Assessment of climate variability impacts on the Brazilian Large Marine Ecosystems using statistical analysis and regional ocean modeling

Helena Cachanhuk Soares, Douglas Gherardi and Luciano Ponzi Pezzi
National Institute for Space Research (INPE)/Remote Sensing Division (DSR)
helenacs@dsr.inpe.br

Abstract

Impacts of interannual climate variations on Brazilian Large Marine Ecosystems (LMEs) are investigated using total and partial correlations between climate indices and oceanic and atmospheric variables. Numerical experiments using ROMS will investigate the possible physical process behind the observed correlation patterns. Model results of a 15 years experiment with ROMS are shown.

Introduction

LMEs are units established for assessment and management of marine resources and have been defined based on differences in hydrographic regimes, bathymetry, productivity, and trophycally dependent populations (Sherman 1991, 1993). The impacts of climate variability on the Brazilian LMEs (Figure 2) depends on how the South Atlantic ocean is affected by local and remote climate forcings (Figure 1). Local influences are represented by the Tropical South Atlantic (TSA) and Tropical North Atlantic (TNA) indexes and remote influences are EL Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO) and Antarctic Oscillation (AAO). Simulations with ROMS will help understand the physical process likely to be involved in the impacts of climate variability along the LMEs. Here, model results of a 15 years experiment with ROMS are shown (Figure 4 and 5), together with some correlation maps (Figure 3) which will form the basis for specific experiments.

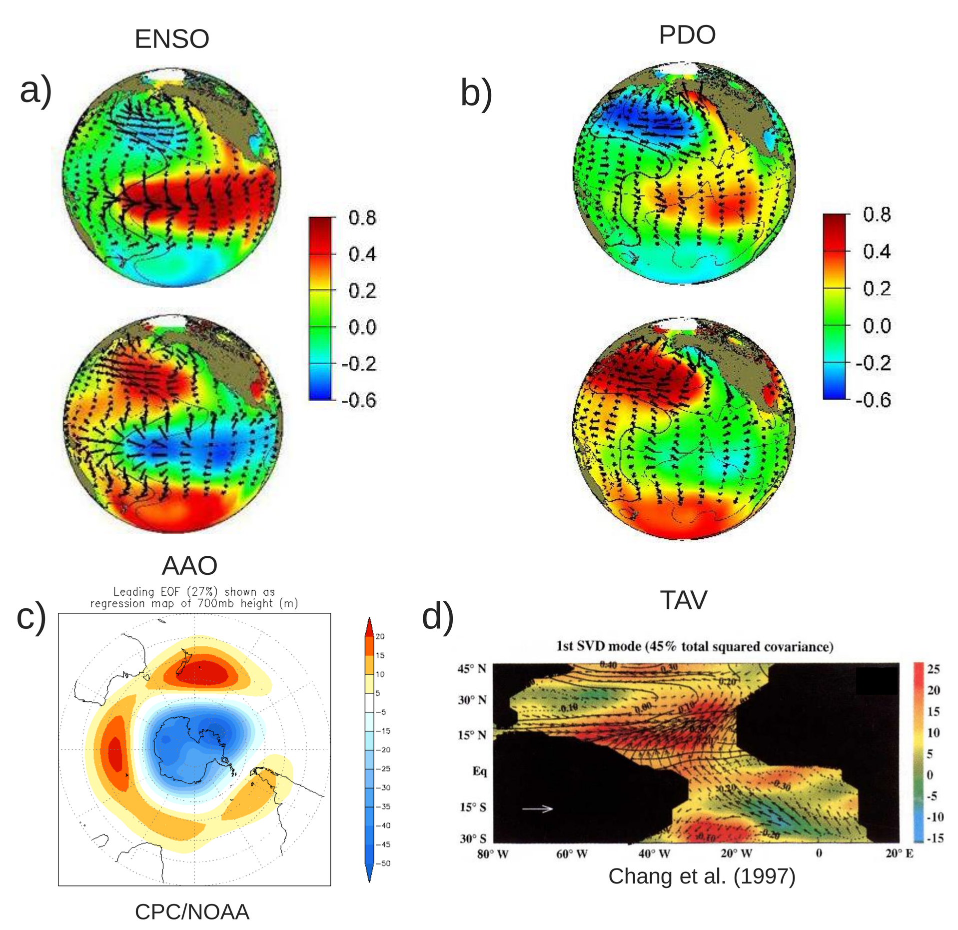

Figure 1. Climate variability modes: a) ENSO; b) PDO; c) Antartic Oscillation; d) Tropical Atlantic Variability

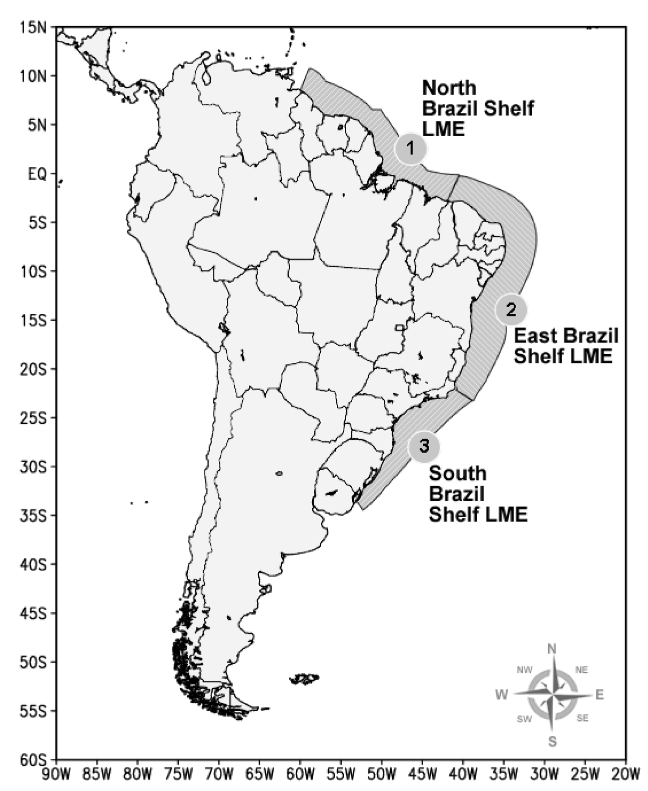

Figure 2. Brazilian Large Marine Ecossystems.

Methodology

Configuration:

- **Grid:** South Atlantic basin (10°N:75°S/70°W:25°E)
- **Spatial resolution**: 0.25°
- **Vertical levels:** 30
- **Atmopheric Forcing:** Climate Forecast System Reanalysis (CFSR) – NCEP (Saha et al. 2010)
- **Ocean Boundary Condition:** Simple Ocean Data Assimilation (SODA) (Carton and Giese, 2008)
- **Sea- Ice model component** (Budgell, 2005)

Planned Experiments:

- **Spin up experiment:** 15 years (1980-1995) (shown here).
- **Simulation for 1980-2008:** Comparing with satellite data: SST/AVHRR; SLH/AVISO) to evaluate whether the model is able to reproduce the South Atlantic oceanic variability
- **Sensibility tests:** Oceanic and atmospheric conditions related with climate index extremes (ENSO, TAV, AAO) will be applied as forcing for 2 years simullation
- **Biogeochemical model:** (Fennel et al. 2006) The aim it will be evaluate the effects of the climate variability on the biological productivity (phytoplankton and zooplankton) of Brazilian LME

Results

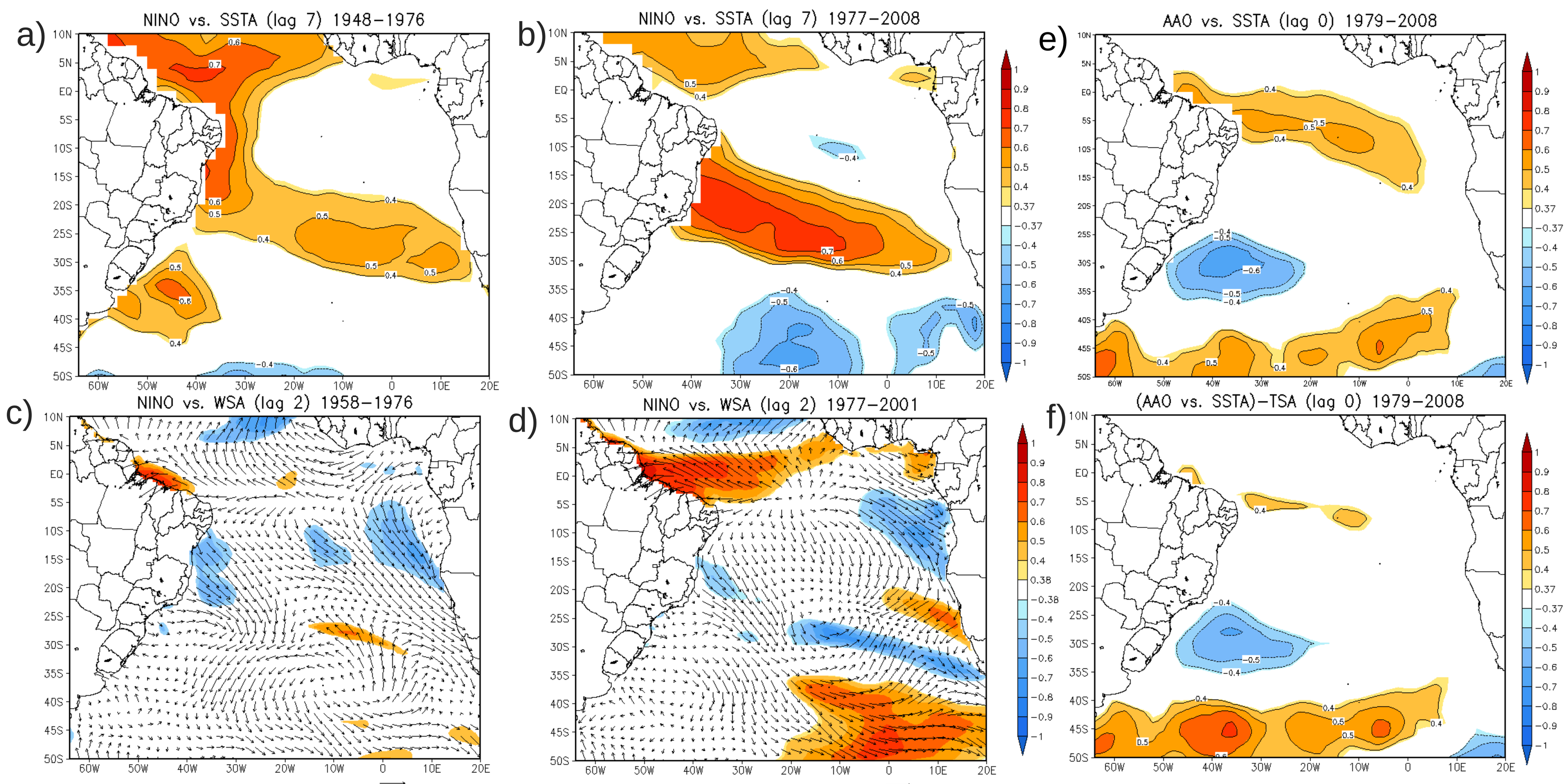

Figure 3. Correlations between: Niño and Sea Surface Temperature Anomaly (SSTA) for a) cold PDO; b) warm PDO phase. c) Niño and Wind Stress Anomaly (WSA) for: c) cold PDO (d) warm PDO. e) Correlations between AAO and SSTA. f) AAO and SSTA with exclusion of TSA

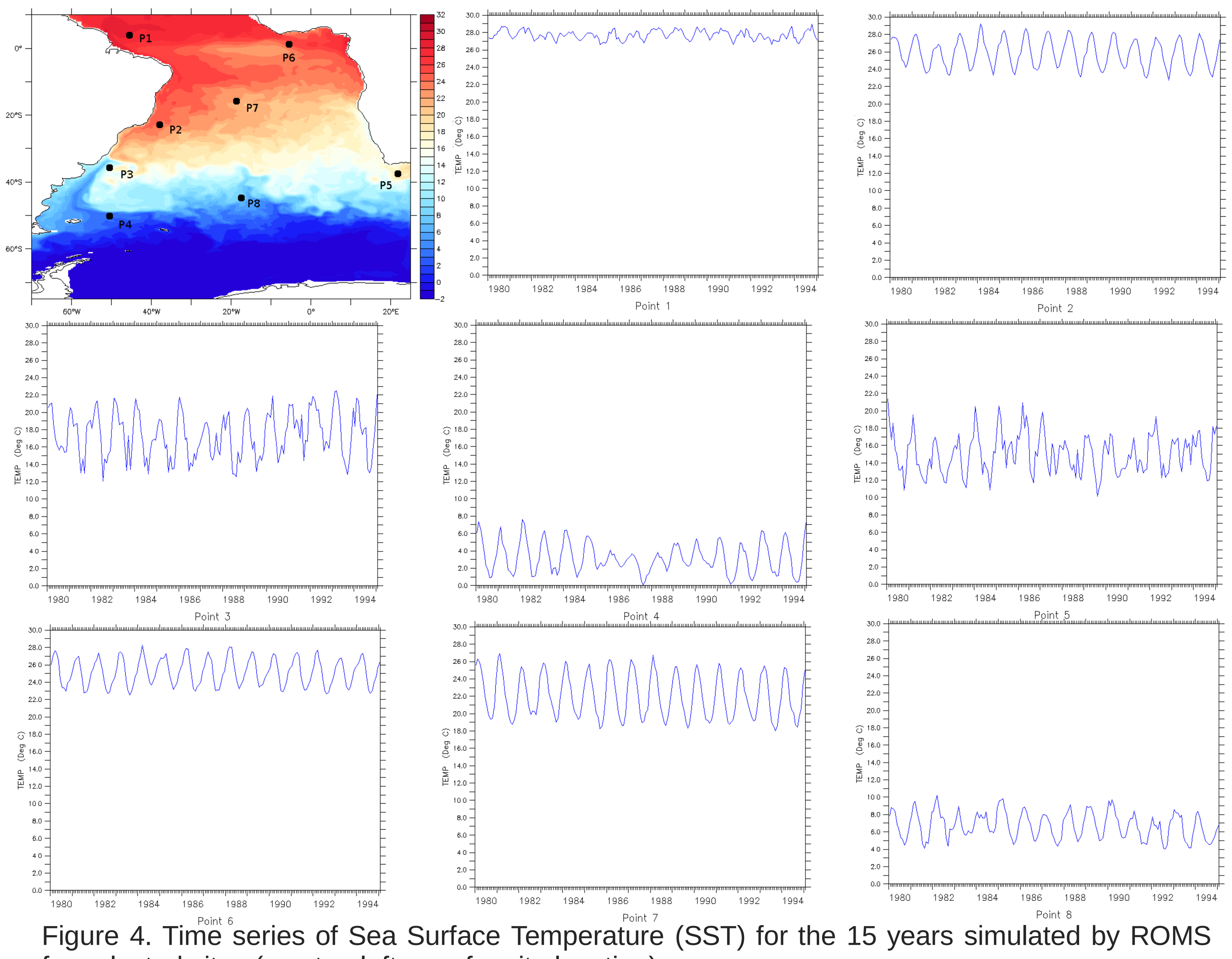

Figure 4. Time series of Sea Surface Temperature (SST) for the 15 years simulated by ROMS for selected sites (see top left map for site location).

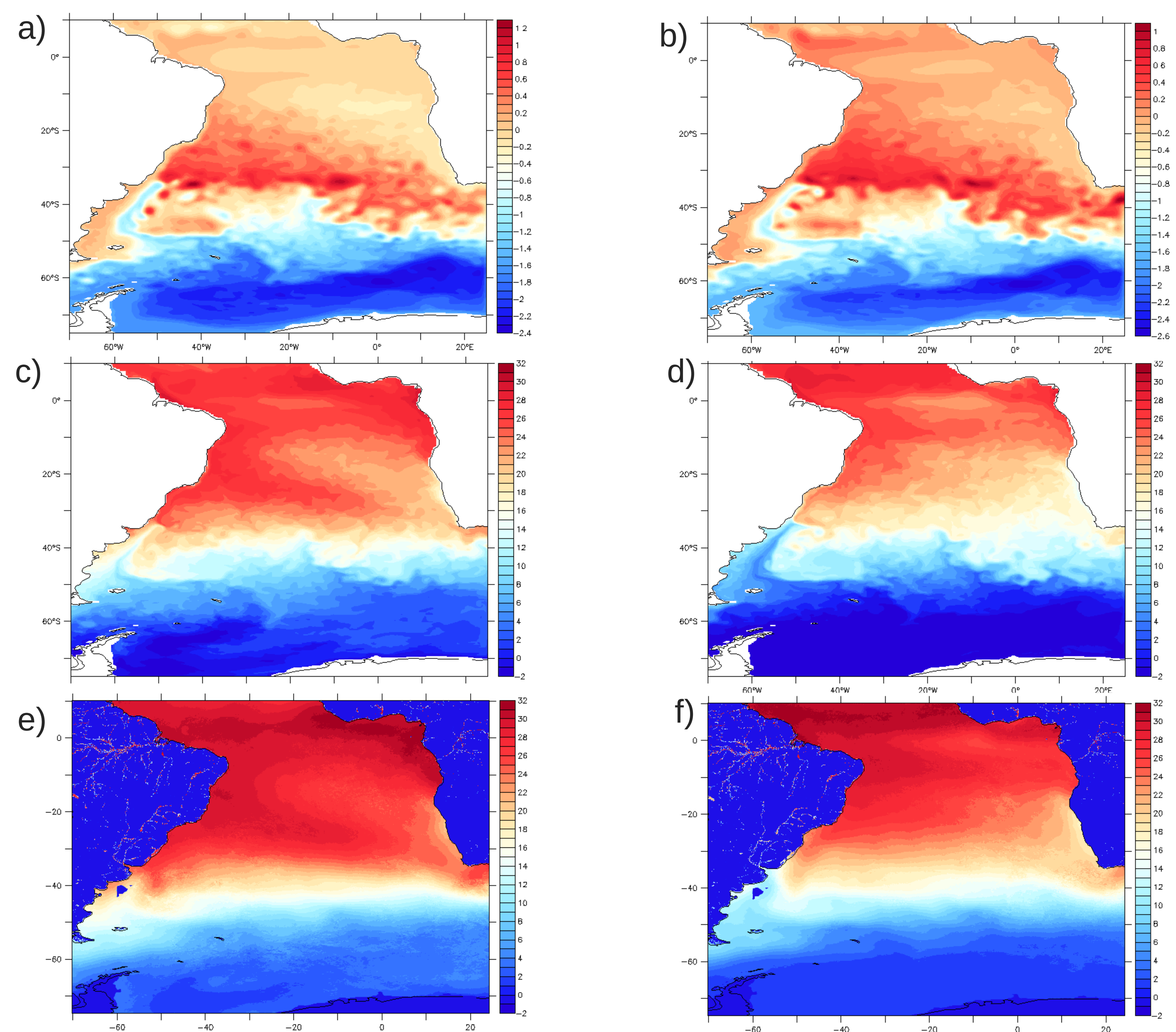

Figure 5. ROMS Sea Level Heigh for: a) Jan/1993; b) Jul/1993. ROMS Temperature for c) Jan/1993; d) Jul/1993; AVHRR SST for: e) Jan/1993; f) Jul/1993. Note the Brazil Malvinas confluence, the Subtropical Convergence Front and the North Brazil current meanders. The sazonal changes in SST compare very well with SST from AVHRR.

Conclusions

This initial analisys provide evidences that simulations with ROMS represent major South Atlantic oceanic features and the sazonal changes. The next step will be a statistical validation analisys with the results of a simulation between 1980-2008 initialized with the initial conditions generated in the spin up run.

Acknowledgments

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