Temporal, spatial, and sampling heterogeneities in species distribution modeling. The case study of the data-poor area of the Kerguelen Plateau.

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Abstract

Modeling species and community distributions over wide expanses of waters like the Southern Ocean presents strong interests for improving our understanding of marine life in remote and little-investigated areas.
However, available presence-only data – used to generate habitat models - often rely on the compilation of heterogeneous datasets produced from different campaigns, and might thereby introduce strong spatial (sampling strategies and areas) and temporal biases (environmental changes over the sampling period) in models. As such heterogeneities influence the performance of models, assessing their impact is critical to the relevance of modeling procedures.

The present study aims at testing the influence of different temporal and spatial biases in widely used modeling procedures (MaxEnt and BRT), using a dataset from the Kerguelen Plateau, for four echinoid species which display contrasted ecological niches and distribution areas. Presence-only data were compiled from different oceanographic campaigns (led over a long time period : 1872-2015) and show significant sampling heterogeneities.

The influence of data quantity and distribution in space and time on model performances was analyzed and compared with the influence of present and future environmental changes. BRT and MaxEnt abilities to project the models over different time periods was also tested, by comparing models based on contemporaneous data with models extrapolated from the past.
Results were used to model species potential shifts predicted from IPCC A1B scenarii proposed for 2100 and 2200 AD; they were compared with the magnitude of changes recorded in the past (1955-2012).

Keywords: species distribution modeling, prediction, heterogeneities, sea urchins, Kerguelen plateau

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