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Title	Wind-Blown Sediment Transport and Topographic Changes of Coastal Dune and Backshore

(800 words)

The Nakatajima dune is approximately 1 km length (from West to East) and 0.6 km width, located near Magome River mouth on the Enshu-Nada coast, Hamamatsu city of Japan. The Nakatajima dune has been changed in topography not only by wind-blown sand but also due to the limited sediment supply from the eroded beach. The beach had been eroded approximately 230 m and 150 m in the East and West part of the dune respectively during the period of 1962-2005. Moreover, the evolution of the dune has been accompanied by dramatic changes in the land cover in the surrounding areas, where the sand dune in the West part has been replaced by artificial coastal forest in 1979 with 440 m width. As a result, the available sand supply has been reduced and subsequently the elevation in the West part of the dune.

In this thesis precise field measurements of the shape of Nakatajima dunes and correlated measurements of the wind speed and sand flux onto the Nakatajima dune will be presented. We will discuss the long- and short-term topographic changes and the characteristics of wind-blown sand due to the limited sediment supply from the eroded beach. The short-term and long-term topographic changes of Nakatajima dune, associated with beach erosion and coastal forest developments that is investigated based on aerial photographs, the data of wind and regular field survey. Short-term topographic changes of the Nakatajima dune have investigated with continuous field surveys over three years period (2007-2009). Measurements of wind and wind-blown sand transport rate were also carried out several times in winter. These approaches led to deep understanding of characteristic of blowing sand in the Nakatajima dune. The final goal, however, is to create a long term protection with less or even no maintenance and costs.

The objectives of this study are (1) to map the spatial patterns of erosion, deposition and horizontal dune migration using the data of aerial photography (several aerial photographs in the years of 1946, 1962, 1975, 1983, 1991, 1997, and 2005), and topographical maps of 1969, 1983, 1992, 2001, and 2005, and topographical survey using Global Positioning System (GPS) with Real Time Kinematics (RTK); (2) to measure the wind-blown sand transport rate, and orientation volume of mobilized sand of the sand dune into monitoring area over three years period (2007-2009).

The long-term topographic changes were observed using the digitized data from scanned topographical map of 1969, 1983, 1992, 2001 and 2005. The topographical map from GPS and 3D terrestrial laser were also used for the analysis. We found that the topography of Nakatajima dune has changes by wind-blown sand, and migrated eastward as predominant westerly wind direction in years or decades. The source of the sand transported is mostly from the dune itself and limited amount of sand come from the shoreline, resulting the decreased in the elevation significantly in the West side of the dune. Simultaneously the sand transported and deposited in the East side.

The wind-blown-sand transport rates in the Nakatajima dune were observed by field survey for three years period. The eastern end edge of the dune migrated 6-7 m from Feb 2007 to Feb 2008 and 3-4 m from Feb 2008 to Feb 2009. The total volume of sand transported to the eastern edge of dune was approximately 2450 m^3 and 1775 m^3 in Feb 2007 to Feb 2008 and Feb 2008 to Feb 2009 respectively. Comparison of the results with predicted formula proposed by Bagnold (1941) and Kawamura (1951) give reasonable results for this dunefield.

The characteristic of wind-blown sand on the Nakatajima dune conducted with the sand trap experiment. From these experiments we found the windward slope/dune crest in the middle part of the Nakatajima dune is an actively eroding region by wind and migrated eastward. From the topographic change in the mid-dune area, we found the sand dune has been eroded with a total volume rate of approximately 50 m^3/m/2year. Comparing the result of the volume rate change on the mid-dune and the volume of sand transport to the eastern edge of the dune, we may understand that the sand transport to eastern edge of dune, mostly, was from the mid-dune area. In the monitoring area, near the eastern end edge of the dune, the migration rate of the edge of the dune decreased after the sand removal near the edge of the dune (Feb 2008) which form like a trench trap, but not significant. The trench was not effective in trapping the wind-blown sand. The reason for this might be that the width of the trench which is parallel to the predominant westerly wind was too big, hence allowed the wind to blown the grains inside the trench to east. The eroded sand was higher than deposit sand in the trench with a volume rate of approximately 8 m^3/m/year.