

Detection and Attribution of 20th Century Drying of the Tropical Atlantic Sector

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Project Sumamry: The models of the third Coupled Model Inter-comparison Project (CMIP3) identify the tropical Atlantic sector—the region that spans from East Africa across the Atlantic proper, to the Caribbean, Central America and the East Pacific warm pool—as a region with high sensitivity to external forcing, where the 20th century trend is more likely to surface above the noise. In simulations of the 20th century the Atlantic forced trends are: (i) a widespread reduction of the summertime mean rainfall in the Atlantic sector and (ii) southward shift of rainfall in the Atlantic and South America.

The project will create a century-long data set of the Atlantic marine ITCZ that will complement the available land-based historical precipitation data; the combined land and ocean data sets will allow us to determine the long-term variations and forced trends of precipitation in the entire Atlantic sector. If detection is the process of demonstrating that an observed change in climate is unusual, and attribution is the process of linking observed climate variations and changes to specific forcings, then the proposed project turns detection and attribution on their heads. It starts out with the CMIP3 estimate of the forced response of rainfall in the Atlantic sector to 20th century forcings, and sets out to determine whether the forced response is present and detectable in the historical records.

The scientific objectives of the proposals are:

- To derive a record of rainfall over the ocean from a multi-variate model with surface wind, sea level pressure, cloudiness, and surface humidity from the ICOADS data set. The model will be calibrated over the last 30 years, when satellite records insure full spatial coverage for rainfall.
- To investigate the characteristics of interannual and interdecadal variability of rainfall in the Atlantic sector, assess the spatial coherence between land and ocean, verify its stationarity over the century, and link it to variability in global SST and circulation. The observations will be contrasted to the CMIP3 simulations and century-long ensemble AGCM integrations forced by observed SST.
- To apply signal-to-noise maximizing EOF analysis to attribute rainfall trends in the Atlantic sector to either natural or anthropogenic causes.

Scientific Merit: The proposed project will advance our knowledge of natural and anthropogenic variability in the tropical Atlantic sector. The creation of a century-long observational record of the ITCZ will allow us to describe observed variability at timescales not observed before and trace the mechanisms responsible for long-term changes. The analysis of the CMIP3 simulations will validate the models and indicates for what aspects of the climate their projections are, or are not, trustworthy.

Broader Impact: The climate community will benefit from the creation of a publicly available, long record of rainfall over the Atlantic ocean. The validation of the CMIP3 models' rainfall on centennial time scales corroborates the usefulness of the models in assessing climate change beyond global mean temperature. This is important both to the larger scientific community (e.g. hydrologists, agronomists and others interested climate impacts) and to policy makers planning for adaptation to global warming.

The project will 'sustain the pool of human resources required for excellence in global atmospheric dynamics and climate research' by (i) supporting continued employments of researchers in soft-money appointments and (ii) supporting and training a student. By giving the opportunity to an undergraduate or a Climate and Society Master student to engage in climate research, the project will contribute to the education of the next generation of climate scientist or climate-related policy makers.