Using language to detect potential change in ecosystem services in the light of ecological surprises.

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Abstract

Assessing which ecosystem services are likely to be affected by ecological surprises is one of the greatest challenges of current ecological research. Despite some ecosystem services has been assessed and valued for particular ecosystem configurations; very little is known on which bundles of ecosystem services tend to conjointly change when ecosystems cross thresholds and undergo non-linear change, also known as regime shifts. One side of the problem is the lack of high quality datasets and time series to assess ecosystem services change. Another side is the difficulty of experimenting with ecosystems, especially when it comes to large scale phenomena, possible irreversible, with great potential to affect human well-being. While a bulk of research comprises localized case studies where data is available and experimentation is possible, a global assessment of regime shifts consequences is missing.

Aware of such limitations, this paper investigates which bundles of ecosystem services are likely to jointly change a as consequence of regime shifts. Here we explore an indirect approach by using machine learning algorithms for topic modeling in the scientific literature. Many papers are published reporting non-linear ecosystem change, but its consequences might not be framed as ecosystem services. By applying topic models to scientific literature we identified clusters of papers referring to similar ecosystem services. Based on this indirect approach, our method allow us to identify which ecosystem services that are likely to be affected by the same regime shifts. We found that identifying ecosystem services is possible and results are sensitive to the training dataset. We used the Millennium Ecosystem Assessment as training dataset and the corpus of papers of the regime shifts database.

We successfully identified the majority of regulating and supporting services. Our preliminary results suggest that biodiversity is the supporting service most affected by regime shifts and general patterns of bundles of ecosystem services include regulating services, pest and diseases are closely related with freshwater, while cultural services seem to be linked with nutrient cycling. Our models, however, do not capture the level of detail of the regime shifts database. They can substantially be improved by supervised hierarchical approaches based on expert opinion and richer corpora.

Keywords: ecosystem services, regime shifts, global change, modelling

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