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Development of an early flood warning system based on ensemble method using quantitative precipitation forecasts in Huong River, Vietnam

Masahiro Ryo (1), Oliver C. Saavedra V. (1), Toshio Koike (2), and Dang Ngoc Tinh (3)

(1) Department of Civil and Environmental Engineering, Tokyo Institute of Technology, Japan, (2) Department of Civil Engineering, University of Tokyo, Japan, (3) National Hydro–Meteorological Service of Vietnam, Ministry of Natural Resources and Environment, Vietnam

The applicability of early flood warning system based on ensemble method in the Huong River basin, Vietnam, was examined using quantitative precipitation forecasts at global scales. Vietnam located in South East Asia is annually affected by climate extremes, particularly floods, droughts and tropical cyclones. Actually large areas of the region are highly prone to flooding and influenced by monsoons. The target area here is one of the provinces with the largest amount of rainfall in the country with annual average rainfall around 3000 mm. Since the Huong river basin has not enough infrastructures for preventing flood inundation such as dams, it suffers from server flooding. Then, it makes sense to focus on nonstructural flood control particularly in early flood warning system to support decision making and reduce causalities and material damages.

Rain gauge and satellite-based products were used as observed precipitation inputs. To consider the spatial heterogeneity of the different rainfall patterns, a distributed hydrological model was set up to represent the hydrological processes. To achieve real-time basis, up to twenty-four hours lead-time quantitative precipitation forecast at global scale were used as input to the system. Since forecasts are associated with uncertainties due to their predictability performance, the spatial and temporal bias was evaluated from previous time steps. To reflect the intrinsic uncertainty of forecasts, ensemble method based on noise perturbation was applied to the most recently issued forecast. To attempt an appropriate ensemble spread, different weights for each grid were proposed according to the spatial and temporal biases evaluated previously. This procedure generated an ensemble flood forecasts at the protection point. Once the river discharge was converted into water stage, a specific flood warning level was obtained for each ensemble member. Then, the evaluation of the members showed the uncertainty of the forecasts as information in the flood warning level emission.

The 24 hours lead-time quantitative precipitation forecast showed a tendency to underestimate the amount of precipitation compared with rain gauge and satellite-based measurements. The 12 hours lead-time forecast predicted the amount of river discharge closer to the observations than the 24 hours. The forecast predicted well the timing of the raising limb and flood peak. The results indicate that it is possible to extent the lead-time even using global quantitative precipitation forecasts in real-time basis.

Actually, this decision support system developed for real-time basis reflects the precipitation forecast's performance from previous time steps for proper and timing early flood warning