Planning for US CLIVAR Multi-year prediction workshop

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When can we extend predictions into "Year 2"?

Pattern correlation for SST in the tropical Pacific

Month 6   Month 12   Month 18

Month 18 skill ≈ Month 6 skill

Niño3.4 skill, 1961-2010
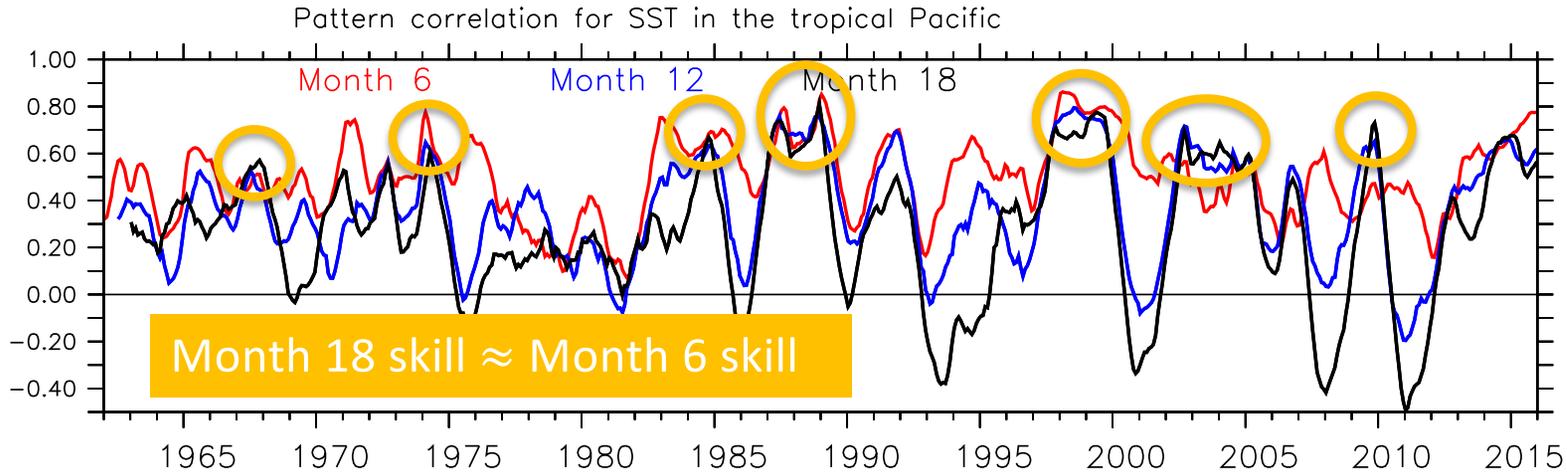
Right: NMME model-analog skill by *initialization month* for leads of 1-24 months

Top: NMME model-analog skill by *verification time* for leads of 6, 12, and 18 months
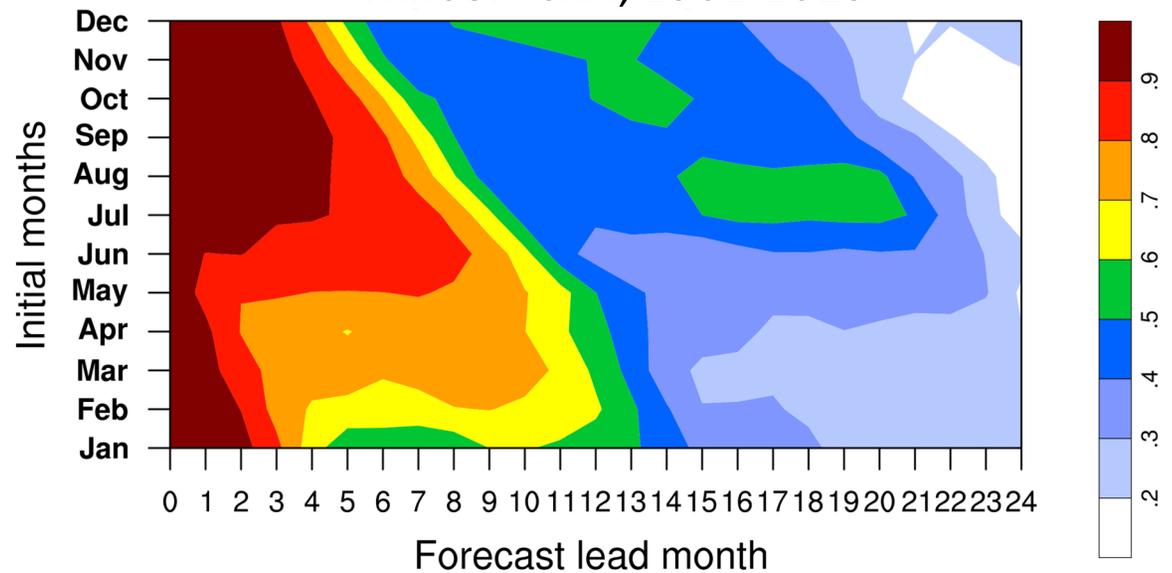
"Soil moisture reemergence": Year-to-year land memory tied to seasonal cycle
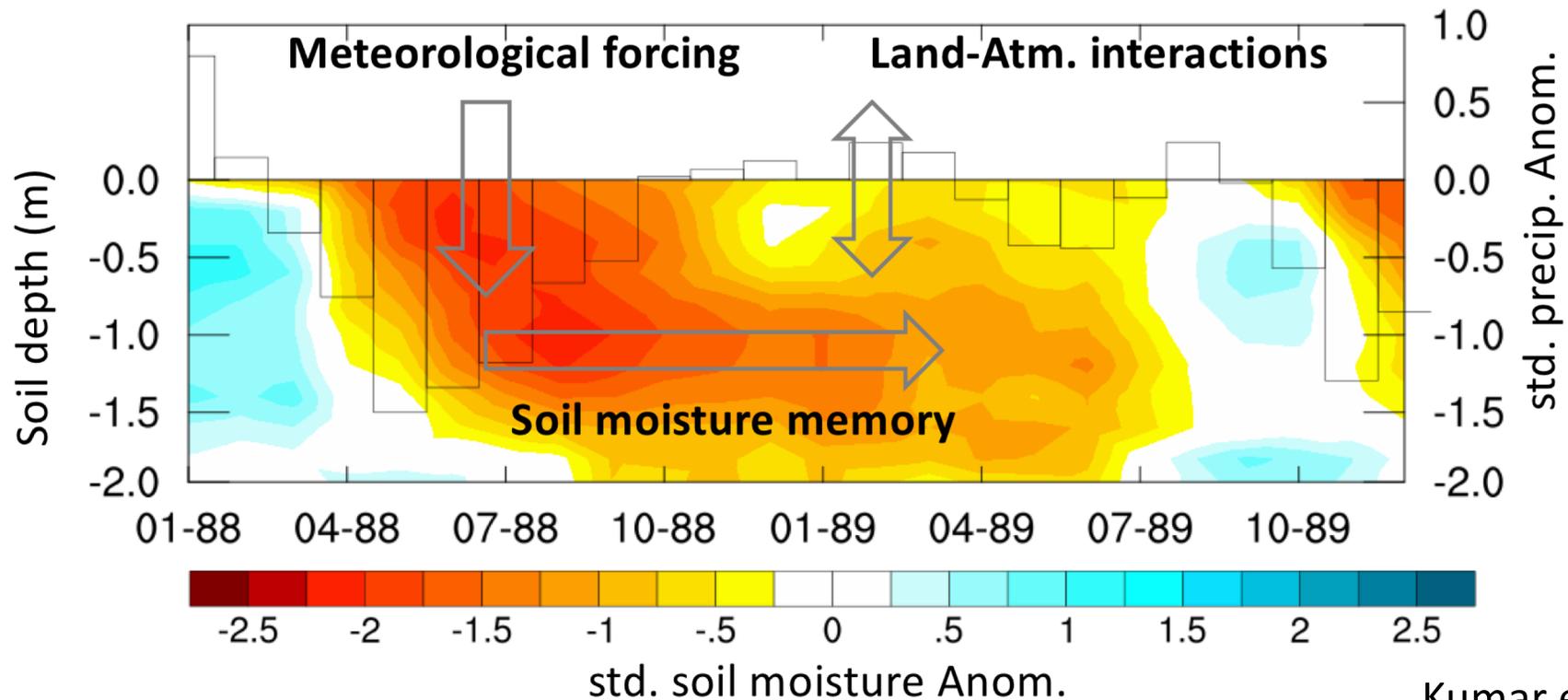
Kumar et al. 2019

Evolution of Illinois soil moisture standardized anomalies during and after the 1988 drought, averaged over Illinois Climate Network (ICN) observations. Also shown are the standardized precipitation anomalies (bars) for each month.

Other potential sources/targets of climate predictability:

- Ocean memory (eg, Rossby waves, WBCs, reemergence, AMV/PDV)
- Volcanoes* (*post-eruption)
- QBO (stratosphere only or also troposphere)
- Sea ice
- Coastal sea level
- Ocean heat waves (eg, the blob)
- NAO (eg, Dunston et al. 2016)
- Drought
- Others?

US CLIVAR Workshop: Prospects for Multi-year Climate Predictability and Societally-relevant Climate Predictions

- Advance scientific understanding of multi-year *predictability*
- Highlight the challenges for producing skillful multi-year *predictions* with state-of-the-art earth system models
- Identify prototype *applications* of multi-year forecasts and assess their utility
- **Identify knowledge gaps, determine future research direction and foster new initiatives and collaborations by bringing together research, operational, and applications community**

US CLIVAR Workshop: Prospects for Multi-year Climate Predictability and Societally-relevant Climate Predictions

The workshop will help define and identify research gaps of multi-year prediction and predictability

- Better understand and leverage processes specifically operating on *year-to-year* time scales
    - cf. decadal forecasts that leverage much slower processes (e.g., AMOC) and external and anthropogenic forcings
- Seasonality impacts on processes and predictability
- Are current data/models/initialization/observing systems up to this task (and if not, what would it take)?

US CLIVAR Workshop: Prospects for Multi-year Climate Predictability and Societally-relevant Climate Predictions

Determine how to formulate multi-year prediction

- Apply current understanding to start defining the multi-year prediction problem
  - For example, decadal forecasts are mostly initialized once a year. Is this enough for multi-year predictions?
- Identify target forecast variables
  - Focus on "memory" variables such as soil moisture and oceanic mixed layer heat content?
- What are requirements for data assimilation/forecast initialization and ensemble construction?

US CLIVAR Workshop: Prospects for Multi-year Climate Predictability and Societally-relevant Climate Predictions

Identify potential applications & forecasts of opportunity

- Prediction problem is inseparable from assessing predictability
  - Only some forecasts will have useful skill

- Engaging users essential to focus predictability research
  - Predictability problem involves not just what can be predicted but what needs to be predicted

- **Intersection of quantities that are predictable, *and* verifiable, *and* of societal use will anchor** the workshop
  - Goal: scientists, forecasters, and stakeholders will together explore how to best tackle this new prediction problem

US CLIVAR Workshop: Prospects for Multi-year Climate Predictability and Societally-relevant Climate Predictions

Potential attendees/invitees:

- Scientists from major US/Canada operational and research **modeling centers** (eg, NASA/GMAO, NCAR, GFDL, Environment Canada/CCCma), and international centers (e.g., UK Met Office, ECMWF, BSC, Australian BOM, MPI, JAMSTEC)

- Academic/government researchers, especially students/early-career scientists

- Members of both **public agencies and private companies**, including those who make predictions and those who may have in-house climate offices or knowledge (financial institutions including hedge funds and reinsurance)

- **Potential customers/users**, including those from the aquaculture (fisheries), coastal inundation (water level), agriculture (crop forecasts, drought), energy, and water resources communities

US CLIVAR Workshop: Prospects for Multi-year Climate Predictability and Societally-relevant Climate Predictions

Three plenary sessions (invited overviews + contributed talks + posters)

- Multi-year processes/predictability in observations and models
- Current prediction efforts and modelling issues
    - e.g., initialization, drift, ensemble, forecast verification/uncertainty
- Applications

(Hoping to make both oral and poster presentation videos available online)

Plenary/ breakout discussions

Networking event (private sponsor?)

US CLIVAR Workshop: Prospects for Multi-year Climate Predictability and Societally-relevant Climate Predictions

Venue: UCAR Center Green, Boulder, CO
Date: Week of March 30, 2020 (3 days)

Scientific Organizing Committee:
Matt Newman, University of Colorado/CIRES and NOAA/ESRL/PSD, co-chair
Ben Kirtman, University of Miami, co-chair
Toby Ault, Cornell University
Ed Blanchard-Wrigglesworth, University of Washington
Pedro DiNezio, University of Texas
Sarah Kapnick, NOAA/GFDL
Sarah Larson, North Carolina State University
Haiyan Teng, NCAR

All other help appreciated, especially to engage international + private companies/user + applications communities (who are obviously not well-represented here)