1 Introduction

Floods are the costliest natural hazard in the world. A review of the losses caused by floods events in the period of the last ten to fifteen years indicate that in Europe economic losses are dramatically increasing, mainly because there has been a marked increase in the number of people and economic assets located in flood hazard zones. Flood risk mitigation can be done reducing vulnerability and/or hazard in order to reduce the total flood impact. The aim of this project is to examine the relative efficiency of non-structural flood mitigation measures. To do this, new scientific frameworks and technical tools integrating multidisciplinary approaches (meteorological, hydrological, hydraulics and socio-economical) on flood risk assessment will be used and tested in three different and, at the same time, complementary case study areas. Three study catchments will be selected, the semiarid Rambla del Poyo in Spain (380 km²), the humid/midland Kamp in Austria (1500 km²), and the alpine/prealpine Iller in Germany (950 km²). The floods in these catchments cover a wide spectrum of processes to be expected in the European Research Area.
2 Methods

This project will focus on a comparison of the efficiency of non-structural flood mitigation measures. In particular measures which realise the non-structural flood risk mitigation concepts “retain the water in the catchment” and “room for the river” will be evaluated: Land use changes (agricultural to forest; local infiltration in urban areas), local retention measures in the landscape through micro ponds and Flood retention along the main stream by providing inundation area.

The project is divided in 4 work packages:

In WP1, scenarios will be defined that represent the various mitigation measures as well as "input" scenarios.

WP2 focuses on the catchment hydrology, and includes parameterisation and verification of distributed hydrological models, performing simulations for the scenarios and a statistical assessment of the simulated events.

These simulations are used in WP3, where hydraulic analyses will be performed along the river reaches of interest by running non-steady state models and/or linking up to existing results of hydraulic models. These analyses will allow the assessment of retention measures along the main stream and will provide flood inundation areas. Flood hazard maps will be the main output of this WP.

WP4 assesses the efficiency of the flood mitigation measures in terms of the impact or risk by combining the hazard with the vulnerability of the flood prone areas. It is expected that the relative efficiency will differ both with the magnitude and the type of the floods.
3 Results and Discussion

Most important scientific results and important events

At this moment, basically the work done was in WP1 (finished), WP2 (almost finished) and in WP3 (in progress). The most important results are:

1.- As a result of an analysis of the characteristic land use structure in the Iller basin, the afforestation of natural grasslands and pastures was identified as the most effective runoff reducing measure. For that purpose, CORINE-land use information was intersected with topography data to identify maximum potential afforestation areas (Fig. 2). The increase in overall water retention capacity (by means of increased interception, roughness and soil porosity) was estimated for each subcatchment and equalled 74-82 mm on areal average.

2.- The continuous daily simulation in the last 50 years in R. Poyo basin resulted in an independency between the events greater than 5m³/s in Autumn (when the Mesoscale Convective Storms can develop) and the initial soil moisture condition. Two representative initial conditions were estimated at 10 and 70% of the total upper soil capacity.

3.- 200 event simulations where performed using the distributed model TETIS, using 100 synthetic storms (generated with the software RAINGEN) and with the two different initial conditions mentioned above. Fig. 3 shows the generated peak discharge as a function of the return period of the maximum 24 h areal precipitation within the basin. In general, the dry initial condition produces smaller peaks than the wet
condition. Also, the different spatial and temporal distribution of each storm results in a dispersion of the peak discharge for similar total precipitation magnitude.

4.- Analysis of the local retention measures in the landscape through micro ponds in the humid/midland Kamp basin resulted in the following findings. The micro ponds do not operate like traditional retention basins. They behave hydrologically different in that they mainly contribute to the decrease of soil moisture in the landscape. Traditional retention basins, in contrast reduce stream flow in the stream. A large number of micro ponds was used, about 8000 micro ponds in a 622 km² catchment. The simulations indicated that the retention effects, overall, are small. The magnitude of the flood retention effect, for a given number and volume of micro ponds, is mainly controlled by two factors as illustrated in Fig. 4. The first factor is the scale of the floods. The larger the flood events, the smaller were the percent reductions in the flood peaks. For small events, the reduction in the flood peak discharge was 15% in the 622 km² catchment. For the largest floods on record, however, the reduction was only 1%. It should be noted that this was an extreme event, where most of the landscape was saturated. A reduction in the soil moisture within the landscape through construction of micro ponds would hence not reduce the magnitude of the flood much. The second factor is the antecedent soil moisture in the case of small and moderate events. Micro ponds result in somewhat larger flood peak reduction in the case of wet soil conditions. This is because during wet conditions surface runoff is larger, so the ponds are more readily filled.

5.- In parallel, in R. Poyo it was compared three landscape scenarios: present, 184 ponds and small dams and a single equivalent in volume dam. A specific statistical analysis was developed in order
to deal with independent synthetic events. Fig. 5 shows that for small return periods, the local flood retention structures perform better reducing the peak flow, but this is not the case for medium to high return periods.

6.- Overall the findings indicate that the potential of micro ponds, ponds and small dams as local flood retention measures is moderate to small, depending on the scale of the magnitude. Decision on whether such structures are a suitable retention measure in any one catchment would have to be based on an integrated flood management plan that balances the various options of flood mitigation and management.

7.- In the estimation of the hydraulic characteristics and the DEM of the R. Poyo basin flood prone area, it was stressed the potential sensitivity of the results to the DEM resolution. Four DEM from 5 to 50 m resolution have been constructed, showing clear differences (Fig. 6).

8.- Starting with an a priori calibrated 2d-hydrodynamic model using the 1999 the "Pentecost flood" along the Iller River, simulations for the current river conditions and for planned river training measures have been conducted for reduced and enlarged flood waves of estimated return periods from 5 to 1000 years. The results show the possible effects of the establishment polders and other river training measures to reduce the flood peaks. The effects are relatively larger, if the return period is small (i.e. floods of a smaller magnitude), which is according to the expectations. The results of these hydrodynamic simulations will be linked to the results of the hydrological simulations obtained in this project (for different retention scenarios) in order to quantify and compare the whole flood reduction and flood management potential of the “landscape-river-system”.

Figure 6. 5 and 50 m DEMs of R. Poyo flood prone area.
Comparison work plan – progress

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(Note: In black the work done)

Prospect of success (from present point of view)

Given the nowadays situation, there is a maximum likelihood of a final success.

Scientific, economic and political relevance of expected project results (from present point of view), including added value (or dissemination) to national policies

We are very confident that our project will contribute to improve the standards of European Flood Risk Management (FRM), including an improved exploitation and dissemination of FRM research and will yield a positive economic impact by the comparative character of the evaluation of the different non-structural measures efficiency:

i) An efficient exploitation and dissemination of the project results requires the active involvement during the project of an end-users panel. The end-users panel is involved in the project through a two-way exchange of ideas and a seminar in each study catchment. The members of this panel at each country have a strong interest in the potential of non-structural measures to reduce the flood risk.

ii) The project web page (www.iama.upv.es/roomfortheriver/home.html) will have a public access to the case study maps, flood measures
recommendations, final report of the project, etc. At this moment, only the provisional results are available.

iii) A final meeting between all the participants and invited speakers, and opened to scientists and end-users will be held for presenting and discussing the results and conclusions of the project.

Dissemination to scientific community (published papers, conferences)

Due to the partial results until now, the dissemination to the scientific community has been limited. Until now only it has been presented in a Symposium:

Authors: F. Francés, G. Blöschl and A. Bronstert
Poster: Efficiency of non-structural flood mitigation measures: "room for the river" and "retaining water in the landscape".
Congress: European Symposium On Flood Risk Management, Dresden (Germany), February 2007.

Dissemination mechanisms within the scientific community will also include:

i) Scientific publications. Two common papers are predicted to be published related with the hydrological scenarios and the efficiency of the non-structural measures.

ii) Attendance and communications to more symposiums and conferences, etc.

iii) A special session in the annual EGU congress will be promoted.
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