Waves due to sub-aerial slides in narrow waterways. Experiments and computational challenges.

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Abstract: In the last decade an unstable slope at Åkneset, in the fjord region of western Norway, has been thoroughly surveyed and it is currently under extensive monitoring. A slide with a volume up to 80 Mm^3 will be released some time in the future. Motivated by this event the University of Oslo and the Norwegian Geotechnical Institute have made an combined effort in experimental investigations and modeling of sub-aerial slides into fjords. Similar events may occur in Alaska, Chile, Greenland and alpine lakes.

The experiments have been performed in a 1:500 scale model of the fjord. This has a size 36 m × 40 m (18 km × 20 km in full scale), while the size of the slide is 2.25 m × 0.91 m × 0.16 m (40 Mm^3 in full scale). The impact velocity is estimated to 1.75, m/s (140 km/h in full scale). Surface elevations are measured with resistance and acoustic wave probes, point velocities with acoustic Doppler probes, while shoreline motions and velocity fields are obtained by digital image techniques.

From a modeling point of view such an event inherits important differences from an oceanic tsunami generated by an earthquake. First, a proper description of the generation requires some kind of primitive model with a free surface and moving slide. Next, the propagation of the leading waves in the fjord system is dispersive as well as nonlinear, which suggests a Boussinesq type models with standard or enhanced dispersion properties. Along the fjord the slopes are generally very steep (30° or steeper), which poses extra challenges for long wave models. On the other hand, the exceptional flat regions are the ones that are inhabited and here a robust and efficient inundation model is crucial. Finally, all the models must be combined and compared to measurements.

The group is presently working in parallel on processing and analyzing the experimental data, on the modeling of the slide impact and on propagation models. A number of the state of the art models have been tested and a various strengths and weaknesses have been unraveled. We may mention, for instance, artificial surface boundary layers which are present in some VOF models, while absent in other, and stability prob-

lems for high order Boussinesq models on steep slopes. The most relevant findings, in an updated version, will be presented at the conference.