The effect of freshwater discharge on Tropical Atlantic climate variability

First year activity of the 2010 ISSNAF fellowship

Stefano Materia

1. Introduction

Eastern Tropical Atlantic (ETA) collects a huge quantity of fresh water due to discharge from several rivers. The Congo river alone releases every year 1270 km$^3$ of freshwater into the Gulf of Guinea (GG, Weldeab et al., 2007), which is the second-largest flow in the world second only to the Amazon River. The aim of this study is to improve our understanding of the climate variability in Africa and Tropical Atlantic, accounting for the forcing represented by the continental freshwater discharge, often neglected in the majority of previous studies. Our main objective is to understand the feedbacks between freshwater discharge and atmospheric and ocean circulation in ETA.

The first stage of the study was performed on observations. Results indicate that feedback processes between sea surface temperature (SST), precipitation and river discharge play a role in affecting the interannual variability in the ETA region. Afterwards the same processes were investigated through numerical experiments, in order to evaluate their capability to reproduce the observed processes. Given the large biases affecting coupled general circulation models (GCMs), a restoring of the temperature profile along the coast was necessary to create improved ocean initial condition.

2. First year activity

My activity abroad is conducted at the National Center for Atmospheric Research (NCAR), Boulder, CO, supervised by Dr. Joseph Tribbia, while my Italian advisor is Dr. Antonio Navarra at Centro Euro-Mediterraneo per I Cambiamenti Climatici (CMCC), Bologna, Italy.

During the first year, I completed the work concerning the role of Congo freshwater discharge on ocean and climate variability in Western Africa, using data coming from observations and reanalyses. One paper has been submitted to “Climate Dynamics” and the authors are waiting for reviewer’s response.
In the meantime, I started the numerical experiments with the GCM developed at NCAR, the Community Earth System Model version 1 (CESM 1.0). The first part of the year was dedicated to the restoring of the simulated temperature profile along the coast of southwestern Africa, in order to correct the large biases affecting the majority of climate models. The correction worked very well, and many other atmospheric (precipitation, wind, etc.) and ocean (salinity, ocean currents, etc.) fields positively responded to temperature modification. These results lead to the preparation of another manuscript, which will soon be sent to a peer-reviewed journal.

In the last few months I outlined the experiments on Congo River. I am performing a series of ensemble experiments modifying the simulated river discharge. I intend to evaluate the capability of the model to reproduce the processes analysed through observation, and understand the physical causes of such processes. Model results and output analysis will be ready by the end of my first fellowship year, which is meant to be January 31st.

**Paper submitted**

**Paper in preparation**

**References**