Updated Gridded Analysis Products provided by the Global Precipitation Climatology Centre (GPCC), its Quality Control, and Interpolation Schemes

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Outline

1. Current GPCC Products
2. Interpolation Schemes
3. Products under Development
4. Conclusion

GPCC Database

- core data from national meteorological and hydrological services
- global and regional data collections (e.g., FAO, GHCN, CRU)
- near-real time data from WMO-GTS (SYNOP reports, CLIMAT messages)

GPCC Quality Control

- data stored in relational data bank with source specific slots
- data checked before import into data bank against background statistics and available data from other sources to correct or eliminate
  - wrong precipitation data (coding errors, factor-10-errors, conversion errors)
  - wrong station metadata (location and interchange with other station)

GPCC product suite

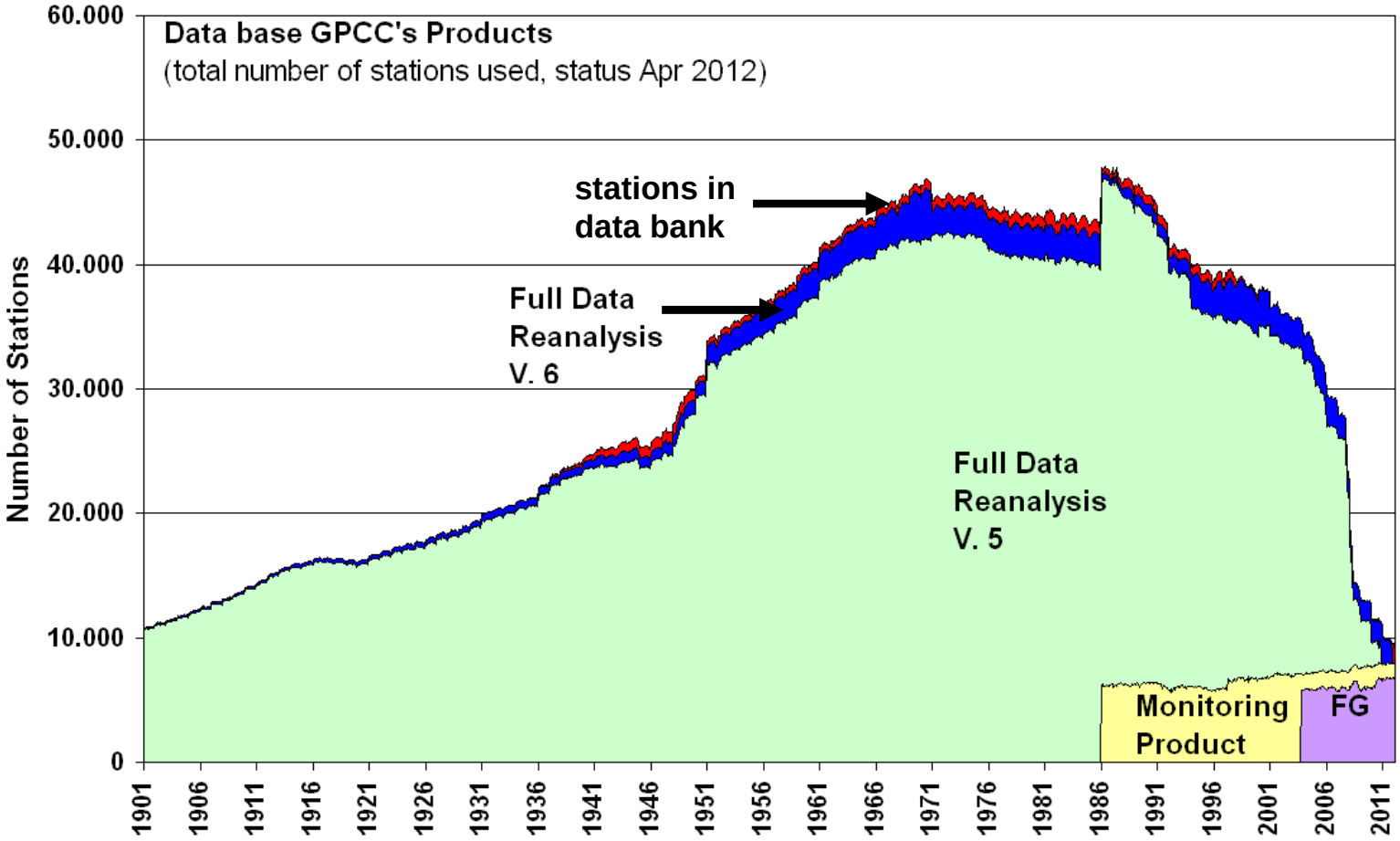
- non-real-time products
  - Climatology (long term means)
  - Full Data Reanalysis (best data coverage)
  - VASClimO (current homogenized product)

- near-real-time products
  - First Guess Product (based on SYNOP reports, automatic quality control)
  - Monitoring Product (First Guess Product extended by CLIMAT messages, CPC data and manual quality control)

Latest released (non-real-time) GPCC Products

- Climatology (Version 2011)
  - based on about 67200 stations (former version about 64400 stations)
  - target reference period 1951 – 2000
  - stations with at least 10 years of data
  - if possible, uses above reference period, else 30 year reference period, at least 10 year reference period
  - background climatology for GPCC products (Full Data Reanalysis, Monitoring Product, First Guess)
- Full Data Reanalysis (Version 6)
  - uses same stations as Climatology
- Monitoring Product (Version 4)
  - reanalyzed applying new Climatology for all months since 2007

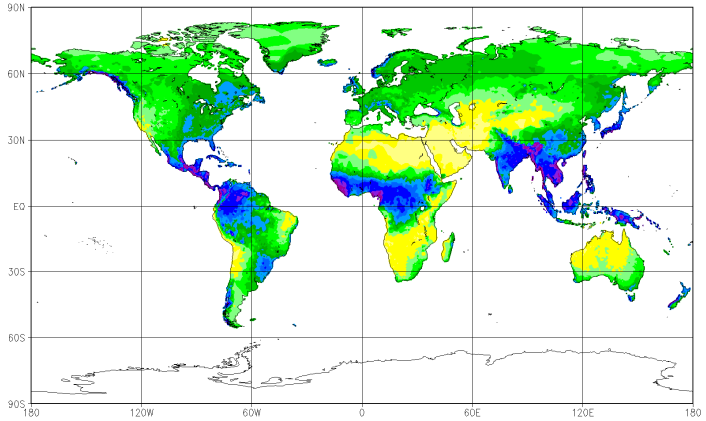
Applied number of stations for GPCC products



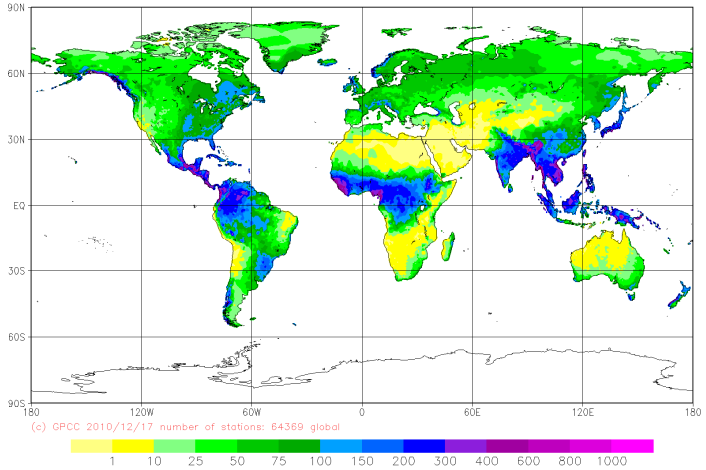
➔ non-utilized stations loaded after last product release

Difference between former and current Climatology

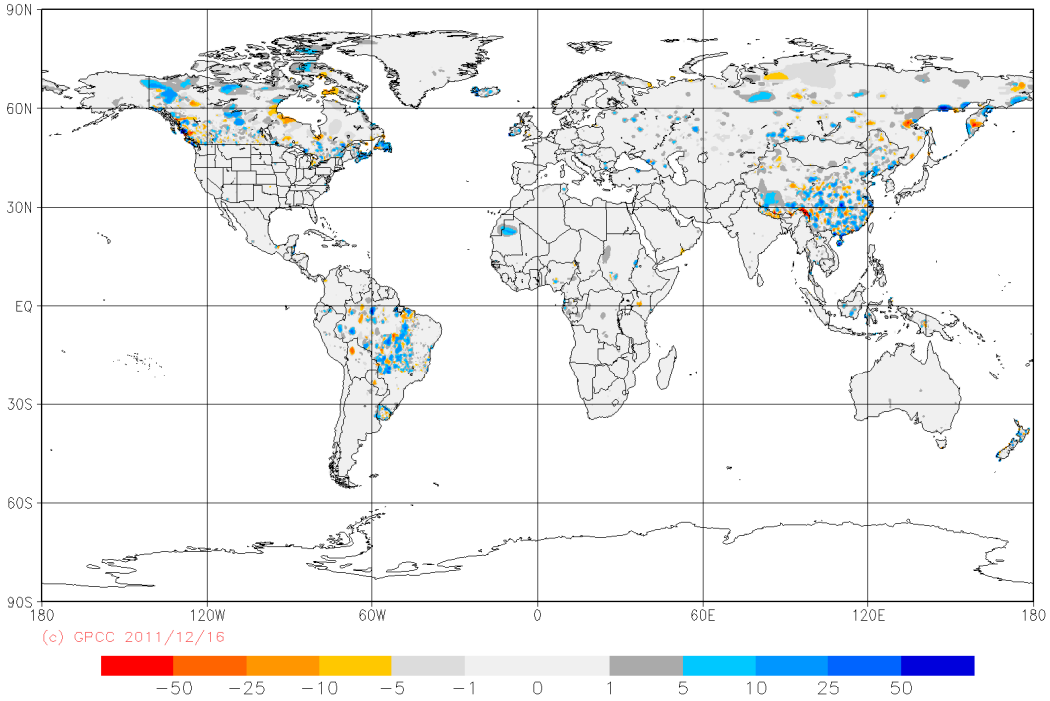
Current Climatology (Version 2011)



Former Climatology (Version 2010)



Difference of September Climatologies Version 2011 vs. Version 2010

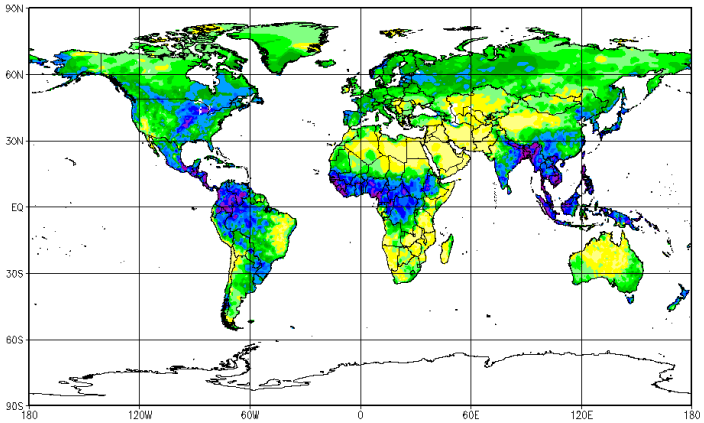


- ➔ example: September
- ➔ differences due to new additional data
- ➔ most differences less than 25 mm/month

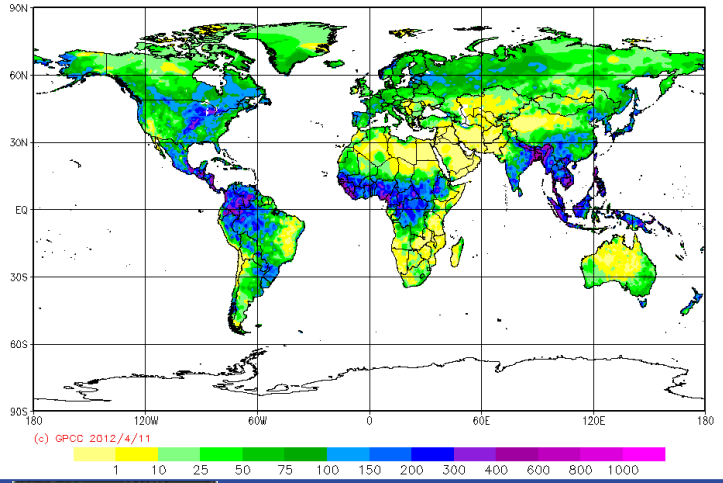
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Difference between former and current Full Data

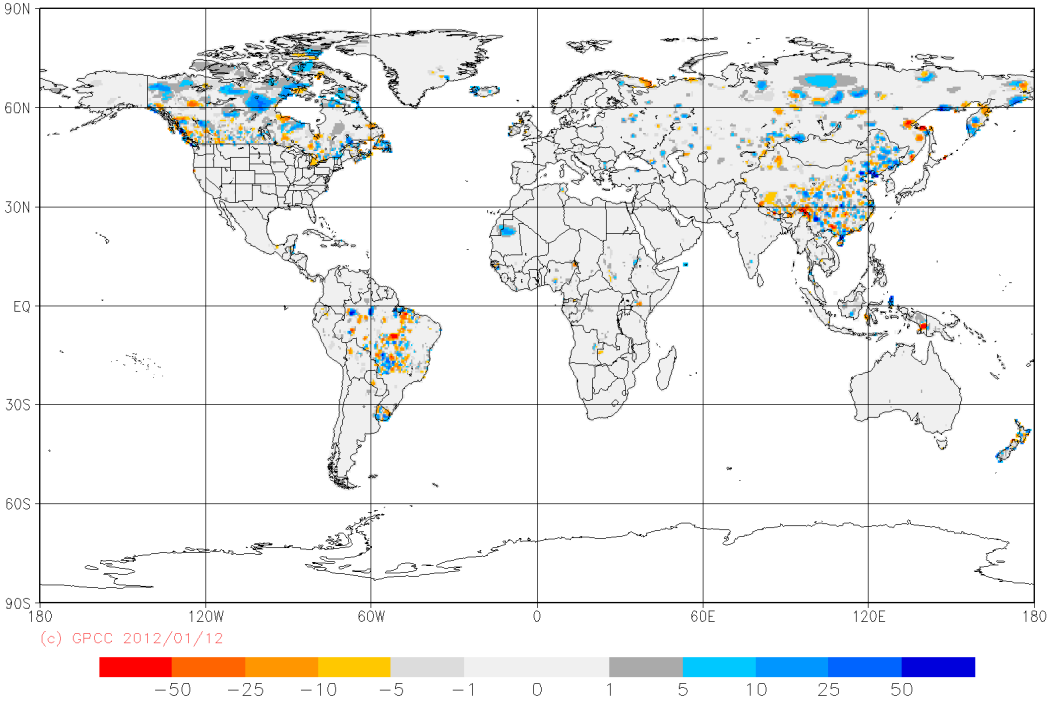
Current Full Data Reanalysis (Version 6)



Former Full Data Reanalysis (Version 5)



Difference Full Data Reanalysis (Version 6 minus Version 5)
for September 1986

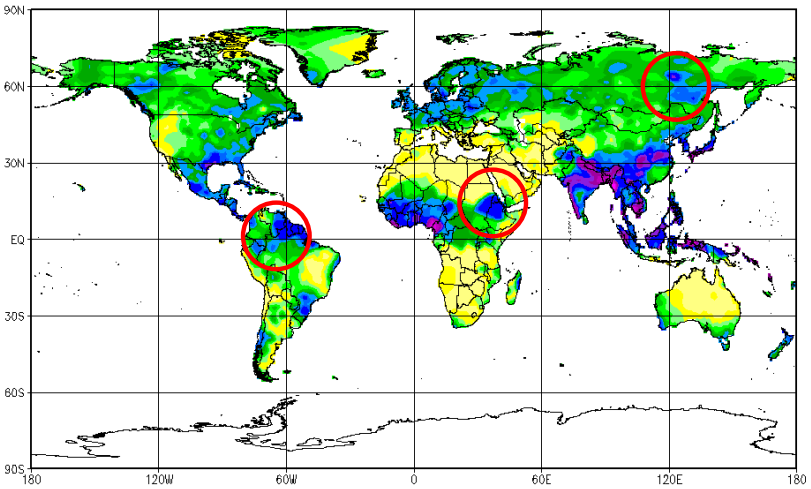


➔ example: September 1986

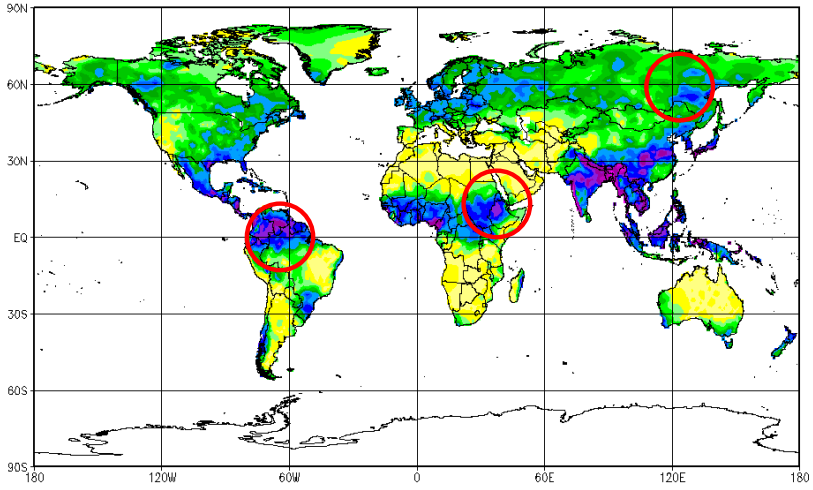
➔ differences due to new additional data

Comparison GPCC Products

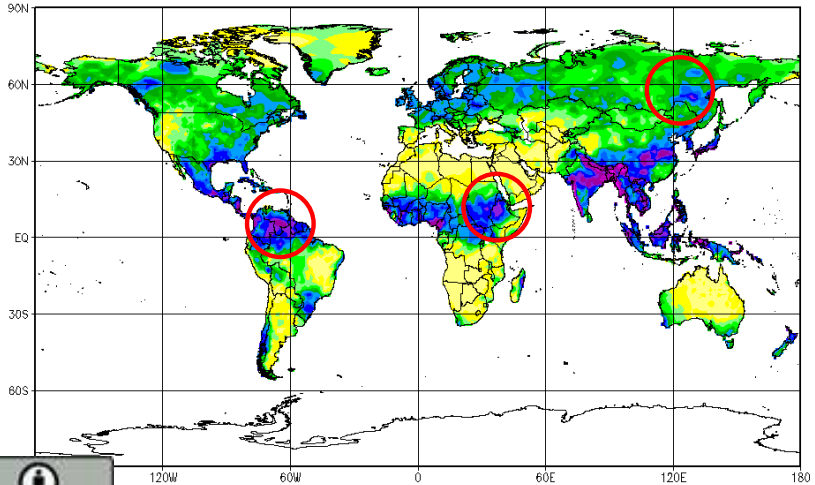
First Guess, July 2007



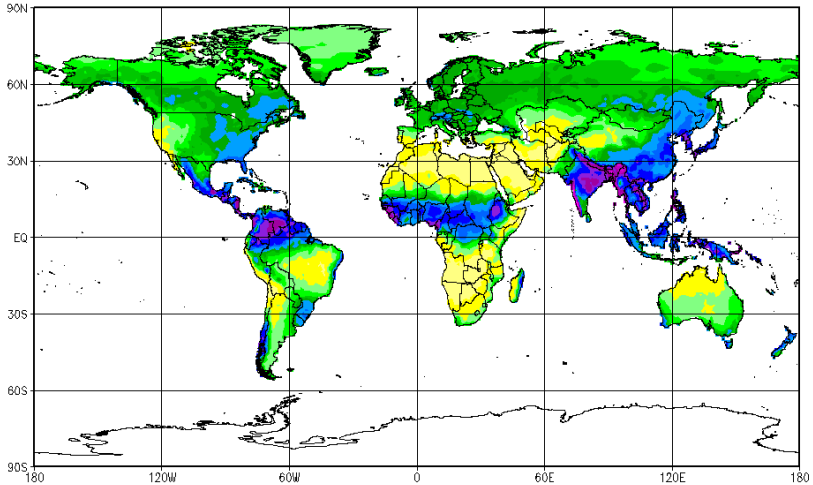
Monitoring Product, July 2007



Full Data Reanalysis (V.6), July 2007



Climatology, July



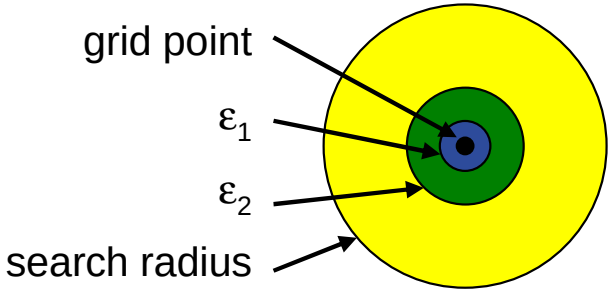
Comparison of Interpolation Schemes

- used interpolation schemes:
  - modified SPHEREMAP
  - ordinary Kriging
  - arithmetic mean
- two test months: July 1986 and January 1987
- population divided into collectives with 300 stations
- using 4800 stations as reference
- 50 runs with arbitrary selected reference stations to calculate skill scores
- stepwise reduction of station density (input stations, not reference stations)
- runs with interpolation of anomalies and absolute values
- reduced station density in Germany (219 instead of more than 4000)

SPHEREMAP (Willmott et al. 1985)

- application of Shepard's scheme on a sphere (Shepard 1968)
- current operational interpolation scheme at GPCC
- combines angular and distance weighting
- uses at least 4, at most 10 stations
- search radius depends on station density

Modifications in SPHEREMAP



- defined other inner search radius ε: ε_1 and ε_2
- ε_1 = 10% of grid size, ε_2 = 50% of grid size
- if stations were found within ε_1 but not between ε_1 and ε_2 → arithmetic mean of stations within ε_1
- if stations were found within ε_2 interpolation runs as usual
  - using more stations in case of high station density
- interpolation runs on 0.25°/0.5° subgrid
- using area weighting and land-portion weighting to calculate on final grid
- runs operationally since 1995, as anomaly interpolation on basis of our Climatology since 2008

Kriging (Krige 1966)

- statistical interpolation scheme
- calculates correlations on basis of variograms
- not operational at GPCC
- uses at least 4, at most 10 stations
- search radius depends on station density
- test version applies only one variogram for global interpolations

Used skill scores

- mean squared error (MSE)

  [MSE] = mm²/month²

  - sensitive to outliers

$$MSE = \frac{1}{n} * \sum_{K=1}^{n} (y_k - o_k)^2$$

- mean absolute error (MAE)

  [MAE] = mm/month

  - measure of average error

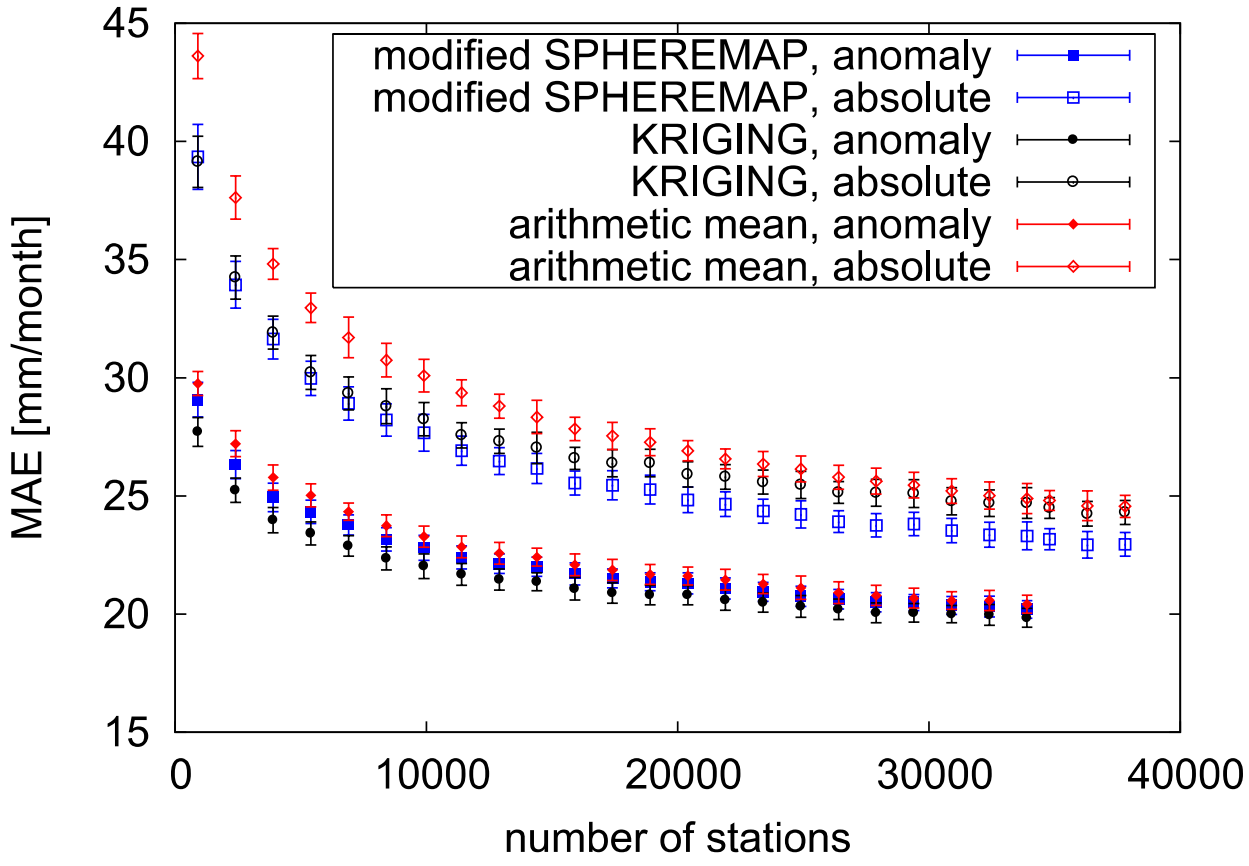
$$MAE = \frac{1}{n} * \sum_{k=1}^{n} |y_k - o_k|$$

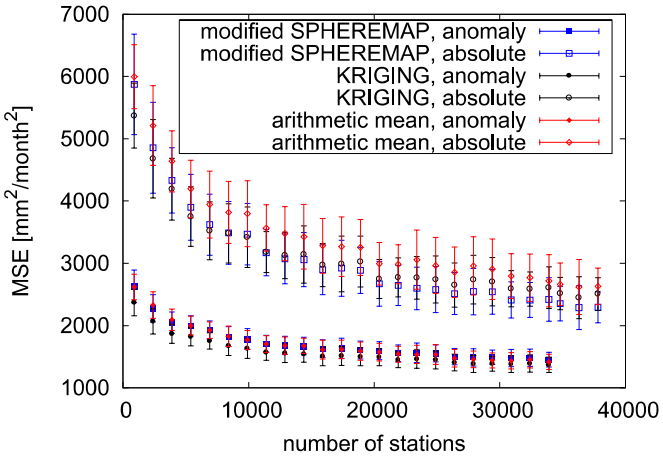
o – observed value at station

y – interpolated value at station

n - number of stations

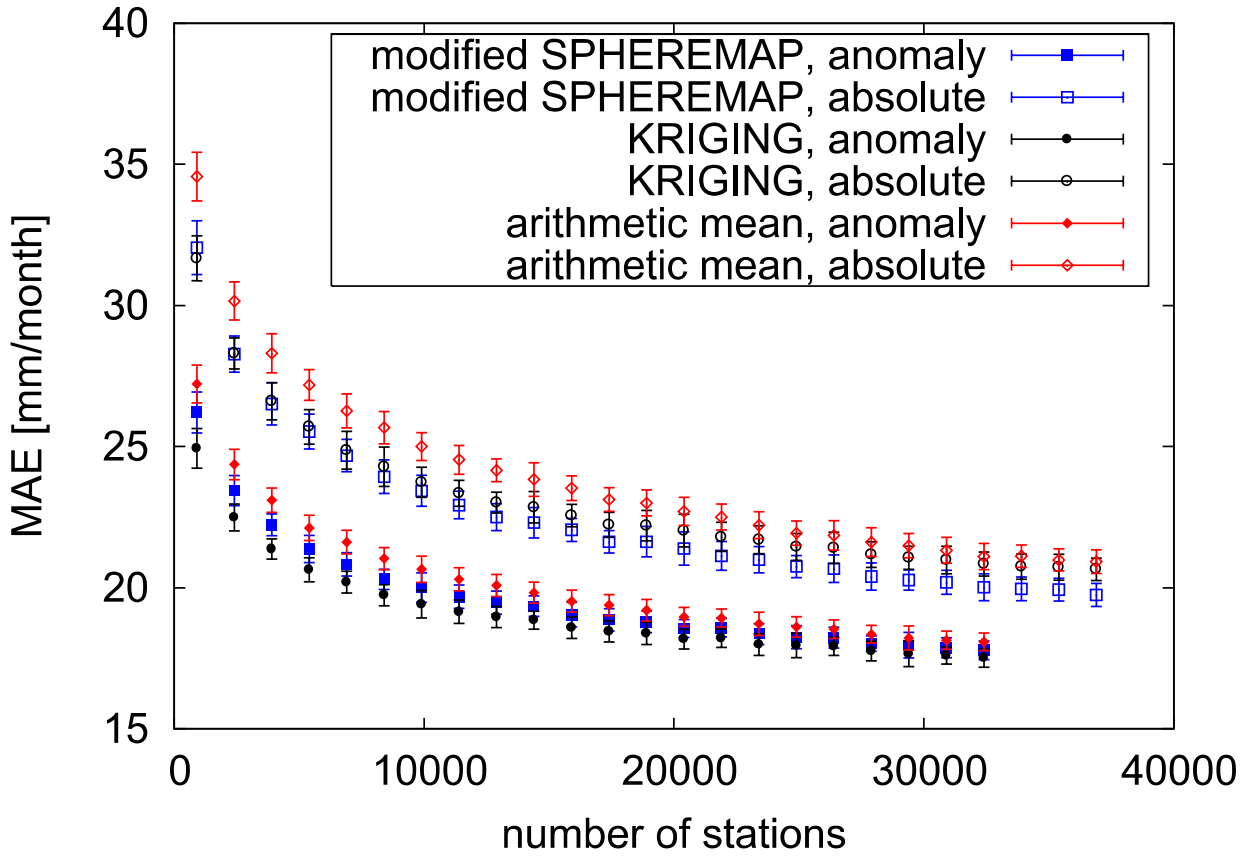
Comparison July 1986

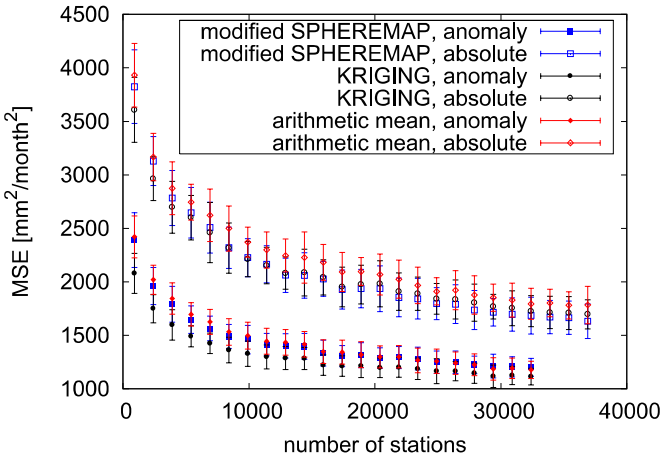




- ➔ anomaly interpolation better than absolute interpolation
- ➔ modified SPHEREMAP best for absolute interpolation (Climatology)

Comparison January 1987

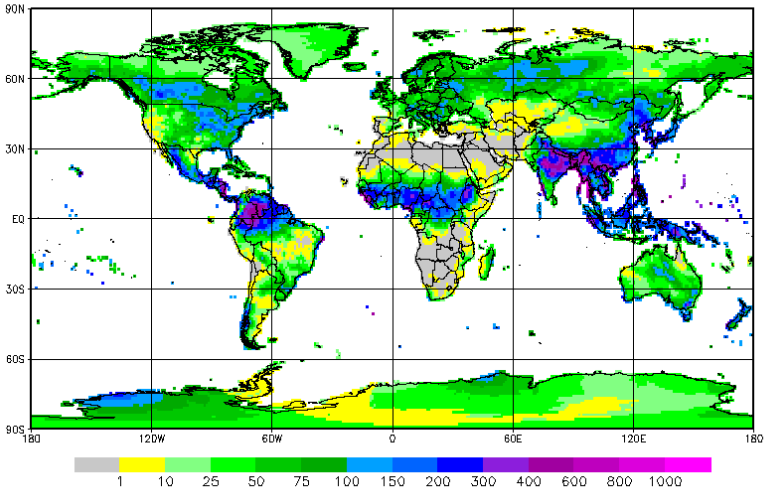




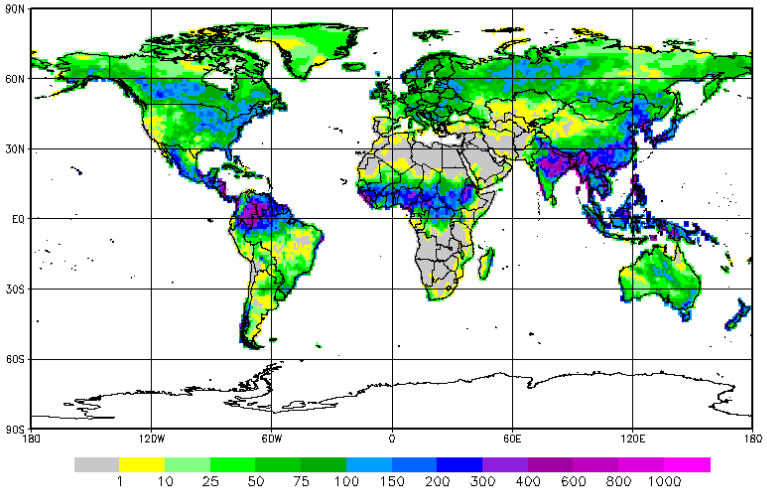
- ➔ anomaly interpolation better than absolute interpolation
- ➔ modified SPHEREMAP best for absolute interpolation (Climatology)

Comparison SPHEREMAP and Kriging July 1986

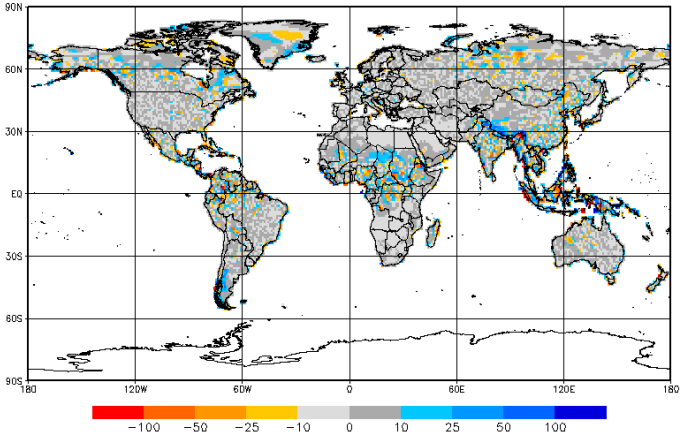
Kriging



modified SPHEREMAP



Kriging - SPHEREMAP



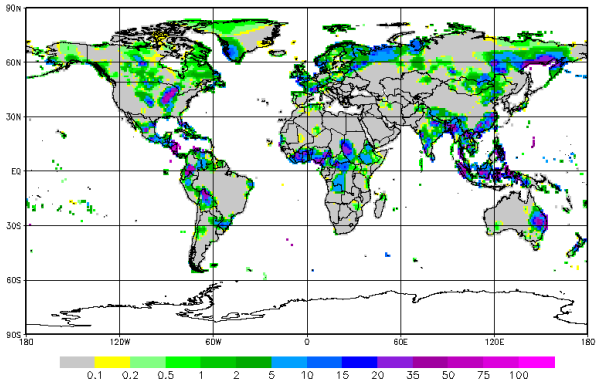
- overall patterns look similar
- Kriging produces smoother patterns

- most differences due to different gradients of precipitation and in data sparse areas

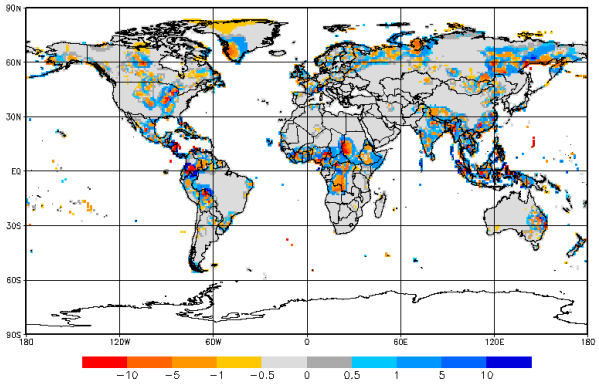
Products under Development

- restarting daily analysis
  - First Guess Daily will be released together with First Guess Product 3 to 5 days after each month
  - based only on SYNOP reports
  - currently testing and optimizing interpolation schemes (modified SPHEREMAP and Kriging)

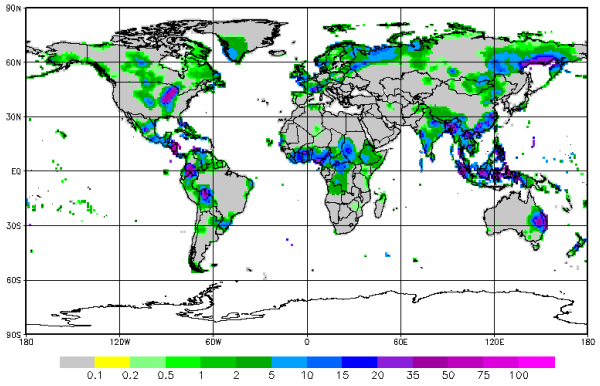
modified SPHEREMAP



Kriging - SPHEREMAP



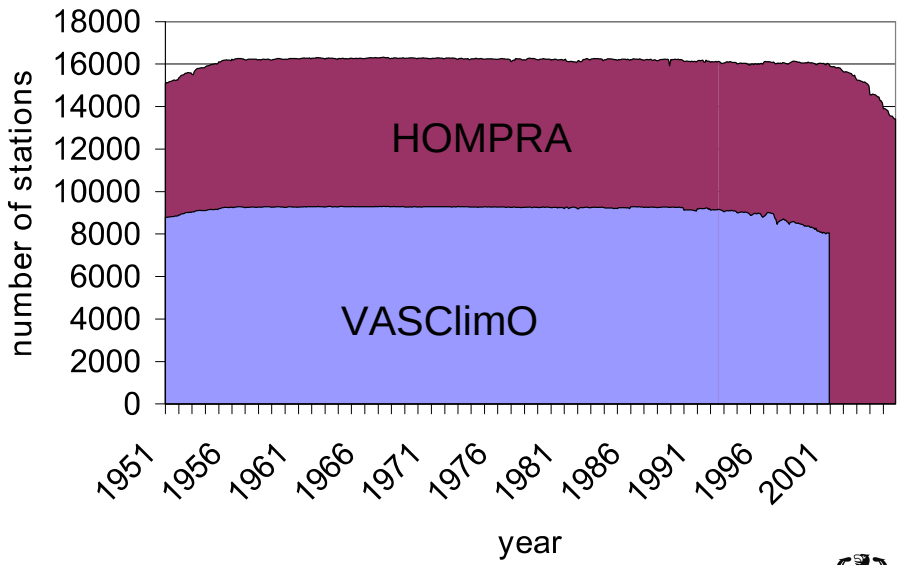
Kriging



- example 2008/09/04

Products under Development

- new homogenized analysis
  - HOMPRA (HOMogenized PRecipitation Analysis)
  - will replace VASClimO
  - applies PRODIGE (Mestre 2004)
  - collaboration with university Bonn (development of automated PRODIGE, see E. Rustemeier et al., EGU2012-10654, room 16, 14:45, today)
  - covers period from 1951 to 2005
  - 16388 stations selected for homogeneity tests (VASClimO 9343 stations)



Conclusions

- new Climatology and Full Data Reanalysis were released in December 2011
- modified SPHEREMAP has good performance at GPCC, no need to change interpolation scheme
- anomaly interpolation reduces interpolation error more than using different schemes with absolute values
- First Guess Daily and HOMPRA still under development (release of HOMPRA scheduled for end of this year)
- products are free available from GPCCs website gpcc.dwd.de
- contact: gpcc@dwd.de
- GPCC team: Dr. Andreas Becker (head)

  scientists: Udo Schneider, Anja Meyer-Christoffer, Kirstin Lehner (new since January 2012), Dr. Markus Ziese

  programmer: Peter Finger

  technician assistants: Astrid Heller, Peter Stender, Jan-Nicolas Breidenbach