



OpenCLIM: Open Climate Impacts Modelling Framework

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UKCR FINAL CONFERENCE: LONDON, 8-9 MARCH 2023

OpenCLIM Aims



Goal

- An assessment method for CCRA4 and beyond.
- Enhance the UK's capability to assess climate change risks and adaptation choices.



Vision

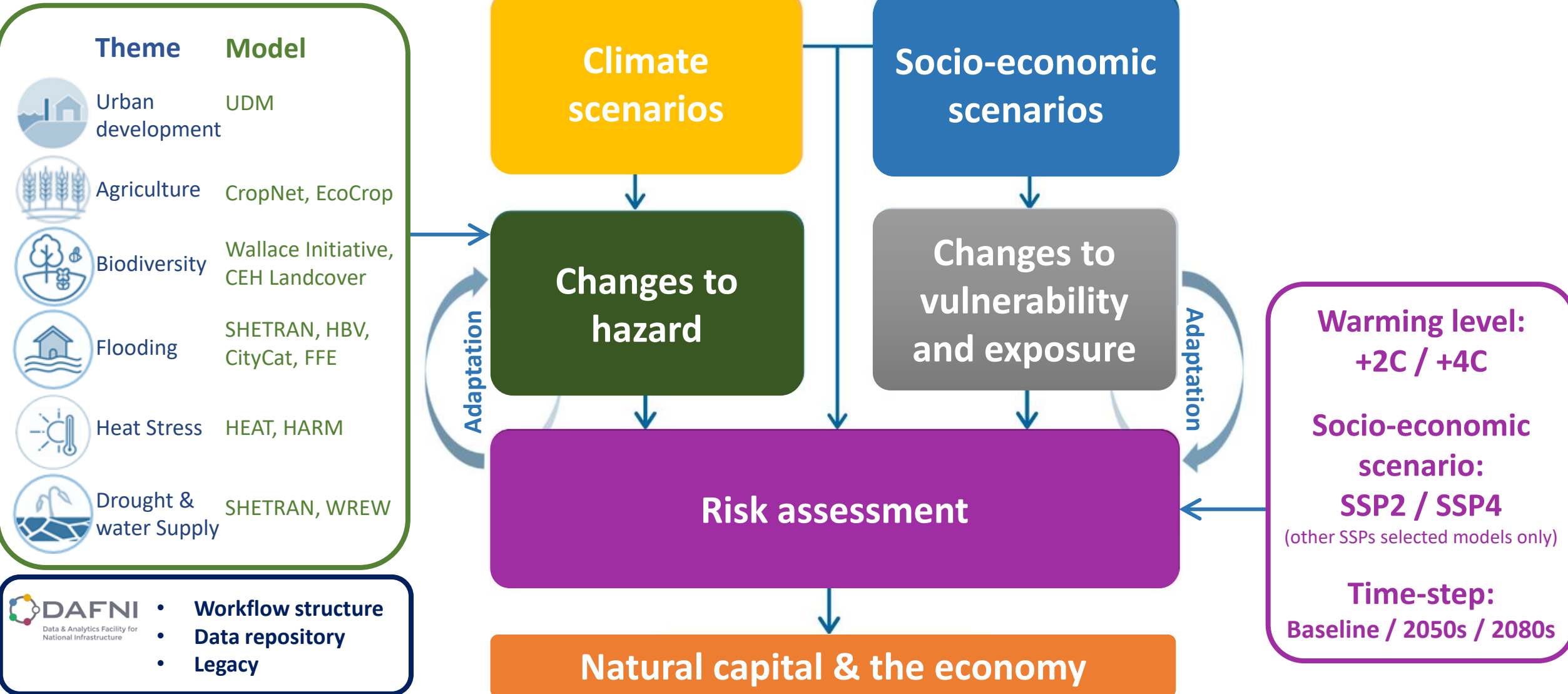
- Linked risk and adaptation models across multiple sectors in an open, integrated framework for community development.
- A process that integrates models to facilitate science/policy development.



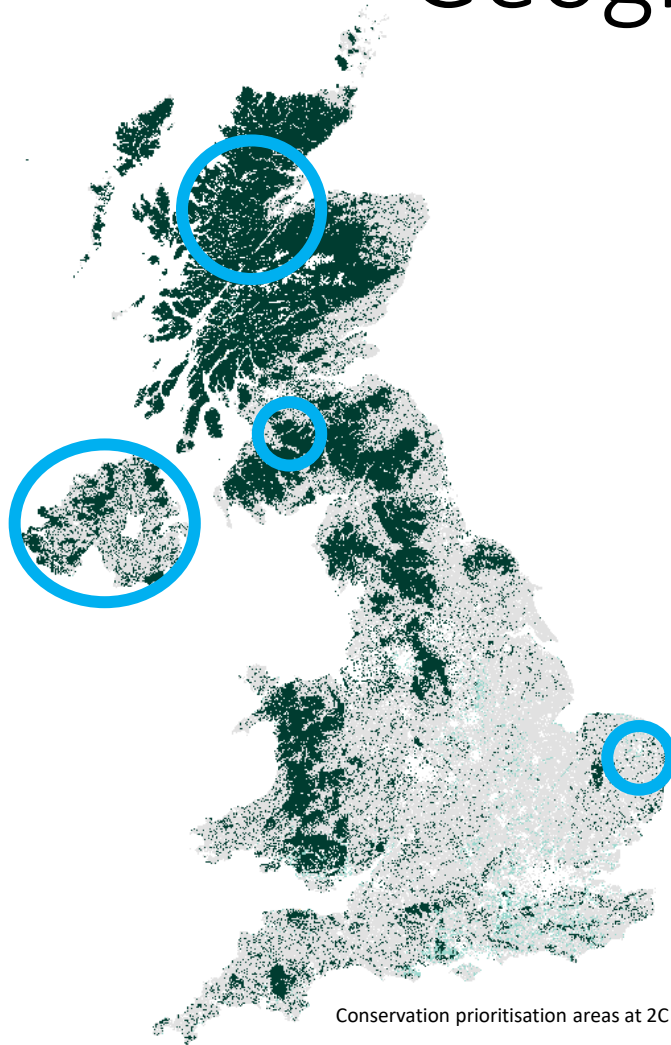
Innovation

- Consistent and spatially explicit results.
- Identify risk hotspots, including compound risks (detailed maps).
- Assess adaptation.

Framework structure



Geographic coverage

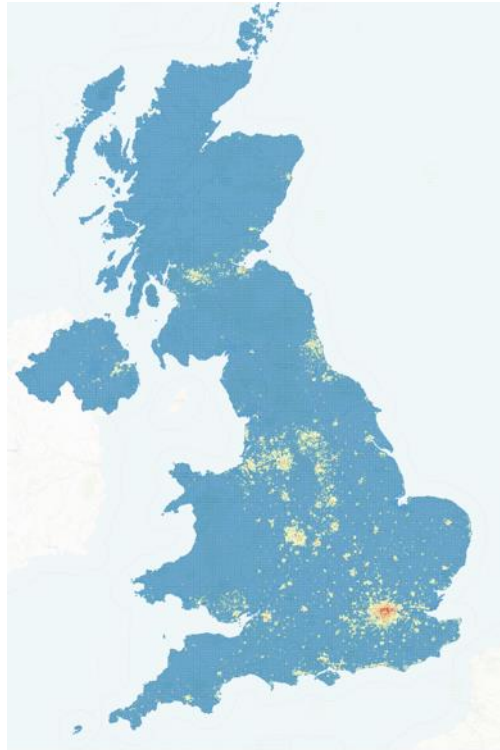


Conservation prioritisation areas at 2C

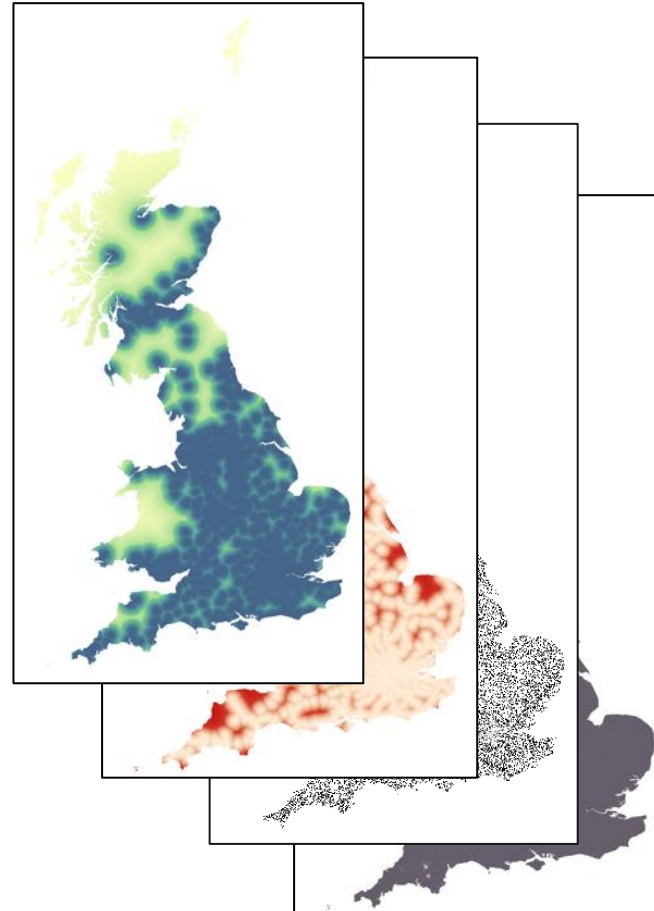
Results Available

- Nationally – United Kingdom
- Devolved Administrations
- Sub-National (with examples)
 - Clyde
 - Norfolk
 - Highland Council
 - Northern Ireland
- Sectors

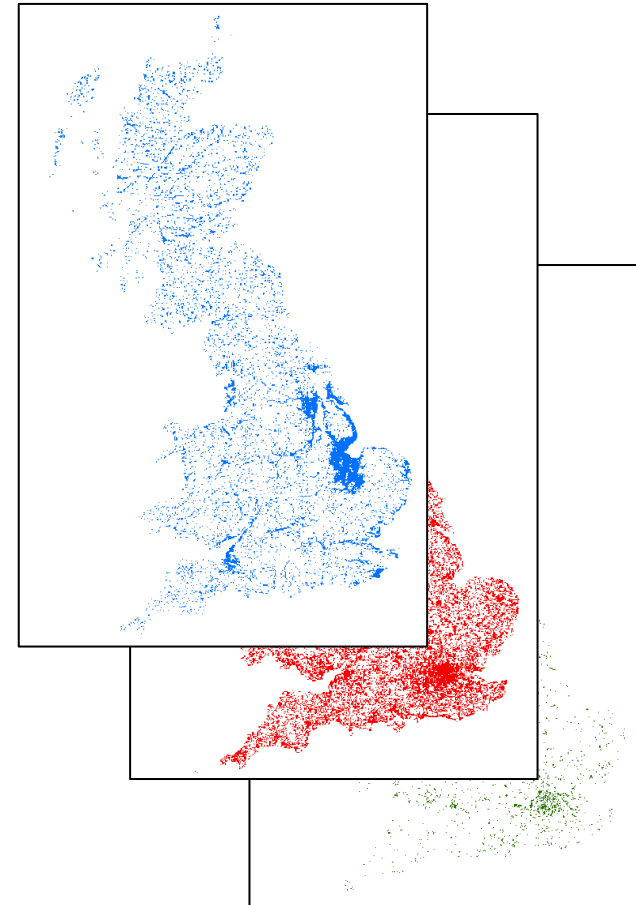
Urban Development



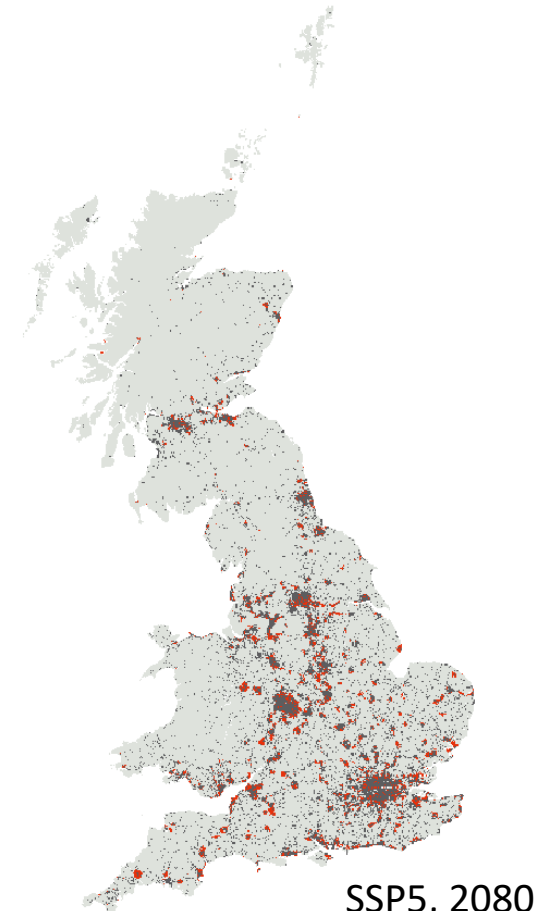
UK SSPs: future population grids



Spatial **attractors** define suitable urban development



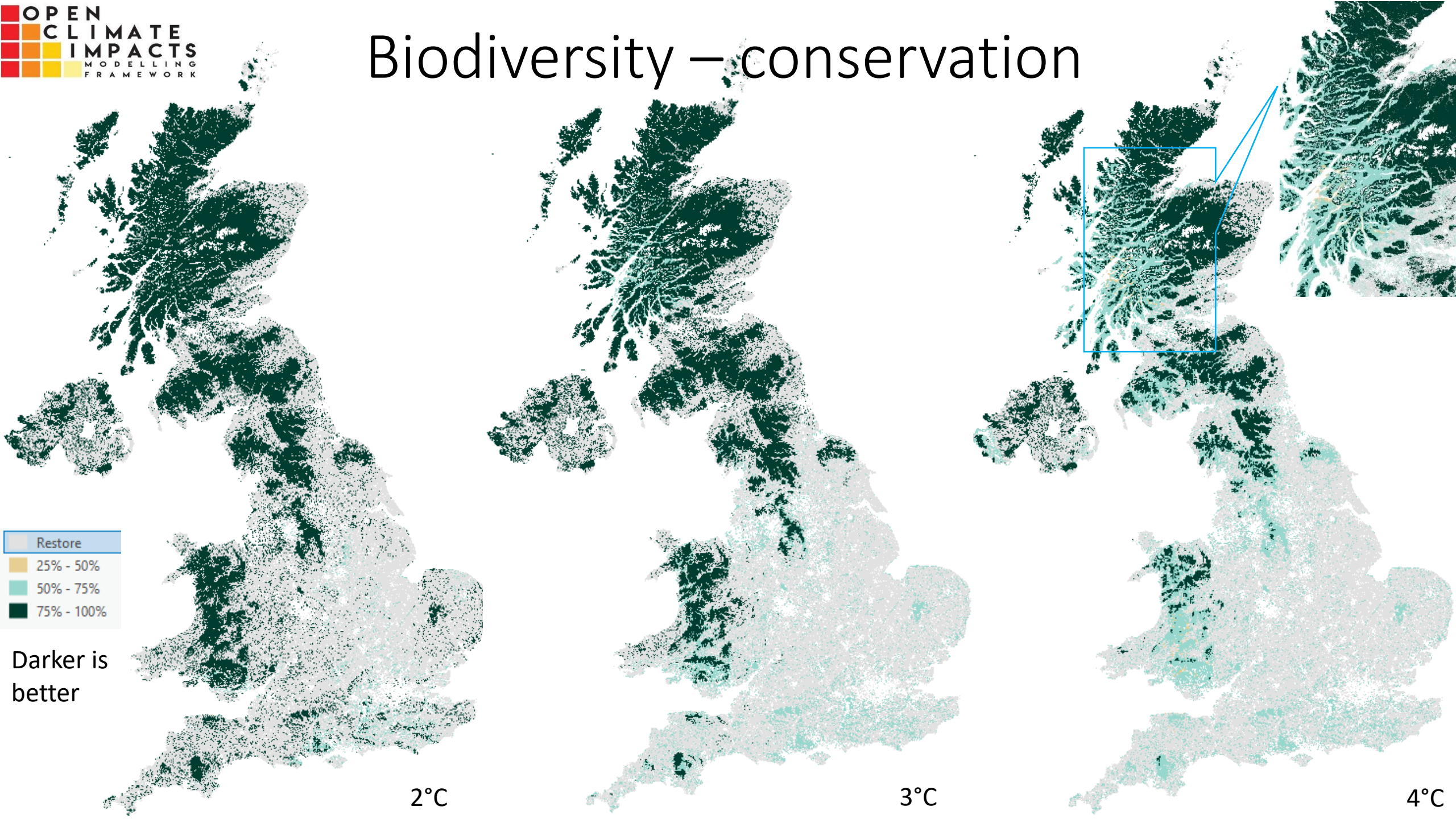
Spatial **constraints** preclude development



SSP5, 2080

New **urban development** simulated at 100m resolution for each SSP scenario

Biodiversity – conservation

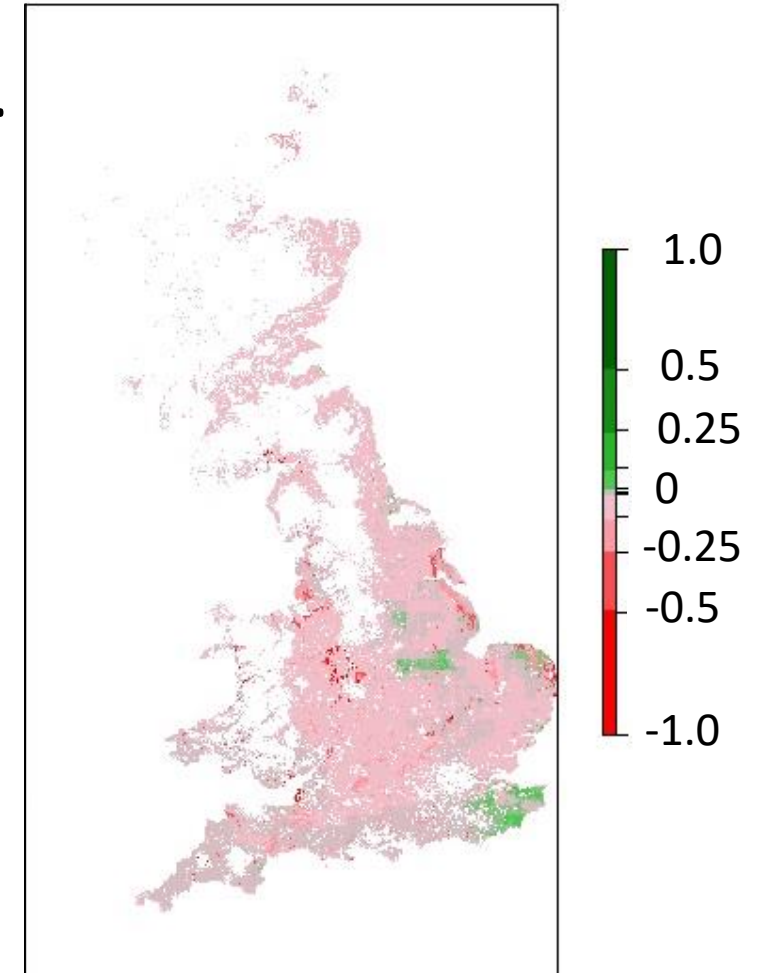


Agriculture

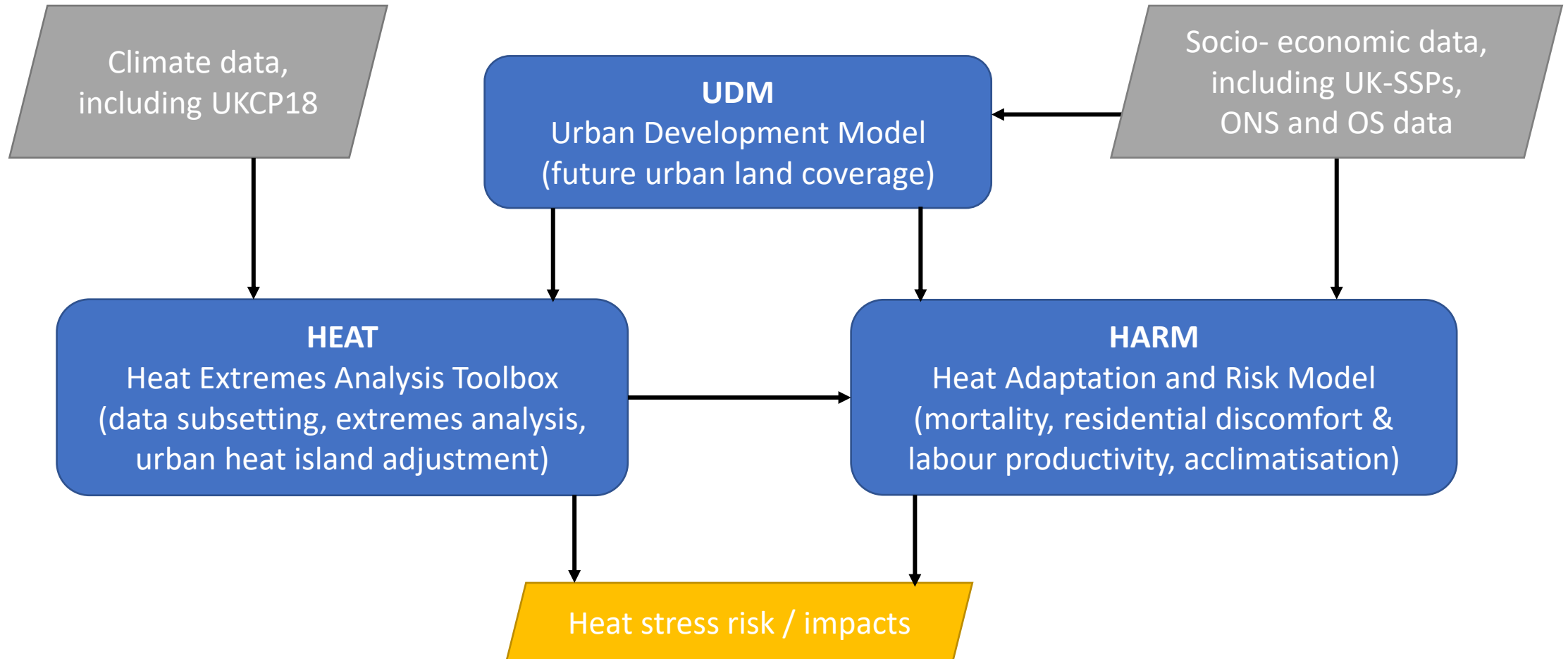
Crop diversity and yield increases or decreases with climate change for 4 degrees warming, depending on location and crop.

Crop name	Mean change (2070)	Range	
		(Min	& Max)
Maize	19.5	7.6	31.2
Sunflower	6.9	2.5	13.4
Potato	5.0	-3.2	12.5
Green Bean	3.8	-6.6	16.3
Chickpea	3.3	-1.2	8.5
Sugarbeet	2.7	-4.8	11.2
Wheat	2.2	-8.8	11.1
Cabbage	0.4	-9.1	12.5
Onion	-3.7	-12.6	3.1
Strawberry	-9.4	-20.1	-3.1

Normalised Diversity Change

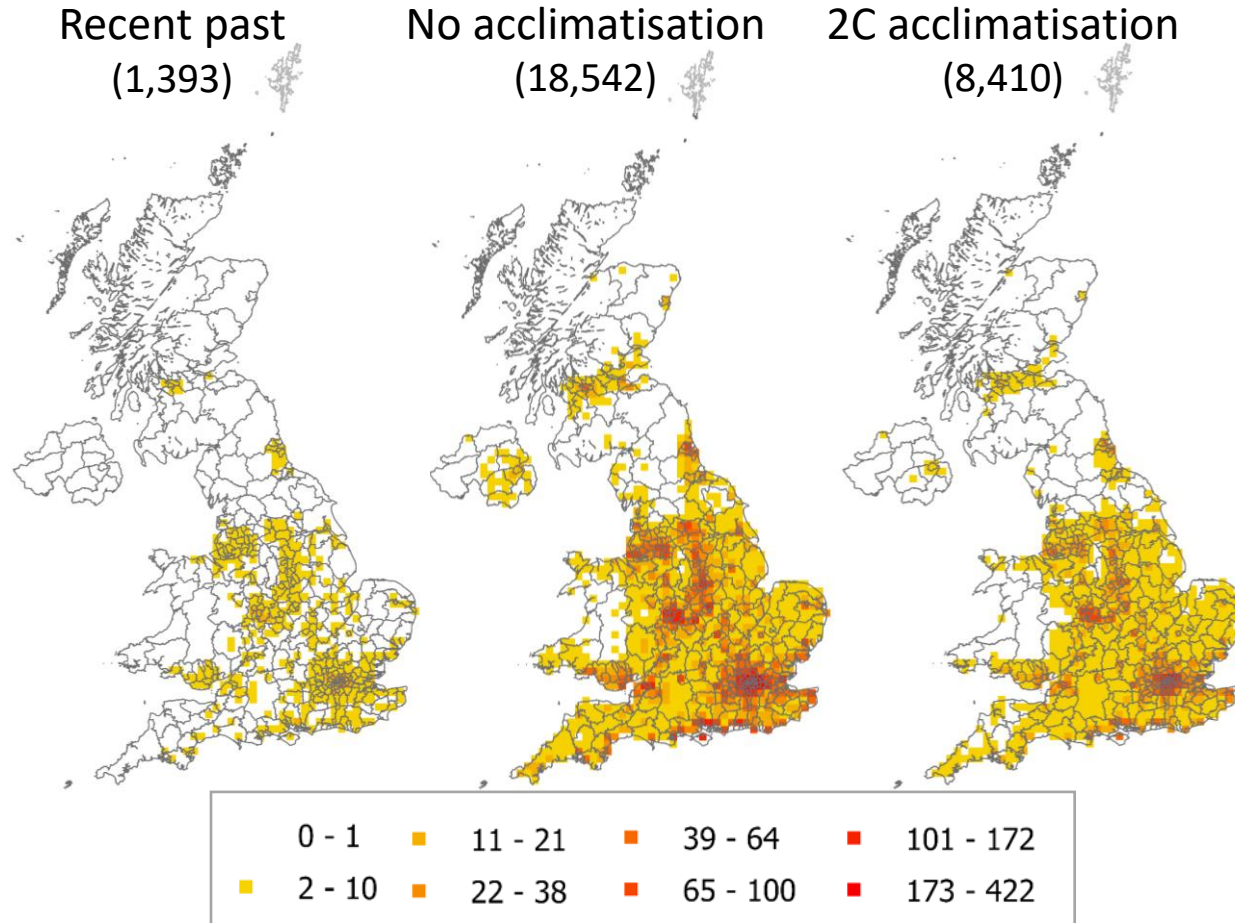


Heat workflow in OpenCLIM

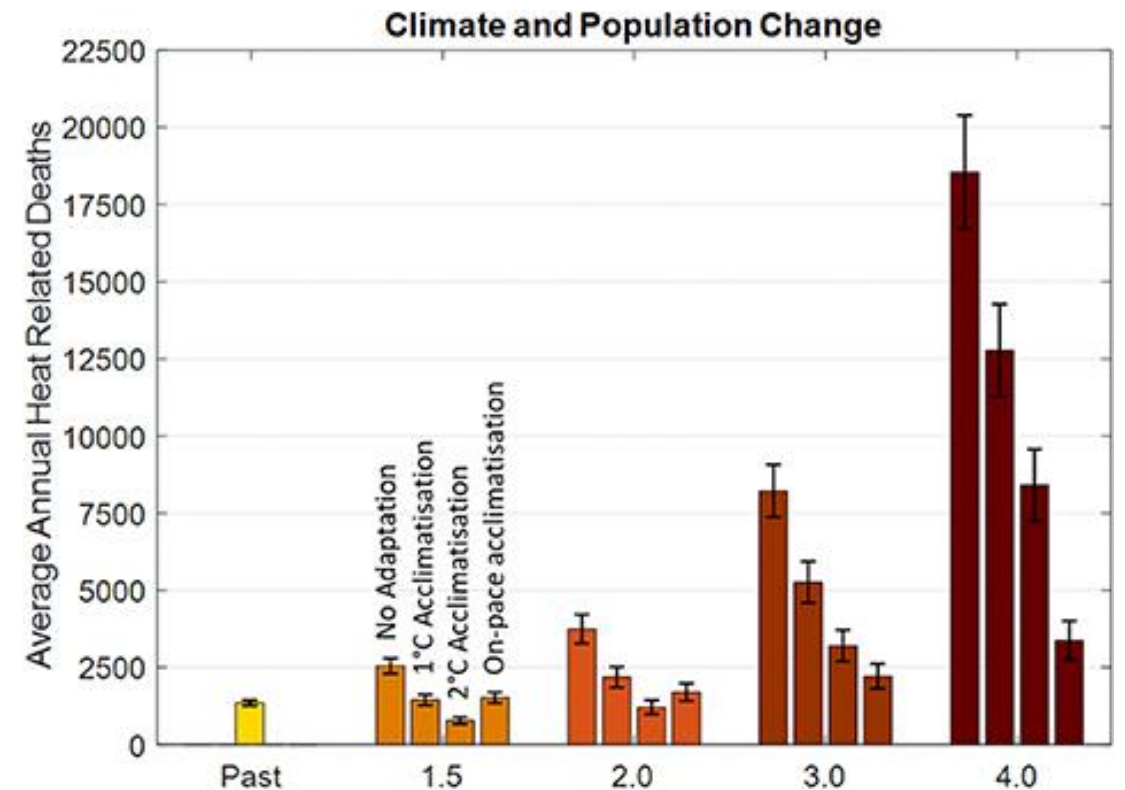


Example HEAT-HARM outputs

Average annual heat-related deaths



HEAT-HARM derived UK heat related mortality (UK-SSP5)

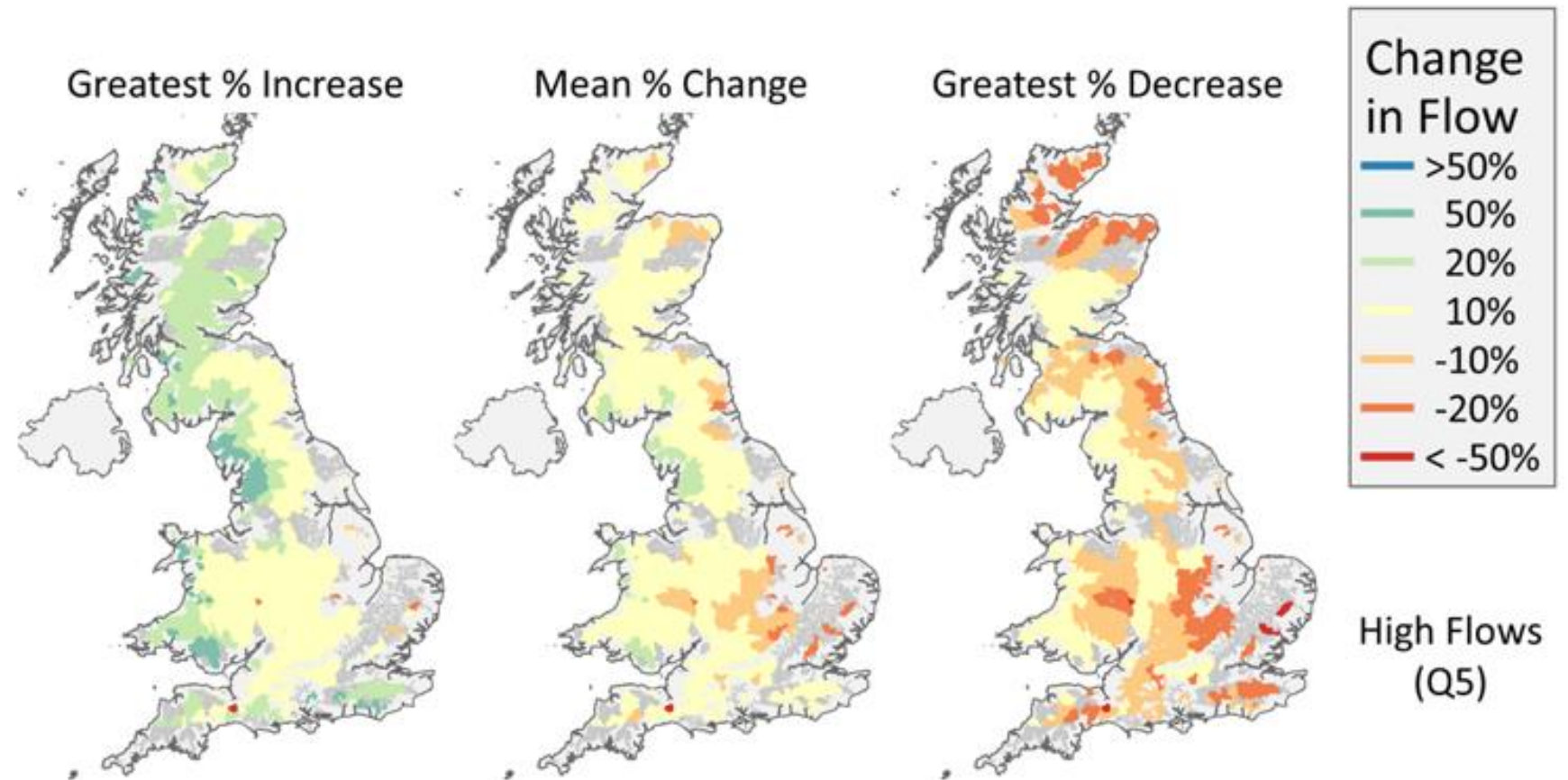


Jenkins et al., 2022

Catchment Flooding: future changes

SHETRAN Model

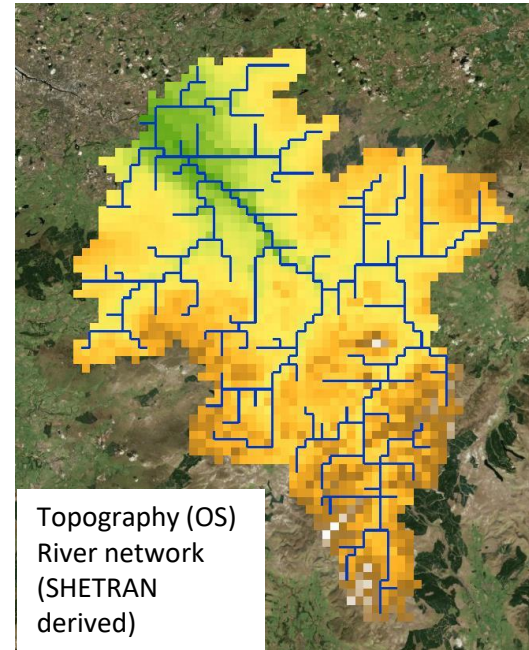
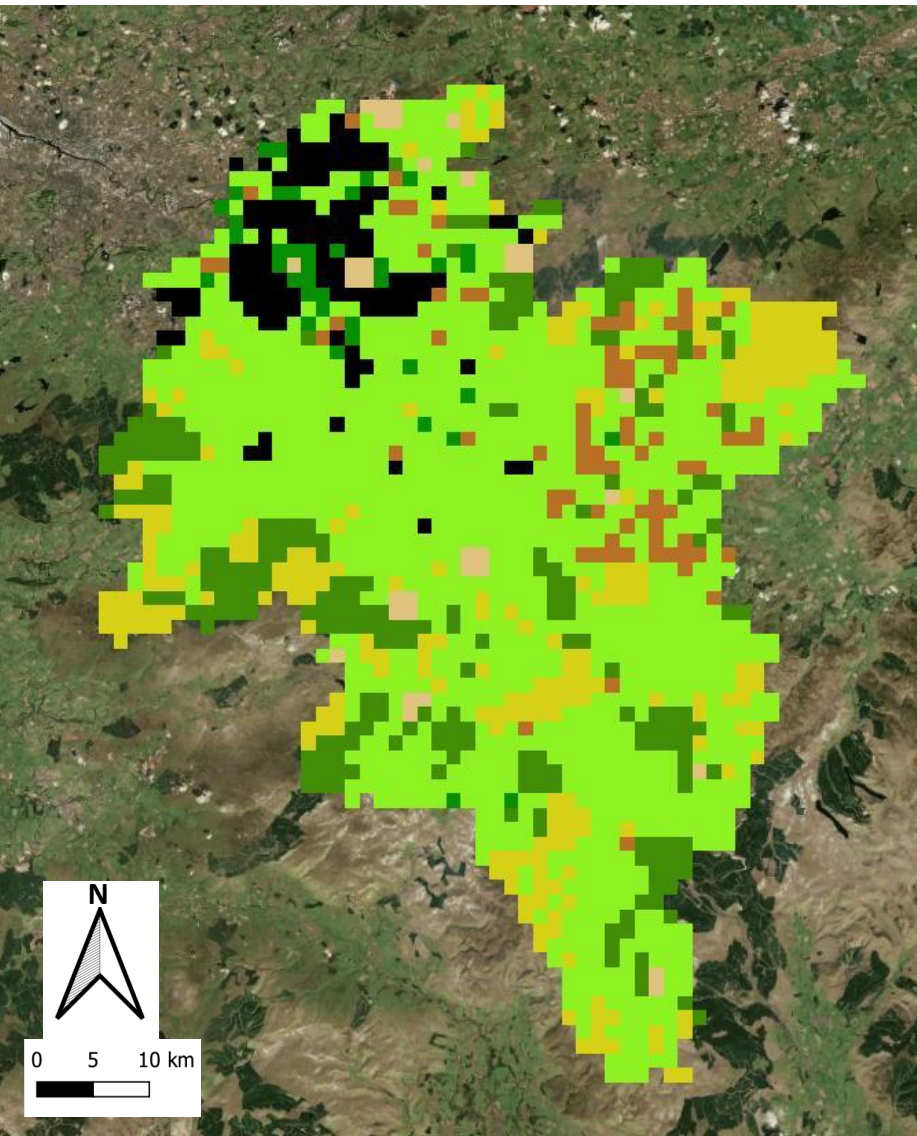
- Increases in western GB.
- Decreases in central/eastern GB.
- Some catchments in progress, including NI.



Changes to high flows (Q5) between future (2040-2070) and baseline 1980-2010

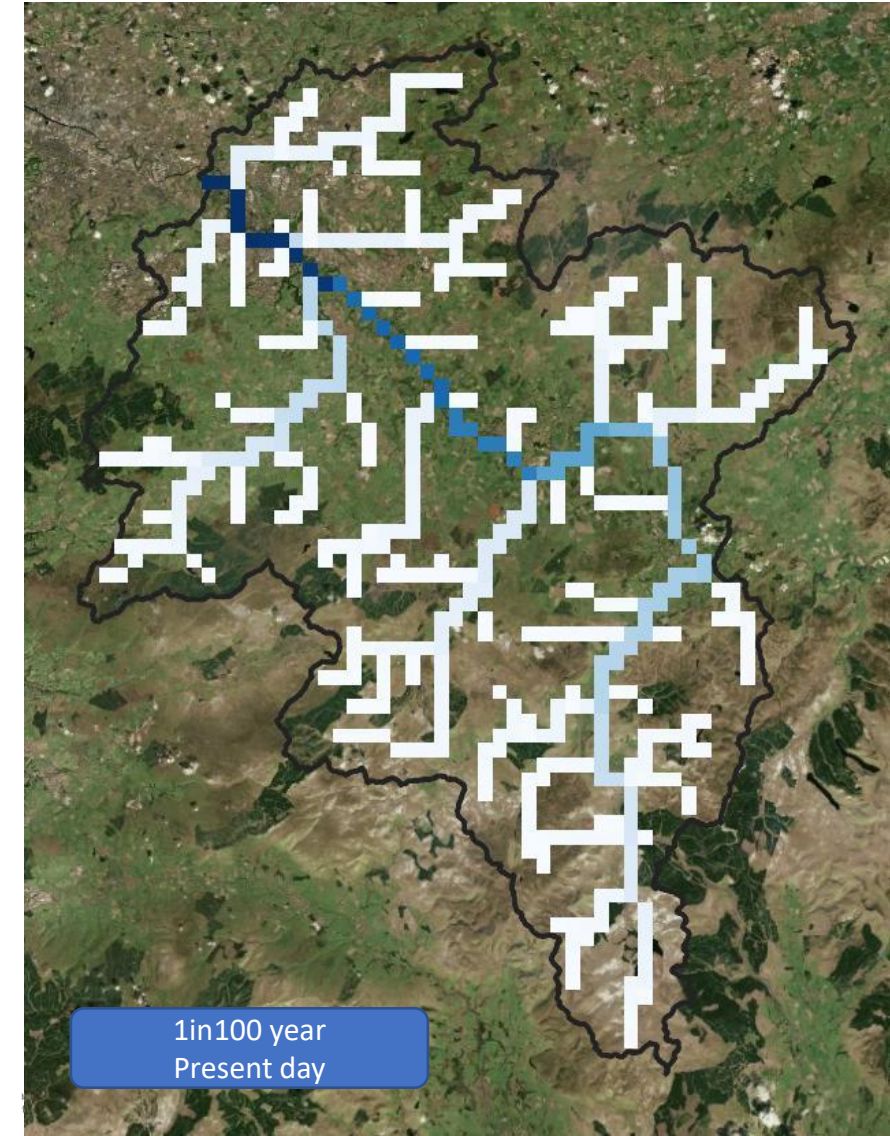
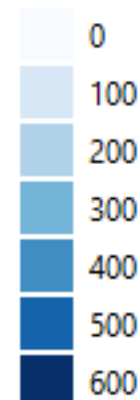
Natural Flood Management

Clyde Catchment: present baseline



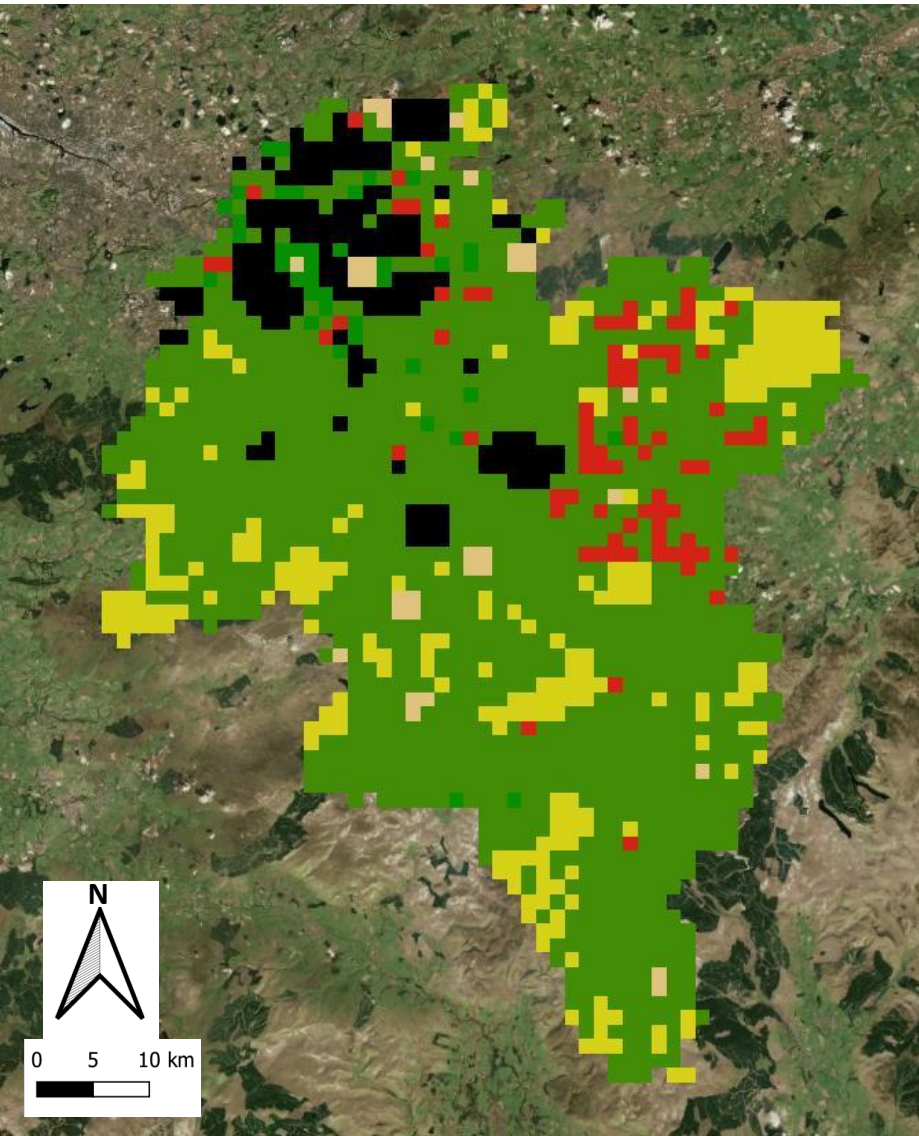
- Arable
- Bare Ground
- Grassland
- Deciduous Forest
- Evergreen Forest
- Shrub
- Urban
- Storage

Flow (m^3/s)



Natural Flood Management

Clyde Catchment: land use adaptation



Future scenarios (simple at present)

#1 - Grassland to Evergreen Forest (**NFM**)

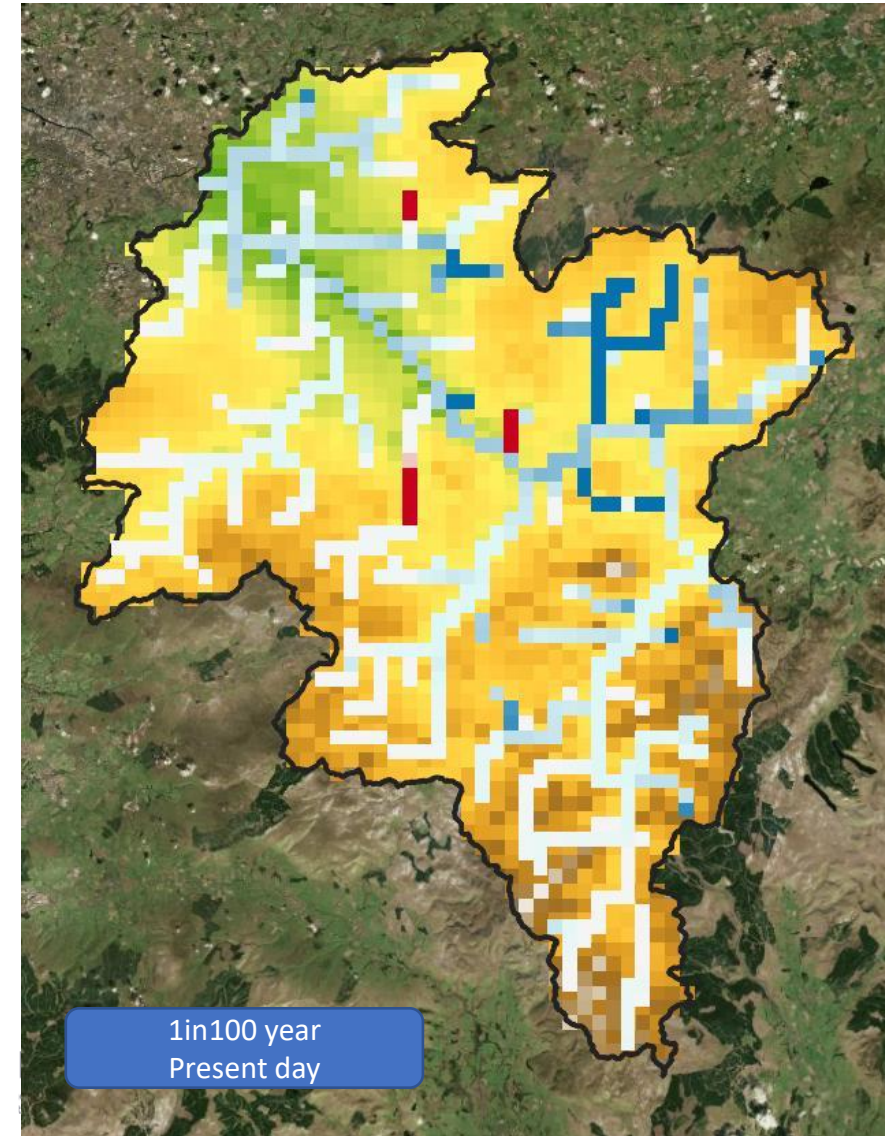
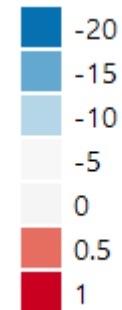
#2 - Grassland to Evergreen Forest and
Arable to surface storage (**NFM max**)

#3 – Urban development from UDM
(**more urban**)

#4 – All the above (**combined**)



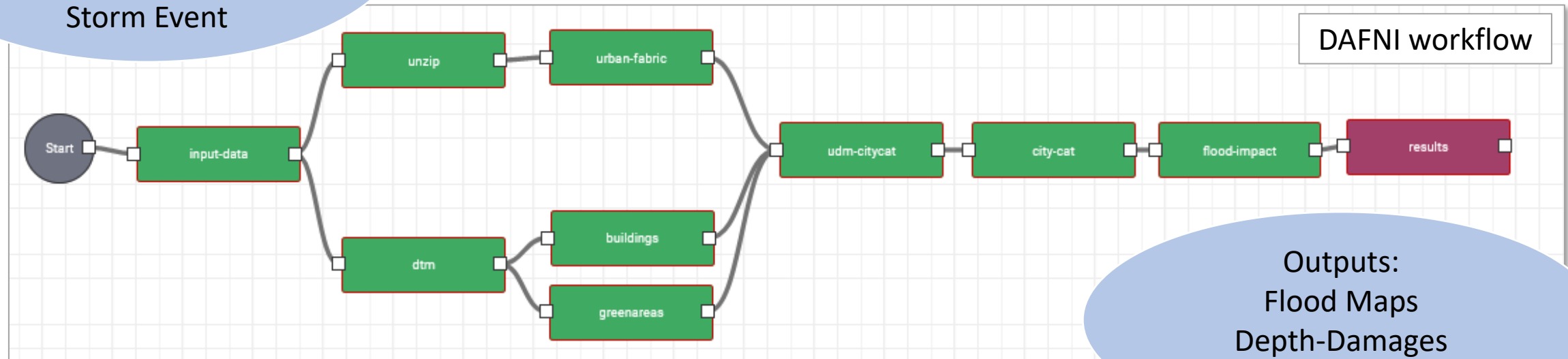
Change in flow (m^3/s)



Urban Flooding using CityCat

- Coupled models to analyse the impact of flooding events

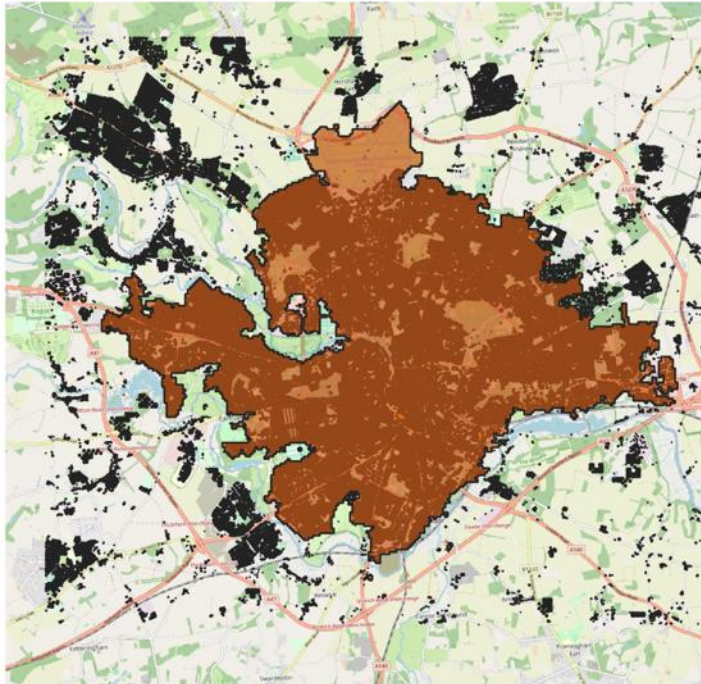
Inputs:
Socio-economic narrative
Year of Interest
City of interest
Storm Event



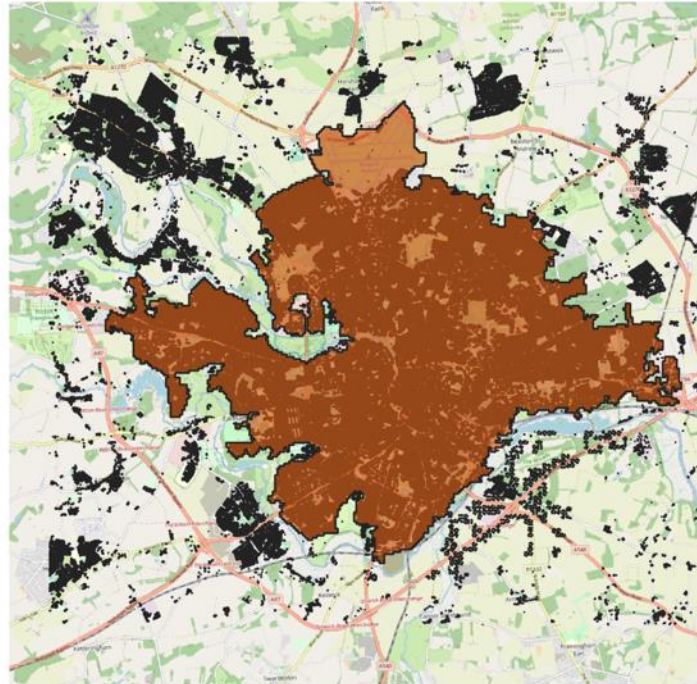
Outputs:
Flood Maps
Depth-Damages
Impacts

Urban Flooding using CityCat

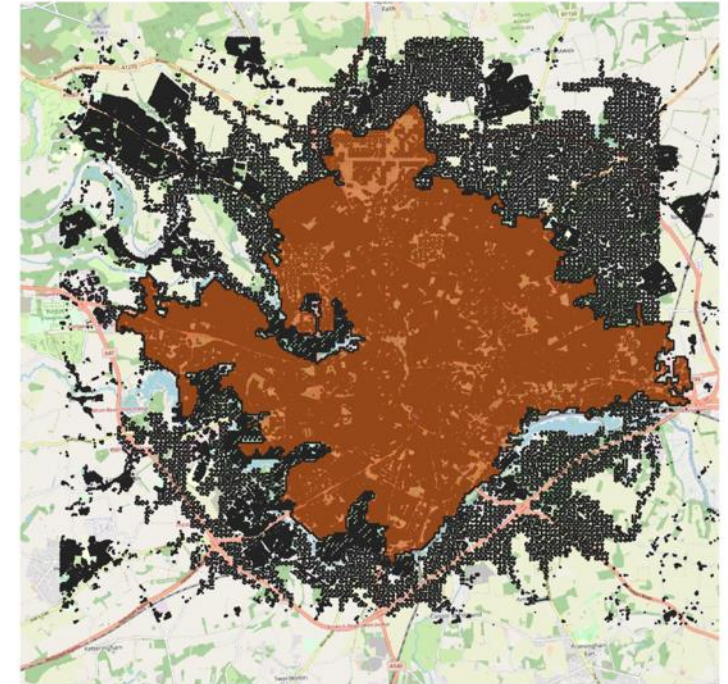
- City expansion based on population growth narratives
- Attractors and constraints when accommodating population growth



2080 - SSP2



2080 - SSP4

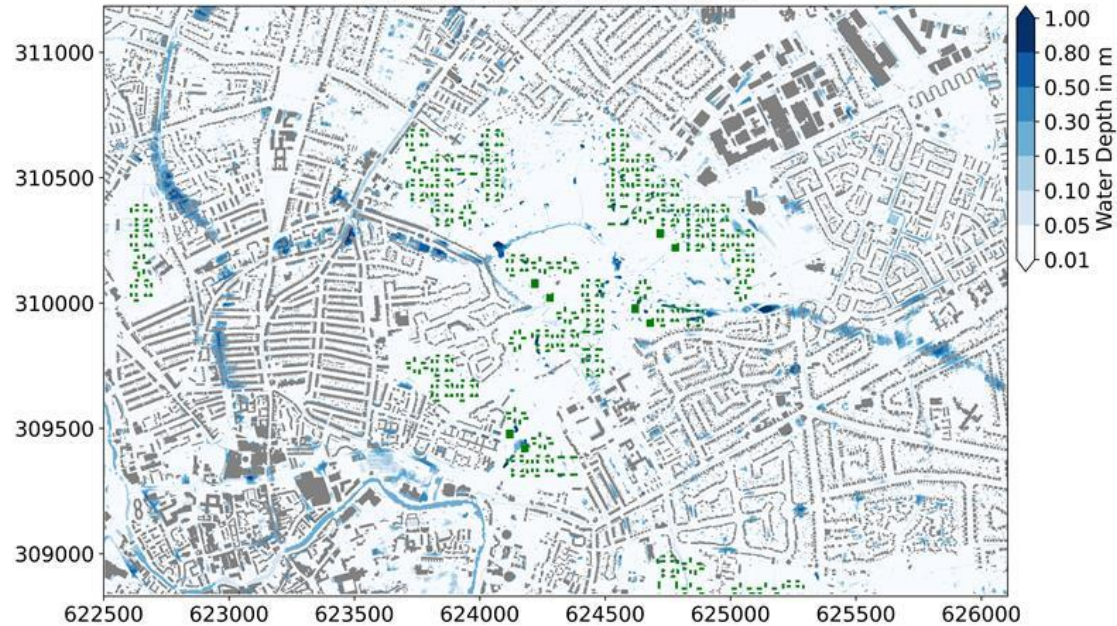


2080 - SSP5

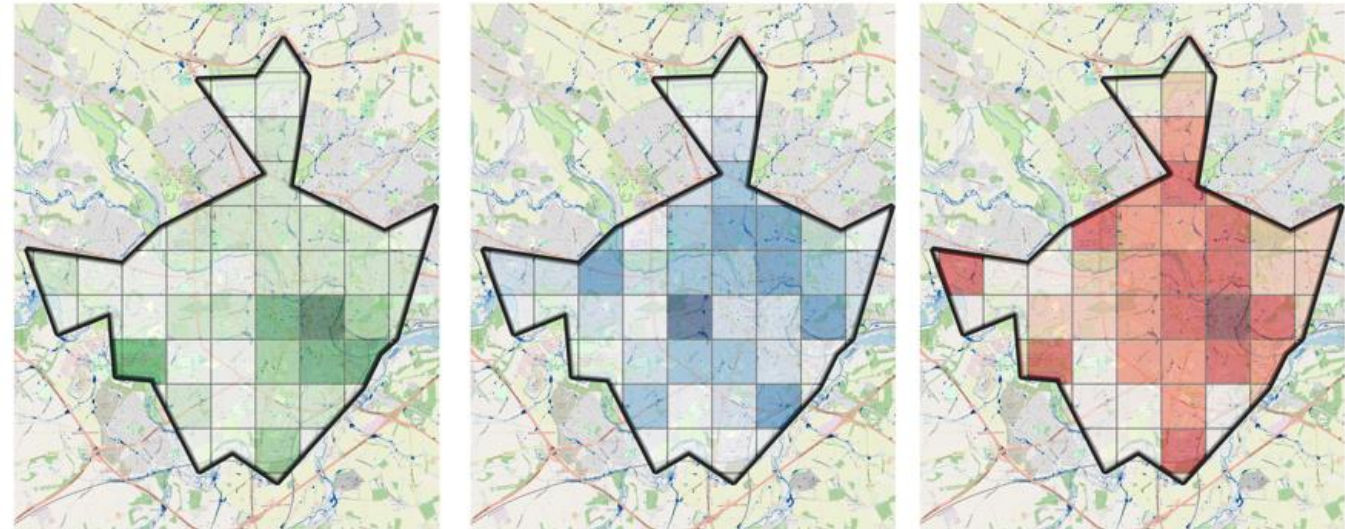
Urban Flooding using CityCat

- Coupled models to analyse the impact of flooding events

Norwich - 2080 - SSP4 - 40mm



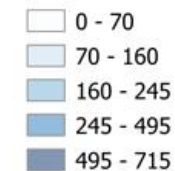
Results for Norwich Local Authority District, 1km grid



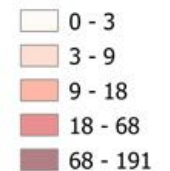
Total Damages (£)



Residential Building Count



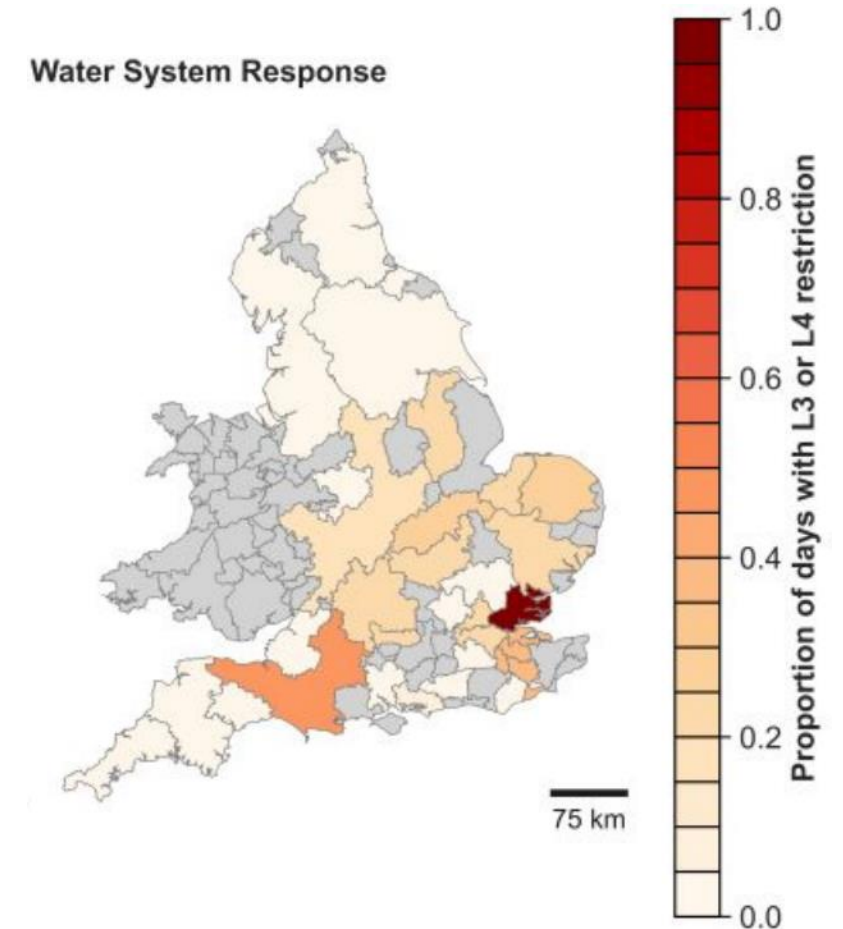
Non-Residential Count



Linking to New Models-- Water Supply

OpenCLIM and the EA

- The Water Resource for England and Wales (WREW) model (developed by Oxford University) sits on DAFNI.
- Integrating with OpenCLIM for a set of agreed scenarios using the latest model version.
- Assess demand and supply-side adaptation under different levels of environmental protection and climate change:
 - System behaviour
 - Human metrics
- Work with the EA to interpret results and produce a paper.
- Future collaboration will hopefully follow.



[Murgatroyd et al \(2022\) https://doi.org/10.1098/rsta.2021.0292](https://doi.org/10.1098/rsta.2021.0292)

Adaptation inventory

- Online database of UK adaptation on the ground
- Systematic review of
 - peer-reviewed journal articles
 - 2nd round adaptation power reports
- ~360 examples

Database:

nismod.ac.uk/openclim/adaptation_inventory

Journal paper: Jenkins et al. (2022)

<https://doi.org/10.1016/j.crm.2022.100430>

UK Adaptation (version 1)

About

Below is the UK Adaptation project. Use the options to filter the results.

A full user guide is available.

Filters

Sector:

All

Export CSV

Id	Hazard
1	Higher temperature
2	Higher temperature



Identifying adaptation 'on the ground': Development of a UK adaptation Inventory

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ARTICLE INFO

Keywords:
Adaptation
Climate Change
Systematic Review
Implementation
Stocktake

ABSTRACT

Adaptation plays a crucial role in managing the unavoidable risks from climate change. The UK is considered to be at the forefront of national adaptation planning. However, the extent to which plans and programmes translate into tangible risk reducing action on the ground, as opposed to adaptive capacity building, remains less clear. Given that there is no formal database of adaptation action for the UK, despite the various needs of government to identify, assess and report on adaptation progress, including the UK national stocktake on adaptation under the UNFCCC Paris Agreement, this study outlines the development of an up-to-date and forward-looking UK Adaptation Inventory. The Inventory documents adaptation on the ground, based on national reporting to government by public and private sector organisations and a systematic review of peer-reviewed literature. The framework is centred on identifying and documenting current and planned adaptation; how it is being implemented in terms of the types of adaptation actions; and the sectors where adaptation is occurring and where gaps may remain. For the sub-set of sectors captured there is clear evidence of a wide range of cross-sectoral and sector-specific adaptation being implemented. In total, 360 examples were identified, over 80% of which have already been implemented. This comprises 134 different types of adaptation action, largely aimed at reducing vulnerability using engineered, built environment or technological mechanisms. Compared to the situation a decade earlier, this suggests that significant progress has occurred in the UK in terms of reporting and implementing adaptation, including adaptation by the private sector in climate sensitive sectors. At the broader level, the Inventory is a first step in providing a baseline assessment for the UK stocktake on adaptation; can help inform other organisations about adaptation options that are available; and provide case studies of actions in practice to help support decision-making.

1. Introduction

The Intergovernmental Panel on Climate Change (IPCC, 2018; 2014) estimate that human activities have already caused approximately 1 °C of global warming above pre-industrial levels. It is not only the human influence on the climate system that is clear, but also evidence of widespread impacts on human and natural systems, which will increase in severity in a warmer world (IPCC, 2018; 2014). The global community is demonstrating significant cooperation in terms of mitigation under the UNFCCC Paris Agreement,

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<https://doi.org/10.1016/j.crm.2022.100430>

Received 13 August 2021; Received in revised form 28 March 2022; Accepted 31 March 2022

Available online 4 April 2022

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Outputs

Modelling workflow	Resolution	Coverage	Warming scenario	Socioeconomic scenario [§]	Time-step*
Urban development	100m	GB	N/A	SSP1-5	2035, 2050, 2055, 2065, 2080, 2085, 2100
Agriculture	1km	UK	2C and 4C	N/A	2050 & 2080
Biodiversity	20m	UK	1.5, 2, 3, 4C	N/A	2050 & 2080
Heat	12km	UK	1.5, 2, 3, 4C	SSP2, SSP4 & SSP5	2050 & 2080
Water supply	Water resource zone	England & Wales	2C and 4C	ONS high pop	2050 & 2080
River flooding	Catchments, 1km	UK	2C and 4C	SSP2 & SSP4	2050 & 2080
Urban rainfall flooding	2m	GB cities	Flood event-based	SSP2 & SSP4	2050 & 2080
Natural flood management	Catchments, 1km	UK	2C and 4C	SSP2 & SSP4	2035, 2050, 2055, 2065, 2080, 2085, 2100

[§] UKSSPs projected for GB only due to data access restriction in NI for UDM workflow.

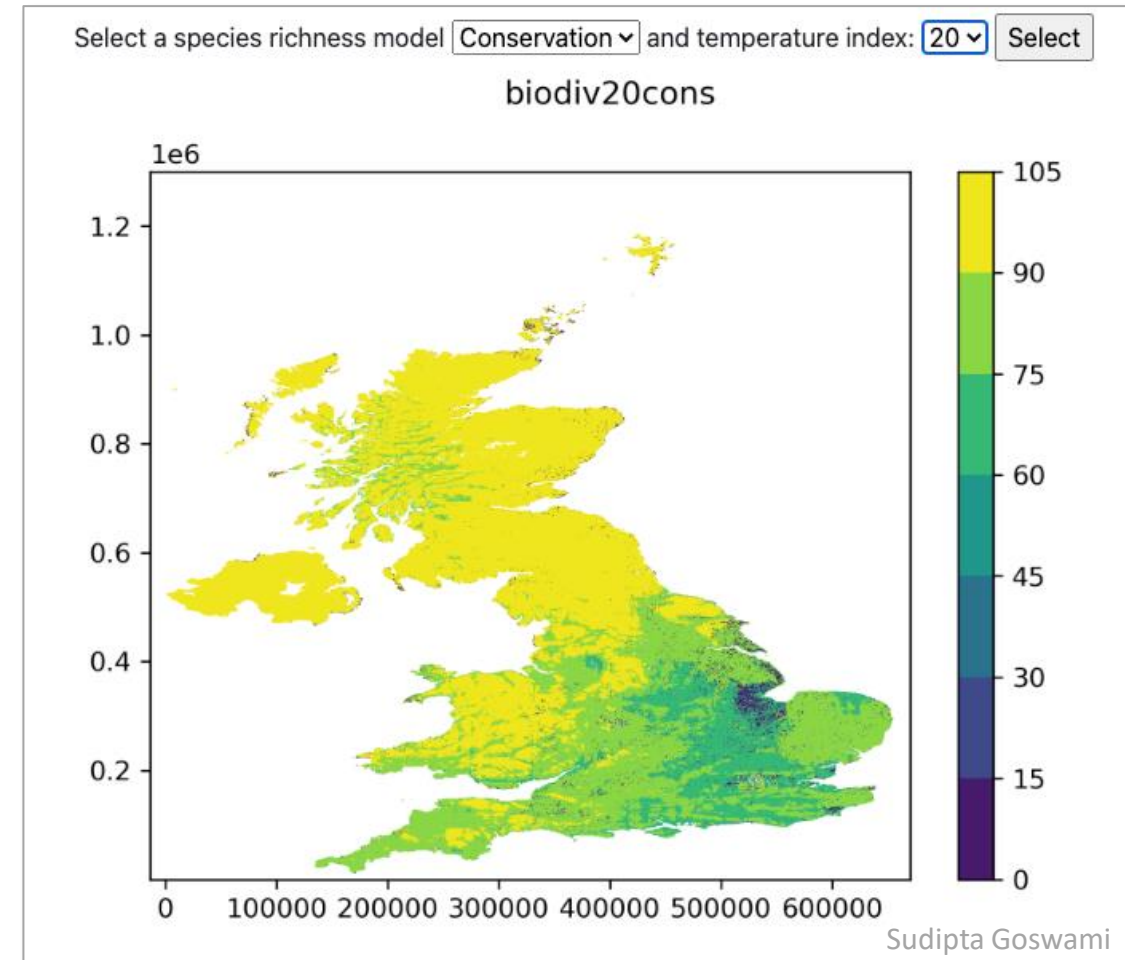
* Time step can be a single year or 30 year average, depending on model or input data.

Next steps

- Compile the results database.
- Engage stakeholders at London showcase and regionally.
- Train end-users to access results and workflows.
- Publish reports and papers
- Data visualisation front-end
- Further develop DAFNI capability

Project ends August 2023

Web-based data visualisation (*work in progress*)



OpenCLIM London Showcase

- Wednesday 29 March
- Central London
- Up to 125 attendees – places available



High-level agenda (11am – 5pm)

Session 1: Key results & big picture

Session 2: World Café: deep-dive, parallel discussions

Session 3: Interactive climate resilience performance: [Who you gonna call? \(in event of emergency\)](#)



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