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Simulating the tropical Atlantic air-sea CO2 exchange with a Regional high resolution ocean modeling system

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Recent assessments indicate that the oceans are responsible for the absorption of approximately 30% to 40% of excessive CO2 emitted by anthropic sources since the onset of the industrial revolution (Canadell et al., 2007; UNEP, 2009). Shall the current rates of emission be maintained, the concentrations of CO2 in the atmosphere will increase from 385 ppm in 2008 to 450-650 ppm by 2060, which would modify the average acidity of the ocean surface from 8.1 to 7.9–7.8 pH units (UNEP, 2009). To better assess this process, international programs are in place to monitor the evolution of seawater pCO2. Although the tropical Atlantic is a source of CO2 to the atmosphere, very little is known about the spatial and seasonal-interannual variability of the CO2 flux across the air-sea interface in this region. In this paper the Regional Ocean Model System (ROMS) coupled to the Pelagic Interaction Scheme for Carbon and Ecosystem Studies (PISCES) biogeochemical routines is used to simulate the seasonal cycle of the physical and biogeochemical parameters in the tropical Atlantic ocean (20°N-30°S) with an isotropic horizontal grid resolution of 1/12° including 40 vertical levels. Model results are compared with the oceanic and atmospheric pCO2 data obtained from the underway ship measurements made along two transects regularly sampled (France-Brazil and France-French Guiana), and from the CARIOCA sensors installed on two ATLAS buoys of the Prediction and Research moored Array in the Tropical Atlantic - PIRATA network (6°S-10°W and 8°N-38°W). Air-sea CO2 fluxes are then calculated using the Sweeney et al. (2007)′s formula for gas transfer velocities. Results illustrate the complexity of the space-time variability of the air-sea CO2 exchange in the tropical Atlantic, evidencing the need for expanding the observational pCO2 array in this region. The authors thank the Brazilian National Council of Scientific and Technological Development - CNPq under the scope of the Project BIO-NE (Grant 558143/2009-1).