

How can morphometric characteristics and failure conditions of a historic gully caused by intense rainfall be reconstructed?

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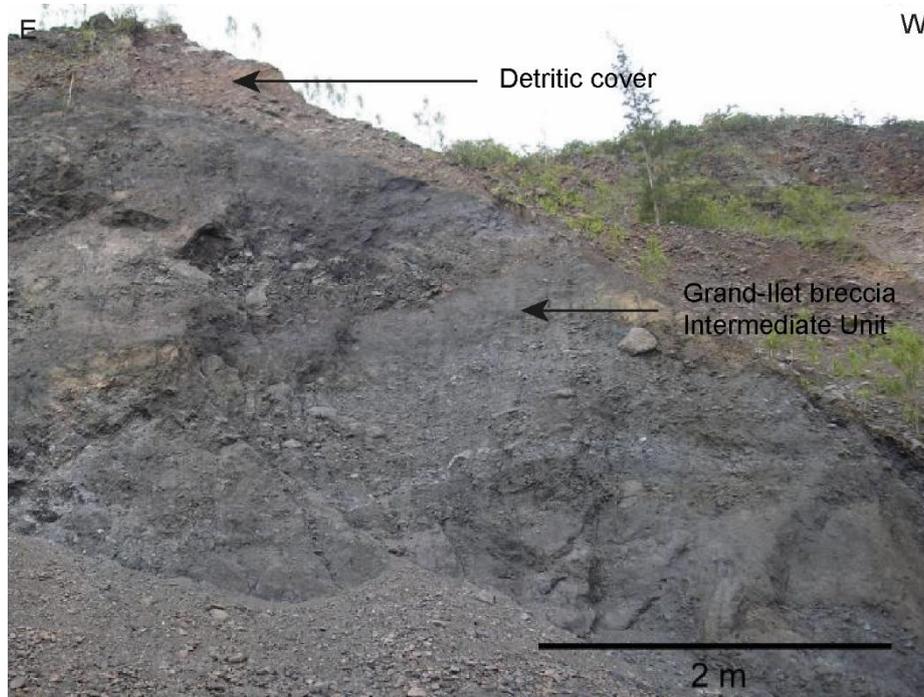


Figure S1. Unconsolidated coarse materials of the intermediate unit of Grand Ilet in the gully of the Ravine de l’Eglise.

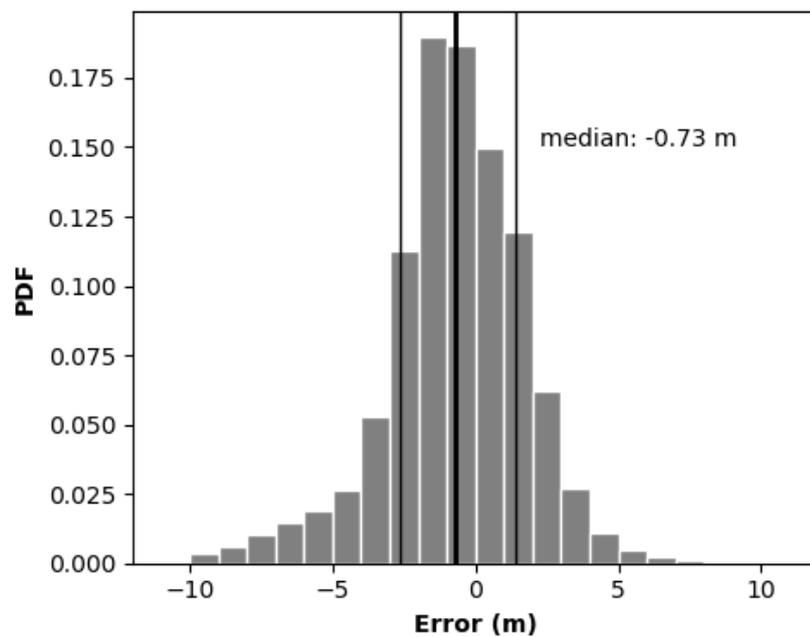


Figure S2. Histogram of elevation difference between 1978 and 1984 in Mare à Vieille Place over a stable area of $7 \times 10^5 \text{m}^2$. No major geomorphic changes occurred during Cyclone Hyacinthe in that location. The median (black vertical line) (-0.73 m) and the quantiles at 17% and 83% (gray vertical lines) are respectively -2.64 m and 1.42 m. The RSME is equal to 0.88 m and the median absolute deviation 1.45 m. The error in the estimation of the volume erased during the rainfall of Cyclone Hyacinthe is calculated using the RMSE multiplied by the surface of the area of interest.

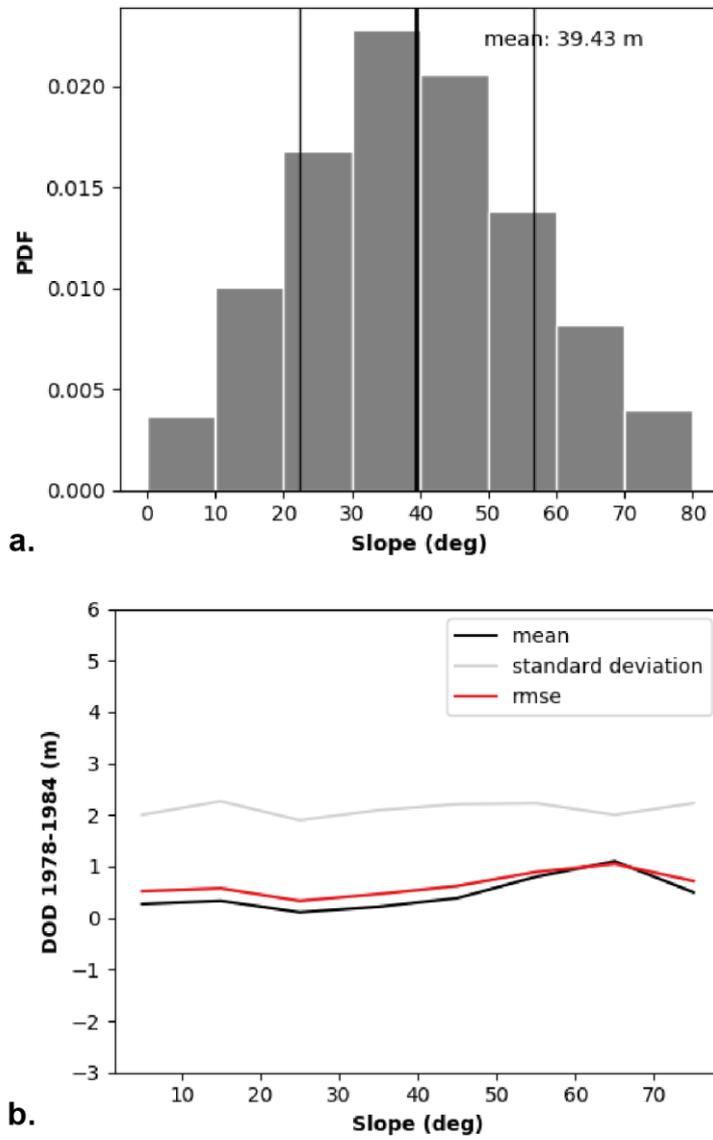


Figure S3. Estimation of the difference of elevation between the DSM 1984 and the DSM 1978 in Mare à Vieille Place (an area where no major geomorphic change occurred during Cyclone Hyacinthe). **(a)** Distribution of topographic slopes in the area considered. The mean and the mean ± 1 standard deviations are represented by the black and gray lines respectively. The mean slope is 40° with a standard deviation of 17° . **(b)** Mean, standard deviation and RMSE of the elevation difference between 1984 and 1978 as a function of slope bins. No major differences are observed as a function of the slope, meaning that the error in elevation difference can be uniformly evaluated without considering slope effect, at least for the slopes with angle below 50° .

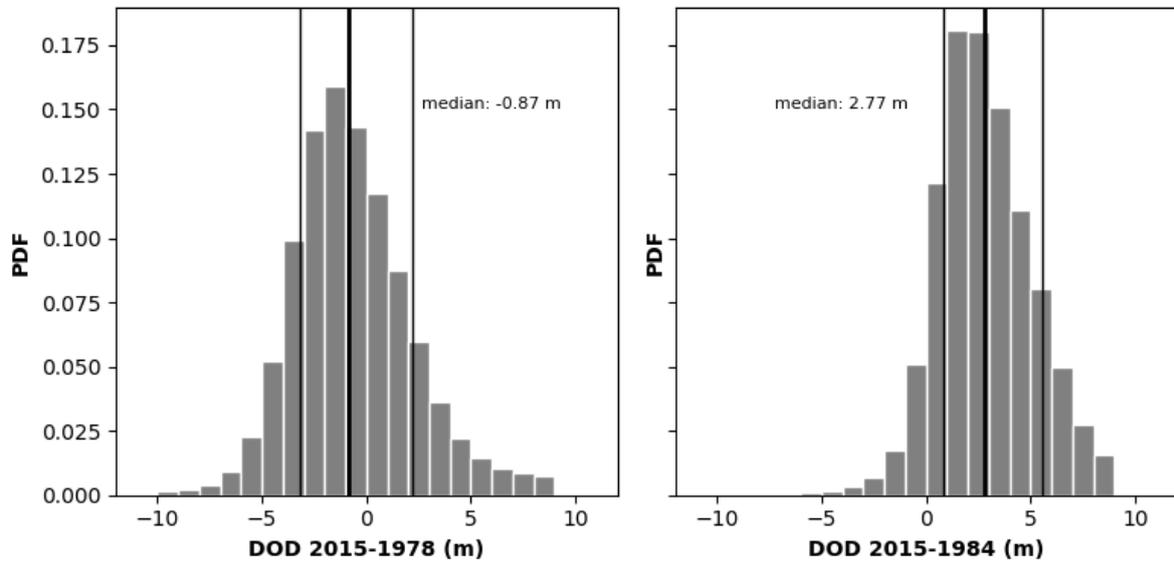


Figure S4. Histograms of elevation differences between photogrammetric elevation (a. 1978 b. 1984) with LiDAR of 2015 DTM at 1m resolution in Mare à Vieille Place over a stable area of $7 \times 10^5 \text{m}^2$. The black and gray lines represent the median and the 17% and 83% quantiles respectively. Quantiles 17% and 83% of difference equal to $[-3.16; 2.17]$ for 2015-1978 and to $[0.85; 5.52]$ for 2015-1984. The median absolute is 1.81 for 1978 and 1.59 for 1984.

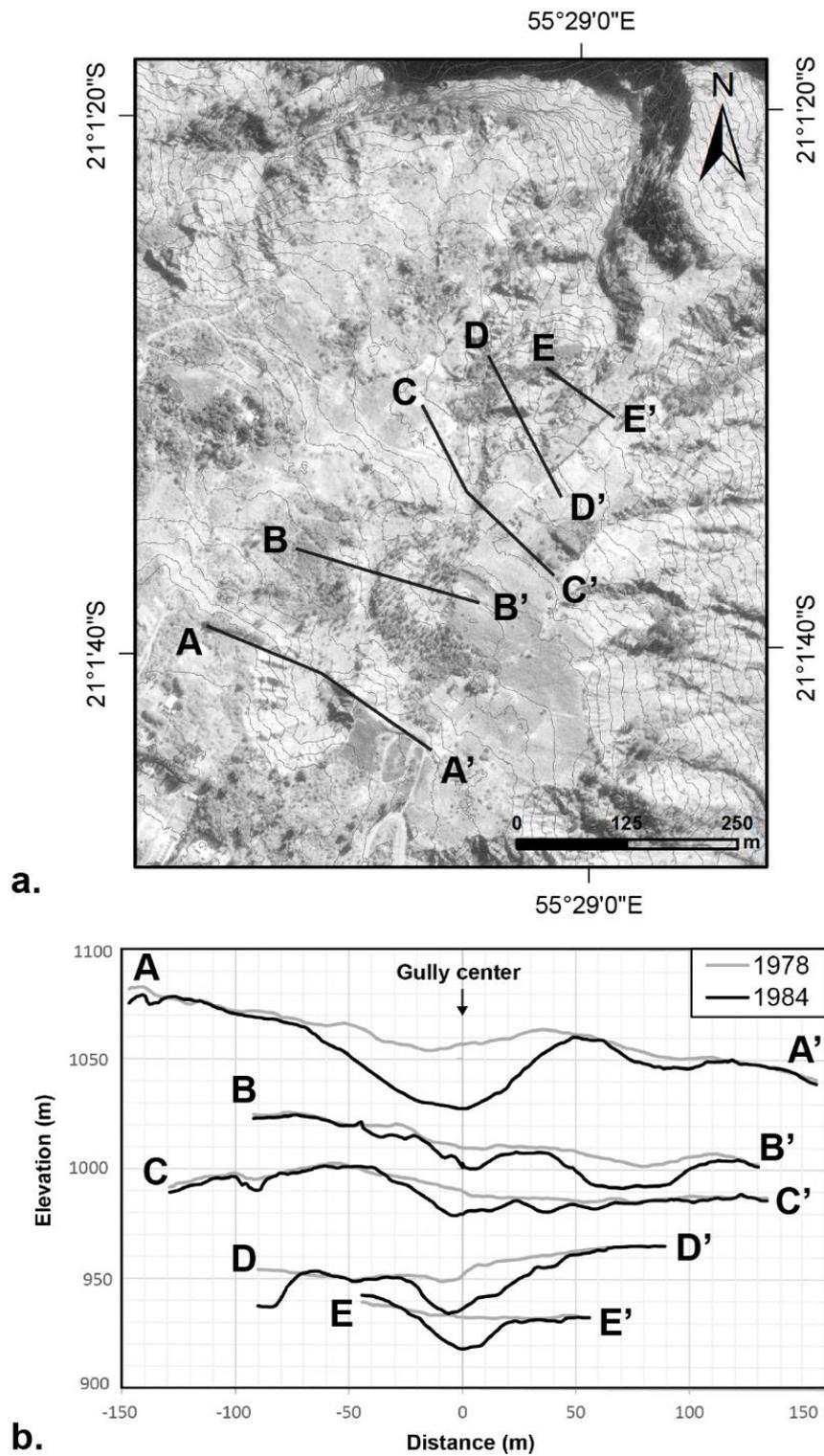


Figure S5. Transverse topographic profile of the gully of the Ravine de l'Eglise. (a) Topographic profiles of the Ravine de l'Eglise located on the orthophotography of 1984 with the 10m elevation lines of the 1984 DSM. (b) Topographic profiles of the gully of the Ravine de l'Eglise extracted from the 1x1 m DSM 1978 and DSM 1984.

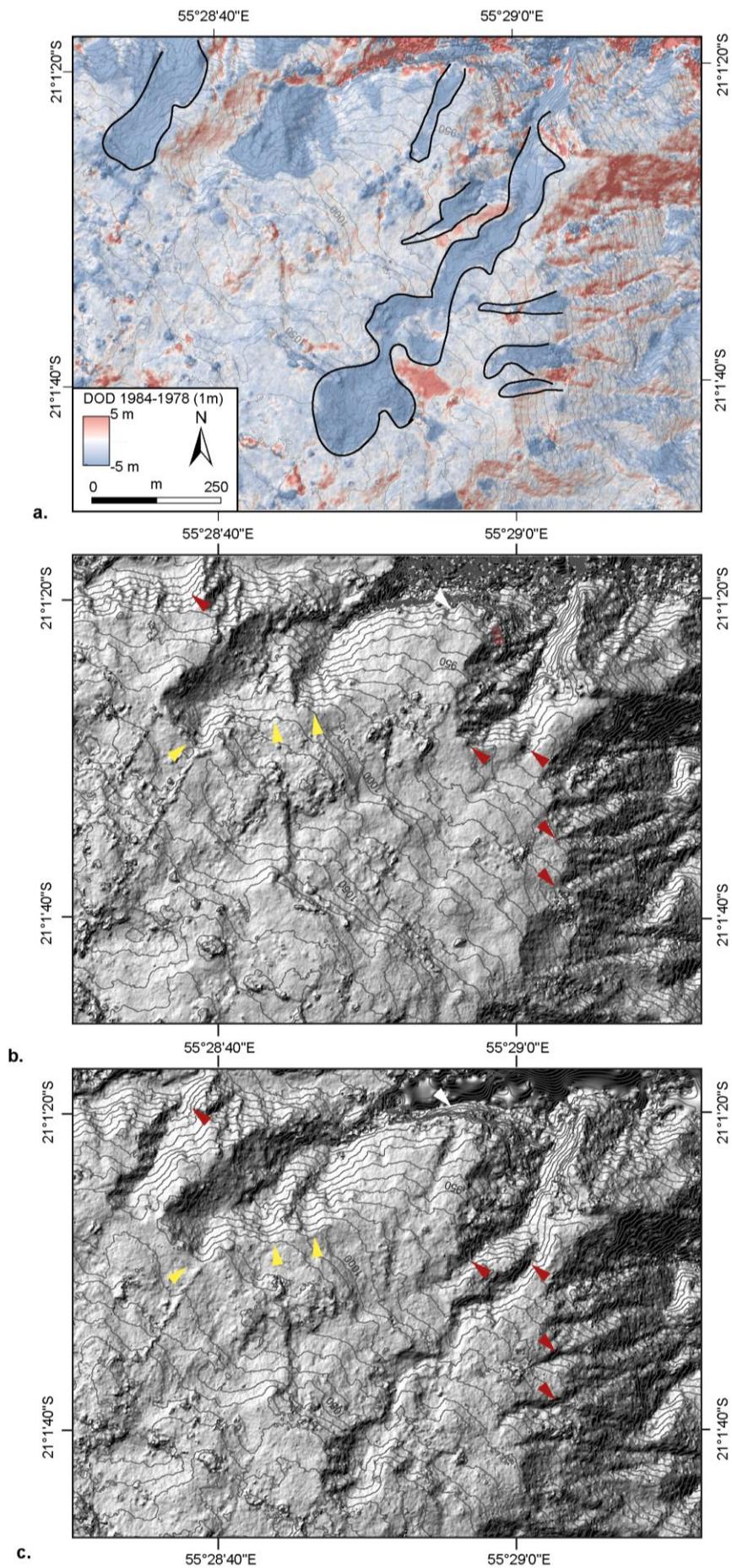


Figure S6. Morphologic changes caused by the heavy rainfall of Cyclone Hyacinthe (1980) on the north of the Grand Ilet plateau. **(a)** 1x1 m DOD comparing the DSM produced of 1984 with that of 1978. Dark blue and red marks reveal major geomorphic changes between these two dates. The black line delineates the gully formed by a déboulé. **(b)** Elevation contour lines of 1978 and **(c)** 1980 showing topographic depressions. Small and light depressions where most of the déboulé took place were already present in 1978. The red arrows show the areas where gully outlets were already present in 1978. The yellow arrows show areas where headward erosion occurred between 1978 and 1984.

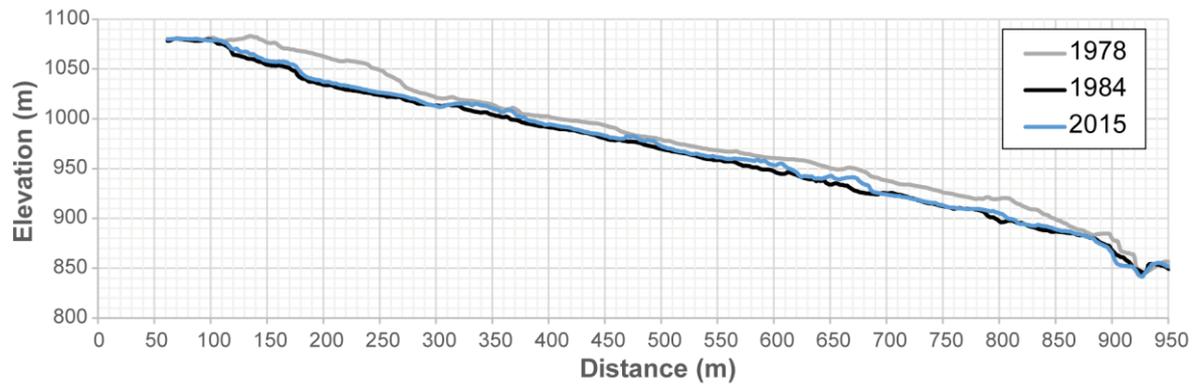


Figure S7. Longitudinal profile of the gully based on the 1978, 1984 and 2015 topographies. No major changes occurred between 2015 and 1984, demonstrating that the gully is stable.



a.
Figure S8. Evidences of landslide processes (a) in the Ravine de l'Eglise and (b) along scarp A-A'.