



An application of complementary strategic level and high-resolution modelling of the Water-Energy-Food-Environment nexus in the transboundary Zambezi watercourse

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The combined impacts of climate change, river basin management, planning and development on the components of the Water-Energy-Food-Environment (WEFE) nexus are different depending on the specific scale and location where they are assessed. This implies that a wide variety of natural and anthropogenic components should be modelled together to obtain a comprehensive picture of the inter-connections and tradeoffs among the WEFE components. The main goal of the high-resolution WEFE modelling framework we will present is to provide a quantitative framework for evaluating nexus indicators at a range of locations and at various space and timescales within a river basin. The framework can then be subjected to different scenarios of projected climate, land-use, and socio-economic developments as well as infrastructure operation policies to aid in robust planning and development for an uncertain future.

The concept developed makes use of a two-level modelling approach to quantify the impacts:

Firstly, based on a concise description of the basin and bulk infrastructures, the strategic Multi-Objective Robust Decision Making model produces basin operating rules (policies) through optimization with respect to several key WEFE objectives. This allows a subsequent screening analysis to assess tradeoffs among the policies and objectives set for the different sectors.

In a follow up phase, a high-resolution WEFE simulation model, is used to quantify in greater detail the impact on a broader set of evaluation indicators. This is done by implementing the basin infrastructure developments and policies in the high-resolution model and simulating under various future climate and socio-economic development scenarios. The high-resolution WEFE model is based on a detailed description of the river basin and relevant infrastructures and simulates the WEFE nexus at high spatial and temporal resolution using the optimized policies coming from the strategic model. The goal is to compute an extended set of WEFE evaluation indicators.

We will present an outline of the above methodology and selected results of the framework implementation in the transboundary Zambezi river basin, as part of the European Union funded GoNEXUS project.

