应用气象学报 Journal of Applied Meteorological Science

FY 3A微波资料偏差订正及台风路径预报应用

Bias Correction for FY 3A Microwave Sounding Data with Its Application to Typhoon Track Forecast

基金项目：资助项目：国家自然科学基金项目(41001283)，公益性行业（气象）科研专项(GYHY200906002)

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摘要：

我国极轨气象卫星FY 3A大大增强了对地球系统的综合探测能力，而偏差订正对卫星资料的应用非常必要。试验中FY 3A卫星微波资料的偏差订正方案是在Harris等的TOVS辐射资料偏差订正经验方法的基础上结合WRF 3DVAR系统发展的，偏差订正后微波资料各通道拟合结果基本位于主对角线上，大多数卫星观测数据与观测算子利用背景场计算的亮温值分布趋于合理，偏差得到很大程度的降低。偏差订正后，利用数值模式直接同化FY 3A气象卫星微波资料，通过对2008年和2009年的4个台风进行预报评估表明：同化FY 3A气象卫星资料后路径预报能力提高明显，尤其是36 h后路径预报结果；同化FY 3A气象卫星微波资料后台风预报路径误差平均降低20%，而只同化常规资料路径误差仅仅降低了4%。

关键词：FY 3A气象卫星 微波探测 偏差订正 直接同化 台风

Abstract:

The quality of numerical weather prediction depends closely on accuracies of initial condition provided by observation system. Satellite observations are very important source for data assimilating models, which is of good overcast, high resolution and stable, improving prediction compared to conventional data in many cases. A new generation polar orbiting meteorological satellite of China, FY 3A is successfully launched on 27 May 2008, and FY 3B is also successfully launched on 5 November 2010. The two kinds of microwave vertical sounding sensors aboard are very similar in capability to ATOVS (the Advanced TIROS Operational Vertical Sounder) of NOAA series satellite. One of them is microwave temperature sounder (MWTS), and the other one is microwave humidity sounder (MWHS). They are used to sound the vertical distribution of the atmospheric temperature and humidity respectively. They provide very important observations for application in regional and global data assimilation system.Because of the observation instrument accuracy, observation operator approximation, assimilation model limitations, to the assimilating bias needs correction. The significant characteristics of bias effect are to cause systematic increment field, and the increment field could be obtained by OMB (observed minus background) statistic. This bias correction experiment of FY 3A satellite microwave data is developed on the basis of Harris and Kelley s bias correction experience method for TOVS radiation data, and with combination of improved WRF 3DVAR system. By analyzing the algorithmic method of radiative transfer in the spectral of microwave coverage, mapping function of model variables and brightness temperature of satellite microwave channel is established, making the fast radiative transfer model to be of quasi linear expression, with considerable accuracy. Under the fast radiative transfer model and its corresponding tangent linear and adjoint model, a direct variational data assimilation system is established in the original assimilation framework using FY 3A microwave temperature sounder and microwave humidity sounder as input. In consideration of the spatial variations and the air mass dependence of satellite radiation data， the microwave data are processed with scan bias correction and air mass bias correction. And the microwave data of each channel basically has a fitting line along the leading diagonal after bias correction. Distribution of most the satellite observation and the brightness temperature derived by observation operator using background tends to be reasonable, and the bias is reduced a lot.With bias correction, FY 3A microwave data is directly assimilated in numerical weather prediction. The assessment of the forecast experiments for 4 typhoons shows that after assimilation the track forecasting ability is significantly improved, especially after 36 hours. And assimilation of FY 3A microwave data has reduced track forecast error by an average of 20%, while the assimilation of conventional data can reduce it by only 4%.

Keywords:FY 3A meteorological satellite microwave observation bias correction direct assimilation typhoon

杜明斌,杨引明,杨玉华,张 洁,朱雪松.FY 3A微波资料偏差订正及台风路径预报应用[J].应用气象学报,2012,23(1):89~95.Du Mingbin,Yang Yinming,Yang Yuhua,Zhang Jie and Zhu Xuesong.Bias Correction for FY 3A Microwave Sounding Data with Its Application to Typhoon Track Forecast[J].Journal of Applied Meterological Science,2012,23(1):89~95

主办单位：中国气象科学研究院，国家气象中心，国家卫星气象中心，国家气候中心，国家气象信息中心，中国气象局气象探测中心 单位地址：北京市海淀区中关村南大街46号 中国气象科学研究院《应用气象学报》编辑部

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