FREQUENCY ANALYSIS OF SEDIMENT DISASTERS

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INTRODUCTION

Risk-analysis depends on frequencies of design-events. Frequency-analysis on sediment disasters are quite difficult to carry out because of the lack of suitable long-term recorded data. But the Austrian "Flood-Protocols" (ANDRECS, 1995) contain such data.

In the presented study, the previous developed method (WEINMEISTER et al. 2004, 2005) is simplified and improved and a tool is developed using statistical software (DataDesk) for calculating of return periods and corresponding magnitudes.

METHOD

The "Flood Protocols" contain among other things volume of deposited material and area size of the torrent catchment. 3490 disaster events in 1999 torrents during 33 years are used for the analysis. For every event the specific deposited volume (sDV [m^3/km^2]) is derived as magnitude by dividing the deposited volume by catchment area size. The procedure follows two steps:

- First the descending sDV's are ranked ascending and the probability of occurrence is calculated by the POT-formula (SALAS et al. 1992) extended by WEINMEISTER (2004). Because the length of the record (3490 events) the probabilities correspond to a record of 3490 years. Therefore an adaption to the record time-span of 33 years is necessary. For this the average occurrence of an event is calculated in the form of division of the number of all events (3490) by the number of torrents (1999) during the time-span (33). This average probability of an event is set in relation to the probability of the mean of sDV and all probabilities are converted by this relation.
- In a second step parameters for the probability distribution are developed. Instead of a common frequency distribution like GUMBEL-distribution and their first and second moment, the parameters of transformed magnitudes and transformed probabilities are used for interpolation and extrapolation of magnitude-frequency pairs. The probabilities are transformed in logarithms, the sDV are transformed in different radicals (roots) depending on an exponent like 0.377 for the "Austrian Standard Torrent" which contains the full data-record. By a linear-regression procedure of the both variables the transformation-exponent of sDV is changed successively until the regression coefficient is a maximum. The slope and the intercept of the regression line are used as parameter for determination of the return-periods. sDV's can be predicted by re-transformation of the corresponding return-periods.
- As refinement for this procedure a mixed regression coefficient is used consisting of the average of the above mentioned regression-coefficient and the regression coefficient derived from the measured deposited volumes and the predicted volumes via predicted sDV's
- Special tools of the software allow the evaluation of regional or other categorical subsets.

The method was developed with the software DataDesk which is now available for Apple-Computer (Mac OS X); I used the old Windows-version.

REMARKS ON sDV AND THE DATA SET

The specific deposition volume could be â problem. Therefore the catchment area size is investigated to show the influence. The logarithms of the area size are normal distributed within a span between 0.1 km^2 and 60 km^2. Only the sDV of very small or very large areas could be problematical within the data-set.

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For the method the randomness and independence of the data are assumed. The homogeneity of the data is problematical because of the combination of different torrents in different geological and climatic conditions. But this weakness exists for all analyses dealing with regions. The stationarity of the sDV's is more or less given. The annual mean of sDV is slightly decreasing, the maxima are slightly increasing.
In general the accuracy of the data is not very high. The deposited volumes are rough estimations. Therefore it seems justified that a rough method – as introduced above – is used.

EXAMPLE

The derivation of return-period magnitude pairs of the "Austrian Standard Torrent", which means the average features of a torrent within Austria, is used to illustrate the procedure. The sDV's are transformed with an exponent 0.377. The linear regression-line has the maximum average regression coefficient of 99.66%. The transformed variables deliver a slope -23.67±0.031 and an intercept -10.03±0.034. In the following table the results for different return-periods are given:

Tab. 1: The sDV of the return period of 100 years is about 15,000 m^3 and corresponds quite well with estimations for the area of the Alps made at a workshop of torrent experts 1987 in Switzerland (10,000 m^3) as reported by SCHLAEPFER & VISCHER, 1988. For the regression procedure the exponent a = 0.377 is used.

Return period [years]	sDV of the Austrian standard torrent [m^3/km^2] all Data
1000	54,600
500	39,200
250	26,900
100	14,800
50	8,400
25	4,100
10	1,000
5	100

Assessments for different regions of Austria show strong differences between glaciated (LGM) and unglaciated (Eastern and Northern parts) areas. The highest values exist in West of Austria, in the area of Salzkammergut and the Southern Limestone Alps.

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