Boroneant, C., Potop, V., Caian M.,: Validation of RegCM precipitation simulation over Republic of Moldova. Application for Standard Precipitation Indices calculated for the period 1960-1997.Šiška, B. – Hauptvogl, M. – Eliašová, M. (eds.). Bioclimate: Source and Limit of Social Development, International Scientific Conference, 6th – 9th September 2011, Topoľčianky, Slovakia

VALIDATION OF REGCM PRECIPITATION SIMULATION OVER REPUBLIC OF MOLDOVA. APPLICATION FOR STANDARD PRECIPITATION INDICES CALCULATED FOR THE PERIOD 1960-1997

Constanta Boroneant[1], Vera Potop[2], Mihaela Caian[3]

[1]Center for Climate Change, Geography Department, University Rovira I Virgili, Tortosa, Spain, constanta.boroneant@urv.cat,
[2]Czech University of Life Sciences Prague, Department of Agroecology and Biometeorology, Prague, Czech Republic, potop@af.czu.cz,
[3]Rossby Centre, SMHI, Norrköping, Sweden, mihaela.caian@gmail.com

Abstract. We validate the ability of the regional climatic model RegCM to simulate seasonal precipitation over the Republic of Moldova. The RegCM simulations were conducted at a horizontal resolution of 10 km in the framework of EU-FP6 project – CECILIA. The domain was centered over Romania at 46ºN, 25ºE and included the Republic of Moldova. The model simulations forced by ERA40 were compared with the observations from CRU TS2.1 dataset and station observations. The validation period is 1960-1997. First, we compare the annual cycle of precipitation based on RegCM simulations with the corresponding values calculated from CRU TS2.1 land observation data set and from observations at 15 representative stations from Republic of Moldova. Then, the maps of mean seasonal precipitation for simulation and CRU data are compared. Both the simulated and CRU data are downscaled at station locations and compared with station data in terms of means and standard deviation of seasonal precipitation totals. The Standard Precipitation Indices (SPI) for 3, 6 and 12 months for each grid point of Moldova domain both for the RegCM simulation and CRU data were calculated, spatially averaged and compared. The results will present the RegCM performance in simulating precipitation and their influence on the SPI values which are exclusively based on precipitation.

Introduction

Large areas of Europe have been affected by drought during the 20th century. Severe and prolonged droughts observed in many countries but mostly in the southern and south-eastern Europe have highlighted the region´s vulnerability to this natural hazard and alerted the public, governments, and operational agencies to the many socio-economic problems accompanying water shortage and to the need for drought mitigation measures. In this context, Republic of Moldova is likely to experience a diverse range of impacts in response to climate change, with temperature increases accompanied by extreme precipitation (dry and wet events). Changes in the distribution of climate extremes including the daily precipitation totals and the persistence of dry days may lead to an increased frequency of droughts in some areas and increased precipitation in others (Potop, 2011). In the framework of the EU-project CECILIA (Central and Eastern Europe Climate Change Impact and VulnerabiLIty Assessment) RegCM simulations at 10 km for climate change impacts and vulnerability assessment in targeted areas of Central and Eastern Europe have been conducted. In this paper we validate the ability of the regional climatic model RegCM to simulate seasonal precipitation over the Republic of Moldova. The model simulations forced by ERA40 were compared with the observations from CRU TS2.1 dataset and station observations. The Standardized Precipitation Index (SPI), originally developed by McKee et al. (1993) was selected to assess the drought characteristics in the Republic of Moldova based on regional climate model (RegCM) simulations. The validation and analyisis period is 1960-1997.

Data and methods

We used monthly precipitation totals simulated with the Beta version of the regional climatic model ICTP_RegCM3 at a horizontal resolution of 10 km. The RegCM simulations conducted in CECILIA-FP6 Project (Halenka, 2010; Boroneanţ et al., 2011) covered a domain centered over Romania (46ºN, 25ºE) including Republic of Moldova (45.01ºN-49.01ºN; 26.52ºE-30.48ºE) (Fig. 1). The simulations were driven by ERA40 double nested from 25 km RegCM run for the period 1960-1997.

The CRU TS2.10 land observation data set (http://www.cru.uea.ac.uk/cru/data/hrg/cru_ts_2.10) has been used to validate both the RegCM temperature and precipitation simulations. The horizontal resolution of CRU TS2.10 data set is 0.5ºlat x 0.5ºlon.

The monthly temperature and precipitation simulations have been also validated against observations recorded at 15 meteorological stations of Moldova's State Hydrometeorological Service (SHS).

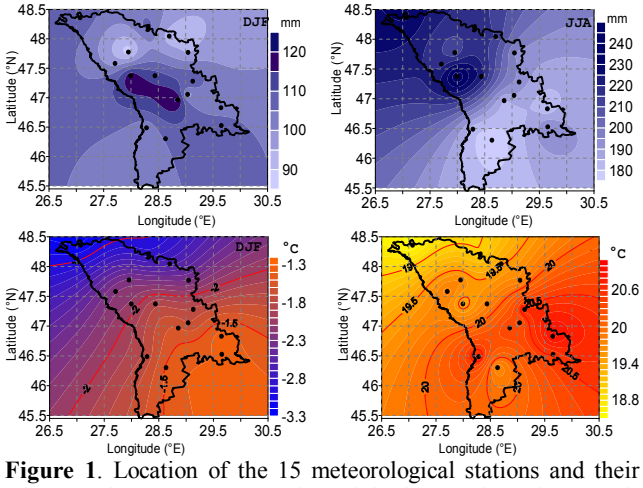

Figure 1. Location of the 15 meteorological stations and their winter and summer means of precipitation totals and mean air temperature for the RegCM-Moldova domain (26.5°-30.5° E; 45°-49°N)

SPI is a simple index (McKee et al. 1993) intensively used to quantify precipitation deficits on multiple time scales. It is calculated from the long term record of precipitation in each location. It is simply the transformation of the precipitation time series into a standardized normal distribution. The SPI is computed by fitting a probability density function to the frequency distribution of precipitation summed over the time scale of interest. This is performed separately for each month and for each location in space. Each probability density function is then transformed into a standardized normal distribution and the anomaly strength is classified into 7 categories.

Results and disscussion

The model validation has been achieved at station level for the period 1960-1997. In this respect, the gridded data of temperature and precipitation totals (RegCM simulations forced by ERA40 data and CRU observation data) have been downscaled to station coordinates. For these series, monthly and seasonal means and standard deviations were calculated for the validation period. Fig. 2 presents the winter and summer means of precipitation totals and mean air temperature calculated at the nearest station coordinates for RegCM. The model overestimates the winter precipitation at all stations and only small differences are observed during summer.

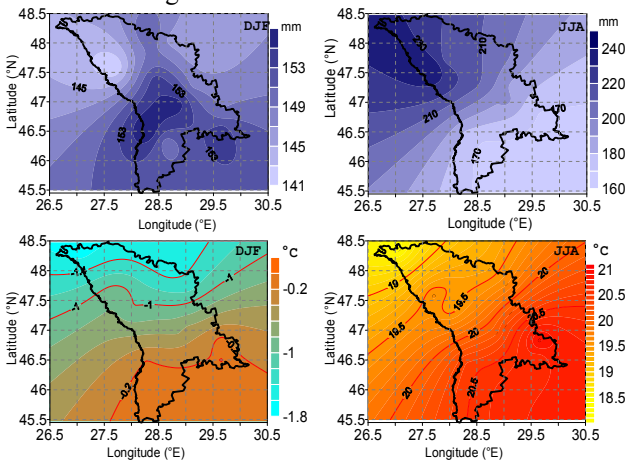

Figure 2. Winter and summer means of precipitation totals and mean air temperature at RegCM nearest grid point to station coordinates

Then, these series of monthly means of RegCM simulations, CRU observations in each grid point and station observations were spatially averaged and compared. The results are presented in Figure 3. The model does well representing the annual cycle of temperature but slightly overestimates the winter (DJF) temperatures and slightly underestimates autumn (SON) temperatures. Precipitation totals are systematically overestimated by the model compared to stations and CRU data (Figure 3). The largest magnitude of model precipitation errors are observed in late spring (AM) and summer months (JJA).

The SPI was calculated for each gridpoint of the model, CRU data and station level for comparison in terms of temporal evolution and frequency distribution. The normal conditions represent 67% out of the total values of SPI in all grid point of the domain by RegCM simulation. Whreas for observational dataset normal condition represent 76 %. Moderate drought and moderate wet by RegCM simulation are almost equally distributed around 9% while severe drought and severe wet are equally distribute around 5%. Slightly increase in extremely dry conditions (5%) compared to extremely wet conditions (3%) is observed.

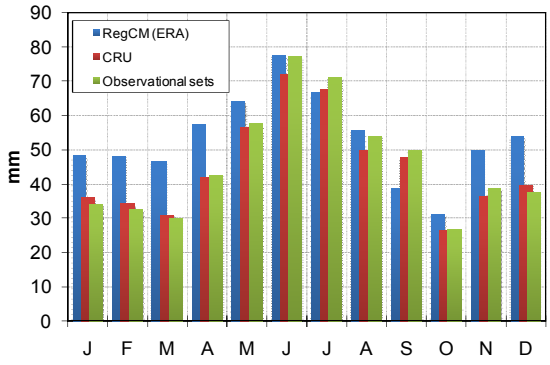

Figure 3. Annual cycle of precipitation for RegCM (ERA), CRU and observational datasets for the reference period 1960-1997

Conclusions

1) RegCM simulations forced by ERA40 data were compared with station observations and CRU data downscaled at station coordinates. The results show that the model does quite well in representing the annual cycle of temperature but precipitation totals are systematically overestimated compared both to stations and CRU data. This feature is transferred to SPI which is based only on precipitation. Consequently, the model underestimates the severity of droughts.

2) The evolution of the SPI series calculated for 3 months presents a high variability of the index around normal conditions. As the time scale for calculation the SPI increases (6 and 12 months) the wet and dry conditions can be better identified as well as their persistence.

Acknowledgements: The research on drought conditions in the Republic of Moldova was supported by the Czech research project MSM 60460901. The RegCM simulations have been produced in the NMA-Romania in the framework of CECILIA–EU-FP6 Project, Contract 037005 GOCE/2006 (http://www.cecilia-eu.org).

References

Boroneant, C., Caian, M., Vasile, L., Cheval, S., Ilie, C. and Coll, J. R., *Summer drought analysis across Romania based on RegCM simulations.* In: WCRP (GEWEX/CLIVAR) Workshop on Drought Predictability and Prediction in a Changing Climate: Assessing Current Capabilities, User Requirements and Research Priorities, Barcelona, Spain, 2-4 March, 2011. http://drought.wcrpclimate.org/workshop/posters/Boroneant.pdf

Halenka, T., *Cecilia – EC FP6 Project on the Assessment of Climate Change Impacts in Central and Eastern Europe.* Global Environmental Change: Challenges to Science and Society in Southeastern Europe, SpringerLink, Part 3, 125-137, DOI: 10.1007/978-90-481-8695-2_11. 2010.

McKee, T.B., Doesken, N.J., Kleist, J., The relationship of drought frequency and duration to time scales. Preprints Eighth Conf on Applied Climatology Anaheim CA. Amer Meteor Soc, pp 179–184. 1993.

Potop, V., Evolution of drought severity and its impact of corn in the Republic of Moldova. *Theor Appl Climatol.* DOI:10.1007/s00704-011-0403-2. 2011.