Geophysical Research Abstracts
Vol. 16, EGU2014-1744-5, 2014
EGU General Assembly 2014

Surface water, groundwater and unified 3D-crack network as a triple coupling dynamic system for a river watershed functioning - manifestation in catastrophic floods

Tatiana Trifonova (1), Nikita Tulenev (2), Dmitriy Trifonov (3), and Sergei Arakelian (4)

(1) Lomonosov Moscow State University, Moscow, Russia (tatrifon@mail.ru), (2) Stoletovs Vladimir State University, Vladimir, Russia (n1tulenev@gmail.com), (3) Stoletovs Vladimir State University, Vladimir, Russia (matthew_sp@mail.ru), (4) Stoletovs Vladimir State University, Vladimir, Russia (arak@vlsu.ru)

1. Surface water and groundwater interaction model under conditions of huge level of precipitation in catastrophic floods and mudflows for mountain river watershed is introduced. Seismic processes and volcanic activity impact on the formation of disastrous floods due to dramatic change of the pressure field in groundwater horizons, is under discussion for such a triple coupling system, i.e. surface water − groundwater – crack network.
Under the conception we analyze recent (2013) catastrophic water events: the catastrophic floods in Western Europe (May-June, 2013), in the Amur river basin, Russia/China (Aug.-Sept, 2013) and in Colorado, USA (Sept. 12-15,2013). In addition, a separate analysis is carried out for debris event in the Krimsk-city, Caucasus (Krasnodar) region, Russia (July 06-07, 2012).

2. There is a group of problems determined by dramatic discrepancies in water mass balance and other vital parameters, on the one hand, by estimation for different types of atmospheric precipitation (both torrential rain and continuous precipitations) and, on the other hand, for observable natural water events (i.e. catastrophic floods and/or mudflows/debris) on concrete territory. Analysis of many facts result in conclusion that we have the hard comparable/coincidence parameters under traditional conception for discussed events as an isolated/closed (river + rain) runoff-system. In contrast, the reasonable point of view does exist if we take into account the contribution of extra water source, which should be localized in river channel, i.e. functioning of open [(river + rain) + groundwater] flow-system has a principal meaning to understand the events occurrence.

3. The analysis and modeling for the events are carried out by us taking into account the following databases:
(i) groundwater map dislocation, it resources and flow balance in studied areas, especially near the land surface being unstable in hydrological sense by many reasons, as well due to heavy rain stimulating a trigger mechanism for releasing of groundwater;
(ii) the crackness/fracturing structure as a characteristic property for all rocks, being dissecting by totality of cracks/fissures and along which (in the case when a good development crack becomes a fault) a vertical and/or lateral movement (of both groundwater and surface water mass) occurs as a result of excessive strain;
(iii) areas of formation and modification in time of groundwater transit system, and especially the modalities for it exit on surface by different factors including tectonic processes under adjustable conditions for both localization of earthquake epicenters/volcanos activity areas and occurring floods in respect of propagating of seismic waves and dislocation of border for lithospheric plates/magma objects in the river basin region;
(iv) the way of distribution over surface for water flows/fronts in the further, which can be described by nonlinear hydrodynamic approach, e.g. by different classes of solutions for Korteweg-de Vries equation, associated with observable natural phenomena.

4. Monitoring in dynamics of state of hydrostatic/hydrodynamic pressures in underground aquifers (e.g. by artesian wells in comparison with two databases: before and after the events) is an important factor in assessing of acceptable risk for the events. Combining it with monitoring of seismic activity should allow to make a more detailed forecasting and zoning of potentially dangerous areas for such natural disasters.