

Comparison between Climate Forecast System Reanalysis (CFSR) weather data and data from meteorological stations in Brazil to evaluate the suitability of CFSR data for SWAT

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Hydrological Modeling - Input Data Challenges

Input Data

► Static data

- Topography (DEM)
- Soil type
- Soil cover (natural vegetation vs. land use)
- (River map)

► Dynamic data (weather data)

- Temperature
- Precipitation
- (Solar radiation)
- (Relative humidity)
- (Wind speed)

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- Temperature
- Precipitation
- (Solar radiation)
- (Relative humidity)
- (Wind speed)
- Impossible to reassess!

Alternatives to observed weather data

Name	Organization	Spatial res.	Temporal res.	Period
CRU	University of East Anglia	0.5°	Monthly	1901–2012
MERRA	NASA GMAO	~0.5°	Hourly	1979–present
CFSR	NCEP	0.5°	6 hourly	1979–2010

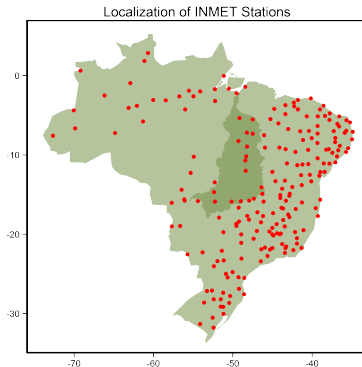
CFSR

- ▶ First climate reanalysis that includes atmosphere and ocean
- ▶ More accurate representation of observed mean precipitation in tropical regions (Wang et al. 2011, Clim Dyn)

CFSR vs. INMET observations in Brazil

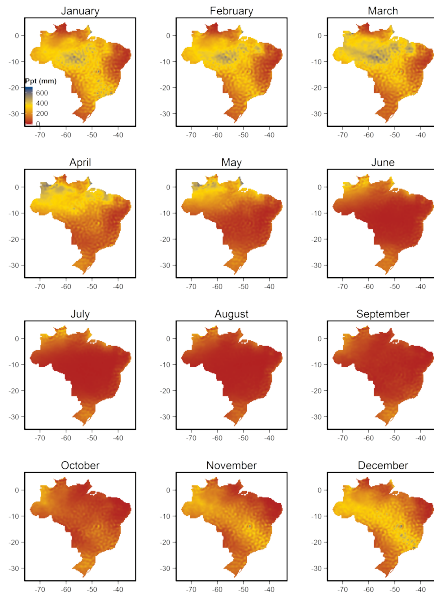
Comparing CFSR to observed weather data

- ▶ INMET observed data
 - 209 stations: 1980–2010
 - (15 in the Tocantins Basin)
 - Uneven distribution
- ▶ CFSR for Brazil
 - 12,201 'stations'
 - (642 in the Tocantins Basin)



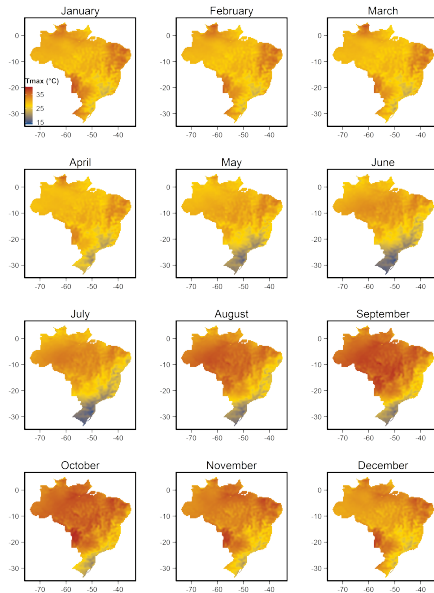
Meta-analysis CFSR

Geographic Consistency - Monthly Precipitation



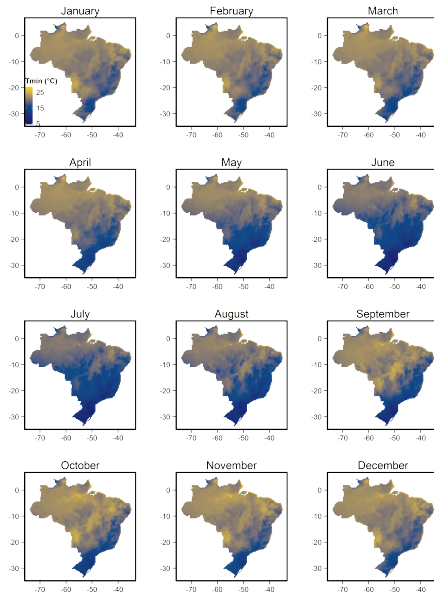
Meta-analysis CFSR

Geographic Consistency - Maximum Daily Temperature



Meta-analysis CFSR

Geographic Consistency - Minimum Daily Temperature

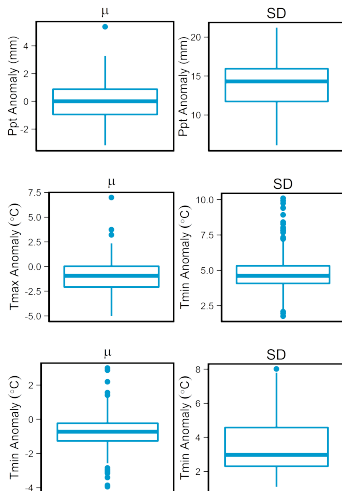


Meta-analysis CFSR

Daily Anomalies: Frequency Distribution

$$\text{Anomaly} = \text{CFSR} - \text{INMET}$$

- INMET stations paired with closest CFSR station
- Frequency distribution μ
- Frequency distribution SD

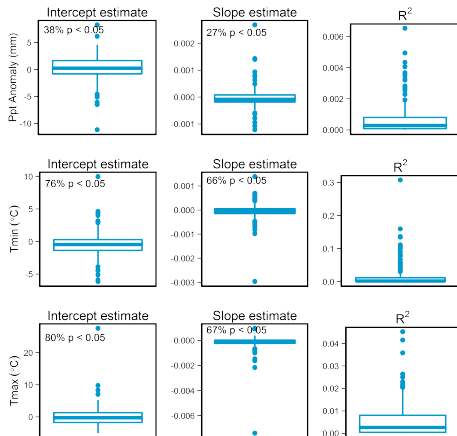


Meta-analysis CFSR

Daily Anomalies: Linear Regressions

$$\text{Anomaly} = \text{CFSR} - \text{INMET}$$

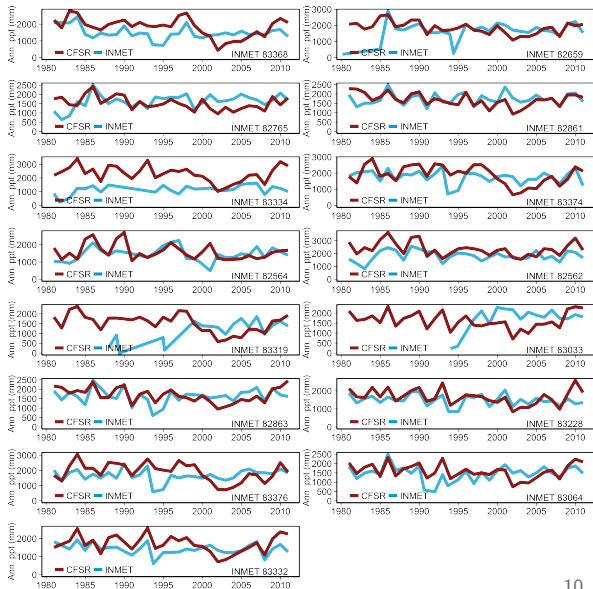
- Anomaly time series \rightarrow linear regression
- $f(x) = a + bx$



Deeper Analysis - Tocantins Basin

Annual Precipitation Time-Series

INMET vs. CFSR



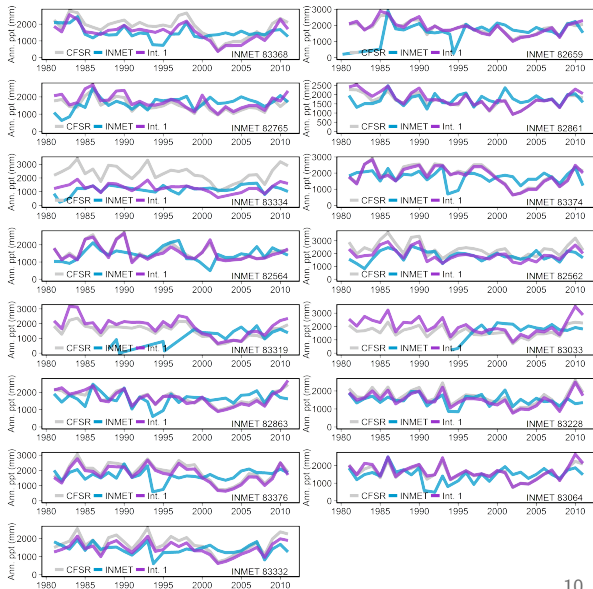
Deeper Analysis - Tocantins Basin

Annual Precipitation Time-Series

INMET vs. CFSR

INMET vs. Int. 1

- ▶ $CF = \frac{CFSR}{INMET}$
 $\frac{CFSR}{CF} = \text{Interpolation}$
- ▶ Corrected by means of monthly ratios (months as factors, i.e. Januaries, Februaries, etc.)



Deeper Analysis - Tocantins Basin

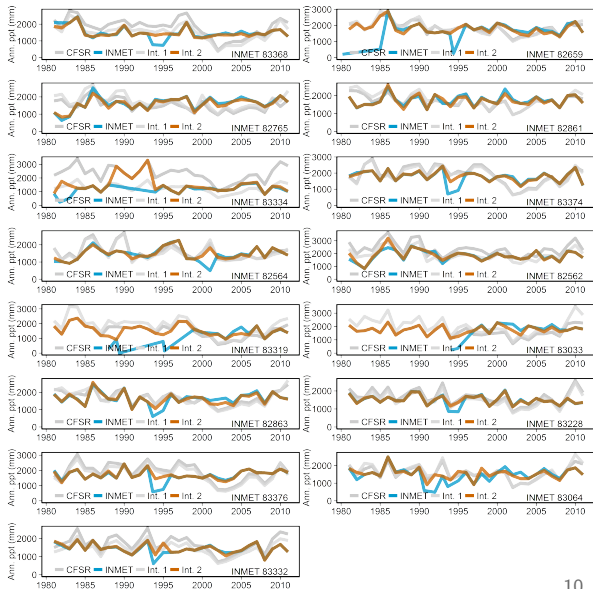
Annual Precipitation Time-Series

INMET vs. CFSR

INMET vs. Int. 1

INMET vs. Int. 2

- Corrected by means of monthly ratios (months as time series, i.e. January 1980, February 1980, etc.)



Deeper Analysis - Tocantins Basin

Annual Precipitation Time-Series

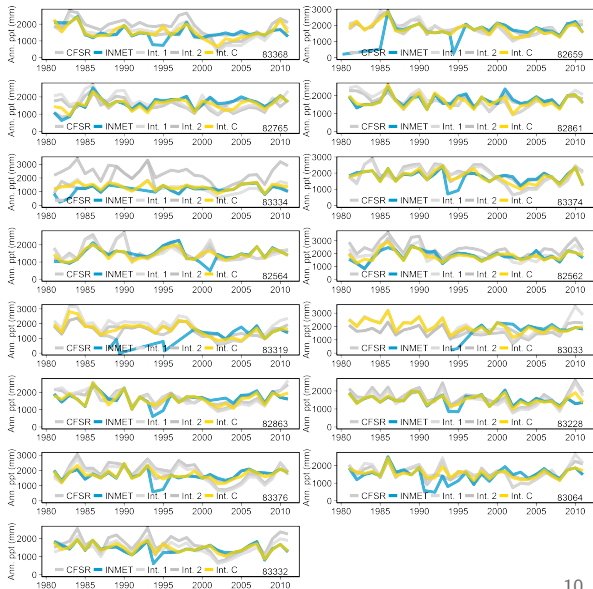
INMET vs. CFSR

INMET vs. Int. 1

INMET vs. Int. 2

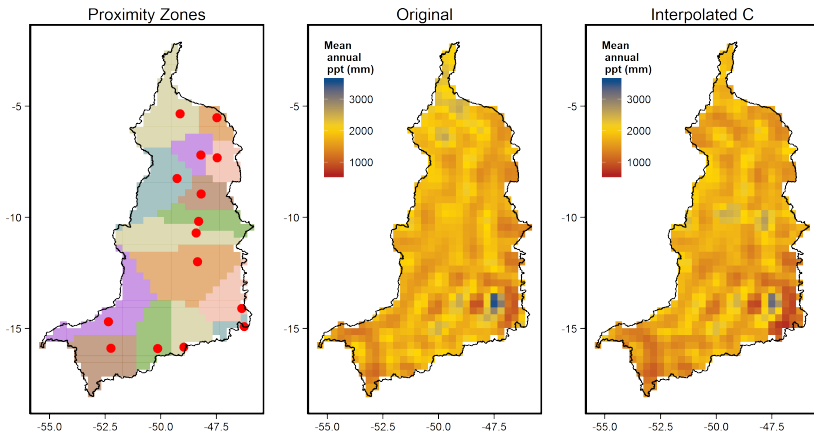
INMET vs. Int. C

- Combination of both previous methods.
- Whenever possible, use of Int. 1
- Whenever INMET lack, use of Int. 2



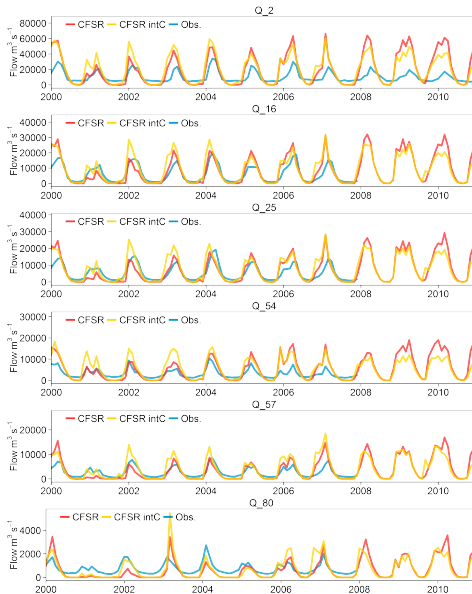
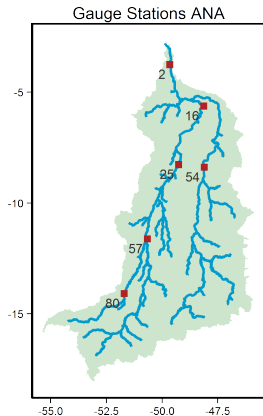
Deeper Analysis - Tocantins Basin

Applying the Correction Factor



Deeper Analysis - Tocantins Basin

Interpolated Data Set Used in SWAT



Conclusion

- ▶ In the broad picture, CFSR represented Brazilian weather and is therefore a good alternative to observed data, especially for large-scale projects.
- ▶ Nevertheless, we advice a comparison with observed data previous to the use of CFSR for hydrologic modeling, and, if necessary, apply correction methods.

Acknowledgments

- ▶ Swiss National Science Foundation
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Thank you for your time!