RETRIEVAL OF AEROSOL OPTICAL THICKNESS FROM HJ-1A/B IMAGES USING STRUCTURE FUNCTION METHOD

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1. INTRODUCTION

Small Satellite Constellation for Disaster and Environment Monitoring and Forecast is a national project proposed by State Environmental Protection Administration and National Committee for Disaster Reduction. It is composed of a number of small satellites, the ground system, and the application system. China is projecting its first satellite for monitoring environment and natural disasters, the 'HJ-1', to improve the country's abilities in monitoring environmental changes and reducing calamities. 'HJ-1' consists of two small optical satellites, the 'HJ-1A' and the 'HJ-1B', and one radar satellite, the 'HJ-1C'. Two mini satellites HJ-1A and HJ-1B were launched on September 6, 2008, and were successfully placed on sun-synchronous orbits at the altitude of 650 km. The HJ-1A mini satellite is equipped with a CCD camera and a hyper-spectral optical camera, while the HJ-1B mini satellite is fitted with the same CCD camera and an infrared camera. The CCD cameras on both mini satellites are standard optical scanner systems for imagery with 30 meter spatial resolution and 720 km swath in four spectral bands (blue band 0.43-0.52μm, green band 0.52-0.60μm, red band 0.63-0.69μm and near infrared band 0.76-0.90μm), and its average global coverage time is 48 hours.

Tropospheric aerosols play an important role in the Earth radiation budget directly through scattering and absorption of solar and infrared radiation, and indirectly by modifying cloud microphysical and radiative properties. Lifetime of aerosol is very short (a few hours to about a week), so that the distributions of aerosol particles vary extensively in space and time, especially in urban area. So it is necessary to study AOT in high spatial and temporal resolution. As is mentioned in the paragraph one, HJ-1A/B could provide the images with high spatial and temporal resolution, so they are suitable for monitoring change of aerosol. In this paper, CCD images of HJ-1A/B are used to retrieve AOT.

AOT distribution over ocean and dark dense vegetation areas has been retrieved from remote sensing data with high precision. In the dark area, aerosol properties could be well obtained using path radiance, which does not work well in the bright area. Tanre et al.[1] proposed a method named structure function method (SFM) and applied it to TM images over an arid region. In the SFM, surface reflectance is not necessary to be given, and is expressed indirectly by the structure function. AOT is determined from the atmospheric transmission based on the ratio of the transmission among several images[2]. SFM has been confirmed to show good capability in retrieving AOD distribution over arid regions from either high-resolution Landsat TM images[1,4] or low-resolution NOAA AVHRR images[2,4]. Sunlin[3] improved SFM and retrieved AOT over urban area from MODIS data considering the BRDF of the surface. As is above mentioned, SFM is advantageous to retrieve AOT over bright area. This paper attempts to retrieve AOT of bright areas (such as desert, city, and arid area) using SFM.

2. METHODOLOGY

We improve SFM by establishing a structure function formula which can describe the real characteristics of the surface structure more exactly and choosing the optimal distance value and window size to calculate the structure function value in the paper. There are following processes to obtain AOT from HJ-1A/B. Firstly, a series of images should be pre-processed; secondly, the clearest day is chose among the series as the reference according to ground observation; thirdly, structure function values of images are calculated using the developed structure function formula, the optimal distance value and window size; fourthly, the look up table is established between AOT and atmospheric transmission (total atmospheric transmission minus diffuse transmission between ground and satellite); fifthly, AOTs of polluted days could be obtained by given AOT of reference day and structure function values calculated; sixthly, AOT retrieved is validated through comparing with the ground sun-photometer observations.

3. CONCLUSION

SFM is improved and used to retrieve AOT of bright area in this paper, and AOT distribution of high spatial and temporal resolution could be obtained, which could reflect the condition of air quality directly. The two mini satellites HJ-1A/B could play an important role in assessing the air quality because of their high spatial and temporal resolution.

KEYWORDS: Structure Function Method (SFM), Aerosol Optical Thickness (AOT), HJ-1A, HJ-1B

4. REFERENCES

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