Differentiating sources of backscattering in the Southern Ocean to improve remote carbon pool assessments: calcite, bubbles and other optical constituents

I. Abstract

This proposal is in response to the solicitation for the Southern Ocean Carbon Program – Field Component (Air-Sea CO2 Flux and Improvement of Remotely Sensed Data). Remote sensing reflectance from the southern ocean is higher than most of the world's oceans. We propose to evaluate two primary hypotheses for the high reflectance: 1) Southern Ocean waters contain high levels of backscattering materials such as Particulate Inorganic Carbon (PIC); or 2) High reflectance is primarily due to the excessive amounts of bubbles produced by consistently high winds in this region. Understanding the magnitude of the spectral reflectance from the Southern Ocean will require a detailed understanding of the backscattering properties of the water column in relationship to wind-driven processes. Here, we propose to measure both wind-driven processes (e.g., bubbles and whitecaps) and water-column properties (e.g., calcite, coccolithophores and detached coccoliths, dissolved and particulate organic matter, etc.) in order to evaluate the contribution of each to measured inherent and apparent optical properties. High water-leaving radiance may have little impact on spectral ratios used in standard remote sensing algorithms, but significantly impacts the more advanced remote sensing algorithms that quantify backscattering and particulates from the magnitude of water-leaving radiance. As part of this effort, we propose to develop an approach to quantify the contribution of bubbles to water-leaving radiance and develop a wind-based algorithm to correct for bubbles in the remote sensing reflectance spectrum. We will also use these data to refine approaches to remotely estimating phytoplankton chlorophyll and PIC in Southern Ocean waters. The diverse expertise of our proposed team allow us to exploit cutting-edge technology *(in situ* VSF, acid-labile backscattering) and leverage existing equipment and ongoing research projects that strengthen the proposed research efforts at lower overall cost.