Chapter 3
Flash Floods:
Causes, Effects, and Modeling Possibilities With Advanced Hydroinformatic Tools

Erika Beata Maria Beilicci
Politehnica University, Timisoara, Romania

Robert Florin Beilicci
Politehnica University, Timisoara, Romania

ABSTRACT

The objectives of the chapter are the identification of flash flood causes, their negative effects on environmental factors, and to study of modeling with advanced hydroinformatic tools. The authors analyzed the following models: DUFLOW, developed by the International Institute for Hydraulic and Environmental Engineering, Delft, The Rijkswaterstaat (Public Works Department), Tidal Water Division, The Hague, The Delft University of Technology The Netherlands; Hydrologic Engineering Center's Hydrological Modeling System runoff model, developed for the U.S. Army Corps of Engineers; Water Erosion Prediction Project, developed by USDA Forest Service, Agricultural Research Service, Natural Resources Conservation Service, Department of Interior's Bureau of Land Management, and Geological Survey from USA and MIKE11 by DHI, developed by Danish Hydraulic Institute, rainfall-runoff module. The authors conducted case studies of these models on different small hydrographic basins, located in west Romania, in the Banat region. Some possible measures to reduce the negative effects of flash floods are listed.

INTRODUCTION

Flash Floods Causes

Flash floods are becoming more frequent nowadays. For flash floods study are important the following aspects are: causes, concentration time of runoff, maximum water and solid discharge, and maximum water level in different cross sections of valleys. Their occurrence is due, in specially, to both climate

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change and anthropogenic causes: heavy rain, massive deforestation, irrational exploitation of sloping lands, and absence of small watershed arrangements with runoff and soil erosion control works. The rains, and especially the torrential ones, consist of the fall of large amounts of precipitation in a very short time so that the infiltration capacity of the soil is quickly exceeded and almost the entire amount of water that falls flows towards the network of valleys, generating floods. Also, flash floods may be caused by heavy rain, associated with meltwater from ice or snow flowing over ice sheets or snowfields. Flash floods may occur also, after the collapse of a natural ice or debris dam, or man-made hydrotechnical structures, such as dams or dikes. Flash floods can occur under several types of conditions: when precipitation falls rapidly on saturated soil or dry soil that has poor infiltration capacity. The runoff collects in gullies and streams and often forms a fast-flowing front of water and debris.

Among the factors that favor rapid flooding is the inadequate maintenance of channel networks designed to collect and transport water from precipitation [Beilicci & Beilicci, 2015a]

A flood can be considered a flash flood if the area of the catchment does not exceed 200 km^2, the time of concentration of runoff is less than 6 hours, the rain duration is less than the time of concentration, and the rain height exceeds 100 mm. [Drobot, 2007]

A flash flood is a rapid inundation of low-lying areas. Flash floods are characterized by the short duration of the rising and falling branches of the flood hydrograph, tens of minutes or hours. Flash floods occur predominantly on specific watercourses draining small catchments (up to a few hundred km^2) characterized by high slopes, pronounced landscape fragmentation, low forest cover, and a high rate of impervious surfaces. They are generated by torrential rains with high intensities (high height and short duration), often of the convective type with short durations (of 2-6 hours), which exceed the concentration time of the basin. The speed of the water flow is very high, it causes a strong erosion of the bed of the river and causes the dislocation and entrainment of alluvium of different sizes. Such floods are generally localized but destructive, which is why they are called “brutal floods”. [National Oceanic and Atmospheric Administration, 2000], [Drobot, 2007]

Flash Floods Effects

Flash flood effects are multiple and complex: social, economic, and environmental.

Social effects are loss of human life, health effects - illness, psychological effects, destruction and damage to homes and family farms, impairment of educational, cultural, sports activities, damage to transport infrastructure, and deterioration of objectives and social-cultural institutions.

Economic effects are direct and indirect damage, damage to multiple items with economic importance, loss due to malfunctioning of public institutions and economic entities, as a result of the reduction or temporary interruption of work caused by lack of manpower, raw materials, interruption of power supply, etc., payment of material and human goods insurances.

Environmental effects are pollution of flooded areas, changes in the physic-chemical and bacteriological properties of water courses, silting of reservoirs, bio-edaphic effects, and reduction in the stability of slopes: landslides, and collapses.

Material and social vulnerability constitutes an important factor that can amplify the effects of flash floods. The material vulnerability is due to the location of human settlements in areas exposed to the risk of flooding, and the practice of economic activities in these areas. [https://www.academia.edu]

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