An algorithm for aerosol remote sensing from multispectral single-viewing polarimetric measurements over land

Weizhen Hou and Zhengqiang Li*

State Environment Protection Key Laboratory of Satellite Remote Sensing, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing 100101, China

**Presenting author (houwz@radi.ac.cn)*

A new space-borne instrument called Synchronization Monitoring Atmospheric Corrector (SMAC) has been launched onboard the corresponding satellite of Chinese High-resolution Earth Observation System [1] in 2018. SMAC was designed with multispectral single-viewing polarimetric measurements with 490(P), 550, 670(P), 865(P), 910, 1380, 1610(P), and 2250(P) nm, aiming to provide the aerosol properties for atmospheric correction of the main sensors onboard the same satellite platform [2,3]. Based on the optimal estimation (OE) theory, we develop an optimized inversion algorithm for remote sensing of spectral aerosol optical depth (AOD) from single-viewing intensity and polarization together over land, by taking full advantage of available multispectral polarimetric measurement information form the visible to shortwave infrared wavelength with the synthetic and real measurements of SMAC.

In the theoretical framework for aerosol retrieval, the principal component analysis (PCA) method is used to reconstruct the multispectral surface reflectance by about three principal components (PCs) extracted from the USGS and ASTER spectral library, and thus we can try to retrieve the weighting coefficient of each PC instead of the direct retrieval of surface reflectance [4, 5]. Besides, a bidirectional polarized reflectance distribution function (BPDF) is used to describe the surface polarized contribution [6]. Unified Linearized Vector Radiative Transfer Model (UNL-VRTM) is employed as the forward model for the retrieval test with synthetic and real data, which are generated by the integration of surface reflectance and surface polarized contribution together for various scenarios with different aerosol models, observation geometries over typical surface types, such as vegetation and bare soil [7]. Preliminary retrieval tests show that the spectral AOD could be well retrieved, as well as the surface reflectance constructed by PCA and BPDF parameter.

References

[1] Gu, X., and X. Tong, 2015: Overview of China earth observation satellite programs. *IEEE Geosci. Remote Sens. Mag.* **3**, 113–129.

[2] Dubovik, O., Z. Li, M. I. Mishchenko, *et al.*, 2019: Polarimetric remote sensing of atmospheric aerosols: Instruments, methodologies, results, and perspectives. *J. Quant. Spectrosc. Radiat. Transfer* **224**, 474–511

[3] Hou, W., Z. Li, J. Wang, *et al*., 2018: Improving remote sensing of aerosol microphysical properties by near-infrared polarimetric measurements over vegetated land: information content analysis. *J. Geophys. Res. Atmos.* **123**, 2215–2243.

[4] Hou, W., J. Wang, X. Xu, *et al*., 2016: An algorithm for hyperspectral remote sensing of aerosols: 1. Development of theoretical framework. *J. Quant. Spectrosc. Radiat. Transfer* **178**, 400–415.

[5] Hou, W., J. Wang, X. Xu, *et al*., 2017: An algorithm for hyperspectral remote sensing of aerosols: 2.

Information content analysis for aerosol parameters and principal components of surface spectra. *J. Quant. Spectrosc. Radiat. Transfer* **192**, 14–29.

[6] Li, Z., W. Hou, J. Hong, *et al*., 2018: Directional Polarimetric Camera (DPC): monitoring aerosol spectral optical properties over land from satellite observation. *J. Quant. Spectrosc. Radiat. Transfer* **218**, 21–37.

[7] Wang, J., X. Xu, S. Ding, *et al*., 2014: A numerical testbed for remote sensing of aerosols, and its demonstration for evaluating retrieval synergy from a geostationary satellite constellation of GEO-CAPE and GOES-R. *J. Quant. Spectrosc. Radiat. Transfer* **146**, 510–528.

Preferred mode of presentation: Oral