Water Availability Grand Challenge for North America Workshop

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Water-related limitations in process-understanding, modeling, monitoring

**Process understanding**

• **Impact of atmospheric aerosols on precipitation**, in terms of first-order (radiative) and second order (cloud-drop nucleation) effects. How these both impact convective precipitation is especially not well known.

• **Dynamic processes that lead to extreme precipitation, drought** on a variety of spatiotemporal scales (e.g. atmospheric rivers, teleconnection patterns, synoptic transients)

**Monitoring**

• Generally speaking, **higher spatiotemporal resolution observed information to better characterize weather and climate extremes.** A particular problem in **complex terrain** because alpine water sheds important source of snowpack and mountains are convective initiation point. A great lack of information on this outside of the United States (e.g. Mexico, Central America)

• How can **emerging observing systems** help to better characterize precipitation and the water cycle in such places? (e.g. GPS water vapor measurements, lightning)
Modeling

- Meso-γ scale (less than 5km), to explicitly resolve convective processes and orographically-forced precipitation (i.e. snowfall). Need to ascertain the value of such modeling added in terms of physical process metrics (e.g. organized convection) and statistical characterization of precipitation extremes, against existing, more statistical downscaling-type approaches.
- Conclusively demonstrating the value added of of meso-γ multi-model ensemble modeling approaches in climate forecasts and projections, for example, in the area sub-seasonal to seasonal forecasting is urgently needed but will require a coordinated community effort (e.g. like MRED, NARCCAP).
- Hydrologic and land surface modeling approaches (e.g. WRF-Hydro, NOAH-MP) that can have more explicit treatments horizontal transports of water, dynamic vegetation, groundwater, and anthropogenic components (urbanization, irrigation). Impacts of two-way interaction at convective permitting scales is unknown.
- Two-way coupling to dynamic ocean models may be important for more accurate climatological representation of precipitation, especially in the IntraAmericas seas region (Mexico, Caribbean, Central America).
- Bin-microphysical parameterization coupled to interactive chemistry (e.g. WRF-CHEM) investigate the aerosol-precipitation question.
Key objectives, tasks, resultant benefits

**Key objectives, tasks**

- **Form coordinated teams of groups** to investigate modeling, observational challenges in a way that emphasizes multi-model ensemble modeling, so as to address questions of both statistical and physical confidence. Should address challenges of resourcing to produce and analyze very large amounts of data (computation + labor).
- Can we collectively **identify the most urgent research gaps** in our processed-based physical understanding?
- Ascertain from stakeholder agencies what their **most critical resource needs** are.
- **Engage with relevant federal agencies** to develop white paper(s) and/or highly visible articles that may inform new research initiatives.
- Identify what new observations needed and/or how existing ones can be better used.

**Resultant benefits**

- More physically confident forecasts and projections of the hydroclimate.
- Better characterization and projection of hydroclimate extremes.
- Produce information at a spatial scale more relevant to decision making and impacts assessment.