基于多源数据的 HY-2C 高度计湿对流层延迟校正研究

孙洁[1,2]，杨俊钢[2]，崔伟[2]

（1.山东科技大学，中国 山东 青岛 266590；2.自然资源部第一海洋研究所，中国 山东 青岛 266061）

卫星雷达测高(RA)任务是全球海洋观测、全球和区域海平面变化监测的重要手段之一，卫星雷达测高技术能够提供连续、全天候、近乎覆盖全球海洋的观测。大气湿对流层延迟(WTD)是卫星测高的误差来源之一。湿对流层延迟与雷达信号传播路径上对流层水汽和云液态水在信号传播路径上的变化有关，其变化范围为0~50cm，且随时间和空间的变化而变化。HY-2C 卫星是中国的第三颗海洋动力环境监测卫星，该卫星搭载了雷达高度计(RA)、扫描微波辐射计、微波散射计和校准微波辐射计(CMR)等。校准微波辐射计可为高度计海面高度观测提供湿对流层延迟数据，但受近岸陆地、海冰、降雨和仪器异常等影响，辐射计反演湿对流层延迟存在较大误差甚至缺失。为解决 HY-2C 卫星高度计的湿对流层延迟数据缺失或精度偏低的问题，本研究基于 GNSS 数据、再分析数据和其他微波辐射计数据，开展 HY-2C 高度计湿对流层校正研究。以基于 ERA5 再分析数据得到的湿对流层延迟校正(WTC)数据为背景场，综合 HY-2C 高度计校准辐射计沿轨有效湿对流层延迟、基于 GNSS 数据的 HY-2C 高度计近岸湿对流层延迟和基于其他卫星微波辐射计的湿对流层延迟数据，采用时空匹配和客观分析方法，在保留 HY-2C 校准辐射计湿对流层延迟有效数据的基础上，开展多源数据融合，弥补 HY-2C 高度计湿对流层延迟的缺失数据，进而提高 HY-2C 卫星高度计的测高精度，以满足日益增长的数据需求。

Study on Wet Tropospheric Correction of HY-2C Altimeter based on Multi-source Data

Satellite Radar Altimetry (RA) missions are one of the important means of global ocean observation and global and regional sea level changes monitoring. Satellite radar altimetry technology can provide continuous, all-weather, nearly whole coverage observations of global ocean. Atmospheric Wet Tropospheric Delay (WTD) is one of the error sources in satellite altimetry. The WTD with the range of 0~50cm is related to the variabilities of tropospheric water vapor and cloud liquid water in the radar signal propagation path, and varies spatially and temporally. The HY-2C satellite is the third China's marine dynamic environment monitoring satellite, which carries Radar Altimeter (RA), Scanning Microwave Radiometer, Microwave Scatterometer and Calibrated Microwave Radiometer (CMR). The CMR can provide WTD data for the correction of RA sea surface height. Due to the pollutions of coastal land, sea ice, rainfall and anomalies of instrument, CMR wet tropospheric delay sometimes has large errors or even is missing. In order to solve the problem of missing or low accuracy of CMR WTD data, the Wet Tropospheric Correction (WTC) of HY-2C RA is carried out by GNSS data, reanalysis data and other microwave radiometer data in this study. Taking the WTD correction data obtained by ERA5 reanalysis data as the background field, and combining the effective CMR WTD data along the ground track of the HY-2C altimeter, the nearshore WTD data obtained by the GNSS data and the WTD data obtained by other satellite microwave radiometers, multi-source data fusion was carried out on the basis of retaining the effective CMR WTD data by using spatiotemporal matching and objective analysis methods. Eventually, the missing CMR WTD data are filled and the accuracy of sea surface height measurement of HY-2C RA is improved to meet the growing data demand.