Sea State and Boundary Layer Physics of the Emerging Arctic Ocean

Office of Naval Research, Code 32, Arctic and Global Prediction, Department Research Initiative

Investigators: J. Thomson, V. Squire, S. Ackley, E. Rogers, Y. Fan, A. Babanin, P. Guest, T. Maksym, P. Wadhams, S. Stammerjohn, C. Fairall, O. Persson, M. Doble, H. Graber, H. Shen, J. Gemmrich, S. Lehner, B. Holt, T. Williams, J. Bidlot, F. Girard-Ardhuin, W. Perrie, J. Brozena

Program managers: Martin Jeffries, Scott Harper

Motivation

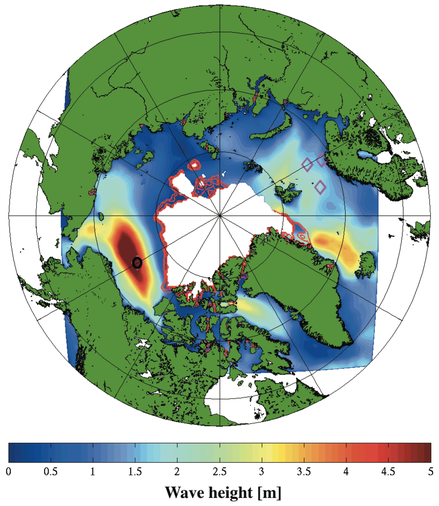

Figure 1. WAVEWATCH 3 model hindcast of waves during a storm in Sept 2012. The storm coincided with the minimal ice extent on record.

The central hypothesis of the 'Sea State' DRI is that surface waves now have a much greater role in the contemporary Arctic Ocean (e.g., Figure 1) and the dynamics of the seasonal ice zone. There is the potential for a feedback, as wave generation is controlled by the amount of open water fetch (Figure 2). At smaller scales, waves and ice interact to attenuate and scatter the waves while simultaneously fracturing ice into ever changing floe sizes. The changing seasonal ice zone presents new opportunities and new problems. Navigation and other maritime activities become possible, but waves, storm surges, air-sea fluxes and coastal erosion will likely increase.

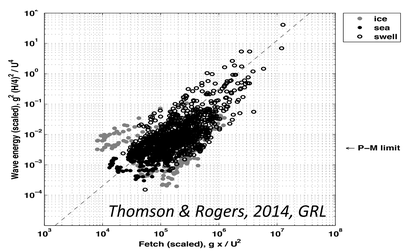

Figure 2. Measured wave energy and open water distance, scaled by wind speed, during the open water season of 2012.

Climatology & Models

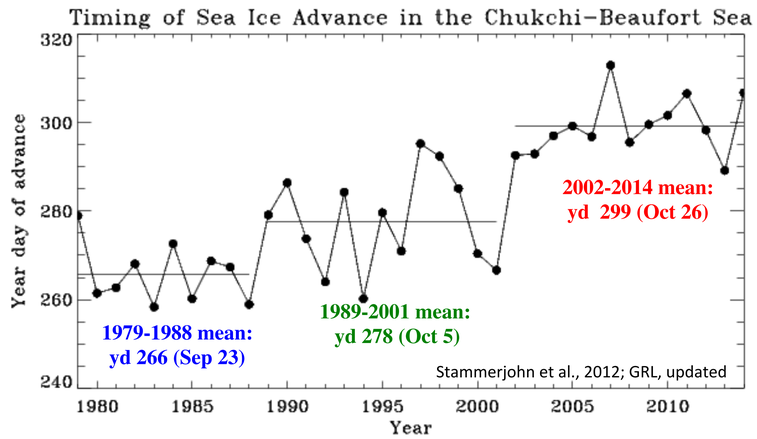

Figure 3. Date of seasonal transition, when ice begins to advance in the Chukchi-Beaufort Sea, by year. Data from NSIDC.

The DRI will focus on arctic conditions during the late summer and early autumn, especially the freeze-up of the Beaufort and Chukchi seas, to capture the strongest storms and maximum open water. The fall ice advance now occurs much later than in previous decades (Figure 3). To understand the implications of this shift, the WAVEWATCH3 model has recently been upgraded with several different ice algorithms. These can be applied in a hindcast (e.g. Figure 4) or forecast mode to quantify the related changes in the wave climate. Results suggest that stronger wave energy flux events have occurred in recent years.

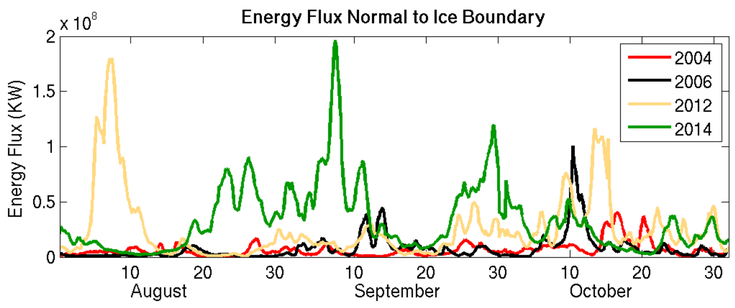

Figure 4. Daily time series of wave energy arriving at ice edge for a selection of recent years. Results from WAVEWATCH 3.

Measurements

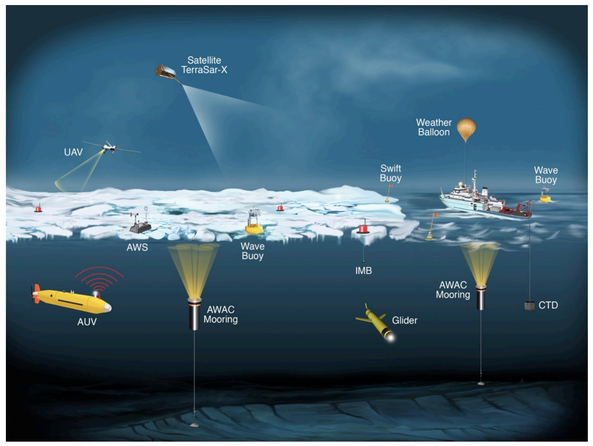

Figure 5. Schematic of the fall 2015 field campaign.

In the fall of 2015, a 6 week experiment will be conducted to measure physical processes at the air-ice-ocean boundary, using in situ and remote sensing techniques (Figure 5). The central platform with be the R/V Sikuliaq, which will transit north to the ice edge on Oct 1, and follow the advancing ice south (Figure 6).

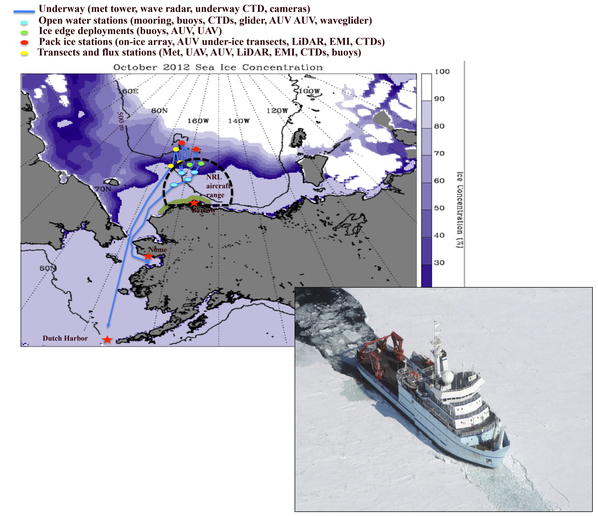

Figure 6. Cruise track for the R/V Sikuliaq during the fall 2015 field campaign.

http://www.apl.washington.edu/project/project.php?id=arctic_sea_state