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Emerging insights on the dynamics of submarine debris flows

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The recent large-scale investigation on the holocene Storegga slide area in the North sea has produced very precise data of unprecedented quality for the submarine environment.

It has thus become possible to statistically study a great number of distinguishable lobes in this area, and to try to simulate numerically the flow and emplacement of some of these lobes.

The statistical analysis reveals power-law scaling behavior of the runout distance with the release mass over many orders of magnitude. Mathematical flow models based on visco-plastic material behavior (e.g., BING) successfully reproduce the observed scaling behavior only for relatively small clay-rich debris flows while granular (frictional) models fail at all scales. For very large release masses, either hydroplaning or significant softening of the shear layer due to water incorporation must be invoked to recover the observed scaling behavior.

Simple extensions of BING indicate that either mechanism can potentially explain the observations with reasonable assumptions; better knowledge of the deposit distribution in the distal region of Storegga would help to discriminate between the two alternatives. Most likely, however, a combination of both effects will give the most realistic description of the phenomenon.

The BING model turns out to be a practical tool to produces a large number of results for our statistical studies. On the other hand, depth-integrated models like BING do not capture important features during the flow of the debris.

These can only be investigated by thoroughly solving the Navier-Stokes equations on a mesh. We present simulations of debris flows based on a fully fluid-dynamical

approach, which reproduce some of the observed features of the Storegga deposits as well as some of those observed in laboratory tests.