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基于半解析法有效和快速估计GRACE全球重力场的精度

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摘要 首先基于半解析法建立了新的GRACE卫星K波段测量系统星间测速、GPS接收机轨道位置和加速度计非保守力误差联合影响累计大地水准面的误差模型；其次，基于各关键载荷精度指标的匹配关系，论证了误差模型的可靠性；最后，基于美国喷气动力实验室（JPL）公布的2006年的GRACE Level 1B实测误差数据，有效和快速地估计了120阶全球重力场的精度，在120阶处累计大地水准面的精度为18.368 cm，其结果和德国地学研究中心（GFZ）公布的EIGEN-GRACE02S全球重力场模型符合较好. 本文的研究为将来国际卫星重力测量计划（如GRACE Follow-On, 360阶）中高阶全球重力场模型精度的有效和快速估计提供了理论基础和计算保证.

关键词 GRACE 半解析法 联合误差模型 全球重力场
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Efficient and rapid estimation of the accuracy of GRACE global gravitational field using the semi-analytical method

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Abstract In this paper, firstly, the new combined error model of cumulative geoid height influenced by three error sources including the inter-satellite range-rate of K-band ranging system, orbital position of GPS receiver and non-conservative force of accelerometer from GRACE satellites is established using the semi-analytical method. Secondly, the dependability of error models is demonstrated based on matching relationship among the accuracy indexes of key payloads. Finally, the accuracy of global gravitational field up to degree and order 120 is effectively and rapidly estimated from GRACE Level 1B measured observation errors of the year 2006 publicized by the Jet Propulsion Laboratory (JPL) in the USA, and the cumulative geoid height error is 18.368 cm at degree 120, which preferably accords with the Earth's gravitational field model EIGEN-GRACE02S provided by the GeoForschungsZentrum Potsdam (GFZ) in Germany. This work can provide theoretical foundation and calculational guarantee for the efficient and rapid estimation of the accuracy of high-degree global gravitational field model in the future international satellite gravity measurement mission (e.g. GRACE Follow-On, degree 360).

Key words GRACE; Semi-analytical method; Combined error model; Global gravitational field

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