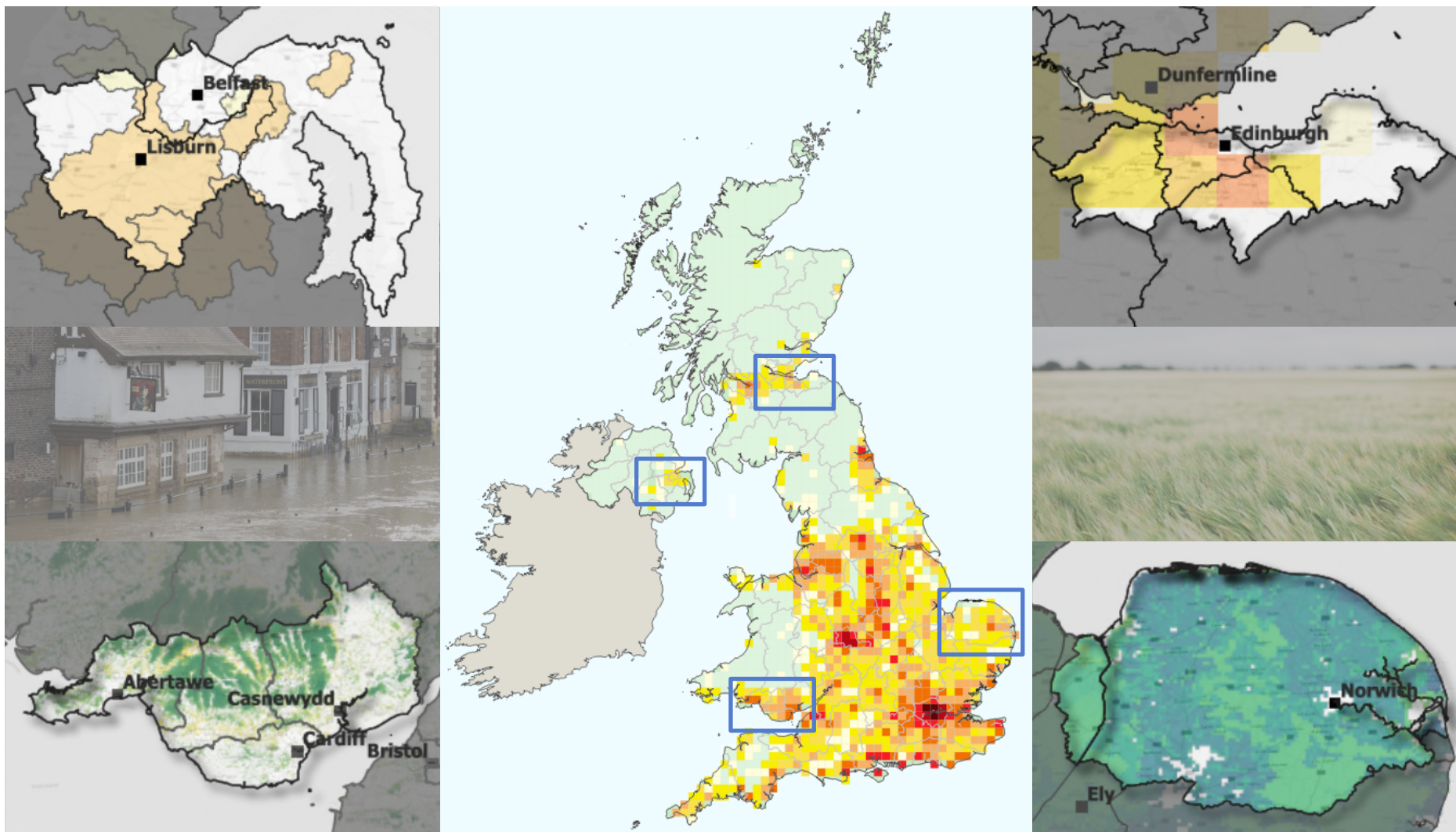


OpenCLIM Local Climate Risk Reports

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)

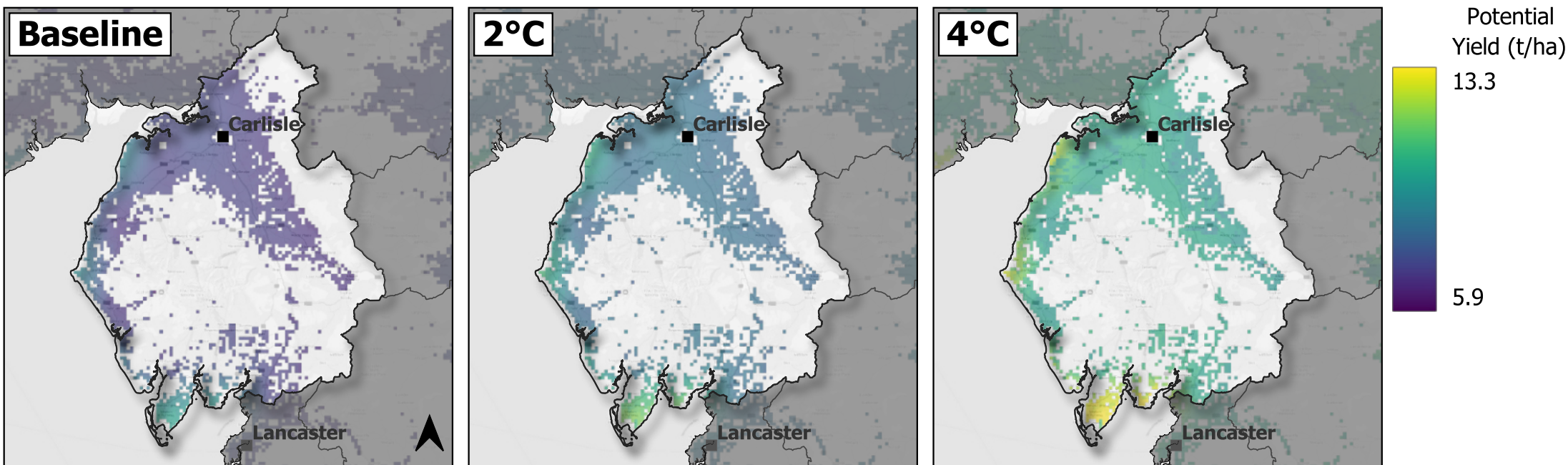
This metric projects the total number of heat-related deaths that could occur in a warmer future. 12 km grid (inherited from UKCP18 regional climate model).

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.

Cumbria | 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).

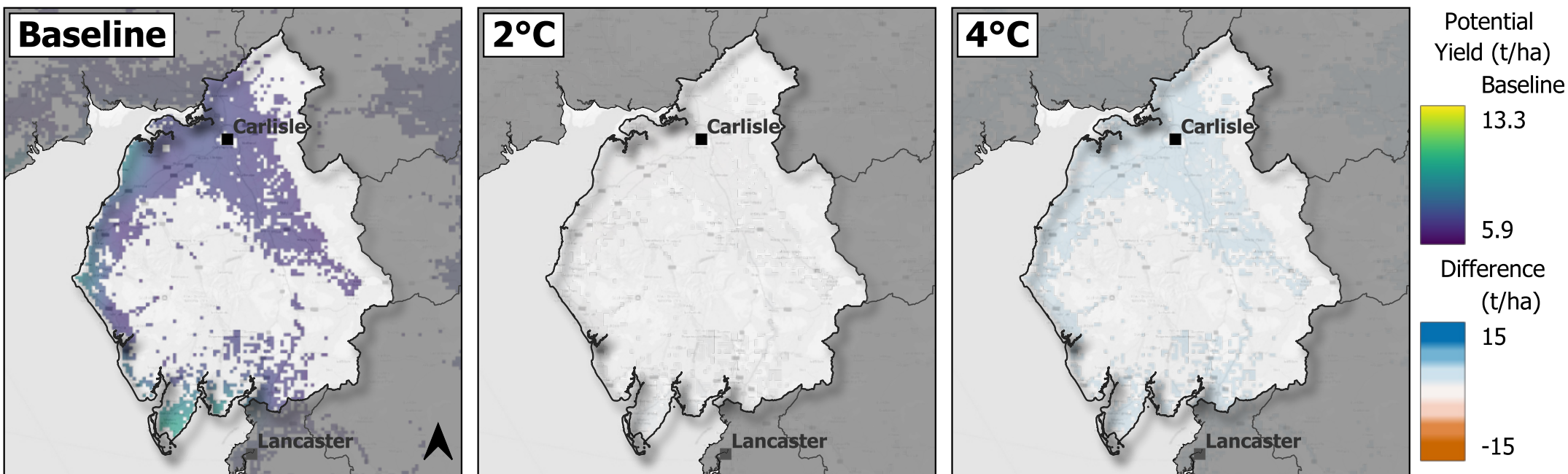
A modest increase in potential yield is projected at 2°C and 4°C for most of the Cumbria area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the Cumbria 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
Cumbria	7.4	8.8	10.4	6.3	7.5	7.2	10.2	11.9	11.4

Cumbria | 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).

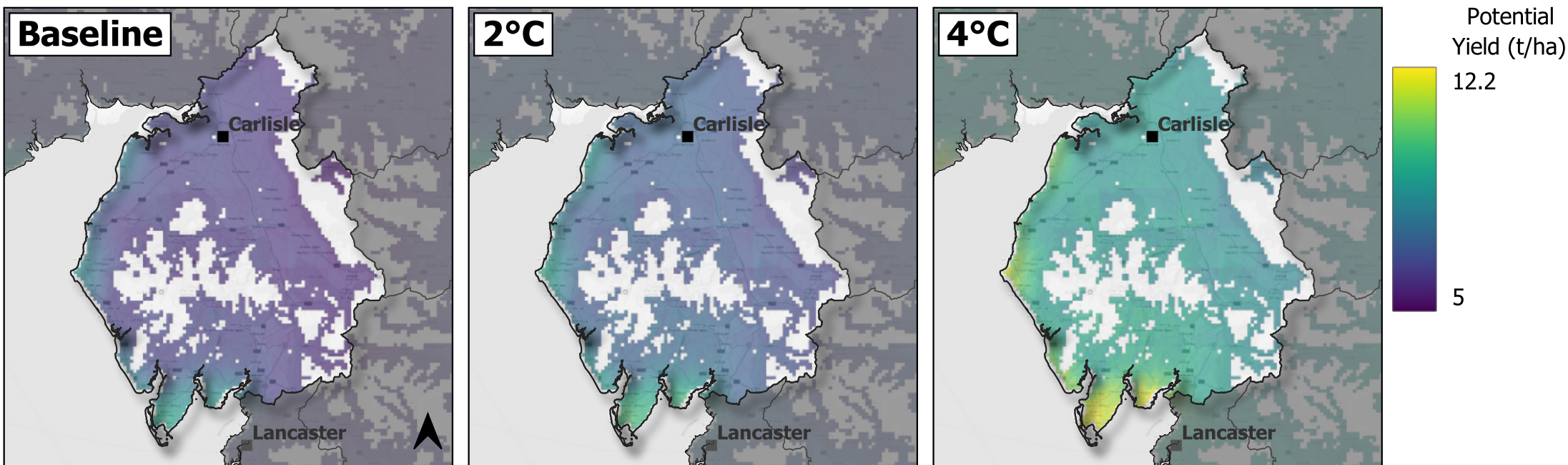
A modest increase in potential yield is projected at 2°C and 4°C for most of the Cumbria area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the Cumbria 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
Cumbria	7.4	8.8	10.4	6.3	7.5	7.2	10.2	11.9	11.4	1.4	3

Cumbria | 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).

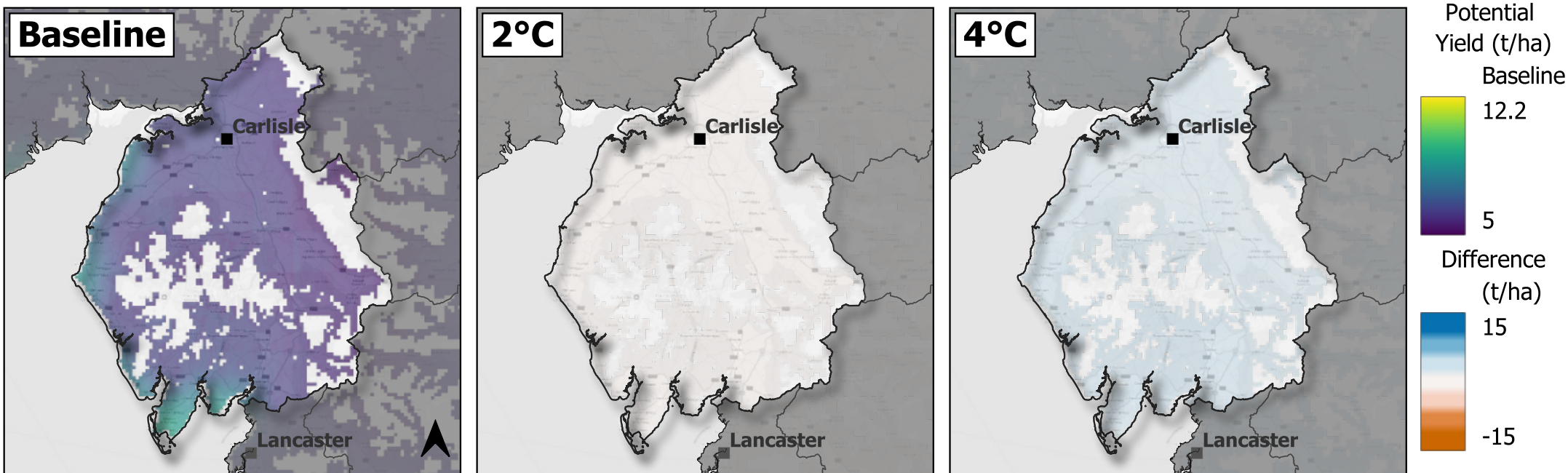
A modest increase in potential yield is projected at 2°C and 4°C for most of the Cumbria area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the Cumbria 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
Cumbria	6.3	7.1	9	5.1	5.7	7.5	9.4	10.3	12.2

Cumbria | 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).

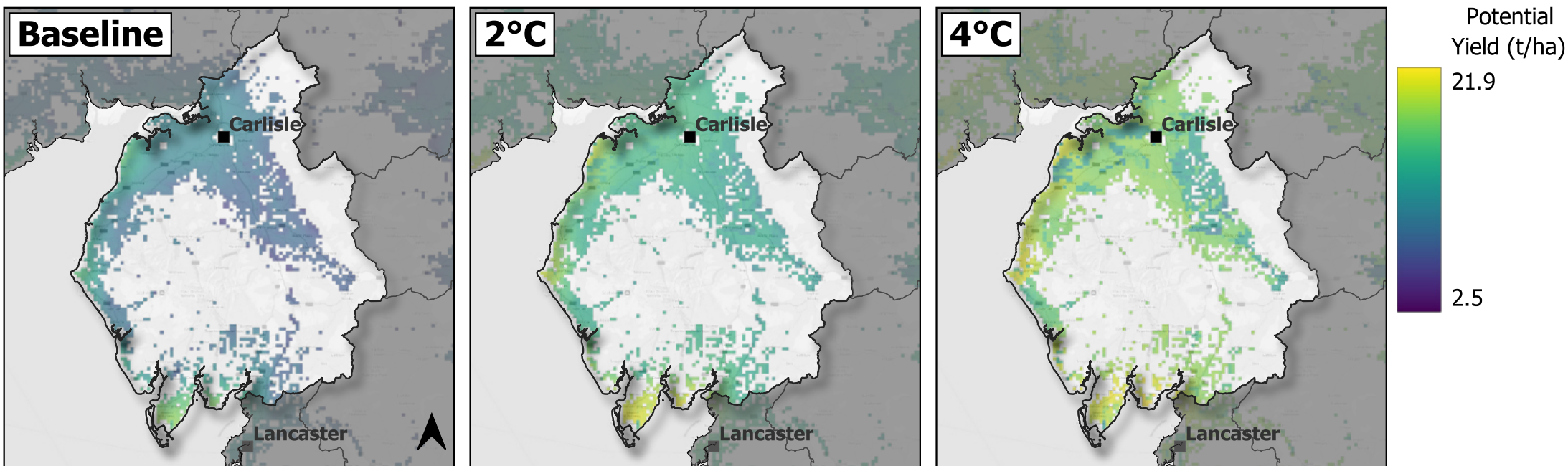
A modest increase in potential yield is projected at 2°C and 4°C for most of the Cumbria area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the Cumbria 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
Cumbria	6.3	7.1	9	5.1	5.7	7.5	9.4	10.3	12.2	0.8	2.6

Cumbria | 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).

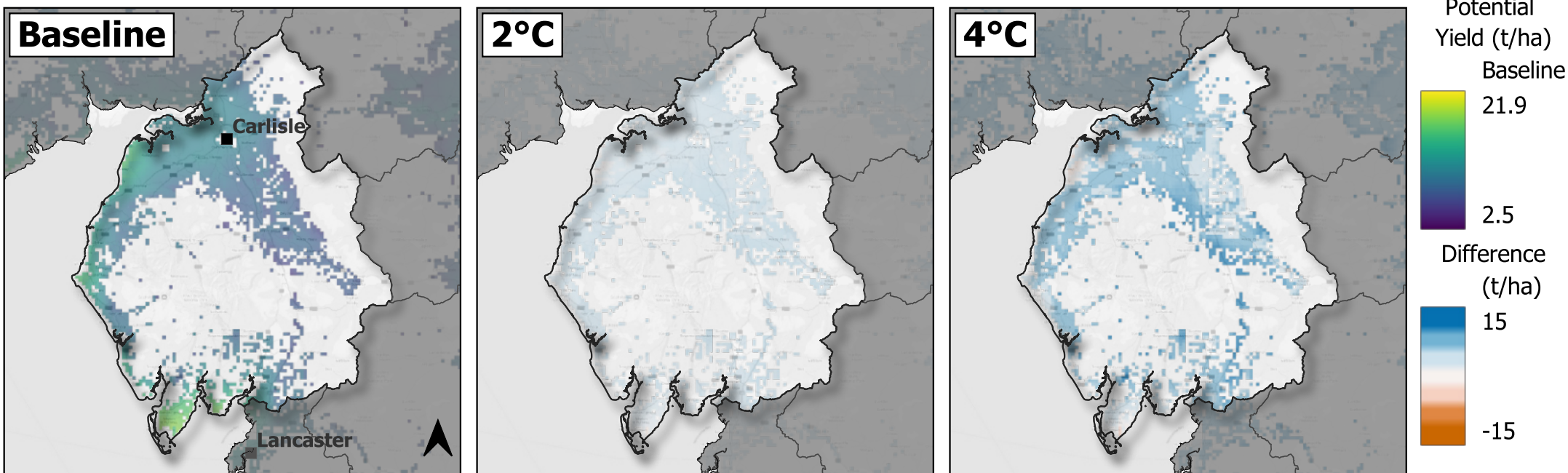
There is a slight increase in potential yield projected at 2°C and 4°C for most of the Cumbria area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the Cumbria 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
Cumbria	13.6	15	17.3	5.4	10.2	9.3	18.6	21.3	22.9

Cumbria | 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).

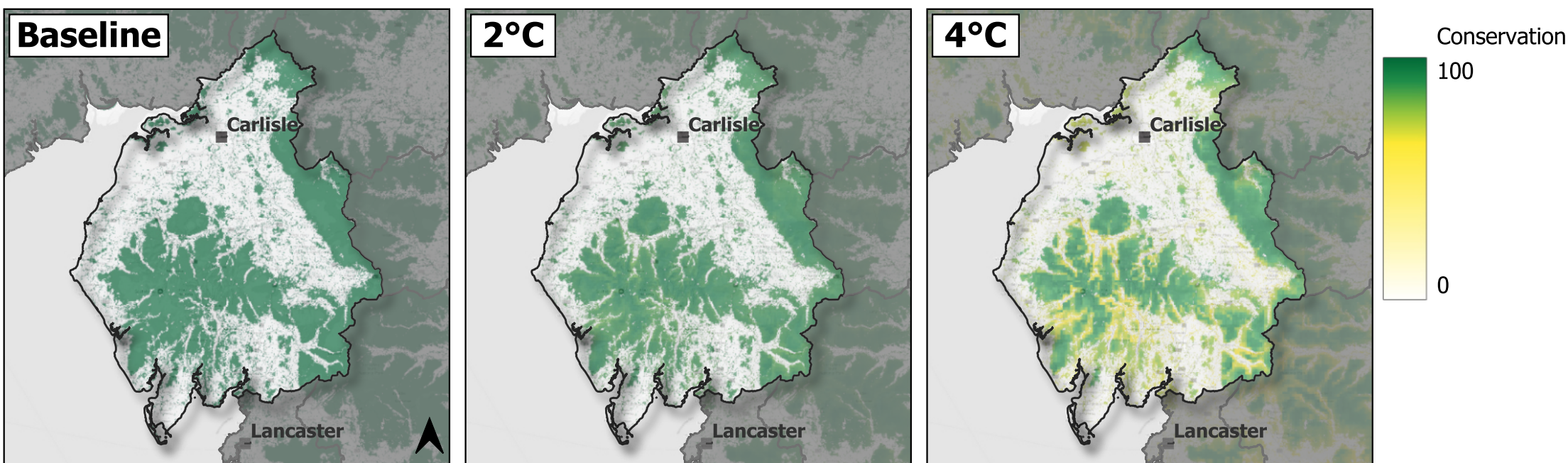
There is slight increase in potential yield projected at 2°C and 4°C for most of the Cumbria area.

Local Summary

Minimum, mean and maximum potential yield (t/ha) for the Cumbria 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
Cumbria	13.6	15	17.3	5.4	10.2	9.3	18.6	21.3	22.9	1.4	3.7

Cumbria | 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).

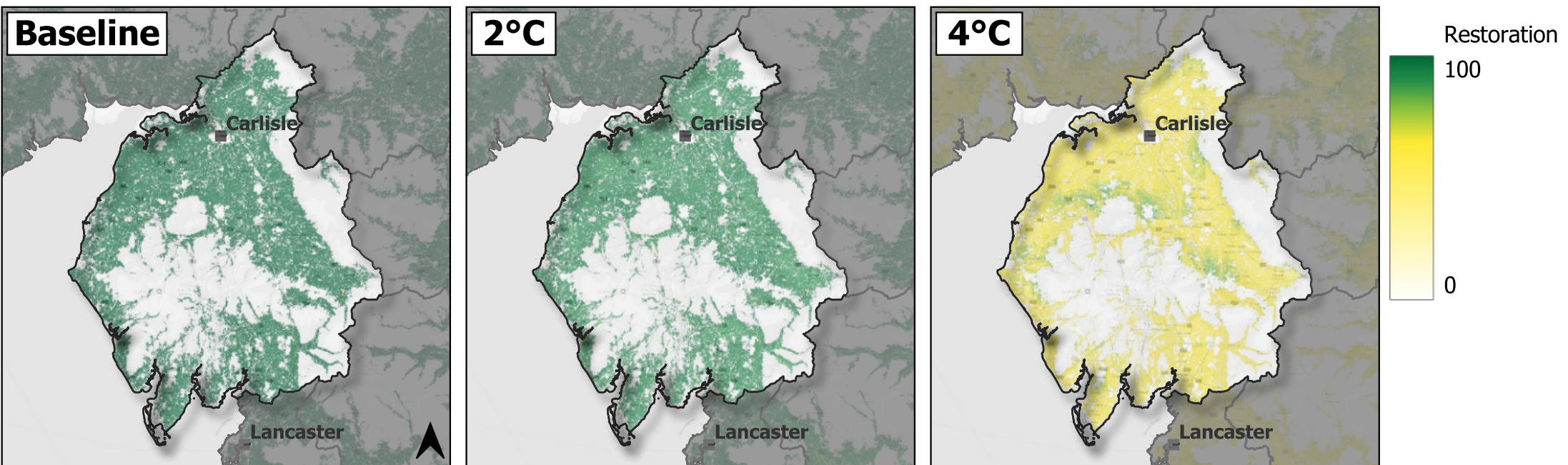
Under 4°C of warming, only one area is projected to retain a maximum suitability of 100 (range = 60 to 100), while the mean rarely exceeds 50, showing the importance of limiting warming to 2°C or less.

Local Summary

Minimum, mean and maximum conservation potential (%) for Cumbria 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
Cumbria	51.5	48.8	39.6	0	0	0	100	100	97

Cumbria | 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).

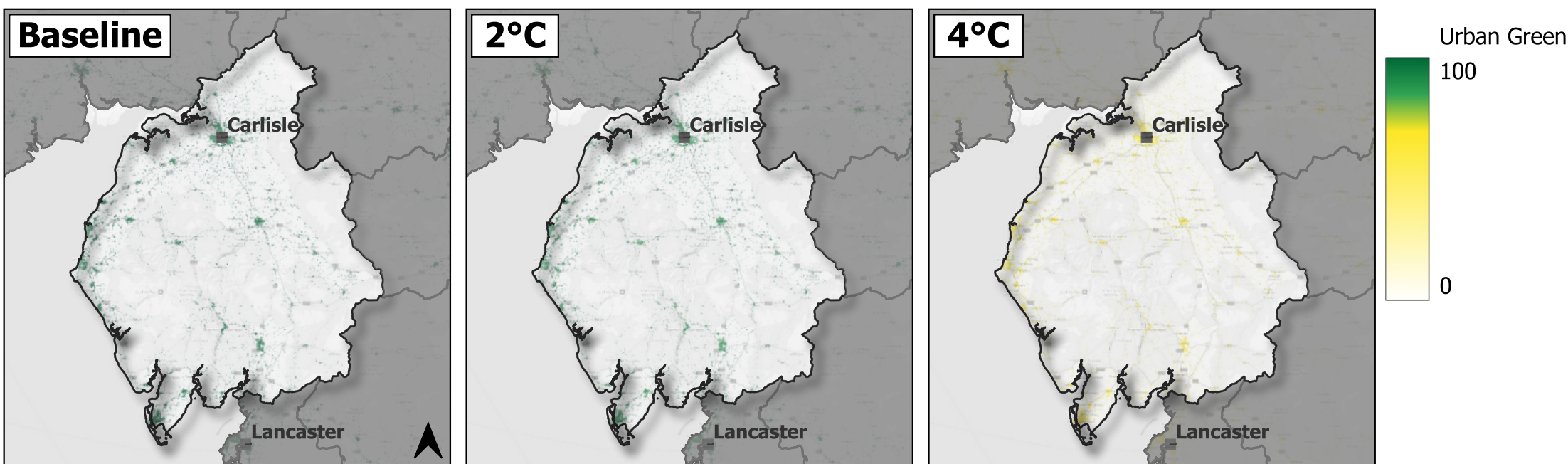
Under 4°C of warming no areas remain with a projected maximum suitability of 100 (range = 60 to 95), showing the importance of limiting warming to 2°C or less.

Local Summary

Minimum, mean and maximum restoration potential (%) for Cumbria 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
Cumbria	48.5		33.2	0	0	0	100	100	93

Cumbria | 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).

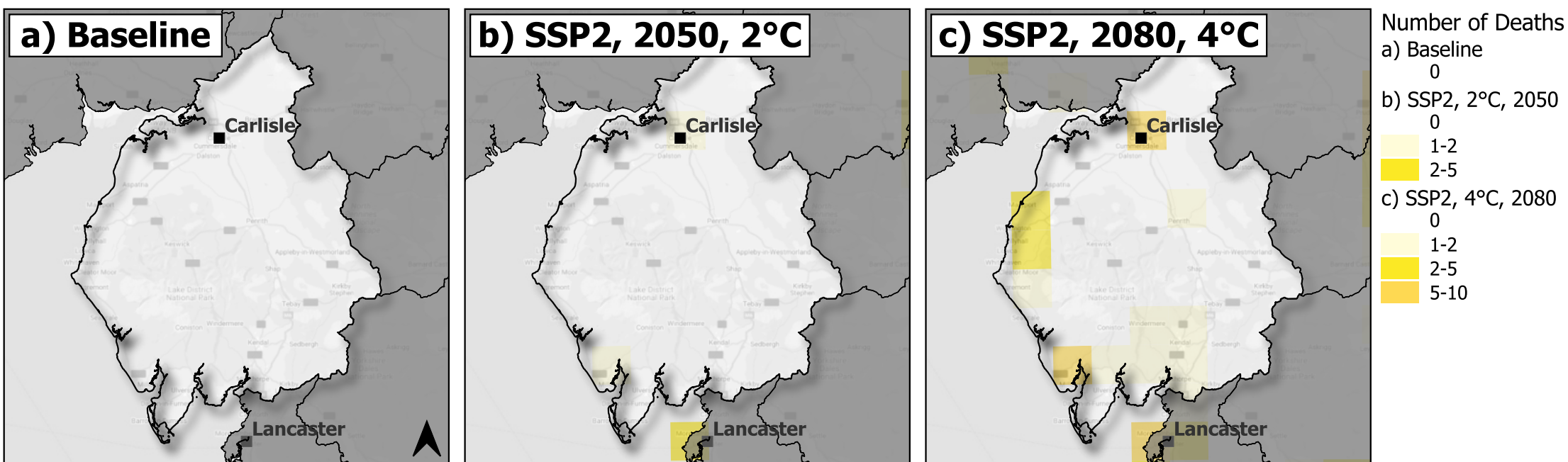
Under 4°C of warming there are no areas remaining with a maximum suitability of 100 (range = 60 to 95), showing the importance of limiting warming to 2°C or less.

Local Summary

Minimum, mean and maximum urban greenspace potential (%) for Cumbria 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
Cumbria	4.2	3.8	2.8	0	0	0	100	99	91

Cumbria | 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

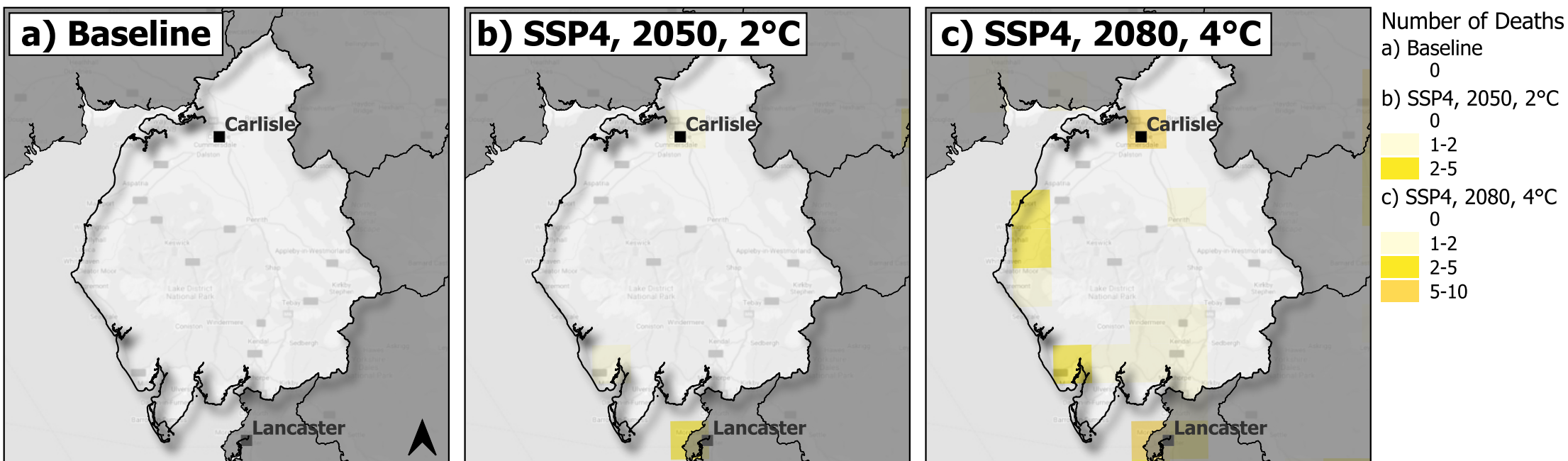
Mean deaths per year and cumulative deaths in Cumbria for baseline and future scenarios.

County	Baseline		SSP2 2050 2°C			SSP2 2080 4°C		
	Mean	Cumulative	Mean	Cumulative	Difference	Mean	Cumulative	Difference
Cumbria	0	1.9	0.2	9.3	0.1	0.7	33.8	0.7

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	SSP2 2050 2°C Mean	10th - 90th percentile	SSP2 2080 4°C Mean	10th - 90th percentile
Cumbria	0	0 - 0.6	0.2	0 - 2.3	0.7	0 - 8.1

Cumbria | 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

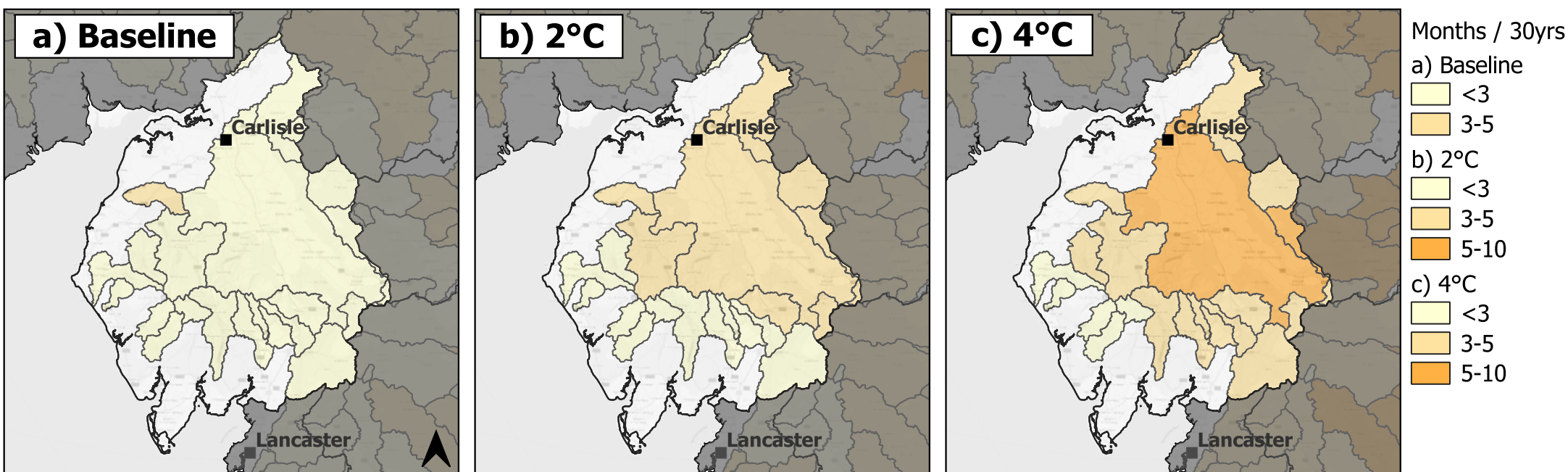
Mean deaths per year and cumulative deaths in Cumbria for baseline and future scenarios.

County	Baseline		SSP4 2050 2°C			SSP4 2080 4°C		
	Mean	Cumulative	Mean	Cumulative	Difference	Mean	Cumulative	Difference
Cumbria	0	1.9	0.2	9.3	0.1	0.6	33.8	0.6

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
Cumbria	0.2	0 - 2.1	0.2	0 - 2.2	0.6	0 - 6.9

Cumbria | Drought Duration | Warming Levels



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

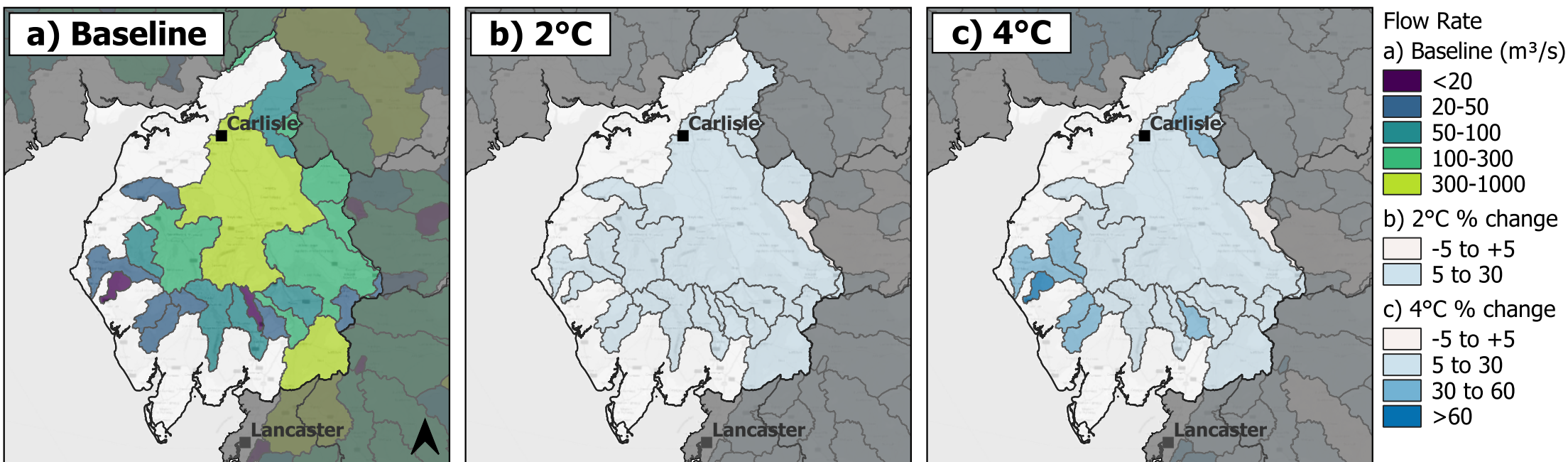
Median, minimum, and maximum drought duration (months/30-yr) for baseline scenario in Cumbria, and the percentage change from baseline for a 2°C and 4°C warming scenario.

County	Median			Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Cumbria	2.6	3.1	3.7	2.1	2.5	2.7	3.3	4.5	6.7

Median drought duration (months/30-yr) for baseline scenario in Cumbria, 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
Cumbria	2.6	2 - 7	3.1	2.2 - 9.7	3.7	2.5 - 17.2

Cumbria | 10 year Return Period Flow | Warming Levels



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

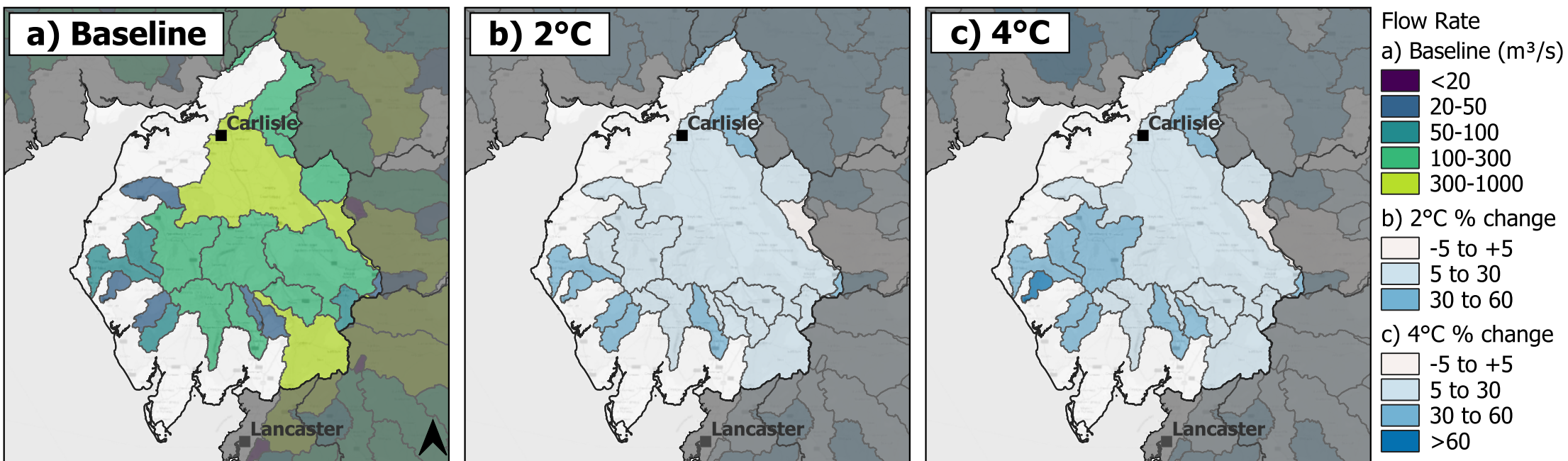
Median, minimum, and maximum flow rate (m³/s) for baseline scenario in Cumbria, and the percentage change from baseline for a 2°C and 4°C warming scenario.

County	Median Baseline	% change		Minimum			Maximum		
	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Cumbria	121.1	16.6	20.7	17	4.3	0.1	558.9	28.9	67.7

Median flow rate (m³/s) for baseline scenario in Cumbria, 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
Cumbria	121.1	14 - 634.9	16.6	20.7

Cumbria | 100 year Return Period Flow | Warming Levels



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 Cumbria, 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
Cumbria	166.4	25.7	23.7	27.9	-0.4	-2.9	733	58.4	74.1

Median flow rate (m³/s) for baseline scenario in Cumbria, 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
Cumbria	166.4	15.8 - 1318.7	25.7	23.7

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).

