

Accounting for surrounding agricultural ditches in hydro-thermal coupling modeling at Hokkaido Bibai marsh, Japan

Kaoru Inaba^{1*}, Hiroataka Saito², Ken Kawamoto³, Toshiko Komatsu⁴

¹Takenaka Corp., ²Ecoregion Sci., TUAT, ³Science and Engineering, Saitama Univ.,

⁴Science and Engineering, Saitama Univ.

Functions and values of wetlands (marshes, swamps, peat bogs, and etc), in particular their rich natural resources and biological diversity, have come to be recognized as significant elements in natural environments (Ramsar convention, 1971). Among developed countries, there have been numerous projects for conservation and restoration of wetlands to harmonize their functions such as water storage, flood control, and water filtration/purification with surrounding watershed and environment. On the other hand, among developing countries, the wetlands including surrounding areas are important landfill and infrastructure development sites for cultivated and residential lands.. Thus, there is growth of the demands for applicable management and wise-use of wetlands. In spite of this, due to lack of information, scientific evidences, etc., measures or engineering tools have not been sufficiently taken for evaluating ongoing methods/ techniques for wetland conservation and restoration.

Our study aims to characterize mass movement and circulation systems in wetlands combining with geoen지니어ing properties such as consolidation and strength. Based on such scientific/engineering knowledge, our final goal of the study is to develop an integrated tool which predicts water flow and transport of greenhouse gases, energy, and nutrients simultaneously in marshes by taking geoen지니어ing properties and behaviors of wetland soils into account, and to evaluate conservation and restoration methods at natural and constructed wetlands in pursuit of site-specific management and wise-use of wetlands.

The study site is Bibai marshland in Hokkaido, Japan. An intensive field monitoring has been conducted at the marsh: methane emission has been monitored since 2003, methane content distributions have been measured since 2006, and groundwater levels and soil temperatures have been monitored since 2008. At the same time, we have developed and improved integrated flow simulation codes to model movement of water and heat in geospheres from the field scale to the regional scale.

A hydro-thermal coupling modeling and simulation of the water-circulation at Bibai marsh surrounded by agricultural ditches (area of about 1 km x 1.5 km) was executed. The model can simulate changes in water flow, evapotranspiration, and the depth of snow cover. As a result, the distribution of the water content, the direction of the groundwater flow, the distribution of evapotranspiration at surface, and the distribution of temperature at surface and subsurface on this site were adequately calculated. The model verification and update using the observed data collected from the Bibai site will be conducted .

Keywords: hydro-circulation, thermal circulation, evapotranspiration, snow cover and snow melt, hydro-thermal coupling model, marsh