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Integrated flood damage modelling in the Ebro river basin under hydrodynamic, socio-economic and environmental factors

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This paper presents a model of flood damage measurement. It studies the socio-economic and environmental potential damage of floods in the Ebro river basin. We estimate the damage to the urban, rural and environmental sectors. In these sectors, we make distinctions between residential, non residential, cultural, agricultural, public facilities and utilities, environmental and human subsectors. We focus on both the direct, indirect, tangible and intangible impacts.

The residential damages refer to the damages on housing, costs of repair and cleaning as direct effects and the re-housing costs as an indirect effect. The non residential and agricultural impacts concern the losses to the economic sectors (industry, business, agricultural): production, capital losses, costs of cleaning and repairs for the direct costs and the consequences of the suspension of activities for the indirect costs. For the human sector, we refer to the physical impacts (injuries and death) in the direct tangible effects and to the posttraumatic stress as indirect intangible impact. The environmental impacts focus on a site of Community Interests (pSCIs) in the case study area.

The case study is located the Ebro river basin, Spain. The Ebro river basin is the larger river basin in term of surface and water discharge. The Ebro river system is subject to Atlantic and Mediterranean climatic influences. It gathers most of its water from the north of Spain (in the Pyrenees Mountains) and is the most important river basin of Spain in term of water resources.
Most of the flooding occurs during the winter period. Between 1900- 2010, the National Catalogue of Historical Floods identifies 372 events: meanly 33 events every 10 years and up to 58 during the 1990-2000.
Natural floods have two origins: (i) persistent rainfalls in large sub basins raised up by high temperature giving rise to a rapid thaw in the Pyrenees, (ii) local rainfalls of short duration and high intensity that gives rise to rapid and wrenching floods.

Our integrated model combines hydrologic, land use, environmental and economic data. The combination of the cadastral data with the flood characteristics (flow, depth, duration) for various periods of return enables to draw damage maps expressed as function of flood characteristics (Penning-Rowsell et al. 2005).
This methodology also enables to illustrate consequences of risk prevention measures. We can thus measure the value of information in the alert system of Civil Protection Agency, give information on risks for urban development plans and simulate the consequences of hydraulic interventions like river bed cleaning. This methodology would then contribute to match with the requirements of the 2007 EU flood risk Management Directive (2007/60/CE).