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Constraining the tsunami initiation area associated with the 2010 M7.7 Mentawai and 2024 M7.5 Noto peninsula earthquakes from first-arrival measurements on TEC data

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Forecasting the impact of a tsunami on coastal areas requires accurate location of the source of the tsunami. This is particularly challenging because tsunamis often originate far from seismological and geodetic networks. However, tsunami waves often induce total electron content (TEC) perturbations in the ionosphere, which can be detected using Global Navigation Satellite Systems (GNSS). Tracking the source of these perturbations makes it possible to determine the tsunami source area. Previous studies have confirmed this approach. However, this is usually done by (1) using a "quasi-homogeneous" model to propagate the disturbances in the atmosphere and (2) arbitrarily fixing the height of the ionosphere. These approximations lead to relatively large uncertainties in the location of the tsunami source. Therefore, in this study we try to reduce these uncertainties by using a 1D model of the atmospheric structure and by including the search for the optimal height of the ionosp here in the inverse problem. To do this, we use a Bayesian approach to invert the onset times of the TEC disturbances. First, we test our method on synthetic data to determine the potential gain in accuracy between using a "quasi-homogeneous" and a 1D model of the atmosphere. We then apply our approach to study the 2010 M7.7 Mentawai tsunami earthquake and discuss the strength and limitations of the method as well as its usability for tsunami warning. We finally show preliminary results for the 2024 M7.5 Noto peninsula earthquake, and related tsunami offshore Japan.