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Machine Learning for Passive Microwave Snowfall Regime Classification: a Global Analysis

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Multiple research efforts have highlighted the critical role of snowfall regime classification in accurately retrieving snowfall rates from Passive Microwave (PMW) observations. Regardless of whether precipitation algorithms rely on a-priori information or training datasets, developing comprehensive and representative datasets is essential for proper snowfall detection and quantification using satellite-based sensors. This study examines snowfall retrievals within the Goddard PROFiling (GPROF) algorithm, the PMW precipitation product of the Global Precipitation Measurement (GPM) mission.

The research employs a merged CloudSat-GPM dataset to create training data for an eXtreme Gradient Boost (XGB) model. This model correlates GPM Microwave Imager (GMI) brightness temperatures with Cloud Profiling Radar (CPR)-derived snowfall regimes, categorizing observed scenes into four classes: 'not snowing', 'shallow convective', 'deep stratiform', or 'other' snowfall types.

The Machine Learning (ML) methodology is essential for deciphering the strong yet intricate relationships between atmospheric PMW signals and surface snowfall patterns. The ML classifier undergoes training using CloudSat's classification methodology, which incorporates snow profiles and cloud categorization principles, then applies this knowledge to GPROF operations. The presentation will feature a comprehensive global comparison of snowfall regime classification results, contrasting those obtained using CloudSat data against classifications based solely on PMW observations.