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Projections of regional climate change in Ukraine based on multi-model ensembles of Euro-CORDEX

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Climate change is one of the major challenges for future development in every country including Ukraine where actual warming already has impacted many sectors, population, and ecosystems. Recently, the International Initiative of Coordinated Downscaling Experiment for Europe (Euro-CORDEX) has provided RCM data for 0.1° grid. This detailed RCM projection dataset is an excellent basis for estimation of exposure and vulnerability to climate change of different objects and for updating projections for a new National Communication of Ukraine to UNFCCC as well as for Strategy of Ecological Safety and Adaptation to Climate Change in Ukraine.

The study is focused on the estimation of the essential and special climatic characteristics and their changes in the near future (2021-2040) as well as to the middle (2041-2050) and end (2081-2100) of the century over the base period 1991-2010 for three scenarios: RCP2.6, RCP4.5, and RCP8.5. We used bias-adjusted RCM data for daily maximum, mean, and minimum temperature and precipitation provided via ESGF web-portal. We applied a multi-model ensemble approach with further bias-correction by delta-method for multi-year monthly values of the essential characteristics as well as calculated climatic indices using a gridded observational dataset of E-Obs v.20.0e. Ensembles for RCP4.5 and RCP8.5 consisted of 34 RCMs while for RCP2.6 only data of 3 RCMs were available. That is why RCP2.6 is only indicative, while the other two scenarios results have a high confidence level and quartiles and percentiles of the ensemble range are estimated.

More consistent temporally and spatially results were obtained for temperature projections. Increases relative to the baseline were in the range of 0.5-1.5°C for all the RCPs with a bit higher warming in the North of the country in 2021-2040. In 2041-2060, the increases were 1.0-2.0°C under RCP2.6 and 1.5-2.5°C under RCP8.5, with RCP4.5 in between. By the end of the century 2081-2100 the differences between scenarios became much pronounced: from 1-2°C for RCP2.6 to 4-6°C for RCP8.5.

Precipitation changes are much complex with high variability across the seasons and the territory. In winter precipitation tends to increase relative to the baseline in most of the country for all the RCPs. In early spring (March) there is a relative decline in the near-future period, especially in RCP2.6 and RCP8.5 but not in RCP4.5. In later periods the decline becomes less and in the higher RCPs, there is a relative increase. Later spring rainfall changes show a decline in RCP2.6 but an

increase for the other RCPs. The summer months show a relative decline with all the higher RCPs getting drier over time. In the fall relative changes are mixed, with declines in some months and increases in others.

Based on these two essential climatic characteristics other important indices were calculated and analyzed: length of vegetation season, tropical nights, summer days, water deficit, aridity/humidity index, etc.

Obtained projections of climatic characteristics were(will be) used for further agriculture, forest, and human health impact assessments, that will be the basis for the development of adaptation measures to climate change in the frames of the National Adaptation Plan of Ukraine.