Final Report to NOAA:

AWARD NO.	NA11OAR4310090
PROJECT TITLE	Climatology and variability of tropical rainfall in the 20th Century Reanalysis
PRINCIPAL INVESTIGATOR	Michela Biasutti /Mingfang Ting
AFFILIATION	Lamont-Doherty Earth Observatory The Earth Institute | Columbia University
NOAA PROGRAM MANAGER	Dan Barrie

Research Goals: The goal of the project is to validate the simulation of precipitation in the 20th century reanalysis, version 2 (20CRv2, Compo et al., 2010). The 20CR has been evaluated for monthly and seasonal means globally, and compared to comprehensive reanalyses (NCEP2, CFSR, and ERA-interim) and an AMIP-like ensemble simulation (GOGA).

Research Progress:

Our research has led to a journal article that is in review in Journal of Climate. Our main results are summarized in the abstract as follows:

> Wintertime rainfall variability in the midlatitude continents and storm tracks is captured with great accuracy, on par with the comprehensive reanalyses, but summertime rainfall is not, probably in consequence of the greater importance of convection in the summer season. Over the tropics, the accuracy of all reanalyses is much less than over the midlatitudes. Over tropical land, the performance of the 20CR is better than NCEP2 and on par with ERA-interim and CFSR, but over the tropical oceans the most recent reanalyses perform significantly better.
>
> The analysis of the accuracy and ensemble spread in the 20CR and the GOGA ensembles suggests that in some tropical regions such as the Sahel the assimilation of sea level pressure is effective in constraining precipitation values, but model biases in the teleconnections with global SST limit the performance of the 20CR.

We think that our conclusions regarding tropical rainfall are especially significant. For tropical land where observations are not uncertain (outside of equatorial regions), we show that 20CR does as well as other reanalyses, and there is room for improvement. For example, we show that assimilating a denser observational network in the Sahel has a large impact on the reliability of the 20CR. We also show that model biases in the teleconnections of regional rainfall and global SST hinder the simulation of correct rainfall anomalies. This is shown in the differences in skill displayed by the 20CR in the

Sahel and the Nordeste. In the case of the latter, skill is high throughout the record (independently of the paucity of early observations) because the model captures the correlation of Nordeste rainfall with the Atlantic gradient mode. In the case of the former, the correlation of Sahel rainfall with the Indian and Atlantic oceans SST is poorly captured, so that even if the inclusion of more observations is quite effective at constraining the 20CR, the skill only reaches values comparable to those of the best AMIP integrations (see attached figures showing the reliability of the 20CR for Nordeste and Sahel over the 20th century and the correlation patterns of regional rainfall for global SST during the same period).

Publications (list by category with full citation those in review, in press, and published within this reporting period)

Climatology and interannual variability of rainfall in the 20th century reanalysis. Don Eun Lee and Michela Biasutti. Submitted to Journal of Climate.

Seminars

Michela Biasutti presented this work as a webinar in the MAPP series.

Figures

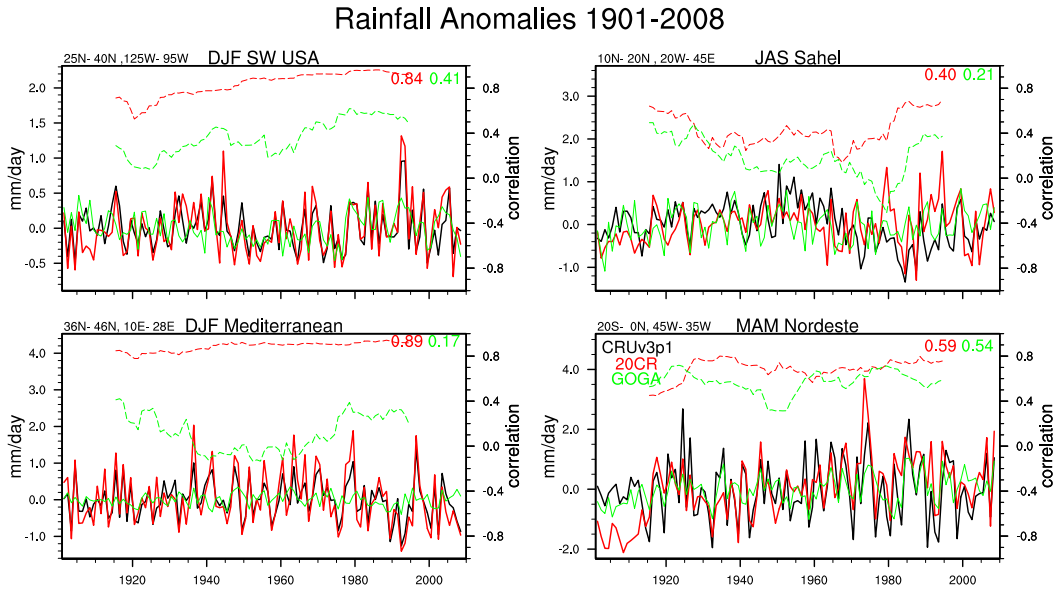

Figure 1: Time series of rainfall anomalies from 1901 to 2008, for (a) the Southwest USA in DJF, (b) the Sahel in JAS, (c) Mediterranean in DJF, and (d) the Northeast Brazil in MAM. CRUv3.1 is in black, 20CR in red and GOGA in green. Correlation coefficients of 20CR and GOGA with observations for sliding windows of 29 years are shown in dashed lines (red for 20CR and green for GOGA); the correlation values for the whole period are written on the top right of each panel, color-coded as in the rest.

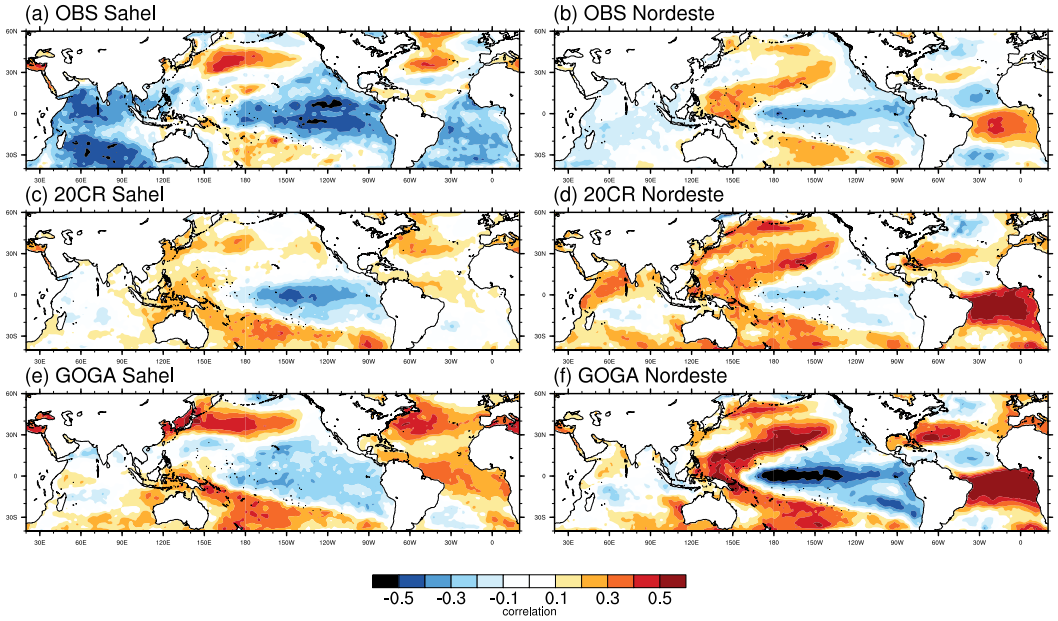

Figure 2 Correlation coefficients of SST anomalies against the rainfall indices of Sahel (20W-45E, 10N-20N), on the left, and of Nordeste (45W-35W, 20S-0) on the right, for observations (top), 20CR (middle), and GOGA (bottom).