OBSERVATIONS OF THE CARBON CYCLE IN THE SOUTHERN OCEAN FROM AUTONOMOUS PROFILING FLOATS

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Motivation
To better understand the carbon cycle in the Southern Ocean, including the mechanisms governing the exchange of CO$_2$ between the atmosphere and the surface ocean and between the surface and deep ocean.

Biogeochemical Floats
Autonomous profiling floats have been equipped with sensors to measure temperature, salinity, pressure, oxygen, nitrate, pH, and optical properties.

Observations
The first full year of data reveals a complex seasonal cycle which varies considerably across regimes. At most locations, oxygen is produced and nitrogen is consumed in association with the spring phytoplankton bloom and restratification of the mixed layer.

Temperature
Salinity
Oxygen

Apparent oxygen utilization = [O$_2$]$_{sat}$ - [O$_2$]$_{meas}$

Biogeochemical Floats

Nitrogen

Total carbon is calculated from measured pH together with alkalinity estimated from nitrate, oxygen, temperature, and salinity using a regression model developed with all available bottle data.

Carbon cycle
Total carbon is calculated from measured pH together with alkalinity estimated from nitrate, oxygen, temperature, and salinity using a regression model developed with all available bottle data.

Ocean absorbs CO$_2$
Ocean releases CO$_2$

Temperature has largest effect on pCO$_2$ at subtropical location

Conclusions and Future Work
New data from biogeochemical floats offer an unprecedented look at the seasonal cycle of nutrients, oxygen, and carbon in the Southern Ocean, one of the most poorly-sampled regions in the world ocean.

Carbon concentrations directly estimated from the data suggest that the exchange of CO$_2$ with the atmosphere is driven more by thermodynamics in the subtropical region, while biological production becomes more important at higher latitudes.

Current work is focused on quantifying net community production, analyzing the optical data to infer chlorophyll and particulate organic carbon, and comparing these observations with the results of a high resolution coupled-climate simulation.