Evaluate before use – temporal performance differences of gridded precipitation products in complex terrain

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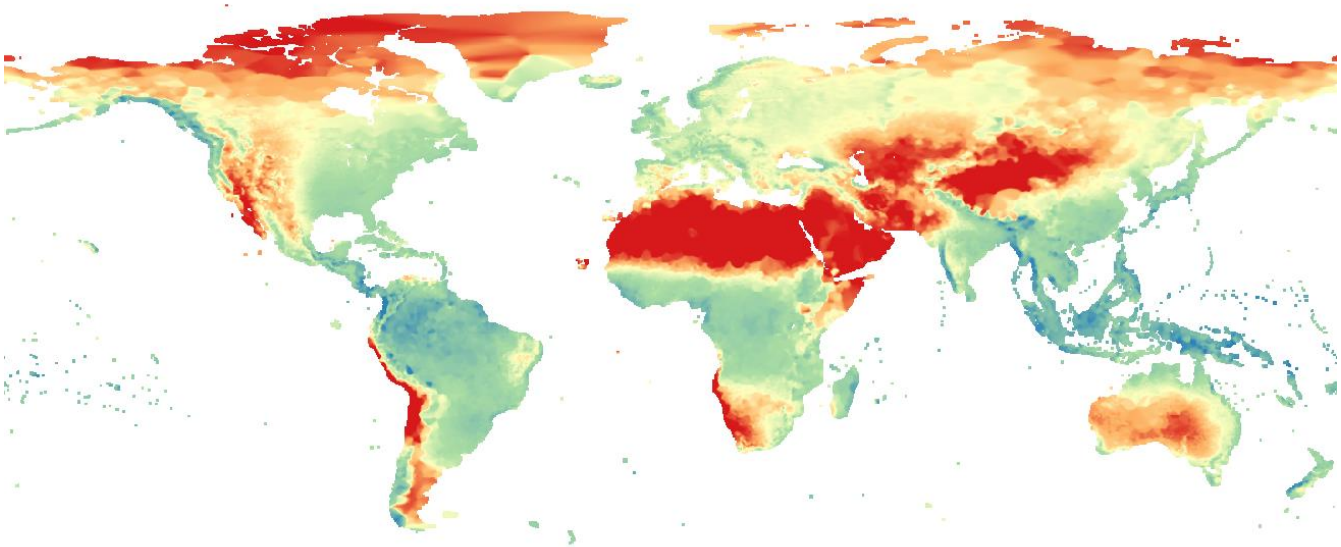
Gridded precipitation products are crucial for geosciences

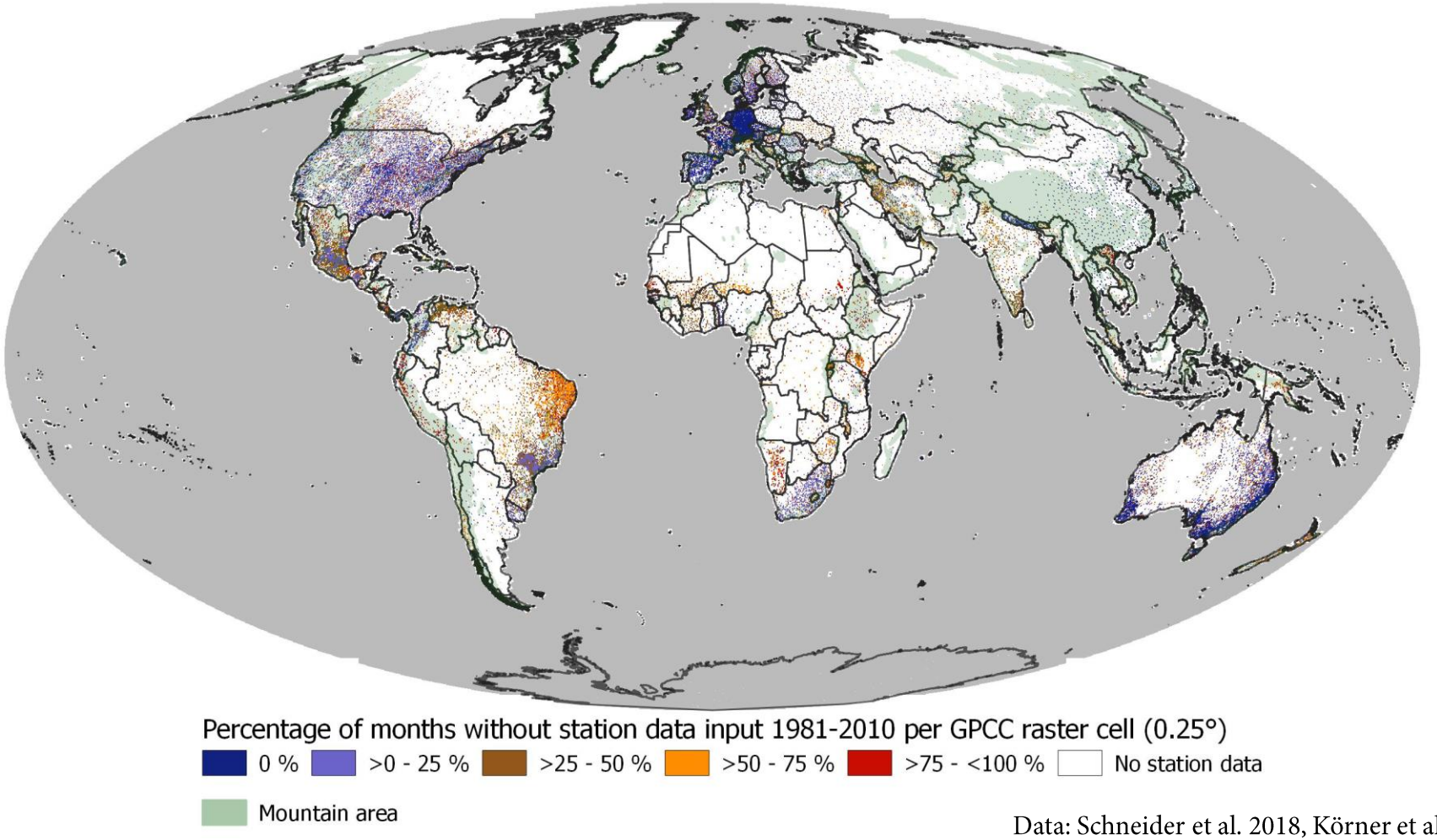


Precipitation data: Schneider et al. 2018

Introduction

BUT …

Meteorological infrastructure is scarce in peripheral mountain regions

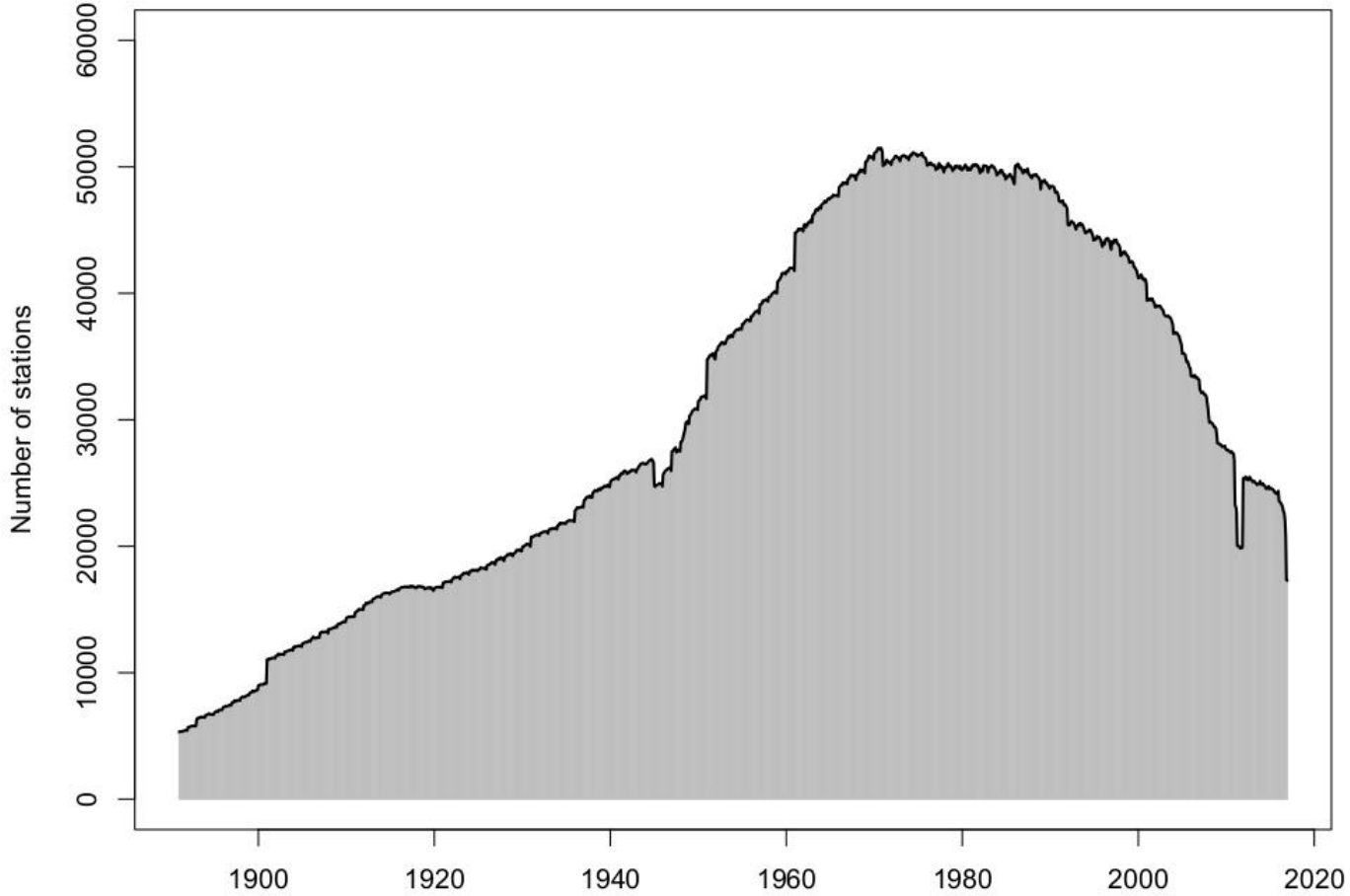


Data: Schneider et al. 2018, Körner et al. 2017

Introduction

BUT …

Strong temporal data variations exist



Global sum of included station data in the largest precipitation data base in the world, the GPCC Full Data Product Version 2018

Data: Schneider et al. 2018

Introduction

Research issue:

Existing product evaluation studies often use the same stations that are also used for dataset creation. Thereby, the analysis is not independent from the original dataset. Temporal variations of incorporated gauge numbers are usually not considered.
This leads to a **positive evaluation-bias**.

➡ Respective results are not equally valid for all time periods or in peripheral regions with poor meteorological infrastructure

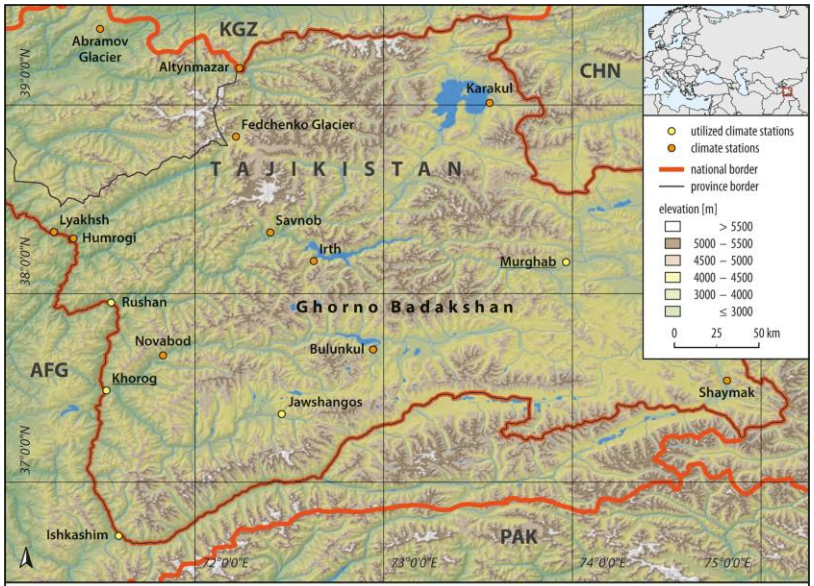
Presented approach:

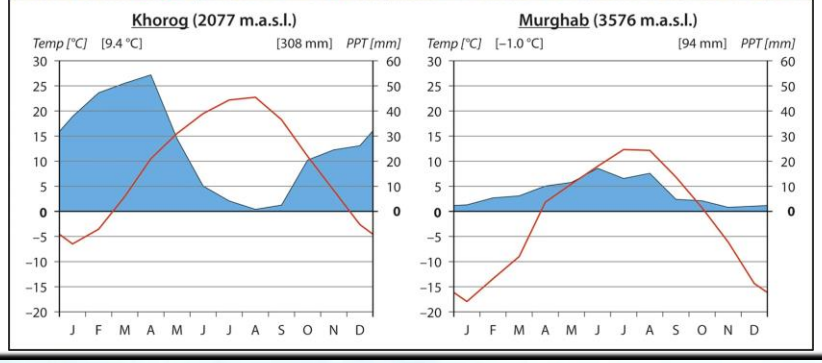
Considers the **temporal variation** of station availability, the **location** of the observations and the **potential dependence of evaluation and dataset stations**!

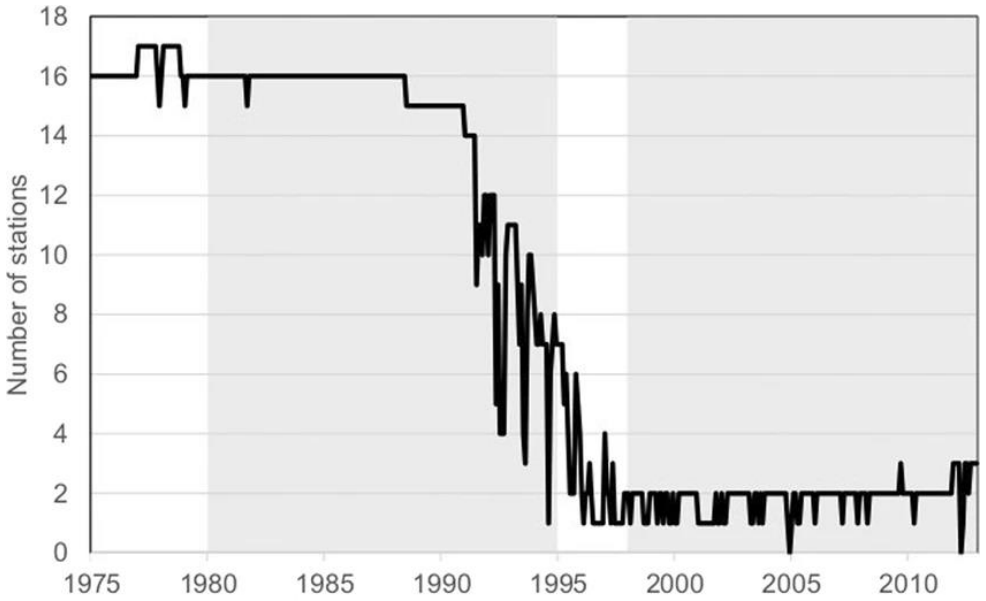
Research area

Pamir mountains:
Ideal area to test performance of gridded precipitation products

Different precipitation regimes







Temporal variation of utilized stations in gridded climate datasets in the region

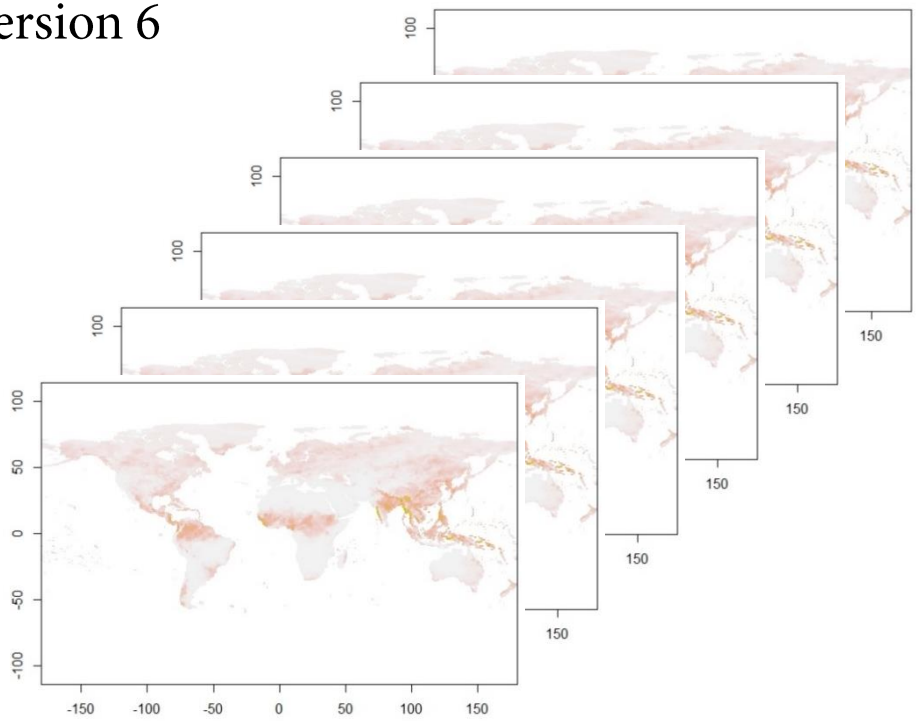
Evaluation divided in two different research periods (grey highlighted)

Figures: Zandler et al. 2019

Datasets

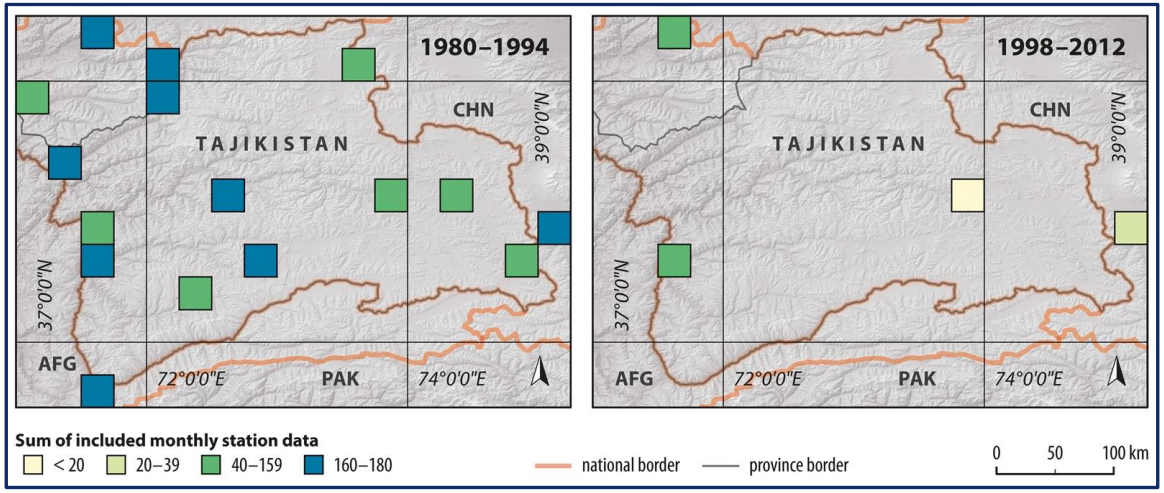
- Validation dataset: station data 1980–1994 & 1998–2012

- Evaluated gridded precipitation datasets:
  - Gauge based:
    - CRU TS 4.03
    - GPCC Full Data Product Version 2018
    - GPCC Monitoring Product Version 6
  - Reanalysis:
    - MERRA-2
    - ERA-interim
    - ERA5
  - Satellite based:
    - PERSIANN-CDR
    - TRMM 3B43
  - Combined:
    - MERRA-2 bias corrected
    - GPCP Version 2.3

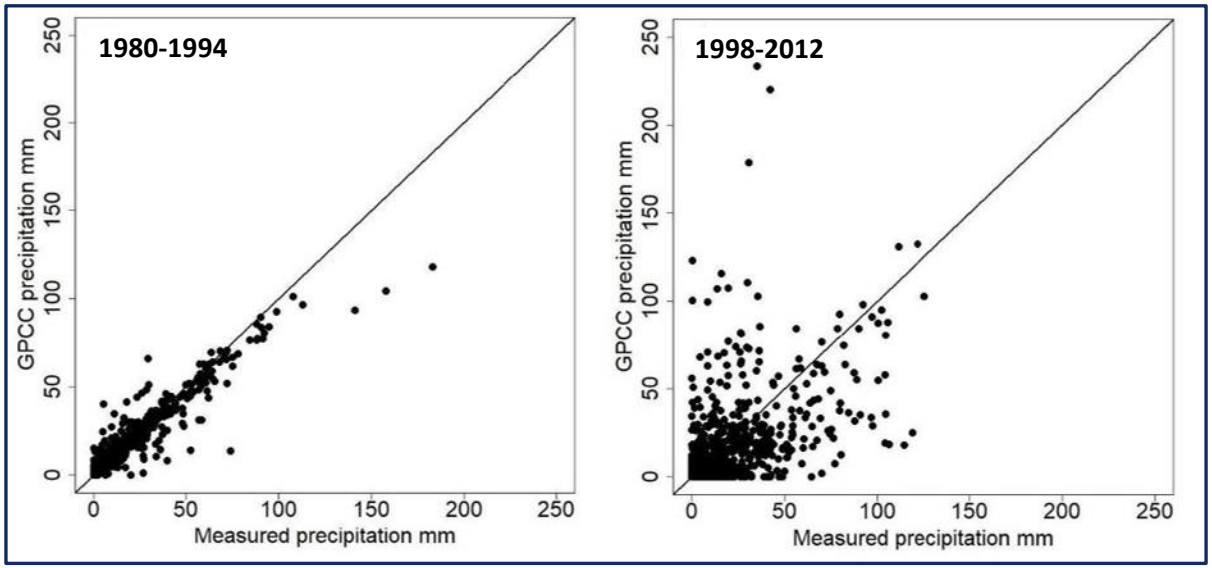


Data: Schneider et al. 2018

Results



Gauge datasets: Fourfold increase of errors during periods with poor station data availability



Images: Zandler et al. 2019 (modified)

Results

According to the coefficient of efficiency and relative mean absolute error (MAE), only three products provide better surface precipitation values than the long term mean in periods of poor station data availability with independent validation data:

- GPCC Full Data Product Version 2018 (relative MAE: 87 % , R^2: 0.2)
- GPCC Monitoring Product Version 6 (relative MAE: 88 % , R^2: 0.21)
- MERRA-2 bias corrected (relative MAE: 73 % , R^2: 0.28)

Errors of all products are relatively high during periods of poor station data availability. Gauge-based datasets show high performance if station data is available, but independent evaluation is impossible due to lack of independent station data (GPCC Full Data Product Version 2018 relative MAE: 22 % , R^2: 0.9 1980-1994)

Higher R^2 values of reanalysis products indicate better correlation but they are characterized by high absolute errors:

- MERRA-2: (relative MAE: 278 % , R^2: 0.47)
- ERA-interim (relative MAE: 258 % , R^2: 0.5)
- ERA5 (relative MAE: 252 % , R^2: 0,48)

Conclusions

- Independent local or regional evaluation is essential before using gridded datasets in geoscientific research

- Extreme temporal performance differences in station based products exist in mountain regions. GPCC performance decreases fourfold in the period 1998-2012 compared to 1980-1994 due to lower station data availability.

- Only three of the ten tested datasets perform better within periods of low station availability (1998 - 2012) than the measured long-term mean (MERRA-2 bias corrected, GPCC, GPCC MP). Reanalysis datasets show higher correlations but large absolute errors.

- Lower errors in proximity of stations with the exception of reanalysis data

- Broad independent evaluation not always possible in data poor regions due to insufficient spatiotemporal station data availability

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