Geophysical Research Abstracts
Vol. 21, EGU2019-14838, 2019
EGU General Assembly 2019

Spatial and temporal variability of solar penetrating depths from chlorophyll blooms in the Bay of Bengal during the 2016 summer monsoon

Jack Giddings (1), Karen Heywood (1), Adrian Matthews (1), Manoj Joshi (1), Ben Webber (1), Alejandra Sanchez-Franks (2), Brian King (2), Pn Vinayachandran (3), and Nicholas Klingaman (4)

(1) University of East Anglia, School of Environmental Sciences, Norwich, United Kingdom (j.giddings@uea.ac.uk), (2) National Oceanography Centre, University of Southampton, Southampton, United Kingdom (alsf@noc.ac.uk), (3) Center for Atmospheric and Oceanic Sciences, Indian Institute of Science, Bangalore, India (vinay@iisc.ac.in), (4) Department of Meteorology, University of Reading, Reading, United Kingdom (n.p.klingaman@reading.ac.uk)

The South Asian monsoon system is strongly coupled to the underlying Indian Ocean as it provides an essential source of moisture and heat. During the boreal summer, the absorption of solar radiation leads to intense heating of the Indian Ocean surface. As previously shown by model studies of the Arabian Sea, chlorophyll blooms decrease the penetrative depth of solar radiation, increasing upper ocean radiant heating and sea surface temperature, intensifying monsoon rainfall over south-west India. However, the impact of summer chlorophyll blooms in the southern Bay of Bengal on sea surface temperature and the intensity and extent of monsoon rainfall has not yet been quantified.

As part of the joint Indian-UK Bay of Bengal Boundary Layer Experiment (BoBBLE), one ocean glider and three Argo floats were deployed in 2016 to measure upper ocean light intensity and biological constituents over a period of 1 to 3 months. We determine the transmission of light through the water column with varying chlorophyll concentrations using a constrained double exponential function, representing known parameters for the transmission of red wavelengths and unknown parameters for blue wavelengths, which was fitted to each vertical profile of photosynthetically active radiation. With the scale depth of red wavelengths fixed at 1 m, the mean scale depth for blue wavelengths was found to be 17 m for this region during the summer chlorophyll bloom, indicative of Jerlov Water Type IB. The observed scale depth for blue wavelengths ranged from 10 m when maximum chlorophyll concentrations in the Southwest Monsoon Current reached 0.8 mg m^{-3}, to above 26 m when chlorophyll concentrations were less than 0.1 mg m^{-3}.

We can now simulate the impact of temporal and regional variability of chlorophyll concentrations in the Southern Bay of Bengal using glider and float-observed scale depths of blue wavelengths of light in an ocean mixed layer model. Two sets of idealised experiments using the 1-dimensional KPP ocean mixed layer model were run during the month of July 2016 with two different, but constant, scale depths of 14 m and 26 m. The difference in SST between the two simulations show an increase of 0.24˚C by the end of July 2016. We confirm that a 12 m change in observed scale depths, equivalent to a 0.3 mg m^{-3} change in chlorophyll concentration, impacts on the depth and distribution of heating at the ocean surface. This would have a subsequent impact on monsoon rainfall amount and extent.