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Impact modeling with Bayesian inference for crop yield assessment and prediction

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It is common knowledge that climate variability and change have a profound impact on crop production. From the principle that “it is green and it grows” to the assessment of the actual impacts of major weather drivers and their extremes on crop growth through the adoption of agro-management strategies informed by tailored and effective climate services, there is a well documented scientific and operational gap. This work focuses on the development, implementation and testing of an AI-based methodology that aims to reproduce a crop growth model informing on grain maize yield in the European domain. A surrogate AI model based on Bayesian deep learning and inference is compared for its efficiency against the process-based deterministic ECroPS model developed by the Joint Research Centre of the European Commission. The rationale behind this effort is that such mechanistic crop models rely on multiple input meteorological variables and are relatively costly in terms of computing resources and time, crucial aspects for a scalable and widely adopted solution. Such approaches make it possible to run very large ensembles of simulations based, for instance, on ensembles of climate predictions and projections and/or a perturbed parametrization (e.g. on the atmospheric CO2 concentration effects). Our surrogate crop model relies on three weather input variables: daily minimum and maximum temperatures and daily precipitation, where the training was performed with the ECMWF-ERA5 reanalysis.