

Bedforms

There are three basic classes of ‘classic’, unidirectional bedforms: ripples, dunes and antidunes. Each of these will be discussed at depth. However, moving sediment can generate a variety of different forms depending on the characteristics of the material and its substrate, which ultimately effect transport and bed morphology.

Barchan dunes



Occur when sediment supply is limited and the substrate is not erodible. Note the low-speed streaks in the photo.

Ripples

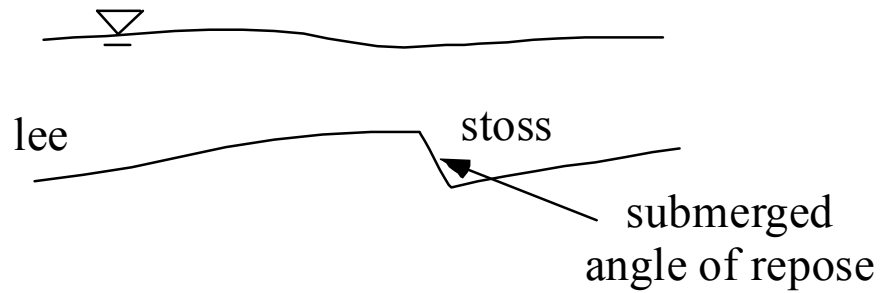


The cause of ripples is unknown. Stability analyses indicate that ripples can form by collective sorting processes, however, these analyses cannot explain the limited size range for ripples. Therefore, others have speculated that ripples are the result of a reinforcing instability related to the vortices in the viscous boundary layer.

Ripples

- generally only occur for well-sorted fine sand (50-500 μm) in water.
- are reasonably symmetric (as compared to dunes).
- do not represent a large increase in drag
- spacing appears to be strongly controlled by the viscosity of the working fluid, but not much else.
- propagate only downstream.
- become increasingly three-dimensional with time.
- do not affect the water surface or boundary layer thickness

Dunes

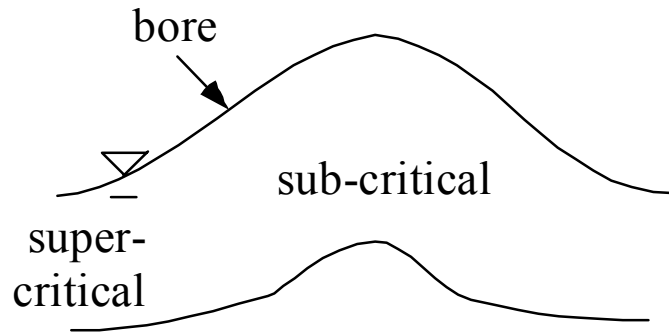


Dunes

- are very common.
- are asymmetric.
- are out-of-phase with the water surface elevation.
- have their 'downstream', or 'stoss', slope controlled by avalanching.
- are well-described by stability analyses.
- represent a significant contribution to drag.
- only propagate downstream.

Antidunes

Occur generally in shallow flows (small tidal streams, for instance). They are primarily a result of supercritical flow.



Antidunes

- can propagate either upstream or downstream.
- are generally more symmetric than dunes.
- are in phase with water surface.
- occur only for supercritical flow.
- are ephemeral.

Characterization of bed regime

Again, considerable work has been done by many researchers. In short, if one increases in the flow velocity in a channel, the progression of bedforms is (Southard and Boguchwal, 1990):

No motion => Ripples => Dunes => Upper-plane bed => Antidunes

However, there are many complications to this simple characterization. Boguchwal and Southard (1990) describe NINE variables that can affect the presence and appearance of bedforms. These variables related to the flow, the fluid and the sediment.

But for wide open-channels, of moderate depth (0.25-0.4 m), well-sorted, quartz grains, and fresh 10°C water, the relationship is simply a function of two variables –

