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The influence of dune lee side shape on flow above bedforms

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Dunes which develop in large rivers, in tidally-constrained environments (estuaries and tidal channels) and in open marine areas (e.g. continental shelf) commonly have gentle lee sides, and more rarely steep lee sides close to the angle-of-repose (30°). Lee side angle has a strong influence on the interaction between dunes and flow: over steep lee side angles (> ca. 25°), the flow separates and a strong turbulent wake is formed. Over intermediate angles (ca. 15 to 25°), flow separation is reduced or intermittent and the wake is small and weak. Over angles less than ca. 15°, there is no flow separation and only little turbulence produced.

However, the lee side is rarely made of a straight line with a constant angle. Instead, it usually varies, with gentler and steeper portions. Recently, it has been demonstrated that dunes in big rivers have their maximum lee side angle situated close to the trough. On the other hand, the lee side of estuarine bedforms is situated close to the crest. The influence of the position of the steepest slope on flow properties above bedforms is currently unknown.

To characterise it, many numerical modelling experiments were carried out to simulate flow properties (Reynolds-averaged velocities and turbulence) over low and high-angle dunes, with their steepest slope varying between the crest and the trough. The results show that the position of the steep portion on the lee side has an influence on flow properties over dunes.