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利用卫星温度资料计算风场的方法分析与比较

肖存英[1,2],胡雄[1],田剑华[1]

1 中国科学院空间科学与应用研究中心，北京 100080;2 中国科学院研究生院，北京 100049

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摘要 本文分析和比较了利用卫星温度资料计算水平风场的方法，包括地转风、梯度风和平衡风的计算方法.以DAAC提供的MLS/UARS 1992年12月份的大气温度数据为例，计算了20～55 km高度范围的地转风、梯度风和平衡风，并与ECMWF提供的ERA-40再分析风场资料作了对比和分析，包括12月16日以及12月月平均风场随纬度-高度的变化、风场随经度-纬度的变化、纬
圈平均风场随纬度-高度的变化特征和规律.计算结果表明，利用卫星温度观测数据计算的风场与再分析资料的特征和规律基本一致.计算的地转风在高纬地区比梯度风和平衡风大，在中低纬地区三者的差别较小，随着纬度的增大，曲率项的影响也逐渐增大，在高纬地区不可忽略.平衡风在梯度风的基础上还考虑了大气平流项的影响，能更好地反映风场的变化特征，尤其是高纬地区经向风的变化规律.利用平衡风场的计算结果，文章首次定量地计算了平衡方程中各项的大小和比值，分析了各项的贡献和相对重要性.结果表明，重力位势梯度项的贡献最大，并且随着纬度的增大有升高的趋势；曲率项的贡献随着纬度的增大也有增大的趋势，在高纬度地区的比值超过10%；平流项占有一定的比值，其变化范围相对较大，变化规律比较复杂.

关键词 临近空间,温度,地转风,梯度风,平衡风

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Analysis and comparison of deriving winds from satellite temperature data

XIAO Cun-Ying[1,2], HU Xiong[1], TIAN Jian-Hua[1]

1 Center for Space Science and Applied Research, Chinese Academy of Sciences, Beijing 100080, China;2 Graduate University of the Chinese Academy of Sciences, Beijing 100049, China

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Abstract Several methods of deriving horizontal wind fields from satellite temperature data are analyzed and compared in this paper, including the calculation methods of geostrophic wind, gradient wind and balance wind. Taking the temperature data of MLS/UARS in December, 1992 offered by DAAC for example, wind fields at the altitude range of 20～55 km are inferred. Comparing with ERA-40 reanalyzed wind fields which are offered by ECMWF, the characteristics of latitude-height, longitude latitude distributions of winds at December 16th and monthly-averaged winds in December, the latitude-height distributions of zonal mean winds are discussed. Results show that, the characteristics of wind fields deriving from the satellite temperature data through theoretical equations are similar with that of the reanalyzed data. The geostrophic wind is larger than gradient and balance winds over high-latitude areas, while the differences of the three are small over middle- and low-latitude areas. The influence of curvature terms increases with latitudes, which should not be neglected over high-latitude areas. Based on the gradient winds, also containing the effect of advection terms, balance winds have a better exhibition of the wind characteristics, especially the characteristics of the meridional winds over high-latitude areas. Moreover, values and ratios of the terms in balance equations are firstly calculated in this study, and the contribution and relative importance are also analyzed. Results suggest that the terms of geopotential derivative play a crucial role in the balance equations, which have the trend of contributing larger with increasing latitudes. The contribution of the curvature terms also increases with latitude, with the ratios generally larger than 10% over high-latitude areas. The advection terms have some contribution, of which the ratios change relatively larger with more complicated rules.

Key words Near space Temperature Geostrophic wind Gradient wind Balance wind

通讯作者:
肖存英 xiaocy@cssar.ac.cn
作者个人主页: 肖存英[1;2];胡雄[1];田剑华[1]