International Cartographic Association
Association Cartographique Internationale

Present And Future Climate Characteristics Of Syria Based On Cordex Simulations

Nour Naaouf [a,*], Csaba Zsolt Torma [b], José Jesús Reyes Nuñez [a]

[a] *ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences. Department of Cartography and Geoinformatics, Budapest, Hungary. – nournaaouf@ gmail.com, jesusreyes@ik.elte.hu*

[b] *ELTE Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Meteorology, Budapest, Hungary. – csaba.zsolt.torma@ttk.elte.hu*

* Corresponding author

Keywords: Syria, Climate Change, CORDEX, GIS, TAS, RSDS, CLT, PR.

Abstract:

Climate change is one of the biggest challenges for sustainable development in every country but the consequences on a country like Syria which already suffering from ongoing armed conflict and its economy relies on the agriculture industry along with scarce water resources are going to be severe. These effects are already being felt through severe drought waves and other climate extremes which affect every aspect of society and the economic life of the Syrian people (ACSAD, 2011; Massoud, 2010).

Still global climate models (GCMs) are the primary tools for climate research, but in the recent decades regional climate models (RCMs) have been used extensively over selected sub-domains focusing more on regional and local levels at higher resolution (Giorgi, 2019). However, the performance of these models is different from one to another in representing recent and future climatic conditions.

In this study, we demonstrate the performance of 5 RCMs (HIRHAM, RACMO, RCA4, RegCM and REMO) provided by different programs of Coordinated Regional Climate Downscaling Experiment international initiative (CORDEX, Giorgi et al., 2009). All RCM simulations accomplished on a 0.44° horizontal resolution grid following the moderate and high Representative Concentration Pathways scenarios (RCP 4.5, 8.5; Moss et al., 2010) encompassing the whole territory of Syria.

Syria has a unique geographical location in western Asia, north of the Arabian Peninsula, at the eastern end of the Mediterranean Sea. Thus, its location is shared between regions characterized by different topographical features which gives a wide variety of options to test the performance of RCMs integrated over different CORDEX domains (MENA; the Middle East and North Africa, WAS: West Asia and AFR: Africa).

The selected RCMs first need to be evaluated against reliable, high quality observational datasets (CRU, Climatic Research Unit, Harris et al. 2020) as well as satellite-based data (SARA, Pfeifroth et al., 2018 and CLARA, Karlsson et al., 2020). Our study mainly focuses on the following four climate variables: near surface temperature (TAS), precipitation (PR), solar radiation (RSDS) and cloud cover (CLT). The performance of RCMs are evaluated at individual level and the ensemble mean of the RCMs are also calculated. Then results are presented in the form of annual cycles, spatial plots and Taylor diagrams. The results of this research will help to answer the following questions:

- How do perform the selected RCMs in simulating the current climate (1989-2008) of Syria?
- What are the main future climatic characteristics of temperature, precipitation, solar radiation, and cloud cover over Syria by near future (2031-2050) and by far future (2080-2099) with respect to present (1989-2008)?
- How well the assessed RCMs agree on the sign of the previously mentioned changes in the analysed climatic variables?

This research assesses and uses maps to visualize the analysed climatic data and will provide insights into the present and future situations and underpin any related decisions and investments.

Acknowledgements

The research is supported by the Hungarian Scientific Research Fund (OTKA FK-142349).

References

Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD). Drought vulnerability in the Arab region: case study - Drought in Syria, ten years of scarce water (2000-2010), 2011. https://www.unisdr.org/files/23905_droughtsyriasmall.pdf.

Giorgi, F., Jones, C. and Asrar, G. (2009) Addressing climate information needs at the regional level: the CORDEX framework. WMO Bulletin, 58, 175–183.

Giorgi, F., Coppola, E., Solmon, F., Mariotti, L., Sylla, M.B., Bi, X., Elguindi, N., Diro, G.T., Nair, V., Giuliani, G., Turuncoglu, U.U., Cozzini, S., Güttler, I., O'Brien, T.A., Tawfik, A.B., Shalaby, A., Zakey, A.S., Steiner, A.L., Stordal, F., Sloan, L.C. and Branković, C. (2012) RegCM4: model description and preliminary tests over multiple CORDEX domains. Climate Research, 52, 7– 29. https://doi.org/10.3354/cr01018.

Giorgi, F. (2019) Thirty years of regional climate modelling: where are we and where are we going next? Journal of Geophysical Research: Atmospheres, 124, 5696–5723. https://doi.org/10.1029/2018JD030094.

Harris, I., Osborn, T.J., Jones, P. et al. Version 4 of the CRU TS monthly high-resolution gridded multivariate climate dataset. Sci Data 7, 109 (2020). https://doi.org/10.1038/s41597-020-0453-3.Karlsson, Karl-Göran; Anttila, Kati; Trentmann, Jörg; Stengel, Martin; Solodovnik, Irina; Meirink, Jan Fokke; Devasthale, Abhay; Kothe, Steffen; Jääskeläinen, Emmihenna; Sedlar, Joseph; Benas, Nikos; van Zadelhoff, Gerd-Jan; Stein, Diana; Finkensieper, Stephan; Håkansson, Nina; Hollmann, Rainer; Kaiser, Johannes; Werscheck, Martin (2020): CLARA-A2.1: CM SAF cloud, Albedo and surface RAdiation dataset from AVHRR data - Edition 2.1, Satellite Application Facility on Climate Monitoring, DOI:10.5676/EUM_SAF_CM/CLARA_AVHRR/V002_01, https://doi.org/10.5676/EUM_SAF_CM/CLARA_AVHRR/V002_01.

Kupiainen, M., Samuelsson, P., Jones, C., Jansson, C., Willén, U., Hansson, U., Ullerstig, A., Wang, S. and Döscher, R. (2011) Rossby Centre Regional Atmospheric Model, RCA4. Rossby Centre Newsletter, The Rossby Centre Regional Climate model RCA3: model description and performance.

Massoud Ali. (2010). Years of Drought: A Report on the Effects of Drought on the Syrian Peninsula. Heinrich-Böll-Stiftung - Middle East Office. https://lb.boell.org/sites/default/files/uploads/2010/12/drought_in_syria_en.pdf

Moss, R.H., Edmonds, J.A., Hibbard, K.A., Manning, M.R., Rose, S. K., van Vuuren, D.P., Carter, T.E., Emori, S., Kainuma, M., Kram, T., Meehl, G.A., Mitchell, J.F.B., Nakicenovic, N., Riahi, K., Smith, S.J., Stouffer, R.J., Thomson, A.M., Weyant, J.P., and Wilbanks, T.J. (2010) The next generation of scenarios for climate change research and assessment. Nature, 463, 747–756.

Pfeifroth U, Sanchez-Lorenzo A, Manara V, Trentmann J, Hollmann R (2018) Trends and variability of surface solar radiation in Europe based on surface-and satellite-based data records. J Geophys Res Atmospheres 123(3):1735–1754.