

Supporting Information for

The unlocking process of the 2016 Central Italy seismic sequence

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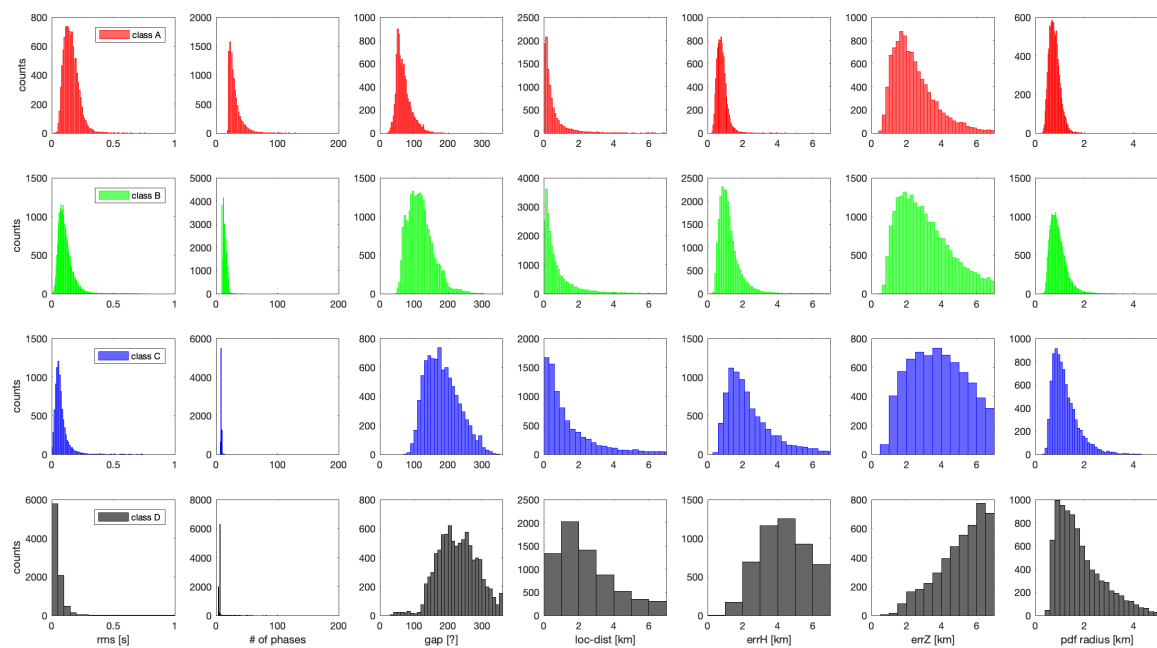


Figure S1 - Statistical distribution of the uncertainty estimators used to evaluate the location quality factor.

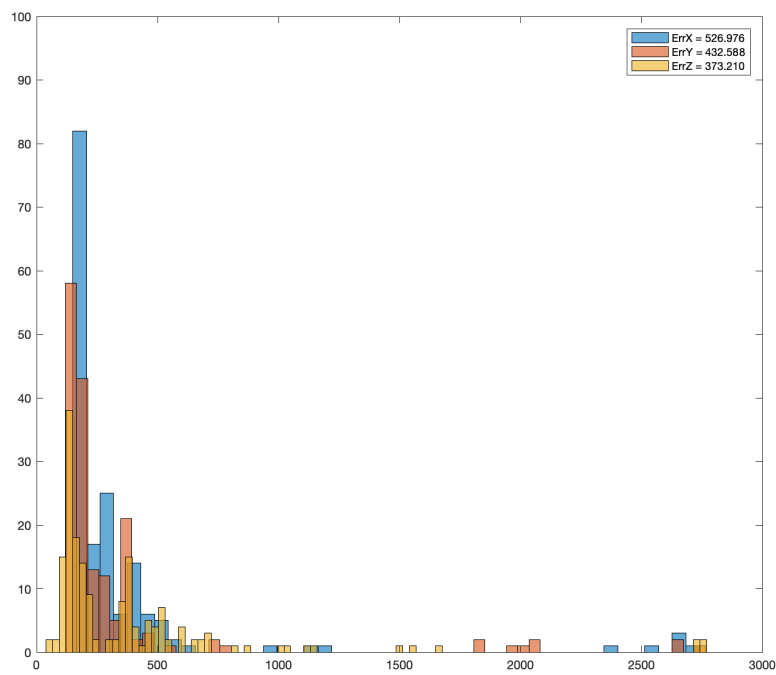


Figure S2 - Histograms of relative location errors in the three components (x, y, and z) were obtained from the full covariance matrix of a 200 events subset.

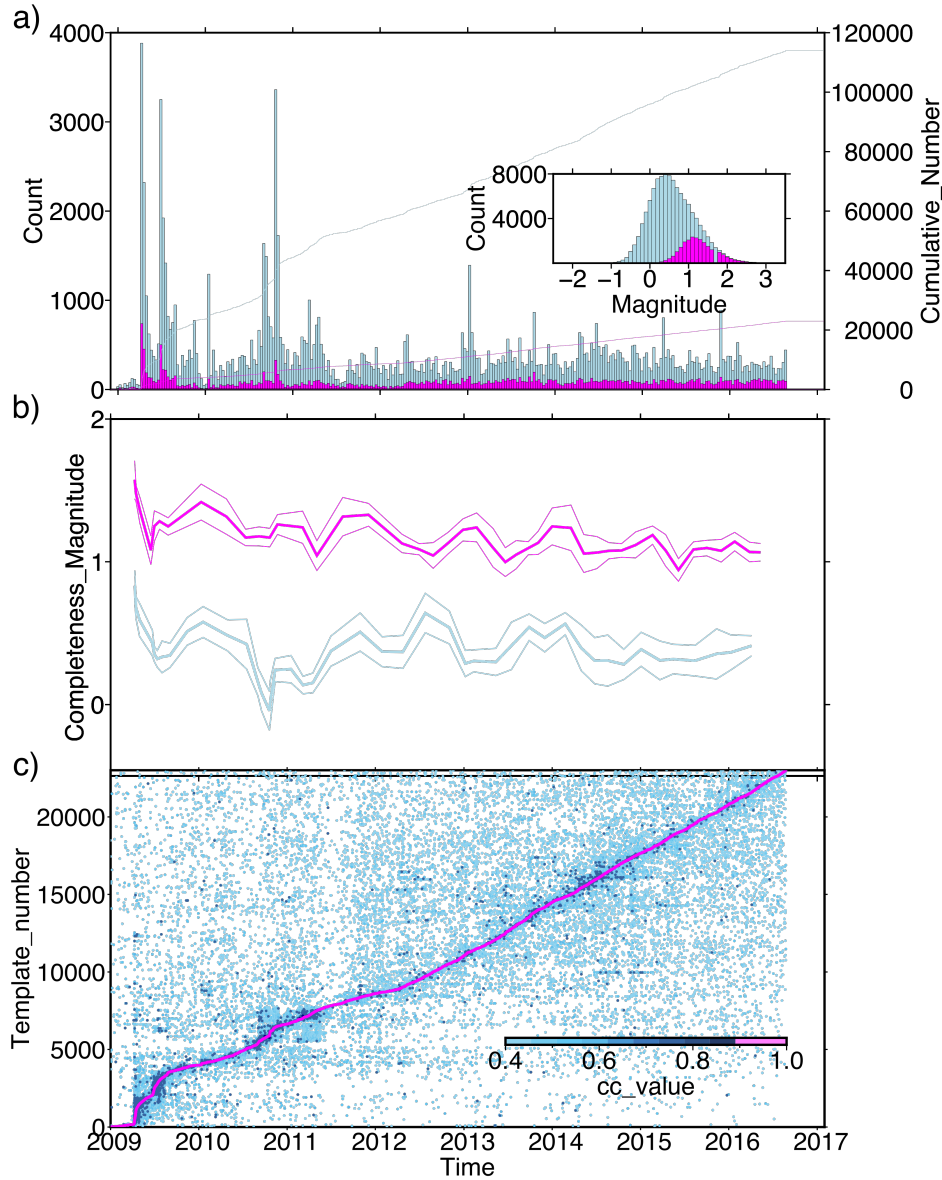


Figure S3 – a) Templates (magenta) versus new detections (light blue) histograms from 2009 to 24th August 2016. In the inset of a), we also show the number of events versus magnitudes. b) Completeness magnitude of templates (magenta) and the augmented catalog versus time (light blue). c) Time distribution of templates (magenta line) and associated new detections. New events are color scaled accordingly with the average cross-correlation value of detection. The diagram represents the ability of the templates to find new events before and after the template itself.

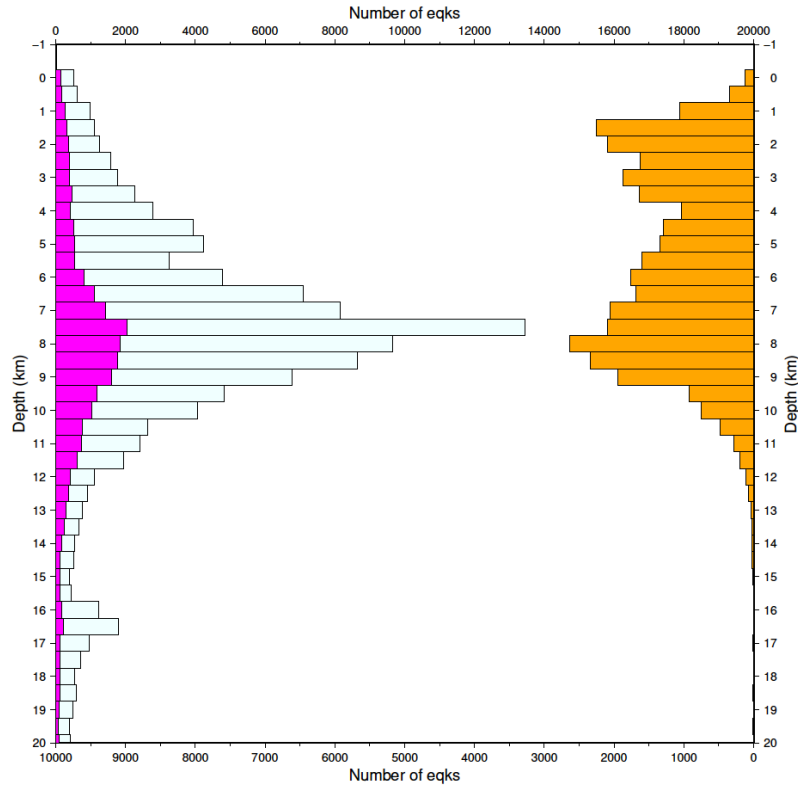


Figure S4 – Histogram showing the depth distribution for templates in magenta (this study), augmented catalog in light blue (this study), and aftershocks in orange (Michele et al., 2020). Template and augmented catalog trends at depth are consistent, showing that seismicity concentrates in the 7-12 km range. Shallower seismicity is present with a lower number of events. Aftershocks activated a broad depth range.

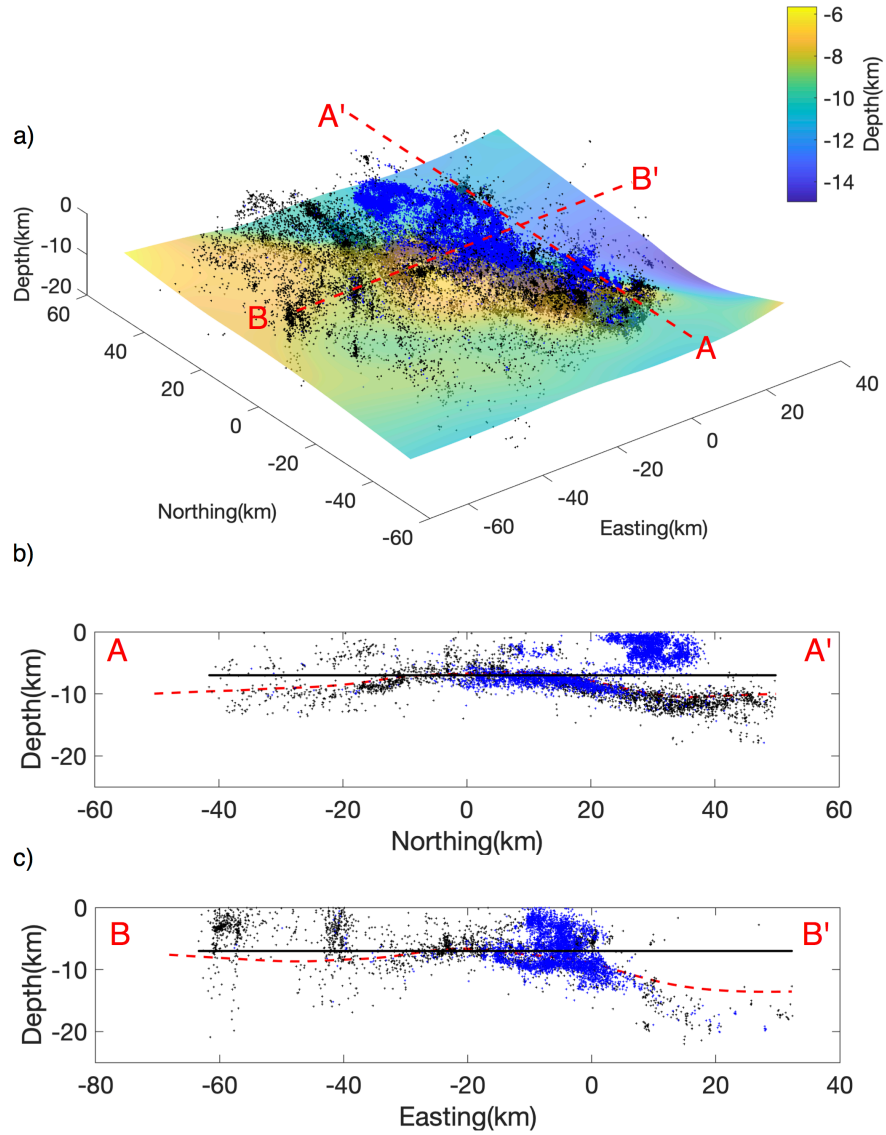


Figure S5 – a) 3D surface of the Top of the Shear Zone (TSZ), dots correspond to templates (black) and aftershocks (blue); b) A-A' cross-section; c) B-B' cross-section. The red dashed line corresponds to the TSZ; the black horizontal line marks the 7 km depth as a reference. The sections cross the epicenter of 2016, 24th August mainshock.

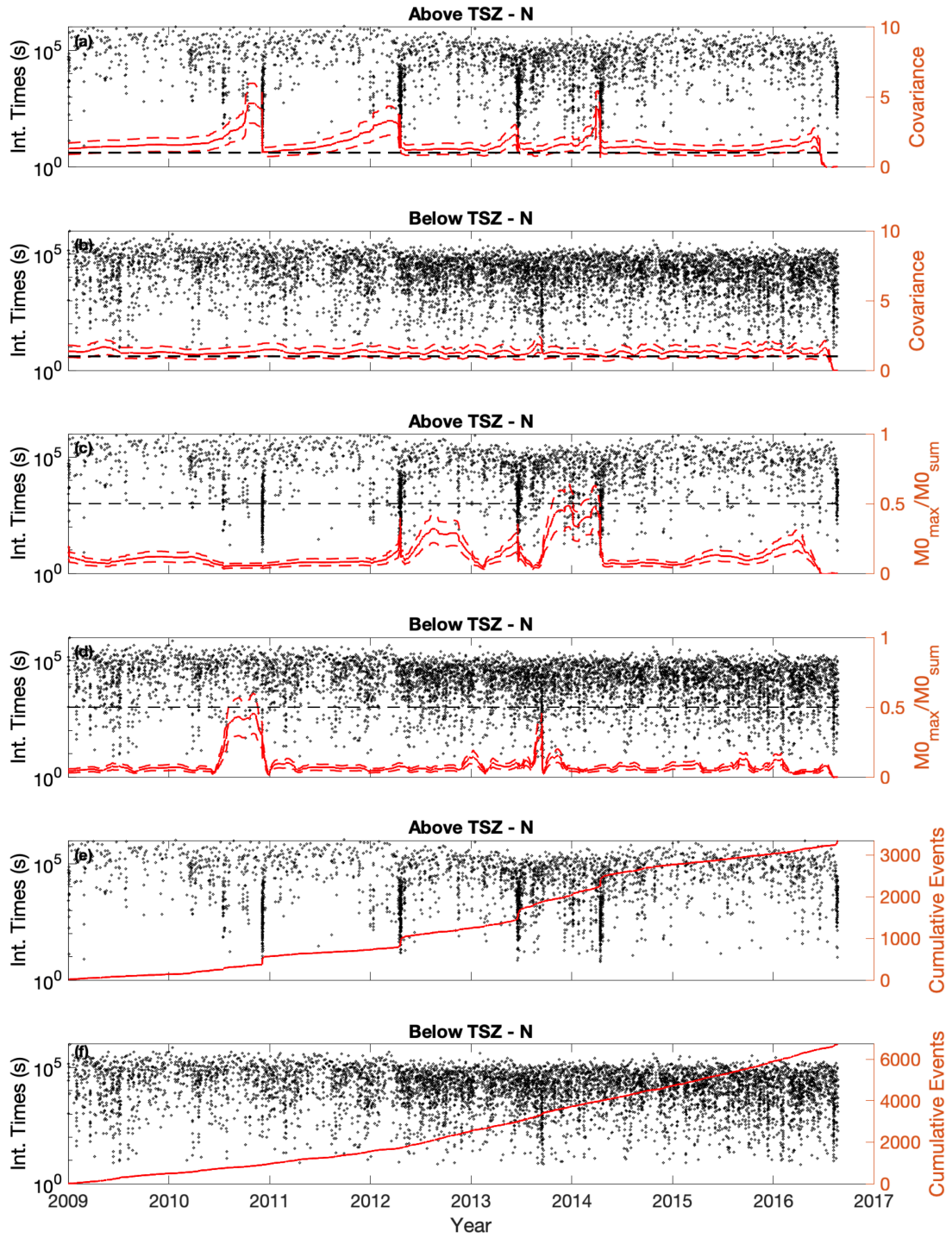


Figure S6 – Covariance values of interevent times above (a) and below (b) the TSZ. Moment ratio of interevent times above (c) and below (d) the TSZ. Dashed lines show the associated standard deviation. The abrupt drop of covariance and moment ratio at the end of the analyzed time span in 2016 is related to the moving windows used, and should not be considered in the interpretation. The cumulative number of

events above (e) and below (f) the TSZ. The analysis is performed for the northern volume (N in Figures 3a and b)

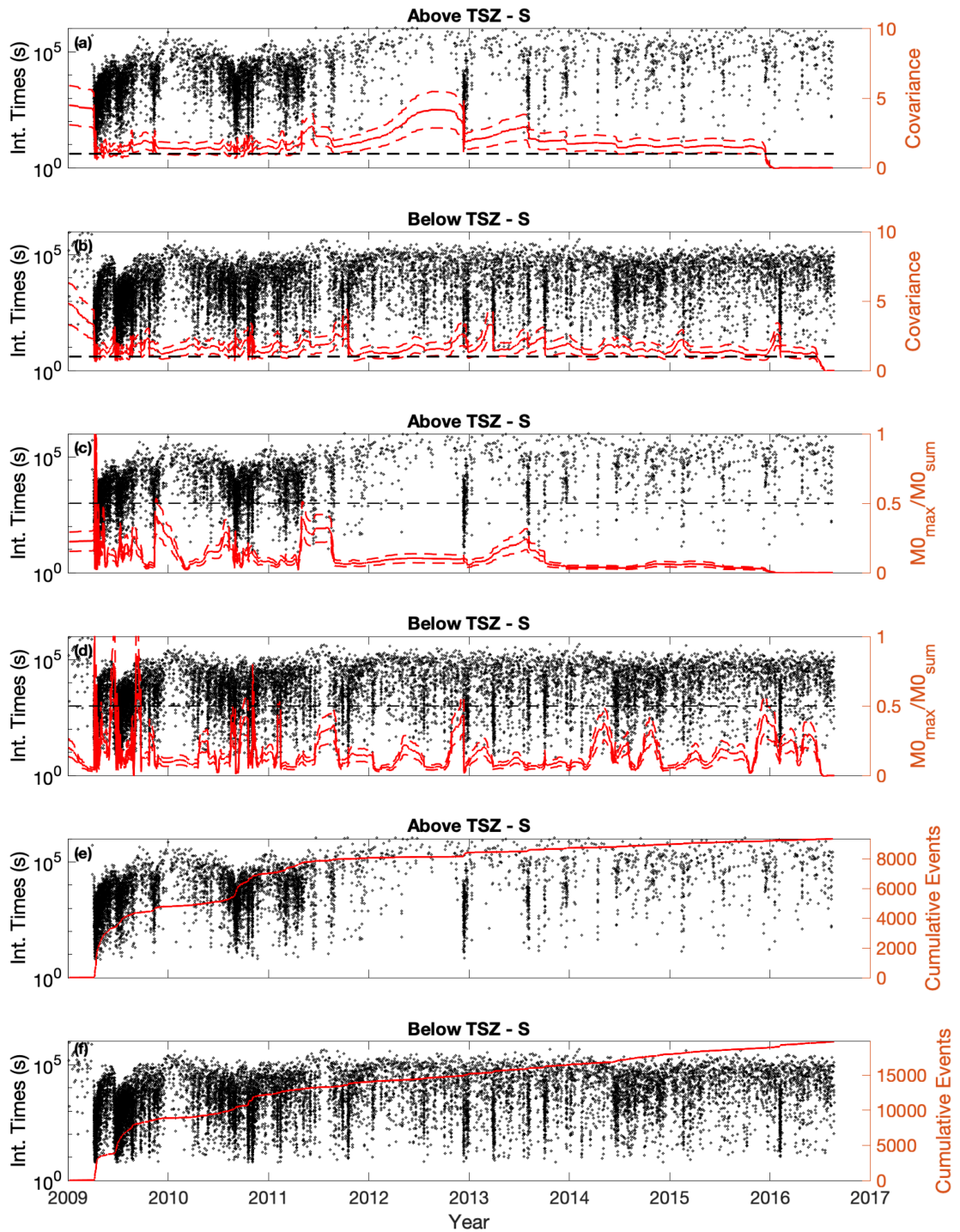


Figure S7 – Covariance values of interevent times above (a) and below (b) the TSZ. Moment ratio of interevent times above (c) and below (d) the TSZ. Dashed lines show the associated standard deviation. The abrupt drop of covariance and moment

ratio at the end of the analyzed time span in 2016 is related to the moving windows used, and should not be considered in the interpretation. The cumulative number of events above (e) and below (f) the TSZ. The analysis is performed for the southern volume (S in Figures 3a and b).

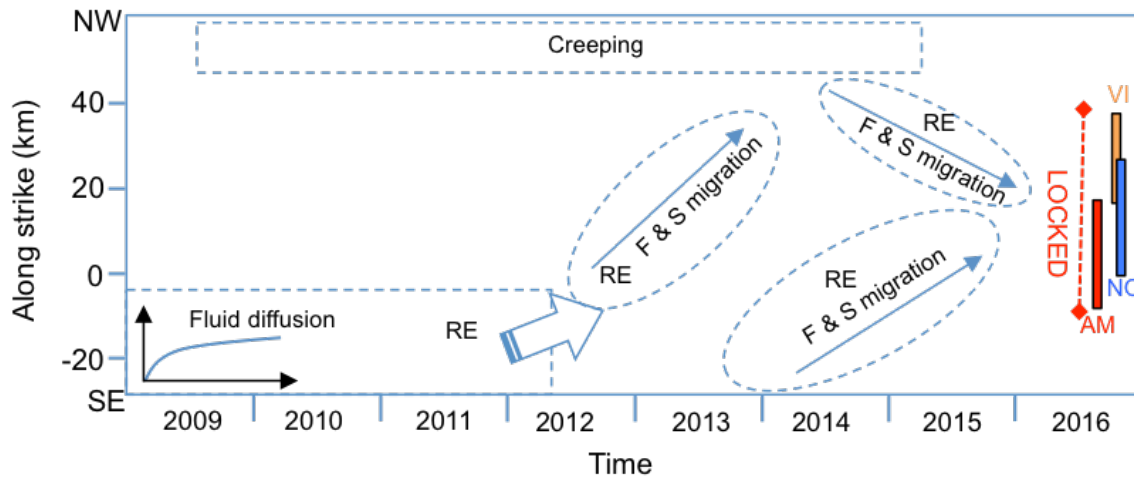


Figure S8 - Conceptual sketch showing the preparation process of the 2016 Central Italy seismic sequence. The locked area that hosted the main sequence is located between the southern region, where fluid diffusion prevails at the beginning of the observed period, and the creeping region in the northern sector, where the creeping rate increased from 2012-2013. Foreshock (F) and swarm (S) migrations are observed, together with repeating earthquakes (RE) during the preparation process, starting from 2013. They suggest slow slip transient combined with increased overpressurized fluids in the fault volume. At the end of 2015, the number of clusters decreased significantly, and only some of them were found within the main fault volume, becoming predominant from the mid-end of June. AM: fault associated with Amatrice earthquake; VI: fault associated with Visso earthquake; NO: fault associated with Norcia earthquake.