Geophysical Research Abstracts
Vol. 19, EGU2017-11536, 2017
EGU General Assembly 2017


# Seasonal scale water deficit forecasting in Africa and the Middle East using NASA's Land Information System (LIS)

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Drought and water scarcity are among the important issues facing several regions within Africa and the Middle East. A seamless and effective monitoring and early warning system is needed by regional/national stakeholders. Such system should support a proactive drought management approach and mitigate the socio-economic losses up to the extent possible. In this presentation, we report on the ongoing development and validation of a seasonal scale water deficit forecasting system based on NASA's Land Information System (LIS) and seasonal climate forecasts. First, our presentation will focus on the implementation and validation of the LIS models used for drought and water availability monitoring in the region. The second part will focus on evaluating drought and water availability forecasts. Finally, details will be provided of our ongoing collaboration with end-user partners in the region (e.g., USAID's Famine Early Warning Systems Network, FEWS NET), on formulating meaningful early warning indicators, effective communication and seamless dissemination of the monitoring and forecasting products through NASA's web-services.

The water deficit forecasting system thus far incorporates NOAA's Noah land surface model (LSM), version 3.3, the Variable Infiltration Capacity (VIC) model, version 4.12, NASA GMAO's Catchment LSM, and the Noah Multi-Physics (MP) LSM (the latter two incorporate prognostic water table schemes). In addition, the LSMs' surface and subsurface runoff are routed through the Hydrological Modeling and Analysis Platform (HyMAP) to simulate surface water dynamics. The LSMs are driven by NASA/GMAO's Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2), and the USGS and UCSB Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) daily rainfall dataset. The LIS software framework integrates these forcing datasets and drives the four LSMs and HyMAP. The Land Verification Toolkit (LVT) is used for the evaluation of the LSMs, as it provides model ensemble metrics and the ability to compare against a variety of remotely sensed measurements, like different evapotranspiration (ET) and soil moisture products, and other reanalysis datasets that are available for this region. Comparison of the models' energy and hydrological budgets will be shown for this region (and sub-basin level, e.g., Blue Nile River) and time period (1981-2015), along with evaluating ET, streamflow, groundwater storage and soil moisture, using evaluation metrics (e.g., anomaly correlation, RMSE, etc.). The system uses seasonal climate forecasts from NASA's GMAO (the Goddard Earth Observing System Model, version 5) and NCEP's Climate Forecast System, version 2, and it produces forecasts of soil moisture, ET and streamflow out to 6 months in the future. Forecasts of those variables are formulated in terms of indicators to provide forecasts of drought and water availability in the region.