Geophysical Research Abstracts
Vol. 15, EGU2013-7332, 2013
EGU General Assembly 2013


# Stochastic Modeling of Vegetation Growth, Mortality and Invasion in a Fluvial Floodplain in Interaction with Floods

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Vegetation overgrowth in fluvial floodplains and sand bars has become a serious engineering problem for riparian management in Japan. From both viewpoints of flood control and ecological conservation, it would be necessary to predict the vegetation dynamics accurately for long-term duration.
In this research, we have tried to develop a stochastic model for predicting the dynamics of trees in fluvial floodplains with emphasis on the interaction with flood impacts. The model consists of the following four components: (i) long-term stochastic behavior of flow discharge, (ii) hydrodynamics in a channel with floodplain vegetation, (iii) variation of riverbed topography, and (iv) vegetation dynamics on floodplains. In the model, the flood discharge is stochastically simulated using a filtered Poisson process, one of the conventional approaches in hydrological time-series generation. The modeling for vegetation dynamics includes the effects of tree growth, mortality by flood impacts, and infant tree invasion.
Vegetation condition has been observed mainly before and after flood impacts since 2008 at a field site located between 23.2-24.0 km from the river mouth in Kako River, Japan. The Kako River has the catchment area of 1,730 km2 and the main channel length of 96 km. This site is one of the vegetation overgrowth locations in the Kako River floodplains, where the predominant tree species are willows and bamboos. In the field survey, the position, trunk diameter and height of each tree as well as the riverbed materials were measured after several flood events to investigate their impacts on the floodplain vegetation community.
In this presentation, the three effects in vegetation dynamics, i.e. the tree growth rate, mortality, and infant tree invasion, are refined for improving the model predictability. The growth rate curve proposed here is derived by introducing inhibition effect of larger trees into the conventional Richards growth curve. As for the mortality rate, Gaussian distribution is used to represent randomness of tree damage due to differences of individual tree conditions on fluvial floodplains. The infant tree invasion is modeled by taking both seed propagation and vegetative reproduction into account. The results of the present model for the fluvial floodplain in Kako River confirm the high applicability of the present refinement and its optimal model parameters for predicting current vegetation distributions in the floodplain.