

Analysis of the spatial and temporal distribution of regional total aerosols in China based on MERRA-2 remote sensing assimilation data

Zhi Zheng¹ Heming Bai²

¹ Heilongjiang Institute of Engineering, Harbin, Heilongjiang 150008

² Research Center for Intelligent Information Technology, Nantong University, Nantong, Jiangsu 226000, China

Abstract: Based on the ground-based observations of the Automatic Aerosol Monitoring Network (AERONET) and the aerosol optical thickness (AOD) products of MODIS, the applicability of MERRA-2 reanalysis data AOD products in the Chinese region is evaluated, and the spatial and temporal characteristics of aerosols in the Chinese region are further analyzed.

The results show that the correlation coefficients between MERRA-2 AOD products and the AOD observations at six AERONET sites in China range from 0.53 to 0.79, with the root mean square error ranging from 0.13 to 0.32. MERRA2 has the best reproduction effect in northern China and the poorer effect in the Yangtze River Delta region. The annual average maximum value of total aerosol optical thickness (TOT) is in the eastern side of Sichuan and Chongqing, with the peak value occurring in June-August and reaching over 0.7; the next highest value is in the north China plain-middle and lower reaches of Yangtze River, with the annual average maximum value between 0.55 and 0.65; the maximum value of AOD in the northwest and southern regions is between 0.4 and 0.5; the aerosol optical thickness in other regions is less than 0.3. Based on the MERRA-2 data from 2014-2018, we estimated the trend of AOD in China, and the results showed that the AOD in Xinjiang region increased most significantly. The most obvious increase of AOD in the Xinjiang region can reach 0.04/y; the northeastern region, north China plain, middle and lower reaches of the Yangtze River, and southern region of China have the most obvious increase of AOD at -0.04/y.

The results show that AOD in Xinjiang region increased the most significantly, up to 0.04/y; in Northeast China, North China Plain, middle and lower reaches of the Yangtze River and South China, the rate of decrease was -0.25/y, while other regions did not change significantly. The trend of changes obtained from MODIS is basically the same in all regions except for Sichuan, where the decrease is not significant. This phenomenon may be due to the assimilation of MERRA-2 data in addition to MODIS data.

Based on the AOD products of AERONET and MODIS, combined with the variance and root-mean-square error, the MERRA-2 data are more applicable in China. The applicability of MERRA-2 data in China is high. However, the correlation between MERRA-2 data and other ground-based observation products has not been explored. However, the correlation between MERRA-2 data and other ground-based observation products was not explored, so more ground-based observation data are needed to validate and optimize the reanalysis data in the future.

Keywords: MERRA-2 reanalysis data, AERONET, MODIS, AOD, spatial and temporal variability.