Global distribution of 3MI's motion-induced polarimetric measurement error

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Multi-directional polarimetric measurements provide a unique collection of data from which cloud and aerosol properties are inverted. The inversion techniques based on the statistical theory require the magnitude of measurement error while the estimation of it for polarimetric channels is challenging. In addition to the radiometric error, errors because of coregistration and polarimetry have to be considered.

This presentation is aimed at addressing the co-registration error induced by the satellite motion for the Multi-viewing, Multi-channel, Multi-polarisation Imager (3MI) sensor, which will fly on the European operational meteorological satellite, MetOp Second generation – A (MetOp-SG-A). The 3MI derives three elements of Stokes parameters (I, Q, and U) from three wide field-of-view images taken sequentially with interval of 0.25 seconds. Within 0.25 seconds, the instantaneous field of view (IFOV) shifts by 1.8 km because of the along-orbit motion of the satellite. This measurement configuration requires the acquired data to be interpolated and coregistered to compensate the satellite motion before the computation of the Stokes parameters, inducing a systematic measurement error.

The error induced by the interpolation and coregistration cannot be completely removed by averaging surrounding pixels because the distribution of this error is not symmetric about zero. However, the major part of the interpolation error is caused by the intensity variation, not by polarization variation, and therefore can be corrected by using the information of adjacent pixels.

In this presentation, we demonstrate with data from the Second-generation Global Imager (SGLI) that the along-track Laplacian of the center image is a useful metric to correct the motion-induced error. Applying the correction, we present global maps of remaining bias and variance over clear-sky scenes over land and clouds over ocean from four-year data between 2018 and 2021. The errors over clear-sky land are further analyzed based on the land surface type product from the Moderate-resolution Imaging Spectroradiometer (MODIS).

Preferred mode of presentation: Oral/Poster