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## Multi-channel Imager Algorithm (MIA): A novel cloud top phase classification algorithm applied to Himawari-8 Geostationary Satellite

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Cloud top thermodynamic phase (liquid, or ice) classification is critical for the retrieval of cloud properties such as cloud top particle effective radius, cloud optical thickness and cloud water path. The physical basis for phase classification is the different absorption and scattering properties between water droplets and ice crystals over different wavelengths. Passive sensors always use the hand-tuned phase classification algorithms such as decision trees or voting schemes involving multiple thresholds. In order to improve the accuracy and universal applicability of phase classification algorithms, this study uses unsupervised K-means clustering method to classify phase using Himawari-8 (H8) multi-channel RGB images (multi-channel image algorithm, MIA). In order to evaluate the phase classification obtained by MIA, H8-CLP (H8 official product), we use CALIOP phase product as a benchmark. Through the evaluation of cloud top phase of cases from April to October in 2017, the hit rate of liquid and ice phase from H8-MIA is 88% and 65% respectively, and the total hit rate of H8-MIA algorithm is 72%. The hit rate of liquid and ice phase from H8-CLP is 81% and 62% respectively, and the total hit rate of H8-CLP algorithm is 68%. The hit rate of H8-MIA is higher than that of H8-CLP in both liquid and ice phases. It shows that the application of MIA algorithm to H8 satellite can provide more accurate and continuous cloud top phase information with high spatial and temporal resolution.