Geophysical research Letters

Supporting Information for

Tsunami Source of the 2021 M_W 8.1 Raoul Island Earthquake from DART and Tide-gauge data inversion

F. Romano[1], A. R. Gusman[2], W. Power[2], A. Piatanesi[1], M. Volpe[1], A. Scala[2], and S. Lorito[1].

[1]Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, 00143, Roma, Italy.

[2]GNS Science, Lower Hutt, New Zealand.

[3] Department of Physics ''Ettore Pancini'', University of Naples, Naples, Italy.

Contents of this file

Additional Supporting Information (Files uploaded separately)

Tables S1 – Table_S1.xlsx
Tables S2 – Table_S2.xlsx
Tables S3 – Table_S3.xlsx

Introduction

Here we describe the synthetic resolution test performed to verify if the fault geometry discretization and the instrumental azimuthal coverage used in this study is suitable for solving for the slip distribution (Text S1).

We also include additional Figures:

- representing the fault model used in this work with the subfaults colored based on the depth variation along the fault surface (Figure S1)
- resolution test (Figure S2)
- showing the slip distribution of the Raoul Island earthquake estimated in this work with super imposed the marginal distribution of the slip values explored during the inversion (Figure S3)
- showing the marginal distribution of the time-shift values explored during the inversion for each tsunami sensor (Figure S4)
- showing the slip distribution of the Raoul Island earthquake inverting a) 2 DARTs within 60 min of the OT and b) 3 DARTs within 90 min of the OT

We also include as separate files the tables containing information about

- The tsunami sensors used (Table S1)
- The fault geometry (Table S2)
- The estimated Slip model (slip, rake and errors) (Table S3)

Text S1.

A resolution test was performed to verify if the fault geometry discretization and the instrumental azimuthal coverage used in this study is suitable for solving for the slip distribution. The "target" slip model is a checkerboard slip pattern of 0 and 10 m alternated on adjacent large blocks composed of 9 subfaults (3x3, Figure S2a). Before calculating the synthetic waveforms, the simulation grids were perturbed by adding a random Gaussian noise (with mean = 0 and variance = 9 m), to mimic inaccuracies of the bathymetric models that we used in the inversion of real data. A random Gaussian noise (mean = 0, variance of 10% of the clean signal) was then added to the synthetic tsunami waveforms. Finally, a random shift from a uniform distribution between 0 and 10 minutes was applied to each waveform.

The result of the inversion (Figure S2b), as well as the comparison between the target and predicted tsunami waveforms (Figures S2c) are satisfactory. Despite an azimuthal gap in both the directions perpendicular to the strike and particularly eastward, as compared to the coverage in the along-strike direction (Figure 1 in the main text), the instrumental coverage used in this study is in principle appropriate for estimating the slip distribution of the Raoul Island earthquake.

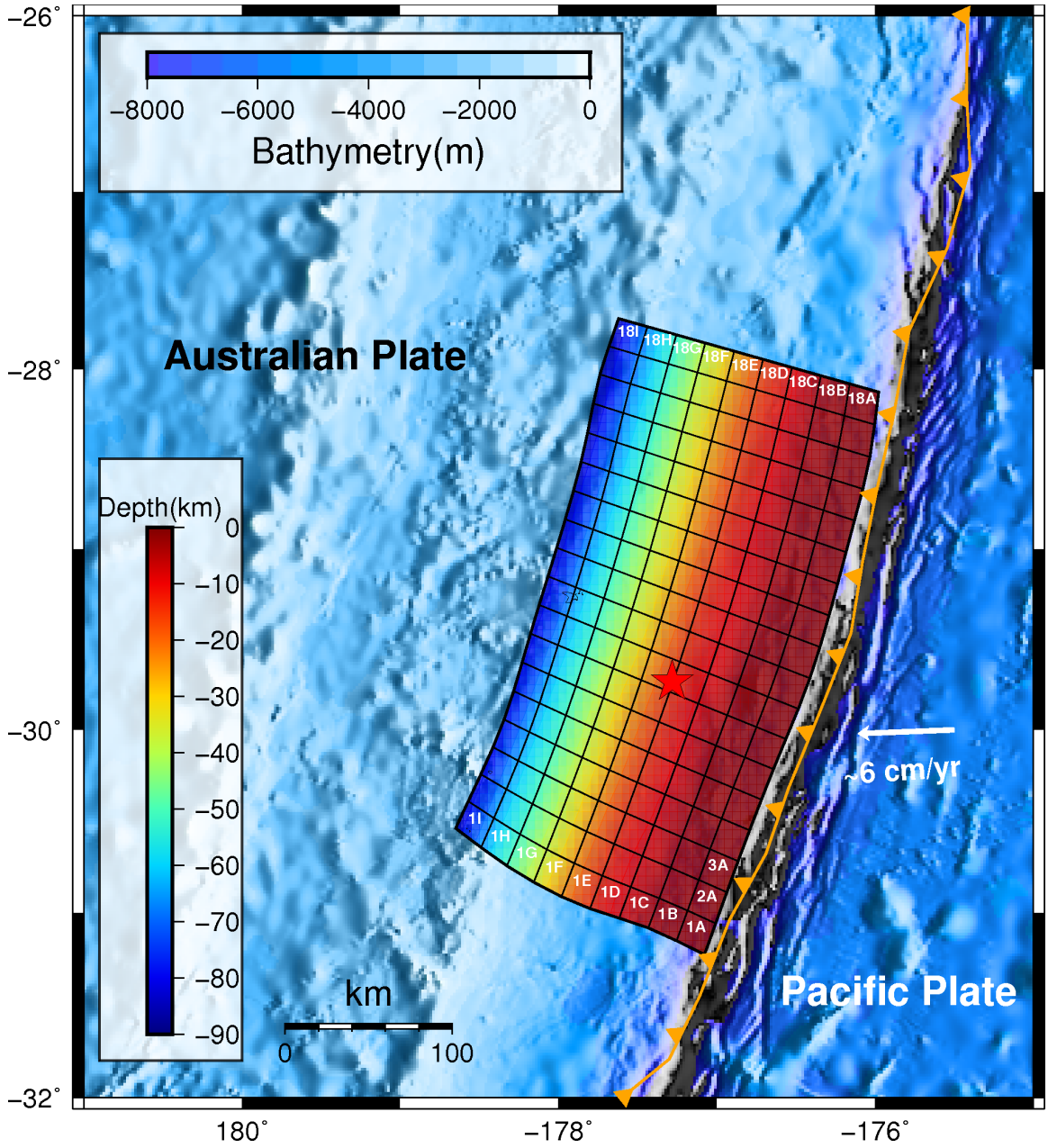
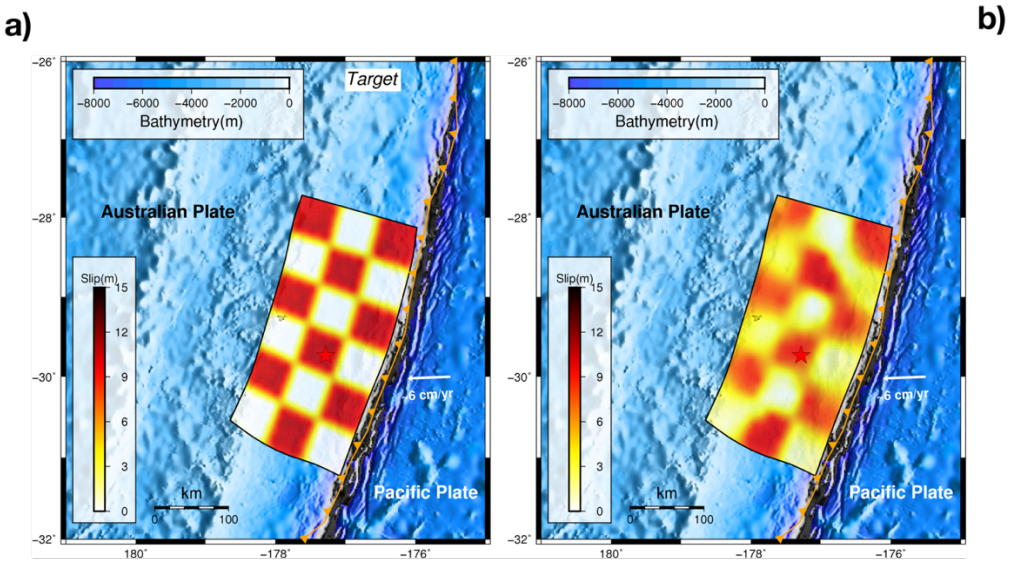


Figure S1. The fault plane is tessellated with 162 subfaults with a size of ~18x18km. The subfaults are progressively ordered from the southernmost shallowest to the northernmost deepest. The subfaults numbering follows that in Table S1, in order to

associate the position on the map to the slip values. Color bar indicates the depth variation along the fault surface. Red star indicates the epicentre position.



c)

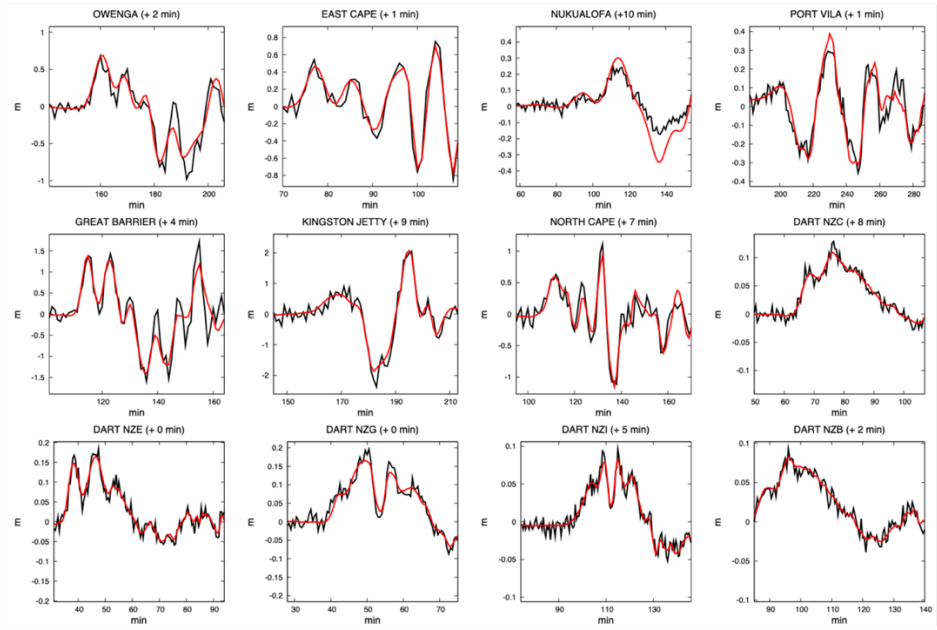


Figure S2 – Synthetic test – a) Target slip model; b) estimated slip model after inverting tsunami waveforms; c) comparison between target "observed" (black) and predicted (red) tsunami waveforms.

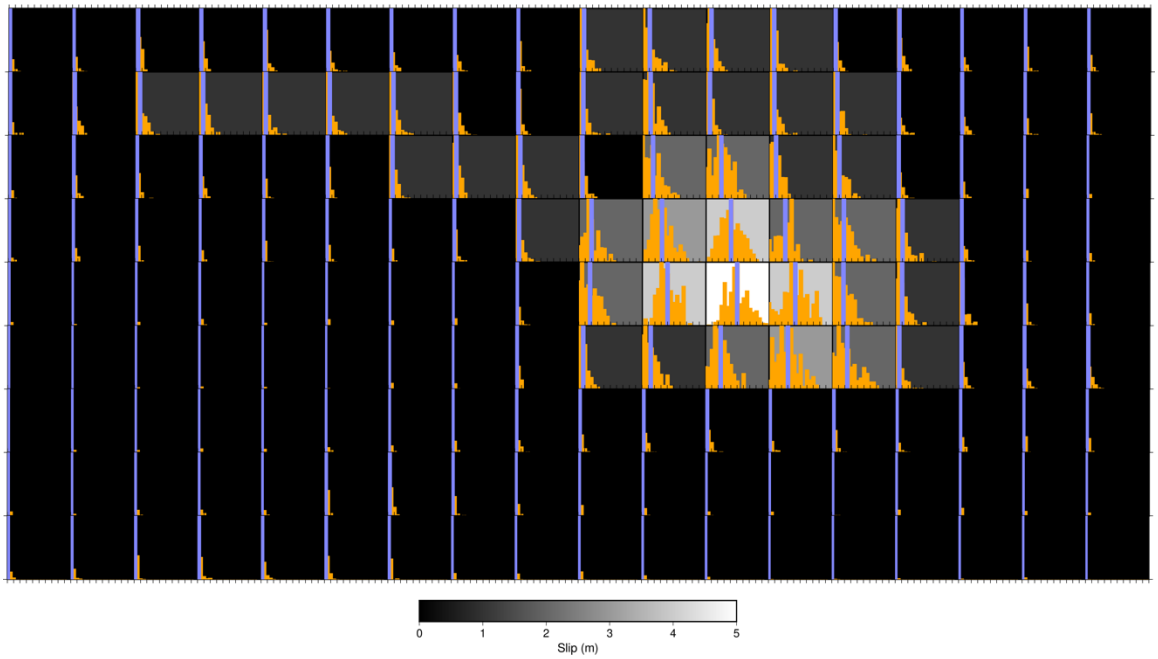


Figure S3. The slip distribution of the 2021 Raoul Island earthquake obtained by the inversions of tsunami waveforms (Figure 3a in the main text); onto each subfault is super

imposed the marginal distribution of the slip values explored during the inversion (in orange); vertical blue lines indicate the average slip model.

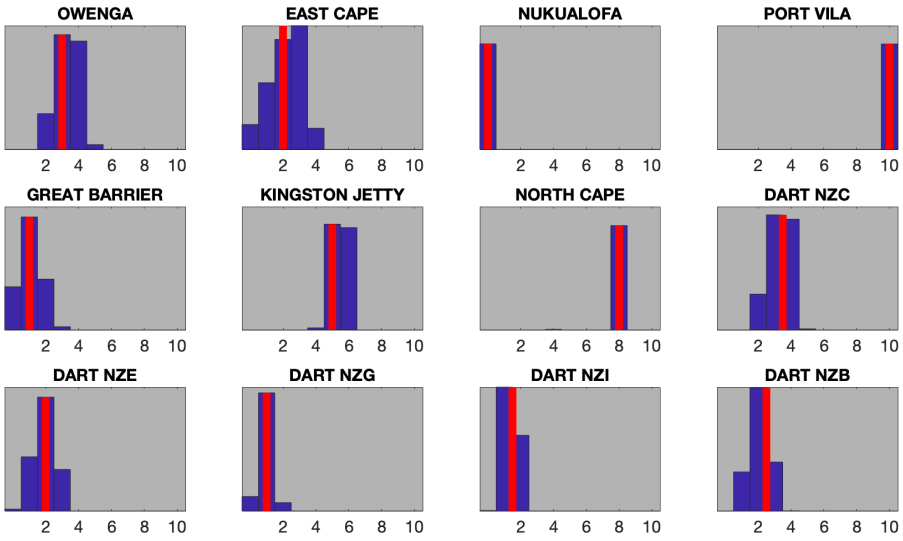


Figure S4. The marginal distribution of the time-shift values (in blue) explored during the inversion for each tsunami sensor; vertical red lines indicate the time-shift corresponding to the slip model in Figure 3a in the main text.

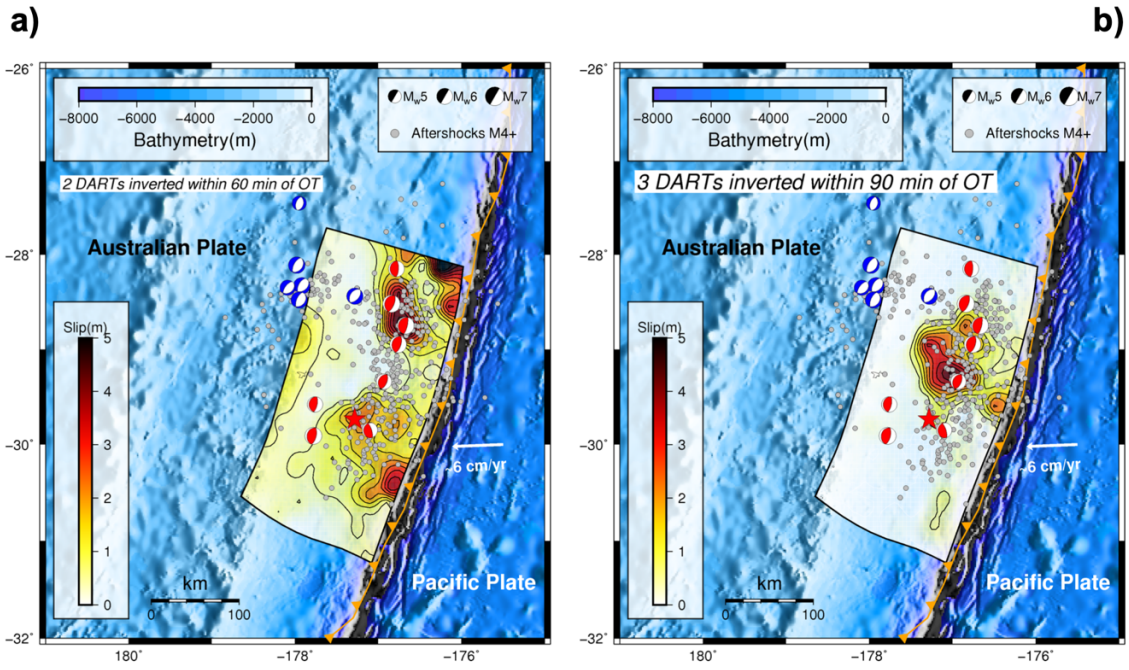


Figure S5. Slip distribution of the Raoul Island earthquake estimated by inverting a) 2 DARTs (NZE, NZG) within 60 minutes of the OT, and b) 3 DARTs (NZE, NZG, NZC) within 90 minutes of the OT.

Table S1 – Tsunami sensors coordinates, sampling, name - separately uploaded (*Table_S1.xlsx*)

Table S1. Table S1 contains information (names, coordinates and sampling) about the tsunami sensors (tide-gauges and DART stations) used in this work.

Table S2 – Fault geometry - separately uploaded (*Table_S2.xlsx*)

Table S2. Table S2 contains information (coordinates and depth) about the fault geometry used in this work. The order of the subfaults follows the one shown in Figure S1.

Table S3 – Slip model for Figure 3a - separately uploaded (*Table_S3.xlsx*)

Table S3. Table S3 contains information (subfaults, slip and rake) about the slip model shown in Figure 3a in the main text.