



GEWEX GHP Meeting, 25 October 2018, Santiago de Chile, Chile

Data Center Report

Global Precipitation Climatology Centre (GPCC)

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Global Precipitation Climatology Centre

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Outline

1

GPCC background

2

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

3

Quality-control processing at GPCC

4

GPCC's portfolio of precipitation analysis products

5

Outlook

GPCC background

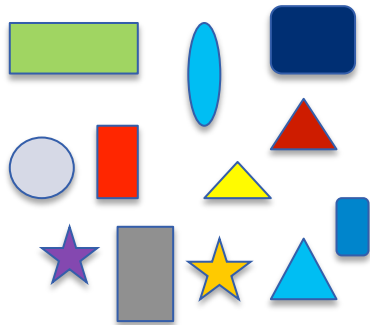
- **GPCC** was established at the beginning of 1989 at Deutscher Wetterdienst (DWD) on invitation by **WMO** (the need for global precipitation data sets); in operation for almost 30 years now
- **GPCC's** main task is the archiving and the analysis of precipitation on the basis of in-situ data for the land-surface
- **GPCC** is contributing to **GEWEX** (Global Energy and Water Exchanges Project) via **GHP** and **GDAP** and to the Global Climate Observing System (**GCOS**)

GPCC background

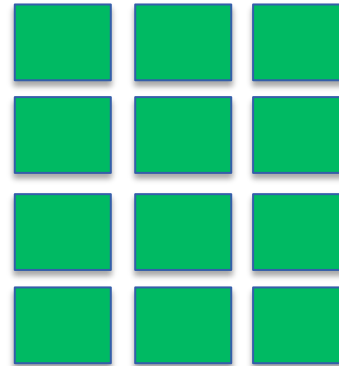
Data delivered in different formats

All data in same format

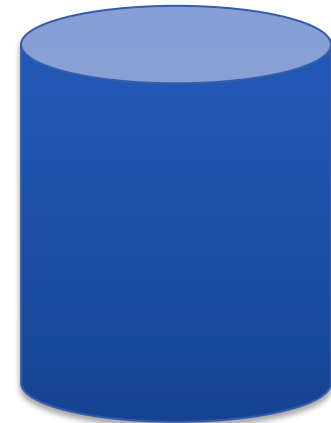
Data stored in data bank



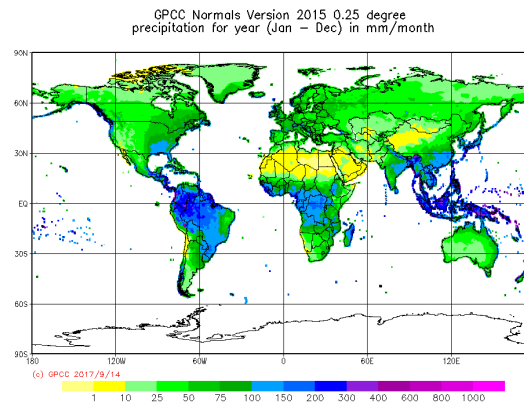
QC



QC



Extracted data for analyses



QC

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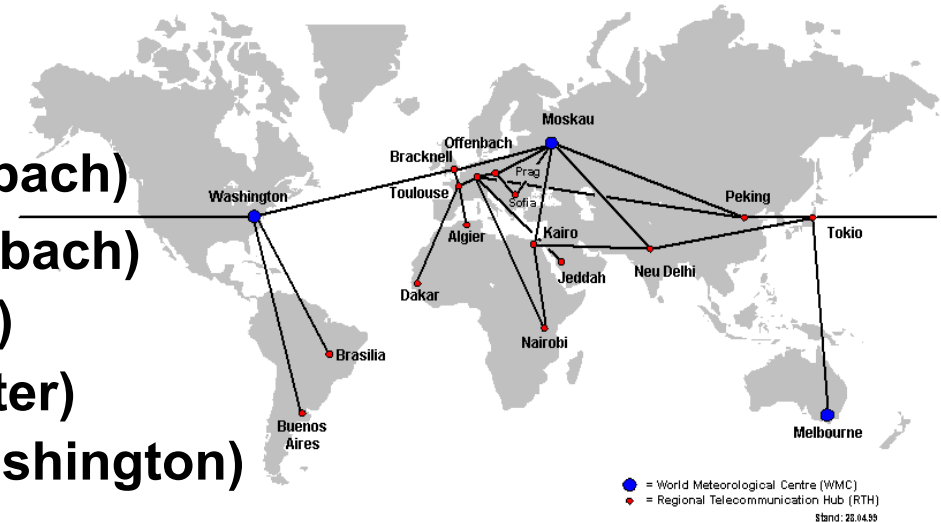
GPCC data sources

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)

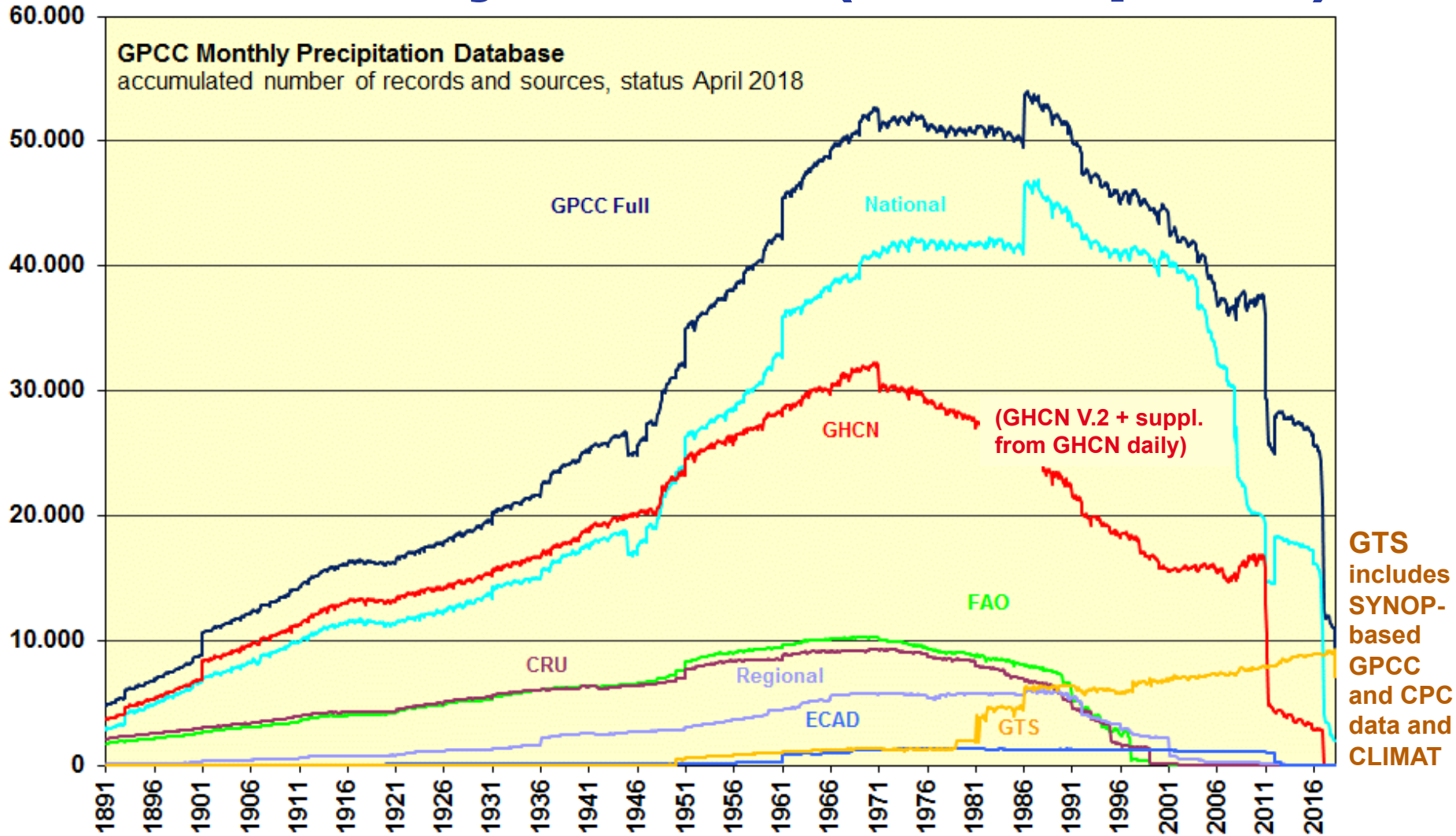
ein globales, standardisiertes Netzwerk zur Verteilung von Wetterdaten innerhalb der WMO Mitgliedsstaaten



Non real-time:

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

GPCC monthly data base (source specific)



GPCC daily data base

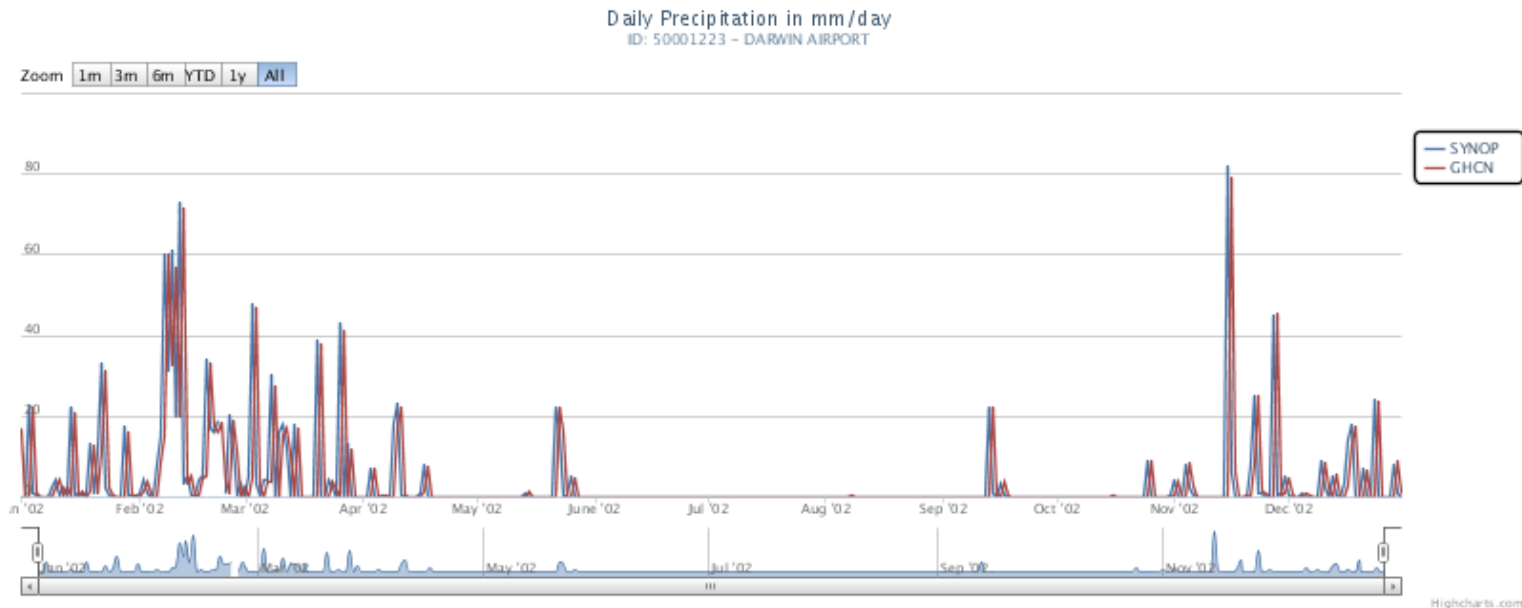
With the beginning of 2012 the GPCC started with the acquisition, processing and analysis of **daily** precipitation data

- 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 (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, but others are doing this differently (i.e. assigning precip to the day when the observation is taken)**

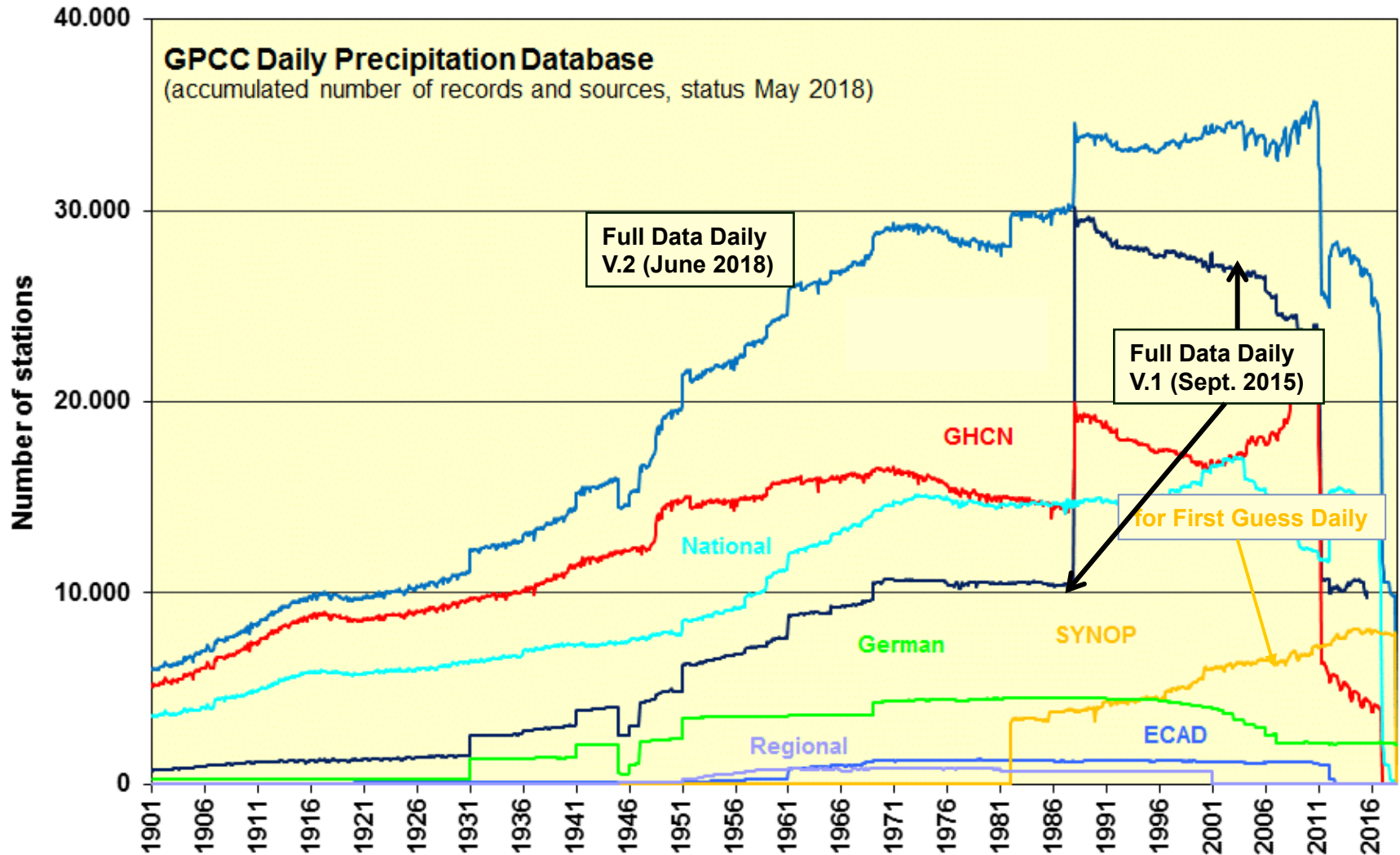
GPCC daily data base

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

GPCC is checking and correcting this, as far as possible, upon integration of **GHCN** daily and of national data sets into its data base



GPCC daily data base (source specific)



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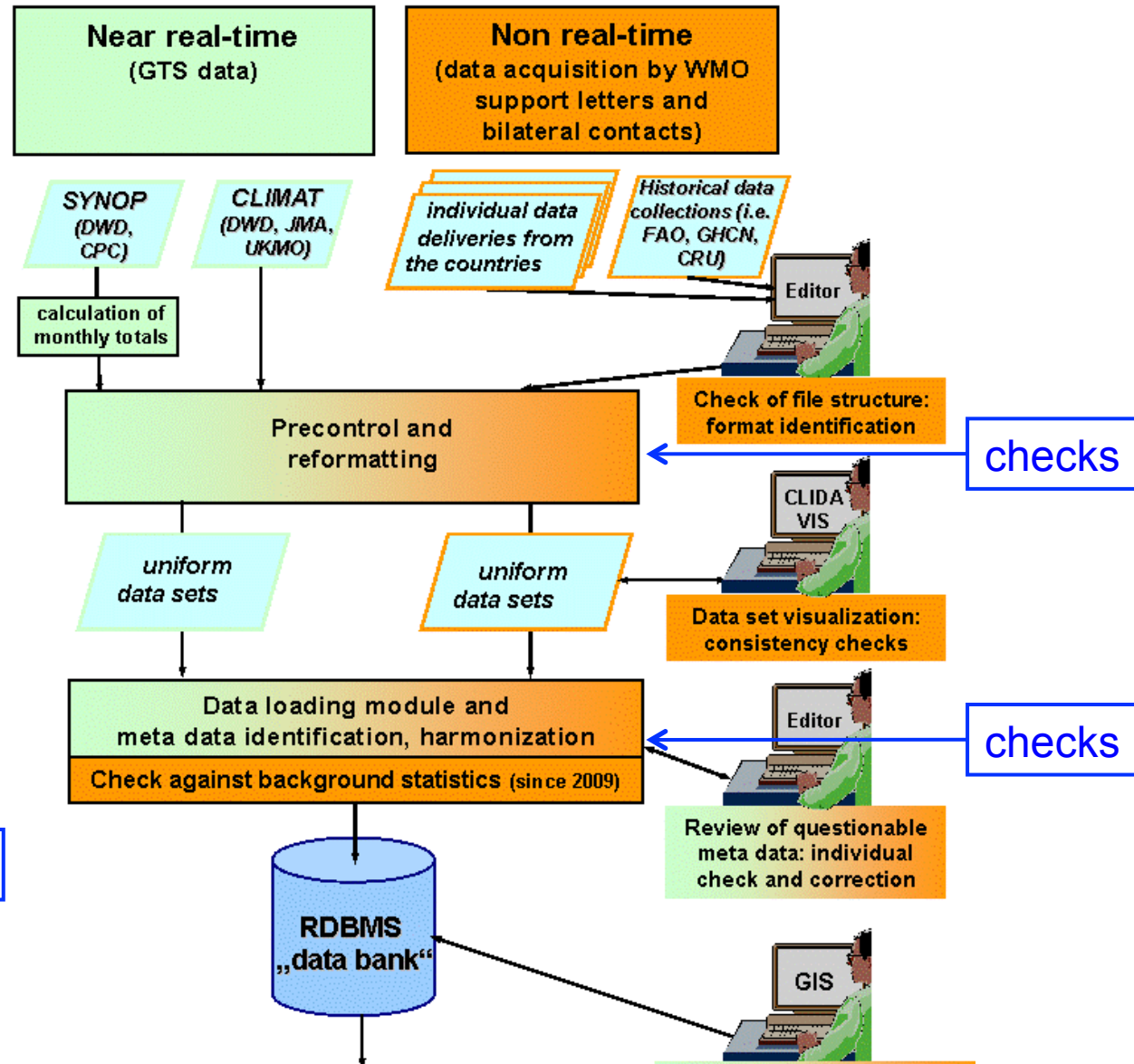
GPCC's portfolio of precipitation analysis products

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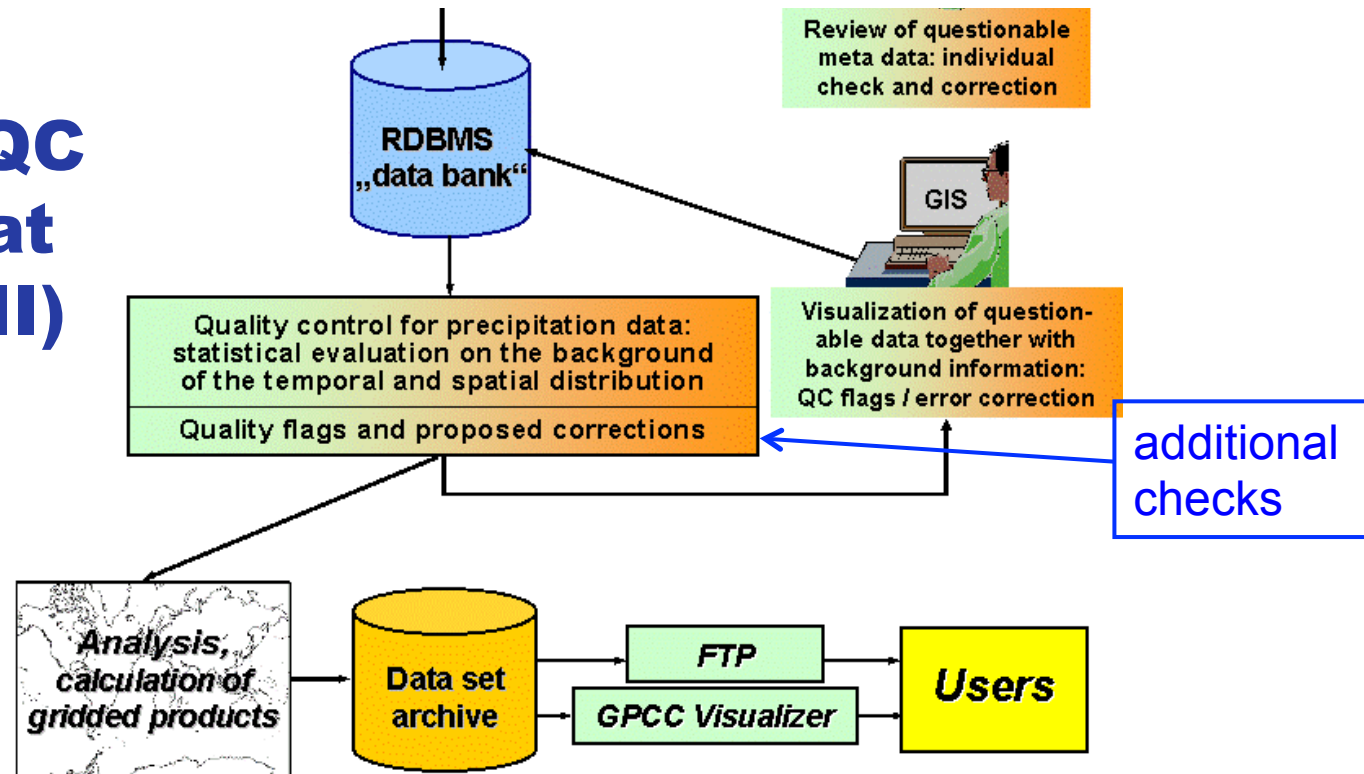
Outlook

Schematic diagram of QC processing at GPCC (part I)

Multi-level QC processing



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

Examples for typical 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“)

Data from different sources are stored separately in the RDBMS, being very helpful in the QC processing

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

➤ **Careful data QC is absolutely necessary !!**



Status Report & Use Cases of the Global Precipitation Climatology Centre (GPCC)

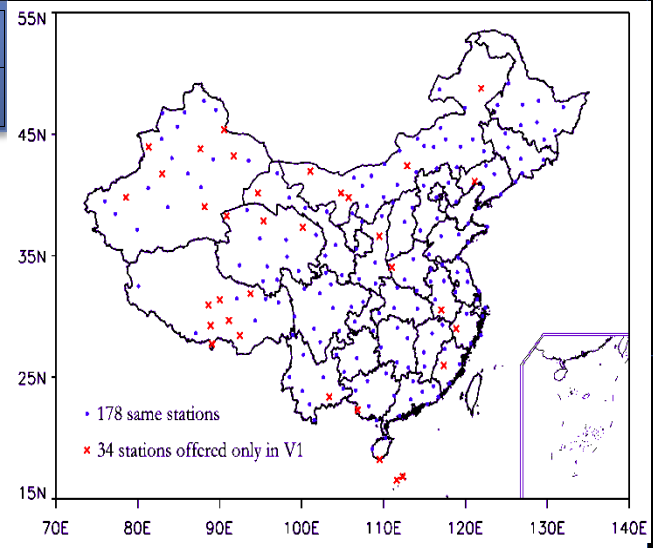
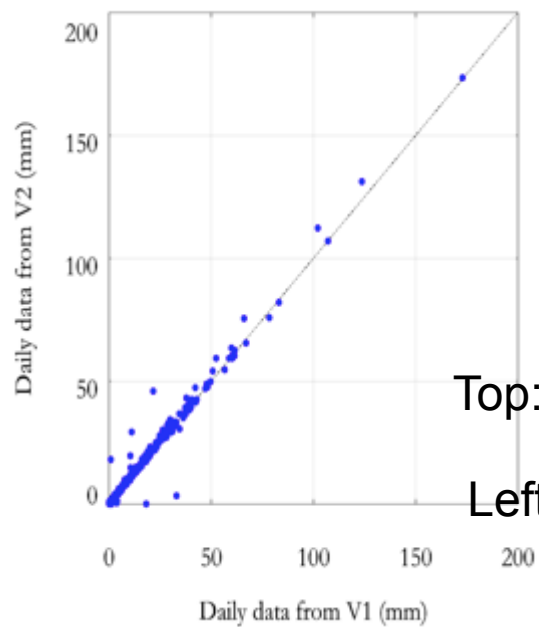


GPCC Function/Capability

2. QA and QC to make data reliable and usable

Since, 2nd of May 2017, Guest Scientist Dr. Yu Yu (CMA) stays with GPCC for 6 Months to study CMA precipitation data contributions and GPCC methods. Step 1: Compare V1 & V2 of CMA's contribution (Yu Yu, 2017)

NO.	Number of Stations	Temporal Extent	Production Time	Provider
V1	212	1981~2010	Dec. 2011	NMIC, CMA
V2	641	1951~2016	Apr. 2017	



Top: Joint and unique V1 stations

Left: Comparison of joint collective

Use Case

1. Global precipitation and drought monitoring (also for Copernicus EMS)
2. Assessment of hydro-climate environment and developments also in context of political crises
3. Seasonal prediction of ENSO related precipitation
4. Centennial analysis of variability and trends
5. Reference data for satellite monitoring across land
6. Potable water resources
7. Arctic Precipitation
8. Wet Deposition



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Deutscher Wetterdienst
Wetter und Klima aus einer Hand



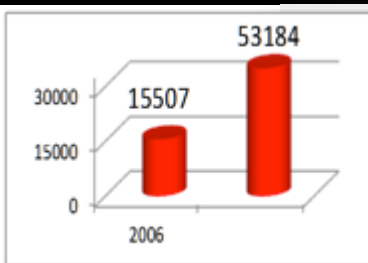
GPCC Function/Capability

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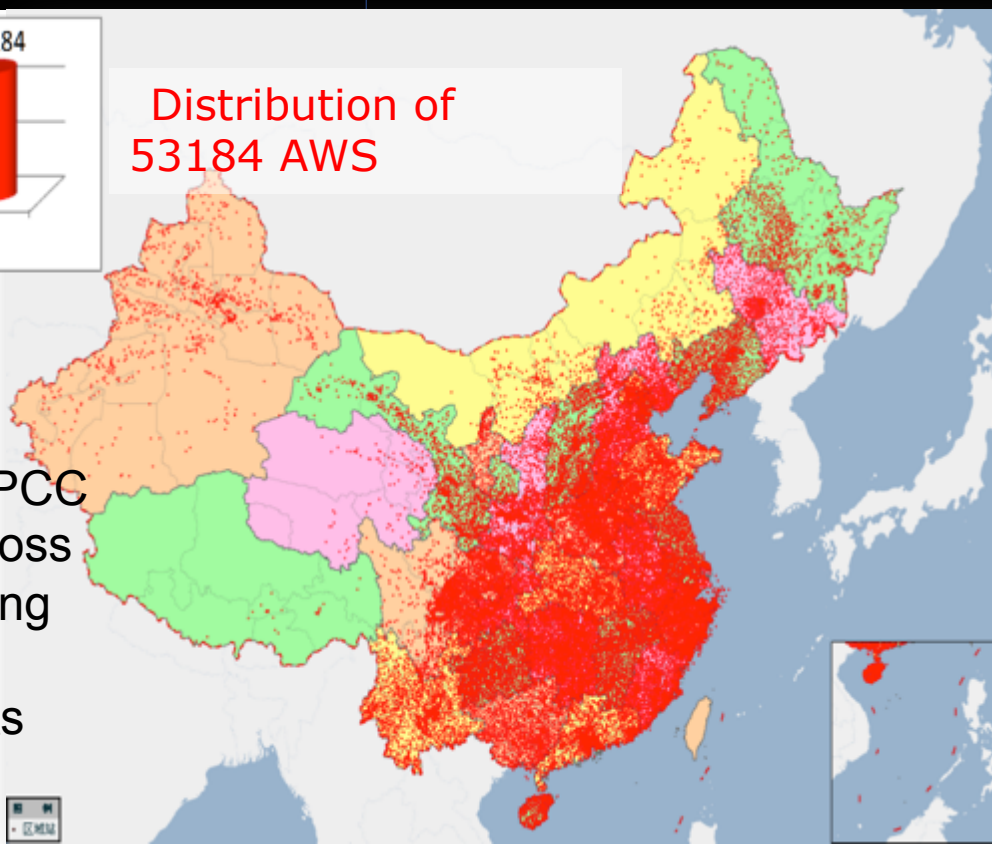
Since, 2nd of May 2017, Guest Scientist Dr. Yu Yu (CMA) stays with GPCC for 6 Months to study CMA precipitation data contributions and GPCC methods. Step 2: Dr. Yu Yu & GPCC QC jointly process CMA data.

Use Case

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Distribution of
53184 AWS



Step 3: A GPCC analysis across China, serving also CMA's requirements

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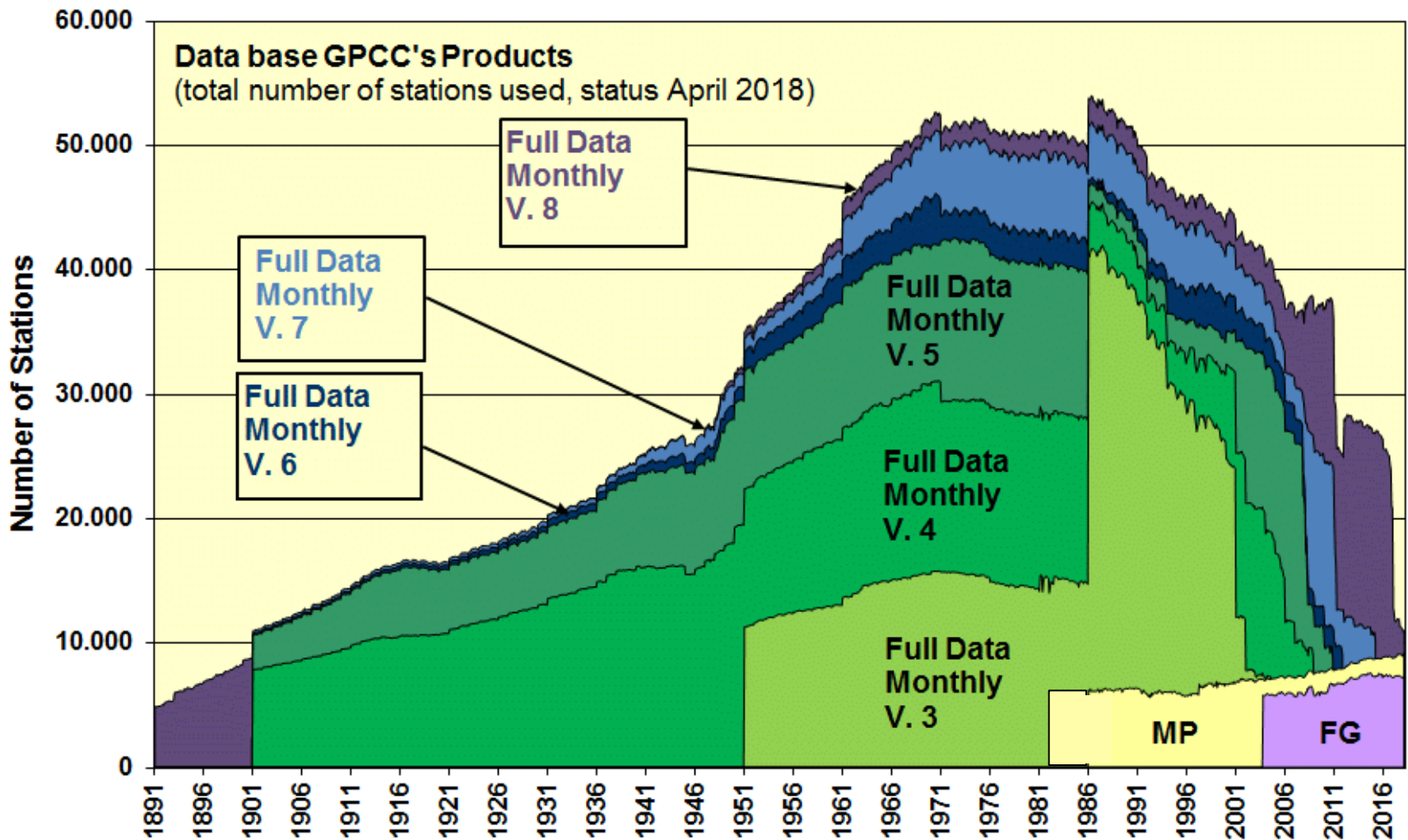
User requirements

- **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



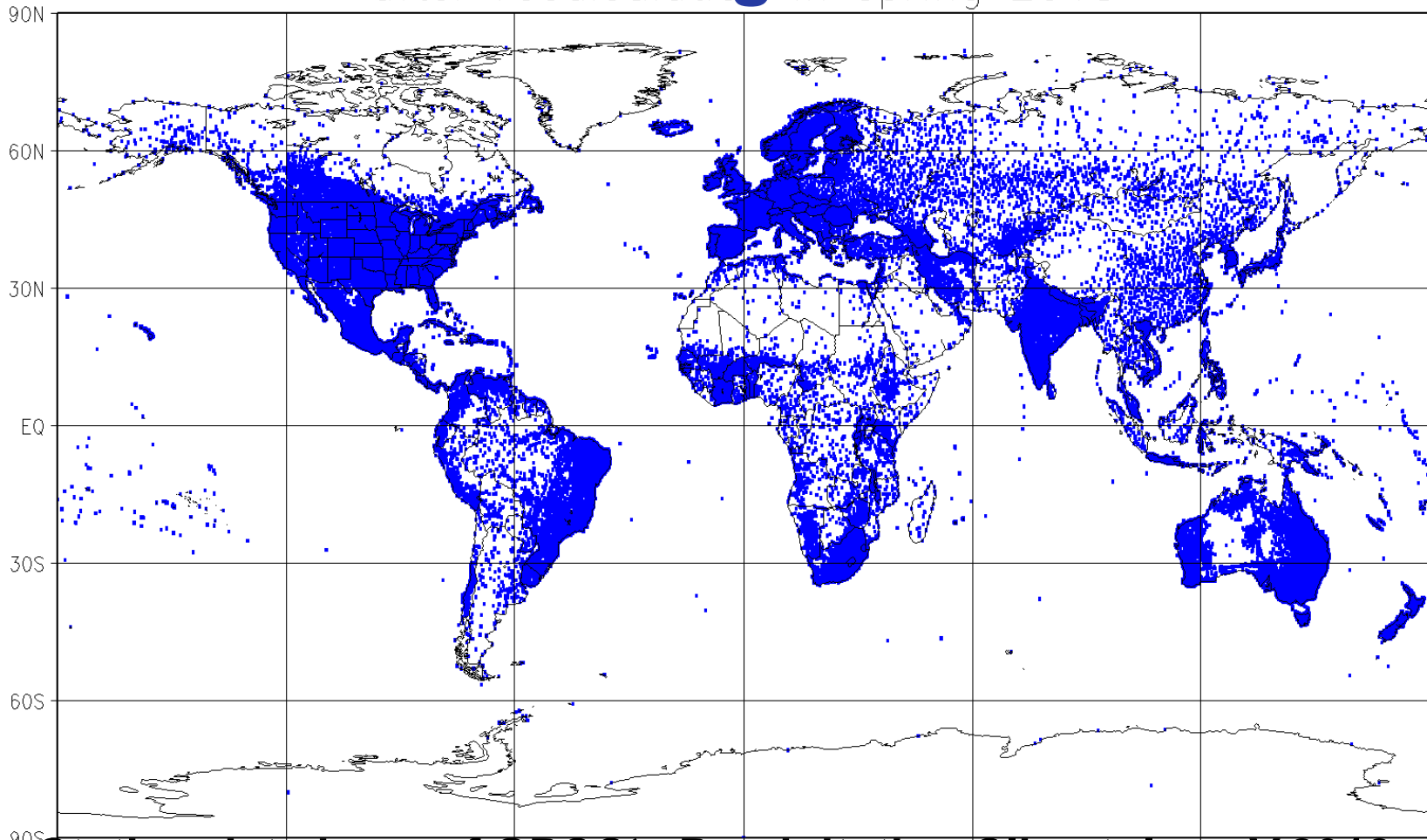
Near real-time monthly precipitation products

- **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.6 !!**)
Period: Jan. 1982 (!) up to present
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 2018)**, background for all other GPCC precipitation analysis products, based on ca. 79,200 stations with climatological normals (overall data of more than 116,000 stations in GPCC data base)

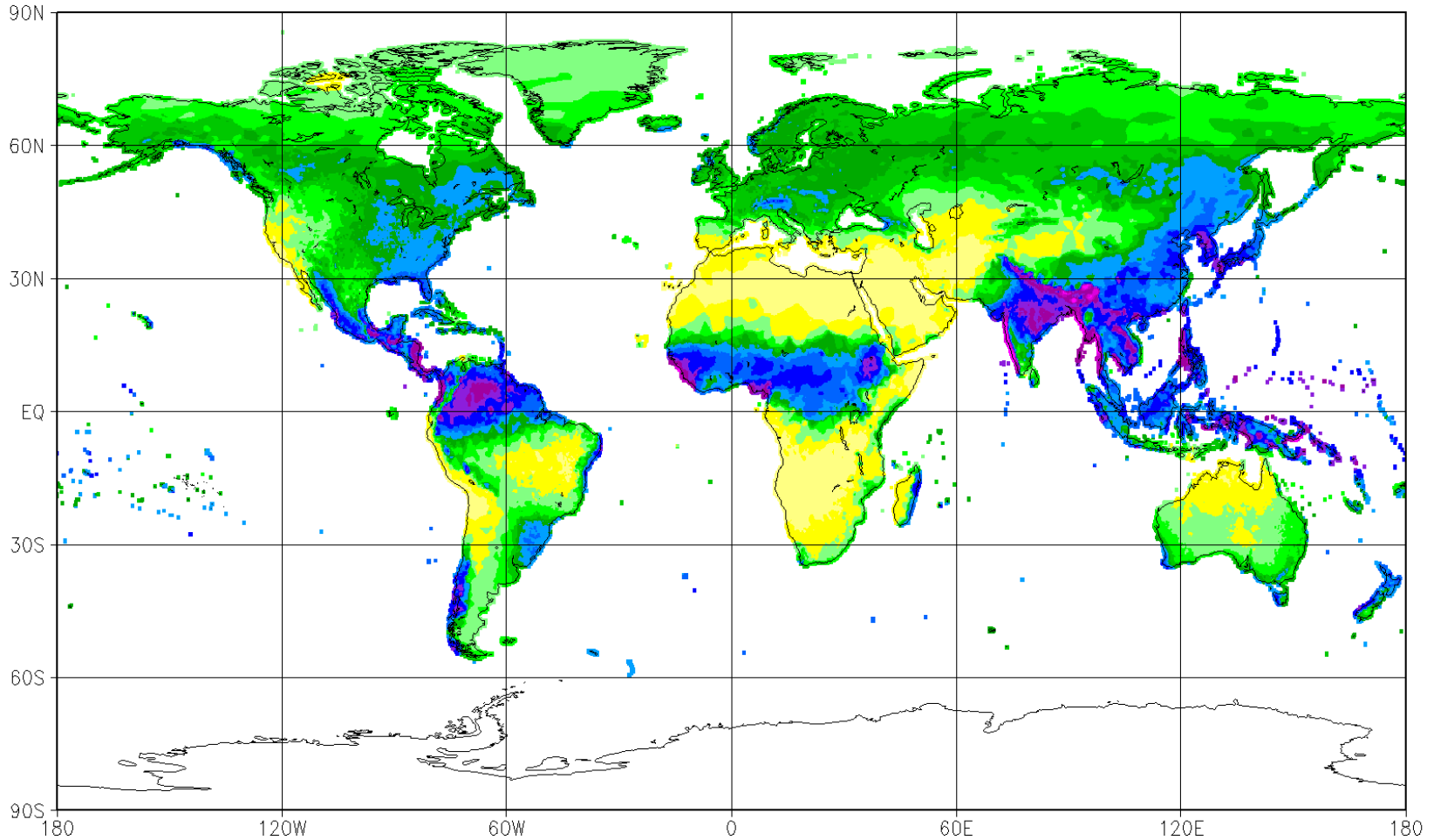
GPCC Climatological data base



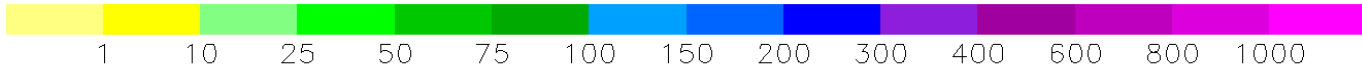
Station data base of GPCC's Precipitation Climatology V.2018 as basis for anomaly analyses (number of stations: ca. 79,200)

(c) GPCC 2018/05/04, number of gauges: 79278

GPCC's Precipitation Climatology V.2018 for July on a 0.25° grid



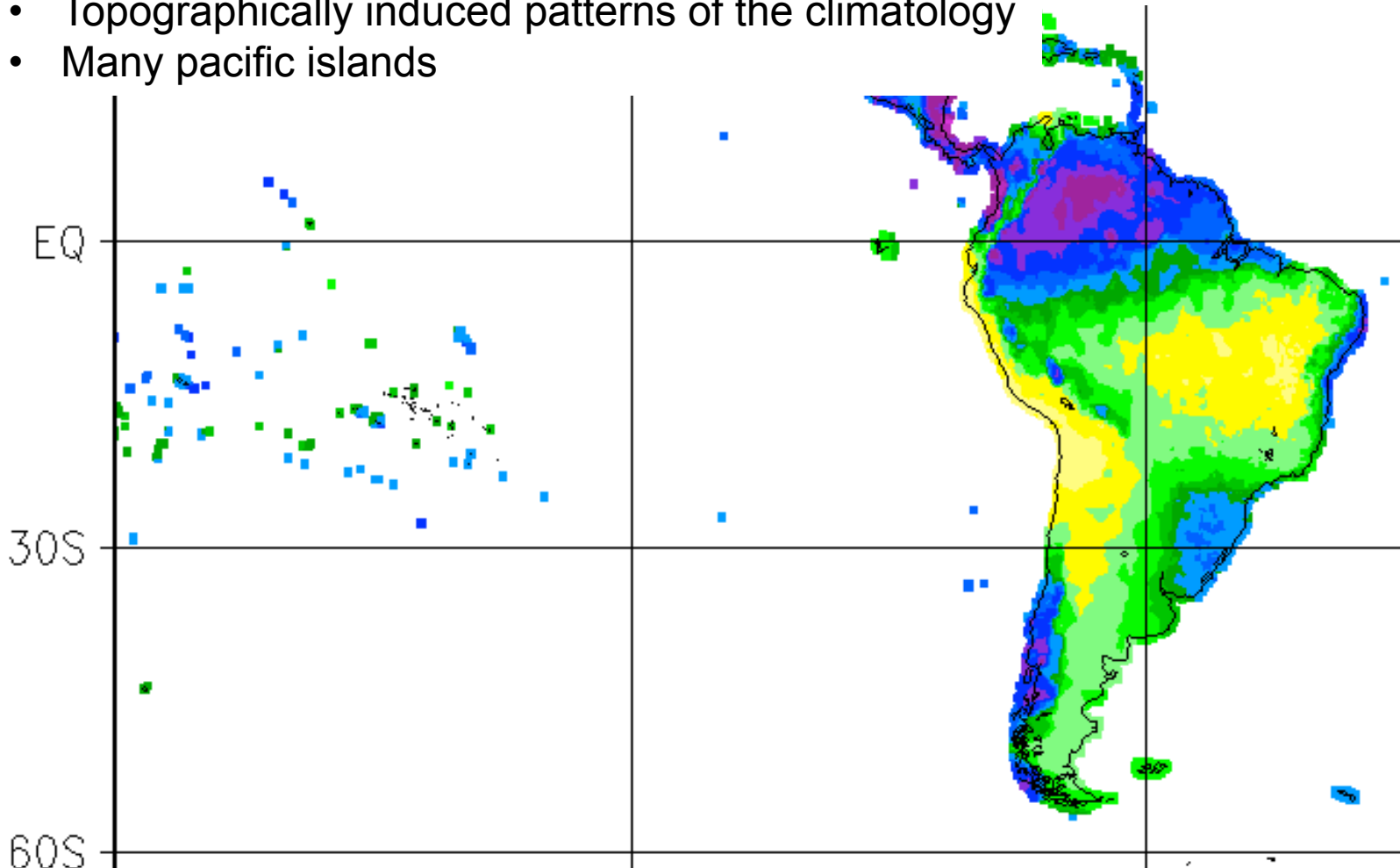
(c) GPCC 2018/05/04 number of stations: 79278 global



GPCC's Precipitation Climatology V.2018 for July on a 0.25° grid

Refined Land-Sea Mask and 0.25° resolution resolve

- Topographically induced patterns of the climatology
- Many pacific islands



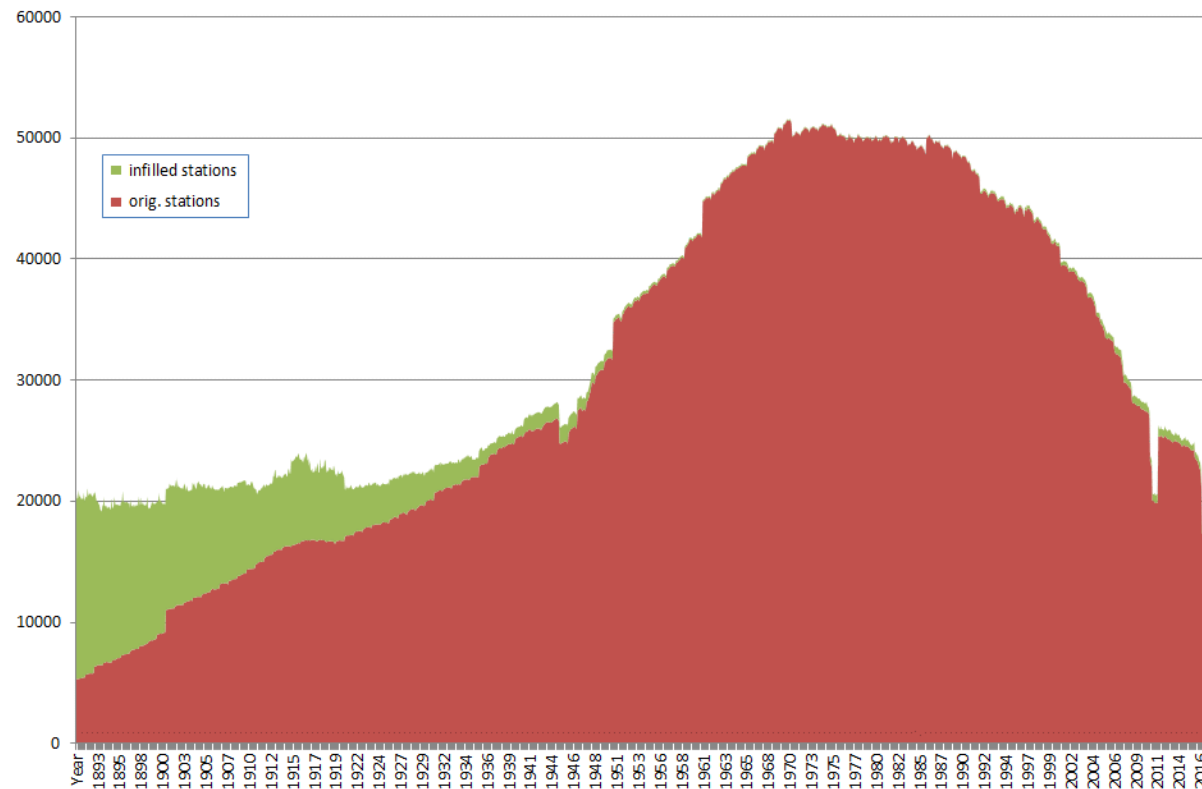
Non real-time precipitation products

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 - The **Global Precipitation Climatology (over land) (May 2018)**, background for all other GPCP precipitation analysis products, based on ca. 79,200 stations with climatological normals (overall data of more than 116,000 stations in GPCP data base)
 - The **Full Data Monthly V.2018 (V.8, June 2018)**, optimized for high spatial resolution and accuracy, used for model verification and hydrological studies
Period: Jan. 1891 up to Dec. 2016
Data base: 6,000-53,000 stations per month
(overall 79,200 stations included)

Non real-time precipitation products

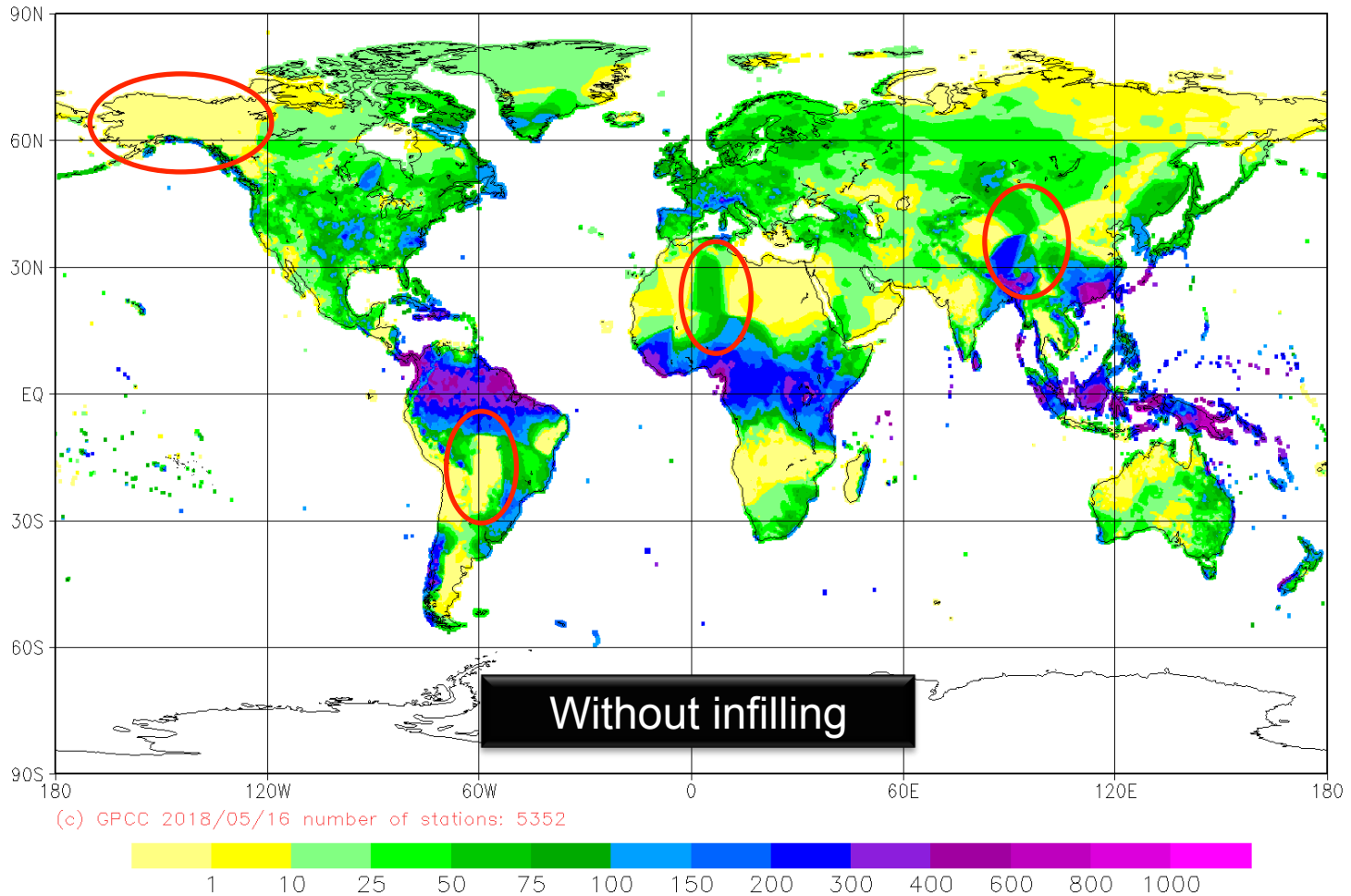
➤ Every data product is DOI referenced and features uncertainty information

- Number of stations per grid cell supporting the analysis
- Interpolation error according to Yamamoto (2000)
- Standard deviation
- An operator field to undo the statistical infilling applied

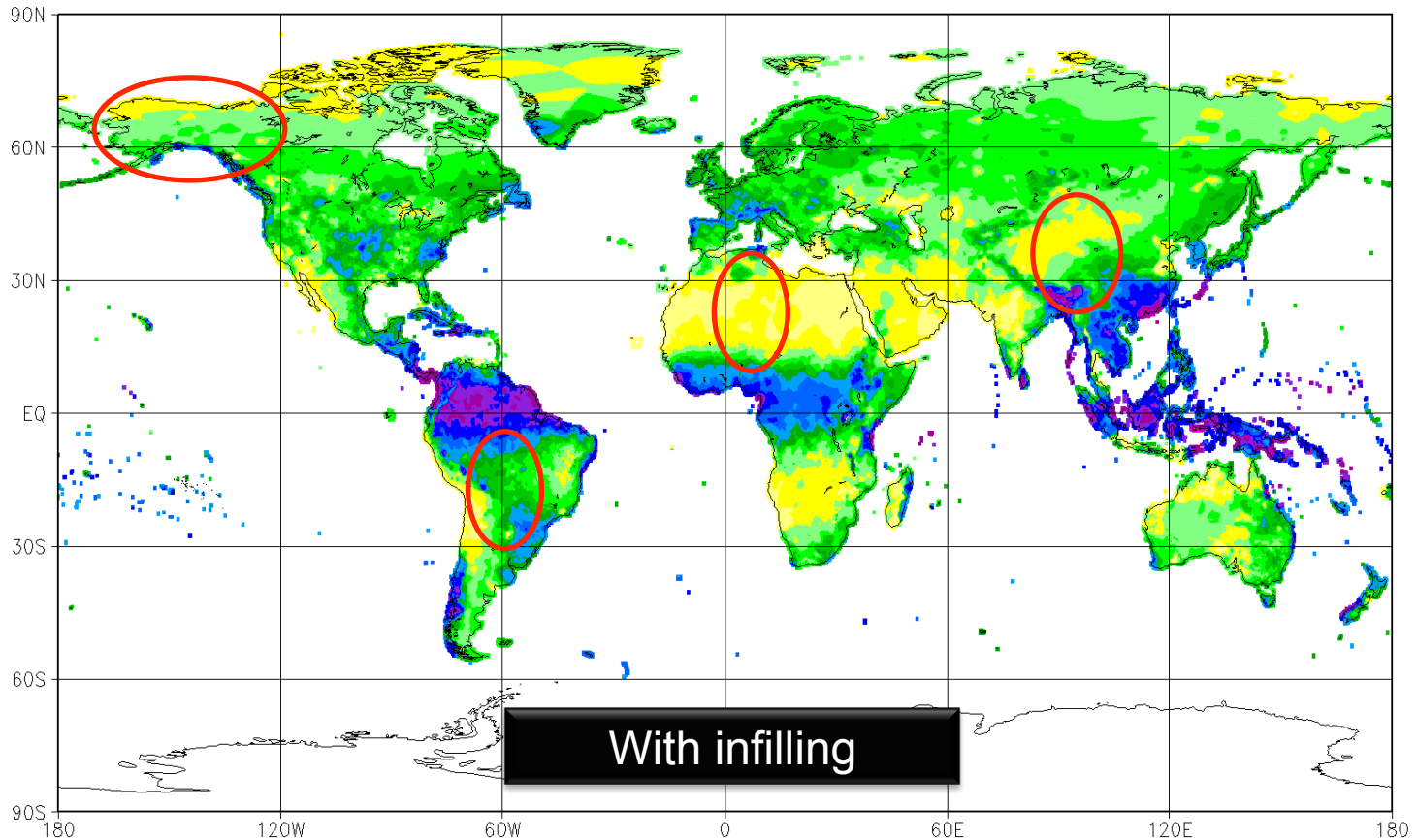


Yamamoto, J., 2000 An Alternative Measure of the Reliability of Ordinary Kriging Estimates Mathematical Geology, Mathematical Geology, Kluwer Academic Publishers-Plenum Publishers, 32, 489-509.

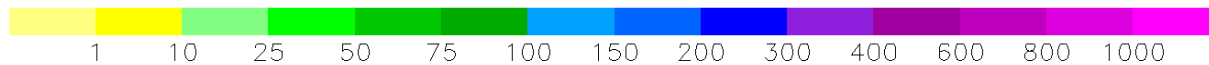
Statistical infilling illustration for May 1891



Statistical infilling illustration for May 1891



(c) GPCP 2018/05/16 number of stations: 5352 + 14997



Daily precipitation analysis products

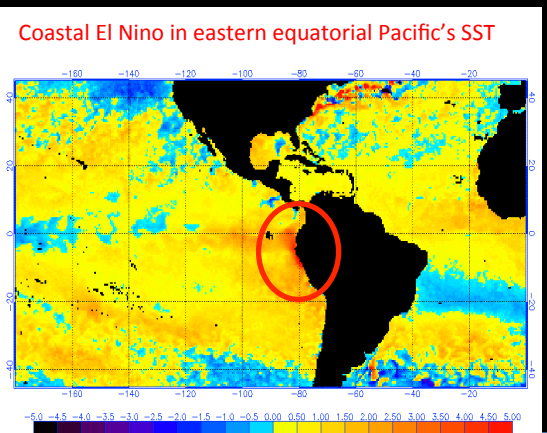
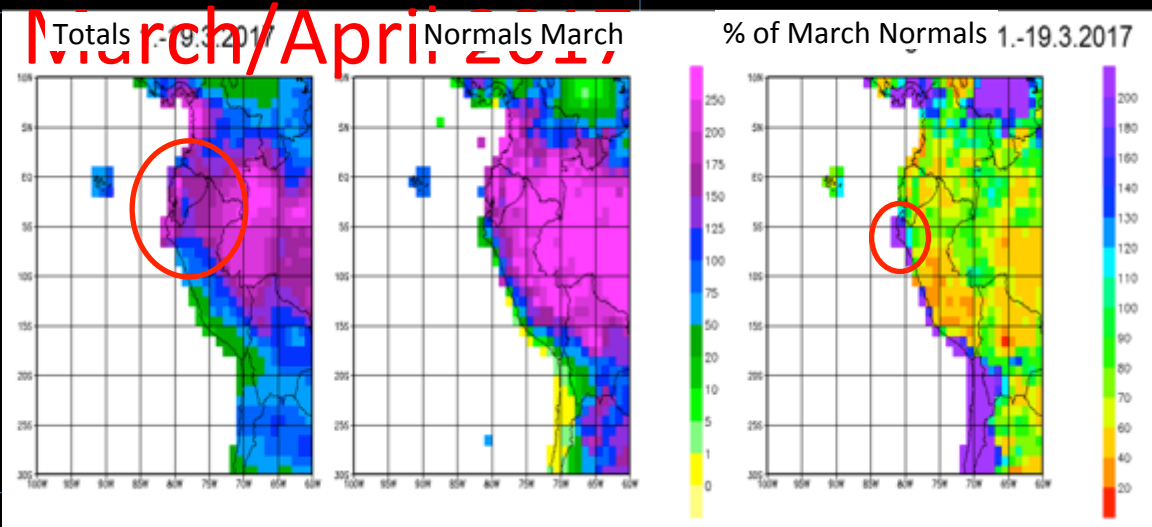
- **GPCC** is providing the following daily gridded data sets:
 - A **First Guess Daily** Analysis available within 5 days after the end of the month via internet
Period: Jan. 2009 to present
Data base: ca. 7,000-8,100 stations
described in Schamm et al. (2014)
 - The **Full Data Daily** Analysis (V.2) updated from time to time
Period: Jan. 1982 to 2016
Data base: ca. 25,000-35,000 stations



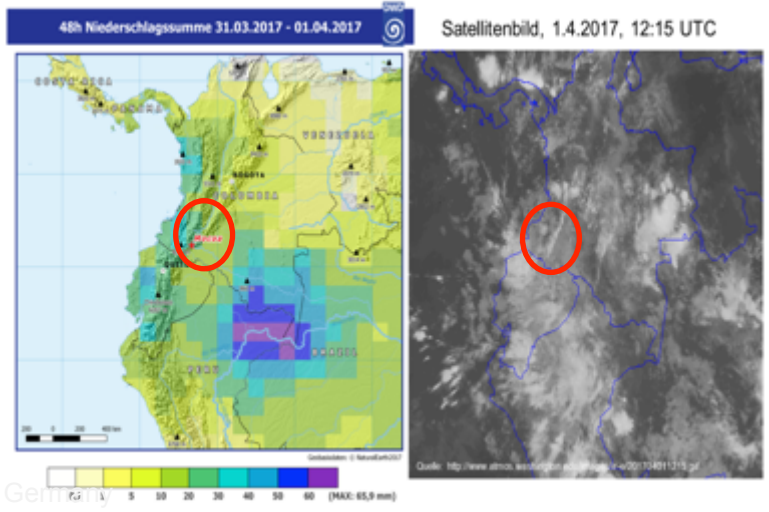
Extreme events: Peru and Colombia

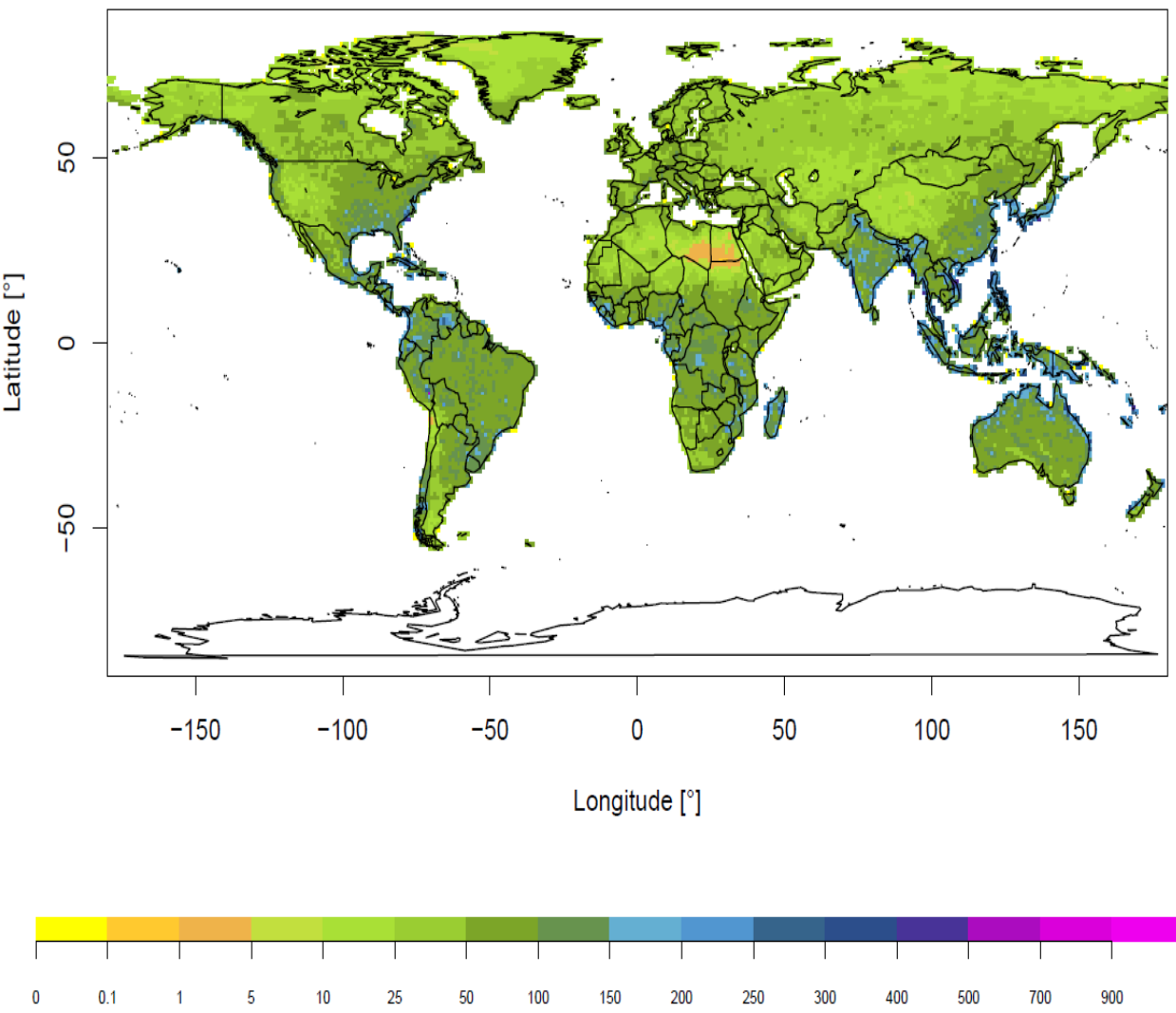
Use Case

1. Global precipitation and drought monitoring
2. Assessment of hydro-climate environment and developments also in context of political crises



Limited representativeness of local scale heavy precipitation events like in Mocoa, Colombia





RX1day in mm: Maximum 1-day values in mm within 21 years. Max(RX1) = 533.2 mm

GPCP has assembled a unique bi-decadal daily precipitation analysis data set together with CM_SAF@DWD

Use Case

- 5. Reference data for satellite monitoring across land
- 6. Potable water resources
- 7. Wet deposition of (radioactive) aerosols
- 8. Arctic Precipitation

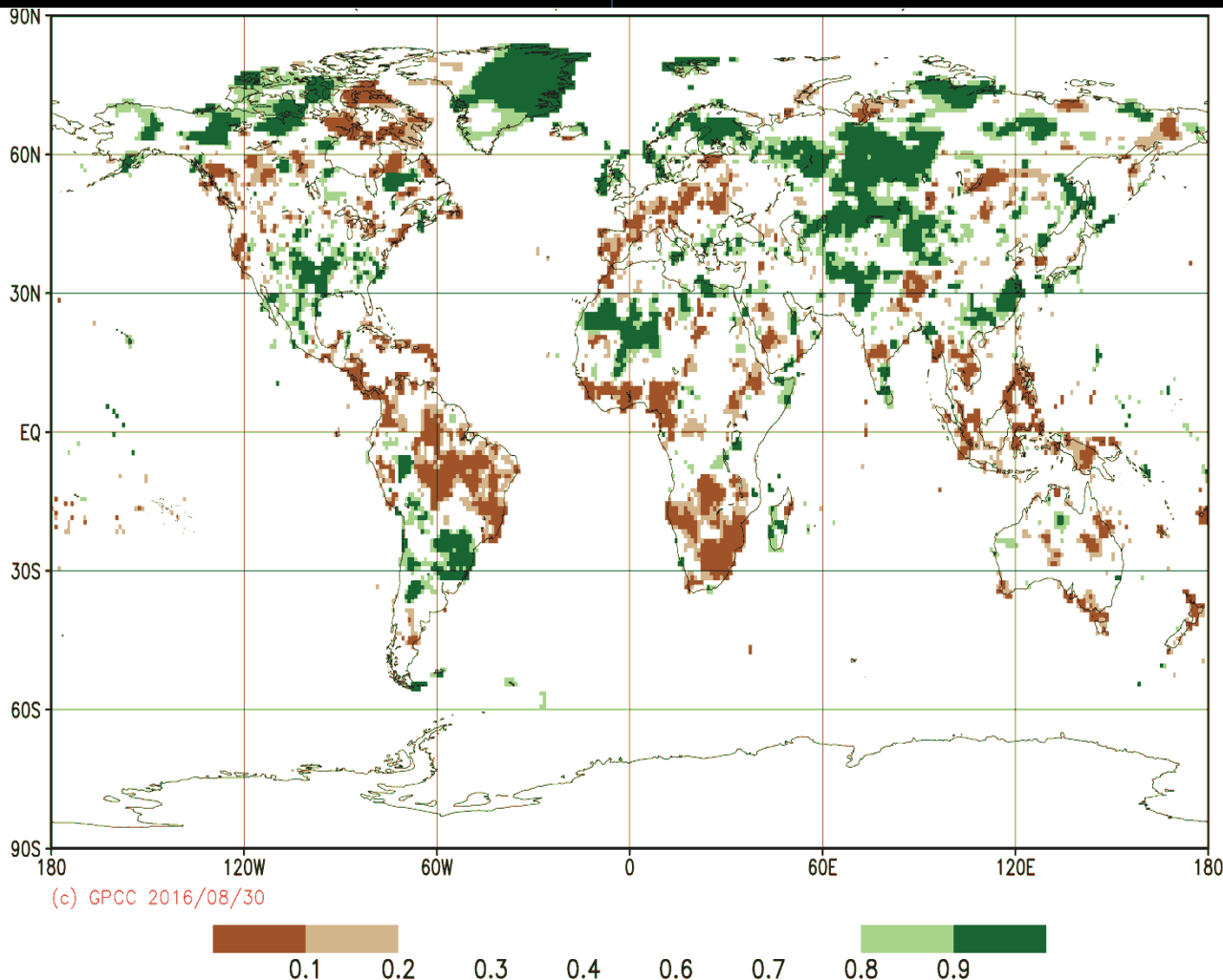


Methods, Products & Use Cases of the Global Precipitation Climatology Centre (GPCC)

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



GPCC Analysis to identify world-wide regions of ENSO sensitive average precipitation



Use Case

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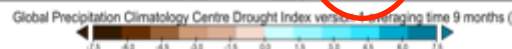
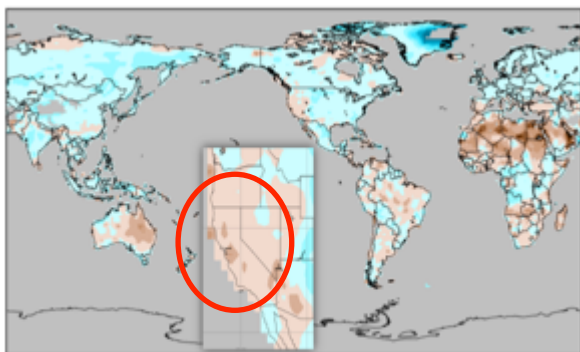
GPCC Drought Index indicating water stress in California & Brazil (Sao Paulo)

GPCC drought analysis since early 1952 allows for cross-checks against historic data in the fields of economy, ecology, and migrations (climate refugees)

Use Case

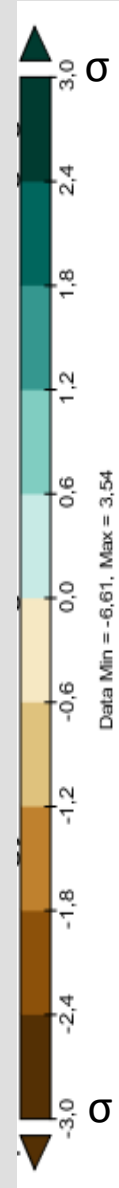
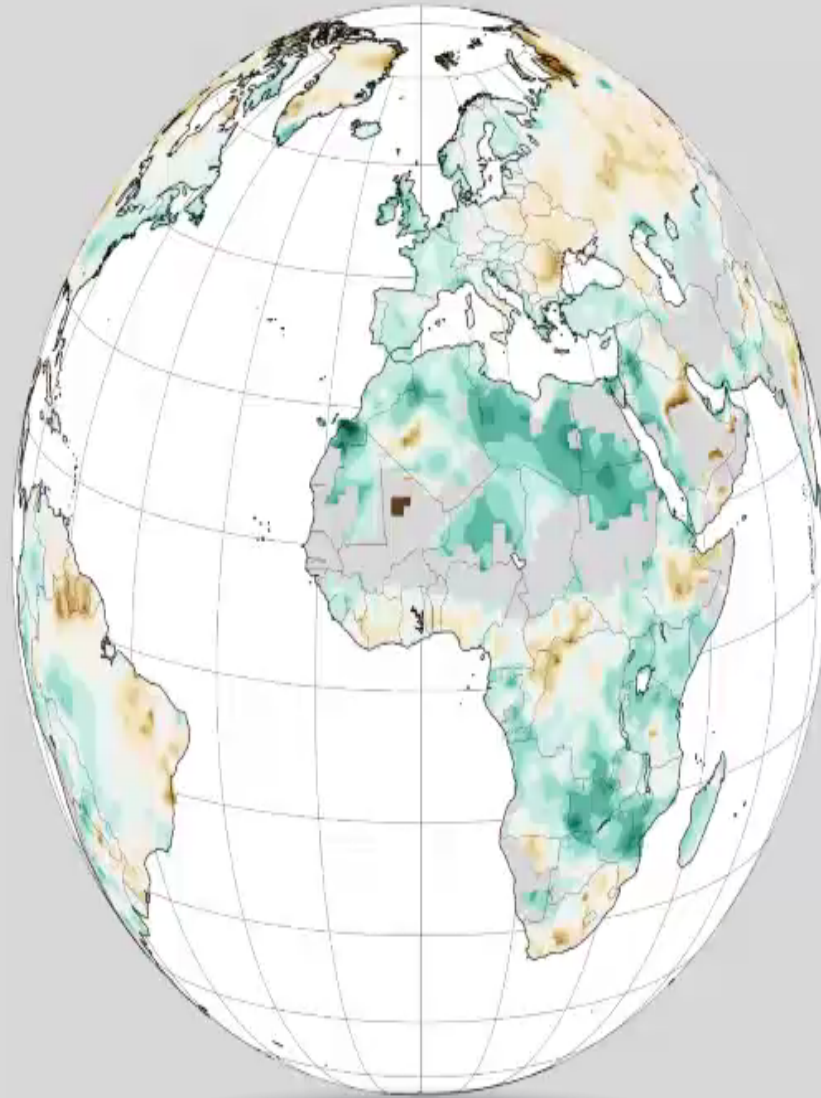
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9 months look-backs since early 2014 (left), October 2014 (right)

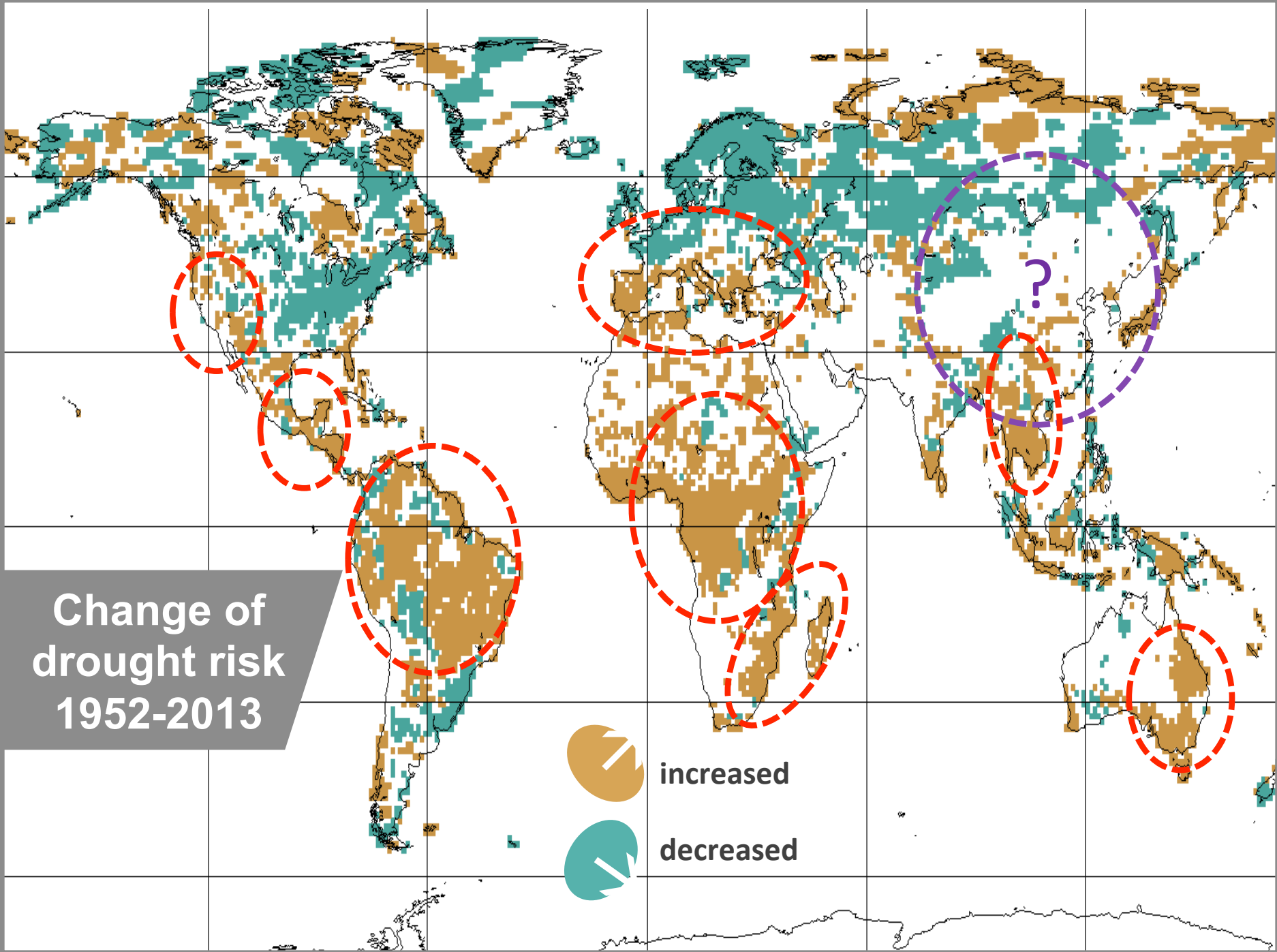
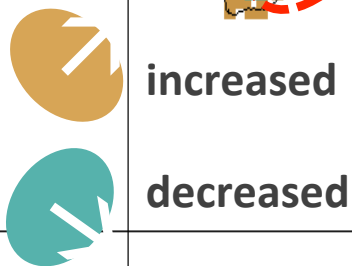


**GPCCs
globally
applicable
drought
index
diagnosed
since 1952**

1952/01



Change of drought risk 1952-2013



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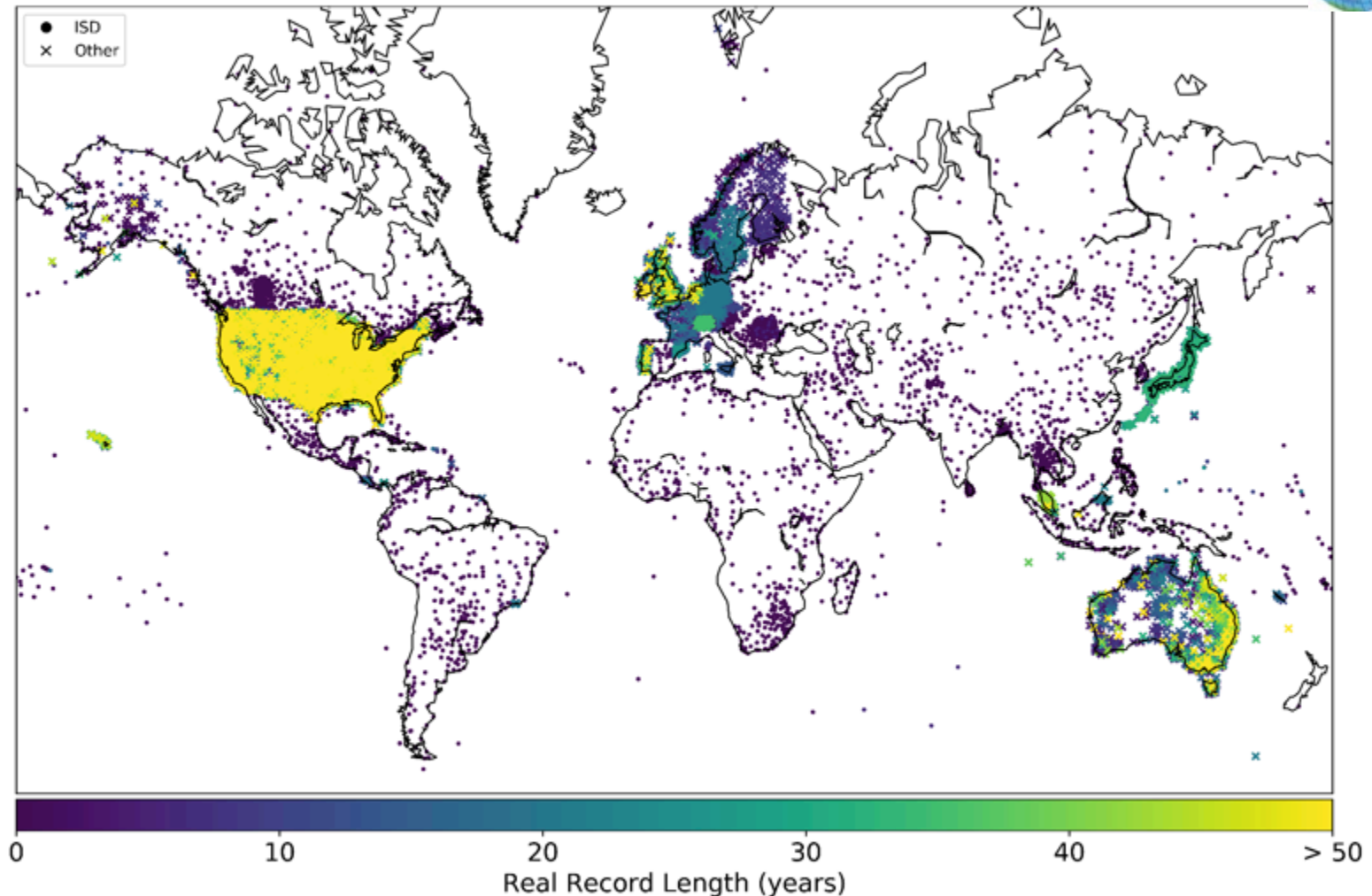
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- The QC of a huge data set from Brazil (>10000 stations) comes to completion
- The **INTENSE** data set (sub-daily data!) was provided to the **GPCC** and will also be integrated into **GPCC's** relational data base management system (will enable studies of extreme events)

So far, collected hourly data from ~25,000 stations...



Global dataset: HadISD, approx. 10,000 stations (varying data quality, more useful data at 3h and 6h), freely available sub-daily precipitation data. Plus access to additional datasets (i.e. E Europe, China) to calculate indices.



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- The INTENSE data set (sub-daily data!) was provided to the GPCC and will also be integrated into GPCC's relational data base management system (will enable studies of extreme events)
- **Integration of satellite and radar information to improve interpolation (e.g. autocorrelation function for kriging)**
- **Intensified data acquisition in so far data scarce areas in collaboration with scientific community (Chris Funk, Sharon Nicolson, Hailey Fowler, Andreas Fink, etc...)**
- **BTW: GPCC serves as a backup for any scientific project that has raised data records of 10yrs length or longer**



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>Monitoring Version 6</i>	1.0°, 2.5°	1982 - present	<i>calibration of satellite data</i>
<i>Full Data Monthly Version 2018</i>	0.25°, 0.5°, 1.0°, 2.5°	1891 - 2016	<i>hydrological studies</i>
<i>Full Data Daily Version 2018</i>	1.0°	1982 - 2016	<i>analysis of extremes</i>
<i>HOAPS/GPCC global daily precipitation Version 1</i>	0.5°, 1.0°, 2.5°	1988 - 2008	<i>analysis of extremes</i>
<i>HOMPRA Europe Version 1</i>	0.5°, 1.0°, 2.5°	1951 - 2005	<i>trend analysis</i>
<i>Precipitation Climatology Version 2018</i>	0.25°, 0.5°, 1.0°, 2.5°	1951/2000	<i>for application as reference, and for utilization of the annual interpolation method</i>
<i>Interpolation Test Dataset</i>	1.0°	1988	<i>comparison of interpolation schemes</i>
<i>Drought Index Version 1</i>	1.0°	2013 - present	<i>drought monitoring</i>
<i>Drought Index Version 1.1</i>	1.0°	1952 - 2013	<i>drought monitoring</i>
GPCC V			access to the GPCC Visualizer,

**Thank you
for
your attention!**

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

