

## The expanding Earth confirmed by geodetic observations

SHEN, Wen-Bin<sup>1\*</sup>, Zi-Yu Shen<sup>1</sup>, Rong Sun<sup>1</sup>

<sup>1</sup>School of Geodesy and Geomatics/Key Lab of Geospace Env and Geod, Wuhan Univ, Wuhan, China

Whether the Earth is expanding or contracting is an interesting question in geoscience. Some scientists support the viewpoint of the Earth expansion, and some are against this viewpoint. This study focuses on estimating the Earth expansion rate using the space-geodetic data over land, global gravimetric observations, and altimetry data over oceans. Space-geodetic data recorded at stations distributed over land areas were used to estimate the Earth expansion rate, and the results suggest that the Earth is expanding at a rate about 0.24mm/a. Based on the EGM 2008 and the secular variation rates of the second-degree coefficients determined by satellite laser ranging and Earth mean-pole data, the principal inertia moments of the Earth (A, B, C) and in particular their temporal variations were determined, and the results show that the Earth is expanding at a rate ranging from 0.17 mm/a to 0.21 mm/a, which coincides with the space-geodetic evidences. Further, by examining the sea level rise observed by satellite altimetry, taking into account the contributions of the mass migration due to glacier and ice sheet melting, global temperature increase and post-glacier respond effects, we find that the Earth is expanding at a rate around 0.9 $\pm$  0.6 mm/a. A relative large uncertainty ( $\pm$  0.6mm/a) is due to the fact that the sea level rise and the relevant contributions to it cannot be relatively well estimated at present, and further investigations are needed. Finally, a possible expansion mechanism is provided in this investigation. This study is supported by Natural Science Foundation of China (grant No. 41174011; 40974015; 40637034).

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