Decomposing correlated occurrence with a hierarchical Joint Species Distribution Model

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Abstract: A goal of ecology is to understand the processes underlying species distributions. Two major strands of ecology—habitat modelling and community ecology—approach this problem differently. Habitat modellers often use species distribution models (SDMs) to quantify the relationship between species and their environments without considering potential biotic interactions. Community ecologists, on the other hand, tend to focus on biotic interactions and, in observational studies, use co-occurrence patterns to identify ecological processes. Here, we describe an approach that integrates these branches of ecology by incorporating species co-occurrence data into a SDM. We describe a hierarchical multispecies SDM and use it to decompose species co-occurrence patterns into components of shared environmental response and residual co-occurrence. Environmental filtering is captured by correlations in occurrence due to the environment, whereas residual correlation suggests that other ecological or evolutionary processes may be important. We demonstrate our modelling approach using two case studies: frogs and *Eucalyptus* trees. Overall, shared environmental correlation was stronger than residual correlation for both frogs and eucalypts, but there were cases of strong residual correlation, suggesting that biotic interactions may influence species distributions. Including residual correlations between species in SDMs provides a more refined depiction of the relationship between species distributions and environmental variables and can help clarify the influence of ecological processes (e.g. environmental filtering and species interactions) on species assemblages.

Will consider delivering lightning talk