地球物理学报 » 2013, Vol. 56 » Issue (7) :2218-2227 doi:10.6038/cjg20130709
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引用本文(Citation):
姚宜斌, 何畅勇, 张豹, 许超钤.一种新的全球对流层天顶延迟模型GZTD. 地球物理学报, 2013,56(7): 2218-2227,doi: 10.6038/cjg20130709

YAO Yi-Bin, HE Chang-Yong, ZHANG Bao, XU Chao-Qian.A new global zenith tropospheric delay model GZTD.Chinese Journal Geophysics,2013,5
2218-2227,doi: 10.6038/cjg20130709

一种新的全球对流层天顶延迟模型GZTD

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A new global zenith tropospheric delay model GZTD

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摘要

对流层延迟是GNSS导航定位主要误差源之一,主要受气象参数(如总气压、温度和水汽压等)的影响,具有变化随机性强的特点.本文利用 GGOS Atmosphere提供的2002—2009年全球天顶对流层延迟格网时间序列研究了全球对流层天顶延迟的时空变化特征.并以此为基础对全球天顶对流层延迟(Zenith Troposphere Delay, ZTD)进行建模,提出了一种基于球谐函数的全球非气象参数对流层天顶延迟改正模型——GZTD模型.实验对比结果表明考虑ZTD经纬向变化的GZTD模型内符合精度全球统计结果(bias:0.2 cm,RMS:3.7 cm)优于只考虑ZTD纬向变化的UNB3m (bias:3.4 cm,RMS:6.0 cm)、UNB4 (bias:4.7 cm,RMS:7.4 cm)、UNB3 (bias:4.0 cm,RMS:7.0 cm)和EGNOS (bias:4.5 cm,RMS:6.9 cm)等模型.使用全球385个IGS站进行外符合检验,统计结果表明GZTD模型(bias:-0.02 cm,RMS:4.24 cm)同样优于其它模型.GZTD模型具有改正效果良好、使用简单、所需参数少等优点.

关键词 天顶对流层延迟, GZTD模型, EGNOS模型, UNB系列模型

Abstract:

Troposphere delay is one of the main error sources in global navigation satellite systems (GNSS). Its obvious randomness is mainly attributed to meteorological parameters (total pressure, temperature and water vapor pressure, etc.). In this paper, the temporal and spatial variations of global Zenith Troposphere Delay (ZTD) is analyzed using the time series of global 4D-grid ZTD from 2002 to 2009, provided by Global Geodetic Observing System (GGOS) Atmosphere. According to the analysis, a new global ZTD correction model without requiring meteorological parameters, called GZTD, is developed based on spherical harmonics. Experimental results show that the precision of inner coincidence of GZTD model (bias: 0.2 cm, RMS: 3.7 cm) considering the longitudinal and latitudinal variations of ZTD performs better than other latitude-only models, such as UNB3m (bias: 3.4 cm, RMS: 6.0 cm), UNB4 (bias: 4.7 cm, RMS: 7.4 cm), UNB3 (bias: 4.0 cm, RMS: 7.0 cm) and EGNOS (bias: 4.5 cm, RMS: 6.9 cm). Compared to ZTD time series from 385 global International GNSS Service (IGS) sites, GZTD model (bias:-0.02 cm, RMS: 4.24 cm) is still clearly superior to other similar models. The GZTD model owns such advantages as well-performance, simplicity in computation and less parameters-requirement.

Keywords Zenith tropospheric delay, GZTD model, EGNOS model, UNB series model

Received 2012-12-26;

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