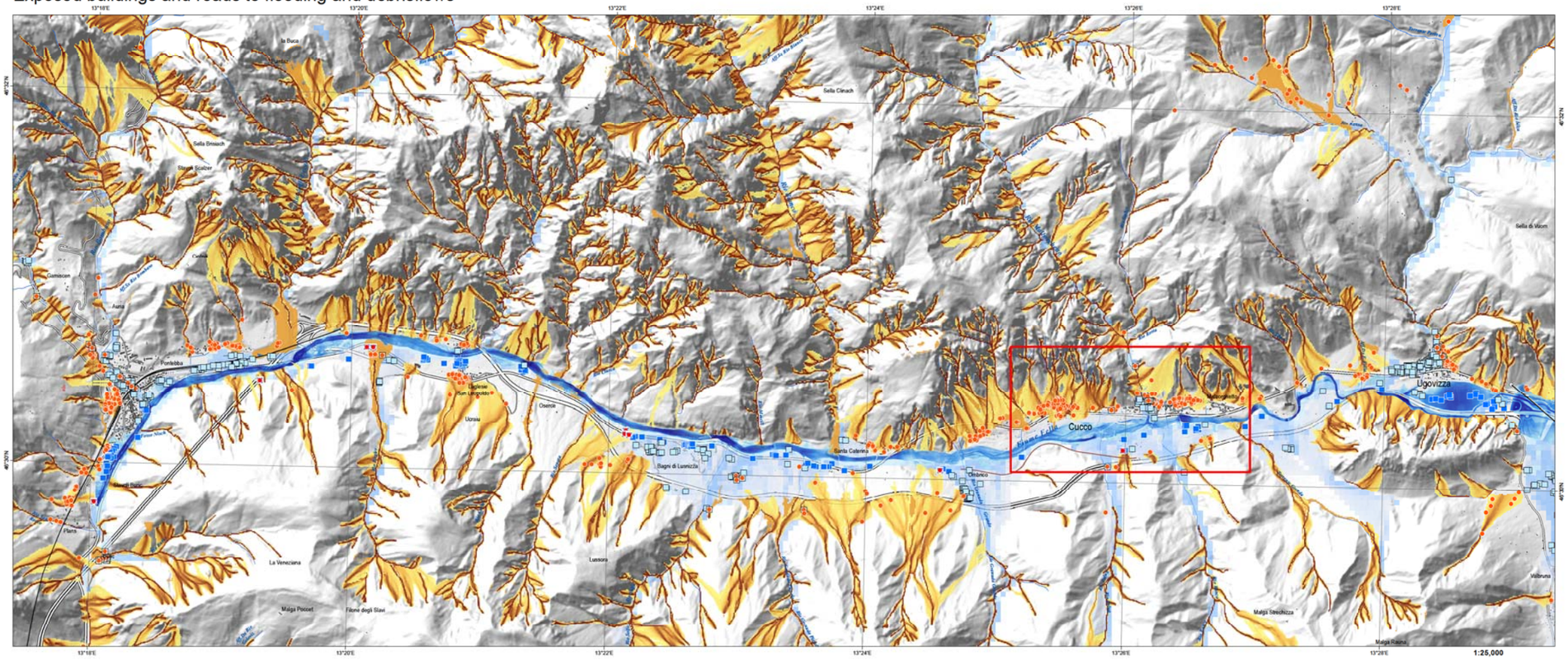
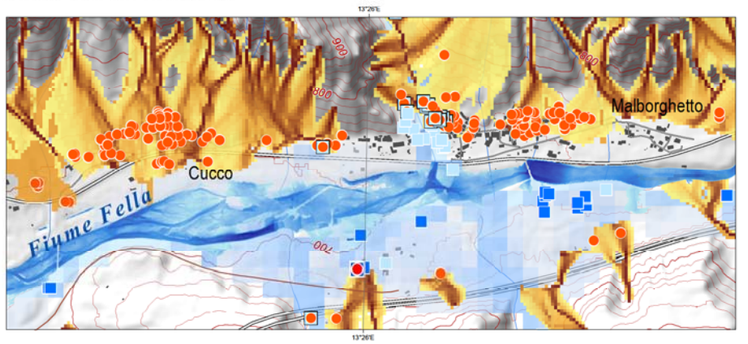
Exposed buildings and roads to flooding and debrisflows



Detail (Scale 1:10,000)

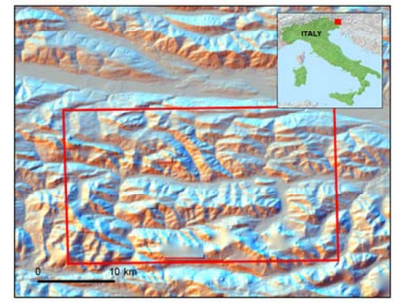


Exposure, vulnerability and risk

for flooding and debrisflows

Fella River/ Italy

Overview map



Legend

Population
- Settlement

Hydrology
- River
- Stream

Flood water depth
- High (6 m)
- Moderate
- Low (0)

Debrisflow Impact pressure
- High (35 KPa)
- Moderate
- Low (0 KPa)

Infrastructure / Transport
- Motorway
- Primary road
- Secondary road
- Residential road

Elevation
- Normal Contourline
- Index Contourline (Contour Interval 20 meter)

Exposed buildings
- To debrisflows
- To river flooding
- To flash flooding

Interpretation

This map contains results from the exposure analysis, vulnerability assessment and risk assessment for the Fella area. Risk was analysed for debris flows and river floods. The areas affected by flash floods are not taken into account due to lack of accurate data.
The input flood depth maps were for 4 different return periods (3-5, 40-50, 300-400, and 400–700 years). The debrisflow runout maps were also for 4 different return periods (1-10 years, 10-25 years, 25-100 years and 100-500 years). Also the building was used (with attributes related to the occupancy type, construction type, minimum and maximum building value, and population information for two scenarios.
The maximum intensity for each return period and hazard type for each building was analysed in GIS. Summary information on the number of exposed buildings for different communes and hazards were generated.
Vulnerability curves were generated, partly based on available curves from the literature, and partly based on actual damage information from the 2003 event, combined with expert opinion. Curves were made for debrisfow impact pressure, and flood water depth, for 8 building types (which are a combination of the material type and the number of floors). Curves were made for the physical vulnerability for buildings, and for population.
The hazard intensity data for each building and hazard return period in combination with the vulnerability curves, were used to convert them into vulnerability data.
Losses were then calculated for each building and hazard return period by multiplying the vulnerability, the spatial probability and the amount. The amount is related to the minimum and maximum building values in the case of economic losses, and for the minimum and maximum number of persons per building (taking a normal scenario and a tourist season scenario) to calculate the population loss.
The risk was analysed by aggregating the loss data per building, and hazard return period for administrative units within the study area. Flood risk was analysed for a smaller area thatn debrisflow risk due to data limitations.
Minimum values for temporal probability (1/return period) were used in combination with minimum values of loss (multiplying minimum values of intensity, and amount) to generate minimum risk curves, and maximum values to generate maximum risk curves.
The areas under the curves were calculated, which represent the average annual loss.

Cartographic Information

Geographic Coordinate System: GCS_WGS_1984
Datum: D_WGS_1984

Scale 1:25,000
0 0.5 1 2 3
Kilometers

Data Sources

This map is based on a number of other maps, described earlier as deliverables for the Fella area, such as: the harmonized landslide inventory map, the debrisflow initiation susceptibility map, the debrisflow runout hazard map, the flashflood hazard map, the river flood hazard map, and the riements-at-risk (building) map. All data sources required for generating these maps are also used for this map, therefore, but are not repeated
here. The reader is referred to the list of data sources for the other maps.

Framework

IncREO and its suppliers have attempted to provide mapping that is as accurate as is available with the source material, however all geographic information has limitations due to the scale, resolution, date and interpretation of the original source materials. Accordingly, IncREO maps are distributed as is, without any warranty, either expressed or implied, including but not limited to warranties of suitability to a particular purpose or use. The entire risk as to the results of the use of these data is assumed by the user and the supplier accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the mapping.

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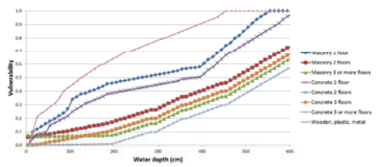
Work package partners:

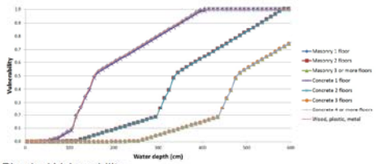
The collection of input data was coordinated by Simone Frigerio and Alessandro Pasuto (CNR-IRPI) .Tha maps were made by a group consisting of Cees van Westen, Haydar Huskin, Roxana Ciurean, Thea Turkington, and Lixia Chen (UT-ITC).
Map produced by: Koert Sijmons (GeoMapa) © 2014

Vulnerability curves

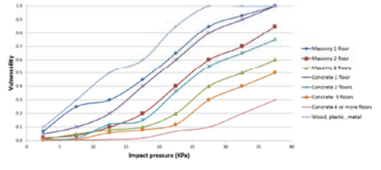
Physical Vulnerability Floods



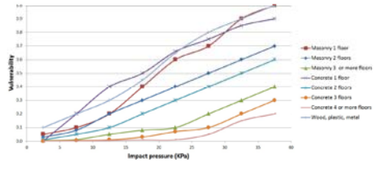
Population Vulnerability Floods



Physical Vulnerability Debrisflows



Population Vulnerability Debrisflows



Exposure results: Debrisflows

Number of buildings exposed to debrisflows

Events	Return Period		Dogna		Pontebba		Malborghetto Valbruna		Tarvisio		All Comunes	
			Min	max	Min	Max	Min	Max	Min	Max	Min	Max
Major	100	500	11	14	235	391	198	363	9	25	453	793
Moderate	25	100	10	11	60	132	51	143	15	19	136	305
Minor	10	25	4	8	23	41	37	52	3	3	67	104
Frequent	1	10	1	1	6	6	0	0	0	0	7	7

Building value (Euro)exposed to debrisflows

Events	Return Period		Dogna		Pontebba		Malborghetto Valbruna		Tarvisio		All Comunes	
			Min	max	Min	Max	Min	Max	Min	Max	Min	Max
Major	100	500	377717	566426	18795410	52067193	21933266	63026491	1149464	9927155	42255857	125587265
Moderate	25	100	371002	532825	5025245	16034686	6427791	27554282	4607597	6528665	16431635	50650458
Minor	10	25	111330	500845	2123470	5314116	4474899	8711277	167298	214650	6876997	14740888
Frequent	1	10	9935	13040	603606	876796	0	0	0	0	613541	889836

Population (number of persons) exposed to debrisflows

Events	Return Period		Dogna		Pontebba		Malborghetto Valbruna		Tarvisio		All Comunes	
			Min	max	Min	Max	Min	Max	Min	Max	Min	Max
Major	100	500	7.38	7	125.14	227	110.5	234	29.32	247	272.34	715
Moderate	25	100	7.38	7	43.26	97	32.3	186	43.98	155	126.92	445
Minor	10	25	0	7	17.56	31	23.8	40	7.33	7	48.69	85
Frequent	1	10	0	0	5.69	6	0	0	0	0	5.69	6

Exposure results: Floods

Number of buildings exposed to floods

Events	Return Period		Dogna	Pontebba	Malborghetto Valbruna	Tarvisio	All Comunes
			Number	Number	Number	Number	Number
Major	500	700	no data	63	151	no data	214
Moderate	300	400	no data	46	83	no data	129
Minor	40	50	no data	31	63	no data	94
Frequent	3	5	no data	25	52	no data	77

Building value (Euro) exposed to floods

Events	Return Period		Dogna		Pontebba		Malborghetto Valbruna		Tarvisio		All Comunes	
			Min	max	Min	Max	Min	Max	Min	Max	Min	Max
Major	500	700	no data	no data	13452872	19043702	15567862	22041471	no data	no data	29020734	41085173
Moderate	300	400	no data	no data	9339413	13129846	4108850	5889816	no data	no data	13448263	19019662
Minor	40	50	no data	no data	5545221	7757969	3541326	5083498	no data	no data	9086547	12841467
Frequent	3	5	no data	no data	4578198	6400540	2751482	3951046	no data	no data	7329680	10351586

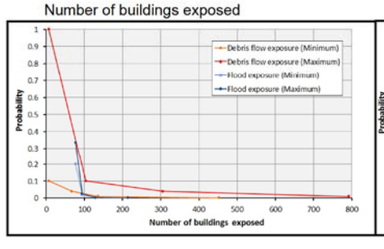
Population (number of persons) exposed to floods

Events	Return Period		Dogna		Pontebba		Malborghetto Valbruna		Tarvisio		All Comunes	
			Min	max	Min	Max	Min	Max	Min	Max	Min	Max
Major	500	700	no data	no data	22	35	71	94	no data	no data	102	119
Moderate	300	400	no data	no data	20	22	26	30	no data	no data	45	52
Minor	40	50	no data	no data	9	10	24	28	no data	no data	33	38
Frequent	3	5	no data	no data	6	7	19	22	no data	no data	25	29

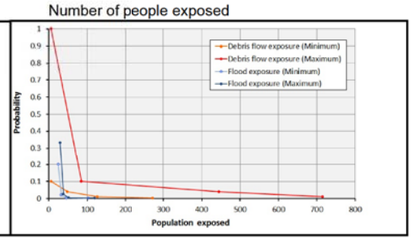
The risk assessment was carried out only for riverfloods and debrisflows. Due to lack of data, flashfloods were not taken into account.The building inventory of the current situation was used. Only building risk was assessed. Risk to transportation and other infrastructure as well as building conents are not included. The impact pressure resulting from the FLOW-R modelling procedure are probably too low.
This is why the calculated losses are smaller than the losses reported for the 2004 event.
In this regional analysis it was difficult to incorporate the effect of the recent risk mitigation measures. For this a local scale analysis would be required.

Risk results

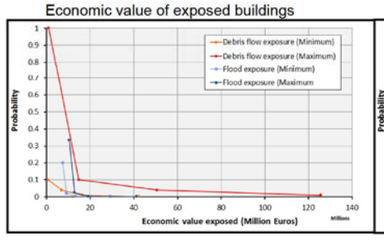
Number of buildings exposed



Number of people exposed



Economic value of exposed buildings



Estimated economic building losses