Geophysical Research Abstracts
Vol. 17, EGU2015-6872-2, 2015
EGU General Assembly 2015

Coevolution of hydrodynamics, vegetation and channel evolution in wetlands of a semi-arid floodplain

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The Macquarie Marshes are located in the semi-arid region in north western NSW, Australia, and constitute part of the northern Murray–Darling Basin. The Marshes are comprised of a system of permanent and semi-permanent marshes, swamps and lagoons interconnected by braided channels. The wetland complex serves as nesting place and habitat for many species of water birds, fish, frogs and crustaceans, and portions of the Marshes was listed as internationally important under the Ramsar Convention.

Some of the wetlands have undergone degradation over the last four decades, which has been attributed to changes in flow management upstream of the marshes. Among the many characteristics that make this wetland system unique is the occurrence of channel breakdown and channel avulsion, which are associated with decline of river flow in the downstream direction typical of dryland streams. Decrease in river flow can lead to sediment deposition, decrease in channel capacity, vegetative invasion of the channel, overbank flows, and ultimately result in channel breakdown and changes in marsh formation. A similar process on established marshes may also lead to channel avulsion and marsh abandonment, with the subsequent invasion of terrestrial vegetation. All the previous geomorphological evolution processes have an effect on the established ecosystem, which will produce feedbacks on the hydrodynamics of the system and affect the geomorphology in return.

In order to simulate the complex dynamics of the marshes we have developed an ecogeomorphological modelling framework that combines hydrodynamic, vegetation and channel evolution modules and in this presentation we provide an update on the status of the model. The hydrodynamic simulation provides spatially distributed values of inundation extent, duration, depth and recurrence to drive a vegetation model based on species preference to hydraulic conditions. It also provides velocities and shear stresses to assess geomorphological changes. Regular updates of stream network, floodplain surface elevations and vegetation coverage provide feedbacks to the hydrodynamic model.