Southern Ocean aerosol optical depth maximum: MISR, MAN, and Aeronet perspectives

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Abstract

There is still substantial ambiguity regarding Aerosol Optical depths (AODs) over remote oceans, in particular over the pristine Southern Ocean. Satellite retrievals (e.g. MISR, MODIS) and global aerosol transport models show distinct AOD maximum around the 60°S latitude band. In-situ measurements performed by the Marine Aerosol Network (MAN), on the other hand, indicate no increased AOD over the Southern Ocean. Here, MISR, MAN, and Aeronet data are used to investigate the Southern Ocean AOD maximum. Over 1100 MISR-Aeronet and 210 MISR-MAN comparison points serve as a test bed for evaluating the accuracy of satellite retrievals. As expected, there are discrepancies between satellite and in-situ observations (RMS=0.068), which can be related to satellite retrieval uncertainties and the comparison procedure itself (spatial and temporal matching). However, MISR also shows a positive AOD bias as compared to the in-situ measurements. This bias can be substantially reduced by applying a more rigorous screening procedure, i.e. by investigating retrieval area homogeneity with respect to contamination by clouds, glitter, and other retrieval impediments. The bias correction is effective across different AOD regimes, including scenes with low aerosol content (AOD≤0.05). Twelve years of MISR data are analyzed using the newly established screening method. As a result, the Southern Ocean maximum is substantially reduced, but still present in satellite retrievals. This confirms the intuition that strong surface winds over Southern Ocean increase sea salt aerosol emission and hence AOD. This result highlights the need for more in-situ AOD observations over the windy Southern Ocean.

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