Development of High Resolution Rainfall Climatology for Ghana

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Abstract And Introduction

Abstract
Various sectors of the country's economy (health, energy, agriculture and the like) depend on climate, and as such availability of quality climate data becomes essential for climate impact studies in these sectors. Rainfall climate database for Ghana has been developed using Gmet station data spanning a 33-year period (1980 – 2012). Seasonal rainfall for the four agro-ecological zones have been derived based on 0.25^o x 0.25^o grids covering the entire country. This allowed a clear evidence of the Inter-Tropical Discontinuity (ITD) migration from the South of the country to the North and back. This study provides a firsthand data for climate impact study, in the aforementioned sectors, across the country.

Introduction
Present increase in global warming and subsequent climate change has necessitated a more rigorous research geared towards finding and understanding their possible cause. According to Barnett *et. al.* (1996), knowing both the spatial and temporal patterns of climate change over the past, remains key to assessing possible anthropogenic impact on post-industrial climate. To this end, availability of climate data is very vital to climate change and impact studies. Climate variables that are key to providing rich evidence of climate change is precipitation and temperature (Mengistu Tsidu, 2012). At present, a country-wide rainfall database is unavailable, inhibiting quality climate impact studies countrywide in the various sectors of the country's economy. This study seeks to provide a high-resolved (0.25^o x 0.25^o) rainfall database for quality climate impact studies across the country.

Methods

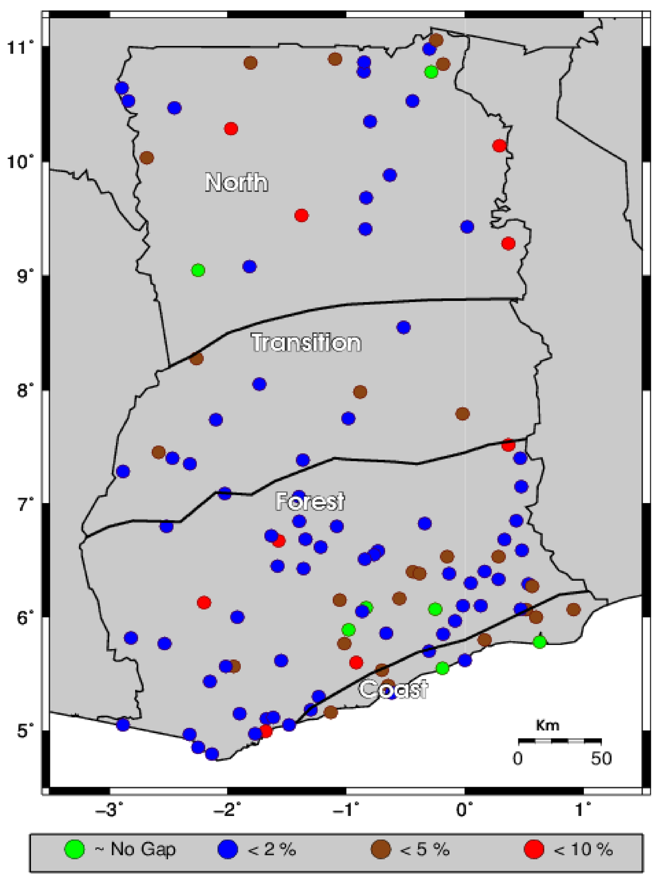

Figure 1: Percentage of missing data in each station's records.

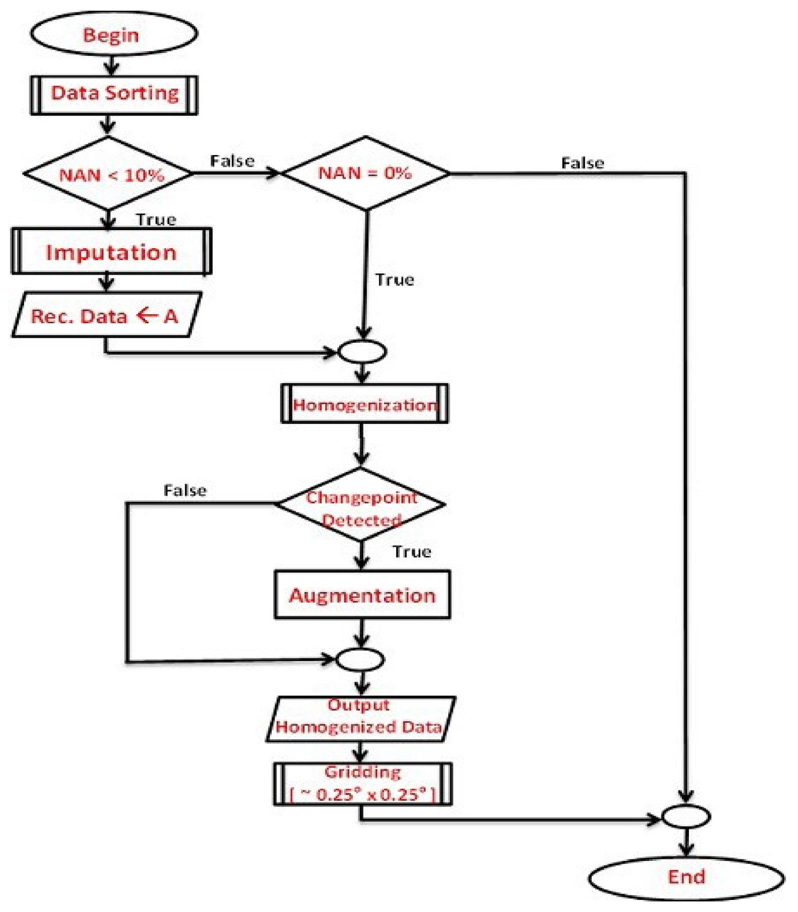

Figure 2: Flowchart of the study carried out.

- Datasets with gaps greater or equal to 10% of the data were discarded.
- Missing data was estimated by Regularized Expectation Maximization (RegEM) algorithm.
- Absolute homogenization was done using Quantile Matching Adjustment (Qmadj) regression fit.
- Minimum surface curvature (MSC) algorithm with tensioning parameter was used to grid rainfall datasets at a 0.25^o x 0.25^o spatial resolution.
- Validation of generated database with Climate Research Unit Time Series (CRU TS 3.22) satellite data.

Gridding of Reconstructed Rainfall Data

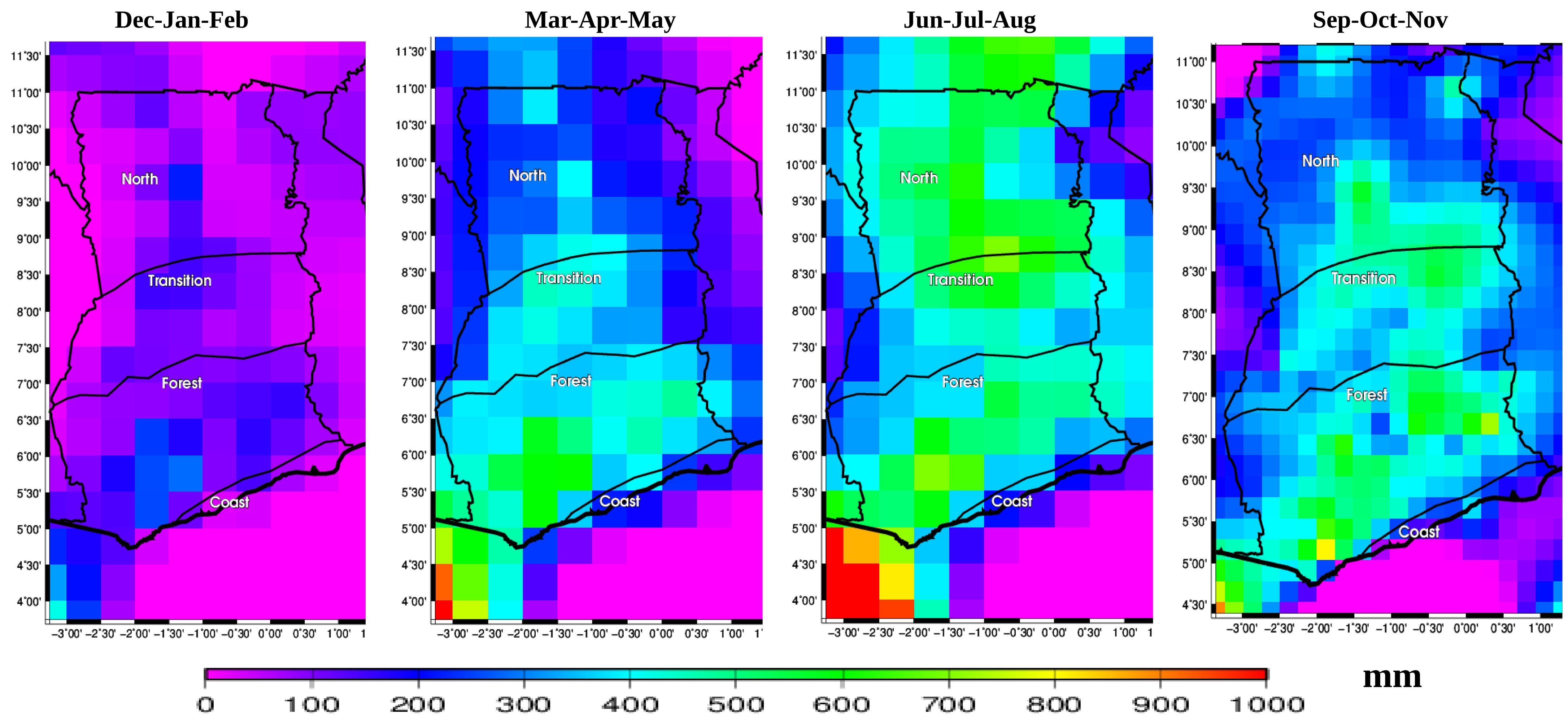

Figure 3: Seasonal grids of reconstructed rainfall

CRU TS 3.22 Gridded Precipitation Data

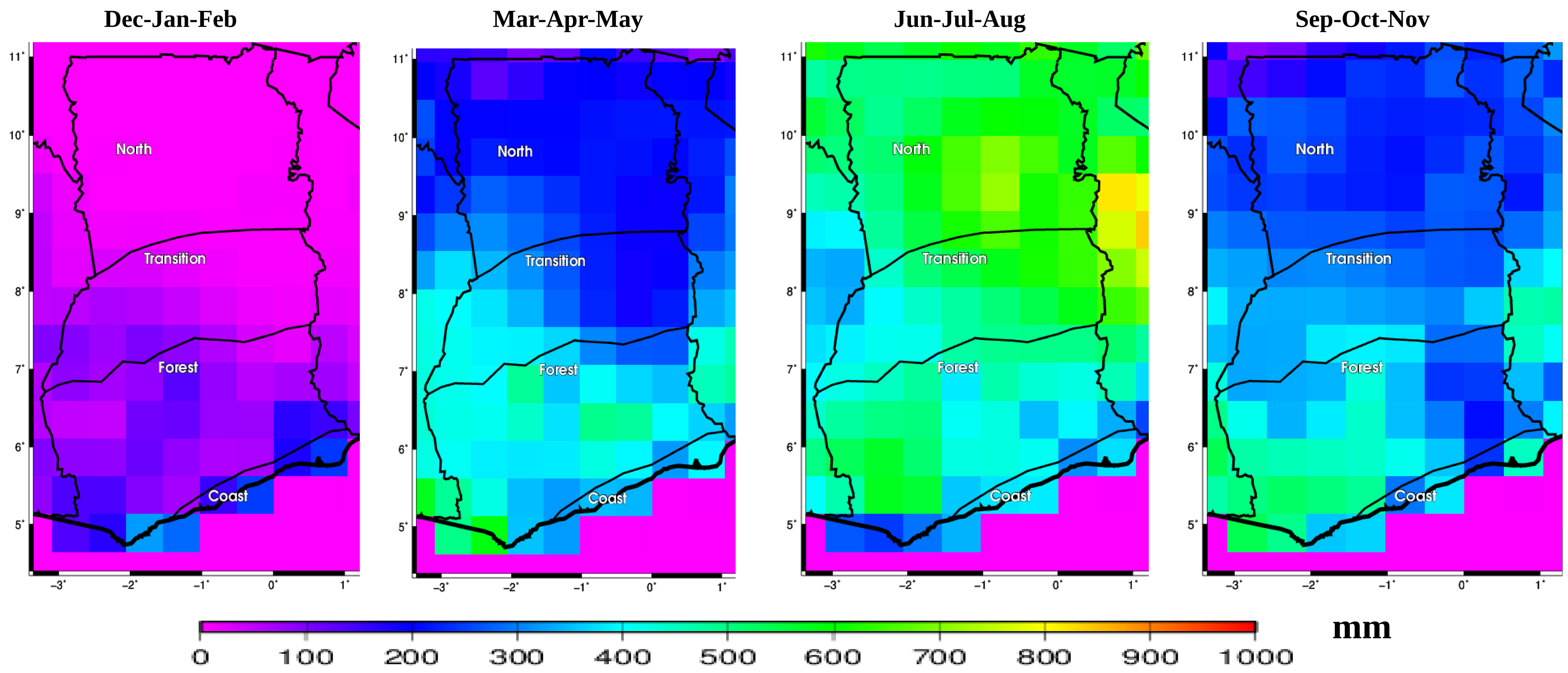

Figure 4: Seasonal grids of CRU TS 3.22 satellite rainfall data

Validation

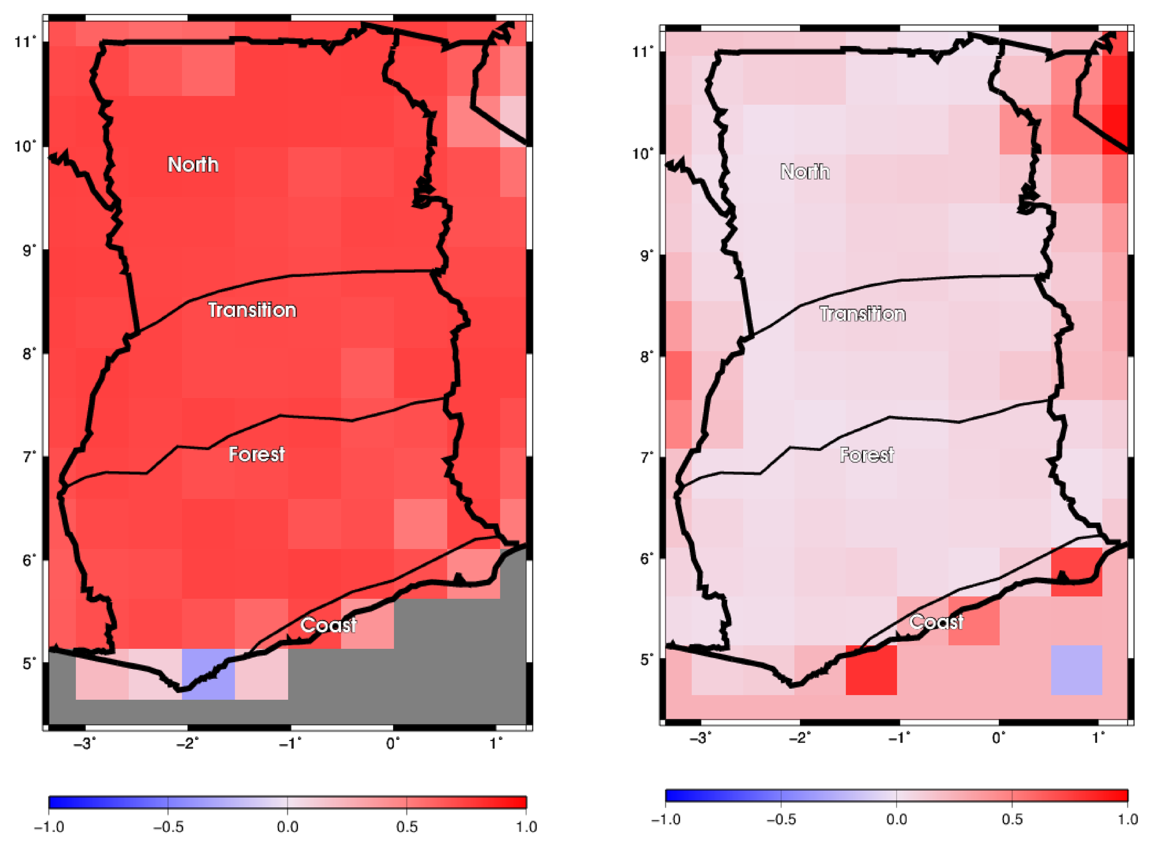

Figure 5 : Pearson Correlation Co-efficient **(a)** and Relative Mean Difference **(b)**

- **The first trimester (Dec-Jan-Feb) is the extremely dry period over the entire country. Very low rainfall amounts (~ 300mm or less) are recorded in the two datasets. This is attributed to the position of the ITD below the country's latitude. Dry, dust-laden Trade Winds dominate over the entire country.**

- **The second trimester (Mar-Apr-May) is the rainfall onset period over the Coastal, Transition and Forest Zones. The advancement of the ITD northwards accounts for the onset, feeding in more rains over the country.**

- **The third trimester (Jun-Jul-Aug) is the wettest duration over the entire country. Within these periods, ITD continually advances to its maximum apex and thus, more rains are brought inland. Rainfall amounts typically range up to about 800 mm.**

- **The fourth trimester (Sep-Oct-Nov) is the minor rainy season for the Transition, Forest and Coastal Zones. The recess of the ITD southwards accounts for the rainfall over the aforementioned zones. Traces of the Harmattan period are already showing in the Northern Zone.**

- **High Pearson correlation co-efficients ranging from 0.5 to 0.9 were attained country-wide which is an indication of a strong agreement between the reconstructed dataset and CRU TS 3.22 satellite data.**

- **Very low Relative Mean Difference (RMD) ranging from 0 to 0.3 was attained country-wide. This shows a low variation between the two datasets.**

Conclusions

- High correlation and low relative mean differences show a good agreement between the reconstructed datasets and the CRU TS 3.22 satellite data.

- For the first time, a highly-resolved rainfall climatological database has been developed from the GMet dataset over the entire country which will now serve as precursor for quality countrywide climate impact studies.

- Evidence of the ITD migration is clearly seen from the study and that accounts for the overall rainfall variability over the country, as described in literature.

Acknowledgements

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References

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