Relationships between coastal sand dune vegetation and landforms: A preliminary analysis using TLS and UAV-SfM photogrammetry in Tottori Sand Dunes

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Coastal sand dunes have been closely related to human activities. In recent centuries, the landward sides of sand dunes have been modified by the creation of farmlands and erosion control forests, as well as the construction of harbors, airports, roads, and residential areas. On the sea side of sand dunes, coastal structures, including revetments and detached breakwaters, have been installed to prevent coastal erosion. By these reasons, the total area of sand dunes has significantly decreased in Japan, and the ecosystem therein has been greatly affected by these changes. The number of endangered species per unit area is particularly large when compared with those in forests and wetlands. These facts encourage the need for the conservation and restoration of sand dunes and their ecosystem.
Meanwhile, investigating sand dunes in the natural state is indispensable for future planning of such conservation planning. This study focuses on the vegetation in sand dunes, which is the primary producer of the ecosystem. In previous studies, it has been suggested that the accretion of sand has the greatest influence on the distribution and survival of vegetation in sand dunes. However, although many studies have explored relationships between coastal sand dune vegetation and environmental factors, effects of landforms on the vegetation growth and distribution have rarely been examined. Here we investigate the spatial relationships between vegetation and landforms in the Tottori sand dunes using high-resolution ground surface information obtained from terrestrial laser scanning (TLS) and unmanned aerial vehicle-based structure-from-motion (UAV-SfM) photogrammetry. Sand dunes vegetation was classified into several communities, and a vegetation map was created based on the orthorectified images obtained by UAV-SfM photogrammetry. We analyzed the spatial correlation between vegetation and landforms. In particular, there is a relationship between the aspect of slope and distribution of vegetation. The distribution of vegetation and landforms is likely affected by the constant wind from the south having a speed of more than 5 m per second, as well as the seasonal winter wind from the northwest having a speed of more than 10 m per second. Because coastal sand dunes are a part of the dynamic ecosystem, it is necessary to further explore the dynamic relationships of vegetation growth with changing landforms, which will be clarified by their continuous monitoring.

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