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Flume experiments on the isolated sand dunes under bidirectional flows across non-180 degrees angle: the formation process and resultant topography depending on the angular variation and intensity ratio

K. Taniguchi (1), N. Endo (2), and H. Sekiguchi (3)

(1) Osaka University (tani-k@astroboy.ess.sci.osaka-u.ac.jp), (2) Kanazawa University, (3) Kyoto University

A series of flume experiments aiming to understand the formation process of isolated sand dunes under bidirectional flows showed that the angular variation θ of two flows is the most effective on the resultant types of topography. The directional shift of sand movement due to the flow direction change led three kinds of deformation process depending on θ. The resultant topographies after repetition of bidirectional flows can be categorized into four types. As they are formed by one or two deformation processes and θ is the ruling parameter on the processes, it can be concluded that the angular variation is the dominant condition. On the other hand, the intensity ratio α influences only the shape of crest lines whether linear or crescentic, not effective on the kind of deformation process. In addition, particular topographies were formed under flows with 75, 90 and 180 degrees angular variation. Based on the results, a new diagram of relationship between dune shapes and conditions in respect to bidirectional flows is presented.