NATIONAL ACADEMIES Sciences Engineering Medicine

Board on Atmospheric Sciences and Climate
Water Science and Technology Board

Extreme Rainfall in Mountainous Terrain: Modeling and observational challenges for warm-season precipitation

Agenda

EVENT NOTES

Registered participants will receive information on joining the workshop. [Event registration | Event page]

This is a dissemination event for the study *Modernizing Probable Maximum Precipitation Estimation* (2024). It is designed to inform understanding of specific orographic precipitation challenges identified in the PMP study; no new consensus recommendations or guidance will be produced in this workshop.

OBJECTIVES

- Convene researchers and practitioners working to understand, model, and translate orographic precipitation mechanisms and impacts to inform and advance understanding and modeling of extreme warm-season orographic precipitation to inform inputs to modeling of flood and debris flows.
- Identifying gaps and opportunities for advancing 1) understanding of extreme warm-season orographic precipitation processes in mountainous environments, 2) modeling of orographic precipitation and inputs to hydrologic / hydraulic rainfall-runoff modeling, and 3) scientific basis for orographic enhancements in PMP estimation.

TUESDAY, NOVEMBER 4, 2025 (Times Eastern)

10:00–10:10a **Welcome** — **Jim Smith**

Workshop objectives, grounding in PMP report

10:10–11:00a **Framing: Extreme warm-season rainfall in Mountainous Terrain**

- Extreme rainfall from tropical cyclones in the Appalachians: Lessons learned from Hurricane Helene (2024) — **Ken Kunkel**
- Extreme rainfall from warm season thunderstorms in complex terrain: Lessons learned from the Texas Hill Country flooding of July 2025 — **John Nielsen-Gammon**

Questions / feedback from workshop participants

Moderator: Robert Mason

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11:00a–1:00p	**Session 1: State of the Science: Extreme Warm Season Rainfall in Mountainous Terrain** ▪ Key mechanisms in understanding warm-season extreme convective rainfall in mountainous terrain **Bob Houze** ▪ Case Studies of Extreme Tropical Cyclone Precipitation in the Southern Appalachian Mountains: Observational & Modeling Challenges **Gary Lackmann** ▪ Mesoscale analyses of extreme convective rainfall in mountainous terrain **Angela Rowe** ▪ Climatology of extreme rainfall and flooding in the Appalachians from tropical cyclones **Gabriele Villarini** ▪ How does extreme sub-daily rainfall in the CONUS404 simulation compare to observations, and what can we learn from it? **Russ Schumacher** Questions / feedback from workshop participants *Moderator: Ruby Leung*
1:00–1:30p	**BREAK**
1:30-3:15p	**Session 2: Modeling Extreme Warm Season Rainfall in Mountainous Terrain** ▪ Science Challenges for Modeling Extreme Warm-Season Rainfall in Mountainous Terrain **Rich Rotunno** ▪ Microscale and mesoscale modeling of extreme convective rainfall in mountainous terrain **Daniel Kirshbaum** ▪ Challenges for Modeling Extreme Rainfall from Tropical Cyclones in the Appalachians **Ana Barros** ▪ Sensitivity of heavy rainfall in mountainous terrain to cloud microphysical processes **Adam Varble** Questions / feedback from workshop participants *Moderator: John England*

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3:15–4:30p	**Session 3: Observations and Models of Extreme Rainfall for Flood Studies in Mountainous Terrain** *How to achieve goals of PMP/PMF estimation for warm season extremes in mountain watersheds? How to use recent extreme flood events in future PMP / PMF development?* ▪ Radar estimation of extreme warm season rainfall in mountainous terrain **Witek Krajewski** ▪ Large-sample, high-resolution climate model data sets and flood modeling (rainfall runoff) of warm season floods in mountainous terrain **Andy Newman** ▪ Stochastic Storm Transposition in mountainous terrain: probabilistic spatial methods for extreme rainfall and flood analysis in mountainous terrain **Dan Wright** Questions / feedback from workshop participants *Moderator: Shih-Chieh Kao*
4:30p–5:00p	**Workshop Highlights and Observations for Future Work** ▪ Session 1 summary **Ruby Leung** ▪ Session 2 summary **John England** ▪ Session 3 summary **Shih-Chieh Kao** ▪ Cross-cutting insights for enhancements to Probable Maximum Precipitation estimation **Katie Holman, Bill McCormick** ▪ Opportunities for advancing understanding, observation, and modeling of extreme warm-season precipitation in mountainous terrain **Jim Smith** *Moderator: Robert Mason*

Core references

- NASEM, *Modernizing Probable Maximum Precipitation Estimation* (2024)
- Ron Smith, *100 Years of Progress on Mountain Meteorology Research* (2019)