Impact of climate change scenarios on sediment load assessments

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Introduction: Environmental models play a key role in assessment of sediment loads released from the catchment and transported through the riverine systems under current and future conditions. To discuss the future ones the climate change scenarios are commonly incorporated into the models. Since precipitation have the most significant impact on surface runoff consequently the choice of its projections seems to be crucial for future sediment assessments. To highlight the difference in sediment loads under the different scenarios the digital platform - Macromodel DNS, has been employed to calculate sediment loads released from the Raba River (Poland, Carpathian Mts.) to the impoundment reservoir.

Methods: The sediment loads were followed under the RCP 4.5 and 8.5 predictions in the short (2021-35) and long (2036-50) time horizons. Regarding the importance of spatial resolution of the model, especially in the case of precipitation (RR), two sets of data were investigated (both ensembles initially composed from 14 different GSM-RCM model chains): 1) of a single meteorological station located in a vicinity of the study area (V), and 2) of the whole catchment, i.e. areal mean calculated from gridded data (E). To display the possible range of load variability under different precipitation projections additional two sub-ensembles (selected from E) were examined: dry (RR<25th percentile calculated for a reference period 1981-05, D) and humid (>75th percentile for the same reference period, H).

Results: As the reference point for the all created precipitation change scenarios (V, E, D, and H) the calibrated and verified Raba River model has been used (baseline scenario) [1]. The response of the model has been presented and as monthly sediment loads expressed in tones/month (t/m).

Discussion: The simulations showed pronounced differences between sediment loads predicted under the V and E scenarios, reaching over 1000 t/m in April under the RCP 8.5-long scenario (Fig. 1). When dry and humid conditions have been taken into consideration the range of monthly load differences varied from approx. 1 to 630 t/m (Fig. 2).

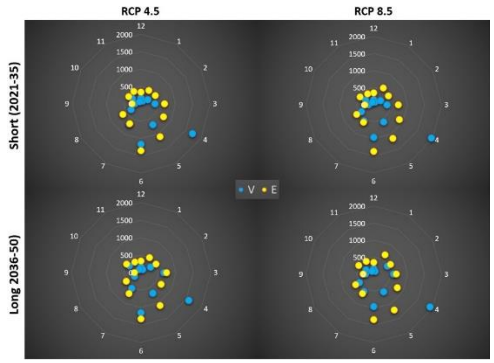

Fig. 1: Monthly sediment loads (t/m) for the V and E scenarios under RCP 4.5 and 8.5

These results show that special attention should be paid when a precipitation model ensemble is selected for the sediment loads calculations as well as its spatial representativeness. Especially, when e.g. the load delivery to the impoundment reservoir is discussed. In this case such extreme load differences could greatly affect not only reservoir management actions but also measures undertaken in the entire catchment [2].

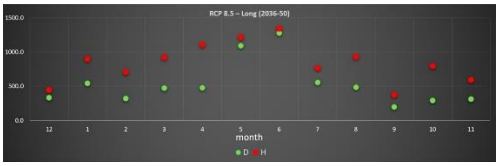

Fig. 2: Monthly sediment loads (t/m) for the D and H scenarios under RCP 8.5- long

However, given current number of possible models to be used to form the ensemble and the differences in their predictions, further research focusing on the best precipitation representativeness in particular models as well as practical aspects of their usage is absolutely necessary.

References: [1] Szalińska et al. (2020) *J Soils Sediments* **20**:2641-2652; [2] Wilk et al. (2022) *J Soils Sediments* **22**:2929-2947.