

Airborne wind lidar to evaluate air/ocean exchanges at high wind speeds

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Abstract

An airborne Doppler wind lidar has been deployed by the Office of Naval Research and the Integrated Program Office of NPOESS to study the dynamics and energy exchanges at the air/water interface, especially during high winds. The ONR is most interested in the high wind regime where flux parameterizations are currently inadequate for hurricane force winds. The IPO is most interested in understanding the water surface motions as they impact the use of surface returns to calibrate future space-based wind lidars. In the Spring of 2002, several weeks of flights were conducted using a 2 micron coherent lidar mounted in a Twin Otter (TODWL: Twin Otter Doppler Wind Lidar). These flights were over open ocean, rivers, lakes and wetlands. Through the use of a side-door-mounted two axis scanner, data were taken that allows, for the first time, detailed study of the water reflectance as a function of nadir viewing angle and the discrimination of the water surface velocity from the motion of the overlying aerosols.

Capitalizing on the lidar's small footprint (<20 cm), details of the wave structure, foam, spray plumes and wind variance within single waves (with wavelengths > 10 meters) were observed. From these observations of the water surface and the adjacent aerosol layer we attempt to discriminate four different velocities: 1) wind speed of the air at 10 meters, 2) speed of the spray particles generated by the wind/wave interaction, 3) vertical velocity of the wave surface, and 4) the net horizontal motion (surface current) of the surface. Experimental results from overflights of Monterey Bay, San Joaquin River and San Luis Reservoir in California will be presented along with suggested ways to compute energy and momentum fluxes. These results will have implications to the use of airborne lidars in future field programs such as ThorPEX and CBLAST.