Verification of multi-model sub-seasonal precipitation predictions at global and regional scales

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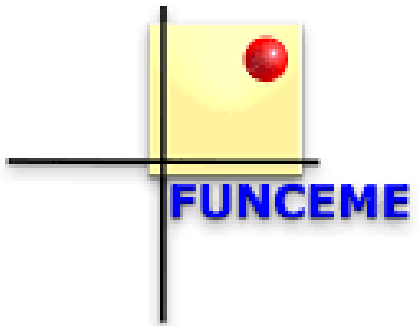

FUNCEME - FUNDAÇÃO CEARENSE DE METEOROLOGIA E RECURSOS HÍDRICOS

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Research context

Anticipated information for the expected meteorological conditions for the next weeks or fortnights (known as sub-seasonal predictions) are relevant for planning the activities of various socio-economic sectors (e.g., water management, agricultural and electricity production)

These predictions are produced with global numerical models and need to be tailored to conform with the requirements of users at regional and local scales

This work presents research developments towards the implementation of a multi-model prediction system designed to produce global and regional precipitation sub-seasonal predictions for the northeast region of Brazil and for the State of Ceará (located within this region), and the associated verification

Verification strategy

The retrospective performance of the multi-model sub-seasonal prediction system assessed in terms of fundamental forecast quality attributes for deterministic predictions (namely association measured with the correlation between the predicted and observed anomalies) and for probabilistic predictions for the event positive precipitation anomaly (namely reliability, resolution, and discrimination) on time scales of weeks, fortnights, and longer accumulations (30 and 44-days)

The benefit of multi-model ensemble calibrated predictions assessed by comparison with individual models calibrated predictions using a bootstrap resampling procedure for estimating sampling uncertainty in the computed performance metric

Main features of used global models

Model	Hincast period	Number of ensemble members (hindcasts/realtime predictions)	Prediction length	Initialization	Characteristics
CPTEC/INPE BAM1.2	1999-2016	11/11	35 days	Every Wednesday	Atmosphere and land components, prescribed sea surface temperature
NCEP/EMC GEFSv12 (SubX)	1999-2016	11/31	35 days	Every Wednesday	Atmosphere and land components, prescribed sea surface temperature
NOAA/ESRL FIM (SubX)	1999-2016	4/4	32 days	Every Wednesday	Coupled ocean-atmosphere-land-sea ice components
NCEP CFSv2 (SubX)	1999-2016	4/4	44 days	Every Day	Coupled ocean-atmosphere-land-sea ice components

The three selected Subseasonal prediction Experiment Project (SubX) models and BAM1.2 produce real time predictions allowing the generation of operational multi-model ensemble predictions

Predictions of these three SubX models are accessed through the IRI data library

SubX is now the Subseasonal Consortium (SubC)

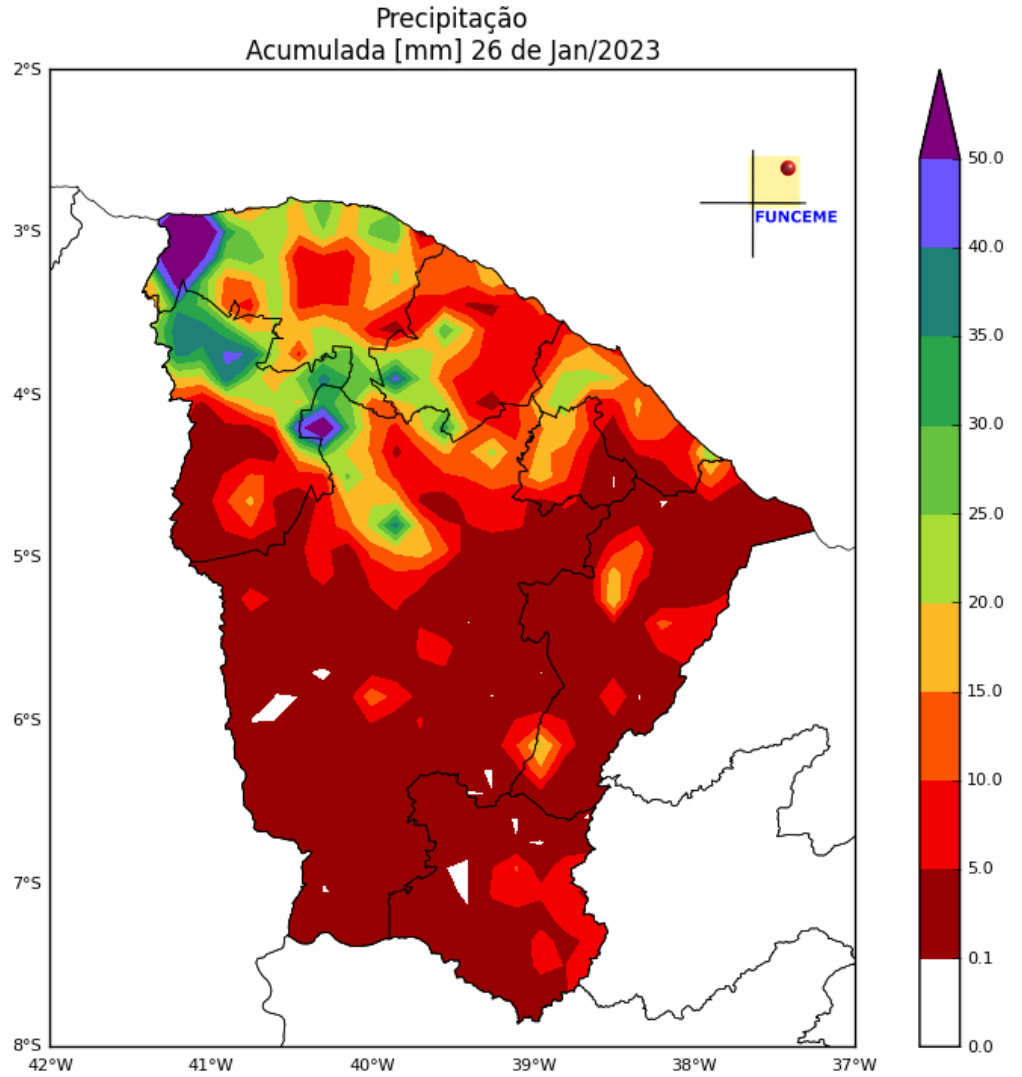
Multi-model ensemble calibration procedure for global and regional predictions

- Interpolation of hindcasts of all models to a common 1° x 1° spatial grid
- Generation of hindcast multi-model ensemble mean values of the 4 models for the 1999-2016 period (18 years)
- Aggregation of hindcasts from the two-neighbour weeks of the target week to increase sample size when applying the calibration procedure
- Calibration: Linear regression of hindcast multi-model ensemble mean values on past observation. Both hindcast multi-model ensemble mean and observed values standardized by the mean and standard deviation of the data sample
- Cross-validation (leave one out) at each grid point for calibration hindcast assessment

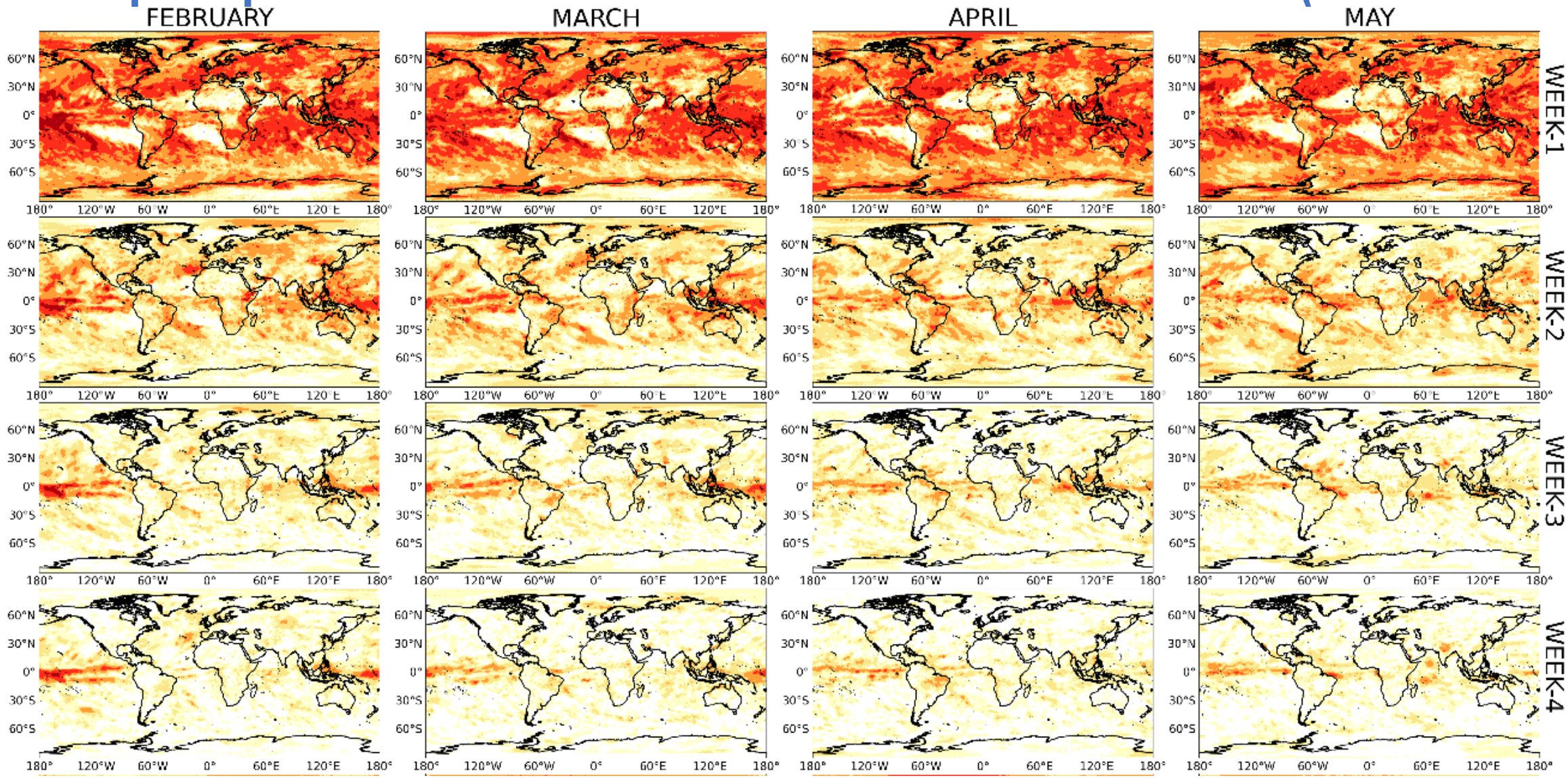
Obs dataset: Daily values from *Global Precipitation Climatology Project* (GPCP)

Multi-model ensemble calibration procedure for Ceará State

- Use observed data from FUNCEME stations network over Ceará State, available at the 0.15º x 0.15º spatial resolution
- Interpolation of hindcasts of all models to 0.15º x 0.15º grid
- Perform linear regression calibration procedure as earlier described now using the higher resolution data

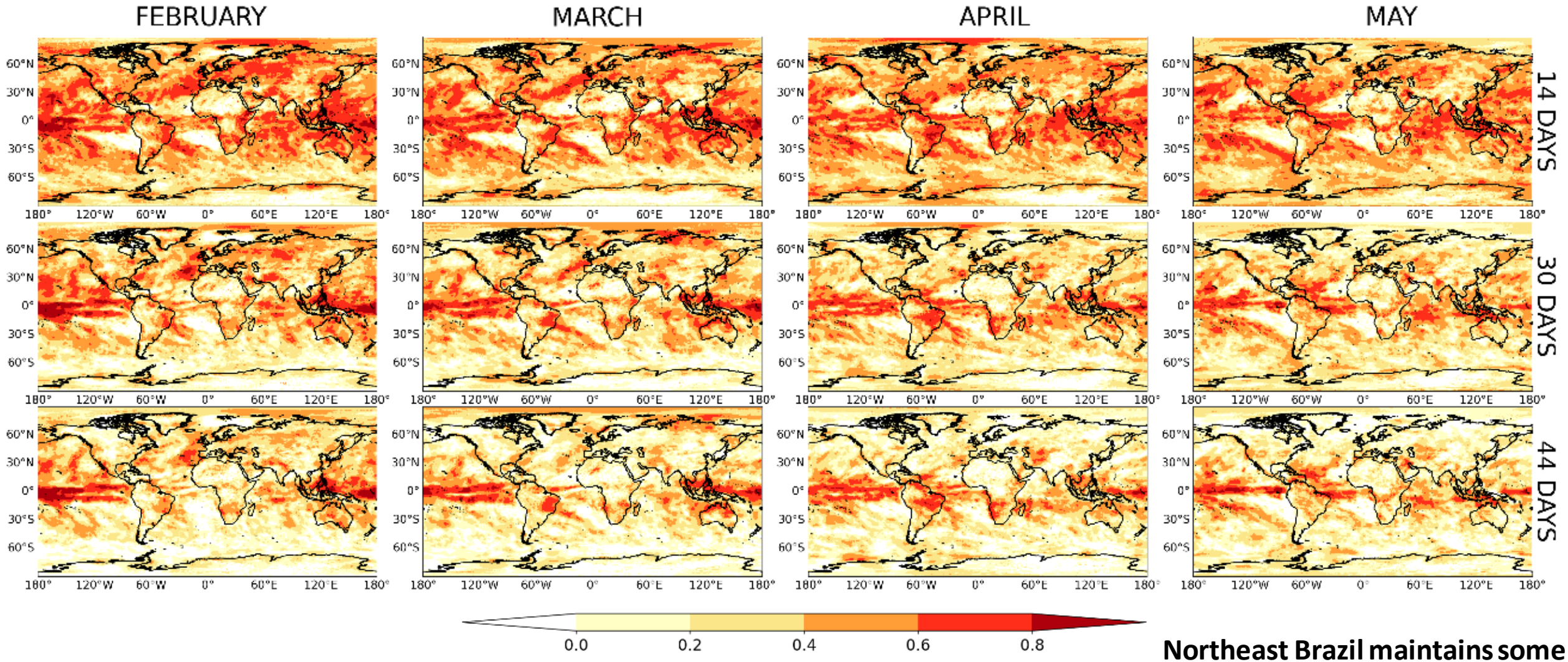


What is the association btw multi-model ensemble calibrated predictions and obs precip. anomalies? Global assessment: Correlation (Weeks 1 to 4)



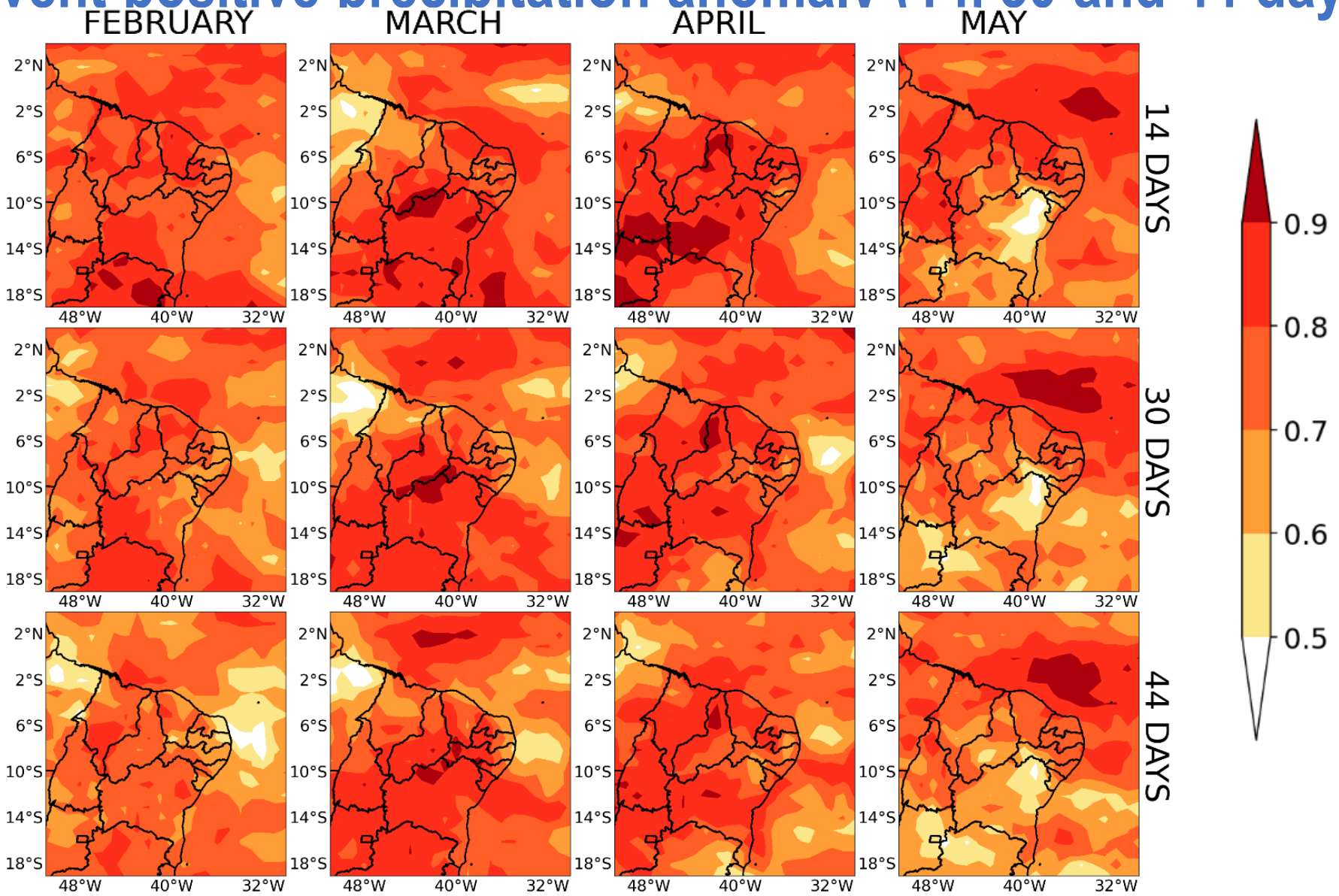
Northeast Brazil maintains some level of association up to week 4

What is the association btw multi-model ensemble calibrated predictions and obs precip. anoms.? Global assessment: Correlation (14, 30 and 44 days)

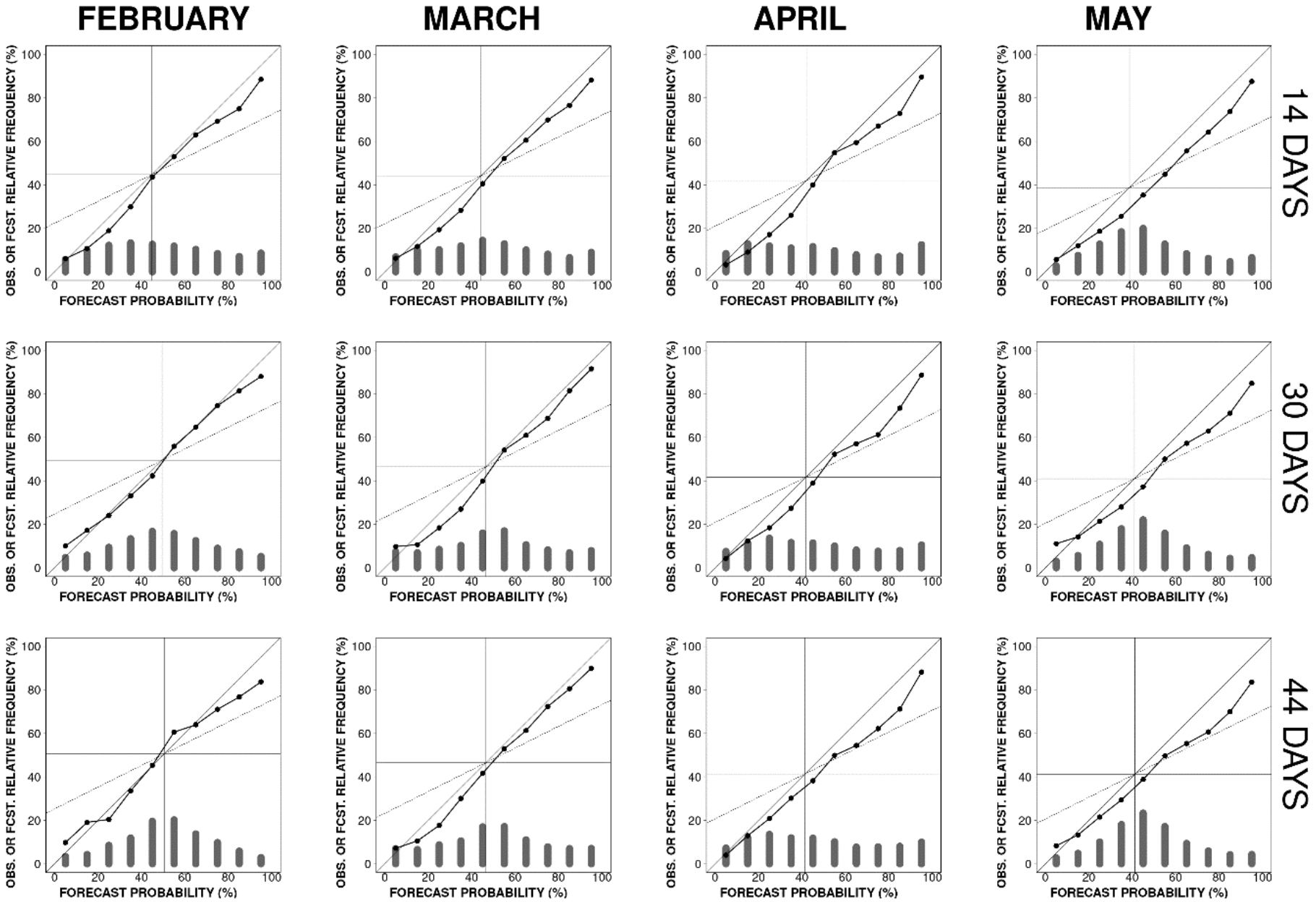


Northeast Brazil maintains some level of association up to 44 days

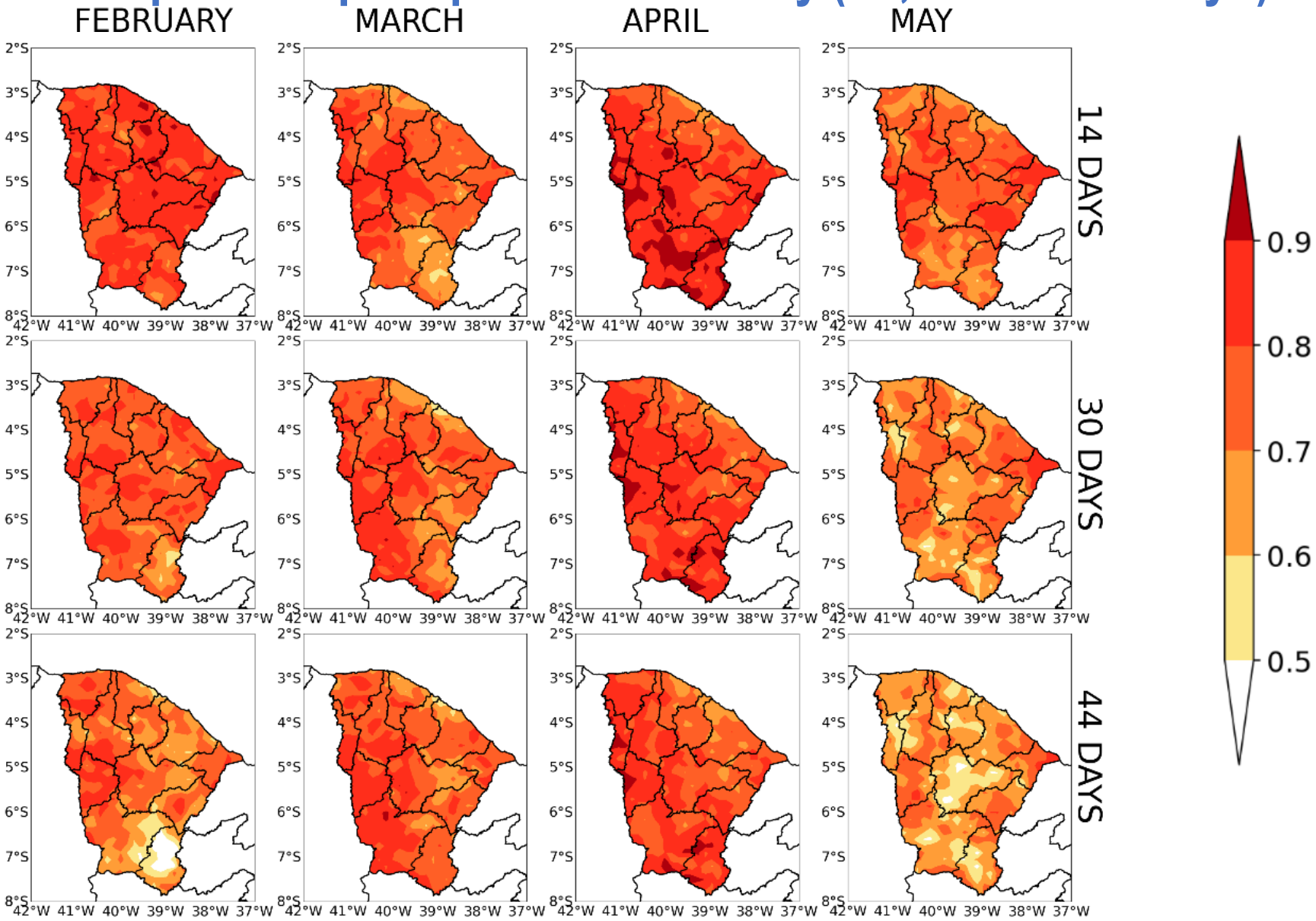
Can calibrated multi-model ens. probs. distinguish wet from dry events?
Northeast Brazil discrimination assessment: Area under ROC curve for the event positive precipitation anomaly (14, 30 and 44 days)



How reliable are calibrated multi-model ens. prob. predictions?
Northeast Brazil assessment: event positive precip. anom. (14, 30 and 44 days)

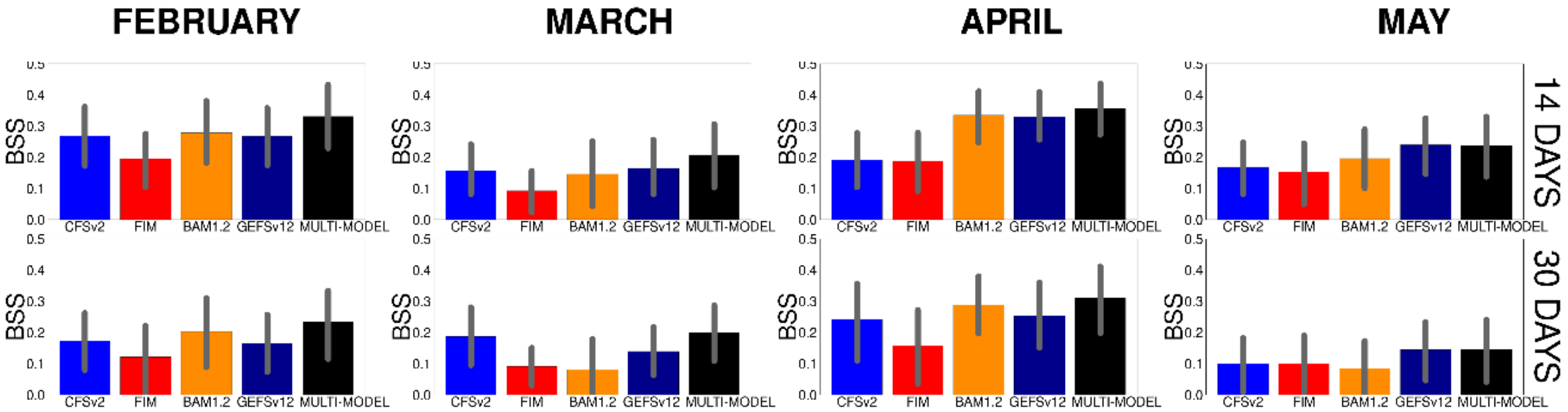


Can calibrated multi-model ens. probs. distinguish wet from dry events?
Ceará State discrimination assessment: Area under ROC curve for the event positive precipitation anomaly (14, 30 and 44 days)



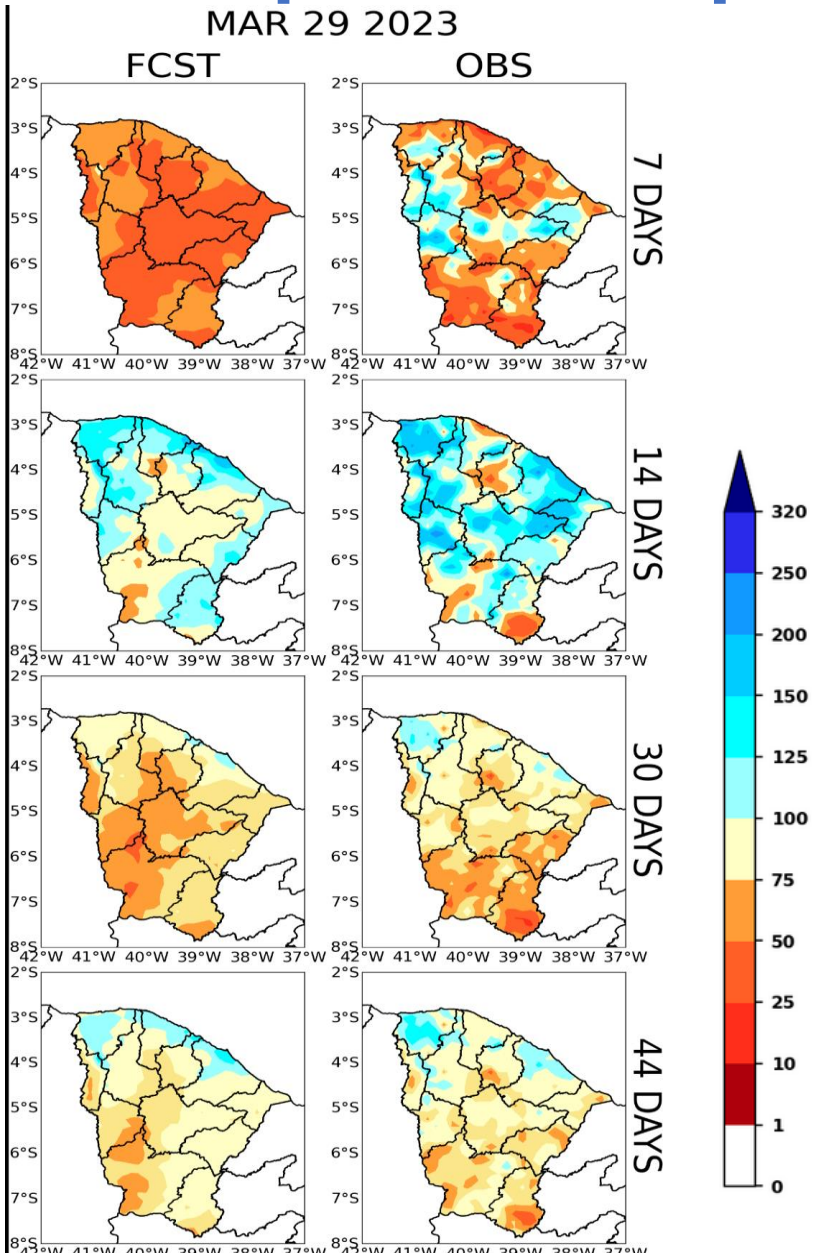
Assessing the benefit of multi-model ensemble calibrated predictions compared to individual models calibrated predictions for Ceará:

Brier Skill Score (BSS) wrt to climatology for the event positive precipitation anomaly

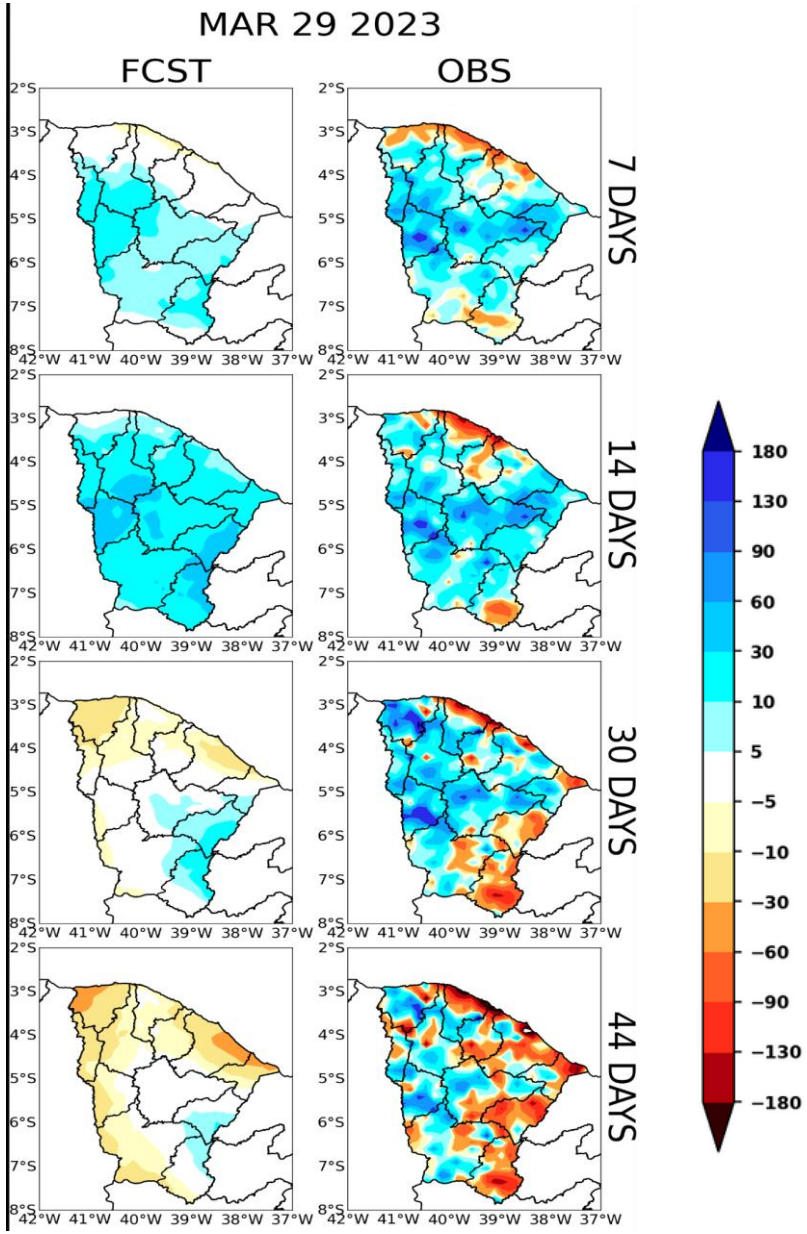


Example of calibrated multi-model ensemble precipitation prediction product developed for Ceará

Accumulated precipitation

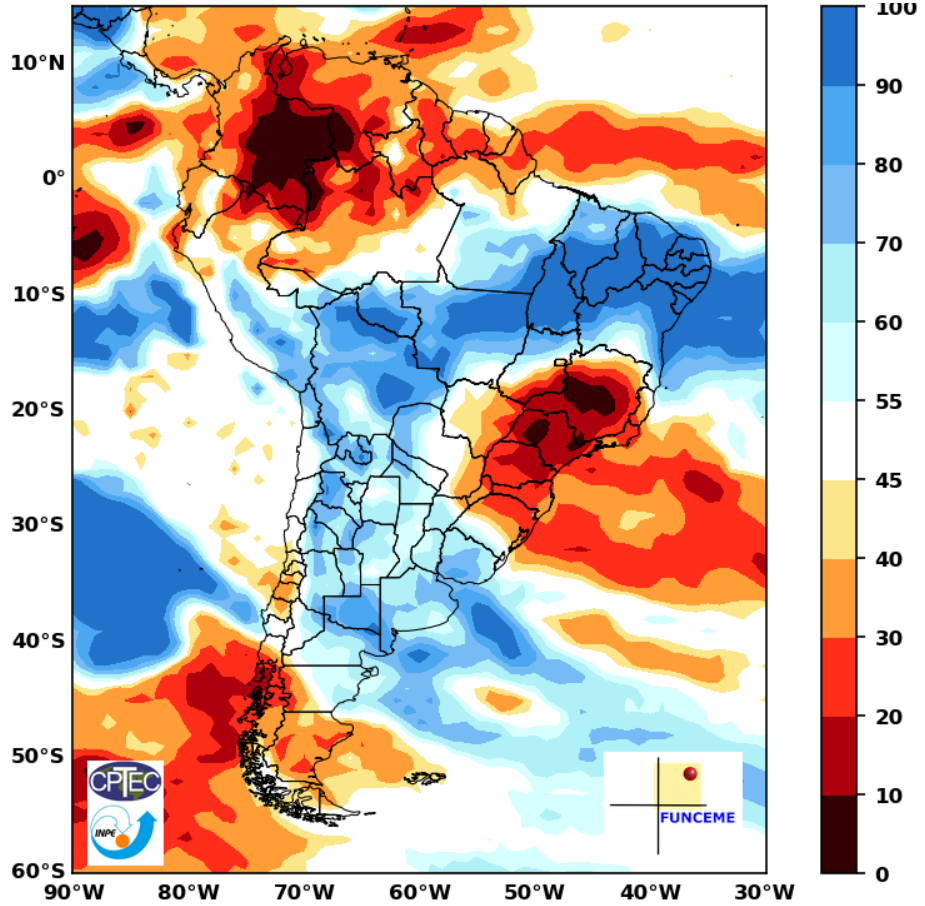


Precipitation anomalies

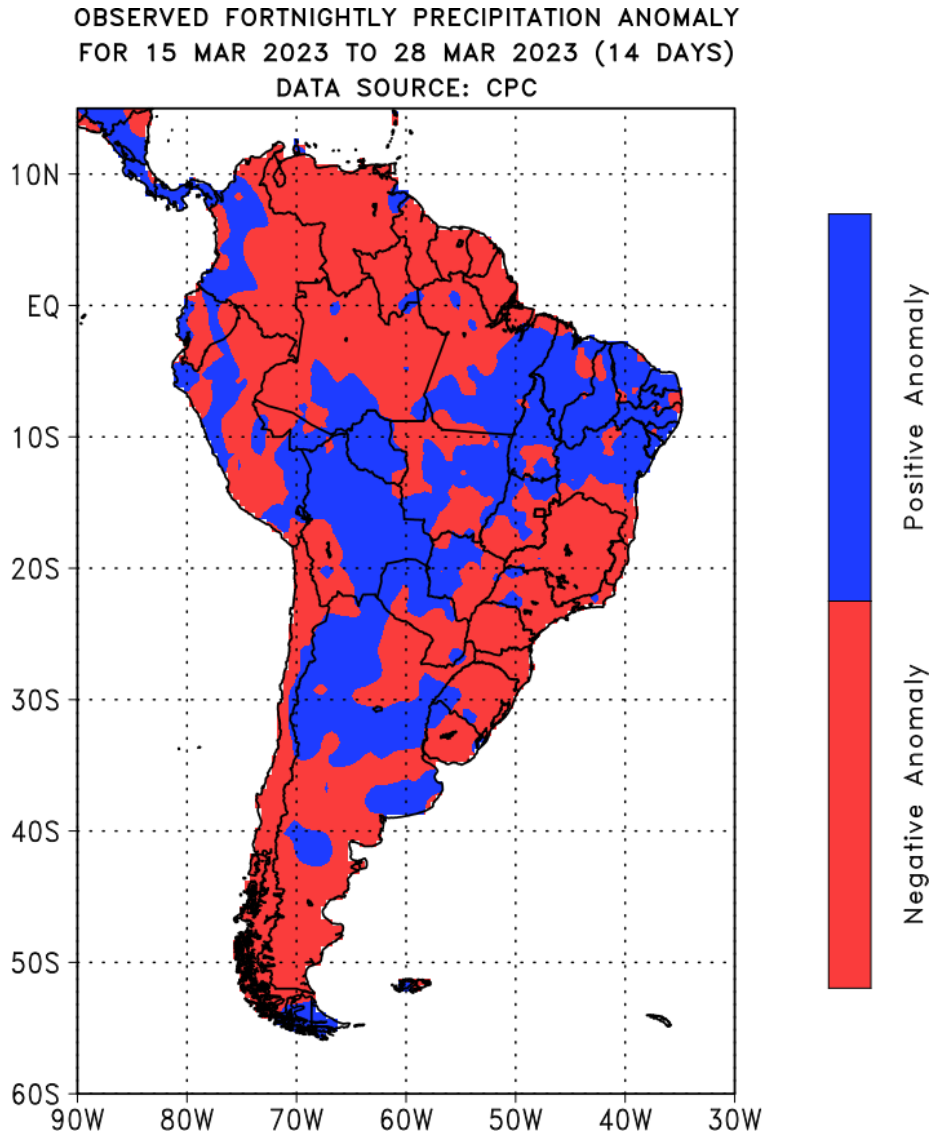


Example of product developed for South America

Calibrated multi-model ensemble prediction:
Probability of positive precipitation anomaly
for the period 15 to 28 March 2023, issued on 15 March



Modelos: BAM-1.2/CPTEC, CFSv2/NCEP, GEFSv12/NCEP, ESRL/NOAA (Fonte: SubX e CPTEC/INPE)



Additional Global and regional prediction and verification products available at http://www.funceme.br/dashboard/subsaz_forecast

Final remarks

- Developed, assessed performance and implemented a multi-model sub-seasonal precipitation precipitation prediction system for producing routinely (every Wednesday) global, regional and local (for Ceará State) predictions
- Encouraging performance of the prediction system over northeast Brazil and Ceará State: reasonable performance levels in terms of association, discrimination, reliability and resolution
- The produced prediction are being used to help guide planning water management and agricultural activities in Ceará State

Thank you for your attention

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