Bulk Microphysical Properties of Orographic Rainfall Deduced by Vertically Pointing Radars in the Western United States

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I. INTRODUCTION

NOAA’s Earth System Research Laboratory (ESRL) operates two different types of vertically pointing S-band Doppler radars: a pulsed radar (S-PROF; Figure 1) and a frequency-modulated, continuous-wave radar (SLR, Figure 2). Johnston et al. (2017). These radars provide vertical profiles of radar reflectivity and Doppler vertical velocity, which are subsequently analyzed to partition rainfall observed at the radar site into three categories using the technique developed by White et al. (2003): brightband (BB) rain, non-brightband (NBB) rain, and convective rain. NBB rain is primarily a shallow, warm rain process driven by collision and coalescence. Because of its shallow nature, NBB rain is often undetected by the operational U.S. WSR-88D precipitation scanning radar network, especially in the western U.S., where radar coverage is poorest. Examples of data collected by the S-PROF and SLR are shown in Figures 3 and 4, respectively.

II. RAINFALL PROCESS PARTITIONING METHODOLOGY

(1) Each radar profile is examined for the existence of a radar brightband.

(2) Statistics are computed for each 30-minute observation period that received at least 0.5 mm of rain. If less than 50% of the profiles identified as rain contain a bright band, then the period is assigned to non-brightband (NBB) rain. If greater than or equal to 50% of the profiles contain a bright band, then the period is assigned to brightband (BB) rain.

(3) Periods labeled as NBB rain are inspected to subjectively determine if the algorithm was fooled by a) convection: the brightband structure is smeared by turbulent motions; b) snow: the brightband is below the minimum detectable radar range; or c) attenuation: wet snow has accumulated on the antenna radome preventing accurate reflectivity retrievals. If the S-PROF algorithm problem is solved by using the stepped range modes.

(4) Algorithm results are modified accordingly and daily and seasonal statistics are produced (see Table 1).

III. RESULTS

Figure 5 shows the locations where S-PROFs and SLRs have been deployed as part of NOAA’s Hydroeteorology Testbed (HMT, hmt.noaa.gov) and other related projects. Figure 6 compares BB and NBB rain observed at the MDT S-PROF site with rainfall estimates by NOAA’s operational multi-radar, multi-sensor (MRMS) quantitative precipitation product. Figure 7 illustrates differences in drop-size distribution parameters for BB and NBB rain (Martin et al., 2008).

IV. RELATED WORK

NOAA’s ESRL, Colorado State University, U.S. Geological Survey (USGS), and Scripps Institution of Oceanography are partnering with water agencies in the San Francisco Bay area on the Advanced Quantitative Precipitation Information (AQPI) project. The project is sponsored by the California Department of Water Resources and is managed locally by Stoner Water. The project will deploy five gap-filling radars such as the one shown below to improve quantitative precipitation estimation for the highly populated region. The project will also provide high resolution (1-km grid) precipitation forecasts from NOAA’s High-Resolution Rapid-Refresh (HRRR) numerical weather prediction model. NOAA’s National Water Model will be coupled to the coastal storm model (CoSiMS) developed by the USGS for coastal flood and inundation forecasts for the San Francisco Bay coastline.

V. REFERENCES


