ABTRACT

Pluvial flooding is a critical issue in many cities worldwide and for flood mitigation measures the causes and characteristics behind pluvial flooding are of interest. Pluvial flooding occurs when the rainfall amounts exceed the capacity of storm water drains to collect the water and the capacity of the ground to absorb water. This is usually associated with short-duration storms. In the situation that the frequency of rainfall with strong intensity would increase due to climate change, risk reduction of pluvial floods is further challenge. However, it is hard to understand substantial characteristics of pluvial floods especially on the scale of city blocks, because they are seldom measured with instruments. It is also difficult to predict areas prone to the flood caused by heavy rainfall with a certain intensity. Indeed, even not in the climate change situation, insufficient capacity of a drainage system, which may be different from that of design, is also another important factor to cause pluvial floods to cope with these challenges. Modelling approach alone is not adequate to evaluate the causes and severity of pluvial floods.

If actual from that of design, the primary goals of this study, therefore, is to propose an effective data collection system for understand substantial characteristics of pluvial floods and applies it to models for identifying pluvial flooding processes including drainage models. Utilizing these results, the severity of pluvial flood is finally evaluated in relation to controlling factors.

In this study, I set Tsushima, Japan and Yangon, Myanmar as the target areas. These areas suffer frequently pluvial floods during monsoon seasons and typhoon approach. It could be described that the elevation, weather, drainage system, urban development and altitude of the citizens, which are characterized in each city, are strongly influenced on pluvial flood occurrence and severity. I presented the water logger monitoring system in urban storm drainage to identify the process of pluvial floods in both cities during heavy rain. It is also applied to preparation for inundation map with high resolution terrain data compared with simulation model results. I used New Integrated Lowland Inundation Model (open source) and InfoWorks ICM (commercial models) to assess the pluvial flood and to explore the effects of sediment depth and other factors in a different storm drainage system of each city that influence on flood severity.

Pluvial flood severity depends on not only rainfall intensity but also other controlling factors in the urban area such as sediment depth and garbage clogging inside drainage channels and water level variation of a river that receives the water from drainage systems. Pluvial flood severity is strongly related to sediment depth in the drains, and duration of flood is more sensitive affects than flood discharge. Flood inundation map is set based on joint impact of sediment and increased rainfall that shows where flooding may occur and how severe flood will be over a range of water levels in the urban city center.

We demonstrated that estimating local pluvial flooding process in an urban area using water depth loggers and a digital elevation model, which are cost-effective and do not require the latest technology. The results showed recorded water depths in storm water drainage systems could be applied for tracking the pluvial flooding process by combining it with high-resolution altitude distribution. The results of modelling demonstrated that considering with open channel storm drain can retain flood water than without considering open channel storm drain. Because considering with storm drain has less impacts of floods, while considering without storm drain has big impacts of floods.

Pluvial flood can occur typically coincide with sediment depth and garbage clogging inside drainage channels, garbage blockage at trash screen and water level variation of a river that receives the water from drainage systems according to the comparison of the logger and simulation results and site inspection. InfoWorks ICM provides faster calculating time, accurate flood characteristics of the simulation results like flood depth that can directly compare with logger depth, special feature like sediment in drain than New Integrated Lowland Inundation Model (NILIM). All of the simulations with different scenarios by applying InfoWorks ICM is more effective and efficient for flood risk evaluation and identification for this study. Effluent capacity of open channels is more sensitive in flooding than closed drain system. Indeed, the pluvial floods often occur closely to the open channel drainage system.

Flood risk management of developing countries have a lot of challenges, not only structural mitigation measures but also non-structural mitigation measures especially lack of land use regulation, enforcement of illegal waste disposal, and weakness of collaboration among different departments. I set pluvial flood risk management governance structure of Yangon, to reduce overlap and gap in responsibilities and to promote bridging concepts of visions for flood risk management plans and programs, clear rules of sharing responsibilities among different departments. I suggested some pluvial mitigation measures based on simulation results and field inspection that are reliable and achievable.