Soil degradation and salinisation

Objective

To create maps of the 25 member states of the EU, showing the risk of soil degradation and salinisation for scenarios that differ with respect to land use and climate

Assumptions

Since soil erosion is a complex process, many simplifying assumptions are needed to produce a map of erosion risk for Europe in a short time period. The most obvious is that at this scale it is not possible to take much process knowledge into account; methods need to be quite simple.

Method

In recent years, several erosion assessments have been conducted for Europe, although these usually do not encompass all of EU25. The most recent methods that have been developed are the INRA and PESERA methods. The INRA method is based on a decision tree, which uses 4 input maps: slope, land use, soil and climate. It was first applied to France (Le Bissonnais et al., 2001), and afterwards also to Europe (http://rea.ei.jrc.it/netshare/grimm/erosion/inra/europe/analysis/maps_and_listings/web_erosion/index.html). Figure 1 shows the concept of the INRA method, while figure 2 shows the decision tree that is used. PESERA is a more complicated model that simulates erosion using process-based descriptions. Both models were developed for datasets with 1-km resolution. Because of the limited time available, and because of copyrights issues surrounding PESERA, it was decided to use the INRA method. To use this method, the decision tree (figure 2) was slightly adapted as the CLUE land use maps have somewhat different units than the INRA land use map.
Neither INRA nor PESERA simulate salinisation risk. Nor were data about it available at JRC. Therefore, a very simple method was developed that assumed that salinisation risk consists of 3 parts: elevation (below sea level), soil type (salt containing soils), the balance between precipitation and evaporation (evaporation more than 10% larger than precipitation). If none of these 3 factors are present, salinisation risk is assumed to be absent, if one is present, it is assumed moderate and if 2 or 3 are present it is assumed high.

Current and historical situation

Figure 3 gives the current erosion risk for Europe, as determined with the INRA method. As can be seen it gives data for most of the EU25 countries, but not for Sweden, Finland and Cyprus.

Input (data sets)

The land use maps provided by CLUE were used as input for the scenario simulations. Climate scenarios were provided by IMAGE. The other input data for the INRA method was assumed not to be changing, therefore existing slope map and soil map were used. All these data are in raster format, so that no vector-raster conversions are needed. The analysis is done for all of EU25.

Results

In general, soil degradation decreases for all scenarios, but there are differences. Most profit is in Southern Europe, where the bad current situation improves most. In Central Europe there is a bad situation as well, but shows only a minor improvement (improving with same sequence in scenarios). This causes that differences are less pronouced in the EU10 countries in comparison with the EU25.
For salinisation, the general trend is that the risk in 2000 is highest in the Mediterranean area, small in Eastern Europe and no risk in Northern and Western Europe. Along the shore, there are some areas potentially in risk due to seawater intrusion (e.g. western part of the Netherlands) and a small area in Hungary, France and Spain is potentially in risk due to saline soil types. The difference in salinisation risk between north and south Europe is increasing for the 2010, 2020 and 2030 scenarios. This is totally due to the foreseen climate change. The northern part is getting wetter, whereas the southern part is getting drier. Differences between scenarios within one year are minor.

Output

Ordinal maps of erosion risk and salinisation. The maps are in raster format, but can be converted to vector format for presentation purposes.

Legend

Soil erosion risk in 5 ordinal classes:
1. very low erosion risk
2. low erosion risk
3. moderate erosion risk
4. high erosion risk
5. very high erosion risk

Salinisation risk in 3 classes:
1. no salinisation risk
2. moderate salinisation risk

high salinisation risk

Resolution of output

1x1 km pixels, that can de-aggregated to larger units such as catchments or NUTS regions

Accuracy

The results are at 1x1 km pixel scale. It should be realised that the DEM that is used also has 1-km resolution, and can therefore not be expected to give very accurate slope angles. For the other input maps (like soil and land use) each pixel will be assigned a single value, which is a generalisation of reality.

Conclusions

In general, soil degradation decreases for all scenarios, but there are regional differences in amount of decrease. The difference in salinisation risk between north and south Europe is increasing for the 2010, 2020 and 2030 scenarios. Differences between scenarios within one year are minor.

References

Le Bissonnais, Y., C. Montier, M. Jamagne, J. Daroussin, D. King. 2001. Mapping erosion risk for cultivated soil in France. Catena 46 (2001) 207-220

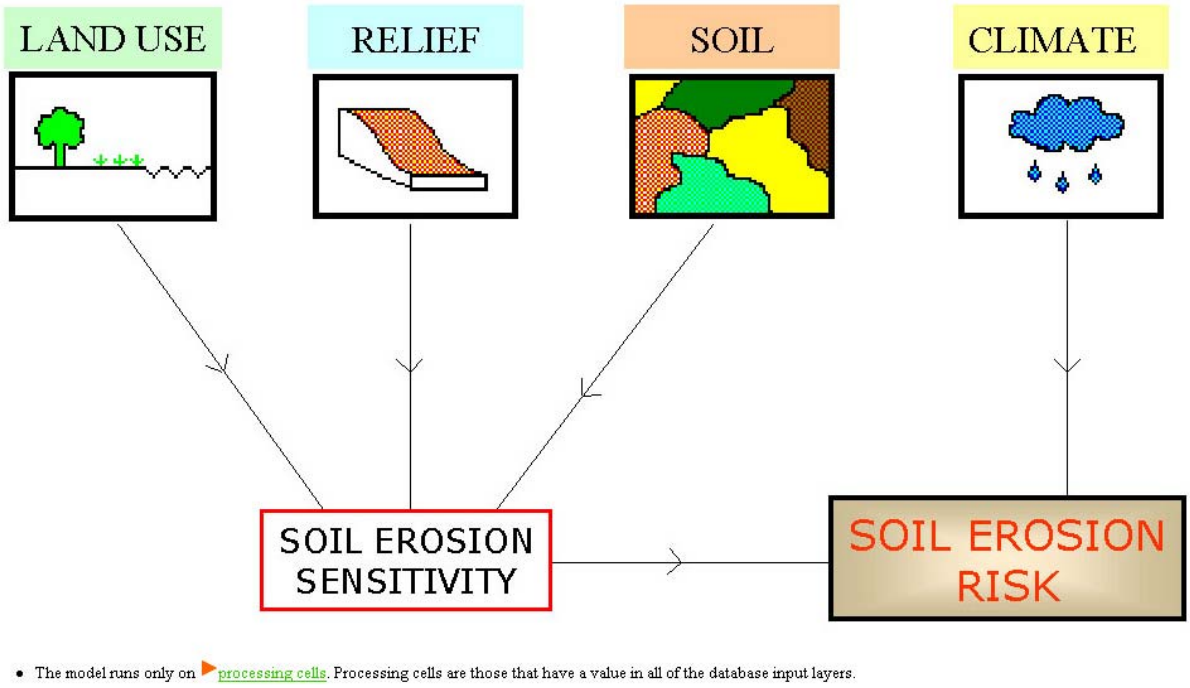

Figure 1. Concept of INRA method

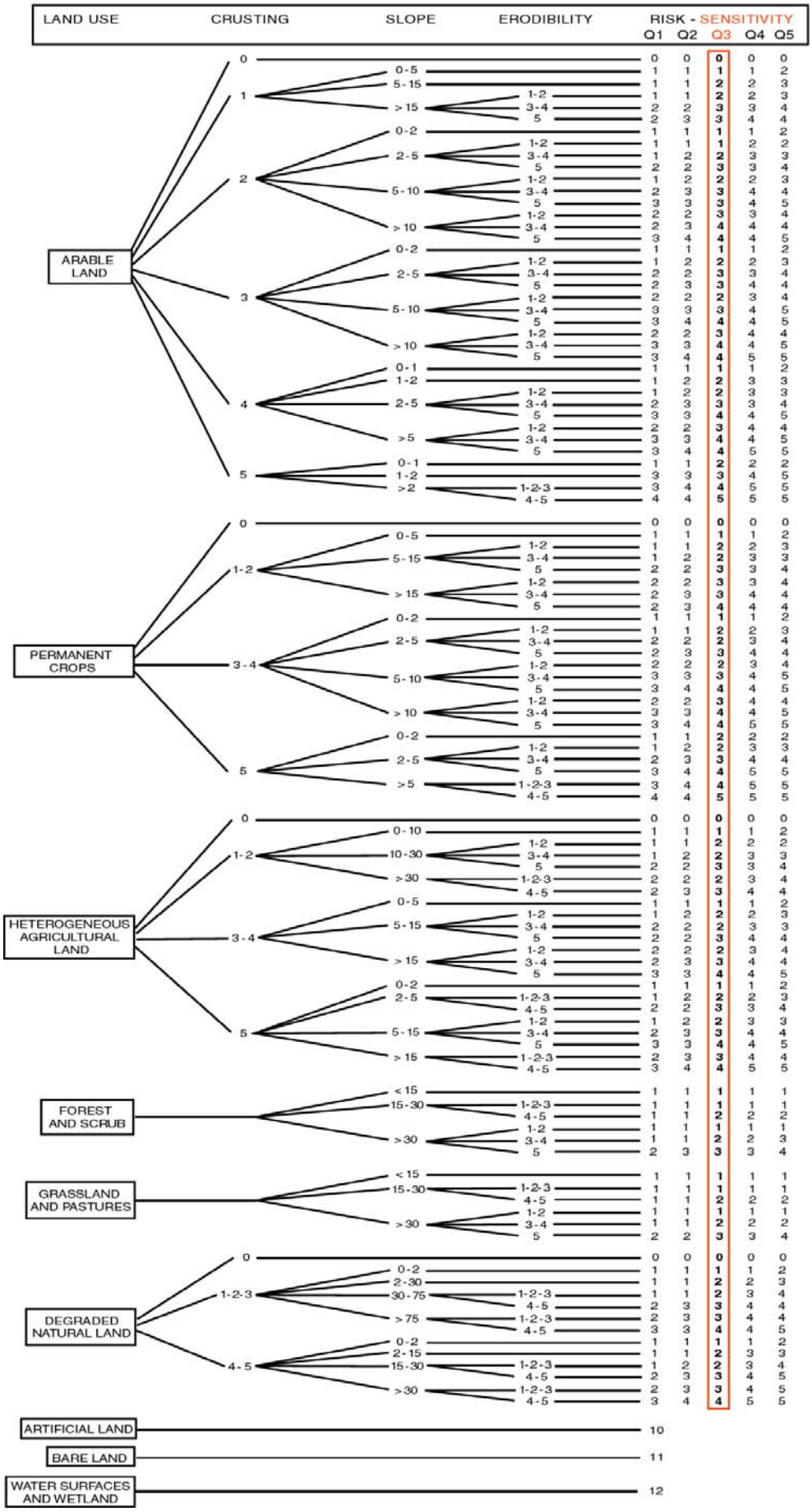

Figure 2. Decision tree of the INRA method

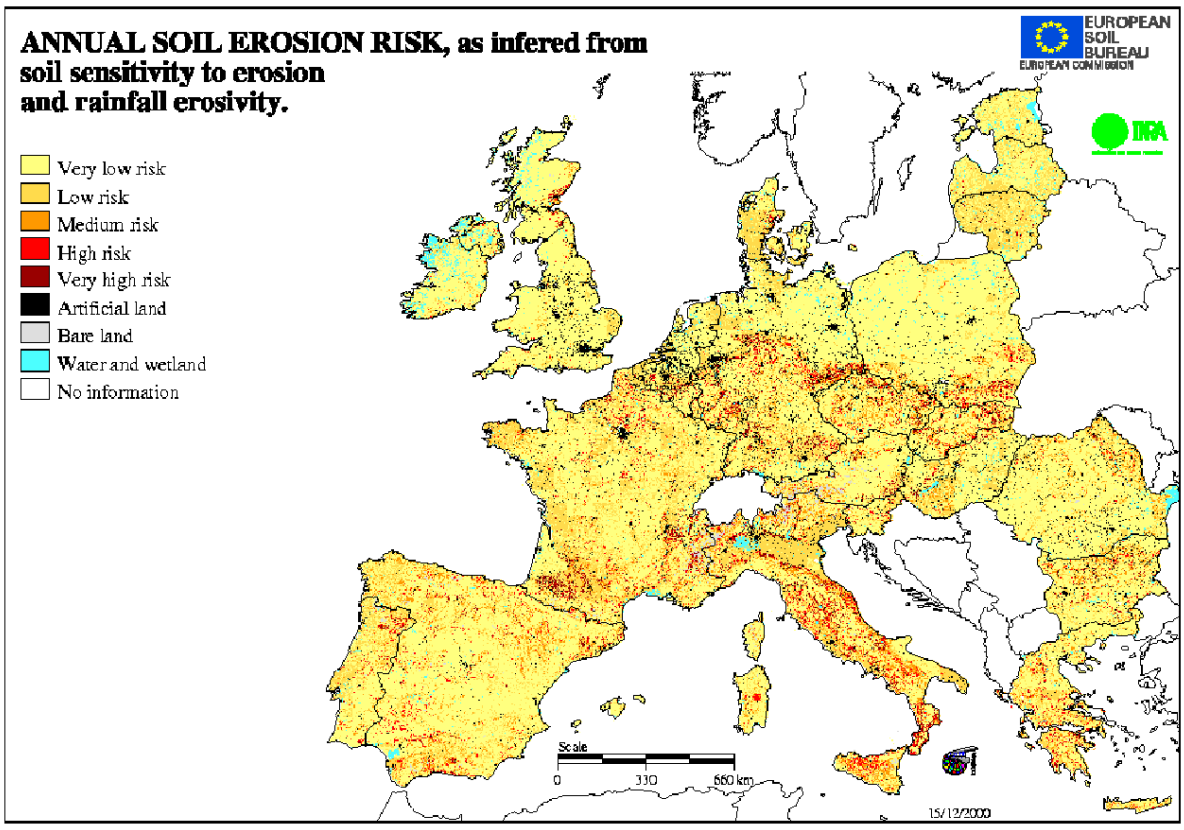

Figure 3. Current erosion risk in Europe, INRA method