Session 3: Observations and Models of Extreme Rainfall for Flood Studies in Mountainous Terrain

- **Considering the needs for flood studies:**
  - Radar-integrated reanalysis and large-ensemble model simulations provide useful inputs
  - Large-sample, high-resolution extreme rainfall estimates are critical for flood modeling.
  - For near-term PMP enhancements, methods for stochastic storm transposition, downscaling, and bias correction play important roles.
- **Radar and reanalysis** (Witek Krajewski)
  - Beam blockage and gaps in radar coverage create significant challenges, but polarimetric radar provides a critical resource for assessing model performance in the extensive mountainous regions of the US with good radar coverage.
  - Advances in polarimetric rainfall estimation algorithms combined with developing radar-rainfall reanalysis are needed for estimating rainfall extremes and their uncertainties, especially for PMP-magnitude events.

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- **Needs for large-sample and high-resolution datasets** (Andy Newman)
  - Current method and data explosion is a key opportunity for analysis; however:
    - Need to quantify adequate/fit-for-purpose (MEP is critical)
    - Recognize the significant data gap in certain regions (e.g., OCONUS)
    - Moving from decadal to multi-century timescales and increasing model process representation using AI/ML and computational hardware advances
  - Improving hydrology, both in offline and coupled models
    - Large-scale optimization and regionalization of model structure and parameters
    - Large-scale climate sensitivity studies – Do our models respond realistically?
  - Improving uncertainty quantification
    - Formal uncertainty analysis across scenario, model structure and parameters, meteorology, and hydrologic states
  - Need partner input and participation
    - Deep partner involvement for co-design of models, experiments, and analysis

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- **Storm transposition** (Dan Wright)
  - Storm transposition remains a necessary step in the near-term PMP/PMF enhancement.
    - A large sample size is needed to estimate the AEP and its uncertainty
    - Transposing warm-season rainfall in mountainous terrain is particularly challenging
  - Stochastic Storm Transposition (SST) meets most of both short-term and long-term recommendations of the NASEM report:
    - Provides AEPs (including low/rare values) and uncertainty
    - Can incorporate climate model simulations and historical storms
    - Can consider transposition factors for mountainous terrain
    - Coordinate with other Federal rain/flood efforts (FFRD, Atlas 15, HEC-HMS)
  - Expect additional challenges transitioning from PMP to PMF (especially with probabilistic PMP)
    - E.g., need to consider watershed initial conditions such as soil moisture and snowpack.