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Integrated system dynamics modelling of the water-energy-food-land-climate nexus in Latvia: exploring the impact of policy measures in a nexus-wide context

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The water-energy-food-land-climate nexus sectors interact in a complex system operating on many scales. Better understanding this system, and its response to change (e.g. climate change, policy implementation) is urgently required, yet little progress has been made on integrating real policy objectives into nexus models to assess potential nexus-wide impacts of policy decisions. Given current concerns on resource scarcity, and on the growing appreciation of how connected the sectors are, understanding how the implementation of policy objectives in one area will impact (1) other nexus sectors and (2) potential future system behaviour, is becoming vitally important. Despite this, little progress has been towards such an understanding. In this work, a fully integrated system dynamics model of the water-energy-food-land-climate nexus in Latvia is presented. The model couples all the nexus sectors in a feedback driven modelling framework. Latvia is represented in five distinct yet inter-acting regions, allowing finer scale interrogation of results and policy implications. In addition,

real Latvian policies are integrated within various nexus sectors (e.g. a policy to improve crop yields or to expand agricultural lands at the expense of other land use types). Due to the integrated nature of the model, executing any policy will not only have an impact within the policy sector (e.g. water), but the nexus-wide impacts can also be determined (e.g. on GHG emissions). Results show that due to the inter-connectedness, impacts range far more widely than may be anticipated. For example, implementing policies to achieve goals related to cereal land coverage in Latvia prevents the attainment of policy goals relating to emissions reductions. As such, synergies can be identified and harnessed, while trade-offs can be avoided. Policy can then be (re-)designed to maximise nexus-wide benefits. This work is carried out in the framework of the H2020 project SIM4NEXUS, which will deliver 10 more such models exploring the policy impacts on the nexus at different scales (sub-national to European). As such, the work starts to fill a crucial academic and applied knowledge gap: how policies designed for a single sector have impacts that ripple throughout the entire nexus. As such, guidelines for more intelligent policy design can start to be formulated, something that is lacking in current nexus research.