Use of Satellite Rainfall Estimates for Improving Climate Services in Africa

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ABSTRACT

Climate variability and change pose serious challenges to sustainable development in Africa. The recent famine crisis in Horn of Africa is yet again another evidence of how fluctuations in the climate can destroy lives and livelihoods. Building resilience against the negative impacts of climate and maximizing the benefits from favorable conditions will require mainstreaming climate issues into development policy, planning and practice at different levels. The availability of decision-relevant climate information at different levels is very critical. The number and quality of weather stations in many part of Africa, however, has been declining. The available stations are unevenly distributed with most of the stations located along the main roads. This imposes severe limitations to the availability of climate information and services to rural communities where these services are needed most. Where observations are taken, they suffer from gaps and poor quality and are often unavailable beyond the respective national meteorological services. Combining available local observation with satellite products, making data and products available through the Internet, and training the user community to understand and use climate information will help to alleviate these problems. Improving data availability involves organizing and cleaning all available national station observations and combining them with satellite rainfall estimates. The main advantage of the satellite products is the excellent spatial coverage at increasingly improved spatial and temporal resolutions. This approach has been implemented in Ethiopia and Tanzania, and partly in Madagascar.

Approach

Three approached are implemented to simultaneously improve the availability, access and use of climate information in Africa.

1) Improving data availability through the development of rainfall time series going back 30-years at 10 daily time scales and spatial resolution of 10-km. This is accomplished by combining station measurements with satellite rainfall estimates. The satellite rainfall estimate used is that of the TAMSAT (Tropical Application of Meteorology using Satellite and other data) from the University of Reading. Combining ground-based observations with satellite proxies will help to overcome spatial and temporal gaps in station data while improving the accuracy of the satellite products. Different approaches have been used to merge the satellite estimates and station observations. These include simple bias adjustment and Regression Kriging.

2) Develop climate Analysis Map Room tools for producing useful information for monitoring rainfall and temperature at ten days time scale. This information is developed on the basis of each country user needs for the appropriate format and content of the products.

3) Train users to understand and use the generated new climate information. This aspect of the project still needs more work.

Outputs

The main outputs include:

1. Thirty-year times series of combined satellite-gauge rainfall time series at 10-daily time scale 10-km spatial resolution (samples are given in Figures 1A, 1B, & 1C);
2. An array of user-specific products for climate analysis and monitoring;
3. An online facility providing user-friendly tools for visualization, querying, and downloading information products (Figures 2A and 2B);
4. Trained man power at the National Met Services to make the work sustainable; and
5. Some trained users on how to use climate the new information products.

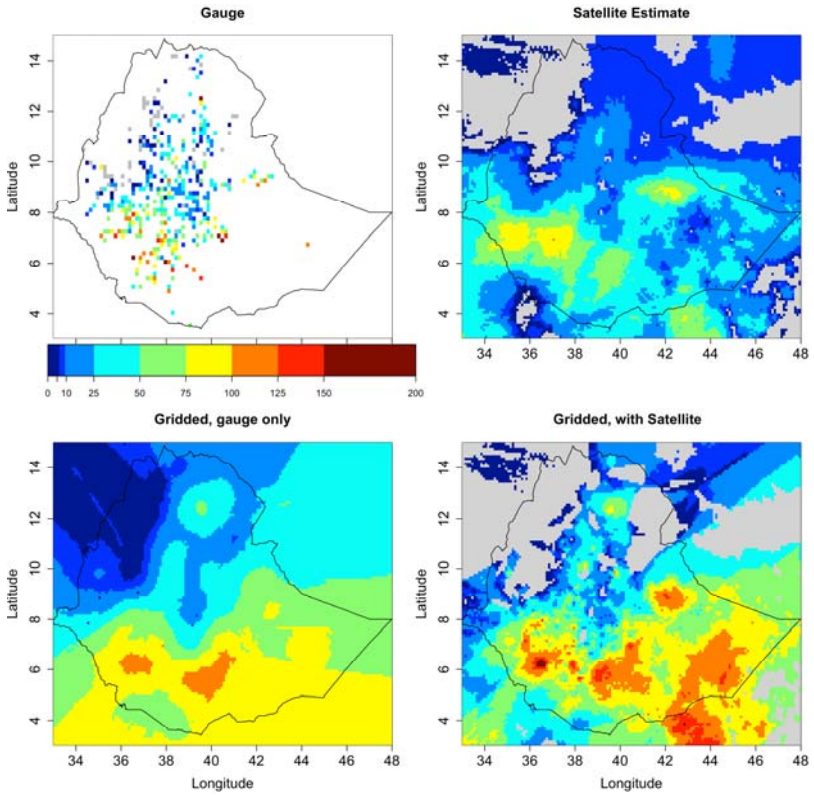

Figure 1A: A sample of Rain gauge data (top left), satellite estimate (top right), gauge-only gridded products (bottom left), and combined gauge-satellite product (bottom right) for Ethiopia.

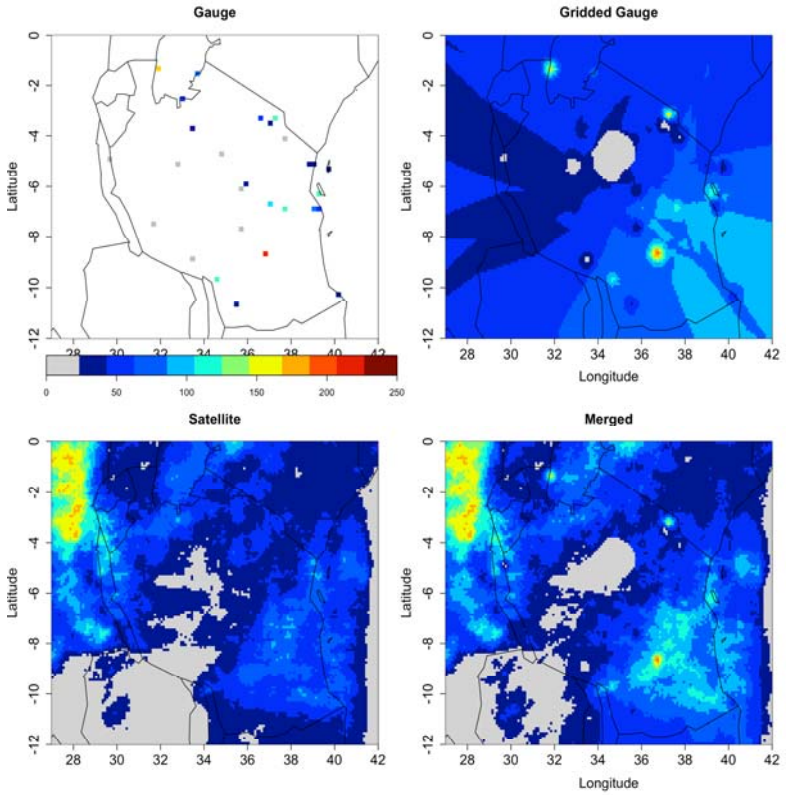

Figure 1B: A sample of Raingauge data (top left), satellite estimate (top right), gauge-only gridded products (bottom left), and combined gauge-satellite product (bottom right) for Tanzania.

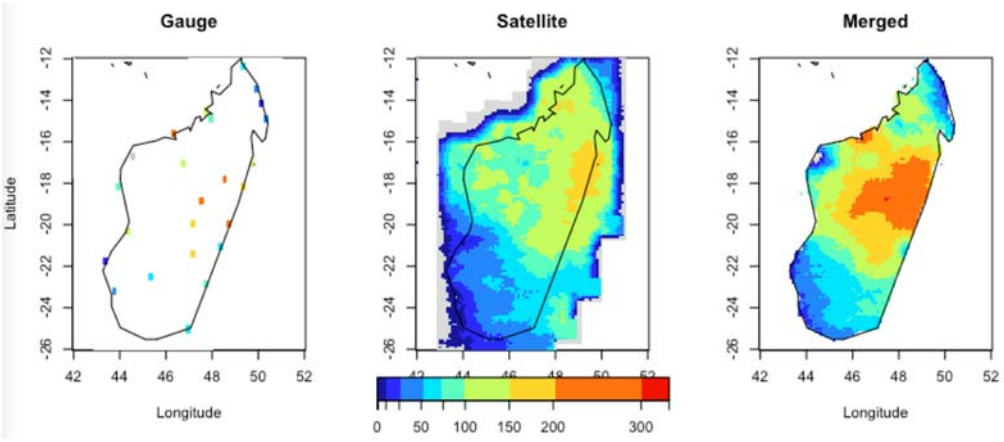

Figure 1C: A sample of raingauge observation (left), satellite estimate (center), and combined gauge-satellite product (right), for Madagascar.

The main strengths of this data set include the following:

- The satellite estimates are produced using a single satellite algorithm and the same satellite information going back 30 years. This makes it a very consistent

time series. This consistency is critical for detecting climate trends, amongst other things.

- The satellite estimates are combined with contemporaneous data from the same set of ground stations. This improves the quality of the rainfall estimates significantly. The combined data covers the whole country. This improves data availability particularly for rural communities where there are no weather stations.

- The combined data are in a format that is easily imported into GIS (geographic information system) browser software for combination with other data of interest.

- National Met Services staff who had been trained on data quality control, satellite rainfall and temperature retrievals, as well as combining station and satellite data did most of the work at NMA. This ensures the continuity of the work.

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Figure 2A: Improved web page and online tools for data analysis and display for Ethiopia.

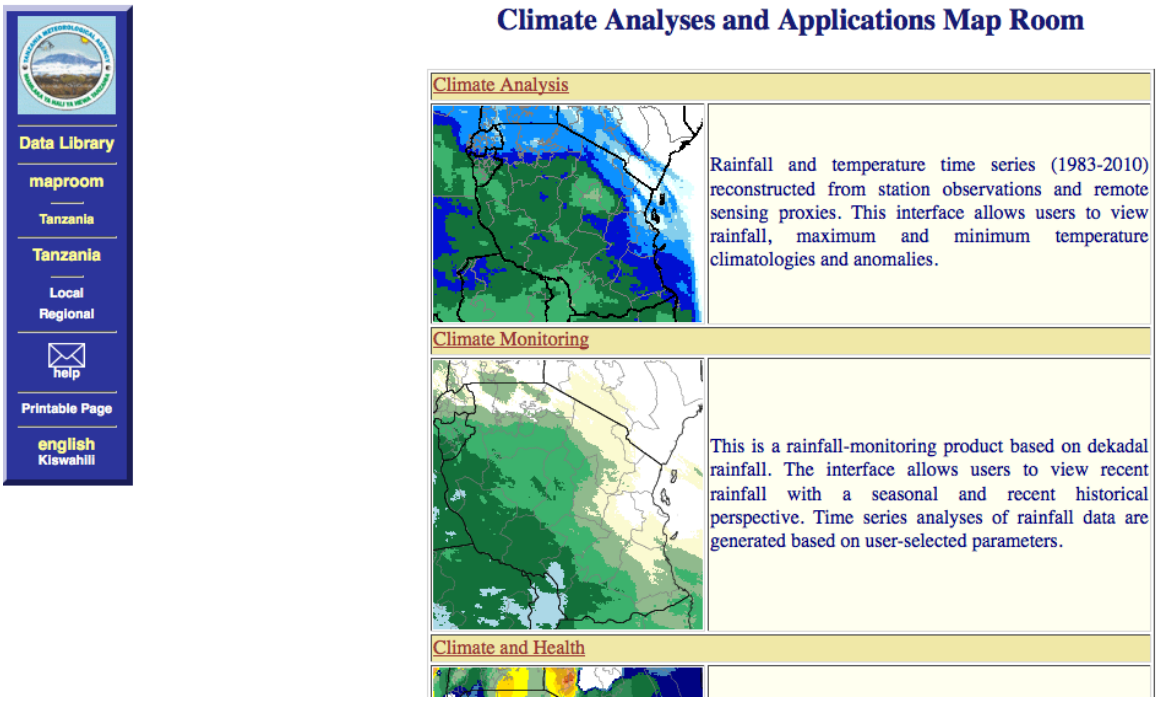

Figure 2B: Online tools for data analysis and display for Tanzania.

The online tools include Climate Analysis and Climate Monitoring Map Rooms. The Climate Analysis Map Room provides information on the mean climate (in terms of rainfall and temperatures) at any point or for any administrative boundary. It also shows the performance of the rainfall seasons over the years as compared to the mean. The Climate Monitoring Map Room enables monitoring of the current season. Different maps and graphs compare the current season with the mean or recent years. This information could be extracted at any point or for any administrative boundary. Data are updated every ten days, thus enabling close monitoring of the season. Extracting and presenting information at any administrative level enables focusing on specific area of interest. The services offered by NMS will be improved further when other three Map Rooms (on Water, Agriculture, and Health) are developed in consultation with respective user communities.

Summary

This project aims to improve data availability and use to serve decision needs in climate-sensitive sectors, particularly agriculture, water and public health, by filling spatial and temporal gaps in climate observations. The spatial gaps are a result of sparse station network, while temporal gaps are due to interrupted observations or lost data due, for example, to communication problems. The project checks the quality of national climate observations from the NMS and combines them with satellite proxies to create a 30-year time series of rainfall and temperature data at 10 daily timescales and spatial resolution of 10km 1. The combined rainfall dataset draws on all nationally available raingauge stations, many of which are not available out side the receptive countries. Derived products are made available using online tools.