Swiss Federal Research Institute
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DIFFERENT SCALES IN EROSIVE EVENTS MAGNITUDE: IMPLICATIONS FOR SEDIMENT MANAGEMENT

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DATA PRESENTATION

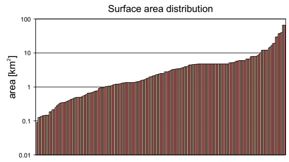
The volume data come from 179 catchments that were active in Switzerland since 1939.

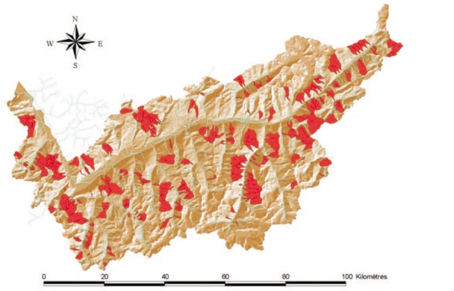
Due to logistic necessity data for instrumented sites come mainly from the Canton Wallis.

Most of the data come from the analysis of events from October 2000.

It is assumed that these features introduce no biais in the analysis. This is reasonable given the diverse geology and the wide variety catchements characteristics. These recent events have been well documented and are more reliable than older data

The median is equal to 2,5 km^2



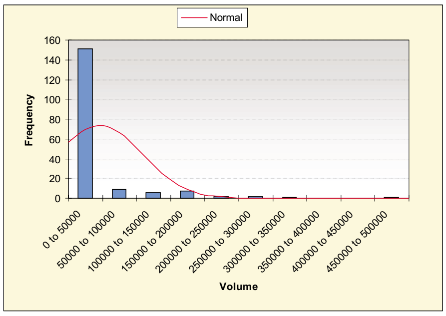


Example of catchment distribution on the Canton Wallis

VOLUME DATA

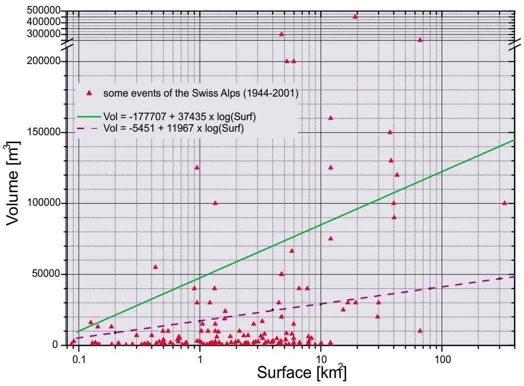
Mean	28'763
Std. error of mean	4'653
Variance	3'876'178'172
Std. Deviation	62'258
Skew	3.524
Kurtosis	14.857
Minimum	50
Maximum	450'000

Highly asymetrical, with a well marked peak, four outliers data (above 250'000 m^3) are recorded. Here we assume that the data can be divided into several populations.



DIFFERENCE IN VOLUME SCALE

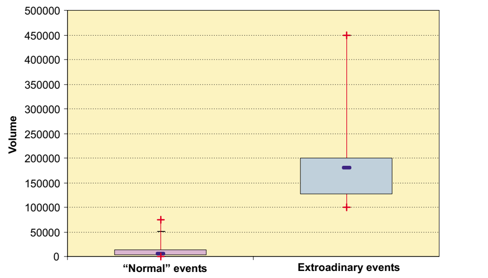
A first visual classification of the event volumes show that at least two families exist in our data, with a transition zone between the green and the purple dashed line.
Note that data for large volumes (< 50'000 m^3) supposed to be exhaustive whereas data for smaller volume are only a sample of the expected events.



By a cluster analysis (classification by Ward's method) a clear distinction can be made between the extraordinary events and the "normal" events, as it is evident on the box& whiskers plot below. In a first approach a limit could be set at 100'000 m^3 to distinguish the two classes of events:

(a) Frequent, smaller-scale events resulting from triggering factors linked with the present catchment predispositions (referred to herein as normal events)

(b) Extraordinarily large, infrequent events resulting from external factors that appear suddenly, enhancing the likelihood of sediment to be moved



DISCUSSION

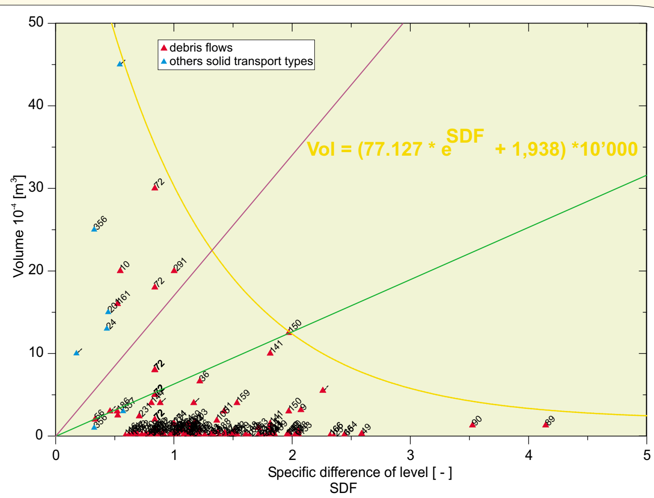
The table below summarize what is known about the causes of the events that are considered to be extraordinary. All these catchments have several other events belonging to the "normal" event family. The analysis done on these low magnitude events show triggering factors similar to the following:

- widespread erosion on the basin
- feeding of the gully by landslide
- internal erosion of the channel
- a combination of some of these triggers

Most of the extraordinary events could be explained by specific causes that change the facility for the sediment being put into movement.

Name	Area [km^2]	Date	Volume [m^3]	Causes
Dorfbach	5.75	14-oct-2000	66'500	Very heavy rainfall over a long period[1]+no previous event for a long period (thus debris accumulation in the channel)
Ritigraben	1.34	24-sept-1993	100'000	Very heavy rainfall over a long period[1]+no previous event for a long period + permafrost thaw
Baltschiederbach	42.64	14-oct-2000	120'000	Very heavy rainfall over a long period[1]+no previous event for a long period
St Barthélémy	12.05	20-july-1930	125'000	Bergsturtz
Saxé	0.94	10-nov-1939	125'000	Heavy rainfall plus likely groundwater discharge via karst features
Täschbach	37.23	15-june-2001	150'000	Lake outburst
St Barthélémy	12.05	11-aug-1927	160'000	Bergsturtz
Illgraben	4.73	3-oct-1995	180'000	Unknown (but possible effect of a rockfall dam)
L'Aboyeu	5.96	30-june-1947	200'000	Unknown
Saasbach	5.22	24-july-1987	200'000	Very heavy rainfall over a long period[1]
Saltina	66.01	24-sept-1993	250'000	Very heavy rainfall over a long period[1]
Illgraben	4.73	6-june-1961	300'000	Lake outburst (lake dammed by a Bergsturz)
Durnagel	19.20	25-aug-1944	450'000	Very heavy rainfall probably influenced by a sagging mass

[1] When heavy rainfall occurs over a long period, it may result in specific discharge 2 to 3 times higher than the predicted 100 year return period rainfall, saturating the soil and increasing the likelihood of an event occurring.



If we plot the same volume data against the specific difference of level (SDF = $\frac{\text{difference of level}}{\sqrt{\text{area}}}$) the existence of at least two families is more apparent. We can see on this plot that it is not the debris flows that produce the largest volume, but the hyperconcentrated flow and bedload transport events. The concentration of these events in the zone of low SDF is consistent with the work of Marchi & Brochot, 2000.
The point 72 between the purple and the green lines is a questionable assessment from a torrent that is not representative of the Swiss watersheds.

Futhermore this representation allows estimation the potential maximum volume based on simple basin characteristics (the specific difference of level). This formula could be of great usefullness for practioners.

Marchi, L. and Brochot, S., 2000. Les cônes de déjection torrentiels dans les Alpes françaises; morphométrie et procesus de tranbsport solide torrentiel. Revue de géographie alpine, 88(3): 23-38