



Hazard and Risk Maps of Bosnia and Herzegovina

First Version

May 2016

FOREWORD

A number of government institutions, international agencies, scientific organizations and non-governmental organizations in Bosnia Herzegovina are currently in the process of scaling up their DRR programming. In order to facilitate this process, UN agencies have compiled a collection of hazard and risk maps that will enable agencies/institutions in BiH to risk-inform their policies, plans, programmes and activities. We believe the geo-spatial hazard and risk maps in this compilation will enable DRR practitioners in the country to identify where individual hazards are most likely to occur as well as the proportion of population and assets at risk.

All maps were developed with open source Geographic Information System (GIS) software relying on a combination of country-specific datasets (floods and landslides) as well as best international scientific data (earthquakes and wild fires). By using analytic tools from open source software, we were able to undertake sophisticated spatial analysis at no other cost than the time invested in conducting the analysis. Significant time and resources can be saved by capitalizing on existing models, datasets and maps for disaster risk assessments for which reason sharing of information is as important as creating new data.

This compilation of maps contain four single-hazard maps (earthquakes, landslides, floods and wild fires) as well as two multi-hazard maps (sudden-onset and livelihood-focus) and four exposure maps of people and GDP in relation to floods and earthquakes.

The authors wish to thank Professor Johann G. Goldammer from the Global Fire Monitoring Centre and Carlos Villacis from the Global Earthquake Model for their valuable advice and support during the risk mapping process.

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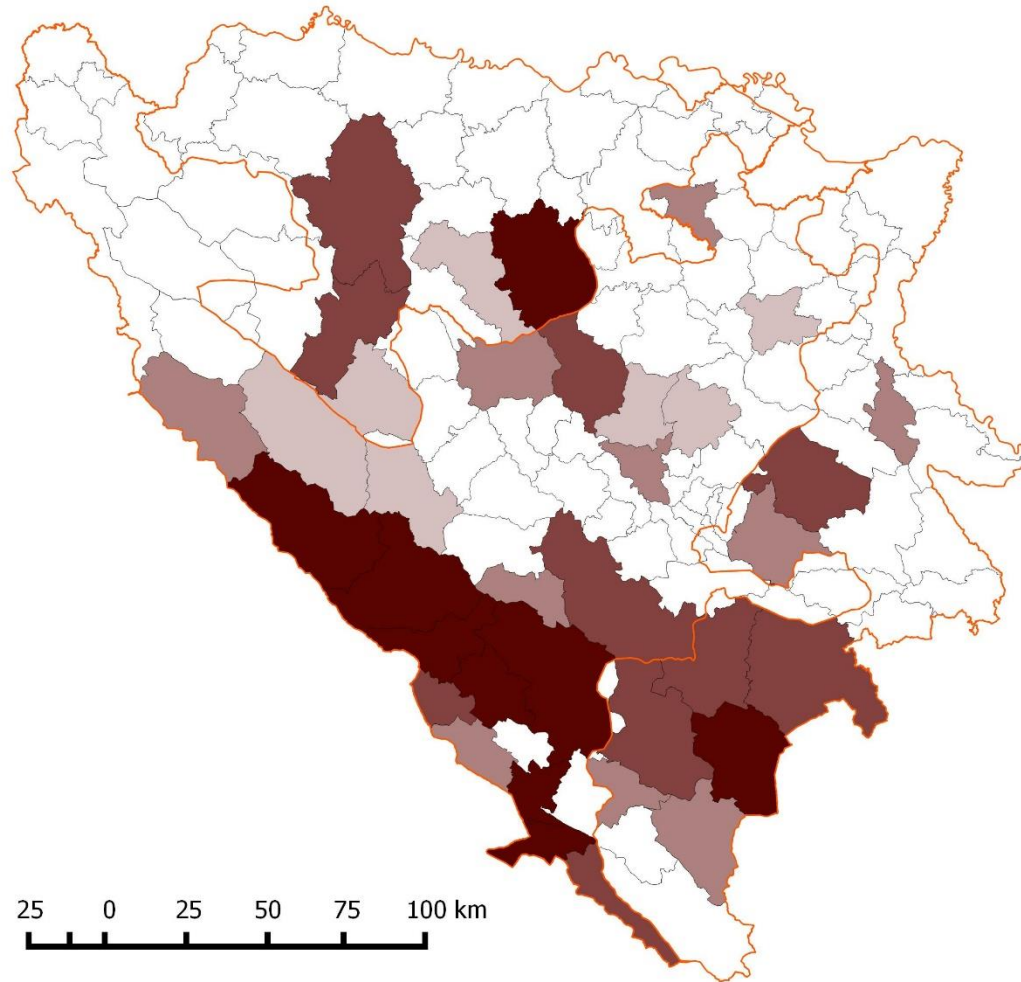
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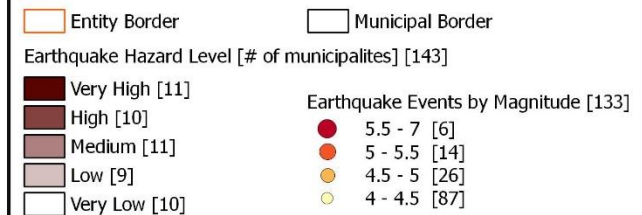
Bosnia and Herzegovina Earthquake Hazard Map



1. Data

This earthquake (EQ) hazard map is based on analysis of earthquake events from 1950 to 2015. The color coding of municipalities indicates the relative level of earthquake risk. The map sums the number and magnitude of seismic events above 4 on the Richter scale within municipal borders.

2. Legend



3. Sources

Data from the United States Geological Survey (USGS) Earthquake Archives extracted on 28 August 2015 filtered by location, magnitude and time period.

4. Feedback

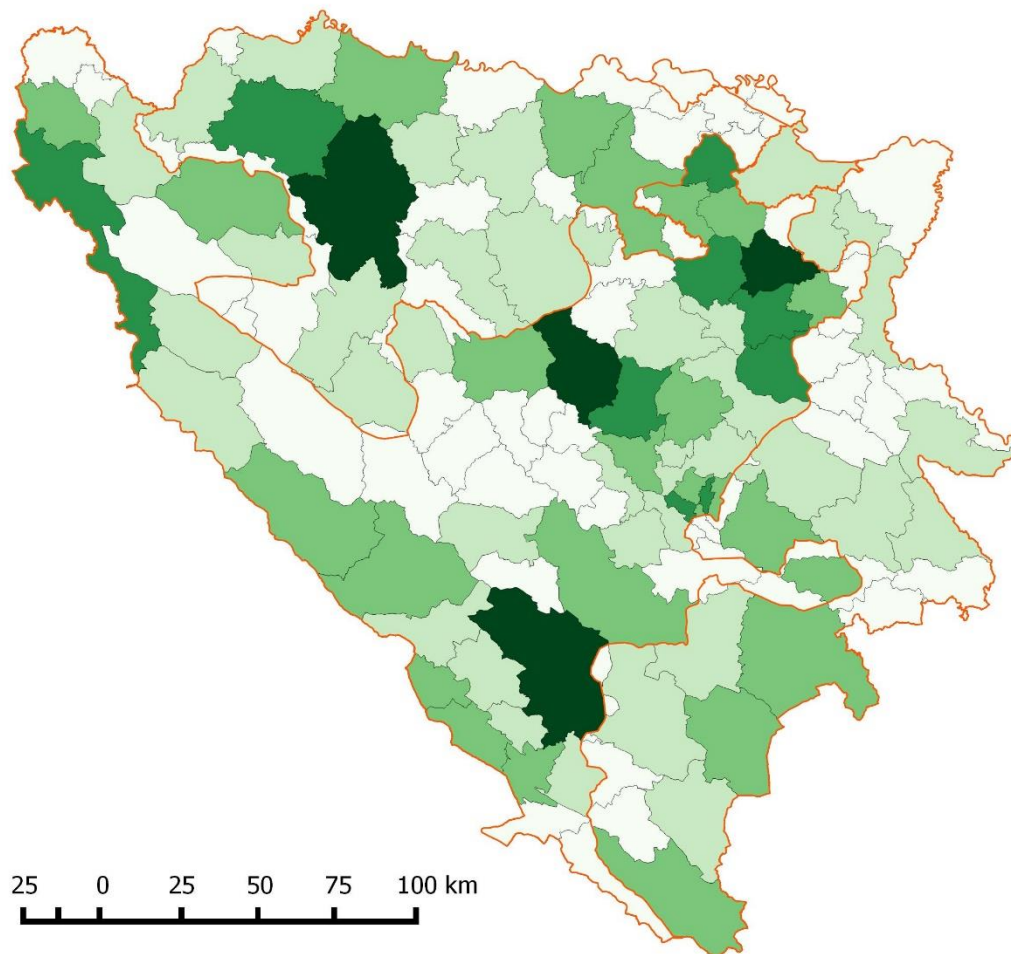
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Date created 25 January 2016

Bosnia and Herzegovina Landslide Hazard Map



1. Data

This modelled hazard map is based on an analysis of four variables of landslide susceptibility including lithology, slope, precipitation and land cover use in order to create area polygons representing the relative level of risk. The data sets were summed and weighted at the municipal level to create a composite risk index represented by the colour coding of municipalities.

2. Legend

Entity Border

Municipal Border

Landslide Risk Level [# of municipalities] [143]

Very High [4]

High [9]

Medium [25]

Low [38]

Very Low [67]

3. Sources

Data for modelling was extracted from the Corine 2006 Landcover by the European Environment Agency (EEA), and by Digital Elevation Model (DEM) provided by the US Geological Survey (USGS) Global Multi-resolution Terrain Elevation Data. Other sources include BiH data by the UNDP Flood and Landslide Housing Risk Assessment.

4. Feedback

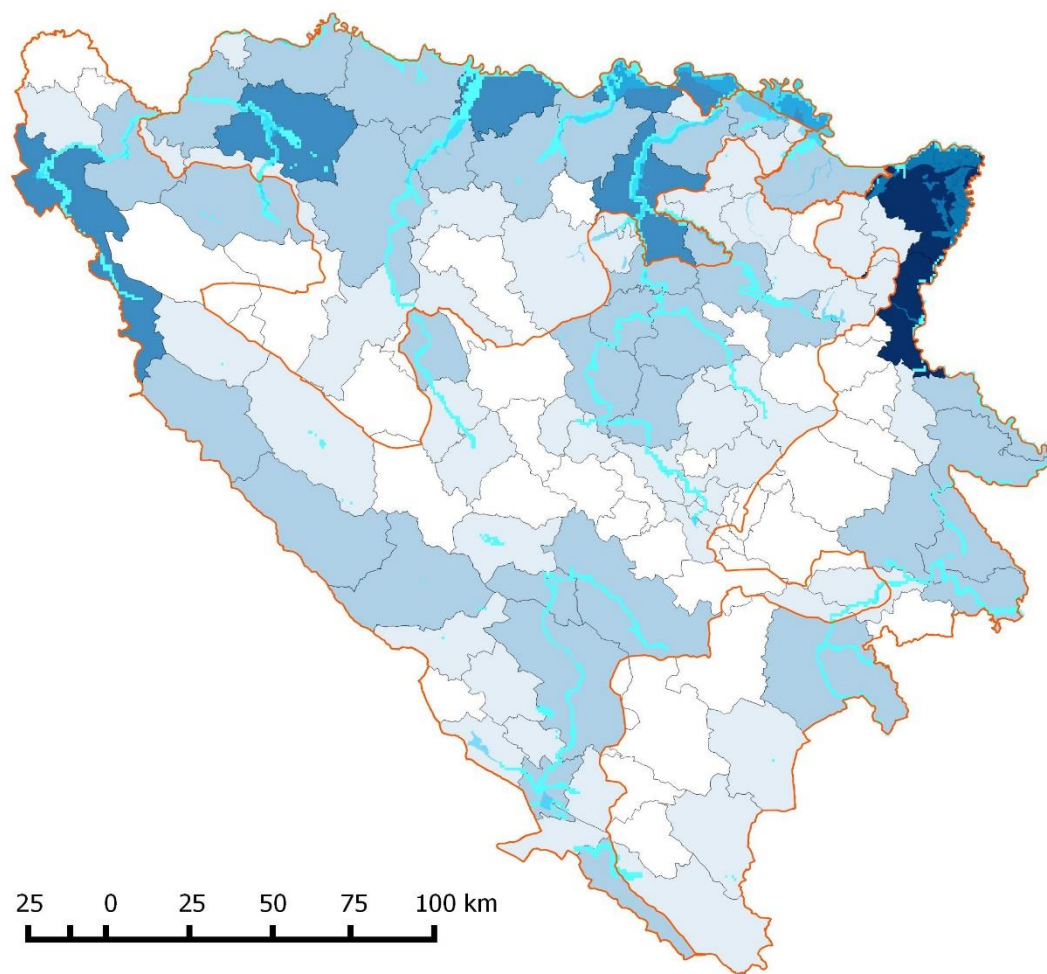
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Date created 25 January 2016

Bosnia and Herzegovina Flood Hazard Map



1. Data

This flood hazard map is based on analysis of flood events 1999-2014. The raster data shows the number of sq kilometer flooded multiplied by the frequency of flooding events in all municipalities in BiH. The color coding of municipalities indicates the relative level of flood risk.

2. Legend

Entity Border Municipal Border
Past inundated areas May 2014 inundated areas

Flood Risk Level [# of municipalities] [143]

Very High [2]
High [7]
Medium [36]
Low [51]
Very Low [47]

3. Sources

Data from the Global Risk Data Platform extracted by UNEP/GRID-Europe. The datasets from 1999 onwards combine modelled data with analysis of real events. In order to account for the May 2014 floods, additional vector data from UNDP was added to the flood analysis.

4. Feedback

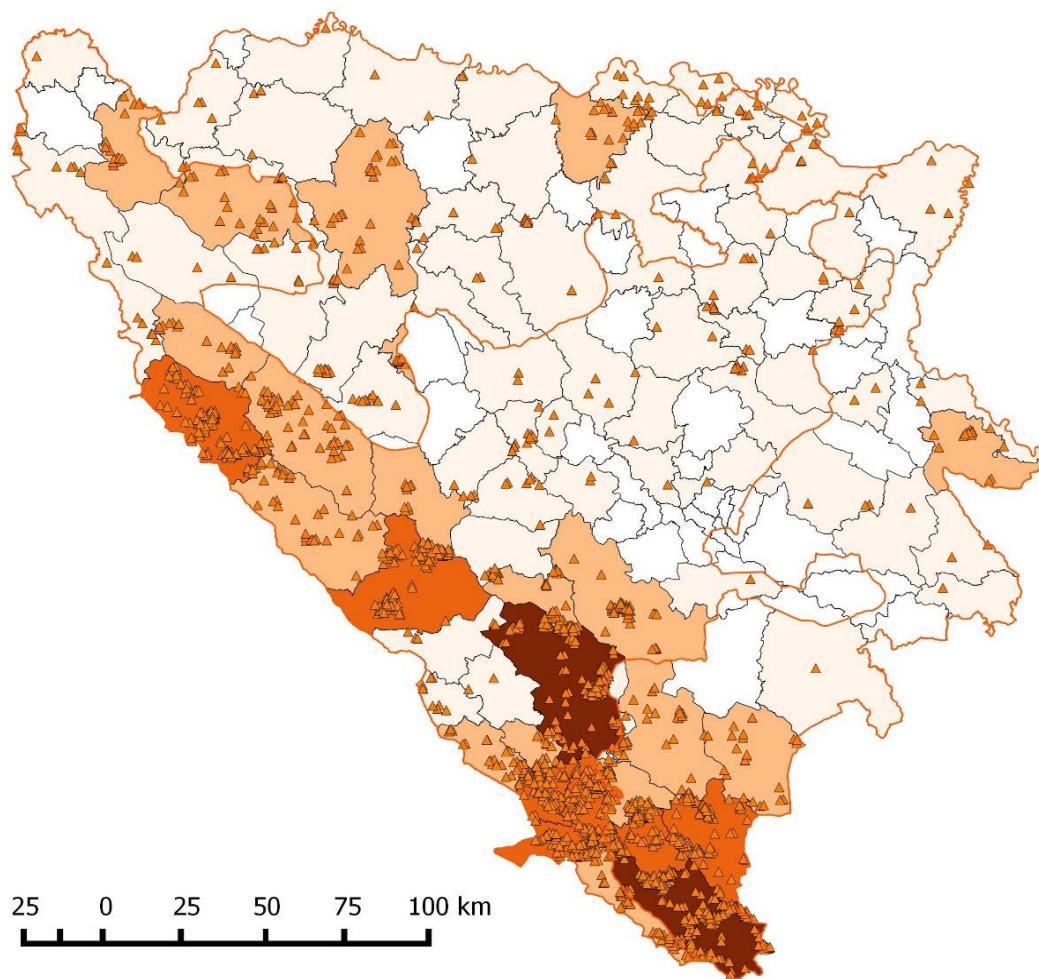
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Date created 25 January 2016

Bosnia and Herzegovina Fire Hazard Map



1. Data

This fire hazard map is based on analysis of fire events 2001-2014. The vector data shows fire events at the GPS coordinate level. The color coding of municipalities indicates the relative level of fire risk estimated by a count of High Temperature Events (HTE) within municipal borders.

2. Legend

- Entity Border
- Municipal Border
- High Temperature Events (HTE)
- Fire Risk Level
 - Very High
 - High
 - Medium
 - Low
 - Very Low

3. Sources

Data from the Fire Information for Resource Management System (FIRMS) provided from Earthdata by NASA. The datasets from 2001 to 2015 is a count in polygon analysis of real events with a confidence above 80% using the MODIS near real-time (NRT) active fire / hotspot database.

4. Feedback

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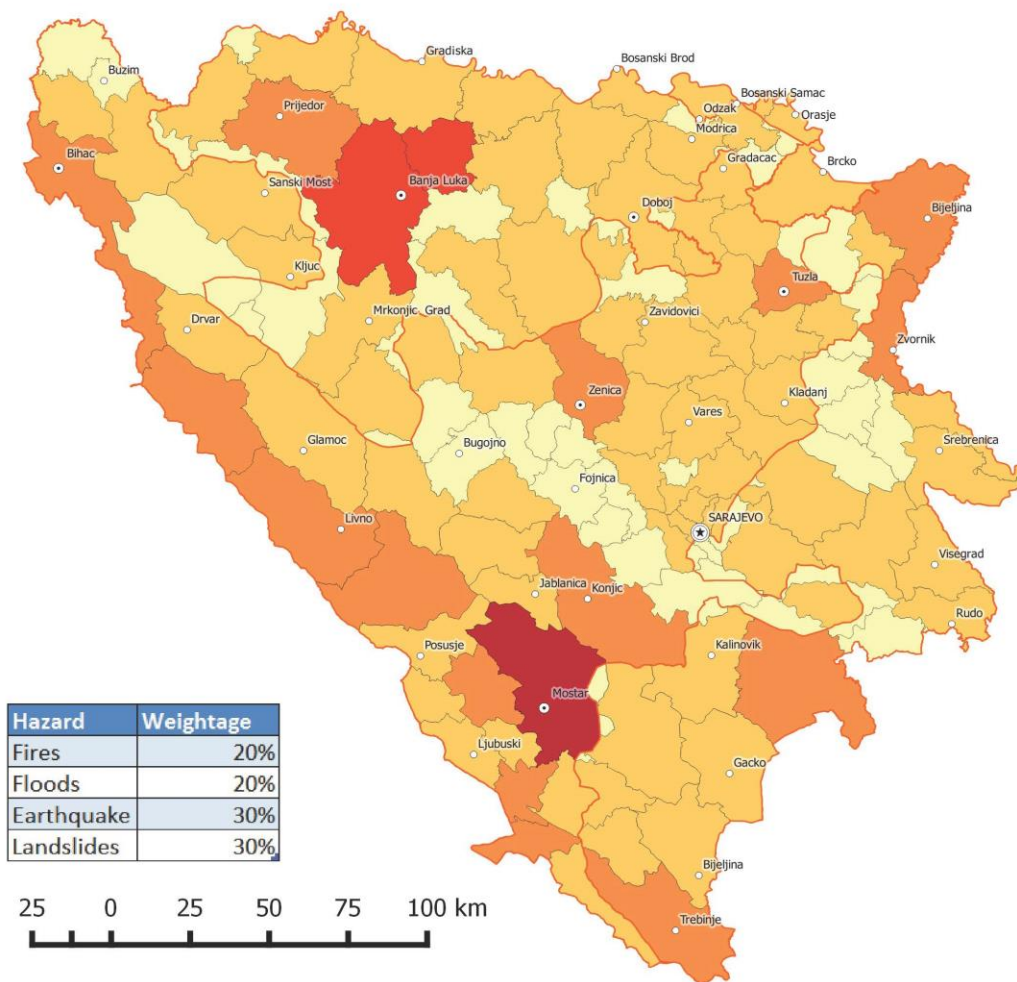
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Date created 26 January 2016

Bosnia and Herzegovina Multi-Hazard Map 3

Sudden Onset Disaster Focus



1. Data

This multi-hazard map depicts fire, earthquake, flood and landslide susceptibility by municipality. The map depicts a composite index of four hazards with the following weightage: floods (20%), fires (20%), earthquakes (30%) and landslides (30%). This weightage pays special attention to sudden-onset hazards that threaten the survival of people in at-risk municipalities.

2. Legend

Entity Border Municipal Border

Natural hazard susceptibility [# of municipalities] [143]

- Very High [1]
- High [2]
- Medium [15]
- Low [74]
- Very Low [51]

3. Sources

For data sources please refer to the four individual hazard maps for Bosnia and Herzegovina developed September 2015 to February 2016. The data sets were normalized and merged based on the index described above and mapped in QGIS.

4. Feedback

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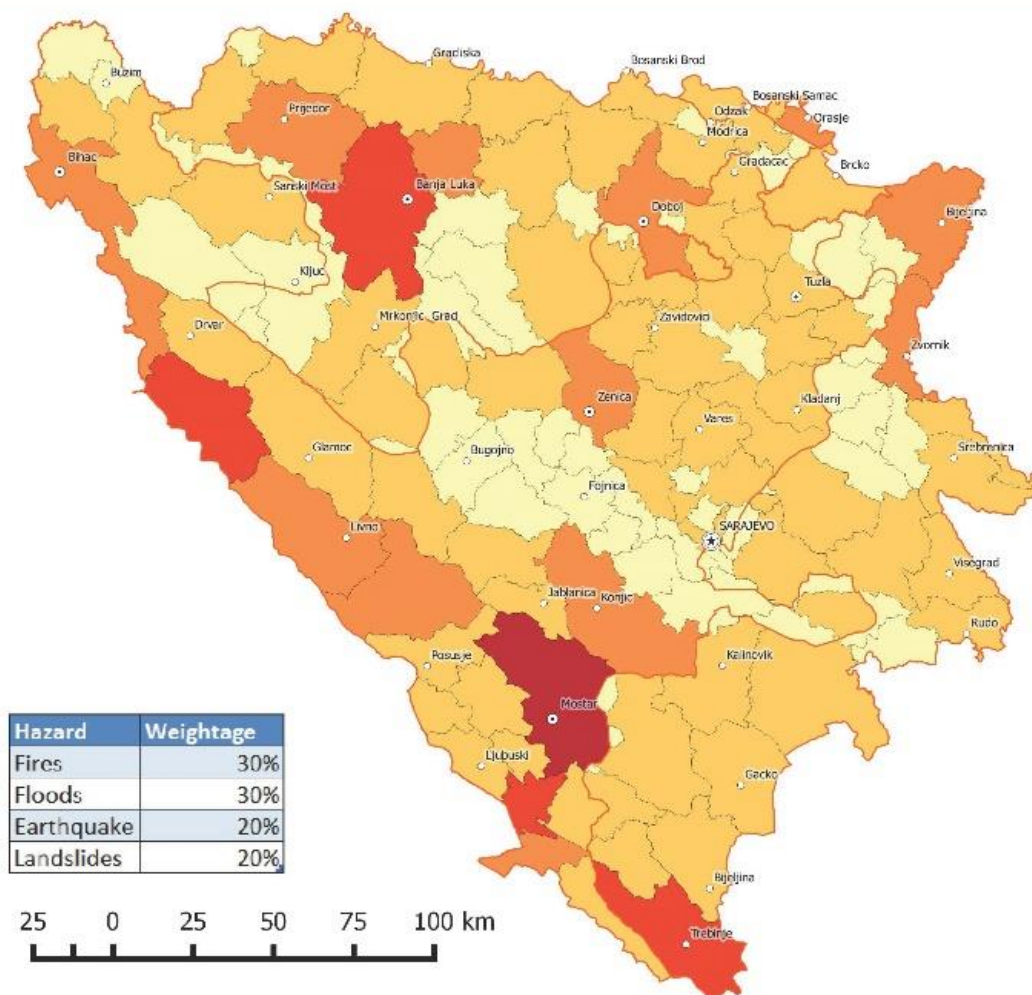
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Date created 17 February 2016

Bosnia and Herzegovina Multi-Hazard Map 4

Livelihood / Climate Change Focus



1. Data

This multi-hazard map depicts fire, earthquake, flood and landslide susceptibility by municipality. The map depicts a composite index of four hazards with the following weightage: floods (30%), fires (30%), earthquakes (20%) and landslides (20%). This weightage pays special attention to flood and fire hazards that threaten the livelihoods of people in susceptible municipalities and are linked to climate change.

2. Legend

Entity Border Municipal Border

Natural hazard susceptibility [# of municipalities] [143]

- Very High [1]
- High [4]
- Medium [12]
- Low [67]
- Very Low [59]

3. Sources

For data sources please refer to the four individual hazard maps for Bosnia and Herzegovina developed September 2015 to February 2016. The data sets were normalized and merged based on the index described above and mapped in QGIS.

4. Feedback

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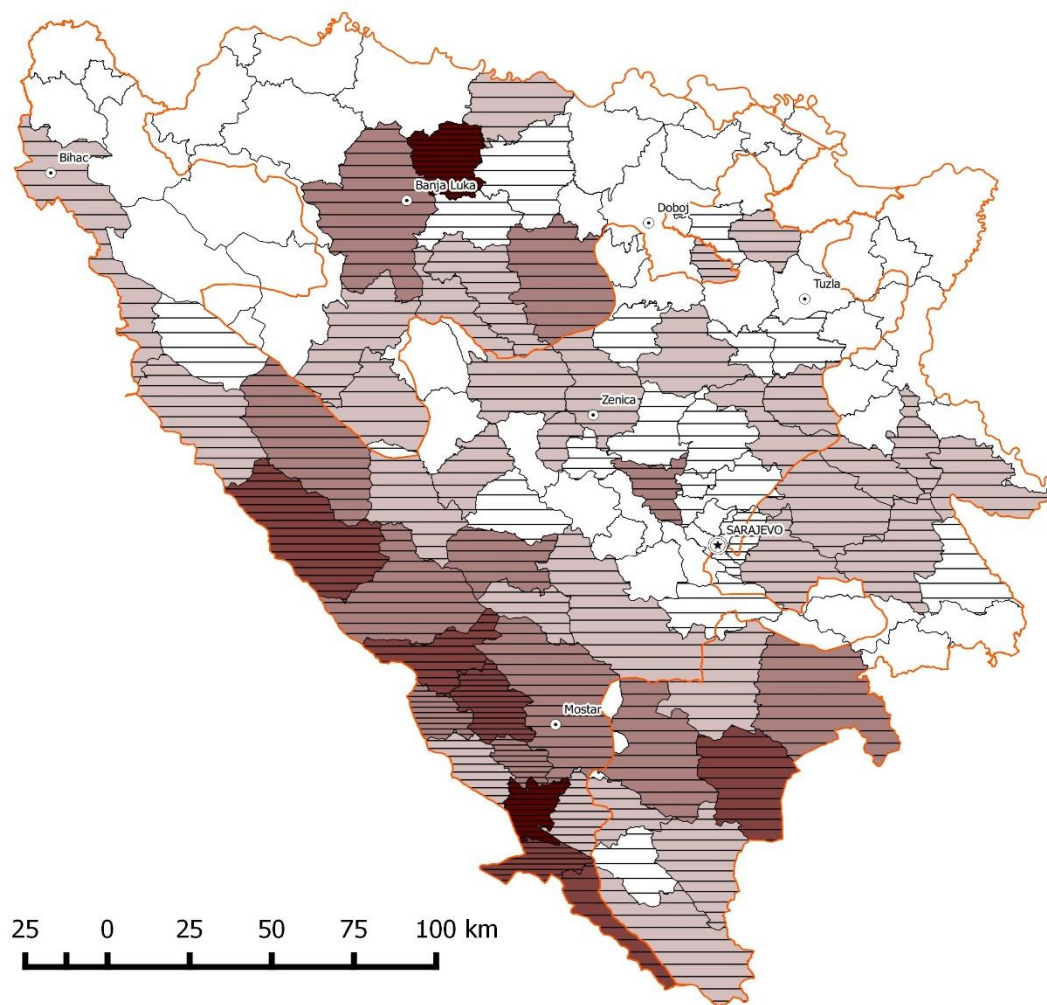
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Date created 17 February 2016

Bosnia and Herzegovina Population Exposure Map 2

Population Exposure to Earthquake Risk



1. Data

This map shows the relative earthquake risk and the population exposed to earthquake risk as a ratio of the total population in each municipality. The data is based on the earthquake hazard map developed in February 2016. The data was calculated using an earthquake distribution grid investigating concentration and probability of earthquake events above magnitude 4 on the Richter scale within a 0.1 degree area with a return period of 65 years, and the Gridded Population of the World data from Columbia University. Using the QGIS raster calculator, these layers were multiplied to extract GDP pixels within EQ hazard pixels. This layer was then summed using zonal statistics and aggregated at municipal level. At the end, data was clustered using a Jenks natural breaks optimization method.

2. Legend

Entity Border	Municipal Border
Earthquake Hazard [143]	Population Exposure [143]
Very High [2]	64% to 92% [6]
High [6]	39% to 64% [8]
Medium [11]	23% to 38% [16]
Low [31]	7% to 23% [25]
Very Low [93]	0% to 7% [17]
	0% [71]

3. Sources

United States Geological Survey and Columbia University data available from the websites at www.usgs.gov/ and www.sedac.ciesin.columbia.edu/

4. Feedback

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5. Disclaimer

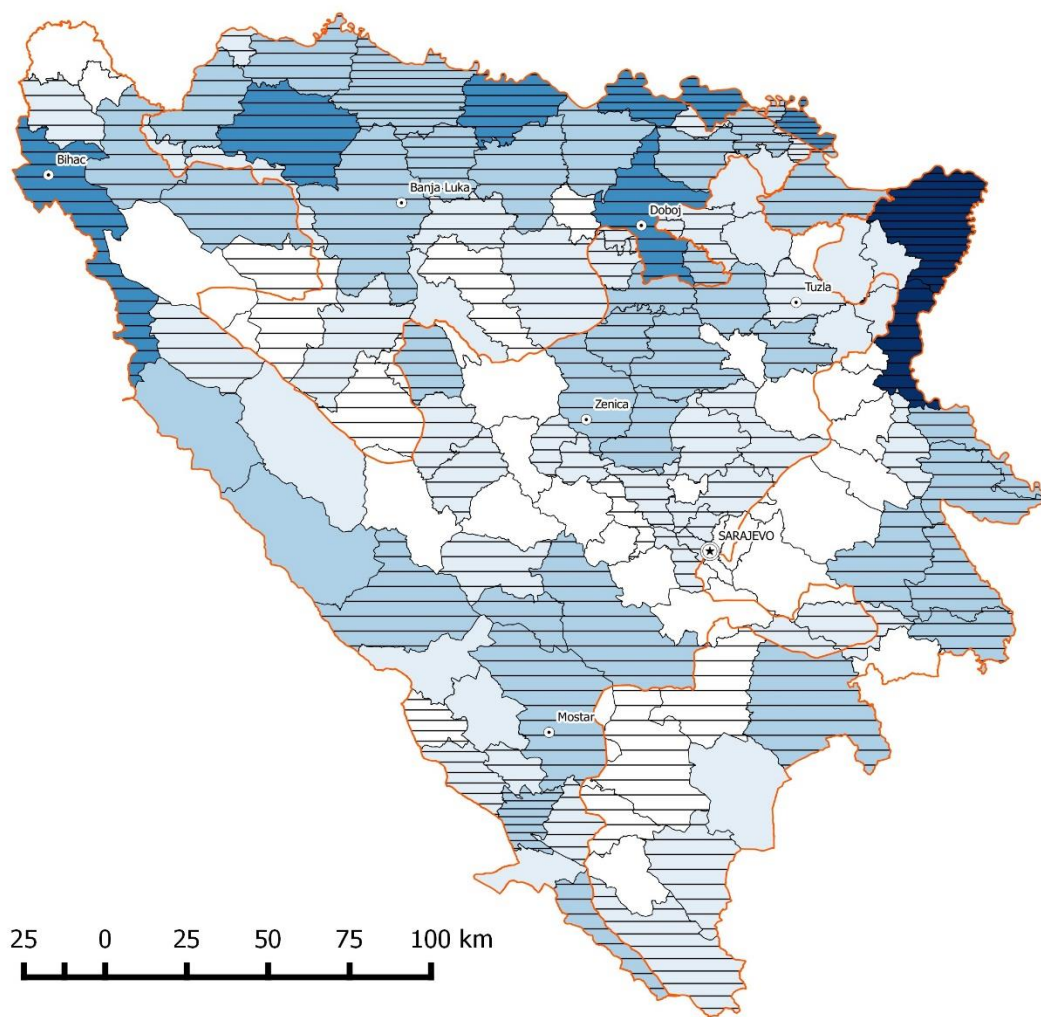
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Date created 03 March 2016

Bosnia and Herzegovina Population Exposure to Earthquake Risk Map

Bosnia and Herzegovina Population Exposure Map 1

Population Exposure to Flood Risk



1. Data

This map shows the relative flood risk and the population exposed to flood risk as a ratio of the total population in each municipality. The flood data is based on the flood hazard map developed in January 2016. The exposure data was calculated using the Global Assessment Report on Disaster Risk Reduction (GAR) 2015 database on flood hazard with a return period of 100 years, and the Gridded Population of the World from Columbia University. Using the QGIS raster calculator these layers were multiplied to extract population pixels within flood hazard pixels. This layer was then summed using zonal statistics and aggregated at municipal level. At the end, the data was clustered using a Jenks natural breaks optimization method.

2. Legend

Entity Border

Municipal Border

Flood Hazard Level [143]

Very High [2]

High [7]

Medium [36]

Low [51]

Very Low [47]

Population Exposure Ratio [143]

60% to 97% [3]

36% to 60% [6]

20% to 36% [8]

10% to 20% [24]

1% to 10% [50]

0% [52]

3. Sources

GAR 2015 and population data available from the websites at <http://risk.preventionweb.net/capraviewer/main.jsp> and <http://sedac.ciesin.columbia.edu/data/collection/gpw-v4>

4. Feedback

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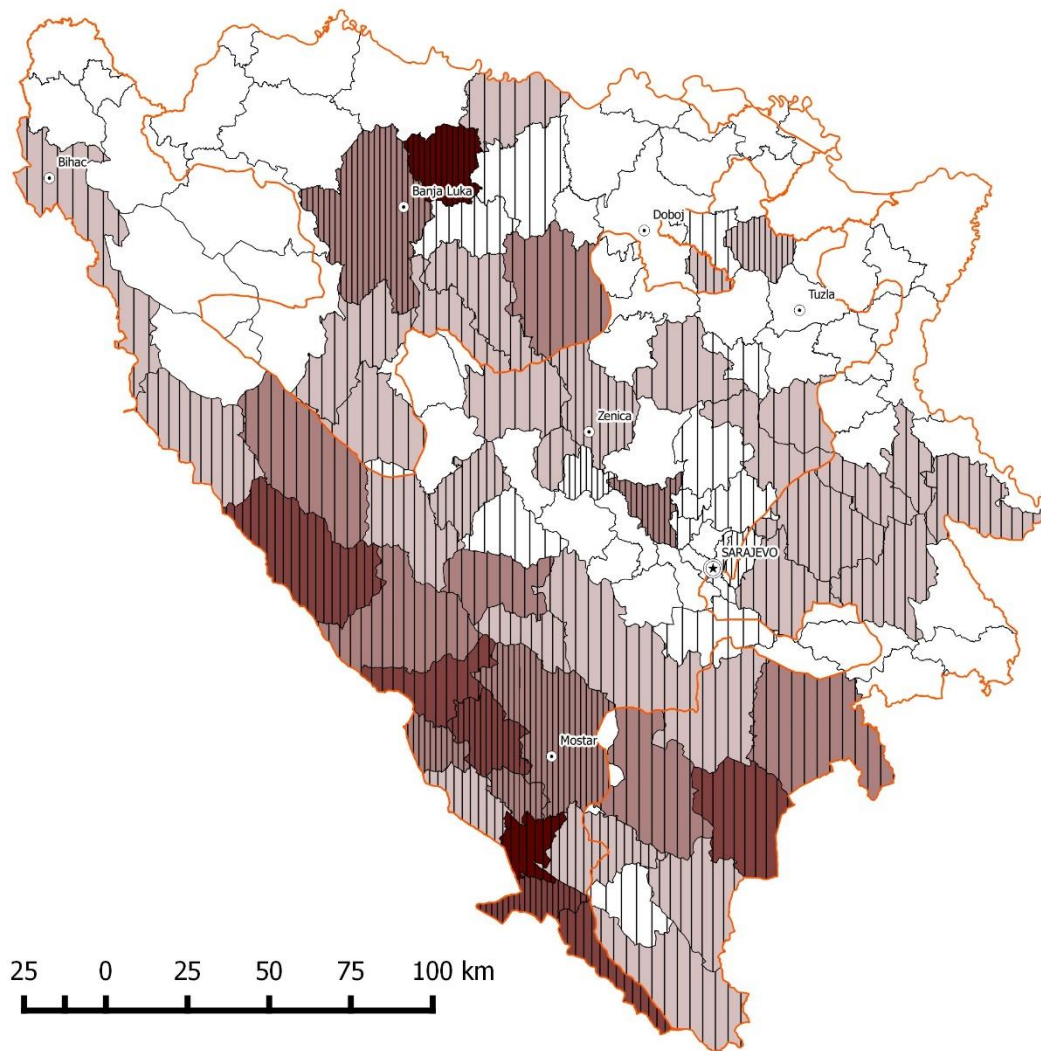
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Date created 03 March 2016

Bosnia and Herzegovina GDP Exposure Map 2

Gross Domestic Product (GDP) Exposure to Earthquake Risk



1. Data

This map shows the relative earthquake (EQ) risk and the exposed annual Gross Domestic Product (GDP) to earthquake risk as a ratio of the total GDP for each municipality. The seismic data was calculated using an earthquake distribution grid investigating concentration and probability of earthquake events above magnitude 4 on the Richter scale within a 0.1 degree area with a return period of 65 years. The exposure data was calculated using the GDP Global Grid Raster from GAR 2013. Using the QGIS raster calculator these layers were multiplied to extract GDP pixels within EQ hazard pixels. This layer was then summed using zonal statistics and aggregated at municipal level. At the end, data was clustered using a Jenks natural breaks optimization method.

2. Legend

Entity Border	Municipal Border
EQ Hazard Level [143]	EQ GDP Exposure Ratio [143]
Very High [2]	64% to 99% [11]
High [6]	39% to 64% [10]
Medium [11]	17% to 39% [13]
Low [31]	5% to 17% [17]
Very Low [93]	0% to 5% [16]
	0% [76]

3. Sources

GAR 2015 and GAR 2013 data available from the websites at <http://risk.preventionweb.net/capraviewer/main.jsp> and <http://preview.grid.unep.ch/index.php>

4. Feedback

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5. Disclaimer

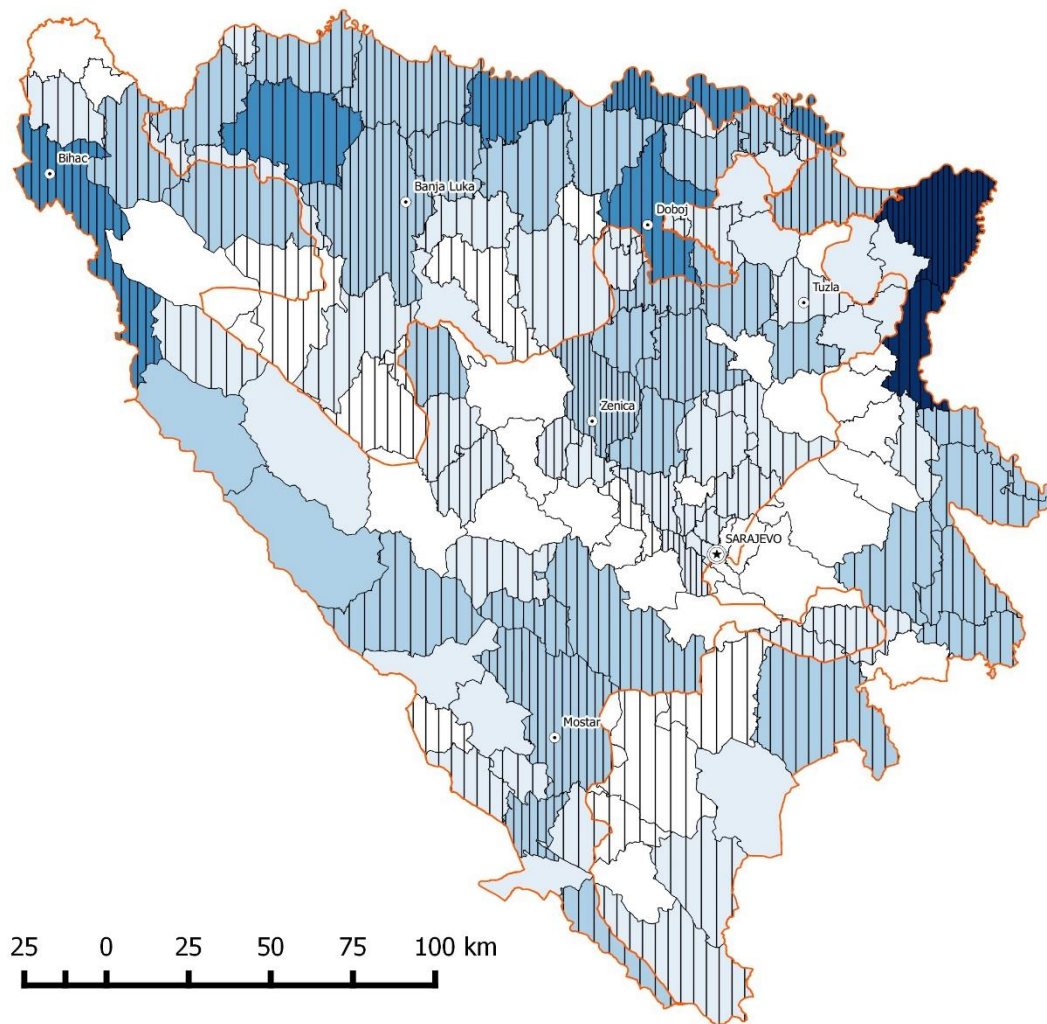
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Date created 03 March 2016



Bosnia and Herzegovina GDP Exposure Map 1

Gross Domestic Product (GDP) Exposure to Flood Risk



1. Data

This map shows the relative flood risk and the exposed annual Gross Domestic Product (GDP) to flood risk as a ratio of the total GDP for each municipality. The flood data is based on the flood hazard map developed in January 2016. The exposure data was calculated using the Global Assessment Report on Disaster Risk Reduction (GAR) 2015 database on flood hazard with a return period of 100 years, and the GDP Global Grid Raster from GAR 2013. Using the QGIS raster calculator, these layers were multiplied to extract GDP pixels within flood hazard pixels. This layer was then summed using zonal statistics and aggregated at municipal level. At the end, data was clustered using a Jenks natural breaks optimization method.

2. Legend

Entity Border	Municipal Border
Flood Hazard Level [143]	Flood GDP Exposure Ratio [143]
Very High [2]	71% to 99% [6]
High [7]	48% to 71% [15]
Medium [36]	32% to 48% [22]
Low [51]	10% to 32% [23]
Very Low [47]	0% to 10% [25]
	0% [52]

3. Sources

GAR 2015 and GAR 2013 data available from the websites at <http://risk.preventionweb.net/capreviewer/main.jsp> and <http://preview.grid.unep.ch/index.php>

4. Feedback

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Date created 03 March 2016

Chart of the Sendai Framework for Disaster Risk Reduction 2015-2030

Scope and purpose

The present framework will apply to the risk of small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or manmade hazards as well as related environmental, technological and biological hazards and risks. It aims to guide the multi-hazard management of disaster risk in development at all levels as well as within and across all sectors.

Expected outcome

The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries

Goal

Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience

Targets

Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared to 2005-2015

Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015

Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030

Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030

Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020

Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030

Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030, through adequate and sustainable support to complement their national actions for implementation of this framework by 2030

Priorities for Action

There is a need for focused action within and across sectors by States at local, national, regional and global levels in the following four priority areas.

Priority 1
Understanding disaster risk

Priority 2
Strengthening disaster risk governance to manage disaster risk

Priority 3
Investing in disaster risk reduction for Priority Understanding disaster risk resilience

Priority 4
Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction