Landslide susceptibility assessment over Europe according to the "Tier 1" approach: Experiment and perspectives

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Background: “Tier 1” approach

“Tiers” in risk area identification as indicated by SIWG (to be applied for soil threats subject to spatial assessment)

<table>
<thead>
<tr>
<th>Tier</th>
<th>Description</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Tier 1</td>
<td>Risk area identification</td>
<td>- Data must be available</td>
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<td>- Low spatial resolution (1:1 Mil.)</td>
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<td>- Qualitative approach, or Model approach combined with thresholds</td>
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<td>Tier 2</td>
<td>Measures/implementation plans within the risk zones</td>
<td>- Higher spatial resolution</td>
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<td>- Any approach (or combinations)</td>
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<td>- Enhanced data need to allow model application</td>
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Eckelmann et al., 2006
Background: “Tier 1” approach

General specifications for “Tier 1” as formulated by the Landslides Working Group

- “Tier 1” to be carried out for the whole of Europe
- Small scale (~ 1:Million), mapping unit: 1 km grid cell
- Use of a reduced, common set of data as conditioning factors already available for the whole of Europe: lithology, slope, and land cover
- Application of a qualitative heuristic indexing approach for landslide susceptibility assessment
- Validation and calibration using representative inventory data for the main geological, geomorphological and environmental scenarios in Europe

Hervás et al., 2008
**Background: “Tier 1” approach**

Common elements proposed in Annex 1 of the draft of the directive

<table>
<thead>
<tr>
<th>SECTION 5 COMMON ELEMENTS FOR THE IDENTIFICATION OF AREAS AT RISK OF LANDSLIDES</th>
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<tbody>
<tr>
<td>Soil typological unit (STU) (soil type)</td>
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<tr>
<td>Occurrence/density of existing landslides</td>
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<td>Bedrock</td>
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<td>Topography</td>
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<tr>
<td>Land cover</td>
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<tr>
<td>Land use (including land management, farming systems and forestry)</td>
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<tr>
<td>Climate</td>
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<td>Seismic risk</td>
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</table>

**Availability from pan-European or global datasets**

- **STU soil type from SGDBE 1M**
  - Does not exist on European level
- **STU parent material from SGDBE 1M**
- **DEM (SRTM 90, SRTM 30, GTOPO30)**
- **CORINE, PELCOM Land cover**
- **LUCAS, European census data**
- **Precipitation: MARS, PRUDENCE**
- **PGA: GSHAP, Earthquake catalogues**

“Tier 1” experiment: Susceptibility map preparation

**Conceptual workflow:**

- Organization and rasterizing (1 km grid cell) of three EU-wide data: lithology, slope, land cover
- Preparation of three susceptibility maps for lithology, slope, land cover through subjective (expert) classification of the input data into five susceptibility levels
- Susceptibility map combination
- Normalization of the combined susceptibility estimate and slicing into five equal-interval susceptibility levels
“Tier 1” experiment: Data and classification

Data

- Lithology
- Slope
- Land cover

Susceptibility classification

- Lithology
- Slope
- Land cover

Susceptibility map

- Expert-based parameter combination
  - Class II: 28.5%
  - Class III: 39.5%
  - Class I: 10.5%
  - Class V: 2.7%
  - Class IV: 18.8%

Area percent of Susceptibility classes
Conceptual workflow:

- Gathering of national landslide location information for European countries where this data is available
- Calculation of bivariate information values for national input data parameter classes for EU countries with landslide information
- Calculation of global parameter class information values for EU countries without landslide information (data gaps) using total landslide inventory
- Spatial merging of national- and EU wide calibrated conditioning factor data, summation of information values on 1 km grid cell
- Classification of merged susceptibility estimate through success-rate evaluation into five classes containing 50%, 25%, 14%, 8%, 3% of landslides
“Tier 1” experiment: Landslide information

European counties with landslide information on a national level

- landslide locations
- landslide density
- no data
“Tier 1”: Perspectives

- Conditioning factor data: Experimental data should be replaced by higher quality available information.

- Landslide information: More information on landslide locations to be used at the 1:1 Mil. scale should be collected.

- Triggering factor data: Data on seismicity and climate should be incorporated for higher level susceptibility mapping.

- Calibration: Model calibration should be done for main geomorphological/climatographical regions of Europe and extrapolated over areas without landslide information.