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Offshore wind waves tracked by surface drifters with a point-positioning GPS sensor

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Wind-generated waves have been recognized as one of the most important factors of the sea surface roughness which plays crucial roles in various air-sea interactions such as energy, momentum, heat and gas exchanges. At the same time, wind waves with extreme wave heights representatively called as freak or rogue waves have been a matter of great concern for many people involved in shipping, fishing, constracting, surfing and other marine activities, because such extreme waves frequently affect on the marine activities and sometimes cause serious disasters. Nevertheless, investigations of actual conditions for the evolution of wind waves in the offshore region are less and sparse in contrast to dense monitoring networks in the coastal regions because of difficulty of offshore observation with high accuracy. Recently accurate in situ observation of offshore wind waves is getting possible at low cost owing to a wave height and direction sensor developed by Harigae et al. (2004) by installing a point-positioning GPS receiver on a surface drifting buoy. The point-positioning GPS sensor can extract three dimensional movements of the buoy excited by ocean waves with minimizing effects of GPS point-positioning errors through the use of a high-pass filter. Two drifting buoys equipped with the GPS-based wave sensor charged by solar cells were drifted in the western North Pacific and one of them continued to observe wind waves during 16 months from Sep. 2007. The RMSE of the GPS-based wave sensor was less than 10cm in significant wave height and about 1s in significant wave period in comparison with other sensors, i.e. accelerometers installed on drifting buoys of Japan Meteorological Agency, ultrasonic sensors placed at the Hiratsuka observation station of the University of Tokyo and altimeter of the JASON-1. The GPS-based wave buoys enabled us to detect freak waves defined as waves whose height is more than twice the significant wave height. The observation conducted by the wave buoys in 2007-2008 indicated a little more frequent occurrence of freak waves comparing with Forristall's (1978) empirical formula and Naess's (198 5) distribution for a narrow-band Gaussian sea.

Keywords: offshore wind waves, surface drifter, point-positioning GPS sensor