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Transferring an agent-based model to simulate land use and climate change adaptation in a contested, water-stressed region in southern Spain

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Land-use is facing multi-dimensional challenges, among other things stemming from climate change and extreme weather events, taxing socio-economic and market conditions, changing societal and consumer trends, as well as complex subsidy regimes and environmental regulations. These combined challenges require land users to increasingly adapt their management strategies and decision-making routines. To test for potential effects of these challenges on patterns of land-use change requires models that incorporate systemic feedbacks between land users and their environmental, socio-economic and political framework conditions. To this end, we developed the agent-based model SECLAND-ABM, simulating land-use change resulting from decision-making processes of individual farm agents (i.e. agricultural holdings). The model enables to link biophysical and societal drivers of land-use change and, through subsequent (soft) coupling with biodiversity or ecosystem models (e.g., SDM, LDNDC), their effects on ecosystem change.

The first model version was developed for the alpine LTSER Platform Eisenwurzen in Austria. The focus of the present study is to transfer SECLAND-ABM to a new study region, the LTSER Platform Doñana in southern Spain. This region represents a completely different environmental, agricultural and socio-economic context, comprising a unique and well-protected wetland ecosystem surrounded by a complex matrix of mostly intensive and mono-functional agriculture. This mediterranean socio-ecological system is critically impacted by climate change as well as excessive anthropogenic land and water use, threatening local biodiversity and agricultural production.

The transfer of agent-based models between study regions is rare and often constricted by the need for a broad range of quantitative and qualitative data, as well as by a lack of flexibility in adapting the model logic to new types of agents and their behaviors and interactions. Therefore, we further developed the SECLAND-ABM to enable its transfer to other study regions. This development represents a significant methodological innovation in the field and the present study

provides a proof-of-concept generating critical insights for further progress.

To implement the model transfer we require different data sets spanning the natural and social science domains (i.e., geo-spatial, environmental, census and qualitative data), describing the local land system and its land users' behaviors. Subsequently, we define model agents and their decision options congruent within this new context and create distinct scenario conditions to test for the effects of potential changes in the biophysical, socio-economic and political frameworks.

This presentation aims to provide (i) a short description of the SECLAND-ABM and its main components, (ii) a brief overview of the LTSE Platform Doñana and its core challenges connected to land use and climate change, as well as (iii) a spotlight on the status-quo of model transfer, particularly related to the collection of input data, the specification of model agents and their decision options, and the definition of scenario conditions.