Earth Information Day 2022

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Enhanced Ocean Carbon Sinks Triggered by Climate Change

Seen from the Space

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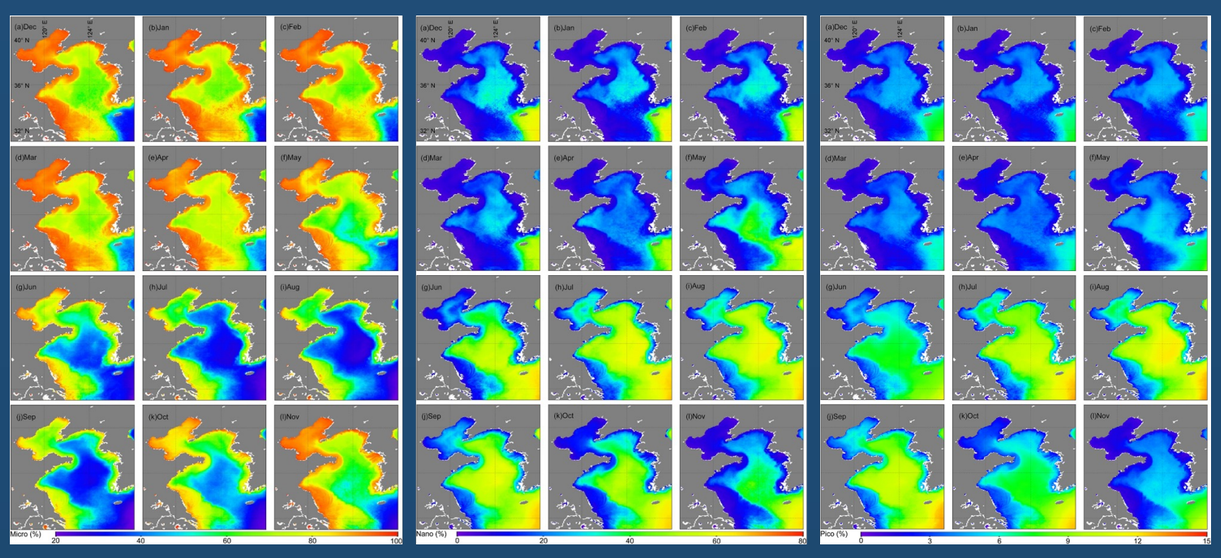
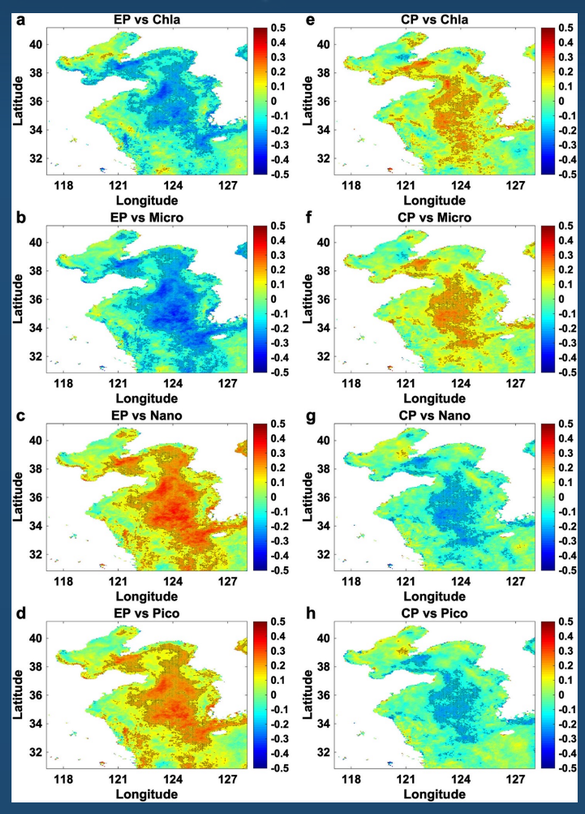
Science

Phytoplankton pigment (Chlorophyll a, Chl-a) is a good proxy for biological removal of atmospheric carbon dioxide in the ocean.

Fang Shen's group developed a series of three-component models in estimating Chl-a of phytoplankton size classes (PSCs) in the ocean using the Space born ocean color data, including pico- (<2 μm), nano- (2-20 μm), and microplankton (>20 μm) [*Sun et al., JGR Oceans, 2018, 2019*]. Phytoplankton size structure affects the sinking rate that consequently influence the ocean carbon cycle.



Based on 20 years of observation (1997-2006), *Sun et al., 2019* concluded that the central surface south Yellow Sea had higher Chl-a and microplankton dominance in April, while, from May to October, much lower Chl-a were observed, with a change from microplankton to nanoplankton dominance and a higher contribution from picoplankton, due to the existence of Yellow Sea cold water mass in the bottom water column. (**Figure 1 above**).



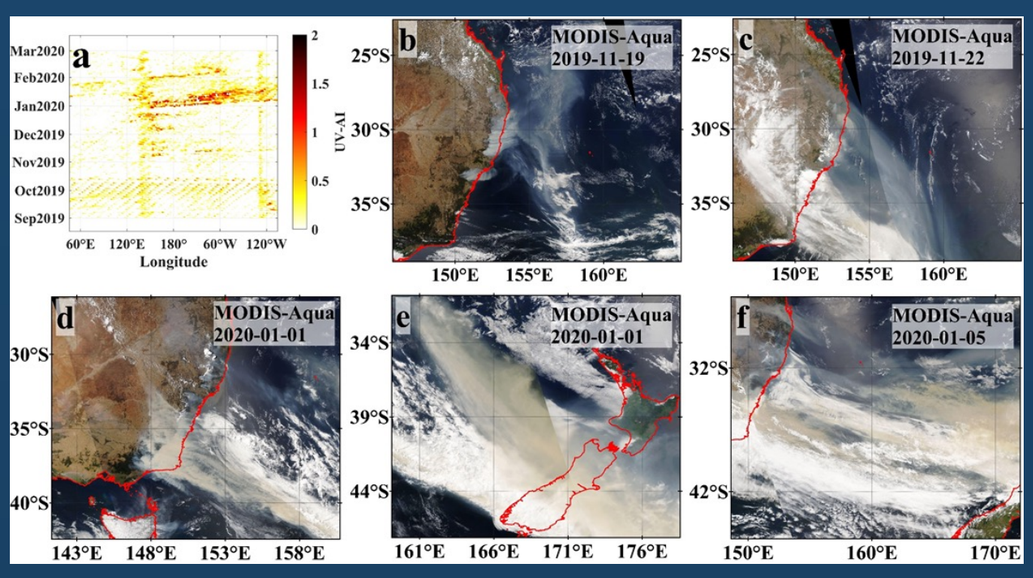
The interannual variations of PSCs were observed to be affected by the periodic oceanic changes. The physical and biological responses of PSCs to two types of El Niño events (Eastern Pacific [EP], Central Pacific [CP]) were different in the Bohai Sea and Yellow Sea (**Figure 2 left**). Intrusion of warmer (colder) water during the EP El Niño (CP El Niño) caused a decrease (increase) in Chl-a concentration and microplankton percentage, and an increase (decrease) in nano- and picoplankton percentages in the central south Yellow Sea (**Figure 2 left**) [*Sun et al., JGR Oceans, 2019*]. The amount of carbon drawdown from the Chinese marginal seas (Bohai, Yellow, and East China Sea) is now under investigation.

Figure 1 (left). Monthly-averaged PSCs percentages from 1997 to 2016.

Figure 2 (right). Correlation maps between EP/CP El Niño indices and surface monthly anomalies of Chl-a and PSCs from 1997 to 2016.

Science

Wildfire emissions contain plant nutrients to stimulate phytoplankton productivity to draw down the atmospheric CO_2 into the ocean.



Her group also observed the impact of the Australian wildfire in late 2019-early 2020 on the rise of phytoplankton biomass in the Pacific Ocean. The particles emitted from the wildfire were blown away over about two thousand kilometers and impacted the vast area of the South Pacific.

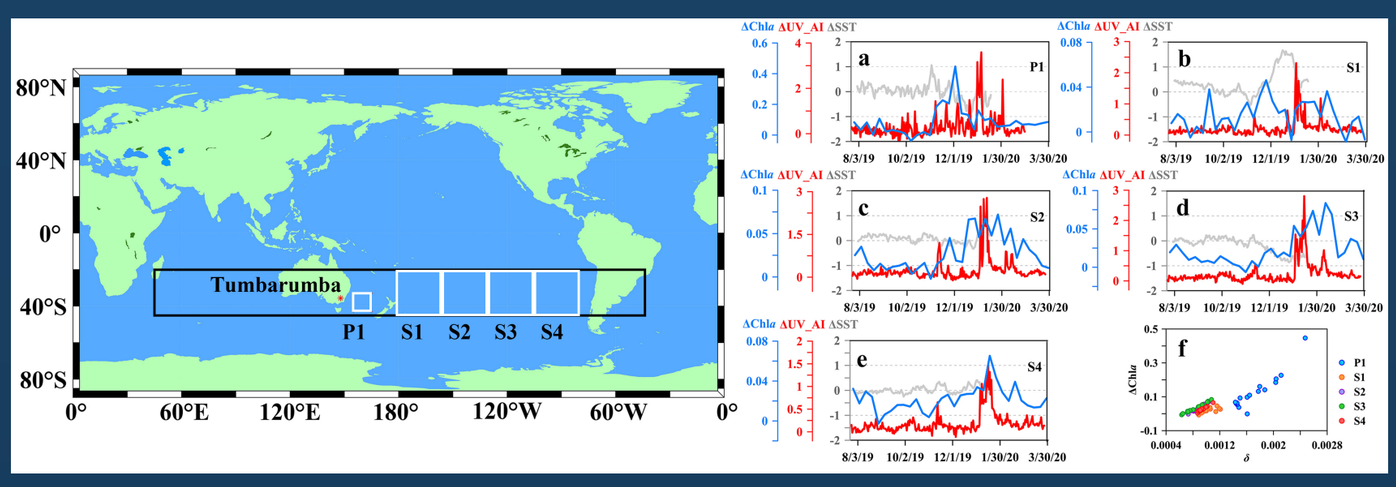
Massive bushfires fuelled by record-breaking high temperatures and months of extreme drought raged in eastern Australia during the summer of 2019–2020 in the shadow of climate change. The fires destroyed 3113 houses, claimed 33 lives, and caused an economic loss of up to 20 billion dollars.

Figure 3 (left). Satellite images provide detailed information on the migration of bushfire emissions spread to the coast of southeastern Australia, covered the Tasman Sea and New Zealand (November 2019 to February 2020).

The wildfire emissions (represented by UV aerosol index anomalies) stimulated phytoplankton productivity (represented by Chl-a) at the surface ocean within 8 days of its arrival (**Figure 4 right**).

Biogeochemical Argo floats also confirmed that Chl-a concentration increased to 1.85 mg/m^3 at depth of 64.7 m on 15 January 2020. This value was much higher than that in the earlier years of no wildfire.

[*Li et al., Scientific Reports, 2021*]



New Initiative

IMBeR OC-PC Synthesis Group

Ocean Color based Plant species identification and Carbon flux in the Indo-Pacific oceans

Contact Us

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