Response to Referee #1
Manuscript: *From Fragmentation to Spanning: Connectivity Regime Transitions in Equal-Probability Geohazard Fields*
Manuscript ID: egusphere-2026-2387

We thank the referee for the positive and constructive assessment of the manuscript. The referee's question is addressed below, and the corresponding clarification has been incorporated into the revised manuscript.

RC1: 'Comment on egusphere-2026-2387', Anonymous Referee #1, 04 Sep 2026 reply
I found this manuscript both interesting and enjoyable to read. The author considers equal-probability geohazard fields and investigates how their connectivity changes as spatial coherence is varied while keeping the occupation fraction fixed. Using an observed liquefaction manifestation field as an empirical reference, the manuscript demonstrates how increasing spatial coherence can reorganize the spatial fields from fragmented and clustered configurations toward dominant-connected and spanning states. I find the distinction between activation extent and spatial organization particularly useful for characterizing correlated hazard fields.

One aspect of the results that I found particularly interesting concerns the dependence on the occupation fraction p. The different connectivity measures appear to show broadly similar trends with increasing spatial coherence σ_c but the value of p at which the strongest response occurs seems to differ between the various measures. Is there an intuitive explanation for this behavior? In particular, does it reflect the fact that the different measures probe distinct aspects or length scales of the connectivity transition?

Overall, I find the manuscript clearly written and the numerical results convincing. I have no major questions or objections, and I recommend the manuscript for publication.

Author's Response: Thank you for the positive assessment of the manuscript and for this helpful question. Yes, the different dependences on occupation fraction reflect the different structural properties and normalizations represented by the connectivity measures.

At a fixed occupation fraction (p), increasing spatial coherence reorganizes a fixed number of active cells. The component count (Nc) measures how many separate clusters remain, whereas the dominant-cluster ratio Γ measures the fraction of active cells contained in the largest cluster. Consequently, a substantial reduction in the number of small clusters need not produce an equally substantial change in dominance. The fragmentation index is a normalized component count, (FI=Nc/A); it therefore has the same coherence dependence as (Nc) at fixed (p), although its normalization affects comparisons between different occupation fractions.

Susceptibility emphasizes a different part of the cluster-size distribution: it is the size-weighted mean cluster size after excluding the largest component. It is therefore sensitive to the presence of substantial secondary clusters and can decrease as these clusters become incorporated into the dominant component. Spanning probability, in turn, measures whether a connected component reaches the prescribed opposite boundaries. This depends on cluster shape, position and orientation relative to the domain, as well as cluster size.

An intuitive example is a compact cluster containing all active cells. Such a configuration has ($\Gamma = 1$), but it may still fail to span the domain. Thus, strong dominance and boundary-to-boundary connectivity need not develop together. Changing (p) changes the available active area, the separation between occupied regions and the scope for each measure to change. The strongest changes or ensemble fluctuations with increasing coherence therefore need not occur at the same occupation fraction.

These differences support an interpretation in terms of complementary aspects of connectivity. Spanning explicitly concerns connectivity across the domain, whereas the other measures characterize cluster abundance and the distribution of active cells among clusters. The observed differences alone do not establish distinct physical correlation lengths or separate critical transitions.

During verification of the connectivity metrics, an implementation edge case was identified in the susceptibility calculation: the largest component had not been excluded when it was the only component present. The implementation was corrected so that exactly one largest component is consistently excluded and susceptibility is set to zero when no residual clusters remain. The affected analyses, tables, and figures were recomputed using the corrected implementation. This clarification has been added to Section 3.3 of the revised manuscript, with the corresponding interpretation reflected in Section 5.2.