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中国区域IGS基准站坐标时间序列非线性变化的成因分析

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Cause analysis of the non-linear variation of the IGS reference station coordinate time series inside China

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摘要

GPS坐标时间序列呈现显著的季节性变化,通常认为大气压、非潮汐海洋负载及水文负载(统称为地表质量负载)是引起测站谐波变化的主要因素.本文计算了不同地表质量负载造成的测站位移,以此修正中国区域11个IGS基准站的坐标时间序列.建立了地球物理现象与测站季节性变化及噪声特性之间的初步数值联系,认为其会造成测站的噪声特性变化,主要表现为带通及随机漫步噪声特征,且仅能减小测站*U*分量的周年运动,但并不是造成测站*U*分量半周年运动及水平方向周年运动的主要原因.深入分析了造成中国区域IGS基准站非线性变化的其他可能因素,重点探讨了周日(S1)、半周日(S2)大气潮汐对基准站周年振幅的贡献,由此提出S1、S2大气潮汐是造成中国区域IGS基准站周年运动,尤其是中南部测站垂向周年运动的主要因素之一.

关键词 地表质量负载, IGS基准站, 非线性变化, 噪声特性, 周日、半周日大气潮汐

Abstract:

GPS position time series exhibit dramatic seasonal variation. It is generally considered that atmospheric pressure loading, nontidal ocean loading, snow depth and soil moisture loading account for the main contribution of this seasonal change. Focusing on the 11 IGS reference stations inside China, this paper calculates the above four kinds of surface mass loadings induced station displacement to correct the coordinate time series of these 11 stations during period of 1995—2010 under ITRF2005. We establish preliminary numerical link between certain geophysical phenomenon, seasonal variation and noise characteristics, finding that the calculated four kinds of surface mass loading could produce variation in station's noise feature, mainly exhibiting characteristics of band pass noise and random walk noise, and could reduce the annual amplitude of station's Up component. However, it could not well interpret station's semi-annual and horizontal annual movement. We deeply investigate the possible factors that could cause non-linear variations of IGS stations, take emphasis on the contributions of diurnal (S1) and semi-diurnal (S2) atmospheric tides to the annual amplitude of the 11 stations, and propose that the S1-S2 atmospheric tides could be one of the main reasons that cause annual motion of IGS stations inside China, especially for the vertical annual motion of stations in central and southern regions.

Keywords Surface mass loading, IGS reference station, Non-linear variation, Noise characteristics, S1-S2 atmospheric tides

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