Intercomparison of Biogeochemical Properties at Atlantic and Pacific Observatory Sites Using Ocean Data and a PARADIGM Model

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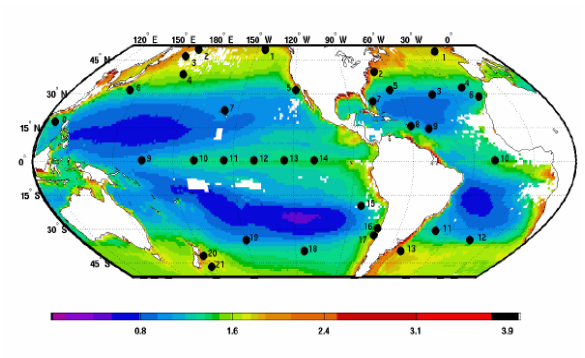
Introduction

Using remote sensing and in situ data (*data*), as well as output from a PARADIGM model (*model*) we compare 34 locations in the Atlantic and Pacific Oceans with respect to key upper ocean ecological and biogeochemical variables during the SeaWiFS era (1997-2004). Our purpose is to examine differences among the sites with respect to the seasonal cycles of key variables and identify factors contributing to seasonal variability. In addition, we use the model to investigate interannual variability.

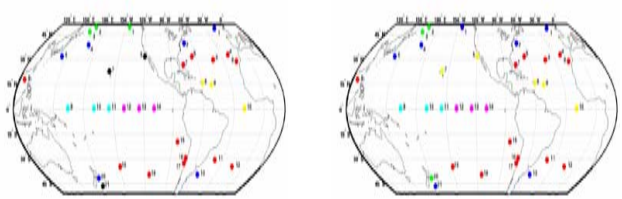
The ecological regimes in which observatory sites are located are shown by SeaWiFS mean chlorophyll: low chlorophyll ocean gyres, comparatively high chlorophyll ocean margin waters and equatorial upwelling systems, and high concentration ~40° to 50° N/S latitude belts.



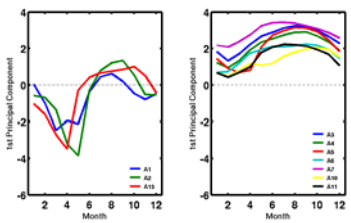
Mean Seasonal Cycles

Mean seasonal cycles were compared using Principal Component Analyses of temperature, salinity, chlorophyll, mixed layer depth, diffuse attenuation coefficient for downwelling PAR, K_{PAR} (400-700 nm), and nitrate to identify sites with similar patterns of variability. The first 3 PCs explain 85% of the variance for both *data* and *model*. Chlorophyll, K_{PAR}, N, S, and T contributed the highest weights to PC1. Nitrate had higher weighting in the *model* than K_{PAR}. MLD contributed the most to PC2.

Groups were identified based on similar seasonal cycles of PCs. *Data* PCs 1 and 2 separate the sites into 7 (left) and 6 (right) groups, respectively (as identified by the same symbol color). Sites P5, P7 and P21 do not fit well with other groups for PC1, while sites P1 and P20 change groups between PC1 and PC2.

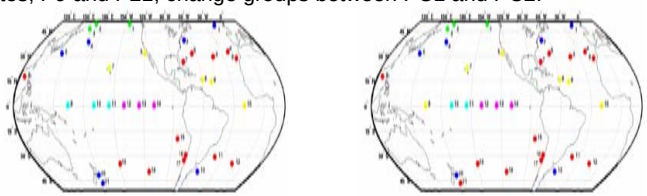


High latitude sites have large PC1 amplitude seasonal cycles with rapid spring property increases (left). Subtropical gyre sites have lower amplitude seasonal cycles (right).



Amplitudes for Southern Hemisphere sites were lagged by 6 months.

Six groups were identified for *model* PCs 1 (left) and 2 (right). Two sites, P9 and P21, change groups between PC1 and PC2.



Conclusions

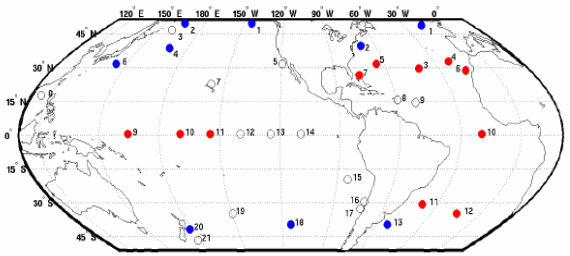
Our analyses show that current and proposed Atlantic observatory sites show 3 fundamental patterns based on mean seasonal cycles of hydrographic and some biogeochemical characteristics.

Pacific sites show same 3 patterns as Atlantic sites with 3 additional patterns required to describe high latitude North Pacific and eastern and western equatorial waters.

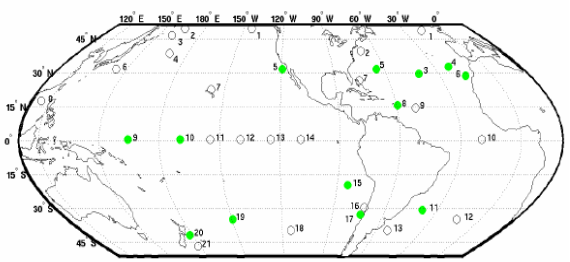
Model and SeaWiFS chl deviations are correlated in subtropical North Atlantic and western equatorial Pacific waters where *model* MLD and nitrate deviations as well as *model* MLD and chl are correlated.

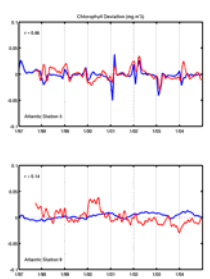
Interannual Variability

Time series deviations (from annual means) of key variables were examined to study interannual variability. In the Atlantic, with the exception of tropical sites (A8 and A9), *model* MLD and nitrate deviations are correlated (r>0.5, blue and red dots). However, less than half of the Pacific sites show significant correlations between *model* MLD and nitrate deviations (western equatorial and 6 of 11 sites poleward of 30°).Only the subtropical gyre sites in the Atlantic and western equatorial sites in the Pacific (red dots) show significant correlations between *model* MLD and Chl deviations.



Model Chl and SeaWiFS Chl deviations are correlated (r>0.5, green dots) throughout the North Atlantic subtropical gyre (e.g. A3, time series below left) and in the western Equatorial Pacific (e.g. P9, below right). Deviations at high latitude sites are uncorrelated in both the Atlantic and Pacific.





Chl devations are also uncorrelated in the tropical Atlantic and Eastern Equatorial Pacific. The model under predicts Chl deviations in the tropical Atlantic (A9, left) and over predicts Chl deviations in the eastern equatorial Pacific (P13, right).