

Aerosol variation over Continental Europe from 1980 to 2015 Using ALAD Aerosol Retrievals

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The Advanced Very High Resolution Radiometer (AVHRR) on-board National Oceanic and Atmospheric Administration (NOAA) series satellites has been used to observe the Earth and is the only spaceborne instrument which can provide users continuous long time series global coverage for more than 35 years since 1979. The initial purpose of AVHRR is for cloud detection and monitoring thermal emission of the Earth so that it lacks visible channels (only $0.64\mu\text{m}$) and spaceborne which is unignorablely unfavourable to its applications in aerosol retrieving over bright and inhomogeneous surface. Using AVHRR data, an Algorithm for the retrieval over Land of the Aerosol optical Depth (ALAD) was developed data which has great potential to be used to retrieve long time series aerosol globally from 1979 to now. The core of ALAD is to assume that the contribution of aerosol at $3.75\mu\text{m}$ wavelength to reflectance at top of the atmosphere (TOA) is negligible. At this basis, one stable and firm relationship between surface reflectance at $0.64\mu\text{m}$ and $3.75\mu\text{m}$ will be found by regression analysis at different land types after separating reflectance from radiance at $3.75\mu\text{m}$. Then, an atmospheric transfer model is applied to calculate AOD at $0.64\mu\text{m}$. In this study, we recalibrate AVHRR Global Area Coverage (GAC) data and then apply ALAD to calculate AOD over continental Europe (30°N to 80°N , 170°W to 40°E) to investigate aerosol changes and possible reason in past 35 years from 1981 to 2015. The retrieved AOD has been validated with ground-based data from Aerosols, Clouds, and Trace gases Research InfraStructure (ACTRIS) and AErosol RObotic NETwork (AERONET). The correlation of ALAD AOD with AERONET and ACTRIS is 0.77 and 0.66, respectively. Further, we also make long time series comparison of monthly averaged ALAD AOD with AERONET, ACTRIS and MODIS, showing that ALAD underestimate AOD a little. Finally, we find that the AOD over most areas in Continental Europe are less than 0.3, even less than 0.1, changing little without any obvious increase.