Discussion on development of research-to-operations (R2O) and operations-to-research (O2R) collaboration opportunities

ET-OPSLS co-chairs and WGSIP

What would be our recommendations?

slide from WGSIP 18

Initial suggestions:

- GPCs and LC prepare for eventual provision of daily data to support forecasting of
  - risks of extremes
  - anomalies in onset and cessation dates and other threshold phenomena that vary interannually
- GPCs and LC prepare for eventual provision of additional variables including snow, soil moisture and … (adequate verification?)
- Forecasts be provided of indices for circulation modes such as NAO and AO for which some systems have developed very appreciable skill (MM presentation could emphasize skill level through line thickness, coloring, etc.)

Document from WMO (IP)ET-OPSLS co-chairs

Configuration of S2S forecast systems

- Relative merits of burst vs. lagged ensembles from the perspective of developing forecast products, e.g., capturing forecast uncertainty, capturing regime transitions etc.
- Relative importance of various observations in influencing skill of S2S predictions? A related question is what details in initial conditions (in different components of the Earth System) are of importance for S2S predictions?
- Techniques for ensemble generation to better quantify forecast uncertainty.
- Given finite computing resources, which configuration aspects of forecasts systems will be more important to devote our resources on – hindcast length, ensemble size (during hindcasts); hindcast frequency; model resolution; initialization and assimilation etc.
- What level of consistency is required for the specification of initial condition between hindcasts and real-time forecasts, i.e., can one switch the source of initial conditions without compromising prediction skill? (note – the question, of course, depends on the component of Earth System but will be good to know for which components the tolerance is higher).
- Defining hindcast requirements and their influence on designing hindcast configuration, e.g., if hindcasts are required for bias correction/calibration vs. for skill assessment then the associated hindcast configurations may differ. Some guidance will be useful.

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- Approaches for reducing initial shocks, e.g., reduction in model bias (an obvious one), coupled DA, anomaly initialization etc. Influence of initial shocks on compromising S2S prediction skill.

Development of S2S forecast products

- Guidance on the selection of optimal lagged ensemble.
- Strategies for multi-model ensembles, e.g., equal vs. skill weighted (within the context of realistic length of hindcasts we currently have); guidance on objective procedures for consolidating forecast information from various models.
- Guidance for the development of complementary forecast products to the traditional tercile category probability summary commonly produced in RCOFs by RCCs and NMHSs.
- Spread-skill relationship; what is the evidence, e.g., does spread has systematic variations on time-scales associated with S2S forecasts?
- Guidance on fixed vs. "on the fly" hindcasts (from the perspective of interfacing with the user community and possibly providing hindcast data to force application models)
- Relative merits for estimating forecast probabilities, e.g., between counting vs. parametric methods
- Investigate the feasibility (e.g., establish a scientific basis) of producing long standing
- wish for products by various sectors based on daily forecast outputs (e.g. probabilistic forecasts of rainy season onset, wet/dry spells, heat/cold waves) together with the corresponding forecast verification products

Development of S2S verification products

- Thoughts on how to quantify improvements in skill as more advanced prediction systems come online [something equivalent to the time history of 500-mb skill scores used on the weather prediction community but can overcome issues related to sampling, changes in hindcast period (as newer systems come online) etc.]
- Use of hindcast to address various question, e.g., regime dependence of forecast skill; conditional vs. unconditional estimate of skill; influence in the evolution of observing system in improving forecast skill
- Contribute to defining uniqueness of verification standards for sub-seasonal forecasts

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a. We all have finite (human and computational) resources and would like to devote them on the issues that are likely to produce best return on investment, and
b. For prediction on a particular time-scale, not everything is of same level of importance.

Given that, it will be good know (a) what is the current level of understanding or perspective on above questions maybe? and (b) whether a research agenda can be formulated to provide guidance to the development of operational forecast infrastructure?

Possible actions*

1) Task WGSIP sub-group to canvas WGSIP members and other experts on current research to identify and recommend promising new products or other forecasting improvements that could be accelerated into operations at the GPCs and WMO Lead Centre

2) Develop a review paper, based on ET co-chairs' list, drawing on practices and experiences (many unpublished) from research and operational centres bearing on these questions
   - "Current challenges in climate prediction" or similar
   - Aimed toward informing operational and research practitioners of best practices and state of the science
   - Too "dry" to be of interest to wider audience, including prospective young researchers?

3) Develop a review paper, not excluding ET co-chairs' list but with broader perspective, on exciting current challenges
   - "Current scientific challenges in climate prediction" or similar
   - Aimed toward wider audience, inspiring young researchers

4) Propose a workshop of invited experts focused on questions posed by (2) or (3) with corresponding review paper as output

5) New WGSIP project(s) addressing item(s) on ET co-chairs' list

6) Joint WGSIP-ET task group with specific focus (products from daily outputs?)

7) Post ET co-chairs' list in WGSIP's web space

*not mutually exclusive