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Modelling hydrological responses of Nerbioi River Basin to Climate Change

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Future climate change will affect aquatic systems on various pathways. Regarding the hydrological cycle, which is a very important pathway, changes in hydrometeorological variables (air temperature, precipitation, evapotranspiration) in first order impact discharges.

The fourth report assessment of the Intergovernmental Panel for Climate Change indicates there is evidence that the recent warming of the climate system would result in more frequent extreme precipitation events, increased winter flood likelihoods, increased and widespread melting of snow and ice, longer and more widespread droughts, and rising sea level. Available research and climate model outputs indicate a range of hydrological impacts with likely to very likely probabilities (67 to 99%). For example, it is likely that up to 20% of the world population will live in areas where river flood potential could increase by the 2080s.

In Spain, within the Atlantic basin, the hydrological variability will increase in the future due to the intensification of the positive phase of the North Atlantic Oscillation (NAO) index. This might cause flood frequency decreases, but its magnitude does not decrease. The generation of flood, its duration and magnitude are closely linked to changes in winter precipitation. The climatic conditions and relief of the Iberian Peninsula favour the generation of floods. In Spain, floods had historically strong socio-economic impacts, with more than 1525 victims in the past five decades. This upward trend of hydrological variability is expected to remain in the coming decades (medium uncertainty) when the intensification of the positive phase of the NAO index (MMA, 2006) is considered.

In order to adapt or minimize climate change impacts in water resources, it is necessary to use climate projections as well as hydrological modelling tools. The main objective of this paper is to evaluate and assess the hydrological response to climate changes in flow conditions in Nerbioi river basin (Basque Country, North of Spain). So that adaptation strategies can be defined. In order to fulfil this objective four subobjectives are defined: (1)selection of the future climate projections for the case study area from a wide spectrum of possibilities; (2) model the hydrological processes of the basin with a physically distributed complex hydrological model; (3) validation of the hydrological model with observation data; and (4) runoff simulation introducing regional climate model data selected.

The analysis of climate models suggests that extreme precipitation in the Basque Country increased by about 10% during the twenty-first century. This increase of extreme precipitations raised discharge and water level in Nerbioi river basin. That is why in the 21st century it is expected that the flood-prone area will expand for precipitation with a return period of 50 years.

In this context, it is necessary to define and evaluate different adaptation options which are already in practice or conceivable according to the current scientific knowledge. As well as evaluate the adaptation measures in terms of their ability to lower the vulnerability of water resources to climate change. For example, land use change could be a useful tool to adapt our basin systems. The land use plays an important role on the water balance of a river by varying the proportion of precipitation that runs off and the fraction that is lost by evapotranspiration.

Therefore, both climate change and adaptation strategies will have an impact on the hydrodynamic conditions of rivers; particularly the changes in flow conditions will have a severe ecological, economical and social impact. As future work, adaptation measures will introduce in the future runoff simulation in order to evaluate the effectiveness and as a decision-making tool to operational organisations.