Effects of Light and Iron on Photosynthetic Electron Transport and Primary Production rates in the Southern Ocean

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Phytoplankton communities of the Southern Ocean exhibit different photosynthetic strategies to the physico-chemical environment by altering the structure and functioning of their photosynthetic membranes. These adaptive mechanisms to changes in light and nutrient availability have large consequences for bio-optical determinations of biomass and primary productivity. These changes include the portioning of different resources, and the alteration of the photosynthetic electron transport chain. These mechanisms are particularly important in areas that experience iron limitation, such as the Southern Ocean, where they can alter the fluorescence signal detected *in situ* and via remote sensing. Understanding how the fluorescence signal is altered by the adaptive mechanisms utilized by Southern Ocean phytoplankton species is important for the development of future remote sensing algorithms.

Novel iron addition productivity versus irradiance (PI) experiments were performed within the Atlantic sector of the Southern Ocean during austral summer 2015/16 to determine whether iron availability limits the maximal primary productivity rates. Experiments indicated that within different regions of the Southern Ocean iron is limiting the maximal primary productivity rates as determined by the uptake of carbon and nitrogen. Indeed, in some cases maximal rates doubled with the addition of the micronutrient iron. In combination with these experiments which measure carbon uptake, electron transport rates were measured optically for the development of a carbon-to-electron conversion factor. Time disparities between the two methods (carbon-uptake = 24 hours, optically = 45 minutes) make it uniquely advantageous for the development of improved primary productivity estimates and regional primary productivity models. Furthermore, this conversion factor can be applied to near and decadal datasets collected in this region of the Southern Ocean.