Sub-project activities

Research to Operations (R2O) and S2S forecast and verification products development

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1. <u>Scientific and Operational Objectives</u>

   - Pursue research for testing and developing methodologies for calibration, multi-model combination, verification and generation of forecast products.

   - Coordinate with the relevant WMO technical commissions to define the standards and protocols for operational implementation and exchange of S2S forecasts such that by the end of the Phase II of the S2S, the infrastructure related to the data exchange to support research can be transitioned into the operational domain. Such coordination will be done through the Expert Team on Operational Climate Prediction System (ET-OCPS). The goal is to finalize the transition by the end of Phase II of S2S so that newly designated WMO Lead Centre(s) for Sub-Seasonal Forecast Multi-Model Ensemble (LCs-SSFMME) can obtain S2S forecasts from newly designated WMO Global Producing Centers for Sub-seasonal Forecasts (GPCs-SSF) and deliver S2S forecasts and reforecasts, building on the developed data archive infrastructure and experience acquired with the S2S project research database. This data exchange follows the paradigm of what is currently done for seasonal forecasts among Global Producing Centers for Long-range Forecasts (GPCs-LRF).

2. <u>Activities report for 2020-2021</u>

   - Created a [wiki page](#) for promoting and disseminating the work performed by the S2S research community on calibration, multi-model combination, verification and forecast products generation, software tools, web portals and publications. This wiki page contains proposed questions to be addressed by the research community.
   - Developed in collaboration with ET-OCPS the designation criteria for Global Producing Centres for Subseasonal Forecasts (GPCs-SSF) and Lead Center(s) for Sub-seasonal Forecast Multi-Model Ensemble (LCs-SSFMME) within the WMO operational infrastructure, and recommended verification scores for sub-seasonal forecasts to be computed and disseminated by GPCs-SSF and LCs-SSFMME, which are all now included in the [WMO Manual 485](#).
   - Provided recommendations to US Weather Research Science Working Group (WRSWG-S2S) to help develop research agenda based on requirements/gaps on verification and products.
   - Contributed article on Research to Operations (R2O) and S2S forecast and verification products development subproject activities to the [S2S project newsletter](#).
   - Organized S2S webinar on R2O post-processing and verification including the following talks: Angel Muñoz: Sub-Seasonal Forecast Skill: When, Where

and How To Find It? Andrea Manrique-Suñén: Choices in the verification of S2S forecasts and their implications for climate services. Paul Dirmeyer and Trent Ford: A Technique for Seamless Forecast Construction and Validation from Weather to Monthly Time Scales.

- Organized S2S and climate verification session at the JWGFVR International Verification Methods Workshop Online (2020-IVMW-O), Nov 9-20 2020: https://jwgfvr.univie.ac.at/
- Contributed with S2S verification lecture in the online verification summer school jointly organized by the Mathematic of Planet Earth – Centre for Doctoral Training (MPE-CDT) and JWGFVR 21-25 June 2021 https://mpecdt.ac.uk/mpe-cdt-jwgfvr-forecast-verification-summer-school/
- Helped to organize the Challenge to improve Sub-seasonal to Seasonal Predictions using Artificial Intelligence: https://s2s-ai-challenge.github.io/
- Several members of the R2O and S2S forecast and verification products development subproject contributed with talks at the 2021 ASP Colloquium - The Science of Subseasonal to Seasonal (S2S) Predictions https://www.cgd.ucar.edu/events/2021/asp-colloquia/
- Delivered talks at S2S monthly webinar on sub-seasonal predictions for Africa and South America including: Felipe M. de Andrade: Sub-seasonal precipitation prediction for Africa: Forecast evaluation and sources of predictability. Caio A. S. Coelho: An inter-comparison performance assessment of a Brazilian global sub-seasonal prediction model against four sub-seasonal to seasonal (S2S) prediction project models.
- Several members of the R2O and S2S forecast and verification products development subproject contributed with lectures at Online training workshop on Subseasonal to Seasonal (S2S) Prediction of Monsoons (1 - 12 November 2021) co-organized by the IRI, WMO, WWRP, WCRP, the S2S Prediction Project, CLIVAR/WEGEX Monsoon Panel, and the Indian Institute of Tropical Meteorology. All lectures are available in the site of the event: https://impo.tropmet.res.in/iwm7training.php
- Developed new forecast products for extreme events, using a co-designed approach, and interfacing forecasts to decision-making. Examples of these new products are available at http://www.bom.gov.au/climate/outlooks/#/overview/summary/ and include a) maps of the probability of top/bottom quintile rainfall, Tmax and Tmin; b) Quintile bars for locations. For some background see this paper).
- Members of the R2O and S2S forecast and verification products development subproject explored methodologies for cross-timescale forecast and verification of deterministic and probabilistic forecasts, and investigated the use of nested cross-validation to perform a less biased forecast verification.
- The Python software for the analysis of weather regimes (PyWR) was updated to include subseasonal-to-seasonal scenarios (after Muñoz et al., 2016), an approach to identify similar years based on the temporal evolution of weather types (i.e., similar to analog years, but defined in terms of sequences of daily atmospheric circulation patterns).
- Members of the R2O and S2S forecast and verification products development subproject co-authored several papers on various aspects of S2S forecast production, evaluation, and applications (see wiki page).

3. Proposed Activities for 2022-2023

- Promote the intercomparison of different methodologies for forecast calibration, multi-model combination, verification, and forecast formats (e.g. probability of threshold exceedance).
- In collaboration with the WMO Infrastructure Commission Expert Team on Operation Climate Prediction System (ET-OCPS) encourage the current centers contributing with forecast and hindcast data to the S2S project database to apply to be designated as Global Producing Centres for Subseasonal Forecasts (GPCs-SSF).
- Promote the development of calibrated sub-seasonal prediction products and associated verification products, by producing a guidance document on the calibration of sub-seasonal prediction for national level operations, in collaboration with the WMO Services Commission Expert Team on Climate Services Information System Operations (ET-CSISO), the WMO Infrastructure Commission Expert Team on Operation Climate Prediction System (ET-OCPS), and the World Climate Research Programme (WCRP) Working Group on Subseasonal to Interdecadal Prediction (WGSIP).
- Develop in collaboration with the WMO Infrastructure Commission Expert Team on Operation Climate Prediction System (ET-OCPS) a set of recommendations for operational centres to promote the homogenization of their real time and re-forecast set-ups to facilitate S2S forecast calibration, multi-model combination and verification.

4. Resources

No external resources have been granted to support the activities of this sub-project.

5. Linkages with WCRP/WWRP WGs & projects

On the operational side, this sub-project has linkages with the Expert Team on Operational Climate Prediction System (ET-OCPS), a WMO team of the Infrastructure Commission (INFCOM), and with the Expert Team on Climate Services Information System Operations (ET-CSISO), a WMO team of the Services Commission (SERCOM).

On the research side this sub-project has linkages with the Joint Working Group on Forecast Verification Research (JWGFVR), a WMO joint working group of the Working Group on Numerical Experimentation (WGNE) and the World Weather Research Programme (WWRP), and with the Working Group on Subseasonal to Interdecadal Prediction (WGSIP) of the World Climate Research Programme (WCRP) through the Climate forecast information for decision making (I4D) project.