Keynote

# Radar and Satellite Techniques for Rainfall Monitoring and Flood Forecasting in Arid Regions: Current Challenges and Future Opportunities

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Arid and semi-arid regions, such as those in several countries in the Middle East and North Africa, are frequently subject to heavy rainfall events that can cause severe flash-flood events. These floods are characterized by sharp peak discharges with short durations, and therefore, can pose a significant threat to the socio-economic developments of local communities. According to the NASA Dartmouth Flood Observatory Active Archive of Major Floods, several flash floods were recorded in several regions such as Sinai and the Red Sea Coast in Egypt, and many other countries in the region. Accurate and timely rainfall information is a pre-requisite for reliable flash-flood forecasting and warning efforts. Recent advances in physically-based and spatially-distributed hydrologic models require high-resolution rainfall information at scales that are relevant to the flashy basins typically encountered in arid environments. While rain gauges represent the most direct way for measuring surface rainfall, they suffer from several shortcomings that can be quite limiting for hydrologic applications in arid areas (e.g., sparse distribution, lack of spatial coverage, and lack of real-time data feeds, among others). Recent technological and scientific advances in satellite and radar technologies present unprecedented opportunities for providing accurate and timely rainfall information. The extensive spatial coverage and relatively high temporal and spatial resolutions of satellite and radar rainfall products are valuable for hydrologic prediction and forecasting applications. In particular, recent developments in physically-based distributed hydrologic models sparked increasing interest in the use of distributed radar-rainfall information. However, it is recognized that radar and satellite-rainfall estimates are associated with significant uncertainties that arise from various factors such as sampling effects, hardware issues, and significant variations and non-uniqueness in the relationship between radar and satellite measured quantities and rainfall rates. Quantification of such uncertainties and how they affect hydrologic predictions has proven to be a challenging task. The current study presents recent research on uncertainties associated with the use of radar and satellite-rainfall estimates for hydrologic modeling and flood forecasting over arid regions. Methodologies for bias corrections and modeling of estimation errors are presented along with emerging techniques for optimal merging with rain gauge measurements. The study discusses research and engineering application efforts that are needed to be able to develop local and regional operational capabilities for rainfall monitoring and estimation systems over arid environments and extend these capabilities to support community efforts in flood protection and water management.