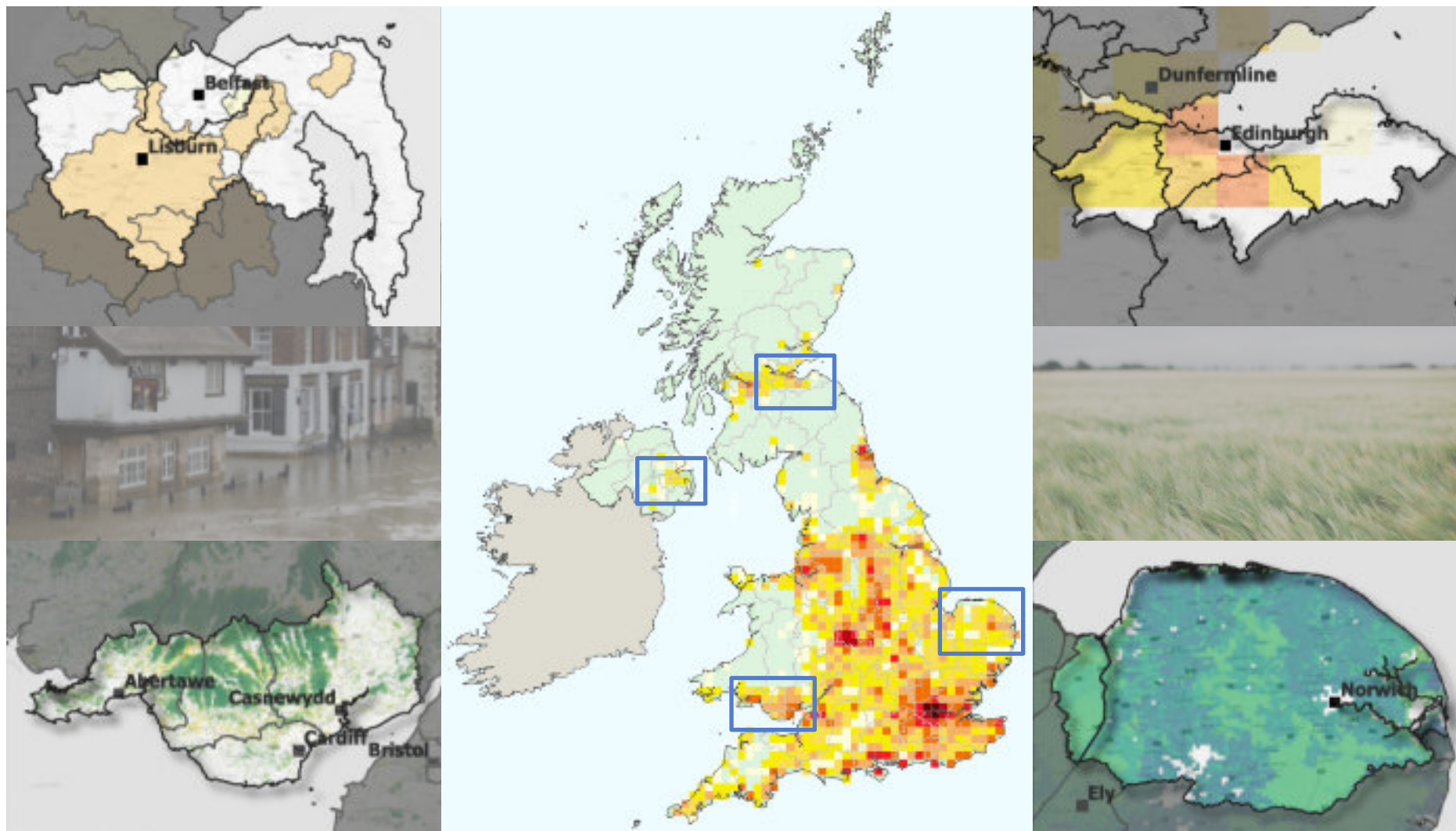


OpenCLIM Local Climate Risk Reports

Local insights from national analysis



Background

For further information visit openclim.science where you will find an outline of the OpenCLIM project, links to local climate risk reports for other counties, and a **user-guide** outlining the risk metrics shown and what they mean.

Agriculture

- Oil seed rape potential yield (units = tonnes per hectare, t/ha)
- Grass potential yield (t/ha)
- Wheat potential yield (t/ha)

These metrics indicate areas where a crop is likely to increase/decrease in yield due to climate-forced changes in temperature and water availability. 1 km grids.

Biodiversity

- Conservation potential (relative units)
- Restoration potential (relative units)
- Urban green space potential (relative units)

These metrics indicate the relative biodiversity impact in a location based on the richness of species remaining. 100 m grids (resampled from 20 m original analysis).

Heat Stress

- Heat-related mortality (units = mean deaths, cumulative deaths)

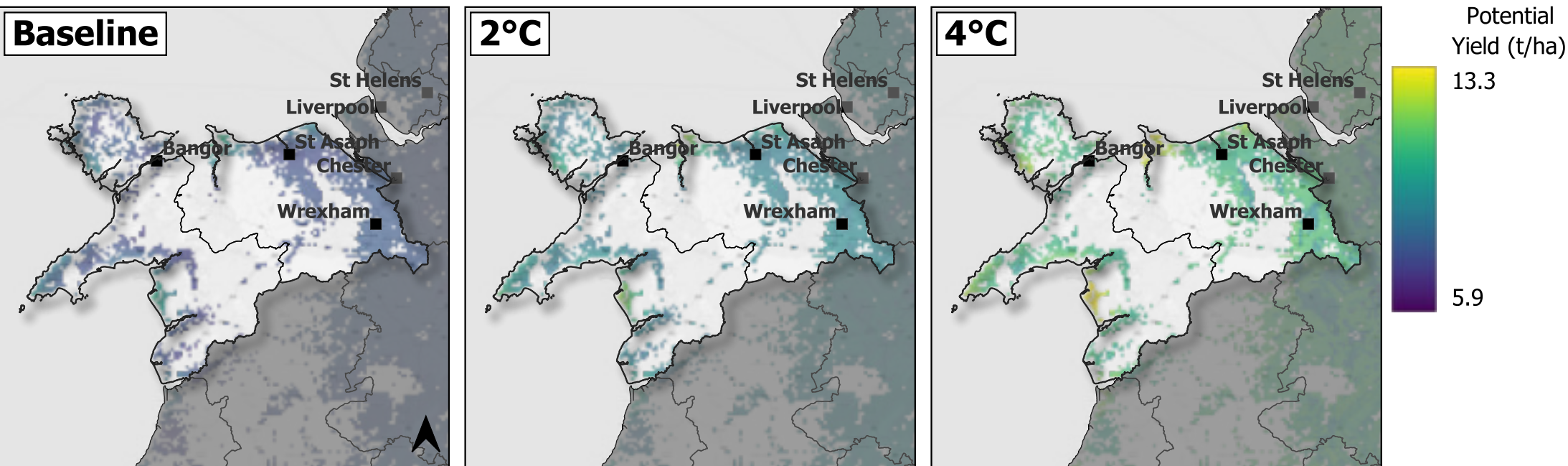
This metric projects the total number of heat-related deaths that could occur in a warmer future. 12 km grid (inherited from UKCP18 regional climate model).

Hydrology

- Drought duration (units = cumulative months per 30 year period)
- 1-in-10-year return period flow (units = flow rate in metres cubed per second, m³/s; difference, %)
- 1-in-100-year return period flow (units = flow rate, m³/s; difference, %)

These river flow-rate metrics are shown as a proxy for drought or flooding and should be used alongside e.g. Environment Agency flood indicators. Tidally-influenced and coastal catchments were not modelled. 1km grids for whole catchments.

North Wales | Potential Yield | Oil Seed Rape



Key Points

Potential yield (tonnes per hectare) shows change in potential oil seed rape yield at 1km resolution, due to heat limitation and water limitation under baseline, 2°C, and 4°C warming scenarios.

Scenarios shown include the CO₂ fertilisation effect (enhanced plant productivity).

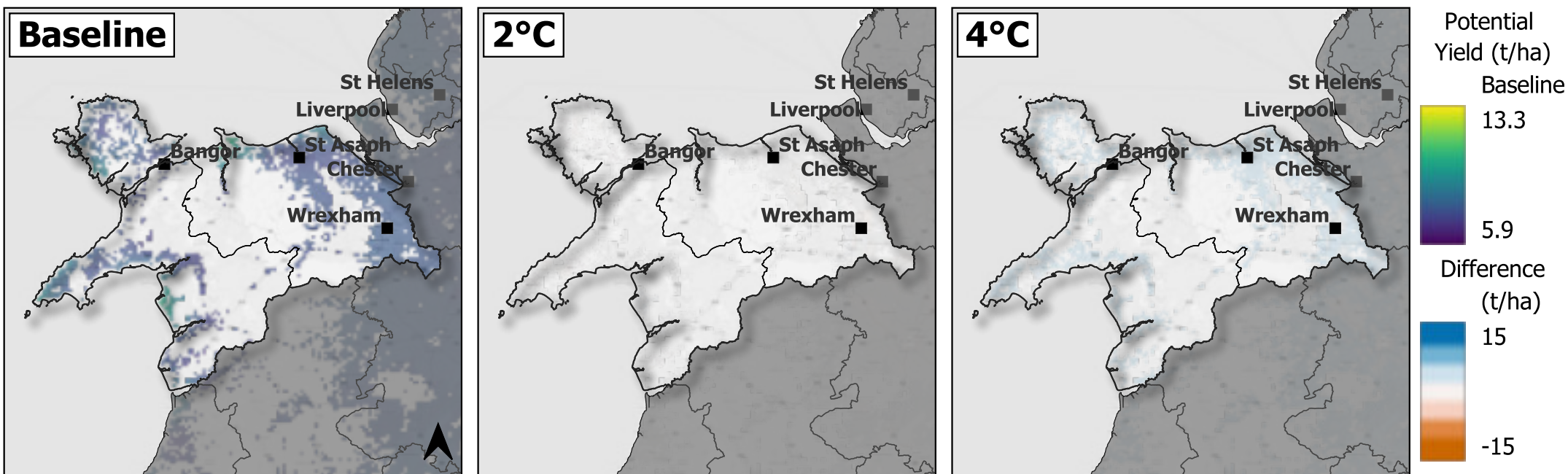
A modest increase in potential yield is projected at 2°C and 4°C for most of the North Wales area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the North Wales region at baseline, 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	8	9.3	11	6.8	7.9	7.6	10.7	12.2	11.7
Clwyd	7.9	9.2	10.8	7	8.3	7.9	10.9	12.4	12

North Wales | Potential Yield - difference | Oil Seed Rape



Key Points

Potential yield (tonnes per hectare) shows change in potential oil seed rape yield at 1km resolution, due to heat limitation and water limitation under baseline scenarios with the difference from baseline at 2°C and 4°C warming level scenarios.

Scenarios shown include the CO₂ fertilisation effect (enhanced plant productivity).

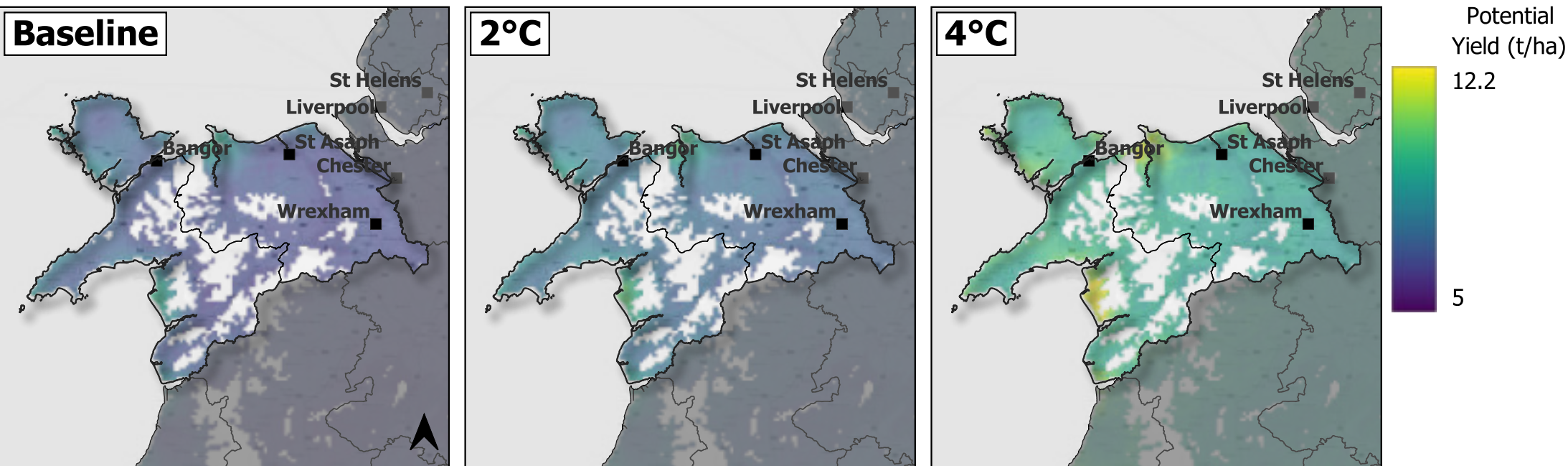
A modest increase in potential yield is projected at 2°C and 4°C for most of the North Wales area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the North Wales region at baseline, 2°C and 4°C warming scenarios, with the difference from the baseline mean for 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum			Difference	
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C	2°C	4°C
Gwynedd	8	9.3	11	6.8	7.9	7.6	10.7	12.2	11.7	1.4	3.1
Clwyd	7.9	9.2	10.8	7	8.3	7.9	10.9	12.4	12	1.4	3

North Wales | Potential Yield | Grass



Key Points

Potential yield (tonnes per hectare) shows change in potential grass yield at 1km resolution, due to heat limitation and water limitation under baseline, 2°C, and 4°C warming scenarios.

Scenarios shown include the CO₂ fertilisation effect (enhanced plant productivity).

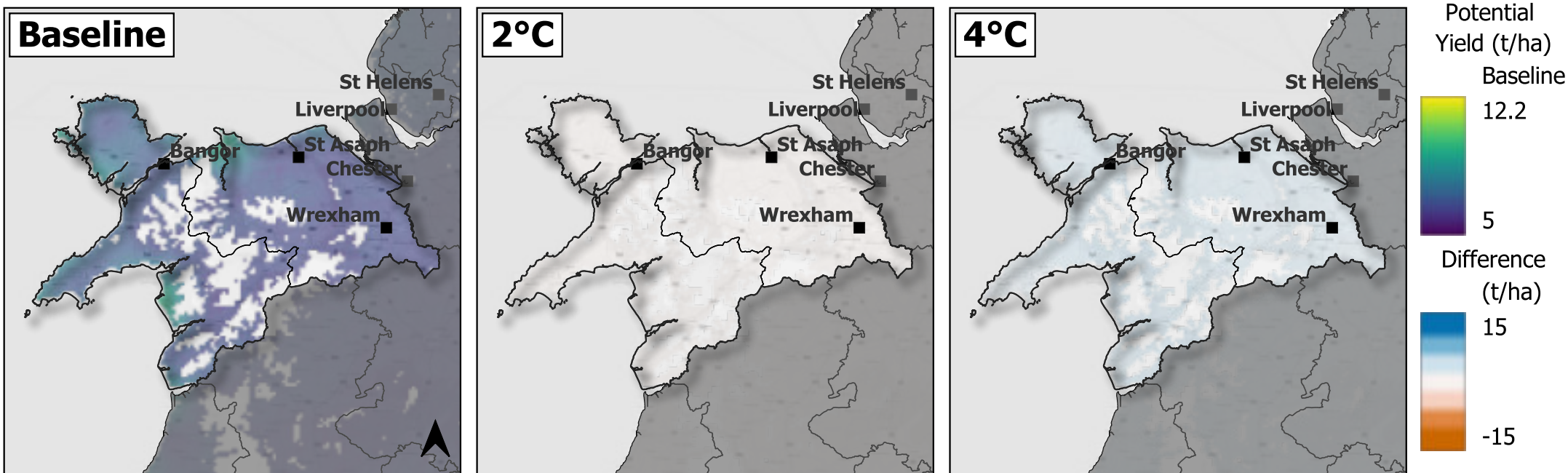
A modest increase in potential yield is projected at 2°C and 4°C for most of the North Wales area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the North Wales region at baseline, 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	7	7.8	9.6	5.9	6.5	8.4	9.8	10.4	12.5
Clwyd	6.7	7.3	9.2	5.9	6.3	8.1	9.9	10.6	12.4

North Wales | Potential Yield - difference | Grass



Key Points

Potential yield (tonnes per hectare) shows change in potential grass yield at 1km resolution, due to heat limitation and water limitation under baseline scenarios with the difference from baseline at 2°C and 4°C warming level scenarios.

Scenarios shown include the CO₂ fertilisation effect (enhanced plant productivity).

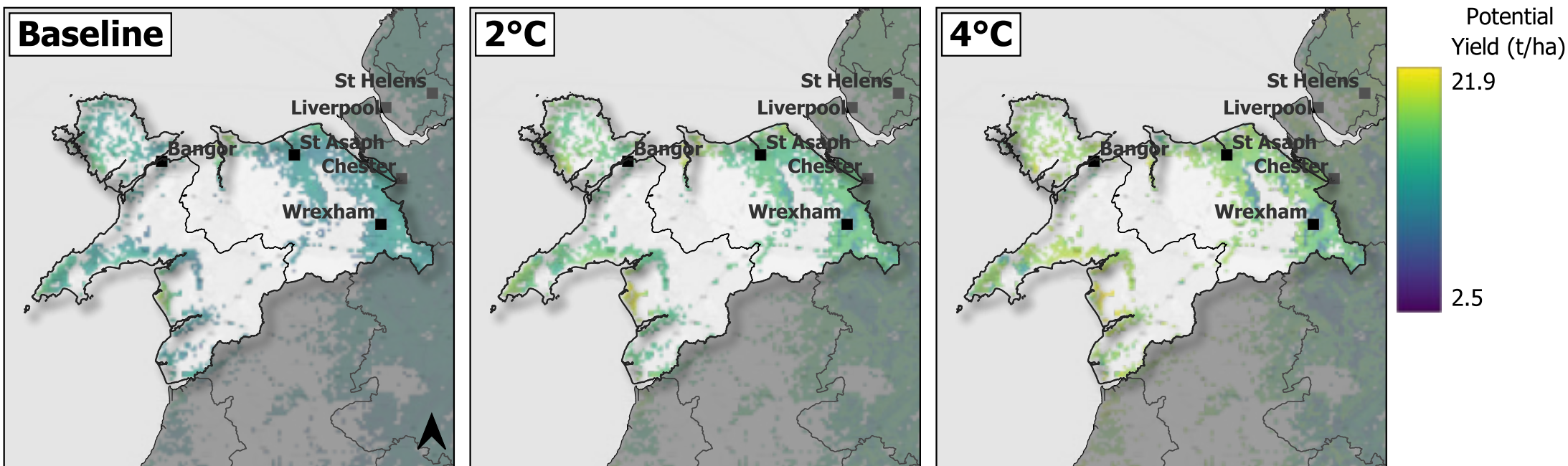
A modest increase in potential yield is projected at 2°C and 4°C for most of the North Wales area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the North Wales region at baseline, 2°C and 4°C warming scenarios, with the difference from the baseline mean for 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum			Difference	
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C	2°C	4°C
Gwynedd	7	7.8	9.6	5.9	6.5	8.4	9.8	10.4	12.5	0.7	2.6
Clwyd	6.7	7.3	9.2	5.9	6.3	8.1	9.9	10.6	12.4	0.6	2.5

North Wales | Potential Yield | Wheat



Key Points

Potential yield (tonnes per hectare) shows change in potential wheat yield at 1km resolution, due to heat limitation and water limitation under baseline, 2°C, and 4°C warming scenarios.

Scenarios shown include the CO₂ fertilisation effect (enhanced plant productivity).

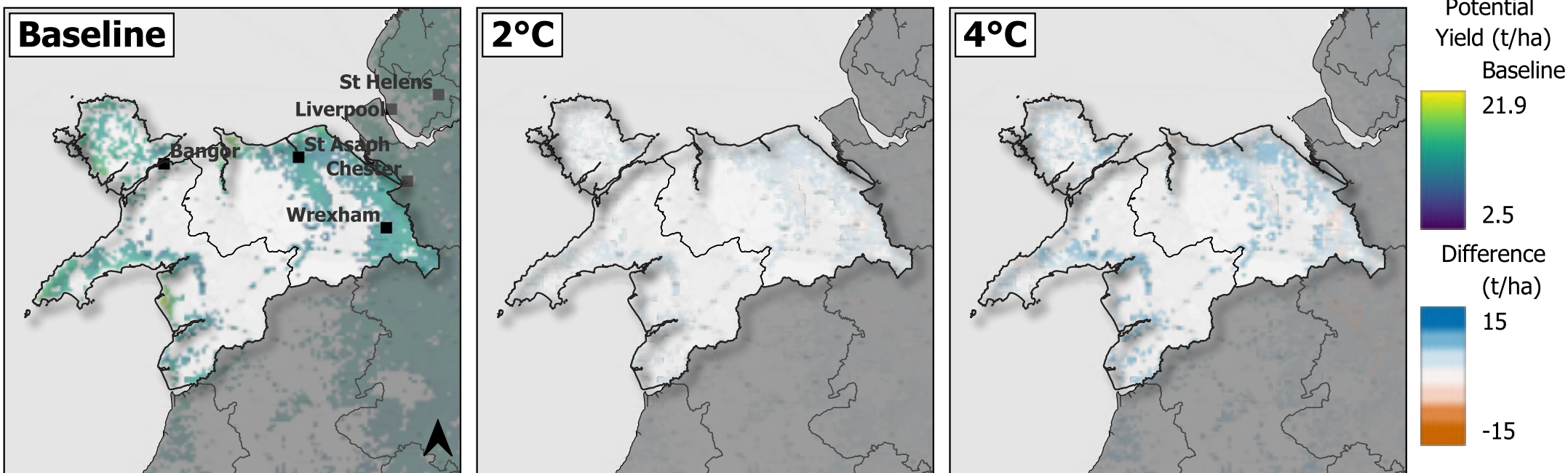
There is a slight increase in potential yield projected at 2°C and 4°C for most of the North Wales area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the North Wales region at baseline, 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	15.7	16.7	18.5	5.4	10.4	10.7	19.5	22	23.1
Clwyd	14.7	15.6	16.5	7.3	9.2	8.7	19.3	20.8	21.1

North Wales | Potential Yield - difference | Wheat



Key Points

Potential yield (tonnes per hectare) shows change in potential wheat yield at 1km resolution, due to heat limitation and water limitation under baseline scenarios with the difference from baseline at 2°C and 4°C warming level scenarios.

Scenarios shown include the CO₂ fertilisation effect (enhanced plant productivity).

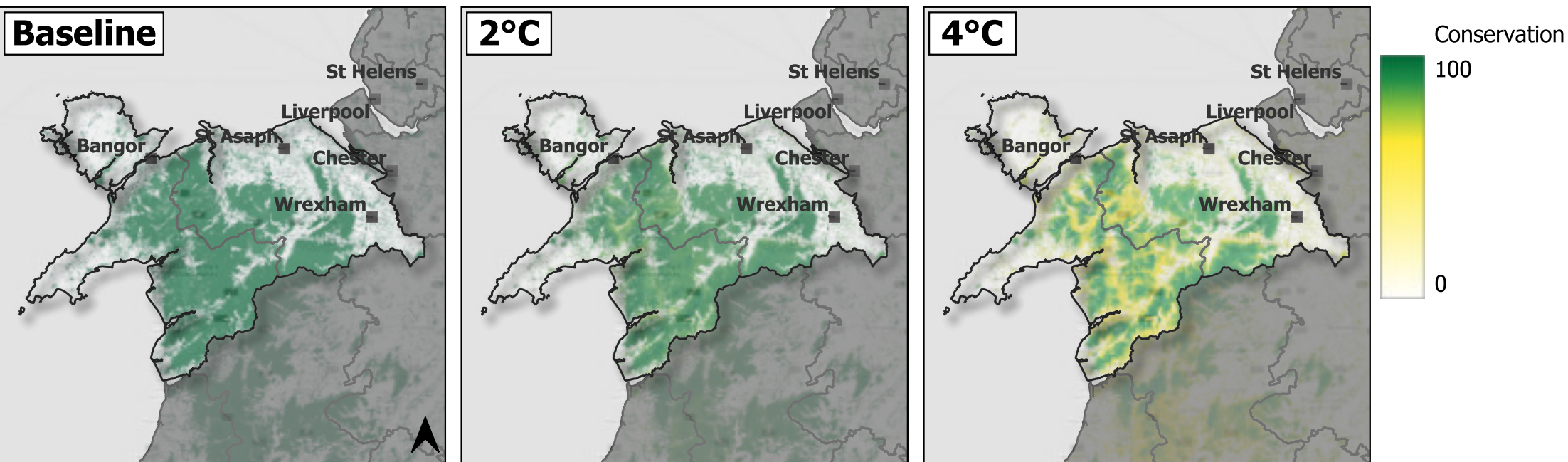
There is slight increase in potential yield projected at 2°C and 4°C for most of the North Wales area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the North Wales region at baseline, 2°C and 4°C warming scenarios, with the difference from the baseline mean for 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum			Difference	
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C	2°C	4°C
Gwynedd	15.7	16.7	18.5	5.4	10.4	10.7	19.5	22	23.1	0.9	2.8
Clwyd	14.7	15.6	16.5	7.3	9.2	8.7	19.3	20.8	21.1	0.9	1.8

North Wales | Conservation | Warming Levels



Key Points

A relative scoring is shown for an area's suitability for Conservation, based on a metric of species richness remaining.

Under 2°C and 4°C warming scenarios, a decline in suitability is projected, with mean values shown in the Table (right).

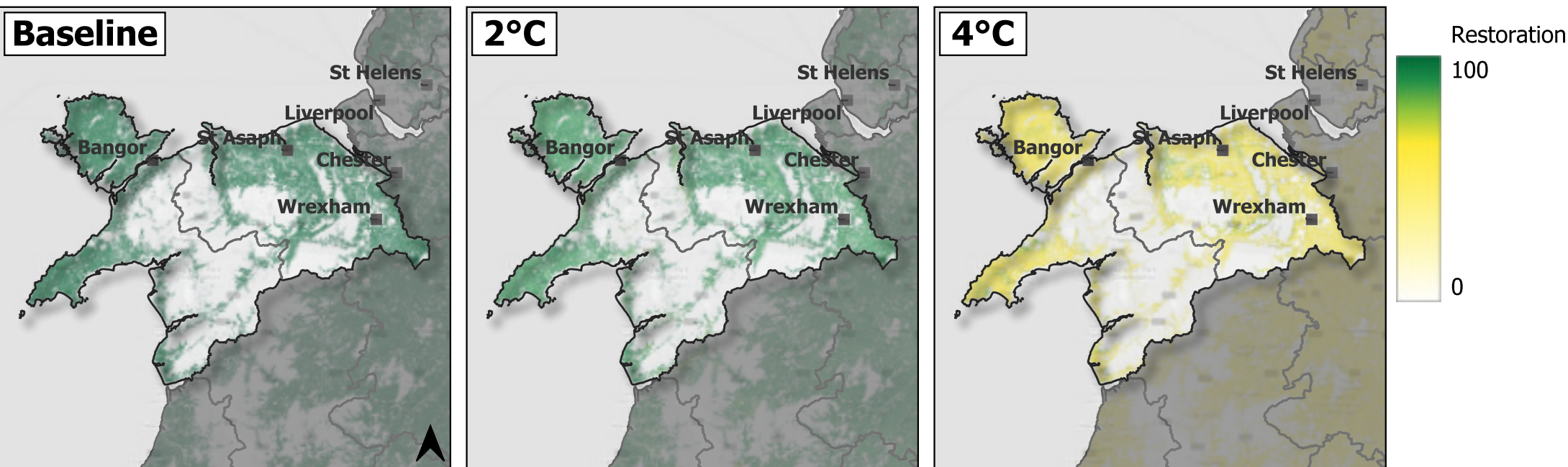
Under 4°C of warming, only one area is projected to retain a maximum suitability of 100 (range = 60 to 100), while the mean rarely exceeds 50, showing the importance of limiting warming to 2°C or less.

Local Summary

Minimum, mean and maximum conservation potential (%) for North Wales at baseline, 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	59.5	55.7	43.2	0	0	0	100	100	99
Clwyd	54.1	50.8	40.2	0	0	0	100	100	99

North Wales | Restoration | Warming Levels



Key Points

A relative scoring is shown for an area's suitability for Restoration, based on a metric of species richness remaining.

Under 2°C and 4°C warming scenarios, a decline in suitability is projected, with mean values shown in the Table (right).

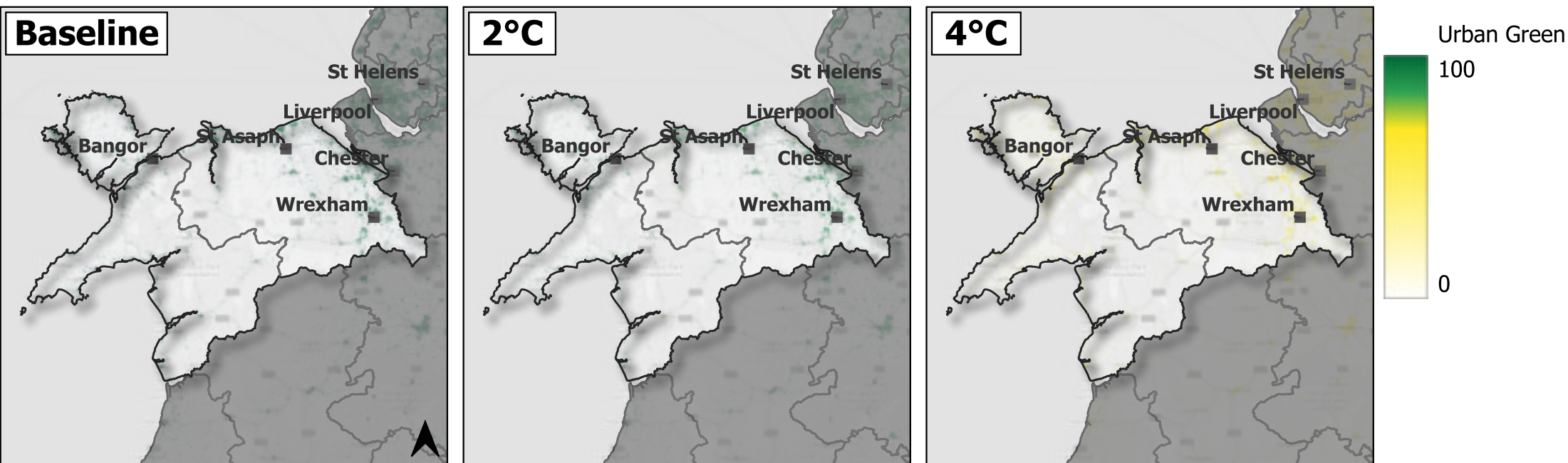
Under 4°C of warming no areas remain with a projected maximum suitability of 100 (range = 60 to 95), showing the importance of limiting warming to 2°C or less.

Local Summary

Minimum, mean and maximum restoration potential (%) for North Wales at baseline, 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	40.5		27.1	0	0	0	100	100	89
Clwyd	45.9		31.1	0	0	0	100	99	90

North Wales | Urban Green | Warming Levels



Key Points

A relative scoring is shown for an area's suitability for Urban Green Space, based on a metric of species richness remaining.

Under 2°C and 4°C warming scenarios, a decline in suitability is projected, with mean values shown in the Table (right).

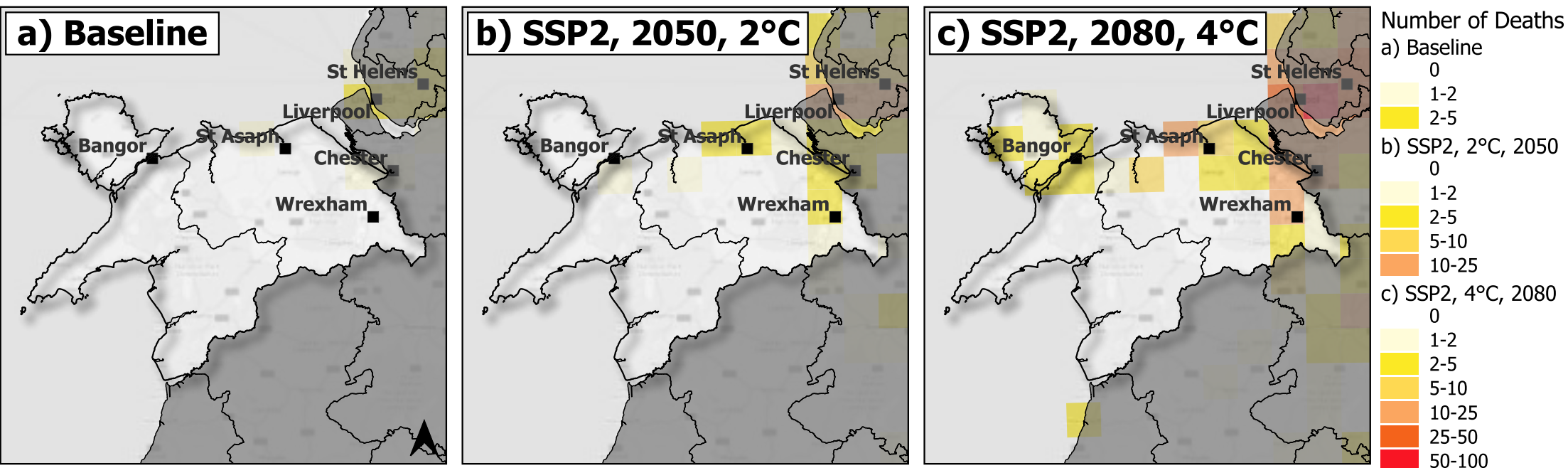
Under 4°C of warming there are no areas remaining with a maximum suitability of 100 (range = 60 to 95), showing the importance of limiting warming to 2°C or less.

Local Summary

Minimum, mean and maximum urban greenspace potential (%) for North Wales at baseline, 2°C and 4°C warming scenarios.

County	Mean			Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	3.7	3	2.2	0	0	0	100	100	88
Clwyd	6.7	5.8	4.3	0	0	0	100	98	87

North Wales | Heat Mortality | Combined Future Scenarios



Key Points

Heat mortality shows average deaths per year at 12km resolution, under future scenarios combining warming (2°C, 4°C), socioeconomics (SSP2, SSP4), and population (2050, 2080).

An increase in heat mortality is projected under 2°C and 4°C scenarios under SSP2. Additional population in 2050 and 2080 also increase mortality.

The climate model ensemble shows a range of outcomes, summarised by the 10th to 90th percentile range (bottom Table, right).

Local Summary

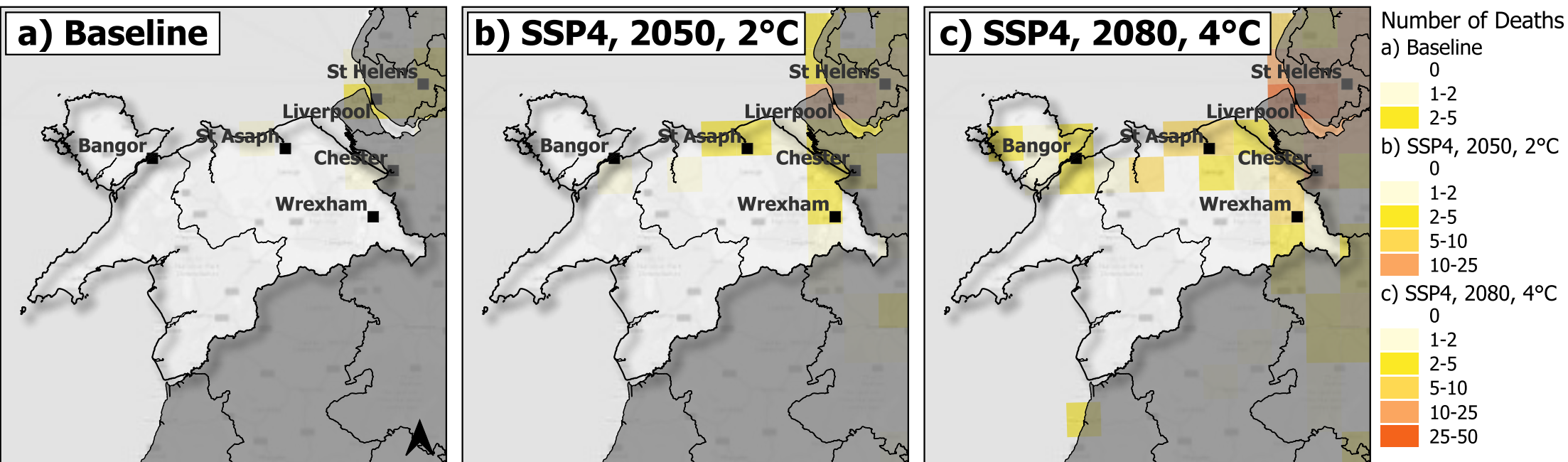
Mean deaths per year and cumulative deaths in North Wales for baseline and future scenarios.

County	Baseline		SSP2 2050 2°C			SSP2 2080 4°C		
	Mean	Cumulative	Mean	Cumulative	Difference	Mean	Cumulative	Difference
Gwynedd	0	1.6	0.2	6.5	0.2	0.8	21.2	0.7
Clwyd	0.3	8.5	1	33.2	0.8	3.4	93.9	3.2

Mean deaths (death/yr) for each future scenario and the climate model ensemble range between 10th and 90th percentile.

County	Baseline Mean	10th - 90th percentile	SSP2 2050 2°C Mean	10th - 90th percentile	SSP2 2080 4°C Mean	10th - 90th percentile
Gwynedd	0.1	0 - 0.4	0.2	0 - 1.5	0.8	0 - 4.6
Clwyd	0.3	0 - 1.4	1.1	0 - 6.3	3.4	0 - 17.2

North Wales | Heat Mortality | Combined Future Scenarios



Key Points

Heat mortality shows average deaths per year at 12km resolution, under future scenarios combining warming (2°C, 4°C), socioeconomics (SSP2, SSP4), and population (2050, 2080).

An increase in heat mortality is projected under 2°C and 4°C scenarios under SSP4. Additional population in 2050 and 2080 also increase mortality.

The climate model ensemble shows a range of outcomes, summarised by the 10th to 90th percentile range (bottom Table, right).

Local Summary

Mean deaths per year and cumulative deaths in North Wales for baseline and future scenarios.

County	Baseline		SSP4 2050 2°C			SSP4 2080 4°C		
	Mean	Cumulative	Mean	Cumulative	Difference	Mean	Cumulative	Difference
Gwynedd	0	1.6	0.2	6.5	0.2	0.7	21.2	0.6
Clwyd	0.3	8.5	1	33.2	0.8	2.9	93.9	2.7

Mean deaths (death/yr) for each future scenario and the climate model ensemble range between 10th and 90th percentile.

County	Baseline Mean	10th - 90th percentile	SSP4 2050 2°C Mean	10th - 90th percentile	SSP4 2080 4°C Mean	10th - 90th percentile
Gwynedd	0.2	0 - 1.3	0.2	0 - 1.4	0.7	0 - 3.9
Clwyd	1	0 - 5.9	1	0 - 6	2.9	0 - 14.9

North Wales | Drought Duration | Warming Levels

Months / 30yrs

a) Baseline

<3

3-5

b) 2°C

<3

3-5

5-10

c) 4°C

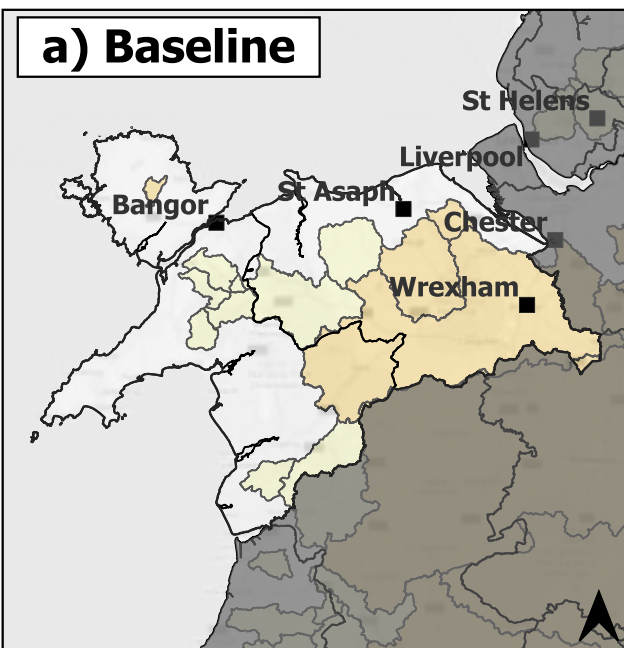
<3

3-5

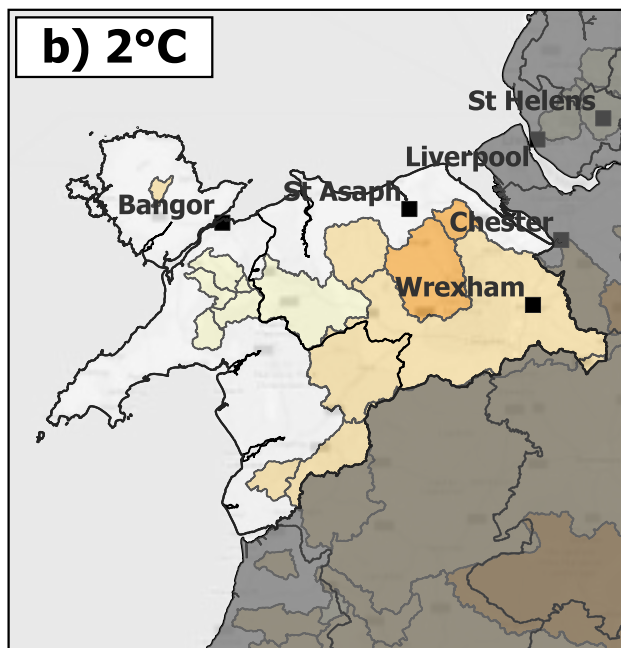
5-10

10-20

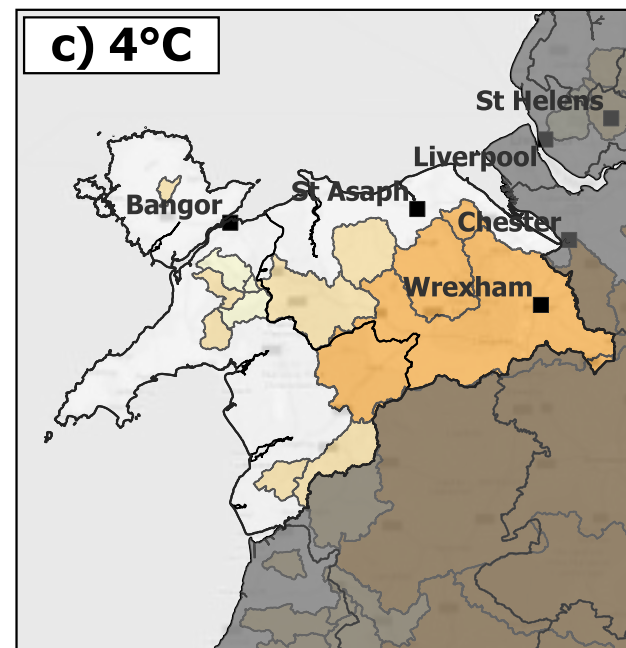
a) Baseline



b) 2°C



c) 4°C



Key Points

Drought duration is a low-flow metric representing the average cumulative duration of drought projected within a future 30-year period. Gridded 1km results are modelled at catchment scale. Coastal or tidally influenced catchments are not modelled.

Nationally for 2°C and 4°C warming scenarios, most catchments are projected to experience an increase in drought duration, particularly in southern and eastern areas.

The climate model ensemble shows a range of possible future outcomes, summarised by the 10th to 90th percentile range (bottom table).

Local Summary

Median, minimum, and maximum drought duration (months/30-yr) for baseline scenario in North Wales, and the percentage change from baseline for a 2°C and 4°C warming scenario.

County	Median			Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	2.6	3.2	4	2.1	2.4	2.8	3.7	5.4	6.9
Clwyd	3.1	4.2	5.8	2.2	2.4	2.8	4.4	6.3	12.7

Median drought duration (months/30-yr) for baseline scenario in North Wales, the climate model ensemble range between 10th and 90th percentile, and the percentage change from baseline for a 2°C and 4°C warming scenario.

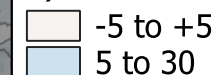
County	Baseline	10th - 90th	2°C	10th - 90th	4°C	10th - 90th
	Median	percentile	Median	percentile	Median	percentile
Gwynedd	2.6	1.9 - 7.5	3.2	2.2 - 11.5	4	2.4 - 29.6
Clwyd	3.1	2 - 7.5	4.2	2.3 - 11.5	5.8	2.5 - 29.6

North Wales | 10 year Return Period Flow | Warming Levels

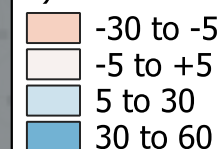
Flow Rate
a) Baseline (m³/s)



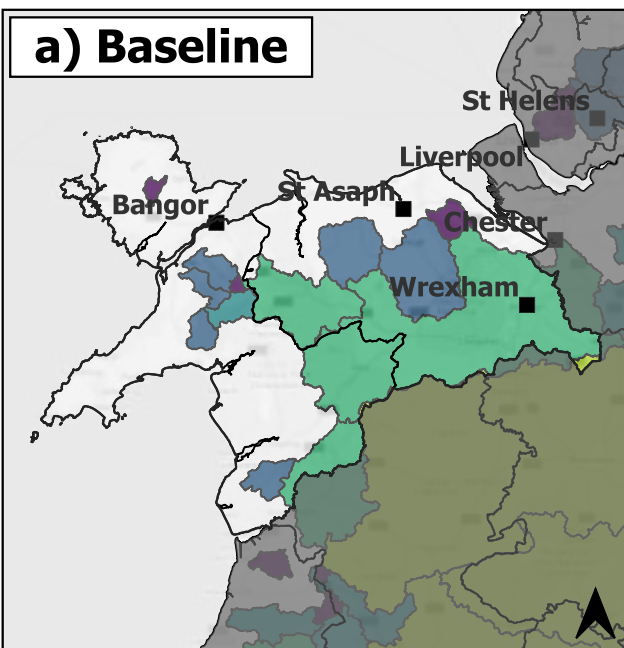
b) 2°C % change



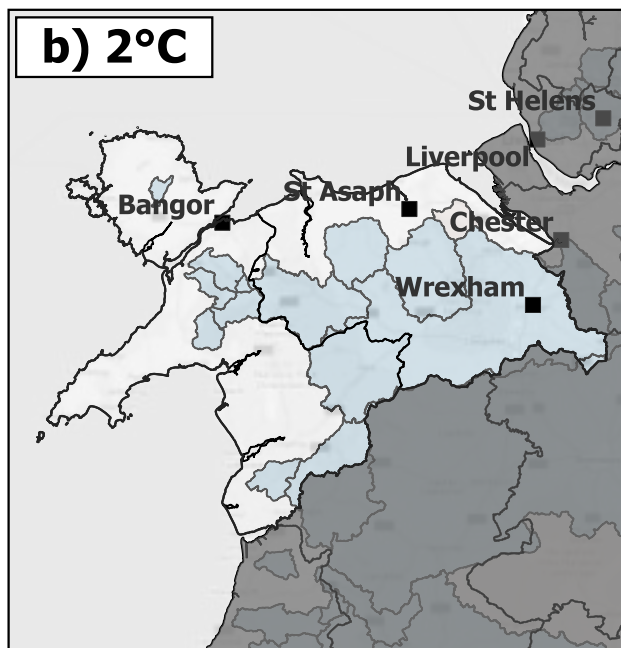
c) 4°C % change



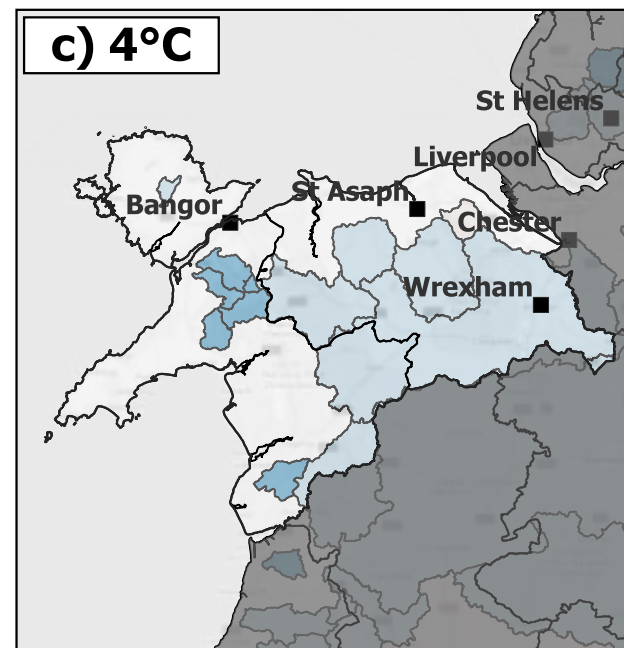
a) Baseline



b) 2°C



c) 4°C



Key Points

The 1-in-10-year return period flow is a high-flow rate metric with a 10% annual probability of occurring. It is a proxy for a low probability, low magnitude flood event.

Nationally for 2°C of warming, most catchments are projected to experience 5% to 30% increase in flows, with little additional increase for most catchments at 4°C. Flow is projected to decrease for some central & eastern catchments.

The climate model ensemble shows a range of outcomes which is summarised by the 10th to 90th percentile range (bottom table).

Local Summary

Median, minimum, and maximum flow rate (m³/s) for baseline scenario in North Wales, and the percentage change from baseline for a 2°C and 4°C warming scenario.

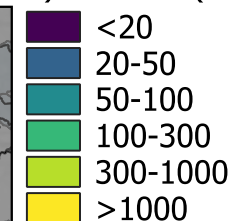
County	Median	% change		Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	73	15.6	20.8	5.5	3.2	6.3	692.2	28.1	46.5
Clwyd	55.6	11.3	14.5	3.4	2	-14.4	692.2	21.9	33.7

Median flow rate (m³/s) for baseline scenario in North Wales, the climate model ensemble range between 10th and 90th percentile, and the percentage change from baseline for a 2°C and 4°C warming scenario.

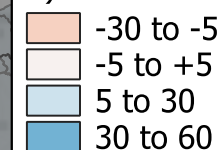
County	Baseline Median	10th - 90th percentile	2°C % change	4°C % change
Gwynedd	73	5.1 - 804	15.6	20.8
Clwyd	55.6	3 - 804	11.3	14.5

North Wales | 100 year Return Period Flow | Warming Levels

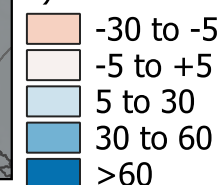
Flow Rate
a) Baseline (m³/s)



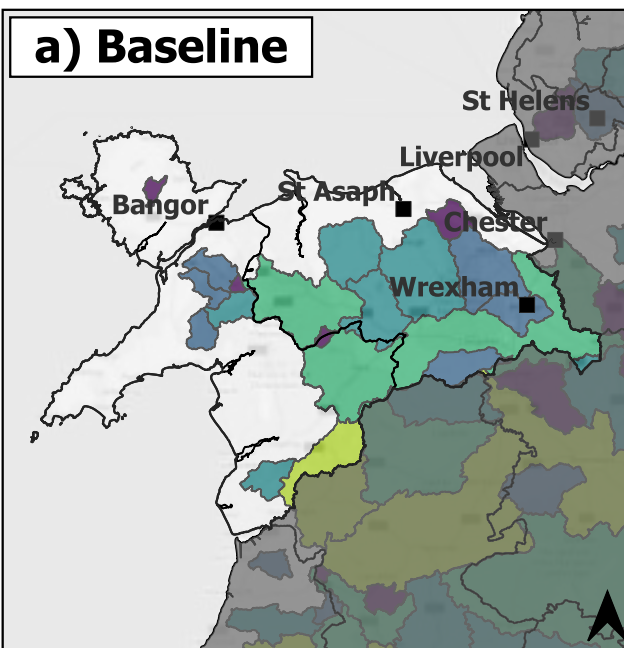
b) 2°C % change



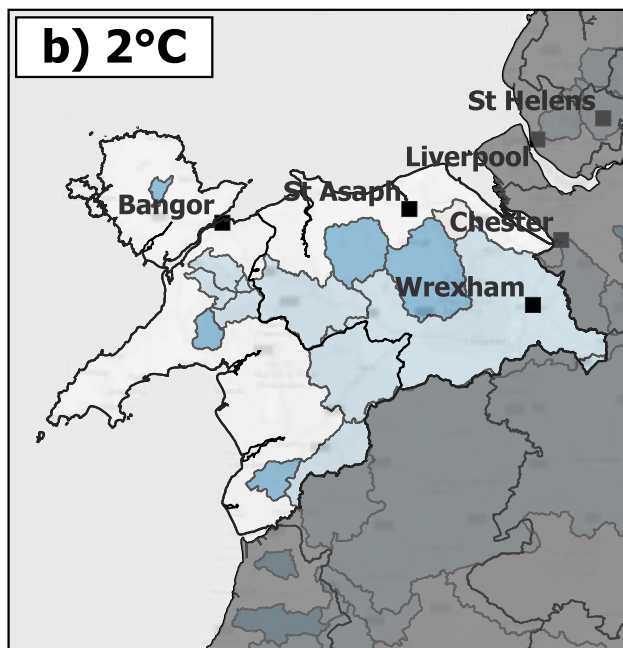
c) 4°C % change



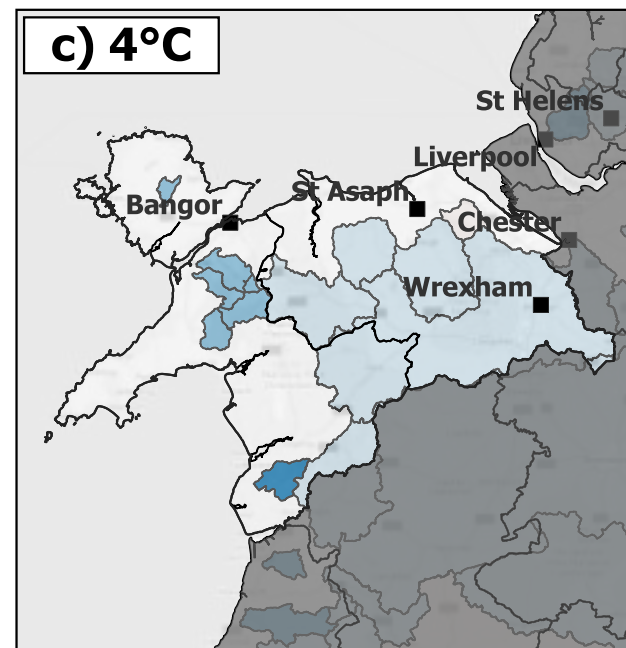
a) Baseline



b) 2°C



c) 4°C



Key Points

The 1-in-100-year return period flow is a high-flow rate metric with a 1% annual probability of occurring. It is a proxy for a low probability, high magnitude flood event.

Nationally for 2°C warming, most catchments are projected to experience 5% to 30% increase in flows, while at 4°C more catchments are projected to increase flow >60%. Flow is projected to decrease for some catchments in the East.

The climate model ensemble shows a range of outcomes which is summarised by the 10th to 90th percentile range (bottom table).

Local Summary

Median, minimum, and maximum flow rate (m³/s) for baseline scenario in North Wales, and the percentage change from baseline for a 2°C and 4°C warming scenario.

County	Median	% change		Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwynedd	91.8	22.9	20.9	9.5	0.2	6.9	1256.6	40.1	75
Clwyd	71	24.4	15.5	6	0	-0.3	1256.6	40.1	65

Median flow rate (m³/s) for baseline scenario in North Wales, the climate model ensemble range between 10th and 90th percentile, and the percentage change from baseline for a 2°C and 4°C warming scenario.

County	Baseline Median	10th - 90th percentile	2°C % change	4°C % change
Gwynedd	91.8	6.1 - 1412.9	22.9	20.9
Clwyd	71	3.7 - 1412.9	24.4	15.5

Disclaimer and Intended Use

Exclusion of Liability

Whilst every effort has been made to ensure the accuracy of information presented, the OpenCLIM team and partner institutions disclaim all responsibility for and accept no liability for any errors or losses caused by any inaccuracies in such information or the consequences of any person acting or refraining from acting or otherwise relying on such information.

Your use of information provided by OpenCLIM is at your own risk. Please read any warnings given about the limitations of the information.

The OpenCLIM team and partner institutions give no warranty as to the quality or accuracy of the information or its suitability for any use. All implied conditions relating to the quality or suitability of the information, and all liabilities arising from the supply of the information (including any liability arising in negligence) are excluded to the fullest extent permitted by law.

The OpenCLIM team and partner institutions give no warranty as to the accuracy or completeness of data or images in the form in which they are cached or downloaded to your computer, as they may be affected by online conditions beyond our control.

Intended-Use

The OpenCLIM framework is a national-scale set of workflows and datasets for describing climate change risks/opportunities and for assessing adaptation needs. Data are at resolutions appropriate for investigating climate risks at national and subnational scales. OpenCLIM is not intended to provide information about climate risks at the scale of individual properties or streets and should not be used for such micro analysis.

Limitations

Data, model results and other information or related records have been produced for a specific purpose, and that may affect the type and completeness of the data and interpretation. The nature and

purpose of data collection and model simulation may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.

The data, information and related records within the OpenCLIM framework should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.

Sharing and re-use

OpenCLIM results are shared under a creative commons licence ([CCBY 4.0](https://creativecommons.org/licenses/by/4.0/)) and may be re-used with appropriate credit to the original creators.



Acknowledgements

These reports are based on the OpenCLIM project, a collaboration led by the Tyndall Centre for Climate Change Research at the University of East Anglia (UEA), with partners from Newcastle University, the University of Bristol, the UK Centre for Ecology and Hydrology (UKCEH), the Data and Analytics Facility for National Infrastructure (DAFNI), and Sayers and Partners. For further information visit openclim.science.

Patrick Fountain and Jasmin Evans provided GIS and other support to develop these reports. Front cover image credits: Don Lodge and Bruno Martins on [Unsplash.com](https://unsplash.com). Maps contain public sector information (administrative boundaries) licensed under the [Open Government Licence v3.0](https://open.gov.uk/open-government-licence).

