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Spatial and scale-dependent variability in data quality and their influence on susceptibility maps for gravitational mass movements in soil, modelled by heuristic method

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For several years now, different methods have increasingly been used to produce susceptibility maps in regarding to for spontaneous gravitational mass movements in soil for regions of different size and different landscape areas. The quality of the produced susceptibility maps are highly dependent on the methods employed, particularly on the quality of the available data (process data and spatial data, for describing the spatial conditions). In general, the larger the area, the more (i) heterogeneous the partial data quality will be and (ii) the poorer the average data quality will be.
A fundamental question is therefore whether susceptibility maps, modelled for large extended areas, are generally applicable to small-extended areas and large-scaled statements.
A simple heuristic Method (developed by GBA) was used area-wide in Lower Austria (Area 1: ca. 20.000 km^2), and in sub-areas of different size (Area 2: ca. 1000 km^2; Area 3: ca. 10 km^2) in order to produce susceptibility maps for spontaneous mass movements in soil. The identification of spatially variable susceptibility was done using area-wide data of the highest quality, which was available in each (sub)area. Internationally recognized methods were used for summarised area-wide validation of the maps produced. “Summarised area-wide validation” (SAW-validation) means one validation for the whole area, without distinguishing different partial sub-area validations.
The resulting susceptibility maps for areas of different size show that:
- Increasingly better SAW-validation results were achieved with decreasing regional extent and concomitant higher data quality (parameter maps (such as digital elevation model and geological map), completeness and localization accuracy of process data). For example, the recognition rate is 60% for Area 1, 50% for Area 2, and 89% for Area 3.
- Fundamentally, however, the validation results obtained for all three areas with different spatial extend can be assessed as good. This was only achieved because the cell size of the respective susceptibility maps was adjusted in each case during calibration to the existing quality of the parameter maps and process data.
- If the susceptibility maps for the larger, more extended areas (Area 1 and 2) are subjected to partial SAW-validation within the scope of the small-extended area (Area 3), the difference in quality between the susceptibility maps becomes very obvious: whereas the susceptibility map produced for the large-extended area provides consistently poor validation results, the results are reasonable for the medium-extended area. However large areas are also declared relatively stable, even though many gravitational mass movements have occurred there.
A comparison between SAW-validations of different extended partial areas clearly demonstrates that there can be apparently good SAW-validations of the respective large-extended area, but this is not necessarily the case in the smaller part-areas. In the case of large-extended areas in particular, this is due both to the spatial variability in the quality of the spatial data as well as the random and selective amount and quality of process data, which is not representative for all partial areas.
This means that using and making statements based on susceptibility maps produced on a large extended area concerning issues for small-extended areas and large-scales is highly dubious and should probably be reassessed. In any case, the cell size of the modelled susceptibility maps should be adjusted to available spatial-data and process-data quality (for example during map calibration), and such adjustment should be oriented towards the partial areas of poorer data quality. This is highly important, in order to prevent misuses (for example invalid “zooming in”) and misinterpretations (for example, the derivation of quantitative statements).