Supercooled water clouds detection from Polarization Muilti-Angel Imager data using the 1.37 μm water vapor polarized channel

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The detection of supercooled water clouds (SWCs) is essential for artificial rain enhancement, the prevention of aircraft ice accretion, and better understanding of radiative energy balance. SWCs are detected by multi-angle polarization sensors with 1.37 μm water vapor polarized channel. The cloudbow from 1.37 μm polarization channel was observed for the first time by short-wave infrared Polarized Multi-Angle Imager (PMAI) onboard FY-3G satellite. In the cases of 1370 nm polarization image, there is an obvious feature that a clear cloudbow can be seen around the 140 ° scattering angle, with a maximum polarization reflectance of about 0.04 and 0.06. The presence of water cloud with spherical particles in the upper altitude can be recognition as SWCs. Then, the identification of SWCs was verified by three other methods, including other polarization channels, solar reflection channels, and thermal infrared channels. The presence of cloudbow phenomenon for both 1030 nm and 1640 nm channels indicates the liquid water cloud. And, the ratio of reflectance of 1030 nm and 1640 nm for inferred SWCs is within the domain of water cloud. Lastly, from the thermal channels of MERSI on the same satellite with PMAI, the brightness temperature of the cloudbow region is far below 273.16 k, which get further confirmation of the existence of SWCs. Therefore, the SWCs can be certainly determined only by the one 1370 nm polarization channel, which provides a new and fast way to accurately identify supercooled water clouds.