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Does land cover change in karst regions have a larger impact than climate change on future groundwater recharge?

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Almost a quarter of the world's population relies on karst aquifers as a source of fresh water. However, little effort has been directed toward assessing the impact of future environmental changes on karst groundwater recharge. Due to the presence of subsurface heterogeneities, karst systems exhibit specific recharge processes and may be particularly sensitive to future changes compared to other less permeable systems. With population expected to grow in the future, environmental changes could potentially aggravate the issue of groundwater depletion, which has already been experienced in karst areas in Europe, the Middle East and Northern Africa
In this study, we aim to assess the sensitivity of karst groundwater recharge to changes in climate and land cover in Europe, the Middle East and Northern Africa. We simulate recharge using a previously developed vegetation-recharge model for karst regions (V2Karst), climate projections from the Inter-Sectoral Impact Model Inter-comparison Project (ISI-MIP) and selected land cover scenarios (forest and grassland/cropland), while accounting for the variability in the degree of subsurface heterogeneity and the uncertainty in model parameters. We analyse the model input-output dataset so created using a 'trading for time' approach and Global Sensitivity Analysis techniques to uncover the controls of simulated recharge.
Our results show that land cover change has a larger impact than climate change for more than half of the locations, while it reverses the direction of change for about a quarter of the locations. Therefore, to ensure water security, future land cover management strategies (e.g. afforestation campaigns) should carefully consider the sensitivity of karst groundwater recharge to changes in land cover.