

SWIFT Observations in the Arctic Sea State DRI

Jim Thomson
1013 NE 40th St
Seattle WA 98105
phone: (206) 616-0858 fax: (206) 616-5467 email: jthomson@apl.uw.edu

Award Number: N00014-13-1-0284
http://www.apl.washington.edu/project/project.php?id=arctic_sea_state
FY15 report (year 3 of 5)

LONG-TERM GOALS

The long-term goal is to understand the role of waves and sea state in the Arctic Ocean, such that forecast models are improved and a robust climatology is defined.

OBJECTIVES

The objectives are to: develop a sea state climatology for the Arctic Ocean, improve wave forecasting in the presence of sea ice, improve theory of wave attenuation/scattering in the sea ice cover, apply wave–ice interactions directly in integrated arctic system models, and understand heat and mass fluxes in the air–sea–ice system.

APPROACH

The technical approach is to measure waves, winds, and turbulence in the Arctic Ocean using drifting SWIFT buoys deployed during a 2015 cruise and moored Acoustic Wave and Current (AWAC) sub-surface instruments maintained yearly. These measurements will be used to estimate the fluxes of momentum and heat between the air, sea, and ice. Results will be integrated with remote sensing products and wave models.

WORK COMPLETED

Work during this second year of the DRI has centered around cruise planning for the FY16 experiment, coordination of remote sensing products, and analysis of climatology. A detailed cruise plan has been written, including a table of the remote sensing and forecast products that will be used in near-realtime. The targeting of remote sensing satellite acquisitions was tested during two “dress rehearsals” of the system, with refinements implemented upon debriefing after the tests.

The climatology work required synthesis of satellite ice products and running hindcast wave models. A domain was defined by the DRI team, as shown in Figure 1, and several data products were applied consistently within that domain. The hindcasts were assessed using probability functions, because the sea state is largely event-driven. The climatology work has resulted in a paper submitted to a special issue of *Ocean Modelling*.

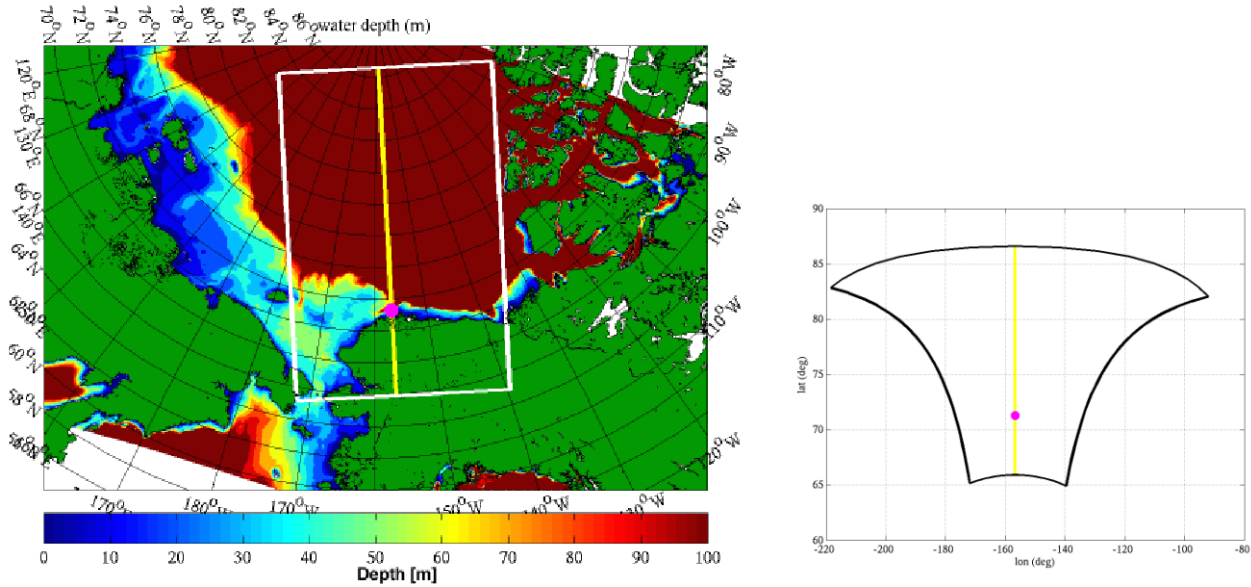


Figure 1. Domain for climatology analysis. The Beaufort and Chukchi Seas are bounded in a box that is a planar rectangle (left pannel) and thus broadens northward in longitude (right pannel).

RESULTS

The wave hindcasts are consistent with a sea state that is tightly coupled to the interannual variations in sea ice. In years with extended durations and distances of open water, larger waves are more likely. This is shown for four select years in Figure 2, using histograms of wave heights throughout the domain. The 2012 record is the extreme, with expanded durations and distance of open water (and higher probability of large waves).

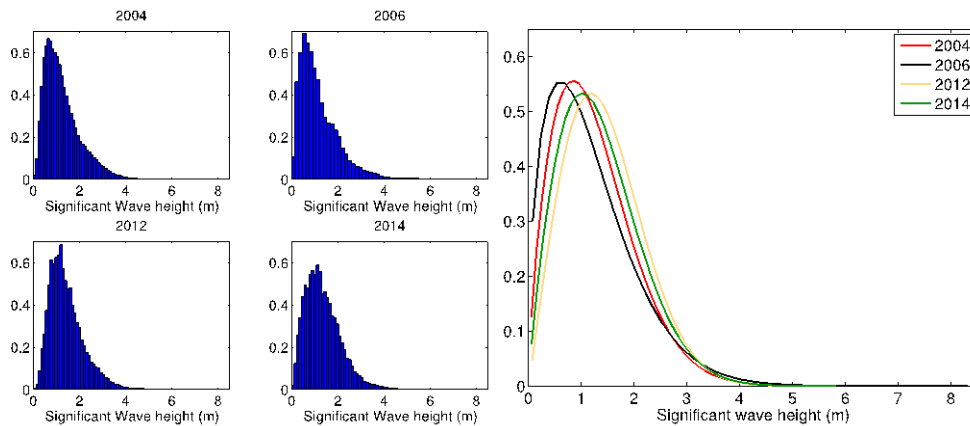


Figure 2. Histograms of significant wave heights in the domain during four recent years.

Futhermore, wave periods are longer during these years with expanded open water. These effects are summarized using the parameters of the probability distribution functions of wave height, wave period, and wind speed in Figure 3. There is a clear trend towards larger and longer waves in recent years, however the wind speed has no trend. Thus, the mechanism of open water is clear: an increased sea

state in the Arctic is occurring without any changing in the wind forcing. It is simply the high probability of open water that increases the probability of large and long waves.

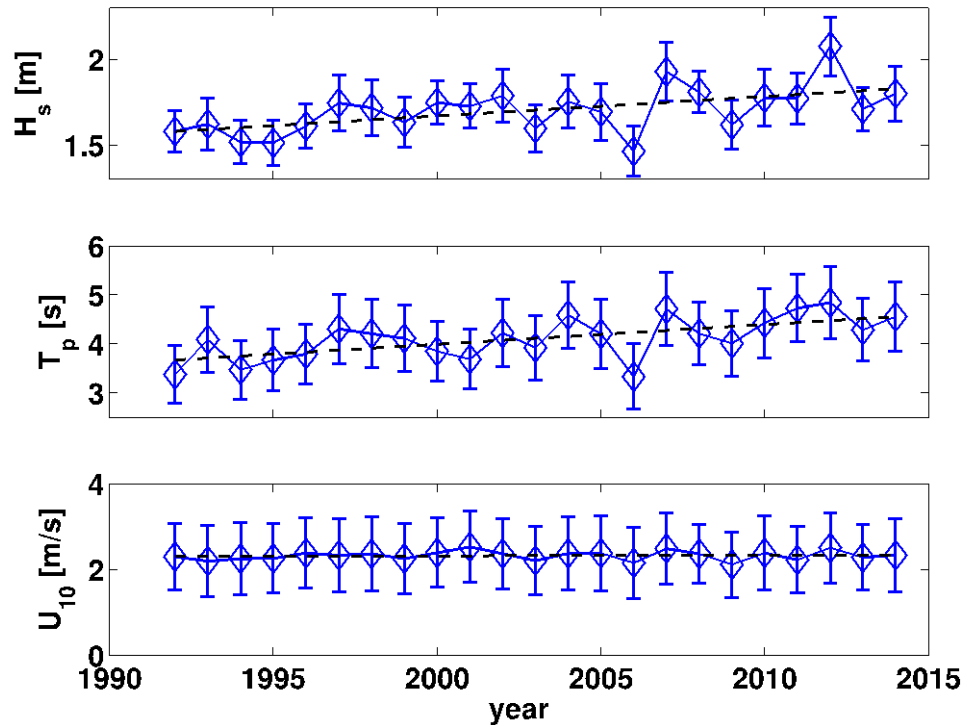


Figure 3. Scale and shape parameters from the probability distributions of wave heights, peak periods, and wind speeds in the Beaufort-Chukchi domain.

IMPACT/APPLICATIONS

Improved sea state predictions in the Arctic Ocean will enable safe naval operations in the region.

RELATED PROJECTS

Resources are data are shared with the “Marginal Ice Zone” DRI. More information is at <http://www.apl.washington.edu/project/project.php?id=miz>

PUBLICATIONS

Thomson, J. and E. Rogers, Swell and sea in the emerging Arctic Ocean, *Geophys. Res. Lett.*, 41 (2014).

Thomson et al, “Science Plan for the Sea State and Boundary Layer Physics of the Emerging Arctic Ocean DRI,” *APLUW Technical Report 1306*, 2013. [published]

Thomson, J. “Observations of wave breaking dissipation with SWIFT drifters,” *J. Atmos. and Ocean. Tech.*, 2012. [published, refereed].