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Millennial scale land subsidence history along the southern China coast

Haixian Xiong and Yongqiang Zong
The University of Hong Kong, Department of Earth Sciences, Hong Kong (xionghx@hku.hk)

Estimation of coastal land subsidence rates due to GIA and tectonic factors on millennial scale has become an urgent task for the hazard assessment of future rising sea level. Whilst geophysical simulation is a promising approach, the modeling uncertainty is still difficult to constrain due to the lack of accurate sea-level data. Another practical approach is based on the present elevations of paleo indicative landforms of known ages, such as coastal terraces and MIS5e marine sediments. However, this method also suffers from uncertainties associated with the measurements of landform relicts. In order to obtain a robust estimation of long-term coastal subsidence rates along the southern China coast, an active economic zone vulnerable to future sea-level rise, this study applies a statistical method to determining the high-probability land subsidence histories of six coastal sectors (the Yangtze Delta, Fujian & Taiwan Strait, Han River Delta, East Guangdong, Pearl River Delta, and West Guangdong & Hainan Island) over the past six millennia. The land subsidence histories of the six sites are produced by comparing their RSL histories reconstructed from qualified sea-level index points (SLIPs) with those of the Malay Peninsula, based on the assumption that the Malay Peninsula has been tectonically stable. Therefore, the RSL history at each site is considered as a function of eustatic sea-level change, global GIA (e.g. ocean siphoning), local GIA (e.g. coastal levering) and tectonic movement. Therefore, a subtraction of RSL histories between the China sites and the Malay Peninsula will result in land vertical movement trends consisting of both the local GIA and tectonic components. The result shows that the coast of southern China has been undergoing linear land subsidence over the past 6000 years. The subsidence rates of the six sites average at about 1.2±0.1 mm/yr, with the highest rate of 2.1±0.1 mm/yr in the Han River Delta and the lowest rate of 0.5±0.1 mm/yr in West Guangdong & Hainan Island. In order to separate the tectonic subsidence rate from the local GIA rate for each site, outputs of GIA models (a 3D Earth model HetM-LHL140 coupled with ICE-6G_C) for China and the Malay Peninsula were obtained. The result suggests that the local GIA component (mainly coastal levering) might have accounted for half of the land subsidence along the China coast over the past 6000 years. This estimation of long-term land subsidence rates should form an integral part of the hazard assessment for the coastal communities in China.