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The Chlorophyll - Albedo Feedback in the NASA GISS Climate Model

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The NASA Biogeochemical Ocean Model (NBOM) is coupled to the Hybrid Coordinate Ocean Model (HYCOM) and the GISS-ModelE atmosperic model using full CO2 gas exchange to investigate the chlorophyl-albedo climate feedback loop. NBOM and HYCOM are run at 2x2cos(φ) resolution with enhanced resolution at the equator and ModelE is run at 4x5 degrees resolution. The coupling is synchronous every half an hour and is carried out for constant atmospheric CO2 concentrations and pre-industrial atmosphere conditions. The ocean biogeochemistry sees the light from the coupled model and feels the effects of clouds. At the same time, phytoplankton absorbs different wavelengths of the surface irradiance and reflects it differently according to relative abundance of each species. Biogeochemistry therefore changes the ocean surface albedo at different wavelengths and thus affects the energy balance of the planet. Our preliminary results show that the effect is more pronounced in the low latitudes where coccolithophores grow at the expense of diatoms.

Quantifying CNPFe Fluxes within a Physically Dynamic, Calcifying, Permeable Coastal Margin: Coral Reefs

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Population growth and their need to congregate induce large changes in the water demand and supply to arid coastal regions. Changes in water supply within high tropical islands can often lead to the increased flux of high DIC, high nutrient water to the coastal environment. Changes of nutrient fluxes can lead to changes in the biological community (coral to macroalgae). Our study focuses on a region within the island of Maui, Hawaii where chronic macro-algal biomass has been accumulating for the past few decades. In this region, nutrient subsidies are though to originate from wastewater injections into the local aquifer. The objective of our study was to achieve a mechanistic understanding of the main factors affecting the high frequency (hours) land-ocean fluctuations in CNP exchange and to quantify the relative contributions of each source. Because of the nature of coral reef sediments, physical forces play a key role in controlling sediment water exchange and potentially water-land aquifer exchange. Our preliminary results indicate that the meteoric submarine groundwater discharge along this coastal margin is responding to physical forces (waves, tides) on the order of hours. High nutrient and carbon pulses originating from submarine groundwater discharge along this coast can drastically affect the biogeochemical estimates of net primary productivity in these systems. Our ability to differentiate carbon sources ant their flux to the atmosphere will greatly improve our capability to understand feedback mechanisms on the CNP biogeochemical cycles within calcifying coastal systems.