Added value of Statistical Downscaling for seasonal forecasting in Argentina

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INTRODUCTION

Global Climate Models (GCMs) are the primary tools used to generate weather and climate predictions at different forecast horizons, from intra-seasonal to centennial scales. However, it is well recognized that these models are unable to provide information at the spatial scale required by many stakeholders. Hence, downscaling methods are necessary for adapting the global model predictions to smaller spatial scales, providing suitable products for a range of applications. In particular, for applications in the field of seasonal prediction in Argentina these techniques have been little explored. In this context **the objective of this work was to explore the added value of multiple linear regression as a statistical downscaling (ESD) tool for seasonal forecast of daily maximum and minimum temperatures.**

DATA

PREDICTANDS:

DAILY MAXIMUM (Tx) AND MINIMUM (Tn) TEMPERATURES of three meteorological stations located in the central region of Argentina (Mendoza Observatory (MO), Santa Rosa Aero (SR) and Central Observatory of Buenos Aires(OCBA))

PREDICTORS:

DAILY NCEP R1 FIELDS IN THE DOMAIN INDICATED BY THE BLUE BOX

- Geopotential height at 500 hPa
- Air temperature and specific humidity at 850 hPa
- Pressure at sea level

CALIBRATION PERIOD: 1978-2000 VALIDATION PERIOD : 2001-2015

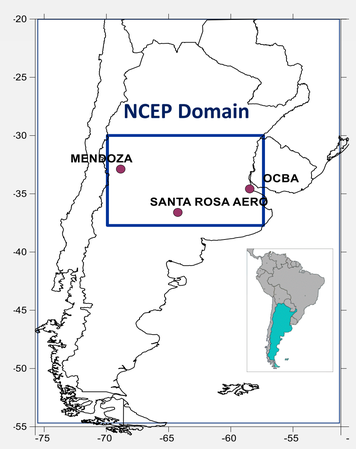
APPLICATION:

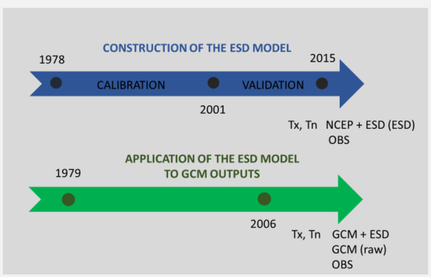
DAILY OUTPUTS OF SEASONAL HINDCAST FROM THE GCMs (WCRP CHFP-SHFP) of the large-scale variables already mentioned :

JMAMRI MIROC 5 CanCM3 CanCM4

Initialized forecasts: Nov 1st Ensamble Members: 9-11

MAXIMUM COMMON PERIOD BETWEEN MODELS: 1979-2006





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METHODOLOGY

EMPIRICAL STATISTICAL DOWNSCALING :

ESD Approach: Perfect Prognosis

Statistical Method: Stepwise Multiple Regression

- The technique of Principal Component Analysis in S mode was applied to reduce the dimension of the set of predictor variables (99% of the variance)
- For each variable Tx and Tn in each meteorological station, the linear regression model was calibrated based on the Stepwise method for the calibration period
- The Cross-Validation technique was used to evaluate the stability of the model

NCEP + ESD

- The model was validated in a independent period

After the construction of the ESD model, it was applied to the daily outputs of the GCM

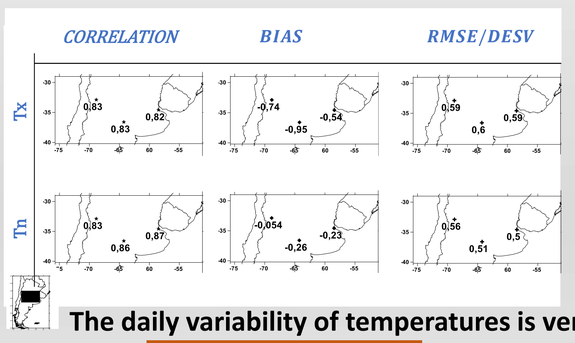
The application was made for each member of the ensemble of each GCM, for each variable Tx and Tn, in the three stations. Also was made for the multimodel ensemble (MM)

GCM + ESD

RESULTS

VALIDATION

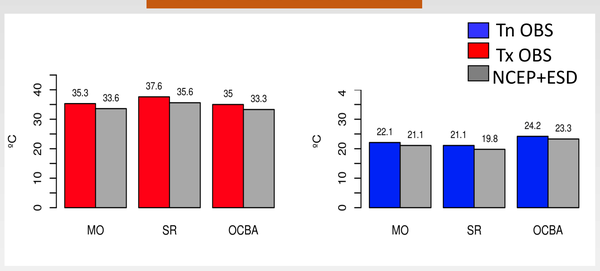
ACCURACY



The correlations between the series of observed and modeled daily values are 0.8 or higher for Tx and Tn in all station indicating a good correspondence in the daily variability of temperatures.
In both variables, the statistical model slightly underestimates the mean values
RMSE represent about half the variability of the variable

The daily variability of temperatures is very well represented by statistical models

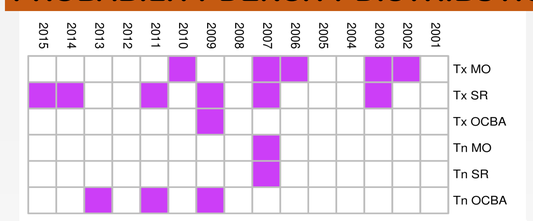
95th PERCENTILE



Percentiles 95 per day for Tx and Tn estimated by NCEP + ESD and observed

The ESD model underestimates the 95th percentile (Tx and Tn)
The greatest differences are observed in the SR station
In the Tn of OCBA and MO, the ESD model simulates the 95th percentile very well

PROBABILITY DENSITY DISTRIBUTION

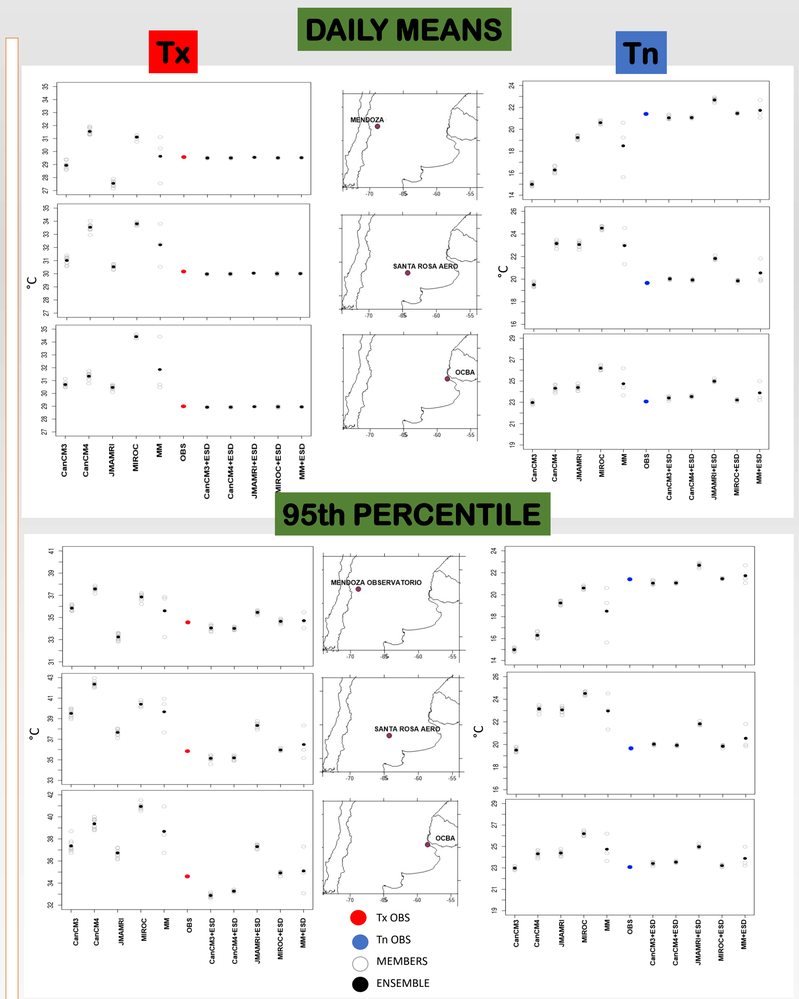


Summers in which the null hypothesis of no difference between pdf in the K-S test is rejected

Evaluation of probability density distributions: Test of Kolmogorov-Smirnov (K-S) to two samples (5% significance)
Considering the entire validation period (2001-2015), the null hypothesis is rejected in all cases. However, if each summer is analyzed separately, in some cases only a few specific summers are rejected

DAILY VALUES

DAILY MEANS



The daily average value was calculated, considering all the summers together in the common period of the GCM:
A clear improvement is observed on the GCM + ESD application over the raw outputs in the representation of the observed average value in both predictands

The results obtained from GCM + ESD are very similar in all stations, especially for Tx

95th PERCENTILE

The 95th Percentile was calculated, considering all the summers together in the common period of the GCM:

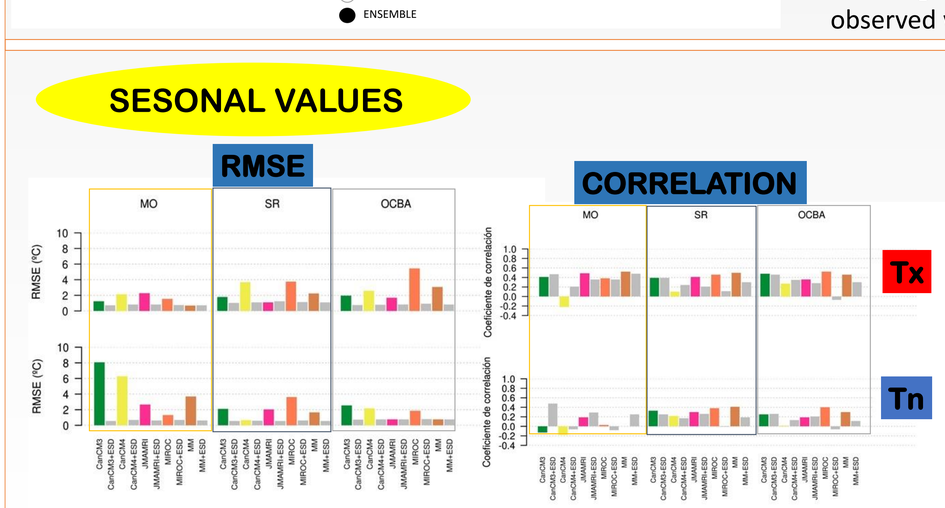
The results obtained show the difficulties in representing the 95th percentile by the GCM and even by the MM, in all cases.

The contribution of GCM + ESD can be observed in all stations, reducing the difference with the observed value.

SESONAL VALUES

RMSE

CORRELATION

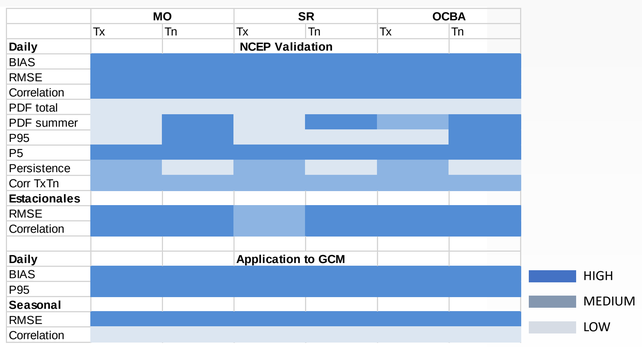


The application MCG + ESD reduces the error of the raw outputs of the GCMs in the three stations, with some particular exceptions.

In general, there is no significant increase in the correlation coefficient based on the application GCM + ESD

SUMMARY

Qualitative summary of the performance of the ESD model



Different statistical aspects of the predictand variables were evaluated (not all shown in this poster)

It was found that the ESD model adds value to the GCMs simulations showing the suitability of statistical downscaling techniques for seasonal forecasting in Argentina

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