

## Point-by-Point Response to Reviewer 2

We thank Reviewer 2 for the valuable feedback on the manuscript. The comments are reproduced below in blue Arial fonts, with our responses and indications of how we have revised the manuscript indicated in black.

The manuscript presents a **comprehensive, technically rigorous modelling study** of seismic and tsunami signals expected along the planned Tamtam SMART subsea cable between Vanuatu and New Caledonia. It integrates **finite-fault rupture models, non-hydrostatic tsunami simulations, and synthetic long-period seismic waveforms** to inform sensor design and hazard monitoring. The work is **timely, regionally relevant, and methodologically sound**, with clear implications for early warning and emergency management.

**A strong, well-structured, and impactful study** that significantly advances the scientific and operational case for the Tamtam SMART cable. The modelling is robust, and the results are highly relevant for hazard monitoring. The main limitations relate to **the simplified seismic structure, the lack of short-period motion analysis, the absence of uncertainty quantification and inundation**. Addressing these would elevate the work to a fully comprehensive hazard-assessment reference.

The paper clearly establishes the need for offshore instrumentation in a region with frequent MW 7.5+ earthquakes and limited on-land coverage. The combination of finite-fault slip models for historical and maximum scenarios, NEOWAVE non-hydrostatic tsunami modelling, and SYNGINE long-period seismic synthetics provides a multi-hazard, multi-scale view. The spectral analysis shows that the planned sensor sites lie outside energetic antinodes, ensuring clean tsunami recordings. The study provides arrival times, amplitudes, and spectral content for both seismic and tsunami signals, directly supporting VMGD and NDMO operational planning. The inclusion of three recent major events (2013, 2021, 2023), five MW 8.33 subevents, and a full MW 8.8 maximum scenario provides a broad parameter space for hazard assessment. The manuscript quantifies P-wave detection arrivals, surface-wave windows for magnitude estimation, and tsunami arrival times (~1 hour for distant events; 11–18 min for local sources). This is directly actionable for early warning system design.

Seismic modelling uses a **1D PREM-based model, which limits realism for path-dependent amplification, basin effects, and sediment-induced resonance**. The authors acknowledge this but do not quantify potential biases. A 1-D model assumes smooth, radially symmetric velocity gradients. The region contains thick sedimentary basins, volcanic arcs, subducting slabs and strong velocity contrasts across the trench. The use of a 1D PREM-based velocity model introduces predictable biases because it cannot account for the strong lateral heterogeneity of the Vanuatu subduction system. These include potential misestimation of ground-motion amplitudes ( $\pm 20$ – $50\%$ ), arrival-time errors (5–20 s for surface waves), incorrect surface-wave dispersion, and the absence of basin or trench resonances that influence waveform duration and coda. The resulting synthetic seismograms are likely smoother and less complex than real observations, with underestimated high-frequency energy and path-dependent amplification. Quantifying these biases, even approximately, would strengthen the interpretation of seismic modelling results and clarify their implications for SMART cable sensor performance and early warning applications.

We have expanded on the limitations of using 1-D PREM-based synthetics, which are reasonable for long-period ground motions but lack path-specific effects for shorter period seismic waves,

while noting high resolution 3-D regional structure that would enable more accurate predictions of motions are not available.

The study explicitly avoids predicting **velocities/accelerations**, yet these are critical for sensor survivability, on-scale recording and sediment–structure interaction. Short-period ground motion (typically 0.1–10 Hz) controls peak ground acceleration (PGA) and peak ground velocity (PGV), which are the high-frequency shaking that can **clip**, **saturate**, or **damage** sensors. Without short-period modelling, the magnitude of this interference is unknown. The manuscript models only long-period displacement (>15 s), which is too slow for early warning.

Predicting useful ground velocities and accelerations for hypothetical earthquakes is not viable without accurate model structure and instrument characterization, neither of which is currently available. We have pointed out in Section 4.2 that it is possible to exploit the abundant regional seismicity to calibrate paths and short-period ground motion behavior after the cable and sensors are in place. We recognize this limitation and removed “to inform system design and data integration” from the title to better reflect the materials presented in the paper.

The modelling lacks sensitivity tests, parameter uncertainty bounds, and probabilistic outputs that provide hazard context. Add uncertainty and sensitivity analyses through slip distribution variability, rupture velocity, bathymetric perturbations and manning roughness sensitivity. Even a simplified 3-D model (regional tomography) would improve amplitude accuracy, arrival-time realism, and surface-wave dispersion.

The structure and high frequency character of calibration effects are not known to a degree that would warrant comprehensive modeling and variability assessment for a probabilistic approach. It is unclear how extensive modeling efforts would translate into improved data implementation planning, as many other factors play into those decisions.

Although the manuscript references the regional DART buoy network from New Zealand and the ORSNET land-based seismic stations, these datasets are not used to validate or calibrate the synthetic tsunami or seismic waveforms. This omission is important because both datasets provide real observations of tsunami propagation, spectral content, and seismic waveforms in the region. Without even a basic comparison between synthetic and observed signals, the reader cannot assess the accuracy of the modelling framework, the realism of the assumed rupture parameters, or the reliability of the predicted amplitudes and arrival times at the SMART-cable sites. Incorporating DART and land-seismic constraints—or, at a minimum, quantifying the expected mismatch—would substantially strengthen confidence in the synthetic results and their application to early-warning system design. The MW 8.8 scenario is hypothetical. Its credibility depends on showing that the modelling framework reproduces the 2013 MW 8.0, the 2021 MW 7.7 and the 2023 MW 7.7 events.

Extensive modeling of global seismic and regional tsunami observations was incorporated in the source model determinations for the 2013, 2021 and 2023 events, as reported in the cited publications. The finite fault models from those studies are used here and the same NEOWAVE code utilized for the scenario events was used in the earlier source studies. We have modified Section 2.1 to emphasize the source models of the three recent events have been inferred from global seismic and regional DART recordings and independently validated with tide gauge data. This will increase confidence on their use in generating synthetic tsunami and seismic waveforms at the planned SMART cable site. We also pointed out in Section 4.2 that the same modeling

approach provides a framework to evaluate future SMART sensor records using finite fault models derived from global seismic and regional DART data.

Without inundation modelling, the hazard interpretation for communities is incomplete. Even coarse inundation maps would strengthen the emergency-management relevance.

The goal of this study is to place first-order bounds on the travel times and waveforms of tsunami and long-period seismic signals that may be observed at the Tamtam cable sites. The paper also includes tsunami amplitude predictions for the recent major earthquakes and maximum scenarios that can aid emergency management in the region. Whether sufficient, quality bathymetry exists anywhere along the island chain for accurate inundation modeling is unclear (and unlikely for most islands). We have pointed out in Section 4.1 that acquiring nearshore bathymetry for inundation mapping, even at low resolution, is a logical next step to strengthen emergency management in the region.