Climate change and fluvial flood peaks supplementary report

A new approach to updating peak river flow allowances

Date: March 2023

Project: SC150009B/R2

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Background and purpose

Climate change allowances for peak river flow are provided in the following Environment Agency guidance:

- Flood risk assessments: climate change allowances (first published in 2016, with peak river flow allowances updated in 2021)
- Flood and coastal risk projects, schemes and strategies: climate change allowances (first published in 2013, updated and published on GOV.UK in 2020, with peak river flow allowances updated in 2021)

The latest UK climate projections (UKCP18) were published in November 2018. We commissioned the UK Centre for Ecology & Hydrology (UKCEH) to use the rainfall projections in UKCP18 to model peak river flow uplifts. The project, 'Climate change and fluvial flood peaks (SC150009B)' was completed in March 2020 with a research report published in March 2023.

This supplementary paper sets out how we have used the outputs of this project to define the geography for the updated peak river flow allowances and the reasons for our chosen approach.

Overview of project SC150009B

Project SC150009B provides peak river flow projections for 1km grid squares for catchments greater than 100km^2 across mainland Great Britain. This data is considered to be robust to provide climate change allowances at a local level. On this basis, this project allows us to provide allowances that better represent variability in peak river flow within river basin districts.

The project also provides peak river flow projections for a range of return periods (10 years, 20 years and 50 years), emissions scenarios from the Representative Concentration Pathways (RCP2.6, RCP4.5, RCP6.0 and RCP8.5), time horizons (2020s, 2050s and 2080s) and percentiles (1, 5, 10, 25, 33, 50, 67, 70, 75, 90, 95, 99).

Using project outputs to update peak river flow allowances

We explored several options using outputs from project SC150009B to identify a preferred approach to updating peak river flow allowances. These included using the:

- 1km grid projections
- mean value of the total number of 1km grid squares within each river basin district
- mean value of the total number of 1km grid squares within each management catchment
- mean value of the total number of 1km grid squares within each operational catchment

Using the 1km grid projections

The 1km grid has relatively limited coverage across all watercourses, as catchments less than 100km^2 were not included. We sought feedback from area teams in the Environment Agency to explore how projections provided by the research could be used for flood risk assessments. Their feedback revealed numerous practical challenges:

- The 1km grid coverage often only covers parts of watercourses (those parts that have a catchment of 100km^2 or more). This means that neighbouring sites can be subject to significantly different allowances if one is subject to the 1km allowances and the other to a catchment allowance.
- The 1km grid data was not always suitable because:
    - it excludes tidally dominant watercourses (posing issues where there are tidal barrages)
    - it has low confidence that these allowances account for reservoirs or flood storage areas
    - it has low confidence that these allowances properly represent bifurcated rivers (rivers with many streams)
    - when applying the data at a local level it is likely to raise significant questions, such as where there is a significant difference in allowances between grid squares, which would be a resource drain on all involved in the planning process
- Limited 1km coverage will mean, for large projects, a mixture of 1km and catchment allowances would be applied with significant variation that is likely to be challenged.
- There were questions about which grid square is best to use when it does not follow the watercourse, which grid square to apply if there is more than one dominant source of flooding, and it was also unclear if tributaries are covered.

Using the mean value of the 1km grid squares within each river basin district

Analysis of the data from project SC150009B showed that a large proportion of the 1km grid peak river flow projections are 10%+ greater than the mean value of the 1km grid square values within the river basin district. Therefore, it is important that our approach considers a smaller geographical area to reasonably represent the projections at a local level.

Using the mean value of the 1km grid squares within each management catchment and operational catchment

Management catchments are sub catchments of river basin districts. They have logical hydrometric boundaries and are made up of whole waterbodies. There are up to 16 management catchments within a river basin district.

Operational catchments are sub catchments of management catchments. Like management catchments, they have logical hydrometric boundaries and are made up of whole waterbodies. There are typically 3 to 6 operational catchments within a management catchment.

The mean value of the 1km grid square projections for the management catchments and operational catchments are calculated. Analysis found a significant number of operational catchments that are not covered by the 1km grid and, therefore, a mean value cannot be calculated.

On this basis, it was decided that the most appropriate approach would be to provide peak river flow allowances at a management catchment scale using the mean value of the 1km grid projections from project SC150009B.

Justification for using management catchments

The reasons for providing peak river flow allowances at a management catchment scale are because:

- it is a straightforward approach that will be easy and quick for those using the guidance and Environment Agency teams to apply - in comparison, using operational catchments and 1km grid allowances would require more complex guidance in practice risking misapplication
- there are no significant practical challenges in using this approach - in comparison, there are challenges to using operational catchments and 1km grid due to a lack of coverage in a number of locations
- while management catchments provide allowances at a lower resolution than operational catchments or at the 1km grid scale, they are representative of the overall 1km grid projections and, in most locations, that will be within 10% of the management catchment allowance
- by using the 50th percentile of RCP8.5 (high emissions scenario equivalent) as the basis for the management catchment allowances, we are taking a precautionary approach that means there is a margin for error for those locations where the 1km projections are higher
- our climate change allowances guidance allows for different approaches where local data indicates deviation from national guidance
- our approach is a significant improvement on our previous approach (prior to the 2021 update), which ‘masked’ higher and lower projections to a greater extent

Reasons for parameters chosen

Project SC150009B provided projections for a range of parameters:

- return periods (10 years, 20 years and 50 years)

- time horizons (2020s (2015 to 2039), 2050s (2040 to 2069) and 2080s (2070 to 2099))
- emissions scenarios (RCP2.6, RCP4.5, RCP6.0 and RCP8.5)
- percentiles (1, 5, 10, 25, 33, 50, 67, 70, 75, 90, 95, 99)

Return period

We used projections based on the 50-year return period data. This is the closest available to the 100-year return period used for calculating current day peak flow design flood events for flood risk assessments – see Planning Practice Guidance. The same approach is applied for the appraisal of flood and coastal erosion risk management schemes.

Time horizons

We used projections for all available time horizons (2020s, 2050s and 2080s). The 2080s provides a long-term time horizon needed for assessing 100-year lifetime for housing development as required in Planning Practice Guidance. Allowances for the 2020s and 2050s epochs are provided for developments with shorter lifetimes.

Emission scenarios and percentiles

The allowances are based on emissions scenario 'RCP8.5'. The central allowance is based on the 50th percentile, the high central allowance on the 70th percentile, and the upper end is based on the 95th percentile.

The 50th percentile (central allowance) of RCP8.5 is the closest available scenario to a 4°C increase by 2100. The flood risk assessment guidance advises this is used for most flood risk assessments. The guidance for flood and coastal erosion risk management projects, schemes and strategies advises that this is used as the design allowance for all projects, schemes and strategies. This provides a robust baseline approach to climate resilience, based on the latest evidence on the global climate change pathway we are currently following. This is reflected in the UNEP Adaptation Gap report (Jan 2020), which states that we are heading for a 3°C temperature rise this century, but this could be as high as 4°C. This is also referenced in the UK Climate Change Risk Assessment 2022.

The flood risk assessment guidance advises the higher central allowance is used for essential infrastructure (defined in the Flood Risk Vulnerability Classification in Planning Practice Guidance) and for other development that could affect essential infrastructure from downstream or upstream impacts. The guidance for flood and coastal erosion risk management projects, schemes and strategies advises taking a proportionate approach. This can be achieved by applying the higher central allowance to assess the sensitivity of the leading option to changes in risk, and identify any additional resilience or mitigation measures required to cope with the impacts. This is to ensure that all projects, schemes, and strategies can adapt to a range of future climate scenarios.

The flood risk assessment guidance advises the upper end is used to reflect credible maximum scenarios. This is important to consider for nationally significant infrastructure projects and for developments that create large new communities, such as urban extensions and large redevelopments within urban areas. The guidance for flood and coastal erosion risk management projects, schemes and strategies advises that the upper end allowance is used to show the impacts of extreme climate change and help inform community wide resilience. This is particularly important where the scale of flooding or coastal erosion risk impacts are extreme and where management options involve very high value or low adaptability assets.

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