THE MARINE BIOGEOCHEMICAL COMPONENT IN THE BRAZILIAN EARTH SYSTEM MODEL (BESM)

Helena Cachanhuk Soares[1] and Paulo Nobre

Center for Weather Forecast and Climate Studies (CPTEC) - National Institute for Space Research (INPE), Rodovia Presidente Dutra, km 40 SP/RJ, Cachoeira Paulista, SP 12630-970, Brazil.

1- helena.soares@cptec.inpe.br

Introduction

This work presents current developments on the marine biogeochemical component of the Brazilian Earth System Model (BESM). The BESM is a fully coupled global ocean-atmosphere-biosphere model described in Nobre et al (2013). The marine biogeochemical model that integrates the BESM is the Tracers of Ocean Phytoplankton with Allometric Zooplankton (TOPAZ) (Dunne et al. 2010; Dunne et al. 2013). The ocean dynamics in the BESM is reproduced by the GFDL/ NOAA Modular Ocean Model (MOM) version 5 and the CPTEC Atmospheric General Circulation Model (AGCM) represents the atmospheric dynamics. The results which are shown here were produced with the TOPAZ integrated with MOM5. The first results are from the configurations tests for the TOPAZ (Figure1). There is also a experiment to evaluate the effects of the removal of the rivers discharges on the ocean biogeochemical fields (Figure2).

Methodology

The experiments were run for one year with climatological atmospheric forcing. One is the GFDL test case for TOPAZ, another is a simulation with the configuration of Nobre et al. (2013) for MOM5 and the initial condition for the biogeochemical model are from World Ocean Atlas 2013 (WOA13) for concentrations of nitrate, phosphate, dissolved oxygen and silicate. The last experiment is similar, however with tides and geothermal heating activated.

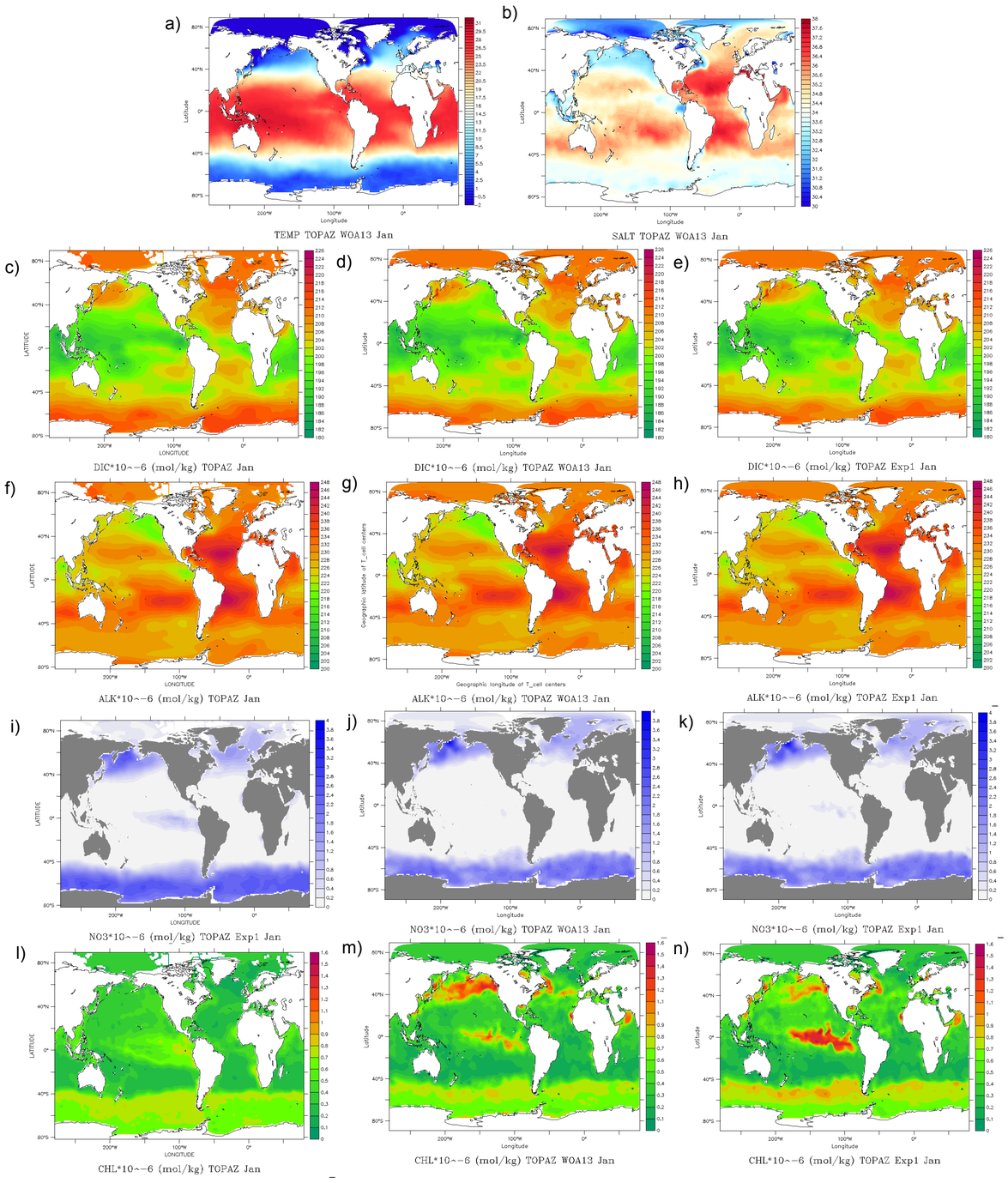

Figure 1 Fields reproduced by TOPAZ run with MOM5 for January for: a) Temperature and b) Salinity; c) Dissolved Inorganic Carbon (DIC) for GFDL Test case; d) DIC for WOA13 and configuration used in Nobre et al. (2013); e) DIC for Exp1: with tides and geothermal heating activated; f), g) and h) are the fields for alkalinity; i), j) and k) are the fields for nitrate concentration; l), m) and n) are the fields for chlorophyll concentration.

Results

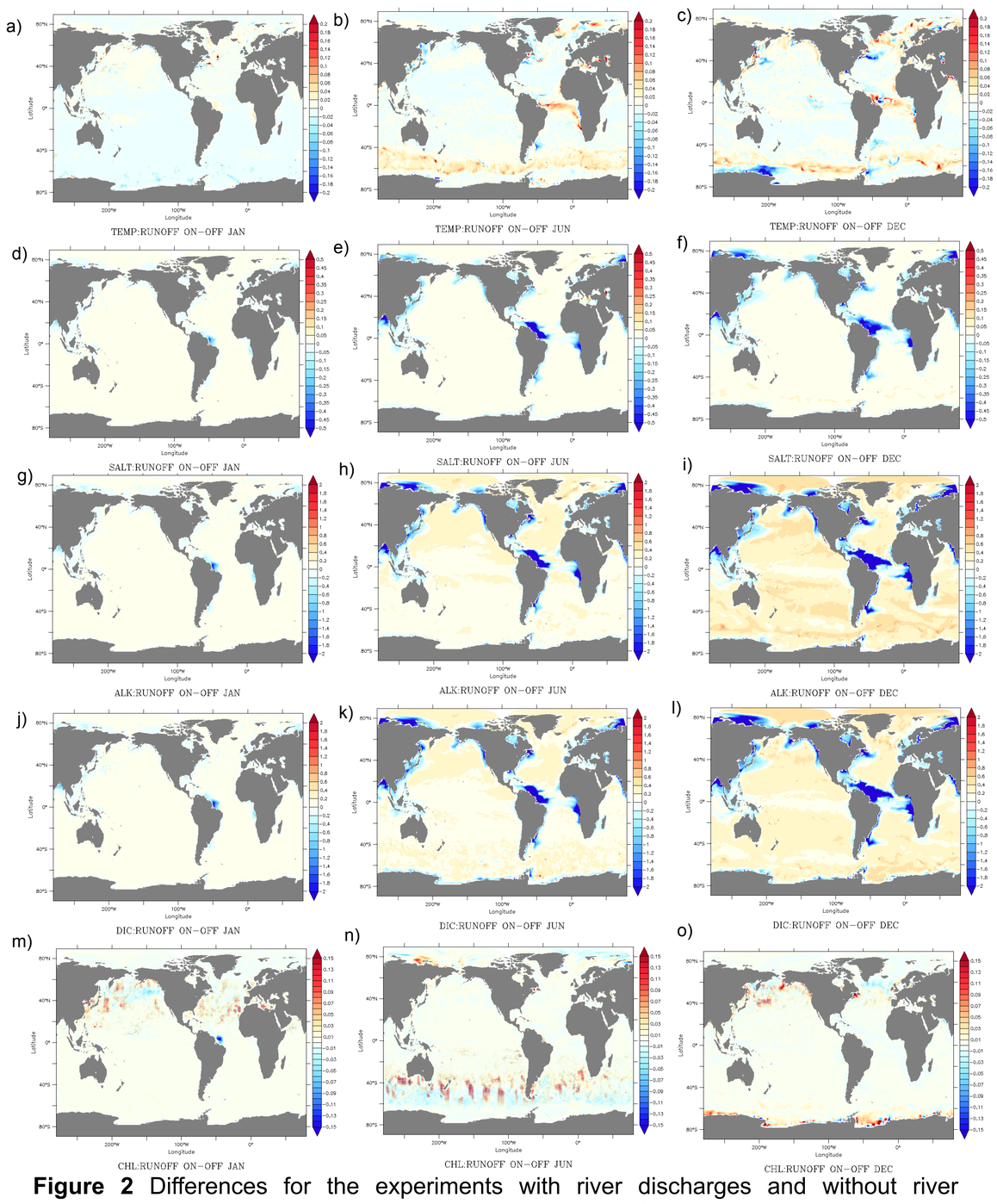

Figure 2 Differences for the experiments with river discharges and without river discharges for January, June and December for: temperature: a), b) and c); salinity: d), e) and f); alkalinity: g), h) and i); DIC: j), k) and l); and chlorophyll: m), n) and o); .

Conclusions and Future Developments

- The inclusion of tides and geothermal heating in the MOM5 configuration result in a better representation for the nutrients concentration;
- The river discharges affects directly the fields of alkalinity, DIC and Chlorophyll. The removal of river discharges cause an increase of alkalinity and DIC in the regions of discharge of the major global rivers;
- The next step for the work is to execute a simulation of spin up for TOPAZ (200 years) with MOM5 and validate the results;
- Experiments with the atmospheric model coupled to MOM5 will be performed to evaluate the impacts of increase of CO_2 on the biogeochemical fields and in the flux of CO_2 between ocean and atmosphere. Also the impact of the river discharges variability on the DIC distributions and in the ocean and atmosphere exchanges of CO_2 will be evaluated.

Acknowledgments

This work is a contribution of the Brazilian Model of the Global Climate System (BESM) funded by FAPESP Grant Number 2009/50528-6 and is also a contribution to REDE CLIMA. Helena C. Soares is funded by a REDE CLIMA fellowship from CNPq: 383774/2015-2.