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Spatial variability of Holocene relative sea level on the China coast

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The coast of China is located in the far-field of past large ice sheets, and therefore relative sea-level (RSL) data from this region have been used to infer sea-level equivalent changes during the Holocene using geophysical models of the glacial-isostatic adjustment (GIA) process. However, there are known misfits between GIA models and Holocene RSL data along the coast of China. For example, GIA model predictions compared to RSL data from China and the Malay-Thailand peninsula show misfits in the amplitude and timing of maximum RSL (highstand) and temporal variations of RSL from the highstand to the present. Furthermore, two different preferred viscosity profiles were recognized between China and the Malay-Thai Peninsula, suggesting the presence of lateral (3D) variations in mantle viscosity across this region. These previous findings lead to several questions: 1) Are the interpretations of RSL proxies and ages robust? 2) Do 3D GIA models improve the fit compared to 1D models? and 3) Are other local- to regional-scale processes significantly influencing RSL on the China coast?

We aim to answer these questions by completing an updated, quality-controlled database of Holocene RSL data and integrating it into a spatio-temporal empirical hierarchical model (STEHM) and comparing the results to GIA models. Here, we use standardized protocols to present a preliminary compilation of Holocene RSL data (105 index points and 134 limiting points) from the southern China coast, which extends geographically from 119.19°N (Fuzhou city of Fujian Province) to 111.82°N (Xisha Islands) and 21.82 °E (Qinzhou city of Guanxi Province) to 25.22 °E (Putian city of Fujian Province). Sedimentary (salt marsh, mangrove, tidal flat, lagoon), geomorphic (Chenier ridge, beach rock), fixed biological (oyster), and coral indicators comprise the majority of RSL data in the compilation for the last 12 ka. The database is divided into sub-regions to investigate the influence of tectonics and GIA on RSL.

We apply the STEHM to the preliminary dataset to estimate the magnitudes and rates of RSL, and compare them to the radially symmetric (1D) ICE-6G_C (VM5a) GIA model pairing and an analysis of the sensitivity of the region to 3D viscosity structure. We find that sub-regional variability (i.e., spatial variability over a shorter spatial scale than the long-wavelength GIA signal) is observed

throughout the Holocene. This spatial pattern suggests there is strong influence of local- to regional-scale processes causing RSL to vary from GIA model predictions because no data from sub-regions most sensitive to 3D viscosity structure (e.g., Bohai Bay) were included in these model runs. This preliminary analysis lays the groundwork to assess the potential influence of local-scale processes, such as sediment compaction and tidal range change, as well as regional impacts from tectonic vertical motion.