Working Group 3: International Multi-model Efforts and Collaborations

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How can we encourage the development of more commonly agreed metrics and diagnostics <u>to evaluate and compare model performance</u>, in line with what has been done with the MJO? (e.g. Taylor diagram as for seasonal)?

It is currently expected that the S2S Verification subgroup will determine a collection of common evaluation metrics geared towards forecasts and products. We recommend adoption of these metrics. Additionally there is a desire to collaborate on process-oriented and diagnostic metrics for research purposes so that evaluation of S2S phenomena and relationships will be consistently compared across the S2S and NMME databases. Each of the S2S sub-projects is also expected to determine process-oriented metrics and diagnostics related to their own projects. This working group recommends the creation of a subseasonal metrics/diagnostics task team (SMDTT) to coordinate this activity across S2S and NMME, possibly under the purview of WGNE, for the purpose of facilitating common diagnostic activities across both databases. It should be a joint task force across S2S and NMME. It is essential to ensure that the metrics and diagnostics are developed and documented for ready uptake by the research community similar to the CLIVAR MJO working group. One way to accomplish this may be to leverage crowd-sourced/open source capabilities for archive and dissemination (e.g. github).

How could we harmonize the studies using S2S data/NMME/CBS?

Harmonizing the studies across the various projects requires both communication and a bringing together of the communities. We recommend that this begins with communication between the subseasonal NMME Core Team, S2S project co-chairs, S2S Verification Project leads, WMO Commission for Basic Systems (CBS) leads, and representatives from the WMO Secretariat, via a teleconference. Additionally, we recommend that a concerted effort is made to have joint workshops and conference sessions through leveraging of the International CLIVAR meeting in Qingdao, China scheduled for Sep 2016 as well as organizing sessions at the American Geophysical Union, American Meteorological Society, European Geophysical Union, and American Society of Civil Engineers. This working group also recommends utilizing the Subseasonal Metrics/Diagnostics Task Team (SMDTT) recommended above, the proposed NOAA MAPP Task Force on S2S (selections will be made for this team in Spring 2016), which includes a charge to coordinate with International S2S Project, and the S2S subprojects. We also recommend leveraging the WMO/Commission for Basic Systems (CBO)/Commission for Climatology (CCI) Expert team on Operational Predictions from Sub-seasonal to Long-Time Scales (ET-OPSLS).

What coordinated experimentation should we encourage? (resolution or process oriented, coupling, data assimilation...)?

Coordinated experimentation should take place through leveraging of and coordination with activities that are already taking place. For case studies, we recommend that NMME adopt some of the case studies from S2S when selecting cases in the future. We also recommend coordination of experiments associated with specific projects already planned by the S2S subprojects and other groups such as the Year of Mid-latitude and Extratropical Teleconnections (S2S tropical – extratropical teleconnections sub project), the year of the Maritime Continent planned (MJO subproject), snow sensitivity experiment planned by WGSIP (SNOWGLACE), and Polar Prediction Project Forecast and hindcast experimentation for the year of Polar Prediction. Additionally, NOAA MAPP will announce results from a call for proposals to evaluate prediction system setup for S2S timescales that will also be coordinated by a S2S Task Force. These selections are expected to be announced in Spring 2016 and coordination with these projects and activities is also recommended.

How could we increase the links between research and operational prediction centers?

We should make an effort to infuse S2S/NMME products into existing coordinated research activities such as Stratrosphere-troposphere processes and their role in climate (SPARC)/Stratospheric network for the assessment of predictability (SNAP), the Global Ocean Data Assimilation Experiment (GODAE), the Global Water and Energy Exchanges Project (GEWEX), The Madden-Julian Oscillation Task Force (MJOTF), and the Sea Ice Prediction Network (C. Bitz). We also suggest relying on attending relevant meetings and use of targeted email by S2S/NMME chair(s)/steering groups and WCRP leadership. Hold targeted Research to Operations Workshops – joint with and/or at operational research centers (e.g. 2016 NOAA Climate Diagnostics and Prediction Workshop). Encourage region/country specific targeted research/experimental products that could feed into wider operational capabilities such as cultivating collaborations between a local met service and a global operational center.

Does the multi-model approach add value at subseasonal time scale (widely demonstrated for seasonal forecasting but not for TIGGE)?

The answer to this question is an open one and experience from seasonal predictions (e.g. DEMETER, NMME, etc) and weather predictions (e.g. TIGGE) indicate varied results depending on the timescale. Addressing this question is a central objective of NMME-Subseasonal activity for both research and operational purposes. For S2S, this will be undertaken by the Verification subproject with primarily research considerations. The WMO Lead Centre for Long-Range Forecast Multi-model Ensemble is exploring multi model combinations in an operational

context. The European Commission Joint Research Center for drought forecasting will also undertake multi-model ensemble prediction.

The above activities could utilize the performance metrics developed above to establish threshold capabilities for individual models, and then combine the higher fidelity models to explore potential increases in skill in a MME context. We highly recommend leveraging lessons learned from the seasonal prediction community (e.g. NMME, APCC) as well as the calibration expertise from the weather forecast community.

How to improve the visibility of sub-seasonal prediction with the funding agencies?

Since the topic of funding agencies is specific for each government, our discussion focused on countries/governments that we had strong expertise present in our working group.

a) United States
We expect ready exposure will occur through the upcoming release of the 2015 National Academy Study on Setting the US Research Agenda on S2S. Additionally, US CLIVAR is the natural vehicle to raise visibility with the main funding agencies, namely through their 3 panels, especially the Predictability, Prediction, Applications Interface (PPAI). Within NOAA specifically, we should work with the NOAA MAPP S2S Task Force.

b) Canada
There was no clear funding agency identified. Environment Canada will leverage the NOAA-funded NMME Project (namely H. Lin).

c) Europe
We should work with Horizon 2020 and Copernicus interacting with European Commission to promote future applied research solicitations and services based on S2S Project forecast information.

d) Korea
There are currently efforts underway to establish and obtain funding for a Korea S2S Working group, including KMA and university participants.   It may be useful to get a letter of support from WMO signed by the S2S Project co-chairs.   This may also be relevant to other in-country efforts.

e) Other countries/regions
We could seek support from India via their National Monsoon Mission (inquire R. Krishnan and Rajeevan/IITM). We had limited representation in our group from Australia. We should inquire with H. Hendon. The APEC Climate Center could also be a potential source of funding. We should inquire with Hej Kim, the lead of research and development and J. Lee, lead of external affairs.

More generally, we could utilize the outcomes from exemplar cases of S2S success to raise awareness with international development agencies (e.g. USAID, WFP, Development Banks). Development Banks (e.g. Islamic, Asian, Latin American, African) may be a vehicle to obtain funding to support participation and development by national meteorological, hydrological, and environment service organizations in these regions.

What is the communication strategy to raise the profile of S2S operational prediction products/capabilities with services and the application community?

The communication strategy for S2S interaction with the applications community should be focused on development of exemplar cases illustrating the capabilities and successes of S2S prediction, particularly those that address the WMO Global Framework for Climate Services (GFCS) priorities, possibly leveraging the WMO regional climate outlook forum (RCOF). Further we think it is important to reach out to these communities by identifying and attending sector specific (e.g. agriculture, water management, energy, health, disaster response) workshops and conferences to present S2S activities/capabilities (e.g. WMO Commissions, International Committee on Irrigation Drainage Conference). Another way to reach out to these communities is to utilize "intermediary" organizations such the Red Cross, World Food Program, USAID, DFID, NASA SEVIR, RIMES, FAO, etc to convey the utility of S2S products in the context of the services they provide.