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Integrated water and renewable energy management: the Acheloos-Peneios region case study

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Within the ongoing research project "Combined Renewable Systems for Sustainable Energy Development" (CRESSENDO), we have developed a novel stochastic simulation framework for optimal planning and management of large-scale hybrid renewable energy systems, in which hydropower plays the dominant role. The methodology and associated computer tools are tested in two major adjacent river basins in Greece (Acheloos, Peneios) extending over 15 500 km2 (12% of Greek territory). River Acheloos is characterized by very high runoff and holds ∼40% of the installed hydropower capacity of Greece. On the other hand, the Thessaly plain drained by Peneios – a key agricultural region for the national economy – usually suffers from water scarcity and systematic environmental degradation. The two basins are interconnected through diversion projects, existing and planned, thus formulating a unique large-scale hydrosystem whose future has been the subject of a great controversy. The study area is viewed as a hypothetically closed, energy-autonomous, system, in order to evaluate the perspectives for sustainable development of its water and energy resources. In this context we seek an efficient configuration of the necessary hydraulic and renewable energy projects through integrated modelling of the water and energy balance. We investigate several scenarios of energy demand for domestic, industrial and agricultural use, assuming that part of the demand is fulfilled via wind and solar energy, while the excess or deficit of energy is regulated through large hydroelectric works that are equipped with pumping storage facilities. The overall goal is to examine under which conditions a fully renewable energy system can be technically and economically viable for such large spatial scale.