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末次冰期冰盖消融对东亚历史相对海平面的影响及意义

汪汉胜¹, 贾路路^{1,2}, WU Patrick³, 江利明¹, 胡波^{1,2}, 相龙伟^{1,2*}

1. 中国科学院测量与地球物理研究所动力大地测量学重点实验室, 武汉 430077;
2. 中国科学院研究生院, 北京 100049;
3. Department of Geoscience, University of Calgary, Calgary T2N 1N4, Canada

Effects of last-deglaciation on the historical relative sea levels of East Asia Seas and the implications

WANG Han-Sheng¹, JIA Lu-Lu^{1,2}, WU Patrick³, JIANG Li-Ming¹, HU Bo^{1,2}, XIANG Long-Wei^{1,2*}

1. Key Laboratory of Dynamical Geodesy, Institute of Geodesy & Geophysics, Chinese Academy of Sciences, Wuhan 430077, China;
2. Graduate University of Chinese Academy of Sciences, Beijing 100049, China;
3. Department of Geoscience, University of Calgary, Calgary T2N 1N4, Canada

摘要

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摘要 基于新的末次冰期冰川均衡调整(GIA)模型,利用有限元算法模拟了盛冰期以来东亚相对海平面的变化,并与观测数据进行比较分析.研究表明,早期相对海平面上升由盛冰期后全球冰盖消融控制,后期的变化则由地壳黏性均衡调整控制;每个时期的结果均具有显著的区域性差异,与地壳均衡作用及远场均衡效应的区域性差异有关;模拟的不确定性主要来自冰盖消融模型差异的影响,量级在观测误差范围内.此外,利用本文的GIA模拟结果,对东亚海岸历史相对海平面观测进行改正,揭示了华南全新世以来不同阶段的地壳垂直运动,其中3—8 kaBP地壳以较稳定的速率(1~4 mm/a)下沉,之后则以较小速率下降或隆升,推测可能与东南部菲律宾板块的俯冲有关;揭示近千年来粤东海岸和珠江三角洲地壳垂直运动有长期隆升趋势,而近三十年的观测结果则显示下沉,推测该差异与人类活动导致的沉降有关.

关键词 末次冰期, 冰川均衡调整, 东亚地区, 历史相对海平面, 地壳垂直运动

Abstract: Observed relative sea level (RSL) changes in East Asia Seas are studied with the help of our latest 3D glacial isostatic adjustment (GIA) model, which employs the finite element method to simulate RSL changes since the Last Glacial Maximum (LGM). From the temporal and spatial variation of predicted RSL, it is shown that the early rise of sea levels after LGM is mainly influenced by the addition of melt-water into the oceans while the later RSL changes are strongly affected by mantle flow, ocean loading and crustal adjustment. Thus, the RSL results show obvious regional changes for each epoch. The uncertainty of modeled RSL is mostly attributed to the differences in the ice models used, and its magnitude is found to be comparable to the measurement error. Second, the predicted RSL results are used to correct the historical observations. The residuals along the coast of South China show different stages of crustal vertical motions since the Holocene. Crust subsidence rates (1~4 mm/a) are found to be stable from 3 kaBP to 8 kaBP, while the rates during the last 3 ka are small. These may be caused by the subducting of southeastern Philippine plate. In East Guangdong and Pearl River Delta, residual RSL since 1 kaBP shows the long term crustal uplift while the rates observed from precise leveling during the last three decades show that the crust is subsiding. The differences can be caused by the crustal subsidence due to human activities.

Keywords Last Ice-Age, Glacial isostatic adjustment, East Asia Seas, Historical relative sea level, Crustal vertical motion

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