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Regional climate regulation by different land cover types: comparing homogeneous and heterogeneous structures in agricultural landscapes

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Modern agricultural production involves large areas of continuous crop fields. Such homogeneous landscapes are prone to be strongly affected by, and contribute to summer droughts and heat waves. During such extreme events, regional climate regulation is important for the specific area, but also influences the global climate. Through interaction with the atmosphere, the land surface influences important variables, such as the sensible heat flux, the latent heat flux, the ratio of the turbulent fluxes (Bowen ratio) and the land surface temperature. However, different vegetation types provide the ecosystem service of regional climate regulation to different extents.
This study aims to answer the question, whether we can increase the resilience of agricultural areas to summer droughts and heat waves by landscape structuring. The influence of forest patches in crop growing areas, on the turbulent fluxes and on land surface temperature, is investigated. Methodologically, a micrometeorological model is utilized in conjunction with remote sensing data. The research site is located in Bavaria, where rising temperatures and increasing summer extremes are projected. Confirming the effect of forest islands, average and maximum land surface temperatures are lower over heterogeneous than over homogeneous agricultural landscapes. Furthermore, the partitioning of energy is found to be balanced by forest patches in the year 2003, when a strong heat wave struck Europe. Accordingly, heterogeneous agricultural landscapes provide the means to increase regional climate regulating ecosystem services.