

**Recommendations for establishing Action Programmes under Directive 91/676/EEC  
concerning the protection of waters against pollution caused by nitrates from agricultural sources  
Contract number N° 07 0307/2010/580551/ETU/B1**

**Appendix 2 of Part A**

**Maps of pedo-climatic zones in Europe**

**December 2011**

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## Executive Summary

This Appendix 2 is part of the study “Recommendations for establishing Action Programmes under Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources” (Contract N° 07 0307/2010/580551/ETU/B1). The general objective of this study is ‘to build further on the study of ERM (2001), to cover EU-27 and take into account the most recent relevant scientific and technical data on nitrogen emissions, agricultural practices and environmental and climatic conditions’. The outcome of this study should provide useful inputs for a better implementation of the Nitrates Directive across the whole EU-27.

The study consists of four parts:

**Part A:** Review and further differentiation of the pedo-climatic zones in Europe: definition of pedo-climatic (sub) zones

**Part B:** Detailed analysis of the link between farming practices and the risks for leaching/run off towards waters and eutrophication processes

**Part C:** Detailed analysis of the processes in the soil (surface and subsoil) that influence nutrient leaching and run off that could lead to pollution of waters and eutrophication processes

**Part D:** Recommendations for the measures referred to in Annex II and Annex III of the Nitrates Directive, differentiated for each pedo-climatic (sub) zone.

This Appendix 2 presents maps of pedo-climatic zones in Member States of the EU-27. It is the Annex of the Part A report, in which the pedo-climatic zones are described in detail. Here, a brief summary is provided.

The pedo-climatic zones have been based on two separated layers of information. The first layer of information is the environmental stratification: the Environmental Zones (EnZs). The second layer of information deals with the surface run-off risk potential and nitrate leaching risk potential, which are based on a combination of land, soil and climate factors (ie. pedo-climatic information). These two layers of information have been combined into two maps, showing the surface run-off risk potential and nitrate leaching risk potential for each EnZs, respectively.

Table S1 briefly describes the 13 distinguished EnZs. Figure S1 shows a map of the Environmental Zones (EnZs) in Europe.

*Table S1. The 13 Environmental Zones (EnZs) as the first layer of information for pedo-climatic zonation in Europe.*

Nr	Environmental Zone	Main locations and characteristics
1	Alpine North (ALN)	Scandinavian mountains; these have been named Alpine north, because they show environmental conditions as the Alps on a higher latitude, but in lower mountains.
2	Alpine South (ALS)	The high mountains of central and southern Europe that show the environmental conditions of high mountains. Also small Alpine patches are found in mountain areas in Pyrenees and Carpathians.
3	Atlantic North (ATN)	The area under influence of the Atlantic ocean and the North sea, humid with rather low temperatures in summer and winter, but not extremely cold.
4	Atlantic Central (ATC)	The area with moderate climate where the average winter temperature does not go far below 0°C and the average summer temperatures are relatively low. This is a main agricultural production zone in EU-27.
5	Boreal (BOR)	The environmental zone covering the lowlands of Scandinavia
6	Continental (CON)	The part of Europe with an environment of warm summers and rather cold winters. This is a main agricultural production zone in EU-27.
7	Lusitenean (LUS)	The southern Atlantic area from western France to Lisbon. Here, summers are rather warm and sometimes dry, while winters are mild and humid. This is a main agricultural production zone in EU-27.
8	Mediterranean North (MDN)	The Mediterranean north represents the major part of the Mediterranean climate zone with Cork Oak, fruit plantations and Olive groves
9	Mediterranean Mountains (MDM)	These mountains are influenced by both the Mediterranean and mountain climates.
10	Mediterranean South (MDS)	This zone represents the typical Mediterranean climate that is shared with northern Africa, short precipitation periods in winter and long hot, dry summers.
11	Nemoral (NEM)	The zone covering the southern part of Scandinavia, the Baltic states and Belarus. This is a main agricultural production zone in EU-27.
12	Pannonian (PAN)	This is the most stepic part of Europe, with cold winters and dry hot summers. Most precipitation is found in spring.
13	Anatolian (ANA)	Represents the steppes of Turkey, a Mediterranean stepic environment.

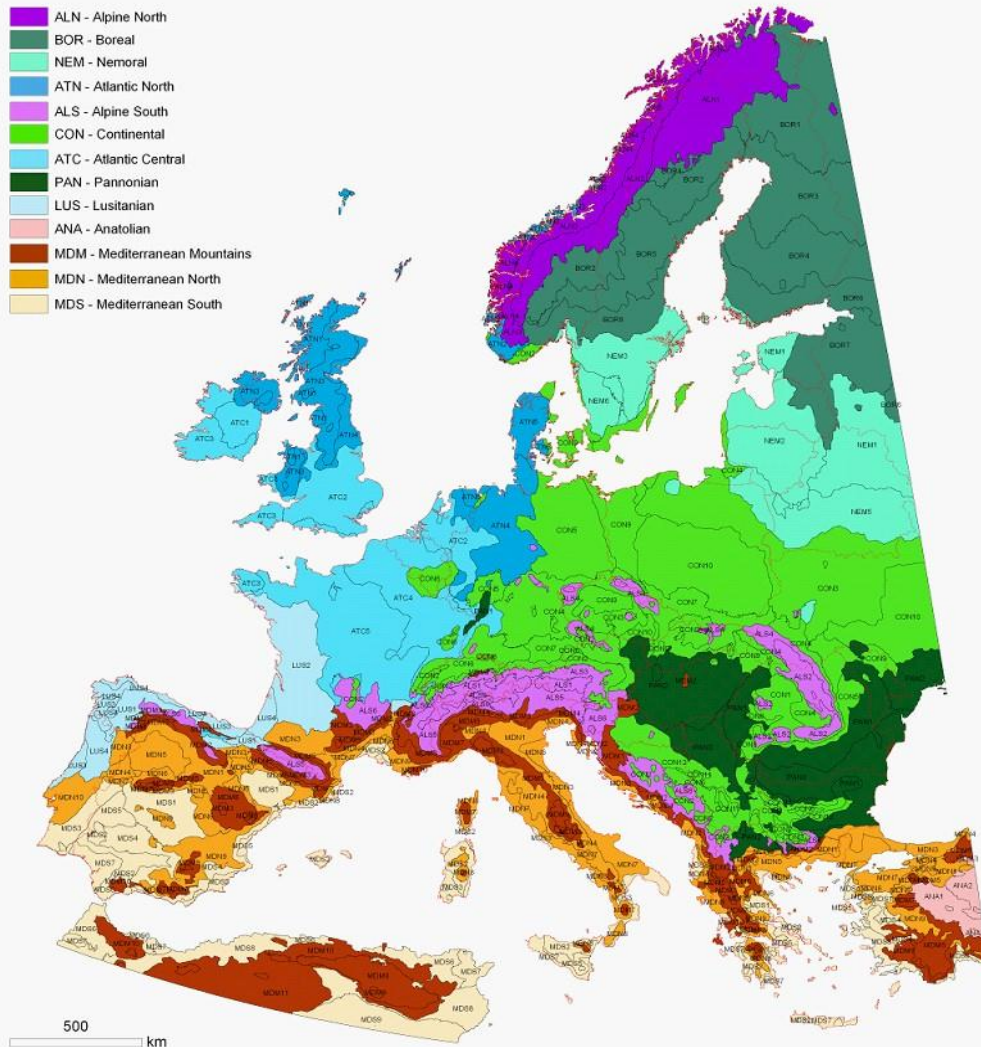
*Figure S1. The Environmental Stratification of Europe (EnZs) (Metzger 2005).*



# Environmental Stratification of Europe

## Environmental Zone

- ALN - Alpine North
- BOR - Boreal
- NEM - Nemoral
- ATN - Atlantic North
- ALS - Alpine South
- CON - Continental
- ATC - Atlantic Central
- PAN - Pannonian
- LUS - Lusitanian
- ANA - Anatolian
- MDM - Mediterranean Mountains
- MDN - Mediterranean North
- MDS - Mediterranean South



The second layer of information is based on soil-related factors, which basically overlay the EnZs. The soil-related risk areas hold for all EnZs. Important soil-related factors have been summarized in Table S2 here below.

The map of the Environmental Zones (EnZs) has been combined with the map of the utilized agricultural area and with maps indicating the land, soil and climate factors that determine the surface runoff risk potential and the leaching risk potential. This combination has resulted in a pedo-climatic zoning that show the surface runoff risk potential (Figure S2) and the leaching risk potential (Figure S3) for utilized agricultural land within the Environmental Zones. Three classes have been distinguished for the surface runoff risk potential and the leaching risk potential: low, medium and high.

Note that there are uncertainties related to the maps of utilized agricultural area and the soil and geomorphological maps underlying the surface runoff risk potential (Figure S2) and the leaching risk potential (Figure S3). Hence, these maps have to be used with care, especially when used at a regional scale.

Finally, maps of the surface runoff risk potential and the leaching risk potential are presented for the Member States of the EU-27. These are not further discussed here.

*Table S2. Soil-related factors that determine the surface runoff risk potential and the leaching risk potential in Environmental Zones.(see also part B of this Report)*

Nr	Soil factor	Characteristics, classes and potential risks
1	Slope	<p>Slope determines the risk for overland flow; the risk increases with increasing slope.</p> <p>Flat: 0 to 2%; negligible risk</p> <p>Rolling: 2 to 8%; moderate risk</p> <p>Sloping: 8 to 15%; high risk</p> <p>Moderately steep: 15 to 25 %; very high risk</p> <p>Steep (&gt;25%); extremely high risk</p>
2	Depth	<p>Soil depth determines the crop growth potential and drainage characteristics.</p> <p>Shallow (&lt; 40 cm); very high risk, especially when karst in subsoil</p> <p>Moderate (40-80 cm); high risk, especially when karst in subsoil</p> <p>Deep (80-120 cm); moderate risk</p> <p>Very deep ( &gt; 120 cm); low risk</p>
3	Texture	<p>Soil texture determines water and nutrient retention capacity, structure, and hydrological conductivity</p> <p>Heavy clay (clay &gt; 35%); relatively high risk for overland flow</p> <p>Loamy-clay (≤35% clay and &lt; 65% sand); relatively low risk</p> <p>Coarse (&gt; 65% sand and &lt;8% clay); relatively high risk for downward leaching</p>
4	Structure	<p>Soil structure determines root growth, hydrological conductivity, drainage, vulnerability to erosion.</p> <p>no slaking and cracking; low risk to overland flow and preferential flow</p> <p>slaking soils; high risk to overland flow</p> <p>cracking soils; high risk to preferential flow</p>
5	Organic matter	<p>Soil organic matter content determines nitrogen supply and nitrate removal through denitrification</p> <p>Peat soils; &gt;15% organic matter in top 40 cm; high risk for denitrification and mineralization</p> <p>Organic-rich soils; 5 - 15%: moderate risk for denitrification and mineralization</p> <p>Organic-low soils; &lt;5%: low risk for denitrification and mineralization</p>
6	Cover	<p>Soil cover determines evapotranspiration and the vulnerability to erosion.</p> <p>Bare soil: no green cover for &gt;1 month per year; high risk for runoff and leaching</p> <p>Soils with green cover for more than 11 month per year; low risk for runoff and leaching</p>
7	Frost	<p>Soils with frozen soil layers have very low water infiltration rate and hydrological conductivity:</p> <p>no frost in soil; low risk for runoff and leaching</p> <p>frozen top soil and/or frozen subsoil, including soils with snow cover; high risk for runoff and leaching;</p>
8	Buffering	<p>Buffering indicates the presence of terraces, tree-lines, buffer zones, riparian zones.</p> <p>no buffering; no opportunity for retention of leached nutrients and soil</p> <p>buffering; opportunity for retention of leached nutrients and soil</p>

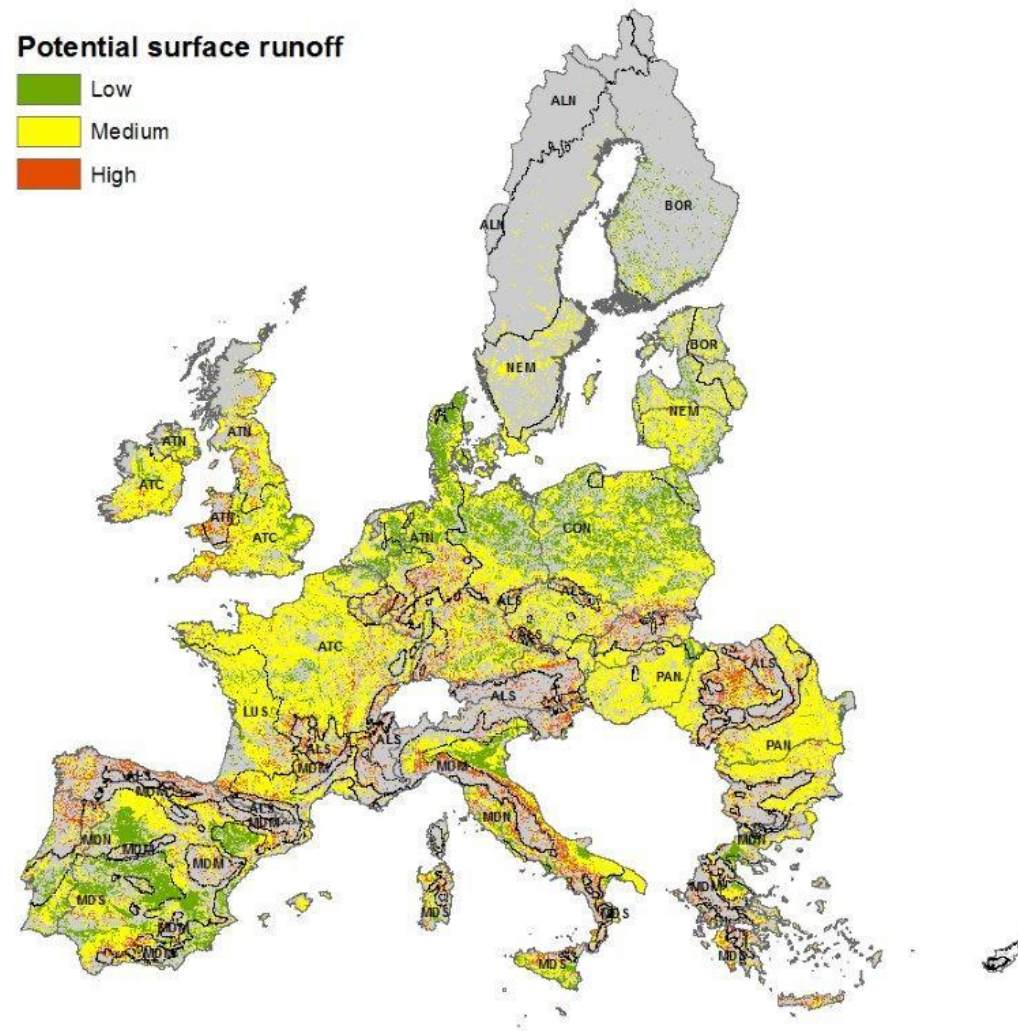


Figure S2. Map showing the surface runoff risk potential for agricultural land within the Environmental Zones in the EU-27. Abbreviations of the Environmental Zones are explained in Figure S1 and Table S1. Note that grey areas indicate non-agricultural areas.

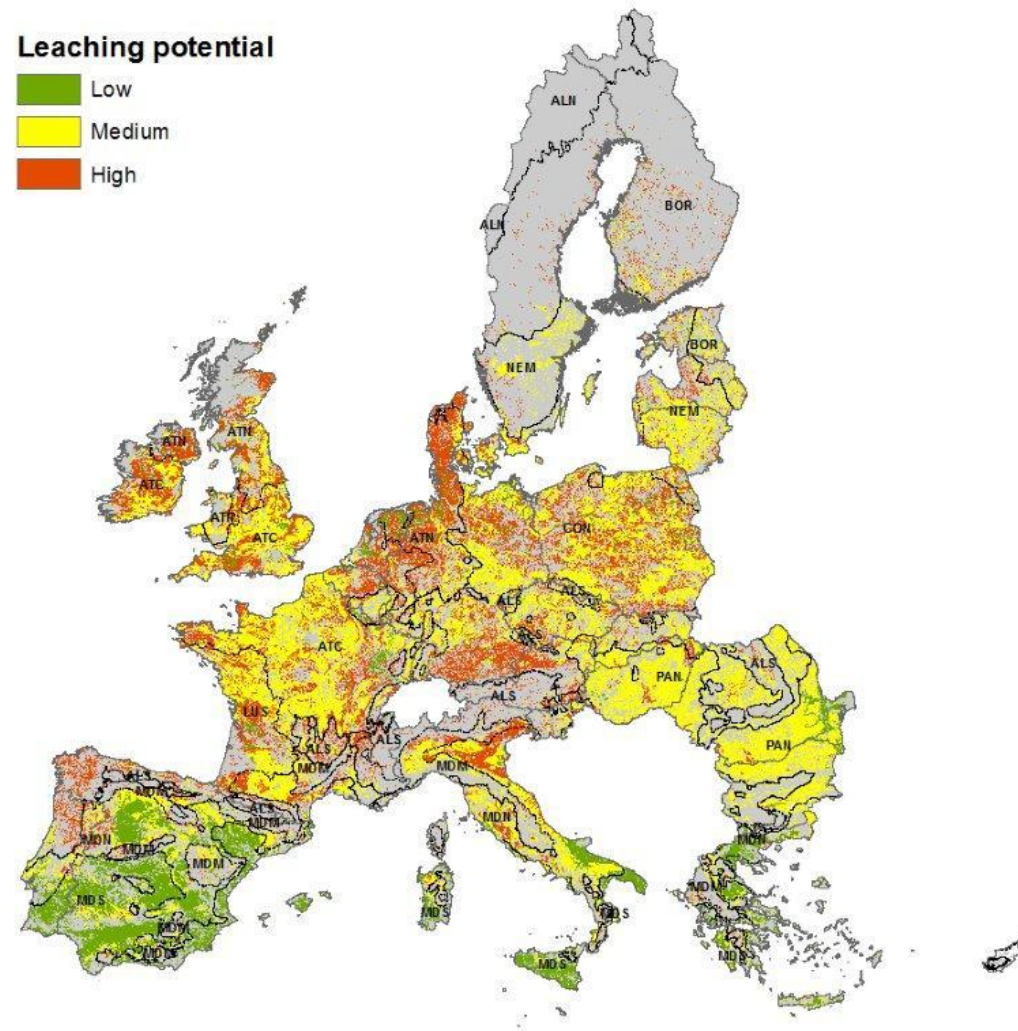


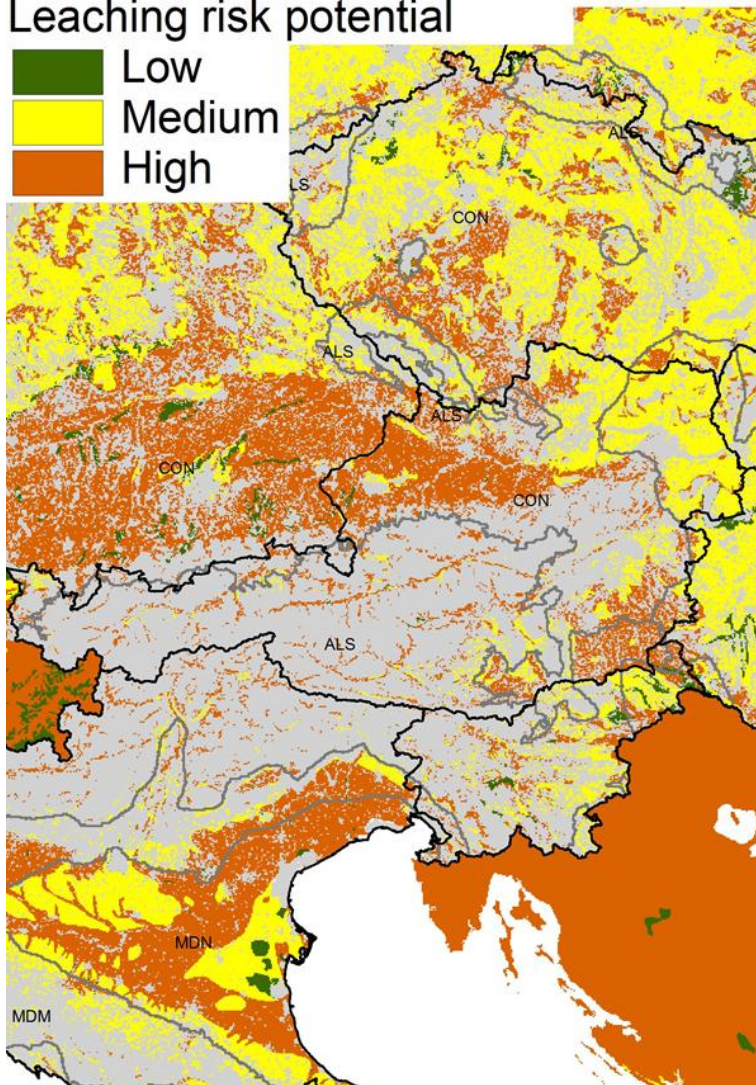
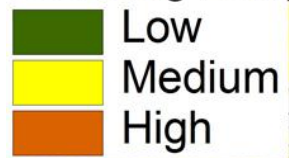
Figure S3. Map showing the leaching risk potential for agricultural land within the Environmental Zones in the EU-27. Abbreviations of the Environmental Zones are explained in Figure S1 and Table S1. Note that grey areas indicate non-agricultural areas.



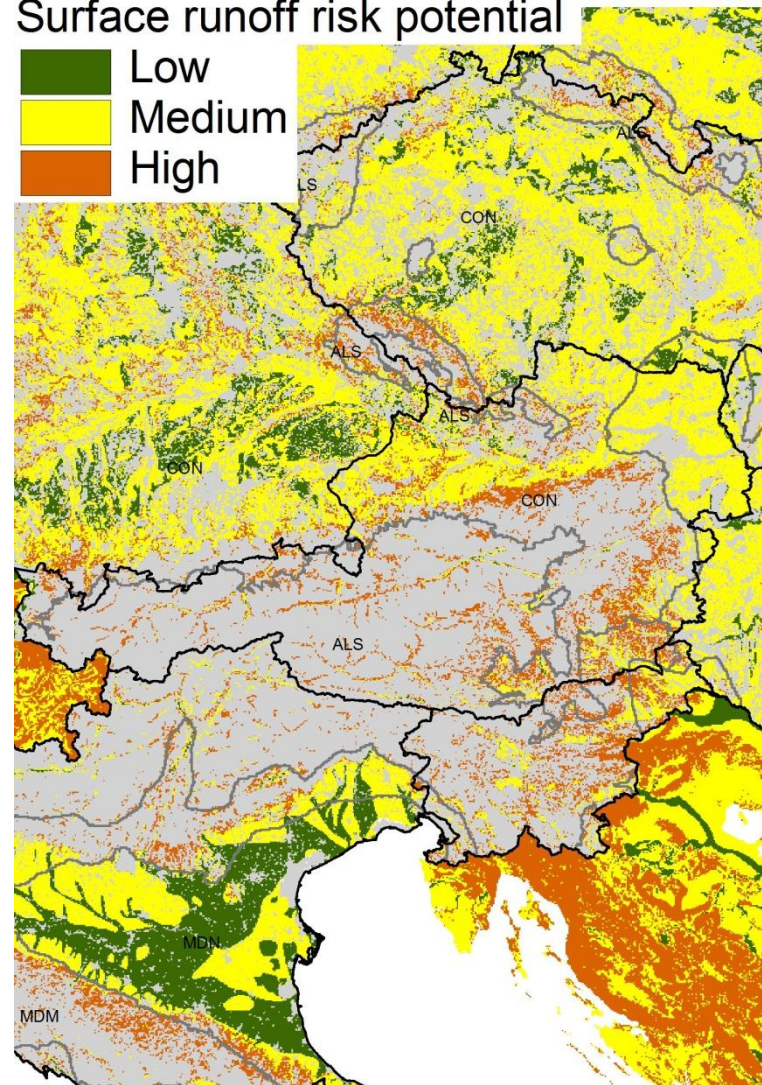
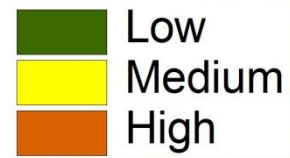


Austria

### Leaching risk potential



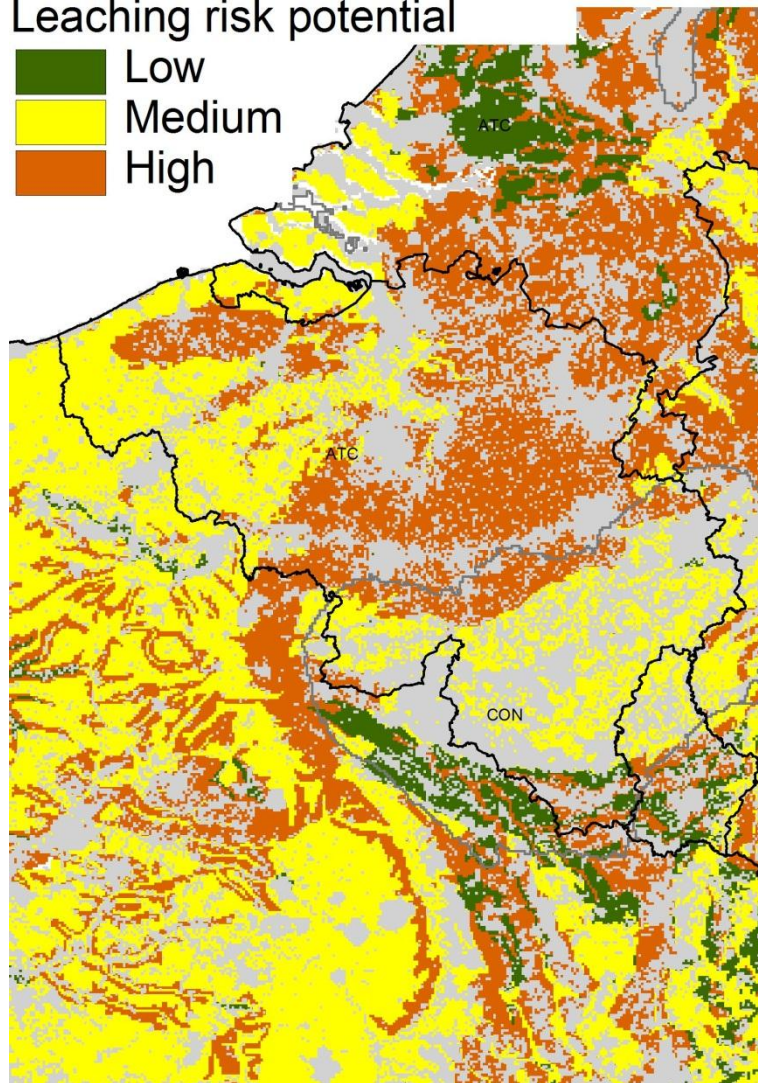
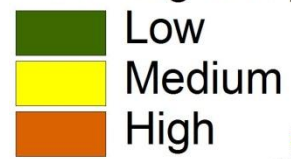
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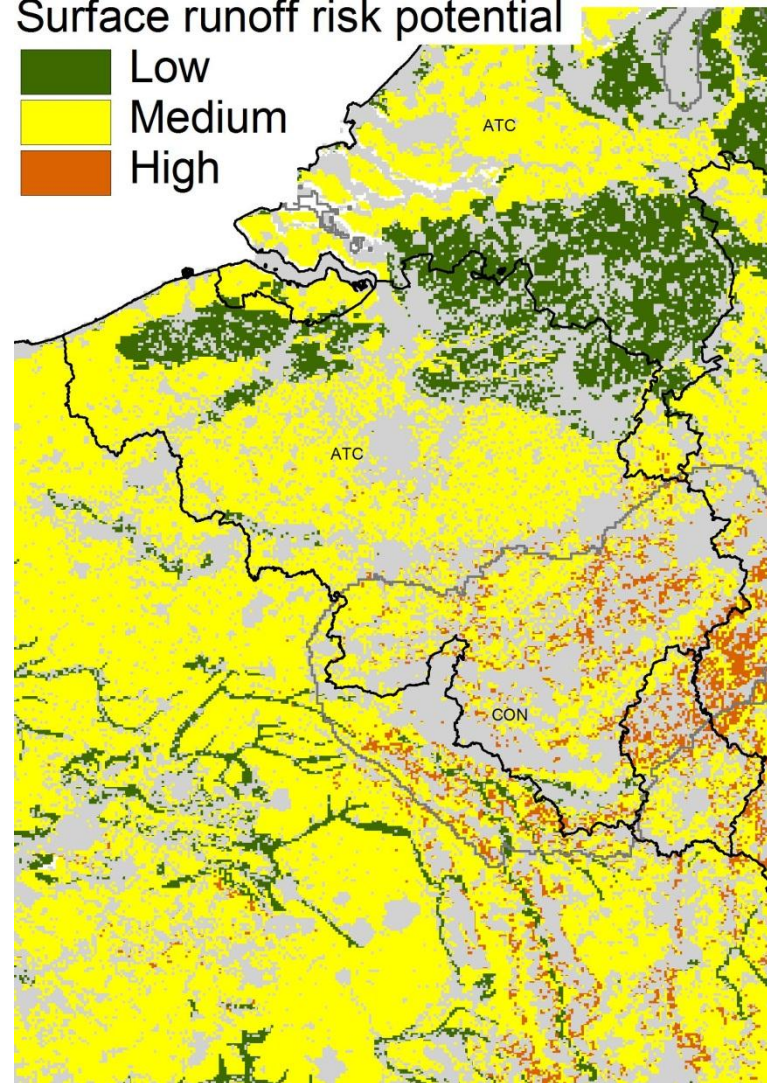
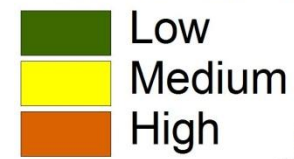


Belgium

### Leaching risk potential



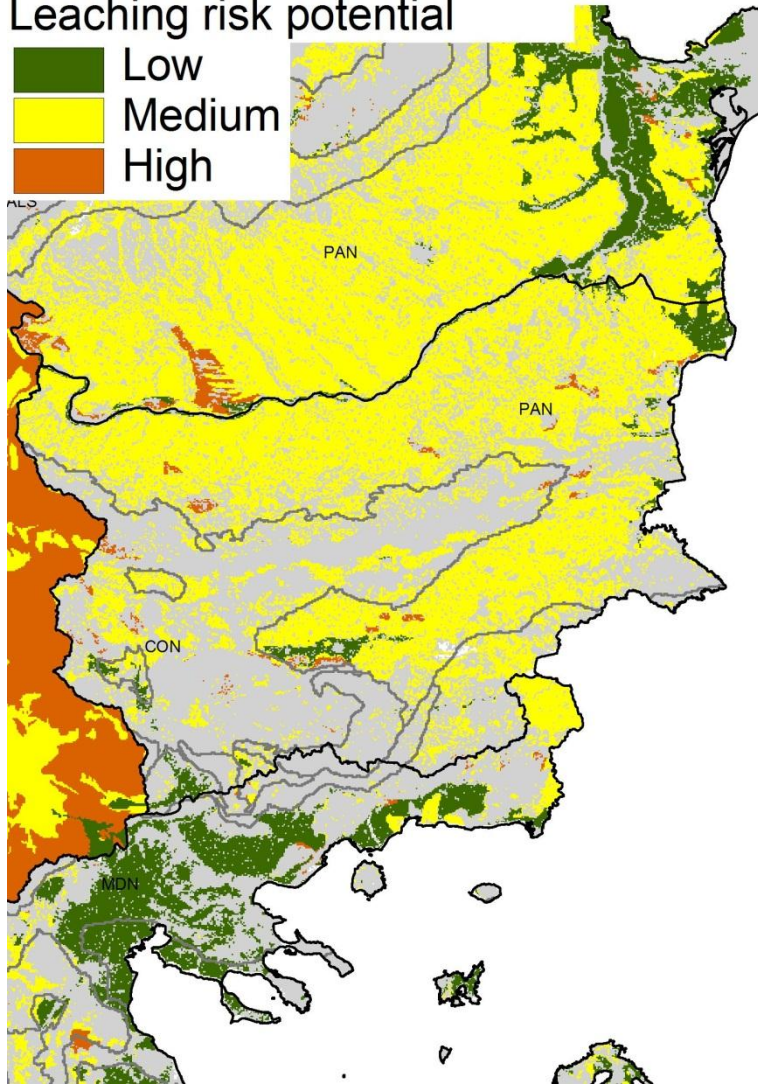
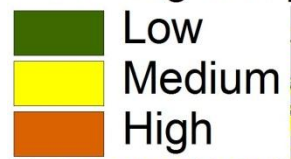
### Surface runoff risk potential



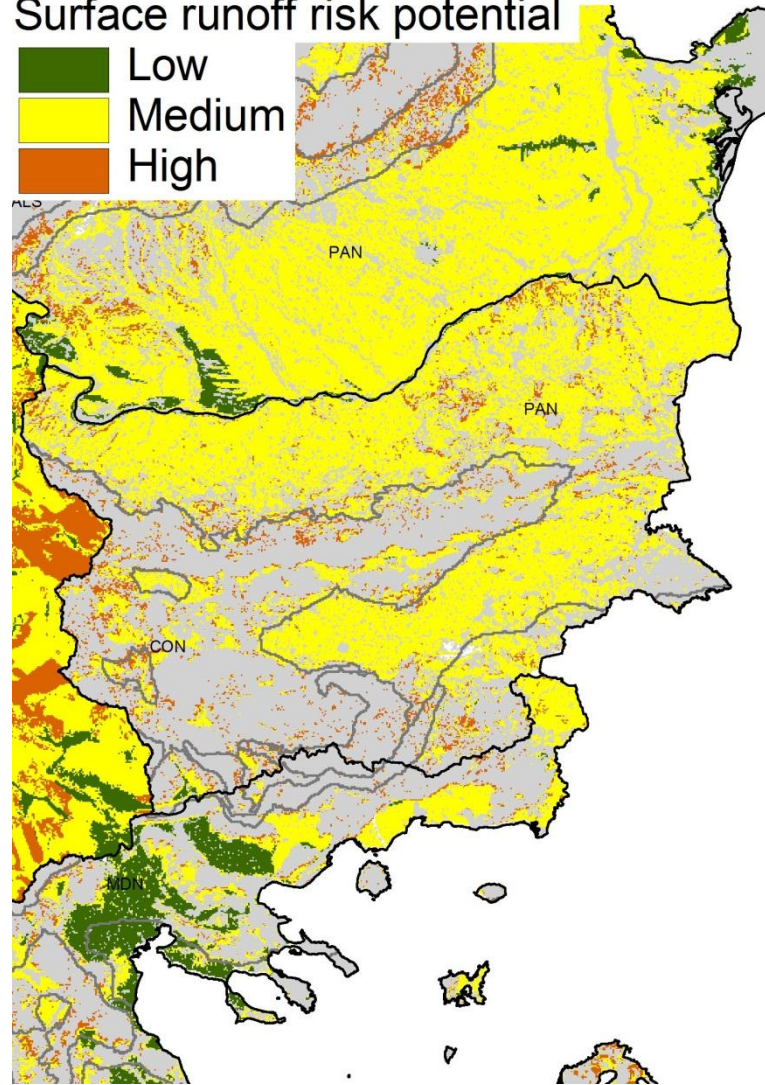
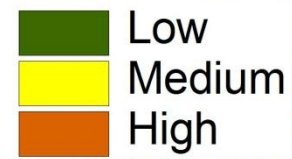


Bulgaria

### Leaching risk potential



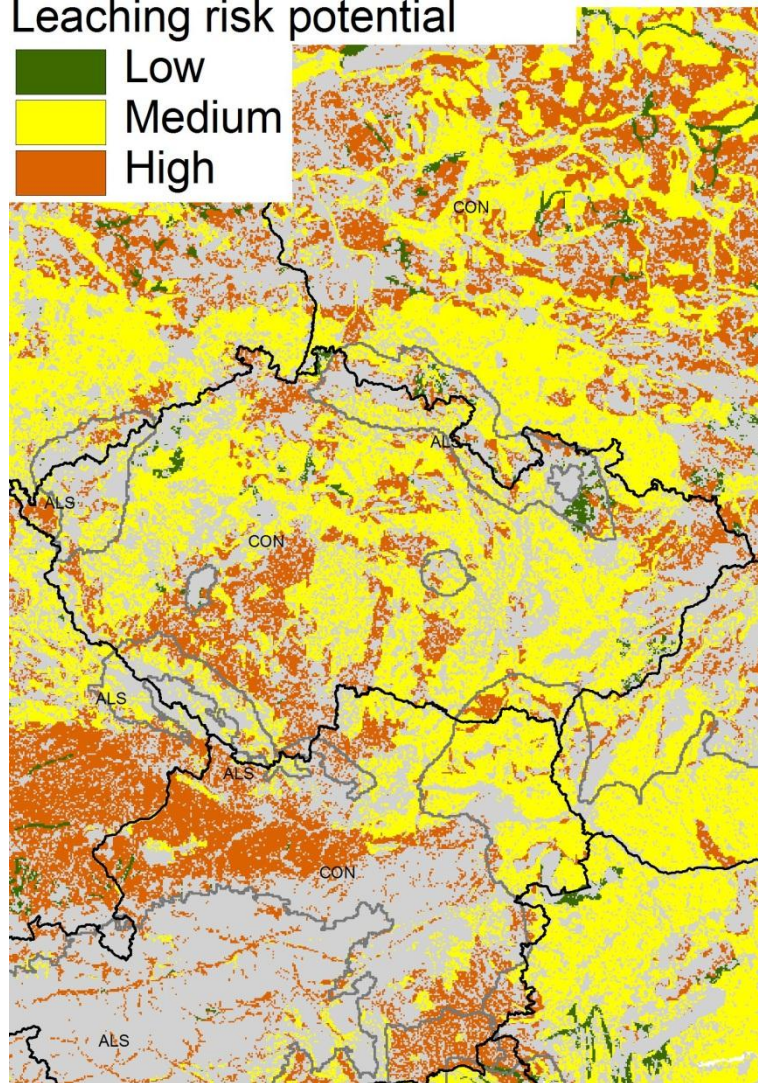
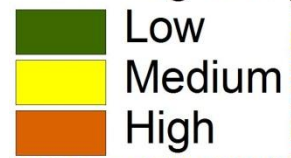
### Surface runoff risk potential



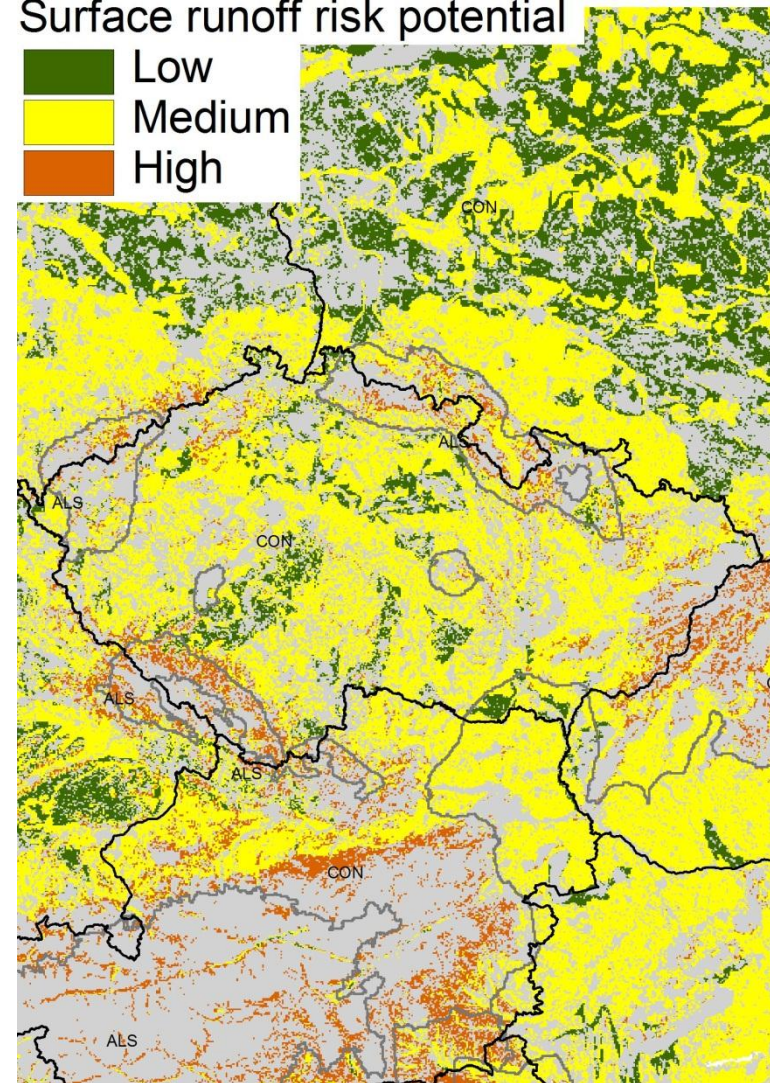
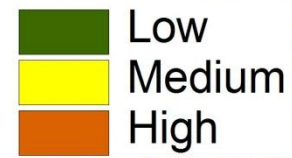


Czech Republic

### Leaching risk potential



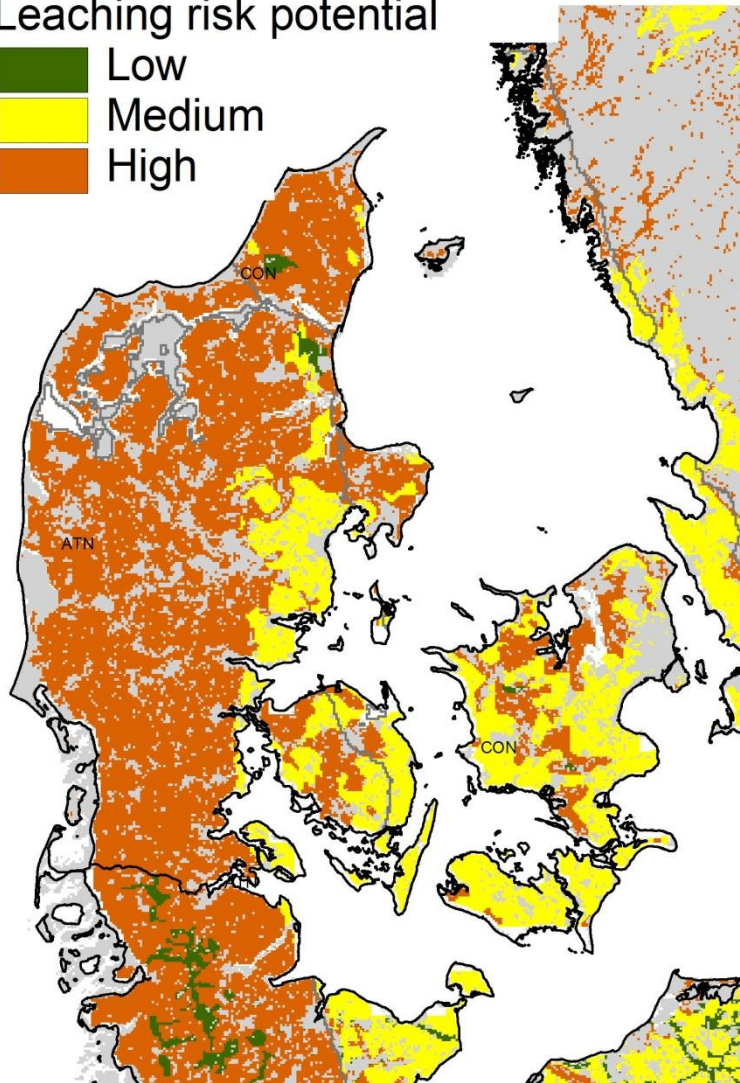
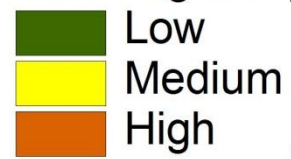
### Surface runoff risk potential



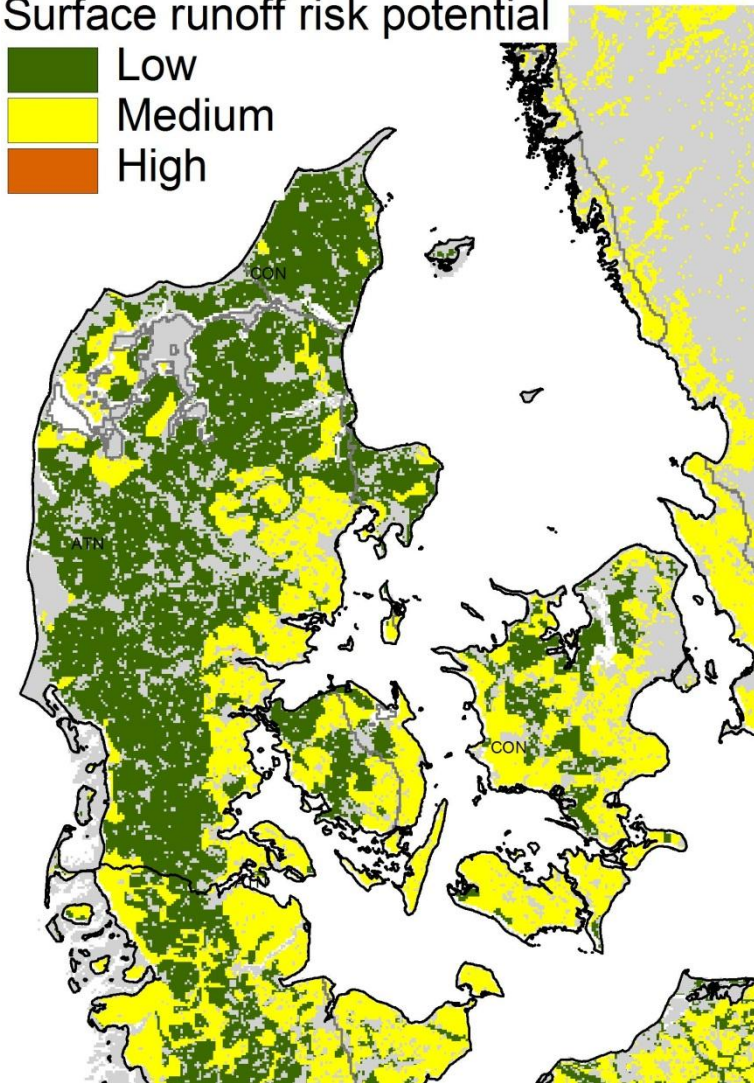
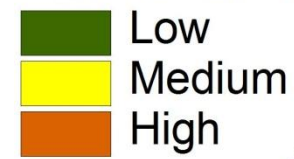


Denmark

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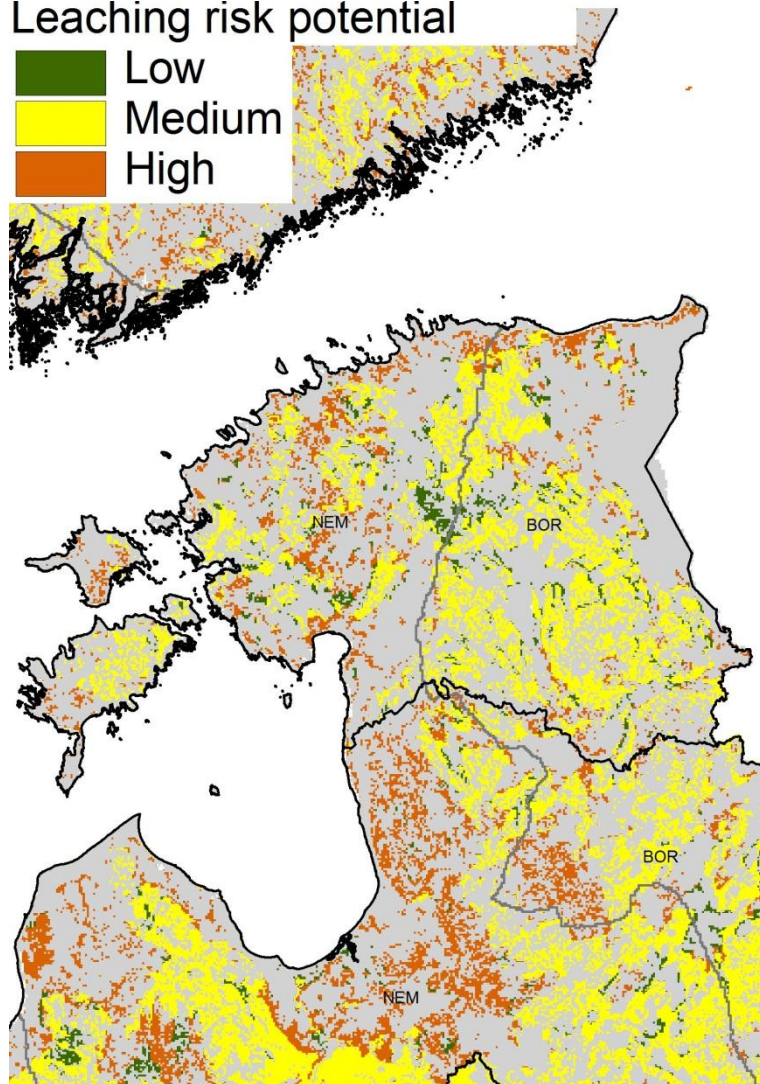
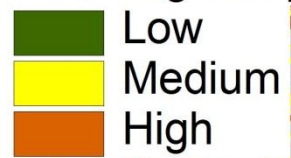


### Surface runoff risk potential

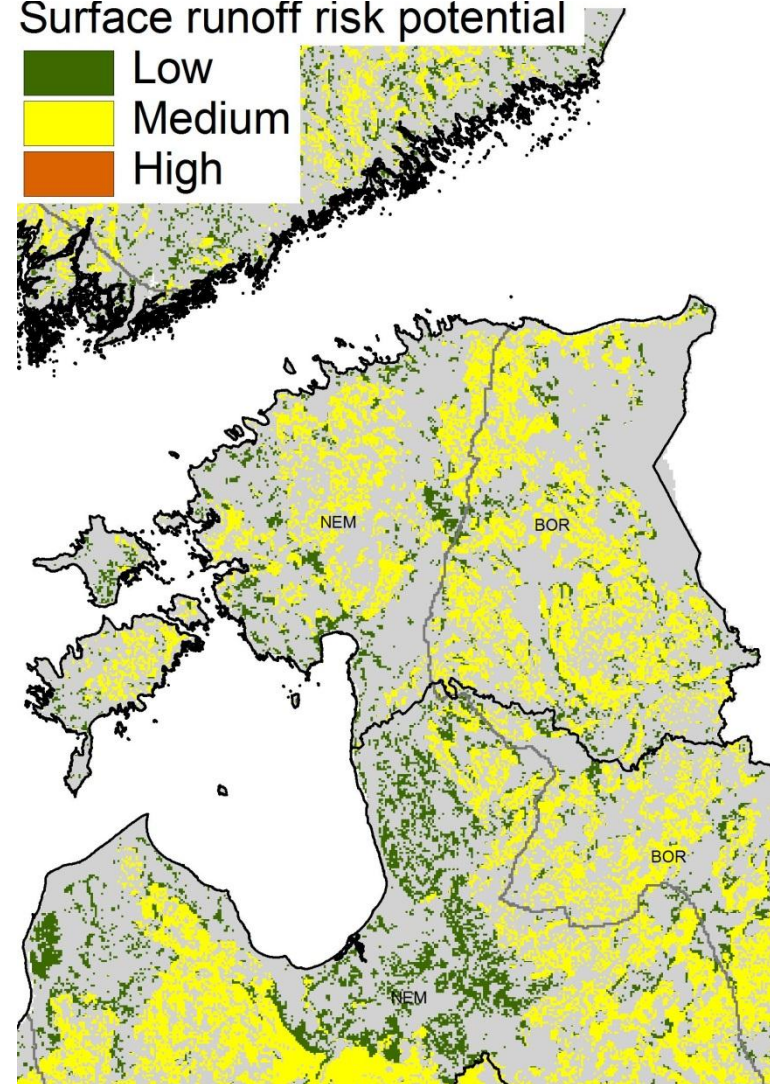
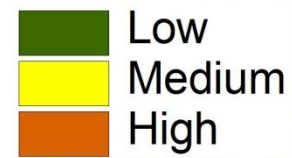


Estonia

### Leaching risk potential



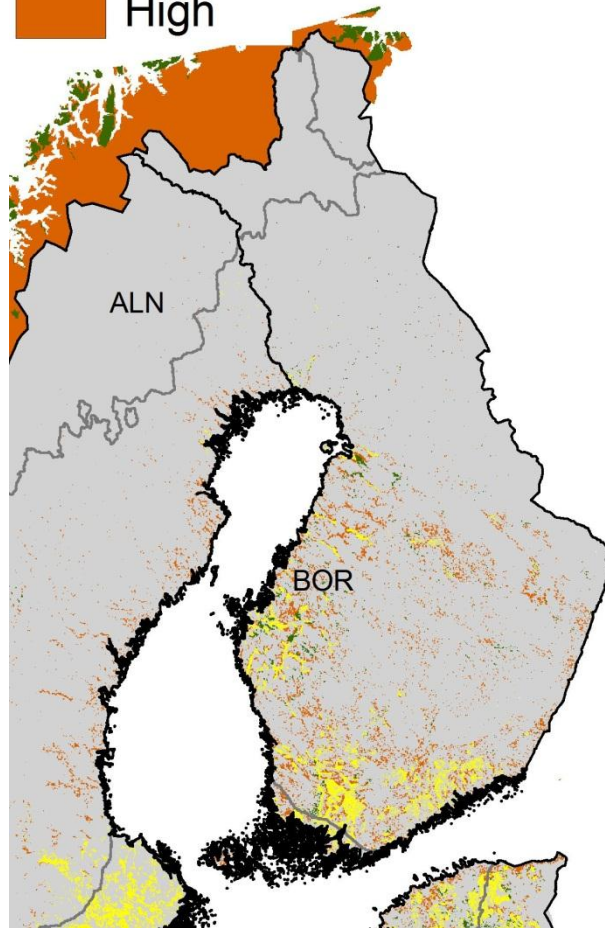
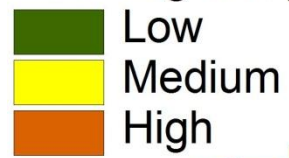
### Surface runoff risk potential



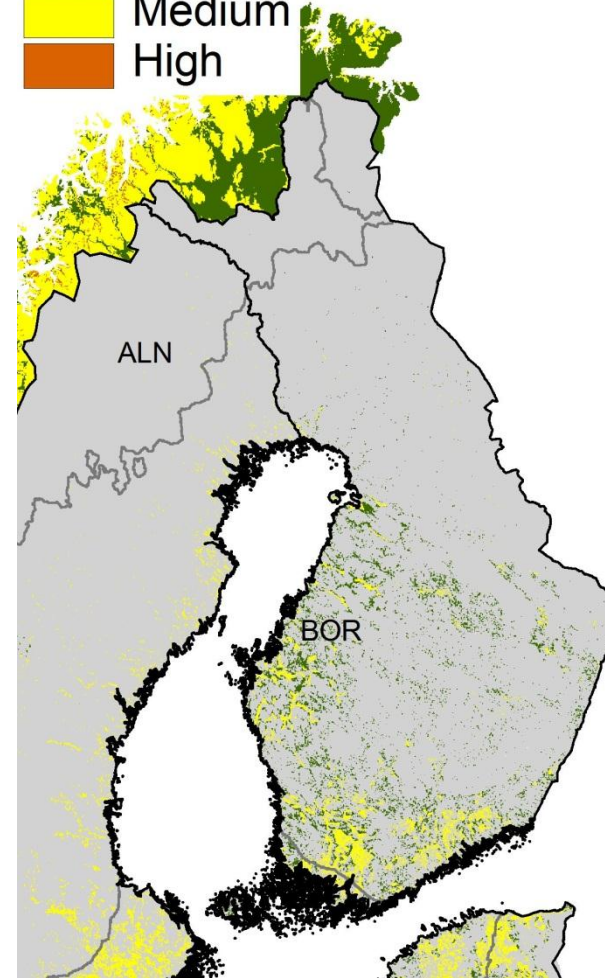
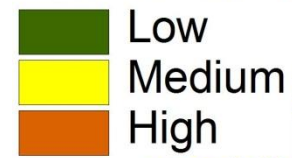


Finland

### Leaching risk potential

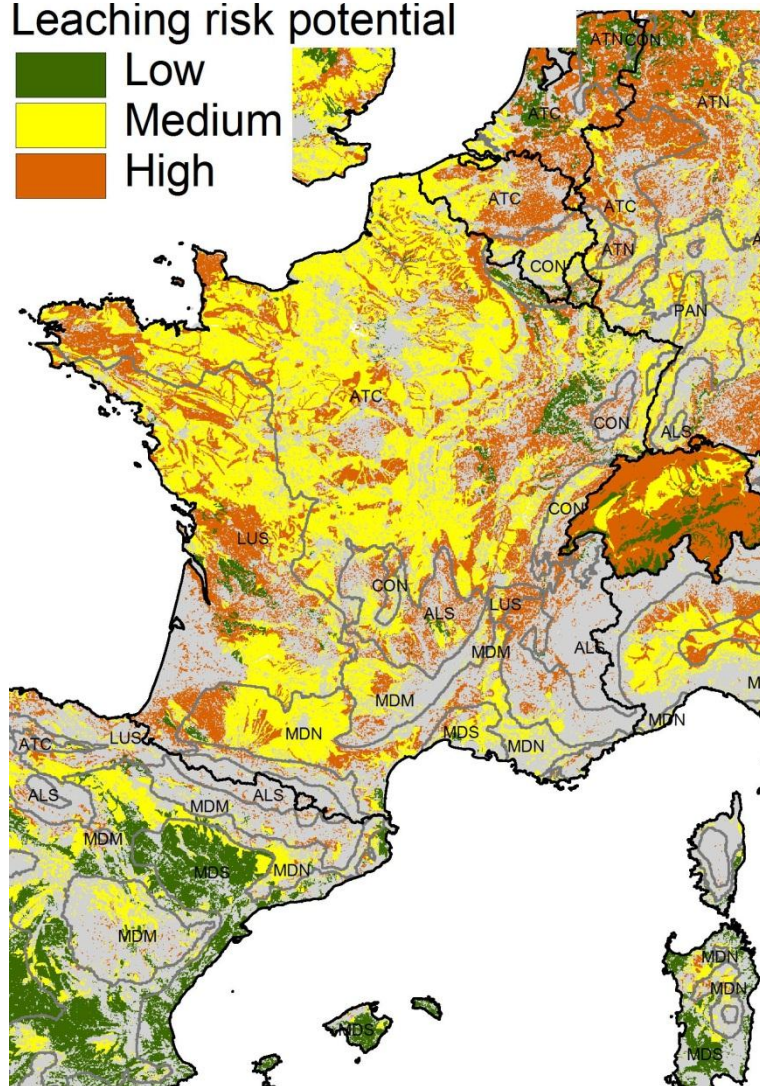
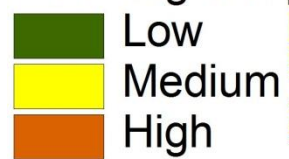


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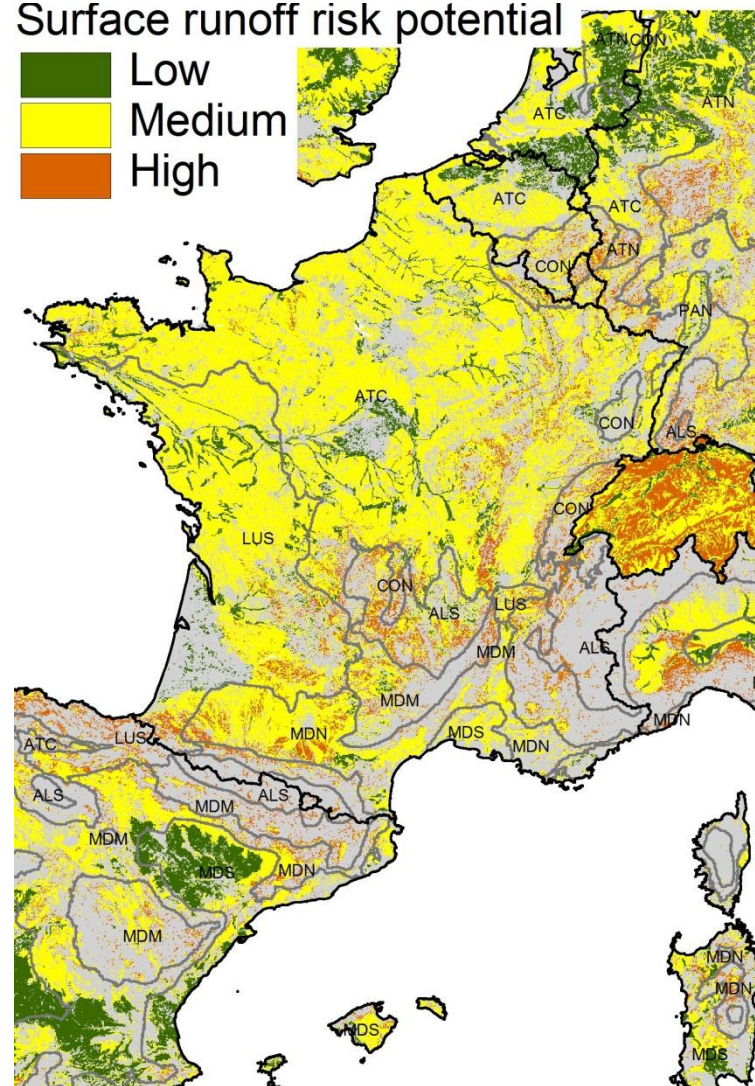
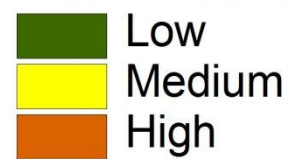


France

### Leaching risk potential



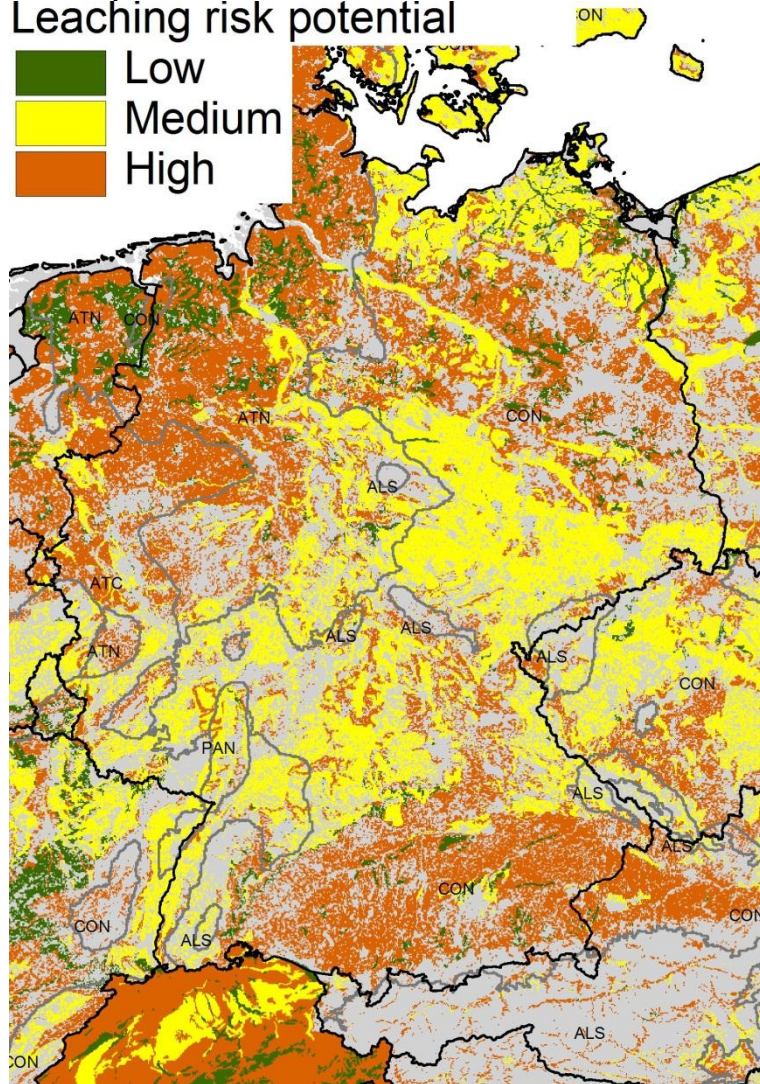
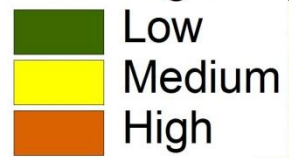
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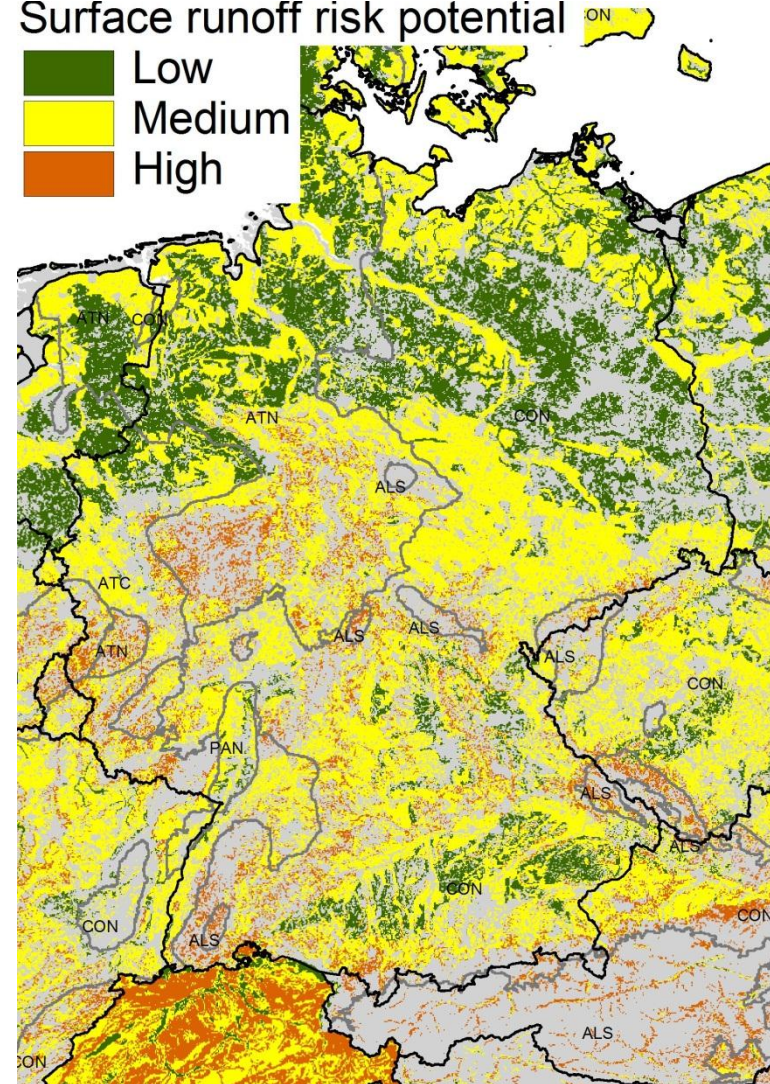
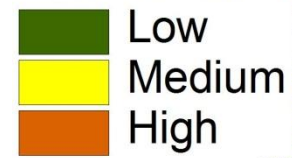


Germany

### Leaching risk potential



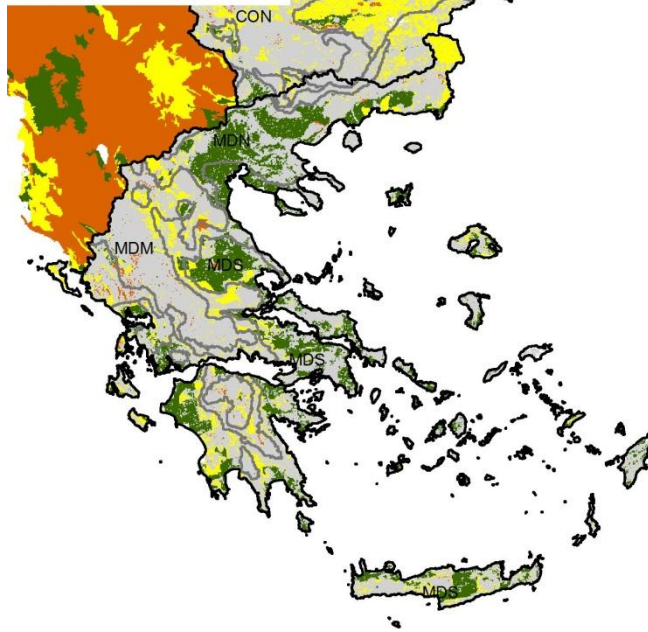
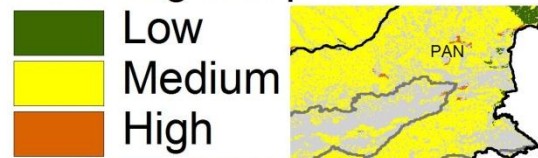
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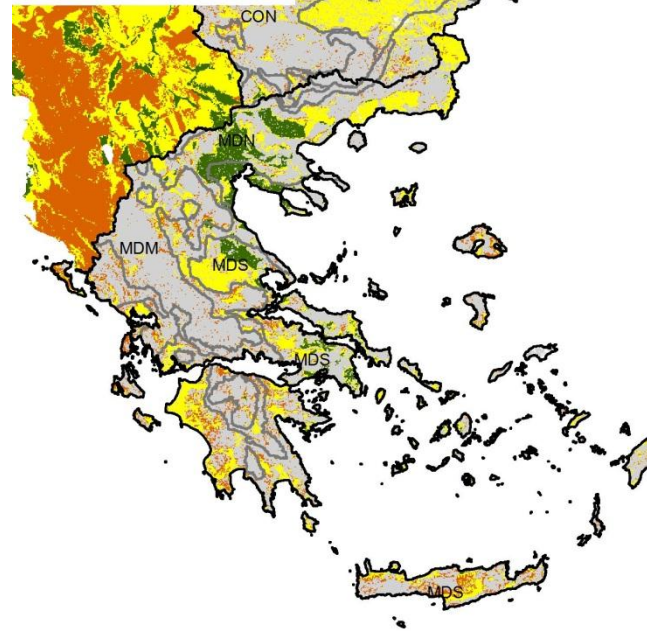
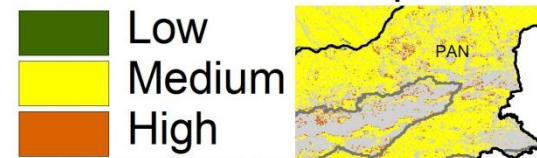


Greece

### Leaching risk potential



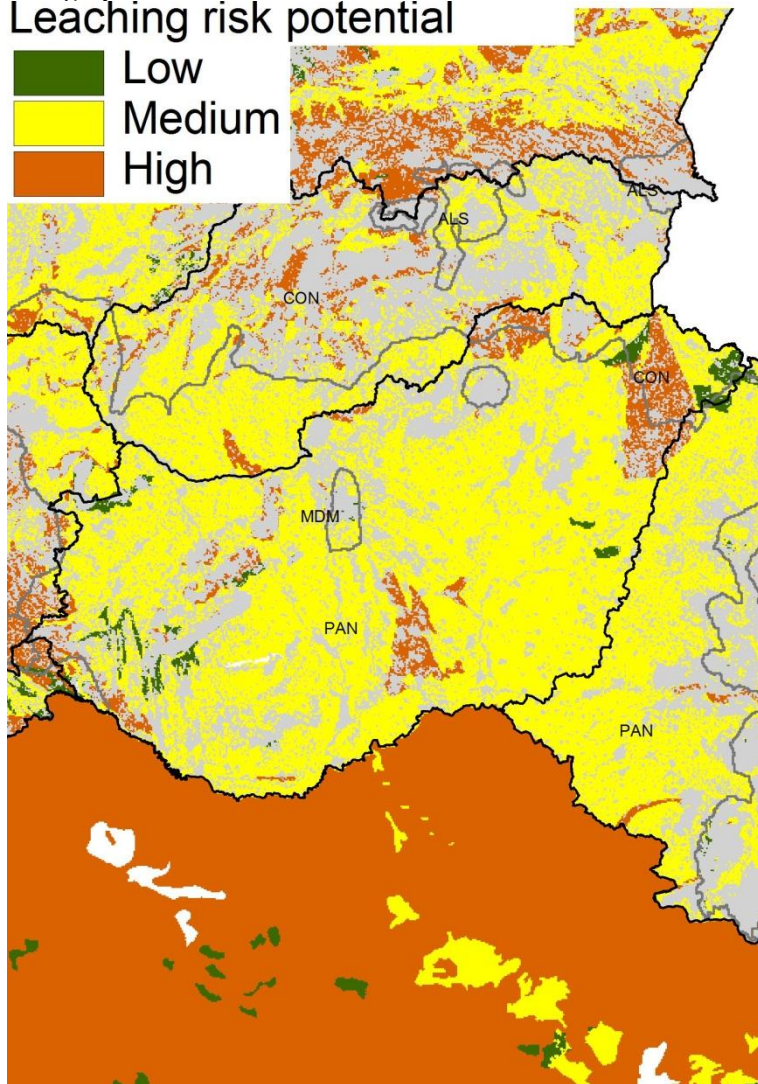
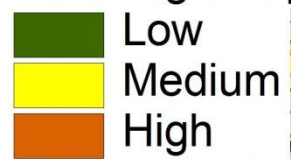
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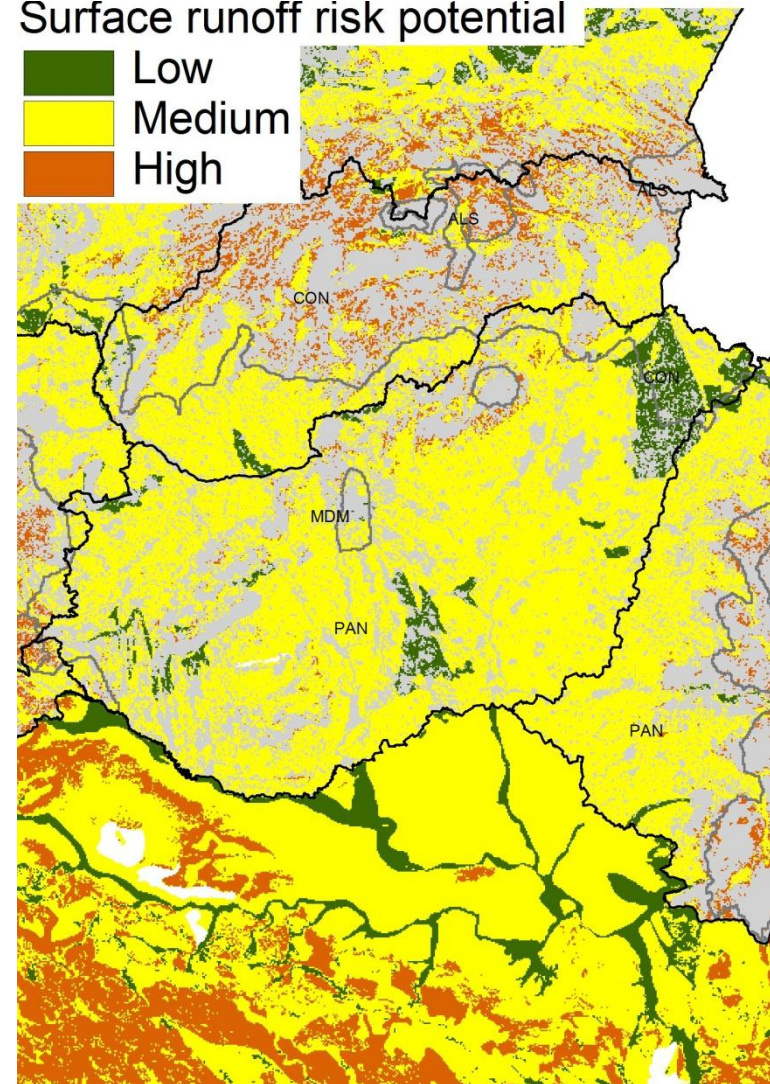
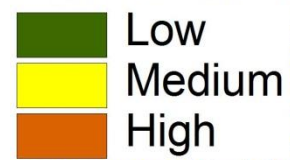


Hungary

### Leaching risk potential

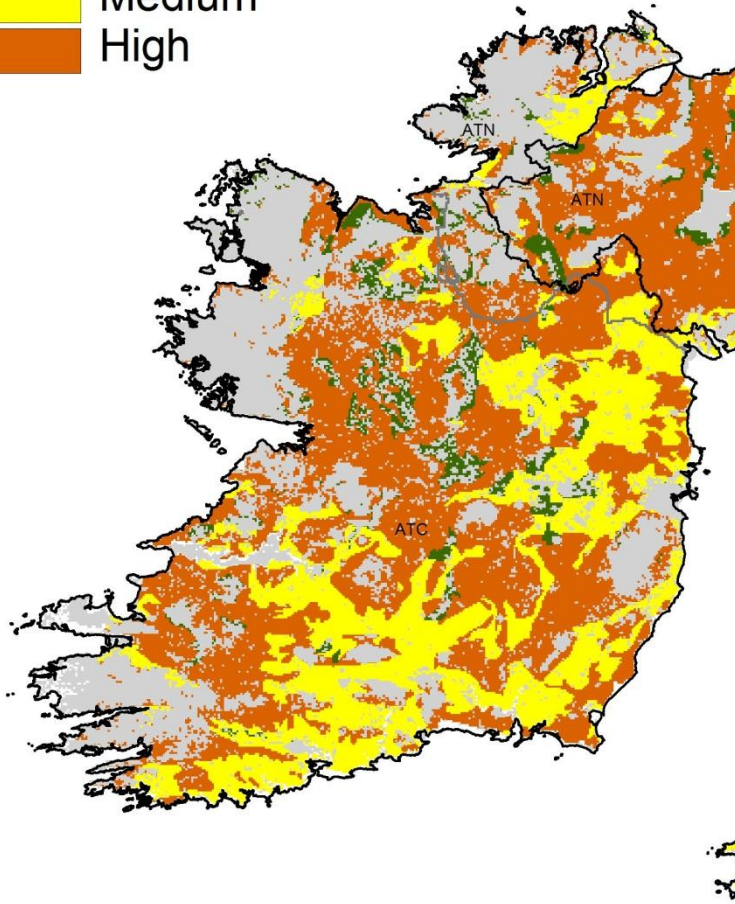
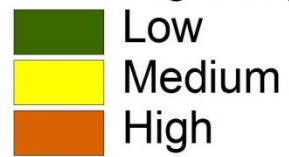


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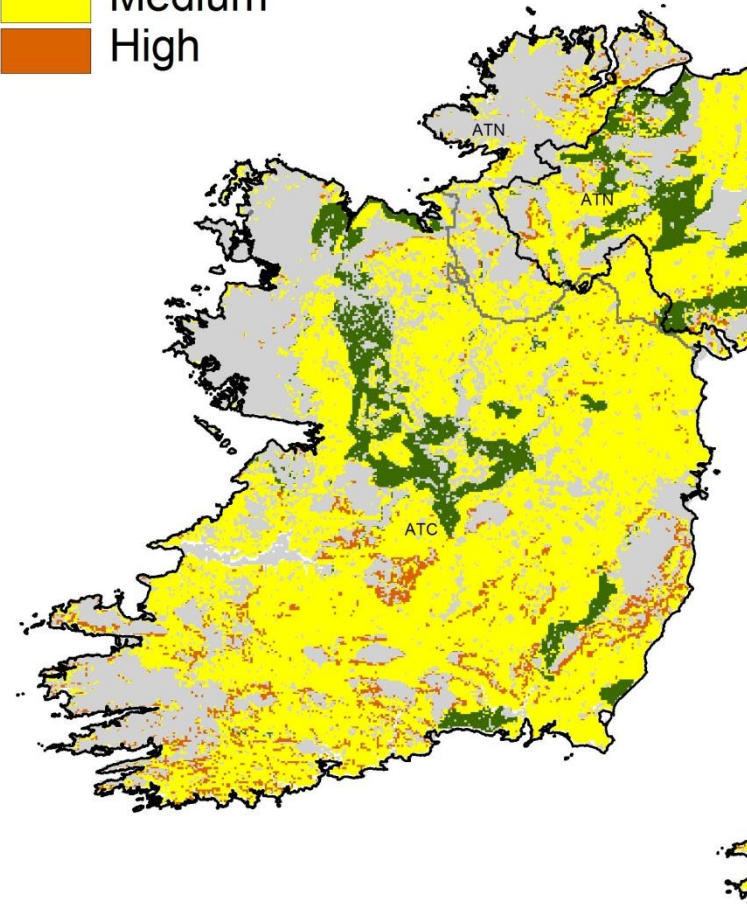
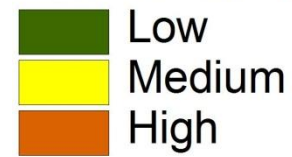


Ireland

### Leaching risk potential



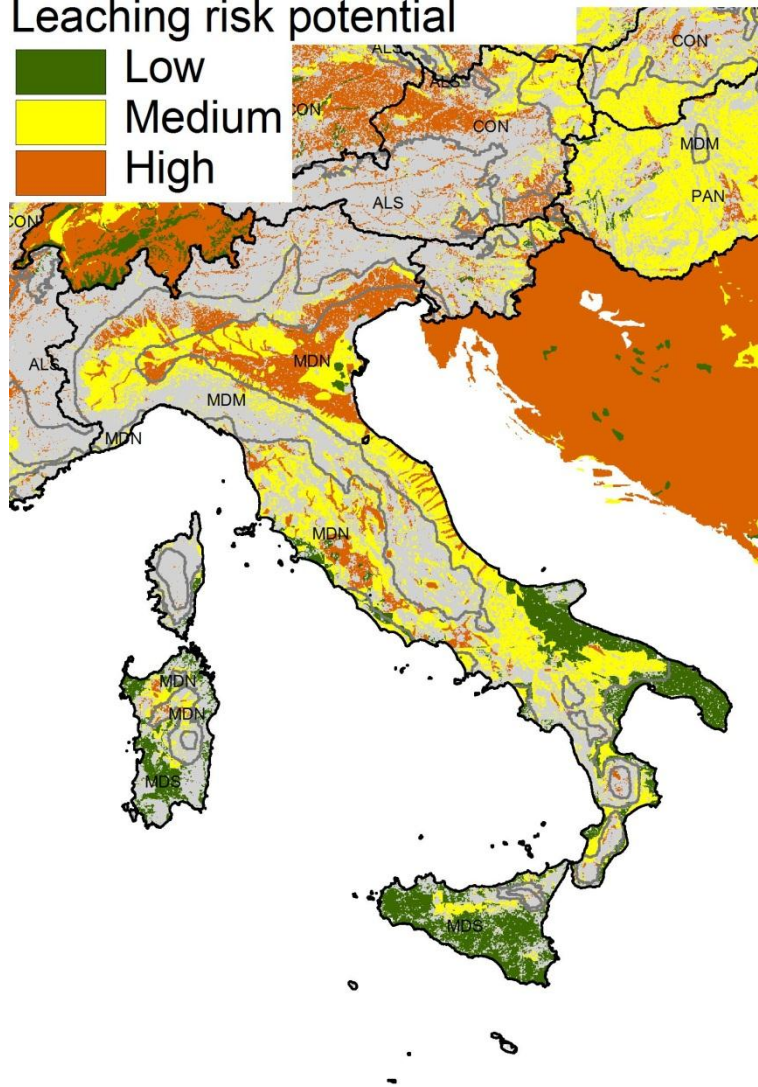
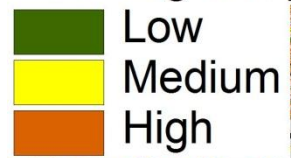
### Surface runoff risk potential



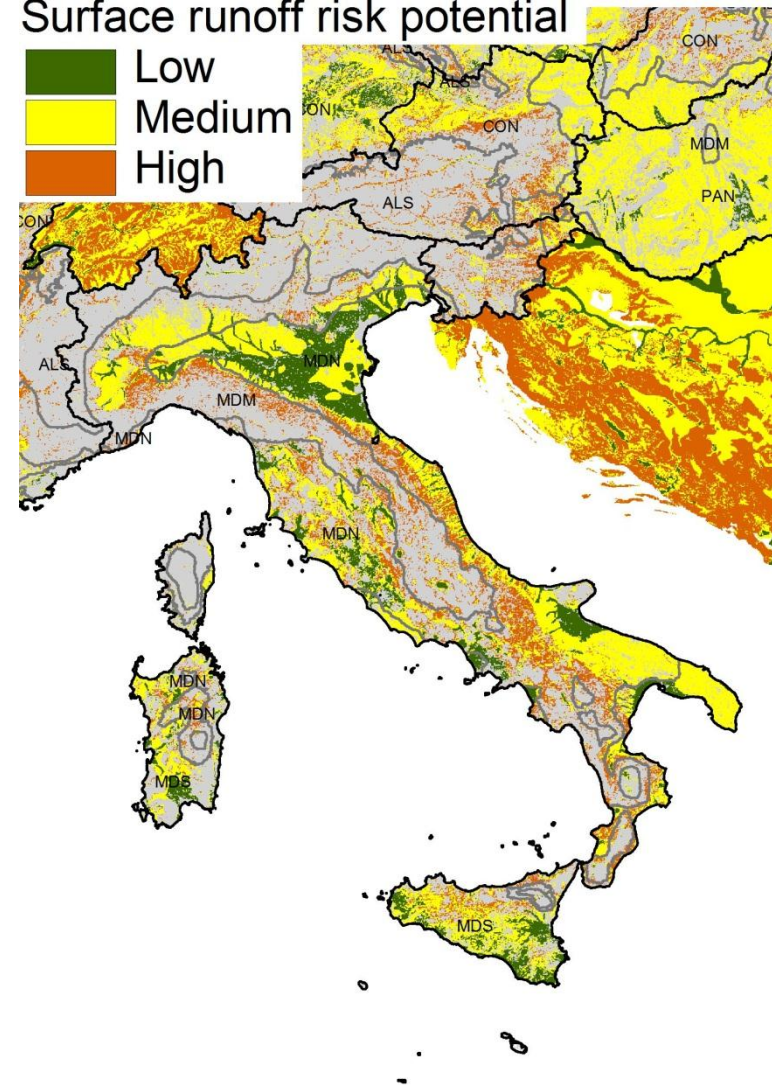
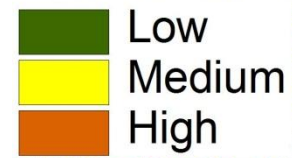


Italy

### Leaching risk potential

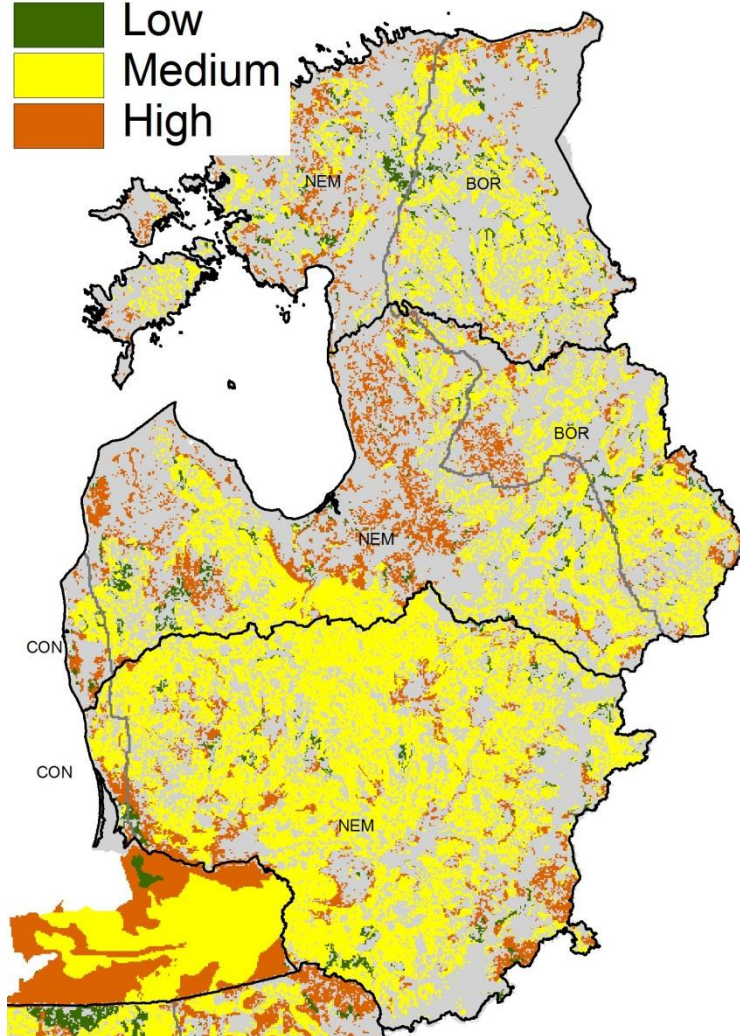
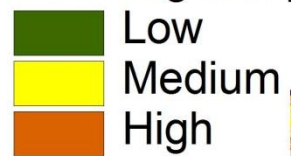


### Surface runoff risk potential

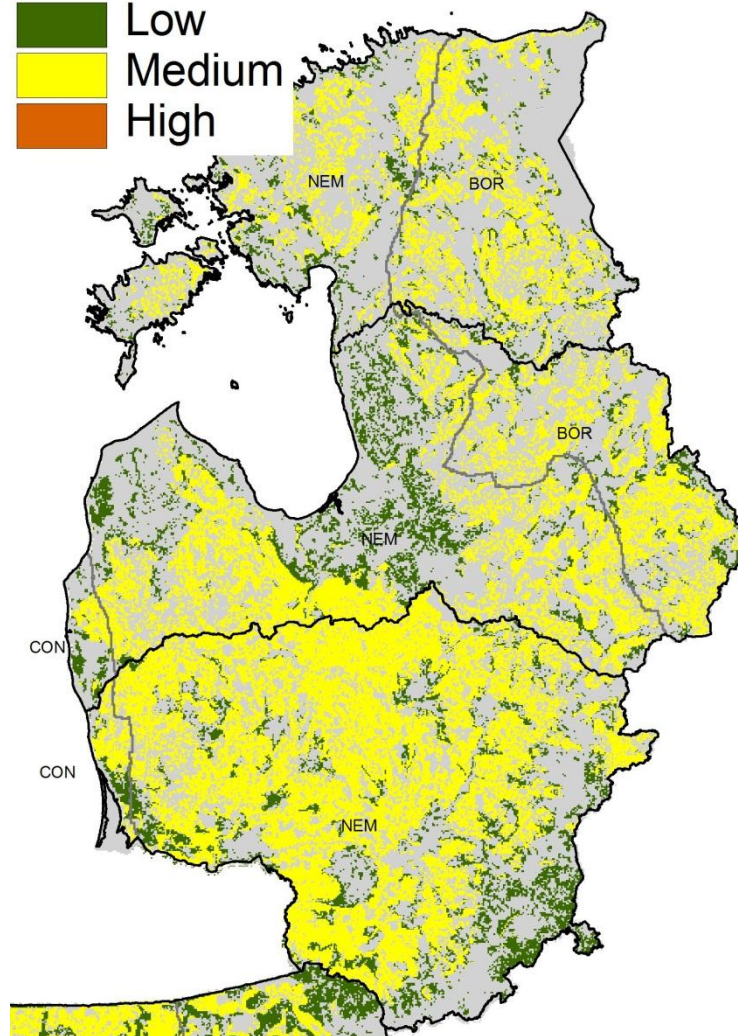
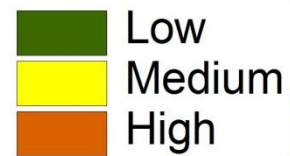


Latvia

### Leaching risk potential



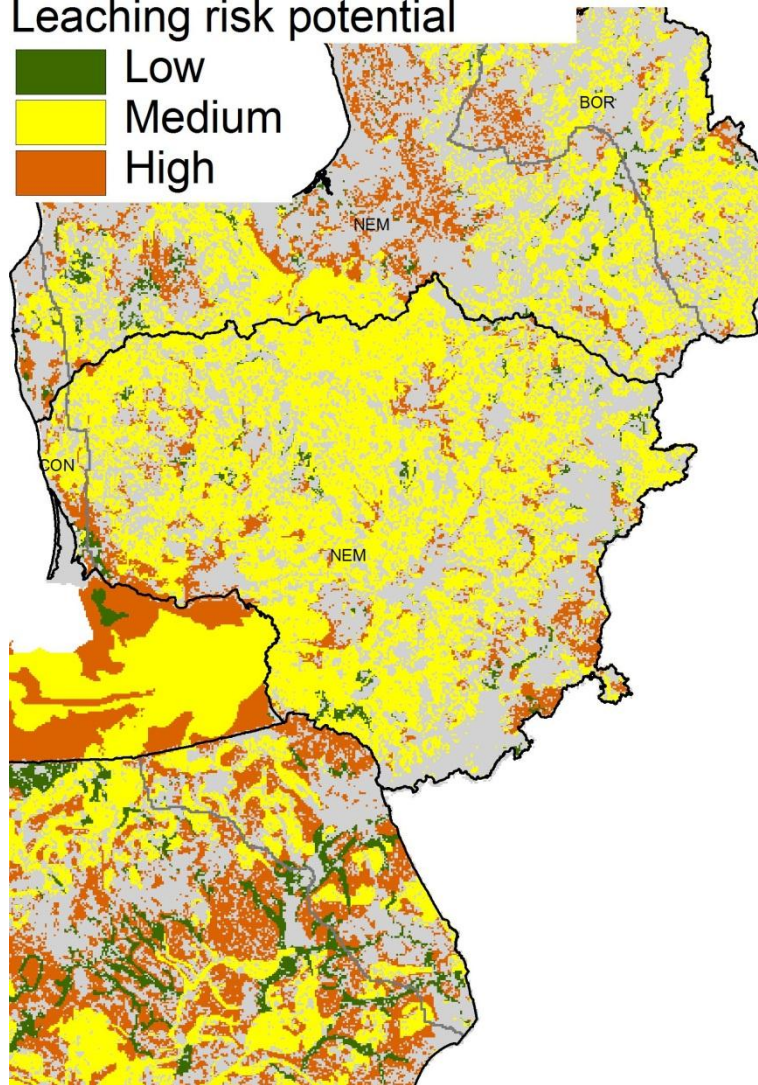
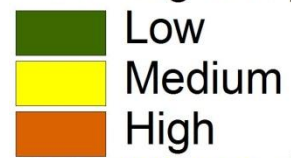
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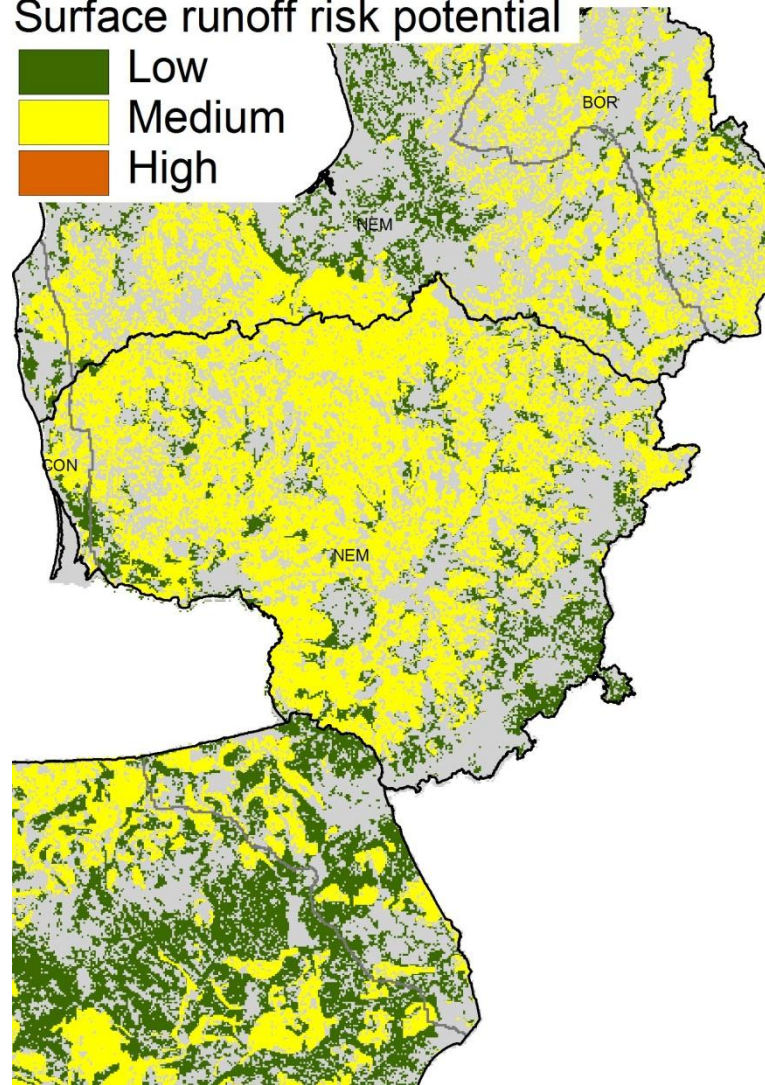
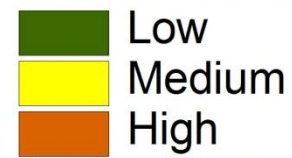


Lithuania

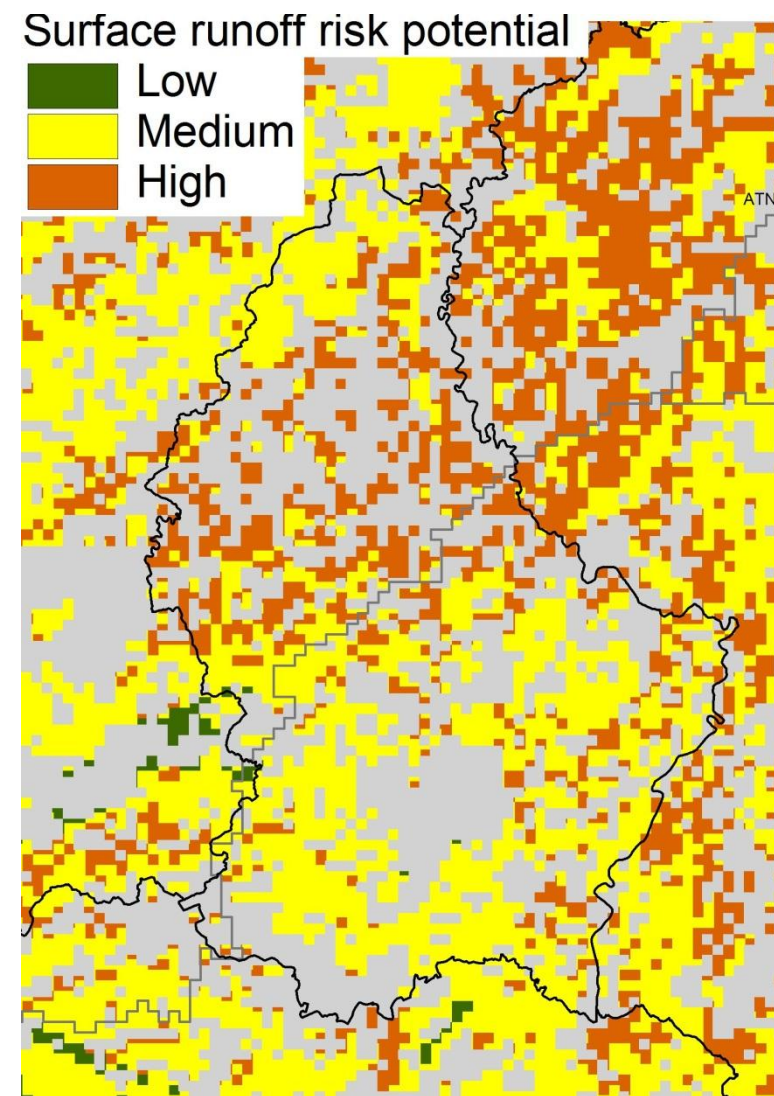
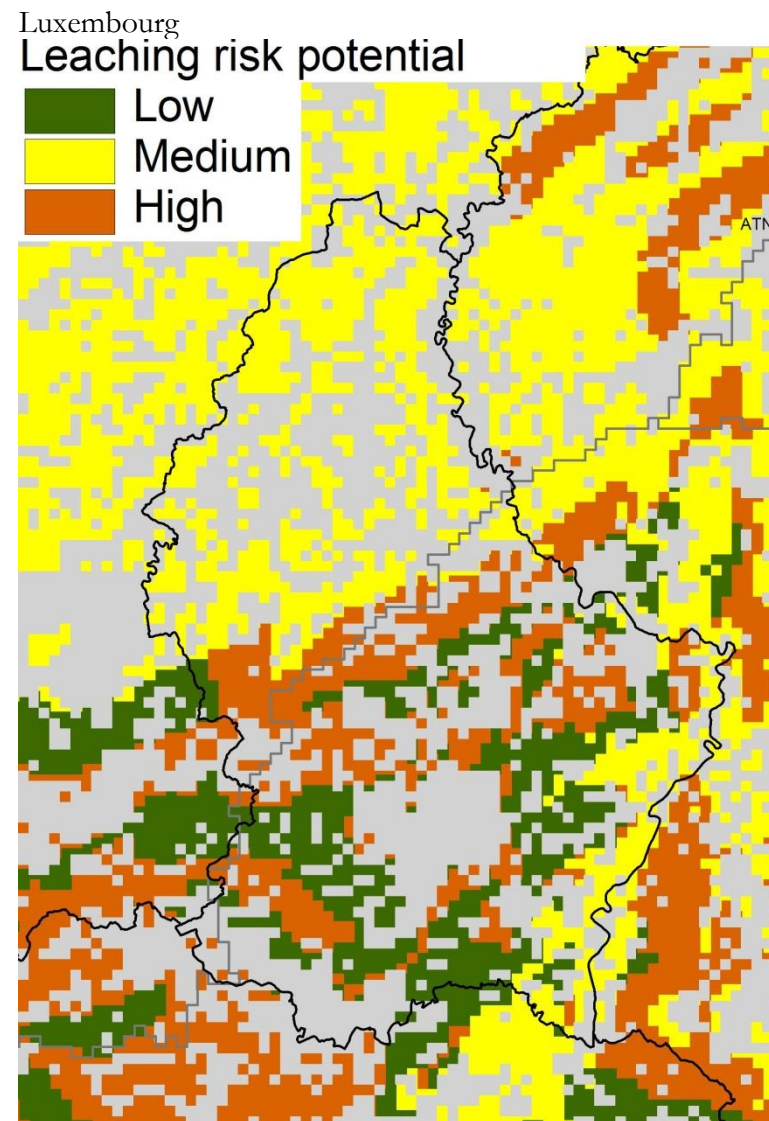
### Leaching risk potential



### Surface runoff risk potential



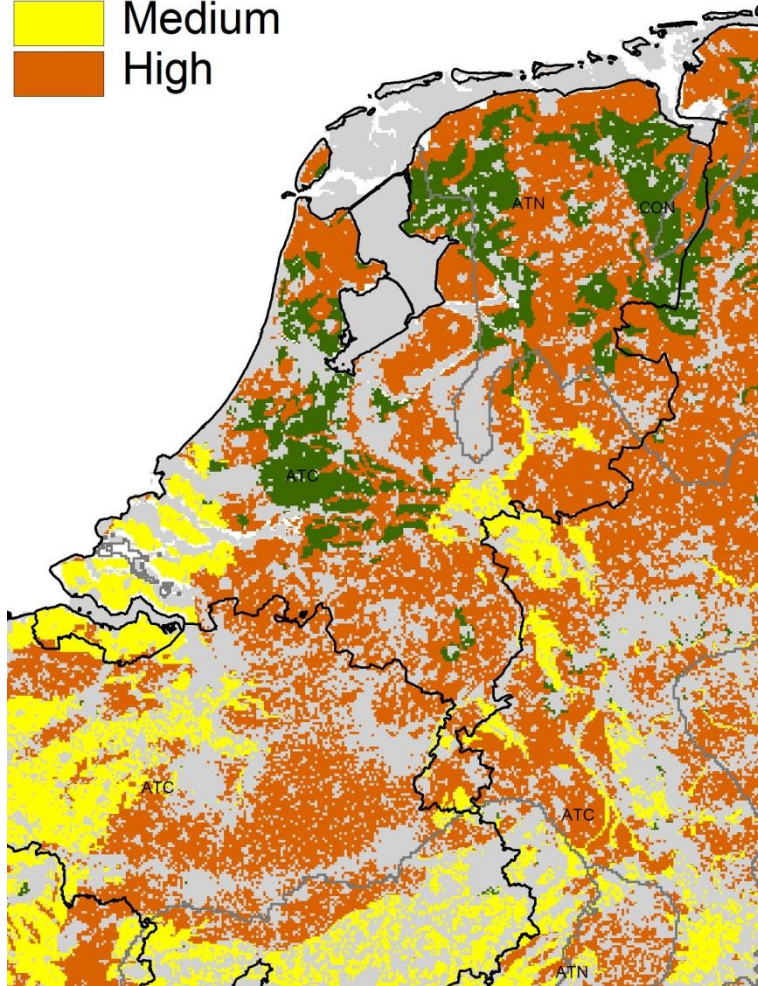
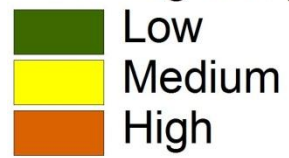




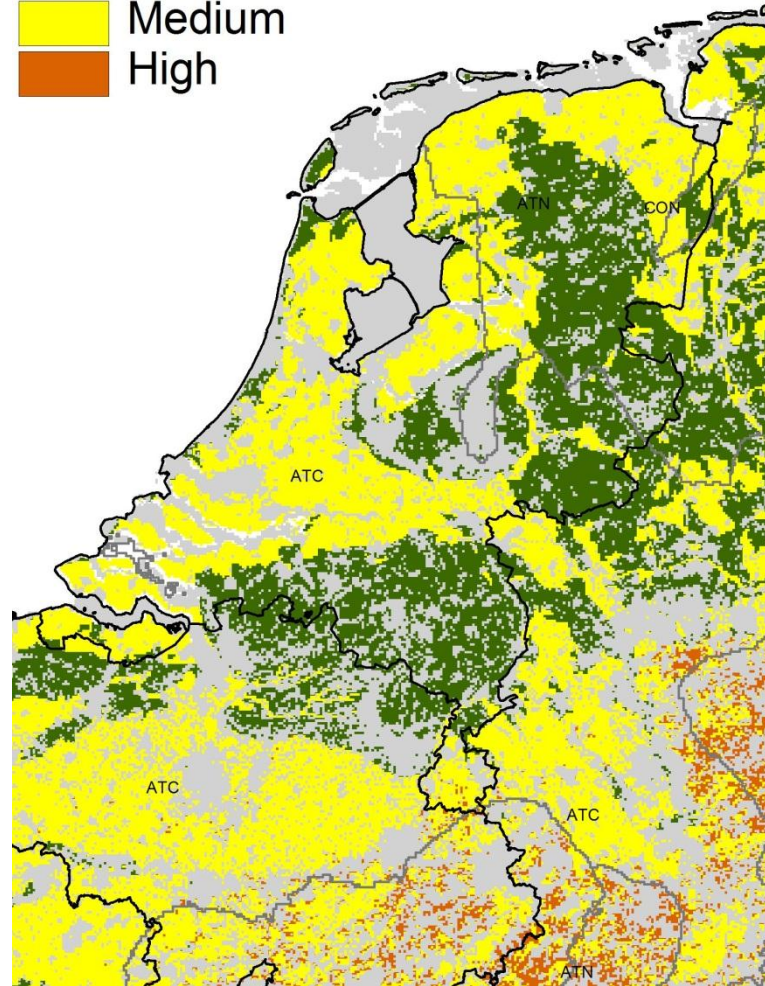
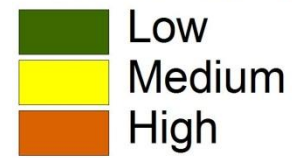


the Netherlands

### Leaching risk potential



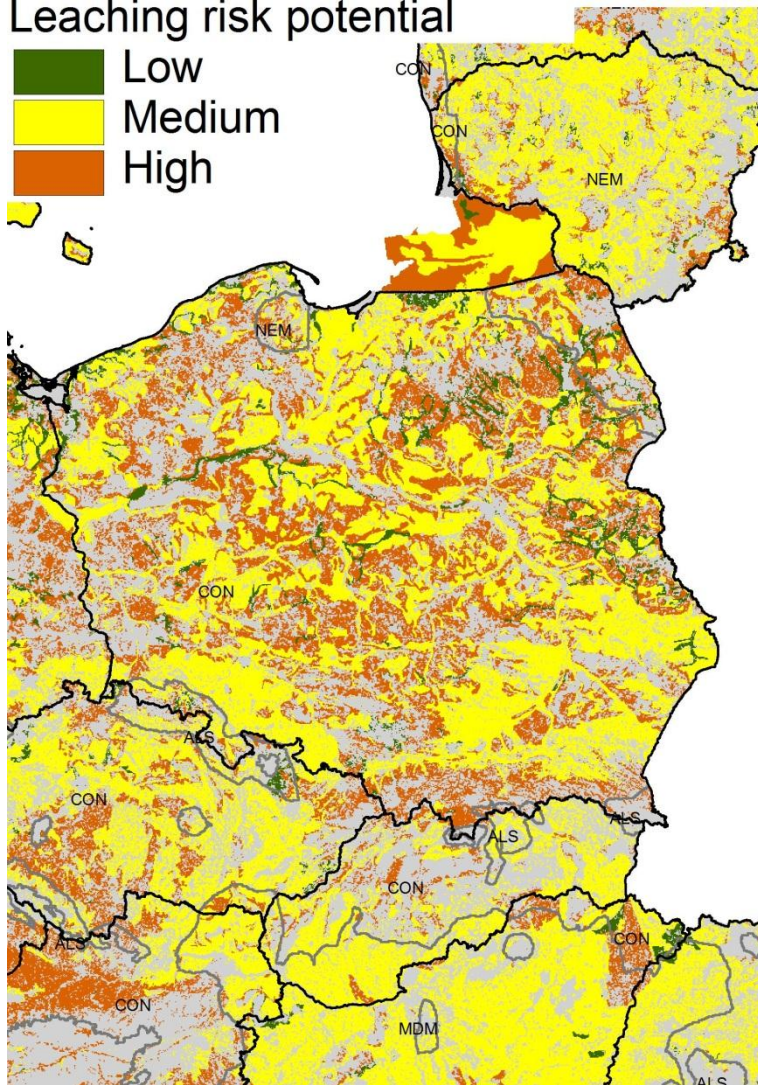
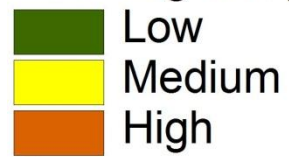
### Surface runoff risk potential



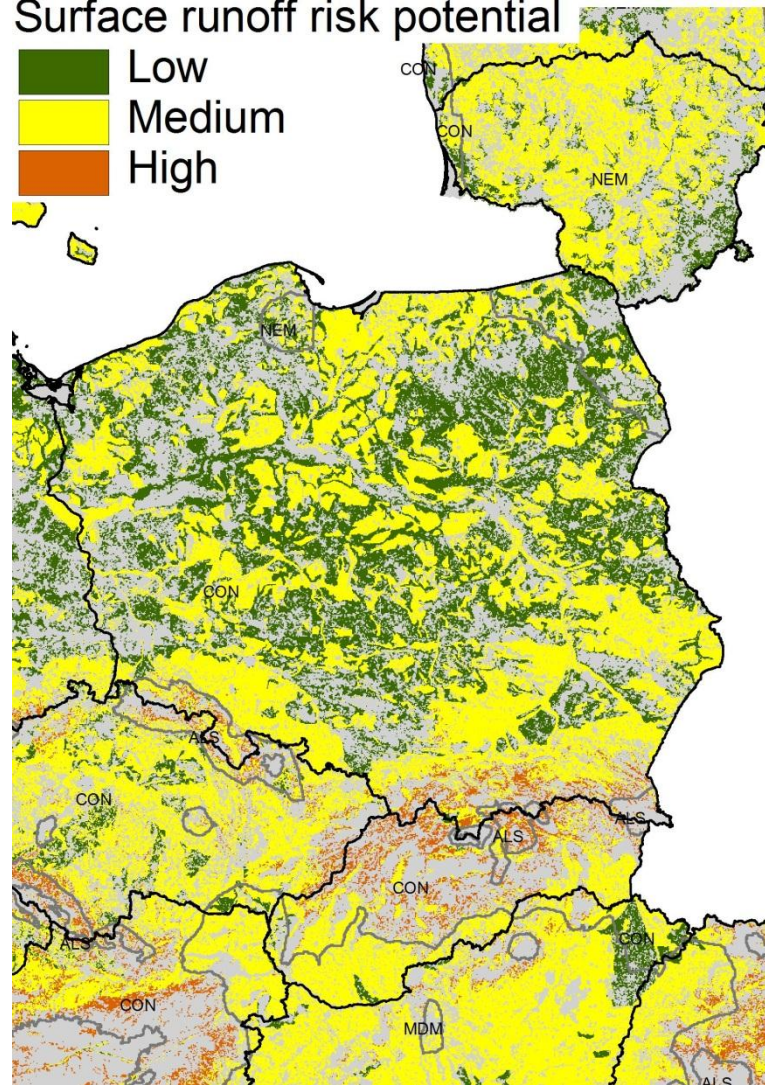
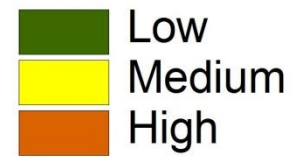


Poland

### Leaching risk potential



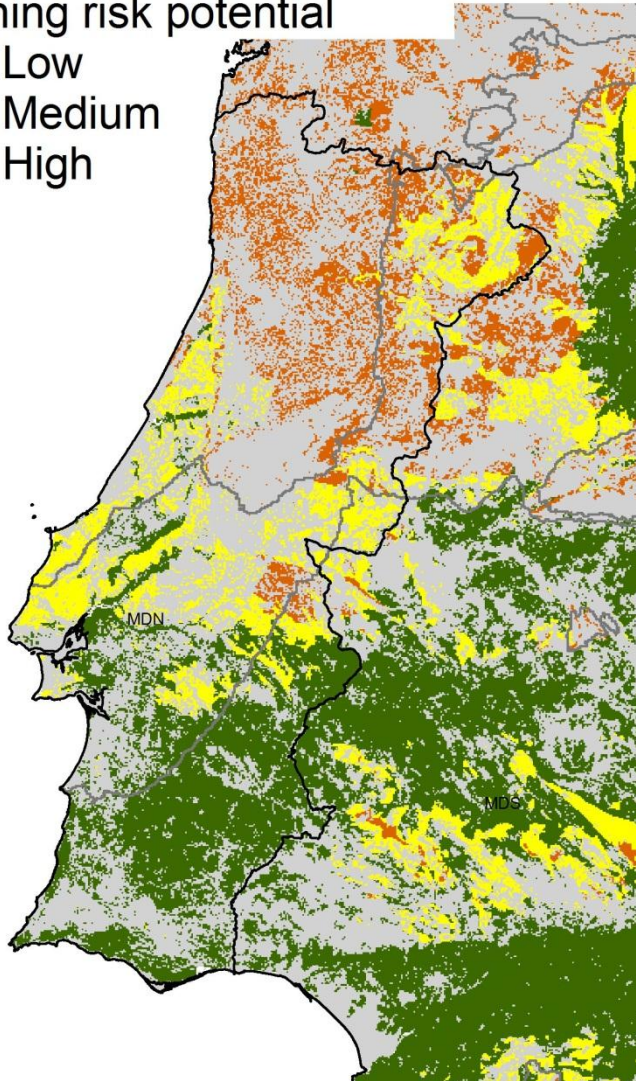
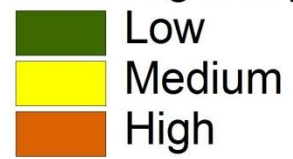
### Surface runoff risk potential



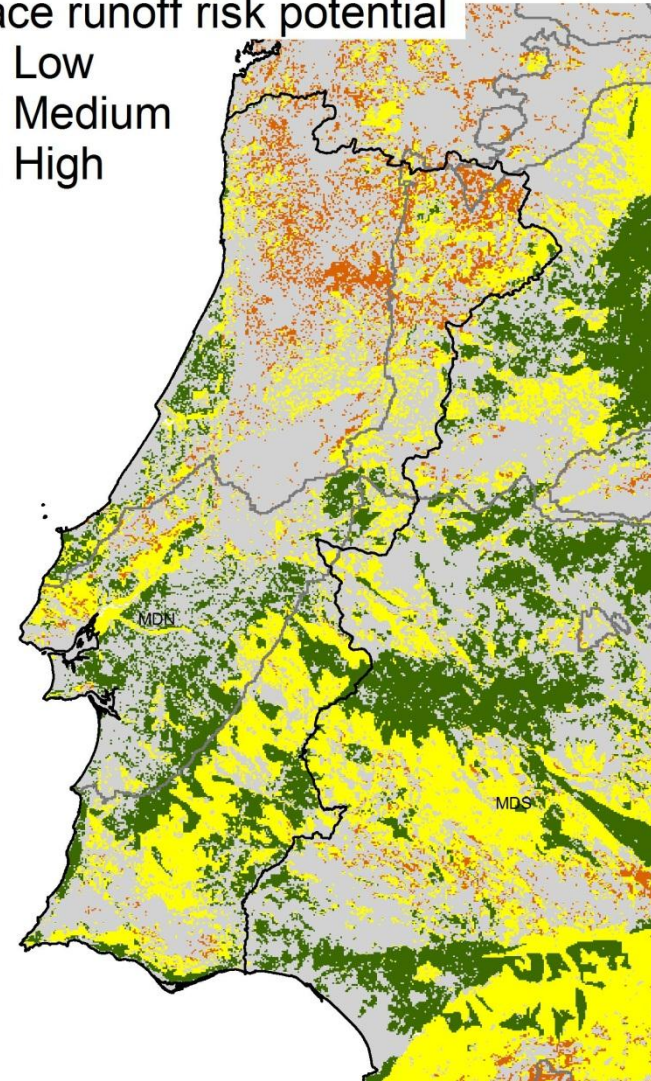
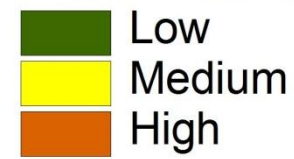


Portugal

### Leaching risk potential



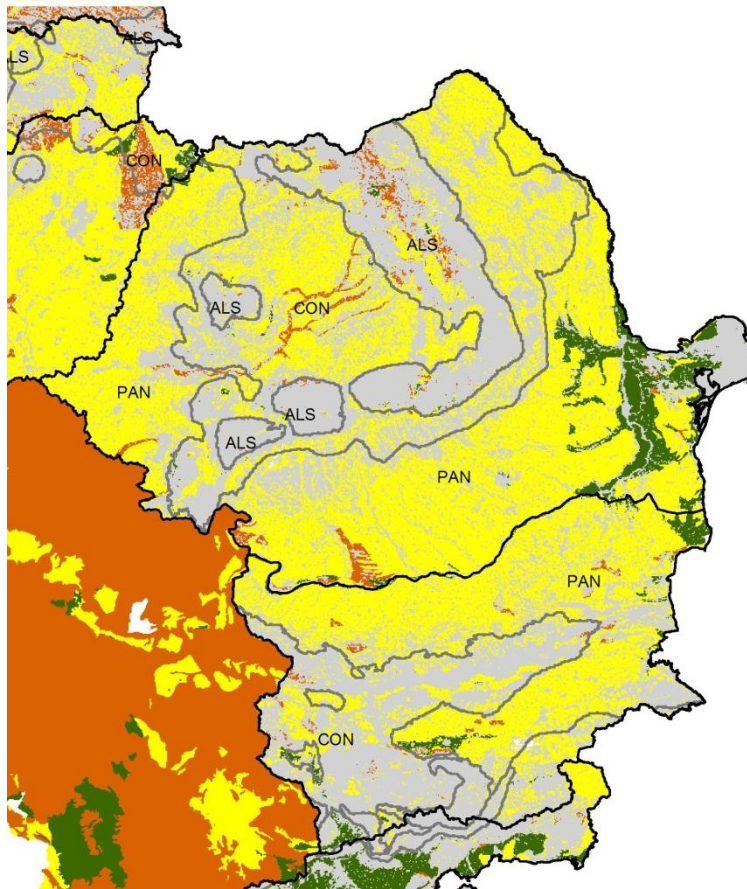
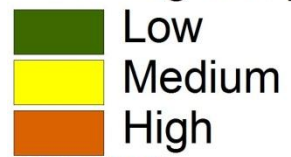
### Surface runoff risk potential



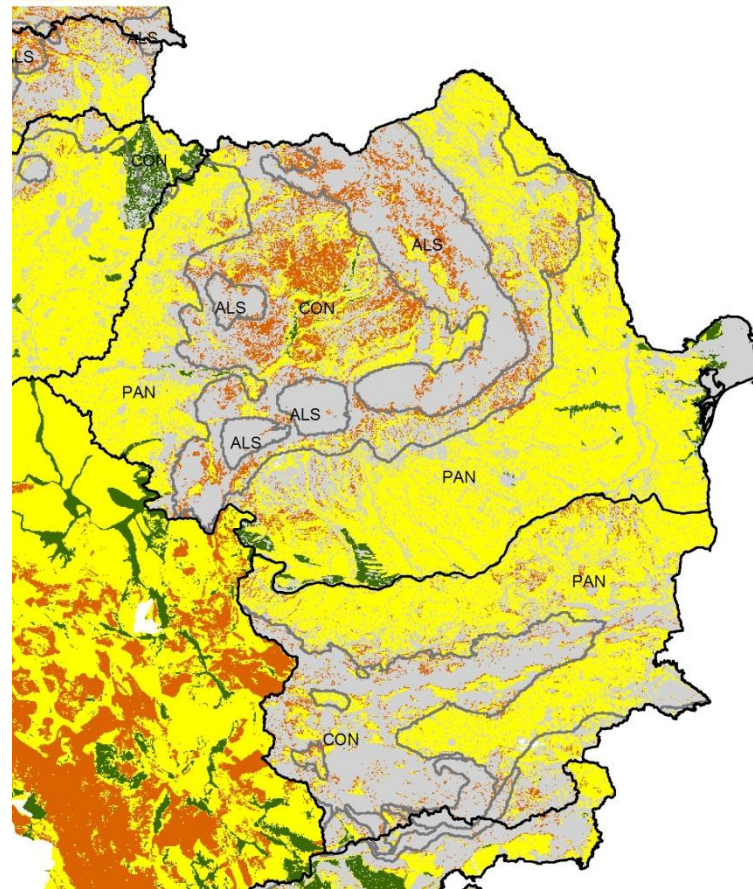
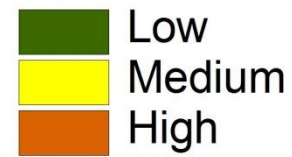


Romania

### Leaching risk potential



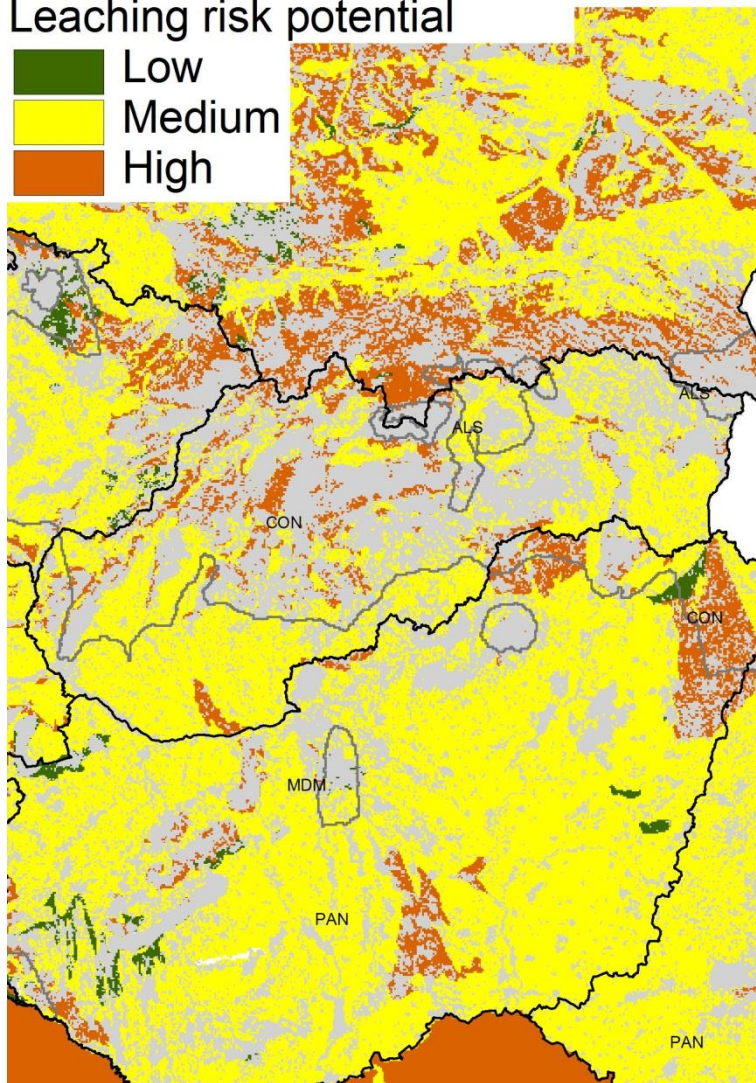
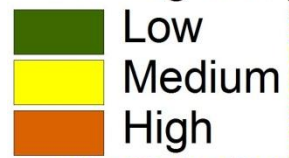
### Surface runoff risk potential



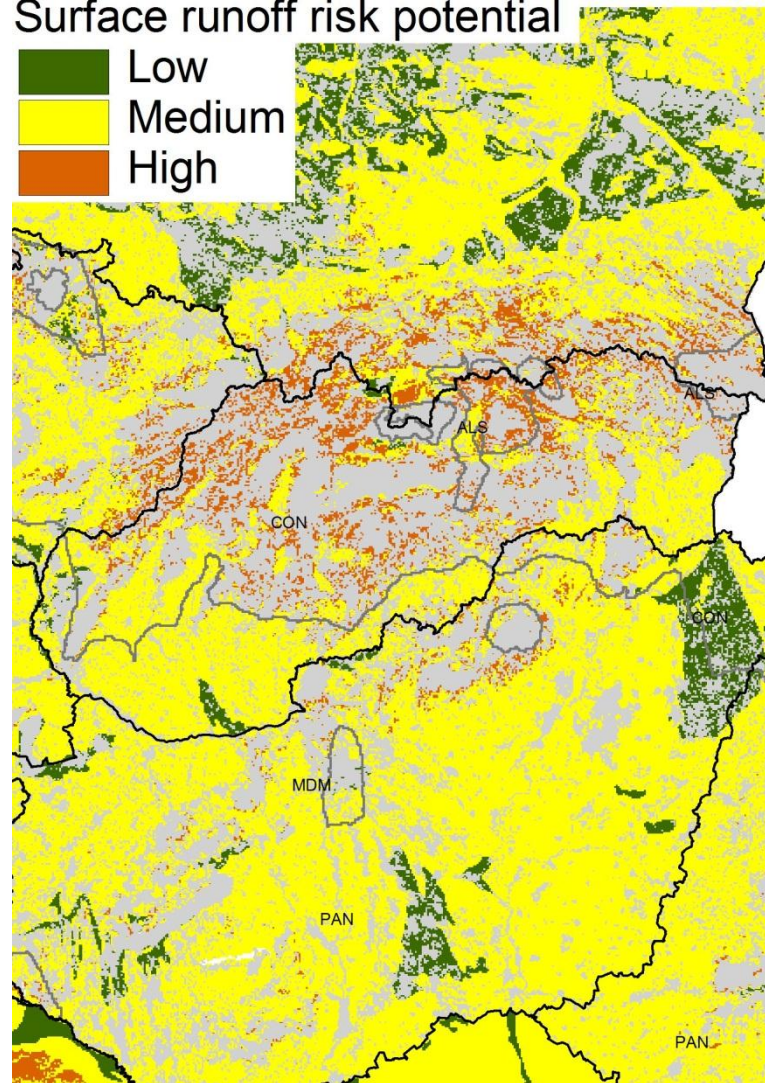
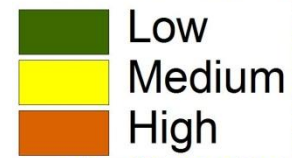


Slovakia

### Leaching risk potential



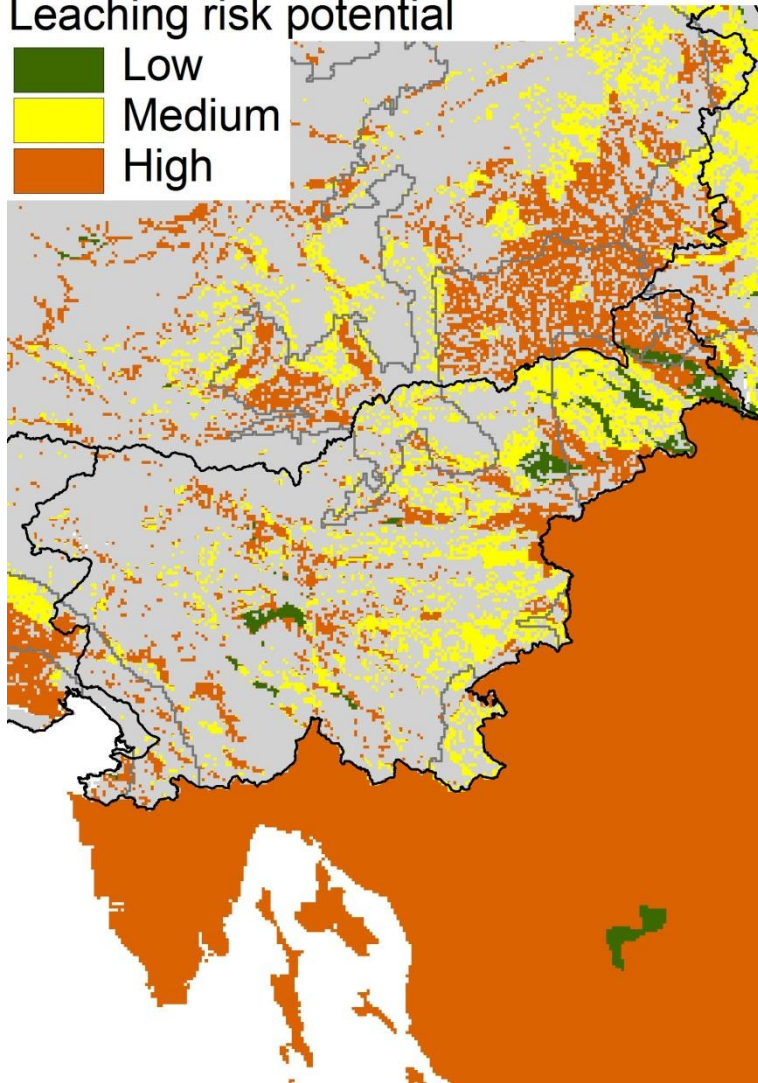
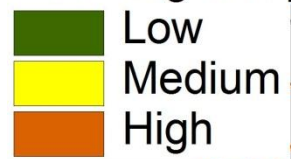
### Surface runoff risk potential



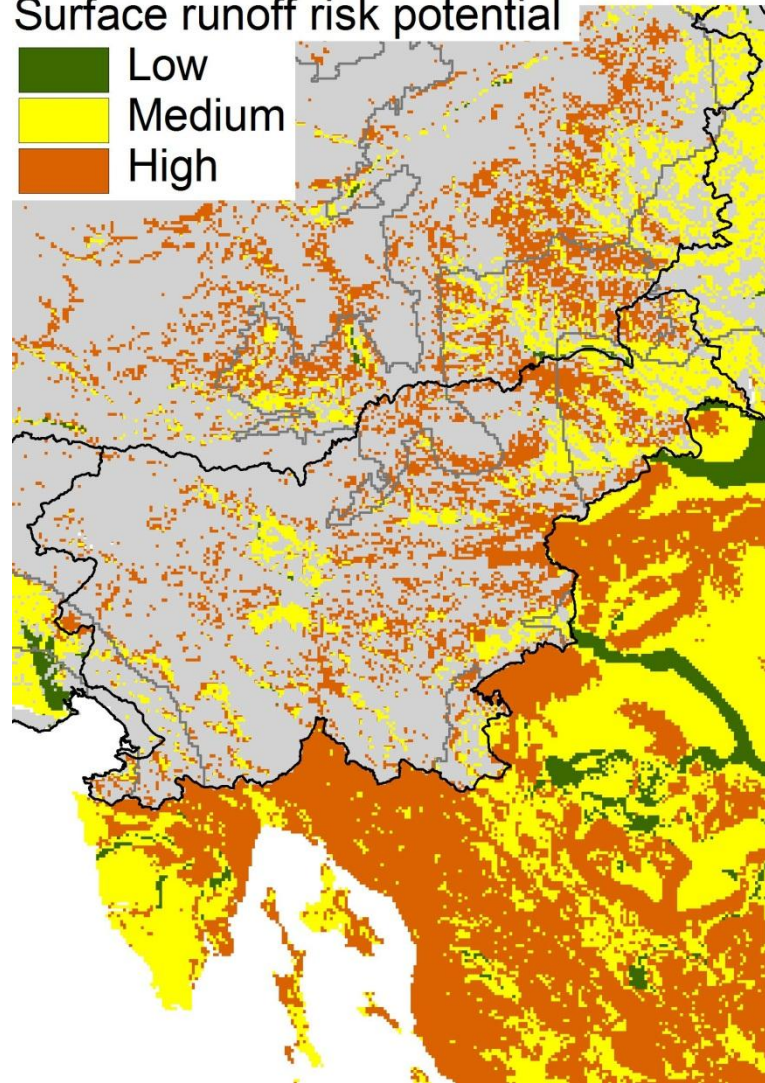
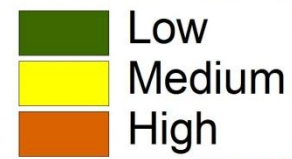


Slovenia

### Leaching risk potential

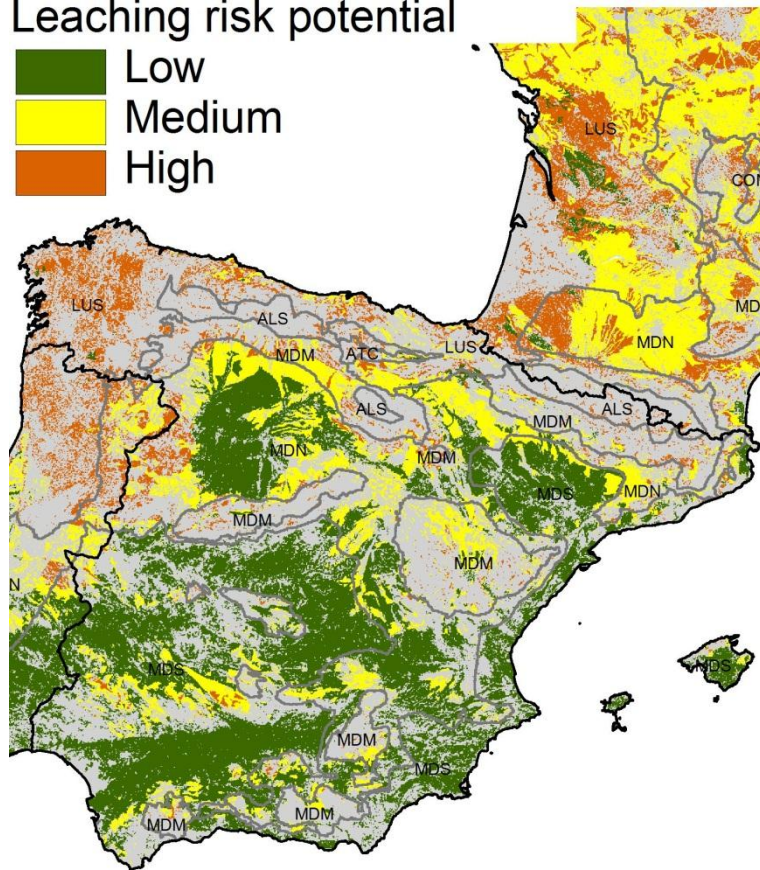
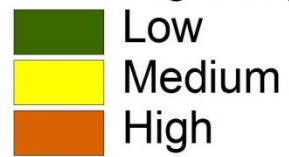


### Surface runoff risk potential

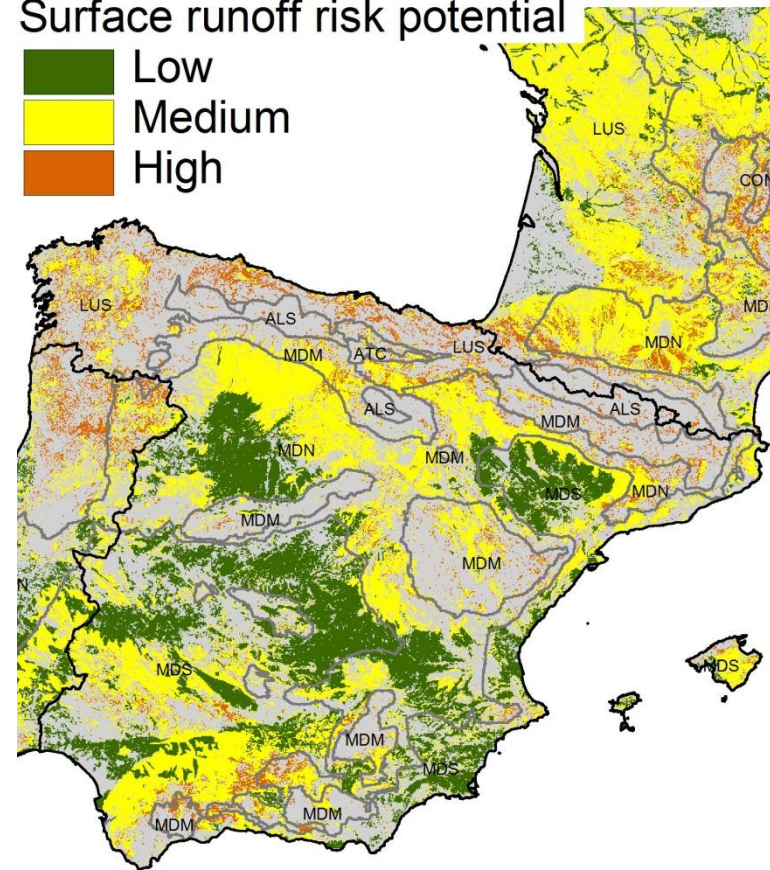
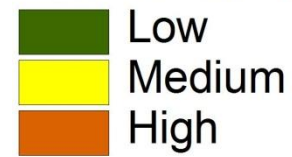


Spain

### Leaching risk potential



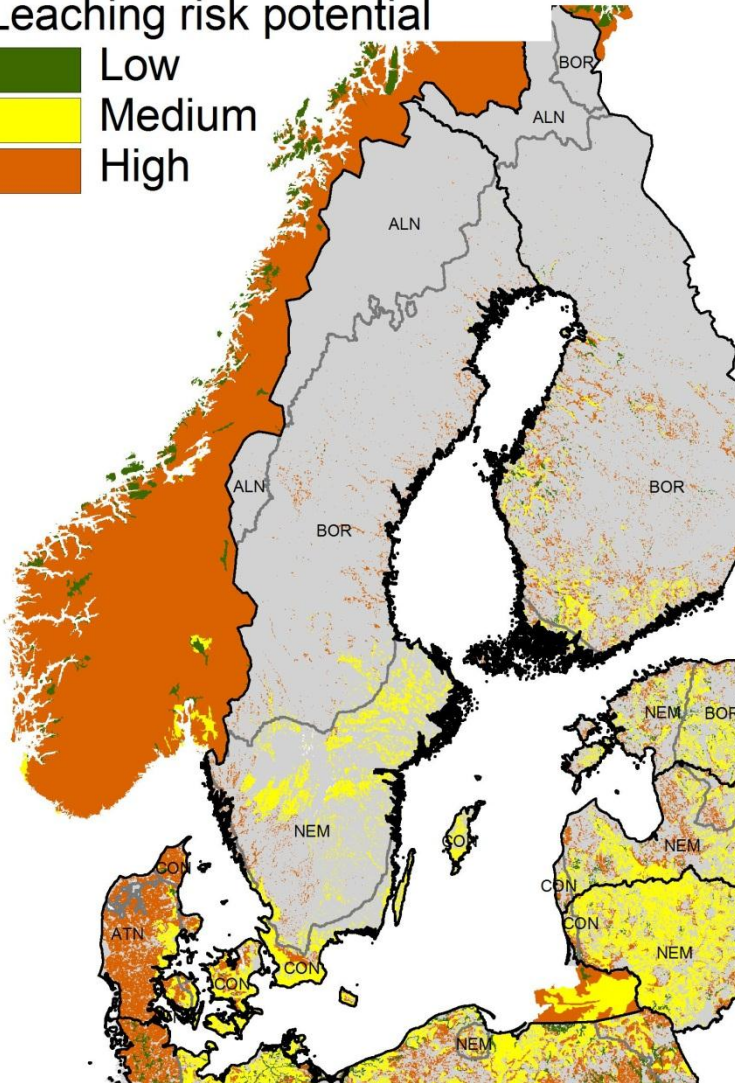
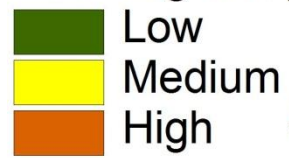
### Surface runoff risk potential



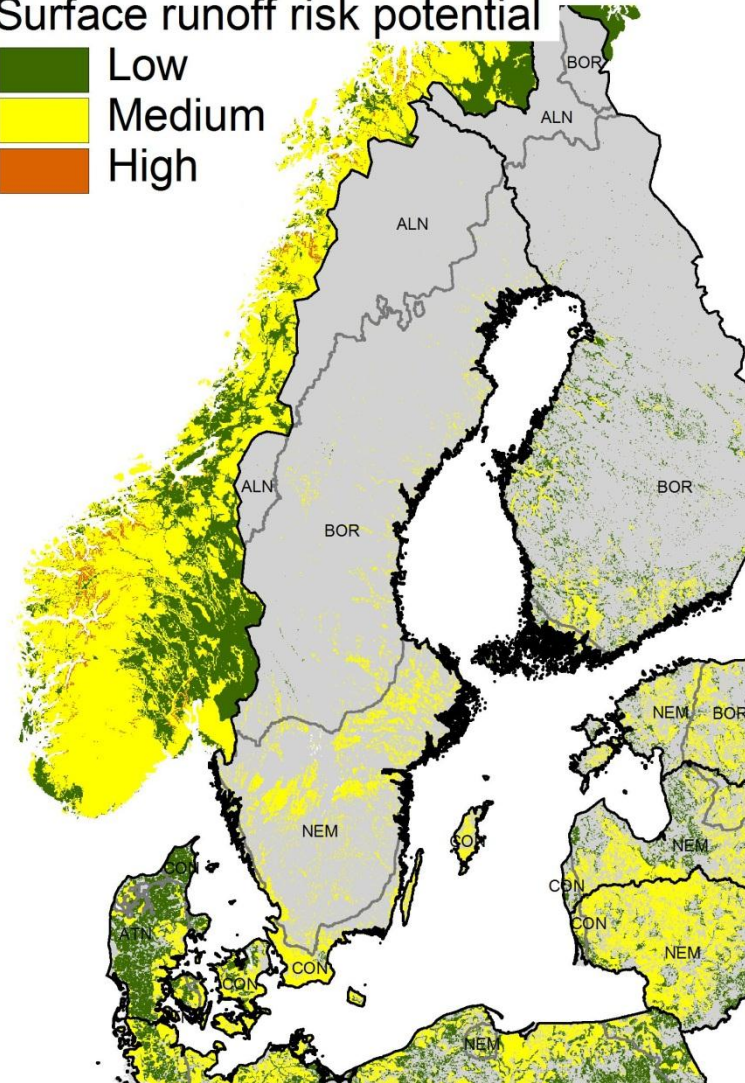
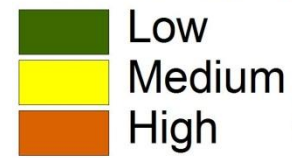


Sweden

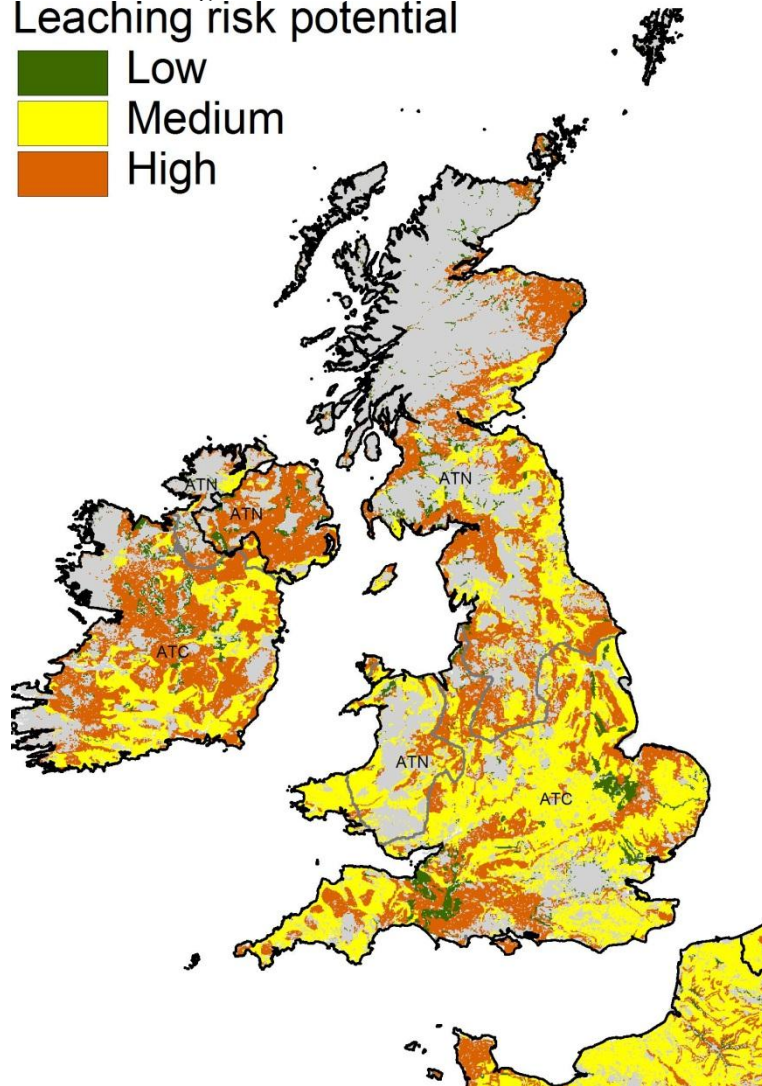
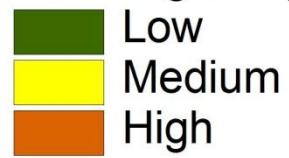
### Leaching risk potential



### Surface runoff risk potential



the United Kingdom  
Leaching risk potential



Surface runoff risk potential

