

“Dry” rivers hydrology on the territory of active volcanism in Kamchatka

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Territories of modern volcanic activity are specific regions including hydrology. The largest volcanic regions on the Russian territory are Avachinskaya and Kliuchevskaya volcano groups.

Special characteristics have rivers flowing down the active volcanoes. Friable volcanic deposits on the slopes and foots of volcanoes determine peculiar features of rivers' hydrological regime, sediment inflow and transport, channel morphology. Rivers carry out large quantity of sediment into the ocean in these conditions.

Upstream of volcanic territories rivers is characterized by maximum slopes; rivers mainly have mountain channel. River sources are at the height of 2000 – 2500 m for Kliuchevskaya volcano group; length of upstream river reach is about 5 km. The similar characteristics for Avachinskaya volcano group are 1400 – 1600 m and 4 km accordingly. Fluctuations of water level and turbidity are anisochronous here (fig. 1).

At the height 1000 – 1500 m rivers flow within lahar valleys. Characteristic is heightened turbidity of the flow here which is determined by maximum rate of suspended sediment runoff. Turbidity and water level fluctuations are synchronous here (fig. 2). Erosion of friable volcanic deposits and steep slopes (about 25 – 60 ‰) contribute capability of “dry” rivers to transport significant amount of suspended sediment even for small water discharges.

Downstream of “dry” rivers is characterized by heightened turbidity as the result of material receipt from upstream feeders. Flowing into rivers forming outside of volcanic slopes “dry” rivers bring a lot of suspended sediment; turbidity trail spreads to deltas.

Characteristic features of volcanic rivers hydrological regime are shown in daily, annual and long-term flow fluctuations. Daily flow fluctuations of volcanic rivers depend on ice and snow melting and transform at the expense of filtration. Water content and sediment flow changes are accompanied with riverbed transformations which rate is the highest one. Within-year variability is also very irregular. During the low-water season most part of volcanic rivers doesn't reach their receiving basins because of high infiltration. The main sediment removal occurs during the flood time; its duration is 3 months for this territory. Fluctuations of high-water, low-water and water-average periods are determined by climatic factors and internal causes. High-water periods are often coincided with volcanic eruptions in winter when huge amount of ice and snow melts. Considerable eruptions are reasons of low-water periods whereas the source of water feeding could be diminished or destroyed.

Temporal averaging of flow fluctuations allows us to estimate sediment yield of “dry” rivers on the basis of regression model taking into account unit discharge of water M_Q , l/sec·km²; catchment area F , km²; coefficient of friable volcanic rocks availability $\frac{F_{vol}}{F}$ on catchment basin.

Estimation is made for 62 basins of Kliuchevskaya and Avachinskaya volcano groups. The total sediment flow with the expense of “dry” rivers into Pacific Ocean from the eastern

coast of Kamchatka is 10.2 mil t/year; sediment inflow from “dry” rivers basins (its area is 5620 km² and about 3% of eastern part of the peninsula area) is 3.5 mil t/year or 35 % of the total sediment flow.

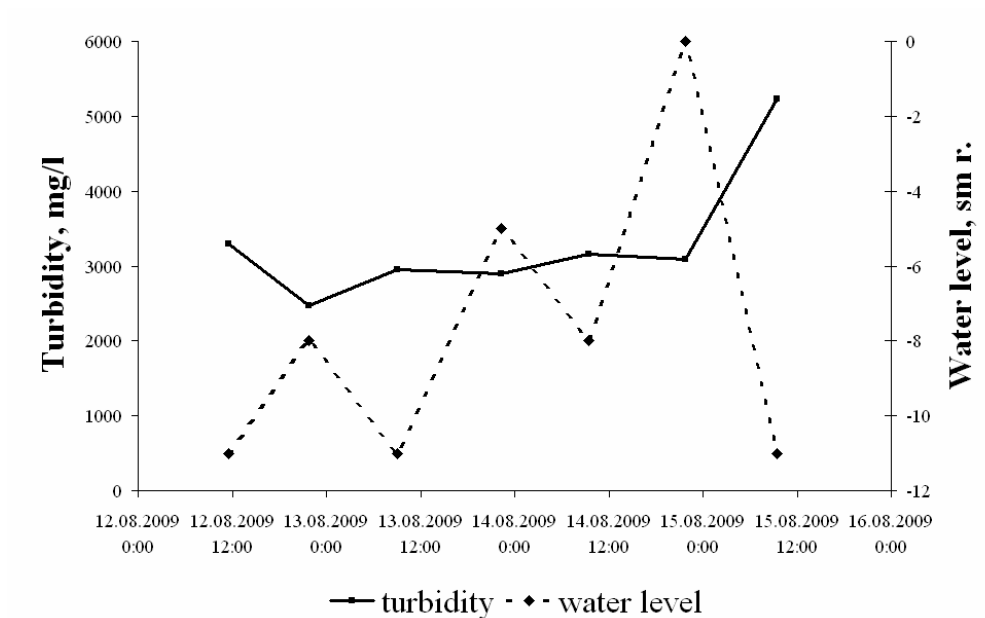


Fig. 1. Diurnal variation of turbidity and water level in the Bilchenok river (Ushkovskiy volcano)

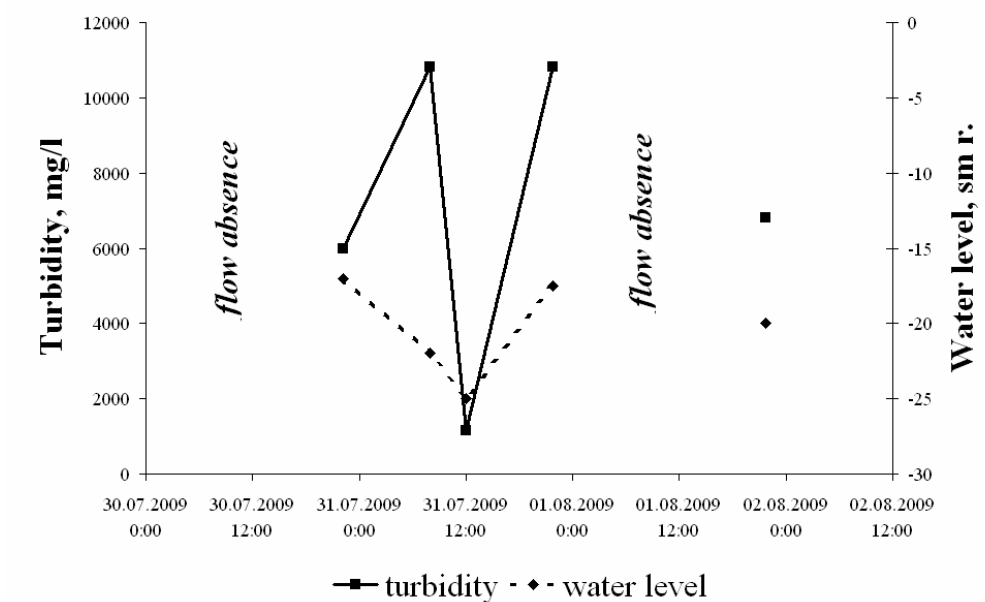


Fig.2. Diurnal variation of turbidity and water level in the Lavoviy river (Kliuchevskoy volcano)