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What selects the wavelength at which subaqueous ripples form?

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Subaqueous ripples form by the same hydrodynamical instability as aeolian dunes. In both cases, the initial wavelength is controlled by the transport saturation length Lsat, which is, by definition, the length needed for the sediment flux to relax to its equilibrium state. Starting from the calculation of the turbulent flow over a wavy bottom, we show how the saturation length can be determined from initial wavelength measurements. It turns out that Lsat is proportional to the drag length $L_{\rm drag} = \frac{\rho_s}{\rho_f}\, d$ over almost five decades. This scaling law is based on existing and new measurements performed in water (subaqueous ripples), in air (aeolian dunes and fresh snow dunes), in a high pressure CO_2 wind tunnel reproducing conditions close to the Venus atmosphere and in the low pressure CO_2 martian atmosphere (martian dunes). In fact, this global scaling results from different dynamical mechanisms in the aqueous and aeolian situations. Accordingly, we investigate the origin of the saturation length in the different modes of transport.