EGU21-16175
https://doi.org/10.5194/egusphere-egu21-16175
EGU General Assembly 2021
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Sediment connectivity in the Koiyavgan glacier's cirques (Adyl-Su river basin, Caucasus, Russia)

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The highland cirques mostly created by nivation and glacial exaration take large areas in mountains and have a significant role in the sediment transit of the basins. The approximate view on the connection of cirques and low levels in the sediment flow could be given with the sediment connectivity index analysis. We study the spatial distribution of the index for typical ice cirque – the Koiyavgan cirque near the join of the Main Caucasus Range and its offshoot (the Gumachy range). This area is located in the tops of the Adyl-Su valley (left side of the Baksan river basin). In August 2020, we got a high-resolution orthophoto image (13+ cm) and digital elevation model (27+ cm) from aerial photography. The territory located in the elevation range from 3230 to 4022 m. Geological conditions: gneiss, metamorphic shale and basic dark coloured igneous rocks. There is no developed vegetation cover. Typical post-glacial cirques topography includes (top-down): mountain tops, very steep bedrock slopes, colluvial footslopes and fans, cirques bottom (moraine ridges with dividing valleys, craters from melting of the in-moraine covered ice etc.) with fluvial, avalanche and creep post-shaping, and bottom surface break as analogue of riegels in glacial trough valleys. The connectivity index (CI) after Cavalli et al. [2013] is very dependent on initial DEM resolution, from the method for filling mistaken depressions, from window size for computing intermediate geomorphometric variables (e.g. roughness index), from choice in flow impedance variable, from area coverage and terrain diversity and others. We compute connectivity index with the parameters: 1) DEM resolution – 27 cm; 2) impedance variable – terrain roughness index (standard deviation of elevation) with window 7*7 cells; 3) standard filling method used in the ArcMap (filling local depression without any limitations on maximum depth); 4) range of impedance values before normalization (partially related to area coverage) is from 0 to 72 m. In the some buffers from the channel network the connectivity index generally grows in the top-down direction. Greatest spurt of the CI values relates to the cirques low border - the riegel (3300 m asl). There are two levels characterised with low values of the CI: 3550 m and 3750 m. The first one is backside of cirques bottom with relatively low flow accumulation area and low-moderate slopes (0-25°), the second one is mountain tops with high steep slopes, but with lowest flow accumulation. For different geomorphodynamical zones the threshold of IC where sediment transit turns into sediment accumulation has differ values: for example, -2.3 for colluvial fans and -2.5 for alluvial fans (p-value for differences significance « 0.01). Maximum values of CI (quantile: the top-95%) for accumulative positions again are -1.27 and -0.72. Its means, those accumulative

processes areas with different mechanics of the deposition may be delineated with using non-constant CI values only. The potential of sediment flow connectivity modelling for high mountain isn't exhausted, but its application needs wide discussion and calibration.

The study was supported by the Russian Science Foundation (project No. 19-17-00181).