



The influence of low frequency climate modes on chlorophyll dynamics at two North Atlantic subtropical ocean sites

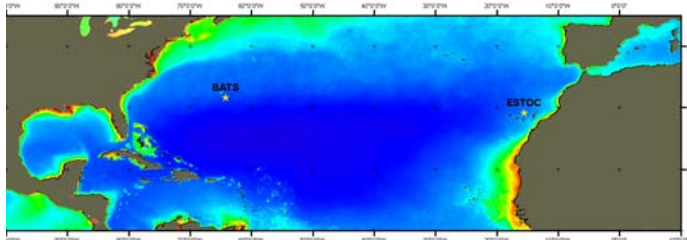


A. Cianca¹, J. M. Godoy¹, S. Neuer², J. P. Marrero¹, J. M. Martín³, M. J. Rueda¹ and O. Llinás⁴.
¹Instituto Canario de Ciencias Marinas (ICCM). ²Arizona State University (ASU). ³Las Palmas de Gran Canaria University (ULPGC). ⁴Plataforma Oceánica de Canarias (PLOCAN)
andres@iccm.rcanaria.es



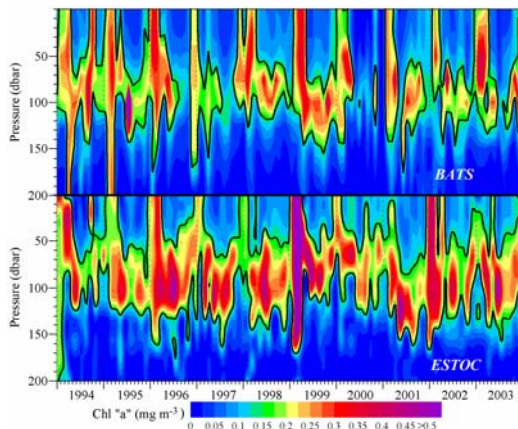
Paper Number: IT15L-10

BACKGROUND AND OBJECTIVES

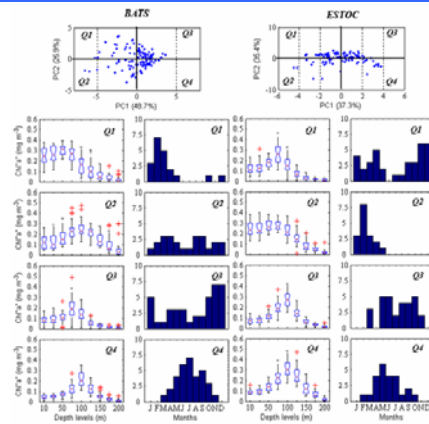


- The impact of low-frequency climate modes on the large scale variability of chlorophyll-a (a proxy for phytoplankton biomass) concentration in the subtropics is little known.
- We have examined the concurrent monthly chlorophyll-a and hydrographical records obtained from 1994 to 2003 at two subtropical time-series stations (Bermuda Atlantic Time-series Study, BATS and European Station for Time-series in the Ocean Canary Islands, ESTOC).
- This study has investigated if a potential correlation exists between the chlorophyll variability and large scale atmospheric oscillations.

CHLOROPHYLL "A" AND NITRATE TIME SERIES



Monthly climatology of Chl "a" at the two stations. The black line shows the limit of DCM in 0.5 mg m⁻³ Chl "a" isohaline. High interannual variability is observed during mixing and stratification periods. DCM vertical displacements are clearly observed which are likely influenced by nutrient availability.



Chl "a" sample classification by use of a Principal Component Analysis (PCA) with concentrations and depth levels as variables. The first two principal components explain most of the variance in the time-series. The box-plots represent the median and confidence intervals from each quadrant and its corresponding time histogram.

SUMMARY

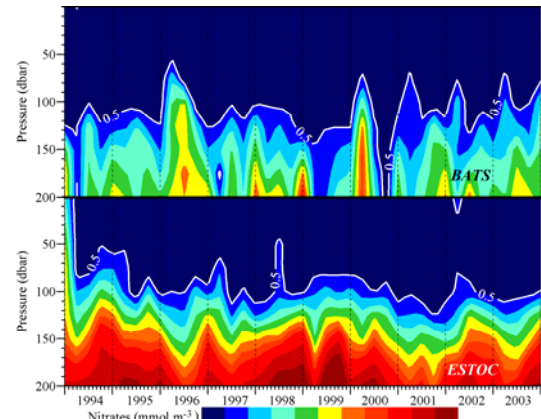
- A comparative analysis of two North Atlantic time-series stations (BATS and ESTOC) provide a unique insight into their chlorophyll dynamics and sensitivity to low frequency climate modes.

- Principal Component Analysis (PCA) has been used to classify the Chl "a" variability as a function of the concentration and the depth level. Two pictures are visible regarding the Chl "a" concentration in its vertical distribution. A near homogeneous layer from surface to 100 m observable during winter, and a clear deep chlorophyll maximum (DCM) centered at 100 m depth level along rest of year.

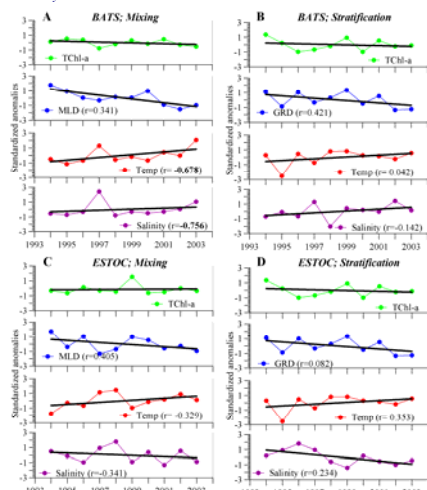
- Hydrography or nitrate availability were not the only responsible factors for the variations found. The interannual variability and some particular anomalous events produced several important deviations from the average.

- The scenarios proposed by Santana-Casiano et al. [2007] have been tested to link chlorophyll and hydrographic dynamics during two periods (mixing and stratification). Colder and fresher waters with deeper MLD caused mostly positive TChl-a anomalies (higher TChl-a values). The inverse relationship between temperature and salinity occurred mostly during the stratification, and the TChl-a responses were mostly negative (lower TChl-a anomalies).

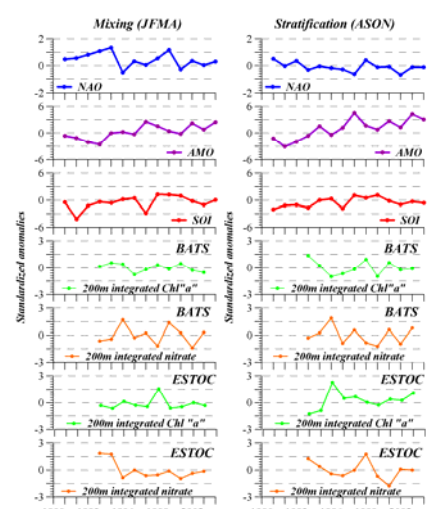
- Correlations of TChl-a with temperature and salinity anomalies were statistically significant at BATS during the mixing period. Correlations with statistical significance were found between TChl-a and low frequency Climate Modes for BATS (NAO) and ESTOC (ENSO) both with +1 year time lag. High TChl-a events are notable in the time-series; one at BATS caused by the passage of a mesoscale feature during summer 1995 and the other at ESTOC in winter 1999; this strongest anomalous event (around 200% increase) observed so far during the time-series and clearly related with a 1 yr lag to ENSO.



Monthly climatology of nitrate + nitrite at the two stations. The white line shows the nitracline estimated from the position of the 0.5 mmol m⁻³ nitrate + nitrite isopleth. The nitracline vertical movements are clearly influenced by the upper layers of the main thermocline.



Yearly anomalies of Temperature, Salinity and MLD computed from the annual maximum MLD value and TChl-a anomaly computed from the 4-monthly averages. Pearson coefficient r of the correlations between TChl-a anomalies and temp., salinity or MLD anomalies, correlations with p<0.05 are in boldface



NAO - North Atlantic Oscillation; AMO - Atlantic Multidecadal Oscillation; SOI - Southern Oscillation Index.

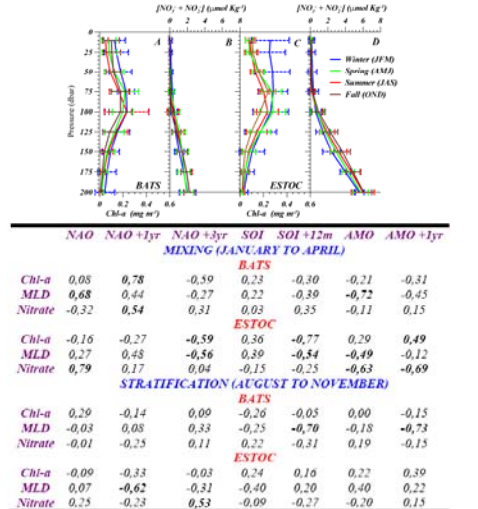


Table. Correlation between total integrated Chl-a, 200 m integrated Nitrate, MLD, GRD and the respective indexes regarding the atmospheric low frequency modes, computed from 4-monthly averages. Correlations with p<0.05 are in boldface.