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## Model selection for extremal dependence structures using deep learning: Application to environmental data

Although the CLIC-based model selection approach is widely used to identify spatial extreme models, the complexity of the associated statistical inference limits the reliability of this criterion. In addition, the strong spatial dependence in small or moderate regions may lead to substantial overlap among the spatial extremes models. This potential overlap increases the risk of model misidentification. In this paper, we exploit the ability of Convolutional Neural Networks (CNNs) to extract spatial patterns in order to develop a CNN-based model selection framework. The proposed approach evaluates how well the dependence structure observed in the data matches the dependence patterns implied by competing models. Two identification strategies are considered. In the first strategy, both the max-stable model and its associated covariance function are identified simultaneously by a single CNN in a one-step procedure. In the second strategy, model identification is performed hierarchically. First, a CNN identifies the class of max-stable model, and then additional CNNs are trained for each model to determine the corresponding covariance function. The performance of the two strategies is evaluated through an extensive simulation study designed to reproduce the spatial dependence structure of 2-m air temperature data over Iraq, where strong dependence and model overlap are observed. The results demonstrate that the proposed CNN-based approach provides an effective alternative for model selection in spatial extremes.

### Special/ Invited session

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