Evaluation and Improvement of MiRS Precipitation Retrievals over the CONUS Using Machine Learning Approaches

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Abstract

The Microwave Integrated Retrieval System (MiRS) is a 1-DVAR inversion algorithm based on physical forward modeling and processes observed multichannel radiances simultaneously to determine key components of the atmosphere and surface state, including precipitation-related parameters. The hydrometeors retrieved directly in MiRS are cloud water, rain water, and graupel water content on 100 pressure layers. These hydrometeor profiles are vertically integrated to obtain cloud liquid water, rain water path, and graupel water path. The surface precipitation rate retrieval in MiRS is determined by a postprocessing algorithm that uses these retrieval system's core hydrometeor retrieval products as input parameters, based on empirical relationships. Previous MiRS precipitation evaluation studies showed that precipitation rate pentad time series showed relatively good agreement with Stage-IV and MRMS observations. Retrieval performance is seasonally dependent, with warm season estimates showing better statistical scores than cold seasons. Comparison with Global Precipitation Climatology Project (GPCP) annual mean precipitation indicated good agreement on the large-scale spatial patterns, but regional differences were also noted. In this study, we will report on progress to date in implementing machine learning approaches to improve retrieval performance including those that incorporate temporal and spatial interrelationships among the input and output variables such as convolutional neural networks (CNNs) and U-Nets. Accounting for spatial interdependence of the data should lead to improvements in horizontal consistency and mitigate the geometric effects of variable field of view sizes associated with cross-track scanning radiometers such as ATMS. The work leverages training datasets containing one full year of collocated ATMS, MRMS and/or Stage IV data.