GHP-Meeting, 10-13 Dec. 2014, Pasadena, USA

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

U. Schneider, A. Becker, A. Meyer-Christoffer, M. Ziese, P. Finger

Global Precipitation Climatology Centre

Deutscher Wetterdienst
Department Hydrometeorology

presented by U. Looser, GRDC, Koblenz

Outline

1. **GPCC background**
2. **Data base and data sources available** (near and non real-time)
3. **Different user requirements and GPCC's portfolio of precipitation analysis products (incl. new ones)**
4. **Contributions to the GEWEX Science Questions and WCRP Grand Challenges**
5. **Outlook**

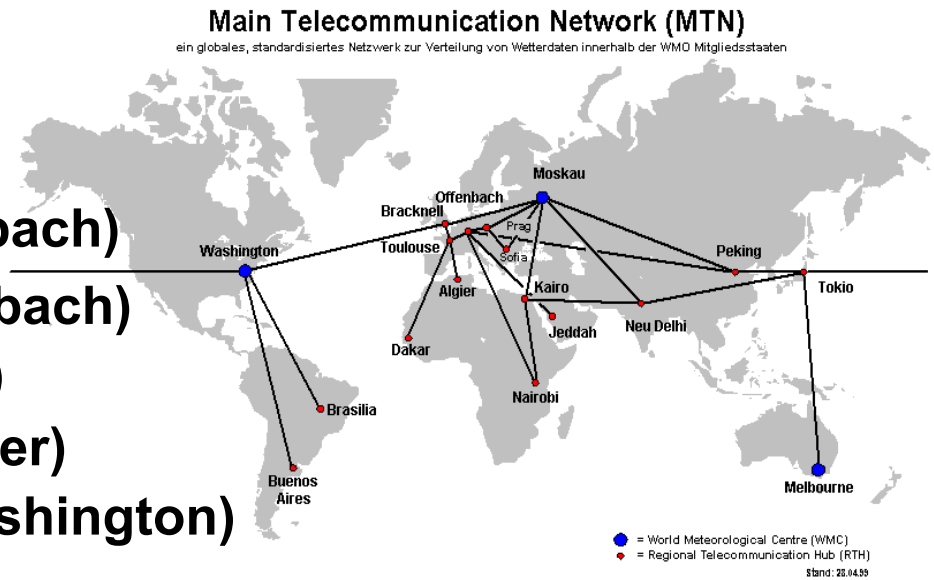
GPCC background

- GPCC was established at the beginning of 1989 at Deutscher Wetterdienst (DWD) on invitation by WMO; now in operation for more than 25 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 (using the Full Data Reanalysis V.6 up to 2010, and the Monitoring Product thereafter)

Outline

1. GPCC background
2. **Data base and data sources available (near and non real-time)**
3. Different user requirements and GPCC's portfolio of precipitation analysis products (incl. new ones)
4. Contributions to the GEWEX Science Questions and WCRP Grand Challenges
5. Outlook

GPCC data sources



Near real-time (GTS):

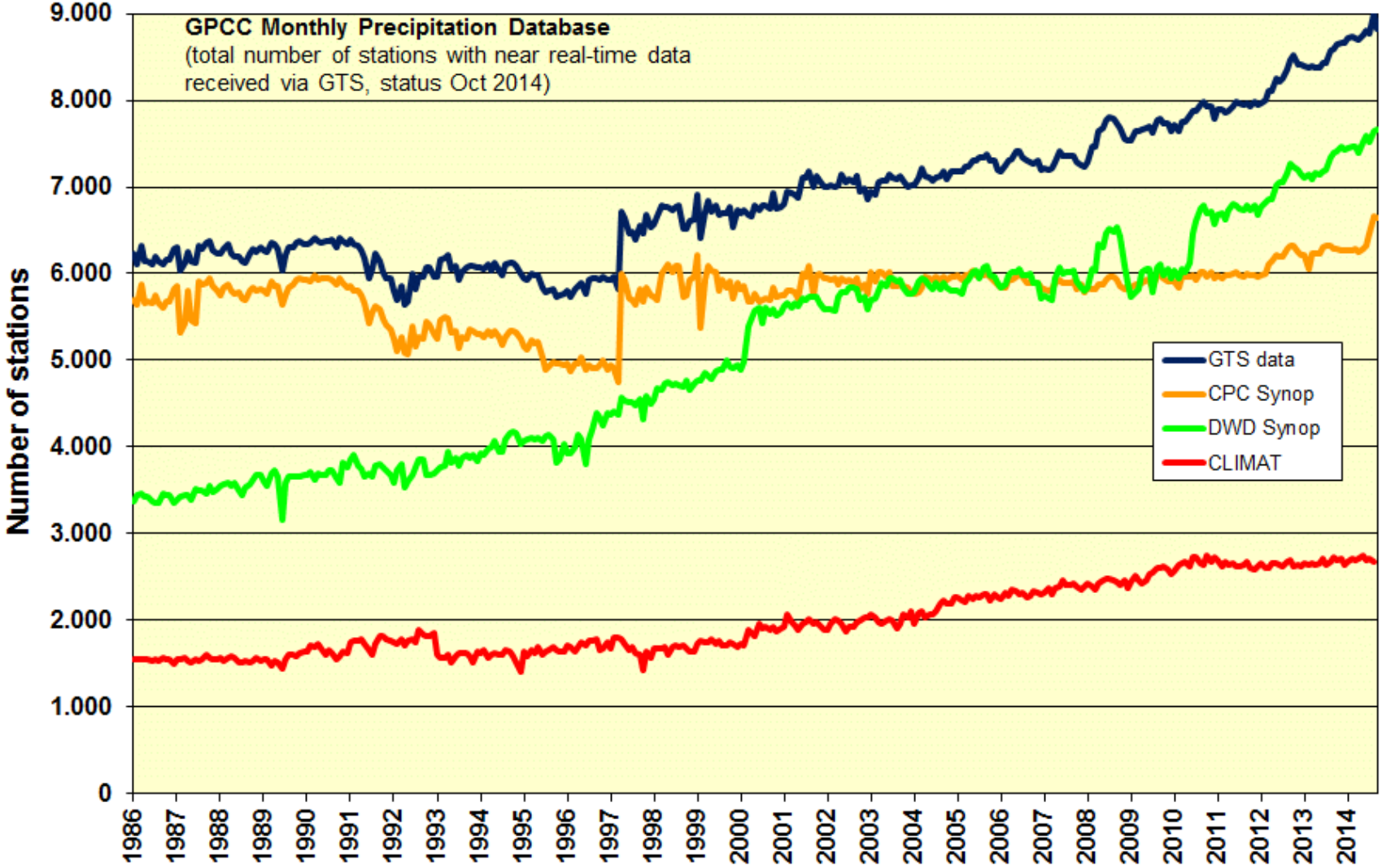
- GTS SYNOP (DWD RTH Offenbach)
- GTS CLIMAT (DWD RTH Offenbach)
- GTS CLIMAT (JMA RTH Tokyo)
- GTS CLIMAT (UKMO RTH Exeter)
- SYNOP-based (NOAA RTH Washington)

Non real-time:

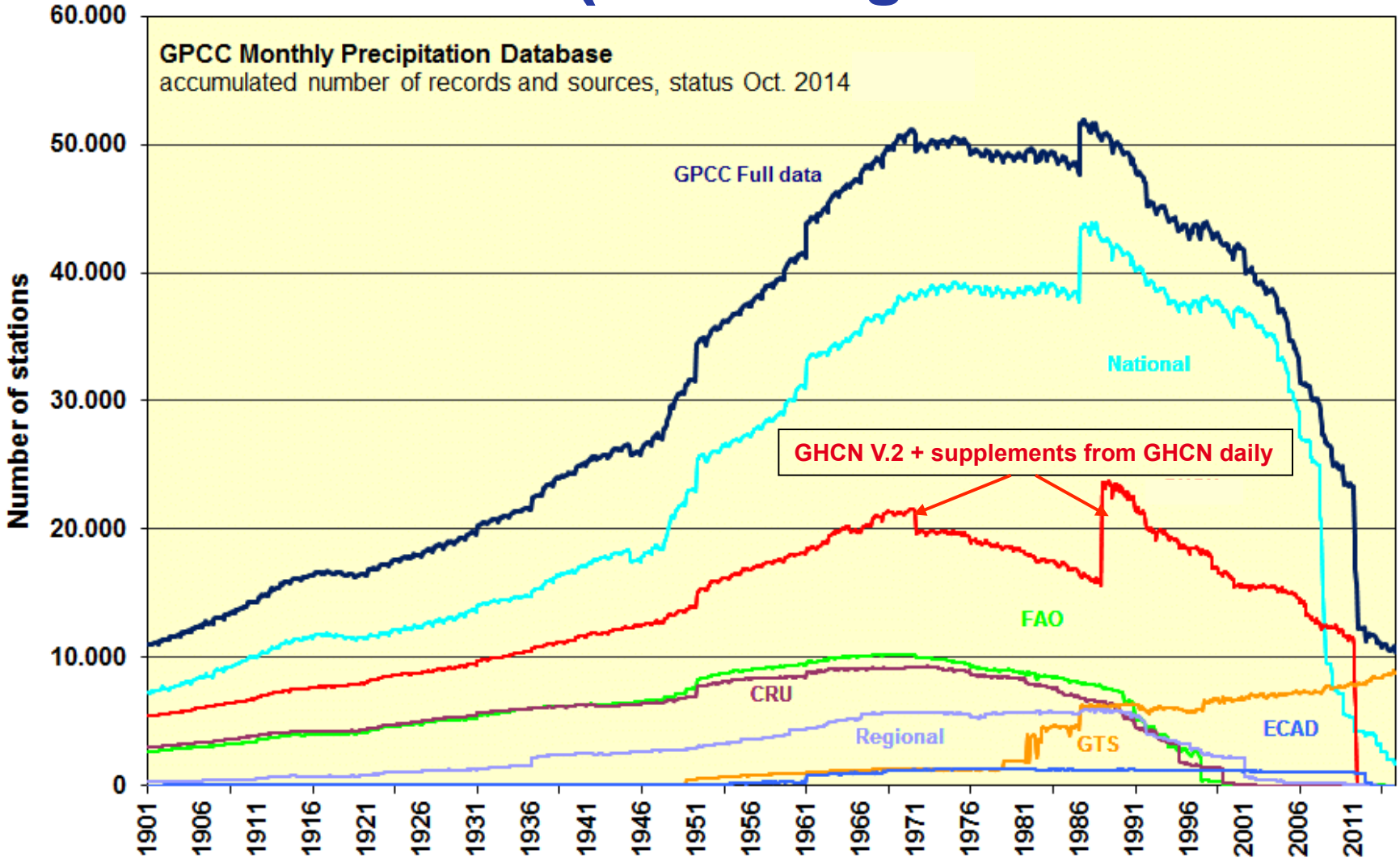
- Additional data from ca. 190 countries
- International project data (GEWEX-related and other)
- Historical data collections (CRU, FAO, GHCN, ECA&D)

+ GHCN daily

GPCC GTS data base



GPCC data base (according to data sources)



GTS includes SYNOP-based GPCC and CPC data and CLIMAT

Outline

1. GPCC background
2. Data base and data sources available (near and non real-time)
3. **Different user requirements and GPCC's portfolio of precipitation analysis products (incl. new ones)**
4. Contributions to the GEWEX Science Questions and WCRP Grand Challenges
5. Outlook

User requirements

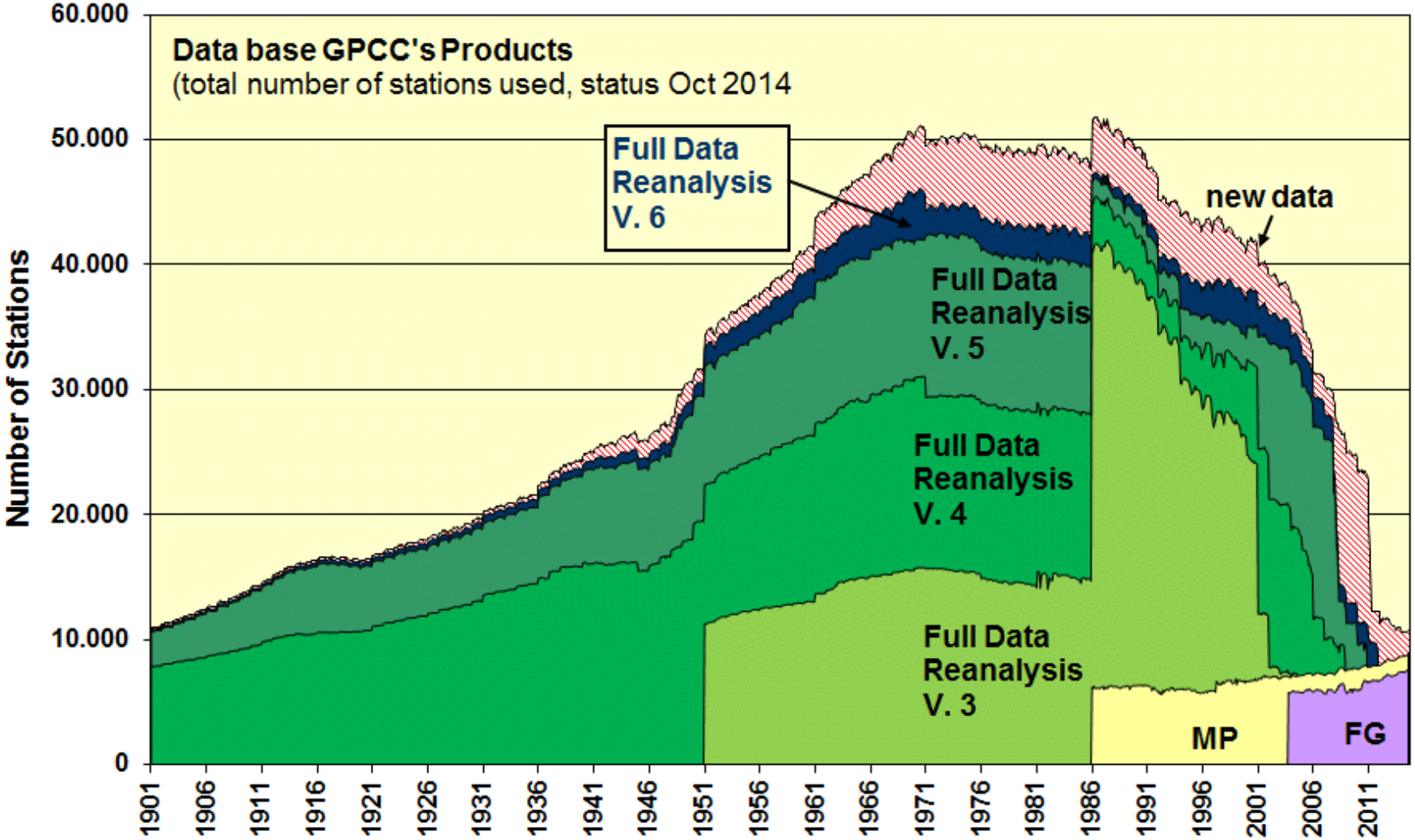
- **Features of gridded precipitation data as required by the users:**
  - **Timeliness** (for drought monitoring)
  - **High resolution** (for regional structures in global maps)
  - **High accuracy** (for verification of model results)
  - **Homogeneity** (for climate change and variability analysis)

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

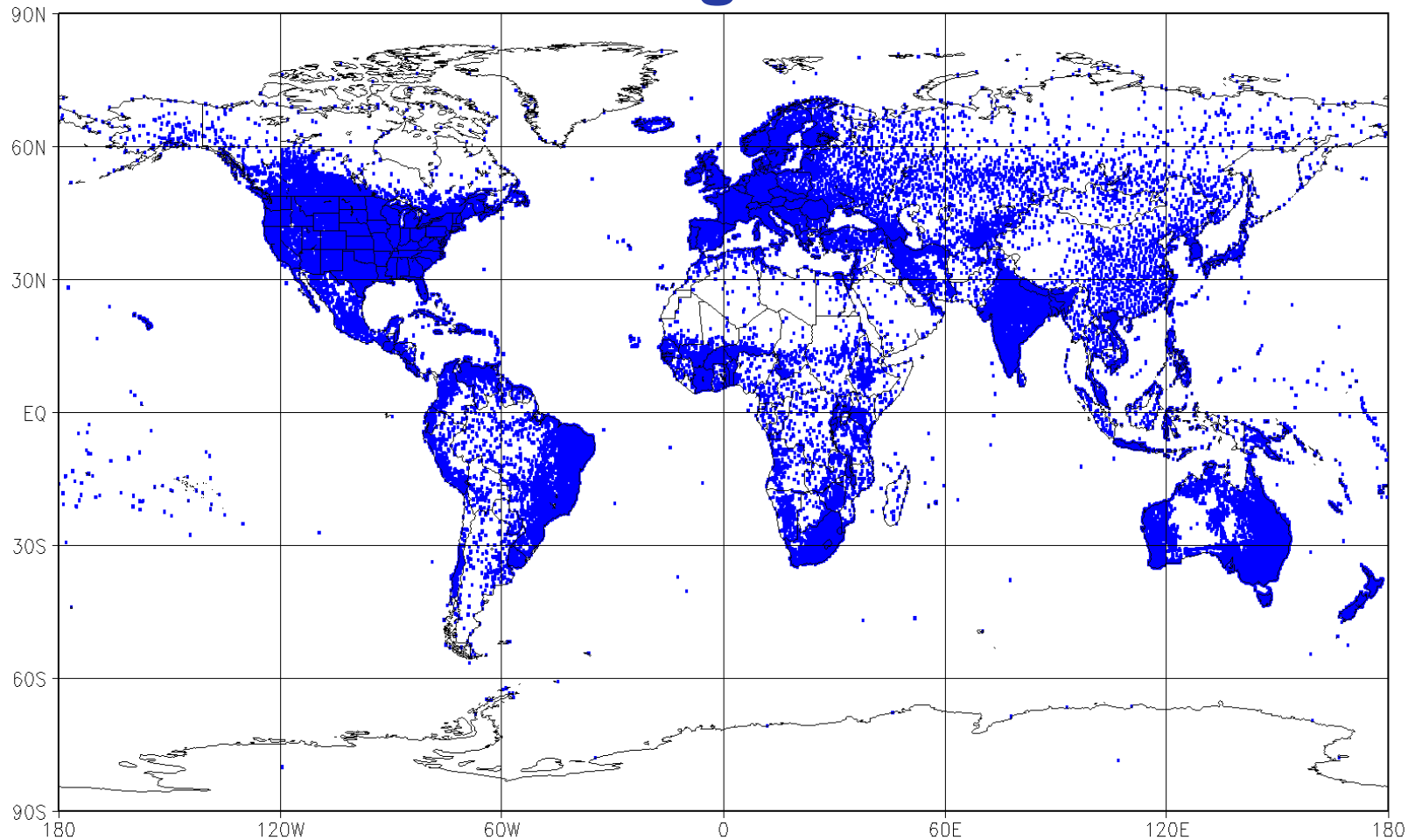
==>

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

Data base for different GPCC products



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)

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).**

  - **The Precipitation Monitoring Product available within 2 months, used by GDAP/GPCP as early in-situ reference for the near real-time.**

GPCC's First Guess Product

- **Availability:**
  - period Oct. 2003 to Nov. 2014
  - within 5 days after the end of the month
- **Data base:**
  - monthly precipitation totals accumulated from SYNOP reports received via GTS at DWD, Offenbach a.M. (ca. 6,000-7,600 stations)

Automatic-only QC of SYNOP reports in the calculation of monthly precipitation totals (check of large precipitation amounts against the weather information, consistency check of reports overlapping in time, etc.)

GPCC's Precipitation Monitoring Product

- **Availability:**
  - period Jan. 1986 up to Dec. 2006 **(V.1)**
  - period Jan. 2007 up to Sept. 2014 **(V.4)**
  - **within 2 months after the end of the month**

- **Data base** (monthly precipitation totals, ca. 7,000-8,900 stations):
  - **accumulated from** SYNOP reports received via GTS at **DWD**
  - **accumulated from** SYNOP reports received via GTS at **NOAA** (CPC „eve data set")
  - **received in** CLIMAT reports via GTS at **DWD**, **UKMO** and **JMA**

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 Full Data Reanalysis (Version 6, Dec. 2011), optimized for high spatial resolution and accuracy, used for model verification and hydrological studies.

New Full Data Reanalysis (Version 7) will become available in spring 2015

GPCC's Full Data Reanalysis V.6

Full Data Reanalysis (Version 6, Dec. 2011) optimized for high spatial resolution and accuracy

- **Availability:**
  - period Jan. 1901 up to Dec. 2010
  - on a 2.5°-, 1°- and 0.5°-grid
- **Data base:**
  - some 10,800-47,000 stations per month (overall 67,200 stations)
  - including additional national/regional data collections from NMHSs and research projects of 190 countries;
  - global data collections of CRU, FAO, GHCN (V.2) + supplements by monthly totals calculated at GPCC from GHCN daily

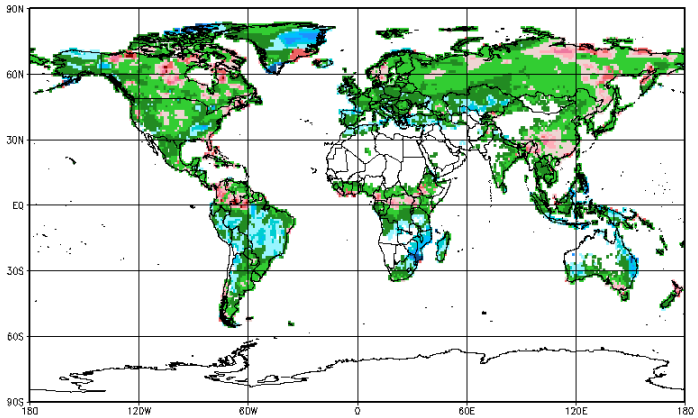
New GPCC products

- The monthly GPCC Drought Index
- The First Guess Daily Product

GPCC Drought Index

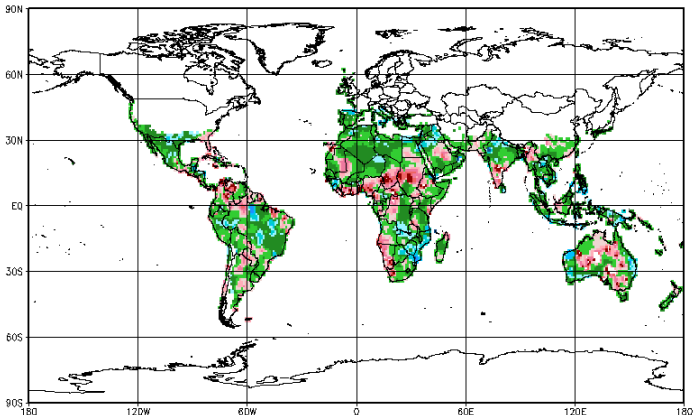
- **Gridded monthly drought index with almost global coverage**
- **Combination of SPI-DWD and SPEI (mean if both are available, otherwise the one available is used)**
- **Input: GPCC First Guess Product, temperature analysis from CPC**
- **Different averaging intervals: 1, 3, 6, 9, 12, 24 and 48 months**
- **Available since Jan. 2013, updated 10 to 13 days after each month**
- **Provided as netCDF-files**
- **Published in Ziese et al. (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 Drought Index: January 2013 (1 Month)



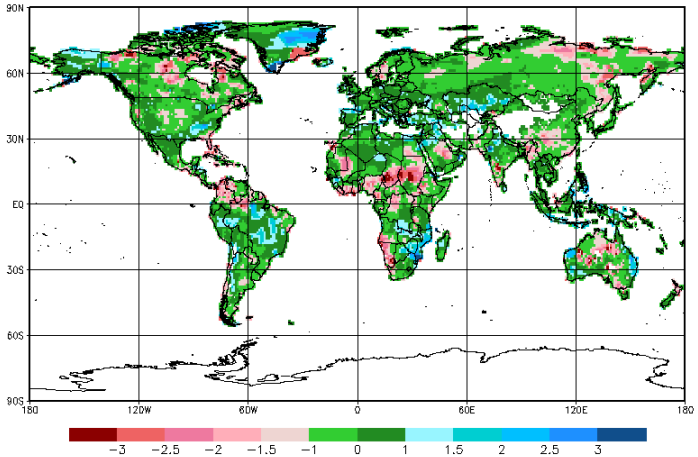
SPI-DWD

+



SPEI

=>



drier than normal wetter than

GPCC_DI

GPCC's First Guess Daily Product

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)**

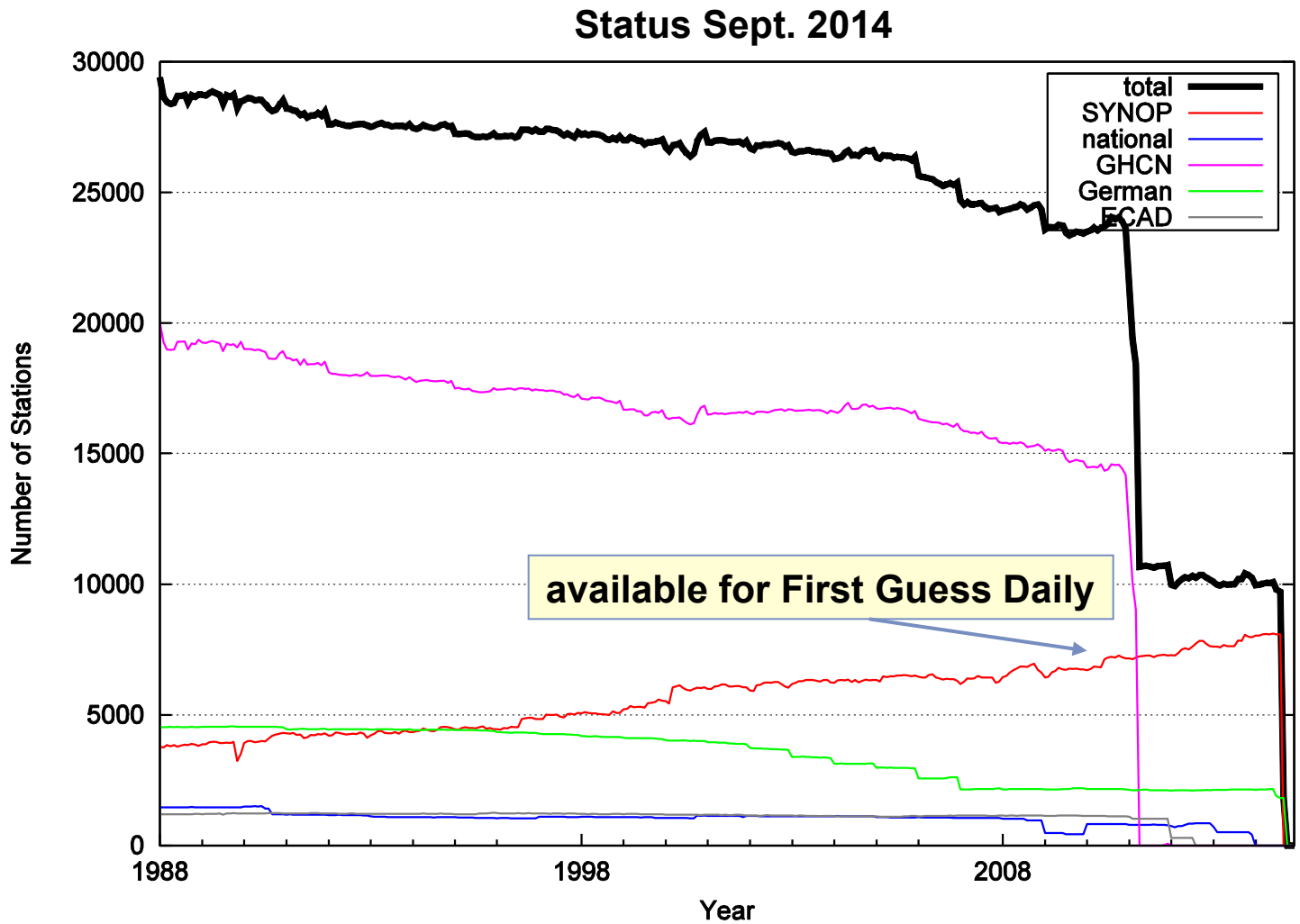
GPCC's First Guess Daily Product

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

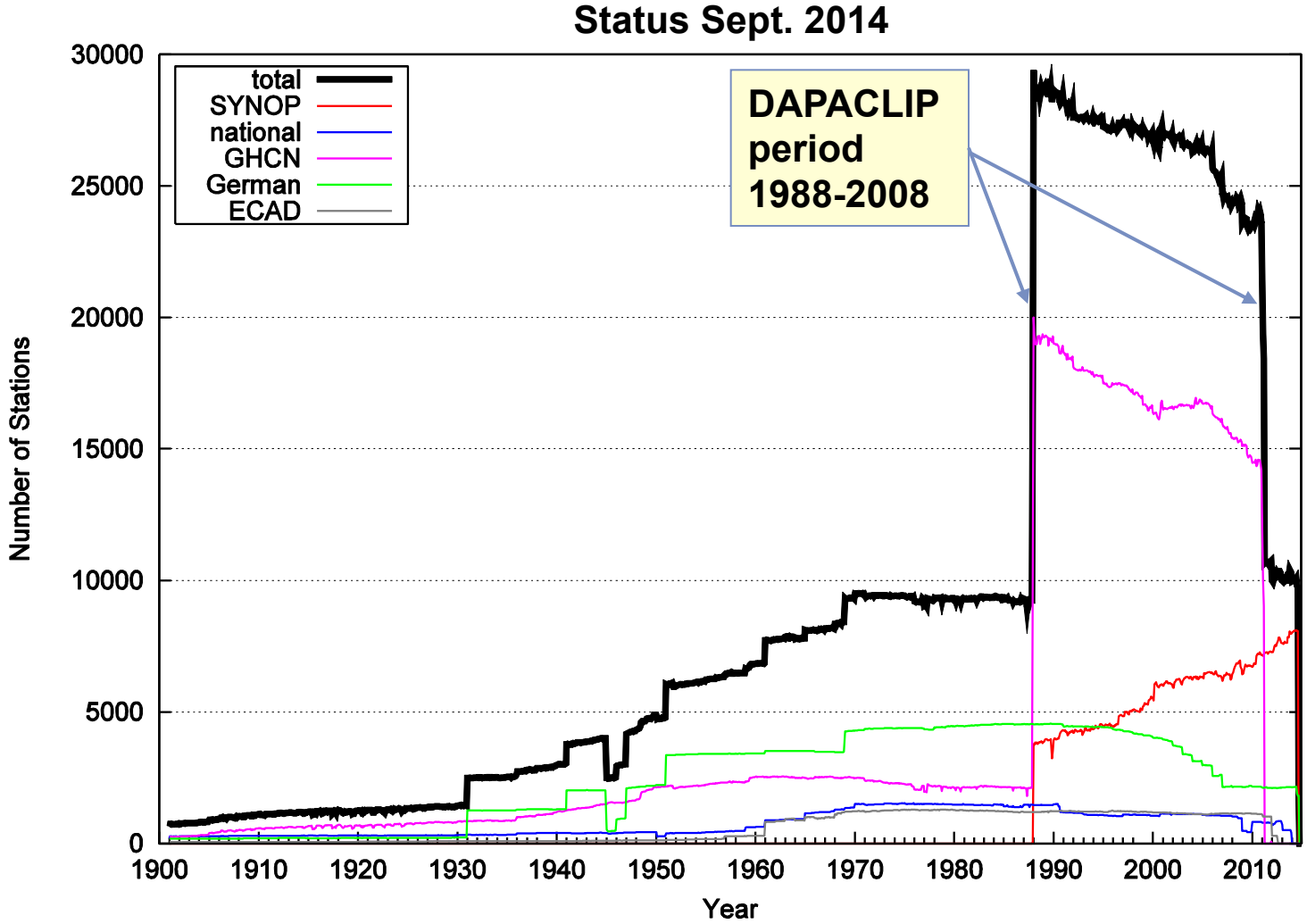
GHCN daily takes the delivered daily data as they are, thus containing a mixture of data assigned to the previous day or observation day (i.e. Brazil, Australia); **GPCC is checking and correcting this, as far as possible, upon integration of GHCN daily and national data sets into its data base**

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

Daily data in GPCC data base



Daily data in GPCC data base



GPCC's First Guess Daily Product

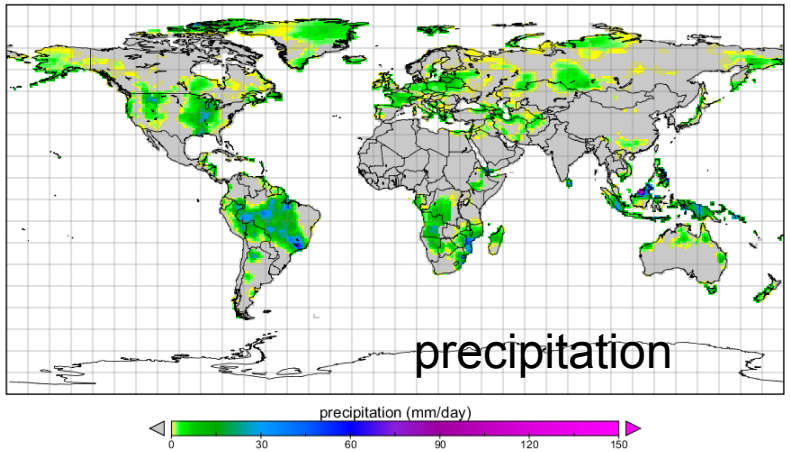
- **Availability:**
  - period Jan. 2009 to Nov. 2014
  - on a 1° grid
  - within 5 days after the end of the month
- **Data base:**
  - daily totals calculated from SYNOP reports received via GTS at DWD, Offenbach a.M. (ca. 7,000-8,100 stations) in a way consistent to WMO recommendation

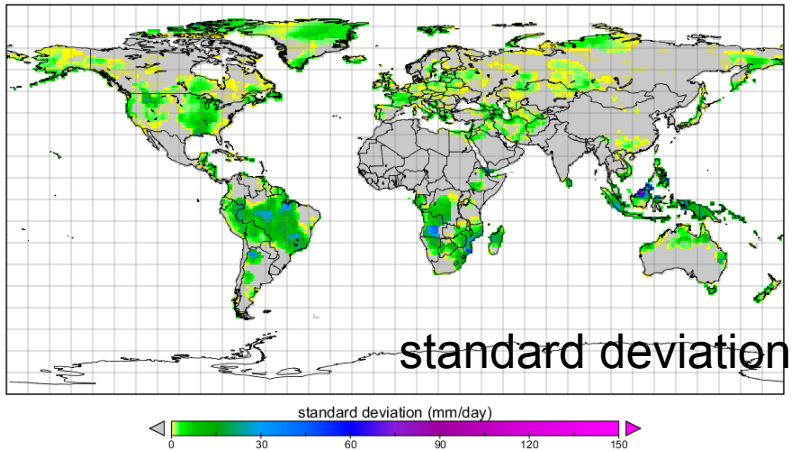
Automatic-only QC of SYNOP reports in the calculation of daily precipitation totals (check of large precipitation amounts against the weather information, consistency check of reports overlapping in time, etc.)

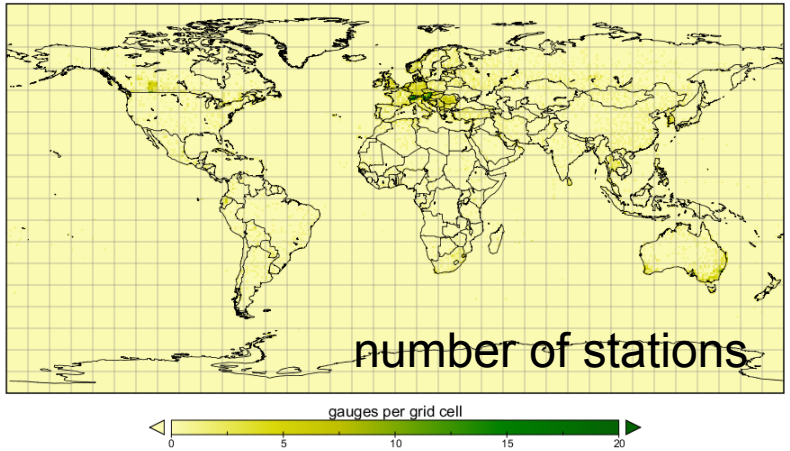
GPCC's First Guess Daily Product

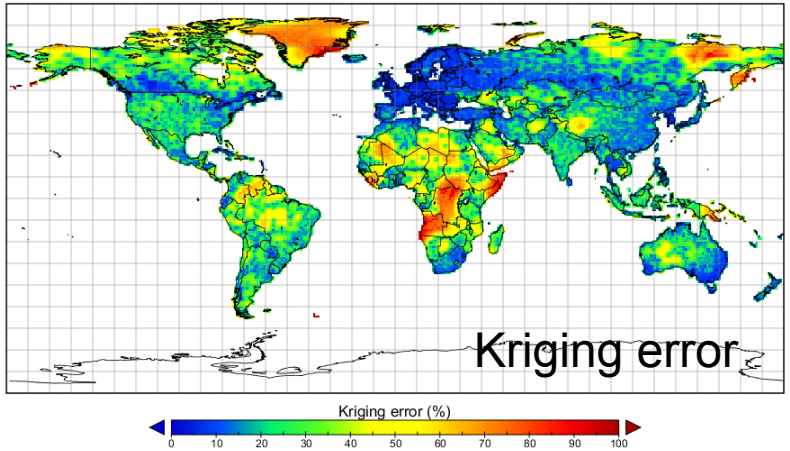
- **Interpolated with ordinary block Kriging**
- **Interpolation of relative values – fraction of daily total in relation to monthly total (only stations with monthly total could be used, at least 70% data coverage required)**
- **Released together with First Guess Product**
- **netCDF-files containing total precipitation, standard deviation regarding Yamamoto (2000), Kriging error and number of stations per grid**
- **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

Example GPCC First Guess Daily: 10 January 2013









Outline

1. GPCC background
2. Data base and data sources available (near and non real-time)
3. Different user requirements and GPCC's portfolio of precipitation analysis products (incl. new ones)
4. **Contributions to the GEWEX Science Questions and WCRP Grand Challenges**
5. Outlook

Contributions to the GEWEX Science Questions and WCRP Grand Challenges

- **GSQ1: Observations and Predictions of Precipitation**

GPCC's precipitation analysis products based on in-situ observed data in near real-time, as well as non real-time, contribute by improving the observational precipitation data sets (Becker et al., 2013)

A combination of GPCC's daily analysis with the satellite-based HOAPS data set, yielding a single sensor global data set for 1988-2008 is planned for 2015 in the framework of the MIKLIP/DAPACLIP project (a prototype for the second decade exists already)

Contributions to the GEWEX Science Questions and WCRP Grand Challenges

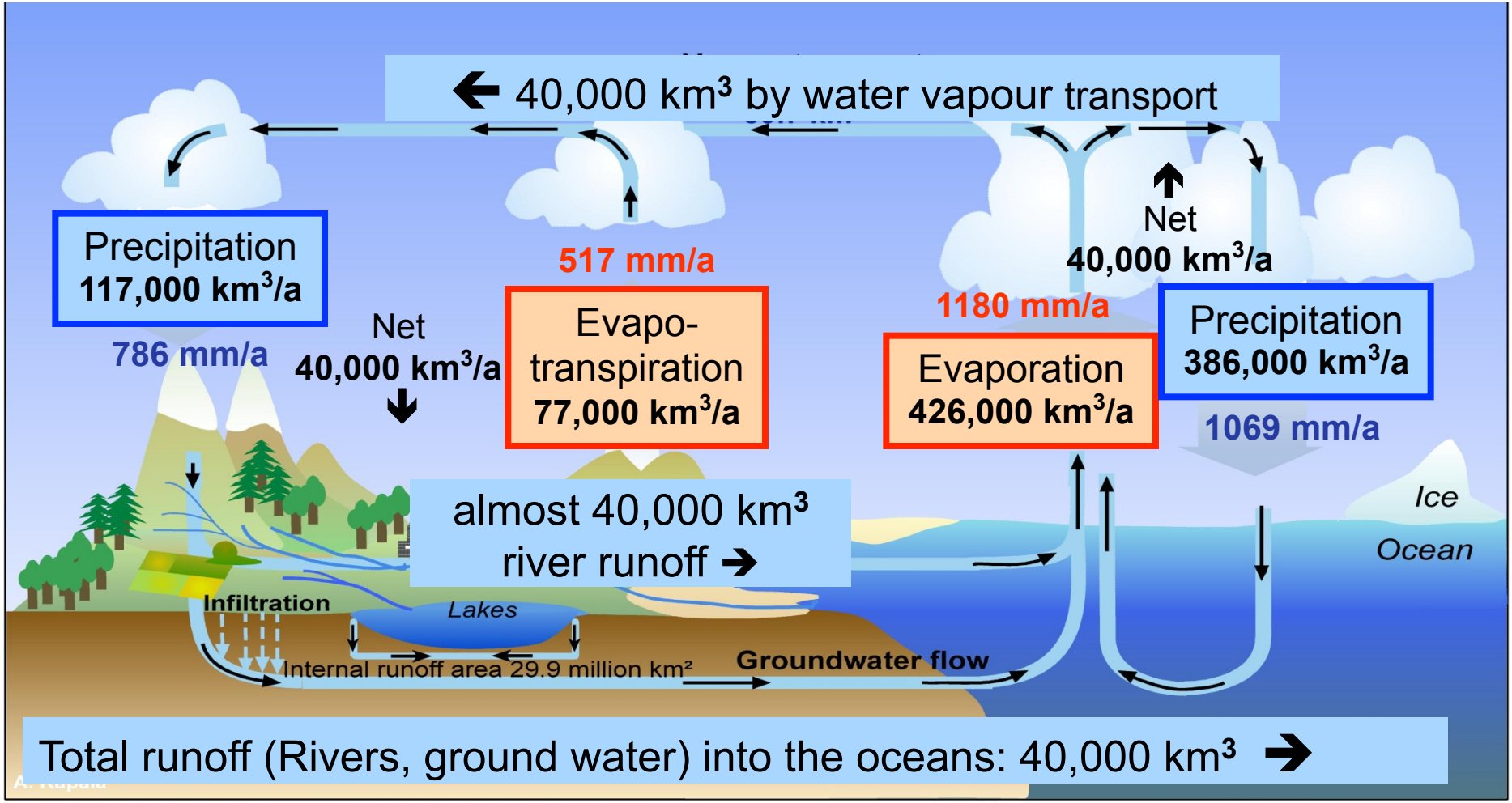
- **GSQ3: Changes in Extremes**

GPCC's new daily precipitation analyses (First Guess Daily, planned Full Data daily) and the underlying daily precipitation data will help to investigate changes in precipitation extremes (Schamm et al., 2014)

- **GSQ4: Water and energy cycles**

The non real-time products Global Precipitation Climatology and Full Data Reanalysis help to determine the average precipitation over land (Schneider et al., 2014).
The best estimate for average precipitation over land for the period 1951-2000 is currently 786 mm/a (equivalent to a water transport of 117,000 km^3/a)

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



Activities contributing to the WCRP Grand Challenges as identified by the JSC

- **Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity**

  This topic can only be addressed in conjunction with the data sets from the other GDAP projects ("Integrated Product")

- **Past and future changes in water availability (with connections to water security and hydrological cycle)**

  The non real-time Full Data Reanalysis (current V.6) is available for the period 1901-2010 and enables investigation of long-term variability of precipitation (Becker et al., 2013)

Outline

1. GPCC background
2. Data base and data sources available (near and non real-time)
3. Different user requirements and GPCC's portfolio of precipitation analysis products (incl. new ones)
4. Contributions to the GEWEX Science Questions and WCRP Grand Challenges
5. Outlook

Outlook

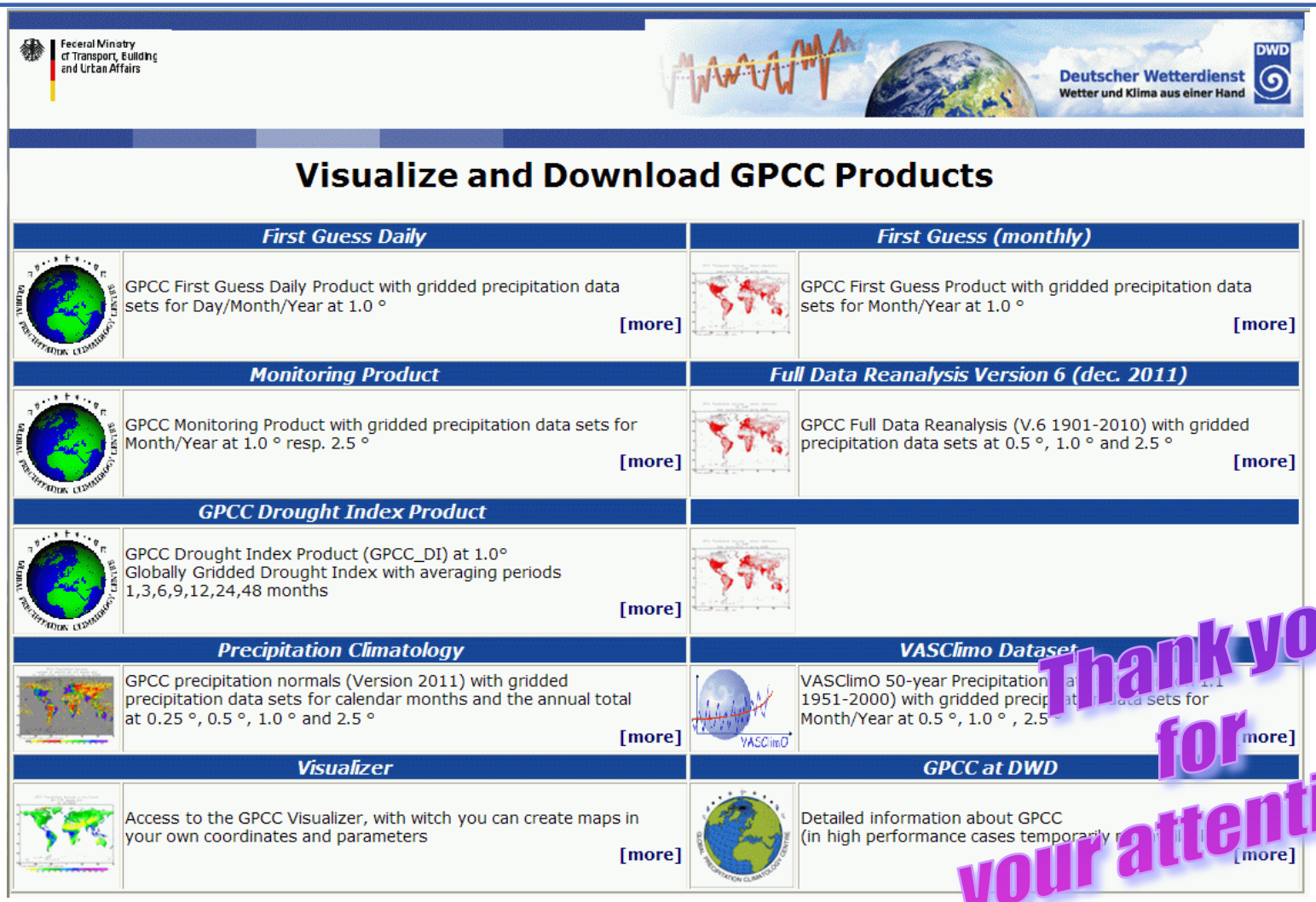
- Homogenized Precipitation Analysis (HOMPRA) for 1951-2005 for Europe (in cooperation with Met. Institute of Univ. Bonn) is now scheduled to become available in spring 2015, on a global scale later

- 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



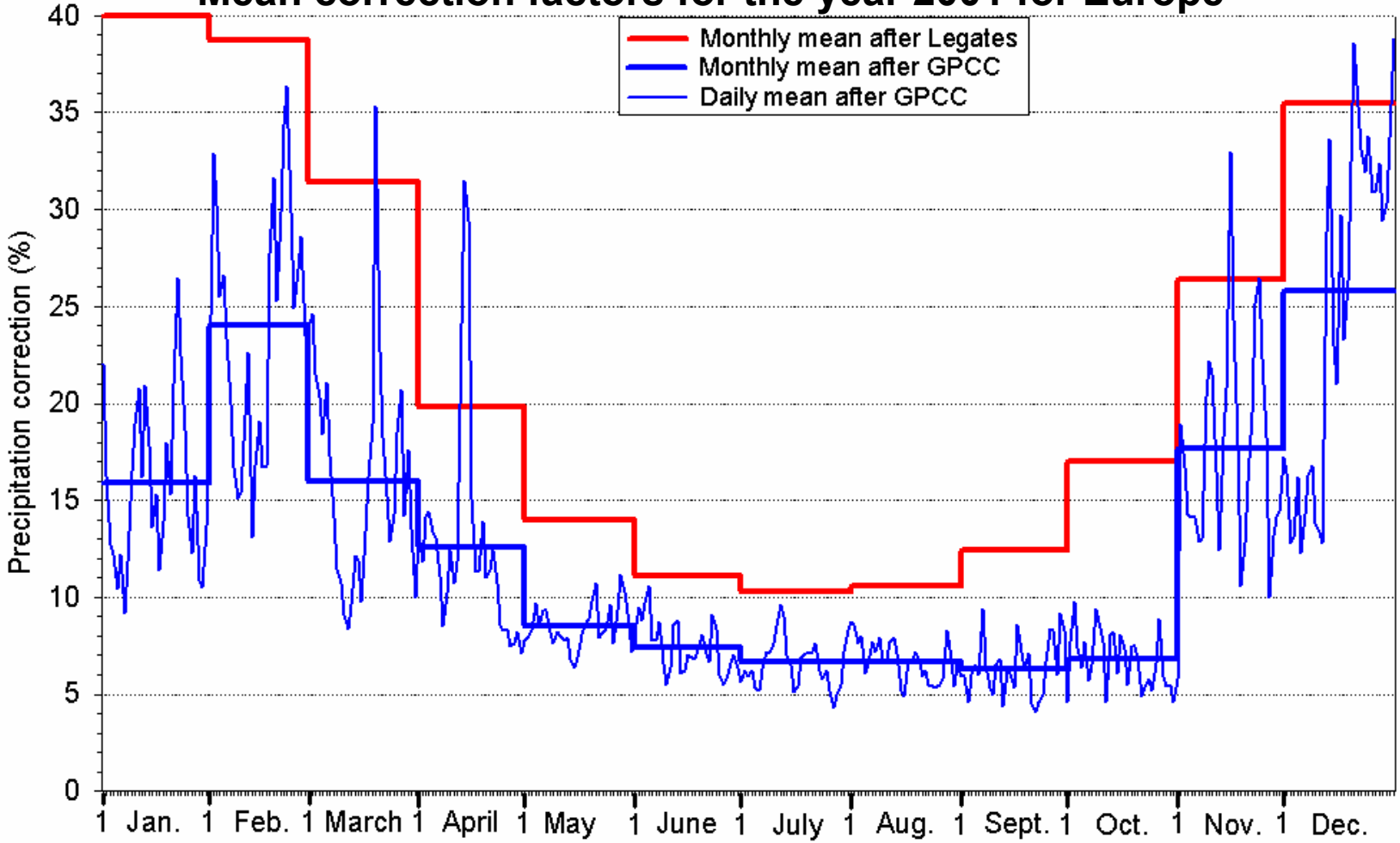
Thank you for your attention !

http://gpcc.dwd.de

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

Additional material

Mean correction factors for the year 2001 for Europe

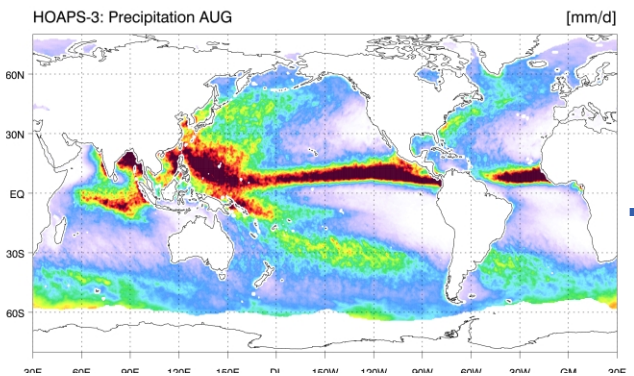


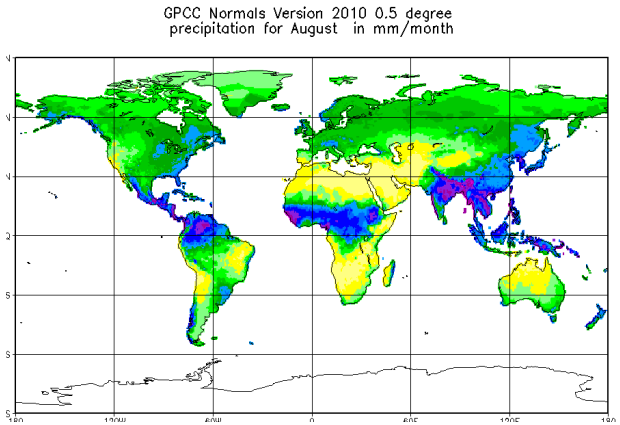
-> New weather-dependent correction (Fuchs et al., 2001) gives lower correction factors than the climatological correction after LW1990

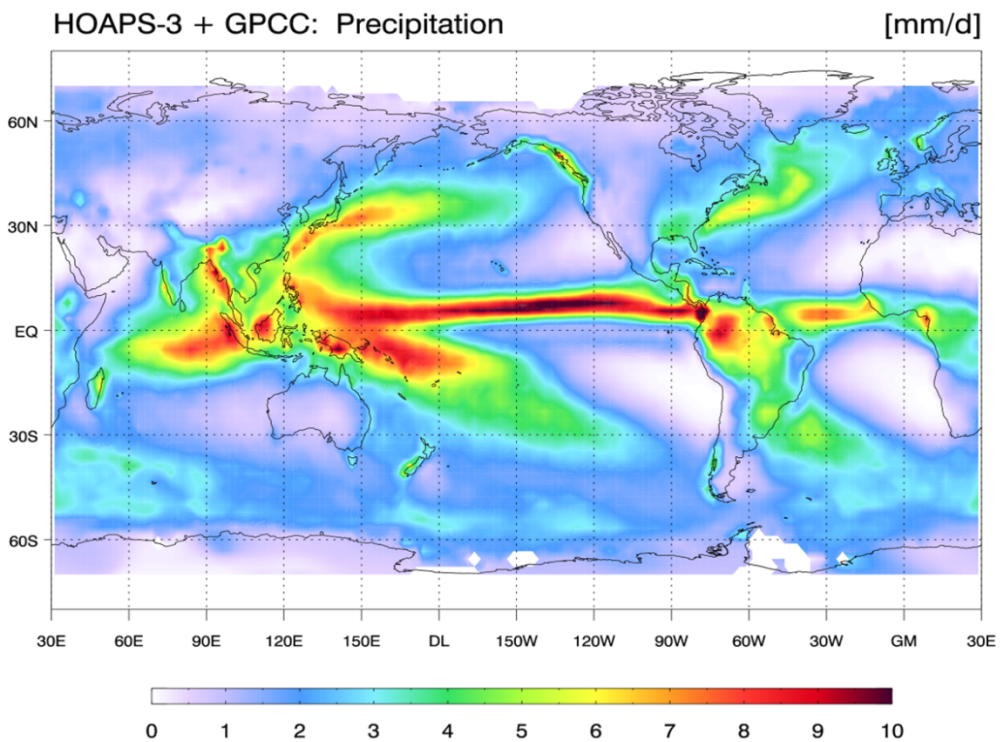
Correction of the systematic gauge-measuring error

- Improved (weather-dependent) correction factors are currently available only from Jan. 2007 onwards
- Until the correction factors based on the improved method are availabe for a longer period the GPCC is utilizing 85% of LW1990‘s bulk climatological correction
- The GPCC will work on the assessment of the gauge-measuring error for the period prior to 2007 on the basis of SYNOP data

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)