"Remote Sensing of the Impact of Waves on Sea Ice"

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LONG-TERM GOALS

The goals of this effort are to observe the impact of waves on the sea ice cover using remote sensing and to provide analyzed results will be provided to coupled ocean-ice modeling efforts for evaluation and potential incorporation as parameters for model validation and improvement, in support of the Office of Naval Research Arctic and Global Prediction Program.

OBJECTIVES

The objective of this effort is to determine the sea ice morphology and floe size distribution of ice that has been impacted from incoming ocean waves, using remote sensing data sets. These analyzed fields will be provided to coupled ocean-ice modeling efforts for evaluation and potential incorporation as parameters for model validation and improvement. This will be done using remote sensing data acquired during the planned Arctic Sea State field campaign, which will take place in the fall 2015 in support of The Office of Naval Research Department Research Initiative (DRI) titled "Sea State and Boundary Layer Physics of the Emerging Arctic Ocean".

APPROACH

The approach of this effort is to utilize multiple remote sensing data sets to quantify the impact of waves on the sea ice cover of the Arctic Ocean. Our efforts are intended to closely align with modeling efforts to seek the optimum and most reliable methods to quantify the impacted sea ice cover and produce analyzed fields for comparison with coupled waves-in-ice models for sensitivity testing and potential improvement of the ice parameters that go into the models.

The key sea ice parameters of interest are floe size distribution and ice morphology, the latter of which essentially specifies the distribution of ridges and cracks along with thickness or a proxy such as ice type. Based on previous and current efforts, we believe these sea ice parameters are best measured with fine-resolution (less than 100 m) remote sensing data to capture the full range of feature scales of these ice parameters. The primary data to be utilized will be from SAR and optical sensors flown on both satellite and aircraft platforms.

In the first two years of the effort, I will analyze older data sets as well as more recent data collections, as a means to develop the floe size algorithm as well as to work with data sets similar to the ones that wil be collected during the field campaign. The field campaign will take place in the third year of the effort and the last two years will focus on data analysis from the field campaign and comparisons and possible parameterization into the wave-ice models.

I will be working closely with Vernon Squire, University of Otago, and Hayley Shen, Clarkson University, along with other members of the Sea State science team.

WORK COMPLETED

I have attended and participated in the initial Sea State DRI meeting in San Francisco, December 6, 2012, and the second meeting in San Diego, February 26-27, 2013. Also I provided input to the "Sea State and Boundary Layer Physics of the Emerging Arctic Ocean Science Plan", which was published in September 2013 (Thomson et al., 2013). This input described the floe size and morphology measurements to be made and the suite of sensors to be acquired and analyzed during the Sea State field campaign, including from SAR and fine-resolution optical satellite imagery including from the National Reconnaissance Office and NASA sensors such as ASTER and Landsat.

My initial effort has focused on re-establishing the floe size algorithm that I have developed in previous efforts (Soh et al., 1998; Holt and Martin, 2001) to new sets of data, of the type that will be utilized in the 2015 field campaign. I have identified available but not-yet-analyzed fine resolution optical aircraft imagery obtained during the Labrador Margin Experiment in 1987, where a significant wave event took place that significantly altered the ice cover (Carsey et al., 1989; Liu et al., 1991). Both sea ice and wave information were obtained during this experiment. The imagery from one flight is available and has been scanned from large-format photographs to a suitable digital format and resolution. I am trying to track down other flight imagery from earlier flights, which were obtained before the wave event, but I have not yet been able to identify a source in Canada for this data.

I have been approved as a Japanese Space Agency ALOS-2 investigator, which will potentially enable me to request ALOS-2 L-band polarimetric SAR imagery to be obtained during the Sea State field campaign. While TerraSAR-X imagery is planned to be routinely acquired, the addition of ALOS-2 data will enable additional temporal coverage and the longer wavelength SAR should prove beneficial for the detection of both waves and young sea ice types due to its reduced sensitivity to wind, as compared to X-band.

RESULTS

I have no significant results to report at this time.

IMPACT/APPLICATIONS

The primary value of the this effort will be to provide a series of floe size distributions and sea ice morphology resulting from the impact of incoming waves into the ice cover. These measurements will then be used for both parameterizations as well as validation of the wave-ice models, to assess the impact of waves particularly on sea ice melt rates as well as to enable short-term predictive capability.

RELATED PROJECTS

There are currently no related projects.

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