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

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Global Precipitation Climatology Centre

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Department Hydrometeorology

presented by U. Looser (GRDC)

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 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

Outline

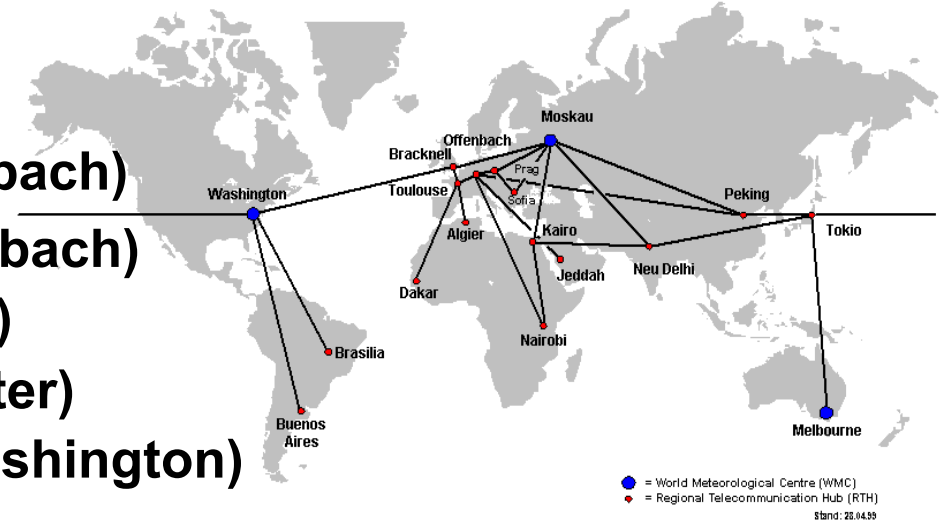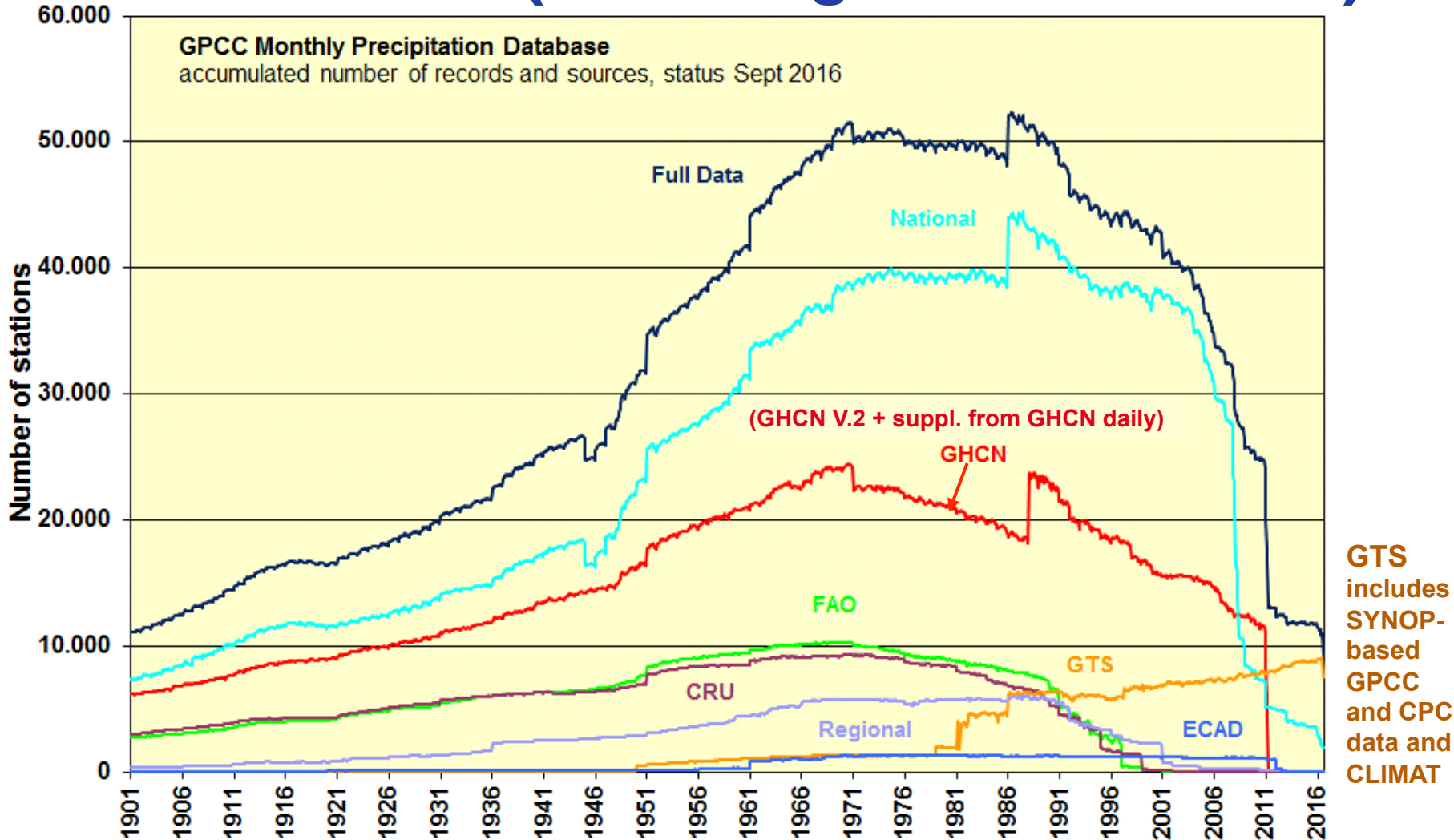|	
1	**GPCC background**
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GPCC data sources

Main Telecommunication Network (MTN)
ein globales, standardisiertes Netzwerk zur Verteilung von Wetterdaten innerhalb der WMO Mitgliedsstaaten

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)**

● = World Meteorological Centre (WMC)
● = Regional Telecommunication Hub (RTH)
Stand: 26.04.99

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)

GPCC Monthly Precipitation Database
accumulated number of records and sources, status Sept 2016

Full Data

National

(GHCN V.2 + suppl. from GHCN daily)

GHCN

FAO

CRU

GTS

Regional

ECAD

GTS includes SYNOP-based GPCC and CPC data and CLIMAT

Outline

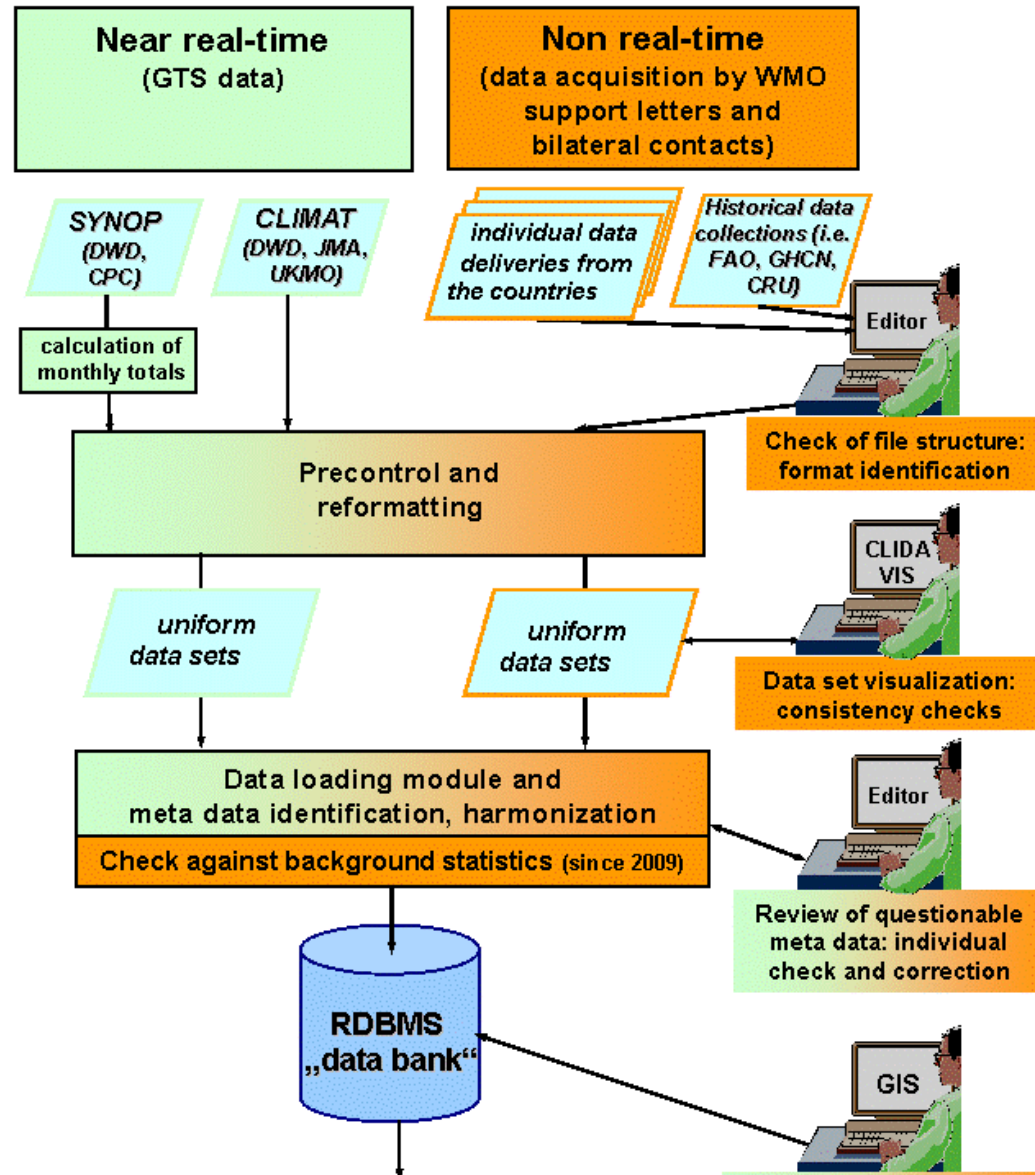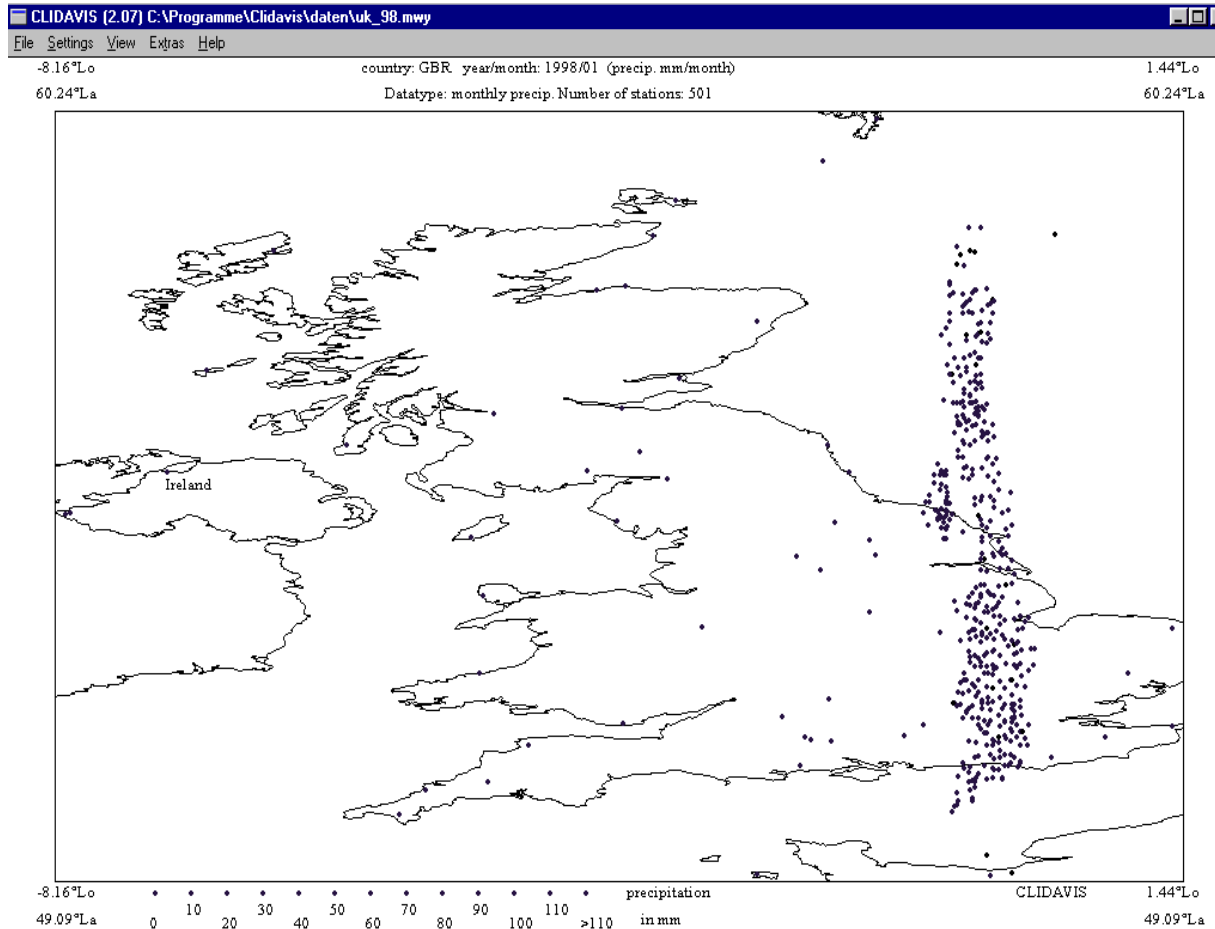|	
1	**GPCC background**
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Schematic diagram of QC processing at GPCC

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
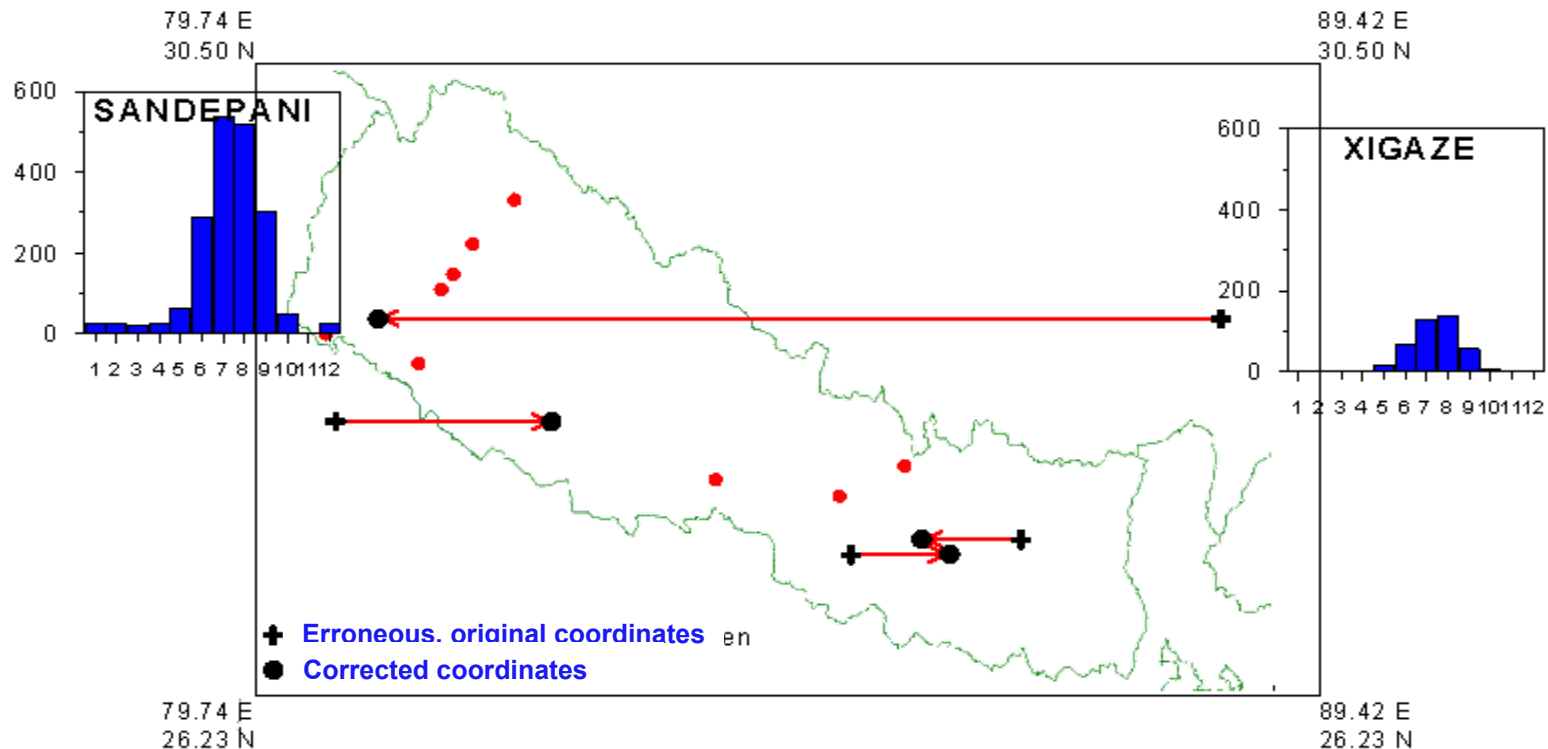
Checks associated with data loading module upon integration into data base

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)
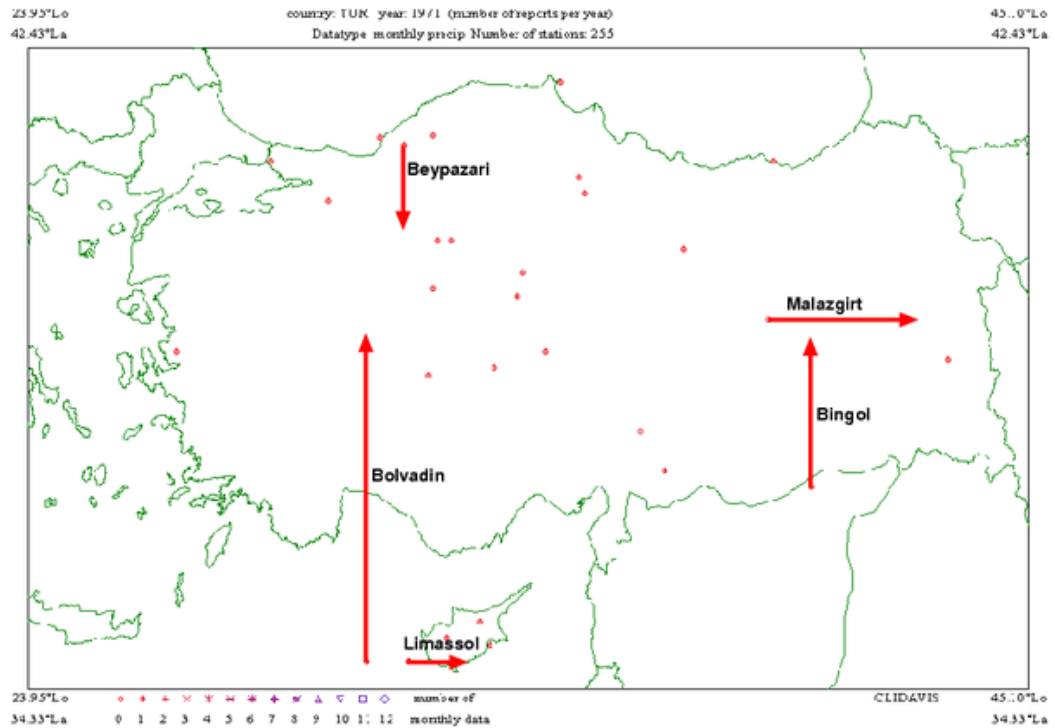
All clarified cases are stored in a library (system memory)

Checks associated with data loading module upon integration into data base

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

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

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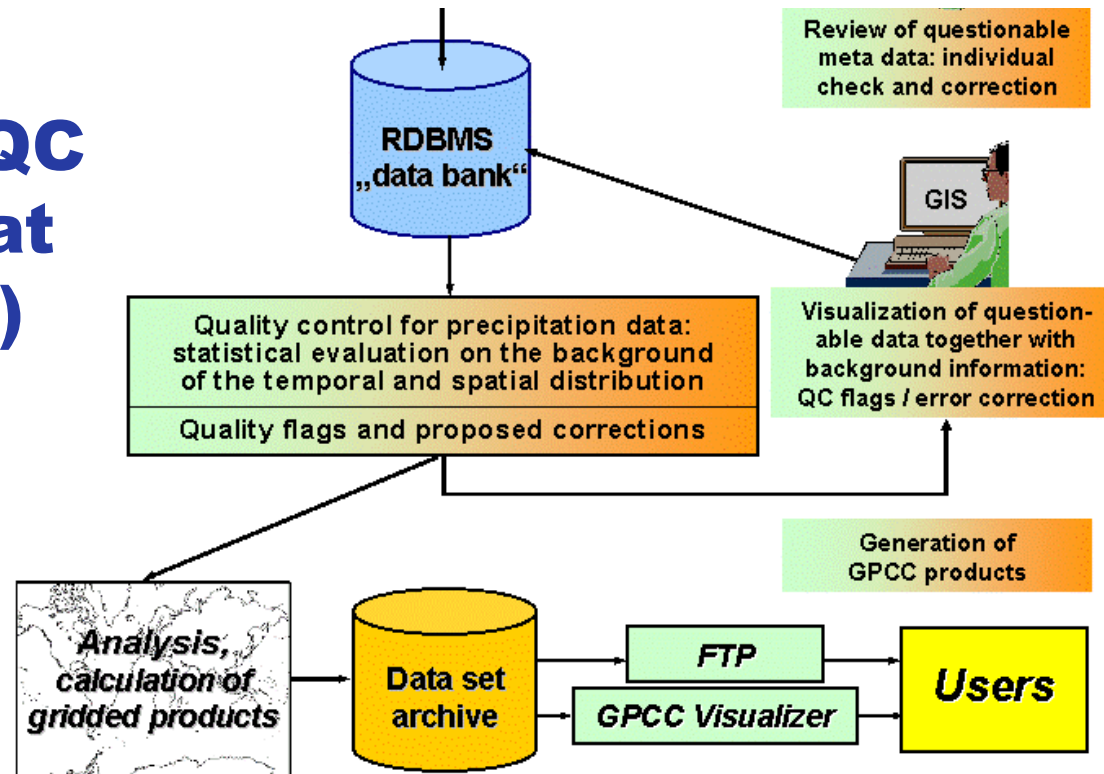
GPCC's analysis products are generated on the basis of the qc'ed data in the RDBMS (relational data base management system)

Checks of precipitation data in the data base

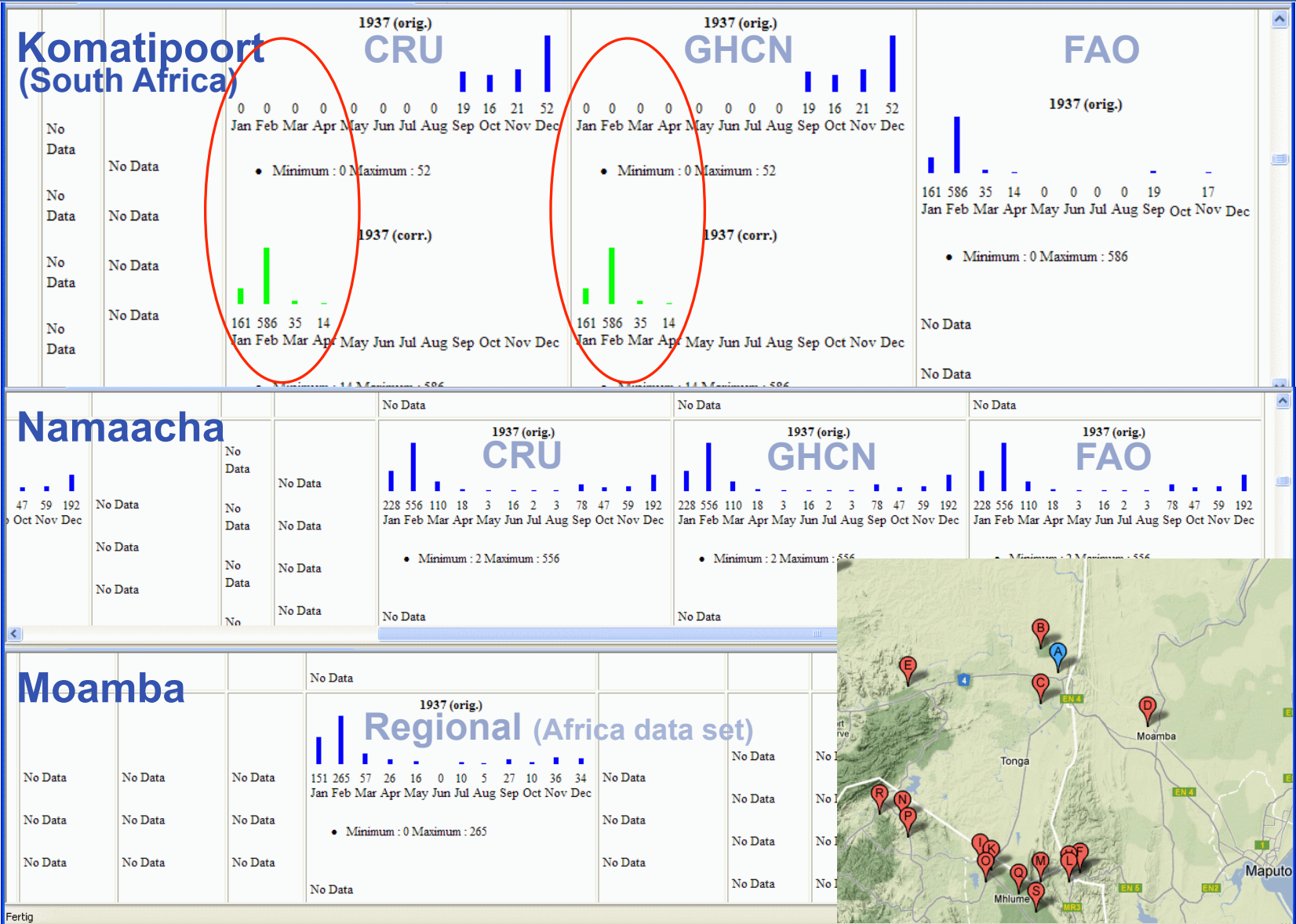Before generation of each new product release:

- 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**

- **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")**

Data from different sources are stored separately in the RDBMS, being very helpful in the QC processing
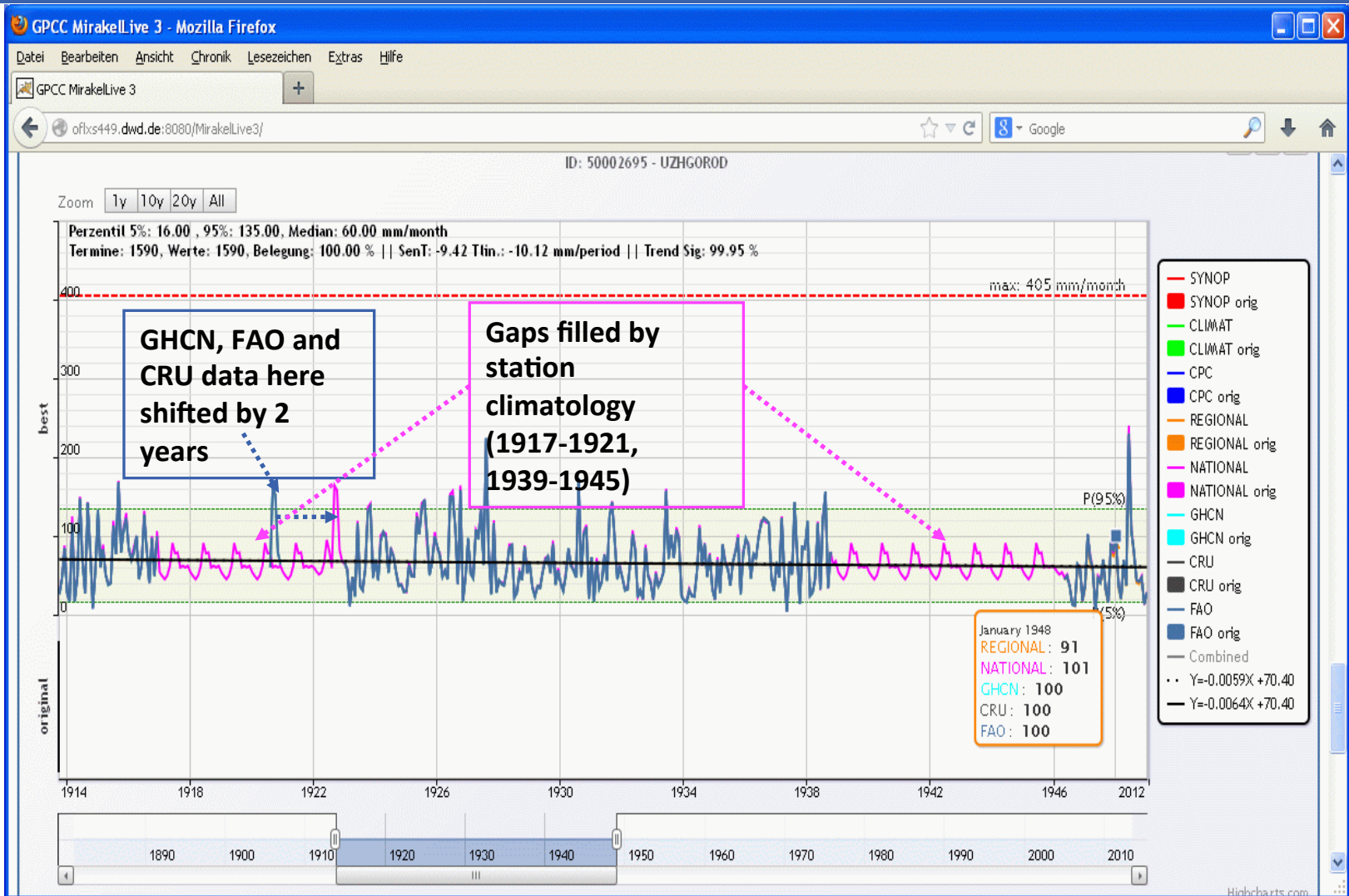
For some stations in Ukraine (example station 33631 UZHGOROD) gaps in time series had been filled with the station climatology by the data originator

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*)**

<u>**Important:**</u>

- **True extreme values <u>must not</u> 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

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

Data base for different GPCC products

GHP-Meeting 03-05 Oct. 2016, Gif-sur-Yvette, France
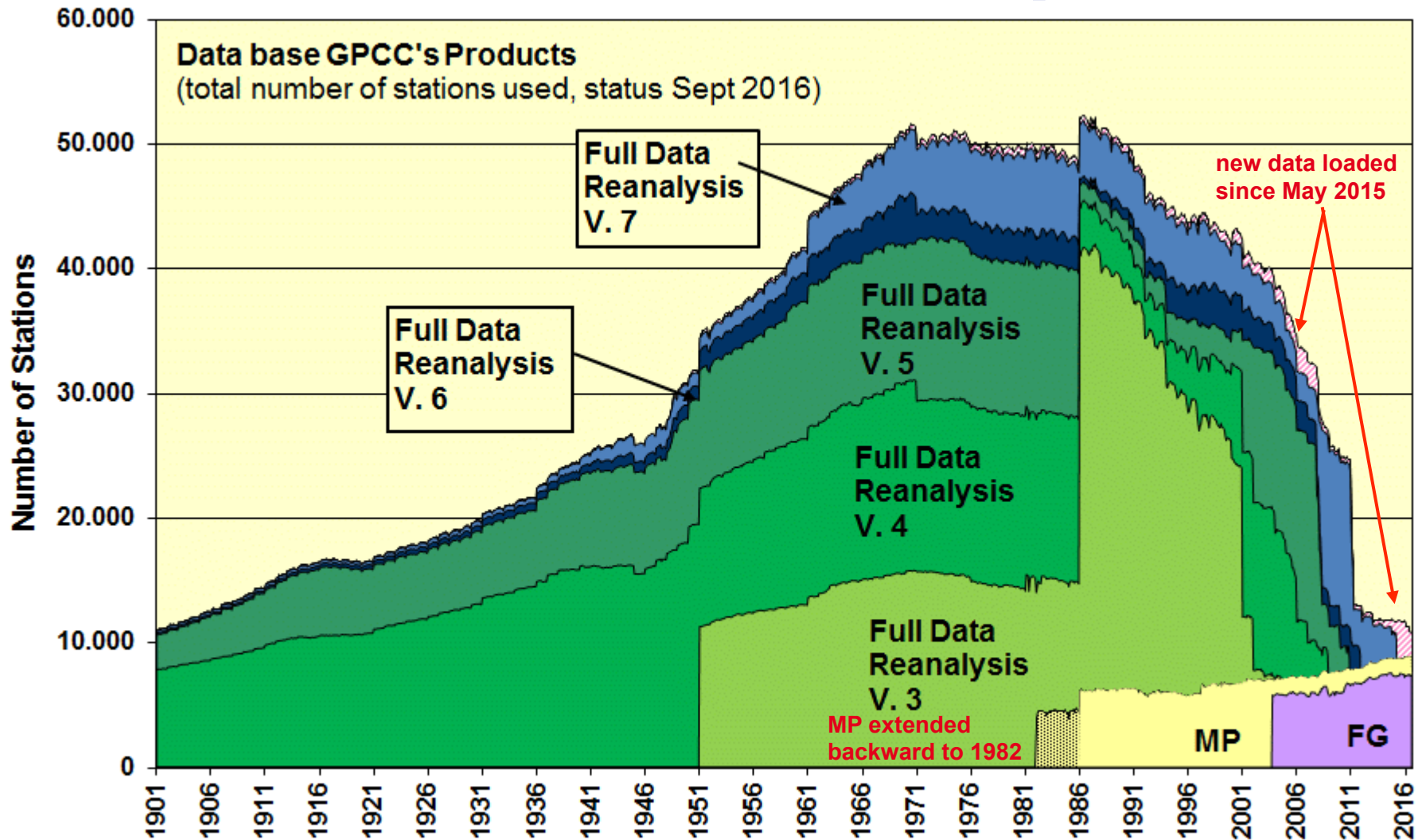
Near real-time precipitation products

➢ **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: ca. 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: ca. 7,000-9,000 stations

Non real-time precipitation products

➢ **From time to time** (after significant enlargements / improvements of the data base) **reanalyes** of the following gridded products are being generated:

- The **Global Precipitation Climatology** (over land) **(V. May 2015),** background for all other GPCC precipitation analysis products, based on ca. 75,100 stations with climatological normals **(overall data of more than 110,000 stations in GPCC data base)**
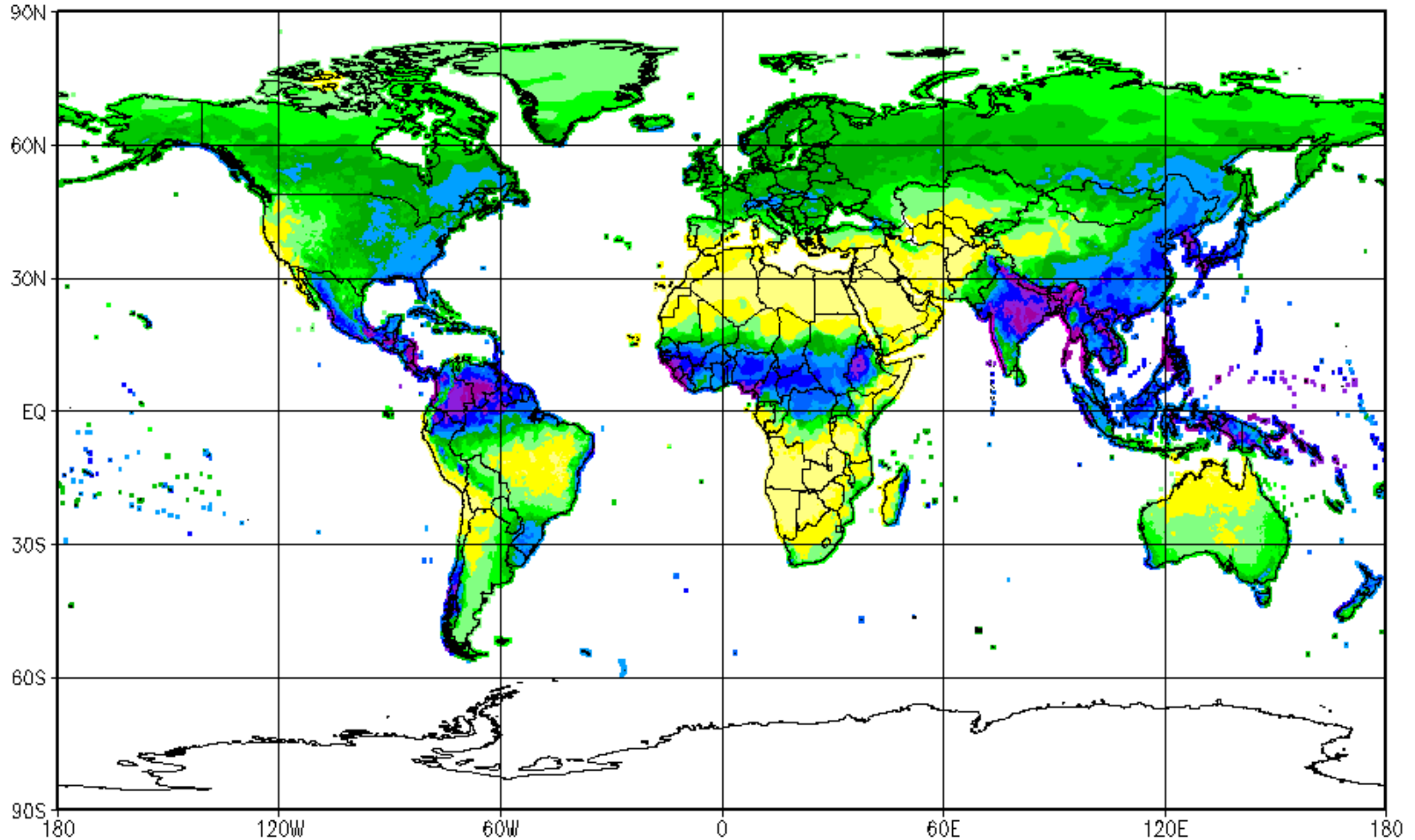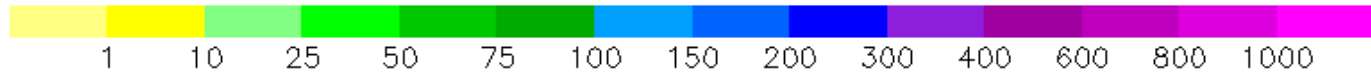
GPCC Climatological data base
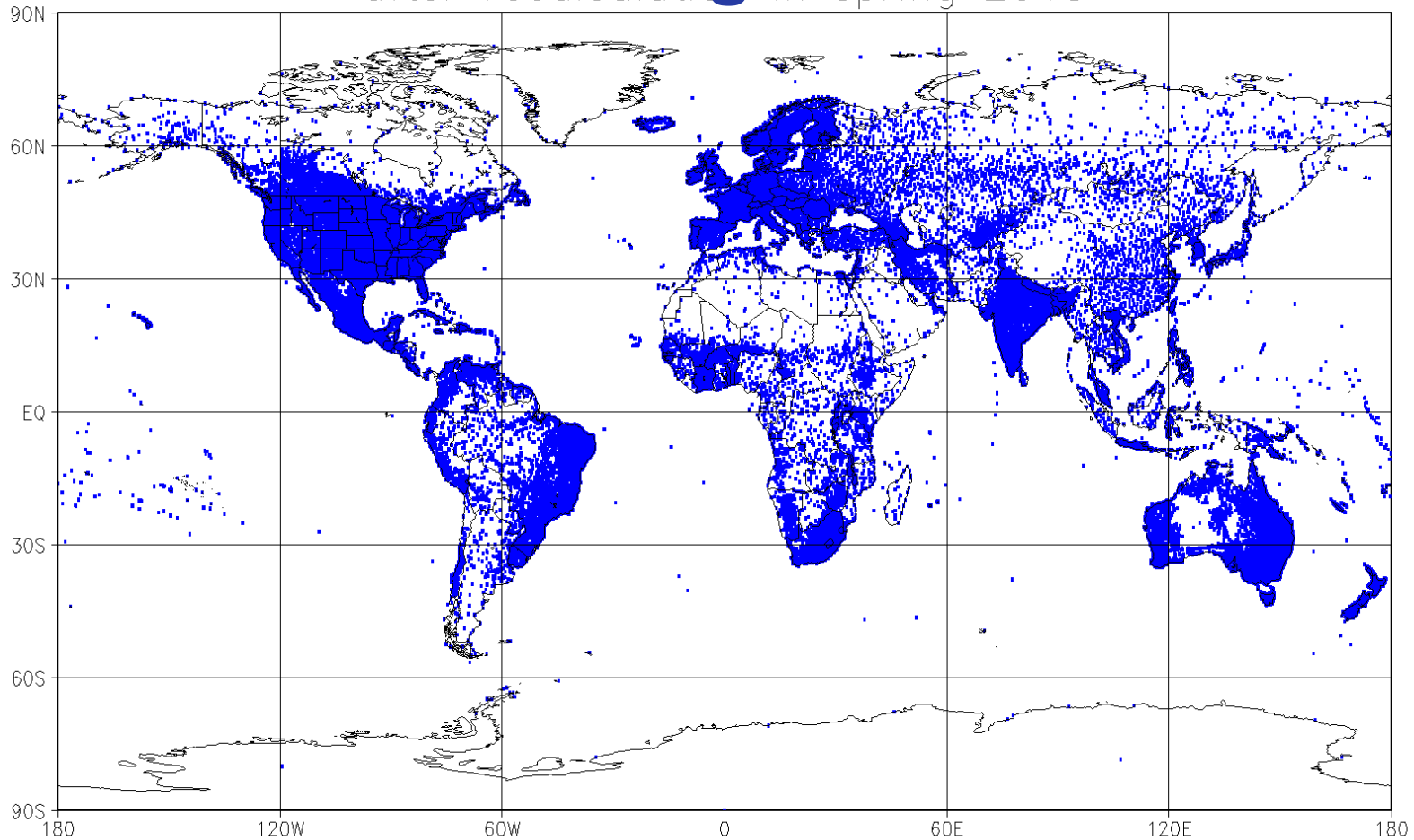
(c) GPCC 2015/05/05 , number of gauges : 75152

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

1 10 25 50 75 100 150 200 300 400 600 800 1000

Non real-time precipitation products

➢ **From time to time** (after significant enlargements / improvements of the data base) **reanalyes** of the following gridded products are being generated:

- The **Global Precipitation Climatology (over land) (V. May 2015),** background for all other GPCC precipitation analysis products, based on ca. 75,100 stations with climatological normals

- 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'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)**
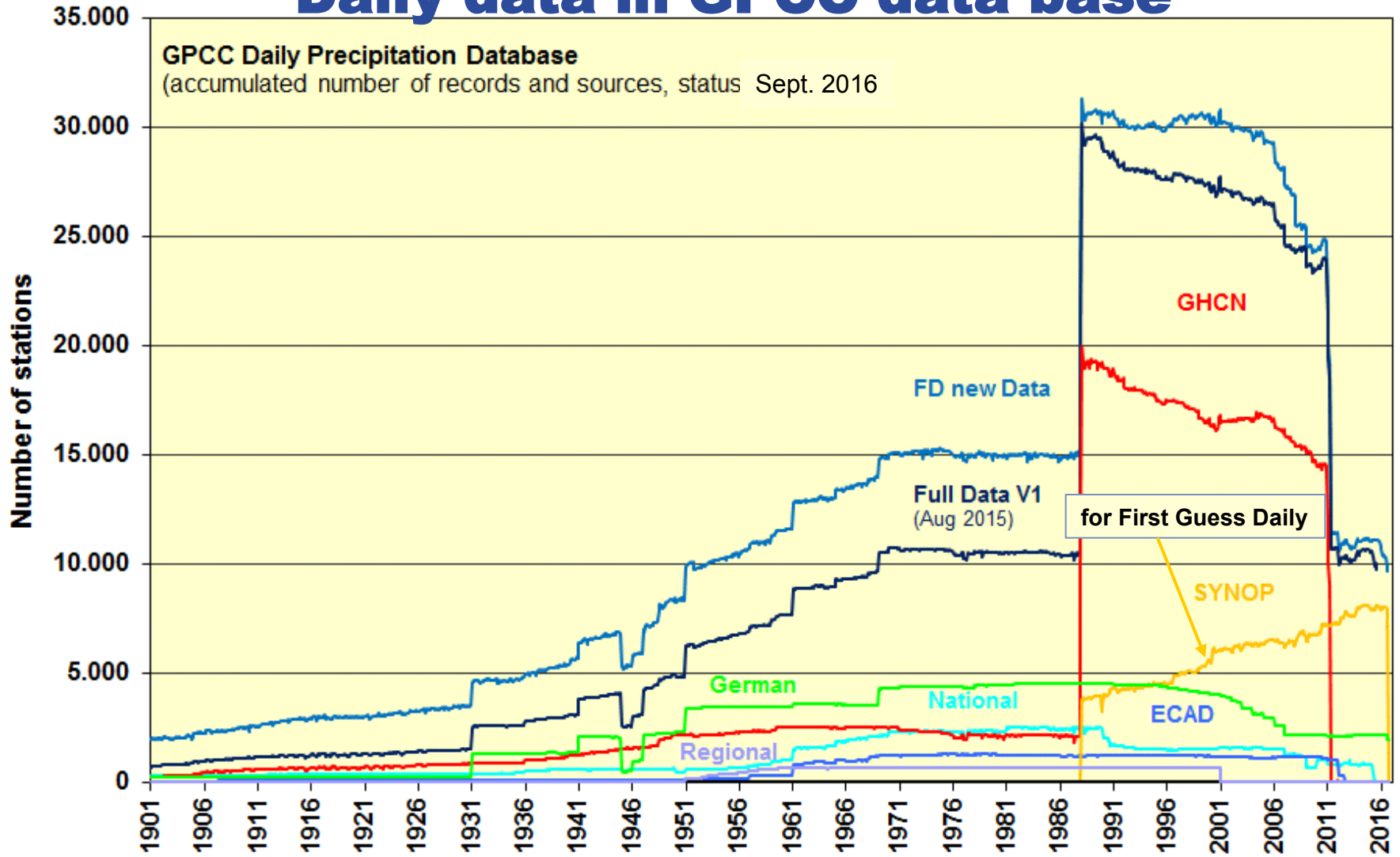
GPCC's Daily Products

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

For the project MIKLIP/DAPACLIP (Global DAily Precipitation Analysis for the validation of medium-range CLImate Predictions) the focus was on the period 1988-2008

Daily data in GPCC data base

GHP-Meeting 03-05 Oct. 2016, Gif-sur-Yvette, France

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): "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
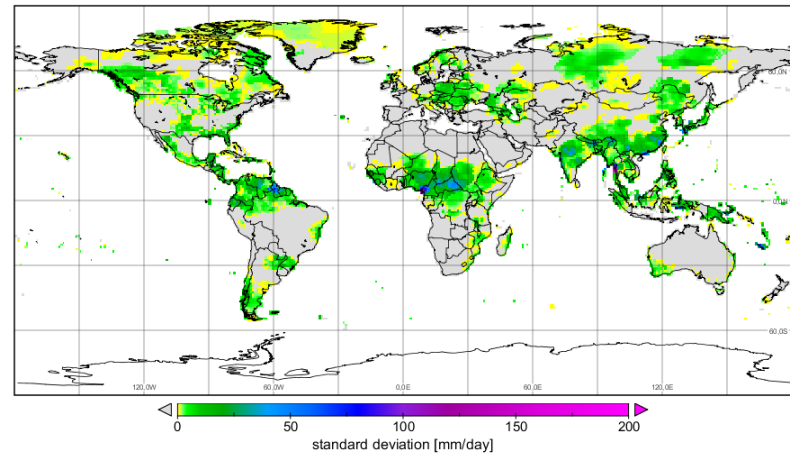
- **The Full Data Daily Analysis (V.1) updated from time to time**
  Period: Jan. 1988 to 2013 (preliminary version for DAPACLIP 1988-2008)

  Data base: ca. 10,000-30,000 stations

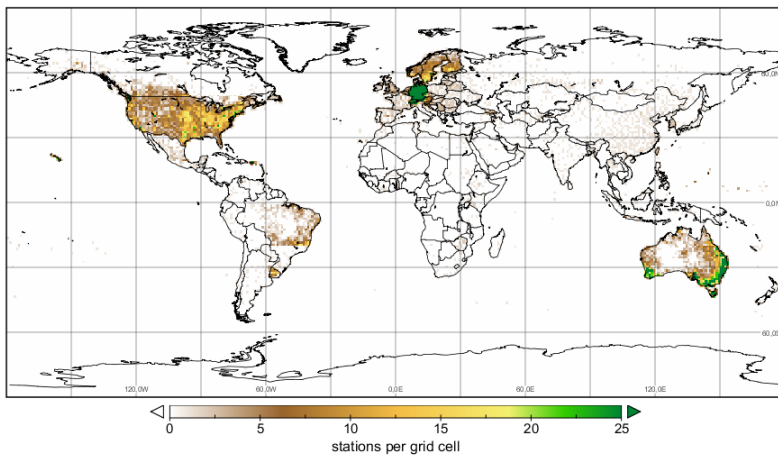# Example: GPCC Full Data Daily: 06 July 1997
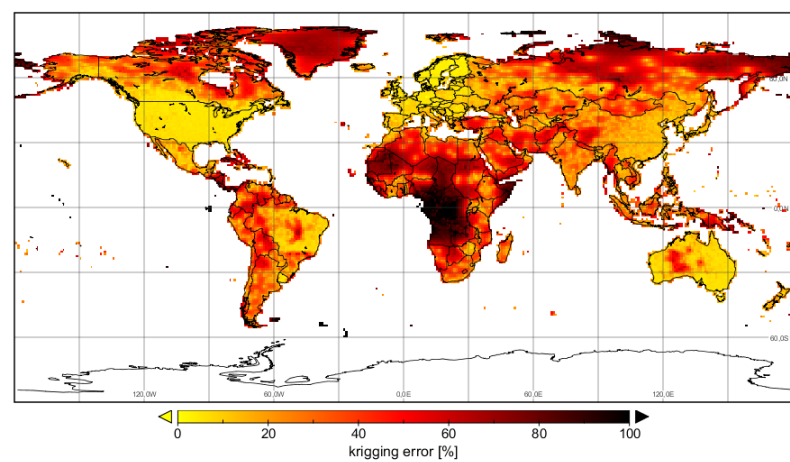
Total Precipitation
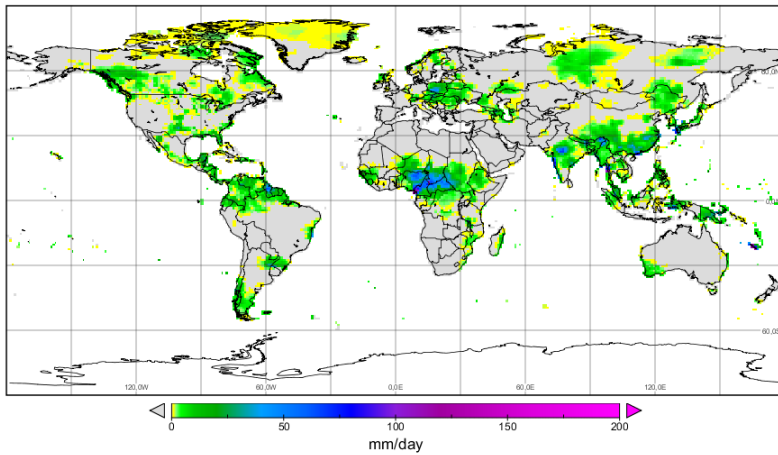
Standard Deviation

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**

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Outlook

- In cooperation with Kisters the GPCC is setting up a Meteorological data collection centre (MDCC) for EFAS (European Flood Awareness System) that is expected to become quasi-operational during the next months

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

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.

Imprint

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Thank you for your attention !

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

Additional material

Generation of a merged global gridded precipitation data set with HOAPS satellite-based data over ocean (CM SAF) and GPCC's in-situ based analysis over land with a daily resolution over the period 1988-2008
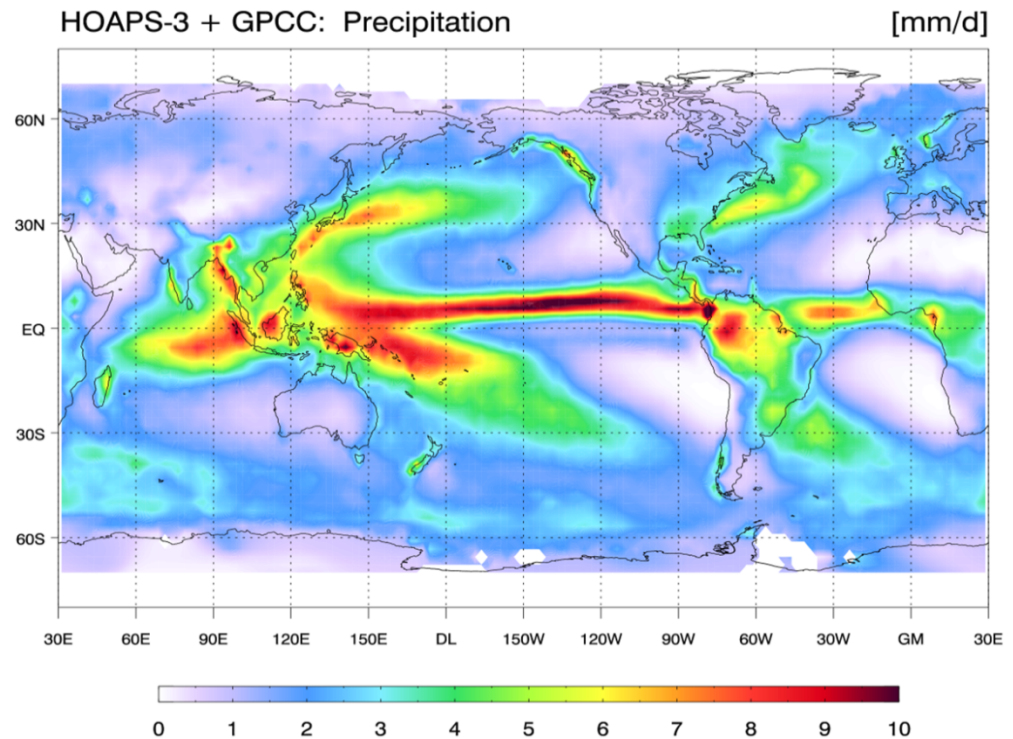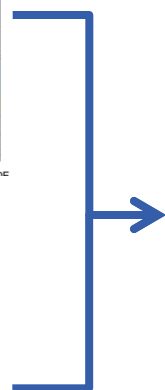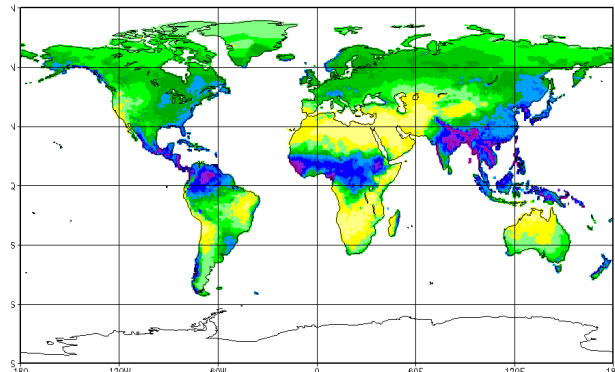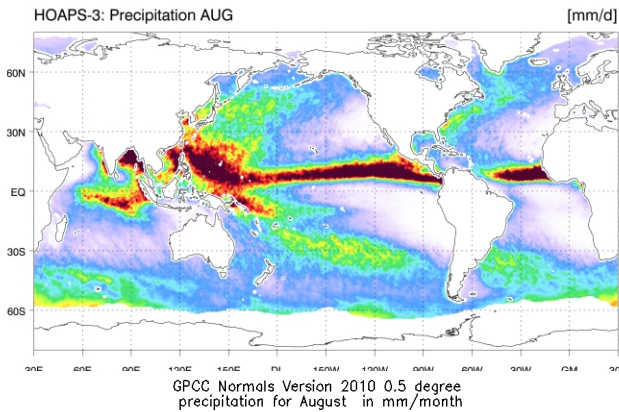
Publications on GPCC's data base, QC, analysis methods and products

2 GPCC reference publications:

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

(focus on GPCC's data base, analysis methodology, products and sample applications)

Schneider, U., A. Becker, P. Finger, A. Meyer-Christoffer, M. Ziese, B. Rudolf (2013):
GPCC'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

(focus on GPCC's data base, QC, precipitation climatology and its relation to the global water cycle)

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.
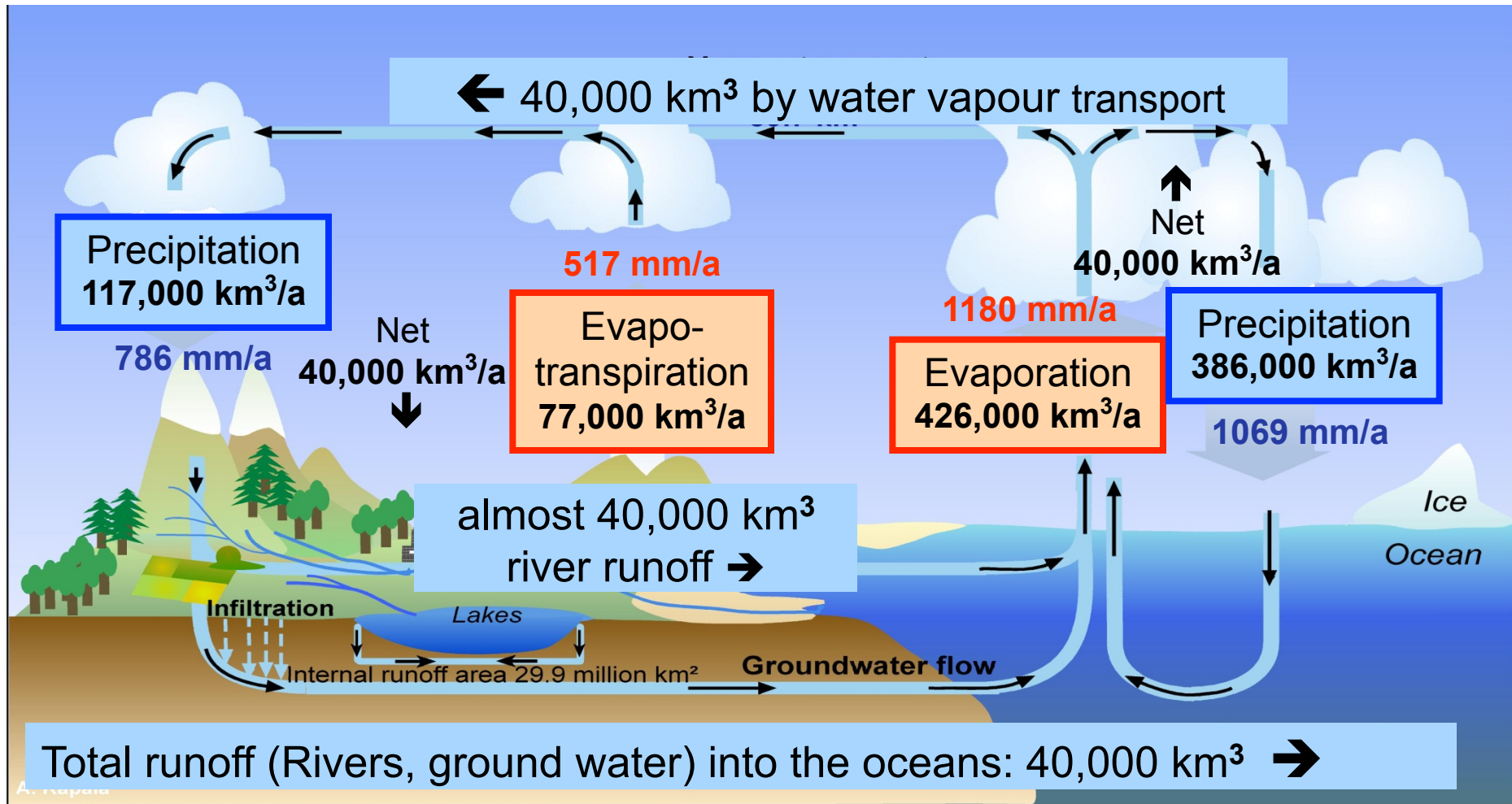DOI: 10.5676/DWD_GPCC/FD_M_V6_050   (etc. for other resolutions)

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)

Global average water exchange by precipitation / evaporation 503,000 km³/a (equivalent to 986 mm/a precipitation); numbers after Trenberth et al. (2011), land-surface precipitation after Schneider et al. (2014), evapotranspiration accordingly

← 40,000 km³ by water vapour transport

Precipitation
117,000 km³/a

786 mm/a

Net
40,000 km³/a

517 mm/a

Evapo-transpiration
77,000 km³/a

Net
40,000 km³/a

1180 mm/a

Precipitation
386,000 km³/a

1069 mm/a

Evaporation
426,000 km³/a

almost 40,000 km³
river runoff →

Infiltration

Lakes

Internal runoff area 29.9 million km²

Groundwater flow

Ice

Ocean

Total runoff (Rivers, ground water) into the oceans: 40,000 km³ →

Precontrol and reformatting of input data

Problems detected in the pre-control process using CLIDAVIS (*especially important for additional individual data collections*):

- stations are sometimes located in the ocean or outside of the boundaries of the country (often typing errors in geographical coordinates, wrong sign, missing convertion ° ' " → 0.1° etc.)

- data sets delivered to the GPCC sometimes show unusual annual cycle or extreme outliers of monthly precipitation

- sometimes temporal shifts in the data can be detected