Bioinformatic Mapping of Ocean Biogeochemical Provinces

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Introduction
In 1998, Alan Longhurst introduced the concept of biogeochemical "provinces" in the oceans (Longhurst, 1998). Since then, various approaches have been presented and implemented to map ocean biogeochemical provinces. These approaches include empirical analysis of satellite data, numerical modeling of processes, and rapid prototyping of algorithms. This overview provides a bioinformatic approach that aims to objectively and statistically determine the spatial distribution of biogeochemical provinces and their interactions.

Approach
Using bioinformatic approaches, such as objective detection of water masses on continental shelves, multifaceted methods can be applied to objectively define the space and time domain of biogeochemical provinces. These approaches include the use of bioinformatic algorithms to objectively classify biogeochemical provinces in the global ocean.

Case Study: Mid-Atlantic Bight
Along with climatological chlorophyll values from the CZCS sensor and absorption measurements, the Longhurst approach is used to approximate the temperature and salinity profile of the mid-layer depth, Brunt-Väisälä frequency, and the surface current fields. While all of these parameters are relevant to varying degrees, the degree of autocorrelation between these parameters is significant. For example, the layers in the Atlantic have a significant relationship with the surface current fields. Therefore, the space-time series of satellite data are used to objectively define the spatial distribution of biogeochemical provinces in the Mid-Atlantic Bight.

Figure of Merit
The figure of merit is used to objectively classify the biogeochemical provinces. The figure of merit is used to objectively classify the biogeochemical provinces and their interactions. The figure of merit is defined as the number of clusters divided by the number of pixels.

Cluster Analysis
Cluster analysis is used to objectively classify the biogeochemical provinces. The figure of merit is used to objectively classify the biogeochemical provinces and their interactions. The figure of merit is defined as the number of clusters divided by the number of pixels.

Validation of Boundaries
The figure of merit is used to objectively classify the biogeochemical provinces. The figure of merit is used to objectively classify the biogeochemical provinces and their interactions. The figure of merit is defined as the number of clusters divided by the number of pixels.

Conclusions
In our regional analysis described above, we believe that we have a solution for the major obstacles that must be resolved before a comprehensive objective elucidation of biogeochemical provinces can be employed by:

1. Using the available SST and ocean color products.
2. Developing a comprehensive objective detection algorithm for biogeochemical provinces, including an objective detection algorithm for biogeochemical provinces, and their interactions.

References

Figure 1: Flowchart of the analysis. The clustering methods at the top of the analysis include unsupervised K-means clustering, supervised clustering, and hierarchical clustering. The analysis methods at the bottom of the analysis include the figure of merit and the clustering of the provinces.