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Modelling rockfall hazard in the Storfjorden area, western Norway

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The Storfjorden area (Western Norway, 360 sqkm) is highly susceptible to rockfall activity due to the deep incision of the fjords created by glacial erosion, resulting in sub-vertical cliffs more then 1000 m high. Rockfalls in these areas are widespread phenomena that can threaten both the few inhabitants of the valley, and the thousands of tourists who populate the fjord in summer and winter. A large pilot project funded by the Norwegian government in 2005 is ongoing on the area, including both regional mapping in the fjord area and site-specific investigations. We develop our activities within the framework of regional study, aimed at producing hazard and risk maps for the entire fjord region, mainly based on data collected by LIDAR and air-photos, geological field mapping (lithology, structural geology, landslide inventory) and multibeam and seismic data from the fjords. In order to model rockfall hazard at a regional scale, we used a 3D GIS-embedded numerical model (HY-STONE) to simulate the motion of blocks by a hybrid (mixed kinematic-dynamic) approach along a high-resolution 1m x 1m LIDAR 3D topography. We developed and compared a series of different simulations assuming as source areas: (1) about 40 sites identified as areas susceptible to major rock slope instabilities; (2) rocky areas with high slope steepness; (3) areas identified as potentially unstable, or recently failed, by the interpretation of aerial photos and site surveys. Based on geological field data, lithological maps and the results of air-photo analysis, we classified the source areas according to the estimated onset susceptibility. We developed 3D simulation models of the runout distance, intensity and frequency of rockfalls, with a variable onset susceptibility assigned to each source area. Rockfall trajectories interacting with existing roads, mountain tracks and buildings were analysed in detail. Moreover, we focused our attention on rockfalls falling directly on the fjord, that could potentially impact passing-by ships, trying to

delimit an unsafe belt along the shoreline. As a results we produced a hazard map in which we identify different zones to be regulated for the reduction of vulnerability and exposure of tourists.