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Properties and Characterization of High Resolution Wave-Air-Sea Interaction

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LONG-TERM GOALS

The long term goals motivating the establishment of the High Resolution Air-Sea Interaction DRI (Hi-Res DRI) are the determination of how well ship-based radars can measure the phase-resolved surface wave field (PRSWF), testing the skill of highly-nonlinear numerical surface wave models to predict the evolution of the PRSWF, and the incorporation of ocean wave effects into models of the Marine Atmospheric Boundary Layer (MABL).

During the Planning Year our principal task will be to participate in meetings, discussions and planning required to formulating an experimental plan for the High Resolution Air-Sea Interaction experiment.

OBJECTIVES

a) Radar imaging of the wave field and translation of the images into snapshots of “elevation maps" of the surface using both satellite and ship or floating platform based sensors.

b) Measurements of the wave field and the atmosphere above the wave field using ASIS buoys to generate data sets that could be compared to wave models and radar both in the spectral and phase-resolved domains, and leads to a better understanding how the wind profile, fluxes, coefficient of drag vary with respect to differing wind and wave conditions.

c) Measurements of breaking using both acoustic and microwave means as well as in-situ sensors locally.

APPROACH

The shortage of well designed field experiments to get to the root of these problems under strong wind forcing and/or high sea states reflects the difficulty of making the necessary measurements, especially in-situ. The maturation of two recent innovative technologies has enabled appropriate field measurements and opened the door to realizing a definitive field experiment in a broad range of wind and wave conditions. These technologies are:

1) ASIS (Air-Sea Interaction Spar) buoys with suitable instrumentation; and

2) Remote Sensing using radar techniques such as marine X-band systems (WaMoS) and RadarSat 1 and 2, TerraSar-X, Envisat ASAR.

The goal of the planned effort is to understand the intrinsic dynamics and coupling of the atmosphere and ocean via the wave boundary layer. The goal of the measurements is to implement, test and improve the capability for timely radar imaging of the surface wave field in a manner useful for describing the response of vessels in simple and complex sea states. Several ASIS buoys will be moored in a patch of ocean with coincident and concurrent radar measurements from a ship and from space. The ASIS buoy will provide detailed wavenumber directional spectra, the momentum flux, sensible and latent heat flux, aerosol concentrations and fluxes as well as ambient noise levels with a WOTAN-type ambient noise sensor, thereby allowing us to examine the effect of strongly forced (and breaking) waves on the atmosphere/ocean coupling. The wave staffs of the ASIS buoys would measure near-instantaneous values of the surface elevation and coupled to GPS would provide detailed information about x,y,z without moving rapidly in space and time. WaMoS marine X-band data collected on the “Explorer of the Sea” and from the R/V Oceanus and R/V Knorr during the NLIWI experiment will be used to examine ship response and motions to different sea states. The WaMoS system would also be installed on a FLIP type platform participating in the field experiment. Both the WaMoS radar and SAR image data would be transformed to surface elevations for studying the distribution and characteristics of wave groups in different sea states and wind forcing.

WORK COMPLETED

1) Development of science and experimental plan.

RESULTS

None.

IMPACT/APPLICATIONS

Enhanced skills in these areas would lead to the goal of improved predictions of the PRSWF around surface vessels and contribute to the safety and effectiveness of naval operations and sea keeping in moderate to high winds and sea states.

TRANSITIONS

None. Project just started.

RELATED PROJECTS

None. Project just started.