



Modern debris flow activity in southern slopes of Rila Mountain, with an example from the area of Cherna Mesta village

Съвременна проява на кално-каменни потоци в южните склонове на Рила с пример от района на с. Черна Места

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Debris flows are common in mountain regions and described as high mobility flows of saturated debris with rapid to extremely rapid velocities in steep channels, impacting large areas (Hungar et al., 2014). In Bulgaria debris flows were observed in the southern slopes of Stara Planina Mountain (Iliev-Bruchev, Ed., 1994; Gerdjikov et al., 2012), Pirin (Baltakova et al., 2018), Rhodopes (Bruchev et al., 2001), Struma valley (Kenderova, Vassilev, 1997; Kenderova et al., 2013, 2014), Kresna Gorge (Dobrev, Georgieva, 2010; Nikolova et al., 2018), etc.

After the analysis of remote sensing data and results from field work there are evidences for modern debris flow activity in southern slopes of Rila Mountain in the area of Cherna Mesta village, located 5 km NE of the Yakoruda town. The last event occurred on July 26, 2019 as a result of torrential rainfall and mobilization of material in the watershed of Cherna Mesta River. High rainfall rates cause flash-floods, debris flows, rising of the river level (up to 2 m), damage of the main roads (National road II-84 Razlog-Velingrad), disruption of water supply and clogging of water catchments.

Cherna Mesta watershed occupies relatively large area (~100 km²). Three main tributaries form the river (from west to east): Leeveshitsa, Dautitsa and Sofan Dere. River valleys are deeply incised with steep slopes (30–40° and > 40° in some places) covered mainly by forests. The geology of the area is represented by coarse-grained granodiorites and medium-grained biotite granites with Late Cretaceous age (Sarov et al., 2010). In the highest parts the mountain slopes are covered by non-sorted Quaternary glacial sediments with gravel to boulder sizes which also fill the upper parts of the river beds.

In the lower parts of the watershed alluvial sediments consist of unsorted to poorly sorted sand, gravel and boulders formed lateral levees on the river banks or in the stream channels and were typical for debris flow deposits (Fig. 1a, b). In the middle parts of the watershed slopes are steep but in some places were formed recent sediment accumulations (levees and dams – where the slope is shallower). They act like a trap for the material with different size and these unconsolidated sediments could be mobilized in the debris flows in case of extreme rainfall (Fig. 1c). In the upper parts of the watershed river channels incised in the basement and were filled with loose debris material (mainly Quaternary glacial sediments and organic) which acts like a main source of sediment supply for the debris flows (Fig. 1d).

The last debris flow event occurred in the interval 0–3 a.m. on July 26, 2019. Local eye-witnesses from the lower course of the river (at the Cherna Mesta village and north of it) report approximately 2 hours of very high water levels (up to 2 m above the normal one) with at least 2 waves carrying a large amount of decimeter-sized clasts. At the village, no strong rain was described, local people reported extremely heavy rain in the upper part of the watershed, close to the Belmeken artificial lake. The flood event caused severe damages to the forestry roads and also caused undermining of the half of the National road II-84. A field survey was conducted 20 days after the event to document the depositional features in the lower course of the river, north of the village of Cherna Mesta. Further field studies confirm the reports of the local government officials that the main source of debris is the north-



Fig. 1. *a*, very poorly-sorted debris flow deposits in the Cherna Mesta River channel near Cherna Mesta village. Red arrows shows the flood level from last event; *b*, unsorted debris flow deposits with boulder size in Sofan Dere River, before the confluence with Dautitsa River; *c*, river dam and levee formed by debris flow deposits; *d*, river channel from upper part of the Cherna Mesta watershed filled with loose gravel to boulder size sediments and organic material

eastern confluence of Cherna Mesta River – Sofan Dere River.

Loose debris in the river channels, steep slopes and intensive rainfall cause a debris flow activity in Cherna Mesta watershed and infrastructure and property damage in the Cherna Mesta village several times in recent time (1937, 2005, 2010), which speaks for repetitive process and puts the area under significant risk in the future. The area must be further investigated for clear delineation of the initiation zone and the behavior of flows in the transport zone. Future research would be useful for risk management and creation of early warning systems.

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