Supplementary material

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1 Introduction Slip linearity assumption

To test the slip linearity assumption we evaluate some waveforms, derived from the same source parameters, except for the slip value. We considered some different slip values, smaller and larger than unity and then normalized the waveform signals to be associated to the same slip value. The difference in terms of waveform is almost imperceptible and less than 5% of the signal. This is true especially for the first part of the signal, the one that contains the most information about the source.
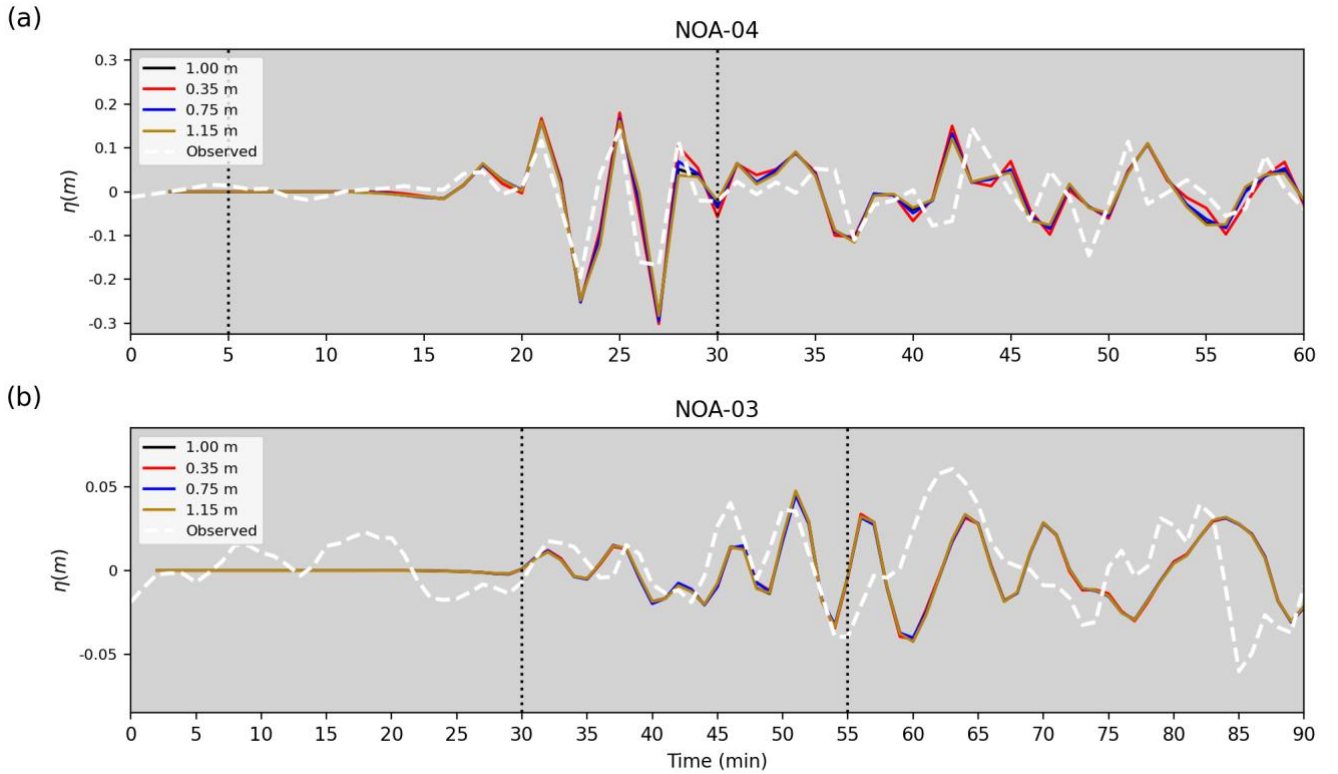
Figure S.1 Waveforms obtained at the Ierapetra NOA-04 (a) and Kasos NOA-03 (b) tide gauges by a target source model for different slip values. The different colours associated to the different slip values are summarised in the legend. The tested slip values are the unitary slip, the edges and the middle value of the slip interval considered in the inversion procedure.

2 Results of the application to the May 2, 2020, Mw 6.6 Cretan Passage earthquake, including the Kasos record

We reported here the results of the inversion following the same method presented in the main manuscript, but giving to the NOA-03 Kasos station a weight in the inversion procedure.

The overall cost function is a weighted average of two cost functions calculated on the two considered tide-gauges. The weights are chosen such that $\frac{w_{NOA-03}}{w_{NOA-04}} = 0.2$, equivalent to the ratio of the maximum tsunami amplitude registered at the two tide-gauges in the first half an hour after the tsunami arrival. The higher sensitivity of the Ierapetra signal to the source details is not surprising, since the Kasos station is much further away from the source, and the associated recorded marigram shows a very low peak-to-trough excursion and a lower signal-to-noise ratio.
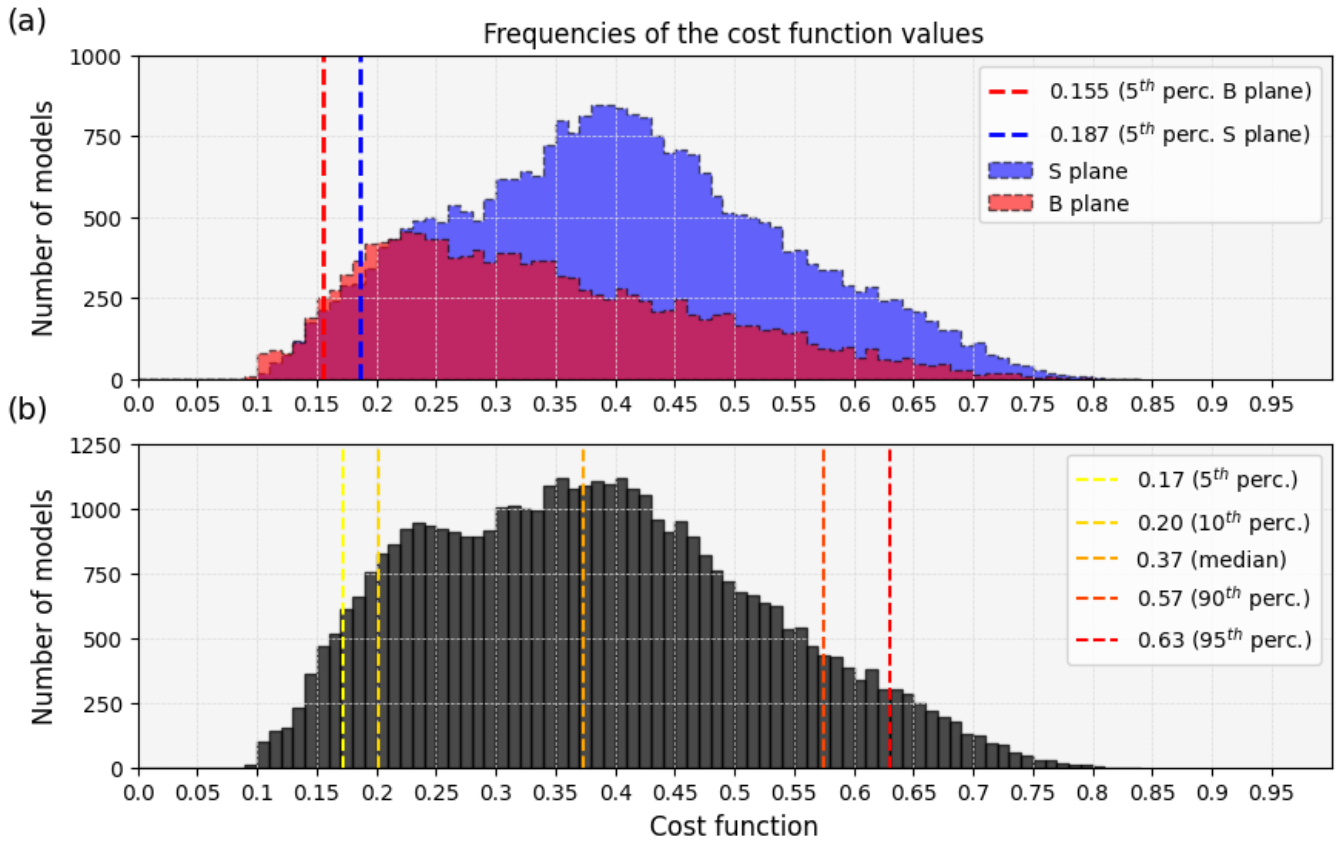
Figure S.2 (a) Cost function distribution for the back-thrust (red) and the splay (blue) models; the vertical dashed lines indicate the 5th percentiles for each of the two focal solutions. (b) Histogram of the cost function values for all the models considered. The vertical dashed lines represent the 5th, 10th, 50th (median), 90th and 95th percentile.

Table 2: see Table 2 of the mail article for details.

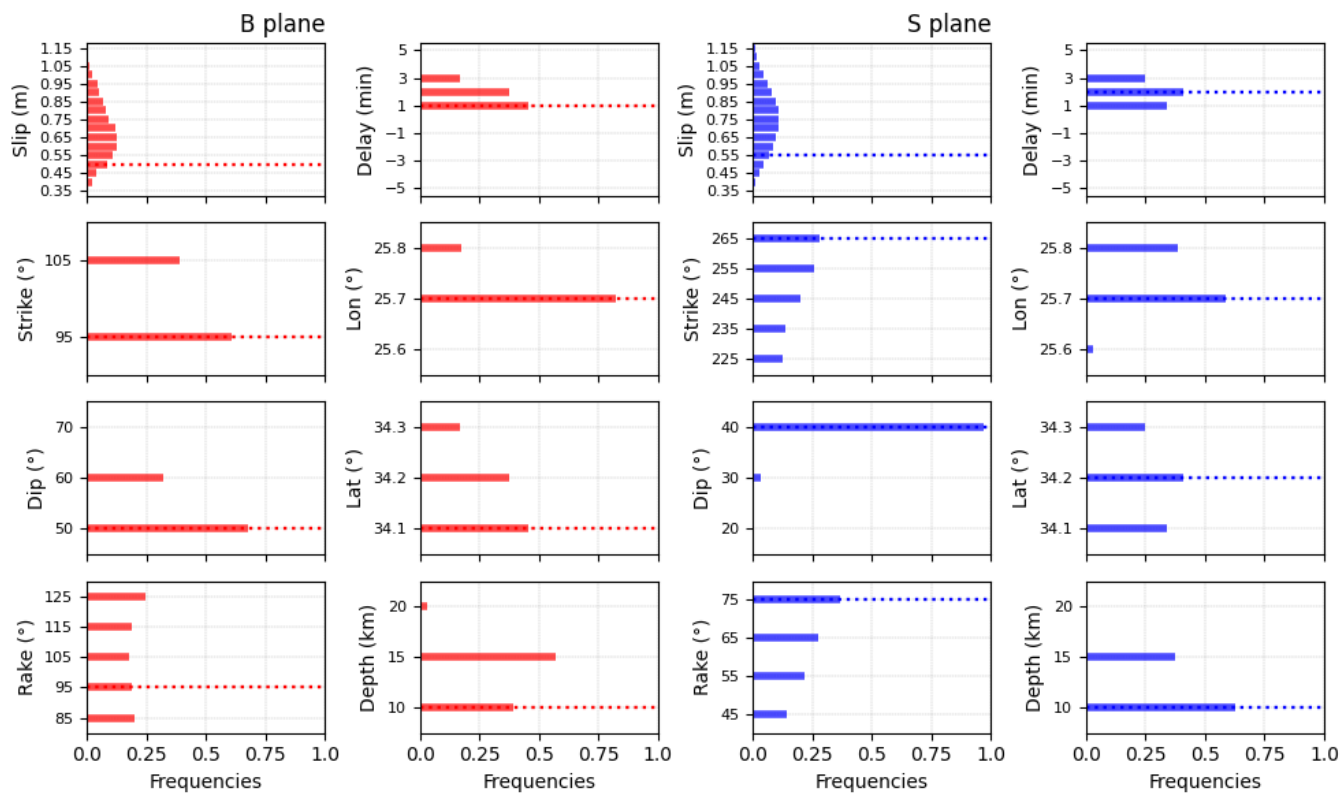|	Best model plane B	Average model (5th) plane B	Best model plane S	Average model (5th) plane S
Depth (km)	10	13 ± 3	10	12 ± 2
Lat (°N)	34.1	34.17 ± 0.07	34.2	34.19 ± 0.08
Lon (°E)	25.7	25.72 ± 0.04	25.7	25.73 ± 0.05
Strike (°)	95	99 ± 5	255	249 ± 14
Dip (°)	50	53 ± 5	40	39 ± 2
Rake (°)	95	106 ± 15	75	64 ± 11
Slip (m)	0.50	0.68 ± 0.15	0.55	0.75 ± 0.16
Time.shift (min)	1	1.7 ± 0.7	2	1.9 ± 0.8

Figure S.3 Marginal distributions for each of the inverted parameters, considering the first 5 percent of B (1st and 2nd columns) and S (3rd and 4th columns) plane models, those at the left of the red and blue vertical line in Figure 3a. The red and blue horizontal dotted lines mark the best models for the B and S planes, respectively.
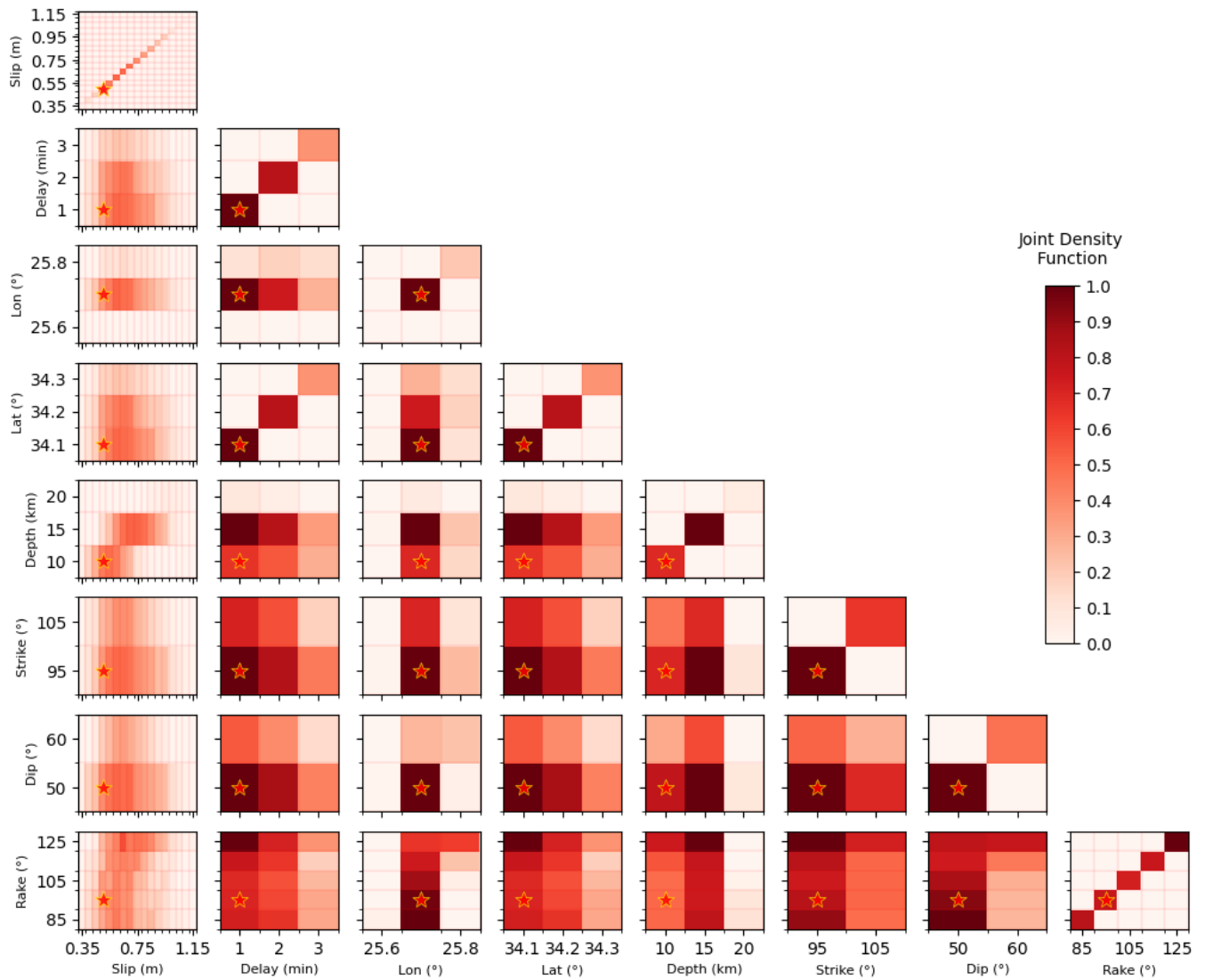
Figure S.4 Joint density distribution for each couple of the back-thrust source's parameters, considering the first 5 percent of B plane models, those at the left of the red vertical line in Figure 3a. The red star identifies the best model.
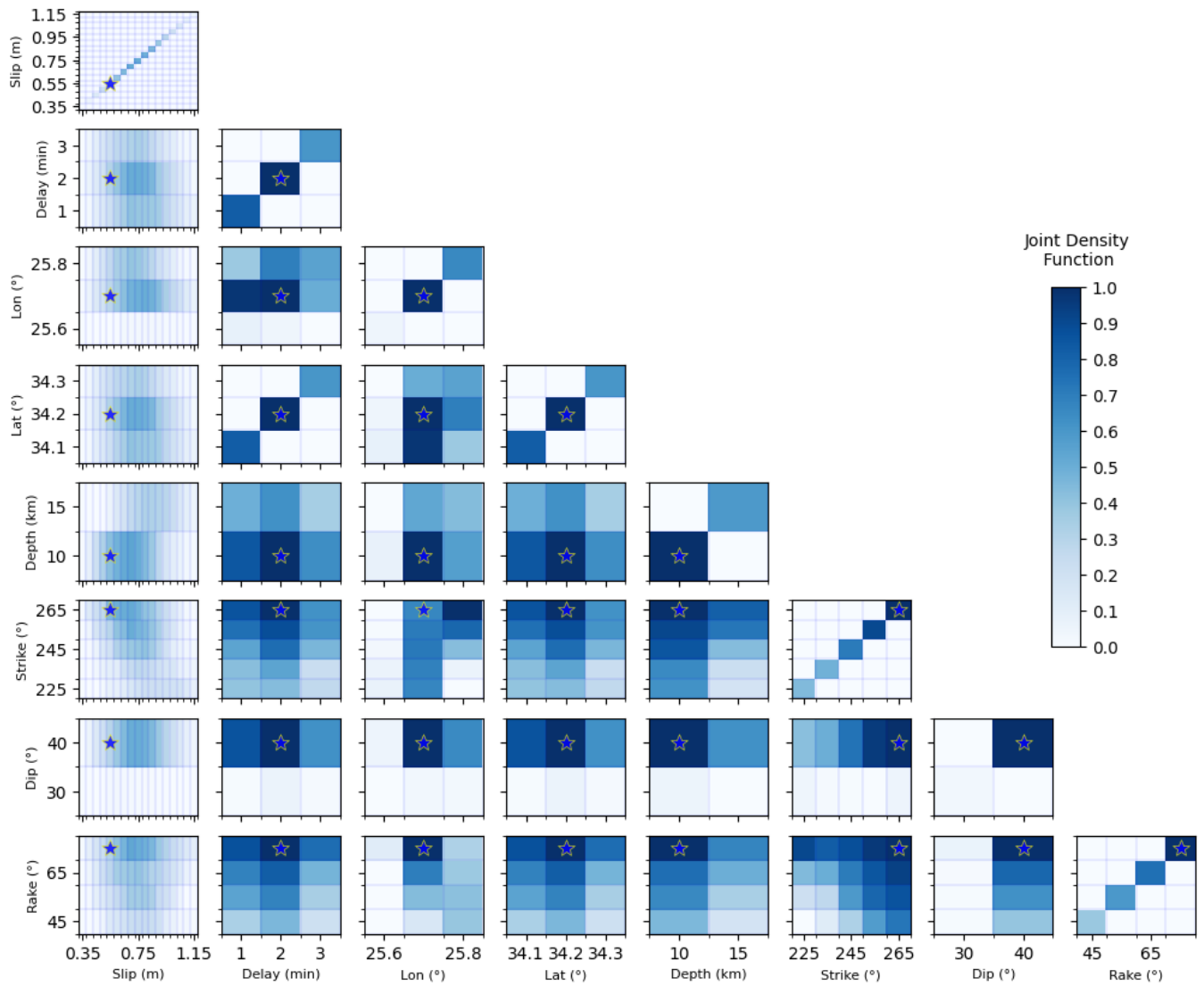
Figure S.5 Joint density distribution for each couple of the splay source's parameters, considering the first 5 percent of S plane models, those at the left of the blue vertical line in Figure 3a. The blue star identifies the best model.
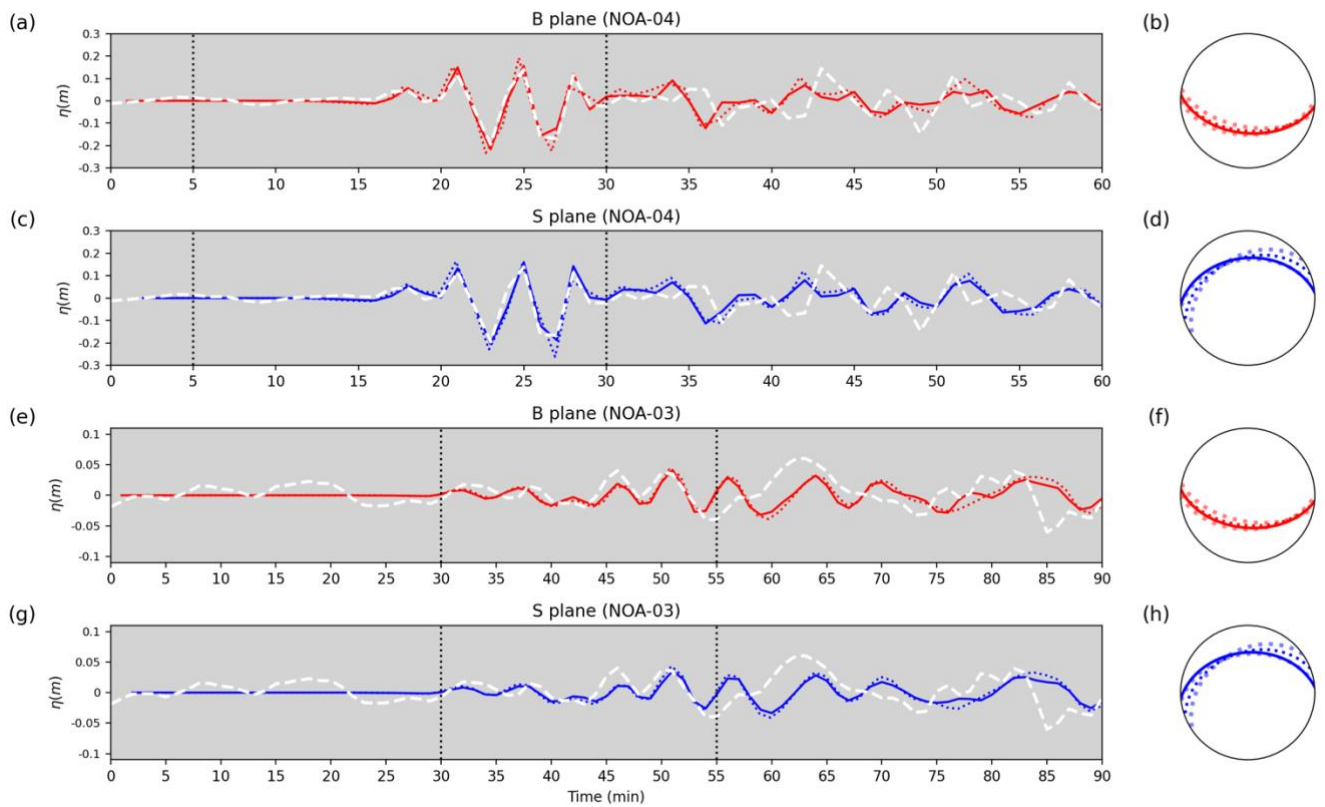
Figure S.6 Best (solid lines) and average (dotted lines) marigrams obtained at the two stations. Plots (a) and (c) refer to the Ierapetra tide gauge (NOA-04) while (e) and (g) to the Kasos one (NOA-03). The white dashed line is the observed water elevation at each tide gauge. B plane (in red) refers to the back-thrust solution dipping south; S plane (in blue) refers to the splay fault dipping north. The vertical dotted lines indicate the limits of the time window used for the inversion. On the right of each marigram plot the stereonets (lower hemisphere) show the fault orientations corresponding to the best signal (solid line) and the average one (dotted line) with the variability derived from the standard deviations of Table 2.
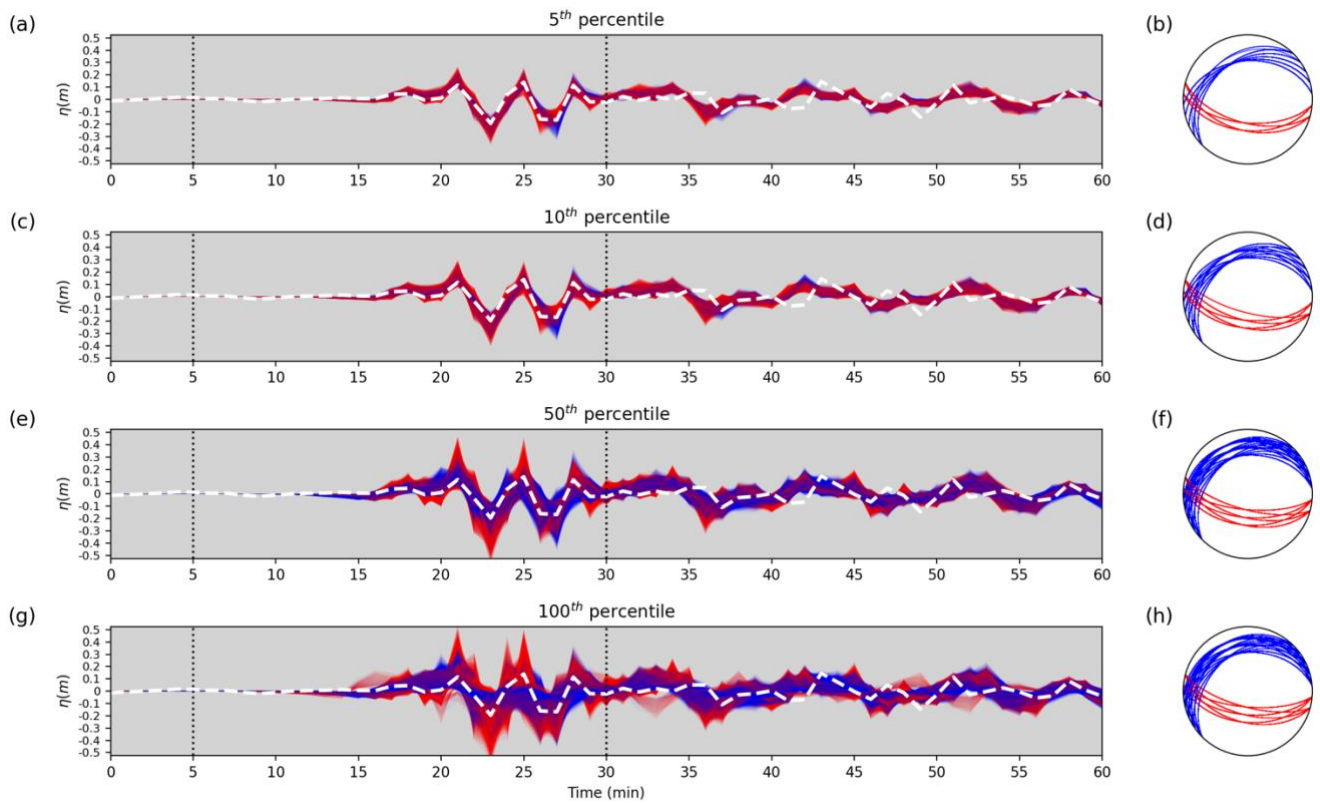
Figure S.7 From top to bottom, the left-hand side panels (a, c, e, g) show the marigrams of the events, ordered by cost function value, corresponding to the 5th, 10th, 50th, and 100th percentiles. The white dashed line is the observed water elevation at the Ierapetra tide gauge (NOA-04). The vertical dotted lines indicate the limits of the time window used for the inversion. The stereonets (lower hemisphere) on the right-hand side (b, d, f, h) show the fault plane variability corresponding to the synthetic waveforms. Red and blue refer to plane B (back-thrust solutions) and plane S (splay fault solutions), respectively, both for waveforms and fault planes.
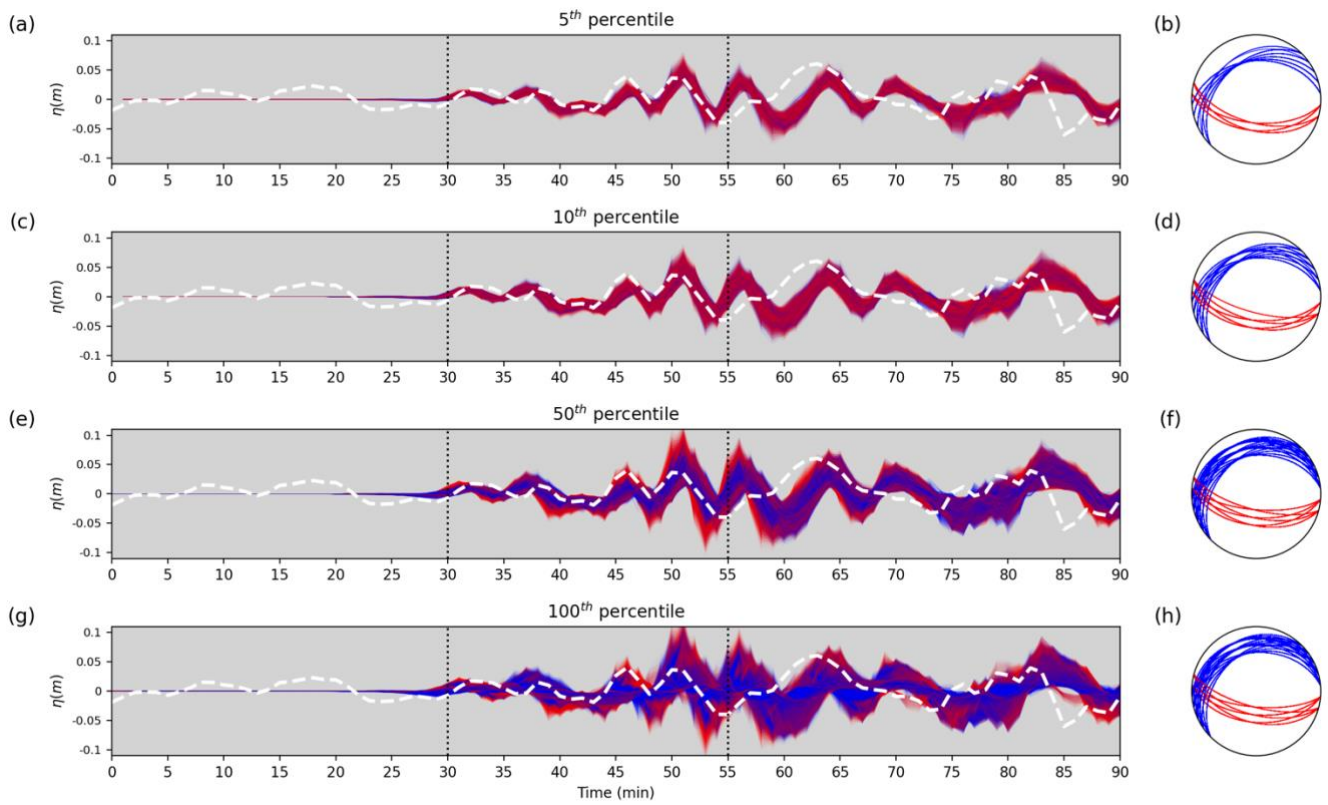
Figure S.8 The same as Figure S.7, but for the Kasos tide-gauge (NOA-03) signal.