Quantifying temporal turnover in biodiversity, and how it varies spatially

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Abstract:
Quantifying species compositional change over time plays an important role in measuring biodiversity trends. In the literature, spatial compositional heterogeneity is often referred to as beta diversity (Lande 1996, Jost 2007). Temporal compositional heterogeneity is usually measured by species turnover over time using presence-absence data. However, if available, it is more informative to use species abundance distributions to measure the compositional change over time (Magurran, 2010). We propose several families of indexes to measure the temporal turnover, some of which have been used for measuring compositional similarity between two assemblages, i.e., the beta diversity. Instead of measuring the similarity between two assemblages, we are interested in the compositional change between two different time periods and how it varies spatially.
We use spatial-temporal data analysis to predict the density surface for each species over time, and use the predictions to assess the species compositional change over time in the survey area. To illustrate the method and study how the turnover measures differ from each other, we use the Quarter 1 International Bottom Trawl Survey (IBTS) data (IBTSmanual, 2010). We fit a hierarchical spatial-temporal model to the IBTS data using the stochastic partial differential equation approach (Lindgren et al 2011) implemented in R-INLA package (Rue et al 2009). We then use the predicted density surface to assess the temporal turnover within a 9-year window. We study how the temporal trends in the species turnover vary spatially, which is helpful to identify how climate change is affecting the North Sea fish community.

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