EUROBRISA products documentation

This page (http://eurobrisa.cptec.inpe.br/) presents 1-month lead South America precipitation forecasts and verification products for three month seasons. For example, a forecast issued in March 2022 is valid for the following April-May-June (AMJ) season.

Forecast and verification products are available for:

a) three dynamical coupled ocean-atmosphere models

- The ECMWF seasonal forecasting system, known as System 5 (Johnson et al. 2019);
- The UK Met Office (UKMO) seasonal forecasting system known as GloSea 6, which uses a new approach for land surface initialization, and is an improved version of the previous system (MacLachlan et al. 2015);
- The Meteo-France seasonal forecasting system 8, which is an improved version of the previous system (Batte and Deque 2011)

The forecast output from ECMWF, UK Met Office and Meteo-France models is coordinated at ECMWF as part of the European Seasonal to Inter-annual Prediction project (EUROSIP)/Copernicus Climate Change Service (C3S).

b) an empirical model (Coelho et al. 2006) that uses Pacific and Atlantic sea surface temperatures as predictor variables for precipitation over South America. For example, the observed sea surface temperature in the previous February is used as predictor for precipitation in the following AMJ. This model is based on maximum convariance analysis (MCA), also known as singular value decomposition (SVD), of the cross-covariance matrix between sea surface temperature and precipitation. Three leading modes of this cross-covariance matrix are used to produce empirical forecasts. Retrospective empirical forecasts for the period 1982-2015 are produced in cross-validation (leave-one-out) mode (Wilks 1995).

c) the so called integrated forecast (Coelho et al. 2006) that combines and calibrates coupled and empirical model predictions using a Bayesian approach, known as forecast assimilation (Stephenson et al. 2005). Integrated forecasts gather all available information (i.e. dynamical and empirical forecasts) at the time the forecast is issued. Integrated forecasts are hybrid (empirical-dynamical) products that combine and calibrate ECMWF System 5, UK Met Office GloSea 6, Meteo-France System 8 and empirical model predictions (i.e. three coupled models and one empirical model). Three leading modes of the cross covariance matrix between past forecasts and past observation are used in the calibration procedure to produce integrated forecasts. Retrospective integrated forecasts for the period 1981-2015 are produced in cross-validation (leave-one-out) mode (Wilks 1995).

1) Forecast products

The following forecast map products are available:

- Mean: Mean forecast anomaly. It is an estimate of the central location of the forecast distribution. Positive anomalies are displayed in blue and negative anomalies are displayed in red, orange and yellow.
- Probability of most likely tercile: Probability forecast of most likely tercile. Lower, central and upper tercile categories are defined using the climatological precipitation distribution. This map shows the probability for the tercile that presents the highest forecast probability value. Blue

colours indicate that the upper tercile (wetter than normal conditions) is forecast with highest probability value. Red, orange and yellow colours indicate that the lower tercile (drier than normal conditions) is forecast with highest probability value. White is used to indicate that the central tercile (normal conditions) is forecast with highest probability value.

● Categorical: Categorical forecast. Denoting B, N and A as the forecast probability values for the lower, central and upper tercile categories, respectively, five forecast categories are displayed as follows.

Dry: displayed in red when A<33.3%, N<33.3% and B>40%, indicating enhanced probability of the lower tercile category (drier than normal conditions)

Dry or average: displayed in orange when B>40% and N>33.3%, or B>33.3% and N>40%, indicating enhanced probability of the lower or central tercile categories (drier than normal or normal conditions)

Average: displayed in white when A<33.3%, N>40% and B<33.3%, indicating enhanced probability of the central tercile category (normal conditions)

Wet or average: displayed in light blue when A>40% and N>33.3%, or A>33.3% and N>40%, indicating enhanced probability of the upper or central tercile categories (wetter than normal or normal conditions)

Wet: displayed in dark blue when A>40%, N<33.3% and B<33.3%, indicating enhanced probability of the upper tercile category (wetter than normal conditions)

● Probability of above average: Probability forecast of above average conditions (i.e. probability of positive precipitation anomaly). Forecast values above 60% are displayed in blue and indicate enhanced probability of wetter than normal conditions. Forecast values below 40% are displayed in orange and yellow and indicate reduced probability of wetter than normal conditions (i. e. enhanced probability of drier than normal conditions). Forecast values between 40% and 60% are displayed in white and indicate a balanced forecast with nearly equal likelihood for above and below average conditions.

● Probability of lower tercile: Probability forecast of precipitation in the lower tercile (drier than normal conditions). Forecast values above 40% are displayed in red, orange and yellow, indicating enhanced probability of drier than normal conditions. Forecast values below 20% are displayed in blue, indicating reduced probability of drier than normal conditions (i. e. enhanced probability of wetter than normal conditions). Forecast values between 20% and 40% are displayed in white, indicating near to climatological probability of drier than normal conditions.

● Probability of upper tercile: Probability forecast of precipitation in the upper tercile (wetter than normal conditions). Forecast values above 40% are displayed in red, orange and yellow, indicating enhanced probability of wetter than normal conditions. Forecast values below 20% are displayed in blue, indicating reduced probability of wetter than normal conditions (i. e. enhanced probability of drier than normal conditions). Forecast values between 20% and 40% are displayed in white, indicating near to climatological probability of wetter than normal conditions.

● Probability of lower quintile: Probability forecast of precipitation in the lower quintile (much drier than normal conditions). Forecast values above 25% are displayed in red, orange and yellow, indicating enhanced probability of much drier than normal conditions (well below normal). Forecast values below 5% are displayed in blue, indicating reduced probability of much drier than normal conditions (i. e. enhanced probability of much wetter than normal conditions). Forecast values between 5% and 25% are displayed in white, indicating near to climatological probability of much drier than normal conditions.

● Probability of upper quintile: Probability forecast of precipitation in the upper quintile (much wetter than normal conditions). Forecast values above 25% are displayed in red, orange and yellow, indicating enhanced probability of much weter than normal conditions (well above normal). Forecast values below 5% are displayed in blue, indicating reduced probability of much wetter than normal conditions (i. e. enhanced probability of much drier than normal conditions). Forecast values between 5% and 25% are displayed in white, indicating near to climatological probability of much wetter than normal conditions.

2) Verification products

Forecast verification is performed using as observational reference dataset version 2.3 Global Precipitation Climatology Project (GPCP) analysis (Adler et al. 2003). ECMWF System 5 is verified using retrospective forecasts (hindcasts) over the 1981-2015 period. UK Met Office GloSea 6 and Meteo-France System 8 are verified using retrospective forecasts over the 1993-2015 period. Empirical predictions are verified using retrospective forecasts over the 1982-2015 period. Integrated forecasts are verified using retrospective forecasts over the 1981-2015 period

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

a) Verification maps:

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.

● Correlation: Correlation between the forecast and observed anomaly

● Brier skill score with respect to climatology for the following event:

negative or positive precipitation anomaly;
precipitation in the lower tercile;
precipitation in the upper tercile;
precipitation in the lower quintile;
precipitation in the upper quintile.

● Ranked probability skill score with respect to climatology for:

tercile categories;
quintile categories.

● Gerrity Score for tercile categories

● ROC Skill Score for the following events:
 negative or positive precipitation anomaly;
 precipitation in the lower tercile;
 precipitation in the upper tercile;
 precipitation in the lower quintile;
 precipitation in the upper quintile.

b) Reliability diagrams and ROC plots for aggregated forecasts over South America for the following events:
 negative or positive precipitation anomaly;
 precipitation in the lower tercile;
 precipitation in the upper tercile;
 precipitation in the lower quintile;
 precipitation in the upper quintile.

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