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Channel formation by turbidity currents: Navier-Stokes based linear stability analysis BRENDON HALL, ECKART MEIBURG, Department of Mechanical Engineering, University of California, Santa Barbara, BEN KNELLER, Department of Geology & Petroleum Geology, University of Aberdeen
— The linear stability of an erodible sediment bed beneath a turbidity current is analyzed, in order to identify mechanisms for the formation of longitudinal channels. Based on the Navier-Stokes equations, the analysis accounts for the coupled interaction of the three-dimensional fluid and sediment motion with the erodible bed. For instability to occur, the suspended sediment base concentration profile needs to decay more slowly away from the sediment bed than the base flow shear stress. This destabilizing effect of the base flow is modulated by the stabilizing perturbation of the suspended sediment concentration, and by the shear stress due to a secondary flow in the form of counterrotating streamwise vortices. These are stabilizing for small Reynolds numbers, and destabilizing for large values. For a current height of 10m, we obtain a most amplified wavelength of about 250m, which is consistent with field observations. In contrast to previous analyses based on depth-averaged equations, the instability mechanism identified here does not require any assumptions about sub- or supercritical flow, nor does it require the presence of a slope.

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