

DYNAMICS AND CLASSIFICATION OF FLOODS IN THE RIVERS OF THE GREATER CAUCASUS

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Summary. Mudflows represent one of the major natural hazards affecting river basins of the Greater Caucasus, where their dynamics are controlled by the interaction of hydrometeorological conditions, basin characteristics, sediment availability, and anthropogenic pressures. This study investigates the dynamics of mudflow events in the Azerbaijani part of the Greater Caucasus and develops a classification framework for evaluating their potential hazard. The analysis was based on hydrometeorological records and long-term monitoring materials, with particular attention to rainfall intensity and direction, spatial coverage of river basins, and mudflow characteristics. The results indicate that the spatial progression of intense rainfall plays an important role in the development of catastrophic mudflows. Rainfall progressing from the upper mountainous parts of a basin toward the downstream reaches creates particularly favorable conditions for the formation of high-magnitude mudflows, whereas rainfall of comparable intensity progressing in the opposite direction does not necessarily produce catastrophic events. Based on the combined characteristics of rainfall and basin coverage, mudflows were classified into seven groups. The seventh group, in which intense rainfall affects the entire river basin from the high-mountain zone to the lowland reaches, represents the highest hazard level and corresponds to catastrophic mudflow events. The proposed classification provides a basis for differentiating mudflow hazards and may support the selection of appropriate engineering and risk-reduction measures in vulnerable river basins of the Greater Caucasus.

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Introduction

Recent monitoring observations indicate that mudflow activity remains significant in the Greater Caucasus and has also been recorded in rivers where such events were not previously observed. The rivers of the Greater Caucasus provide a particularly relevant setting for mudflow research because the major types of mudflows recognized in existing classifications occur within this region. Unlike conventional floods, mudflows can mobilize and transport large volumes of weathered material accumulated within a catchment over extended periods. Therefore, investigating their hydrological characteristics and flow dynamics is essential for understanding their magnitude and potential hazard.

Previous studies have addressed various aspects of mudflow and flood processes, including mudflow modelling, rainfall-induced slope instability, mudflow dynamics, flood mapping, and the influence of forest cover on runoff and hazard formation (Chen & Wang, 2014; Inaba, 2003; Mills & Paul, 2003; Oğuz et al., 2016; Petrascheck & Kienholz, 2003). These issues have also been investigated in Azerbaijan (Guliyeva et al.,

2019; Mamedov, 2024; Nabiyeu et al., 2019). In particular, the transport of coarse bed material and the development of methods for quantifying sediment movement are important for evaluating mudflow dynamics and identifying their hydrological regularities (Mamedov, 2025).

The Azerbaijani part of the Greater Caucasus is characterized by physical-geographical conditions favorable for hazardous natural processes, including catastrophic mudflows. The mudflow disturbance coefficient of river basins ranges from 0.03 to 0.59, indicating substantial spatial variability in mudflow activity across the region (*Catalogue of Mudflow-Prone Rivers of Azerbaijan*, 2008). The interaction of steep mountainous terrain, hydrological processes, sediment availability, and intense precipitation makes the region particularly important for investigating the mechanisms controlling mudflow formation and development.

Despite previous research on the geomorphological, climatic, and geographical aspects of mudflows, their hydrological dynamics and associated regularities remain insufficiently investigated in the Greater Caucasus. This limitation is partly related to the scarcity of long-term stationary observations, limited instrumental measurements, methodological difficulties in quantitative assessment, and challenging field conditions. In particular, the dynamic characteristics of catastrophic mudflows and the influence of rainfall distribution across river basins require further investigation. Therefore, this study aimed to investigate mudflow dynamics in the Greater Caucasus, with particular emphasis on the erosion, transport, and deposition of mudflow sediments, and to develop a systematic classification framework for assessing mudflow behavior and associated hazards.

Materials and methods

The study was based on hydrometeorological data provided by the National Hydrometeorological Service of the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, together with monitoring materials collected by the Institute of Geography in recent years. A comparative approach was applied to evaluate differences in mudflow dynamics under varying hydrometeorological conditions.

Particular attention was given to the onset, intensity, spatial extent, and direction of intense rainfall across river basins, as these factors were used to assess differences in mudflow formation and development. Rainfall conditions were compared with observed mudflow characteristics to identify patterns associated with the formation of high-magnitude and catastrophic events.

Results and discussion

The Azerbaijani part of the Greater Caucasus is characterized by complex and highly differentiated relief (Imrani et al., 2022). Pronounced altitudinal zonation contributes to considerable spatial variability in climatic conditions, landscapes, soils, and vegetation (Museyibov, 1998). These physical-geographical conditions also influence weathering processes, sediment availability, and the accumulation of transported material within mudflow depositional cones.

The deposition and redistribution of mudflow sediments depend strongly on flow dynamics. High-velocity mudflows generate considerable kinetic energy and hydrodynamic pressure, which affect the transport and deposition of coarse and fine material. To examine these processes, the depositional cones of the Balakanchay, Talachay, Mukhakhchay, and Kurmukchay rivers were selected as representative study sites. These rivers provide relatively favorable natural conditions for examining lateral sediment redistribution because mudflows enter comparatively straight channel sections within their depositional cones.

Field observations suggest that the lateral redistribution of mudflow material may also be associated with the Coriolis effect. In relatively straight channel sections, flow deflection could contribute to transverse asymmetry and influence the distribution of transported sediments between the riverbanks. However, this potential effect should be considered together with local channel morphology, flow velocity, sediment characteristics, and other hydrodynamic factors.

Mudflow dynamics were also strongly influenced by the onset, intensity, spatial extent, and direction of intense rainfall across the river basin. Catastrophic mudflows characterized by high flow velocities and destructive potential were associated with intense rainfall reaching approximately 3 mm min^{-1} and extending from high-mountain mudflow source areas toward the depositional cone. The spatial progression of rainfall affected the mobilization, transport, and accumulation of sediment within the channel and could contribute to the formation of temporary sediment blockages and increased hydrodynamic pressure (Figure 1).



Fig. 1. Flash flood in the Balakanchay River, September 27, 2025

The direction of rainfall progression is therefore an important factor in interpreting mudflow development. When intense rainfall progressively affects the basin from the upper mountainous source areas toward the downstream reaches, runoff and sediment supplied from different parts of the catchment may contribute successively to the main channel. Under favorable conditions, this process can increase the magnitude and destructive potential of the resulting mudflow. In contrast, rainfall progressing in the opposite direction may produce a different sediment-transport response because of the transient characteristics of flow within the river channel. These differences provide an important basis for evaluating mudflow dynamics and for the subsequent classification of mudflow events according to their hydrometeorological characteristics.

The lateral displacement of high-magnitude mudflows within depositional cones may also be influenced by centrifugal and Coriolis effects. In particular, the hydraulic impact generated by a high-velocity sediment-laden flow can be estimated as:

$$P = \frac{1000 FV^2}{g} \quad (1)$$

where P is the hydraulic impact force, F is the area of the sediment-barrier wall (m^2), V is the mean flow velocity (m/s), and g is the acceleration due to gravity (m/s^2).

Under intense rainfall conditions of approximately 3 mm min^{-1} or greater, mudflows originating in the high-mountain zone may substantially increase in volume as they move toward the depositional cone. The resulting high-magnitude flows may exhibit lateral displacement within the channel, potentially reflecting the combined influence of flow momentum, channel geometry, centrifugal effects, and Coriolis forcing. The Coriolis effect on mountain rivers remains subject to uncertainty because these rivers generally have smaller dimensions, confined valleys, and lower discharges than large lowland rivers. Its influence may therefore be negligible during low- and moderate-flow conditions but could become more detectable during exceptionally large mudflow events. Accordingly, the observed lateral asymmetry of catastrophic mudflows in the Greater Caucasus is treated here as a potential hydrodynamic effect rather than definitive evidence of Coriolis forcing alone.

The catastrophic mudflows recorded in the Mukhakhchay and Talachay rivers in 1964 provide evidence of pronounced lateral asymmetry in sediment deposition. In Mukhakhchay, large-diameter boulders were predominantly deposited along the right side of the channel, whereas finer sand and loamy sediments accumulated mainly on the left side (Mamedov, 2014). This spatial differentiation may indicate the influence of transverse hydrodynamic forces, including a potential Coriolis effect, particularly during high-magnitude mudflow events.

Mudflow volumes also varied considerably among years and river basins. According to historical records, the mudflow volume in the Balakanchay River was approximately $372,000 \text{ m}^3$ in September 1932 and reached $1,780,000 \text{ m}^3$ in July 2003. Similarly, the mudflow volume in the Talachay River was approximately $282,000 \text{ m}^3$ in 1964 and reached $4,473,000 \text{ m}^3$ in July 2003 (Mamedov, 2011). These substantial differences may reflect the combined influence of physical-geographical conditions, hydrometeorological variability, and anthropogenic pressure within the river basins.

Field observations indicate that intense rainfall in the upper parts of the basins initiates surface runoff and mobilizes weathered material, while mudflow activity becomes more pronounced farther downstream as runoff and sediment contributions converge within the main channel. After tributaries enter the main river, temporary sediment blockages may form in narrow and curved channel sections. The failure of these blockages can generate high hydrodynamic pressure, contributing to the transformation of high-magnitude flows into catastrophic mudflows.

The 1964 events demonstrate the destructive consequences of this process. The Talachay mudflow caused extensive damage to Zagatala and settlements located farther downstream, while the Mukhakhchay mudflow affected agricultural areas around Mukhakh, Chobankol, Zayam, and Tasmali. In contrast, Gozbarakh, located on the left side of Mukhakhchay, experienced comparatively limited damage. The branch directed toward Mukhakh was characterized predominantly by coarse mudflow deposits, whereas the branch toward Chobankol and Zayam contained a greater proportion of suspended and fine material. In the latter area, sand and clay deposits exceeding 1 m in thickness were recorded. This pronounced lateral differentiation in sediment size and deposition supports the presence of complex transverse flow dynamics during catastrophic mudflows and may be consistent with a Coriolis contribution, although local channel morphology and other hydrodynamic controls should also be considered.

The spatial variability in the hydrodynamic characteristics of high-magnitude mudflows on the southern slope of the Greater Caucasus may also be associated with regional climatic conditions, particularly variations in the degree of continentality (Table 1).

Table 1

Indicators Determining the Degree of Continentality in the Studied River Basins

Location	Absolute elevation, m	Long-term absolute		Latitude, degrees	Temperature amplitude, °C	Cloudiness, points	Degree of continentality
		Maximum temperature, °C	Minimum temperature, °C				
Balakan	400	+37°	-21°	41° 40′	58°	6,6	1,40
Zagatala	487	+38°	-23°	41° 38′	61°	6,4	1,47
Gakh	600	+38°	-23°	41° 20′	61°	6,2	1,48
Sheki	639	+37°	-23°	41° 13′	60°	6,1	1,46
Oghuz	700	+38°	-23°	41° 04′	61°	6,0	1,49
Gabala	781	+37°	-26°	40° 57′	63°	5,8	1,55
Goychay	94	+41°	-16°	39° 15′	57°	5,6	1,46
Aghsu	165	+43°	-17°	40° 35′	60°	5,8	1,49
Shamakhi	750	+38°	-19°	40° 38′	57°	5,9	1,41

Analysis of Table 1 shows considerable spatial variation in the degree of continentality across the southern slope of the Greater Caucasus. The highest value was recorded in Gabala (1.55) and the lowest in Balakan (1.40). With the exception of Sheki, continentality generally increases from Balakan toward Gabala and subsequently decreases toward Shamakhi. This spatial pattern is associated with differences in elevation, cloudiness, precipitation, and temperature amplitude. In particular, the relatively high elevation of Gabala and lower winter cloudiness favor radiative cooling and a greater temperature amplitude. Large temperature amplitudes may intensify physical weathering and consequently increase the availability of unconsolidated material within river basins.

The formation of catastrophic mudflows on the southern slope of the Greater Caucasus is associated with the combined influence of intense rainfall, sediment availability, and basin conditions. Rainfall progressing from the upper basin toward downstream reaches may promote runoff concentration and the formation of temporary channel blockages, whose failure can generate high hydrodynamic pressure. Climatic variability, increasing aridity, and anthropogenic modification of catchment surfaces may further influence mudflow activity. On the northeastern slope, damaging mudflows were also recorded in 2009, affecting orchards and settlements located along river channels.

Precipitation is particularly important for mudflow formation in the study area. At elevations of 1,700–3,600 m on the southern slope of the Greater Caucasus, mean daily precipitation during June–September ranges from approximately 6 to 13 mm, which is reported to be 1.2–1.5 times higher than in other mountainous regions of Azerbaijan. Historical records indicate extreme precipitation totals of 100 mm at Damarjiq and 140 mm at Gabala in 1932, and 171 and 188 mm at Zagatala in 1944 and 1964, respectively. In 1983, precipitation reached 176 mm at Gabizdara, whereas recorded values during 1992–2007 ranged from 15.1 to 119 mm.

The intensity of extreme rainfall events generally ranges from 1 to 3 mm min⁻¹. Such rainfall may affect both lower and high-mountain parts of river basins, resulting in rapid accumulation of runoff. To quantify this process, the river basins were divided into three spatial components and potential water accumulation was estimated for different rainfall intensities and durations. For a rainfall intensity of 1 mm min⁻¹ lasting 30 min, each square kilometre of basin area receives approximately 30,000 m³ of precipitation water. Accordingly, basins larger than approximately 40 km² may receive more than 1 million m³ during such an event. Estimated

volumes reach approximately 15.51 million m³ for a 517 km² basin, 28.56 million m³ for 952 km², and 45.0 million m³ for 1,500 km². The accumulated volume increases further with longer rainfall durations (Table 2).

Table 2

Volume of Water Accumulated in River Basins and Their Elementary Subareas
on the Southern Slope of the Greater Caucasus

No.	River–station	Total basin area and its elementary subareas, F, f ₁ , f ₂ (km ²)	Volume of intense rainfall at 1, 2, and 3 mm/min (10 ³ m ³)								
			volume (10 ³ m ³)			30-min volume (10 ³ m ³)			60-min volume (10 ³ m ³)		
			1 mm/min	2 mm/min	3 mm/min	1 mm/min	2 mm/min	3 mm/min	1 mm/min	2 mm/min	3 mm/min
1	Hamamchay–Ilisu	f ₁ 20,7	21	41	62	621	1242	1863	1242	2484	3726
		f ₂ 41,2	41	82	124	1236	2472	3768	2472	4944	7416
		F 62	62	124	186	1860	3720	5580	3720	7440	11160
2.	Bulanigsu–Saribash	f ₁ 6,8	7	14	20	204	408	612	408	816	1224
		f ₂ 13,6	14	27	41	408	816	1224	816	1632	2448
		F 20,5	20	41	62	615	1230	1854	1230	2460	3690
3.	Aghchay–Aghchay	f ₁ 14	14	28	42	420	840	1260	840	1680	2520
		f ₂ 28	28	56	84	840	1680	2520	1680	3360	5040
		F 42	42	84	126	1260	2520	3780	7520	5040	7560
4.	Eyrichay–Bashdashagil	f ₁ 30,7	31	61	92	921	1842	2763	1842	3684	5526
		f ₂ 61,4	61	123	184	1842	3684	5526	3684	7368	11052
		F 92	92	184	276	2760	5520	8280	5520	11040	16560
5.	Damarjig–Near the mouth	f ₁ 11,7	12	23	35	351	702	1053	702	1404	2106
		f ₂ 23,4	23	47	70	702	1404	2106	1404	2808	4202
		F 35	35	70	105	1050	2100	3150	2100	4200	6300
6	Oghuzchay–Oghuz	f ₁ 10,2	10	20	31	306	612	918	612	1224	1836
		f ₂ 20,4	20	41	61	612	1224	1836	1224	2448	3672
		F 30,6	31	61	92	918	1836	2754	1836	3672	5508
7.	Tikanlichay–Tikanli	f ₁ 40	40	80	120	1200	2400	3600	2400	4800	7200
		f ₂ 80	80	160	240	2400	4800	7200	4800	9600	14400
		F 120	120	240	360	3600	7200	10800	7200	14400	21600
10.	Bumchay–Bum	f ₁ 32	32	64	96	960	1920	2880	1920	3840	5760
		f ₂ 64	64	128	192	1920	3840	5760	3840	7680	11520
		F 96	96	192	288	2880	5760	8640	5760	11520	17280
12.	Damiraparanchay–Gabala	f ₁ 42	42	84	126	1260	2520	3780	2520	5040	7560
		f ₂ 84	84	168	252	2520	5040	7560	5040	10080	15120
		F 126	126	252	378	3780	7560	11340	7560	15120	22680
15.	Goychay–Goychay	f ₁ 493,3	493	987	1480	14799	29598	44397	29598	59196	88794
		f ₂ 986,6	987	1973	2960	29598	59196	88974	59196	118392	177588
		F 1480	1480	2960	4440	44400	88800	133200	88800	177600	266400
16.	Ahohchay–Khanagah	f ₁ 22,1	22	44	66	663	1326	1989	1326	2662	3978
		f ₂ 44,2	44	88	133	1326	2652	3978	2652	5304	7956
		F 66,4	66	133	199	1992	3984	5976	3984	7968	11952
17	Vandamchay–Vandam	f ₁ 23,1	23	46	69	693	1386	2079	1386	2772	4158
		f ₂ 46,2	46	92	139	1386	2772	4158	2772	5544	8316
		F 69,4	69	139	208	2082	4164	6246	4164	8328	12492
18.	Girdimanchay–Garanohur	f ₁ 117,3	117	235	352	3519	7038	10557	7038	14076	21114
		f ₂ 234,6	235	469	703	7038	14076	21114	14076	28152	42228
		F 352	352	704	1056	10560	21120	31680	21120	42240	63360
19.	Sangarchay–Galajig	f ₁ 14,4	14	29	43	432	864	1296	864	1728	2592
		f ₂ 28,8	29	58	86	864	1728	2592	1728	3456	5184
		F 43,2	43	86	130	1296	2592	3888	2592	5184	7776
20.	Aghsu–Aghsu	f ₁ 122,3	122	245	367	3669	7338	11007	7338	14676	22014
		f ₂ 244,6	245	489	734	7338	14676	22014	14676	29352	44028
		F 367	367	734	1101	11010	22020	33030	22020	44040	66060
21.	Pirsaat–Poladli	f ₁ 331,7	332	663	995	9951	19902	29853	19902	39804	59706
		f ₂ 663,4	663	1327	1990	19902	39804	59706	39804	79608	119412
		F 995	995	1990	2985	29850	59700	89550	59700	119400	179100

These calculations demonstrate the strong dependence of potential runoff volume on rainfall intensity, duration, and basin area. Together with sediment availability and channel conditions, these factors determine the magnitude and destructive potential of mudflows. Mudflows are distinguished from conventional floods by their high sediment concentration, greater density, substantial transport of coarse material, and distinct flow dynamics. Therefore, a classification that differentiates mudflow events according to their hydrometeorological and basin characteristics is necessary for hazard assessment and for selecting appropriate risk-reduction measures.

Classification of mudflows

Based on the combined effects of the controlling factors, mudflows were classified according to the spatial extent of intense rainfall within the river basin and the resulting hydrodynamic and sediment-transport characteristics. To ensure comparability among the classes, a constant rainfall intensity of 3 mm min^{-1} and a duration of 2 h were considered. Rainfall progression was evaluated in two principal directions: from the foothills toward the high-mountain zone and from the high-mountain zone toward the foothills.

Class I. Weak mudflows occurring mainly in the lower river reaches when intense rainfall affects the lowland and foothill zones. Their relatively low magnitude is associated with the limited contributing area and comparatively short flow path.

Class II. Mudflows generated when intense rainfall extends from the lowland to the lower-mountain zone. Compared with Class I, the larger contributing area increases surface runoff, sediment transport, and flow energy.

Class III. Mudflows occurring when rainfall affects the area from the lowland to the middle-mountain zone. The larger contributing area results in greater runoff and sediment transport than in the preceding classes.

Class IV. Mudflows generated when intense rainfall extends from the lowland to the high-mountain zone. These events involve a larger proportion of the basin and are characterized by greater sediment transport and higher flow magnitude.

Class V. Mudflows associated with intense rainfall affecting the high- and middle-mountain zones. Although the contributing area may be smaller than in some preceding classes, these events are characterized by a relatively high integrated sediment load and may produce temporary channel blockages whose failure generates strong hydraulic impacts.

Class VI. Mudflows occurring when intense rainfall extends from the high-mountain to the lower-mountain zone. Compared with Class V, the larger contributing area results in greater sediment mobilization and more powerful flows.

Class VII. Mudflows generated when intense rainfall affects the entire basin, from the high-mountain zone to the lowland reaches. These events are characterized by the maximum integrated sediment load and the highest destructive potential and are therefore classified as catastrophic mudflows.

Conclusion

The results demonstrate that river basins of different sizes can generate substantially different mudflow volumes even under rainfall of the same intensity and duration. The proposed seven-class classification indicates a progressive increase in mudflow magnitude as the spatial extent of intense rainfall and the contributing basin area increase. Class VII, in which intense rainfall affects the entire basin from the high-mountain source areas to the lowland reaches, represents the highest hazard level and corresponds to catastrophic mudflow events.

Catastrophic mudflows on the southern slope of the Greater Caucasus are associated with the combined effects of intense rainfall, sediment availability, basin characteristics, and channel processes. Rainfall progressing from the upper mountainous parts of a basin toward downstream reaches can promote rapid runoff concentration, sediment mobilization, and the formation of temporary channel blockages. Failure of these blockages under increasing hydraulic pressure can substantially increase the magnitude and destructive potential of the resulting mudflow. The classification developed in this study therefore provides a practical framework for differentiating mudflow hazard levels and selecting appropriate risk-reduction and engineering measures for individual river basins.

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ДИНАМИКА И КЛАССИФИКАЦИЯ ПАВОДКОВ НА РЕКАХ БОЛЬШОГО КАВКАЗА

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Резюме. Селевые потоки представляют собой одну из основных природных опасностей, характерных для речных бассейнов Большого Кавказа. Их динамика определяется взаимодействием гидрометеорологических условий, природных особенностей водосборных бассейнов, наличия рыхлообломочного материала и антропогенных воздействий. В исследовании рассматривается динамика селевых явлений в пределах азербайджанской части Большого Кавказа и разрабатывается классификационная система для оценки степени их потенциальной опасности. Анализ основан на гидрометеорологических данных и материалах многолетнего мониторинга. Особое внимание уделено интенсивности и направлению перемещения атмосферных осадков, пространственному охвату речных бассейнов и характеристикам селевых потоков. Результаты исследования показывают, что направление пространственного перемещения зоны интенсивных осадков играет важную роль в формировании катастрофических селей. Перемещение зоны осадков от высокогорных участков бассейна вниз по течению создаёт особенно благоприятные условия для формирования мощных селевых потоков. В то же время перемещение осадков сопоставимой интенсивности в противоположном направлении не обязательно приводит к возникновению катастрофических селевых явлений. На основе совокупного учёта характеристик осадков и степени охвата ими территории речного бассейна селевые потоки классифицированы на семь групп. Седьмая группа, характеризующаяся выпадением интенсивных осадков на всей территории речного бассейна — от высокогорной зоны до равнинных участков, соответствует наивысшему уровню опасности и включает катастрофические селевые явления. Предложенная классификация создаёт научно-методическую основу для дифференциации селевой опасности и может использоваться при выборе соответствующих инженерно-защитных мероприятий и мер по снижению рисков в селеопасных речных бассейнах Большого Кавказа.

Ключевые слова: сель, перенос наносов, интенсивные дожди, речной бассейн, природные опасности, Большой Кавказ, классификация селей

BÖYÜK QAFQAZ ÇAYLARINDA SELLƏRİN DİNAMİKASI VƏ TƏSNİFATI

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Xülasə. Sel hadisələri Böyük Qafqazın çay hövzələrinə təsir göstərən əsas təbii təhlükələrdən biridir. Onların dinamikası hidrometeoroloji şəraitin, hövzələrin təbii xüsusiyyətlərinin, sel materialının mövcudluğunun və antropogen təsirlərin qarşılıqlı əlaqəsi ilə müəyyən olunur. Tədqiqatda Böyük Qafqazın Azərbaycan hissəsində baş verən sel hadisələrinin dinamikası araşdırılmış və onların potensial təhlükəlilik dərəcəsinin qiymətləndirilməsi üçün təsnifat sistemi hazırlanmışdır. Təhlil hidrometeoroloji müşahidə məlumatları və uzunmüddətli monitorinq materialları əsasında aparılmış, yağıntıların intensivliyinə və hərəkət istiqamətinə, çay hövzələri üzrə məkan əhatəsinə və sel hadisələrinin xüsusiyyətlərinə xüsusi diqqət yetirilmişdir. Nəticələr göstərir ki, intensiv yağıntıların ərazi üzrə hərəkət istiqaməti fəlakətli sellərin formalaşmasında mühüm rol oynayır. Yağıntıların hövzənin yüksək dağlıq hissələrindən aşağı axın istiqamətində hərəkət etməsi güclü sellərin yaranması üçün xüsusilə əlverişli şərait formalaşdırır. Bunun əksinə olaraq, eyni intensivliyə malik yağıntıların əks istiqamətdə hərəkəti heç də həmişə fəlakətli sel hadisələrinin baş verməsinə səbəb olmur. Yağıntıların xüsusiyyətləri və çay hövzələrini əhatə etmə dərəcəsi birlikdə nəzərə alınmaqla sel hadisələri yeddi qrupa təsnif edilmişdir. Yeddinci qrup intensiv yağıntıların çay hövzəsinin yüksək dağlıq qurşağından düzənlik hissələrinə qədər bütün ərazisini əhatə etdiyi halları birləşdirir və ən yüksək təhlükəlilik dərəcəsinə malik olmaqla fəlakətli sel hadisələrinə uyğun gəlir. Təklif olunan təsnifat sel təhlükəsinin dərəcələr üzrə fərqləndirilməsi üçün elmi-metodoloji əsas yaradır və Böyük Qafqazın sel təhlükəsinə məruz qalan çay hövzələrində müvafiq mühəndis-mühafizə tədbirlərinin və risklərin azaldılması istiqamətində tədbirlərin seçilməsinə kömək edə bilər.

Açar sözlər: sel, gətirmələrin daşınması, intensiv yağışlar, çay hövzəsi, təbii təhlükələr, Böyük Qafqaz, sellərin təsnifatı