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用一维变分法校正卫星资料反演地球大气湿度场的试验研究

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摘要 本文采用一维变分法，并将MM5模式的相对湿度6小时预报作为背景信息，对1998年6~7月两种卫星反演地球大气相对湿度资料进行偏差校正试验，以提高其精度.这两种反演资料分别是用统计反演法反演GMS-5静止气象卫星多通道遥感信息得到的GMS反演地球大气湿度，和用同步物理反演法反演NOAA-14极轨卫星的TOVS晴空测值所得的TOVS反演湿度.校正试验结果表明，一维变分法能有效减小两种卫星反演湿度相对于匹配的NCEP/DOE再分析相对湿度的平均偏差和均方根偏差：850~300 hPa GMS反演湿度的绝对平均偏差下降了0.59%~2.87%；各层GMS反演湿度的均方根偏差的减少量为3.26%~7.49%，其中925~400 hPa从11%~14%降为6%~9%，300~200 hPa从20%~24%降为13%~18%；500~300 hPa TOVS反演湿度的绝对平均偏差从7%~13%降至1%~5%；各层TOVS反演湿度的均方根偏差减少了12.61%~15.1%，其中1000~500 hPa从21%~24%降至8%~10%，400~300 hPa从25%~29%降至11%~14%.校正分别使925~400 hPa GMS反演湿度和1000~500 hPa TOVS反演湿度的均方根偏差降至10%以下，达到了WMO对卫星资料反演地球大气湿度垂直分布的可用精度要求.

关键词 变分方法 偏差校正 卫星资料反演地球大气湿度场
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Bias correction study on the satellite humidity retrievals through a one-dimensional variational method

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Abstract By using a one-dimensional variational (1D-Var) method, relative humidity (RH) derived from GMS-5 multi-channel satellite images and from NOAA-14's TIROS Operational Vertical Sounder (TOVS) radiances were corrected by 6-h RH forecasts of the MM5 meso-scale NWP model. Errors with respect to the collocated NCEP/DOE reanalysis (R-2) were assessed. It shows that the root mean square differences (RMSD) of the GMS RH retrievals are 11%~14% in 925~400 hPa and 20%~24% in 300~200 hPa, while the TOVS RH retrievals have RMSD of 21%~24% in 1000~500 hPa and 25%~29% in 400~300 hPa, respectively. After 1D-Var correction, the absolute mean biases of the resulting GMS RH retrievals in 850~300 hPa are reduced by 0.59%~2.87%, and that of the resulting TOVS RH retrievals in 500~300 hPa are reduced from 7%~13% to 1%~5%. The reduction in RMSD of the corrected RH retrieved from GMS and from TOVS is 3.26%~7.49% and 12.61%~15.1% respectively. The RMSD of the corrected RH retrieved from GMS in 925~400 hPa and from TOVS in l000~500 hPa are dropped to below 10%, the accuracy requirement for satellite RH retrievals determined by the World Meteorological Organization (WMO).

Key words Variational method; Bias correction; Satellite humidity field retrievals

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