A 10 year long time series of SeaWiFS data shows spatial and temporal variability of phytoplankton blooms in the Scotia Sea region

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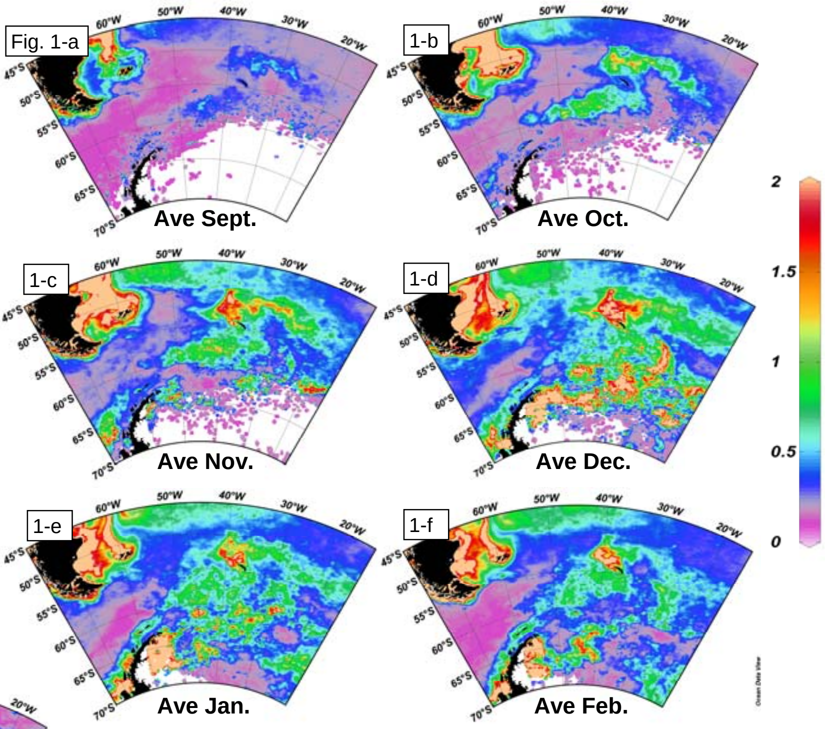
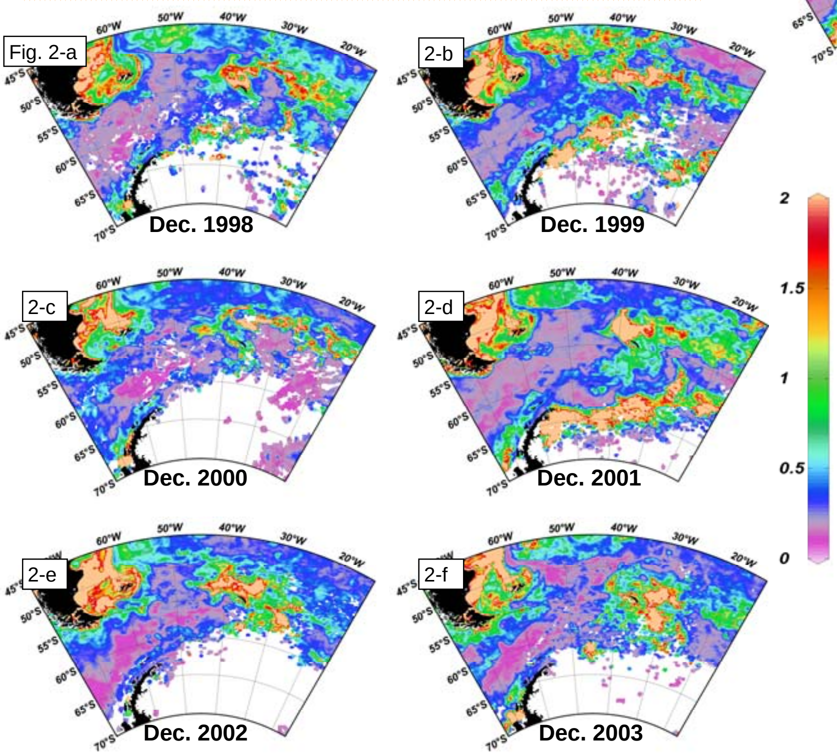
Introduction

The Scotia Sea is a High Nutrient Low Chlorophyll region experiencing intense summer phytoplankton blooms. The average depth is greater than 2000m with a complex bathymetry due to ridges, plateaus and islands. The ACC flows through the region carrying a uniquely high nutrient content. Continental shelves may supply the current with iron, thus enhancing spring and summer primary productivity. A synoptic study of such a vast region is possible only via satellite imagery, although winter low solar elevation does not allow measurements between April and July.

Methods

SeaWiFS estimates of surface Chl-a were obtained from the Goddard Distributed Active Center. Level-3, monthly composites at 9 km resolution were retrieved for the period between January 1998 and December 2007. Each monthly Chl-a image was combined into a climatological average to study seasonal and inter-annual variability. Available data were elaborated with NCO software and displayed with Ocean Data View.





Seasonal variability

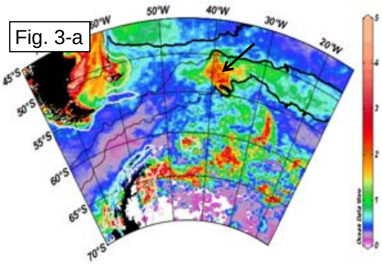
Figures 1(a-f): Climatological average of September to February. The sequence of images indicate a clear seasonal evolution of blooms in the Scotia Sea regions. Chl-a concentrations start increasing in austral spring especially along shallower bathymetries. Maximum concentrations and bloom extensions are reached in Austral summer (Dec./Jan). *Units are mg/m^3.*

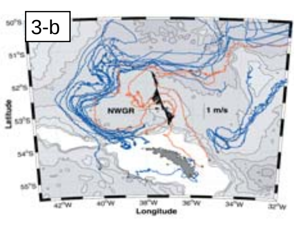
Inter-annual variability

Figures 2(a-f): Chl-a monthly composites of December from 1998 to 2003. The comparison of the 6 images show strong inter-annual variability, especially close to island ecosystem, along shelf regions, and the marginal ice zone. In white are missing values due to clouds and/or sea-ice cover. *Units are mg/m^3.*

Bloom controlling factors

Figure 3.a Climatological average of December. SST and 500m bathymetry contours. Aqua-MODIS derived SST contours (black solid line) confine the plume extending east of the South Georgia island. The western limit and the shape of the intense bloom (arrow) appears to be regulated by circulation patterns as shown by trajectories of deployed surface drifters (**Figure 3.b** as from Meredith *et al.* (2003) GRL, vol. 30, n. 20). The 500m bathymetry contour (white solid line in Fig. 3-a) limits the extension of the Argentine (Chl-a > 4mg/m^3) Antarctic Peninsula bloom. *Units are mg/m^3*





Conclusions

A 10-year long time series of Ocean Color Data in the Scotia Sea shows inter-annual variability, especially close to coastal and island ecosystems.

Cloud cover, sea ice extent, and low solar elevation limit data coverage so that analysis of satellite images needs to be limited to Austral spring and summer.

Seasonal productivity increases in Aug/Sept reaching its maximum extent and intensity in December.

Little inter-annual variability is found upstream the Drake Passage, east of the South Sandwich Islands, and in the region surrounding the Shackelton Fracture Zone where productivity is kept low.

SST contours, shelf regions and circulation patterns may control bloom extension and distribution.