Statistical Analysis of Gridded Global Climate Datasets Compared to Station Measurements

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Introduction

- This study highlights the accuracy of two global climate datasets, which can be used as inputs into the global pest forecast models within the Spatial Analytical Framework for Advanced Risk Information Systems (SAFARIS) project.
- Output from these models assist with protection against the entry, establishment, and further spread of significant pests.
- Previous analysis utilized Global Historical Climatology Network (GHCN) as the comparison dataset. It was noted that GHCN is an input to CRU and ERA-Interim. Thus, an independent observational dataset was identified for use in this evaluation.
- **Hypothesis:** CRU has the smaller spatial resolution, and thus will be more accurate than ERA-INT as compared to ISTI observations across the globe.

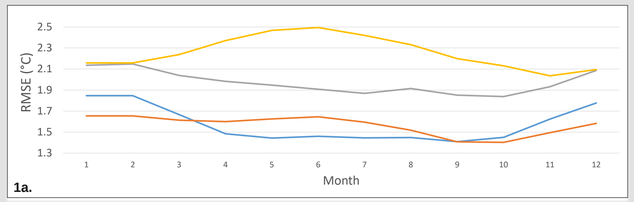
Datasets

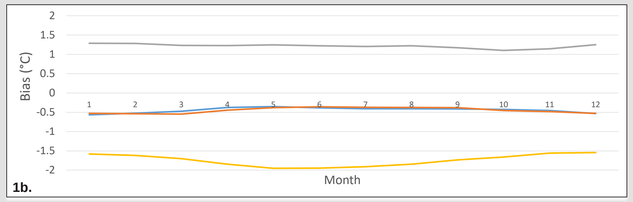
International Surface Temperature Initiative (ISTI) Global Land Surface Temperature Databank - Stage 3 Monthly	**Temporal Resolution:** Monthly **Spatial Resolution:** n/a **Period of Record Available:** 1800 – Present **Type of Observation:** Land-based weather stations
Climatic Research Unit Time-Series version 4.01 (CRU)	**Temporal Resolution:** Monthly **Spatial Resolution:** 0.50° x 0.50° (~35km) **Period of Record Available:** 1901 – 2015 **Type of Observation:** Gridded reanalysis
ERA-Interim (ERA-INT)	**Temporal Resolution:** Sub-daily, Daily, Monthly **Spatial Resolution:** 0.75° x 0.75° (~56km) **Period of Record Available:** 1979 – Present **Type of Observation:** Gridded reanalysis

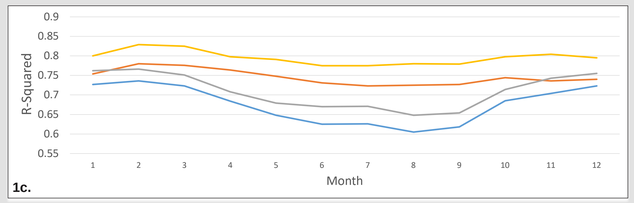
Methods

- Annual and monthly statistics -- including the R-squared, root mean square error, and bias values – were calculated for maximum and minimum temperature at each grid-point -- weather-station pair.
- Presumed GHCN stations were removed from the ISTI dataset.

Results





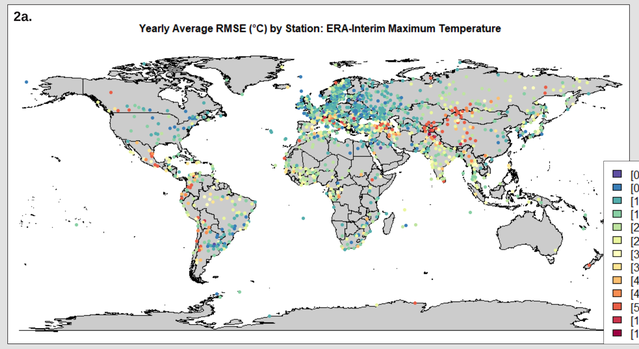


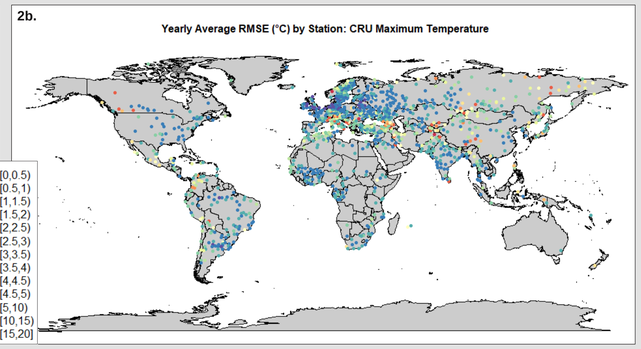
CRU TMIN — CRU TMAX — ERA-INT TMIN — ERA-INT TMAX

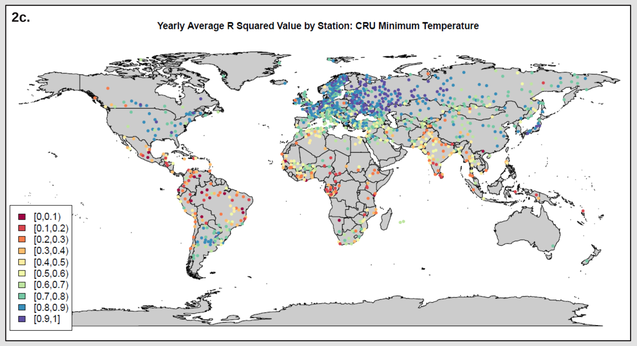
Figure 1a, 1b, and 1c: Yearly, Globally averaged statistics.

	RMSE (°C)	Bias (°C)	R-Squared
CRU TMIN	1.578	-0.449	0.676
CRU TMAX	1.579	-0.467	0.740
ERA-INT TMIN	1.976	1.210	0.711
ERA-INT TMAX	2.287	-1.764	0.792

Table 1: Yearly, Globally averaged statistics.



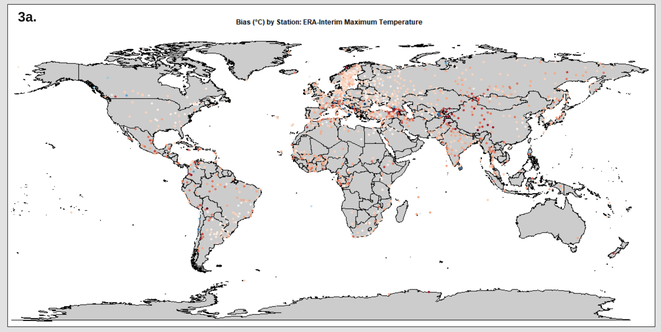




Figures 2a and 2b: Yearly Averaged RMSE for ERA-INT & CRU TMAX
Figure 2c: Yearly Averaged R-squared for CRU TMIN

Discussion

- CRU bias is consistently negative for both TMAX & TMIN.
- ERA-INT bias is always negative for TMAX and always positive for TMIN.
- ERA-INT has slightly larger R-Squared values for both variables but are comparable to those for CRU for TMIN & TMAX.
- RMSE patterns are spatially similar for ERA-INT TMAX & TMIN along with CRU TMAX & TMIN.
- CRU RMSE is slightly lower than ERA-INT throughout the year.



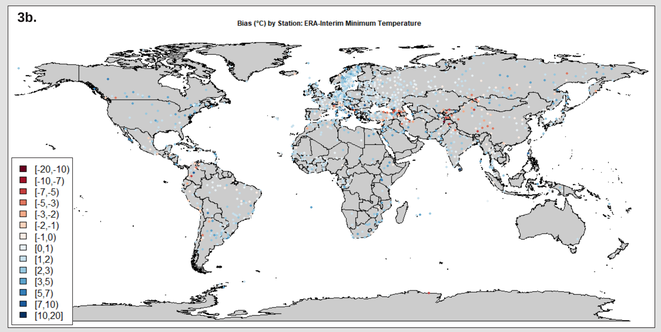


Figure 3a and 3b: Yearly Averaged Bias for ERA-INT TMAX & TMIN

Conclusion

- Based on this analysis CRU performs better statistically than ERA-INT but lacks some temporal requirements of SAFARIS, e.g., sub-daily time steps and near real time updates.
- Accuracy varied by continent when comparing the datasets. Spatial patterns show that areas of higher altitude had lower accuracy, e.g., Himalayans.
- All datasets according to these statistical measures, perform better in the months of November to March.

Future Work

- Evaluate ERA5 dataset, a new version of ERA-INT.
- Find independent land-based precipitation datasets.
- Continue to investigate station-grid pairs with high error, e.g., erroneous station data or model error.

Acknowledgments

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