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Stereophotogrammetry in studies of riparian vegetation dynamics

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Riparian vegetation responds to hydrogeomorphic disturbances and also controls sediment deposition and erosion. Spatio-temporal riparian vegetation dynamics within fluvial corridors have been quantified in many studies using aerial photographs and GIS. However, this approach does not allow the consideration of woody vegetation growth rates (i.e. vertical dimension) which are fundamental when studying feedbacks between the processes of fluvial landform construction and vegetation establishment and succession. We built 3D photogrammetric models of vegetation height based on aerial argentic and digital photographs from sites of the Allier and Garonne Rivers (France). The models were realized at two different spatial scales and with two different methods. The "large" scale corresponds to the reach of the river corridor on the Allier river (photograph taken in 2009) and the "small" scale to river bars of the Allier (photographs taken in 2002, 2009) and Garonne Rivers (photographs taken in 2000, 2002, 2006 and 2010). At the corridor scale, we generated vegetation height models using an automatic procedure. This method is fast but can only be used with digital photographs. At the bar scale, we constructed the models manually using a 3D visualization on the screen. This technique showed good results for digital and also argentic photographs but is very time-consuming. A diachronic study was performed in order to investigate vegetation succession by distinguishing three different classes according to the vegetation height: herbs (<1 m), shrubs (1-4 m) or trees (>4 m). Both methods, i.e. automatic and manual, were employed to study the evolution of the three vegetation classes and the recruitment of new vegetation patches. A comparison was conducted between the vegetation height given by models (automatic and manual) and the vegetation height measured in the field. The manually produced models (small scale) were of a precision of 0.5-1 m, allowing the quantification of woody vegetation growth rates. Thus, our results show that the manual method we developed is accurate to quantify vegetation growth rates at small scales, whereas the less accurate automatic method is appropriate to study vegetation succession at the corridor scale. Both methods are complementary and will contribute to a further exploration of the mutual relationships between hydrogeomorphic processes, topography and vegetation dynamics within alluvial systems, adding the quantification of the vertical dimension of riparian vegetation to their spatio-temporal characteristics.