

# CPTEC operational seasonal forecast documentation: Forecast model and products description

## 1) *Forecast model*

Seasonal climate forecasts are operationally produced using the Center for Weather Forecast and Climate Studies (CPTEC) Brazilian Global Atmospheric Model version 1.2 (BAM-1.2) [Coelho et al. 2021] of the National Institute of Space Research (INPE) with persisted sea surface temperature (SST) anomalies (Reynolds et al., 2002). For example, for a forecast made in February 2021 and valid for the five month period from February to June 2021, the observed SST anomaly of January 2021 is added to the climatological (i.e. long term mean) SST of these five months during the integration of the model. The model resolution is TQ126L43, which represents triangular truncation of 126 waves in the horizontal coordinate (~100 km) and 42 levels in the vertical sigma coordinate (32 in the troposphere and 10 in the stratosphere). Initial conditions for these operational forecasts are obtained from ERA-5 reanalysis (Hersbach et al. 2018, 2019). A total of 15 initial conditions from the previous January in the example above, representing 15 different days of January 2021, are used for producing an ensemble of forecasts. Every month CPTEC produces global 1-month lead forecast maps of precipitation, temperature, 500 hPa geopotential height and sea level pressure for the following 3-month season.

## 2) *Forecast products*

The following forecast map products are available at CPTEC website:

- **Seasonal anomaly:** Mean forecast anomaly for precipitation, temperature, 500 hPa geopotential height and sea level pressure. It is an estimate of the central location of the forecast distribution.
- **Probability of most likely precipitation and temperature terciles** (drier or cooler than normal conditions, normal conditions, wetter or warmer than normal conditions).

## 3) *Verification products*

Forecast verification is performed using as observational reference dataset version 2.3 Global Precipitation Climatology Project (GPCP) analysis (Adler et al. 2018) and ERA-5 two meter temperature reanalysis (Hersbach et al. 2018, 2019). CPTEC predictions are verified using retrospective forecasts (hindcasts) over the 1981-2010 period.

The following verification products are available. All verification scores listed below are described in details in Jolliffe and Stephenson (2003).

### a) Verification maps:

- Correlation between forecast and observed anomaly
- Mean Squared Skill Score
- Mean Squared Skill Score (phase error)
- Mean Squared Skill Score (amplitude error)
- Mean Squared Skill Score (bias error)

- ROC Skill Score for the event positive or negative (precip. or temp.) anomaly
- ROC Skill Score for the event (precip. or temperature) in the lower tercile
- ROC Skill Score for the event (precip. or temperature) in the upper tercile
- ROC Skill Score for the event (precip. or temperature) in the lower quintile
- ROC Skill Score for the event (precip. or temperature) in the upper quintile
- Ranked Probability Skill Score for tercile categories
- Ranked Probability Skill Score quintile categories
- Gerrity Score tercile categories

b) Reliability diagrams and ROC plots for aggregated forecasts over the tropics for the events:

- Negative or positive (precipitation or temperature) anomaly
- Precipitation or temperature in the lower tercile
- Precipitation or temperature in the upper tercile
- Precipitation or temperature in the lower quintile
- Precipitation or temperature in the upper quintile

All skill score maps range from -1 to 1. Positive values are displayed in red, orange and yellow and indicate regions where the forecasts have moderate to good skill. Negative values are displayed in blue and indicate regions where the forecasts have poor skill.

## References

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