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Spatio-temporal dynamics of flood regulating ecosystem services in the Arno river basin, Italy

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Human activities can strongly influence the capacity of ecosystems to provide flood regulating ecosystem services (ES). Therefore, the effects of land use alteration, population migration and urbanization are key aspects to be considered when dealing with flood management. This study aims at analyzing the spatio-temporal dynamics of flood regulating ES to support watershed management planning. The spatial explicit analysis of flood regulating ES is carried out with SWAT - Soil and Water Assessment Tool, using daily meteorological data between 2000 and 2014. Two indicators are elaborated in order to evaluate the retention capacity of each land use setting and to map the ES supply. Demand quantification is obtained from the information derived by the existing flood management plans (i.e. PAI-Piano per l'Assetto Idrogeologico and PGRA-Piano di Gestione del Rischio Alluvioni) which contain the identification and the perimeter of hydraulic hazard classes. Supply and demand data are then merged in order to obtain budget maps of flood regulating ES and their evolution from 1960 up to 2012 (1960, 1990, 2000 and 2012). The results show that both the demand and the supply of ecosystem services change during the time. With the increasing urbanization, the demand values have grown in the Arno floodplains, where residential, industrial and commercial zones are located. At the same time, land use changes (e.g. intensive agriculture) have caused negative effects on water regulation supply. This work shows the advantages of assessing flood regulating ES to improve flood regulation in the Arno river basin and provide a sound base of knowledge to identify floods prevention and mitigation measures.