Supporting Information for Putting faults into motion near the subduction interface and within the forearc

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Contents of this Supplemental Information file

Introduction

The supplemental figures below provide specific information on the gridded P-value calculation detailed in Section 2.2 of the main text. Figure S1 illustrates the location and extent of the ∼20 km overlapping grids used for the high resolution P-value estimates calculated to assess the more localized triggering propensity of the study region as demonstrated by the Sippl et al. (2023) local earthquake catalog. Figure S2 shows the individual histograms of seismicity surrounding the candidate mainshocks in Table 1 (main text) that are combined to create the stacked histogram of Fig 3. Similarly, we compute individual gridded P-value plots for each of the candidate mainshocks that we combine to show the effective triggerability map in Fig. 4 (Fig. S3).The 3D seismicity distribution showing the local cataloged earthquakes used in the P-value calculations for the Japanese mainshocks demonstrate that the seismicity that occurs after the mainshock stressing event (shown in color) is distributed both near the plate interface and throughout the shallower forearc faults (Fig. S4).

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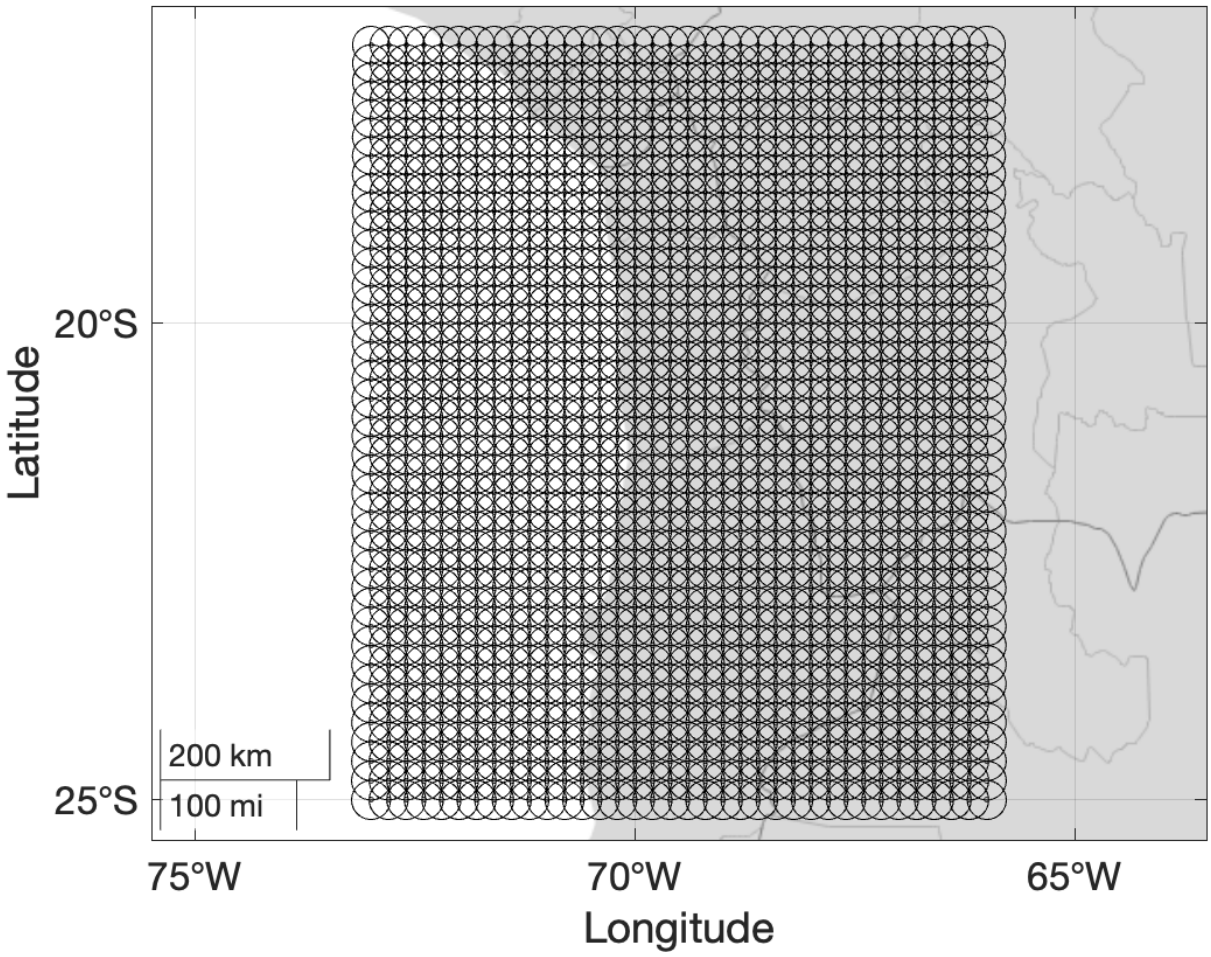

Figure S1 Gridded P-value calculation grid nodes. The dots show the nodal grid points spaced at 0.2° spacing ($\sim$ 20km) with corresponding circles of 20km radius. Detailed (gridded) P-value estimates originate from the grid nodes where at least 10 earthquakes occur before and after each stressing event (mainshock) for the particular node. Circular regions are intentionally overlapping so as not to miss any localized instances of significant seismicity-rate changes.

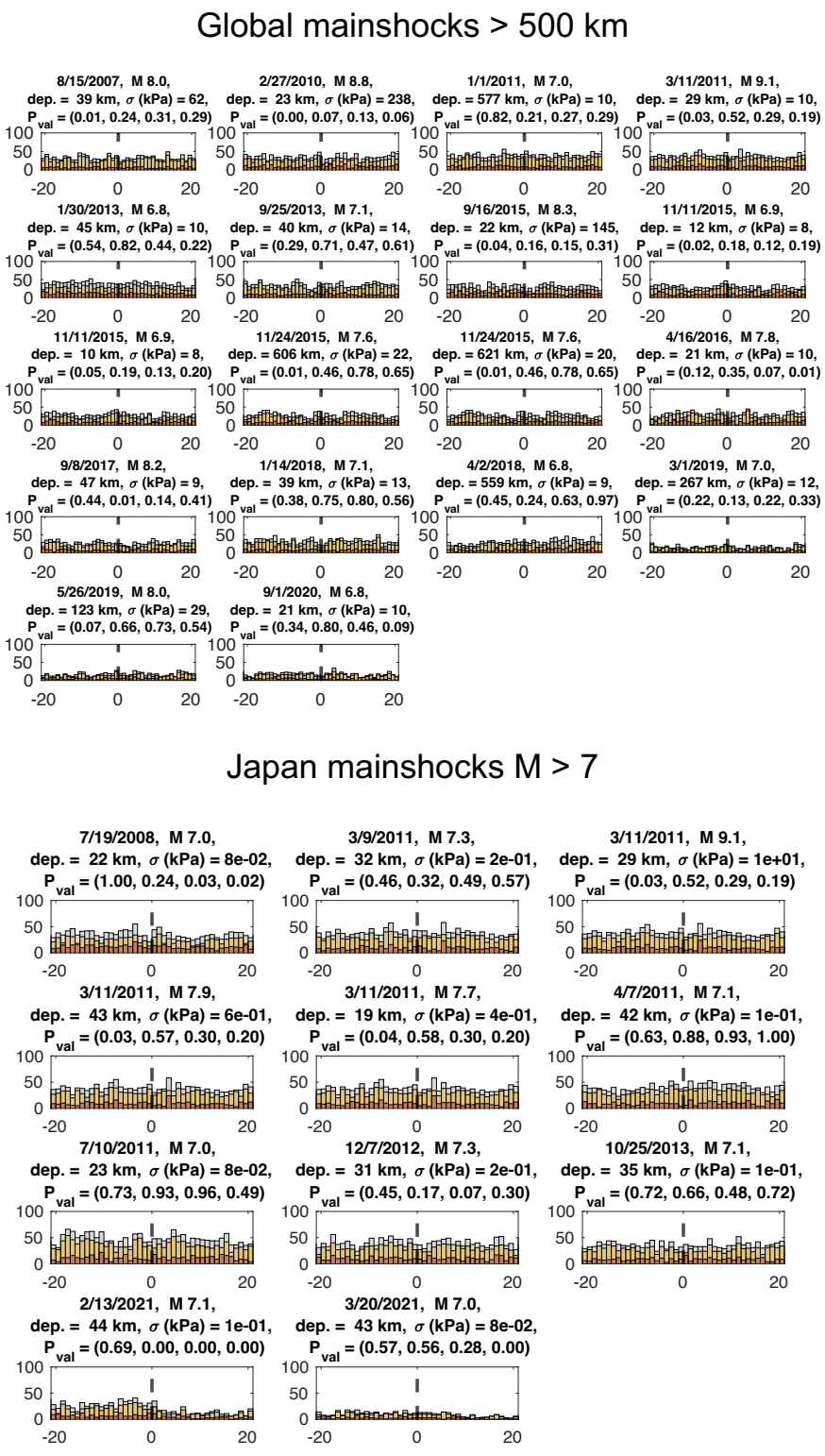

Figure S2 Number of local cataloged earthquakes in 1-day bins surrounding each of the candidate mainshocks in Table 1. Histograms are for the global data set with hypocentral distance > 500 km (top) and the Japanese mainshocks with M > 7 (bottom). Similar to the main text, gray histograms show total cataloged events, yellow are events with depths < 60 km, and red are events with depths $\geq$ 60 km. Each panel title contains information on the mainshock origin time, the depth, and the P-values for 1, 7, 10, and 14 day windows. Note that two mainshocks have $P \geq 0.95$ in the 14-day time windows that may be suggestive of delayed triggering (4/7/2011, Japan; 4/2/2018, global).

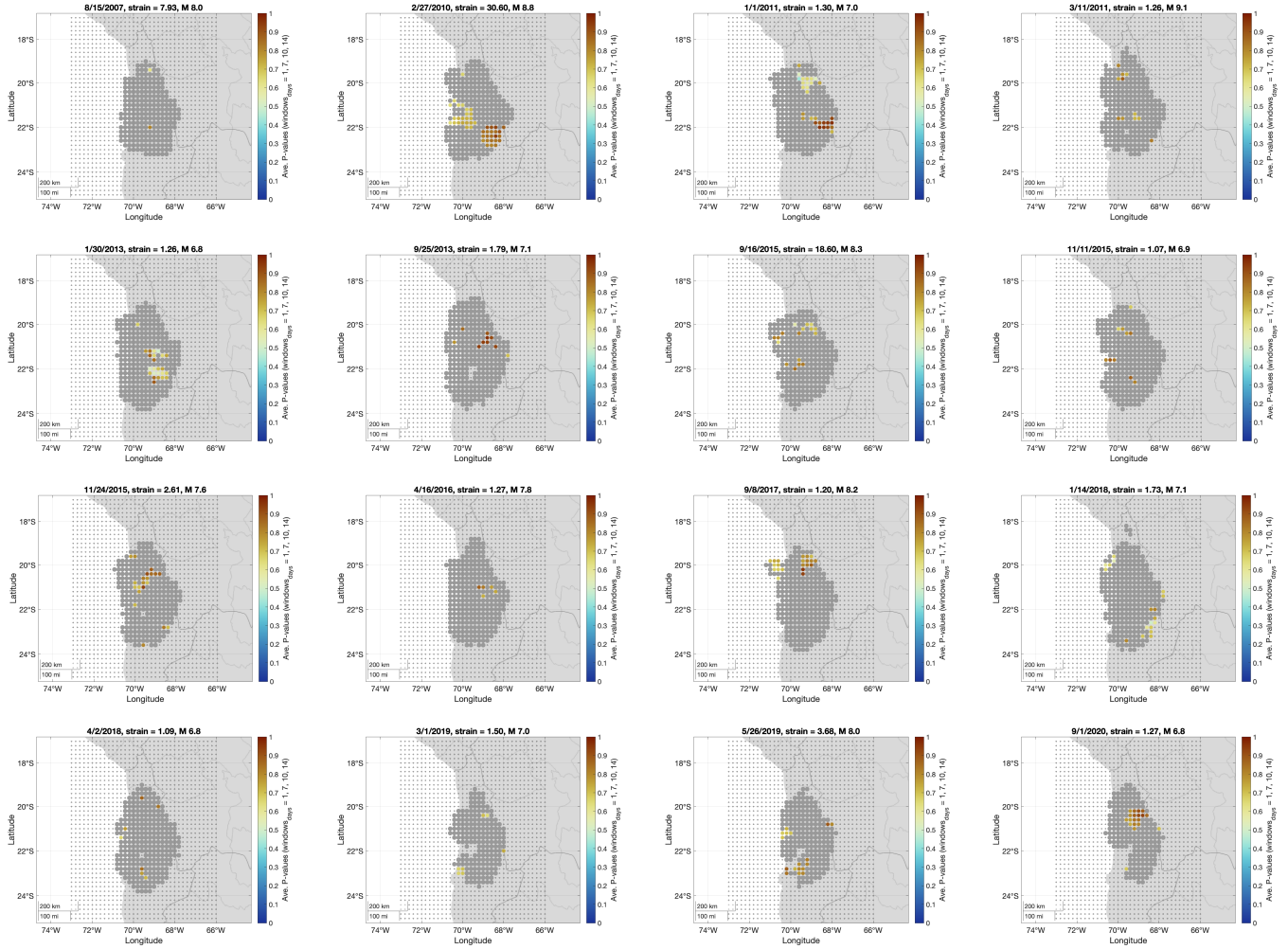

Figure S3 Gridded P-values for individual global mainshocks outside of 500 km from the study area centroid with estimated ambient stresses $\geq\sim$ 10kPa. Colors indicate grids where $P \geq 0.95$ for at least one time window (1, 7, 10, 14 days) with at least 10 local catalog events within the grid before and after the mainshock origin time. The colors indicate the averaged P-value over the four time windows considered. All 28 mainshocks that occurred during the time of the local catalog generated elevated P-values in at least 2 grid nodes.

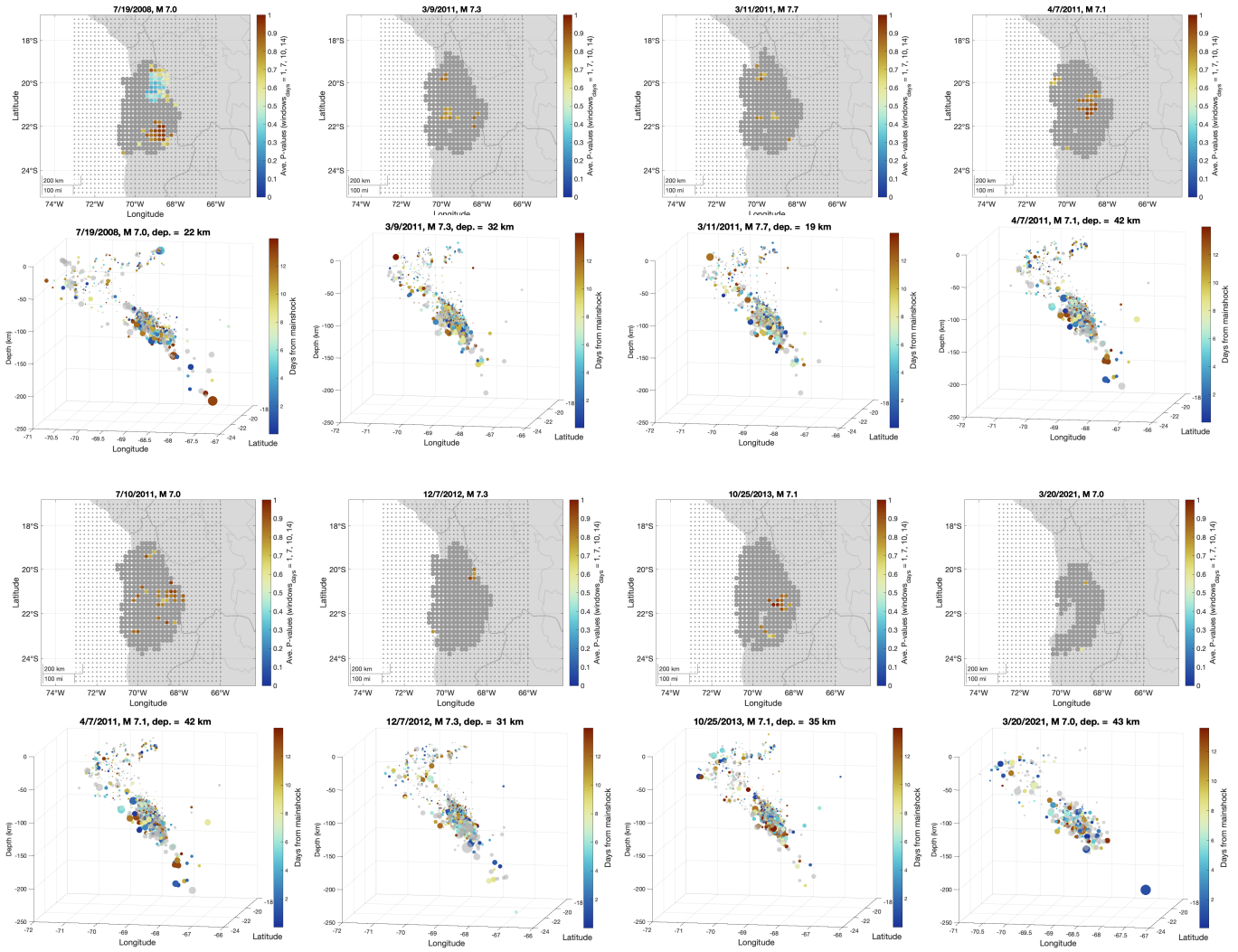

Figure S4 Gridded P-values for individual candidate mainshocks in Japan with M > 7 that are within 500 km of the Tohoku-Oki mainshock. Colors indicate grid nodes where $P \geq 0.95$ for at least one time window (1, 7, 10, 14 days). We only calculate P-values at nodes where a minimum of 10 local catalog events occurred in each window bracketing the mainshock origin time (before and after) within ~20 km of the grid node. Colors indicate the averaged P-value over the four time windows considered. A total of 10 out of the 11 mainshocks that occurred during the time of the local catalog generated elevated P-values in at least 2 grid nodes. Gray nodes indicate grids with $\geq$ 20 local catalog events (a minimum of 10 before, 10 after) where the P-value never exceeds 0.95. Nodes with less that 10 events before and after the stressing event (mainshock origin time) are not plotted. Notably, the 3D seismicity distribution below each of the P-grid maps shows the earthquake distribution extends over a range of depths and occurs both within the forearc and on or near the plate interface (within the depth resolution of the catalog). (Given the the short interevent times and overlapping time windows for the P-value calculations between the earthquakes on 3 March 2011, only the latter aftershock P-value grid is shown for that day).

References

Sippl, C., Schurr, B., Münchmeyer, J., Barrientos, S., and Oncken, O. The Northern Chile forearc constrained by 15 years of permanent seismic monitoring. *J. of S. Am. Earth Sci.*, 126(104326), 2023. doi: 10.1016/j.jsames.2023.104326.