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Evaluating Natural Vegetation Reference For River Restoration Benchmarking

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River restoration performances aimed in restoring the natural or quasi-natural conditions of a riparian ecosystem must be evaluated in respect of their natural reference. Achievement of the restoration goal meant as closure of the restored reach to the natural condition can be hardly assessed on a time specific moment since that riparian ecosystems are highly dynamic and account for high turnover rates of their landscape features. On this premises, the restoration measures shall be assessed at a broader spatiotemporal scale.
Despite their complexity and heterogeneity riparian ecosystems, upon a certain extent, exhibit some common behavior which can be therefore mimicked by models.
To cope with riparian ecosystems heterogeneity and spatiotemporal variations are required models which are able to replicate the common traits of the riverine ecosystems and at the same time that can be adapted to local specific characteristics.
The presented research illustrates the application of a dynamic vegetation model to two different river restoration projects. The key features of the model are the ability of predicting the riparian vegetation recruitment, succession or retrogression in response of physical forces such mean water level and shear stress. Given these inputs, the model is able to simulate, on yearly basis, the evolution of the riparian vegetation and return a raster grid for each one of the simulated years. The model architecture is articulated in execution units (submodels) which allow a flexible adaptation of the geoprocessing workflow. Yet, the encapsulation of the model units allows the addition of components whose development is tailored to the specificity of the modeled ecosystem. Vegetation is treated by the model as consecutive evolutional stages (succession phases) rather than species. With this system, the model is not bound to local vegetation but considers the ecosystem at more abstract level which is easily adaptable to different regions.
The case studies refer to a river reach of the Nakdong river (South Korea) which is flowing after Andong dam and to a reach of the Drau river (Austria) in its upper course, in correspondence of Kleblach-Lind (region of Carinthia). The two reaches widely differ for they hydrologic regime (typically monsoon driven the first while the latter is glacio-nival), their vegetation and for the type of impacts to which these reaches are or where subject. Nakdong river is highly impacted by large dams which altered the natural flood frequency and intensity. Upper Drau, along the study site, was affected by bank protection which impaired the sediment transport and led mainly to bed degradation. The river reach has been restored in 2002 through the digging a side channel and rip raps removal. Ultimately, even the reasons which promote the modeling where different. In the Nakdong case, the modeling has been undertaken to scope what are the outcomes of different restoration measures which have yet to be undertaken. In the second case, upper Drau, the modeling purpose was to evaluate the needs of eventual adjustments of an ongoing restoration project which removed the bank protection and re-established a more dynamic ecosystem.
The key point of the presented research is the demonstration of how the same modeling approach can be used to tackle different modeling objectives in different riparian ecosystems. Such results are made possible by the model implementation which is focused on processes and vegetation-physical factors relationship which are widely found in riparian ecosystems. The modeling of common processes allows then the application of the model to riparian ecosystems which can be very different in their peculiarities and species composition.
The results yield from the simulated riparian ecosystem natural reference can be then used to benchmark the performance of designed or implemented restoration measures.