Joint Working Group on Forecast Verification Research:

Activities overview

Caio Coelho *(CPTEC/INPE)*, Barbara Casati (ECCC)

WGSIP meeting, 16th Nov 2021

Aims

Verification component of WWRP, in collaboration with WGNE and WCRP

("Joint" between WWRP and WGNE)

Promote importance of verification as a vital part of experiments

Develop and promote new verification methods

Training on verification methodologies

Ensure forecast verification is relevant to users

Encourage sharing of observational data

Promote collaboration among verification scientists, model developers and forecast providers

Joint Working Group in Forecast Verification Research

https://community.wmo.int/activity-areas/wwrp/wwrp-working-groups/wwrp-forecast-verification-research

WORLD METEOROLOGICAL ORGANIZATION
Weather · Climate · Water

WWRP WORLD WEATHER RESEARCH PROGRAMME

JWGFVR

Mission: JWGFVR plans and facilitates the development and application of improved diagnostic verification methods to assess and enable improvement of the quality of weather forecasts, including forecasts from numerical weather and climate models. It also collaborates on forecast verification with WGNE and WCRP, and engages in the plans and implementation of the verification component of WWRP projects from their outset.

Promote good verification practices :

- Verification tutorials
- Verification web-page
- WMO recommendation reports and standards for operational centers
- Verification software

Advance verification research:

- Spatial verification method intercomparisons
- International workshops on verification methods
- Verification challenges
- Special issues & publications

Support verification activities in the other **WWRP/WMO projects and Working Groups**

HIWeather

YOPP YEAR OF POLAR PREDICTION

Subseasonal-to-Seasonal S2S Prediction Project

Current S2S research focus: Research to Operations (R2O) and S2S forecast and verification products development sub-project

http://s2sprediction.net/xwiki/bin/view/dtbs/R2O

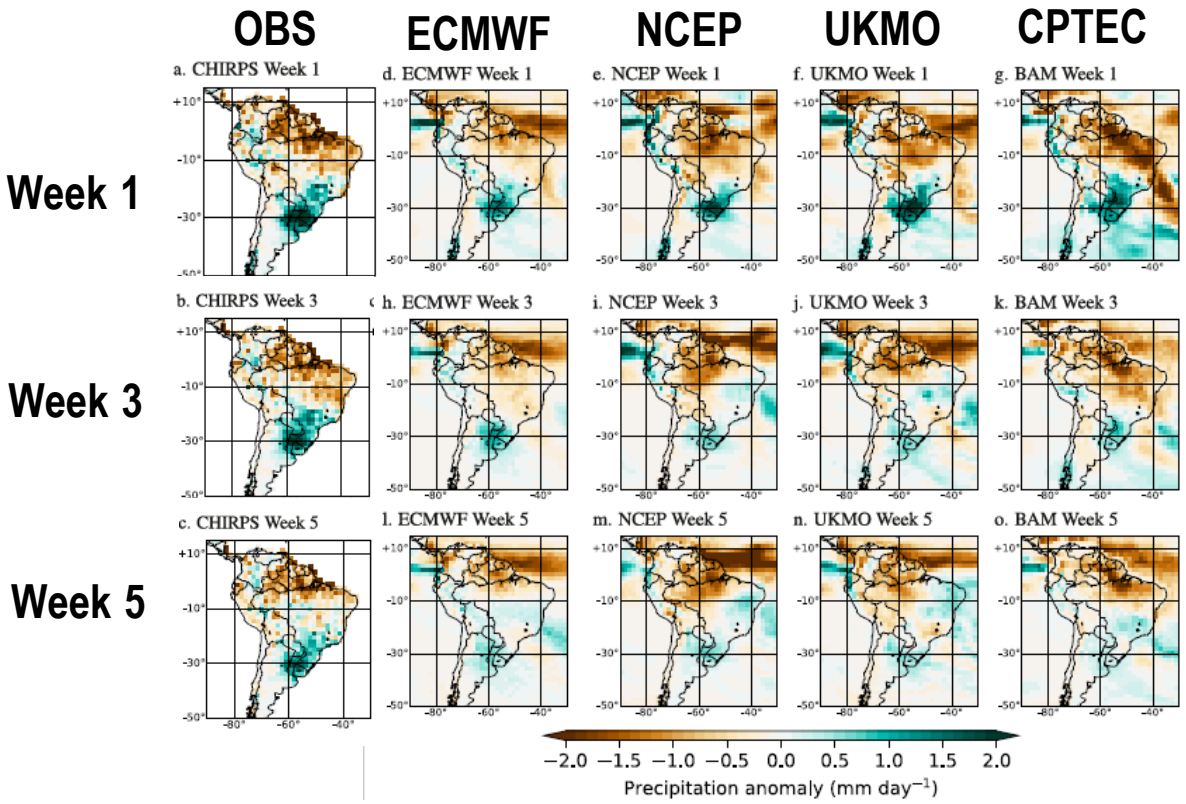
The World Weather Research Programme (WWRP) has flagged improving forecasts of precipitation over land as an important area for S2S to focus research and services development efforts. In order to help advance scientific knowledge and the development of forecast and verification products in this priority area this sub-project invites the S2S research and operational communities to address the following questions:

- What is the current performance level of sub-seasonal precipitation forecasts over land? Over which continental regions can these forecasts be best trusted? How performance levels vary through the seasons of the year? → **Seasonality of prediction performance**
- What is the current capability of S2S models in anticipating the occurrence of extreme precipitation events over land (periods of deficit or excess precipitation)? → **Verification of extremes**
- How well the main patterns of precipitation variability on the sub-seasonal time scale over various continental regions are represented in S2S prediction models? → **Representation of sub-seasonal variability patterns**
- How best to combine and calibrate sub-seasonal precipitation forecasts over land in order to produce improved, combined and well-calibrated products and services? → **Calibration, combination and verification of final forecasts**
- Are there identifiable opportunities for producing sub-seasonal precipitation forecasts over land with improved quality? For example, are forecasts produced during Madden and Julian Oscillation (MJO) and/or El Niño Southern Oscillation (ENSO) events more skilful than when neutral conditions are present? Are forecasts for active and break rainfall phases and dry/wet spells (or other quantities of interest) of adequate quality for developing forecast products for use in application sectors? → **Conditional verification and assessment of weather within climate stats**

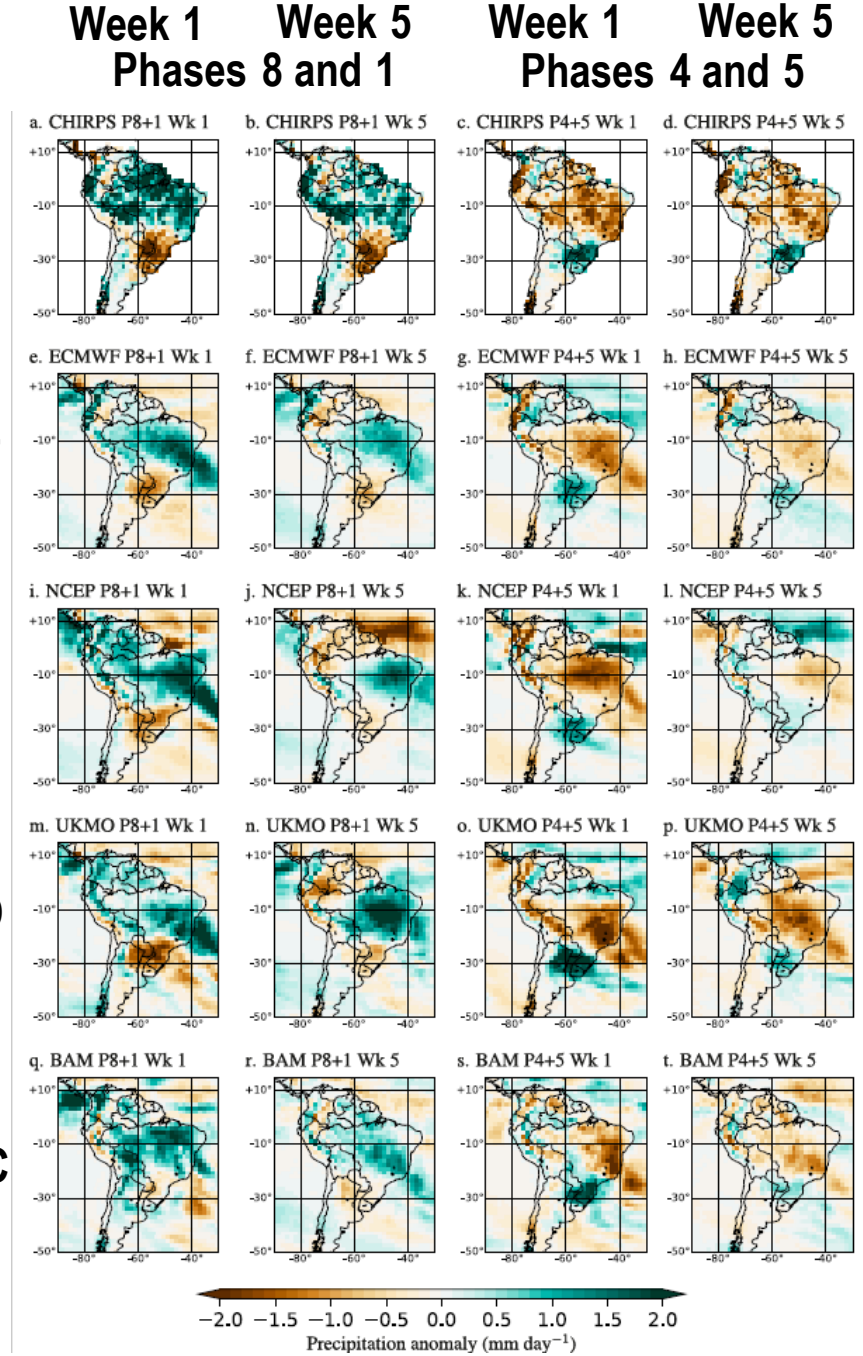
In order to address these questions the research and operational communities are encouraged to explore existing and develop novel methodologies for forecast calibration, combination and verification. Following the S2S verification chapter produced by the JWGFVR for the recent S2S book, it is particularly encouraged the identification of the most relevant forecast quality attributes for the target audiences (e.g. model and forecast developers, and various application sectors) in order to choose appropriate scores and metrics to be able to adequately address clearly and previously defined verification questions of interest. This practice helps performing a thorough assessment of sub-seasonal forecasts from both the probabilistic and deterministic points of view.

Conditional verification: How well CPTEC and S2S prediction project models represent El Niño and MJO phases precipitation patterns?

El Niño pattern



MJO phases patterns



Kingaman, N. P., Young, M., Chevuturi, A., Guimarães, B., Guo, L., Wooolnough, S. J., Coelho, C. A. S., Kubota, P. Y., Holloway, C. E., 2021: Subseasonal prediction performance for austral summer South American rainfall. WEATHER AND FORECASTING, 36 (1), 147-169.

Priority verification research areas

Following up from the November 2020 around the clock International Verification Method Workshop online (2020-IVMWO, https://jwgfvr.univie.ac.at), a **BAMS meeting summary article** was produced (Casati et al., 2021, soon to be published) **highlighting the priority verification research areas** in need of further developments, which includes the following:

- **Observational uncertainty and representativeness:** the WG is planning to follow up on this topic with DAOS and the data assimilation community
- **Process-diagnostics by conditional verification and verification of the relationships between variables:** the WG has started following-up on this topic with WGNE
- **Addressing the complexity of Earth System Modeling:** verification of **coupling** (e.g., ocean and sea-ice, land-atm interactions)
- **Error (back) tracking techniques**: a dynamical approach, analyze the model error propagation in association with large-scale circulation (e.g. Magnusson 2017; Jung et al 2014; Lawrence 2019). Relates to conditioning on weather types / composites / PCA / teleconnection studies.

Observations uncertainty

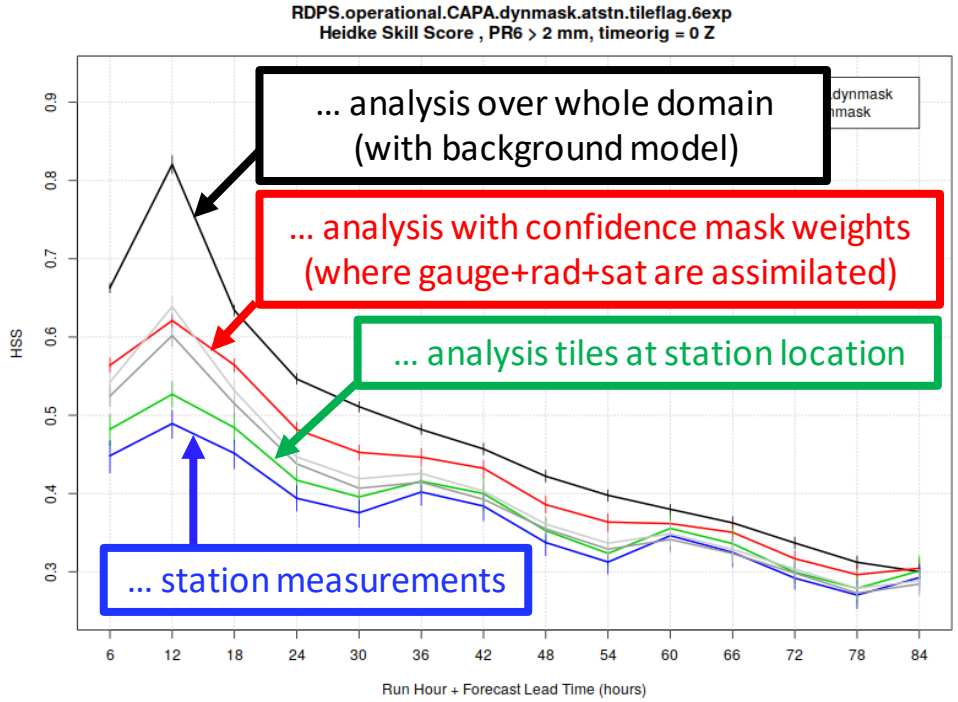
1) Reanalysis not to be considered observations (Park, 2008, QJRMS)

- Characterizing uncertainty associated to reanalyses
- Disentangle model dependence from observation uncertainty

2) Address representativeness issues (Ben Bouallegue, 2020, ECMWF Tech Memo and MWR)

- Short lead times can dominate forecast error

3) Incorporate observation/analysis uncertainty into verification scores and their error bars (Ferro, 2017, QJRMS)



Courtesy: Barbara Casati

Verification approach against model-based analysis exploiting Data Assimilation (DA) knowledge by weighting verification scores with a DA confidence mask

- Subtile representativeness
- Weighting reduces backgound model dependence and accounts for quality and ammount of observations assimilated

Future Plans (to the end of 2023, and hopefully beyond …)

Maintaining JWGFVR Legacy:

- Organize the 9th **International Verification Methods Workshops** (IVMW)
- Deliver **verification tutorials**
- Keep advancing and operationalize **spatial verification methods** (http://projects.ral.ucar.edu/icp/)
- Unify all **web resources** developed by the group in the past 20 years, as reference and legacy
- Keep supporting verification research activities in **WMO projects and WG** (PPP, HIW, S2S, Paris2024RDP, AvRDP2, Tropical Cyclones, …)

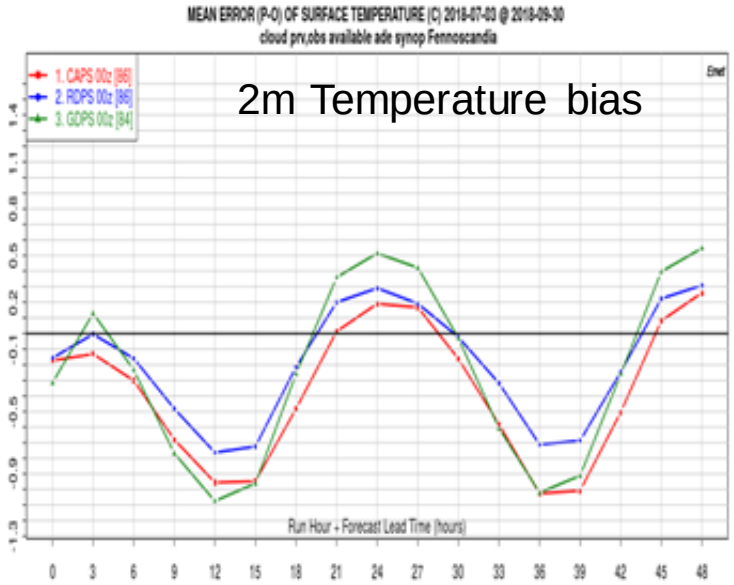
Re-newed Research Foci:

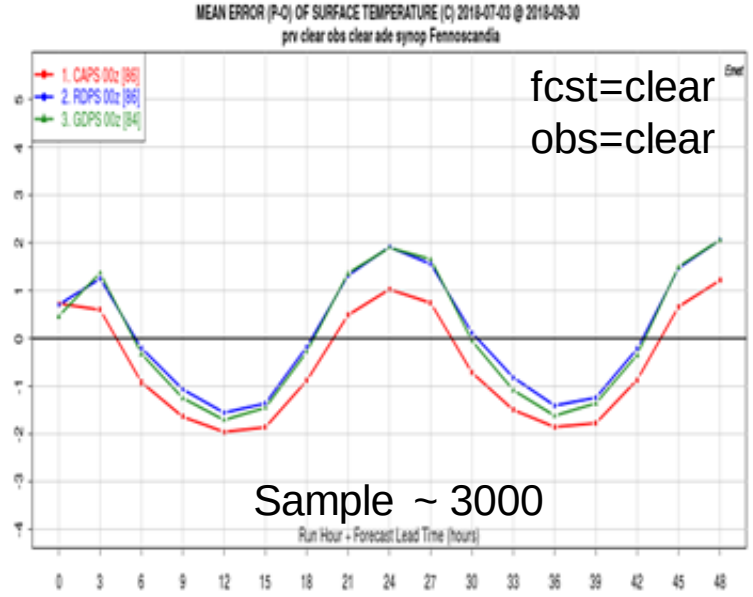
- **Processes diagnostics and ESM verification** (including the interaction of different variables and model components) in collaboration with modellers / WGNE and other WG (e.g., YOPPsiteMIP in PPP; Paris2024 for urban BL)
- **Exploitation of data assimilation knowledge in forecast verification:** representativeness and observations uncertainty
- **Join efforts on model evaluation with the longer-timescale/climate community** (both for upstream -modeling- and downstream -e.g. post-processing- use)
- **Verification for targeted downstream communities** (aviation, hydrology, urban)

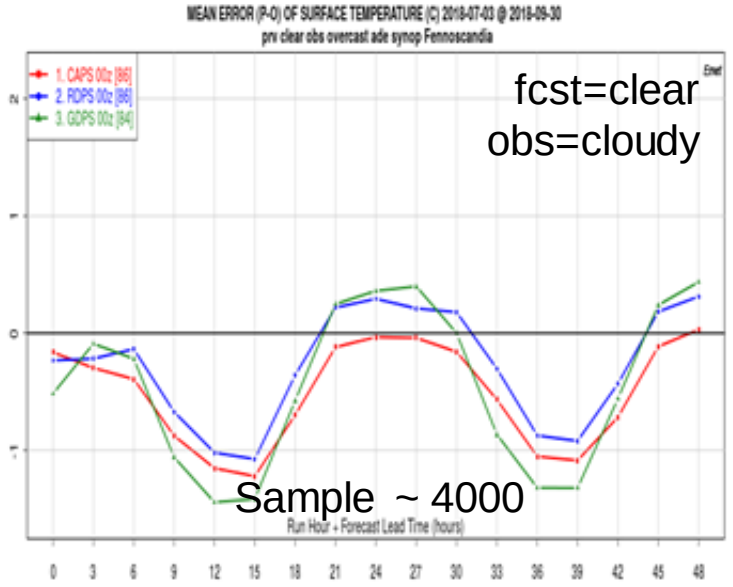
Thank you for your attention!

JWGFVR Members: Barbara Casati (ECCC, co-chair), Caio Coelho (CPTEC, co-chair), Raghu Ashrit (NCMRWF), Marion Mittermaier (UK Met Office), Jing Chen (CMA), Manfred Dorninger (U. Vienna), Eric Gilleland (NCAR), Thomas Haiden (ECMWF), Stephanie Landman (SAWS), Chiara Marsigli (DWD)

Conditional verification: physically meaningful stratification







Example: 2m temperature bias as function of leadtime (0-48h), conditioned on cloud cover; Canadian Deterministic Prediction Systems: CAPS (3km) RDPS (10km) GDPS (25km), Fennoscandia, summer 2018