The silting of river-beds and floodplains of minor streams in Udmurtia

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The Udmurt republic is located to the east of the Russian plain, in the southern part of the Vyatka-Kama interstream area within the subzone of southern taiga and the zone of coniferous-broadleaf forest. The area of the republic is 42.1 10^3 km^2. The territory of the republic is noted for a high degree of agricultural assimilation in spite of the forest zone's closeness. But during the last 200 years the main part of the woods had was cut down and the arable area increased up to 40 %. The total area of assimilated territory grew to the south-east. The target of the investigation was to analyze the agents affecting the silting of the river-beds and floodplains of the minor streams.

Methods

River basins of the 3rd order were chosen as the most important research territorial units (according to Straler - Phylosophov). They can be considered as integral geosystems with one descending substance flow from which enter and exit data can be taken into account both quantitavely and qualitatively. On the whole 620 stream basins of the 3rd order and interbasin sections were distinguished in the territory of Udmurtia.

Indexes and parameters affecting characteristics of the anthropogenic load such as drainage and erosion morphometry (quantity, length, average stream flow slopes of the 1-3 orders, depth and thickness of the relief dispersal), the portion of lithological soil varieties in the basin, soil types, vegetation; the extent of basin territory usage (forestation, cultivation, population density, livestock per square meter); as well as pollution sources such as industry, sewage transport and so on were taken into consideration for each basin.

Basin erosion material deposited in the river channel was measured by special tools which allowed us to define its composition and thickness. Repeated measurements (from 5 to 10 at different points) were taken from all aspects of the river channel (deeps, fords, channel shallows). A series of measurements was made at 160 points in 130 streams of the orders 1-5.

The composition and thickness of the floodplain silt were studied in the natural and artificial outcrops. Depositions overlapping well formed hydromorphic soils were considered as silt layer. The presence of glass and ceramic fragments, lignite pieces in it testify that the floodplain silt layer is a young formation both geologically and historically. Its formation was connected with deforestation and land cultivation during the period of intensive agricultural land reclamation started 200-300 years ago.

Short scientific paper

Measurements of the the floodplain silt layer at each point were taken many times taking into account morphologic floodplain features (at higher or lower sections, in the back swamp lowerings and deposited cones of ravines and balkas) in order to define its minimum, maximum and mean thickness. The floodplain silt layer studies were conducted at 138 points in 108 streams of the orders 1 to 5.

ANALYSIS

Bibliography sources on floodplain and river channel silting are limited. According to single author, E.V.Shantser, deeps are characterized by the slowest flows in summer low water and by deposition of thin suspended matter which takes place in them. As a result silting sublayers are formed that can transform into a buried state. As our study showed this phenomenon occurs in streams of the orders 4-5 with an annual average discharge of more than 2 $m^3 s^{-1}$ in Udmurtia. Thus is a deep silting type formed at minor streams of the orders 1-3 with an annual average discharge up to 1 $m^3 s^{-1}$, predominating over otherford silting types. In this case the greatest silt thickness is connected with fords (point bars). In our opinion it is associated with the fact that minor streams with a fast flow (due to considerable sloping) have clean waters during summer low water because of underground sources. That's why only river bed incising into the silt covering formed in the process of matter washing away from the slopes during the spring floods occurs in summer. As a result only fragments of silt covering in this kind of ford remain on the sides of meandering river channels. Thus the formation of deep and ford silt types depends on different phases of the water regime and they can combine under certain conditions.

At a number of streams of the orders 2-3 with an annual average discharge of 1-2 $m^3 s^{-1}$ an almost equal thickness of silt in deeps and fords is marked. In such cases deep-ford or a transitional type of silting takes place. In the rivers where their natural conditions are damaged by pond creation, by straightening of the river beds and by melioration activity, silting is represented by a more or less complete covering, the thickness of which is a little larger compared with that of the natural river channel.

The river bed silting of minor streams in Udmurtia on the whole increases to the south, varying from 0 to 1.5 m. Correlation between anthropogenic load indexes, morphologic characteristics and the thickness of river channel silt is weak (r= 0.3-0.5) because the regional differences of the latter make up the value of one order of magnitude with inside river bed processes. Correlation between silting thickness in the river channels and on floodplains is practically absent (r=0.025) which shows the relative independence of the processes.

In the spatial distribution of silting the leading role belongs to geomorphologic conditions and the composition of surface deposits. The process of silting was greatly influenced by the territorial differences due to geologic-morphologic characteristics and enforced by uneven economic assimilation. In order to study the influence of physico-geographic and socio-economic agents correlation analyses were conducted. The most

stable index of river bed silting is an average silt thickness. The maximum and minimum values are subject to intra-and-inter year fluctuations. The main reason for river bed and floodplain silting is growing basin erosion (soil and ravine) caused by land cultivation.