A novel toolkit to streamline Land Use Land Cover change assessment in the SWAT+ model to enhance flood management and infrastructure decisions

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Land Use Land Cover (LULC) change is widely recognised as one of the most important factors impacting river basin hydrology. It is therefore imperative that the hydrological impacts of various LULC changes are considered for effective flood management strategies and future infrastructure decisions within a catchment. The Soil and Water assessment Tool (SWAT) has been used extensively to assess the hydrological impacts of LULC change. Areas with assumed homogeneous hydrologic properties, based on their LULC, soil type and slope, make up the basic computational units of SWAT known as the Hydrologic Response Units (HRUs). LULC changes in a catchment are typically modelled by SWAT through alterations to the input files that define the properties of these HRUs. However, to our knowledge at least, the process of making such changes to the SWAT input files is often cumbersome and non-intuitive. This affects the useability of SWAT as a decision support tool amongst a wider pool of applied users (e.g., engineering teams in environmental regulatory agencies and local authorities). In this study, we seek to address this issue by developing a user-friendly toolkit that will: (1) allow the end user to specify, through a Graphical User Interface (GUI), various types of LULC changes at multiple locations within their study catchment, (2) run the SWAT+ model (the latest version of SWAT) with the specified LULC changes, and (3) enable interactive visualisation of the different SWAT+ output variables to quantify the hydrological impacts of these scenarios. Importantly, our toolkit does not require the end user to have any operational knowledge of the SWAT+ model to use it as a decision support tool. Our toolkit will be trialled at 15 catchments in Gwynedd county, Wales, which has experienced multiple occurrences of high flood events, and consequent economic damage, in the recent past. We anticipate this toolkit to be a valuable addition to the decision-making processes of Gwynedd County Council for the planning and development of future flood alleviation schemes as well as other infrastructure projects.