**Christopher Thorncroft**
**Atmospheric and Environmental Sciences**

**Sponsor:** National Oceanic and Atmospheric Administration (NOAA)
**Dates:** August 1, 2010 – July 31, 1013
**Amount:** $511,904

## Decadal Variability and Predictability of the West African Monsoon and Downstream Atlantic Hurricane Activity

The observed multi-decadal variations in West African (WAM) rainfall, between the 1950's and 1990's, was one of the most pronounced decadal signals on our planet last century. Any potential for providing useful decadal forecasts in this region would be extremely useful for decision-makers and societies working and living in this region. In addition to West African nations, variability of the WAM is also important for downstream hurricane activity. Last century hurricane activity increased during wet decades and decreased during dry decades and so it is very likely that the fidelity of decadal predictions of hurricane activity relies heavily on skillful predictions of the WAM. It is important that we continue to increase our knowledge and understanding of the causes of decadal variability of the WAM and its impacts on downstream hurricane activity and to assess whether this variability is predictable. In addition it is important to increase our confidence in climate change scenarios for this region of the world – especially given the lack of model agreement in rainfall predictions in the West African region reported in the last IPCC report.

The three overarching objectives of this work are the following:

(1) To improve our knowledge and understanding of the decadal ocean variability on West African climate including how this impacts downstream hurricane activity.
(2) To develop metrics for assessing the climate decadal prediction and simulation quality of the WAM and its downstream impacts; and to make those assessments.
(3) To quantify the relative roles of radiative forcing changes and natural variability for explaining the observed WAM rainfall variability and the associated impacts on hurricane activity.

To address the first objective basic research must include revisiting the relationship between global SSTs and West African rainfall and to highlight the relative roles the impact of the WAM variability has on the tropical Atlantic environment (e.g. shear, humidity) and the nature of the precursor weather disturbances (e.g. easterly waves). This will be achieved by further exploitation of available reanalysis datasets (e.g. ERA40, ECMWF interim, NCEP, NASA-MERRA) as well as African rainfall data (available from AMMA). This study will provide a thorough assessment of the relationship between decadal variations of the ocean and the WAM including how this relates to downstream hurricane activity.

Based on the analysis and conclusions reached in addressing objective 1, a complete suite of metrics will be established to monitor and evaluate dynamical predictions of the WAM and its downstream impact on Atlantic Hurricanes on decadal timescales, needed to address objective 2. This will include diagnostics that highlight the variations in the oceans (likely including assessment of the evolution of the Atlantic Meridional Overturning Circulation), the state of the WAM including its associated impact on the downstream environment (e.g. shear, humidity), and weather statistics. These will be applied to the CORE hindcasts and prediction ensembles in the "Near-Term" (decadal) suite of CMIP experiments. This will support analysis of the fidelity of the models and provide confidence limits to decadal predictions.

To address objective 3, the metrics developed above will be used to diagnose the decadal variability and trends in the WAM and downstream impacts in the "TIER-1" experiments within the CMIP5 suite of model runs including, most importantly the two planned 156 year runs with and without greenhouse gas forcing.