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Typhoon surface waves

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Microseisms are Rayleigh waves generated mostly by sea waves. It is well known that the amplitude and period of microseisms increase when sea waves become rough. During ordinary weather, the peak amplitude of microseisms is found around a few seconds. Since microseisms are generated on a wide area along the coast and the ocean bottom, it is difficult to specify their source areas. However, when a typhoon affects the Japanese Islands, the origin of Rayleigh waves or microseisms can be specified with the coherent waves propagating over a distance of 1000km. This type of wave is called tentatively "Typhoon surface (TS) wave" hereafter. The predominant period of the TS wave is 10-15 seconds. It is also observed that the source area of the TS waves moves as the typhoon advances from the west to east along the Japanese Islands. The duration of TS waves is about 3-4 min and are generated intermittently with an approximate interval of 10 min. In the case of Typhoon No.18 in 2009, the TS waves were recorded and identified on seismograms in Kyushu and Honshu when the eye of the typhoon advanced in the vicinity of Amami Oshima. In addition, when the eye of the typhoon landed on Tokai region after migrating eastward from Kyushu and Shikoku, the amplitude of the typhoon surface wave tremendously increased.
Based on the above seismograms, the recorded amplitude of the TS wave corresponds to the amplitude of an M3 earthquake. The peaks of TS wave were recorded at the seawave gauge located at Irozaki has maximum height of 10.5m significant waves in Typhoon No.18. An average wave has an amplitude of about 3m and a period of 3s. However, TS wave is not necessarily recorded on all typhoons. Out of 30 typhoons that landed on Japanese islands or passed near the islands in the last 10 years (2000-2009), only 11 events have an associated TS waves. It is noted that when the period and height of the significant wave reaches about 10m and 10s, respectively, the TS wave is generated. Considering this conditions, it is necessary to deal with such coherent waves whenever an attempt is made to detect changes in seismic wave velocity by using ambient noises. This factor becomes much more important when the freak wave, the wave with a pulse height twice the significant wave, is mentioned in conjuncture with the TS wave. Recently, Kedar et al. (2008) has been obtained a good agreement between observed microseism and calculated amplitudes by applying Longuet-Higgins theory (1950). A similar attempt is also made in this study to elucidate the origin of ocean microseisms in the Pacific Ocean along Japanese islands.

Keywords: Microseisms, Typhoon, Rayleigh wave, Longuet-Higgins theory, Significant wave, Freak wave