Report of Transnational Access Projects

(Note: the information here will be publicly disclosed in the Geo-INQUIRE website, do not include sensitive information)

Project ID: C3-TA2-531-3_2

Principal investigator: *Prof. Anne Mangeney (IPGP, Paris, France), https://www.ipgp.fr/~mangeney/*

Project team (if applicable): *Dr. Alexis Marboeuf, Dr. Clea Denamiel, Pr. Anne Le Friant*

Project title: *Simulation of LAndslide generated tsunamis in Mayotte*

Project acronym: *SLAM*

Hosting installation: *HySEA - Earthquake and landslide generated tsunami simulations (TA2-531-3)*

Hosting team: *Piero Lanucara (CINECA)*

Period of access: *No visit*

Report of activities:

The work done has consisted of various numerical simulations of landslide-generated tsunamis in Martinique, using the HySEA code developed in Malaga. In the first phase, we worked with a 100 meters resolution bathymetry and simulated a real-world scenario, seeking the best model parameters to better fit the deposit. Specifically, the following were varied:
- the characteristic length of the landslide grains;
- the landslide-water drag coefficient;
- the landslide volume fraction;
- the friction angles;
- the landslide rheology.

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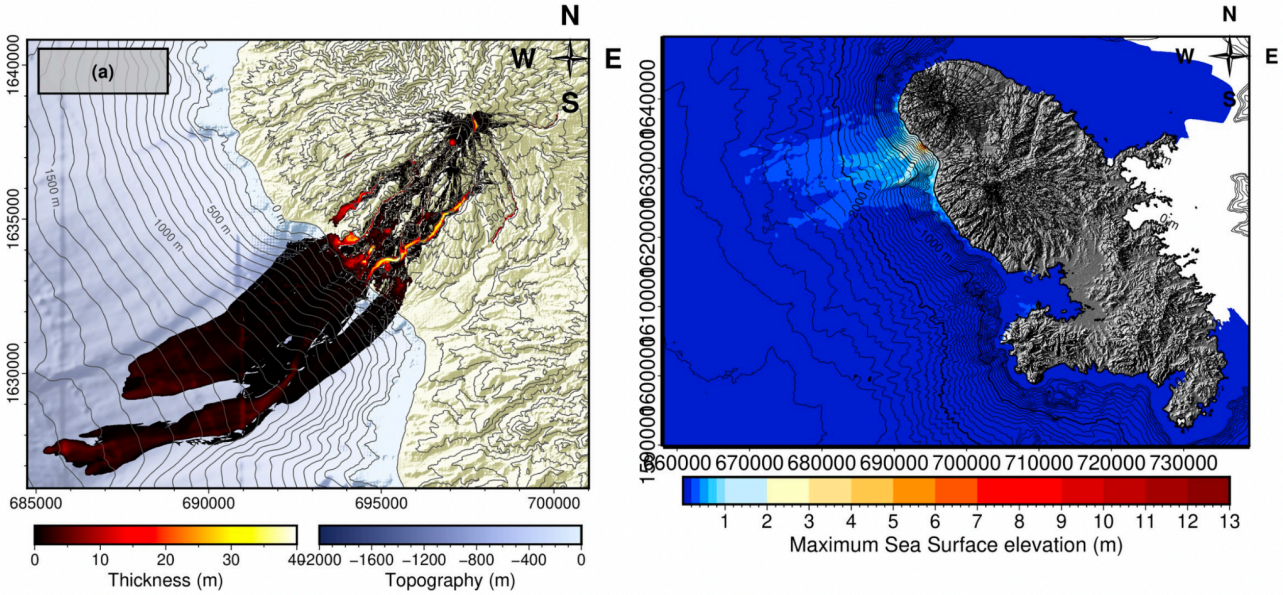
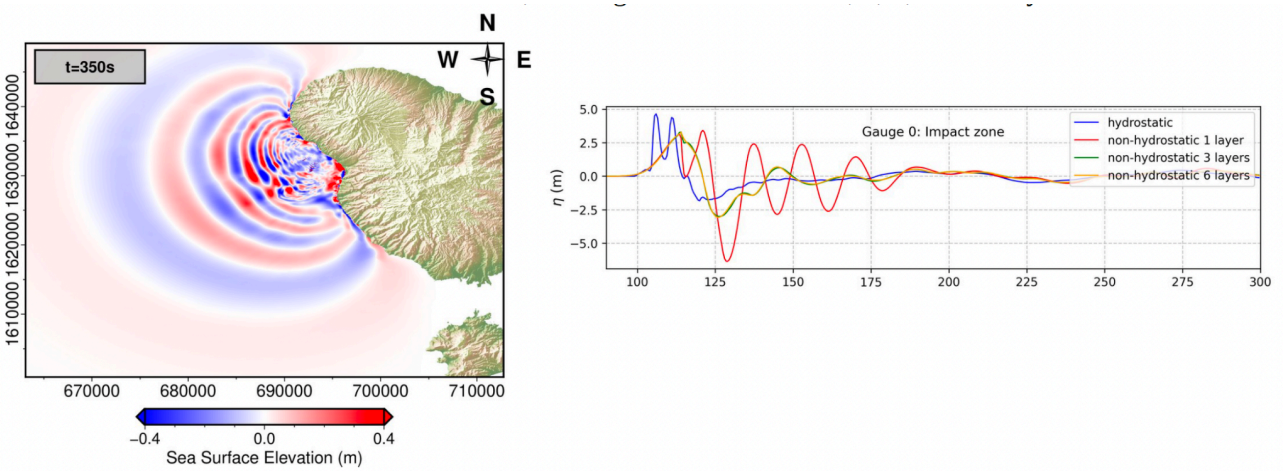


In a second phase, a 10 meters resolution bathymetry was available; the simulations were then repeated on this bathymetry to evaluate the effect of grid spacing. In a third phase, the calibration performed on the first scenario was used on two other scenarios, which had not yet occurred and were therefore probabilistic. Since these are the scenarios of interest for hazard assessment, we moved on to analyze the part of the code relating to water in more detail. In particular:

- we studied the role of the hydrostatic approximation and observed the difference in the wave produced when this assumption was relaxed;

- we studied the role of water stratification, running simulations with 1, 3, 6, and 10 layers.



In addition to simulations in Martinique, a surrogate model was applied on the Mayotte configuration. A few zones of interest were selected, in particular on the Mayotte coral reef presenting slope instabilities. A surrogate has been built on each of these zones. A total of 1035 simulations were conducted.

The first challenge was to build numerous scenarios across these different zones, i.e. across different local topo-bathymetric configurations. Given the number of scenarios, the process has to be done automatically. A geometric method, based on an ellipsoidal 3D surface and a parametric optimization, has been developed and implemented (see Figure 5). The method creates a failure surface at a given location corresponding to a falling mass of a given volume.

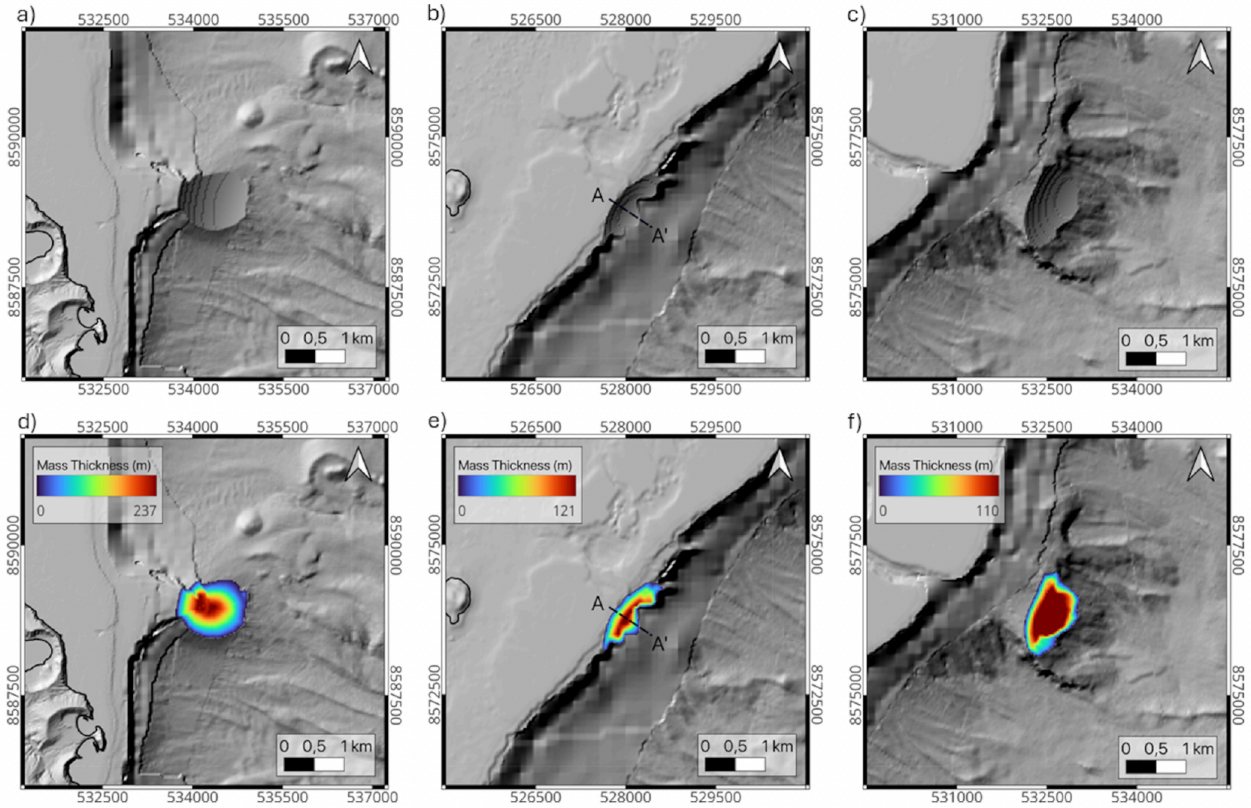


Figure 5. Illustration of three failure surfaces **(a, b, c)** and the corresponding mass thicknesses **(d, e, f)** created by the algorithm, superimposed to the topo-bathymetry at 30 m resolution: **(a, d)** simulation 124 from Piton Offshore ($V = 88.84 \times 10^6$ m^3), **(b, e)** simulation 0 from Mayotte South ($V = 25.5 \times 10^6$ m^3) with the cross section AA' displayed in Fig. 6 and **(c, f)** simulation 114 from Mayotte Offshore ($V = 71.84 \times 10^6$ m^3).

The scenarios were all simulated using HySEA and the results fed the surrogate model. The surrogate is able to predict within seconds the maximum water height, maximum velocity and arrival time of waves at preselected locations in Mayotte, enabling fast and transparent probabilistic tsunami hazard assessment. The friendly user interface is presented in Figure A3. This work has been published in GMD and was presented at the EGU General Assembly in 2026.

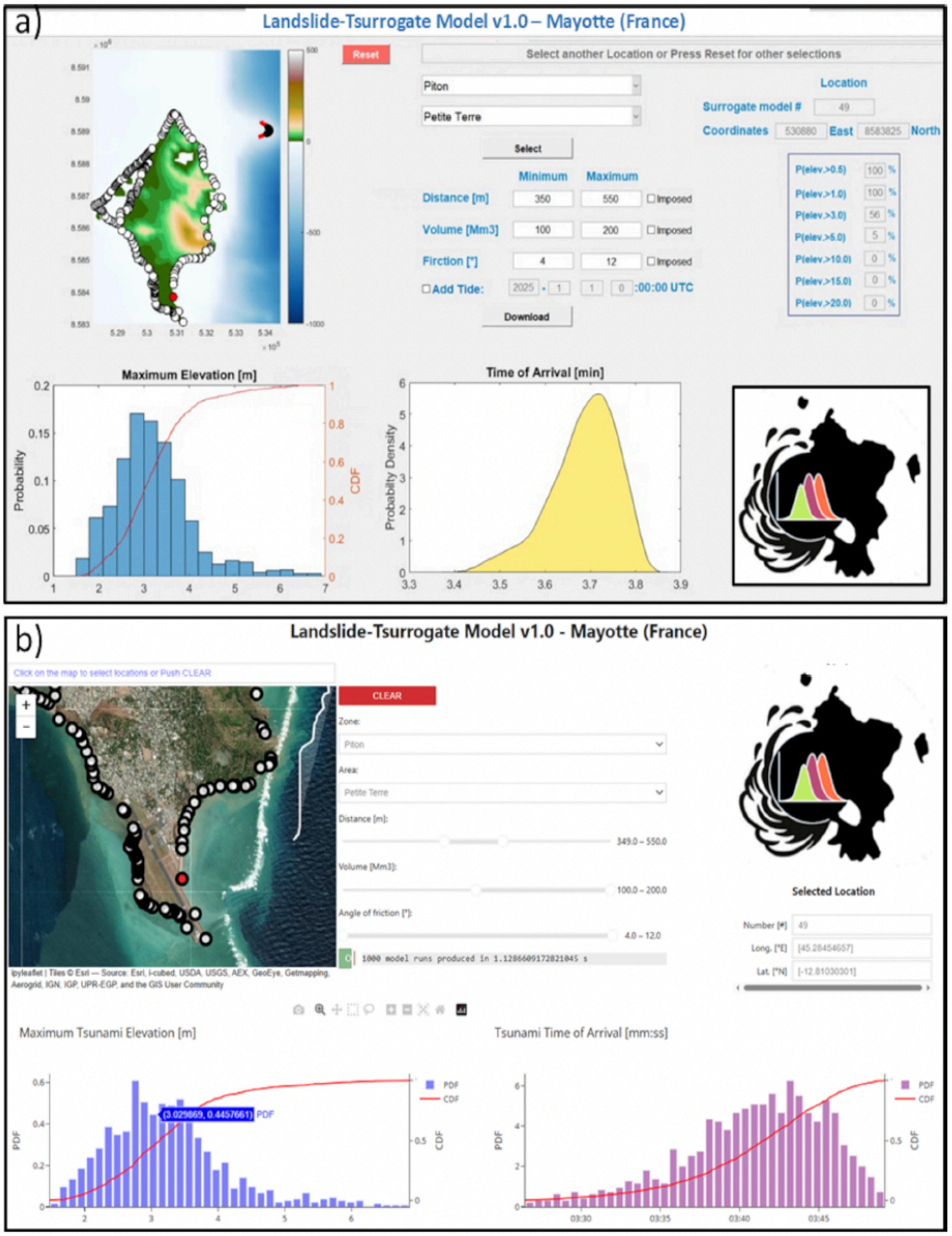


Figure A3. Example of Landslide Probabilistic Tsunami Forecast (PTF) user-friendly interfaces for the Mayotte test case: (**a**) developed in MATLAB and distributed as program files for experts or as a Windows installer (.exe) for non-experts and (**b**) developed in Python and distributed as Jupyter Notebook for experts or deployed as a web application through Voilà for non-experts. Sources: Esri, i-cubed, USDA, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the Gis User Community | Powered by Esri.

Project outcomes:

Denamiel, C., Marboeuf, A., Mangeney, A., Le Friant, A., Peruzzetto, M., Lucas, A., Castro Díaz, M. J., and Fernández-Nieto, E.: Landslide-Tsurrogate v1.0: a computationally efficient framework for probabilistic tsunami hazard assessment applied to Mayotte (France), Geosci. Model Dev., 19, 3075–3107, https://doi.org/10.5194/gmd-19-3075-2026, 2026.

Denamiel, C., Marboeuf, A., Mangeney, A., Le Friant, A., Peruzzetto, M., Lucas, A., Castro Díaz, M. J., and Fernández-Nieto, E.: Towards digital-twin-enabled tsunami hazard assessment: Landslide-Tsurrogate v1.0, EGU General Assembly 2026, Vienna, Austria, 3–8 May 2026, EGU26-4898, https://doi.org/10.5194/egusphere-egu26-4898, 2026.

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