Protocol KICK-OFF MEETING Case Study Friuli Venezia Giulia Region – Fella River Pontebba, Dec 13th 2011			
Date and Time:	13.12.2011/ 9.00h-12.00h		
Venue:	Meeting room – Civil protection Agency – Pontebba, Italy		
Objectives	1- Discussion with personnel of Civil Protection on data availability and modelling techniques for the flooding phenomena on the Fella River 2- Discussion with personnel of Civil protection on their initial expectative from the interaction with CHANGES project 3- General overview to some of the critical points in the Fella river before the meeting and then visit to some of the main interventions after the last flood event in August 2003		
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	Korbinian Breinl (ESR02)	ESR-02, Z_GIS Centre, Austria	
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Following the same sequence of the visit, the structure of this report comprises an introduction to the study area, the three (3) stages of the meeting and some conclusions and wrap up as follows:

INTRODUCTION: Short description about the hydro-meteorological conditions in the study area and the characteristics of the flood problem.

1. STAGE 1: Visit to some critical areas in the Fella River (only in Val Canale) that are interesting both from the hydro-meteorological perspective and the structural intervention after the event of 2003. Only participants of CHANGES project attended this stage as long as it was done on the way to the meeting point in Pontebba. The purpose was having a preliminary idea of the hazards in place.

2. STAGE 2: Civil Protection Agency (CPA) prepared a short presentation about the last flood event in 29 August 2003 (response strategy, damages and recovery process); as well as the hydraulic modeling approach that in Friuli Venezia Giulia is mainly carried out by them. CPA also presented an overview of the available data and the expected result from the interaction with CHANGES project. This report includes a summary of the discussion, whereas the support material of the presentation is part of the Annexes.

3. STAGE 3: Visit with the personnel of the CPA to some of the areas where main structural interventions were done after the flood event in 2003.

4. CONCLUSIONS. Wrap up of the meeting and steps forward.

5. REFERENCES.

ANNEXES

i. Additional folder with pictures of the visited sites in concordance with their description on this report. (.JPG file)
ii. Translated version of the copy that CPA shared from the presentation after the meeting (.PDF)
iii. Translated version of the list of data requirements for risk management, support material given during the presentation by the CPA (.PDF)
iv. Summary of the interventions carried out after the flood event as they were extracted from the copy of the presentation provided by the CPA.
v. List of additional references combined with the one suggested in Poland meeting (September 17th-24th, 2011)

Report prepared by V. Juliette Cortes (ESR 10, CNR-IRPI Padova) on December 20th 2011 with inputs from the CHANGES team.

INTRODUCTION

The study area includes the upper part of Tagliamento river basin, where the major system is Fella River. The catchment is located in the north-eastern corner of Friuli-Venezia- Giulia (FVG) region with an area of 700km^2 and two major valleys: Val Canale and Canal del Ferro. From the hydro-geological point of view the region is characterized by rugged topography, densely fractured bedrock and high seismicity. Also by elongated rainfall events that occur in autumn as well as frequent convective storms that occurred mainly during late fall winter and springs. Consequently, the complexity of the phenomena rely on the combined effect of rainfall and soil moisture patterns, erosion processes, landslides and debris, Interaction that should be consider both at the hydrological and hydraulic level, due to the high load of sediments permanently provided to the river system. (Marchi et al, 2010)

Additionally, the area has three main experiences of flash floods events in the past: September 11th 1983, June 22th 1996 and August 29th 2003. From these events the storm of 2003 is used as a reference, not only because is the latest event but also because of the impressive geomorphic changes it caused. The spatial scale for rainfall accumulation and flooding also caused loss of lives and large effects over the economy of the region (important for its strategic location and the touristic and wood industry).

As described by Borga et al (2007), Marchi et al(2009) and GL-IRPI, 29 August 2003 marks one of the most intense flash floods over the region considering the record storm which exceptionality refers to the following aspects:

- The rainfall started at 12 a.m., firstly affecting the upper sector of the mountain areas among Cucco, Malborghetto and Ugovizza villages, then it gradually moved downwards with increasing intensity. The rainfall and associated debris flow events caused the death of two persons, 300 displaced and 260 damaged houses and it caused substantial damages to infrastructures that were made unavailable for several days.
- The mobilization of more than a thousand of landslides occurred along the studied sides. Hydrological analyses were performed using data recorded by Pontebba rain-gage. This instrument is part of the network managed by the Regional Directorate of Civil Defense.
- Data are available at an interval time of 30 minutes. Maximum values of 50, 8 mm in 30 minutes (between 5 and 5.30 p.m.), 88.6 mm per hour (from 3.30 to 4.30 p.m.), 233.4 mm in three hours (between 2.30 and 5.30 p.m.) and 343.0 in six hours (from 12 a.m. to 6 p.m.) were observed. The total influx of meteoric event, which lasted about 12 hours, was equal to 389.6 mm. These data is complemented by post-flood interviews, field observations and surveys.
- Regarding the payback time characterizing the event, there is a considerable variation dependent on the duration: between 1 and 24 hours, the time of delivery is between 50 and 100 years; for 12 hours it is between 200 and 500 years, while, for a period from 3 to 6 hours, payback time varies between 500 and 1000 years.

Next, relevant information about each of the stages and the activities of the kick-off meeting are summarised. Additionally, in the **Figure 1** there is an overview of the study area that was visited (only in Val Canale) that serves as geographical reference for this report. The area is located on the north-east part of the Fella catchment next to the boundary with Austria and Slovenia.

STAGE 1:	**Critical areas in the Fella river from the hydro-meteorological perspective also considering the latest interventions that have been done in the area.**
P1-MALBORGHETTO VILLAGE WEST	This point refers to the conformation works for slope stabilization after the 2003 event (see **Figure 2 and 3**) that aims to sort out the debris flows before they turn into the Fella river. Sediments are widely available in the region due to the high tectonic activity associated with diffused land sliding, debris flow and sediment transport; as triggered by heavy convective precipitation events are the main cause for flash floods.(Marchi et al 2007). From Rio Solari torrent an alluvial fan of debris reaches two houses that were partially covered by the material. In order to protect the downstream area, a switch wall in concrete has been realized. The wall deviate the flow constraining it in an uninhabited zone. To better constrain the flow, a channel completed coated by large boulders, has been built. The channel ends in a depositional basin provided with a sewer overflow (GL-IRPI).

STAGE 1
P1-MALBORGHETTO VILLAGE WEST
P2-BRIDGE OVER MALBORGHETTO STREAM
P3-HYDRAULIC PROTECTION AT MALBORGHETTO TOWN
P4-CUCCO STREAM
P5-BOMBASO STREAM

STAGE 3
P6 PIETRATAGLIATA UPSTREAM
P6 PIETRATAGLIATA DOWNSTREAM
P7 RETENTION BASIN RIO UCCELI

Figure 1 Overview of the area visited during the meeting with the location of the observed sites as they are identified in the report.


Figure 2 and 3 Conformation works for slope stabilization along debris flow channel in the Malborghetto village, December 2011.


Figure 4 and 5 Hydraulic structure that conducts the flow from the conformed slope channel to the Fella river below the road, December 2011.

P2-BRIDGE OVER MALBORGHETTO STREAM:

Although the capacity of the bridge is enough from the hydraulic perspective, it is still prone to flash flood after intense precipitation events due to the high sediment mass mobilized and deposited in the cross section, which reduce its hydraulic capacity.

Moreover, in extreme events as the one experienced in August 2003 the sediment transported could cause a significant stream widening and incision in the channel. After that flood event hydraulic works were carried out approx. 3km upstream of this point in the form of grade-control structures, with the aim of stabilizing the channel and trap sediments. **Figure 4 and 5** (as taken from the bridge), show the type of sediments accumulated in the bottom of the channel and the works carried out by the CPA after the flood event in August 2003.


Figure 6. (Left) Bottom of the channel in Malborghetto stream. December 2011.
Figure 7. (Right) Conformation works along the stream. December 2011.

P3-HYDRAULIC PROTECTION AT MALBORGHETTO TOWN

Its relevance concerns to the proximity of Malborghetto downtown considering that in the 2003 event the church and the houses next to the structure were hardly affected, with a level of sediments that reached the first level of the houses and caused one human lost.

As part of the first works after the 2003 event, removal of the materials and restoration of the hydraulic regime was done. Later combined with the construction transverse structures (filtering check dams) mainly used to prevent stream bed erosion, while longitudinal structures (run-off channel) was used to control bank erosion. Upstream these structures a small depositional basin in reinforced land was constructed as a measure for temporary debris retention and bed load management downstream. (See figures bellow) This concept allows the passing of some smaller sized particles while large boulders with high destructive potential are retained (Huebl J and Fiebiger G, 2005). Because of the high slide slope with consequent high impact of debris flow over the body, the structure needed special foundation with high wings in an area; techniques too invasive were not recommended due to environmental impact (GL-IRPI). Also it needs regular maintenance for a better operation.

Figure 8 and 9. View from the upstream (left) and downstream (right) point of the structure which reflects the vicinity to the downcenter of Malborghetto and the transverse and longitudinal structures along the channel before it is conducted to the main river. December 2011.

Figure 10 and 11. Overview of the hydraulic structure and the debris dam in which it can be appreciated the high slope of the terrain. Upstream the dam the channel is long enough to accumulate and important load of sediments that are temporary stored and later released when the tailwater is deficient of area sediments. It requires regular maintenance works after after medium and large size events. December 2011.

P4-CUCCO STREAM

At this point a touristic village is located in the derbis fan on the right hand of the confluce of the Cucco stream with Fella river;.and a gas natural reserve has the piple line next to the floodplain for the streams. Protection measures were carried out to protect three debris channels (one of them merged from two channels before the confluence) that turn into the Fella and were highly affected during the 2003 event. According to Marchi et al (2009) the major geomorphic impact of the flood was the enlargement of the active channel network, the channel and bank erosion observed along the channel network. This enlargement finally caused the collapse of the banks and a large load of sediments into the main river.

Several interventions were carried out by the CPA at this point. First to remove all the material deposited after the event, then to restore the hydraulic structures at the SS13 along the Rio Cucco and retain debris; which also imply regular mantainance. The basin has been planned for an amount of debris close to 130000mq, all mitigation measures have been concluded. The figures below give a current overview of the area from the bridge over the Fella.

Figure 12 and 13. View of the three main debris channels that converge into the Fella river, one natural gas reserve and the other two surrounding the touristic village. December 2011.

Figure 14 and 15. View of the Fella river upstream (left) and downstream (right) in which is evident the large amount of transported sediment that are visible due to the low water level conditions. December 2011.

P5-BOMBASO STREAM

At this point Bombaso stream is mainly affected the front of a deep seated gravitational slope deformmation that could be triggered not only for short and intense rainfall events but also for long time rainfall. Scenarios of secondary landslides blocking the stream with different rainfall events and conditions of break dams could be consider in order to assess the risk over the Pontebba downtown which is located nearly 1km distance in the stream lenght. GL-IRPI suggested as a reference the author C Calligaris for scientifical work that analyses the interaction landslides-flood events. One of the author's pubblications on the study are is: Rheological investigation and simulation of a debris-flow event in the Fella watershed MA Boniello, C Calligaris - Natural Hazards and Earth sciences, 2010

The road that passes over this stream connects turistic sky areas in the Austrian side with the italian side. Long time ago studies to connect the sky areas on the Austrian and Italian side were consider through a cable way, but it was never carried out due to their high cost. Additionally, there were intentions to replace the road by a tunnel connection, but considering the gravitational movement along the mountain the works were also abandoned.

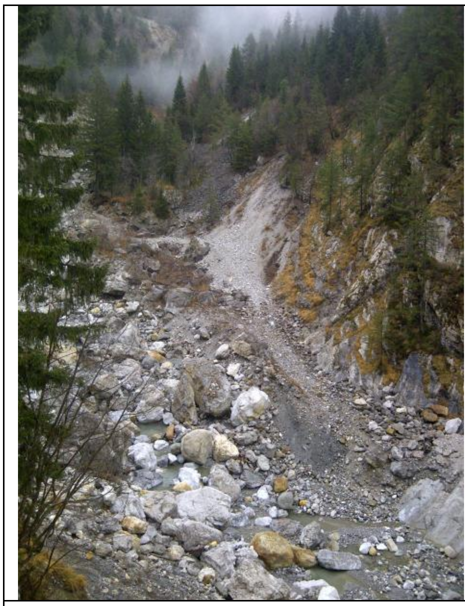 

Figure 16 and 17. Upstream view of the Bombaso stream in which the seated gravitational slope deformmation. December 2011.

 

Figure 18 and 19. View of the bridge over the stream and the downstream section nearly 1km from the Pontebba town. December 2011.

STAGE 2:	**CPA prepared a presentation about the last flood event in 29 August 2003 (damages, reconstruction and recovery process), as well as the data availability and hydraulic modeling approach**

 

Figure 20 and 21. Pictures taken during the kick-off meeting and the field visit accomplished with personnel from the CPA. December 2011.

First the CVP suministred a list of data requirements for risk management (see Annex IV) followed by the presentation (a translated copy in Annex II), which was divided in 3 main topic as summarised below.

Flood event in August 29th 2003 and consequent interventions: During the flash flood event, CPA started the emergency response on August 28th after fax communication was received from the regional authority. This communication was done by the OSMER-meteo service and Friuli-Venezia-Giulia region and comprised a warning of heavy rainfall for August 29th. Considering the short hydraulic response of the Fella river and the high rainfall intensity (400mm of rainfall in4h) there was a disastrous impact over an area of 765km^2 aprox. This area involved mainly 5 comunes where Malborghetto Valbruna and Pontebba were the more affected. An overview of the regional hydrometeorological network of the CPA, the rainfall data and flood wave is available in the copy of the presentation (Annex II), together with several pictures per comune inmediatly after the event.

Particularly, the early interventions after the flood (total of €3millions) were carried out with regional funds of the CPA and included among others, the acqusition of a radio station, differential laser scan surveys, ortophoto ot the study area, removal of sediments and the professionals required for the attention of the emergency. According to information presented in the meeting total economical damages are of €522 millions, due to the innundations and high affectance over the community and railroads in the area; that even later (reconstruction phase) required the construction of variants and bridges.

After the recovery activities with a total cost of €40.000millions consisted on the elements listed below. For further details Annex IV summarises the intervention activities at the 3 preliminar, restoration and recovery level, as it was extracted from the presentation (Annex II – Translated version from the copy of the presentation):

No	Tittle	Activities	Cost (€ in millions)
1	Preliminary activities	Survey of the hydrogeological instability carried out by a team of technicians and authorities of the region based on: laser scan survey, high resolution ortophotos and field survey campaign. As a result GIS database of hydraulic and geological instability was created. A total of 2’750.000m3 was removed from different sections along the river channels to keep the required channel capacity. Municipalities also profited from the fact that construction companies paid for digging rights in the river. CPA did the hydraulic analysis of the Fella river for the planning of interventions to reduce the risk for flooding. The assessment was done in HEC-RAS, first to determine the amount of gravel that need to be removed from the river channel and slides, then the proposal for intervention. Activities also include the provision and installation of stations designed to detect hydro meteorological parameters in the area vulnerable to flooding as well as the recovering of some affected.	14.300
2	Restoration work	Include activities over the transport infrastructure that also required the approvement of variants and modifications for the current conditions. Also activities for prevention, protection of public safety and monitoring of hazards as the ones carried out in Passo Pramollo	11.700
3	Recovery of the damages to the private and business infrastructure affected	The recovery phase was plan based on a loan for 15 years with regional and national fundings. Some houses and stores were realocated after the event. The intervention were mainly structural and vary from the protection of slopes for control of debris channels, check dams to recover the hydraulic regime of the Fella and tributaries, monitoring of landslides, construction of retention basin, variants and reallocations of bridges. Some of this interventions were visited in this first meeting. CPA coordinated the planning of the activities at the initial stage, later on were contracted with private companies or released to the regional authorities in charge. Damages were directed assessed by the municipalities affected, at disposition of the CPA is only the overall balance of the damages.	13.000
4	Cost of professional intervention for the environmental and public activities	The activities were based on the interaction between CPA (Protezione Civile della Regione) and other regional authorities and institutes such as: • Regional department of the environment and public works (Direzione Regionale dell’Ambiente e dei Lavori Pubblici) • Regional head of the agricultural, natural and forestry resources (Direzione Regionale delle Risorse Agricole, Naturali e Forestali) • Basin authority of the Northern Adriatic region (Autorità di Bacino dell’Alto Adriatico) • CNR-IRPI • Department of geological science, environmental and marine from the University of Trieste (Dipartimento di Scienze Geologiche, Ambientali e Marine dell’Università di Trieste)	1.000
TOTAL			40.000

Availability of data by CPA and expectative from the CHANGES Project

The discussion on the available data was done based on the following list with further details in Annex III (Translated version of the list of data requirements for risk management). SF-IRPI will present a full overview of the available data including the additional information that was requested to the Geological service (not included in this report).

Item	**Comments**
Digital elevation model (ideally 5 meters resolution)	LIDAR and digital orthophotos for DEM 0f Fella river catchment (possible resolutions 5m and 10m)
River gauge station data (daily maximum discharge)	CPA coordinates river gauge station (daily maximum discharge). Due to the adjustment of the hydraulic conditions along the Fella river, rating curves must be constructed for the new conditions and probably assesed for different sediments transport conditions.
Rainfall gauge station data (15 min intervals)	There are two meteorological networks, one operated by CPA and the other one by Friuli-Venezia-Giulia authority. However CPA is now passing rainfall data for validation to the regional authority. Definition of the flow of information is required to establish options for optimization and improve interaction in between the authorities.
Land use information	Corine Land Cover 2000 SHP
Lithology	Map with 1:150 '000 lithological surface of the region. GL-IRPI suggested the geological map produced by Venturini, C: Geological map of the Carnic alps, Museo Friulano di Storia Naturale, 2002.
Information on historical flood events	From interpretation with remote sensing techniques of the survey carried out after the event, information for hydrometeorological hazard is already available. (map scale1:10.000)
Information on historical flood events	Inundation levels out of monitoring network are not available
Information on flood defense infrastructures	Hydraulic regimes was controled by several structures after the flood event. Reports should be collected with the documentation of changes in order the construct the new hydraulic model.
Flood hazard maps	Maps are in process of being updated due to the extraordinary of the 2003 event
Upgrade of knowledge – CPA Expectatives	The main aim of the interaction as presented by the CPA are: • Development of a decision support tool (DSS) for the responsible managers of meteorological events in the region. Although, the system is mainly to improve the management of flash flood hazard; interactions with debris flow. Especial considerations should be done for real-time assessment considering the hydraulic response of the catchment (4-12h) • Acquire knowledge for the proper dissemination of information about disasters to the various stakeholders. • Gradually increase the knowledge of the territory and its natural phenomena in order to respond ever more precise. • Transfer the second approach to decision-making patterns and procedures shared among the various entities in charge of emergency management.

Additional Discussion

Time for questions was given after the presentation in which the following issues were raised as discussed with the CPA:

- **Assesment of damages:** ESR-06 was particularly interested in the assement of damages by catefories and their geographical distribution. Because this information is not available on the CPA (only has the summarised values), direct contact should be established with the municipalities where the assesment per building was done after the event.
- **Availability of LIDAR data:** ESR-02 asked about the DEM data availability. This informations is available as coarse data from surveys (laser scanning) carried out in 2006 and 2009. Collection of data was done following the cartography for keeping consistence.
- **Relationship between water level and discharge:** ESR-02 also asked about the availability of rating curves. Due to the structural changes in the river this relationships should be reconstructed and could be a good output from the project.
- **Monitoring network:** ESR-10 asked about the data interaction within the two monitoring networks available (CPA and Friuli-Venezia-Giulia). Interaction in between authorities is being adjusted and might require optimisation.
- **Lead time for response strategies:** ESR-10 asked about the minimun lead time and response strategies that might expect support from the DSS. Considering that the time at which an effective warning can be delivered depending on the lag times of the for hydraulic response (4h-12h), hydrological forecast is of higher relevance. Preparedness also plays an important role because risk conditions must be clear before hand due to the very shor time to do it on real time. Consequently, starting use of the montoring system and rainfall prediction, response strategies may vary from only real-time information on flash flood impacts up to a general warning for local and individual protection of people and properties in critical places previously identified.

- **Forecasting requirements:** OSMER might deliver forecasting up to 3 days in advance. Although this information could be used for hydrological assesment at regional level, more detailed information should be extracted at nowcast level (based in predictions up to 6hours in advance). Therefore, a simplified rainfall-runout model is required for the establishment of thresholds that improve the understanding of the rainfall and consequentlythe reponse strategies for flash-flood. AP-CNR mentioned we should make a difference between the operational warning at organisational level (pre-warning) and comunity level (warning to reach the public). The intended DSS initially deals with pre-warning level.
- **Availability of emergency plans at municipal level:** Each municipality is in charge of the elaboration of their own plan. Therefore, their progress varies according to the available personnel and resources. It is expected a first draft at the beginning of the 2012 for the most advance municipality. Direct contact should be established with the municipalities and the Insititute of Social studies in Gorizia (ISIG, CapHaznet project)
- **Social aspects:** AP-IRPI asked for the availability of social information (flood risk awareness and preparedness) in the study area. However, this studies have been carried out by ISIG and the first contact is in process by SF-IRPI.

STAGE 3:	**Visit with the personnel from the civil protection agency to some of the areas where the main interventions after the flood event were carried out.**
P6 PIETRATAGLIATA UPSTREAM	The relevance of this point refers to the impact over both sides of the Fella river, on the left side 1 house collapsed into the channel due to the extreme widening and incision effects of the 2003 event. On the right side the stability of the road was compromised by the intense erosion over the piles that support the transport infrastructure. This infrastructure included a bridge that had a foundation pile into the river. Therefore, the bridge was reallocated in a wider downstream section of the river without any foundation inside the water channel. Here is also evident that two levels of regional authorities coordinated the reconstruction activities after the 2003 event. The civil protection agency who coordinated the protection works over the left side of the river, the construction and reallocation of the houses affected. One industrial store constructed inside the floodplain and also affected by a previous flash at 1983 flood event was reallocated. The other administrative level is the regional authority responsible for the transport infrastructure, who is still working on the area with equipment into the floodplain still dealing with the protection of the piles.

Figure 22 and 23. Upstream view of both sides of the river that covers the ongoing works for the protection of the piles and finilised works on the right side for the protection of the slope channel, disipation of energy and debris retention. December 2011.

P6 PIETRATAGLIATA DOWNSTREAM	This point corresponds to the location of reallocated bridge next to the confluence of an affluent of the Fella river which also affected a local road which is the only access to small village nearby and that also requires protection and reconstruction works.


Figure 24 and 25. Overview from the bridge perspective of the reconstrction and protection activities after the 2003 event. December 2011.


Figure 26. (Left) Protection works carried out over the affluent of the Fella river where we can observe the online structures for retention of sediments and slope protection along the stream channel. December 2011.
Figure 27. (Right) This picture was taken over the reallocated bridge and shows the new type of structure with post-tensed steel cables without intermediate piles. December 2011.

P7 RETENTION BASIN RIO UCCELI	This retention basin for debris was constructed after the event of 2003 as a structural measure to protect the regional road infrastructure several kilometers dowsntream. The figures below show on the left, signals from the last flash flood event on september 2009 that are still present in the vegetation and fine sediment deposited next to it. On the right, the sectional barriers with fins are visible with a reference person for the scale of the structure. Regular maintenance works are required


Figure 28 and 29. Upstream and downstream view of the retention basin constructed after the 2003 event in the Ucceli river in order to protect the regional road infrastructure several kilometers dowsntream. December 2011.

4. CONCLUSIONS.

- From this meeting it was possible to have a preliminary idea not only about the data availability in Fella river but also about the processes associated with the generation of flash floods and their challenges for risk management, mainly related with hydrogeological hazards and flood response time of few hours. For the availability data CNR-IRPI is preparing the initial database and an update of the activity will be given at ITC, Enschede, NL (Jan 19^{th}-20th,2012)

- The primary hazard under consideration is the occurrence of flash floods in the upper part of a Mediterranean catchment triggered by convective rainfall events; for which a DSS for early warning is openly required by the CPA with the end to define a pre-warning level (managed by operative staff).

- Looking at the complexity of the phenomena, preparedness and real time management are both important. According to the forces in law for the study area, the final end of an emergency management strategy could be proposed as follows:

    1. Real time physical modelling scenarios are integrated as derived from an <u>operative</u> EWS for emergency management. The reliability of the forecasting should be also considered.

    2. During preparedness phases the identification of rate-limiting processes and critical points of the hazardous in place is carried out both from the technical and operative point of view.

    3. Finally as a desired tool to improve the performance of contingency plans, all the elements are integrated in a DSS with expert quality check of the <u>outputs,</u> to be operated by the CPA,.

- Based on the previous considerations of the phenomena, the modelling approach looking for an integration in a DSS could be as follows:
    - Different preparedness scenarios that consider the actual conditions of the Fella River after the structural interventions to control the hydraulic regime of the Fella and some tributaries. There are no rating curves for the Fella and that could be an output of the project. However, river channel changes might be expected after any flood event.
    - Different scenarios might consider modified cross sections with changes in the sediment transport pattern of the stream or different conditions in the terrain.
    - From the preparedness scenarios critical points should be identified under different conditions of sediment transport and rainfall events combining technical and operative knowledge.
    - An online approach for a simplified rainfall run-off model could be implemented using high-resolution operational weather forecasting. Thresholds for the hazard in place combined with the hydrological modelling results and other triggering factors should be considered to the spatial distribution of rainfall estimate on time.
    - After the hydrological conditions have been defined for the current and short-time window, a simplified hydraulic approach could be set up based on a library of already prepared hazard and risk maps for historical and different scenarios, in a way that few parameters could be quickly compared between the time window and the historical situation. Therefore, decisions could be taken in more detail.

The requirements for the models to be integrated in the DSS looking at real time applications should be computationally light and friendly in terms of running-time and number of parameters to set up. This applies for emergency management and might be based on the preparedness phase.

5. REFERENCES

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- Additional references in the ANNEX V to this rerport.