**Understanding the Impacts of Large-Scale Climate Variability on the Global Carbon Cycle**

NASA

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The high latitude regions of both hemispheres have experienced significant climate change over the past several decades, which is strongly linked to secular trends in the Northern and Southern Hemisphere annular modes (NAM and SAM, respectively). Both annular modes have marked cli- mate impacts at the ocean and land surfaces, and hence have likely had a substantial impact on the global carbon cycle. Inverse modeling of atmospheric CO2 shows that the time-mean carbon budget of the extratropics is characterized by land and ocean sinks of about 2/3 of anthropogenic CO2 emissions (partly balanced by weak tropical sources). Interannual variability in the carbon cycle is mostly associated with tropical changes associated with the El-Nino/Southern Oscillation phenomenon, which has been well studied, but relatively little is known about changes in the major extratropical sink regions that are impacted by the NAM and SAM.

We propose a three-year interdisciplinary research program to systematically investigate the mechanisms by which the NAM and SAM affect components of both terrestrial and marine car- bon fluxes. Using a suite of remotely sensed and in-situ data, models of physical and biogeochemical processes on land and in the ocean, and atmospheric inverse modeling, we will quantify the effect of climate variations associated with the NAM and SAM on various time scales. The pro- posed research requires understanding of large-scale dynamics of the atmosphere and oceans, marine and terrestrial carbon cycling, and atmospheric transport inversion modeling of CO2 fluxes. The proposed research has substantial implications not only for our interpretation of secular variations in the carbon cycle over the past few decades, but for projections of future concentrations of atmospheric carbon as well.

This proposal directly addresses the following question from the NRA: How well can cycling of carbon through the Earth system be modeled, and how reliable are predictions of future atmospheric concentrations of carbon dioxide and methane by these models?

Full Proposal

Final Report

Publications

Students