Terms of Reference

Climate change scenarios of streamflow change for the Drina Basin

In the framework of
the "Promoting the Sustainable Management of Natural Resources in Southeastern Europe, through the use of Nexus approach" Project

funded by the Austrian Development Agency

implemented by GWP-Med in partnership with the UNECE

1. Introduction – Background

The Water-Energy-Food-Ecosystems Nexus ("Nexus") approach has been introduced in the natural resources management agenda to facilitate the enhancement of water, energy and food security, while preserving ecosystems and their functions. The Nexus approach provides for an integrated and coordinated approach across sectors, with a view to reconciling potentially conflicting interests as they compete for the same scarce resources, while capturing existing opportunities and exploring emerging ones.

The Nexus approach is especially relevant to South East Europe (SEE), and the Drina river basin in particular, given the significant development and potential of hydropower in the basin. The purpose of the SEE Nexus Project (full title: "*Promoting the Sustainable Management of Natural Resources in Southeastern Europe, through the use of Nexus approach*"), supported by the Austrian Development Agency (ADA) and implemented by Global Water Partnership – Mediterranean (GWP-Med) in partnership with the United Nations Economic Commission for Europe (UNECE), is to introduce the Nexus approach and catalyse action for its adoption and implementation in SEE at the national and transboundary basin levels. Serving this purpose, Nexus Dialogue Processes are being implemented in the transboundary basins of the Drin and Drina rivers, and in Albania, including the development of analytical technical Nexus Assessments.

2. Description of the Assignment

Objective

The objective of the assignment is to provide future hydro-climate streamflow scenarios for the Drina River Basin under a range of emission scenarios, with a focus on changes in streamflow, in support of the energy-water modelling, and to provide a broader assessment of projected climate and hydrological change for the region.

Scope and aims

Following up on previous Nexus initiatives in the Drina basin led by UNECE, the preparation of a "Phase II" Drina Nexus Assessment under the ADA-funded SEE Nexus Project, is under development. In the context of the Assessment, an integrated water-energy model has been developed by analysts from the KTH Royal Institute of Technology to support a modelling analysis on the future relative roles of hydro and non-hydro renewable energy infrastructure in the Drina Basin and the riparian countries. A scenario analysis is developed, considering several options for the long-term development and operation of the water-energy infrastructure in the Drina River Basin, including on infrastructure developments, changes in the electricity supply mix, and costs.

The scenarios being assessed are:

- Business As Usual
- Hydro Power Plant development
- Climate Change impacts
- Carbon pricing
- Enhanced ambition

In this context the aim of the present assignment is to enhance the understanding of how expected impacts of climate change under a range of emission scenarios, are expected to influence in terms of changes in streamflow the functioning of the different reservoirs in the HPPs cascade and impact hydropower generation.

Approach

The overall assignment consists of developing future hydro-climate scenarios for the Drina Basin, under a range of emission scenarios, with a focus on changes in streamflow. Future climate change should be represented by climate model simulations of projected climate from the CMIP6 archive, which hosts the latest set of coordinated climate model run as a contribution to the sixth IPCC assessment report.

Climate model estimated precipitation and temperature data is to be downscaled to the Drina Basin and bias-corrected to be consistent with the historic climate record. This is to be used to force a high-resolution hydrological modelling framework to estimate streamflow at river locations of interest. A suite of streamflow indices is to be calculated based on historic and future projected hydrology and analysed in terms of changes under different emission scenarios. The results are to be described in a report chapter and further details are to e provided in a report.

a. Emission Scenarios and Climate Model Selection

Uncertainty in emission scenarios is to be represented by selecting a lower (RCP2.6) and higher end emission scenario (RCP8.5). A large set of climate models have been run for these scenarios under the CMIP6 protocol and a subset of these models is to be selected based on how well they represent the historic climate regime of the region. Model performance is to be assessed based on a range of metrics that quantify differences between the historic observed climate and the model historic climate, including: regional average annual and seasonal precipitation and temperature, their inter-annual variability, and the spatial pattern of annual and seasonal means. Models that show the lowest biases for this range of metrics are to be selected, with the expectation that 3-5 models have a reasonably realistic representation of the regional climate. This is to be supported by examination of the literature on climate model evaluations for South East Europe.

b. Climate Model Downscaling and Bias-Correction

As current climate models have a coarse spatial resolution (~50-200km grid resolution) they generally cannot represent the fine scale features of regional climate, especially in areas with strong gradients that are influenced by land-ocean transitions and topographic complexity, such as orographic influences. To address this, and to provide climate projection information at the scale of the Drina Basin, the climate model precipitation and temperature data are to be downscaled at least to 5km resolution and corrected to remove biases in their representation of mean climate. The Consultant should propose the most appropriate downscaling approach, taking into account orographic effects and other relevant factors, and justify the choice.

c. Observational Datasets for Precipitation and Temperature

To form the observational baseline for comparison of the climate models and to bias correct them, the Consultant is to use the best available global data products to represent historic precipitation and temperature over the region. The Consultant is to use a high-resolution precipitation dataset for the period 1979-2020, merging some or ideally all of the following sources of data to provide a best estimate given available data: satellite, gauge and reanalysis products. The Consultant should propose an appropriate dataset for the purpose and justify the choice. Temperature data is to be obtained a similar blend of reanalysis datasets that take into account any available station data. These datasets are to be compared with local station data as made available, and adjustments made where there are significant local differences.

d. Hydrological Modelling Framework

The downscaled and bias-corrected precipitation and temperature are to be used to drive the HBV hydrological model that provides estimates of runoff and other relevant hydrological variables such as soil moisture and evapotranspiration. The HBV model is a semi-distributed model capable of simulating the main fluxes and states of the terrestrial water cycle. The modelling of fluxes should be done at a very high resolution, with an adequate calibration (e.g. using a regionalization), and provide realistic representation of the streamflow, which is suitable for the scale of the Drina Basin.

e. Simulations

Streamflow is to be estimated for the historic and future scenario time periods. All model simulations are to be carried out at 5km resolution and for the vector river network, with runoff estimated for all 5km grid cells over the Drina Basin, and streamflow estimated for selected river points on the vector network. An historic simulation is to be performed using the observational precipitation and temperature data record for 1979-2020. Estimated streamflow for this simulation are to be compared to available measured streamflow records within the basin to confirm the performance of the modelling framework. If necessary, the possibility of applying correction should be investigated. Based on the downscaled and bias-corrected climate model data, simulations for the future periods are to also be performed. The future simulations are to be carried out for the period 2020-2100, or as agreed in the beginning of assignment in the light of discussions with other analysts, for each selected climate model and for each emission scenario. This will result in 6-10 simulations (2 emissions scenarios times 3-5 climate models) that will represent the uncertainties in the future projections.

f. Hydrological Metrics and Evaluation

Streamflow data for the historic and future simulations should be made available as daily timeseries for selected river points. Metrics are to be calculated that represent aspects of the streamflow regime of importance to the hydropower sector, flood risk management and environment protection (minimum or environmental flows in particular). These may include:

- the flow duration curve (FDC) and relevant quantiles (e.g. median flow, Q50, high flows Q5 and low flows Q95);

- the distribution of the annual maximum flows;
- the 7-day minimum flow;
- the timing of half the annual flow and the timing of the 7-day minimum and 3-day maximum flow.

These metrics are to be assessed for the current and future simulations, and changes between the two periods documented.

Tasks – Requested Services

The Consultant should prepare and submit the following deliverables:

1) A set of daily streamflow time series data for the historic (1979-2020) and future (2020-2050) time periods to be used as input to the hydro-energy modelling in the basin. This is to be for selected river points in the Drina basin for ~3-5 climate models and the RCP2.6 and RCP8.5 scenarios. Advice is to be provided on the dataset to the analysts working on the water-energy system modelling (modelling changes in hydropower generation in particular), and the appropriate format of the data ensured, as needed. Assist the modelling analysts in the interpretation, including comparison to other results, if available from the basin.
2) A short report on the methodology (5 pages) and a chapter summarising the changes in streamflow (5 pages plus any relevant graphics and tables), the relevance for relevant water-using sectors, frequency risk analysis or high and low flows and e.g. any seasonal shifts that might be important for ecosystems. Address comments from the modelling analysts, country representatives as well as from GWP-Med and UNECE.
3) A set of streamflow metrics for the historic (1979-2020) and future (2020-2100) time periods for selected river points in the Drina basin for ~3-5 climate models and the RCP2.6 and RCP8.5 scenarios. Commenting on the results in the light of any regionally relevant thresholds
4) A report on the projected changes in climate for the region, including changes in streamflow metrics across the basin (15-20 pages including any relevant tables and graphs to illustrate). Integrate comments from the modelling analysts, country representatives as well as from GWP-Med and UNECE.

3. Reporting, deliverables, and timeline

It is required that throughout the implementation of the Assignment, the Consultant closely liaises with the modelling analysts from KTH, with the Project Manager, Tassos Krommydas, Senior Programme Officer at GWP-Med, as well as with the UNECE-appointed Nexus consultant.

All deliverables will be in English, edited for quality, clarity and avoiding errors.

The consultant will deliver the following deliverables, described in detail under the section "Tasks – Requested Services", as per the below schedule (to be possibly adapted based on the actual date of the signature of the contract):

Task #	Deliverables	Deadline
1 – 3	- Set of daily streamflow time series data for the historic and future time periods for selected river points in the Drina basin for ~3-5 climate models and the RCP2.6 and RCP8.5 scenarios	5 July 2021

	- Short report on the methodology (5 pages) and a chapter summarising the changes in streamflow (5 pages plus any relevant graphics and tables), the relevance for relevant water-using sectors, frequency risk analysis or high and low flows and e.g. any seasonal shifts that might be important for ecosystems - Set of streamflow metrics	
4	Report on the projected changes in climate for the region, including changes in streamflow metrics across the basin (15-20 pages including any relevant tables and graphs to illustrate).	15 July 2021

4. Contract Price

The maximum fee for this assignment is **14.000 EUR**. This amount includes all other costs, income taxes and any other amount payable or cost that may be required for the completion of the work/service, including VAT.

Schedule of payments:

- 20% with the contract signature
- 80% after the successful submission of all deliverables

5. Criteria

Selection Criteria (Pass/Fail)

Successful participants must have (in case of a Company or group of experts, the experience listed below applies for the lead expert):

Education (Required)

- PhD in Hydroclimatology or other directly related field

Qualification and Experience

The required qualifications (for the company or/and the lead expert) are presented below. **Failure to provide the minimum required qualifications is considered ground for disqualification.** Qualifications additional to the minimum requested per category will receive additional score under the evaluation process as described in the section Evaluation of Technical offers.

Work experience (Required)

- Minimum 10 years in research positions at senior level in Hydroclimatology or other directly related field
- Minimum 30 scientific publications and/or research projects directly relevant to the scope of the Assignment, including on
  - Regional climate processes, simulations and projections
  - The Coupled Model Intercomparison Project (CMIP) collaborative framework
  - Modelling of river basin hydrology, including hydrological forecasts and projections

6. Awarding Criterion and Evaluation process

The Award criterion is the most economically advantageous tender on the basis of best price / quality ratio.

Offers shall be evaluated as follows:

Offers qualified in terms of exclusion grounds and selection criteria will be further evaluated on the basis of the requirements presented under section "Qualification and Experience", as follows:

<table>
<tr><td colspan="4">Name of Firm / Participant:</td></tr>
<tr><td>(1) Criterion</td><td>(2) weighting
(w)</td><td>(3)
points of criterion (c)
100p Base
+10p for extra criteria over base up to 50 additional points</td><td>(4) Score
= (2) x (3)</td></tr>
<tr><td>Required qualifications</td><td></td><td></td><td></td></tr>
<tr><td>Minimum 10 years in research positions at senior level in Hydroclimatology or other directly related field</td><td>40%</td><td></td><td></td></tr>
<tr><td>Minimum 30 scientific publications and/or research projects directly relevant to the scope of the Assignment, including on
- Regional climate processes, simulations and projections
- The Coupled Model Intercomparison Project (CMIP) collaborative framework
- Modelling of river basin hydrology, including hydrological forecasts and projections</td><td>60%</td><td></td><td></td></tr>
<tr><td>Total</td><td>100%</td><td></td><td></td></tr>
</table>

Failure to provide the minimum requirements in any of the above is considered ground for disqualification

Each Section/evaluation criterion is evaluated autonomously. The final scoring of each evaluation criterion is the outcome of its scoring multiplied by the corresponding weighting factor. The overall score of the technical offer is the sum of the final scoring of all the Sections/evaluation criteria. The overall score of the technical offer is calculated on the basis of the following formula:

Bi = w1 x c1 + w2 x c2 +……

For the overall score which will determine the ranking of offers, technical evaluation will be weighted with 80%, and the financial offer with 20%.

The final listing of the most advantageous offers will be made on the basis of the following formula:

$\Lambda i = 0,8 * (Bi/Bmax) + 0,2 * (Kmin/Ki)$.

Where:

Bmax: the max score received by the best of the technical offers received

Bi: the score of the technical offer

Kmin: The cost of the financial offer with the minimum price offered.

Ki: The cost of the financial offer

The most advantageous offers is the one with the greater value of Λ.

In case of equality of overall scores, the retained proposal is the one whose corresponding technical proposal received the highest rating.

Duration of the Contract

The overall duration of the contract will be maximum 4 months.