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Long-term forecast of temperature and precipitation anomalies for fire danger assessment

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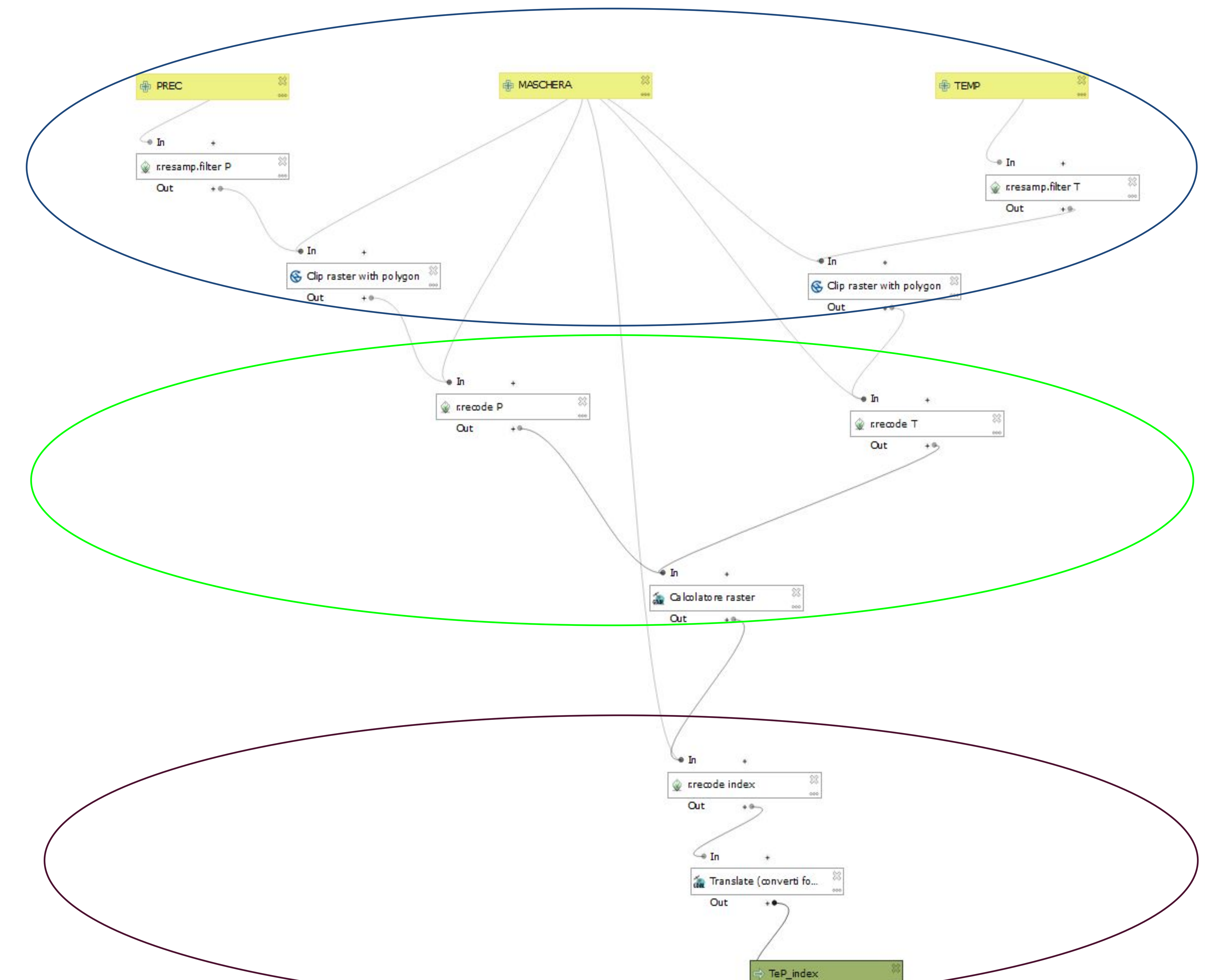
Seasonal fire forecasts are a challenge made possible in recent years thanks to availability of better time series of climatic data and wider statistical databases on fires. In addition, the long-term fire risk estimate is considered an element crucial for the preparation of prevention activities (Mavsar et al., 2013). Many of the studies related to seasonal fire forecasts follow an approach empirical based on statistical correlations between fires and climatic variables antecedents. All relevant changes in local and / or weather conditions changes in the local socio-environmental context can influence the regimes of the climate-related fires. Recent advances in seasonal climate forecasting systems based on the analysis of ocean-atmosphere-earth processes make it possible to use prediction models for fire hazard prediction. Such models based on physical processes use models global climate together with human factors to predict the fire hazard on a scale monthly or seasonal (Roads et al. 2005, 2010; Spessa et al. 2015; Field et al. 2015).

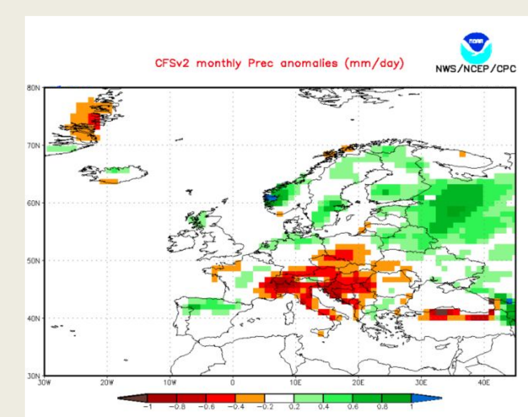


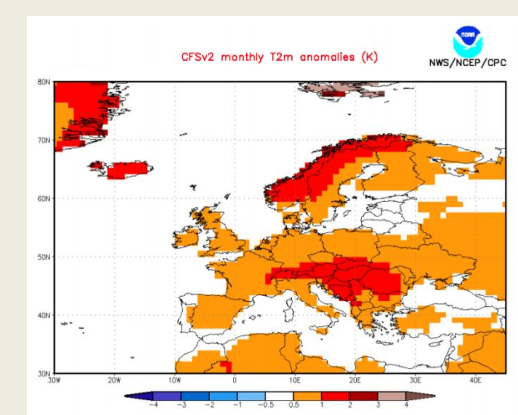
GRAPHICAL MODELER - QGIS

The data processing has been implemented in a model within the QGIS software (www.qgis.org). The aim is to make the spatial analyzes useful for defining an index based on the expected anomalies of Temperature and Precipitation. The study area is the Puglia Region (south of Italy). The data are useful for the Civil Protection of the Region that deals with fire risk. Each processing is relative to the predictions of a decade. Idates discharged at the beginning of the process are related to forecasts of anomalies divided into decades (three per month) for the next 6 months. Therefore, before accessing the model, the forecast data (T and P - Seasonal climate forecast) are downloaded from CFSv2 (https://www.cpc.ncep.noaa.gov/products/people/wwang/cfsv2fcst/). Raster data is reprojected from geographic coordinates in UTM.

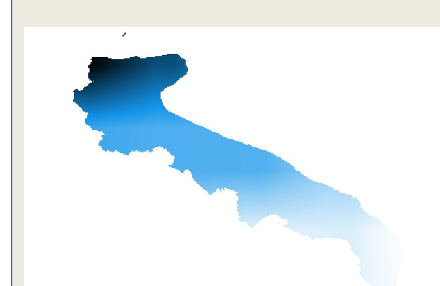
- *Resampling and smoothing for temperature and precipitation anomalies by r.resamp.filter*
- *Clip on the regional extension*

Example of NCEP-CFS maps. Precipitation and Temperature anomalies in Europe





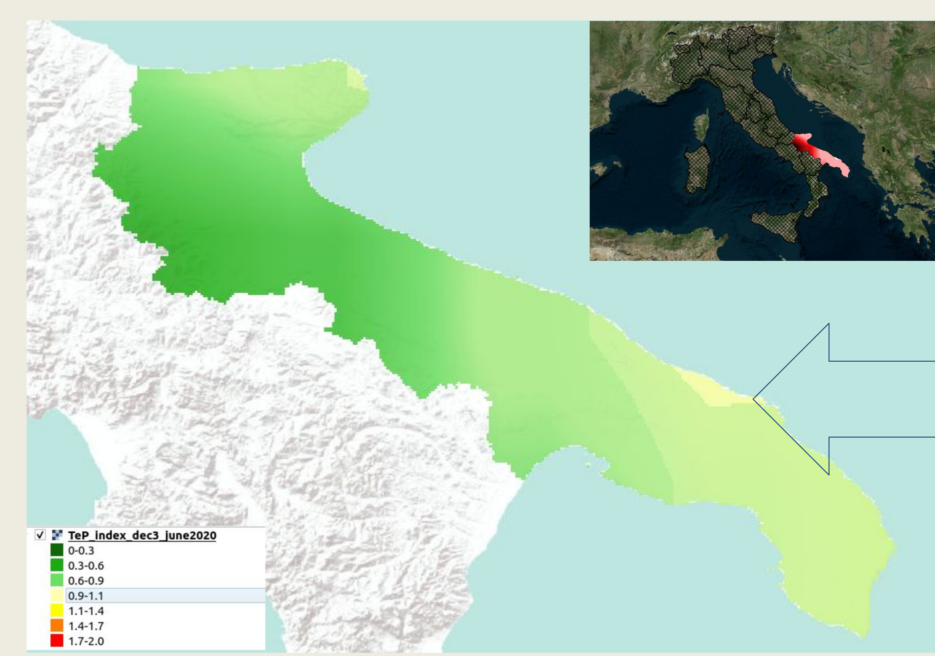
- *Recode Temperature and Precipitatione. the values are rescaled in the interval (-1; 1) taking as reference the minimum and maximum values of the whole available data series*
- *First output raster → (recode_P*0.7)+(rec_T*0.3)0*



seasonal precipitation anomalies - ***third decade of the month of June 2020***

seasonal temperature anomalies - ***third decade of the month of June 2020***

In the map, the cells with a lighter color (on yellow) identify the areas that in the indicated period have a greater probability of occurrence of fires (relative to the two meteorological factors).



- *Synthetic index (output raster) with rescale from 0-2. (in the left image, an example of T and P index. The image refers to the third decade of the month of June 2020)*

Seasonal fire hazard predictions in the USA (Roads et al., 2010) are recorded on the NCEP-CFS (National Center for Environmental Prediction's Coupled Forecasting System) (Saha et al., 2006, 2014). The NCEP-CFS system generates forecasts for ensembles of global and regional spectral models over a period of 3 to 7 months.

The forecasts generated by the NCEP-CFS system were used to derive precipitation and temperature anomaly maps. Forecasts are made starting from the initial conditions of the last 30 days, with four runs per day. The Forecast ensembles are made up of 40 members from an initial period of 10 days. To provide high resolution seasonal forecasts has been developed and a generalized empirical statistical downscaling system is applied. On this basis precipitation and temperature anomaly maps were extrapolated. The values of the precipitation and temperature anomalies in the various decades have been integrated in order to develop a meteorological index capable of highlighting the areas where these anomalies affect the increase or decrease in the fire hazard in relation to the average conditions for each specific decade. The index is built in a way such as to attribute a greater weight to the precipitation anomalies (70%) than the temperature anomalies (30%).

- http://www.imaa.cnr.it/
- http://www2.unibas.it/lisut/
- https://protezionecivile.puglia.it/