

GIRAFE normals and anomalies

- CM SAF is developing climate normal and anomaly products for various parameters including precipitation
- CM SAF data will be accessible via the EUMETSAT-wide CAN service, allowing for data access, visualization and analysis
- both will become publicly available in fall 2026
  - GIRAFE v1 in 2027

GIRAFE normals and anomalies

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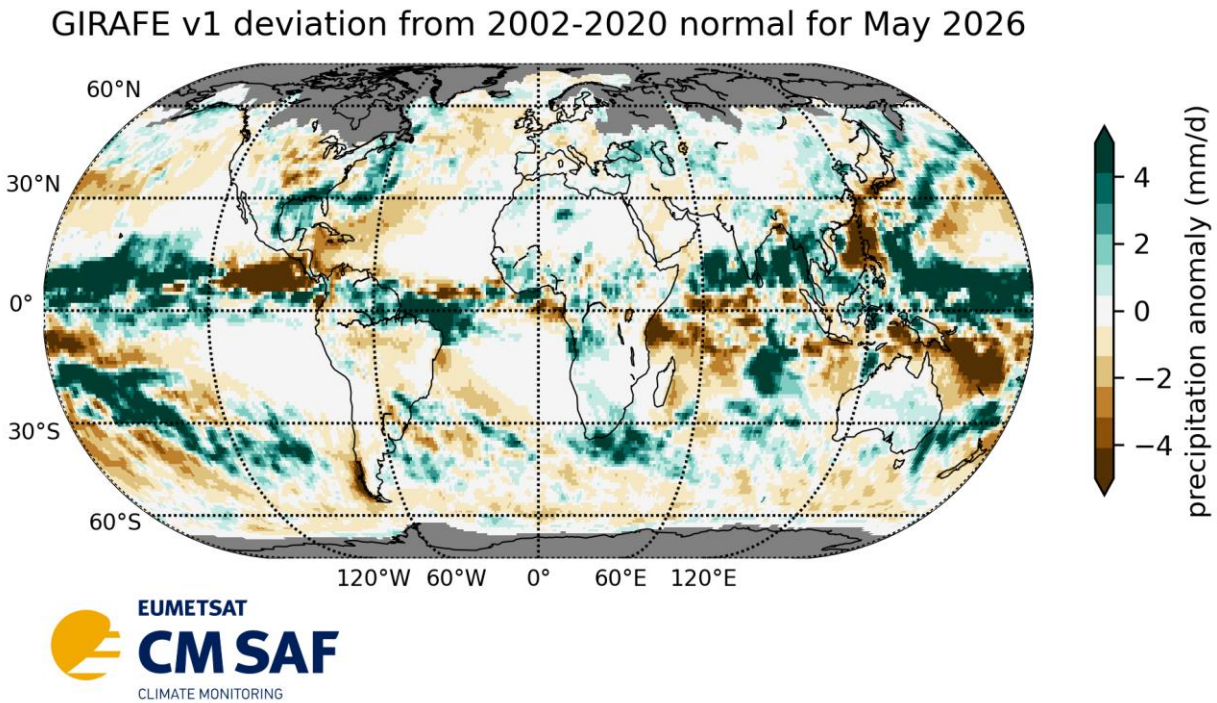
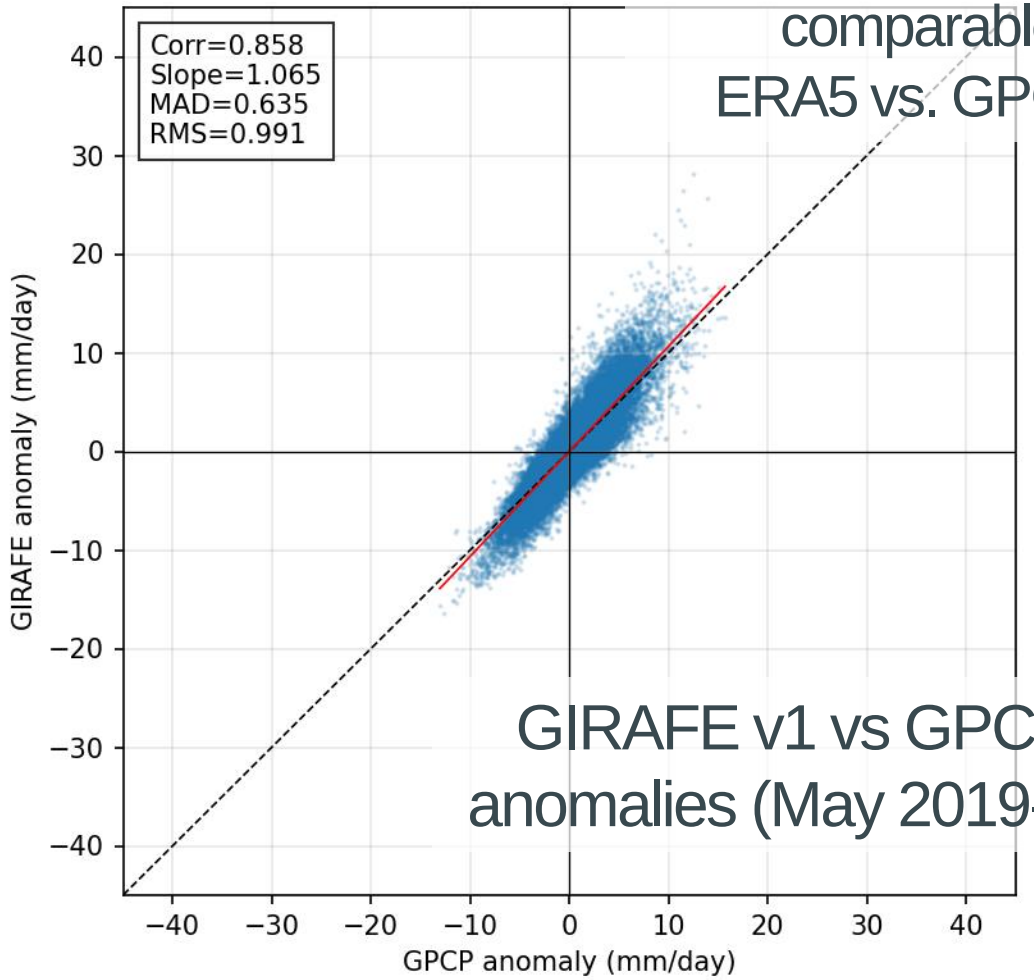
- Good agreement, but structural differences in climate normals
- First results for GIRAFE v1 anomalies



Good agreement, comparable to e.g. ERA5 vs. GPCP v3.3

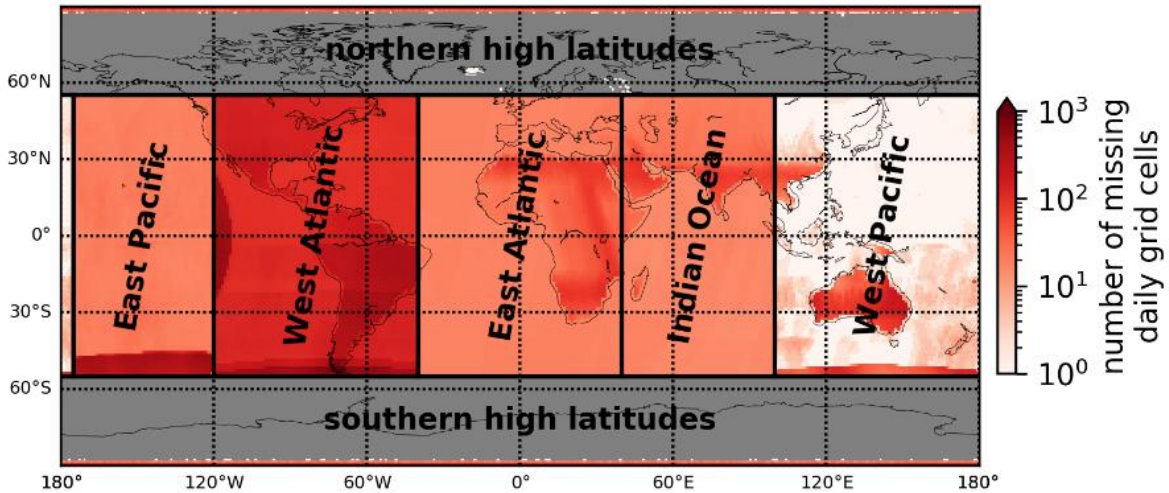


GIRAFE v1 vs GPCP v3.3 anomalies (May 2019-2023)

GPCP v3.3
Huffman et al., 2025
10.5067/MEASURES/GPCP/DATA306

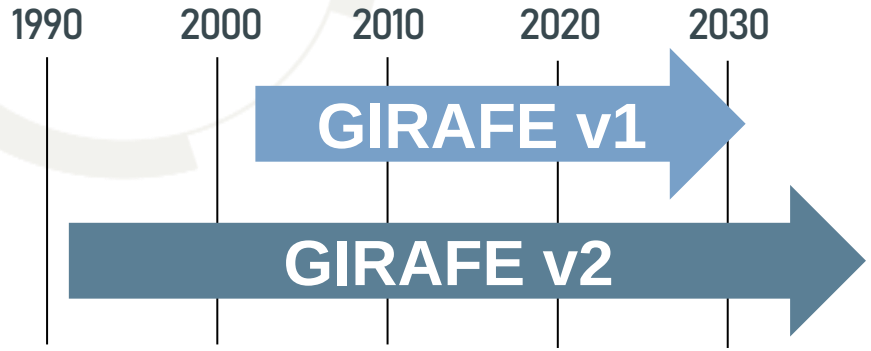
GIRAFE: next steps

- Sub-monthly latency
- Update to GIRAFE v1.1 (late 2027)
  - Fill gaps in Geo-Ring or in MW/Geo collocation database with MW-only
  - Try to improve detection in arid regions
    - Need precipitation events in collocated LEO MW/GEO IR database



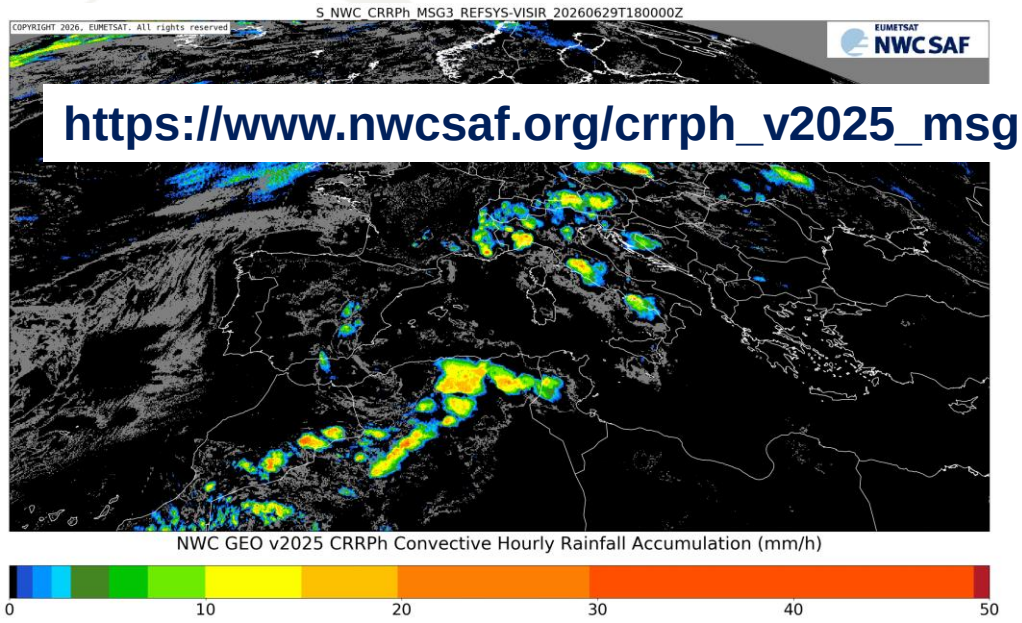
GIRAFE: next steps

- Plans for GIRAFE v2 (major items, release ~2031)
  - Extend back to 1991 using PRPS SSMI(S)
  - Adapt to new sensors (EPS-SG, EPS-Sterna, AMSR-3, WFS MWI, ...) using H SAF methods where possible (implemented by NWC SAF)
    - Improve representation of snow
  - Bias correction
  - More complete uncertainty information
  - Test impact of using Georing L1g
  - Higher output resolution



Summary & Outlook

- GIRAFE v1 is now available continuously
  - Normal and Anomalies service coming up
- Improvements in GIRAFE v1.1 and v2
- CM SAF does not have expertise and capacity for developing precipitation retrieval algorithms for MW sensors, but can offer a platform for operational application of methods
  - If you are interested, please get in touch!
- Precursor study for high-resolution Meteosat-based CDR (NWC SAF, H SAF)



Thank you for your attention!

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