International Society for River Science

RIVERINE LANDSCAPES AS COUPLED SOCIO-ECOLOGICAL SYSTEMS

6TH BIENNIAL SYMPOSIUM OF THE INTERNATIONAL SOCIETY FOR RIVER SCIENCE

8 -13 SEPT. 2019 - VIENNA, AUSTRIA

6th biennial Symposium of the International Society for River Science

BOOK OF ABSTRACTS

Sept. 8-13, 2019

University of Natural Resources and Life Sciences
Vienna, Austria

Session **GS13/14**

Testing the River Continuum Concept with geostatistical stream-network models

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The River Continuum Concept (RCC) provided one of the first unifying frameworks in fluvial ecosystem theory. While the RCC predictions held in many empirical tests, other research highlighted how the model overlooked sources of heterogeneity at different scales e.g. the effects of tributaries. Disentangling these effects requires an assessment of variation in key ecosystem variables over the longitudinal and lateral dimension of river networks. However, so far, no empirical tests have employed a spatially explicit statistical approach to this assessment.

Here, we show how recently-developed spatially-explicit models for river networks can be used to test predictions of the RCC whilst taking into account cross-scale sources of heterogeneity. We used macroinvertebrate data from 195 monitoring sites from 1st to 4th order streams spread across the Adige River network (NE Italy). We compared theoretical expectations with empirical semivariograms that incorporated network topology to assess the continuity and patchiness in the proportion of invertebrates functional feeding groups (FFG) over Euclidean and in-stream distances. Geostatistical stream-network models were then used to quantify the influence of the longitudinal gradient relative to local-scale water quality and land-use drivers, while accounting for network spatial autocorrelation.

Patterns in the semivariograms based on flow-connected relationships were characterised by a nested structure associated with heterogeneity at multiple scales. Therefore, the longitudinal variation in FFG was better described by a patchy discontinuum rather than a gradient, implying that both in-stream processes and landscape factors influenced stream ecosystem function. The overall shift in FFG along the longitudinal profile was generally consistent with the RCC predictions, although the best models often included water quality and local land-use predictors. Stream-network models further indicated that up to 90% of residual variation (mean=50%) was accounted for by spatial autocorrelation, especially among flow-connected communities. Accounting for such autocorrelation not only improved model performance relative to non-spatial approaches, but indicated that most flow-connected communities were spatially correlated to some extent. This has clear implications for the assessment of the RCC tenets. This is the first test of the river continuum model that explicitly accounted for stream network topology and autocorrelation. Results indicated that in the Adige River, macroinvertebrates feeding groups exhibited heterogeneity along the longitudinal gradient, which appeared punctuated by local habitat transitions. Such transitions could be associated with artificial impoundments that alter the natural continuity of river processes, and we advocate the use of spatially explicit network models to test the RCC in more natural contexts.