A telescope based on Scintillator technology for assessing massive rock falls – la Reunion island

Simon Bouteille, Catherine Truffert – IRIS Instruments

Nicole Huebert, Benoit Le Moigne, Kevin Samyn - BRGM

Jacques Marteau – IP2I Lyon

Geological context

- La Réunion, a volcanic island in the Indian ocean
  - An active volcano at the east
  - An extinct one at the west
    - Three cirques formed by erosion and collapse
- The west part of the Mafate cirque
  - 800m high steep Maïdo cliff
  - Small village (Roche-Platte)
  - Large wildfire in late 2020
  - Top of the cliff is fractured in the first 100m
  - Risk of boulder fall for the houses below
  - Trajectography simulations made by the BRGM to asses the risk
  - Need to better understand the top of the cliff to guarantee the security of the inhabitants
- Questions to answer
  - How deep and large are the fractures
  - What are their shape
  - What is the role of the rock water dynamics content for the stability of the structure

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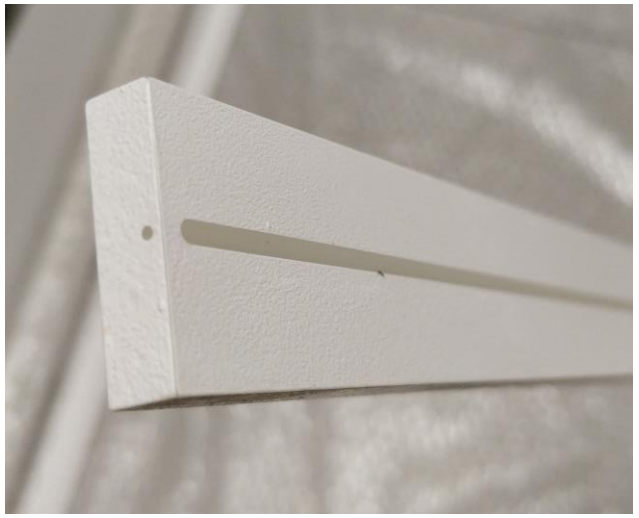
Instrument technology

- Scintillator based instrument
  - Developed by IP2I/Lyon
  - Similar to instruments deployed by DIAPHANE (Guadeloupe)
  - 2.5 × 80cm scintillator bars (32 by plane)
  - 80 × 80cm active area consisting of 3 detecting planes
  - 63° field of view
  - Fully autonomous (40W)
- Mechanical structure revised by IRIS
  - Industrialisation of the instrument
- Use of 150kg of steel for electron shielding



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Field test presentation

- First tests at BRGM premises showed the instrument did not suffer from transport
- Installed in the forest officer shelter in Roche-Platte
- Village is isolated from common services
  - Electrical supply by shelter solar panels with battery and inverters
  - Additional battery buffer to power the instrument
  - Network connection through 4G (ISP antenna at the top of the cliff)
  - No road network : instrument was brought by helicopter
- Data taking is ongoing since 23/11/2021
  - Interrupted during Batsirai hurricane (power failure in early February 2022)
- 30M muons reconstructed so far

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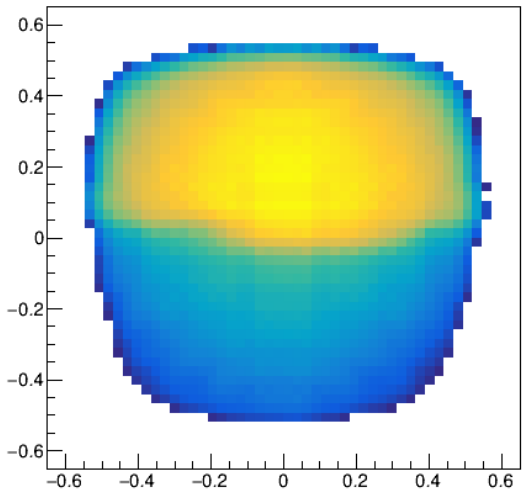
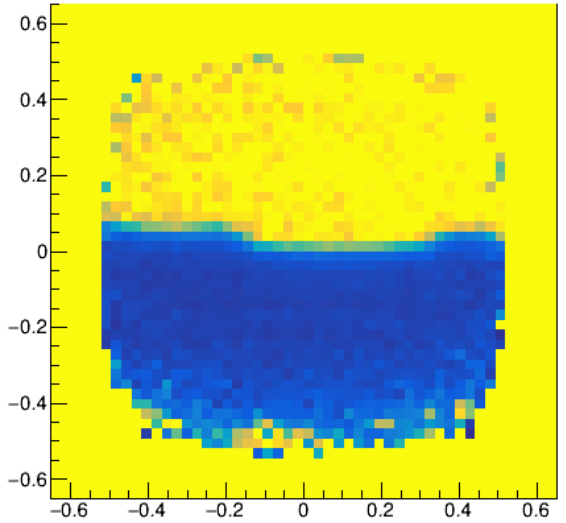
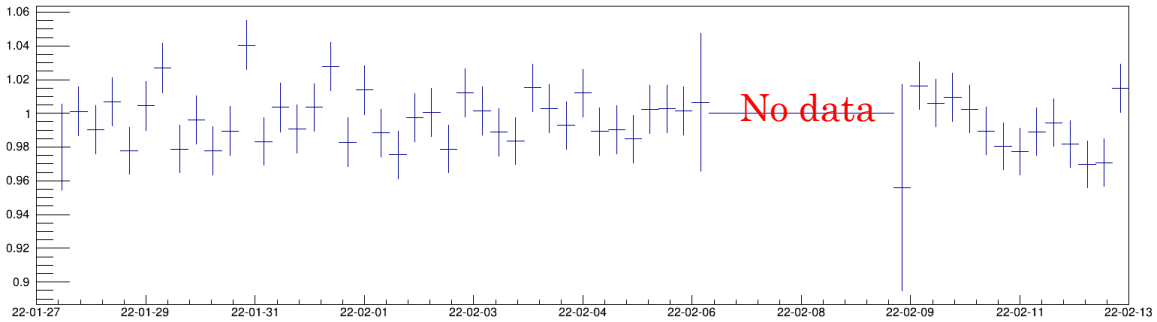
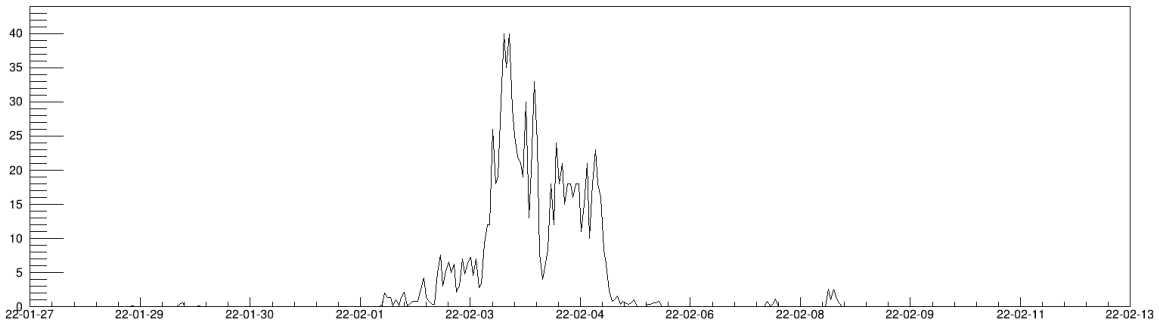
Results

- Calibration run made on site pointing away to the cliff
  - 24h of data
- Data consists of 5 months of data taking
  - 30M muons
- Results are still preliminary since the analysis is ongoing
- At this point it is not possible to clearly assess the mean density variations
  - Computation of the muon path length through rock is ongoing thanks to the precise DEM
- Pluviometry data from the Batsirai event might show water content variations
  - Muon relative flux seems to steadily decrease after the event as if the water is drained from the rock
  - Unfortunately the lack of data just after the hurricane seems crucial









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Future of the mission

- Data taking is prolongated
  - At most to november 2022
- Data analysis is only at the beginning
  - Need of correlation to meteorological data
    - In particular to rainfall
  - Other survey has been conducted at the top of the cliff
    - Extensometer installed in the fractures
- If the risk is confirmed, the instrument can be moved
  - New point of view
  - For instance closer to the cliff to better scan the bottom

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Conclusion

- Thanks to all the team in continental France and in the Reunion island the mission is a success so far
- This proves that the industrialisation of such instrument was correctly done
  - It will be on the market soon
- Industrial grade instruments bring the muography closer to being in the standard toolbox of geophysicists

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