

5th GDAP-Meeting, 29 Nov.-01 Dec. 2016, Washington DC., USA

# Status report and outlook of the Global Precipitation Climatology Centre (GPCC)

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Global Precipitation Climatology Centre

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presented by M. Schröder  
(Satellite-Based Climate Monitoring, Deutscher Wetterdienst)

# Outline

**1**

**GPCC background**

**2**

**Data base and data sources available  
(near and non real-time)**

**3**

**Quality-control processing at GPCC and  
some examples for typical data problems**

**4**

**GPCC's portfolio of precipitation analysis products**

**5**

**Outlook**

## GPCC background

- **GPCC was established at the beginning of 1989 at Deutscher Wetterdienst (DWD) on invitation by WMO; now in operation for more than 27 years**
- **GPCC's main task is the archiving and the analysis of precipitation on the basis of in-situ data for the land-surface**
- **It is GPCP's component for the analysis of the in-situ measurements**
- **GPCC is contributing to GEWEX (GHP and GDAP) and GCOS**

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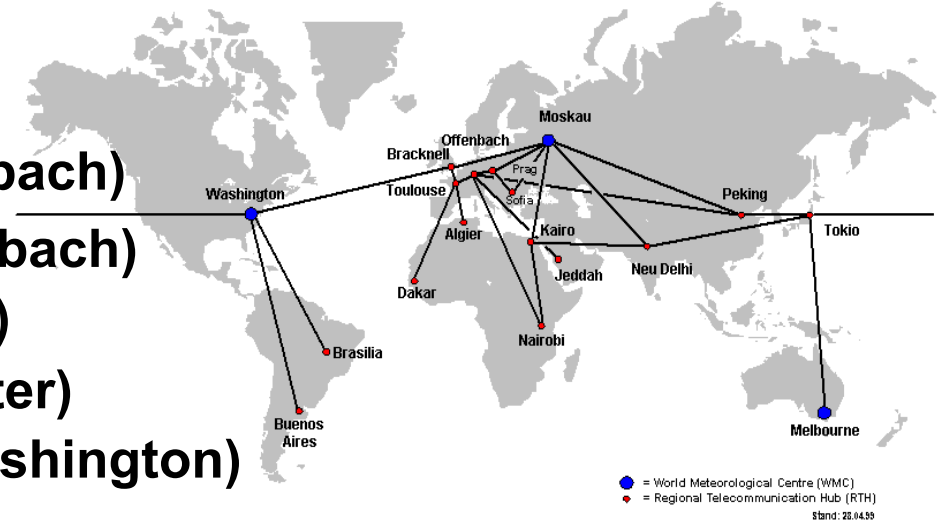
# GPCC data sources

## Near real-time (GTS):

- GTS SYNOP (**DWD RTH Offenbach**)
- GTS CLIMAT (**DWD RTH Offenbach**)
- GTS CLIMAT (**JMA RTH Tokyo**)
- GTS CLIMAT (**UKMO RTH Exeter**)
- SYNOP-based (**NOAA RTH Washington**)

## Main Telecommunication Network (MTN)

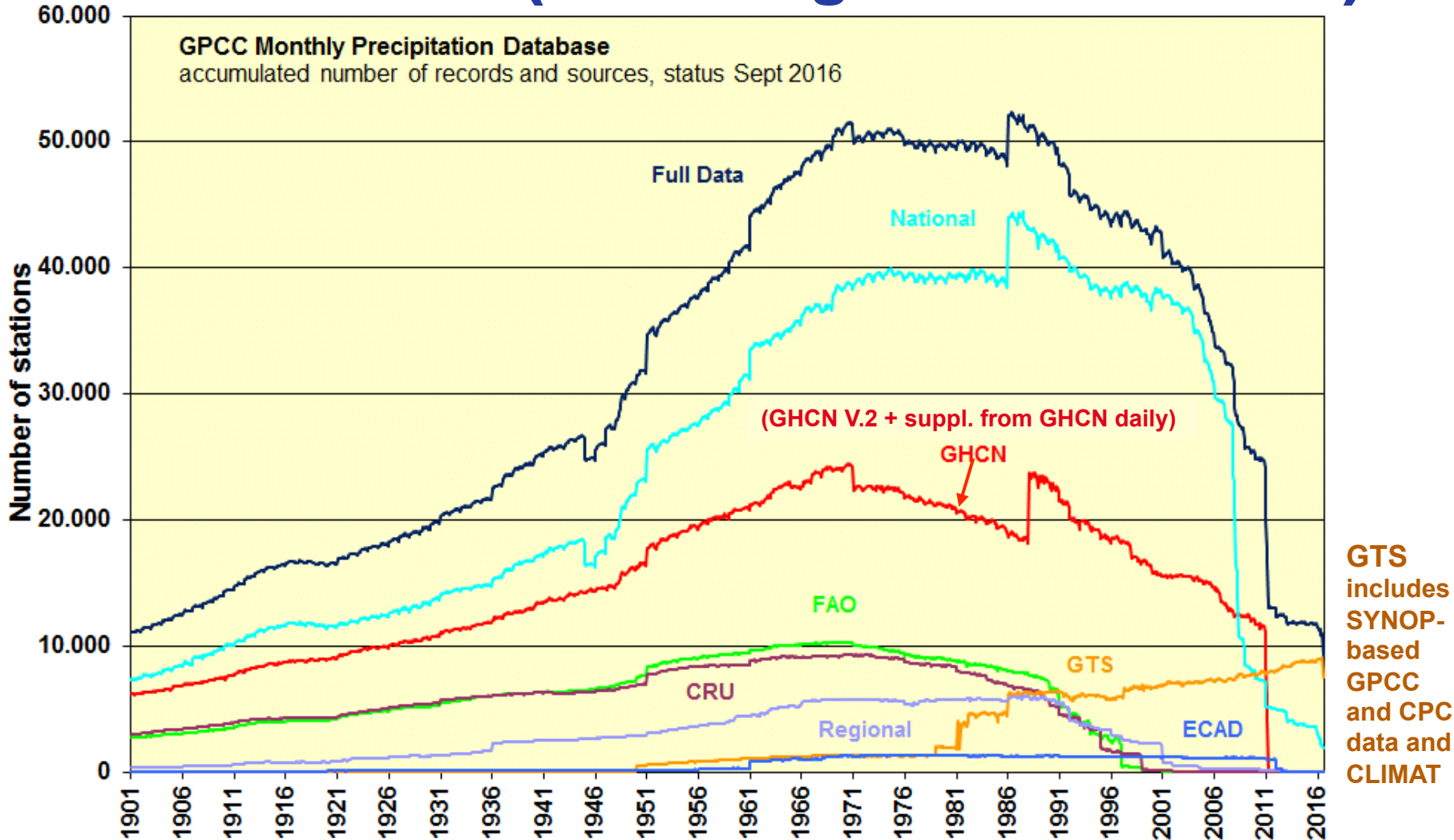
ein globales, standardisiertes Netzwerk zur Verteilung von Wetterdaten innerhalb der WMO Mitgliedsstaaten



## Non real-time:

- Additional data from **ca. 190 countries**
- International project data (**GEWEX-related and other**)
- Historical data collections (**CRU, FAO, GHCN, ECA&D**)  
**+ GHCN daily**

# GPCC data base (according to data sources)



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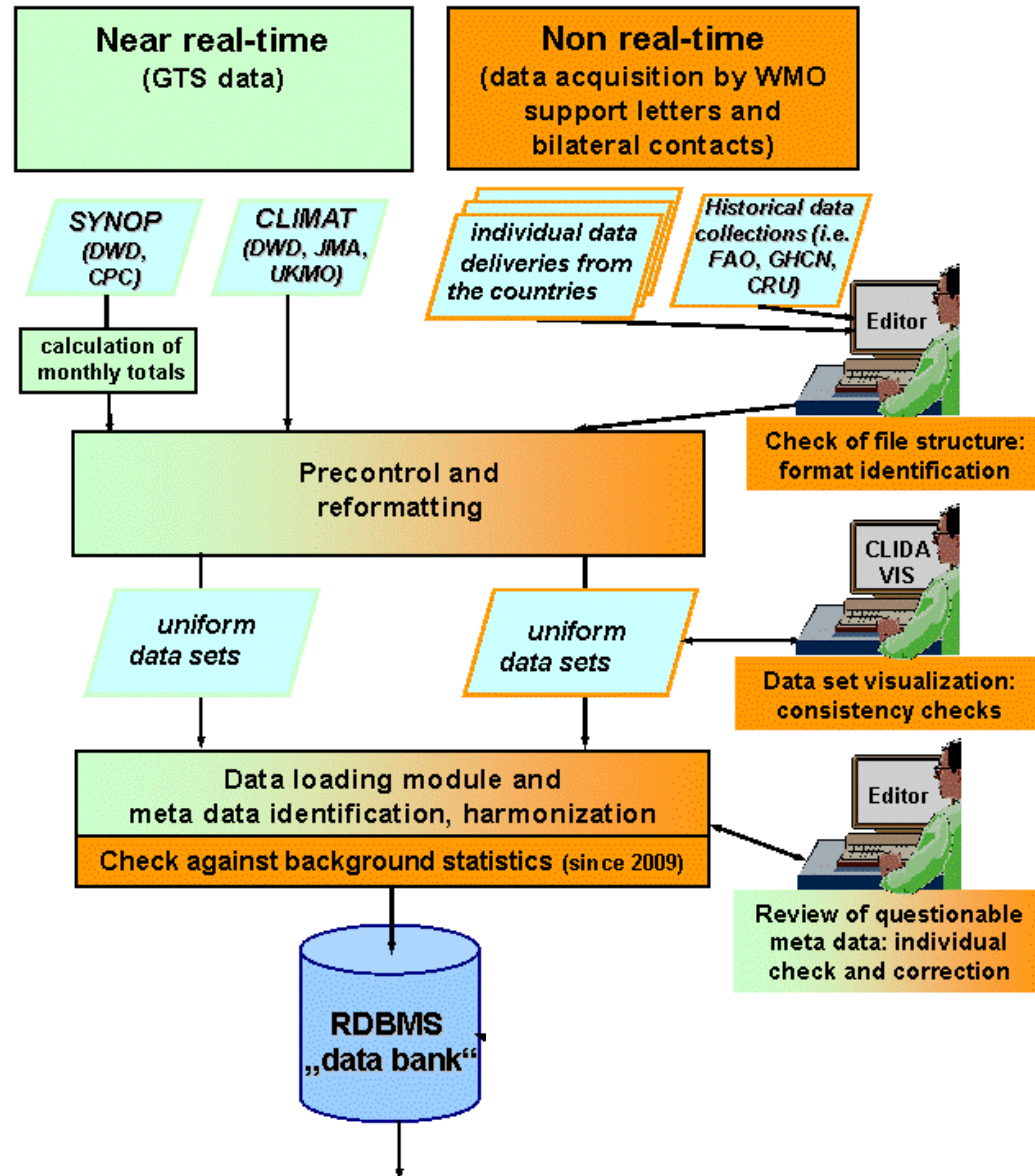
4

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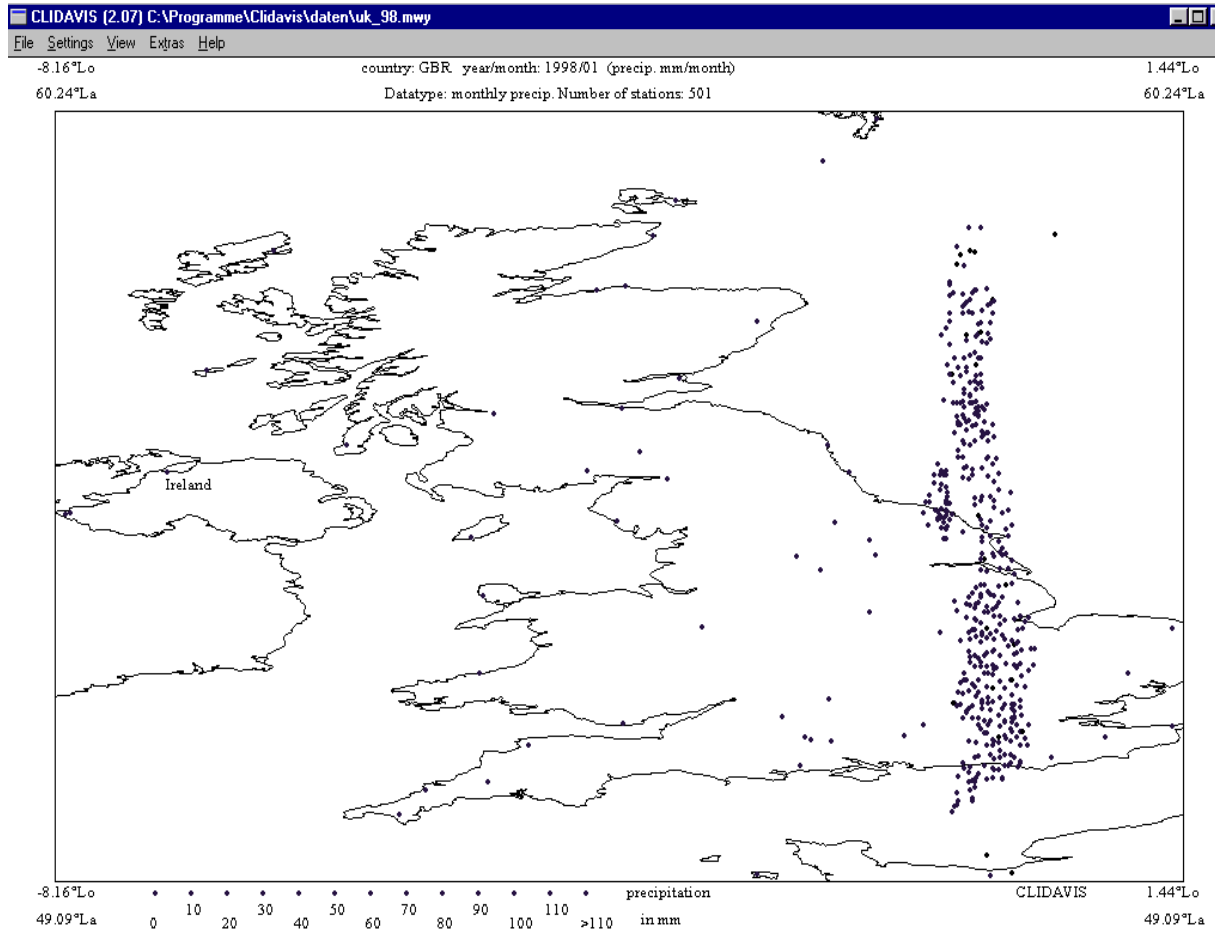
Outlook

# Schematic diagram of QC processing at GPCC (part I)





# Precontrol and reformatting of input data



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

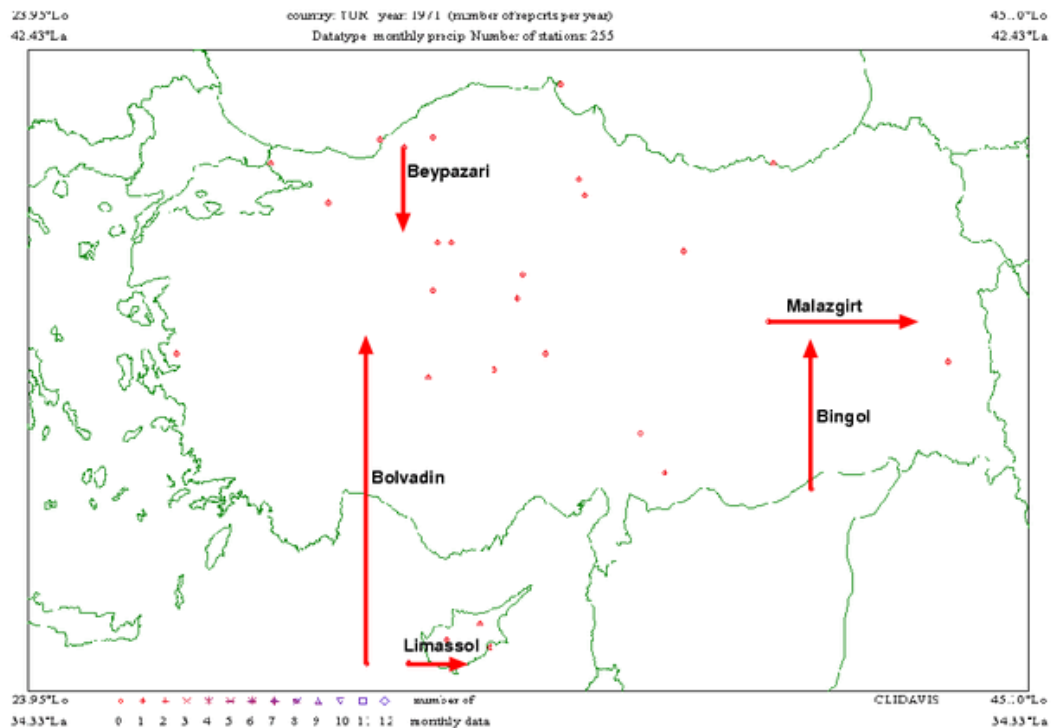
# Checks associated with data loading module upon integration into data base

A sophisticated check of station meta information (*WMO-ID, national number, station name, geographical coordinates and elevation*) is performed when loading station data into the Oracle-based relational data base management system:

- Unequivocal identification of the station data to be loaded is necessary in order to classify:
  - the data belong to a station already existing in the data base
  - the station is a new one
  - it is an unclear case (some information in the data set being loaded is identical with information in the data base, but not all)

All clarified cases are stored in a library (system memory) → the system is learning

# Checks associated with data loading module upon integration into data base



Errors detected in the geogr. coordinates of some stations in **Turkey** in an earlier version of the CRU data set

DWD / GPCC

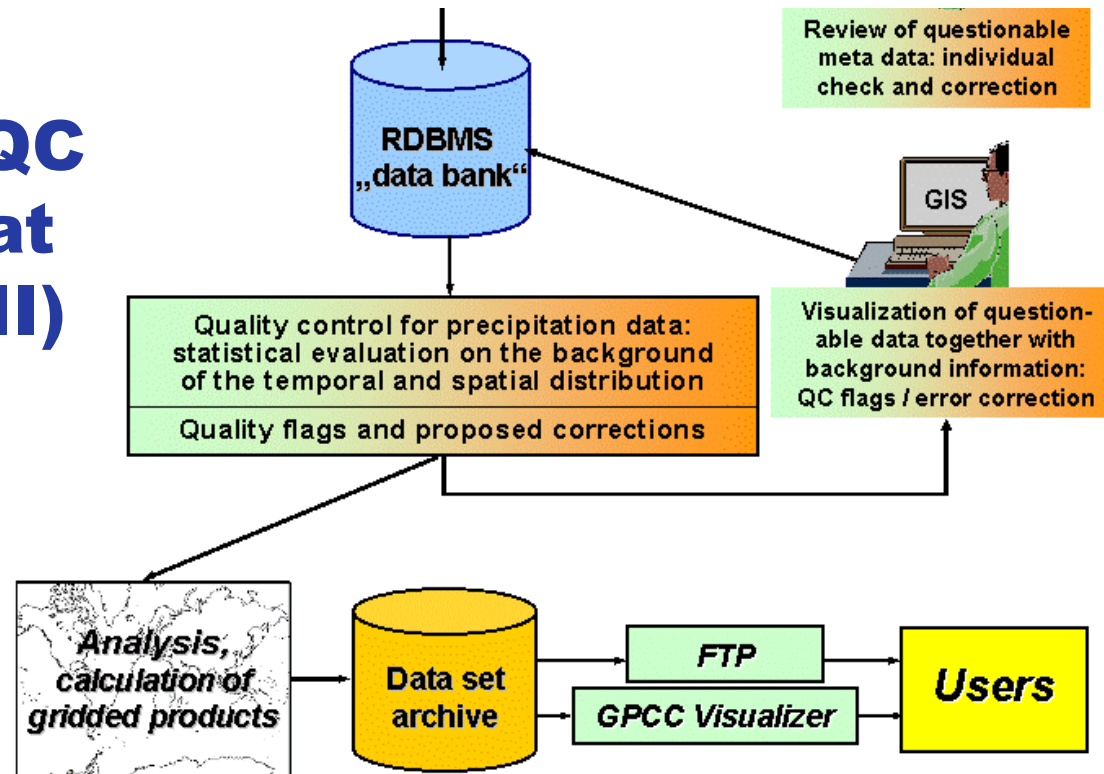
→ before / after correction of geographical coordinates

# Checks associated with data loading module upon integration into data base

All station-related precipitation data are 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 1% or above the 99% percentile) are being checked manually by an expert

# Schematic diagram of QC processing at GPCC (part II)



GPCC's analysis products are generated on the basis of the qc'ed data in the RDBMS (relational data base management system)

# Checks of precipitation data in the data base

**Before generation of each new product release:**

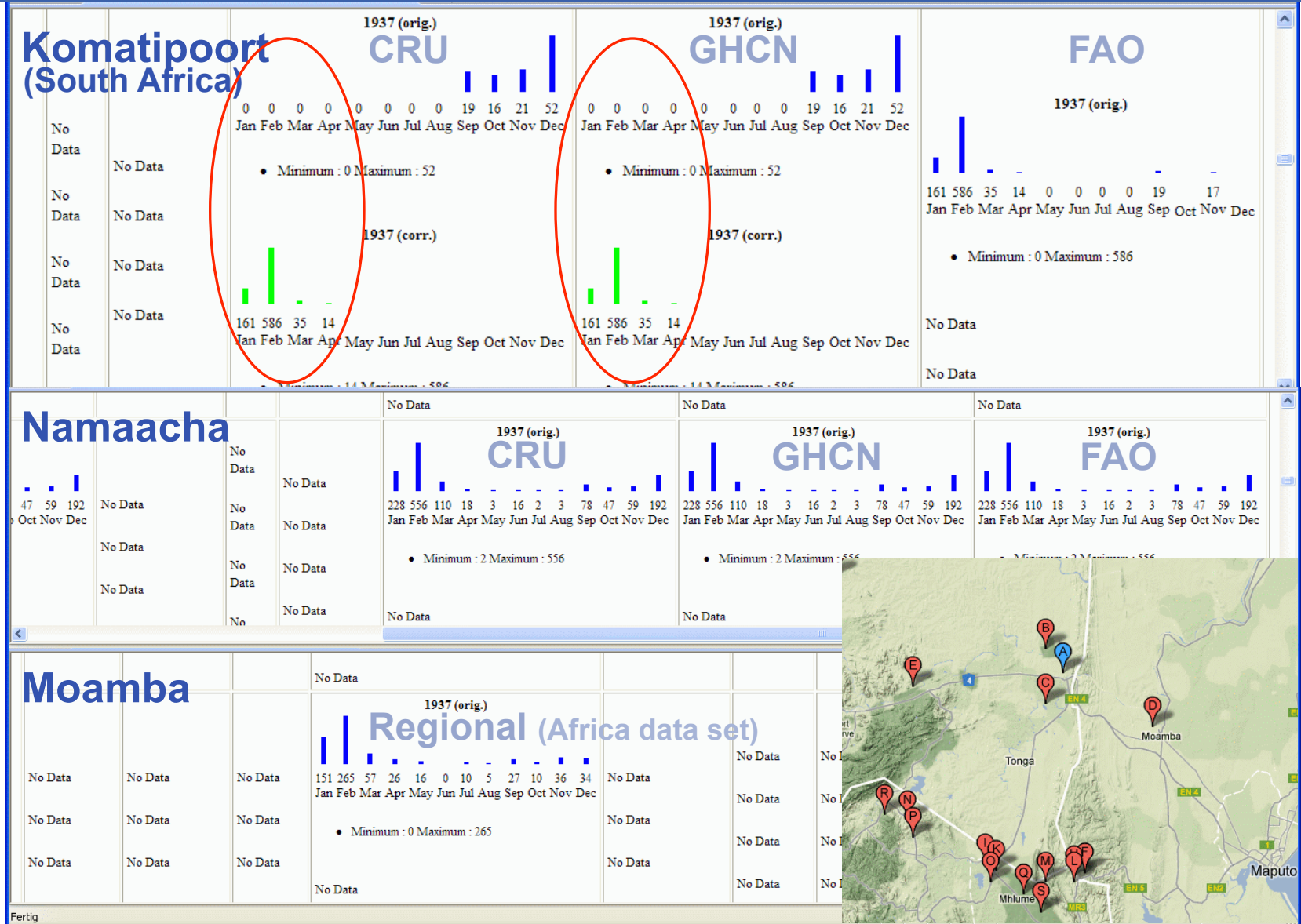
- **Statistical check of the entire data base**
- **Visual check by an expert of the data flagged as questionable**

# Checks of precipitation data in the data base

Typical examples for errors detected in the QC processing:

- Data sometimes shifted by a month, or even a year
- Factor\*10 errors in precipitation rates
- 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“)

# Exemplary manual QC





## QC of precipitation data - Summary

- Almost every large data set is containing more or less frequently erroneous data
- “Bad data” should not simply be thrown away, but corrected where possible (data errors are often obvious and thus can be corrected (*data maybe important in data sparse areas*))

### Important:

- True extreme values must not be eliminated by “QC” (therefore **semi-automatic QC at GPCC**; automatic pre-checks and visual control)
- Corrected data always archived together with the original data
- GPCC is archiving the data from different sources separately in source-specific slots in its relational data base management system (RDBMS) to enable intercomparison of the data from the different sources

➤ **Careful data QC is necessary !!**

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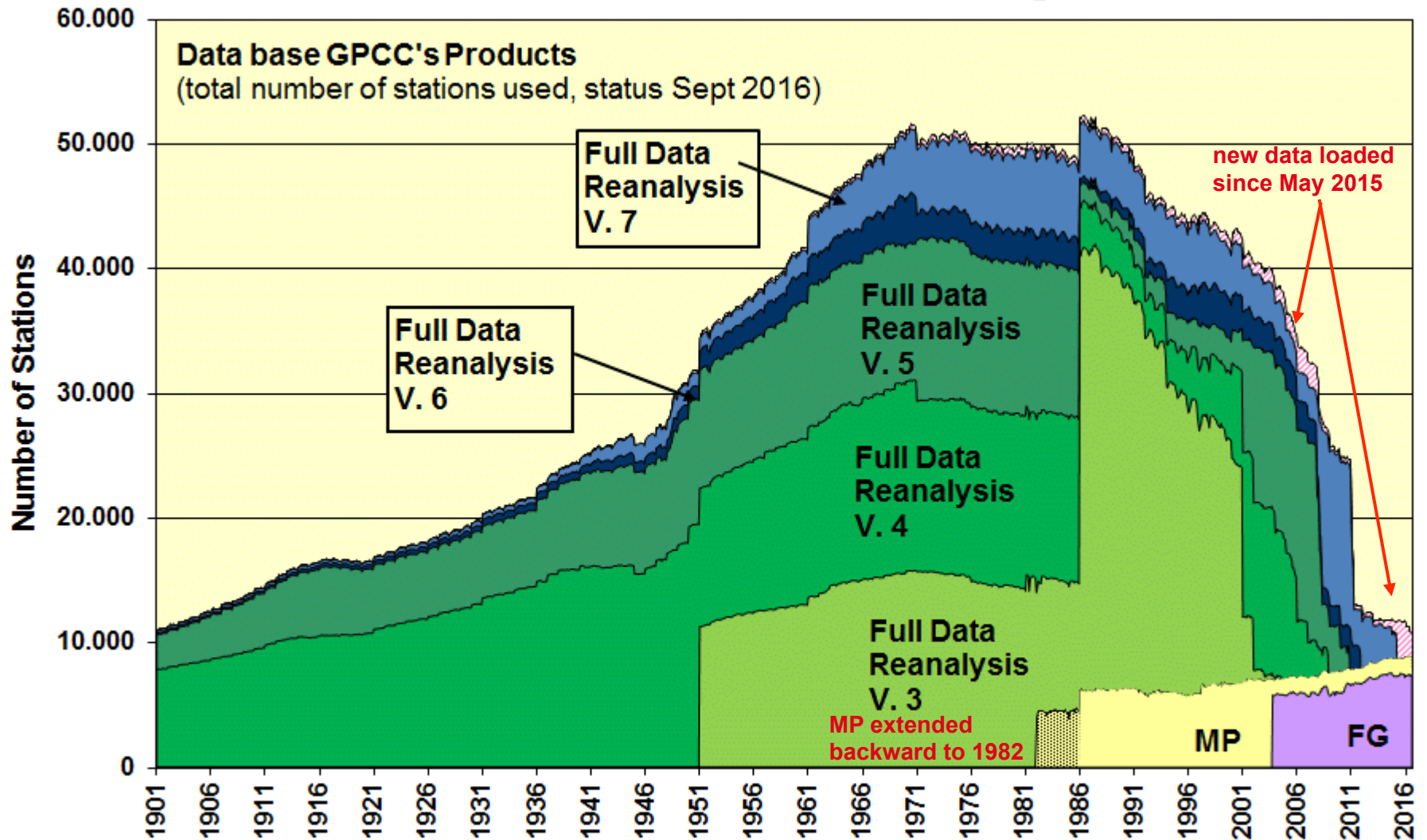
## User requirements

- **Features** of gridded precipitation data as required by the users:
  - **Timeliness** (for drought monitoring)
  - **High resolution** (for regional structures in global maps)
  - **High accuracy** (for verification of model results)
  - **Homogeneity** (for climate change and variability analysis)

All of these requirements cannot be met by one single gridded data set

==> A portfolio of different analysis products has been designed and optimized with respect to the **application purposes**

# Data base for different GPCC products



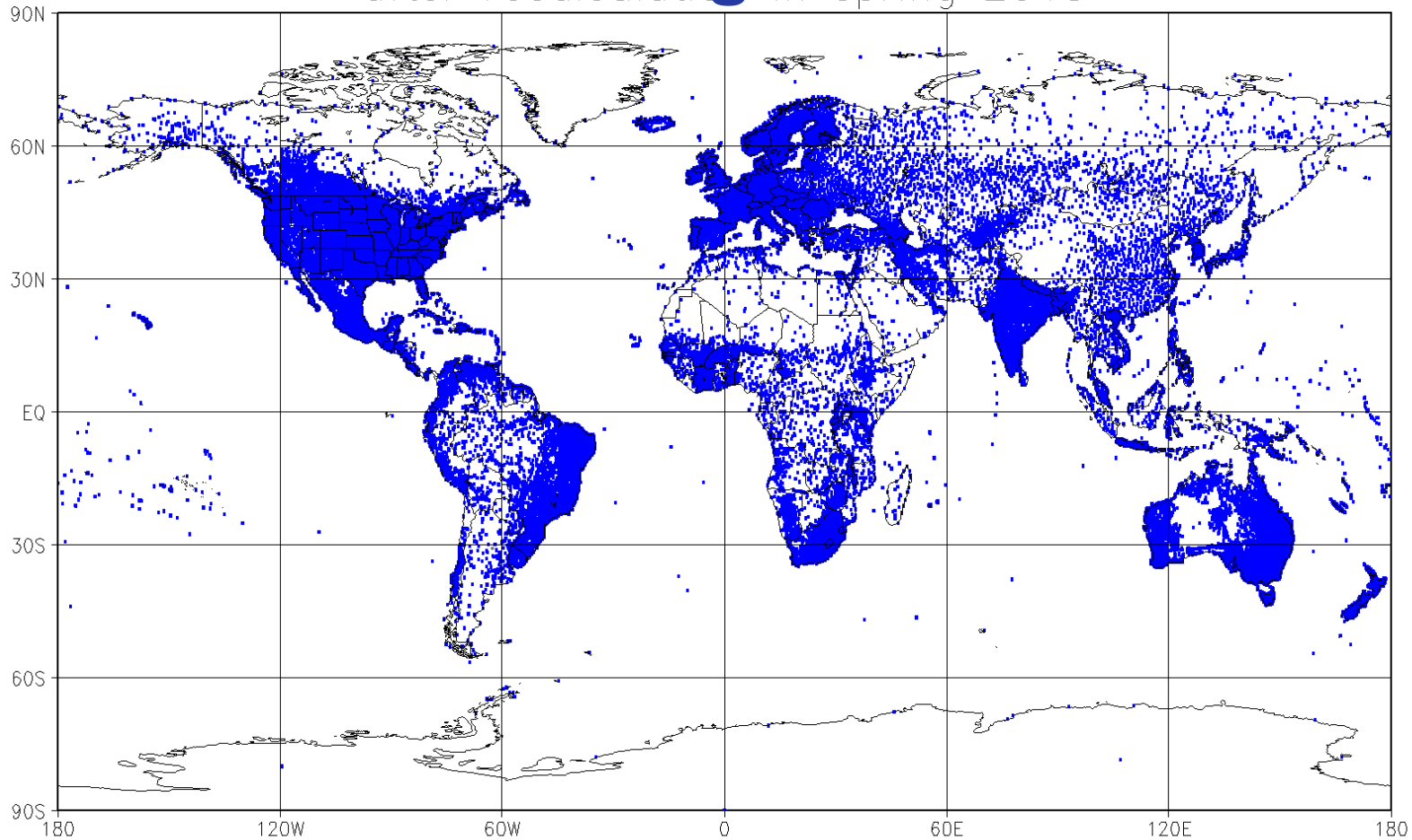
## Near real-time precipitation products

- **GPCC** is providing the following gridded data sets on a **quasi-operational basis** (GTS data base):
  - A **First Guess** Analysis of monthly **Precipitation** available within 5 days after the end of the month via internet, used for **drought monitoring** (e.g. by FAO),  
Period: Oct. 2003 to present  
Data base: ~6,000-7,600 stations
  - The Precipitation **Monitoring Product** available within 2 months, used by GDAP/GPCP as **early in-situ reference** for the near real-time (**new V.5 !!**)  
Period: Jan. 1982 (!) up to present (V.5)  
Data base: ~7,000-9,000 stations

## Non real-time precipitation products

- **From time to time** (after significant enlargements / improvements of the data base) **reanalyses** of the following gridded products are being generated:
  - The **Global Precipitation Climatology (over land) (V. May 2015)**, background for all other GPCP precipitation analysis products, based on ca. 75,100 stations with climatological normals (overall data of more than 110,000 stations in GPCP data base)
  - The **Full Data Reanalysis (V.7, May 2015)**, optimized for high spatial resolution and accuracy, used for model verification and hydrological studies  
Period: Jan. 1901 up to Dec. 2013  
Data base: 11,000-51,000 stations per month  
(overall 75,100 stations included)

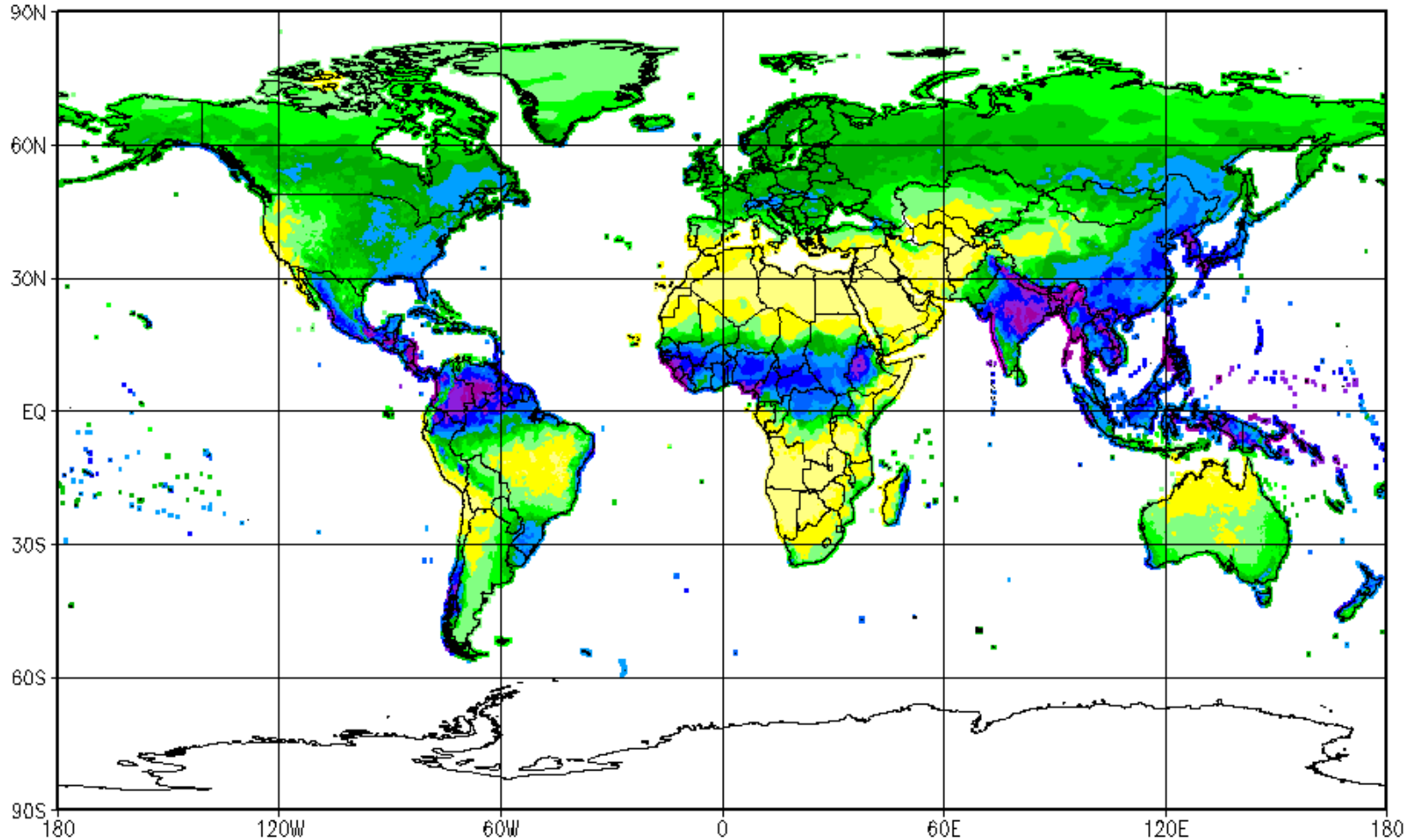
# GPCC Climatological data base



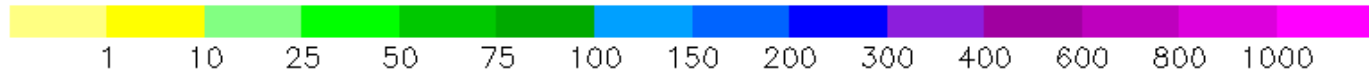
(c) GPCC 2015/05/05 , number of gauges : 75152

**Station data base of GPCC's Precipitation Climatology V.2015 as basis for anomaly analyses (number of stations: ca. 75,100)**

# GPCC's Precipitation Climatology V.2015 for July on a 0.25° grid



(c) GPCC 2016/9/12





## GPCC's Daily Products

With the beginning of 2012 the GPCC started with the acquisition, processing and analysis of **daily** precipitation data

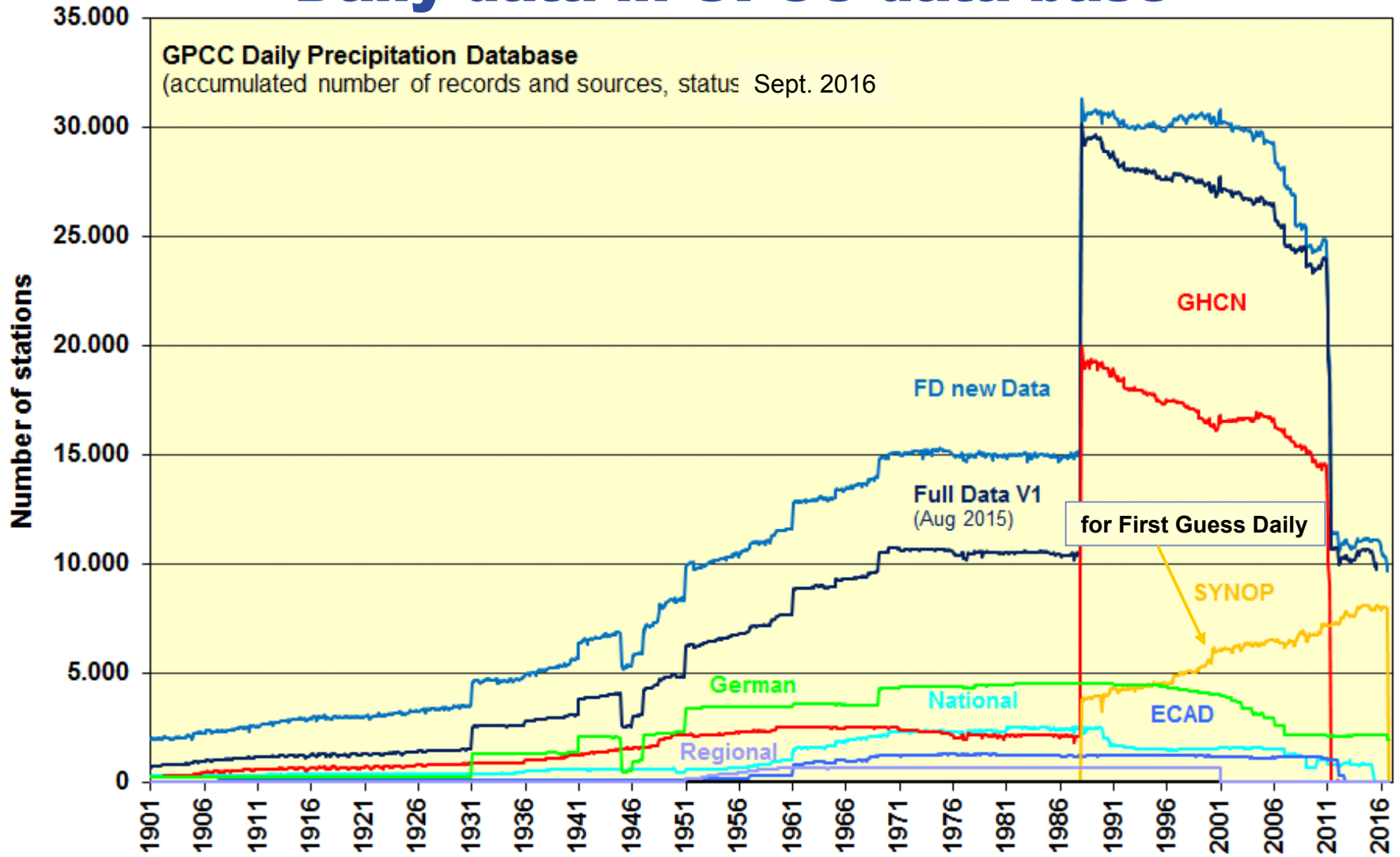
- Almost from the start of this new activity the GPCC ran into the problem **“How is the day defined?”**
- **Daily precipitation - generally being observed at about 07:00 local time - should be assigned to the previous day according to WMO recommendation (most of the accumulation period is lying in the previous day)**
- **Unfortunately this is not done consistently in the different countries; most countries are assigning the daily totals to the previous day (consistent to WMO recommendation), but others are doing this differently (i.e. assigning precip to the day when the observation is taken)**

## GPCC's Daily Products

GPCC calculates the daily precip totals from the SYNOP reports in a WMO consistent way (used for First Guess and Full Data Daily)

GHCN daily takes the delivered daily data as they are, thus containing a mixture of data assigned to the previous day or observation day (i.e. Brazil, Australia); **GPCC is checking and correcting this, as far as possible, upon integration of GHCN daily and national data sets into its data base**

# Daily data in GPCC data base

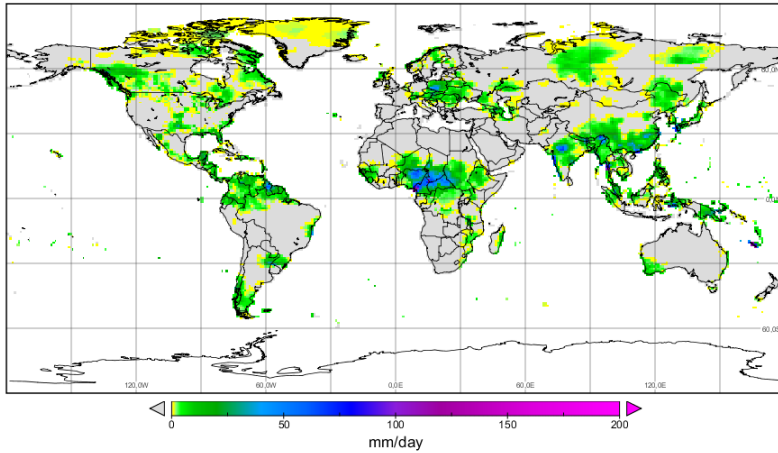


## Daily precipitation analysis products

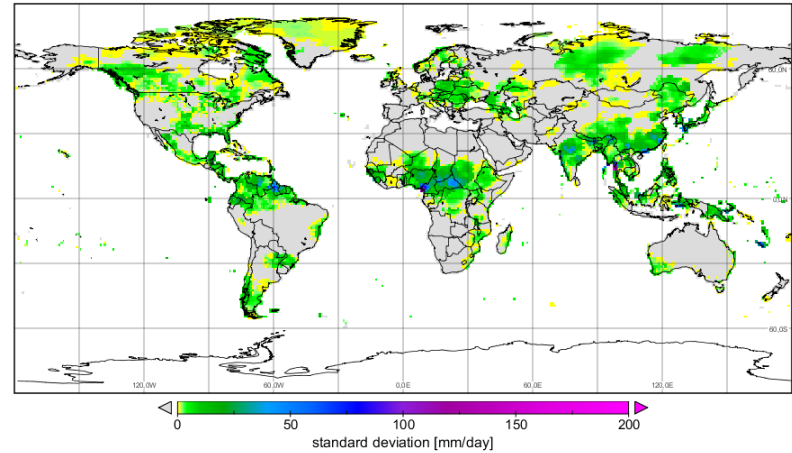
- **GPCC** is providing the following daily gridded data sets:
  - A **First Guess Daily** Analysis available within 5 days after the end of the month via internet  
Period: Jan. 2009 to present  
Data base: ca. 7,000-8,100 stations  
described in Schamm et al. (2014).
  
  - The **Full Data Daily** Analysis (V.1) updated from time to time  
Period: Jan. 1988 to 2013  
Data base: ca. 10,000-30,000 stations

# Example: GPCP Full Data Daily: 06 July 1997

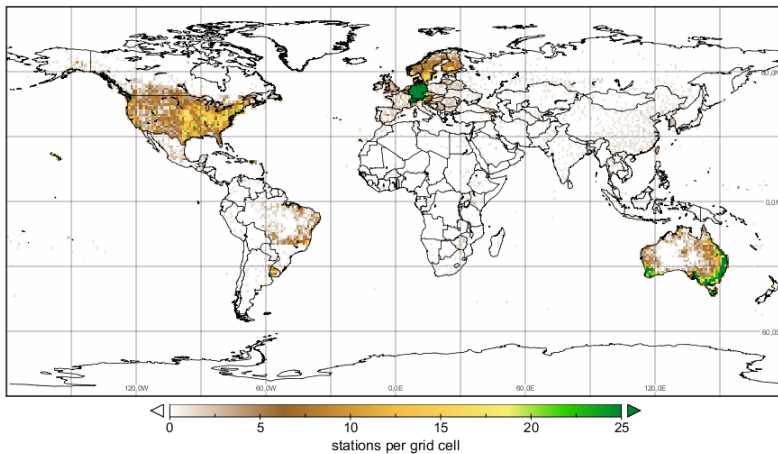
## Total Precipitation



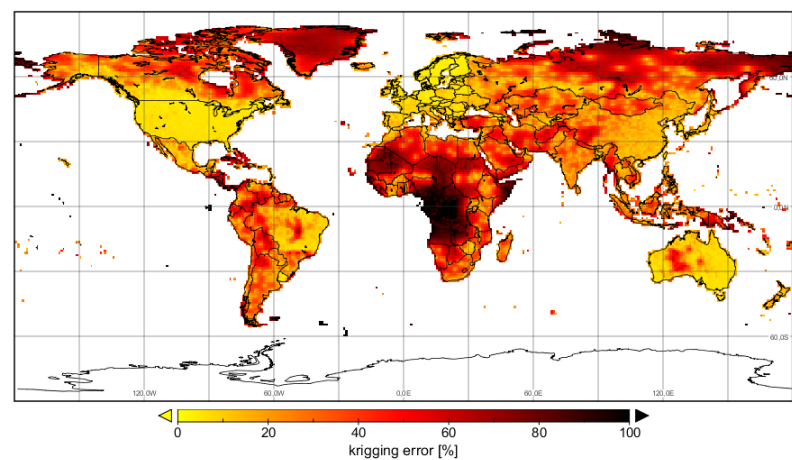
## Standard Deviation



## Number of Stations per grid cell



## Kriging Error



# GPCC's Full Data Daily Product

- **Full Data Daily** (V.1) analysis (1988-2013) merged with the **HOAPS** data set (MiKlip-DAPAGLOCO: DAily Precipitation Analysis for the validation of GLObal medium-range Climate predictions Operationalized)

Precursor version (1988-2008) described in Andersson et al. (2015a,b,c).

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## 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 late 2016, on a global scale later
- A new release of GPCC's product portfolio (**Precipitation Climatology, Full Data Reanalysis V.8, Monitoring Product**) is now planned for summer 2017





# Visualize and Download GPCC Products



GPCC Product	Spatial Resolution	Time Coverage	Possible Application
<i>First Guess Monthly</i>	1.0°	2004 - present	<i>drought monitoring</i>
<i>First Guess Daily</i>	1.0°	2009 - present	<i>analysis of extremes</i>
<i>Monthly Monitoring Version 5</i>	1.0°, 2.5°	1982 - present	<i>calibration of satellite data</i>
<i>Full Data Monthly Version 7</i>	0.5°, 1.0°, 2.5°	1901 - 2013	<i>hydrological studies</i>
<i>Full Data Daily Version 1</i>	1.0°	1988 - 2013	<i>analysis of extremes</i>
<i>HOMPRA Europe Version 1 (coming soon)</i>	1.0°	1951 - 2005	<i>trend analysis</i>
<i>VASClimo Dataset</i>	0.5°, 1.0°, 2.5°	1951 - 2000	<i>trend analysis</i>
<i>Precipitation Climatology Version 2015</i>	0.25°, 0.5°, 1.0°, 2.5°	1951/2000	<i>for application as a reference, and for utilization of the anomaly interpolation method</i>
<i>Interpolation Test Dataset</i>	1.0°	1988	<i>comparison of interpolation methods</i>
<i>Drought Index Version 1</i>	1.0°	2013 - present	<i>drought monitoring</i>
<i>GPCC Visualizer</i>			<i>access to the GPCC Visualizer, where you can create maps with your own coordinates and parameters</i>
<i>GPCC Home</i>			<i>detailed information about GPCC</i>

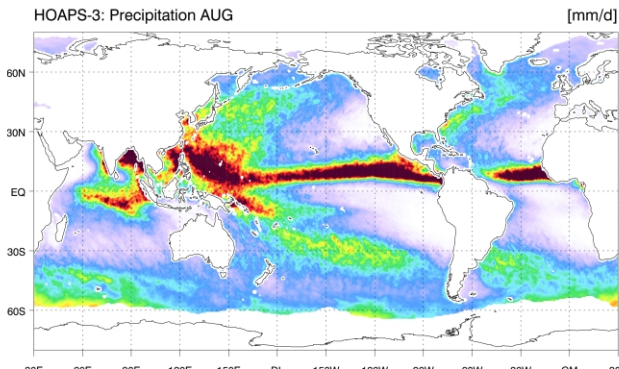
**Thank you for your attention!**

The Global Precipitation Climatology Centre (GPCC) is a specialized Centre supporting climate monitoring and research. It is operated by DWD under the auspices of WMO. Product users are kindly asked to refer to GPCC.

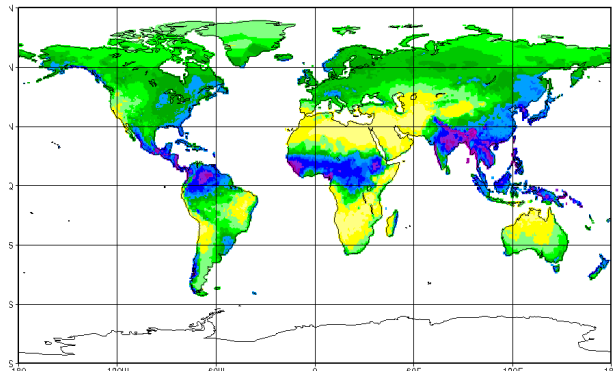


# Additional material

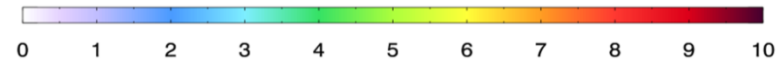
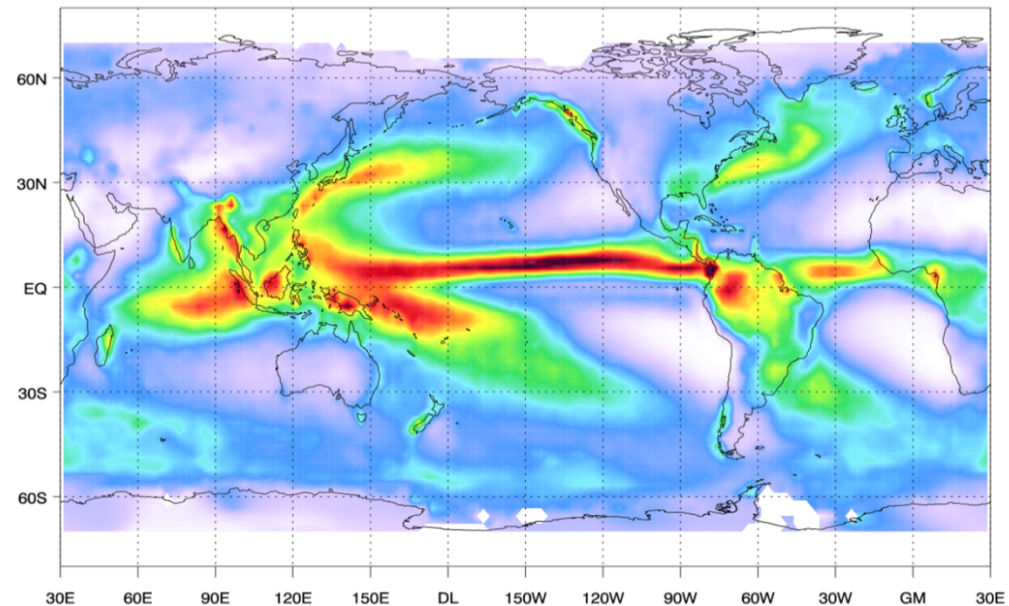
# Generation of a merged global gridded precipitation data set with HOAPS satellite-based data over ocean (CM SAF) and GPCP's in-situ based analysis over land with a daily resolution over the period 1988-2008



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



HOAPS-3 + GPCP: Precipitation [mm/d]



## Publications on GPCP's data base, QC, analysis methods and products

**Becker, A., P. Finger, A. Meyer-Christoffer, B. Rudolf, K. Schamm, U. Schneider, M. Ziese (2013):** A description of the global land-surface precipitation data products of the Global Precipitation Climatology Centre with sample applications including centennial (trend) analysis from 1901-present. *Earth System Science Data*, DOI: 10.5194/essd-5-71-2013

**Schneider, U., A. Becker, P. Finger, A. Meyer-Christoffer, M. Ziese, B. Rudolf (2013):** GPCP's new land-surface precipitation climatology based on quality-controlled in-situ data and its role in quantifying the global water cycle. *Theor. Appl. Climatol.* (Open access), DOI: 10.1007/s00704-013-0860-x

**Schamm, K., Ziese, M., Becker, A., Finger, P., Meyer-Christoffer, A., Schneider, U., Schröder, M., and Stender, P. (2014):** Global Gridded Precipitation over Land: A description of the new GPCP First Guess Daily product, *Earth Syst. Sci. Data*, 6, 49-60, DOI:10.5194/essd-6-49-2014

# DOI references for GPCC's analysis products

## Issuance of DOI references for GPCC's new analysis products:

Meyer-Christoffer A., A. Becker, P. Finger, B. Rudolf, U. Schneider, M. Ziese (2011):  
GPCC **Climatology** Version 2011 at 0.25°: Monthly Land-Surface Precipitation  
Climatology for Every Month and the Total Year from Rain-Gauges built on GTS-  
based and Historic Data.

DOI: 10.5676/DWD\_GPCC/CLIM\_M\_V2011\_025 (etc. for other resolutions)

Schneider U., A. Becker, P. Finger, A. Meyer-Christoffer, B. Rudolf, M. Ziese (2011):  
GPCC **Full Data Reanalysis** Version 6.0 at 0.5°: Monthly Land-Surface  
Precipitation from Rain-Gauges built on GTS-based and Historic Data.

DOI: 10.5676/DWD\_GPCC/FD\_M\_V6\_050 (etc. for other resolutions)

# DOI references for GPCC's analysis products

## Issuance of DOI references for GPCC's new analysis products:

Schneider U., A. Becker, P. Finger, A. Meyer-Christoffer, B. Rudolf, M. Ziese (2011):  
**GPCC Monitoring Product** Version 4.0 at 1.0°: Near Real-Time Monthly Land-Surface Precipitation from Rain-Gauges based on SYNOP and CLIMAT Data.  
DOI: 10.5676/DWD\_GPCC/MP\_M\_V4\_100 (etc. for other resolutions)

Ziese M., A. Becker, P. Finger, A. Meyer-Christoffer, B. Rudolf, U. Schneider (2011):  
**GPCC First Guess Product** at 1.0°: Near Real-Time First Guess Monthly Land-Surface Precipitation from Rain-Gauges based on SYNOP Data.  
DOI: 10.5676/DWD\_GPCC/FG\_M\_100 (etc. for other resolutions)

## DOI references for GPCP's analysis products

Andersson, A., M. Ziese, F. Dietzsch, M. Schröder, A. Becker, K. Schamm (2016a): HOAPS/GPCP European daily precipitation data record with uncertainty estimates using satellite and gauge based observations at 0.5°. DOI: [10.5676/DWD\\_CDC/HOGP\\_050/V001](https://doi.org/10.5676/DWD_CDC/HOGP_050/V001) (for 0.5° resolution)•

Andersson, A., M. Ziese, F. Dietzsch, M. Schröder, A. Becker, K. Schamm (2016b): HOAPS/GPCP global daily precipitation data record with uncertainty estimates using satellite and gauge based observations at 1.0°. DOI: [10.5676/DWD\\_CDC/HOGP\\_100/V001](https://doi.org/10.5676/DWD_CDC/HOGP_100/V001) (for 1.0° resolution)•

Andersson, A., M. Ziese, F. Dietzsch, M. Schröder, A. Becker, K. Schamm (2016c): HOAPS/GPCP global daily precipitation data record with uncertainty estimates using satellite and gauge based observations at 2.5°. DOI: [10.5676/DWD\\_CDC/HOGP\\_250/V001](https://doi.org/10.5676/DWD_CDC/HOGP_250/V001) (for 2.5° resolution)

**Global average water exchange by precipitation / evaporation 503,000 km<sup>3</sup>/a (equivalent to 986 mm/a precipitation); numbers after Trenberth et al. (2011), land-surface precipitation after Schneider et al. (2014), evapotranspiration accordingly**

