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Nonlinear assessment of time series from rock slope monitoring

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Development of rock slope stability failure could be approached as emergence and development of self-organizing, dissipative complex system. Development of a rock slope failure in time and space domains can be then traced as the features of system dynamics. Assessment of hazard of rock fall occurrence has been for many year based on interpretation of time series from systematic monitoring of on rock slopes in a system of regional rock fall hazard management in NW Bohemia, Czech Republic.. Its monitoring network of dilatometric measurements of relative displacements along rock cracks spreads over 327 localities with more than 900 sites, there. The longest monitoring time series span over 25 years. To assess the time series, methods based on Complex Systems Theory have been used in the last several years.

Selected case histories should demonstrate good feasibility of those methods. They combined topological based approaches by phase portraits, correlograms, and visual recurrence analysis (VRA) together with numerical for fixing of distributions and temporal correlation analyses. The latter include techniques of uni- and multivariate surrogate data with simple phase randomization, fast Fourier transform, the construction method of Schreiber & Schmitz, and the method of information-theoretic functionals– redundancies of Paluš. The intrinsic slope dynamics was characterized using analyses of the residuals obtained from the dilatometric series after removing meteorological influences from them.

The methods used have shown themselves as more sensitive for diagnostic of danger of rock fall occurrence - i.e. enabling early warning in more time, as to be able to find so

far unknown diagnostically important patterns of time series dynamics. The latter had been so far hidden from us, because they had shown themselves as featureless white noise for the currently used, linearly based statistical analytic methods. Forecasting of time series dynamics were also realized by the use of the map of fitting a low order polynomial which maps k nearest neighbors of onto their next values.