Satellite-derived Chl Anomalies and Their Relationship to Nutrient Sources in Queensland Continental Shelf Waters

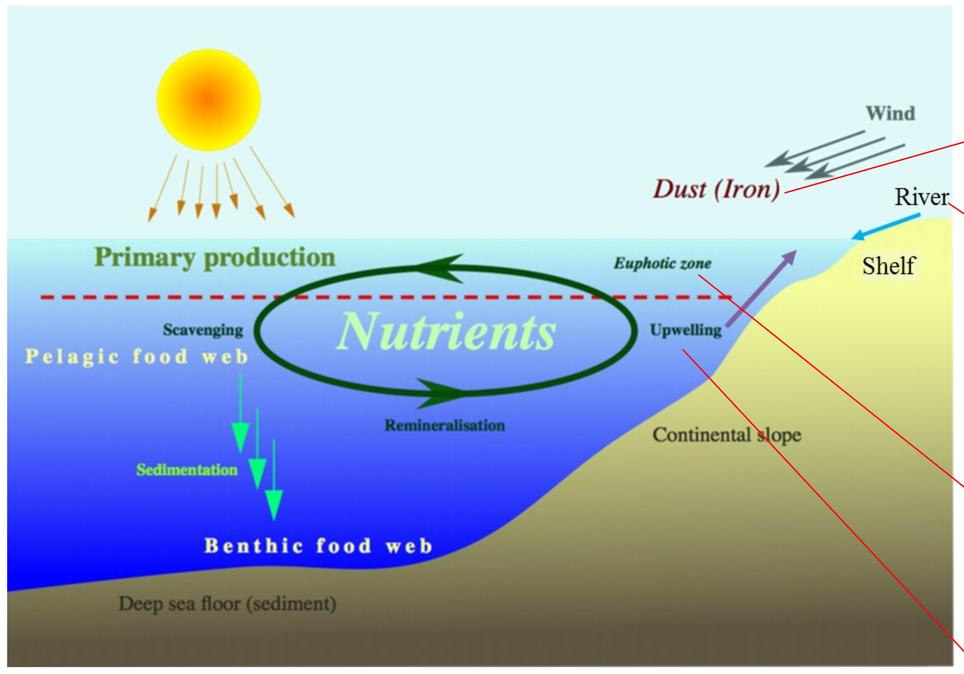
Dien V. Tran, Albert Gabric, and Roger Cropp

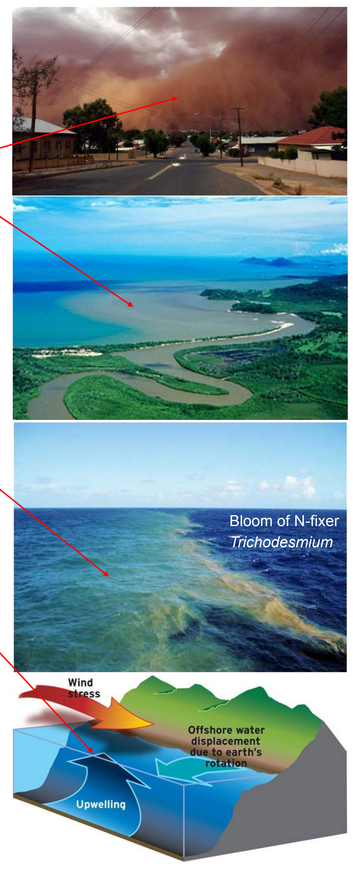
Griffith School of Environment, Griffith University, Brisbane - AUSTRALIA

Griffith UNIVERSITY
GRIFFITH SCHOOL OF ENVIRONMENT
Australian Rivers Institute

Introduction

Eutrophication of coastal water bodies is a global problem. Inshore regions of the central and southern Great Barrier Reef (GBR) are at risk of impacts from increased nutrient loads. Fluvial discharge is a primary source of nutrients for algae growth in the GBR lagoon. Upwelling and biological nitrogen fixation are other sources of new nutrients. Aeolian mineral dust input is a critical source of dissolved iron (dFe) for growth of some important species of phytoplankton such as N-fixing cyanobacteria. However, research on aeolian dust delivery of nutrients in Australia has been very limited. There is a current lack of knowledge on the relative importance of each nutrient source.





Major nutrient sources (Aeolian dust deposition, fluvial discharge, biological N-fixation, and upwelling) in Queensland continental shelf waters and nutrient cycle in coastal ocean (modified from Wikipedia's Free Online Textbook "Basic Ecology")

The study area - Queensland continental shelf consists the GBR and waters from Fraser Island to the Gold Coast. Major dust source area is Lake Eyre basin in western Queensland

Objectives

1) Examine the relationship between satellite-derived Chl anomalies and fluvial discharge and dust deposition in Queensland continental shelf waters .

2) Examine the spatial relationship between Chl, sea surface temperature (SST) and sea wind stress as evidence of upwelling.

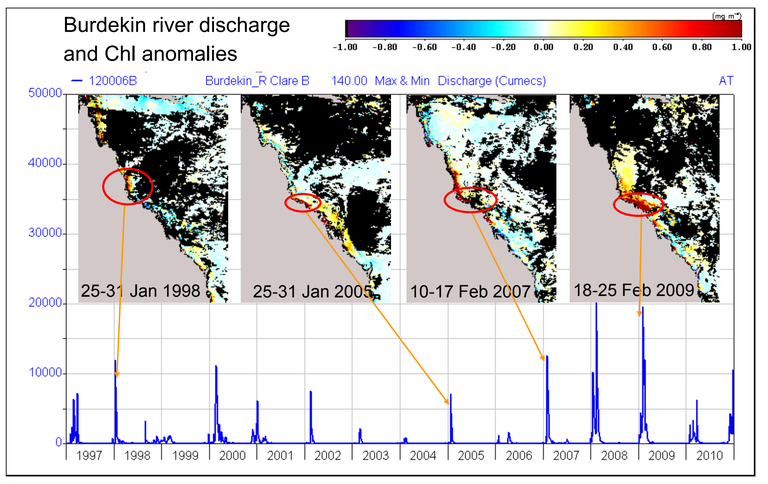
Approach

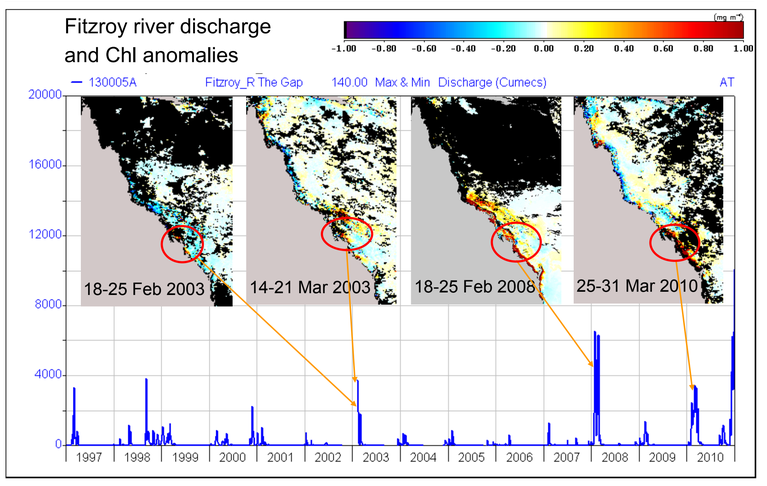
SeaWiFS-derived Chl and MODIS-derived Chl and SST data were acquired from the NASA Ocean Color Data Archive. An 8-day Chl climatology was computed by averaging 8-day binned Chl for the whole SeaWiFS mission (1997-2010). The Chl anomaly for a specific octad was computed by simple subtraction from Chl climatological value. Fluvial discharge data was acquired from the Water Monitoring Data Portal, Department of Environment and Resource Management, Queensland Government. Data plots of fluvial discharge of Burdekin and Fitzroy river during 1997-2010 were examined and compared with Chl anomalies to identify the relationship between Chl anomaly and peak of fluvial discharge. Chl anomalies after dust storm events in October 2002 and September 2009 were examined to detect any relationship between dust deposition of dFe and algal response.

Results

Chl Anomalies and Riverine Discharge

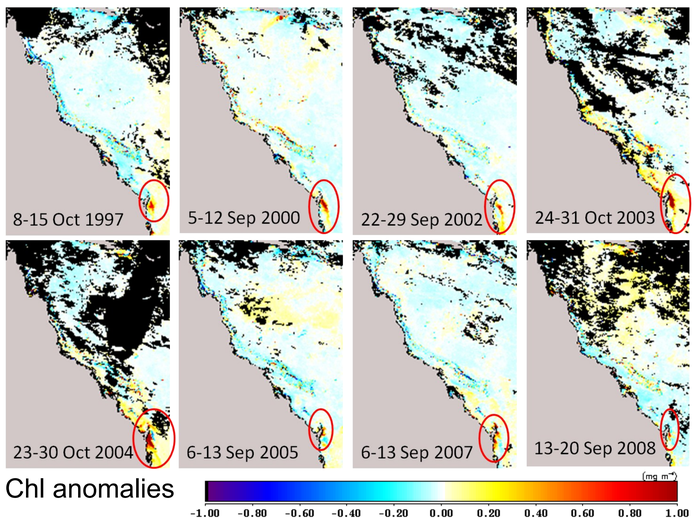
Unusual positive Chl anomalies have been observed in the near-shore areas of the northern, central and southern areas of the GBR lagoon during wet seasons in 1997, 2003, 2005, 2007, 2008, 2009, 2010 which were closely related to peak of fluvial discharge. These unusual positive anomalies may caused by enrichment of nutrients and sediment from terrestrial source as a result of river discharge.



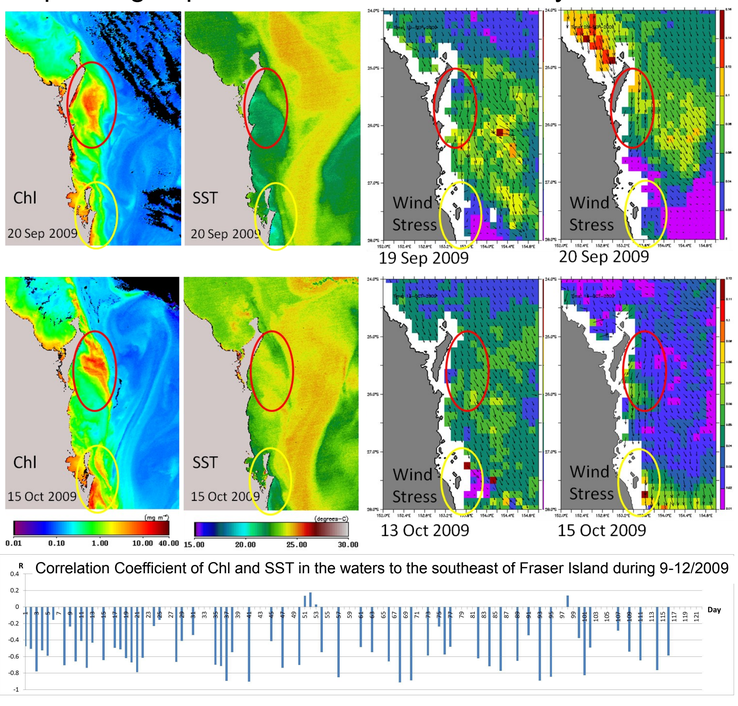


Chl Anomalies and Upwelling

From September to November in 1997, 2000, 2002, 2003, 2004. 2005, 2007, 2008, 2009, there were strong positive Chl anomalies in the waters from Fraser Island to the Gold Coast. This may be due to seasonal upwelling at the continental shelf margin.

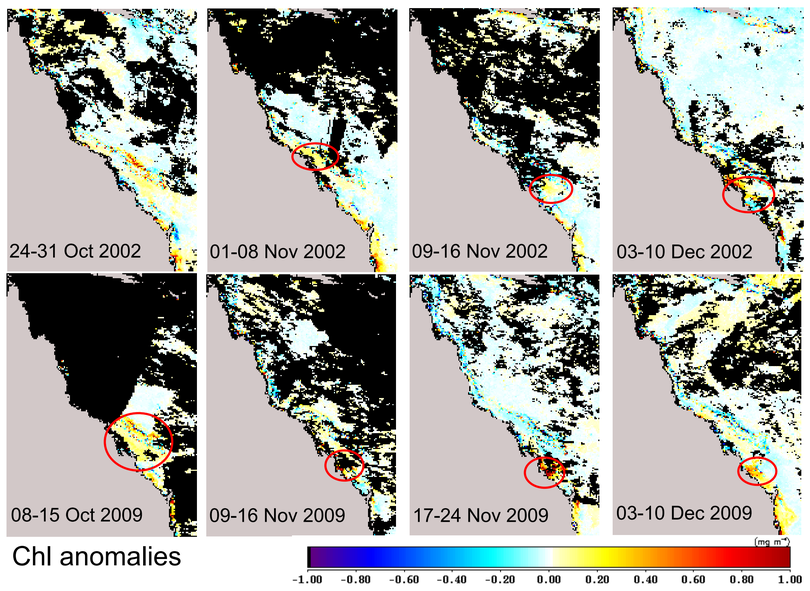


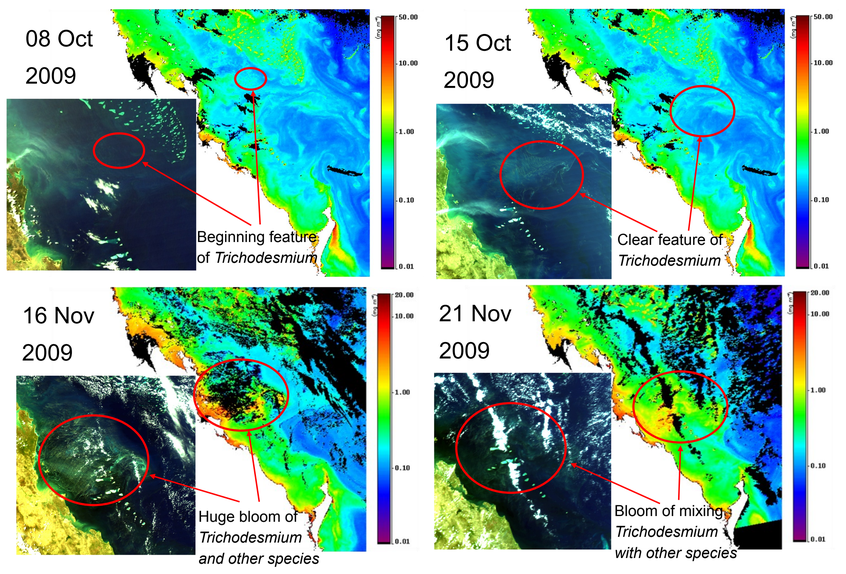
Spatial distribution of MODIS A-derived Chl and SST from 1 September to 31 December 2009 at 1 km resolution and surface wind stress was examined. There was a clear spatial correlation between high Chl and low SST. This provides evidence of upwelling along the shelf break east of Fraser Island and Stradbroke Islands corresponding to periods of consistent northerly winds.



Chl Anomalies and Aeolian Dust Deposition

Major dust storm events occurred during October 2002 and September 2009 in Eastern Australian. There were positive Chl anomalies in the central and southern areas of the GBR lagoon from November to December in 2002 and October to December in 2009 extending over large areas and up to a hundred kilometers offshore. These Chl anomalies may be related to micro-nutrient (dFe) enrichment by dust deposition. True colour imagery provides evidence of blooms of nitrogen fixers such as *Trichodesmium*.





Major Conclusions

There were complex influences of various nutrient sources on marine primary production and algal bloom in Queensland continental shelf waters. The significant positive Chl anomalies which have been observed from satellite-derived 8-day Chl anomaly, were related to fluvial discharge, upwelling and aeolian dust deposition. Further analysis should be conducted to quantify the relationship of Chl anomalies with each nutrient source.