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A new Temporal Transferability Index for range change models

We define and validate here a new metric to assess the temporal transferability of Range Change Models (RCM) that accounts for the dependence of temporal predictive performance on the goodness of fit of RCM. At the moment the only metric assessing transferability of RCMs as a ratio of the goodness of fit is the Transferability Index (TI) defined by Randin et al. (2006). This metric was originally designed for the spatial transference of species distribution models (e.g. when predicting the potential spread of invasive species using native ranges to train the models) and adapted for temporal transference by Dobrowski et al (2011). There are two key limitations of this metric: i) The most important one is that it requires the computation of predictive performance of models transferred both forward (forecasts) AND backward in time (hindcasts), which is an issue because the mechanisms governing range dynamics work directionally in time. Therefore, temporal transferability should be assessed separately for hindcasts and forecasts; and ii) The TI is based on AUC-ROC, which may not be adequate because it is susceptible to changes in the prevalence of the species across time (e.g. when the range change result in range contraction or expansion). Instead, we propose to use a metric that has been reported more robust to changes in prevalence, the AUC-PR. We validate this metric by using the virtual ecologist approach. We simulated recent (1970-2010) and future (2010-2050) range-shifts of shrub and tree species and use them as the true biological phenomena. We then simulated the sampling process in the three times to build RCMs, which were then transferred to generate species distribution forecasts. The forecasts were evaluated using both TI and the new TTI, by contrasting forecasts with the true occupancy known from the simulated data. We show that TTI is better at evaluating model transferability for species that have different predictive performance for forecasts and hindcasts, and for species that have greater changes in prevalence over time.