



Distribution and recurrence of phytoplankton blooms around South Georgia, Southern Ocean

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South Georgia phytoplankton blooms are amongst the largest of the Southern Ocean and are associated with a rich ecosystem and strong atmospheric carbon drawdown. Both aspects depend on the intensity of blooms, but also on their regularity. Here we use data from a 12 year-long time series of satellite ocean colour imagery and calculate the frequency of bloom occurrence to examine spatial and temporal bloom distributions; we also use satellite altimetry to examine how bloom distributions relate to local circulation. We find that upstream of the island and outside the borders of the Georgia Basin phytoplankton blooms were rare, occurring in less than 4 out of the 12 years. In contrast, to the north and northwest of the island (i.e. downstream) blooms occurred in at least 8 out of the 12 years, and in places blooms occurred every year, indicating high predictability. The Typical Bloom Area (TBA, ~ 145000 square km), defined as the region where blooms occurred in at least 8 out of the 12 years, covers the entire Georgia Basin and the northern shelf of the island and shows reduced spatial variability most likely because local circulation is strongly constrained by bottom topography. The time series of surface Chlorophyll-a concentrations averaged over the TBA shows that phytoplankton blooms occurred in every year between September 1997 and September 2010, and that Chlorophyll-a values followed a regular seasonal cycle, with concentration peaks around December followed in many years by a second peak between late January and April, suggesting a bimodal bloom pattern. The bloom regularity we describe here is in line with other sub-Antarctic islands, i.e. those of the Kerguelen or Crozet plateaus, where shelf-sediment interactions and local circulation provide a reliable annual supply of iron to the bloom region. Our results, however, are in contrast with a previous study that considered a significantly different study area around South Georgia.