

Analyzing short-term topographic change in coastal sand dunes using UAS-SfM photogrammetry: A case study in Northern Kujukuri, Japan

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Collection of spatial data is critical for the identification of coastlines and coastal zones and related studies in coastal geomorphology. It is particularly important to obtain high-resolution elevation data in order to observe topographical changes of coastal sand dunes with frequent dynamic movements during a short period of time. Unmanned Aerial System (UAS) photogrammetry combined with Structure from Motion (SfM) offers an effective solution to the acquisition of such data. Kujukuri, facing the Pacific Ocean in Chiba Prefecture, Japan, is a region with a long coastal zone of about 60 km. Although the development of this area since the 1960s has destroyed many natural landscapes, they are relatively preserved in Northern Kujukuri. This study focuses on short-term topographic changes in coastal sand dunes there and discusses the effects of vegetation and wind.

UAV-SfM surveys were conducted seven times from September 2016 to December 2018, and the obtained topographic data were analyzed using GIS software (ArcGIS Pro) to evaluate changes in terrain conditions by season and year. We also analyzed the wind direction data provided by the Japan Meteorological Agency. Vegetation data were obtained from the field surveys and the green-red vegetation index extracted from the UAS images. The following three characteristics were identified: 1) Short-term topographic changes tend to be influenced by specific events such as storm events, and therefore terrain conditions in the same season may be different from year to year. 2) General wind conditions represented by the meteorological data corresponding to the overall change of sand dune topography, especially at seasonal or longer scales. 3) Formation of small sand dunes is affected by vegetation distribution. This study has suggested factors affecting short-term topographic changes of coastal sand dunes based on frequent data acquisition in the field and geospatial technologies.

Keywords: GIS, Coastal sand dunes, UAV, SfM