Evaluating and Exploring Extreme Precipitation in CHIRPS3, CHIMES, and the Climate Hazards Station Database

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Abstract

Between 2015 and 2019, the impacts and losses associated with droughts, floods, and hurricanes surged through the interaction of increasing exposure and more extreme weather and climate (Funk 2021). In 2020, the Aon-Benfield Reinsurance Company reported that cyclones, floods, and droughts resulted in $165 billion (USD) in losses. For 2020, EM-DAT lists 363 flood, landslide, storm, and drought events impacting some 98 million people. As hazards mount, models indicate more variable precipitation, and observations indicate increasing extremes in humid regions, yet the small number of available gauge observations is declining.

In this talk we briefly introduce two new resources: version 3 of the 1981-near present Climate Hazards center Infrared Precipitation with Stations (CHIRPS3) archive, and the 2000-near present Climate Hazards IMErg with Stations archive (CHIMES). The satellite-only CHIRP3 and CHIME components are based, respectively, on geostationary thermal infrared Cold Cloud Duration (CCD) values and the NASA GPM $IMERG_{late}$ product. These archives benefit from thousands of station observations. In addition to standard global sources, the Climate Hazards station database includes about 5,000 additional stations in humid tropical and sub-tropical areas associated with likely increases in extreme rainfall.

While effectively monitoring extreme precipitation is important to humanitarian agencies like FEWS NET, and to hydrologic modeling applications (a, b), evaluations of the widely used CHIRPS2 product indicate a propensity to underestimate extremes. Here, we explain the source of this problem. Then, focusing on pentad totals in 12 well-gauged regions, we use the high-quality gauge-based REGEN dataset to show that CHIRP3 and CHIME perform substantially better than CHIRP2.

e examine trends in extremes in these validation regions, comparing REGEN results with values from the satellite-only CHIRP2, CHIRP3, CHIME and the gauge-enhanced CHIRP2, CHIRP3, CHIME. Trends in dry and humid regions are contrasted and compared.

We conclude with global evaluations of the pentad CHIRP3, CHIRPS3, CHIME, CHIMES, and Climate Hazards station database products. How does the performance

of the shorter period of record CHIME compare with CHIRP3? We anticipate that the sophisticated microwave-based $IMERG_{late}$ inputs into CHIME will perform better. Where do we see the largest increases in extremes in these products? How well might CHIRPS3 and CHIMES perform in the context of humanitarian assistance efforts?