UNCERTAINTY OF RUNOFF PROJECTIONS IN LITHUANIAN RIVERS

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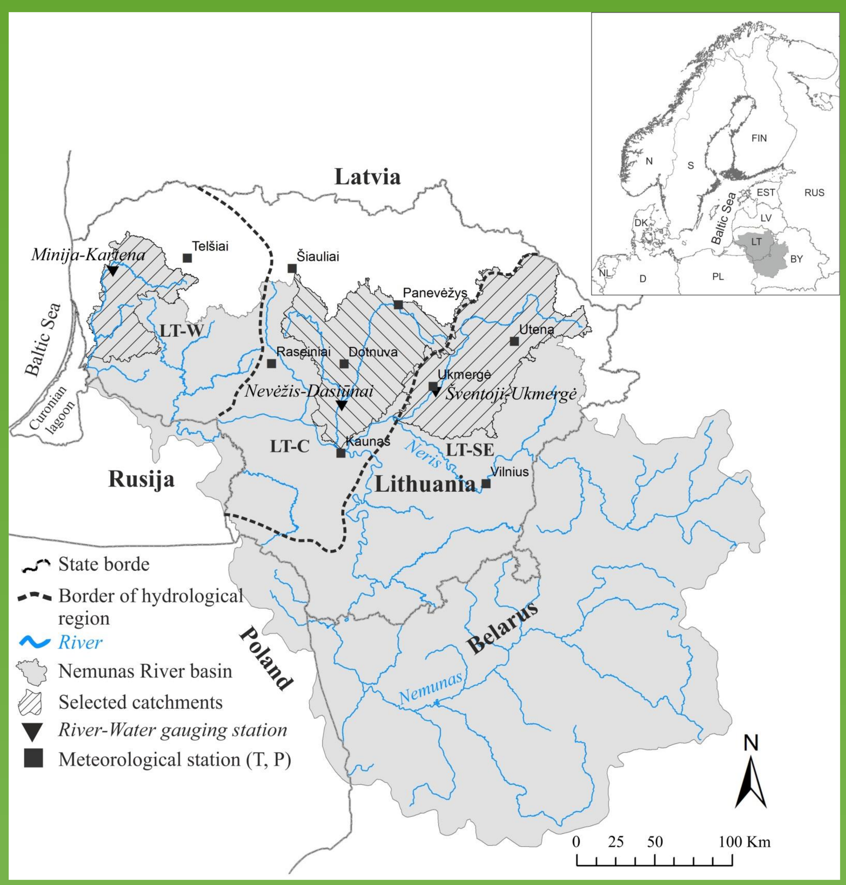
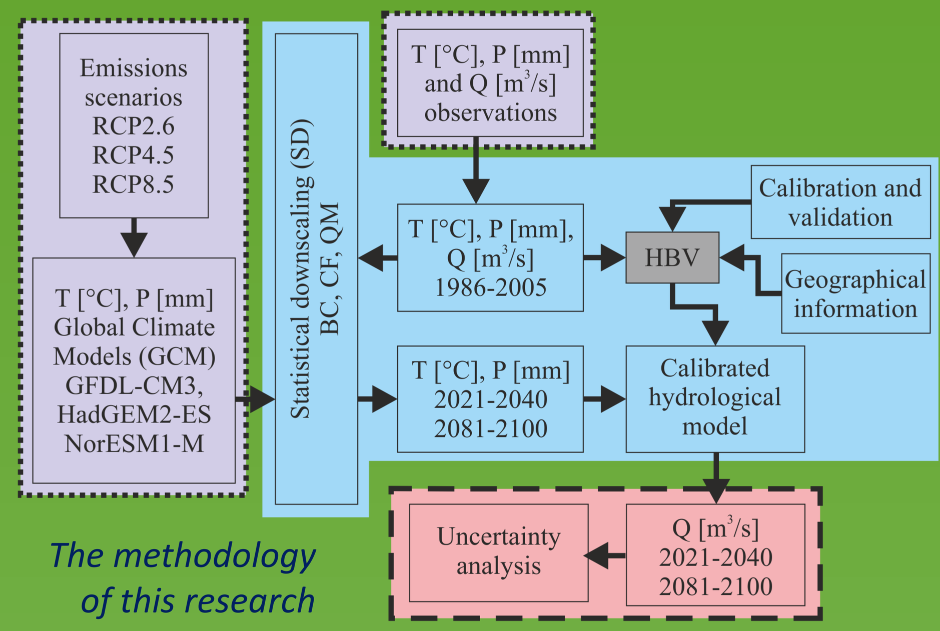
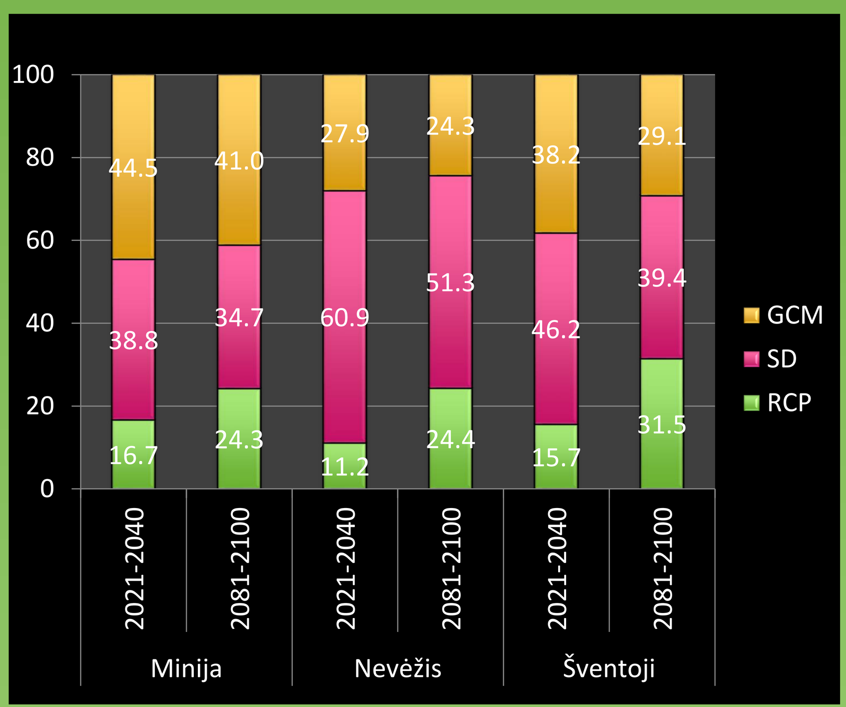


The location of selected river catchments, water gauging stations and meteorological stations

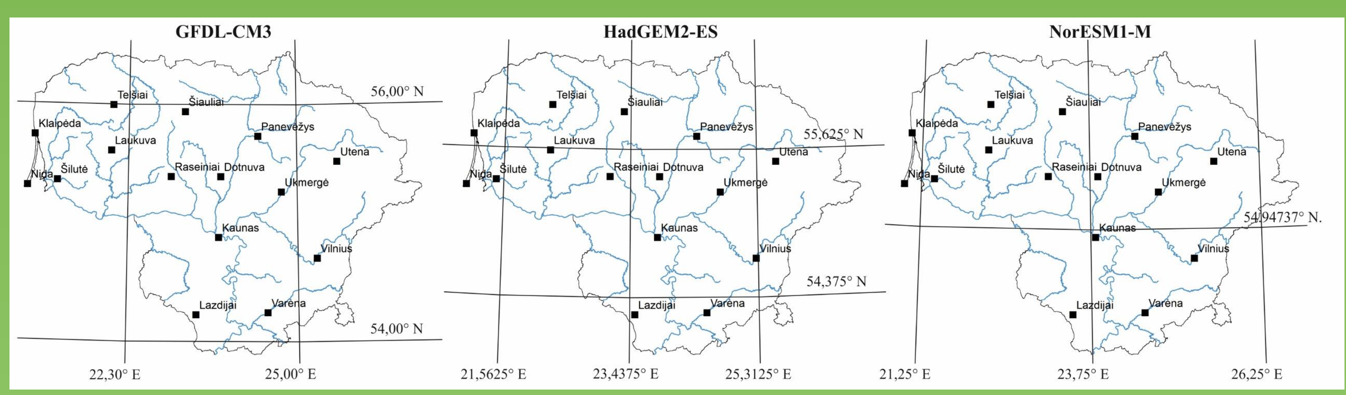
The accuracy of the projections of future runoff highly depends on many factors related to climate change. Therefore, the uncertainty of runoff projections gets higher with each new sources of origin. Usually, the main sources of uncertainty are linked to global climate models (GCMs) and climate change scenarios (RCPs), but there is less attention on influence of statistical downscaling (SD) methods as a new source of uncertainty. This research focuses on evaluation of uncertainty of runoff projections related to major sources of origin (RCPs, GCMs and SD methods) in selected rivers of Lithuania.



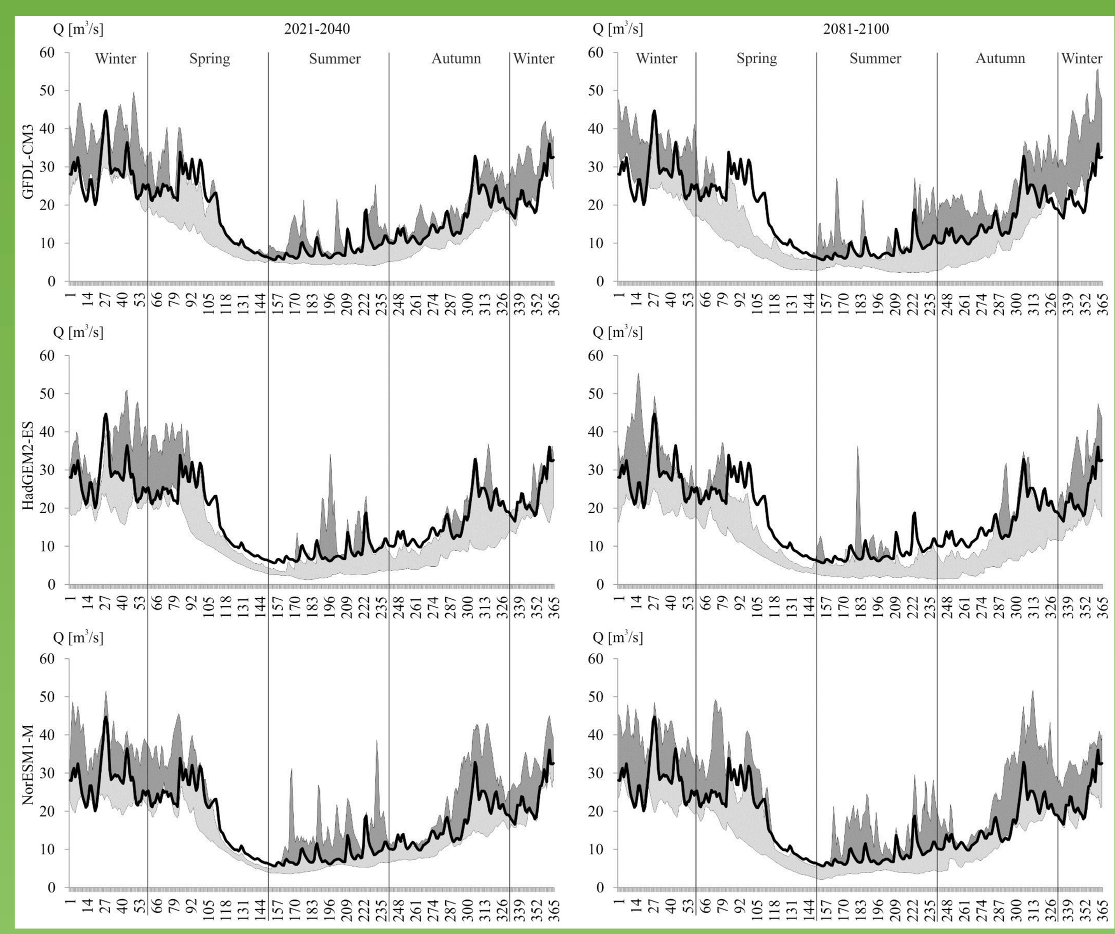
The methodology of this research



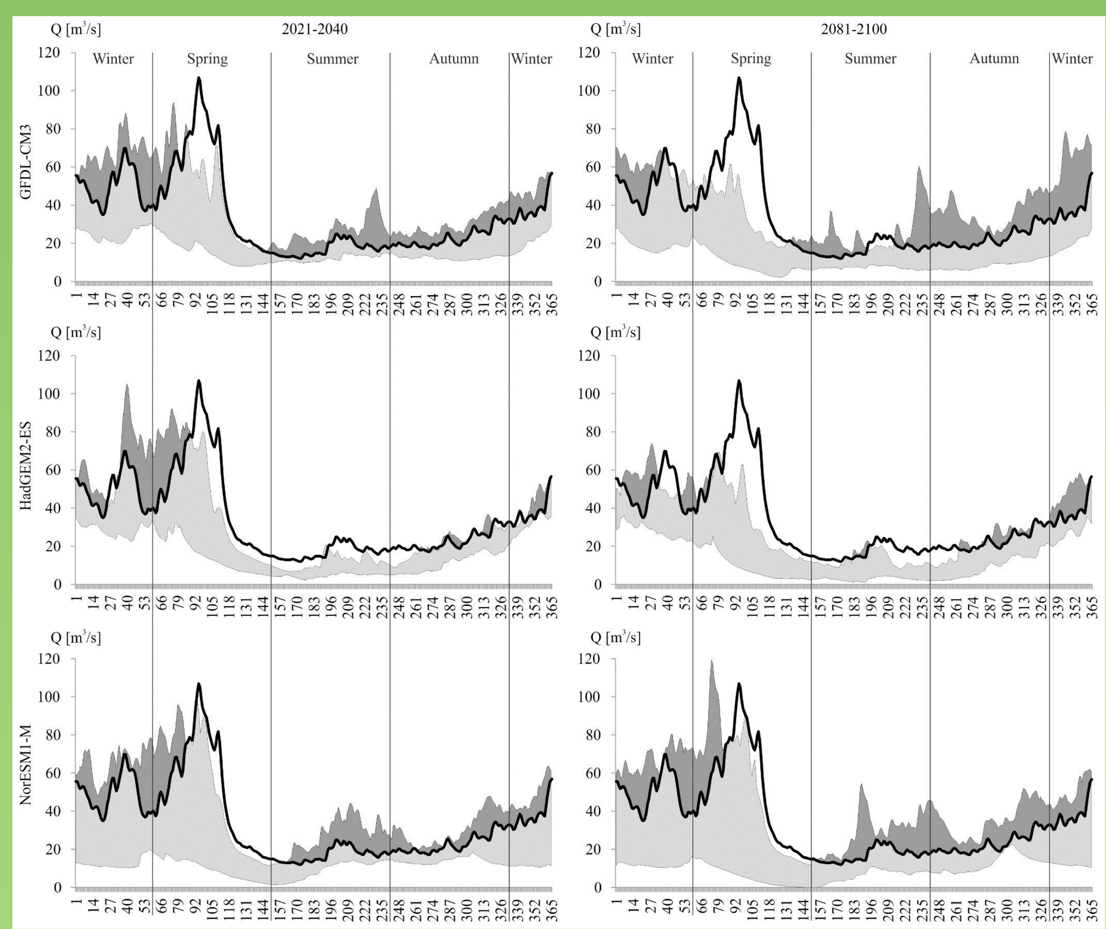
Uncertainty (%) of runoff projections in rivers of Minija, Nevėžis and Šventoji according to different source of origin for the periods of 2021–2040 and 2081–2100



Location of the meteorological stations and spatial distribution of the grid cells of selected GCMs over Lithuania

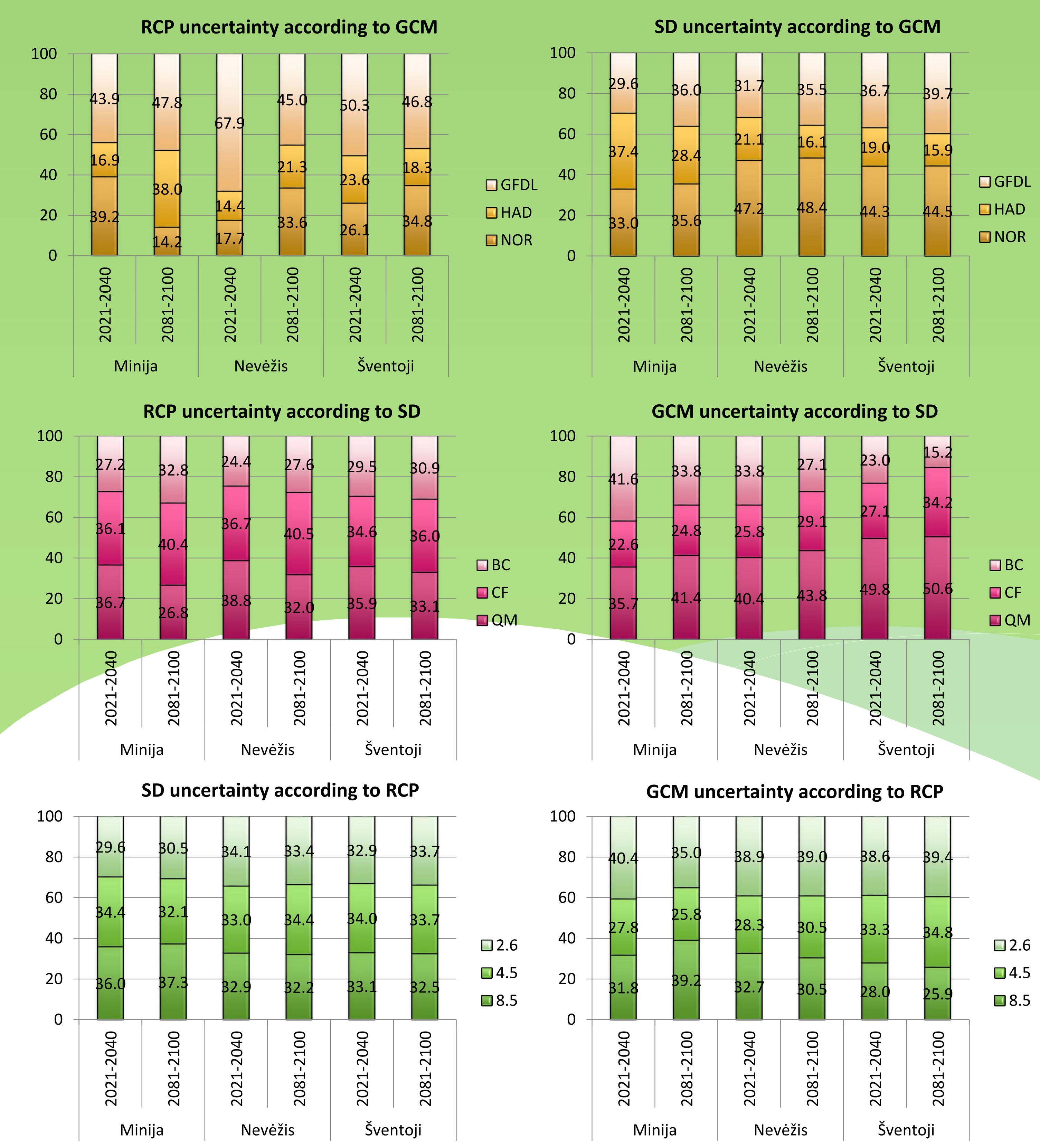


Uncertainty of runoff projections at Minija-Kartena according to GFDL-CM3, HadGEM-2ES and NorESM1-M global climate models for the periods of 2021–2040 and 2081–2100



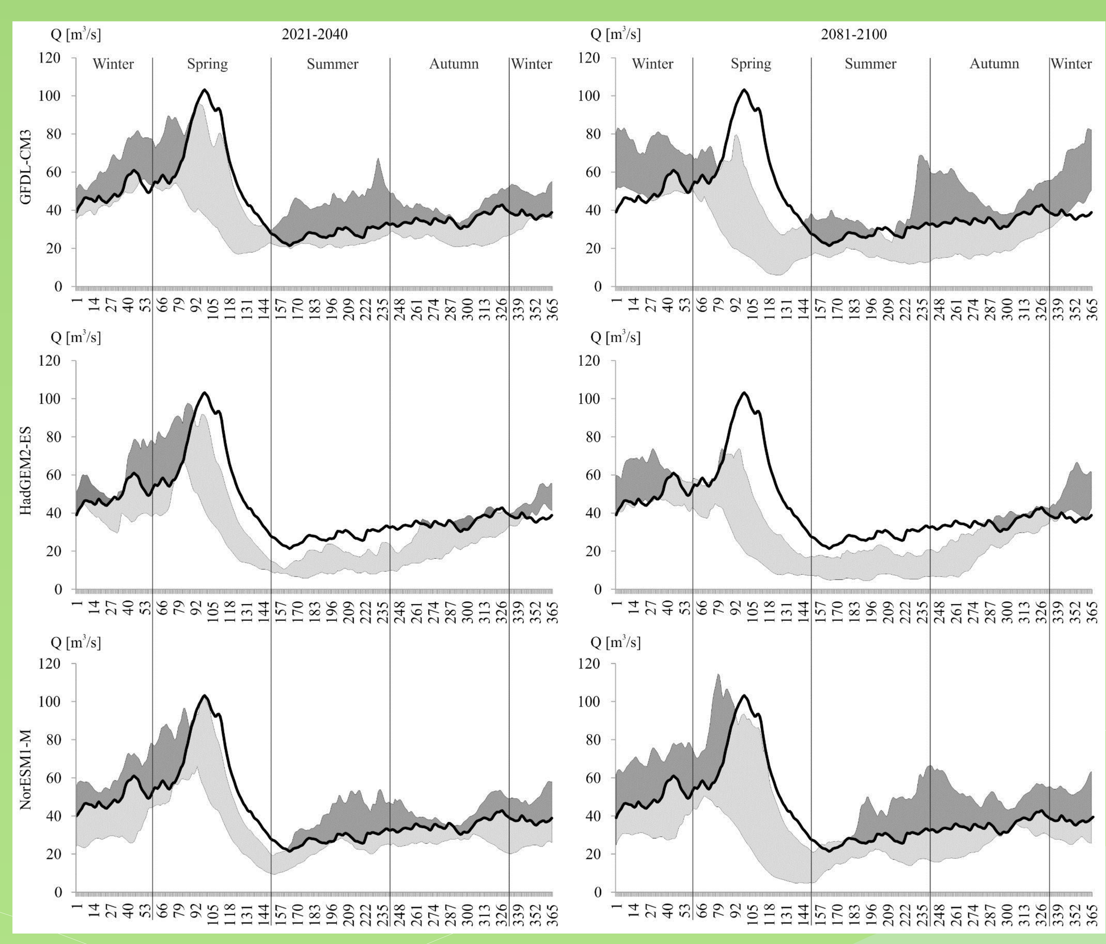
Uncertainty of runoff projections at Nevėžis-Dasiūnai according to GFDL-CM3, HadGEM-2ES and NorESM1-M global climate models for the periods of 2021–2040 and 2081–2100

For this research most typical rivers from hydrological regions (Šventoji – LT-SE, Nevėžis – LT-C and Minija – LT-W) of Lithuania were selected and hydrological models of these rivers using the HBV software for estimation of uncertainty differences of runoff projections were created. The projections of selected rivers according to the three RCP scenarios (RCP2.6, RCP4.5 and RCP8.5), three GCMs (GFDL-CM3, HadGEM2-ES and NorESM1-M) and three SD methods (Bias Correction with variable - BC, Change Factor with variable - CF and Quantile Mapping - QM) were created for the near (2021-2040) and far (2081-2100) future.



Uncertainty (%) of runoff projections in rivers of Minija, Nevėžis and Šventoji between different uncertainty sources (GCM, SD and RCP) for the periods of 2021–2040 and 2081–2100

Uncertainty of projections of annual discharges was evaluated applying the combinations of projections according to uncertainty sources. Analysis of runoff projections of the rivers Šventoji and Nevėžis showed that SD methods were the source of the largest uncertainty in both analyzed periods. Meanwhile, in the Minija River the most significant uncertainty source was GCMs.



Uncertainty of runoff projections at Šventoji-Ukmergė according to GFDL-CM3, HadGEM-2ES and NorESM1-M global climate models for the periods of 2021–2040 and 2081–2100

Conclusions

- In Nevėžis River the highest uncertainties were estimated, where during the spring season projections fluctuated in a wide range.
- In Minija River the GCMs were the most dominant uncertainty source (41.0-44.5%). Meanwhile, in Nevėžis River uncertainties were linked to statistical downscaling methods, consequently 51.3 and 60.9%. The same tendencies of uncertainties were established in Šventoji River, but the influence of SD was smaller – 46.2 and 39.4 %.
- Uncertainties between uncertainty sources showed the widest scattering of results related to different GCMs. The largest uncertainties of RCP projections were caused by GFDL-CM3 climate model and the largest uncertainties of SD projections were sensitive with NorESM1-M climate model, especially according to QM method.
- Understanding the uncertainty of runoff projections let better identify which uncertainty source has the most significant influence on the final results and respectively provide an opportunity to create more accurate runoff projections.