Geophysical Research Abstracts
Vol. 16, EGU2014-15139, 2014
EGU General Assembly 2014

The assessment of natural flood management measures as a climate change adaptation option through land use scenarios

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Climate change is one of the most pressing issues facing civil society. Greater variability and more frequent extremes of temperature and precipitation will result in increased flood risk and corresponding social, economic and environmental impacts. Complementing more traditional structurally-based engineering interventions an important additional adaptation strategy is through natural flood management (NFM) measures utilising natural soil, wetland and groundwater storage at the catchment scale to attenuate runoff generation and downstream flooding. Such schemes have multiple co-benefits including improved water quality, biodiversity and amenity and so contribute to greater resilience to uncertain climate futures. As a case-study of a more integrated approach to land use planning we here consider the policy target of the Scottish Government to expand woodland in Scotland by 100,000 ha by 2025 from the current 3 000 ha/year. In this paper we examine runoff response under different woodland expansion scenarios using climate projections obtained from the UK Climate Projections (UKCP09). Woodland creation has recognised potential as a NFM measure, but locating this new planting is constrained by physical and cultural constraints. Land use choices in the future will also strongly reflect emergent socio-economic contexts, here assessed through scenario analysis. The distributed hydrological model WaSiM-ETH was utilised for the analysis using the case-study of the Tarland catchment, a tributary of the River Dee. Terrain data were obtained on a 50 m grid and the model calibrated using meteorological and river gauge data from 2005 to 2007 following a manual and an automatic calibration process. This novel approach highlights that land use change should be carefully managed for planned benefits and to avoid unintended consequences, such as changing the timing of tributary flood responses. Whilst woodland expansion may only provide modest gains in flood reductions the co-benefits contribute to a coherent ecosystem-based adaptation strategy promoting landscape resilience at the landscape scale.