

# **Polynyas, Ice Production and seasonal Evolution in the Ross Sea (PIPERS)**

## **Principle Investigator**

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## **Project Description**

The PIPERS project will undertake a study of the Ross Sea Polynya and Terra Nova Bay Polynya and adjacent sea ice regions during April-May 2015, under winter conditions. A 60-day cruise (NB Palmer) will be made to study Atmosphere-Ocean-Ice (AOI) interaction during katabatic wind events in polynyas using AUV, ROV, UAS robotic vehicles to study the atmosphere, upper ocean and sea ice during ice formation events. Ship-based measurements include Eddy fluxes of heat and momentum in the atmosphere; high-resolution T,S and currents in the ocean; CO<sub>2</sub> fluxes from or to the ocean; and ice thickness, types and ice properties. Buoy arrays including Ice Mass Balance Buoys and GPS position buoys will be deployed in front of the polynyas to provide information on sea ice growth, ice dynamics and ice flux across the continental shelf during the following winter period. Aircraft flights using airborne lidar in Oct 2015 will use the buoy positions as way points to determine the sea ice thickness distribution across the flux gate of the Ross Sea, traced by the 1000m isobath on the continental slope.

Principal expected results are:

1. Quantify and parameterize for coupled models the full suite of AOI interactions in polynyas.
2. Measure the sea ice growth on and off-shelf in the Ross Sea to determine the contribution of polynyas and shelf sea ice growth to the sea ice regime of the Ross Sea and the salt flux contributing to deep water formation over the shelf.
3. Quantify the direction and magnitude of CO<sub>2</sub> fluxes over sea ice and polynya regions during winter in the Ross Sea.
4. Develop algorithms from cruise measurements to convert surface elevation of sea ice into sea ice thickness for application to airborne and satellite laser altimetry.
5. Determine if airborne lidar flights and future satellite altimetry can be used to monitor the sea ice thickness distributions and flux of sea ice across the Ross Sea continental shelf.

Through the measurements undertaken on PIPERS, the project will contribute to four of the SOOS themes; The Future of Antarctic Sea Ice, Heat and Freshwater Fluxes, The Stability of the SO overturning circulation and The Future and Consequences of Carbon Uptake (CO<sub>2</sub>) in the Southern Ocean. Sea ice thickness distributions have been identified as an EOVS for sea ice and the use and calibration/validation of airborne and satellite altimetry undertaken here is an essential step for its future routine measurement in the SOOS era.

## **Project Timeline**

March 2014 – Feb 2017

## **Key deliverables**

Data to be provided are flux measurements of atmosphere, ocean and ice cover during events of winter polynya opening and freeze over. Buoys will provide time series of ice growth through Ice Mass Balance Buoys and combined with ice drift and deformation will provide data on the ice cover evolution on and off the continental shelf in the Ross Sea. First measurements of CO<sub>2</sub> fluxes in winter polynyas will also be made. By repeated aircraft measurements in subsequent years, the interannual variability of ice flux off the continental

shelf and consequently, salt flux variations for deep water formation, will be seen for the Ross Sea.

**Funding**

US National Science Foundation

**Data Management**

Data collected will conform to US requirements for archiving and metadata. The data center for archiving is NSIDC, a member of the SOOS data network.