



SETOF Soil Erosion and TOrrential Flood
*Prevention: Curriculum Development at the
Universities of Western Balkan Countries*

WP1 – Analysis of soil erosion state and torrential floods in WBC

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Land degradation

- Land degradation and desertification adversely affect food production and security, water security, energy security, biodiversity, and many ecosystem services.
- Land degradation is the persistent reduction or loss of the biological and economic productivity of land.

Nine Main Causes of Land Degradation are as follows:

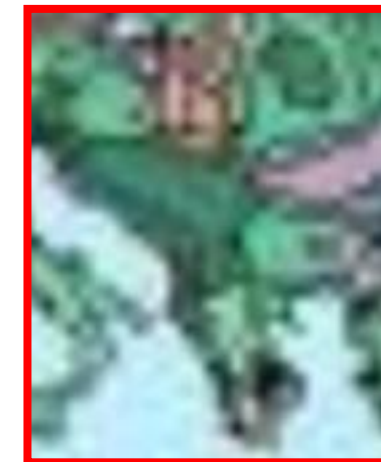
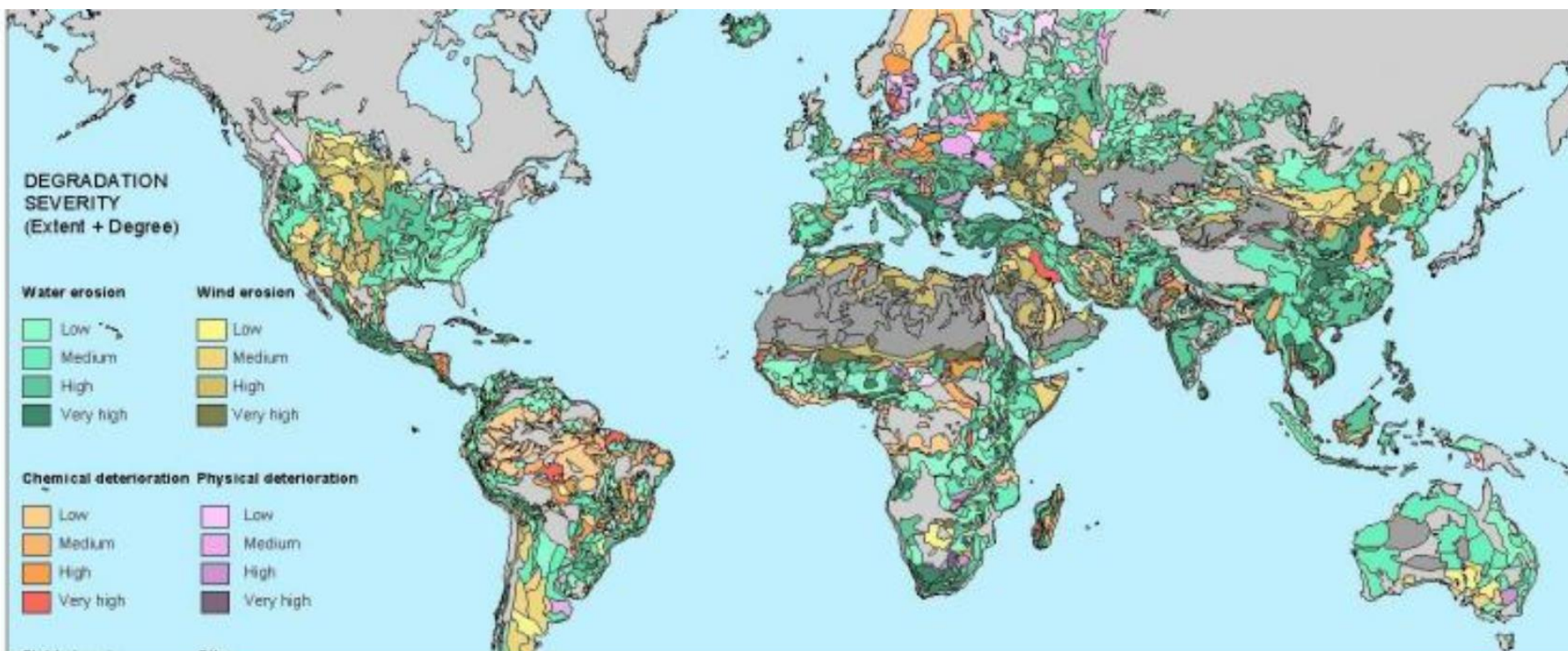
1. Deforestation,
2. Excessive Use of Fertilizers and Pesticides;
3. Overgrazing;
4. Salinization;
5. Water-logging;
6. Desertification
7. **Soil erosion;**
8. Wasteland;
9. ***Landslides***

<http://www.yourarticlelibrary.com/land-pollution/land-degradation-9-main-causes-of-land-degradation/39654>





Global assessment of human-induced soil degradation processes (GLASOD, 1991)



- WBC
- Erosion high – very high





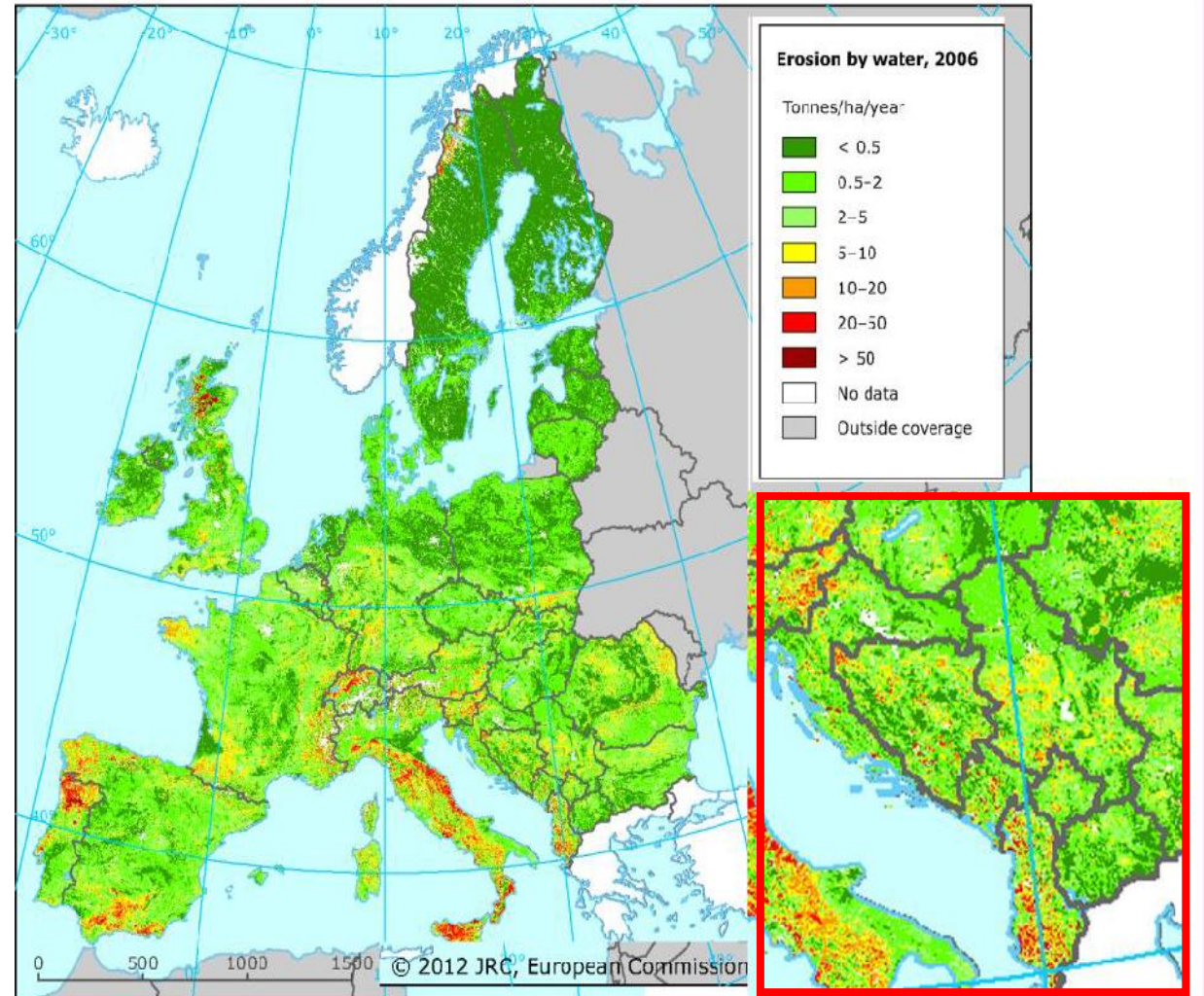
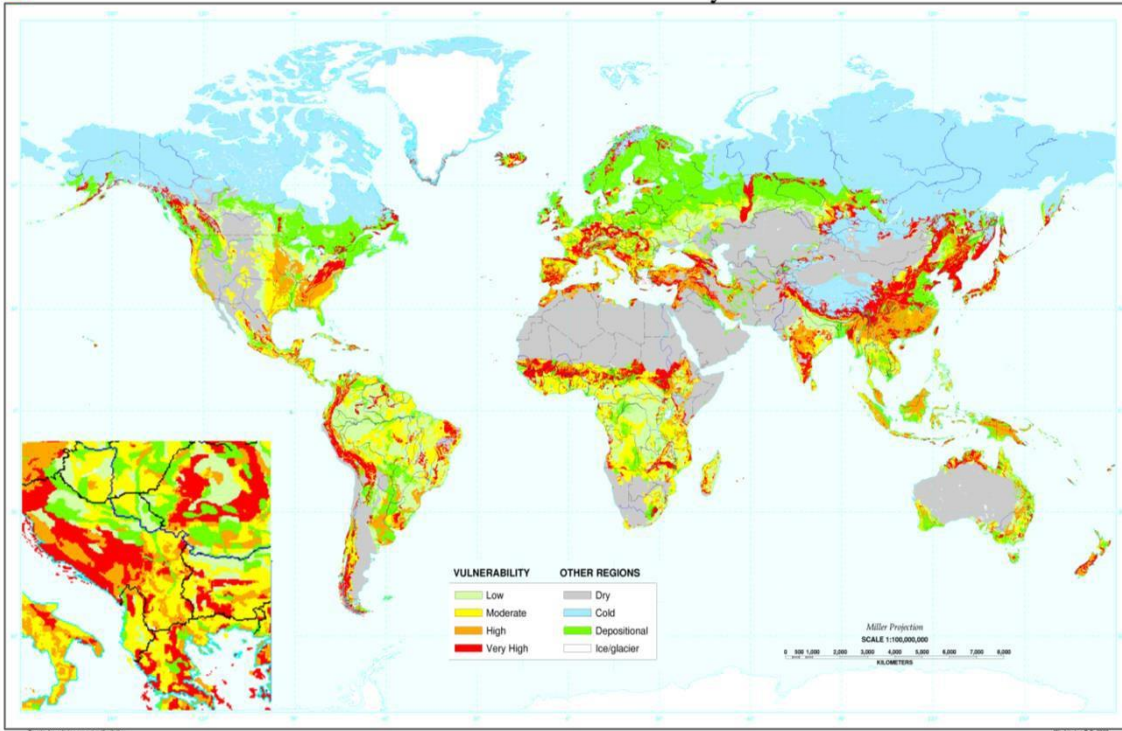
- The main problems for soils in the EU are irreversible losses due to increasing soil sealing and soil erosion, and continuing deterioration due to local contamination and diffuse contamination (acidification and heavy metals) and other human activities.
- **Soil degradation is mainly caused by urbanization and infrastructure development (in western and northern Europe) and erosion (in the Mediterranean region).**
- There is a significant risk of water erosion mainly in southern and central Europe and the Caucasus region; at present, this risk is high to very high in one-third of Europe.
- The incremental loss and deterioration of Europe's soil resource will continue, and will probably increase as a result of climate change, land-use changes and other human activities.
- <https://www.eea.europa.eu/publications/92-9157-202-0/page306.html>





Soil erosion – global and WB

Water Erosion Vulnerability



http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_054006

- <http://www.eea.europa.eu/data-and-maps/figures/estimated-soil-erosion-b>

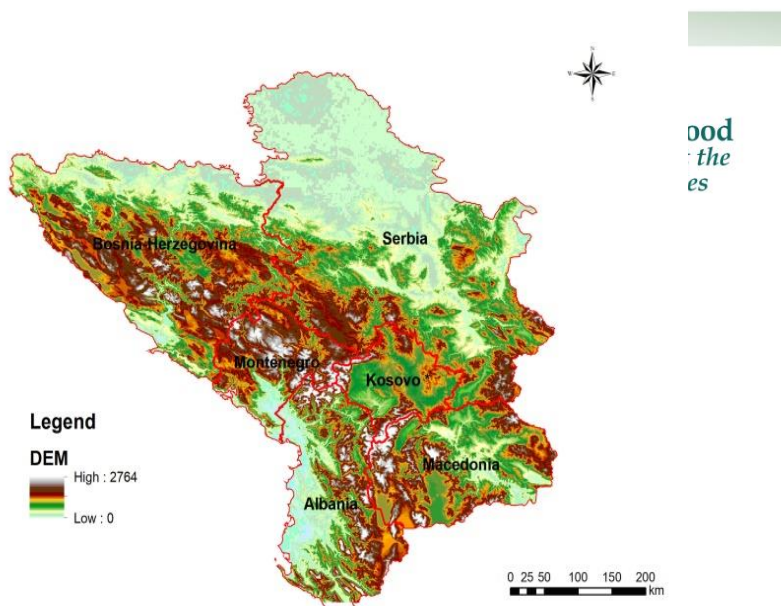




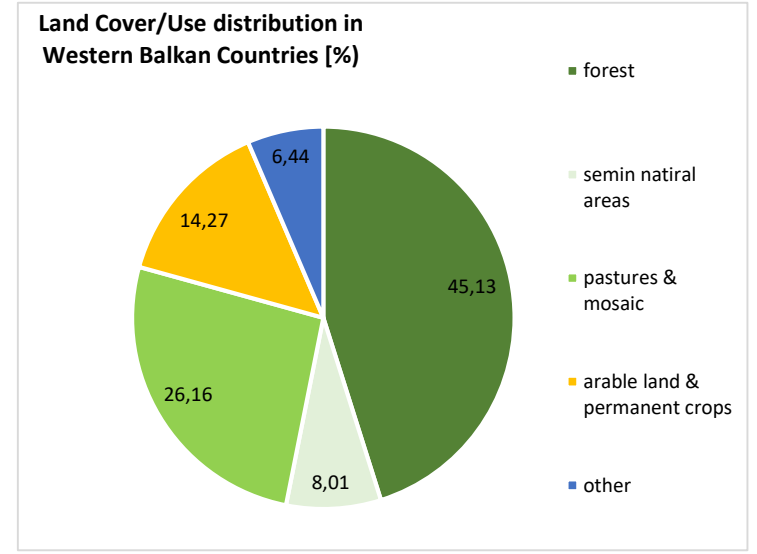
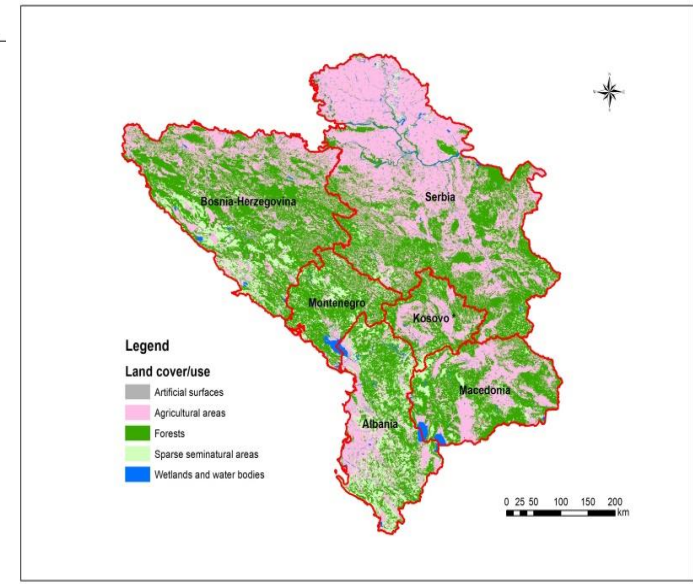
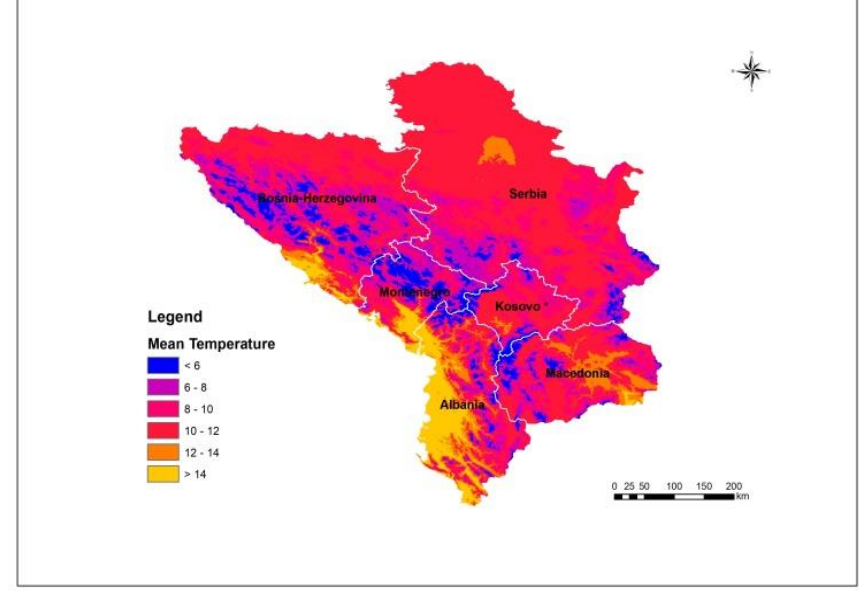
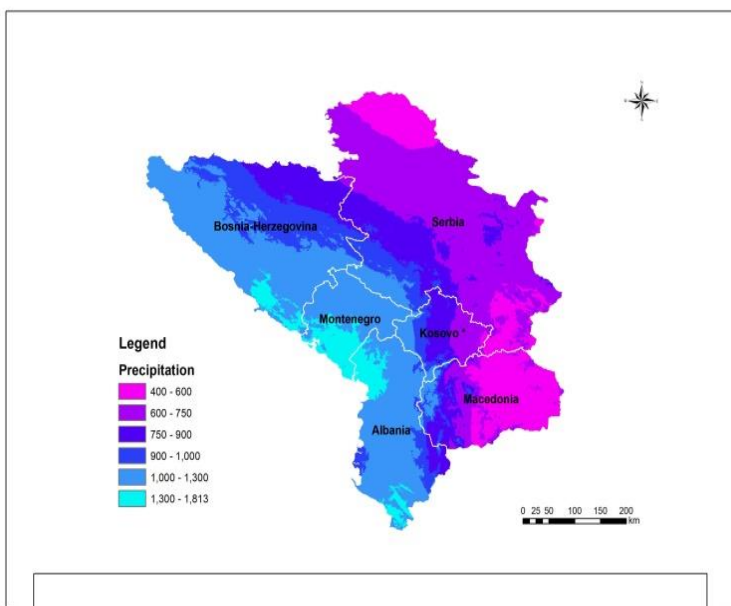
STUDY REGION - WBC

- The Western Balkans is a neologism coined to describe the countries of "ex-Yugoslavia (minus Slovenia and Croatia) plus Albania".
- The region includes: Albania, Bosnia and Herzegovina, Montenegro, Macedonia, Serbia (Kosovo** United Nations Security Council resolution 1244, adopted on 10 June 1999, last retrieved 15.8.2017)
- Western Balkan Countries (WBC) are located in Balkan Peninsula in Southeast Europe.





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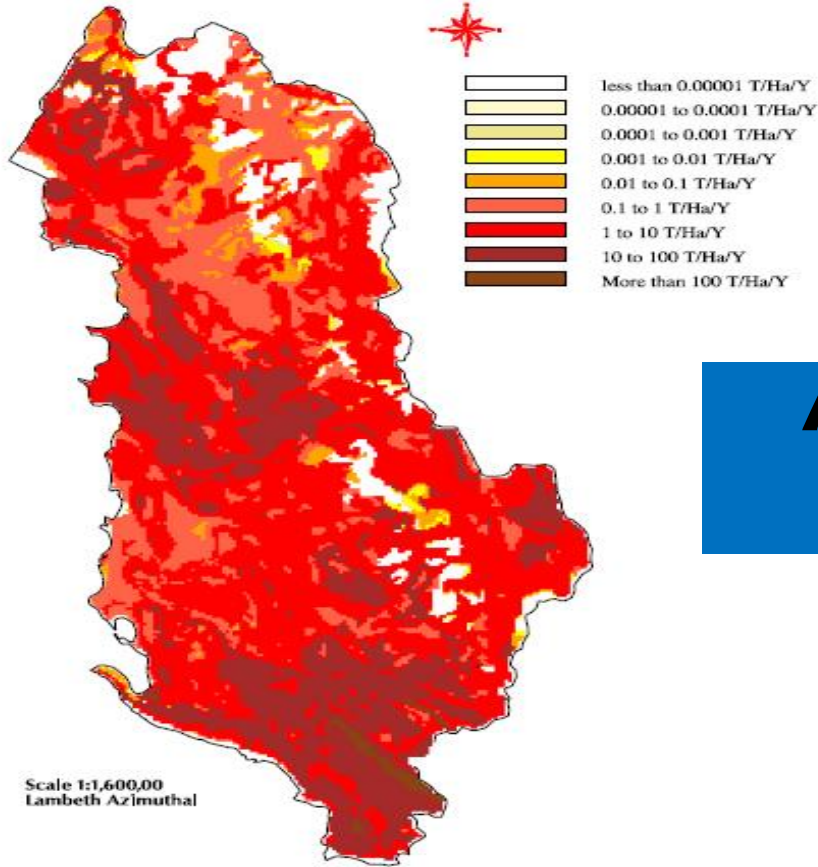


Rugged relief, steep slopes, lithology structure and climate conditions cause various and severe erosion processes, rock weathering falling events, talus cones, landslides and debris torrents. Inappropriate Human activities contribute to this.

Erosion in WBC

- A wide list of projects, scientific papers and data on European level, was analyzed as follow: SERA , PESERA, MESALES, EUROSTAT, EEA, and data from book by Bordman and Poesen (2006). The most comprehensive and appropriate data for this study was found in the EEA report – data and maps 2012, book “Soil Erosion in Europe” and EC – Eurostat: Agri-environmental indicator – soil erosion, 2013
- From the WBC were analyzed the following national reports, database and maps prepared by various scientists :
 - Albania – Grazhdani et al (2006), Zdruli et al (2001)
 - Bosnia and Herzegovina – Lazić et al (2012), Tošić et al (2012, 2013) ,
 - Macedonia – Gjorgjević et al (1993), Blinkov and Trendafilov (2005,2006) .
 - Montenegro – Kostadinov et al (2006),
 - Serbia including Kosovo - Kostadinov et al (2006),





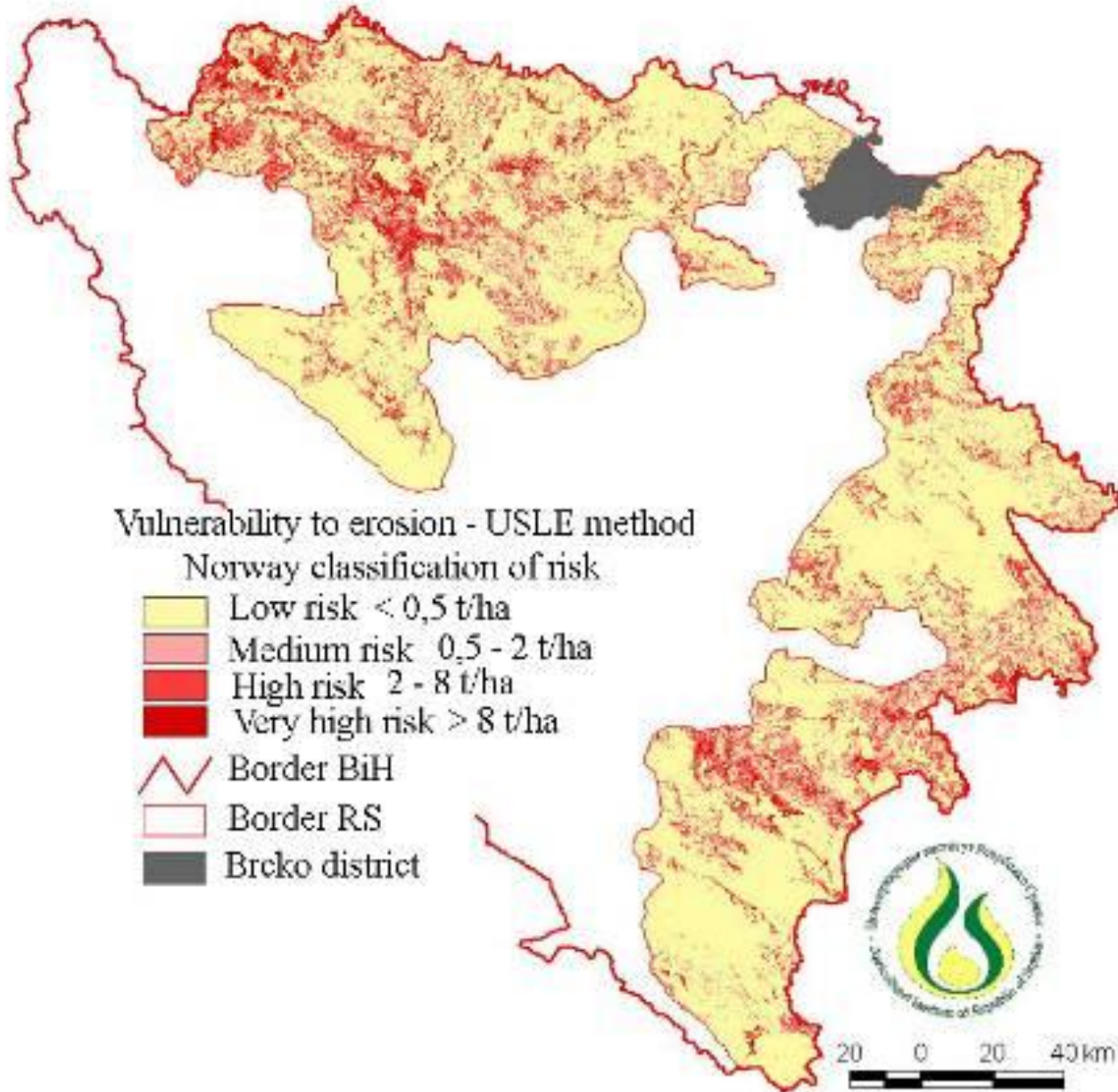
Albania 2010

River basin	Basin area	Sediment yield
	km ²	t/ha.yr
Drini	5973	18.8
Mati	2441	9.3
Fani	1076	11.1
Erzeni	760	26.6
Shkumbini	2444	23.7
Semani	5649	20.9
Vjosa	6706	13.5
Total	18343	18.7

There are three areas where the annual erosion rate is more than 100 t ha⁻¹y⁻¹ (two in Gjirokastër and one in Sarandë).

Erosion rates are highest in October, November, February and December and lowest in June and July (< 1 ha⁻¹y⁻¹). These rates show that soil erosion in most cases is not well controlled and the most appropriate soil management practices are not being applied (Grazhdani *et al.*, 2006).

Bosnia and hercegovina (1985)




According to old data (1985)
the total average amount of
sediment, created on territory of
SR BiH per year was 16.518,031 m³,
or 323 m³/km².

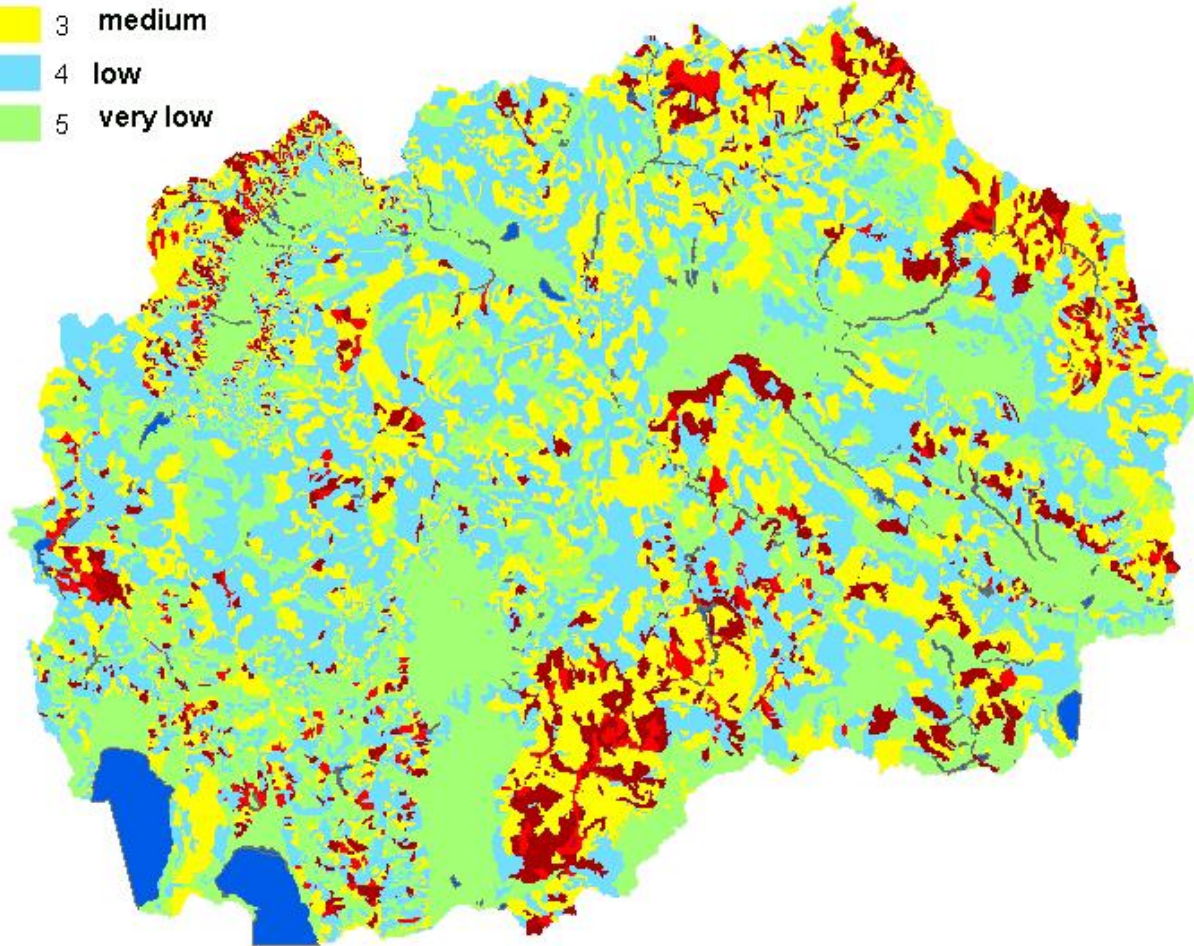


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MACEDONIA (1991)

EROSION MAP

-  sedimentation
-  1 very high
-  2 high
-  3 medium
-  4 low
-  5 very low



Degrad. category	Erosion process intensity	Area endangered	
		km2	%
I	Excessive	698	2.77
II	High	1 832	7.38
III	Moderate	6 893	27.78
IV	Weak	7 936	31.98
V	Very weak	7 463	30.09
	Total	25 713	100.00

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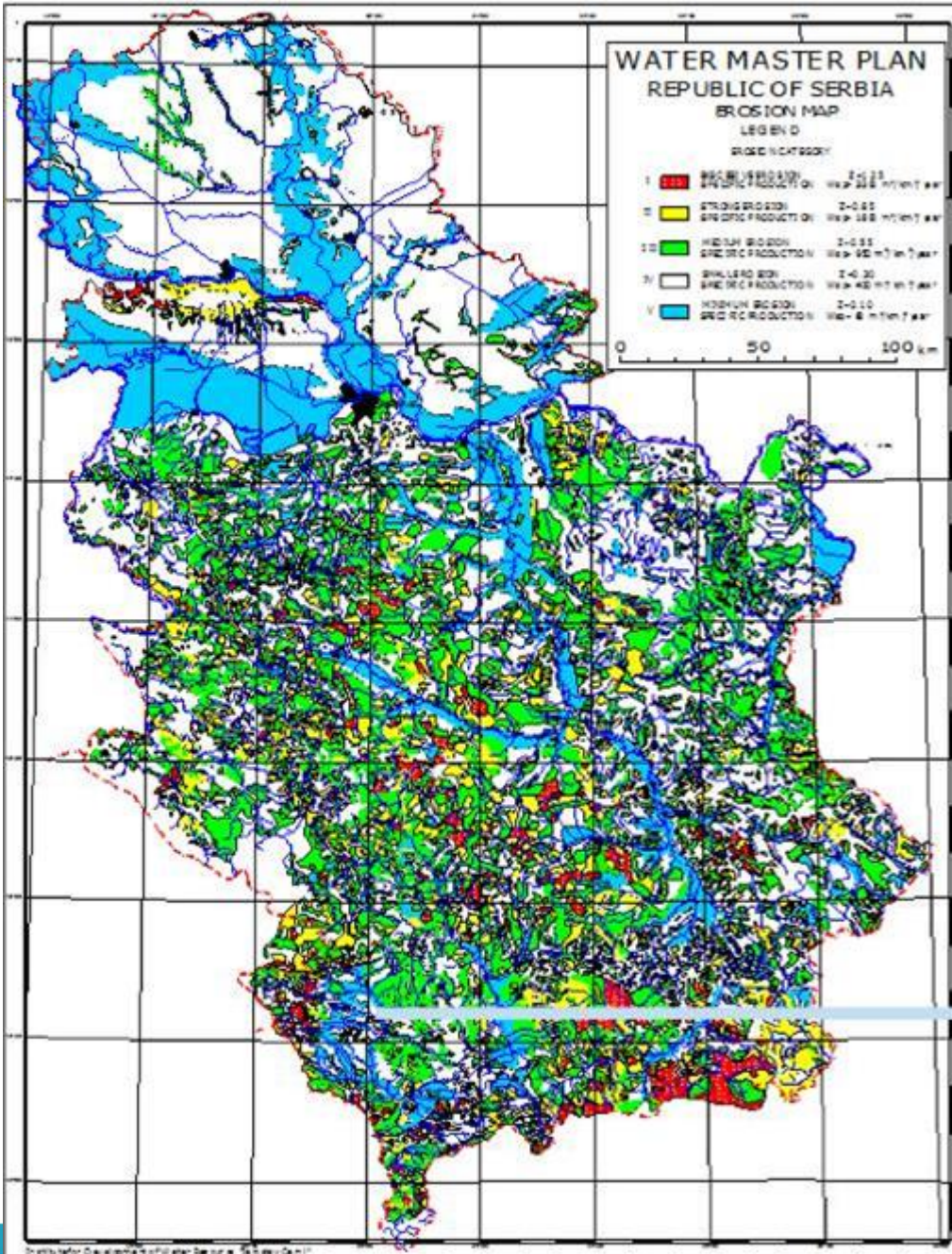


MONTENEGRO

Degrad. category	Erosion process intensity	Area endangered	
		km ²	%
I	Excessive	180	1.3
II	High	1354	9.8
III	Moderate	5027	36.4
IV	Weak	6367	46.1
V	Very weak	884	6.4
	Total	13812	100



Serbia (including Kosovo*)



Category	Erosion Processes Intensity	Area	
		km ²	%
I	Excessive Erosion	2,888.0	3.27
II	Intensive Erosion	9,138.0	10.34
III	Medium Erosion	19,386.0	21.94
IV	Weak Erosion	43,914.0	49.78
V	Very weak Erosion	13,035.0	14.75
Total		88,361.0	100





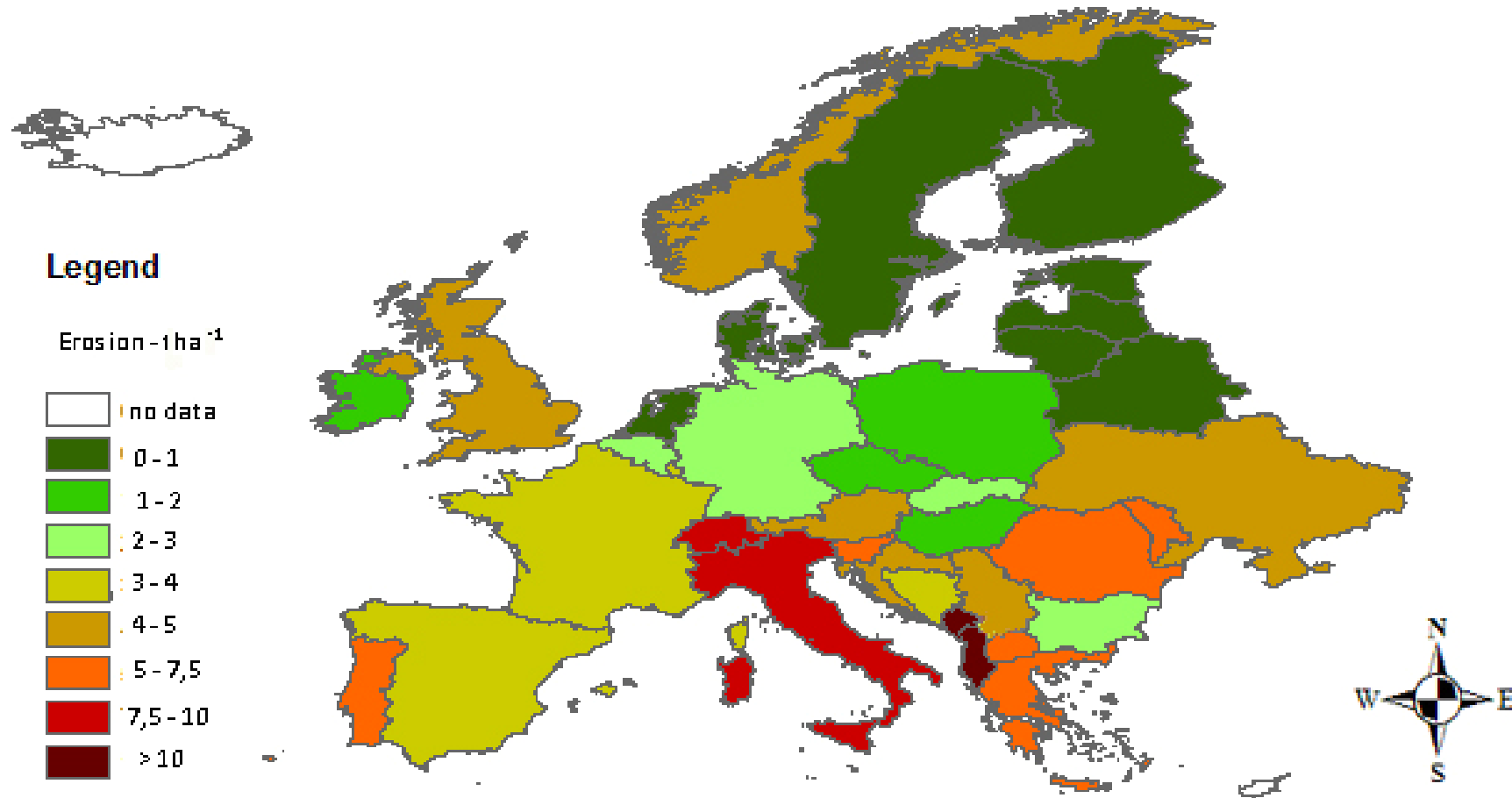
Overview of erosion intensity in Western Balkan Countries

Country	Area km ²	Annual Erosion intensity		Map scale	Source
		t *10 ⁶	m ³ t/ha m ³ /km ²		
Albania	28748	53,0	1870	Pixel 1km	Grazhdani S.* (2007)
B i H	51129	16,5	323	1:25000	Lazić Z. (2012)
Macedonia	25713	17,0	685	1:50000	Gorgević et al. (1993)
Montenegro	13812	17,3	1253	1:50000	Kostadinov S. (2007)
Serbia incl. Kos.	88385			1:50000	Kostadinov S. (2007)
		39,7	435		
Serbia	77477	37,0	488	1:50000	Kostadinov S. (2007)
Kosovo (UN 1244)	10908	2,7	289	1:50000	Kostadinov S. (2007)
Total	207787	143,5	703,4		

EROSION INTENSITY IN EUROPE

annual soil loss per country

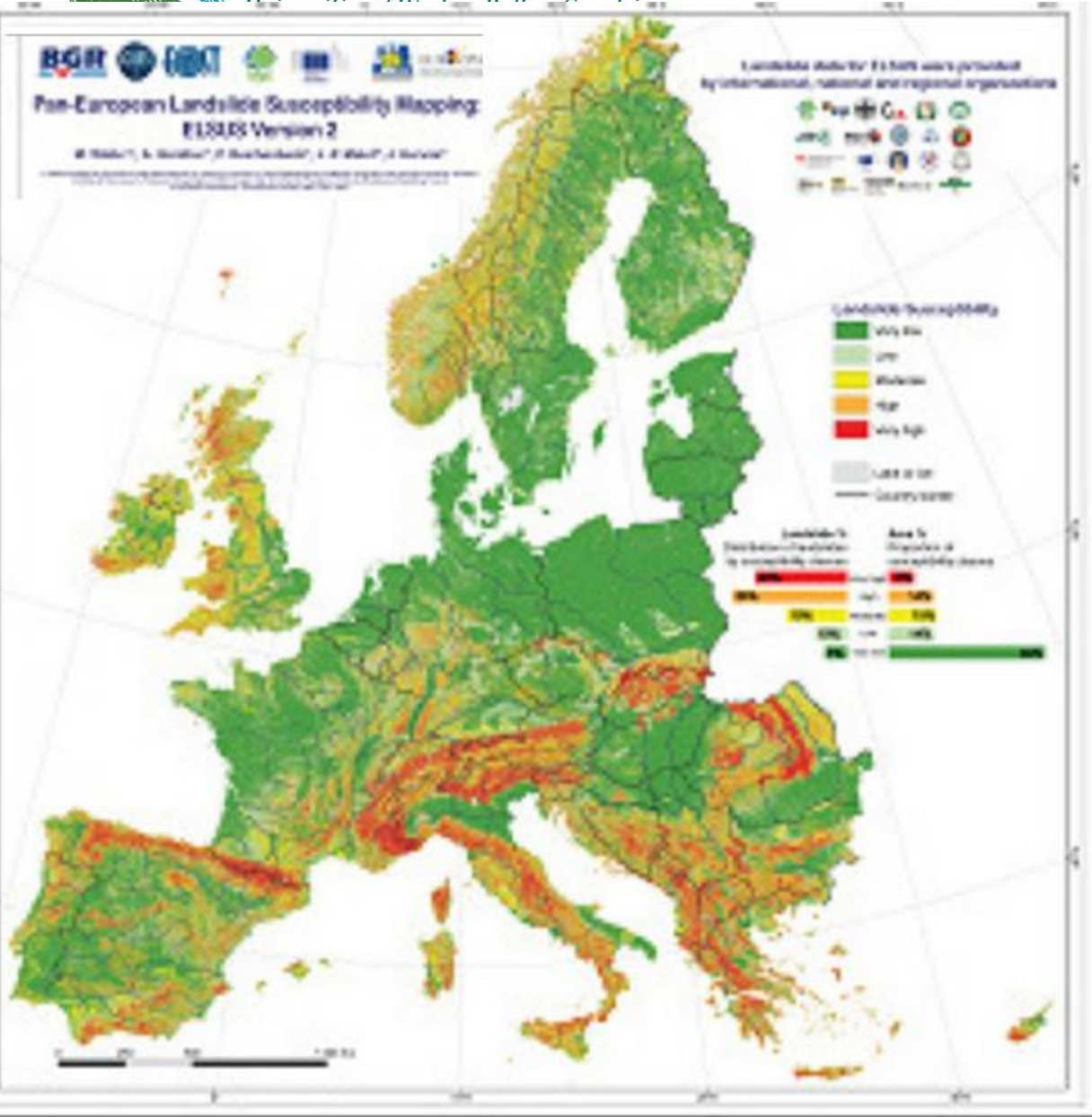
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LANDSLIDES

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- Landslides in the WBC region commonly occur due to increased amounts of precipitation, high levels of groundwater and the unplanned construction of houses and road infrastructure on slopes, uncontrolled cutting of forest and mineral resources exploitation.
- For example, 30% of Serbia's territory is threatened by landslides or some kind of mass earth movements which affects more than 40,000 locations.





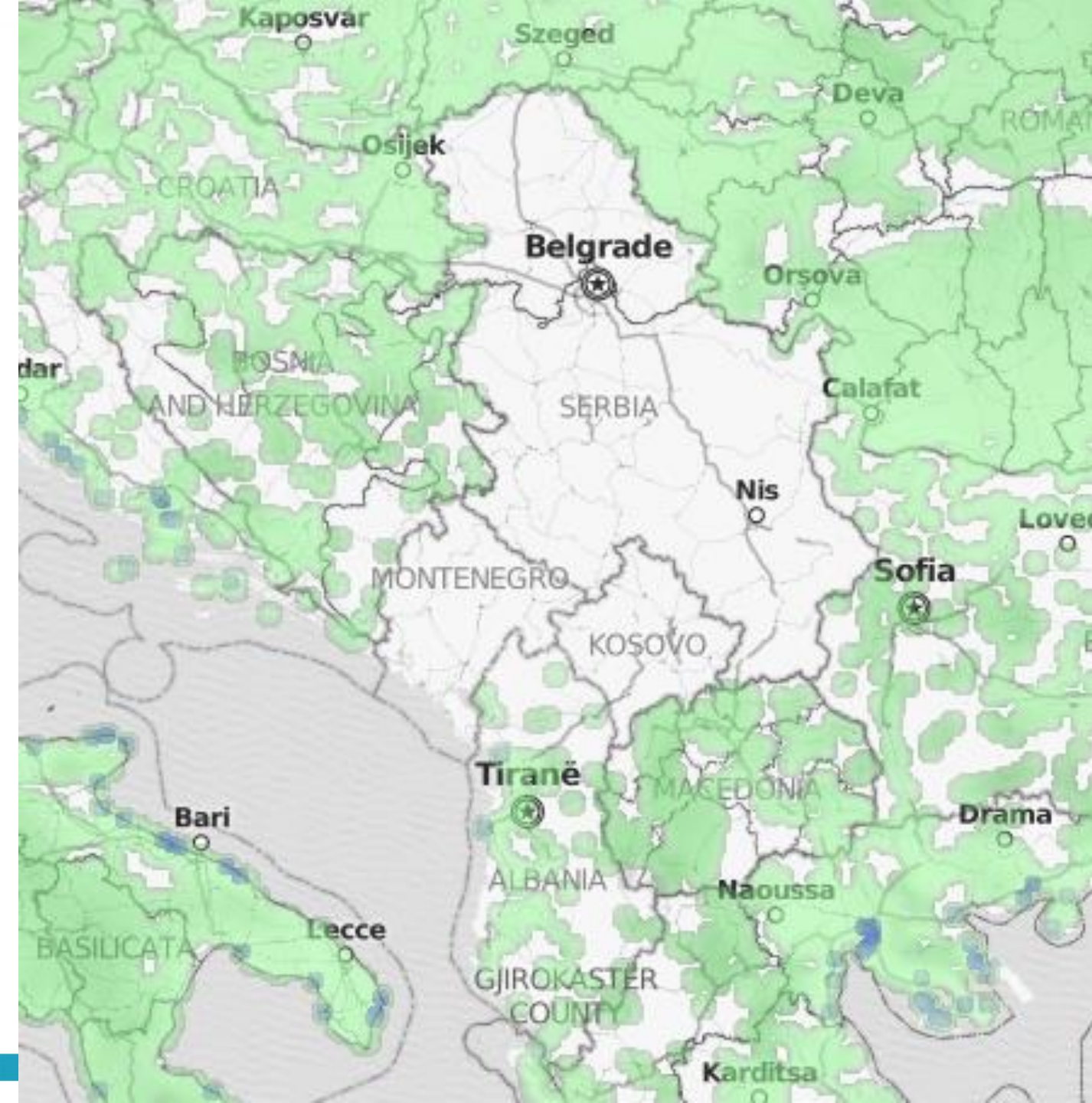
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TORRENT FLOODS in WBC

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Registered floods in WBC



- <http://globalfloodmap.org/>
- Data about floods for Albania, Bosnia and Macedonia.
- No data for Montenegro and Serbia



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SERBIA - Distribution of registered torrential floods



Ristic et al, 2012

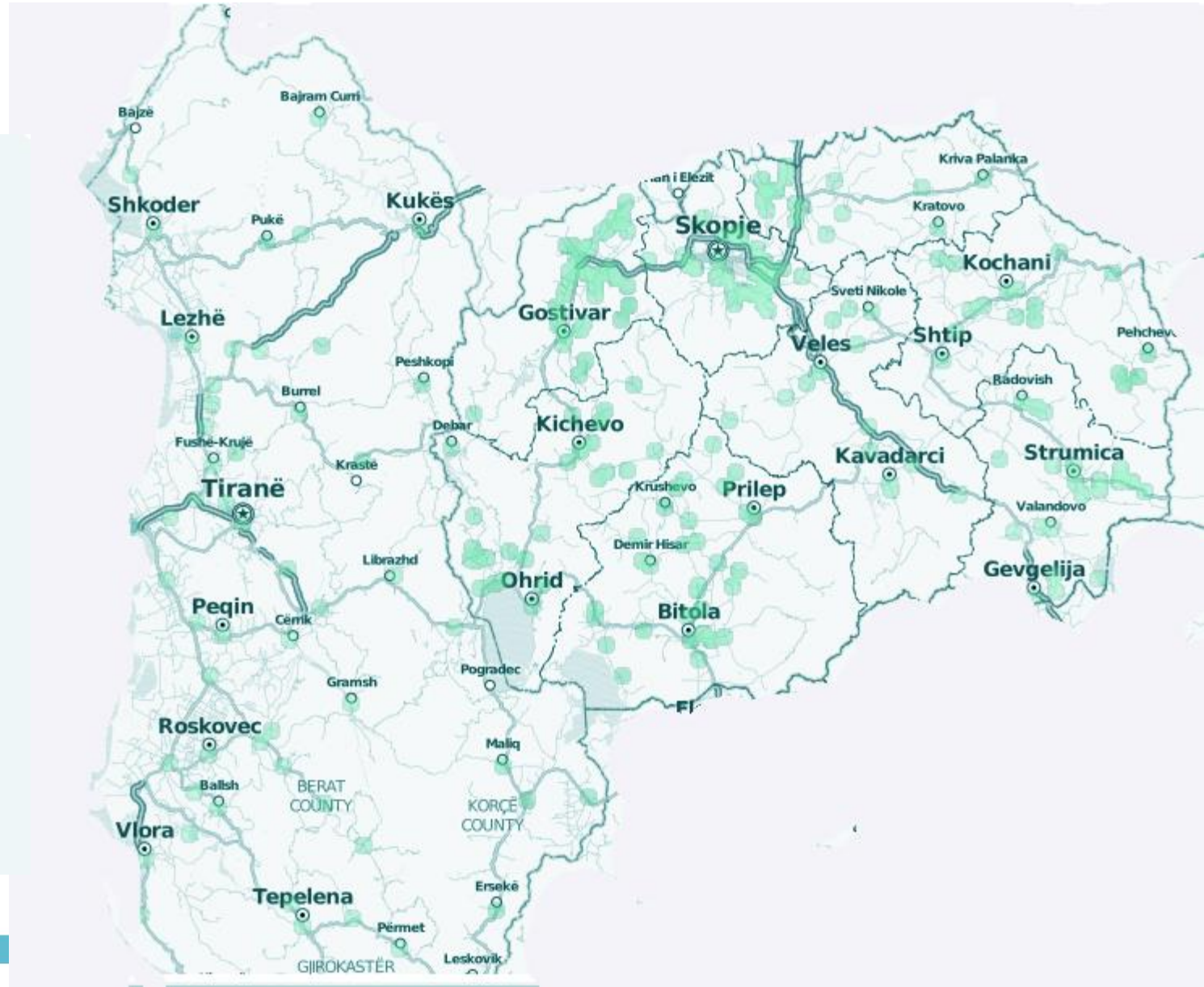
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Registered flood events in BIH, ALB, MKD

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The main factors increasing the flooding risk, besides topographic and land characteristics, are heavy precipitations, removal of forest cover, uncontrolled urbanization, the reduced discharge capacity of regulated river sections (deposition of sediment and garbage; overgrowing by shrubs and trees).

1,539 torrents are registered in Macedonia, 935 in BIH and more than 11,500 in Serbia.

Torrential floods are also frequent in Albania.

During catastrophic torrential floods in BIH and Serbia, in May 2014, 76 lives were lost, 2.6 million people were endangered, and about 12,000 km² were flooded with material damage higher than 3 billion euros.

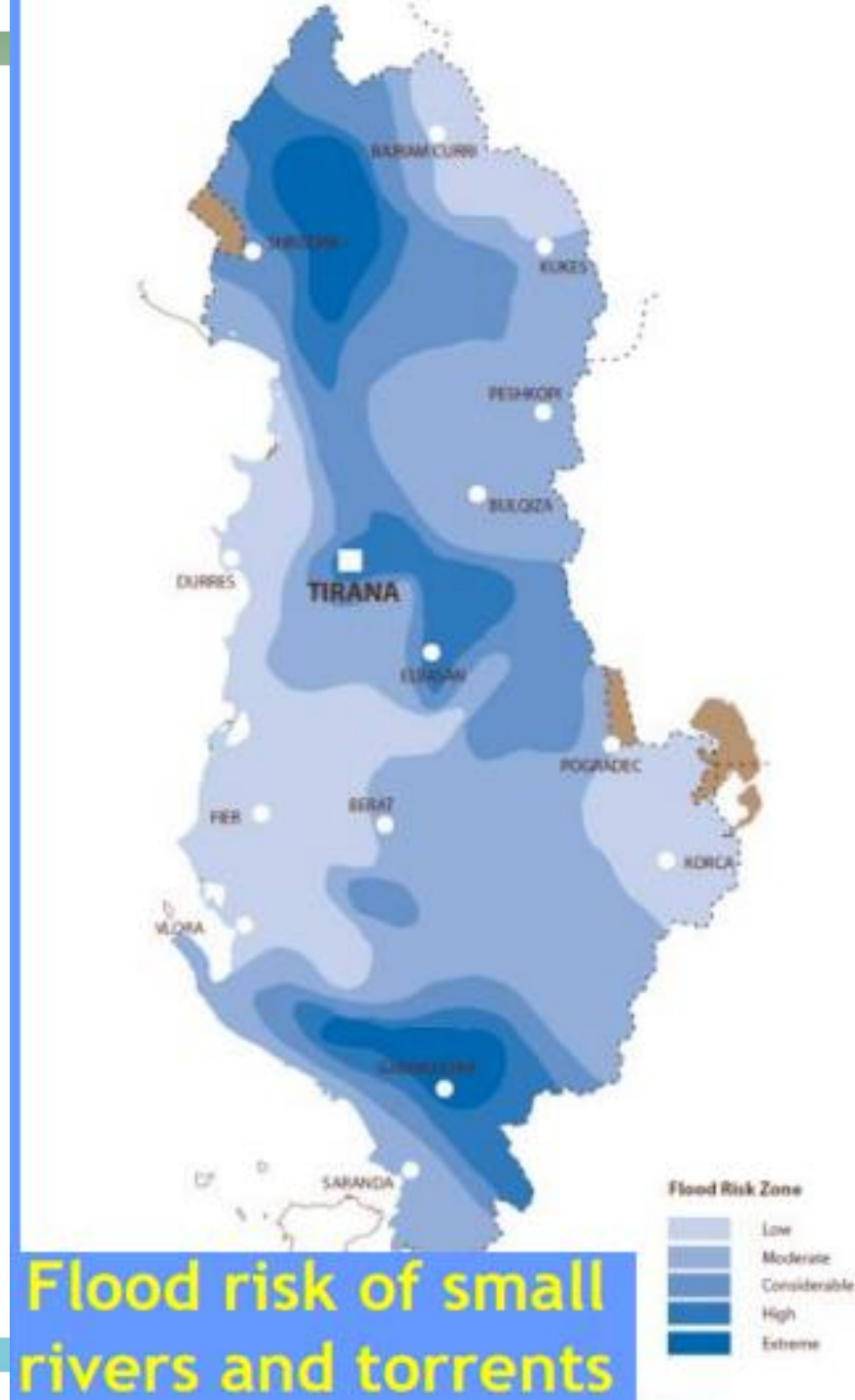
During a torrential event in Macedonia, near Skopje, in August 2016, 22 people died, and costs of losses and damages were significant. Dominant hazard in Montenegro is also torrential floods and erosion processes, with damages higher than 60 million euros, in the period 2010 - 2016.

During torrential floods in the region were recorded maximal discharges from 8.2 m³/s/km² (Serbia) to 10-12 m³/s/km² (Albania and Macedonia), which corresponds to recurrence intervals of 100-500 years.



ALBANIA

- **NO SEPARATE DATA FOR TORRENT FLOODS**
- There is cumulative data for all floods
- 1854-1871. 11 flood events were registered.
- Historically, the floods of November 1962-January 1963 is considered the largest with 70 000 ha agriculture area flooded.
- The second are the floods of September 2002 caused by river Erzeni and some tributaries with a agriculture area flooded of 30 000 ha.
- Floods 2015 - 12500 ha 53 municipalities, 110 Million Euros



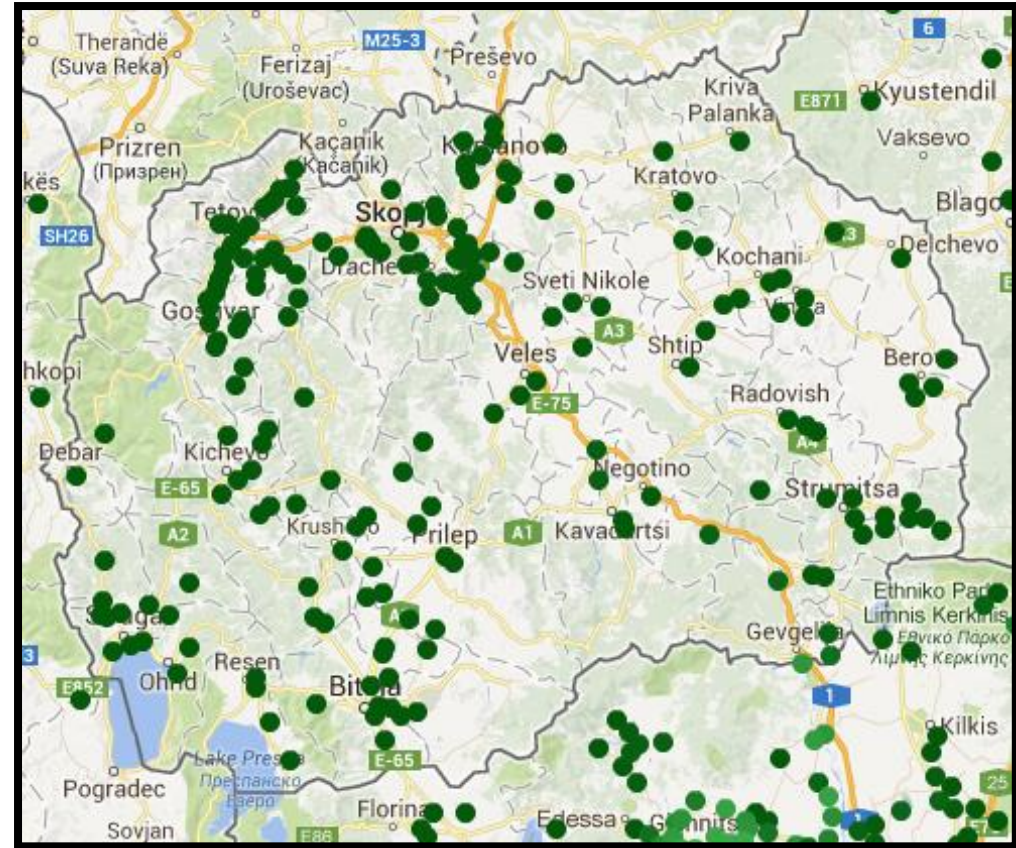


MACEDONIA - flood events in the last 50 years

• Damages and Losses - Torrent floods in last 10 years

- 2008 – Radovis – 3,5 mil. Euros, 1 fatality
- 2015 – Tetovo – Polog – 25 million Euros, 6 fatalities
- 2016 – Skopje vicinity – > 70 Mil.Euros
??? 22 fatalities

Dzepchiska Reka (Poroj) – permanent almost every year,



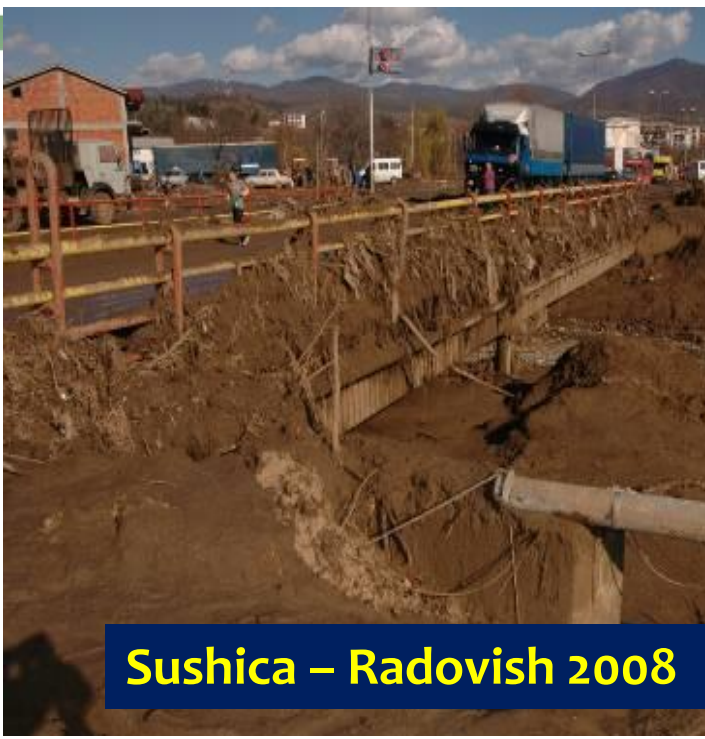
TORRENT FLOOD



Dzepchiska Reka



Shipkovica – Tetovo 2015



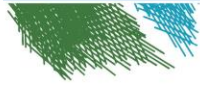
Sushica – Radovish 2008



SKOPSKO 2016



SERBIA - Distribution of registered torrential floods



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No.	Time period	Number of torrential flood events	Average per year	Casualties
1.	1915-1930	33	2.06	>22
2.	1931-1960	175	5.83	>51
3.	1961-1990	384	12.80	36
4.	1991-2014	297	12.38	27
Total (100 yr)		889	9.89	136

Source: Petrović, A., 2014





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CONCLUSION



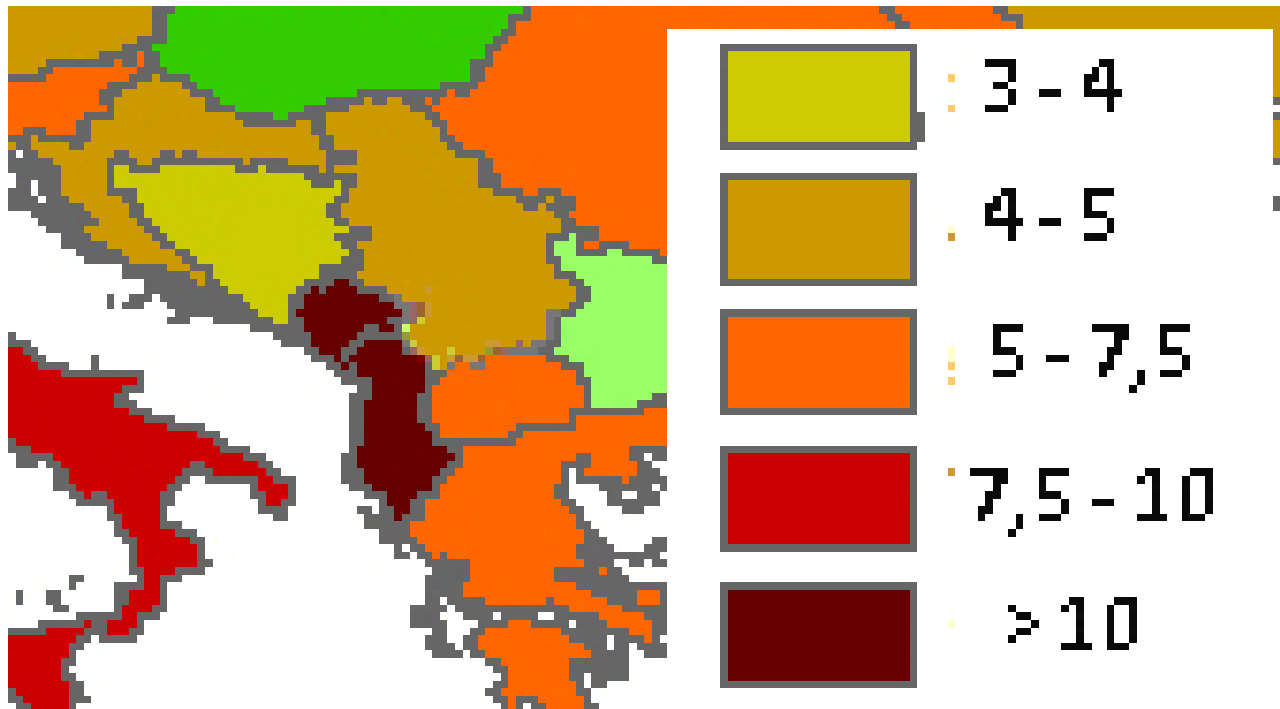
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EROSION INTENSITY in the WBC



- The mean annual erosion intensity of European states is calculated as 3.18 t/ha , and the total soil losses (produced sediments) are $1973 \cdot 10^6 \text{ t/ann}$
- The WBC cover 207787 km^2 or $3,486\%$ of the European territory but total annual erosion production is estimated as $7,435\%$ of total European erosion intensity.
Albania ($18,7 \text{ t/ha}$) and Montenegro ($12,5 \text{ t/ha}$) are the most erosive countries in Europe

- The most significant type of soil degradation in the WBC is soil erosion.
- WBC region is the most erosive part of Europe.
- Methodologies for defining erosion intensity and risk should be harmonized between WBC and with other Europe countries.

NATURAL DISASTERS

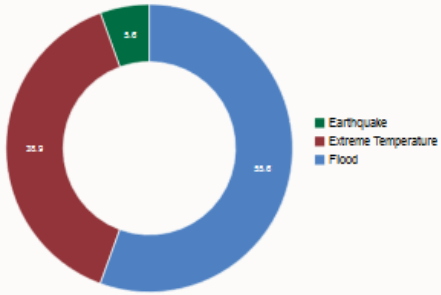
Source: <https://www.preventionweb.net/>

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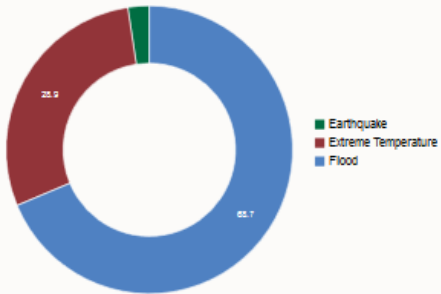
Internationally Reported Losses 1990 - 2014 EMDAT **SERBIA**

CRED EM-DAT (Feb. 2015) : The OFDA/CRED - International Disaster Database www.emdat.be Université catholique de Louvain Brussels - Belgium.

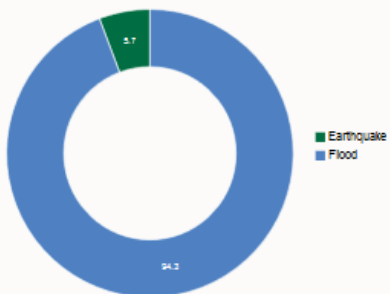
Frequency



Mortality



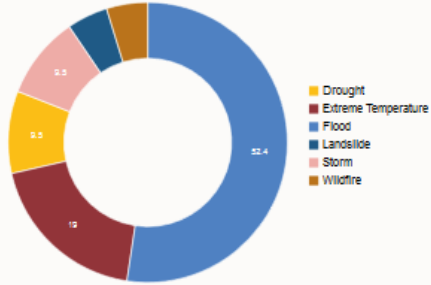
Economic issues



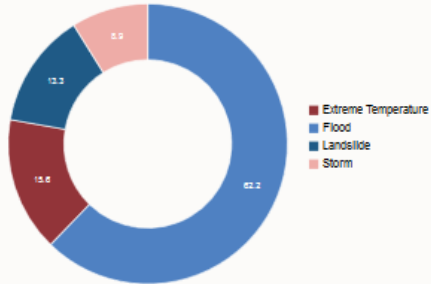
Internationally Reported Losses 1990 - 2014 EMDAT **Bosnia and Hercegovina**

CRED EM-DAT (Feb. 2015) : The OFDA/CRED - International Disaster Database www.emdat.be Université catholique de Louvain Brussels - Belgium.

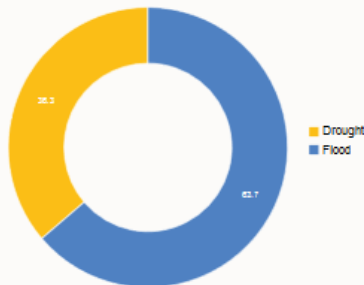
Frequency



Mortality



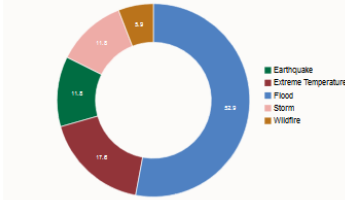
Economic issues



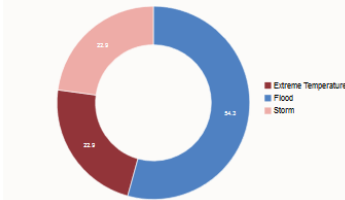
Internationally Reported Losses 1990 - 2014 EMDAT **Albania**

CRED EM-DAT (Feb. 2015) : The OFDA/CRED - International Disaster Database www.emdat.be Université catholique de Louvain Brussels - Belgium.

Frequency



Mortality



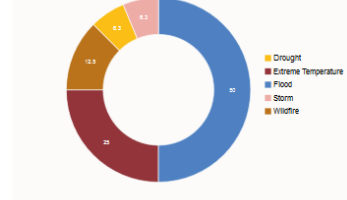
Economic issues



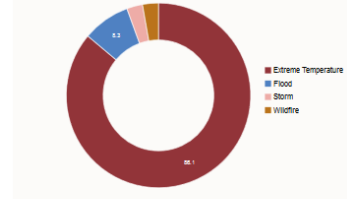
Internationally Reported Losses 1990 - 2014 EMDAT **Macedonia**

CRED EM-DAT (Feb. 2015) : The OFDA/CRED - International Disaster Database www.emdat.be Université catholique de Louvain Brussels - Belgium.

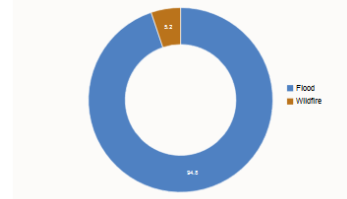
Frequency



Mortality



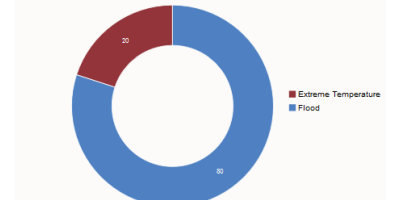
Economic issues



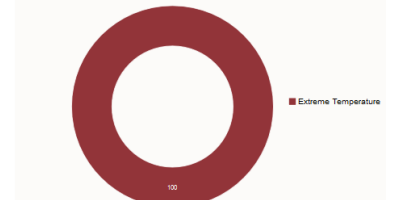
Internationally Reported Losses 1990 - 2014 EMDAT **Montenegro**

CRED EM-DAT (Feb. 2015) : The OFDA/CRED - International Disaster Database www.emdat.be Université catholique de Louvain Brussels - Belgium.

Frequency



Mortality



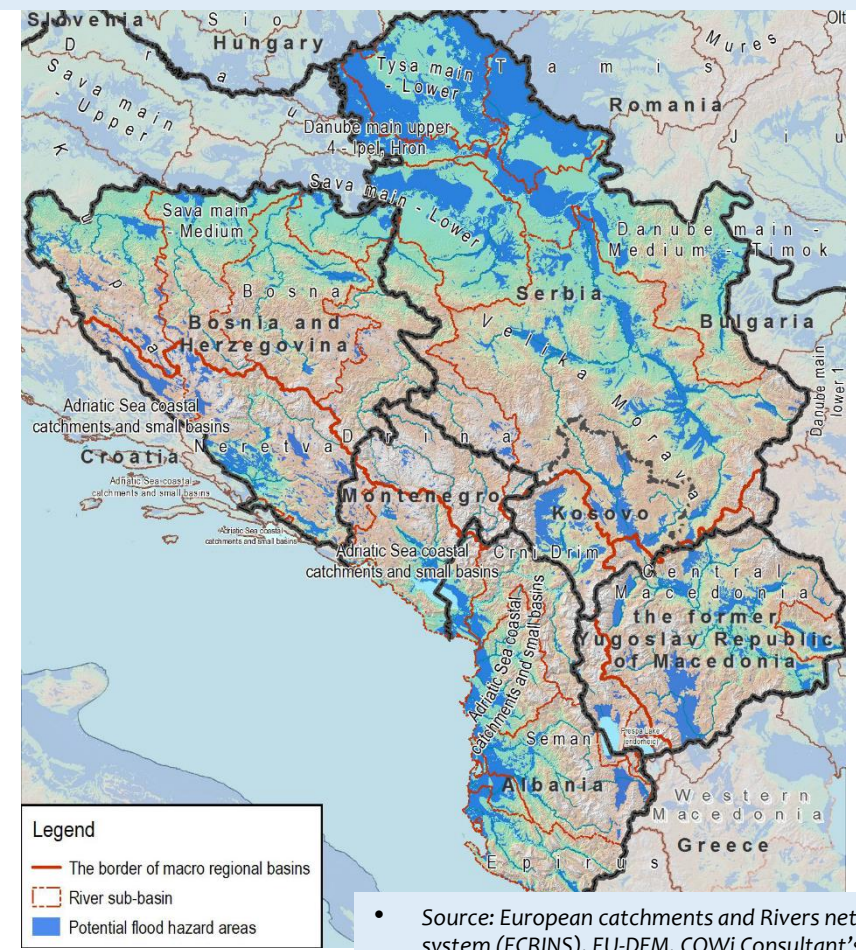
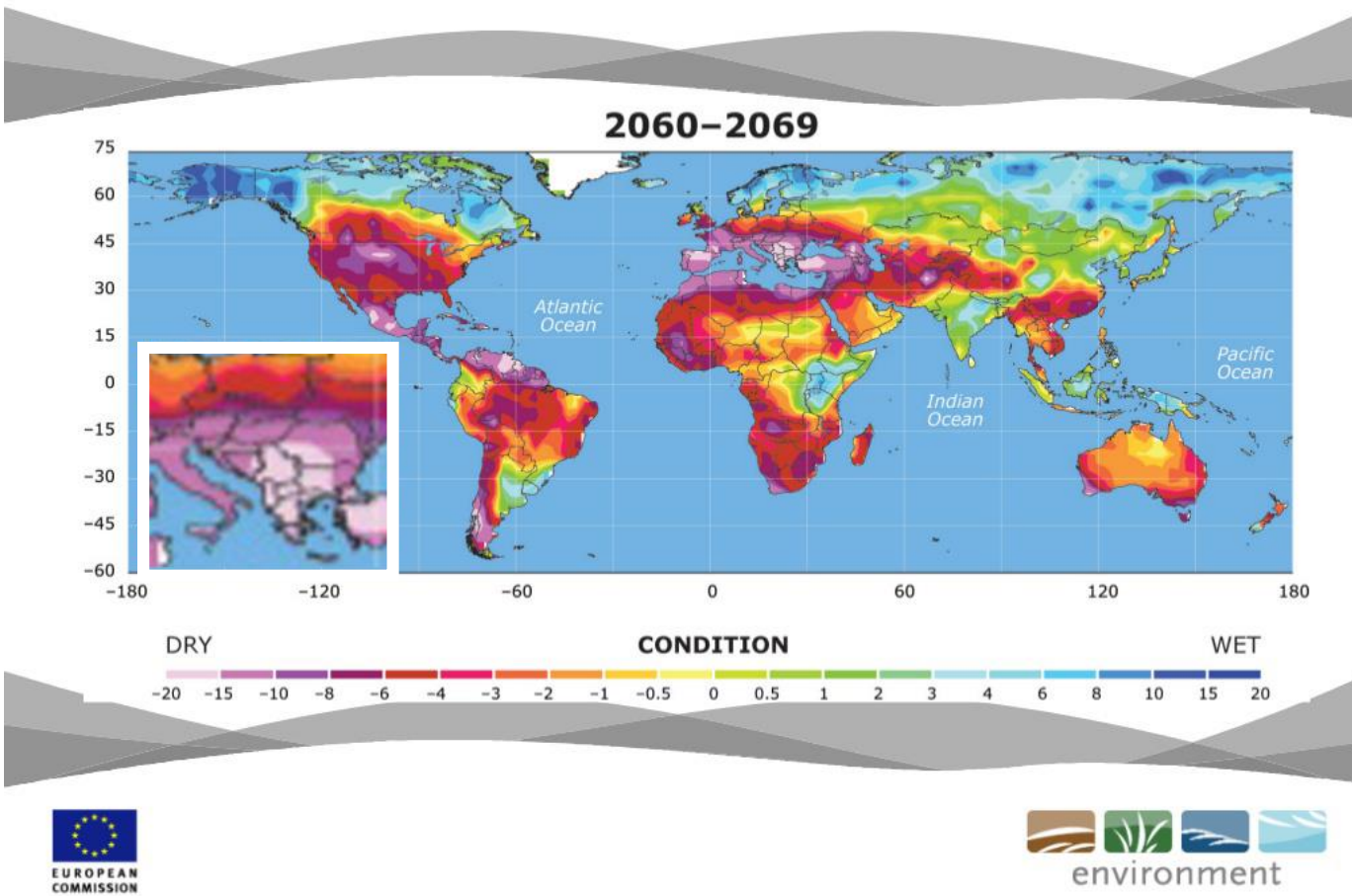
- Landslide
- Drought
- Storm
- Wildfire
- Extreme Temperature
- Flood

Generally floods are the most dangerous natural hazard in the region.

Torrent floods are not separated in the official statistics, but frequency of torrent floods and mortality happened during torrent floods are much higher than river floods.

Climate change: Impact on soil

POTENTIAL FLOOD HAZARD AREAS in WBC



• Source: European catchments and Rivers network system (ECRINS), EU-DEM, COWi Consultant's contribution

With forecast climate changes for WBC (increase of temperature up to 4°C and decrease of precipitation up to -30%, and increase of frequency of heavy precipitation), situation regarding erosion and torrents would be worsen.

Taking in consideration all above, we need deeper knowledge and scientific activities related to erosion and torrents in the region



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