How well is atmospheric river precipitation quantified from space? Composite analysis over the western United States

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A large fraction of extreme precipitation over the western United States is associated with Atmospheric Rivers (ARs), which can lead to flooding or alleviate droughts. They are also important weather phenomena that need to be better understood in a changing climate. A decade (2003-2012) of landfalling ARs impacting the North American West Coast (between 32.5 ^{o}N and 52.5^{o}N) are collected to assess the skill of five commonly used satellite-based precipitation products in capturing ARs precipitation rate and pattern. AR detection was carried out using a database containing twice-daily satellite-based integrated water vapor composite observations from SSMI/SSMIS. We found that some specific features of AR weather systems (e.g., precipitation over cold surfaces, and topographic interactions) present a challenge to satellite retrievals of AR precipitation over the study region. Satellite products are more consistent over ocean than land and often significantly underestimate precipitation rate over land compared to ground observations. Incorrect detection of precipitation from IR-based methods is prevalent over snow and ice surfaces where microwave estimates often show underestimation or missing data. The results using collocated AMSR-E and CloudSat precipitation data show that missing data, often over frozen land, and limitations in retrieving precipitation from systems that lack frozen hydrometeors contribute to the observed microwave-based precipitation errors transferred to the level three products. Bias adjustment using ground observation is found very effective to improve satellite products, but also raises concern regarding near real-time applicability of satellite products for ARs. The analysis using individual case studies and ensemble of AR events suggests that further advancement in capturing orographic precipitation and precipitation over cold and frozen surfaces is needed to more reliably quantify AR precipitation from space. In continue, the study also assesses the impact of errors in precipitation observation on the stream flow simulations based on the VIC model and comparison with streamflow gauges. In light of the operation of the Global Precipitation Measurement (GPM) mission, further opportunity for enhancing the current

status of precipitation retrievals and the hydrology of cold and mountainous regions is becoming available which will be discussed using case studies.