



Hydrodynamic modeling of urban flooding taking into account detailed data about city infrastructure

Vitaly Belikov (1), Sergey Norin (1), Andrey Aleksyuk (2,1), Inna Krylenko (2,1), Natalya Borisova (1), and Alexey Rumyantsev (1)

(1) Water Problems Institute of the Russian Academy of Sciences, Moscow, Russian Federation, (2) Lomonosov Moscow State University, Moscow, Russian Federation

Flood waves moving across urban areas have specific features. Thus, the linear objects of infrastructure (such as embankments, roads, dams) can change the direction of flow or block the water movement. On the contrary, paved avenues and wide streets in the cities contribute to the concentration of flood waters. Buildings create an additional resistance to the movement of water, which depends on the urban density and the type of constructions; this effect cannot be completely described by Manning's resistance law. In addition, part of the earth surface, occupied by buildings, is excluded from the flooded area, which results in a substantial (relative to undeveloped areas) increase of the depth of flooding, especially for unsteady flow conditions.

An approach to numerical simulation of urban areas flooding that consists in direct allocating of all buildings and structures on the computational grid are proposed. This can be done in almost full automatic way with usage of modern software. Real geometry of all objects of infrastructure can be taken into account on the base of highly detailed digital maps and satellite images. The calculations based on two-dimensional Saint-Venant equations on irregular adaptive computational meshes, which can contain millions of cells and take into account tens of thousands of buildings and other objects of infrastructure. Flood maps, received as result of modeling, are the basis for the damage and risk assessment for urban areas.

The main advantage of the developed method is high-precision calculations, realistic modeling results and appropriate graphical display of the flood dynamics and dam-break wave's propagation on urban areas. Verification of this method has been done on the experimental data and real events simulations, including catastrophic flooding of the Krymsk city in 2012 year.