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Surface Visibility Retrieval with observations from the Medium Resolution Spectral Imager (MERSI) Onboard FY-3A Meteorological Satellite

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Visibility reduction caused by air pollution significantly affects the safety of all forms of traffic: roads, sailing and aviation, yet direct visibility observations are limited by the number and location of weather stations. Satellites provide an opportunity of obtaining spatially continuous visibility data. This paper develops an algorithm that retrieves visibility from the Medium Resolution Spectral Imager (MERSI) onboard the FY-3A satellite. Launched in 2008, FY-3A belongs to China's second generation polar orbiting meteorological satellite series. The MERSI instrument provides observations at 20 channels ranging from 0.41-12.5 μm.
The visibility retrieval algorithm consists of two basic steps. First, aerosol optical thickness (AOT) is retrieved with MERSI observations at the 2.1 μm, 0.47 μm, and 0.65 μm channels based on a look-up-table approach. Second, visibility is calculated with the relationship between visibility and aerosol optical thickness and aerosol scale height,which can be derived from the Koschmieder equation. Two sets of aerosol scale heights are tested ,one based on climatic statistics and the other on mixing layer height forecasts. Results show that the distribution pattern and the high and low centers of retrieved visibility match well with that of the surface observations. Compared to the results derived based on climatological aerosol scale heights, the ones based on mixing layer heights deviate less from surface observations. Analysis on errors caused by the uncertainty in aerosol optical thichness and aerosol scale heights will also be presented.