

GPCC's activities in support of the WCRP GC on Extremes

*Presentation to WCRP Workshop
Data Requirements to Address the WCRP GC
on Weather and Climate Extremes*

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Outline

- Background of Global Precipitation Climatology Centre (GPCC)
- Data base, storage and data policy
- Status Quo, monthly / daily archive and products
- New Products released and published
- GPCC's offers to WCRP in context of GC Extremes



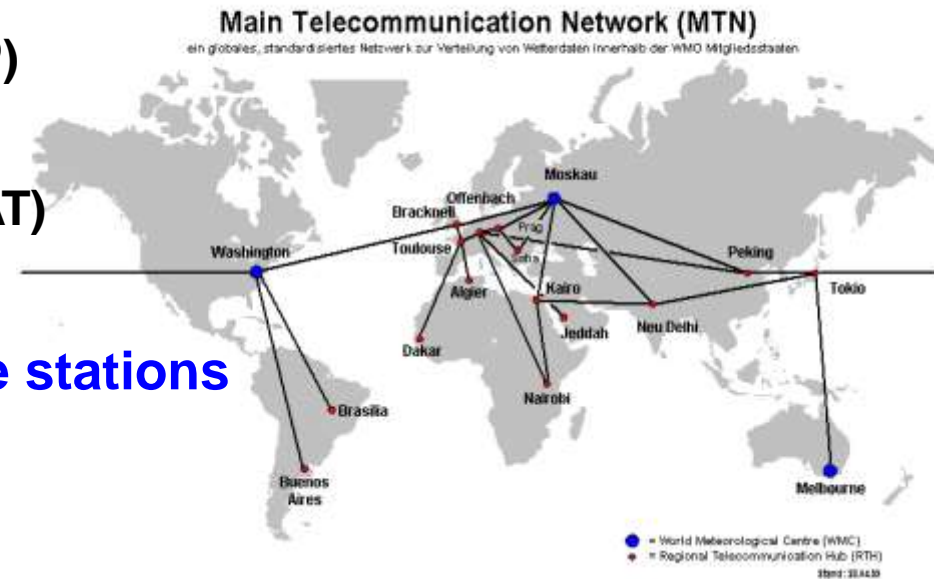
Background of GPCC

- analysis of precipitation on the basis of in-situ data for the land-surface
- established at the beginning of 1989 at Deutscher Wetterdienst (DWD) on invitation by WMO → >25 year of experience with precipitation gauge data
- Contributing to GEWEX (Global Energy and Water Exchanges Project) and GCOS (Global Climate Observing System)
- Many users world wide, analyses used in IPCC-AR5
- Data sources: SYNOP, CLIMAT, SYNOP from CPC, ECA&D, CRU, FAO, GHCN, national meteorological services, regional data collections



Near real-time regularly exchanged data via the WMO Global Main Telecommunication Network

- hourly/daily weather reports (SYNOP)
→ up to 7,500 stations
 - monthly climatological totals (CLIMAT)
→ up to 2,800 stations
- up to 9,000 unique stations



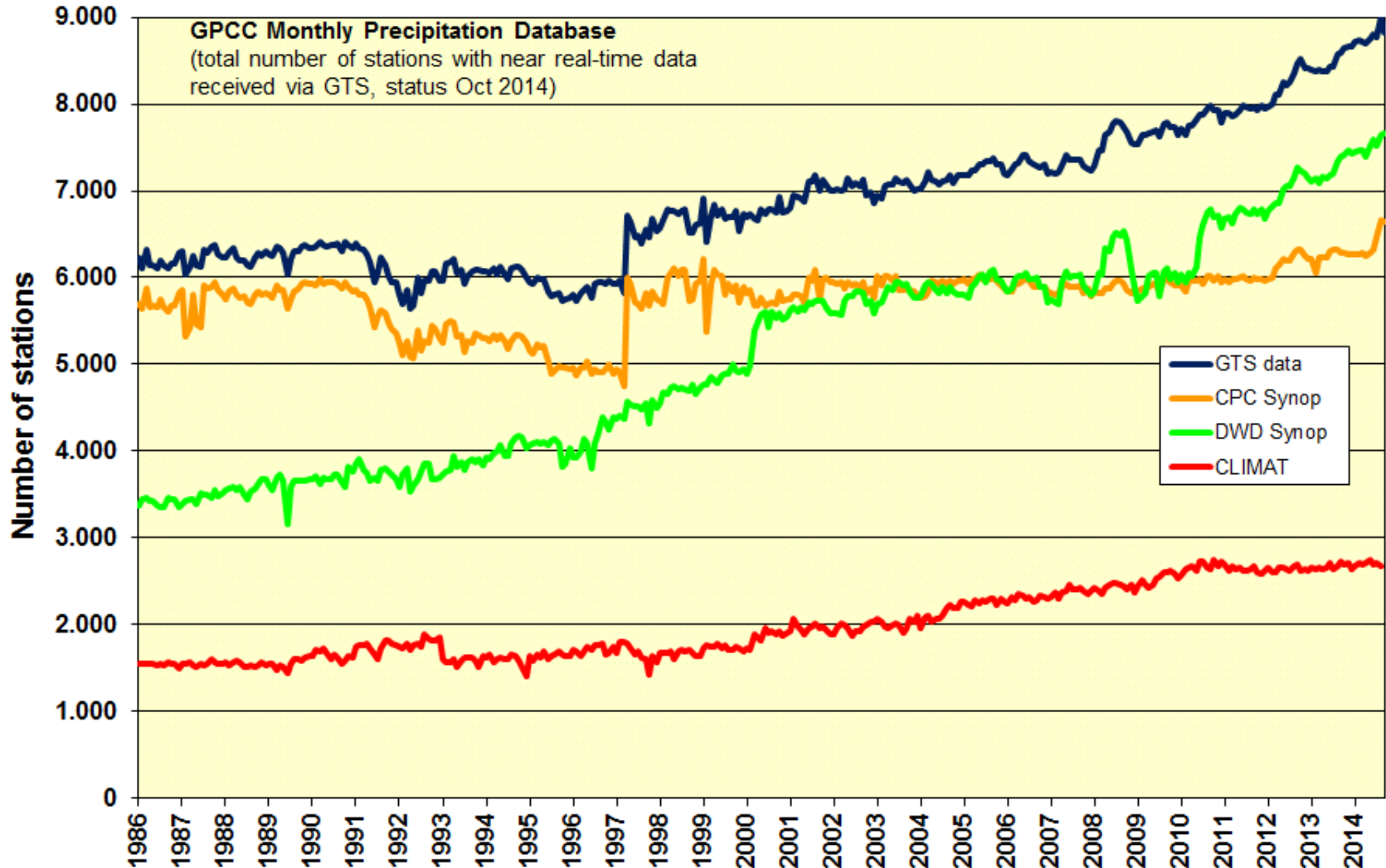
Non real-time:

Additional data received from **ca. 190 countries or regions**

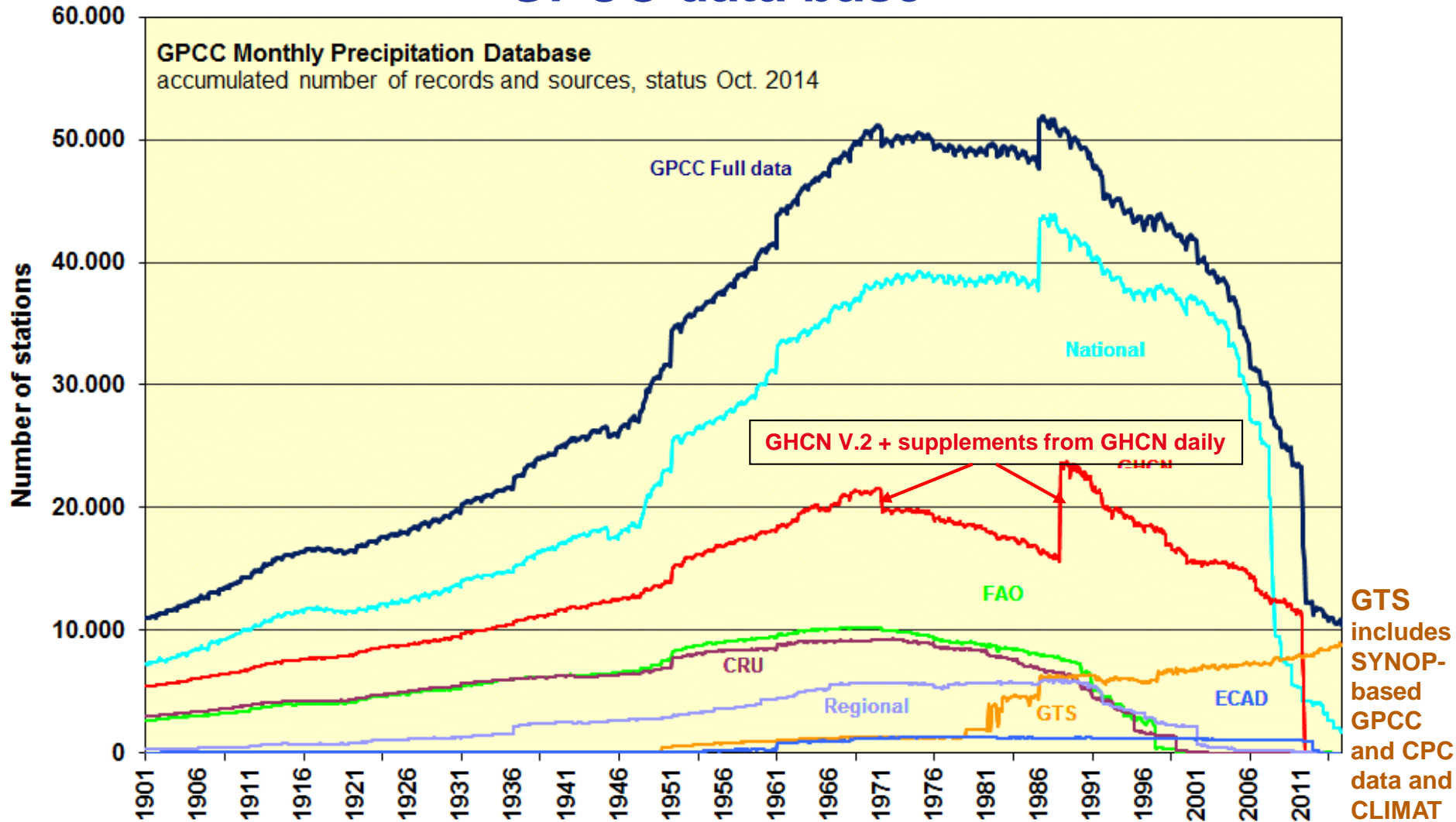
- plus:
- Historical data collections (CRU, FAO, GHCN, Nicolson)
 - International project data (GEWEX and other)

→ **> 95,000 stations in total**

GPCC GTS data base

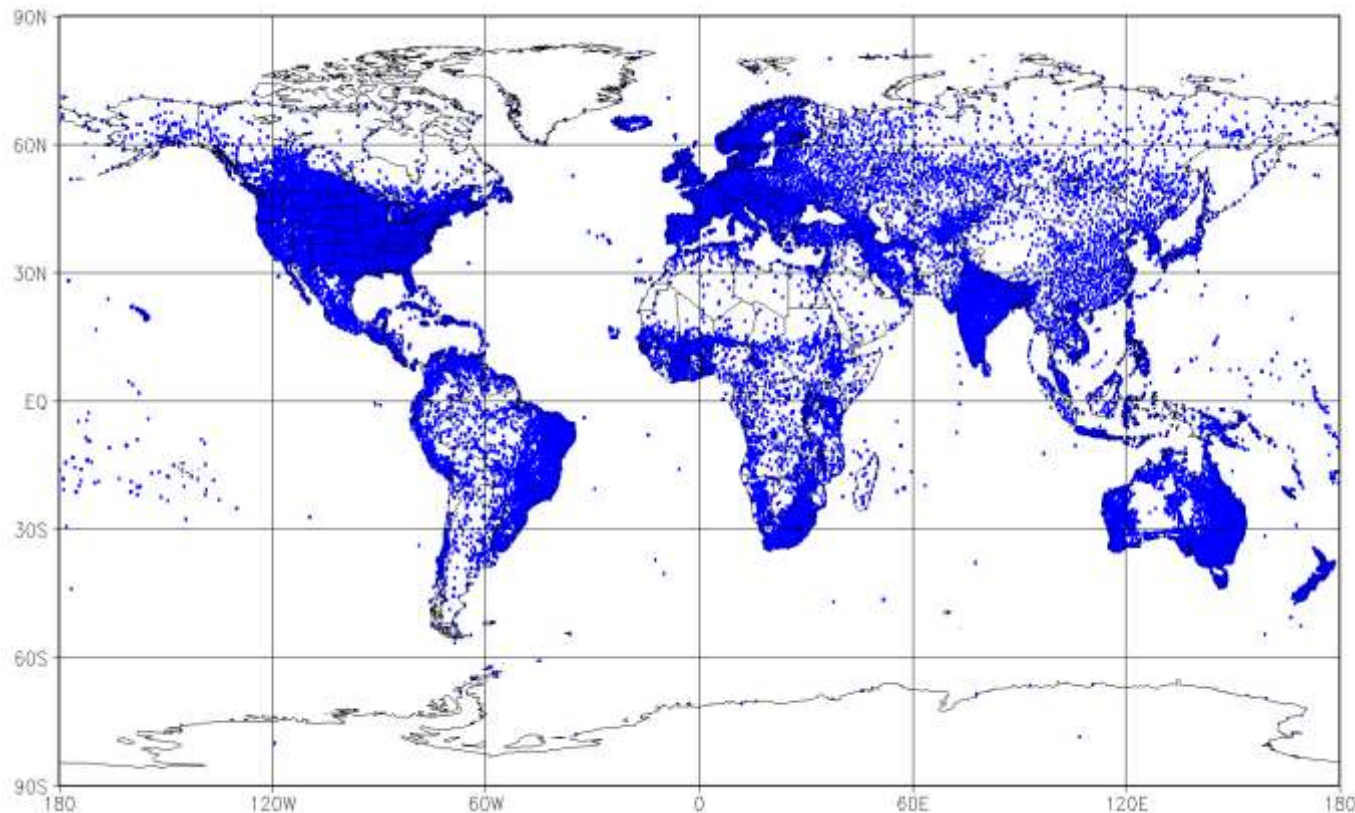


GPCC data base



GPCC Climatological data base

- ➔ Station data base of GPCC's Precipitation Climatology V.2011 as basis for anomaly analyses (number of stations: ca. 67,200)



Steps of quality control at GPCC

- GTS-Data (SYNOP reports):
 - check of precipitation amounts against the weather information
 - consistency check of reports overlapping in time
 - (fill gaps without precipitation, if weather group indicates no precipitation)
- Delivered data
 - Check station location within country and over land
 - Coding of missing values (sometimes 0 is used)
 - Data from existing station or new one (check of meta data)
 - precipitation data checked against background statistics for the station or, if not available, for the corresponding 2.5° grid (since 2009)
 - data being flagged as questionable (below the 5% or above the 95% percentile), checked manually

Example of errors

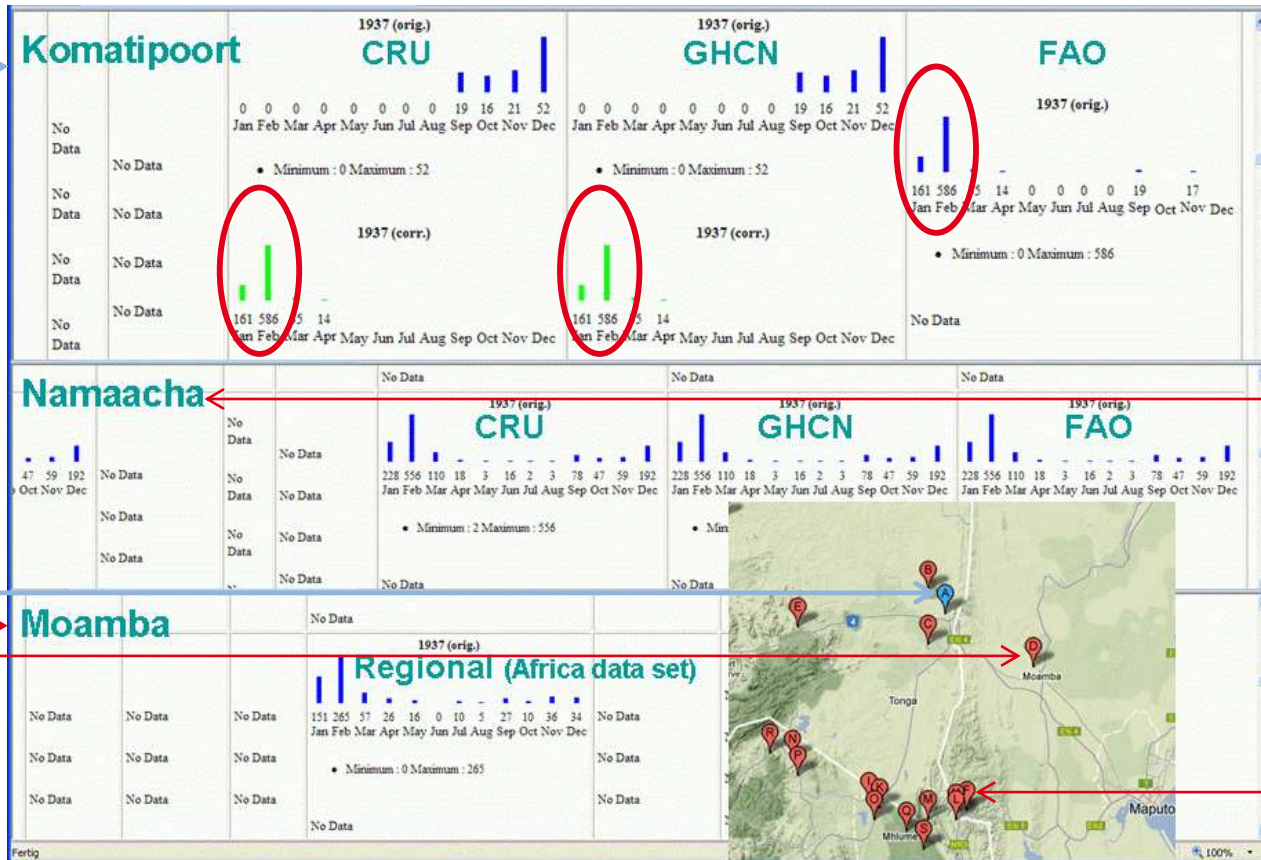
- Name of one station with different spellings:
 - Huddur
 - Huduur
 - Hudur
 - Hodur
 - Oddur
 - Xuddur
 - Xudur

QC: Errors typically detected

- Stations are sometimes located in the ocean or outside of the boundaries of the country
- Unusual annual cycle or extreme outliers of monthly precipitation
- Temporal shifts in the data
- Factor*10 errors
- Typing or coding errors
- Errors in the conversion of inch, mm etc. (mostly with historical data)
- Incorrect flagging of missing precipitation observations (might be misinterpreted as „0“)

Example of errors

➔ Wrong coding of missing values

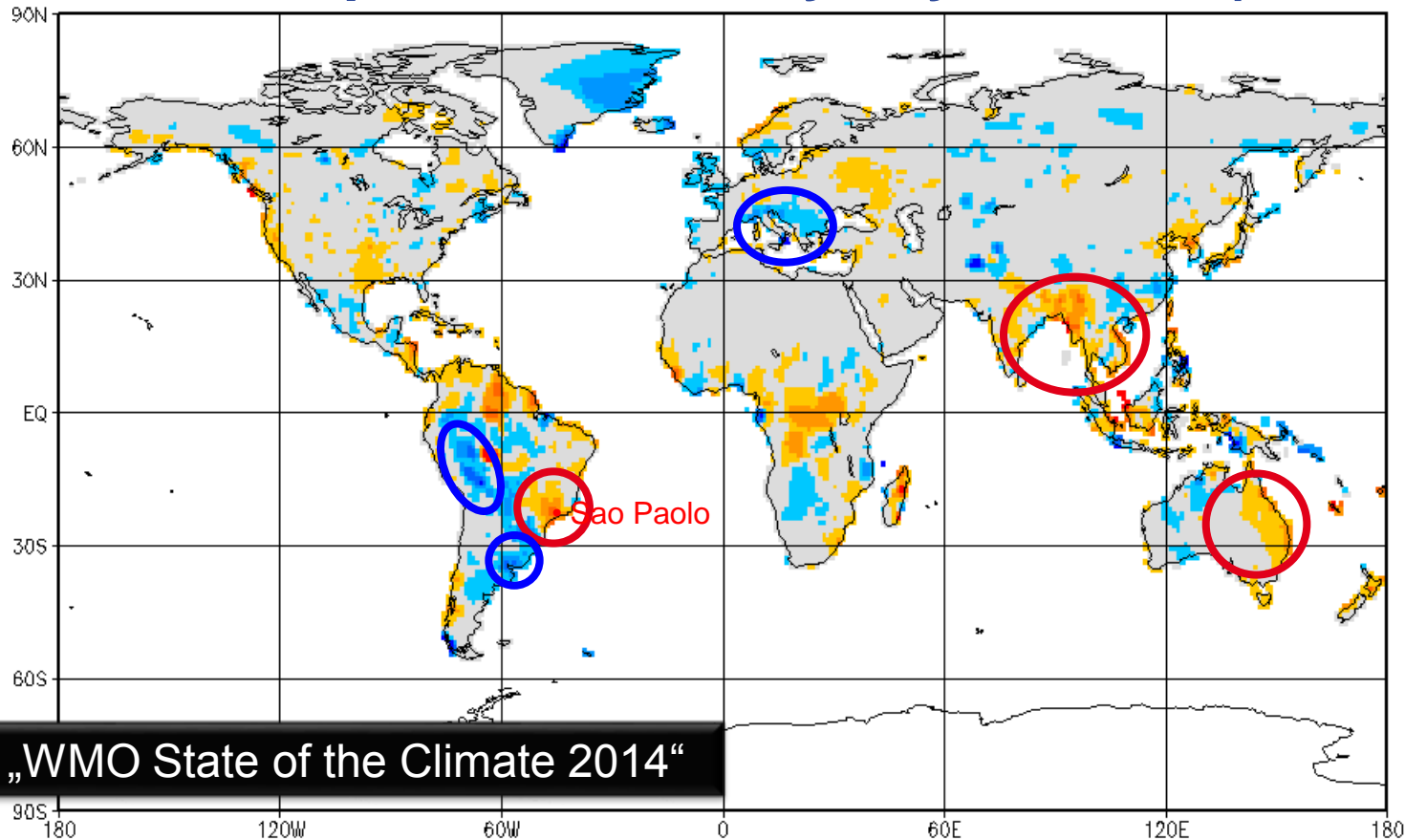


➔ Wrong zeroes from CRU and GHCN corrected by FAO, indicated by surrounding stations

Monthly GPCC Products

- First Guess Product
 - based SYNOP data, automated QC
 - available within 3 to 5 days after the end of each month
- Monitoring Product (Version 4, Version 5 scheduled for April-2015)
 - based on CLIMAT and SYNOP data, enhanced QC
 - available within two month after the analyzed month
- Climatology (Version 2011, Version 2014 scheduled for April-2015)
 - based on about 67200 stations
 - target reference period 1951 – 2000, stations with at least 10 years of data
 - **background climatology for GPCC products**
- Full Data Reanalysis (Version 6, Version 7 scheduled for April-2015)
 - uses same stations as Climatology
 - available from 1901 to 2010 (2013 with V7)

Absolute Precipitation Anomaly in year 2014 (weak El Niño)



-> „WMO State of the Climate 2014“

(c) GPCD 2015/2/20



mm/month

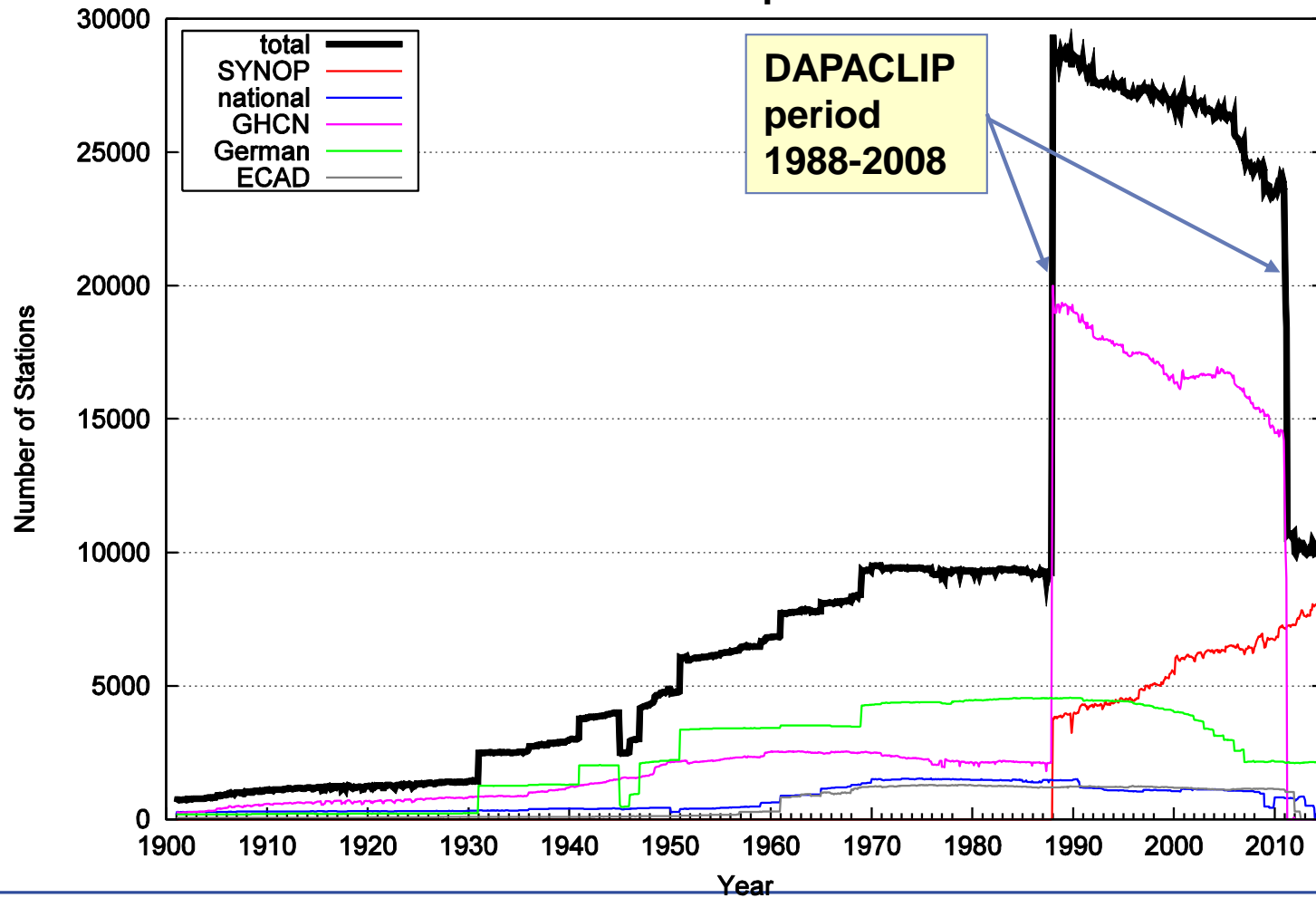


Preparatory work at GPCC for daily data

- participating DAPACLIP (global DAily Precipitation Analyses for the validation of medium-range CLimate Predictions)
 - Daily precipitation analyses for 1988 to 2008 over land
 - Acquisition of daily data
 - Developing QC scheme for daily data (including comparison to monthly total)
 - Loading data into data bank focusing 1988 to present
 - Testing and optimization of interpolation schemes including error estimation
 - Test of optimization possibilities of QC → detection of shift by one or two days

Daily data in GPCC data base

Status Sept. 2014





New data sets available from GPCC

I. Analyses of daily land-surface precipitation

- **First Guess Daily:** automated QC, based on SYNOP reports; near real-time (within five days)
- Paper to DOI reference: Schamm, K., M. Ziese, A. Becker, P. Finger, A. Meyer-Christoffer, U. Schneider, M. Schröder, and P. Stender, 2014: Global gridded precipitation over land: a description of the new GPCC First Guess Daily product, *Earth Syst. Sci. Data*, **6**, 49-60, doi:10.5194/essd-6-49-2014

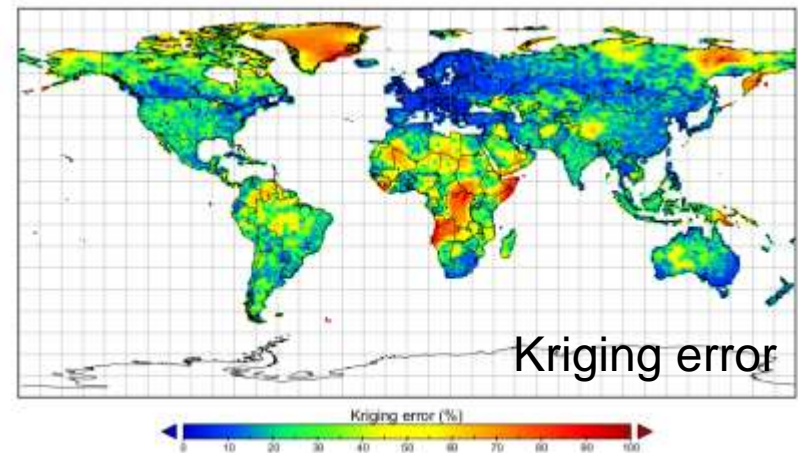
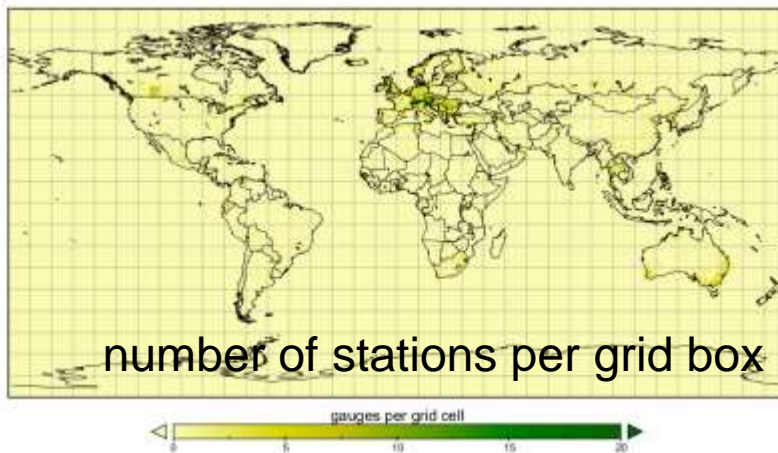
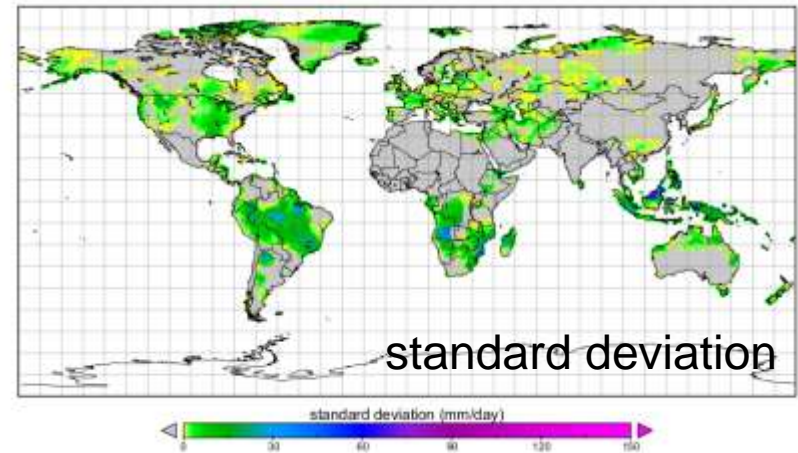
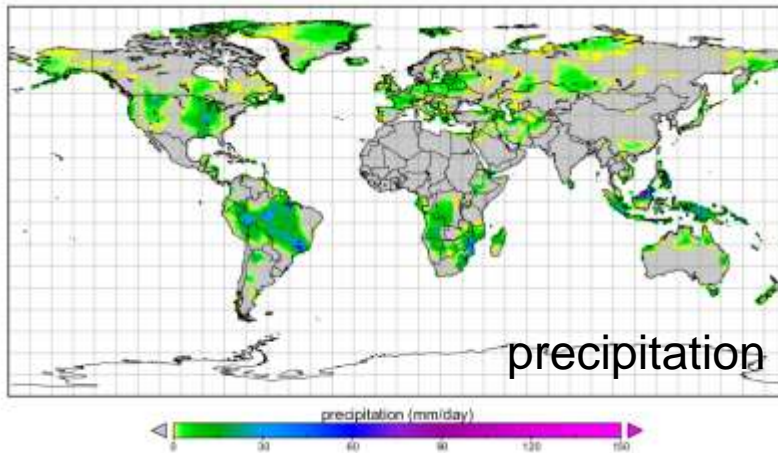
II. Bi-decadal (1988-2008) global analysis of daily precipitation

III. GPCC drought index:

- Combination of SPI-DWD and SPEI with nearly global coverage
- Paper to DOI reference: Ziese, M., U. Schneider, A. Meyer-Christoffer, K. Schamm, J. Vido, P. Finger, P. Bissolli, S. Pietzsch, and A. Becker, 2014: The GPCC Drought Index – a new, combined and gridded global drought index", *Earth Syst. Sci. Data*, **6**, 285-295, doi:10.5194/essd-6-285-2014

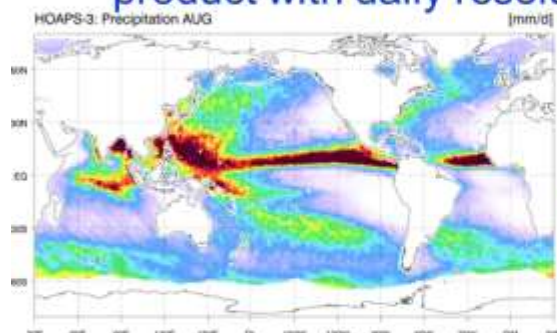


Example GPCC First Guess Daily: 10 January 2013

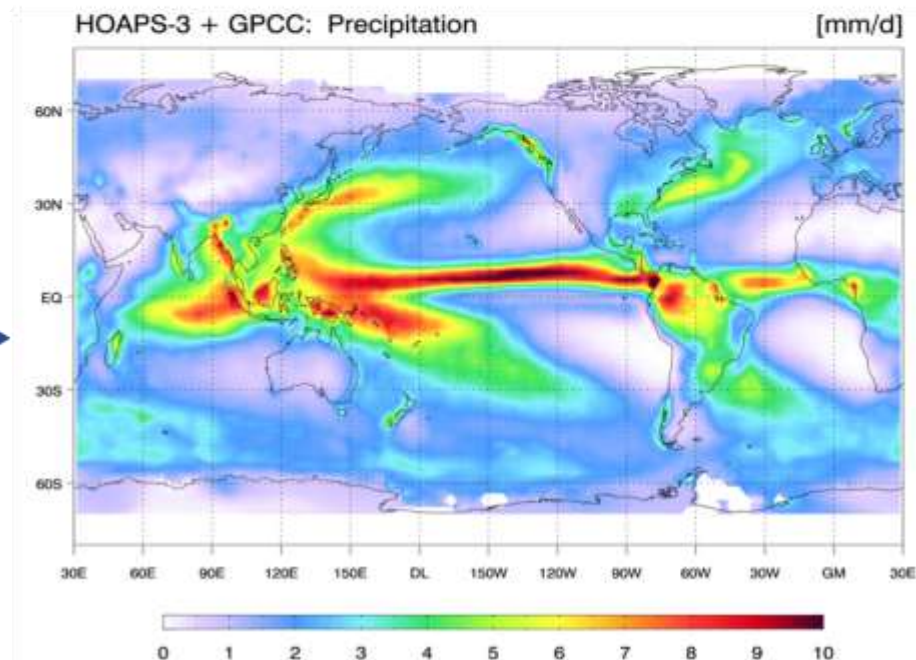
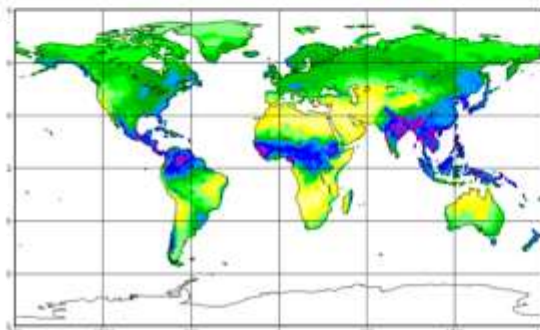


II. Bi-Decadal Global Daily Data Set, 1988-2008

- DAPACLIP: Global Daily Precipitation Analysis for the validation of medium-range Climate Predictions
- Cooperation CM-SAF@DWD and GPCC@DWD
- Construction of a gridded bi-decadal (1988-2008) global precipitation data product with daily resolution composited from HOAPS (CM SAF) and GPCC



GPCC Normals Version 2010 0.5 degree precipitation for August in mm/month





II. Version 1 of a new global satellite-gauge product completed

Joint GPCP and EUMETSAT CM_SAF product from the combination of the follow-up of the HOAPS_3.2 data set and a prototype of a GPCP Full Data Daily Reanalysis for the period 1988-2008.

The interpolation of the gauge data is done by ordinary block kriging using the daily fraction of the monthly precipitation totals. Monthly gridded background fields are taken from the GPCP Full Data Reanalysis Version 6. Across the ocean a 1D-Var retrieval is used to derive the precipitation along with a retrieval uncertainty estimate from passive microwave data of SSM/I, TMI and AMSR-E radiometers. In order to maximize the spatio-temporal sampling, multiple satellite platforms are used (Dietzsch et al., 2014).

Dietzsch, F., Andersson, A., Schamm, K., Schröder, M., and A. Becker, 2014: Global daily precipitation analysis for the validation of medium-range climate predictions (DAPACLIP), [Geophysical Research Abstracts, Vol.16, EGU2014-14363](#)



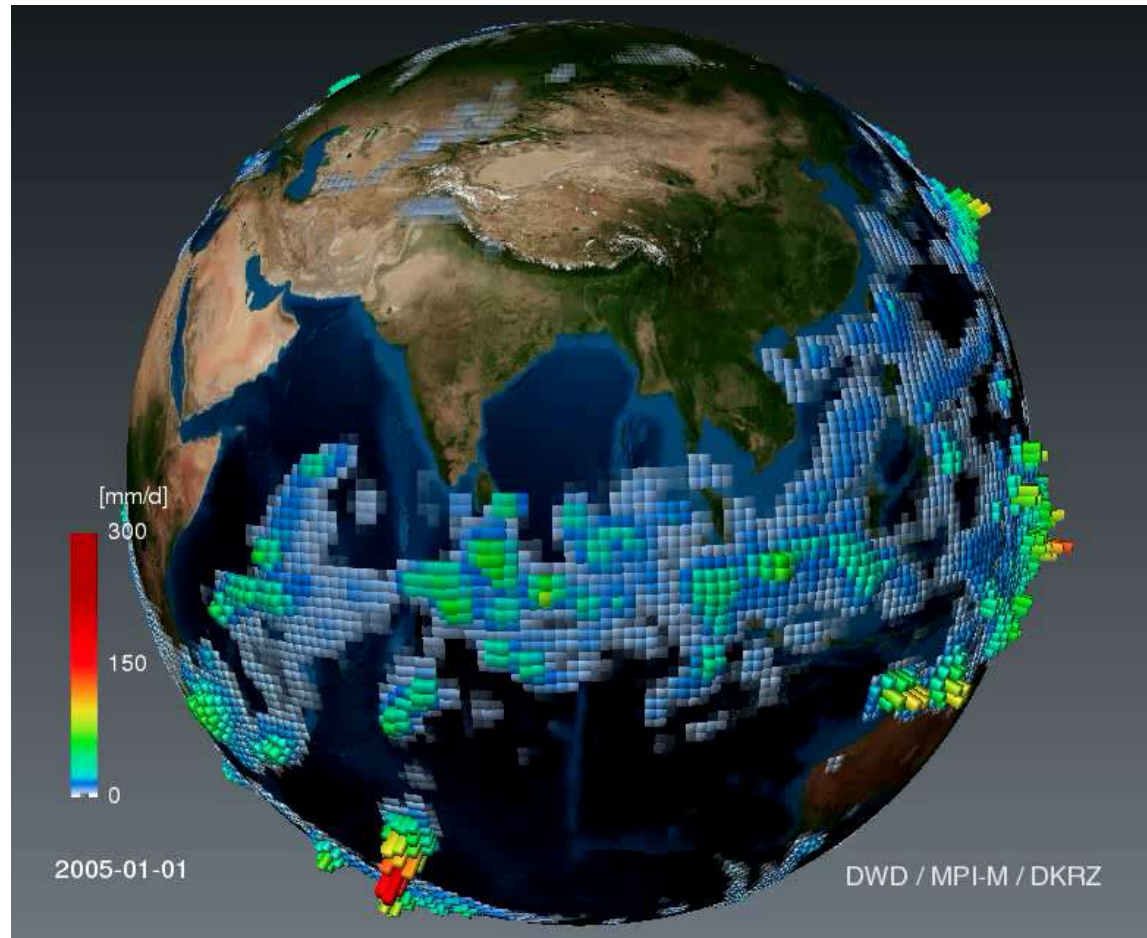
Bi-Decadal Global Daily Data Set, 1988-2008

„Access extreme precipitation and drought world-wide“

Watch a demo on YouTube at
https://www.youtube.com/watch?feature=player_detailpage&v=k7UdHgVJqfl

Action in support of WCRP GC:

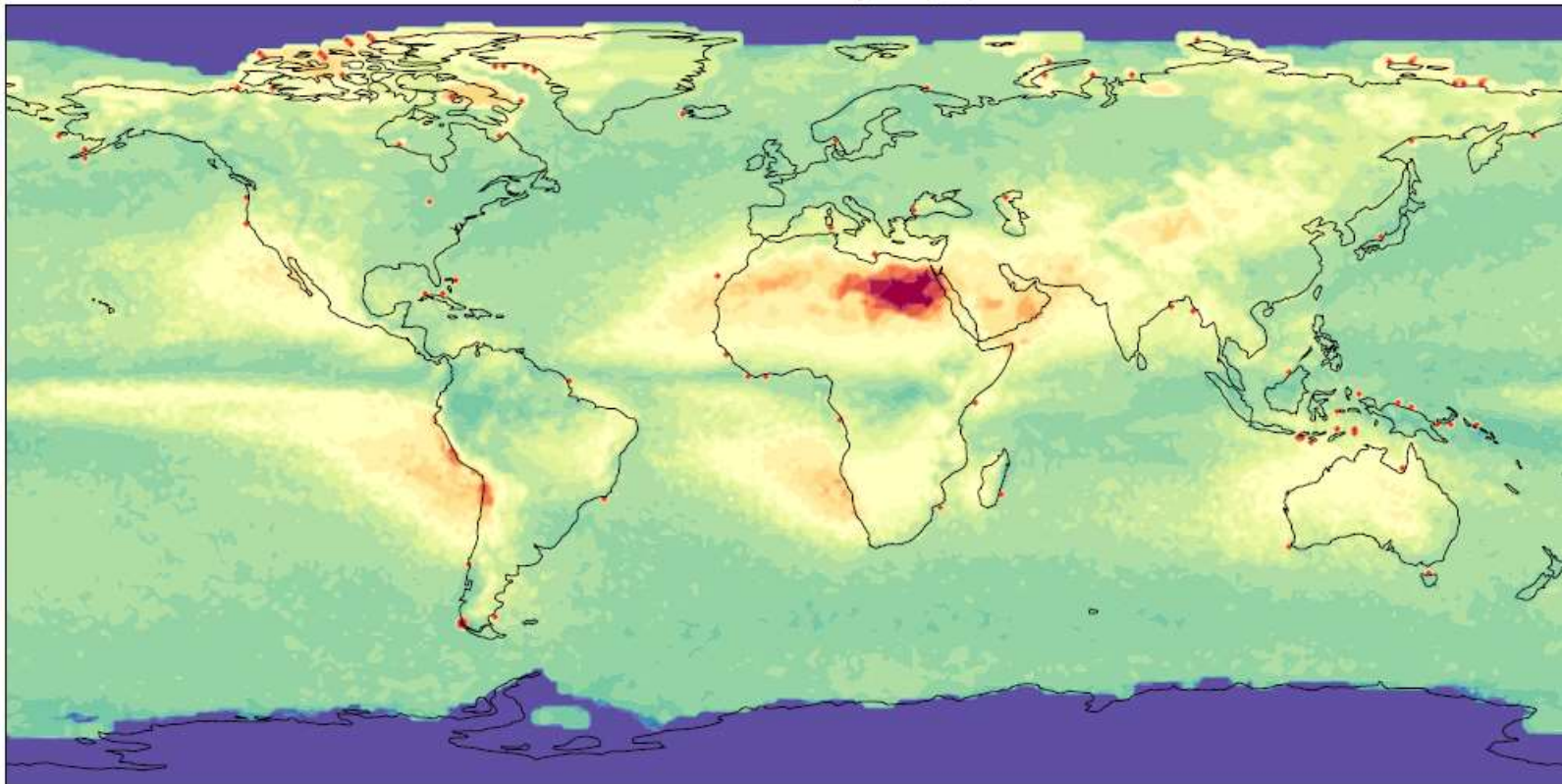
- Publish data set and disseminate through DOI references on GPCC web-portal
- Extend analysis to allow for trend assessments



Dietzsch, F., Andersson, A., Schamm, K., Schröder, M., and A. Becker, 2014: Global daily precipitation analysis for the validation of medium-range climate predictions (DAPACLIP), [Geophysical Research Abstracts, Vol.16, EGU2014-14363](#)

Daily resolving observational data sets allow for assessments on precipitation extremes and hydro-climatological intensity (ETCCDI, Klein-Tank et al., 2009) and model evaluation (Dietzsch et al., EGU2015-3334)

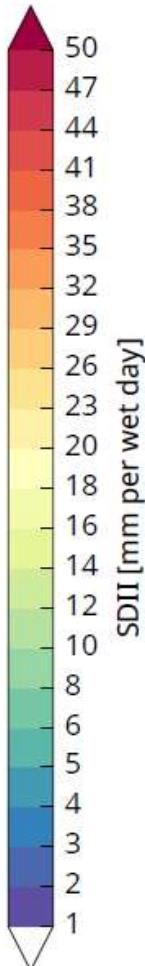
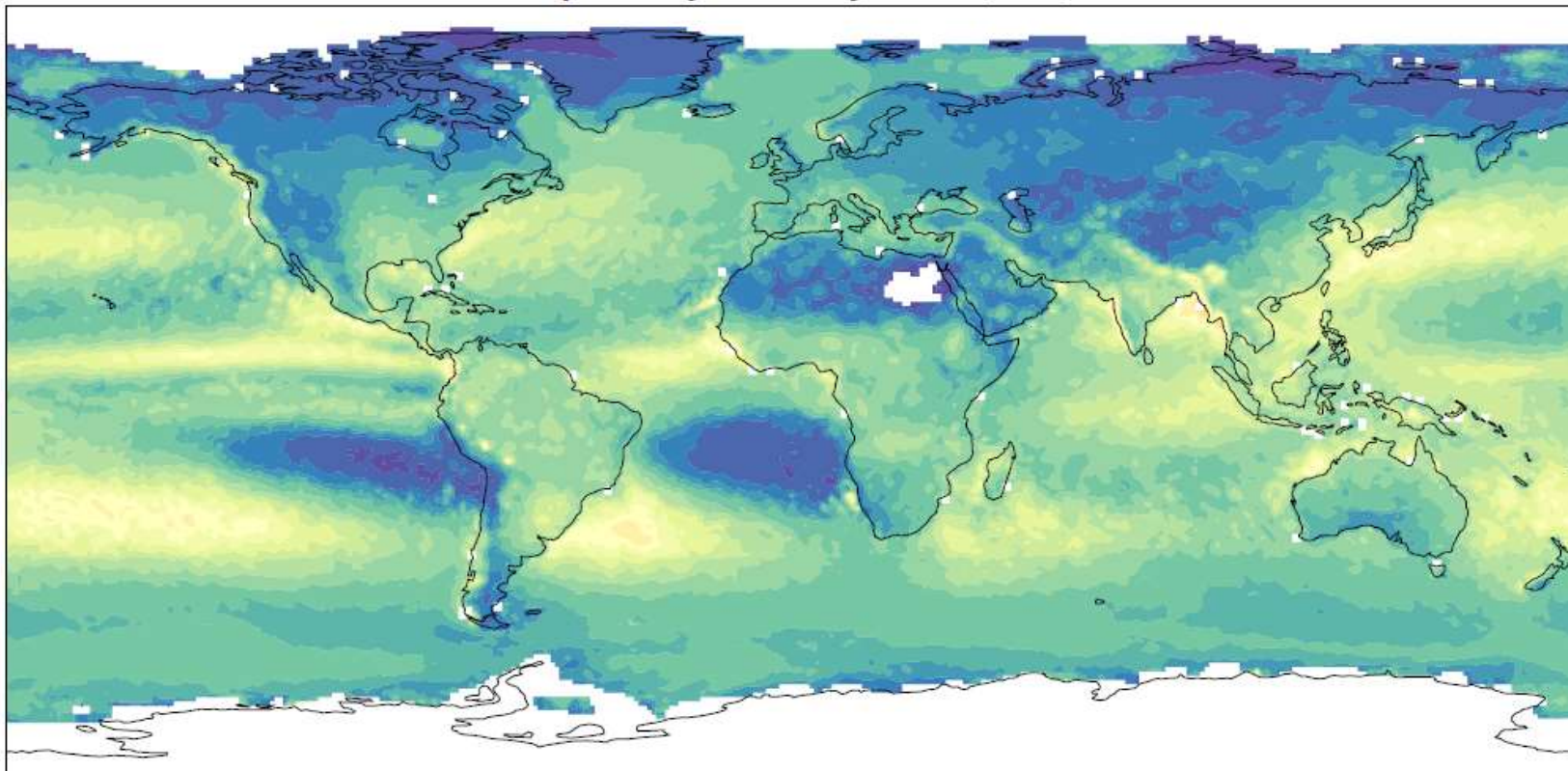
DAPACLIP Consecutive Dry Days, 1998-2008



Klein-Tank, A.M.G., F.W. Zwiers and X. Zhang, 2009: Analysis of extremes in a changing climate in support informed decisions for adaptation., WCDMP-No.72, WMO-TD No. 1500

Dietzsch et al., 2015: Global daily precipitation analysis for the validation of medium-range climate predictions, EGU2015-3334

**Daily resolving observational data sets allow for assessments
on precipitation extremes and hydro-climatological intensity (ETCCDI, Klein-Tank et al., 2009)
and model evaluation (Dietzsch et al., EGU2015-3334)**
DAPACLIP Simple Daily Intensity Index (SDII) 1998-2008

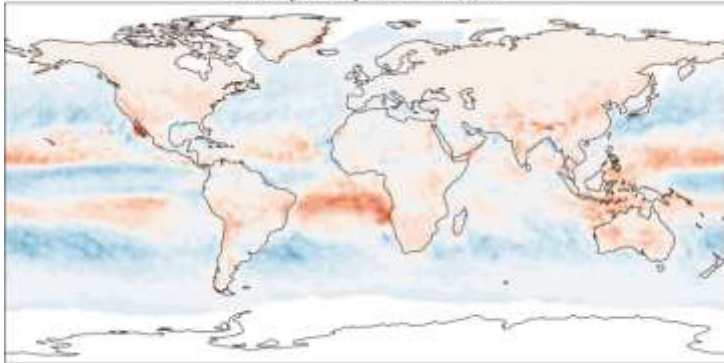


Klein-Tank, A.M.G., F.W. Zwiers and X. Zhang, 2009: Analysis of extremes in a changing climate in support informed decisions for adaptation., WCDMP-No.72, WMO-TD No. 1500

Dietzsch et al., 2015: Global daily precipitation analysis for the validation of medium-range climate predictions, EGU2015-3334

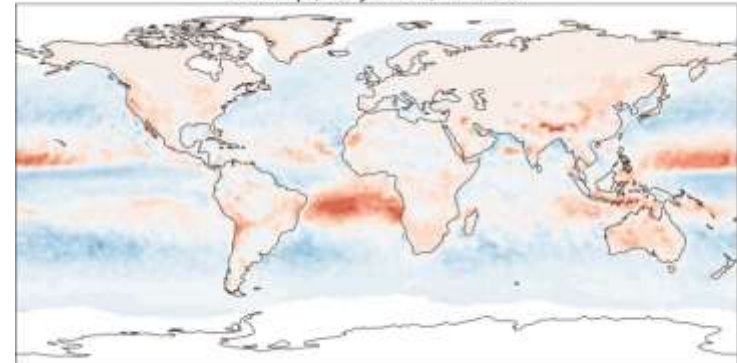
Daily resolving observational data sets allow for model evaluation (Dietzsch et al., EGU2015-3334)

Bias of SDII DAPACLIP vs. Prototype
Ens r1i1p1, lead year 2-5, 1999-2008

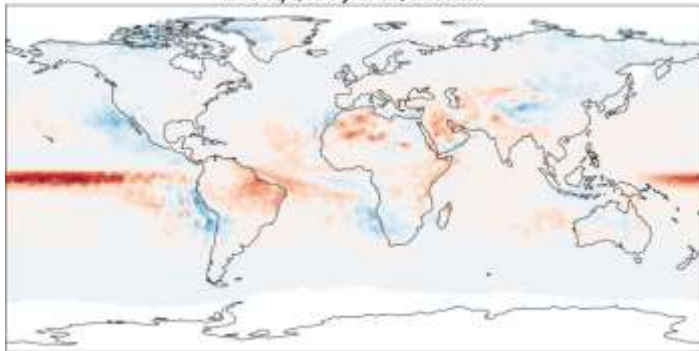


SDII

Bias of SDII DAPACLIP vs. Prototype
Ens r1i1p1, lead year 7-10, 1999-2008

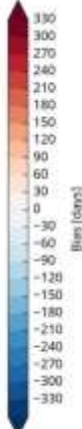
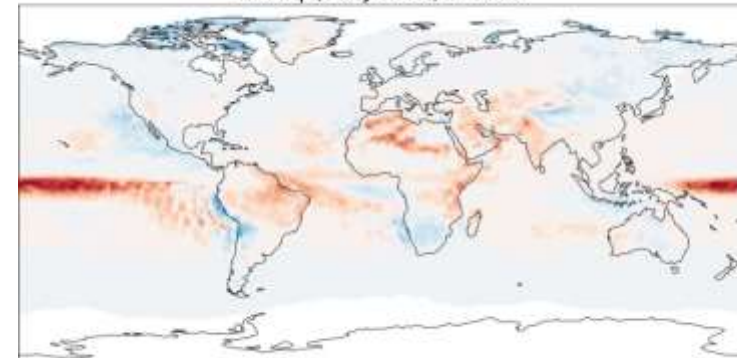


Bias of CDD DAPACLIP vs. Prototype
Ens r1i1p1, lead year 2-5, 1999-2008



CDD

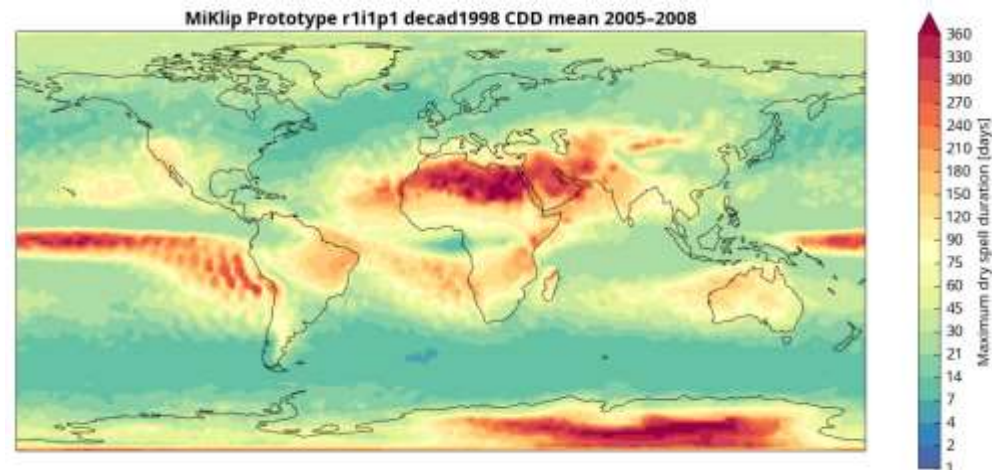
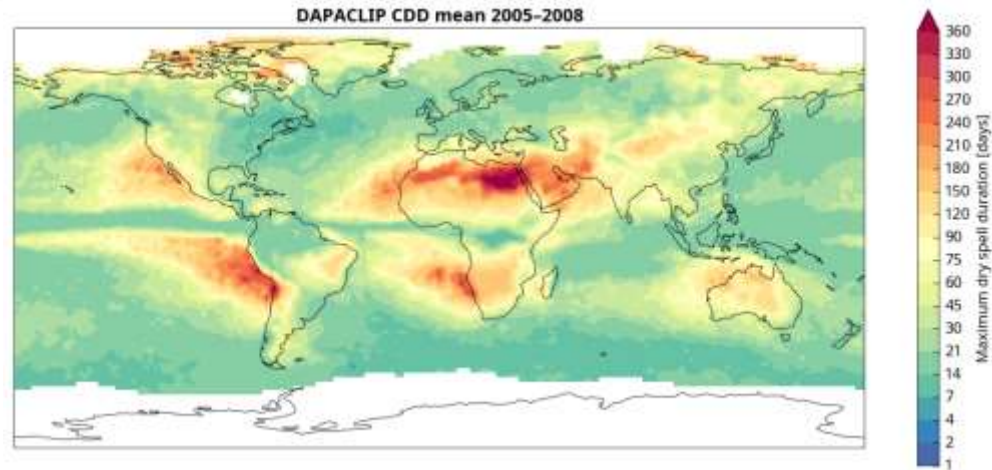
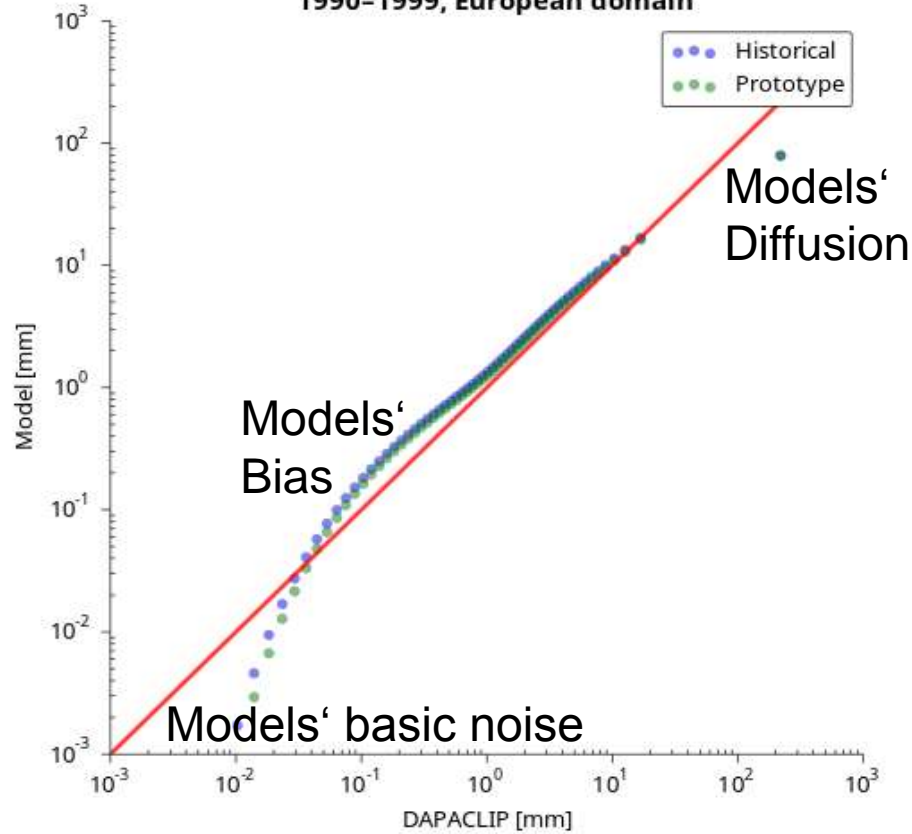
Bias of CDD DAPACLIP vs. Prototype
Ens r1i1p1, lead year 7-10, 1999-2008



Courtesy of Felix Dietzsch, CM-SAF, Deutscher Wetterdienst

Daily resolving observational data sets allow for (decadal) model evaluation (Dietzsch et al., EGU2015-3334)

Percentiles DAPACLIP vs. Historical r1i1p1 vs. Prototype Gecco2 r1i1p1
1990–1999, European domain



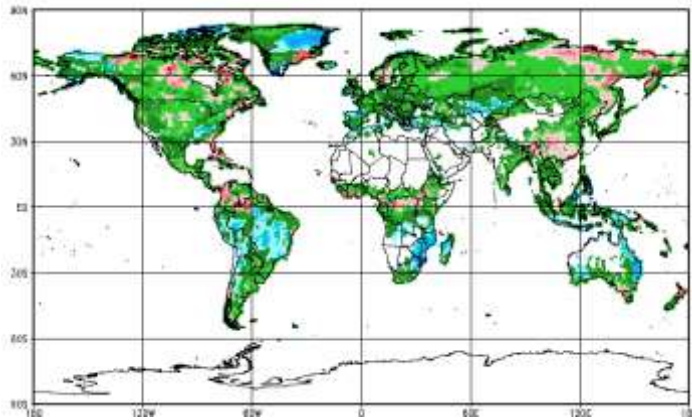
Courtesy of Felix Dietzsch, CM-SAF, Deutscher Wetterdienst



III. GPCC drought index went operational

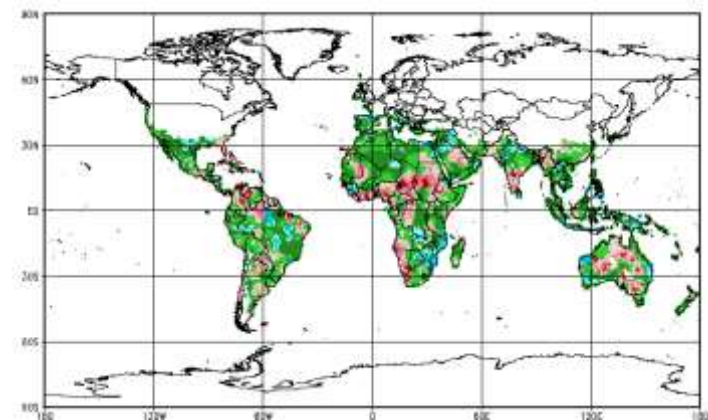
- GPCC_DI: gridded drought index with nearly global coverage
- combination of SPI-DWD and SPEI
- precipitation data from GPCC; First Guess Product
- monthly mean temperature from CPC
- uses mean of SPI-DWD and SPEI, if both can be calculated, otherwise the one which can be computed
- parameters derived from Full Data Reanalysis V.6, period 1961-1990
- several averaging intervals: 1, 3, 6, 9, 12, 24 and 48 months
- using gridded fields, no interpolations → areas with no data possible
- analysis from January 2013 until present
- provided as netCDF-files
- updated 10 to 13 days after each month
- DOI: [10.5676/DWD_GPCC/DI_M_100](https://doi.org/10.5676/DWD_GPCC/DI_M_100)

III. Example GPCC drought index, January 2013, 1 Month



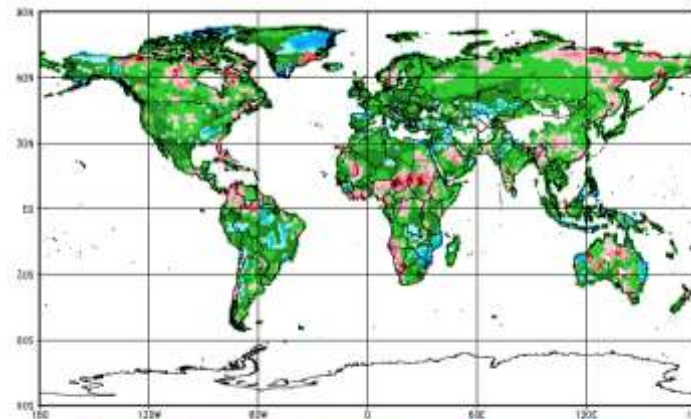
SPI-DWD

+



SPEI

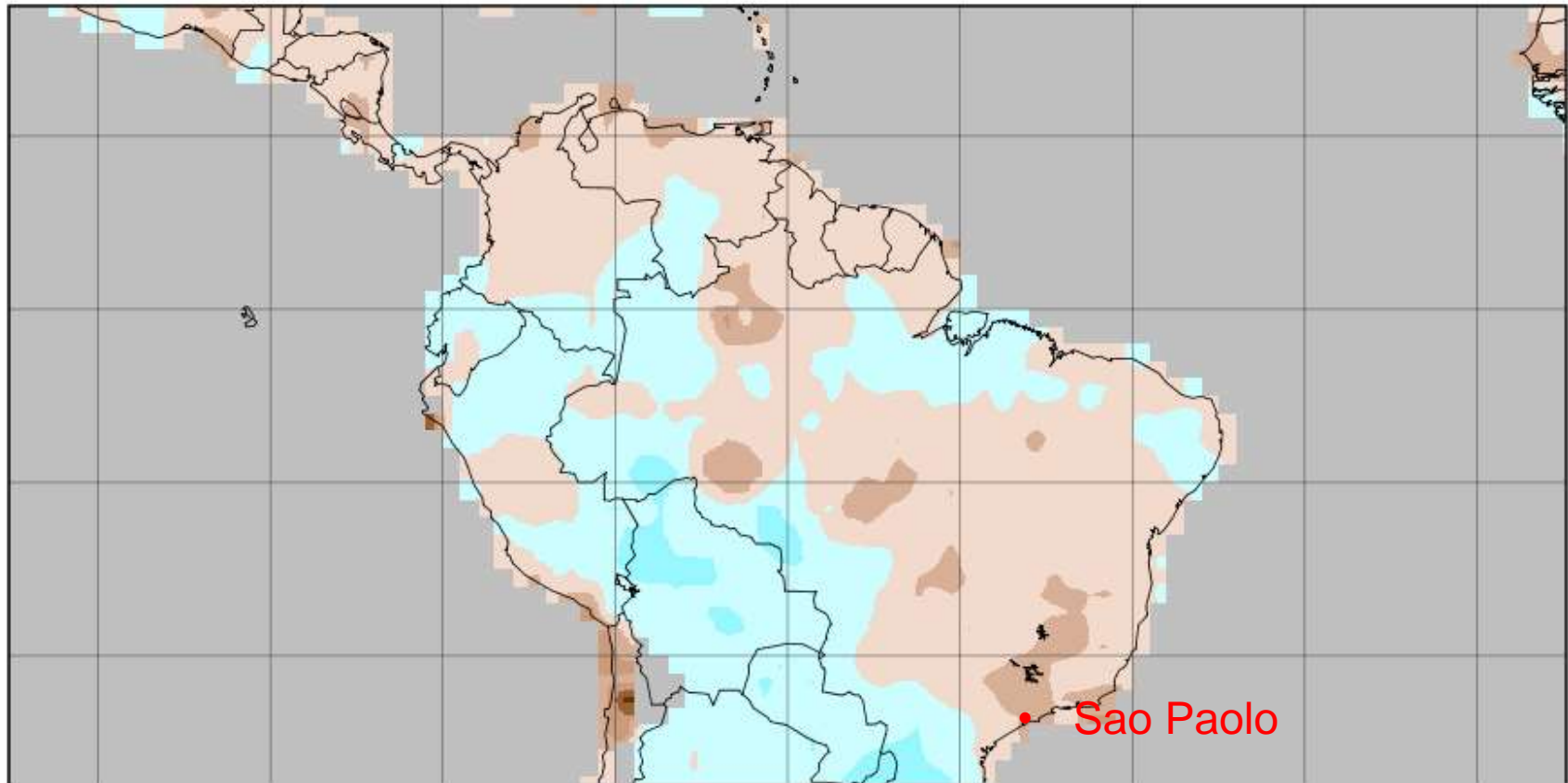
⇒



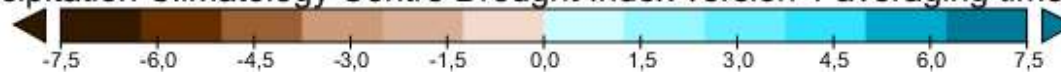
GPCC_DI



III. GPCC drought index for 01.01.-31.09.2014

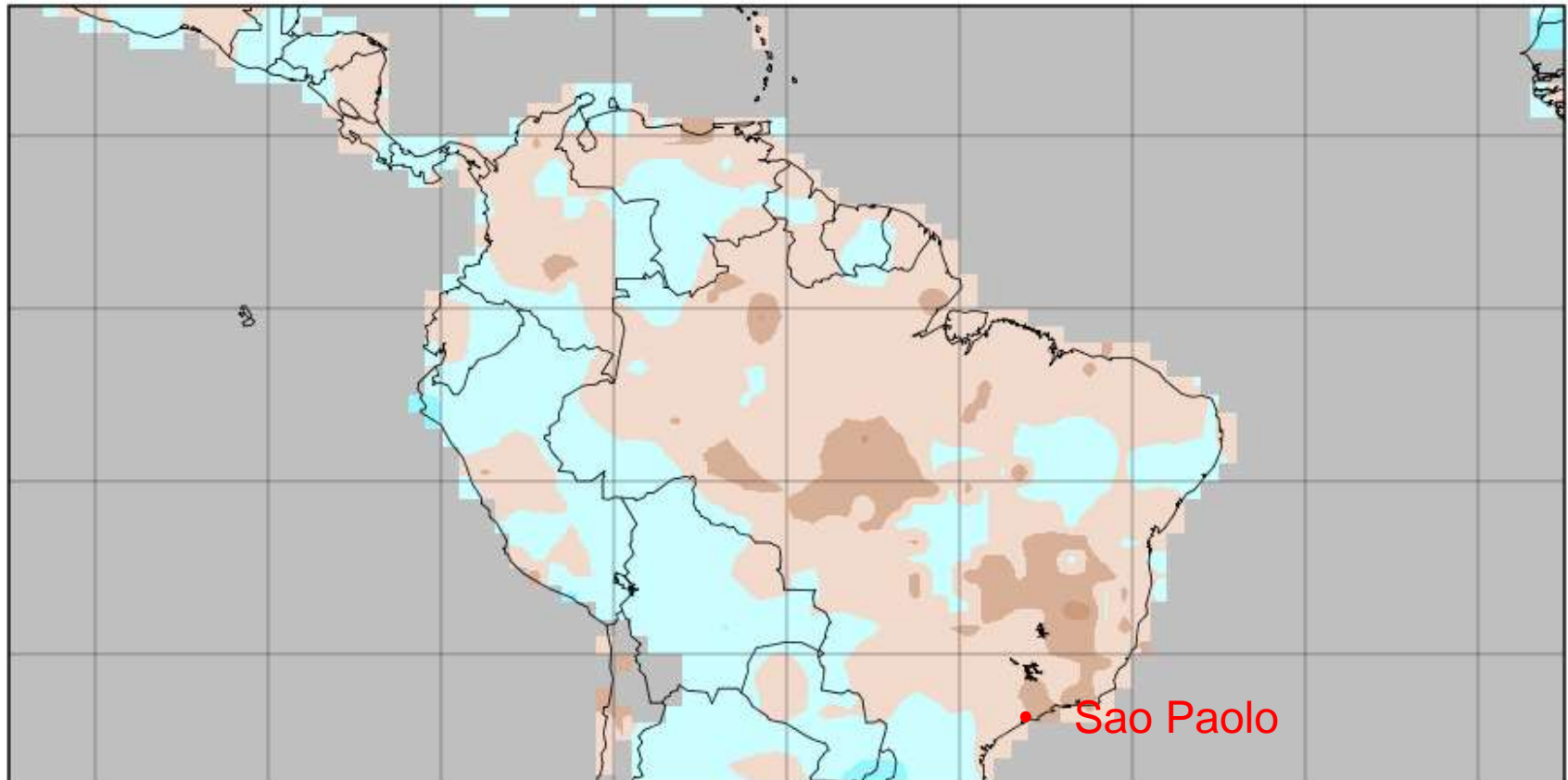


Global Precipitation Climatology Centre Drought Index version 1 averaging time 9 months ()

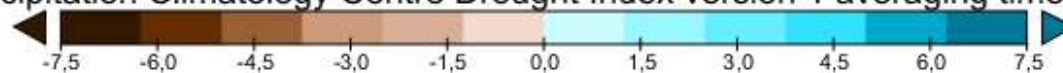


Data Min = -7,63, Max = 5,29

III. GPCP drought index for 01.05.-31.01.2015



Global Precipitation Climatology Centre Drought Index version 1 averaging time 9 months ()



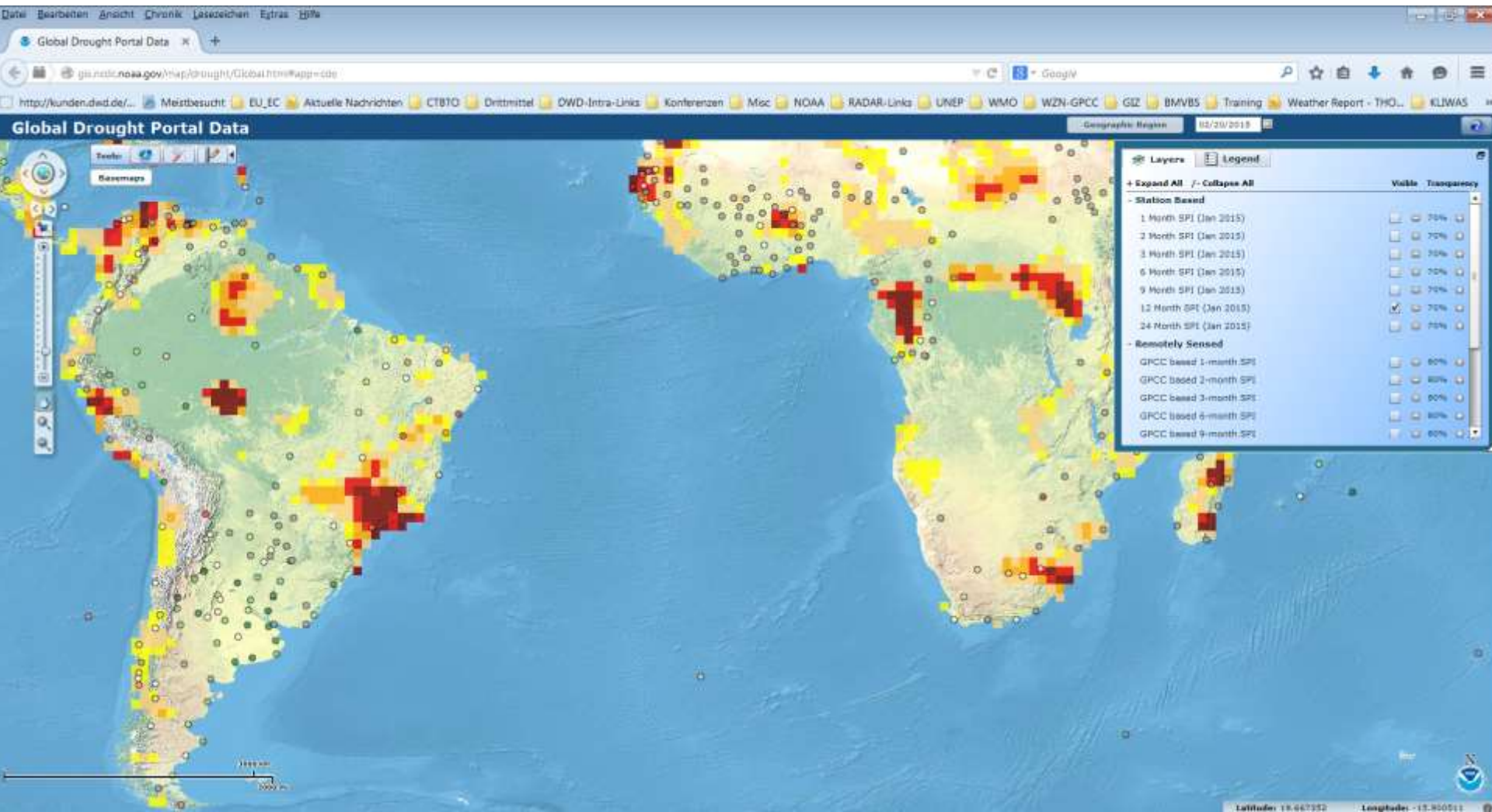
Data Min = -6,51, Max = 5,29



III. GPCCC drought index, netCDF spreads quickly

For example to the **Global Drought Portal Data of NOAA**

<http://gis.ncdc.noaa.gov/map/drought/Global#app=cdo>





Wrap up of GPCC's offers to WCRP in context of GC Extremes

- **GPCC First Guess Daily product** being published. The paper also explains the anomaly method applied on the daily fraction of a monthly total, so that the **daily values are best possible constrained to sum to give the same monthly values as the existing monthly pendant GPCC product**.
- For this quick product GPCC depends on every success in the acquisition of CLIMAT and SYNOP based precipitation records through WIGOS and WIS. Moreover GPCC has gone into contacts with the GEOSS Water community in order to **build up in-house capacities with regard to data acquisition and harvesting through OGC compliant XML standard data like the Water ML 2.0 one**. It has also noted with appreciation, that WMO Secretariat is also following closely this interesting development in the field of web technologies.
- A first historical bi-decadal daily precipitation product covering years 1988-2008 has been completed through a German funded DAPACLIP project. **GPCC** and **CM_SAF** are about to operationalize this product to fill the gap until the present years and to extend the product back in time as much as is feasible, given the input data situation.
- GPCC is about to rationalize its data acquisition to reach required capabilities in daily data processing. In striving for this it has established contacts with ECMWF and jointed a PPP consortium that bids on the recent JRC tender for the EFAS Met. Data Acquisition Centre.





Wrap up of GPCC's offers to WCRP in context of GC Extremes

GPCC commenced calculation of the HOMogenized Precipitation Analysis (HOMPRA) for the Europe. A first release confined to Europe scheduled for Q2-2015, a global version to follow. Since VasCLIMO no homogenized data set really ready for trend analysis has yet been published, but the reason is simply the feasibility at the given data situation.

When it comes to daily or sub-daily data, rescue, acquisition and QC of the data are mandatory but **tedious tasks if you do it seriously**. In this context GPCC is highly appreciative for activities of other actors in the field, such as ECA&D of KNMI, GHCN of NOAA, HadCRU of UK Met Office, APHRODITE of Akiyo, all striving for the same goal namely reliable observational data sets at best coverage and quality, with partly different approaches that all have their unique advantages.

For 25yrs GPCC has made good experiences in data mobilization through the waiver of any claim on copyrights, while clearly understanding the caveats implied for those part of the user community that want to repeat the entire data processing process before making their own science.

However, GPCC has and will always ask data providers to make their data public available AND picks data from sources where this has already been achieved. With its own intrusive data quality control it still believes to be able to put added value even on public rain gauges data, by putting it under its own QC scrutiny.





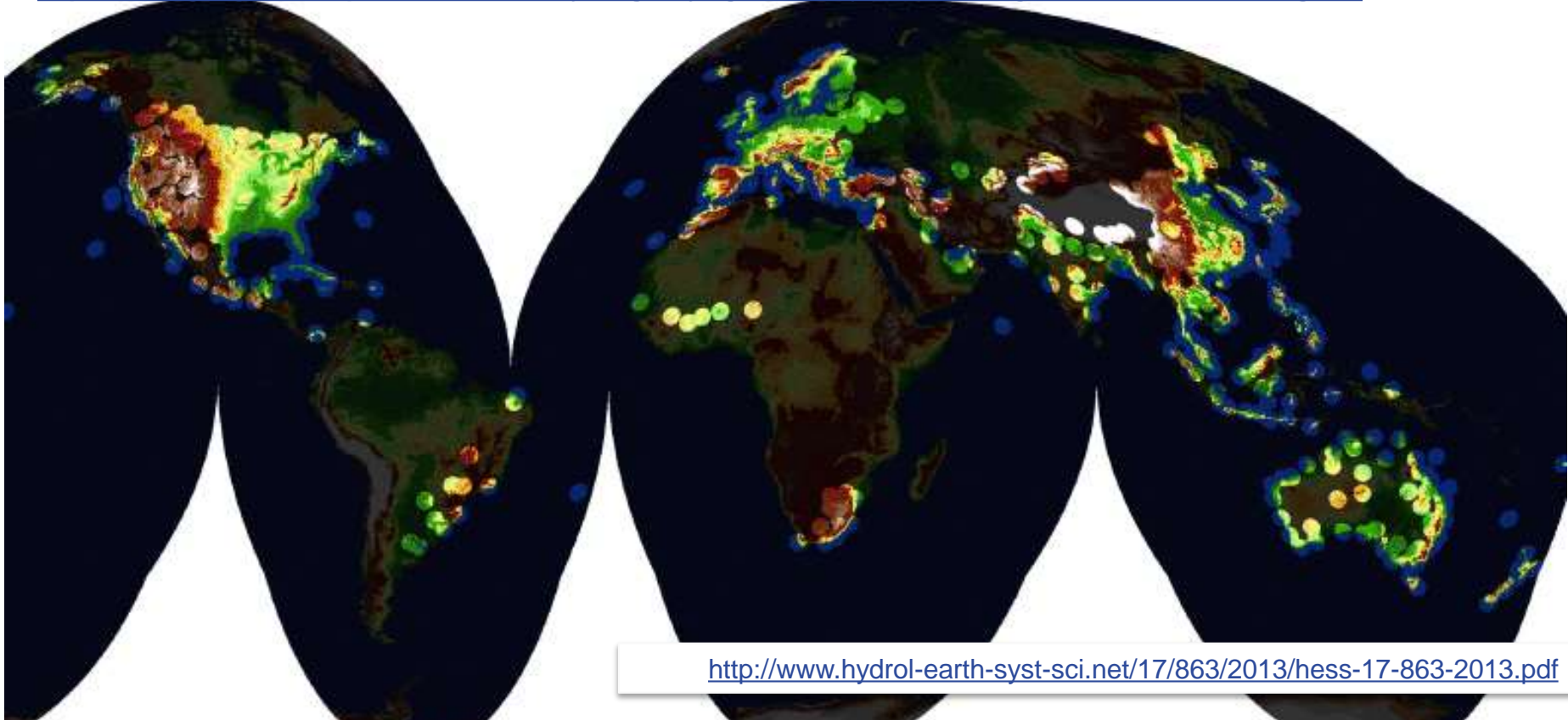
GPCC suggestions WCRP GC and Outlook:

- GPCC is member of the ERA_CLIM2 project and serves reference information to validate the aspired climate quality reanalysis for the precipitation parameter
- For an enhanced data mobilization GPCC supports alternate ways of joint daily data acquisition in cooperation with scientific projects and with activities of the GEO community. In particular the inclusion of OGC compliant XML standards has an considerable potential to attract data suppliers not ready to stand GRIB or BUFR
- Consideration of web-services for data and product dissemination should become an appropriate priority level. GPCC publishes all its data sets in CFnetCDF OGC compliant format and is ready and open for exchange of requirements and plans to make its products highly interoperable
- On the central European scale, DWD has reprocessed its entire radar data archive to come up with a climate robust high-resolution precipitation re-processing data set. Though this is not feasible everywhere on the globe, the potential of radar data has been mainly untapped for WCRPs GC on extremes

World wide weather radar coverage

> 800 systems listed by Heistermann et al., 2013

<https://docs.google.com/spreadsheet/ccc?key=0AgF2xymgUxK3dC1jakt5LWRhQ1gtVHVEWm5CdTFtR3c#gid=1>



Switching from stations (GPCC) to radar will certainly not improve the global coverage, but certain areas (East Asia, Indonesia, West-Africa) show coverage's in climate regimes extremely relevant to study variability's, trends and extremes

Outlook







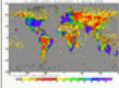
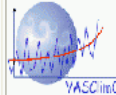
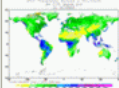

- **Homogenized Precipitation Analysis (HOMPRA)** for 1951-2005 **for Europe** (in cooperation with Met. Institute of Univ. Bonn) is now scheduled to become available in spring 2015, on a global scale later
- **Daily precipitation analyses Full Data Daily** will become available in 2015
- **Merging of daily precipitation analyses with the HOAPS data set is expected in 2015 in the project MIKLIP/DAPACLIP** for the period 1988-2008

Outlook

- Work on an **extension of the improved (weather-dependent) correction of the systematic gauge-measuring error back before 2007 by evaluation of the SYNOP reports is continuing**
- **The next release of GPCC's product portfolio (Precipitation Climatology, Full Data Reanalysis V.7 for 1901-2013, Monitoring Product) is scheduled for spring 2015**



Visualize and Download GPCC Products

<i>First Guess Daily</i>		<i>First Guess (monthly)</i>	
	GPCC First Guess Daily Product with gridded precipitation data sets for Day/Month/Year at 1.0 ° [more]		GPCC First Guess Product with gridded precipitation data sets for Month/Year at 1.0 ° [more]
<i>Monitoring Product</i>		<i>Full Data Reanalysis Version 6 (dec. 2011)</i>	
	GPCC Monitoring Product with gridded precipitation data sets for Month/Year at 1.0 ° resp. 2.5 ° [more]		GPCC Full Data Reanalysis (V.6 1901-2010) with gridded precipitation data sets at 0.5 °, 1.0 ° and 2.5 ° [more]
<i>GPCC Drought Index Product</i>			
	GPCC Drought Index Product (GPCC_DI) at 1.0° Globally Gridded Drought Index with averaging periods 1,3,6,9,12,24,48 months [more]		
<i>Precipitation Climatology</i>		<i>VASClimo Dataset</i>	
	GPCC precipitation normals (Version 2011) with gridded precipitation data sets for calendar months and the annual total at 0.25 °, 0.5 °, 1.0 ° and 2.5 ° [more]		VASClimo 50-year Precipitation (1951-2000) with gridded precipitation data sets for Month/Year at 0.5 °, 1.0 °, 2.5 ° [more]
<i>Visualizer</i>		<i>GPCC at DWD</i>	
	Access to the GPCC Visualizer, with witch you can create maps in your own coordinates and parameters [more]		Detailed information about GPCC (in high performance cases temporarily not available) [more]

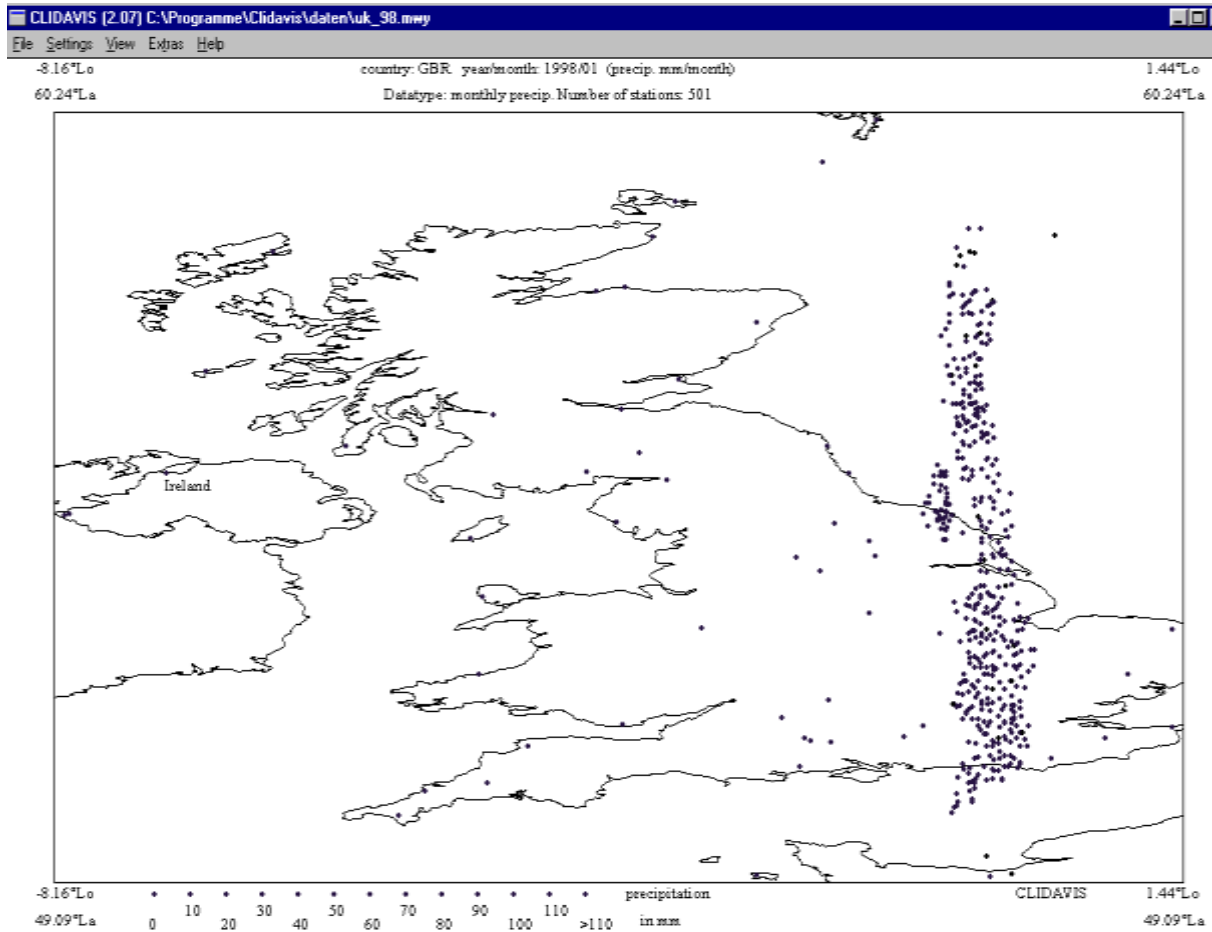
**Thank you
for
your attention!**

<http://gpcc.dwd.de>

ftp://ftp-anon.dwd.de/pub/data/gpcc/html/download_gate.html



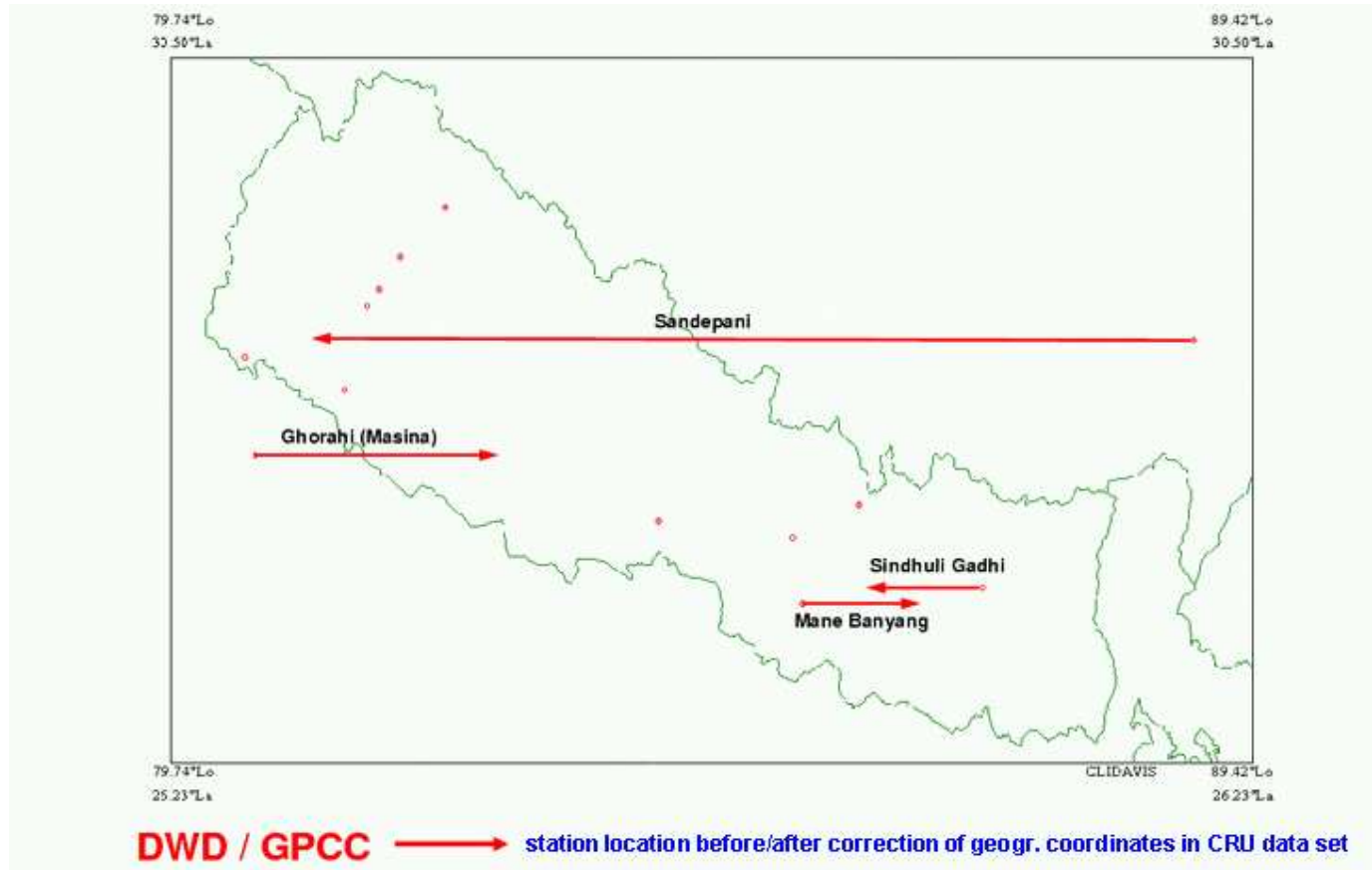
Example of errors



- earlier data set from Great Britain:
- most stations had an incorrect longitude (factor-10) – corrected in the precontrol step

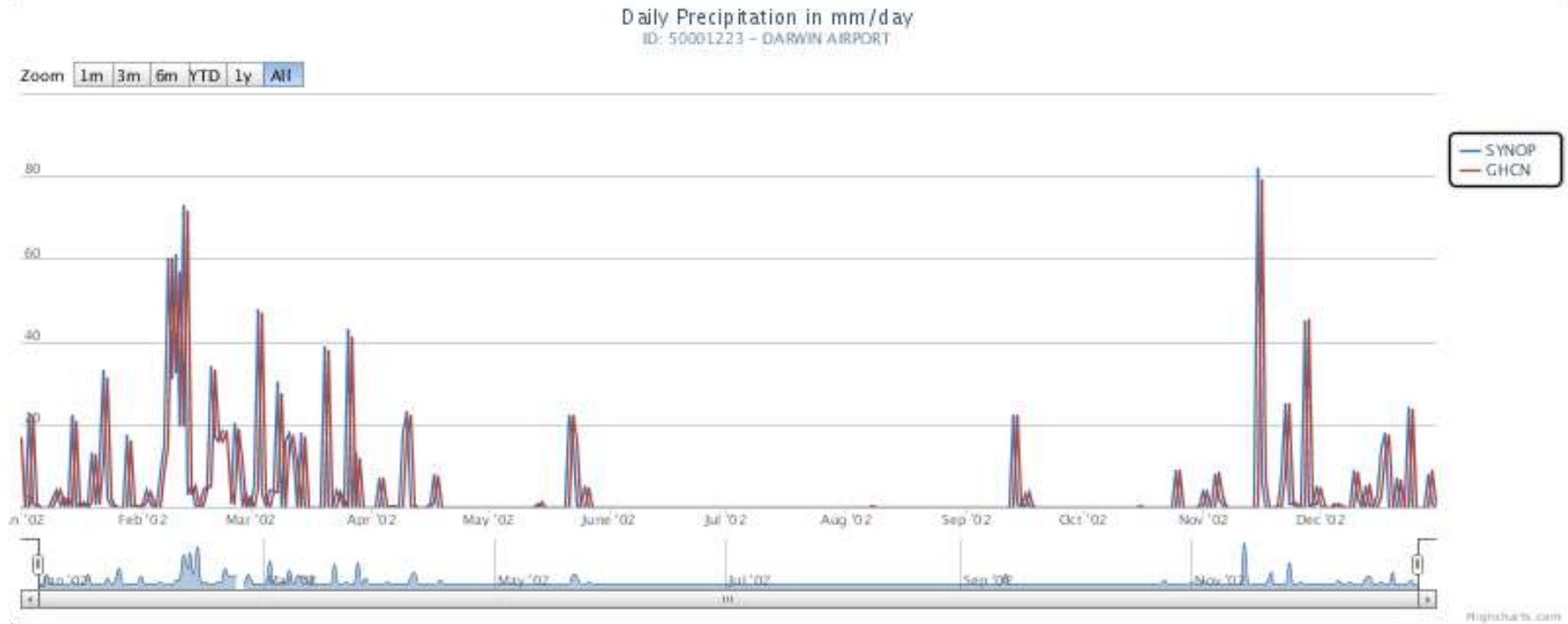
Example of errors

→ Wrong metadata (longitude)



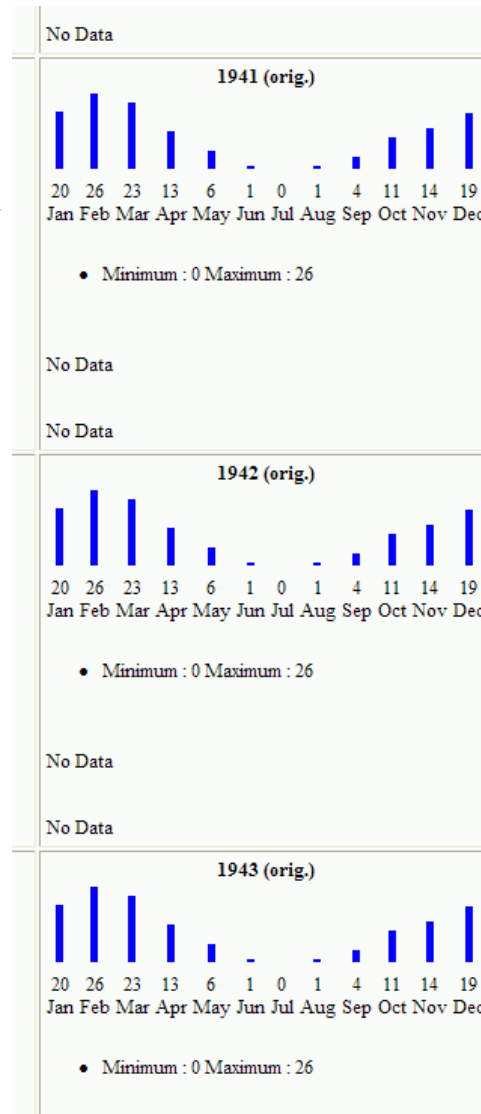
Example of errors

→ Data shifted by one day



Example of errors

➔ Repeating data from year to year



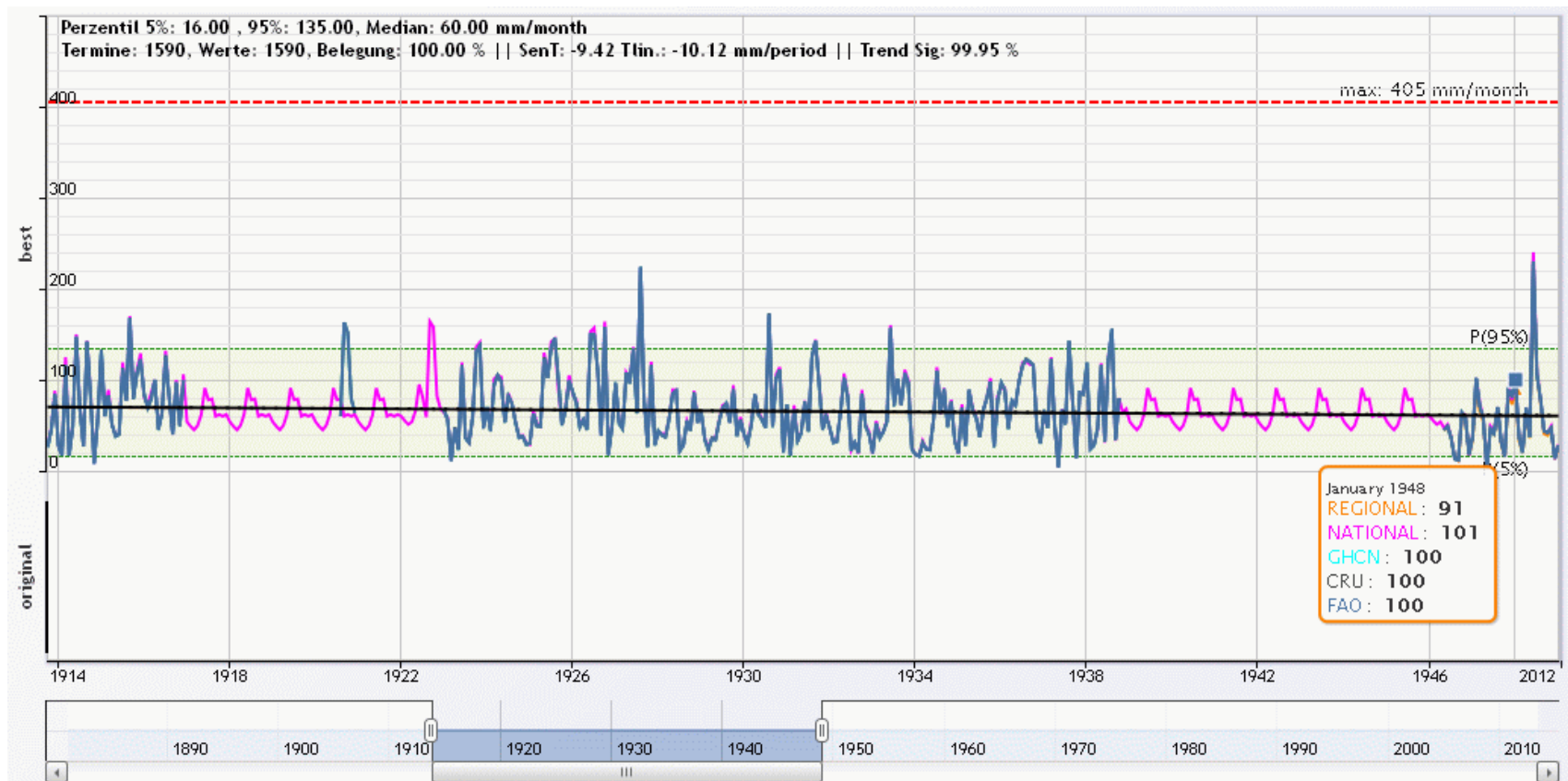
Example of errors

➔ Mix-up of two stations



Example of errors

→ Filled gaps with data from climatology



Example of errors

➔ Shift in time

