Influence of Rossby waves on primary production from a coupled physical-biogeochemical model in the North Atlantic Ocean

Guillaume Charria, Isabelle Dadou and Véronique Garçon

Rossby waves appear to have a clear signature on surface chlorophyll concentrations which can be explained by a combination of vertical and horizontal mechanisms. In this study, we investigate the role of the different physical processes in the North Atlantic to explain the surface chlorophyll signature and the consequences on primary production, using a 3-D coupled physical (OPA)/biogeochemical model (NPZDDON) for the year 1998.

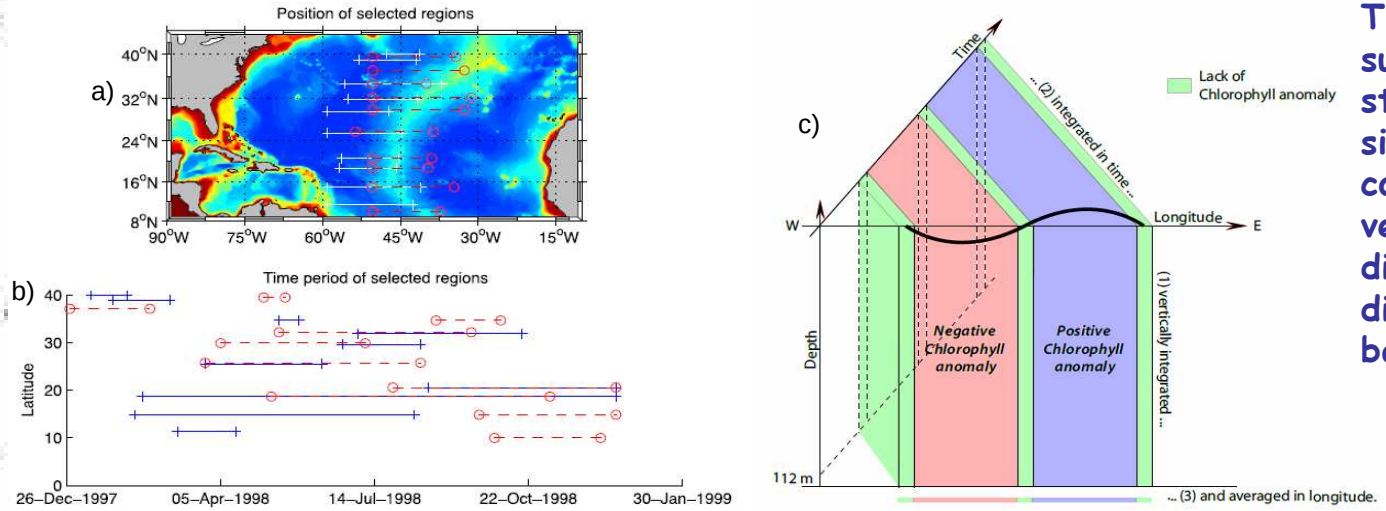

Figure 1: *a) and b) Position (white lines and red lines) of selected regions compared to the model bathymetry (a) and time extensions of these regions (b). Different colours are only used to distinguish regions around close latitudes and are similar in a and b. c) Description of the integration method along the chlorophyll anomalies (CA+, CA- and CA0).*

The analysis at 20 given latitudes, mainly in the subtropical gyre, where Rossby waves are strongly correlated with surface chlorophyll signature (Figure 1), shows the important contribution of horizontal advection and of vertical advection and diffusion of inorganic dissolved nitrogen. The main control mechanism differs according to the biogeochemical background conditions of the area.

The surface chlorophyll anomalies, induced by these physical mechanisms, have an impact on primary production. We estimate that Rossby waves induce, locally in space and time, increases and decreases in primary production, ~ ± 20% of the estimated background production (Figure 2). This symmetrical situation suggests a net weak effect of Rossby waves on primary production.

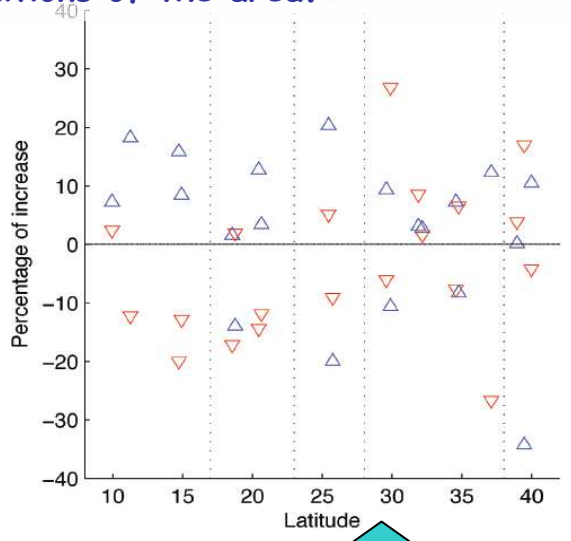

Figure 2: *Primary production increases (in %) following the latitude over the positive (CA+, blue △) and the negative (CA-, red chlorophyll anomalies. Quantities are integrated over the time period, 112 m depth and averaged in longitude. The percentage of increase is derived from the value for the lack of chlorophyll anomaly (CA0).*

Collaboration : Paolo Cipollini (NOCS, UK), Marie Drévillon (Mercator-Océan, France).
Charria et al., 2008, Ocean Sci, 4, 199-213.