

Assessing the Contribution of the Arctic Weather Satellite 325.15 GHz Channels to Improve Observation of Precipitation Events

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The launch of the ESA Arctic Weather Satellite Path Finder Mission (AWS-PFM), forerunner of the EUMETSAT EPS-Sterna mission, equipped with a cross-track scanning radiometer (Microwave Radiometer, MWR) operating at frequencies between 50 and 325 GHz, represents an important improvement in satellite meteorology and innovation in passive microwave radiometry. The main innovation is brought by the four channels in the 325.15 GHz water vapour absorption band offering enhanced sensitivity to cloud ice. Each of these channels, coupled with the corresponding channel in the water vapor absorption band at 183.31 GHz having a weighting function peaking at the same height in clear-sky conditions, provides unprecedented cloud and precipitation observations. Moreover, exploiting coincident overpasses of AWS and spaceborne cloud and precipitation radars, such as the Dual-frequency Precipitation Radar (DPR) onboard the NASA/JAXA GPM-CO mission and the Cloud Profiling Radar (CPR) onboard the ESA/JAXA EarthCare mission, it is possible to analyse the sensitivity of MWR channels to the cloud and precipitation structure and microphysics.

This study presents two case studies. The first is a coincident overpass between GPM-CO and AWS during the mature phase of tropical cyclone Melissa. The second is a coincident overpass between EarthCARE and AWS during a high-latitude snowfall event. Regarding the cyclonic event, the 325.15 GHz channels are useful for analyzing the characteristics of the cloud top and ice microphysics in the spiraling rain bands. At the same time, the high horizontal resolution of the MWR high-frequency channels can be used to accurately identify precipitation and deep convection features around the cloudless eye. Regarding the snowfall event, measurements at 325.15 GHz are useful for identifying and characterizing typical light snowfall events in polar regions because of their very high sensitivity to ice microphysics. Additionally, unlike lower-frequency channels, the 325.15 GHz channels are hardly affected by supercooled liquid water layers, which often characterize cloud systems in polar regions.

This analysis is propedeutic to the future launch of the EPS Sterna mission, a constellation of AWS-like small satellites, designed to improve weather forecasts by providing global measurements of atmospheric temperature, humidity profiles as well as cloud and precipitation features with frequent revisit times. Moreover, this study is ancillary to the development global precipitation products within the EUMETSAT Satellite Application Facility on Support to Operational Hydrology and Water Management (H SAF) based on the exploitation of all available microwave radiometers, including the AWS-MWR, and EPS-Sterna in the future.