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1 The oceanic CO_2 sink in the North Atlantic subpolar gyre: a focus on the CO_2 source anomaly in 2003

2 A. Corbière (1), N. Metzl (1), G. Reverdin (1), C. Brunet (1), D. Thuillier (1), M. Ramonet (2), T. Takahashi (3)

(1) Laboratoire d'Océanographie et du Climat: Expérimentations et Approches Numériques (LOCEAN/IPSL), Université Pierre et Marie Curie, Paris, France, (2) Laboratoire des Sciences du Climat et de l'Environnement (LSCE/IPSL), Gif/Yvette, France, (3) Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, USA (corbiere@ccr.jussieu.fr / Fax: +33 1 44 27 49 93 / Phone: +33 1 44 27 48 61)

The high latitudes of the North Atlantic Ocean, north of 50˚N, is believed to act as a strong ocean sink for atmospheric carbon dioxide, about -0.3 to -0.4 PgC/yr on average (*Takahashi et al.*, 2002). In this region it is expected that air-sea CO_2 flux is varying, modulated by large-scale climatic event such as North Atlantic Oscillation (NAO), through thermodynamics, wind speed, biological processes and ocean circulation changes. In this study, we chose to analyze the interannual variations of the sea surface dissolved inorganic carbon (DIC) and total alkalinity (TA) on the sector 53˚N-62˚N/45˚W-20˚W of the subpolar gyre over the period 1993-2004 (SURATLANT Program). We used these ocean properties to evaluate the sea surface ocean fugacity (fCO_2) and used wind-speed NCEP data to derive air-sea CO_2fluxes. In the investigated region, the DIC and TA concentrations appear relatively stable over eleven years indicating a balance between the vertical mixing, the increase of primary production and anthropogenic CO_2 uptake. On the other hand, the fCO_2increase appears faster in the ocean than in the atmosphere, resulting in a decrease of the oceanic carbon uptake. The ocean fCO_2 evolution is mainly related to sea surface warming, up to 1.5˚C since

1993. During the recent period (2001-2004), we also observed a dramatic change of the source/sink seasonality and as an extreme case, this region was acting as a CO_2 source during all seasons in 2003. In July 2003, the Ocean was at the equilibrium and in late summer the source was close to +1 mmol/m^2/d. This particular situation is explained, not only by the warming but also through large changes of biological processes as detected from Satellite chlorophyll-a distribution.

Takahashi, T., Sutherland, S C., Sweeney, C., Poisson, A., Metzl, N., Tilbrook, B., Bates, N., Wanninkhof, R., Feely, R.A., Sabine, C., Olafsson J., and Nojiri, Y. 2002. Global Sea-Air CO_2 Flux Based on Climatological Surface Ocean pCO_2, and Seasonal Biological and Temperature Effect. *Deep Sea Res. II*, **49**, 1601-1622.