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Investigating the seasonal triggering of earthquakes in the Azores

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The relationship between seismicity rates and water load variations has been recognized across the world at various spatial and temporal scales. In the oceans, one of the most notable such observations is that earthquakes at mid-ocean ridges tend to occur preferentially during low tide. In the region of the Azores triple junction, the analysis of a seismic catalogue from 2008 to 2018 revealed that earthquakes in the ocean present a genuine and statistically significant semi-annual seasonality, with more earthquakes occurring in the summer than in the winter. We have looked for mechanisms that could justify this observation. First, we assembled several geophysical time-series of regionally averaged variables that could constitute likely earth loading mechanisms, such as ocean bottom pressure anomalies, and performed a singular spectral analysis to identify and characterize their main modes of variability. Then, we computed the correlation between the possible loading mechanisms and the principal components of the seismicity rate. We found that the variable that best correlates with the seismicity rate (correlation coefficient of 0.9) is the sea level anomaly, which at the Azores latitude presents a marked seasonality related to the barotropic response to changes in wind stress. We therefore suggest that the seismicity peaks during low tide at mid-ocean ridges and the enhanced seismicity in the summer months in the Azores region share an analogous stress triggering mechanism. This work presents the results of Coulomb stress models that help to verify this hypothesis and better understand the relationship between the Earth's deformation and the annual ocean water load variations. The authors would like to acknowledge the financial support of FCT through project UIDB/50019/2020–IDL. This is a contribution to the RESTLESS project PTDC/CTA-GEF/6674/2020.