Summary of breakout session on Synoptic to Intraseasonal Variability

Summary of our whitepaper

Grand challenge question

Grand Challenge Question: *How do synoptic-scale disturbances and intraseasonal modes of variability emerge from—and feed back onto—the seasonal mean land-atmosphere-ocean-ice state, and how will these interactions evolve in a changing climate?*

- Current Efforts under RGMA
  - Modes of subseasonal variability (predictability on S2S scales)
  - Monsoons
  - Polar-Extra polar interactions
  - Detection & statistical characterization
- Overarching goals
  - When and how to best use the high-resolution data
  - Processes governing cross-scale interaction
  - Project response of synoptic and intraseasonal variability to warming
  - Model hierarchy to augment and interpret the complex models
  - How to better use in situ obs data (e.g. ARM, BER)

Categories of research presented in our session (16 talks)

- Intraseasonal variability & the MJO
  - QBO's influence on MJO
  - Model representation; enhanced MJO teleconnections under warming
  - Impacts on landfalling ARs
  - BAM leads to regional predictability
- Synoptic-scale phenomena
  - Positive radiative feedback on tropical cyclones
  - MJO influence on cyclogenesis
  - Windstorms
  - Favorable weather conditions for wildfire
  - Precipitation extremes
- Detection & predictability (ML applications)
  - Streamflow, atmospheric rivers
  - System identification technique
  - Emergent seasonal delay

Revisiting & revising our whitepaper section

- Agreement on most important research goals:
  - Understanding cross-scale interactions and their potential sources of predictability
  - Connecting theory/understanding with modeling
- Should broaden focus more:
  - Include more non-hydrological impacts (e.g. extreme wind, fire weather) and more climate modes
- Emphasize model hierarchies as a tool

Connections with machine learning

- ML already being used, e.g. talks in our session on:
  - Deep learning to associate extreme rain with MCSs
  - Self-organizing maps for wildfires & fire weather
  - Long Short-Term Memory for streamflow forecasts
  - LIMs and Reservoir Computing for Arctic-Midlatitude interactions
- Agreement on broad need for more:
  - Guidance of ML efforts by process-level understanding
  - Emphasis on model hierarchies and theory for designing & training ML algorithms

Extra slides

Findings by the breakout

§Improvement in mean state (in ocean) help improve the MJO propagation
§Change of mean wind matters for the teleconnection patterns of MJO.
§MJO/ENSO show impacts on AR distributions
§Models have difficulty to capture the QBO → MJO influence
§BAM as new source for intraseasonal predictability
§Positive radiative feedback on TCs---mainly through growing more seeds
§Meteorol. environments for wildfire are investigated: implicative climate change impacts on more wildfires
§First principle-based constraint on the delay of seasonality over tropical land
§LSMT method for streamflow prediction
§System identification technique for the transfer function between input (forcing) and output (response)
§Detection oriented ML techniques developed for fronts, TC, MCs, and ARs.