Advances in sub-seasonal predictions at INPE/CPTEC

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- Configuration and assessment of INPE/CPTEC Global Atmospheric Model for sub-seasonal predictions
- Comparative performance assessment against sub-seasonal to seasonal (S2S) prediction project models
- Examples of experimental predictions for 2022
- Final remarks

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Configuration and assessment of INPE/CPTEC Global Atmospheric Model for sub-seasonal predictions

Guimarães, BS, CAS Coelho, SJ Woolnough, PY Kubota, CF Bastarz, JP Bonatti, SN Figueroa and DC de Souza, 2020: Configuration and hindcast quality assessment of a Brazilian global sub-seasonal prediction system. QJRMS. 146, 728, Part A, 1067-1084

What is the most adequate model configuration for producing predictions 1 to 4 weeks ahead?

Model: Brazilian Global Atmospheric model [BAM (Figueroa et al., 2016)] currently used at INPE/CPTEC for numerical weather and seasonal climate predictions

This is the first BAM outcomes for sub-seasonal predictions aiming to determine which model configuration presents the best performance for this time scale: Aligned with WWRP/WCRP S2S project

Special attention is given to characteristics such as vertical resolution, deep convection and boundary layer parameterizations as well as soil moisture initialization

Chosen horizontal resolution: T126 (~100 km)

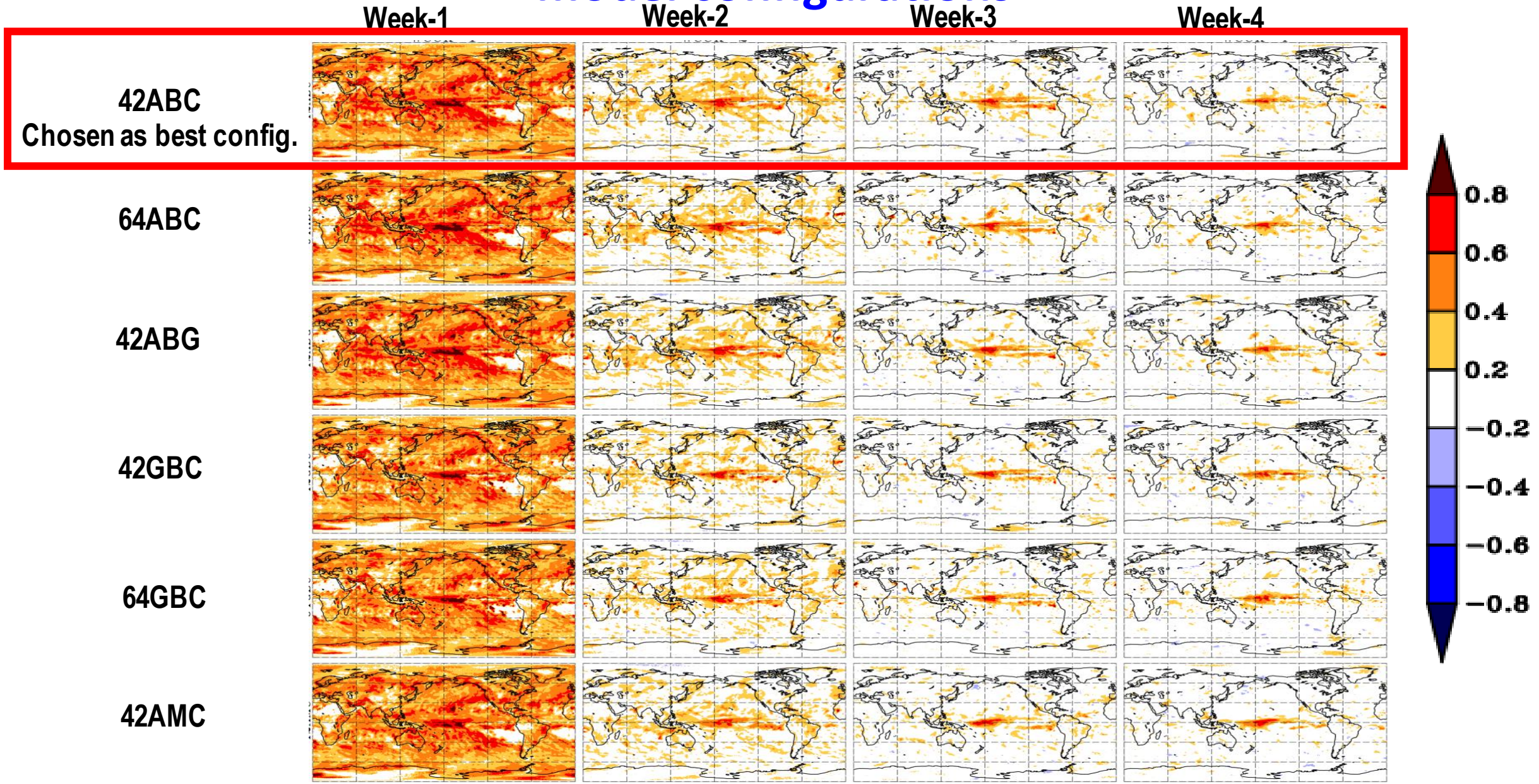
Hindcast ensemble produced twice a month for 12 extended austral summers (Nov-Mar): 1999/2000 to 2010/2011

BAM-1.2 configuration matrix for sub-seasonal predictions

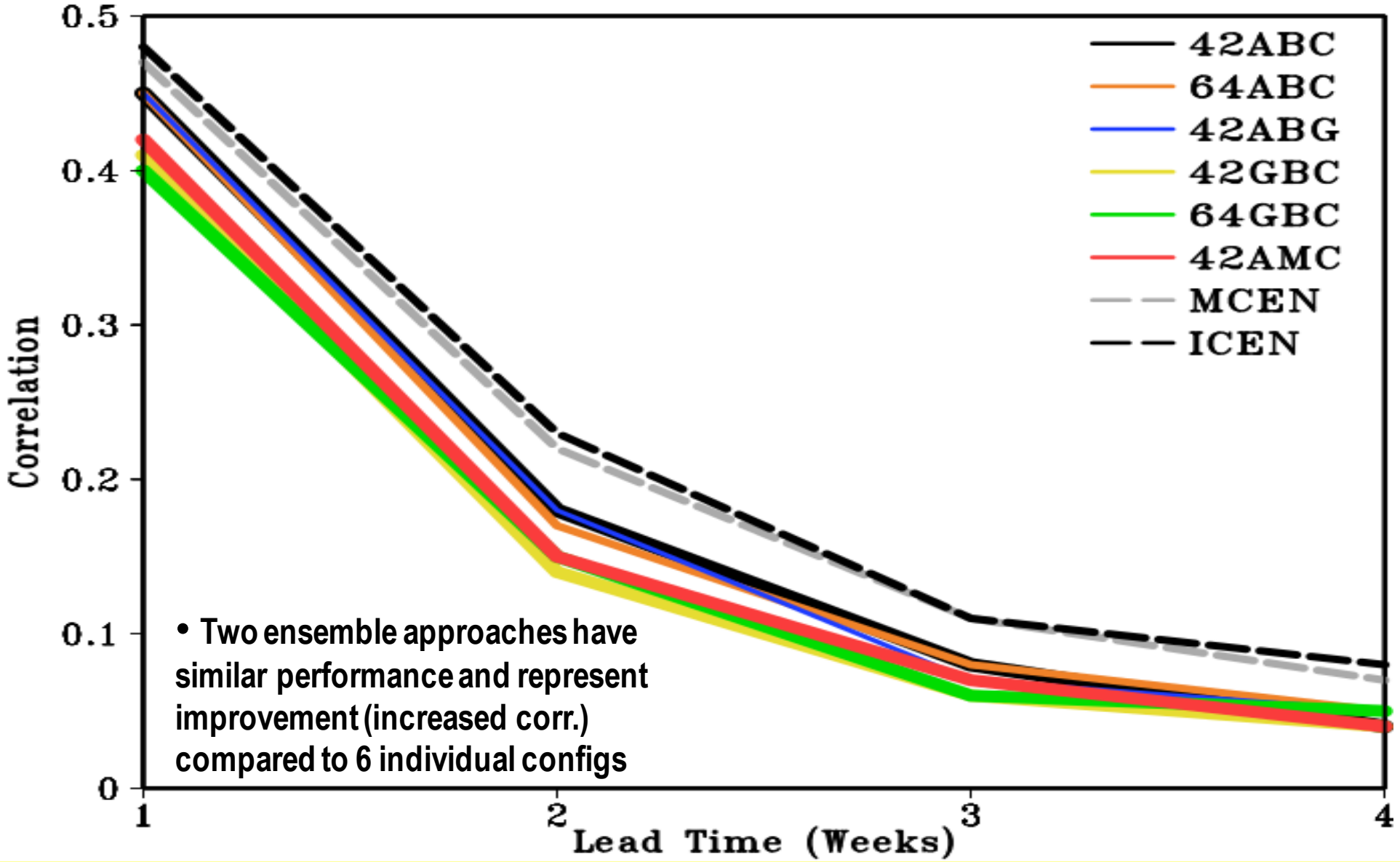
Configurations	Vertical levels		Convection parameterization		Boundary layer parameterization		Soil moisture	
	42	64	Revised Simplified Arakawa-Schubert	Modified Grell-Dévényi	Bretherton-Park (moist scheme)	Modified Mellor-Yamada (dry scheme)	Climatology	GLDAS2
42ABC	42		A		B		C	
64ABC		64	A		B		C	
42ABG	42		A		B			G
42GBC	42			G	B		C	
64GBC		64		G	B		C	
42AMC	42		A			M	C	

Corr. btw predicted and observed precipitation anomalies for the six model configurations

Guimarães et al. (2020)



Global mean correlation for precipitation anomalies averaged over 60°N and 60°S



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How does INPE/CPTEC model compare with S2S project models?

Guimarães, BS, CAS Coelho, SJ Woolnough, PY Kubota, CF Bastarz, JP Bonatti, SN Figueroa and DC de Souza (2021) An inter-comparison performance assessment of a Brazilian global sub-seasonal prediction model against four sub-seasonal to seasonal (S2S) prediction project models, *Climate Dynamics*. 56, 2359–2375.

This study performed a global assessment of INPE/CPTEC model (BAM-1.2) when producing sub-seasonal predictions, focusing on an inter-comparison with four S2S project models (JMA, ECCC, ECMWF and BoM)

Special attention is devoted to performing a fair comparison between INPE/CPTEC and these four S2S project models in terms of using the same hindcast samples size, the same hindcast period (1999/2000-2010/2011) and the same number of ensemble members

Main characteristics of investigated models

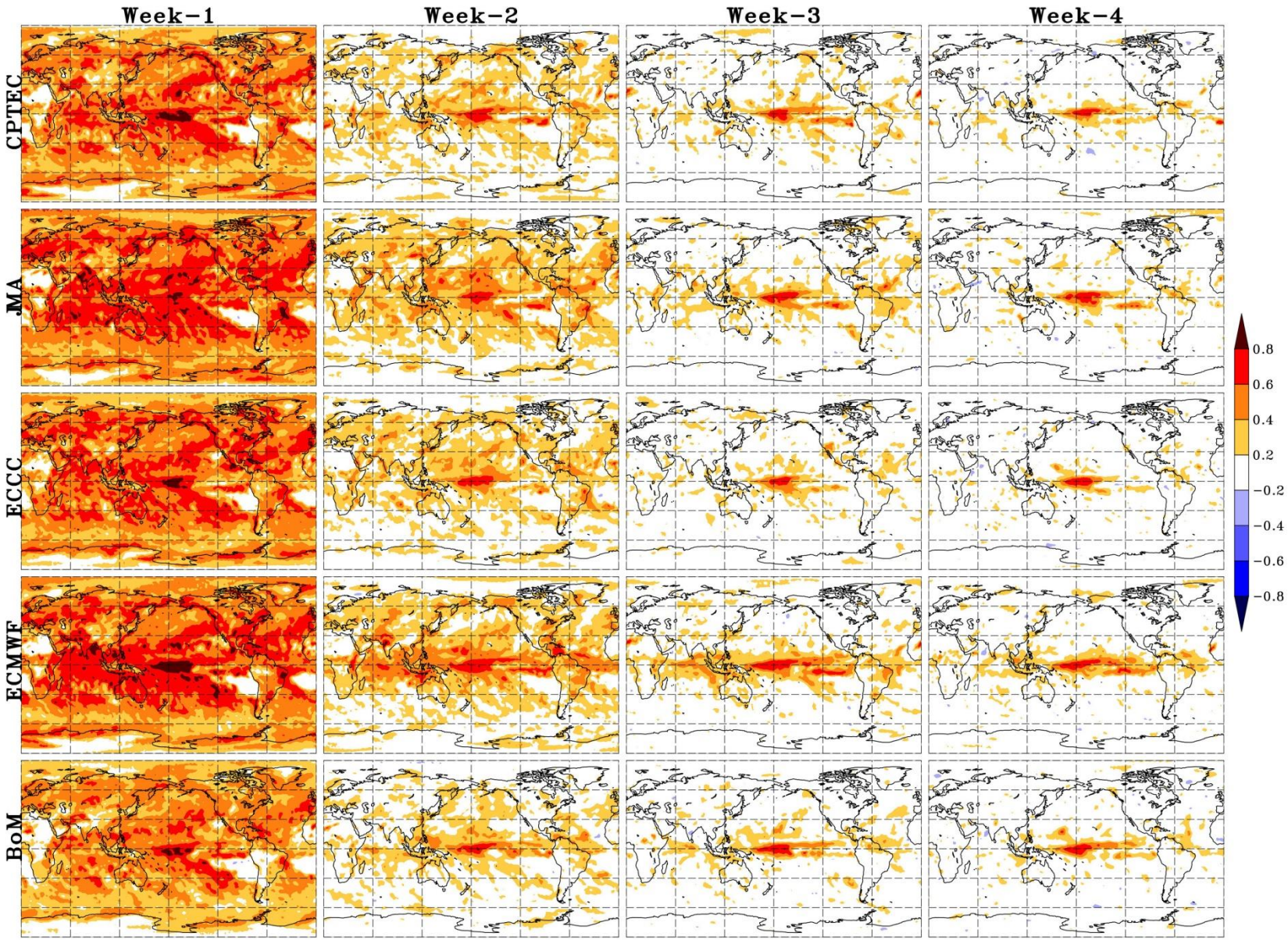
S2S Project models

	Model version	Resolution	Ensemble Size	Ocean Coupling
CPTEC	BAM-1.2	TQ126 L42 (~100 km)	11	NO
JMA	GEPS1701	Tl479 / Tl319 L100 (~40 / 55km)	5	NO
ECCC	GEPS5	0.35°/ L45 (~39 km)	4	NO
ECMWF	CY43R1	Tco639 / Tco319 L91 (~16 / 32km)	11	YES
BoM	POAMA(24a)	T47 L17 (~250 km)	11	YES

Common ensemble size: 4 members of all models (det. assessment of ens. mean)
11 members for CPTEC, ECMWF and BoM (prob. assess.)

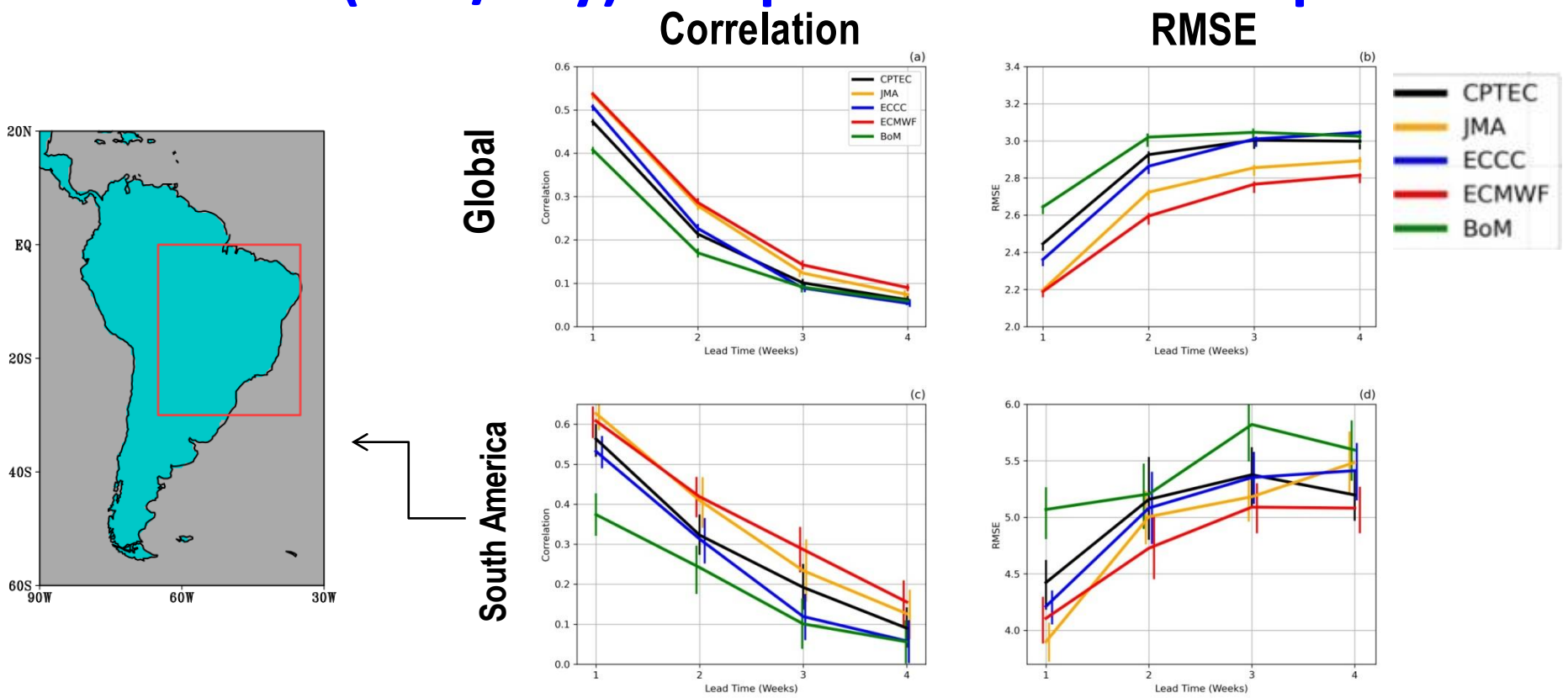
Corr. btw predicted and observed precipitation anomalies for INPE/CPTEC and S2S models

All models with 4 members



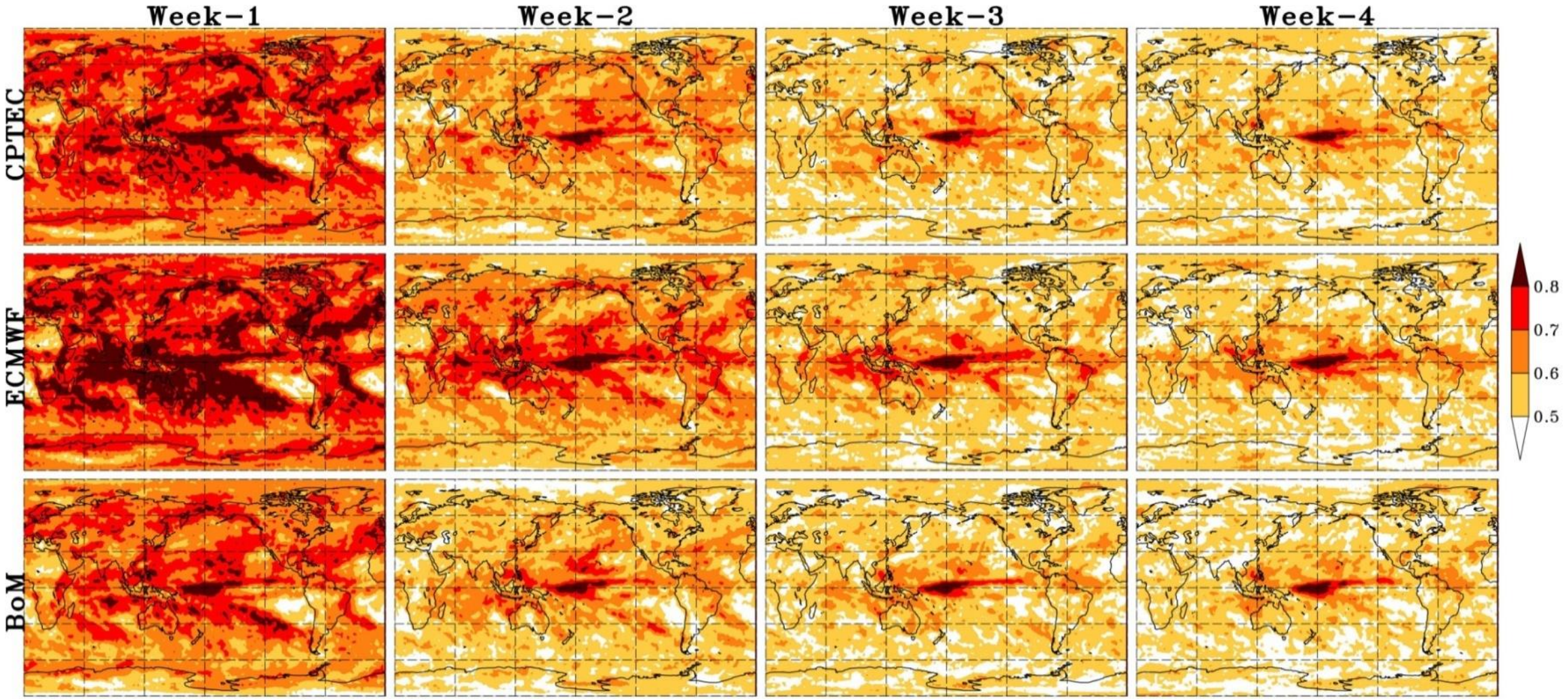
- All models show similar correlation patterns
- Corr. high during first week in most regions and drops rapidly as lead time increases
- High corr. in first two lead times (part. at week-1) assoc. to the pred. prov. by the ICs, high corr. in last two lead times over eq. Pac. assoc. to pred. prov. by ENSO and the MJO
- In general, CPTEC corr. values are larger (smaller) than BoM (ECMWF) and broadly comparable to JMA and ECCC models

Global (60°N – 60°S) and South America (0°–30°S, 55°W–35°W) mean corr. and RMSE (mm/day) btw predicted and obs. prec. anoms.



- All models show a similar drop (rise) in corr. (RMSE) as a function of lead time
- ECMWF (red line) shows the best performance followed by JMA
- INPE/CPTEC (black line) has similar performance to the other models over global and South America region

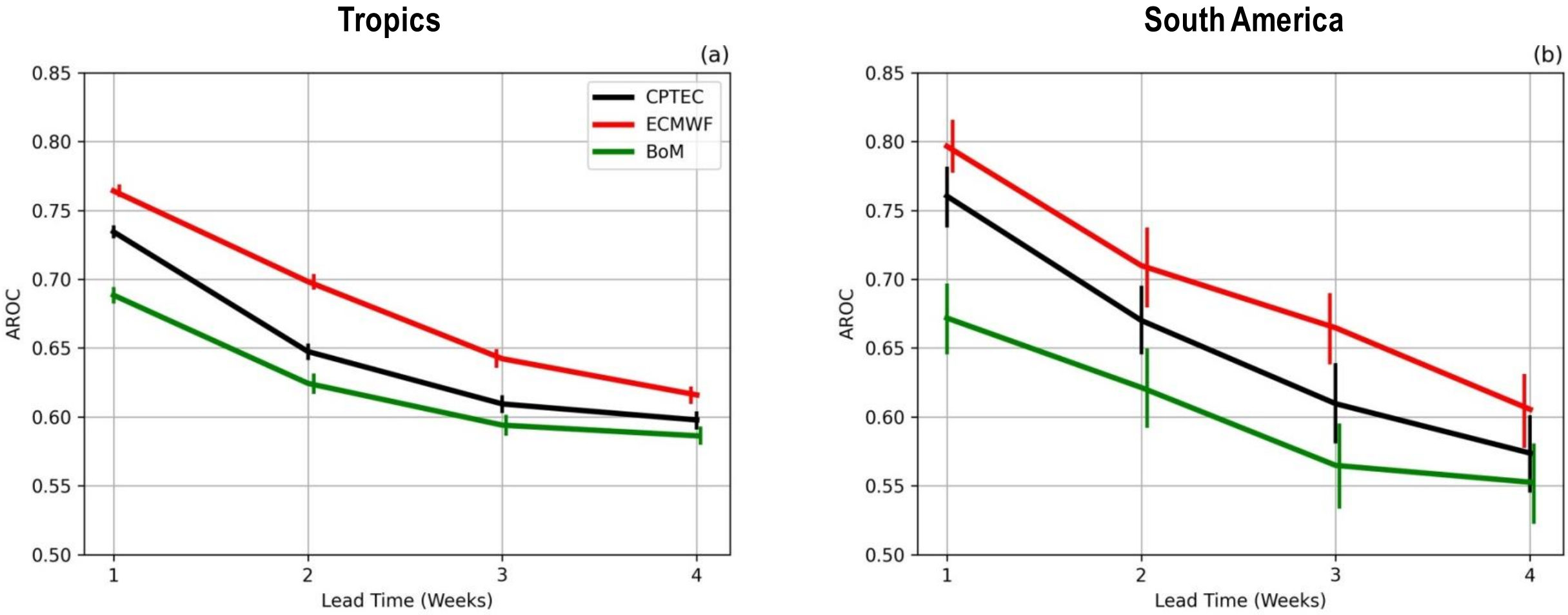
Area under ROC curve (AROC) for CPTEC and S2S models: event pos. precip. anom.



All models with 11 members

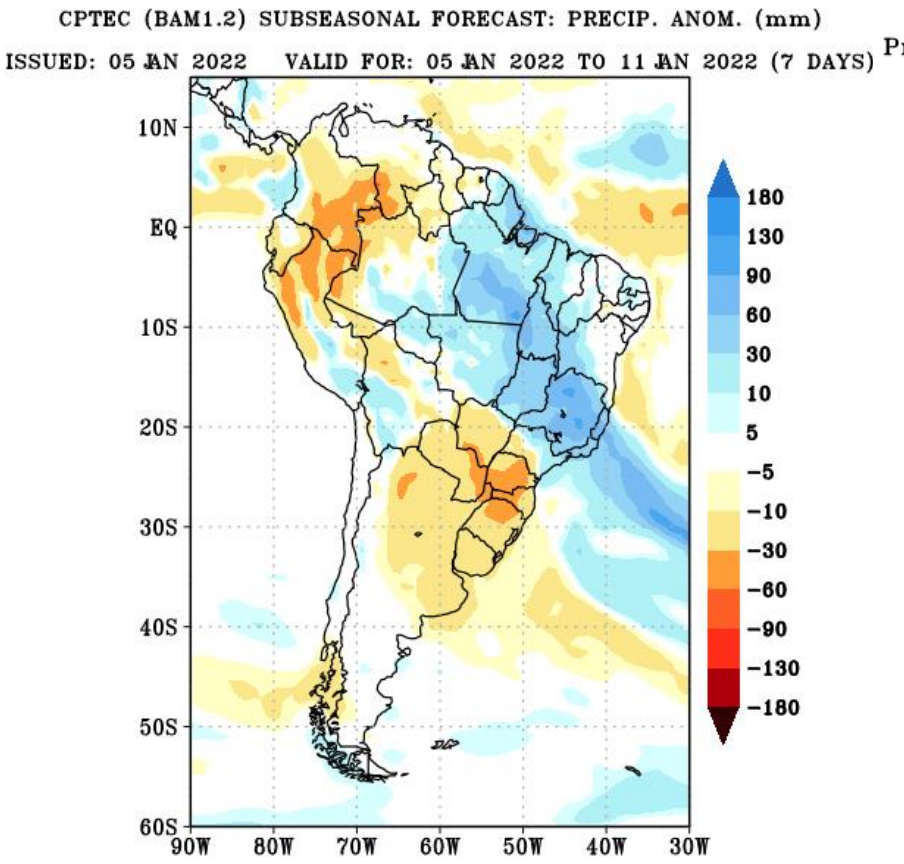
- AROC computed for probabilistic predictions for the event positive precipitation anomaly for assessing discrimination ability
- The three models have comparable AROC spatial patterns

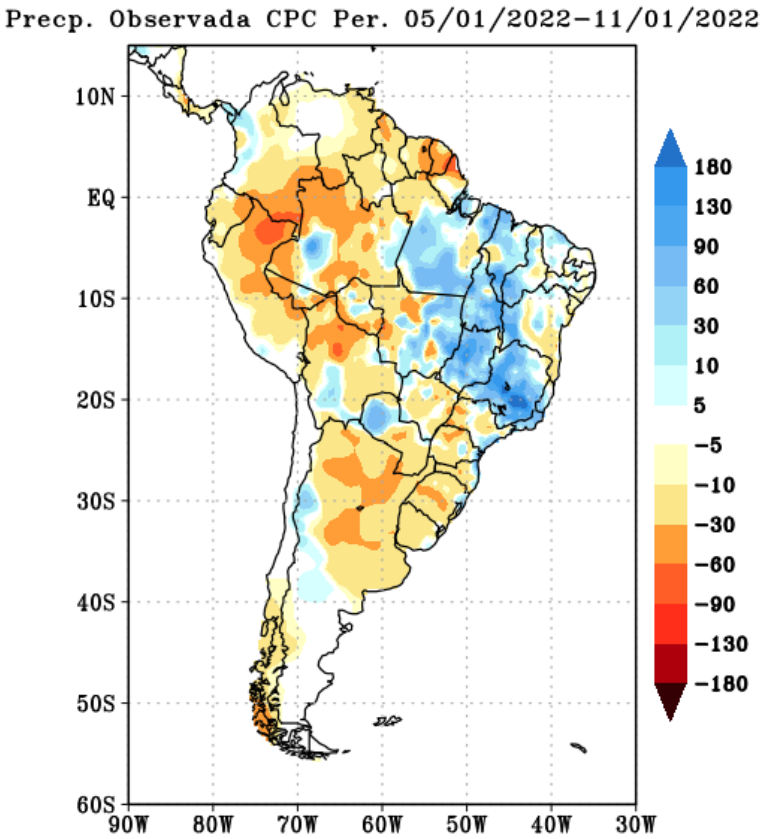
ROC area for Tropical (30ºN – 30ºS) and South America (0°–30°S, 55°W–35°W) regions: mean values for event positive precipitation anomalies

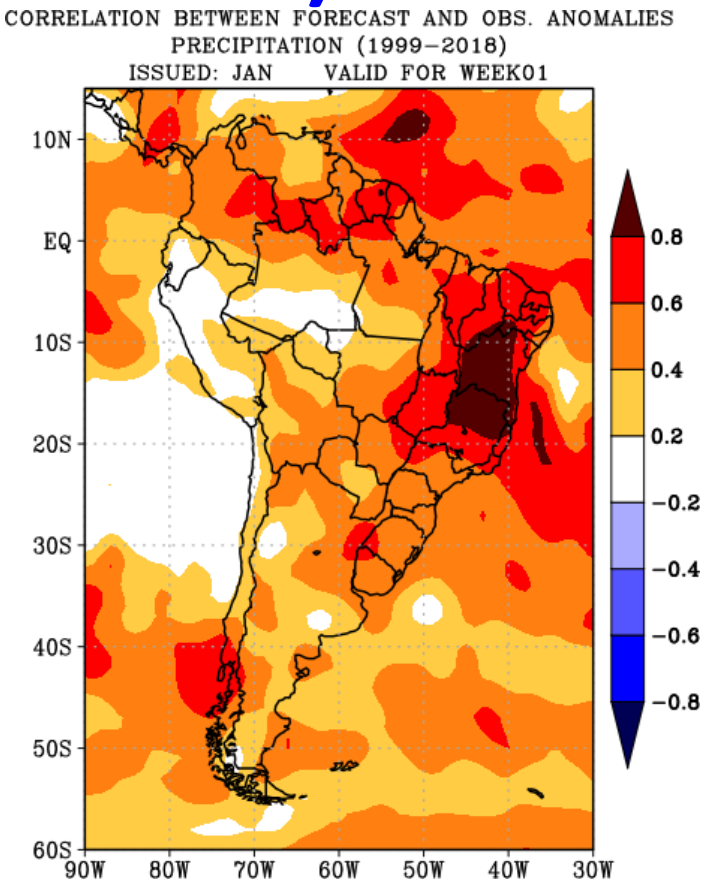


- CPTEC, ECMWF and BoM models show AROC values above 0.5 for all four lead times
- ECMWF ranks as the best model, followed by CPTEC and BoM

Experimental INPE/CPTEC sub-seasonal precipitation prediction for 7 days accumulation (5-11 Jan 2022)

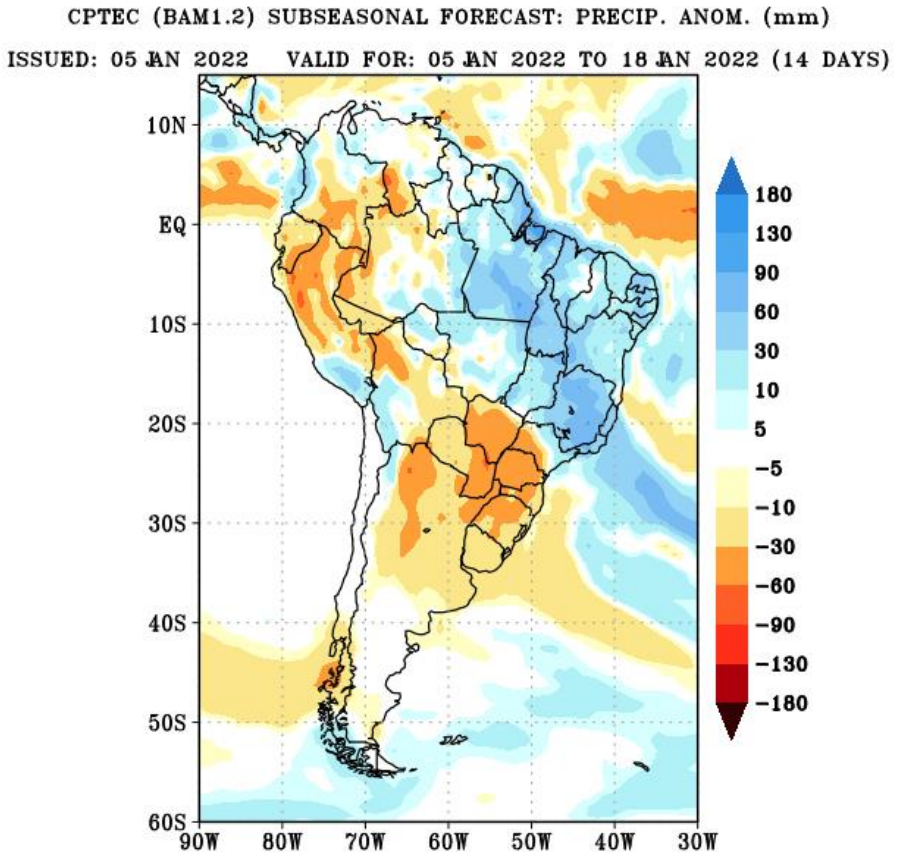


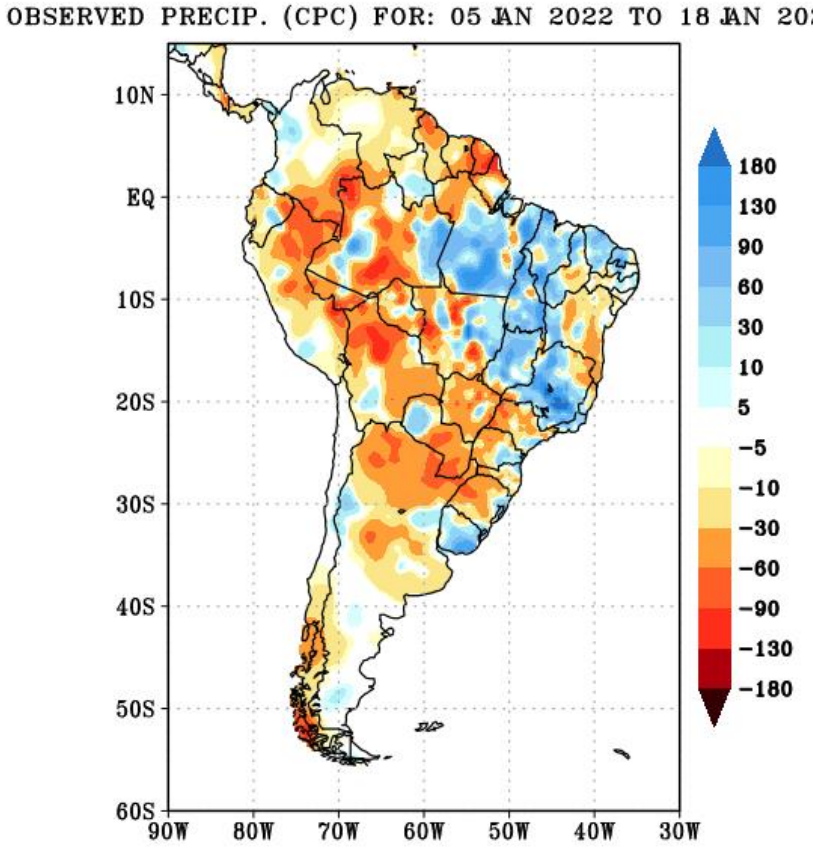


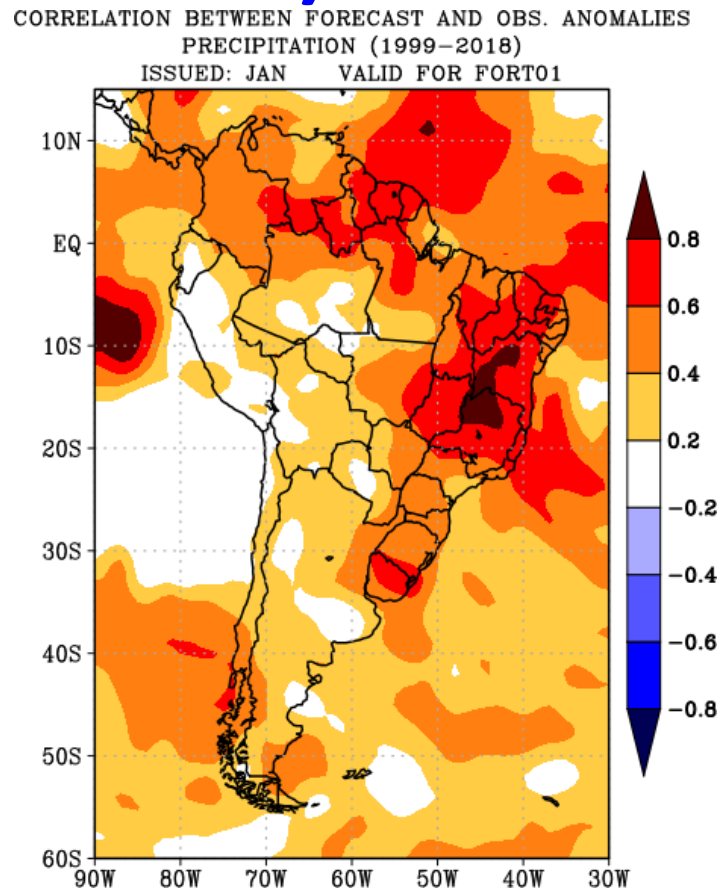


Reasonable performance in representing the observed South Atlantic Convergence Zone (SACZ) event

Experimental INPE/CPTEC sub-seasonal precipitation prediction for 14 days accumulation (5-18 Jan 2022)

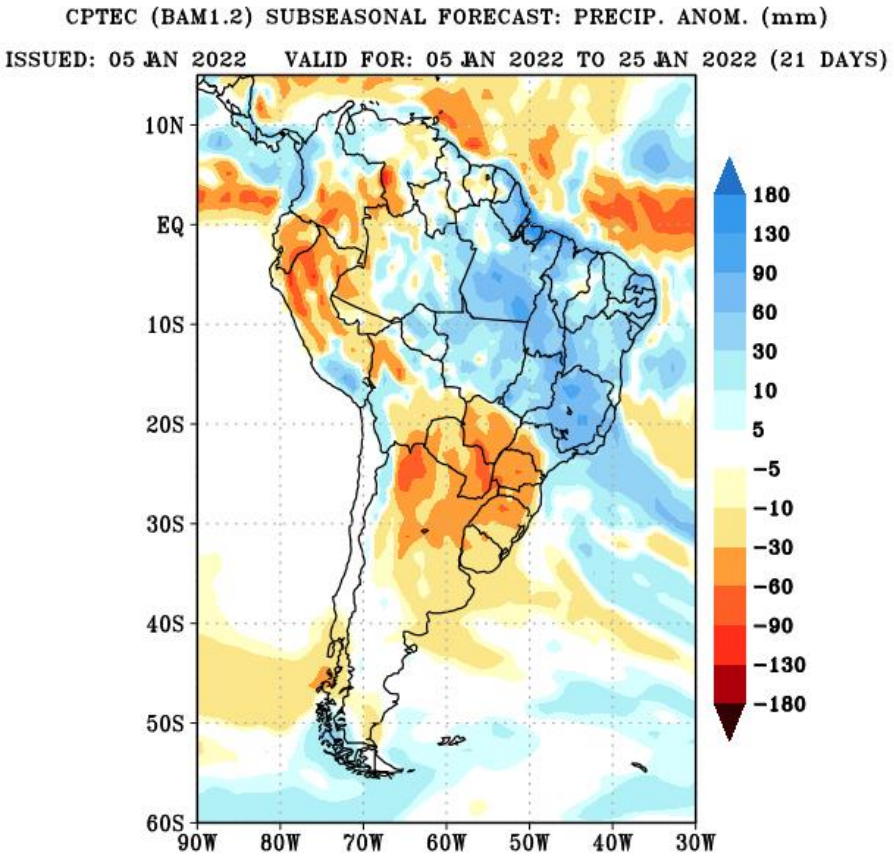


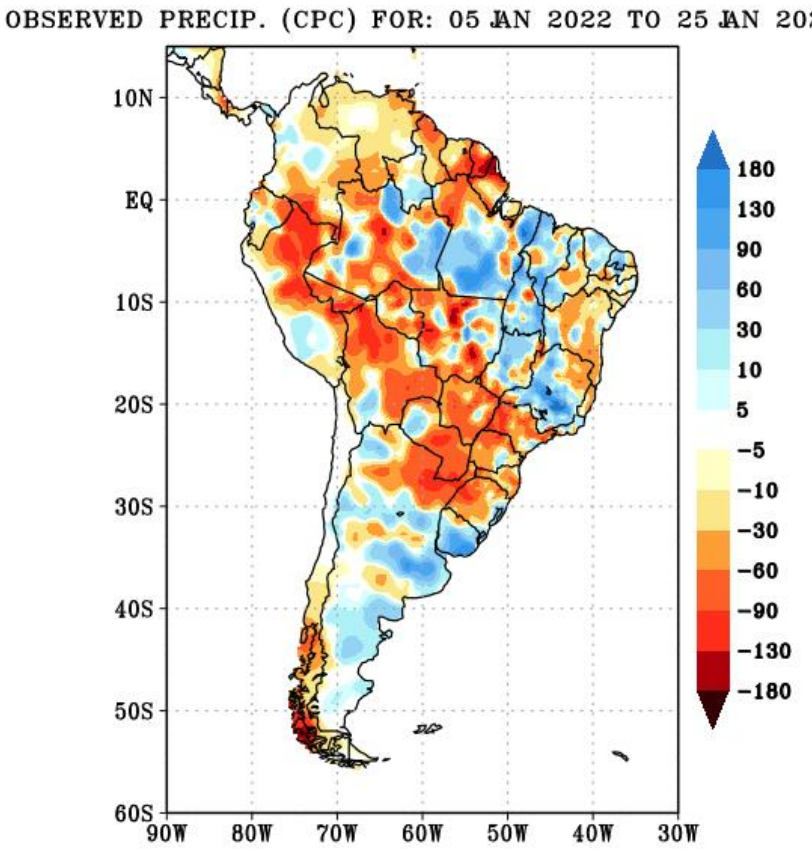


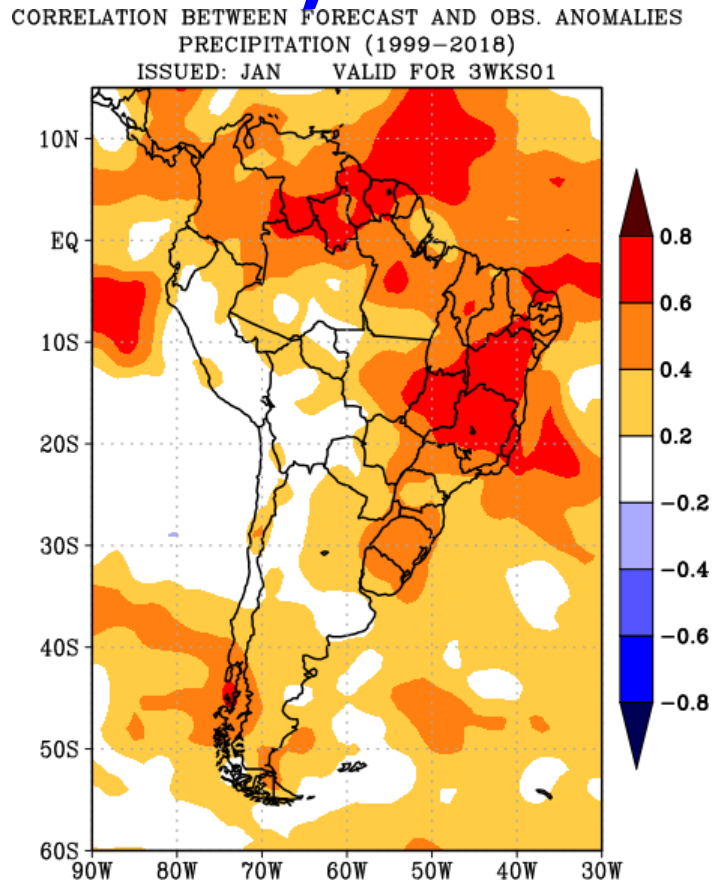


Reasonable performance in representing the observed SACZ and precipitation anomalies over northern NE and south Brazil

Experimental INPE/CPTEC sub-seasonal precipitation prediction for 21 days accumulation (5-25 Jan 2022)

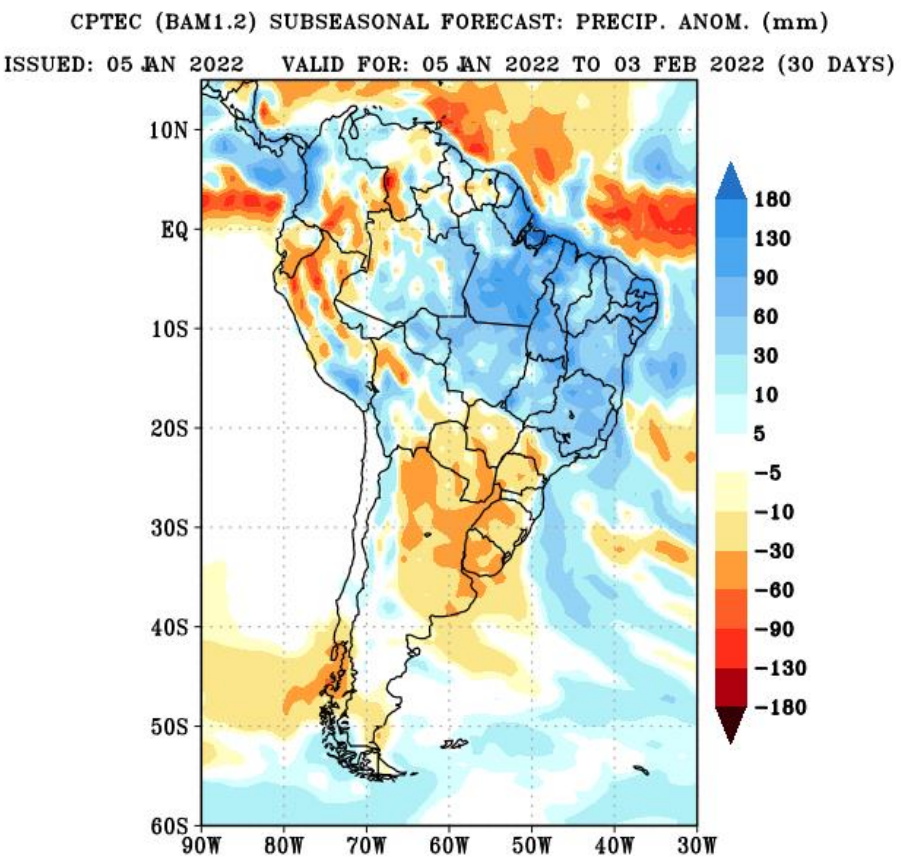


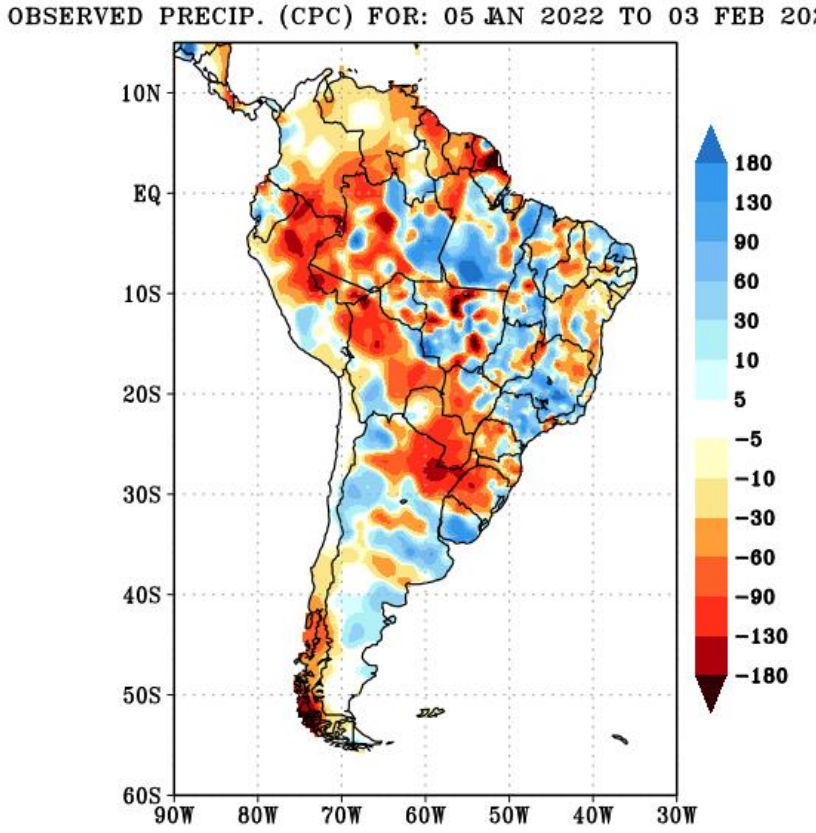


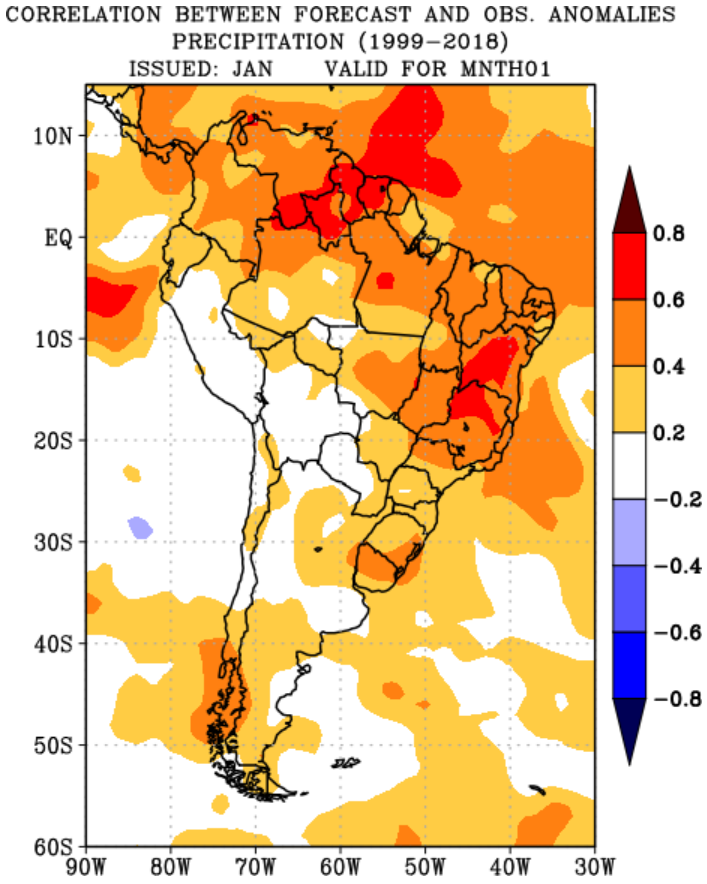


Reasonable performance in representing the observed SACZ and precipitation anomalies over northern NE and south Brazil

Experimental INPE/CPTEC sub-seasonal precipitation prediction for 30 days accumulation (5 Jan to 3 Feb 2022)







Reasonable performance in representing the observed SACZ and precipitation anomalies over northern NE and south Brazil

Final remarks

- Configured INPE/CPTEC model and assessed hindcast quality of INPE/CPTEC, JMA, ECCC, ECMWF and BoM models for austral summer sub-seasonal predictions aiming to perform an inter-comparison of CPTEC sub-seasonal predictions (weekly precip. and MJO) with consolidated S2S models.

- The weekly precip. anom. hindcasts assessment revealed that INPE/CPTEC model has performance comparable to the other investigated models for the four examined lead times

- In general, ECMWF showed the best performance for both deterministic and probabilistic predictions

- Results suggest that there is scope to improve INPE/CPTEC prediction system, likely by a combination of including coupling to an interactive ocean, improving resolution and model parameterization schemes, and better methods for ensemble generation

- Initial experimental sub-seasonal predictions produced with INPE/CPTEC showed encouraging results

Thank you for your attention

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