Goal-oriented evaluation of species distribution models' accuracy: exploring the True Skill Statistic profile

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Abstract:
Despite the wide acceptance of some standard statistics to evaluate the performance of spatial models' predictions, there is a strong on-going debate as to their use. The "area under the curve" (AUC) is a popular measure used to evaluate species distribution models (SDM); however, it does not provide information about model accuracy or the spatial distribution of model errors. A replacement for AUC, the maximum True Skill Statistic (TSS), is gaining acceptance. However, evaluations of a model's accuracy solely based on this statistic may also be misleading.

I demonstrate and compare the advantages of alternative methods to evaluate the accuracy of SDM as continuous probability or presence-absence maps. I evaluate the performance of two SDM approaches (Bayesian logistic model and a machine learning algorithm - MaxEnt) by contrasting model predictions to additional validation datasets. I propose an alternative use of TSS estimated for the whole detection threshold range: the TSS profile. Despite both SDMs score the same high AUC value (0.92), their predictions were very different at the species distribution margins. Also, a high maximum TSS did not guarantee accurate predictions.

The TSS profile allows for a better understanding about how close predictions are to the observation dataset. The proposed TSS profile offer solutions for researchers and practitioners i) to evaluate the overall performance of SDMs and compare between them, ii) to identify the

main source of error, iii) to determine whether the model is suited for the study goal, and iv) to select a detection threshold depending on the maps intended use.