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Keeping an equilibrium: harmonizing environmental and socio-economic water demands in the Tagus River headwaters under climatic change

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The main challenge for sustainable river management is the harmonization of the natural dynamics of water systems to ensure ecological integrity with the dynamics imposed by socio-economic systems and policy goals. The headwaters of the Tagus River basin provide an excellent example of strongly altered human-hydrological systems. The natural strong seasonality of river flows have been utterly transformed into a constant flow rate throughout the year to serve the vigorously expanding water demands imposed by hydropower and agricultural production in the region as well as by the transfer to the Segura catchment. This water management scheme has triggered serious societal debates between the local stakeholders and Segura beneficiaries. It also jeopardizes the environmental state of the Tagus River. This situation is very likely to be exacerbated by projected climate change, as the water availability in this area is expected to decrease dramatically in future. In this study we aim to investigate how the environmental flows restoration of the Tagus River will influence the allocation of water resources for socio-economic needs in the region under limited water availability. By coupling the eco-hydrological process-based model Soil and Water Integrated Model SWIM with a conceptual reservoir and water transfer model, we examine and compare water allocation scenarios of sustainable and business-as-usual management strategies under projected moderate and high-end climate change scenarios. Our results show that to restore the natural variability of the Tagus River, the socio-economic demands, especially the transfer to Segura, should be re-considered and, where possible, lowered to practical levels. We conclude that both natural variability and stability of flows, imposed by humans, should be harmonized in a sustainable way as they are parts of different robust strategies to cope with environmental degradation and climate change threats in a highly transformed river system.