# Bias Correction of Satellite Climate Products: As an Option to Fill the Missing Climate Data

## Case study; Tekeze River Basin, *Ethiopia*


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# Introduction

❖Prediction of climate change impacts on several processes of the earth system needs a spatially explicit, and reliable climate data.

❖However, incomplete climate dataset is the common challenge that encounters most of hydrologists and other climate data based researchers.

❖Together with the recent space technology improvement, satellite climate products become a widely used source of data in the climate related studies.

❖Despite their role in bridging the climate data gap for researchers, they have an error which actual varies between the different products and area of study.

# Objectives of the Study

❖To evaluate the accuracy of different satellite climate products for precipitation (CHIRPS, CFSR and MERRA2) and for minimum and maximum temperature (CFSR).

❖To evaluate the effectiveness of bias correction method in improving the selected satellite climate datasets at station level.

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# Study Area

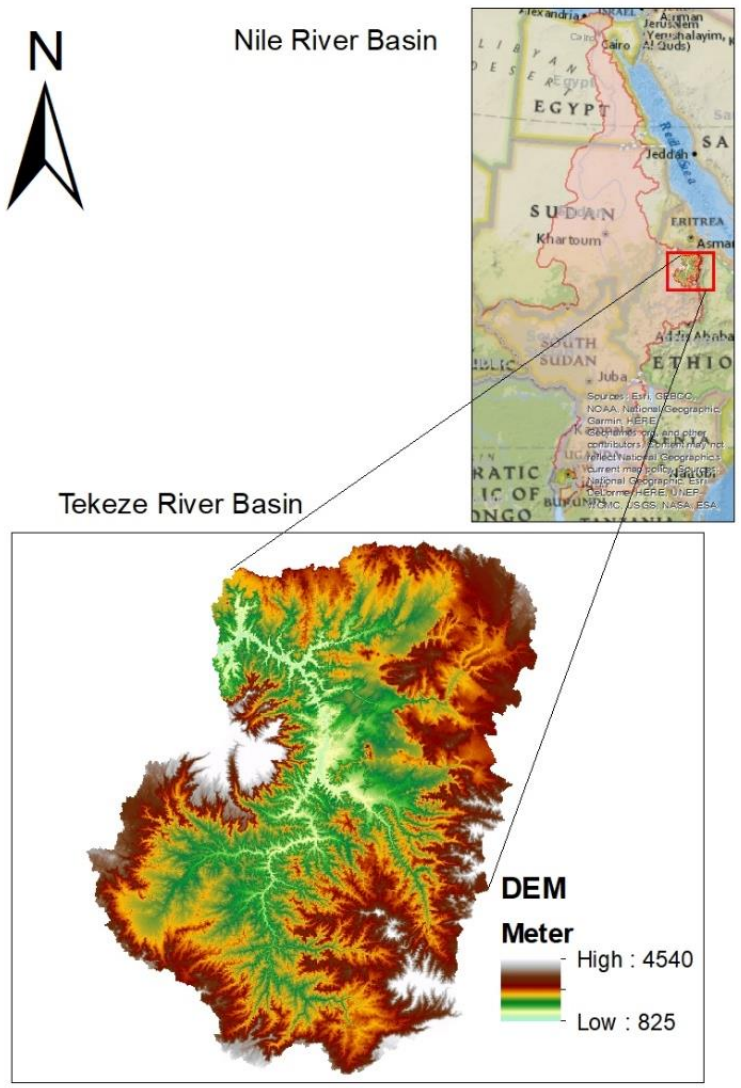


Figure 1: Map of the sturdy area

# Methodology

## Linear Scaling (LS) bias correction method

- $P_{Cor,d} = P_{sat,d} * \frac{\mu(P_{obs})}{\mu(P_{sat})}$
- $T_{cor,d} = T_{sat,d} + \mu(T_{obs}) - \mu(T_{sat})$

Where, $P_{Cor,d}$ is the corrected precipitation at day "***d***", $P_{sat,d}$ is the satellite precipitation data at day "***d***", $\mu(P_{obs})$ and $\mu(P_{sat})$ are mean values of observed and satellite product respectively.

## Performance Evaluation Techniques

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(C_{sat} - C_{obs})^2}$$

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|C_{sat} - C_{obs}|$$

$$PBIAS = \frac{\sum_{i=1}^{n}(C_{obs} - C_{sat})}{\sum_{i=1}^{n}(C_{obs})} * 100$$

$$MBE = \frac{\sum_{i=1}^{n} C_{obs} - C_{sat}}{n}$$

Where, **RMSE** (root mean square error), **MAE** (mean absolute error), **PBIAS** (percent bias), **MBE** (mean bias error), $C_{sat}$ is the satellite or bias corrected climate data, $C_{obs}$ is the observed climate data, "***n***" is the number of time series datasets in the given parameter.

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# Results and Discussion

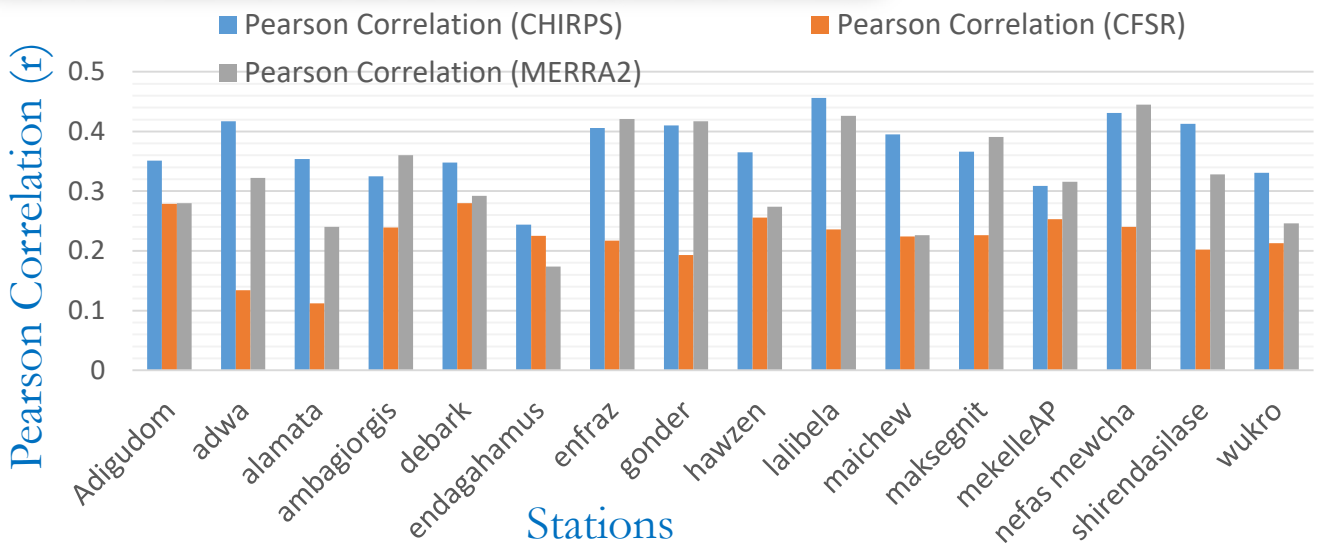


Figure 2: Correlation coefficient (r) of the satellite precipitation data (CHIRPS, CFSR and MERRA2) with observed data

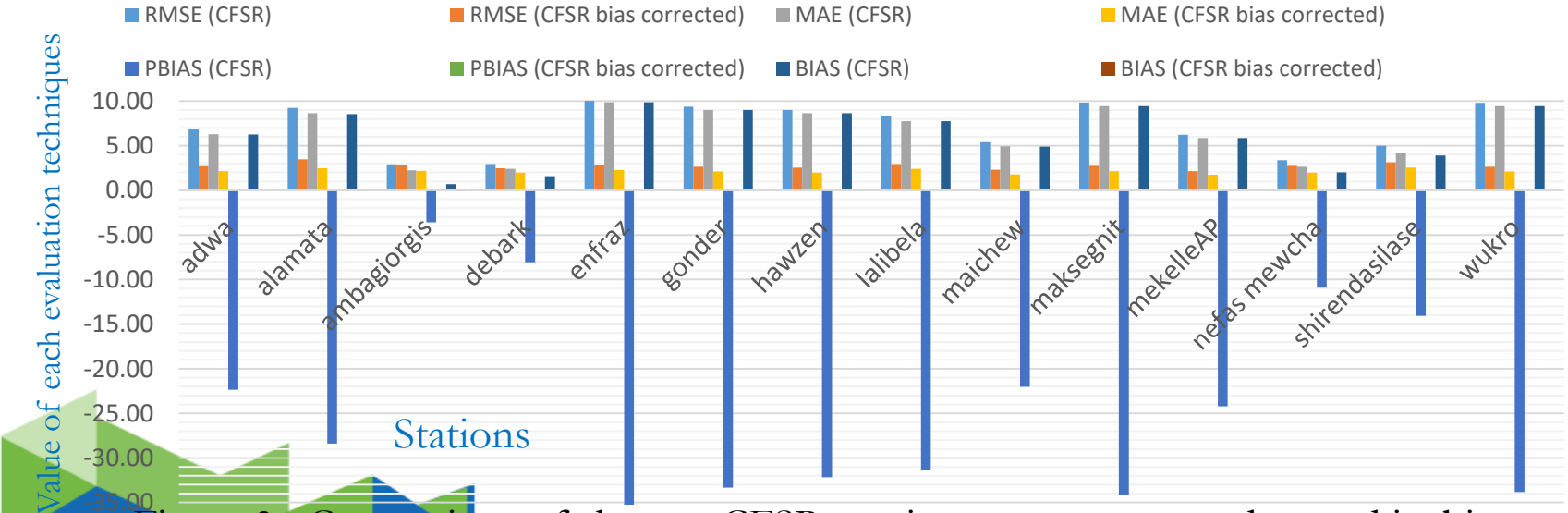


Figure 3: Comparison of the raw CFSR maximum temperature data and its bias corrected datasets

| Stations name | Elevation (in m a.s.l.) | % of missing rainfall data (1986-2016) |
|---|---|---|
| Adigudom | 2100 | **19.5** |
| Adwa | 1911 | **22.2** |
| Alamata (Agr) | 1589 | **15.2** |
| Ambagiorgis Sch | 2900 | 9.2 |
| Debark | 2836 | 14.5 |
| Edaga Hamus | 2708 | **20.4** |
| Enfranz | 1937 | 11.9 |
| Gondar A.P. | 1973 | 5.2 |
| Hawzen | 2242 | **22.5** |
| Lalibela | 2487 | **21.4** |
| Maichew | 2432 | **21.7** |
| Maksegnit | 1912 | 3.3 |
| Mekele Air Port | 2257 | 13.5 |
| Nefas Mewcha | 3098 | 14.1 |
| | | |
| Shire Endasilasse | 1897 | **21.2** |
| Wukuro | 1987 | **25.3** |

Table 2: List of stations with precipitation records and their percentage of missing data

# Conclusion and Recommendation

- CHIRPS sattelite precipitation product has a relatively better correlation result and followed by MERRA2 and CFSR.
- Assuming the same credit to each evaluation techniques, the bias correction improves the **Tmin** and **Tmax** of raw CFSR data by **100%** while it improves the raw CHIRPS precipitation by **65.6%**.
- Due to the high dynamic nature of precipitation (spatial and temporal variability), it needs a special attention to fill the missing data series.
- Beside the effort of choosing the best satellite product, bias correction has to be considered as an option in order to improve the quality of the climate data series.