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DOWNSCALING OF CLIMATIC VARIABLES FROM REANALYSIS NCEP/NCAR IN THE SOUTHWEST OF BUENOS AIRES PROVINCE (ARGENTINA)

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1. INTRODUCTION

Scientists, stakeholders or decision-makers need a long period of meteorological data (more than 30 years) in order to analyze regional climates. There are many regions around the world lacking this information. One alternative to solve this problem is the Reanalysis (NCEP/NCAR), a numerical model that allows obtaining weather data or weather forecast information of diverse climate elements. Through it, it is possible to describe the monthly and seasonal variations of the climate. Climatic data validation with this model for the whole planet was achieved by KALNAY *et al*. (1996) and KLISTER *et al*. (2001). Reanalysis validation data presents some anomalies in small areas.

The study area is the southwest of Buenos Aires province (Argentina). This region is an important economic area of Argentina due to its agricultural livestock production and tourism activities. Nevertheless, this is a vulnerable environment because of the soil erosion, droughts and floods processes. Some authors have studied the weather of this region. Although it has been difficult to analyze its climate variability due to the lack of weather stations that cover the whole area. For this reason, the aim of this study was to propose an easy way to use the Reanalysis data, applying statistical downscaling, and to estimate air temperature, relative humidity and precipitation in the study area.

2. METHODOLOGY

Reanalysis (NCEP/NCAR) and *in situ* data were compared to analyze the accuracy of the Reanalysis data in different time-scales: decadal and climatic (30 years). The seasonal analysis was done considering: Summer (December, January and February), Autumn (March, April and May), Winter (June, July and August) and Spring (September, October and November).

Air temperature, relative humidity and precipitation parameters were selected because they are the meteorological variables most widely used in climate analysis. Meteorological data from 9 weather stations provided by Servicio Meteorológico Nacional (National Weather Service, SMN, Argentina) and Reanalysis data from the period 1981-2010 were processed. Weather stations were chosen considering their proximity to the Reanalysis grid.

Standard statistical techniques were applied with a confidence interval of 95 %. Different indexes were also calculated: Concordance (C), R^2, Pearson (P) and Spearman (S) in order to characterize the adjustment between both sources of information. In this way, formulas (or statistical models) were addressed to estimate the climate variables from the Reanalysis in the study area. Lineal regression was applied with air temperature and relative humidity data while polynomial one with precipitation data.

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3. RESULTS

In the decadal analysis, the best fits were observed in temperature. The correlation indexes, R^2 and Concordance, showed a good correlation between *in situ* and Reanalysis temperature. This meteorological parameter shows the highest R^2 in spring and autumn and the lowest one in winter and summer. The latter two seasons presented the lowest Pearson, Concordance and Spearman values. The winter period of 2001-2010 registered the minimum correlation (Pearson: 0.74 and Spearman: 0.71), the lowest Concordance (0.26) and R^2 (0.58) for the whole studied series.

The relative humidity data presented the best fits in summer. The Concordance was 0.7 and the R^2 ranged from 0.79 (2001-2010 summers) to 0.83 (1981-1990 summers). The precipitation registered the lowest adjustment between both sources of information. The highest R^2 was 0.65 for the 1981-1990 springs. The Concordance was low because the correlation was not linear so, polynomial distribution was applied. The other coefficients maintained the same tendencies. In general, the best adjustments were observed in spring and the lowest one in the summer.

The climate analysis (30 years) permitted to estimate the mean monthly air temperature, relative humidity and precipitation for the Southwest of Buenos Aires province (Argentina), with the following formulas (or statistical models):

$$Te = 1.0174\ Tm - 1.6098 \quad [1]$$

$$RHe = 0.7823\ RH_m + 21.33 \quad [2]$$

$$Ppe = 0.2546Ppm^2 - 2.8626Ppm + 27.441 \quad [3]$$

where T_e is the estimated monthly air temperature and T_m is the average (1981-2010) monthly air temperature from the Reanalysis data, *RHe* is the estimated monthly relative humidity of air, RH_m is the average (1981-2010) of relative humidity from the Reanalysis data, *Ppe* is the estimated monthly precipitation and *Ppm* is the variable that results from the average (1981-2010) of the Reanalysis data.

Significant differences were observed when comparing relative humidity from the three data sources. Results from formula 2 presented a good correlation with *in situ* data. In general, data from the Reanalysis was similar to *in situ* records but with lower values. These differences are generated because *in situ* data represent a fixed station whereas the results from the Reanalysis are generated for areas (2.5 º of latitude and longitude, respectively). The spatial distribution of the relative humidity showed a good correlation at the South and East of the study area. When the proposed estimation formula was applied, the highest values were observed in the East and they decreased to the West. The same results were obtained for precipitation. The estimated precipitation at the South of the study region was higher than *in situ* data.

Reanalysis and *in situ* data presented a good correlation allowing the generation of formulas for the estimation of meteorological parameters with minimum error. Some seasonal differences were observed. Reanalysis data fit properly with *in situ* data in autumn and spring. In summer and winter, the air temperature showed lower values of R^2, Pearson, Spearman and Concordance indexes. The R^2 of the relative humidity ranged from 0.75 in summer to 0.56 in winter. Furthermore, the Pearson and Spearman were always higher than 0.75 and the Concordance higher than 0.44. While precipitation presented Pearson and Spearman indexes ranged from 0.66 to 0.83, respectively. The Concordance was lower than 0.6.

4. CONCLUSION

In conclusion, meteorological data is necessary to carry out environmental studies such as water management projects, urban developments, etc. In some regions meteorological time series are short or have not data. Therefore, stakeholders may obtain information from numerical models, despite of the fact that they might not represent accurately *in situ* data. Therefore, the development of formulas to estimate *in situ* data would be a useful methodology for region lacking meteorological stations.

From the decadal and seasonal analyzes a reduction in the temporal scale increases the errors. Meteorological seasonal study cannot be performed only with the data from the

Reanalysis because they evidence spatial errors but good fits. Reanalysis data had an extensive spatial and temporal coverage that allows studying the climate variability in areas with shortage or lack of *in situ* data. In this study, the Reanalysis data was used for estimating formulas for the southwest of Buenos Aires province (Argentina). By applying formulas [1, 2 and 3] the estimation of these parameters was performed accurately and with good adjustments. From the seasonal analysis the best correlations were observed in spring and autumn and some differences were found in winter and summer. Finally, it is worth to note that due to the good correlation that exists between the Reanalysis and *in situ* data, this methodology can be applied in other regions. .

5. REFERENCES

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