Modelling the effect of directional spatial ecological processes for a river network in Northern Italy

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The River Continuum Concept (RCC) and the Riverine Ecosystem Synthesis (RES) are two different theories proposed by river ecologists to describe the response of biotic communities to environmental variability. River network directional patterns are conveniently described by asymmetric eigenvector maps, an eigenfunction- based spatial filtering method specifically proposed for situations where a hypothesized directional spatial process influences the species distribution. In this work asymmetric eigenvector maps are used in conjunction with canonical redundancy analysis and variation partitioning analysis to describe the distribution of macroinvertebrate communities of a river system in Northern Italy and to test the link between the river theories and the available data. Benthic macrofauna data were collected during the summer of 2009–2013 in 16 rivers, for a total of 283 replicates. We investigate the effects of some measured environmental factors on the benthic macrofauna community, accounting for directional effects intrinsic to the river network structure. The proposed protocol allows to highlight and discuss some of the features relevant to the two river theories. According to the RCC theory, altitude and temperature were relevant factors affecting the macrozoobenthic community, together with the distance from the spring and water depth. Environmental factors representing local and lateral dimensions were less relevant for explaining the variability of the community composition. Nonetheless a role of the surrounding land use was also found, suggesting the presence of lateral effects due to human activities. Overall, the results demonstrated that RCC is a reliable model to describe the distribution of macrobenthic communities in river networks. In socio-ecological

systems, the local and lateral dimensions postulated by the RES theory could be mainly related to surrounding land use and naturalness degree.