RETRIEVAL OF AEROSOL OPTICAL THICKNESS AND SIZE DISTRIBUTION FROM PARASOL IN PEARL RIVER DELTA AREA

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1. INTRODUCTION

Retrieval of aerosol properties has become a hot topic in recent years. Aerosol properties vary with the aerosol type, loading, or atmospheric conditions. Remote sensing of aerosol is more accurate and informative over ocean due to the dark and uniform reflectance (except glint area). However, land surface retrieval is problematic in general since the unknown and variable surface reflectivity can strongly influence the backscattered atmospheric signal that contains the aerosol information [1]. The problem has been approached in several ways, such as using multi-angular information [2], polarization information [3], multi-spectral information [4] and multi-temporal information [5]. In this paper, we take Pearl River Delta area in Guangdong Province as an example to retrieve the aerosol properties based on a multi-dimension parameters LUT (look-up table) using PARASOL (Polarization and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a LIDAR) data.

The PARASOL satellite is a part of the so-called "A-train" series, and carries the only polarimetric sensor which is still operational. It was launched in December 2004 and started its operational life in March 2005. The multi-directional, multi-spectral polarized satellite sensor can acquire global observations of the polarization and directionality of solar radiation reflected by the earth-atmosphere system. The polarized light reflected by ground targets is small and stable enough to allow for correction in TOA (top of atmosphere) measurements [6], so PARASOL has provided a unique opportunity for aerosol remote sensing over land.

2. CHOOSEING AEROSOL MODELS

Selecting a reasonable aerosol model is very important to retrieve the aerosol optical properties. Aerosol model mainly includes complex refractive index and size distribution function. The most popular method to monitor the aerosol size-distribution is combining the spectral optical thickness from direct sun measurement and aureole data [7]. How to retrieve the size distribution by satellite remote sensing data still need further studies.

Based on the analysis of AERONET (Aerosol Robotic Network) aerosol products at Kaiping and Hong Kong PolyU sites, we find that aerosols over these regions are mostly mixture of fine particles and coarse particles, and the aerosol size distribution function can be fit as bi-modal lognormals. As polarized signals are mainly sensitive to small particles such as the aerosols created by anthropogenic pollution or biomass burning [8-9], we just retrieve the fine fraction of aerosols. We have chosen 324 aerosol models for inversion in test area beforehand.

3. THE INVERSION ALGORITHM

The polarized reflectance of TOA is composed of the respective contributions of the atmosphere and surface. In the research, parameterization of the surface polarized reflectance was represented by semi empirical model as a function of surface type and NDVI [10]. Atmospheric contribution to the measured polarized reflectance was derived through vector radiative transfer model.

Based on the hypothesis that surface polarized reflectance is small and rather uniform (varies little with surface type), we have constructed a LUT in which an array of aerosol models at various optical thicknesses is used to calculate the normalized polarized radiances. The constructed LUT is seven-dimensional, including wavelength, altitude, aerosol model, AOT (aerosol optical thickness), solar zenith angle, view zenith angle and relative azimuth angle. The best agreement (i.e., minimum difference) between computed and measured spectral polarized reflectances provides AOT and aerosol model estimates. Our inversion algorithm does not work for coarse aerosols and over desert or snow due to their larger polarized reflectance.

4. RESULTS AND VALIDATION

In this paper, we derived AOTs and aerosol size distribution function in Pearl River Delta area during October, November 2008 and January, February 2009. Figure 1 and Figure 2 show the AOT retrieved results on November 13th, 2008 and February 8th, 2009, respectively. Obviously, retrieving aerosol from PARASOL

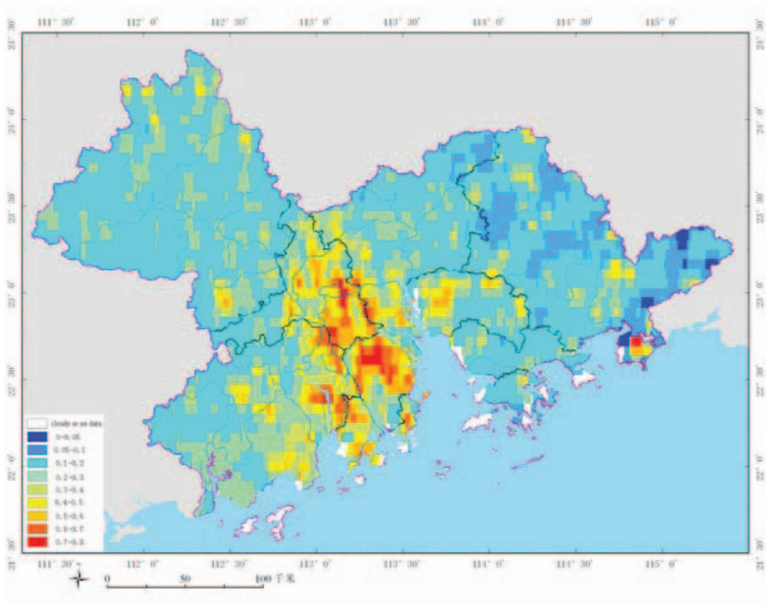

Fig. 1. The retrieved result of AOTs at 0.67 micron on November 13th, 2008

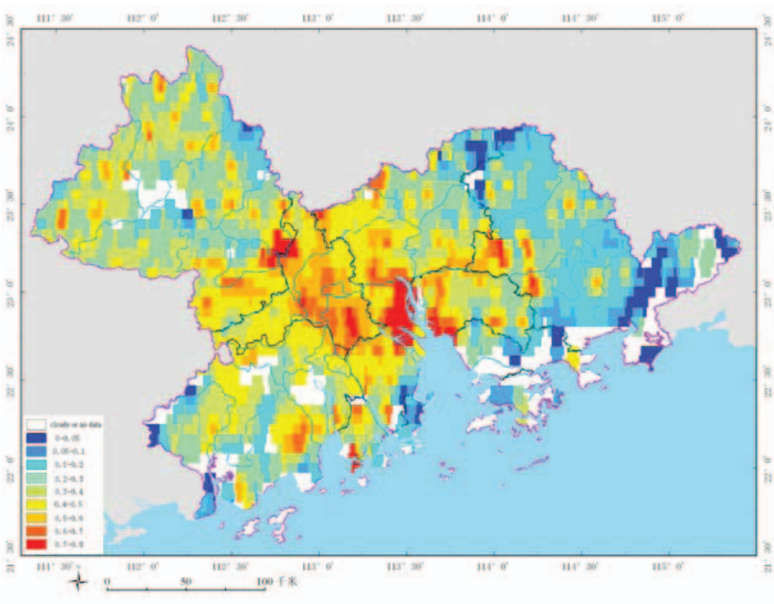

Fig. 2. The retrieved result of AOTs at 0.67 micron on February 08th, 2009

isn't affected by season, as most regions have values not only in autumn but also in winter. Furthermore, our research has compared the retrieve results with AERONET and PARASOL products. The retrieved number particle size distribution was converted to volume size distribution to be consistent with AERONTE products. Validation results showed that the retrieved AOTs agree better with AERONET than PARASOL products. The retrieved values of size distribution for the radii bigger than 0.2 micron are underestimated due to that polarization is insensitive to coarse model aerosol, the ones for the radii less than 0.2 are consistent with

AERONET. The deviation can be also brought by humidity and integration on the vertical column.

5. REFERENCES

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