Interaction between sea wave and surface atmosphere by shallow angle LED lidar

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Interaction between the sea surface and the lower atmosphere is important not only for water circulation of the earth, but also for the transportation of minerals includes sodium chloride, certain gases and so on. Especially in the shore, such interaction becomes more fruitful but complex because the sea wave dynamics and wind will join to the interaction. It is worthwhile to monitor such interaction for geophysics, marine science, and technologies for revetment and boat maneuver. Up to now, the plural reports have been mentioned about the sea wave monitoring, while the above interaction between the sea wave dynamics and wind is not fully discussed.

In this study, we focused on the above interaction monitoring and its visualization. The LED based mini-lidar is developed to visualize the interaction. The LED device is tough for rough usage and static electricity. It is eye-safe and low electrical power consumption. The whole lidar system is compact and drive with DC buttery to operate it on shore. To follow the high temporal and the high spatial dynamics in the shore, the LED lidar system has the high resolutions' performance of 0.2s summation and 0.15m spatial intervals. It is accomplished by the originally developed high speed photon counter. Now, the system has been improved with higher optical pulsed power of >10W and orthogonal polarized detections.

We have been continued the field experiments in an inland sea (Tokyo bay) and oceans (Pacific ocean). The wave motions are confessedly different linking to the sea floor orientation, tide current and weather. The LED lidar system set to the near horizontal direction at shallow angle. The LED beam spreads with 10 mrad, while the receiver optics detects its echoes from the sea waves and the atmosphere with the field of view of 5mrad. The observation range is from in front of the system to more than 100m. The weather sensor and the particle counter are synchronized with the lidar observation. The interactions between the sea wave and the wind have been captured under the several weather conditions and observation locations. They are visualized and evaluated by FFT analysis and estimated depolarization. By the combination with weather sensor synchronization, the sea wave dynamics are discussed with the wind profile and the tide effect trend.