Ecohydrological response of a continuous vegetation transect in wetlands during a typical flooding process

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Introduction
Wetlands are transitional between terrestrial and open-water aquatic ecosystems. Wetlands vegetation assemblages to adapt to changing anoxic and water stress conditions, constantly in the process of adapting to the variable biological, hydrological, meteorological and physicochemical conditions. Over all, the strong coupling between vegetation and these elements leads to important feedbacks between ecosystem processes and environmental changes[1]. Hence, small changes in environmental elements could result in significant biotic changes. In this research, a typical flooding process was captured in one typical freshwater wetlands in China. The ecohydrological response of a continuous vegetation transect in wetlands would be investigated during a typical flooding process in 2017.

Observation Methodology
The Sanjiang Plain is the region with the most extensive and concentrated aquatic habitats of various types in China, including freshwater marsh, marshy meadow, meadow, river, lake, etc. Honghe National Nature Reserve (HNNR) (47°42’18”–47°52’00” N, 133°34’38”–133°46’29” E) is located in the northeast of the Sanjiang Plain, known for its “unique gene pool of wildlife in the Sanjiang Plain.” In this case, selecting a typical transect which is adjacent to a seasonal flooding river and covering a typical vegetation-zonation gradient, would be necessary to investigate the ecohydrological control mechanism of the plant evolution. We selected the 139# study area in HNNR, because this area is right adjacent to the seasonal flooding Nongjiang river and has a relatively complete plant gradient from marsh to forest (Around 600 meters long). In order to run and validate the Lund-Potsdam-Jena Wetland Hydrology and Methane DGV Model (LPJ-WHyMe v1.3.1), we need to capture following in-situ parameters: 1. Fraction of the fine root in upper/lower soil layers; 2. Minimum canopy conductance; 3. Growing degree day; 4. Volumetric fraction of water at the permanent wilting point; 5. Porosity of the soil column; 6. Volumetric fraction of organic/mineral material, etc. In Observation A, we designed transect in 139# HNNR, making plant and soil samples along the plant types; In Observation B, we made detailed ecohydrological monitoring in site scale of each plant type, such as soil thermal conductivity, soil water retention curve, soil moisture, plant root structure parameters, groundwater level, surface water level, net photosynthesis, transpiration, stomatal conductance, daily air temperature, precipitation, wind, solar radiation, etc. The monitoring was conducted between July and October 2017.

Modelling results
We run the LPJ-WHyMe model (Lund-Potsdam-Jena Wetland Hydrology and Methane DGV Model) to simulate the plant physiology (net photosynthesis, heterotrophic respiration, GPP) and hydrological fluxes (water table position and evapotranspiration). Results show distinct difference among different plant types during a typical flooding event in HNNR. Figure 2 briefly shows the ecohydrological response of typical flood tolerant C3 graminoids (Marsh) during a seasonal flooding process in August 2017. The surface water level began to rise from the start of August, with the same trend of the...
simulated water table position. At the same time, daily diffusive CO2 flux reached the peak around 15th August and shrink till the end of growing season. One interesting thing is that the curve of leaf CO2 flux showed distinct differences between marsh, meadow and shrub. Over all, during a 10-days flooding event, marsh showed better adaptability while shrub would die more quickly comparing with the former two plant types. These caused landscape pattern change to some extent in September. (It is a pity that not all the curves were put on this figure this time)

Figure 1: Ecohydrological experiment in a typical transect along a seasonal flooding river in HHNR. Observation A represents monitoring transect design, including plant sampling, soil sampling site, from marsh to shrub. Observation B shows detailed ecohyrological monitoring in site scale of each plant type.

Figure 2: Modeling results of LPJ-WHyMe. For plant function type of flood tolerant C3 graminoids, this model well captured the water table position change from the start of August. At the same time, daily diffusive CO2 flux reached the peak in mid of August and shrink after that. It is quite correlated with the monitoring leaf CO2 flux data.

References