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Spectral polarization distribution models (PDMs) for NASA CLARREO Pathfinder's inter-calibration applications

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Solar radiation scattered by Earth surfaces of various scene types such as oceans, deserts, tree leaves etc and atmospheric molecules and particles is polarized and the amount of polarization depends on the surface composition and particle physical properties. This can be a source of measurement errors in satellite data if a non-polarimetric radiometric sensor is sensitive to the polarization state of light. To obtain highly accurate spectral solar radiation data from the Earth-atmosphere system for the space-borne inter-calibration studies as proposed in NASA's Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission and the CLARREO Pathfinder (CPF) mission, the spectral polarization state of the reflected solar light at the top of atmosphere (TOA) must be known with sufficient accuracy. The degree of polarization (DOP) and the angle of linear polarization (AOLP) of the light at the TOA as functions of incident and viewing geometry and scene type construct the Polarization Distribution Models (PDMs) for correction of polarization-induced error of satellite data. In this work, algorithms for modeling the spectral polarization state of reflected sunlight from various types of Earth, including oceans, deserts, vegetated land surfaces and these scene types with all kinds of clouds, are developed. By comparing the model results with the PARASOL satellite data, our numerical results demonstrate that the model can provide a reliable approach for making the spectral PDMs for wavelengths between 320 and 2300 nm for satellite inter-calibration applications as proposed in the CLARREO and the CLARREO CPF missions.

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