

Wind tunnel experiments on mega-ripple formation processes regarding to spray volume of coarse particles

KODAMA, Yoshinori^{1*}; HIROTA, Shizuka²

¹Fac. Regional Sciences, Tottori Univ., ²Tottori Bank

Mega ripples have been observed at one site in the Tottori Sand Dunes since 2013. At exposure area of ash and pumice layers in Tottori Sand Dunes, rill erosion occurs and aggregated coarse ash particles are supplied to sand surface. According to expanding of the exposed area of ash and pumice layers, supply rate of coarse particles increased. Mega-ripples could appear as a result of increase in supply of coarser particle to sand surface beyond a threshold value.

We made 9 cm wide, 60 cm deep and 7.28 m long wind tunnel for studying formation processes of mega ripples. Maximum wind speed attains 17.3 m/s. As for coarse particles, we selected polypropylene rounded particles (4 mm in diameter, 0.9 in specific weight). Fine sand particles were laid at 16 to 19 cm thickness and then polypropylene particles sparged over the sand surface. Considering results of preliminary experiments on bed-forms according to the volume of polypropylene particles scattered, we selected 45 g/m sparged rate of polypropylene particles for an initial experimental condition. 5 digital cameras were installed parallel to the wind tunnel to get longitudinal shape changes of bed-forms every 1 minute. Another camera recorded plane view of bed-forms particularly distribution pattern of coarse particles every 1 minute. We analyzed bed-form shape changes using these records.

Two types of transverse bed-forms were observed: one has short wavelength of 10 cm to 20 cm with steep erosional slope at stoss side and gentle slope at lee side (A-type), just opposite shape of normal wind ripples. The other has relatively long wavelength of 25 cm to more than 100 cm with a concave upward longitudinal shape (B-type). Coarse particles formed congested zones and smooth zones in successive way. In congested zones, fine sand particles were covered by coarse ones so that it was difficult to erode fine sand in these zones. On the other hand in smooth zones, fine sand particles were easily eroded. These processes form concave upward shapes: ridges and adjacent downward slopes were covered by coarse particles in both bed forms.

After 1 minute of the experiment, many A type bed-forms were formed, which coalesced each other into longer wavelength bed-forms. Within 20 minutes, A-types were decreased in number, instead B-type increased. Both bed-forms moved downwards, the maximum migrating speed of A-type attained 9 cm /min and an average migrating rate of B type was ca.4 cm/min. After 40 minutes, 5 or 6 mega-ripples were formed in the wind tunnel. Maximum wavelength was 115 cm and its height was 7.4 cm. Mega-ripples were formed in degrading stage of sand surface.

Keywords: mega-ripples, wind tunnel experiment, polypropylene particles, degrading stage of sand surface, Tottori Sand Dunes, exposure of ash and pumice layer