

Extreme Air Sea Interaction Buoy for Typhoon Conditions

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LONG-TERM GOALS

The long term goal is to enhance our equipment and instrumentation to measure directly air-sea interaction fluxes and improve our understanding of the atmosphere-ocean dynamics in extreme weather conditions such as typhoons at sea.

The principal task of this project is to acquire a new 6-m NOMAD buoy which is the basis for our extreme air-sea interaction (EASI) buoy and purchase suitable instrumentation for measuring marine fluxes. This new system will complement our existing Air-Sea Interaction Spar (ASIS) buoys and EASI buoy and allow a wider range of experimental designs and high-resolution marine flux, directional wave and turbulence measurements in extreme weather conditions such as those experienced in typhoons.

OBJECTIVES

The quest to obtain better and direct measurements of the air-sea fluxes in storm conditions led to the design of a stable floating platform which allowed measurements of turbulence in the atmospheric and oceanic boundary layers with minimal corrections. The air-sea interaction spar (ASIS) buoy fulfills these requirements with minimal flow distortions and a modular design.

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Specific objectives are:

- 1) To test the combination of an ASIS buoy tethered to an EASI buoy in extreme air-sea interaction conditions.
- 2) To use better measurement strategies and instrumentation that provide high-resolution turbulence and flux measurements near the air-sea interface.
- 3) To improve the data acquisition system to allow storage of longer data records and extend autonomous operations to months and more.

APPROACH

Currently there are no suitable research platforms for use as a turbulence flux and wave buoy in high wind and high sea state environments. The combination of an ASIS buoy tethered to an EASI buoy would provide an opportunity to acquire critical turbulence and flux measurements at the air-water interface in typhoon conditions (Figure 1). Similarly the tandem buoy system would also record the sea state and its directional properties. The Tandem Air-Sea Interaction (TASI) buoy system would provide durable platforms in high sea states and minimal flow distortion. Flow distortion affects both the mean and turbulent components of the flow field, and can have a significant effect on the turbulent fluxes, particularly that of momentum.

Figure 1 shows the tandem buoy system recently deployed off the coast of Jacksonville, Florida.



Figure 1: The EASI and ASIS buoys in tandem with the ASIS buoy tethered to the EASI hull and the EASI hull moored to the bottom with an inverse catenary type mooring. This arrangement is expected to be typical as shown in this photo of the two buoys tethered during a recent deployment in the Atlantic.

WORK COMPLETED

- 1) A new EASI buoy has been manufactured.
- 2) New instrumentation such as deep ocean acoustic releases, linear accelerometer triplets and rate gyros has been purchased. The latter two are used in a special data acquisition and motion sensing system.
- 3) Two new data acquisition system with new computational and recording technologies have been build to store high resolution data at a rate of 20 Hz for six months and measure at high resolution the six-degrees of motion of the EASI buoy.

RESULTS

The tandem air-sea interaction buoy system will allow unprecedented concurrent and co-located measurements of the near-surface dynamics in both the MABL and OBL. We will also be able to estimate spray and foam from breaking waves and how they affect the drag coefficient in typhoon force winds. The data may also become relevant to understand better the impact of spray and foam on satellite radar measurements of the ocean surface. In particular the boundary layers in typhoon conditions and the sea surface itself are very complicated and no reliable direct measurements exist to describe the interactions. Obviously, several new research areas can be conquered with better state-of-the-art platform such as the extreme air-sea interaction buoy.

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.