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Climate change impact on water resources of the Desna river basin

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A river basin management plan has to consider climate change impact because global warming influences the water cycle explicitly. For Ukraine, only continental-scale studies or(and) global hydrological models reflect the climate change impact on water resources. Such resolution is insufficient to develop confident adaptation strategies.

This study aims to assess changes in the river runoff, water flow formation, and soil water of the Desna river basin under future climate. The Desna supply Kyiv, Ukraine's capital, with fresh water. Moreover, soil water capacity across the basin is critical for crop production, the leading sector of the region.

The framework consists of the process-based ecohydrological SWAT (Soil and Water Assessment Tool) model and eight high-resolution (~12 km) regional climate models from the EURO-CORDEX project forced by RCP4.5 and RCP8.5 scenarios till the end of the XXI century. The SWAT model was successfully calibrated on water discharge from 12 gauges across the basin, then it was driven by each climate model to achieve a range of possible future scenarios. This approach better represents the hydrological processes and achieves more confident results than in previous studies.

Seven of eight models project warmer and wetter climate in the near future (2021-2050), and all models project the same in the far future (2071-2100). According to the ensemble mean, the air temperature will increase by 1.1°C under RCP4.5 and 1.2°C under RCP8.5 in the near future, and by 2.2°C under RCP4.5 and 4.2°C under RCP8.5 in the far future. Precipitation surplus will reach 5% (range from -6% to 16%) under RCP4.5 and RCP8.5 in the near future, and 8% (from 2% to 17%) under RCP4.5 and 14% (from 3% to 23%) under RCP8.5 in the far future. The discharge will likely increase (mean signal 6-8% in the near future and 10-14% in the far future) mostly due to higher groundwater inflow.

Intra-annual changes could be very unfavorable for plant growth because of lower soil water content and higher temperature stress during the vegetation period. The models agree about precipitation surplus during the cold period but, in summer, all directions of change are almost equally possible.

We consider that, among other vulnerabilities of the Desna basin, the water stress for crops will be the main issue because of the high dependence of the economy on crop production. Attention should also be paid to forest fires, eutrophication, and the concentration of organic substances in

the stream