**NASA DEVELOP National Program**

****International Research Institute for Climate and Society (IRI)

**Fall 2014**

**East Africa Health and Air Quality III**

*Evaluating Flood Detection Products from NASA Earth Observations Built on the Understanding of the Relationship Between Inundation, Extreme Rainfall Events, and Epidemic Dynamics in East Africa*

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**Team Members:**

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**Applied Sciences National Applications Addressed:**

Health and Air Quality

**Study Area:**

East Africa (South Sudan, Sudan, Ethiopia, Kenya, Tanzania, Somalia) and Thailand

**Study Period:**

January 1, 2013 to March 31, 2013

**Partners/Collaborators**

Red Cross / Red Crescent Climate Centre (RCRCCC): Erin Coughlan, Senior Climate Specialist

City University of New York (CUNY): Kyle McDonald, Terry Elkes Professor; Kat Jensen, PhD Student

NASA Goddard Space Flight Center: Fritz Policelli, Researcher

**80-100 Word Blurb**

Many vector borne diseases have an association with rainfall and flood events. Validation of flood products will aid in the development of Early Warning Systems helping reduce a populations’ vulnerability to vector borne diseases. This project validated three flood detection products and explored the use of a heavy rainfall forecasting product in predicting floods in East Africa and Thailand. While validating the flood detection products, it was discovered that a unified definition of flooding is not present within the literature, preventing consistency across flood detection products. Therefore this research also attempted to develop a baseline definition of a flood event.

**Community Concerns**

* Recent epidemics of vector borne diseases (e.g. Leishmaniasis) have caused an estimated 100,000 deaths and have renewed the impetus for defining the ecological boundaries of the vectors. Previous terms research have demonstrated that climate and environmental factors (e.g. rainfall, temperature, vegetation, and inundation) are reliable predictors of vector borne diseases.
* A unified flood definition would help future satellite products to be more consistent in classifying flood events and differentiating between different types of floods.
* Potential for developing an Early Warning System based on inundation and environmental factors that will be vital for the Ministries of Health in forecasting, preparing, and responding to outbreaks of vector borne diseases.

**Current Management Practices & Policies**

Remote regions in Africa often have sparse meteorological and ecological data. Project partners in this region rely heavily on remotely sensed data as it increases the temporal and geospatial scales of projects. Using data from NASA satellites and sensors (e.g. MODIS onboard Aqua and Terra) enable project partners working in these regions to better prepare countries for outbreaks of vector borne diseases.

**Abstract**

Annual flooding events in East Africa affect both the health and economic aspects of the population. It has been established that vector borne diseases are associated with environmental and climatic factors. Research by previous terms has identified that flooding events are negatively associated with the vector borne disease Visceral Leishmaniasis (VL). Epidemics of VL in East Africa have caused an estimated 100,000 deaths, and have renewed the impetus for defining the ecological boundaries of the disease. Validating remotely sensed products that detect flooding will enable disaster responders to adequately prepare and respond to areas with a greater likelihood of outbreaks of vector borne diseases. A comparative analysis was conducted using Dartmouth Flood Observatory (DFO) flood maps, NASA Goddard Space Flight Center MODIS Near Real-Time Global Flood Mapping Project (NRT-GFM), and City University of New York’s (CUNY) Surface Water Microwave Product Series (SWAMPS) inundation fraction anomaly product to verify precision between the three products in East Africa and Thailand. In order to explore the potential for forecasting these flood events, this term compared these three products (DFO, NRT-GFM, SWAMPS) to the heavy rainfall forecasts developed by the International Research Institute for Climate and Society (IRI) for the International Federation of the Red Cross and Red Crescent Societies (IFRC). Corroborating the IFRC product to flooding events detected by the three flood products would enhance a region’s ability to quickly identify where and when to allocate emergency flood preparedness/relief efforts and could also act as a useful predictor for vector borne disease outbreaks. Additionally, while validating flood detection products, it was discovered that a unified definition of flooding is not present within the literature, preventing consistency across flood detection products. Therefore this research attempted to develop a baseline definition of a flood event.

**Decision Support Tools**

* *Flood Definition* - A flood definition that better helps decision makers to analyze remote sensing data and provide a baseline for practitioners developing satellite products. Additionally, it would help decision makers and on-the-ground responders to be more efficient in allocating resources to affected populations in areas disturbed by floods and outbreaks of vector borne diseases.
* *Validated Flood Detection Product* - Through validation of different flood detection products (e.g. DFO, CUNY SWAMPS, and NRT-GFM) end users will be able to select the best product for managing disaster response in their country and/or community.

**Benefit to End-User:**

* Identification of flood products that accurately depict flood events in East Africa based on case studies in Thailand, which will enable the creation of an Early Warning System for vector borne diseases.
* Improved resource allocation due to identification of more precise flood detection products.
* Having a unified flood definition will benefit the research community and help in the development of satellite products for flood detection.

**Earth Observations & Parameters**

* Aqua and Terra, MODIS – Water body delineation (DFO flood product)
* Aqua and Terra, LANCE MODIS – Flood detection (NRT-GFM flood product)
* SeaWinds, QuikSCAT - Global Monitoring of Wetland Extent and Dynamics (CUNY SWAMPS product)
* AMSR-E, Aqua- Global Monitoring of Wetland Extent and Dynamics (CUNY SWAMPS product)
* TRMM, Precipitation radar - Rainfall

**Future Applicable NASA Missions**

* NASA-ISRO Synthetic Aperture Radar (NI-SAR) – Flood Inundation
* Surface Water Ocean Topography (SWOT) – First global survey of Earth’s surface water

**Models Utilized**

* U.S. National Oceanic and Atmospheric Administration (NOAA), Earth System Research Laboratory, Physical Sciences Division, ESRL Reforecast Version 2 Project
  + The International Federation of Red Cross and Red Crescent Societies (IFRC) heavy rainfall forecast is created using this dataset

**Software Utilized**

* IRI Data Library – Analysis of CUNY SWAMPS product and IFRC flood forecasting products
* QGIS – Raster manipulation/analysis, map creation of Dartmouth Flood Observatory, CUNY SWAMPS, NASA NRT-GFM Flood Mapping Products
* Excel – Statistical analysis of products