remote sensing

Editorial

An Editorial for the Special Issue "Aerosol and Atmospheric Correction"

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Aerosol is an important atmospheric component that severely influences the global climate and air quality of our planet [1–4]. In quantitative remote sensing, aerosol is also a key factor in atmospheric correction of remote sensing data to obtain accurate surface information [5–7]. The radiation signal received by the sensor is surface–atmosphere coupled, including the signal of path radiance, surface reflection, and surface–atmosphere interaction, a phenomenon which impedes quantitative information acquisition from both surface and atmospheric aspects. Accurate aerosol estimation and atmospheric correction are needed to solve this problem.

In this Special Issue, the studies cover several important topics, mainly involving aerosol retrieval, aerosol emission and regional transfer, and atmospheric correction. The goal of this Special Issue is to discuss the accurate retrieval and estimation of aerosols to help with precise atmospheric correction and facilitate various corresponding scientific studies focusing on the development of new technologies, instruments, and methods.

Aerosol product quality limits their data applications. Some advancements are made in this Special Issue that improve aerosol detection and retrieval accuracy. Focusing on the characteristics of Coherent Doppler Wind Lidar (CDWL), a novel method for the calibration and quantitative assessment of aerosol properties is proposed [8]. The result is verified through comparison with synchronous Rayleigh–Mie–Raman Lidar (RMRL) data, resulting in good agreement, proving the ability of CDWL to retrieve aerosol properties accurately. Meanwhile, exploring aerosol retrieval of single-angle and multi-band polarization instruments containing short-wave infrared bands, surface and atmosphere decoupling without prior information about the surface is conducted based on optimal estimation theory [9]. The method can avoid the inversion error caused by the untimely updating of the surface reflectance database and the error in spatiotemporal matching. After being applied to the Particulate Observing Scanning Polarimeter (POSP) and validated by AErosol RObotic NETwork (AERONET) measurements, the effectiveness of the proposed algorithm under different geographical regions and pollution conditions is verified. Another independent article thoroughly examines MODIS aerosol retrieval accuracies under different land cover types, aerosol types, and observation geometries based on AERONET measurements involving three different algorithms, namely Dark Target (DT), Deep Blue (DB), and Multi-Angle Implementation of Atmospheric Correction (MAIAC), each with unique characteristics [10]. This Special Issue also contains studies aimed toward the identification of specific aerosol types. A novel MERSI haze mask (MHAM) algorithm to directly categorize haze pixels in addition to cloudy and clear ones has been designed based on the Medium Resolution Imaging Spectrometer II (MERSI-II) on board the FY-3D satellite [11]. The algorithm can illustrate the boundary of the haze region with high reliability, remaining consistent with the true color image. Determining the threshold value for background aerosol optical depth

(BAOD) is crucial for identifying aerosol types. A statistical method to select the best BAOD threshold value using VIIRS DB AOD products is proposed in this Special Issue [12]. The VIIRS aerosol type classification scheme was further updated using the BAOD threshold. The results indicate that the updated scheme can reliably detect changes in aerosol types under low aerosol loading conditions.

Using aerosol products, further scientific studies of atmospheric aerosol are conducted and included in this Special Issue. The seasonal characteristics and long-term variations in aerosol optical parameters in Hong Kong are analyzed using AERONET data and satellite-based observations based on the extreme-point symmetric mode decomposition (ESMD) model [13]. The interactions between aerosol loading and meteorological factors are also discussed. Another study uses Cloud–Aerosol LiDAR with Orthogonal Polarization (CALIOP) aerosol products to identify the global long-range aerosol transport pathways (the trans-Atlantic, the trans-Pacific, and the trans-Arabian Sea) [14]. Two significant paths within the range of the trans-Pacific transport pathway (aerosols from the Taklimakan Desert and aerosols from the North China Plain) are analyzed in detail. A three-stage conceptual model is further built, providing a straightforward and evident approach to exploring long-range aerosol transport pathways. To investigate frequently occurring severe haze pollution in northeast China, the vertical characteristics of aerosols and the causes of aerosol pollution throughout the year are analyzed using multisource data of ground-based LiDAR and Cloud–Aerosol LiDAR Pathfinder Satellite Observations (CALIPSOs) [15]. The contribution of dust, smoke, and firework aerosols are analyzed, and recommendations for pollution control policies are provided.

The effect of aerosols on atmospheric correction is also discussed. For Soil Organic Carbon (SOC) estimation, Bottom-of-Atmosphere (BOA) VNIR/SWIR reflectance retrieved from Top-Of-Atmosphere (TOA) radiance using atmospheric correction methods is needed. A thorough sensitivity study of SOC estimation in relation to aerosol optical depth and water vapor is conducted based on Earth Observing-1 Hyperion Hyperspectral data [16]. The research suggests using the FLAASH AC method to provide BOA reflectance values before SOC mapping. Another study focuses on improving the accuracy of remote sensing reflectance products in the nearshore waters of the Shandong Peninsula [17]. To achieve that goal, a monthly aerosol model based on aerosol data collected from the Mu Ping site in the coastal area of the Shandong Peninsula is developed to replace the standard model.

In summary, this Special Issue collects a series of representative studies in the research field of aerosol and atmospheric correction, mainly focusing on the improvement in aerosol identification and retrieval methods; atmospheric aerosol formation, transfer, and spatiotemporal variation; and the effect of aerosols on atmospheric correction and quantitative remote sensing. These advancements will help to continuously improve our understanding of atmospheric aerosol and the accuracy of quantitative remote sensing research. Despite the significant progress achieved, further related studies are still needed for the scientific community, policy makers, and the public to reduce evaluation uncertainty and combat the challenges faced in our society.

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