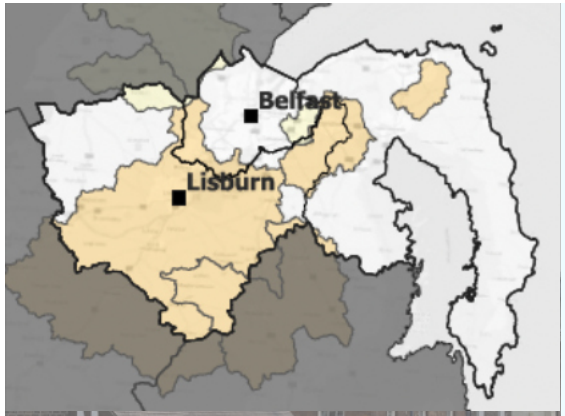
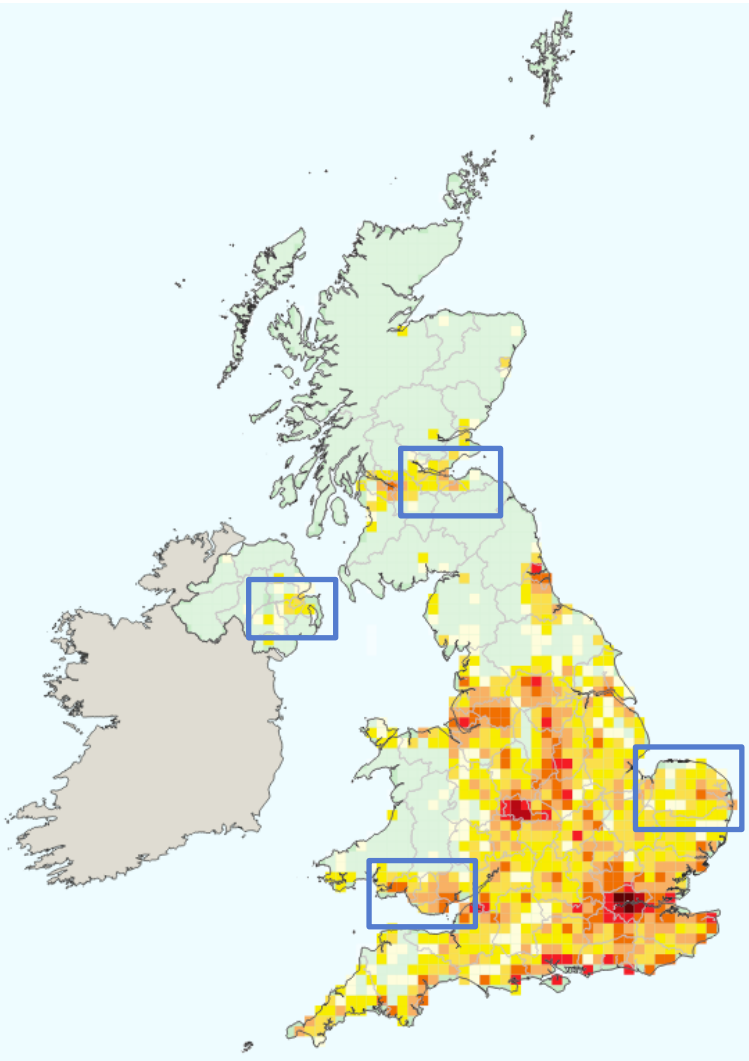
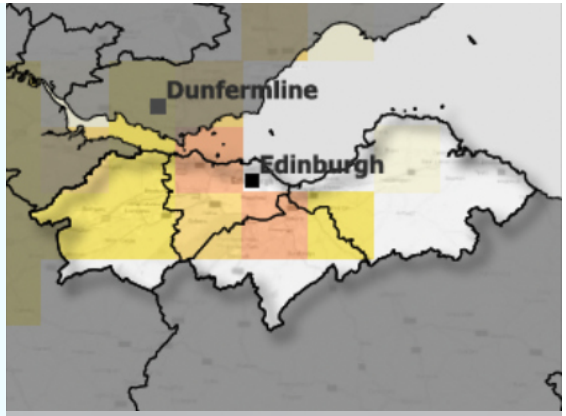
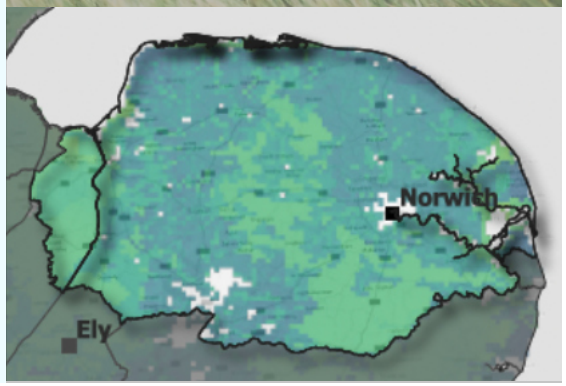
OpenCLIM Local Climate Risk Reports

Local insights from national analysis









Tyndall Centre for Climate Change Research

OPEN CLIMATE IMPACTS MODELLING FRAMEWORK

What's included?

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 10 m original analysis).

Heat Stress

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

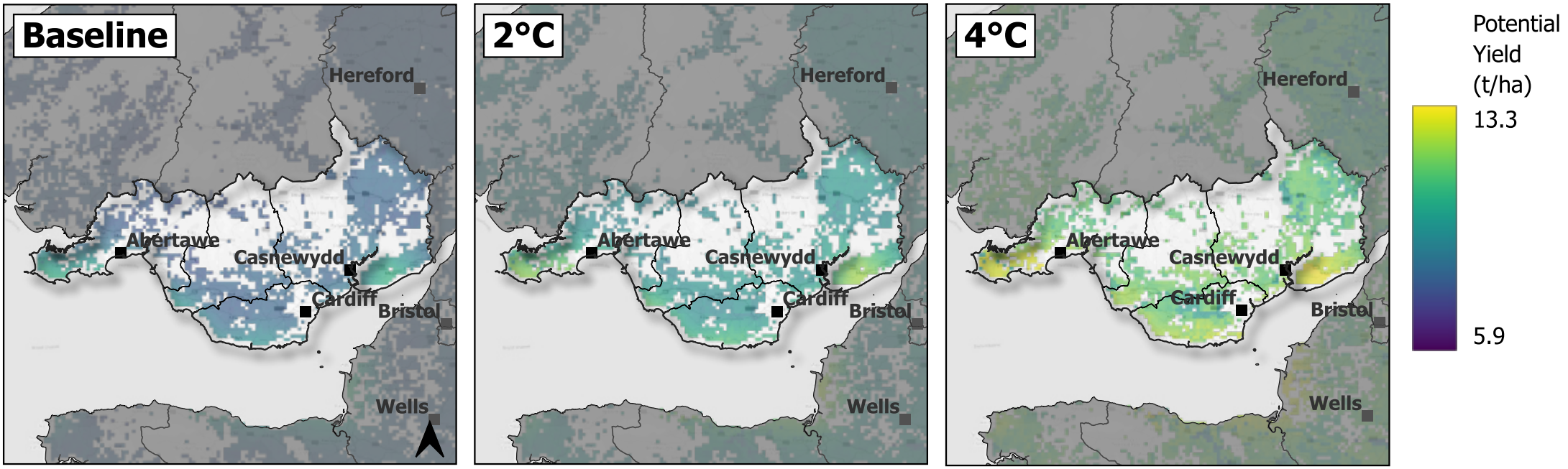
This metric projects the number of excess deaths due to prolonged or extreme warm weather conditions. 12 km grid.

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 in metres cubed per second, m3/s; difference, %)

These river flow-rate metrics are shown as a proxy for flooding and should be used alongside e.g. Environment Agency flood indicators. They are gridded at 1km for whole catchments.

South 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 South Wales area.

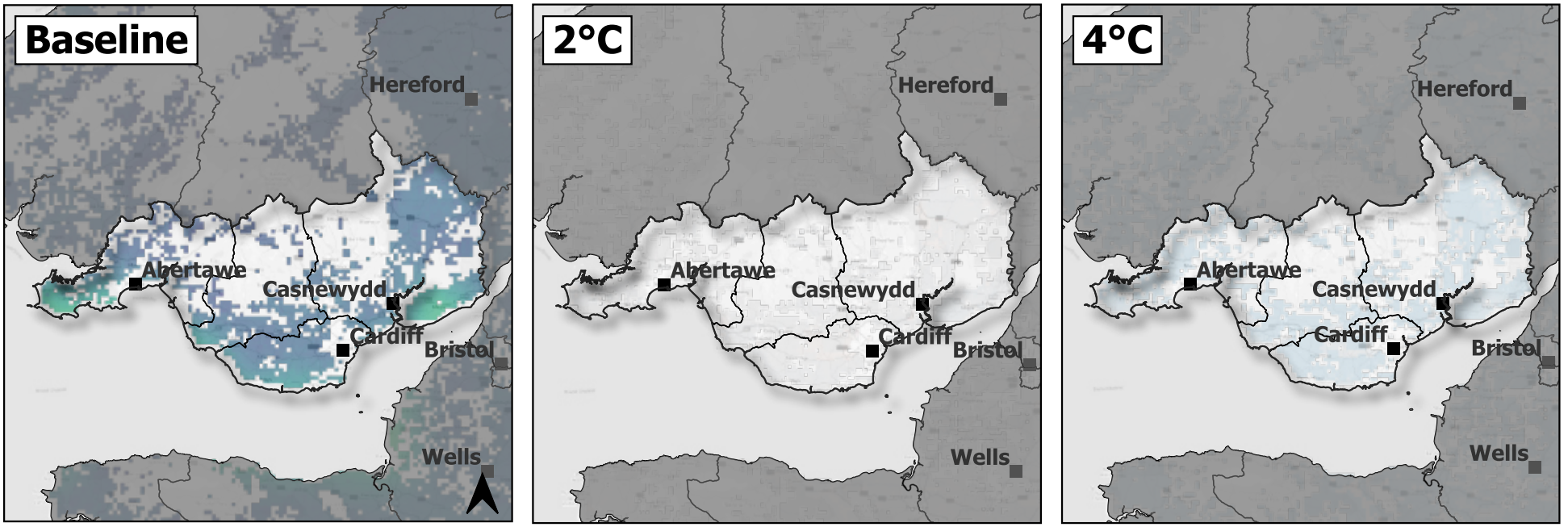
Local Summary

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

	Mean			Minimum			Maximum		
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwent	8.5	10	11.4	7.7	8.9	8.6	10.6	12.3	11.8
South Glamorgan	8.5	9.9	11.4	7.9	9.1	8.7	9.6	11.2	10.7
Mid Glamorgan	8.2	9.7	11.4	7.4	8.6	8.2	10	11.3	11
West Glamorgan	8.6	10	11.7	7.5	8.8	8.4	10.7	12.1	11.7

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

South 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 South Wales area.

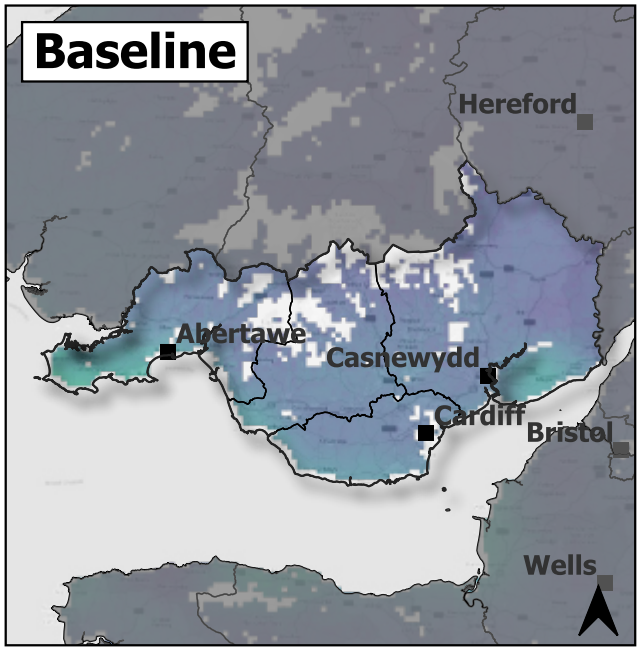
Local Summary

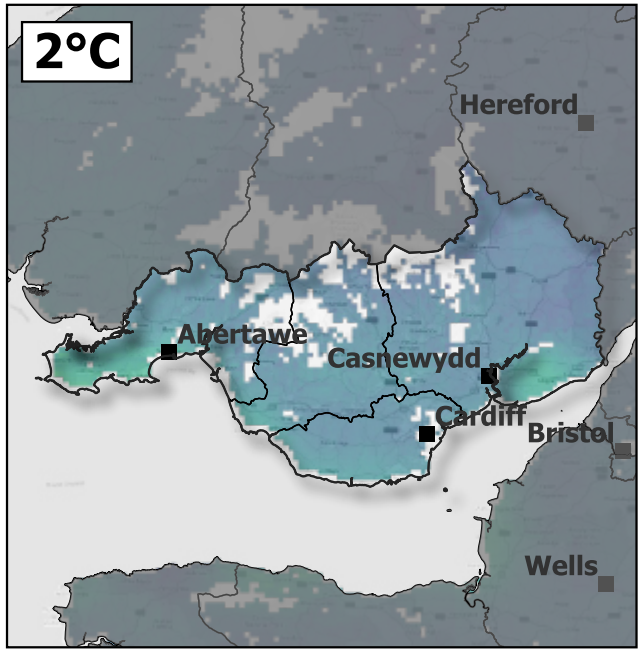
Minimum, mean and maximum potential yield (t/ha) for the South Wales region at baseline, 2°C and 4°C warming scenarios, with the difference from the baseline mean for 2°C and 4°C warming scenarios.

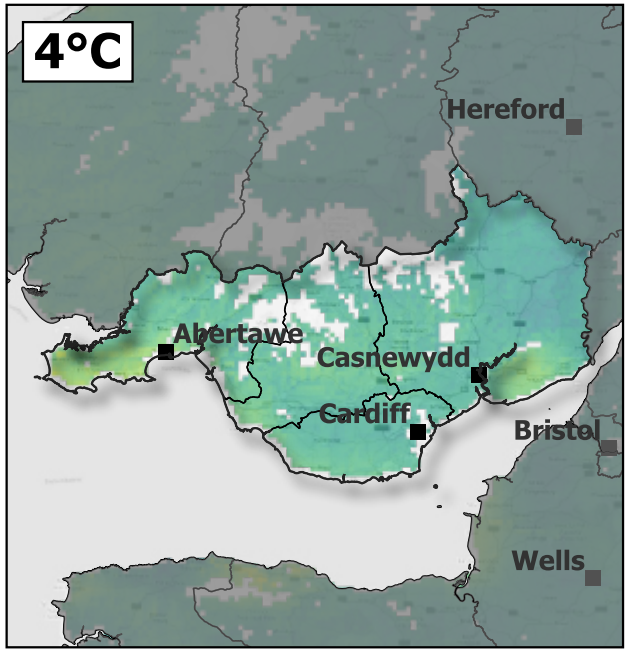
	Mean			Minimum			Maximum			Difference	
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C	2°C	4°C
Gwent	8.5	10	11.4	7.7	8.9	8.6	10.6	12.3	11.8	1.5	2.9
South Glamorgan	8.5	9.9	11.4	7.9	9.1	8.7	9.6	11.2	10.7	1.4	2.9
Mid Glamorgan	8.2	9.7	11.4	7.4	8.6	8.2	10	11.3	11	1.4	3.2
West Glamorgan	8.6	10	11.7	7.5	8.8	8.4	10.7	12.1	11.7	1.4	3.1

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

South 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 South Wales area.

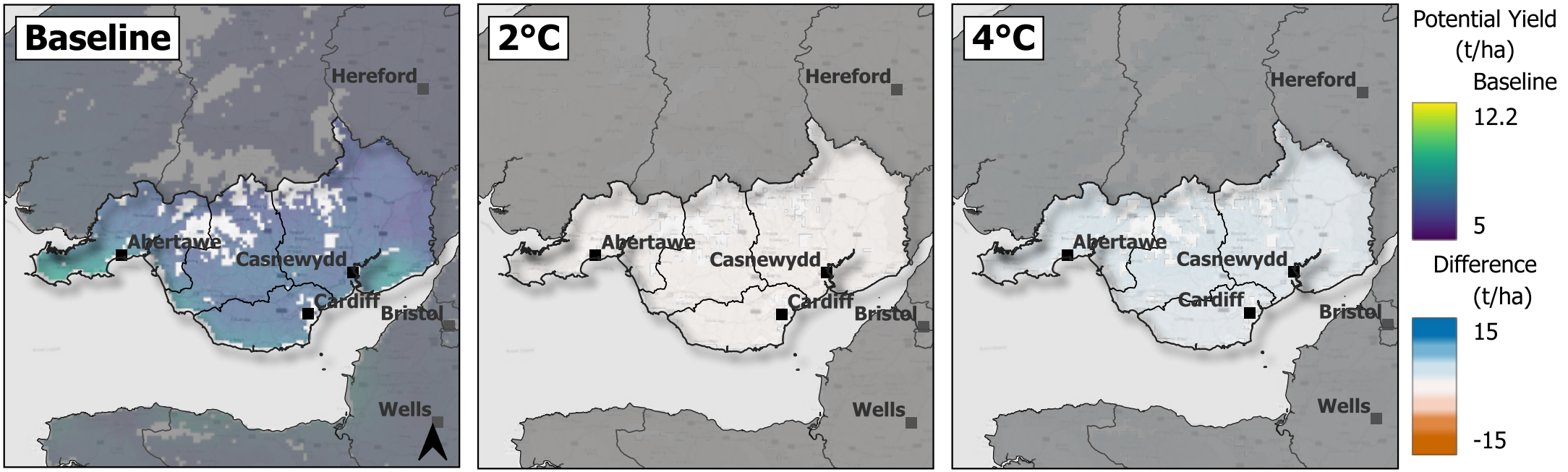
Local Summary

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

	Mean			Minimum			Maximum		
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwent	7	7.6	9.2	6.1	6.5	8	8.6	9.3	10.8
South Glamorgan	7.3	7.9	9.5	6.8	7.4	8.8	8.1	8.6	10.2
Mid Glamorgan	7.1	7.8	9.6	6.3	7	8.7	8.4	8.9	10.4
West Glamorgan	7.5	8.1	9.9	6.5	7.1	8.9	9.4	9.9	11.5

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

South 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 South Wales area.

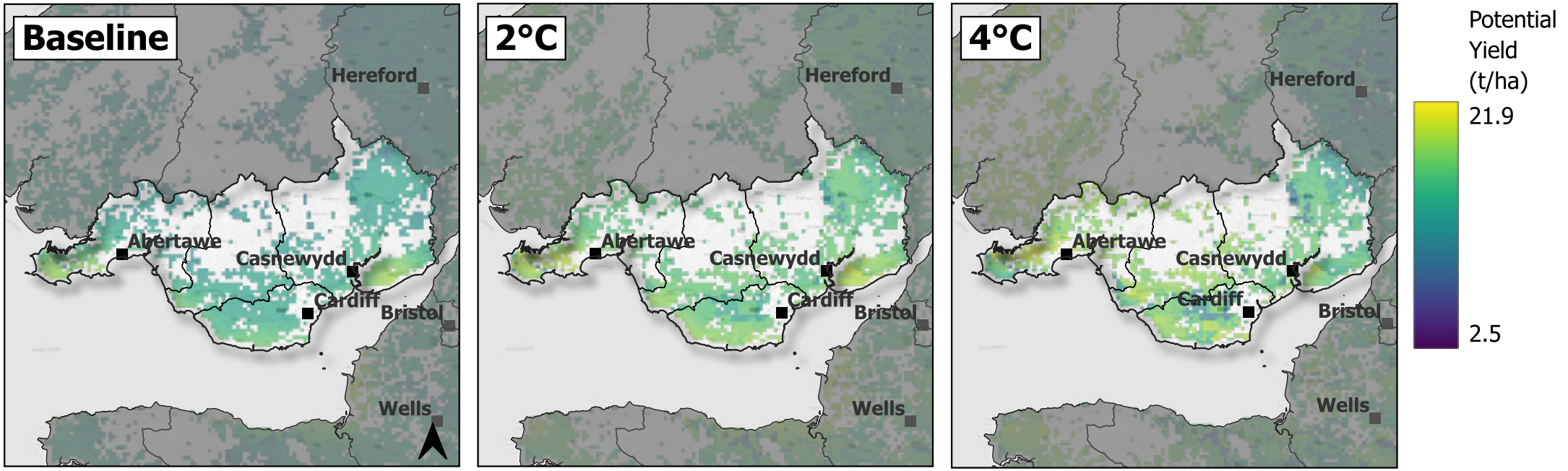
Local Summary

Minimum, mean and maximum potential yield (t/ha) for the South 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.

	Mean			Minimum			Maximum			Difference	
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C	2°C	4°C
Gwent	7	7.6	9.2	6.1	6.5	8	8.6	9.3	10.8	0.6	2.3
South Glamorgan	7.3	7.9	9.5	6.8	7.4	8.8	8.1	8.6	10.2	0.6	2.1
Mid Glamorgan	7.1	7.8	9.6	6.3	7	8.7	8.4	8.9	10.4	0.7	2.5
West Glamorgan	7.5	8.1	9.9	6.5	7.1	8.9	9.4	9.9	11.5	0.7	2.4

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

South 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 South Wales area.

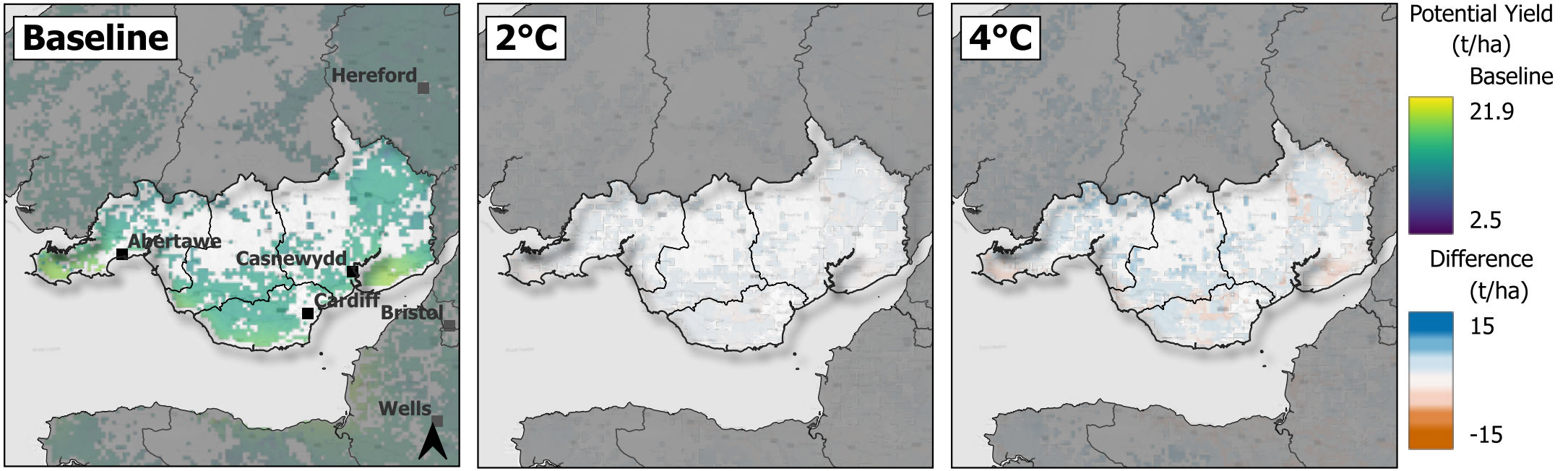
Local Summary

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

	Mean			Minimum			Maximum		
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwent	15.7	16.3	15.5	9.2	10.8	8.8	19.1	20.4	21
South Glamorgan	16.1	16.6	16.3	13.2	13.1	10.5	17.3	19.2	20.5
Mid Glamorgan	15.8	16.6	17.6	9.6	13.6	10.8	17.7	19	20.5
West Glamorgan	16.4	17.1	18.1	10.5	10.9	9.4	18.7	20.3	21.1

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

South 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 South Wales area.

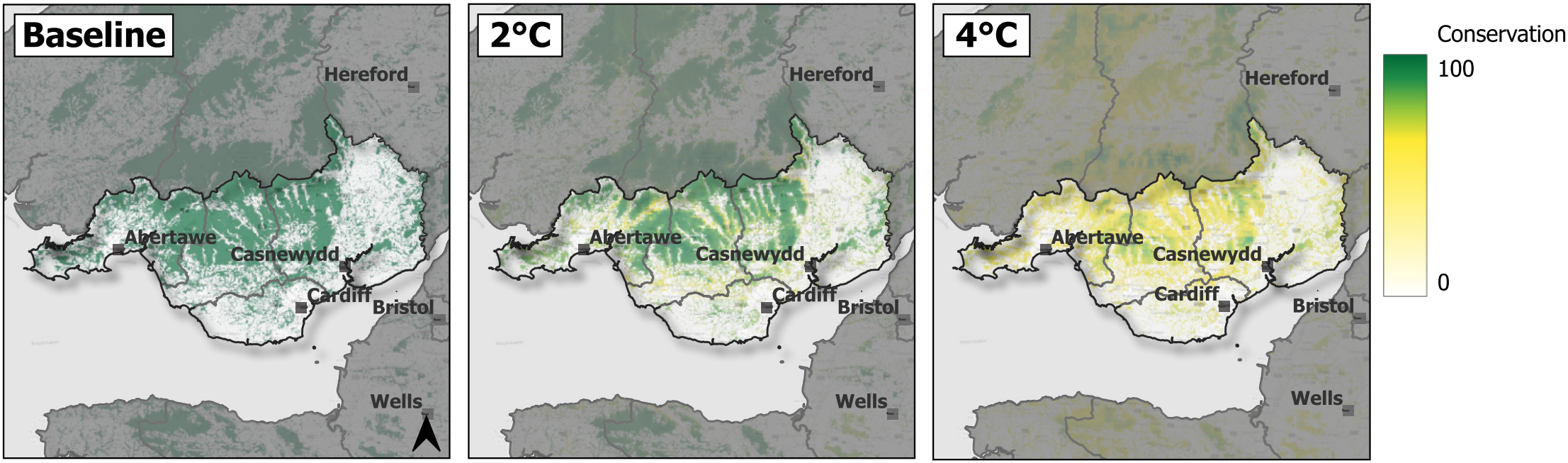
Local Summary

Minimum, mean and maximum potential yield (t/ha) for the South 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.

	Mean			Minimum			Maximum			Difference	
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C	2°C	4°C
Gwent	15.7	16.3	15.5	9.2	10.8	8.8	19.1	20.4	21	0.6	-0.2
South Glamorgan	16.1	16.6	16.3	13.2	13.1	10.5	17.3	19.2	20.5	0.4	0.2
Mid Glamorgan	15.8	16.6	17.6	9.6	13.6	10.8	17.7	19	20.5	0.7	1.8
West Glamorgan	16.4	17.1	18.1	10.5	10.9	9.4	18.7	20.3	21.1	0.7	1.6

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

South 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.

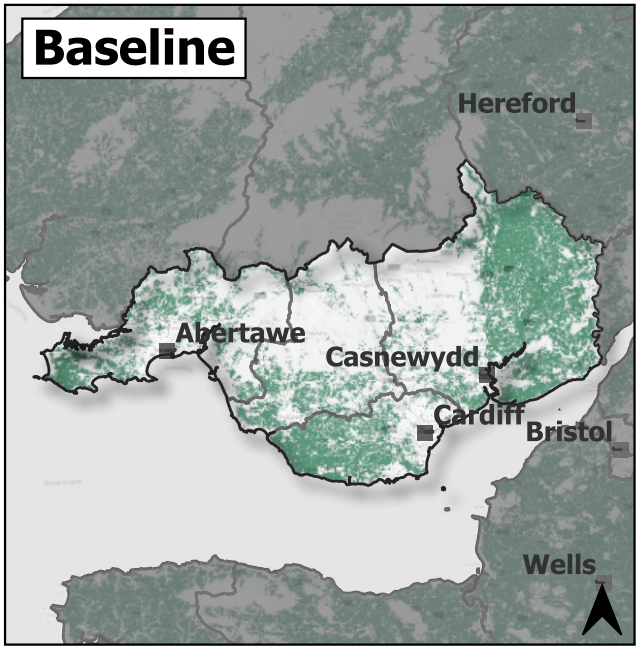
Local Summary

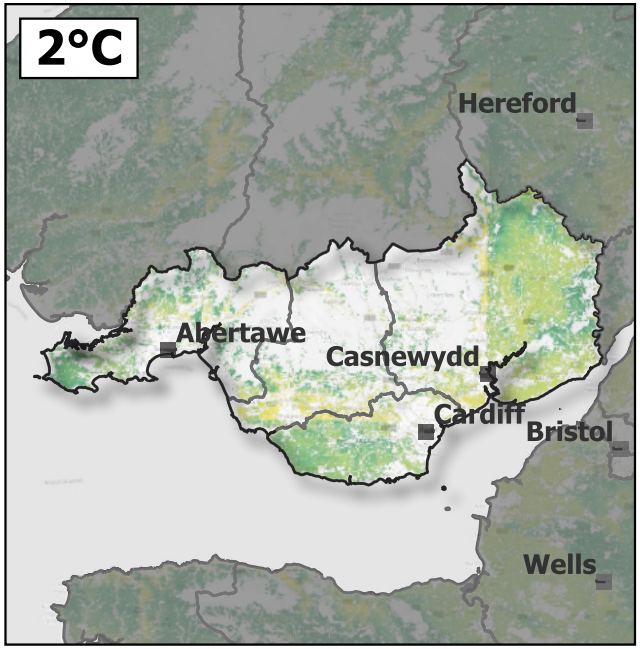
Minimum, mean and maximum conservation potential (%) for South Wales at baseline, 2°C and 4°C warming scenarios.

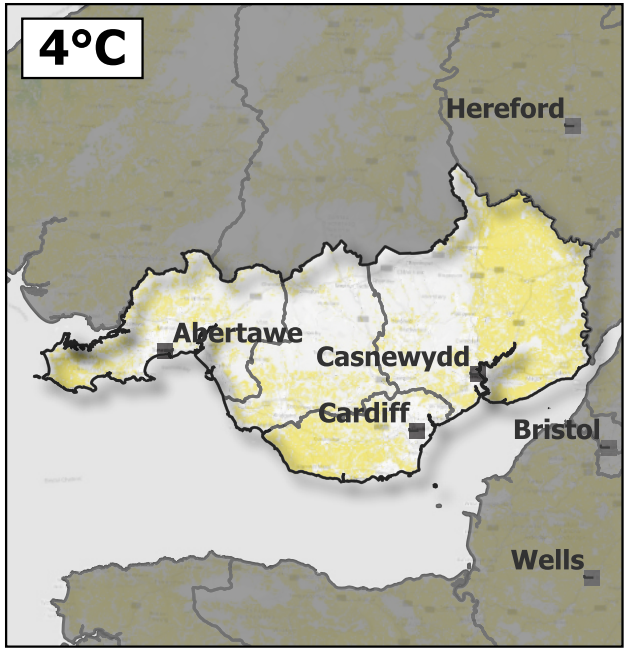
	Mean			Minimum			Maximum		
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwent	48.5	41.5	30	0	0	0	100	100	80
South Glamorgan	26.2	20.6	15.8	0	0	0	100	90	66
Mid Glamorgan	76.1	66	45.6	0	0	0	100	100	75
West Glamorgan	65.6	55.9	39.2	0	0	0	100	100	75

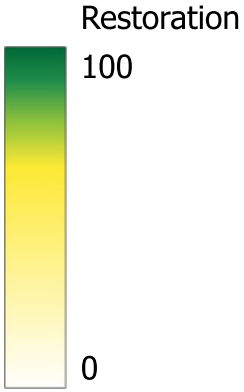
The OpenCLIM project was funded by the UK Resilience Program.For further information visit openclim.science

South 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.

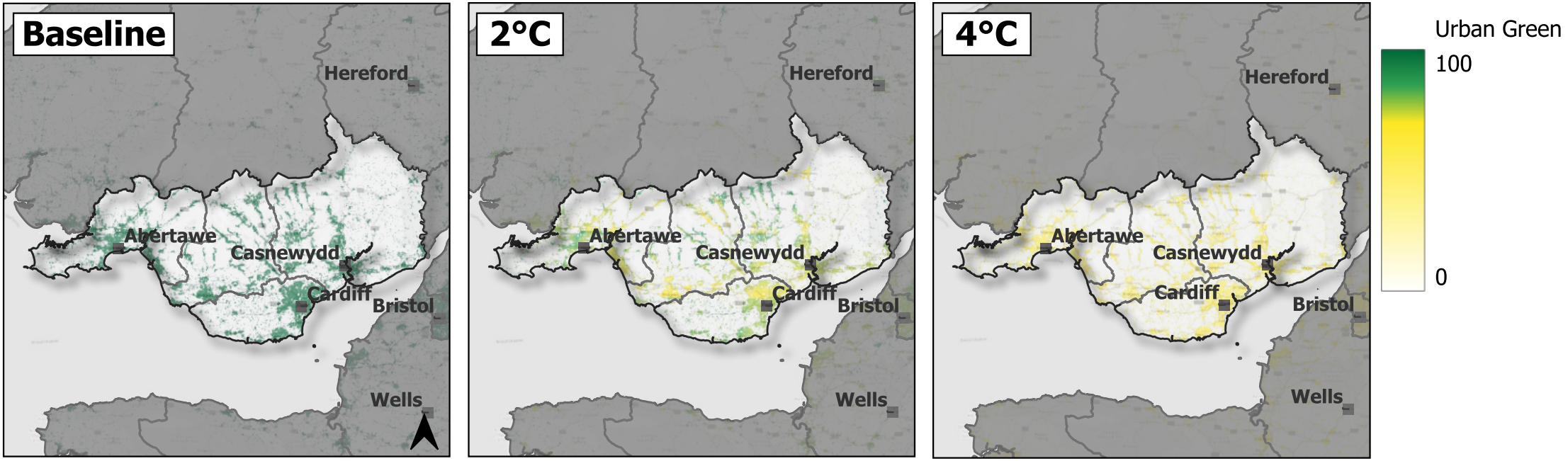
Local Summary

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

	Mean			Minimum			Maximum		
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwent	51.5	41	31.4	0	0	0	100	98	80
South Glamorgan	73.8	59.4	45.6	0	0	0	100	90	66
Mid Glamorgan	23.9	18.7	13.4	0	0	0	100	100	72
West Glamorgan	34.4	28.2	20.1	0	0	0	100	100	71

The OpenCLIM project was funded by the UK Resilience Program.For further information visit openclim.science

South 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.

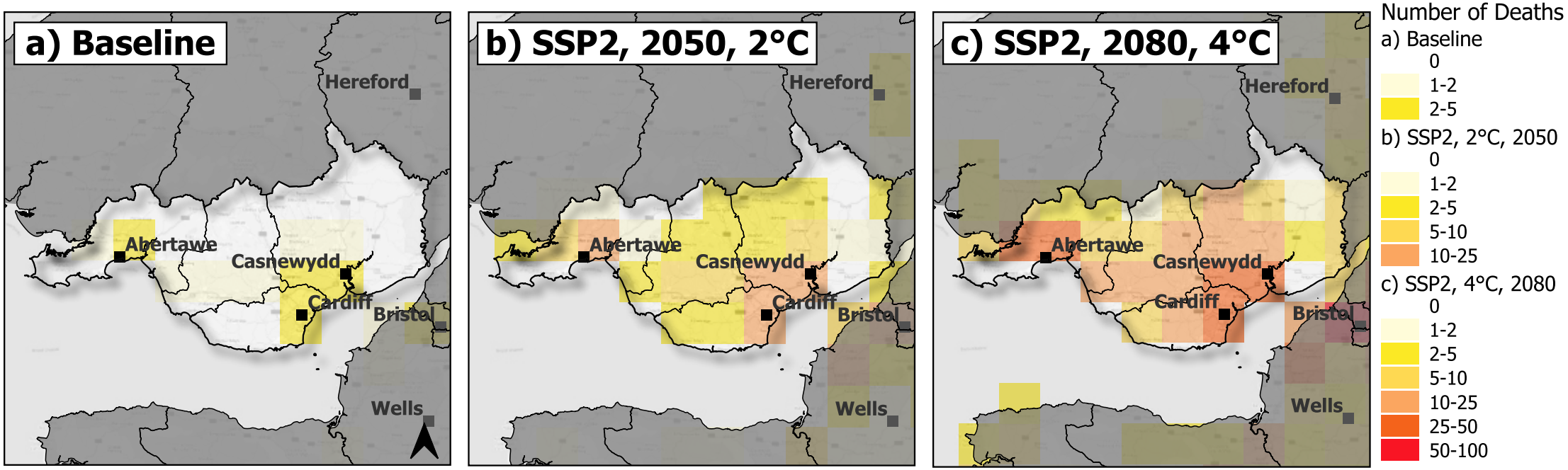
Local Summary

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

	Mean			Minimum			Maximum		
County	Baseline	2°C	4°C	Baseline	2°C	4°C	Baseline	2°C	4°C
Gwent	12.9	10.1	7.6	0	0	0	100	98	73
South Glamorgan	29.4	22.1	17.2	0	0	0	100	90	66
Mid Glamorgan	17.7	13.5	9.8	0	0	0	100	100	74
West Glamorgan	19.1	14.5	10.5	0	0	0	100	100	74

The OpenCLIM project was funded by the UK Resilience Program.For further information visit openclim.science

South 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 South Wales for baseline and future scenarios.

	Baseline		SSP2 2050 2°C			SSP2 2080 4°C		
County	**Mean**	**Cumulative**	**Mean**	**Cumulative**	**Difference**	**Mean**	**Cumulative**	**Difference**
Gwent	0.7	13.5	3.4	64.2	2.7	10.4	196.8	9.6
South Glamorgan	1.7	12.1	8.4	58.9	6.7	25.2	176.1	23.4
Mid Glamorgan	0.8	10.5	3.9	50.4	3.1	12.4	160.6	11.5
West Glamorgan	0.8	7.6	3.5	34.6	2.7	11.1	111.5	10.4

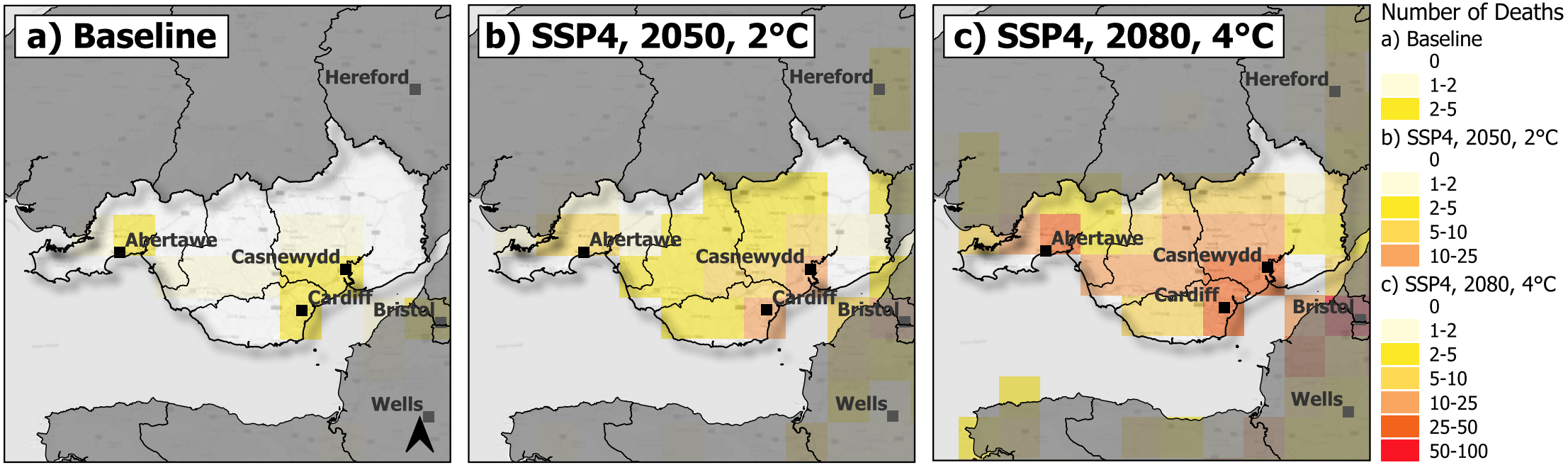
Mean deaths (death/yr) for each future scenario and the climate model ensemble range between 10th and 90th percentile.

County	**Baseline Mean**	**10th - 90th percentile**	**SSP2 2050 2°C Mean**	**10th - 90th percentile**	**SSP2 2080 4°C Mean**	**10th - 90th percentile**
Gwent	0.7	0 - 3.4	3.4	0.1 - 16.6	10.4	0.3 - 45.2
South Glamorgan	1.7	0.4 - 4.1	8.4	2.1 - 20	25.2	6.4 - 59.4
Mid Glamorgan	0.8	0 - 2.8	3.9	0 - 13.6	12.4	0.1 - 40.2
West Glamorgan	0.8	0.1 - 3	3.5	0.4 - 13.7	11.1	1.4 - 40.7

The OpenCLIM project was funded by the UK Climate Resilience Program. For more information visit openclim.science

OPEN CLIMATE IMPACT FRAMEWORK

South 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 South Wales for baseline and future scenarios.

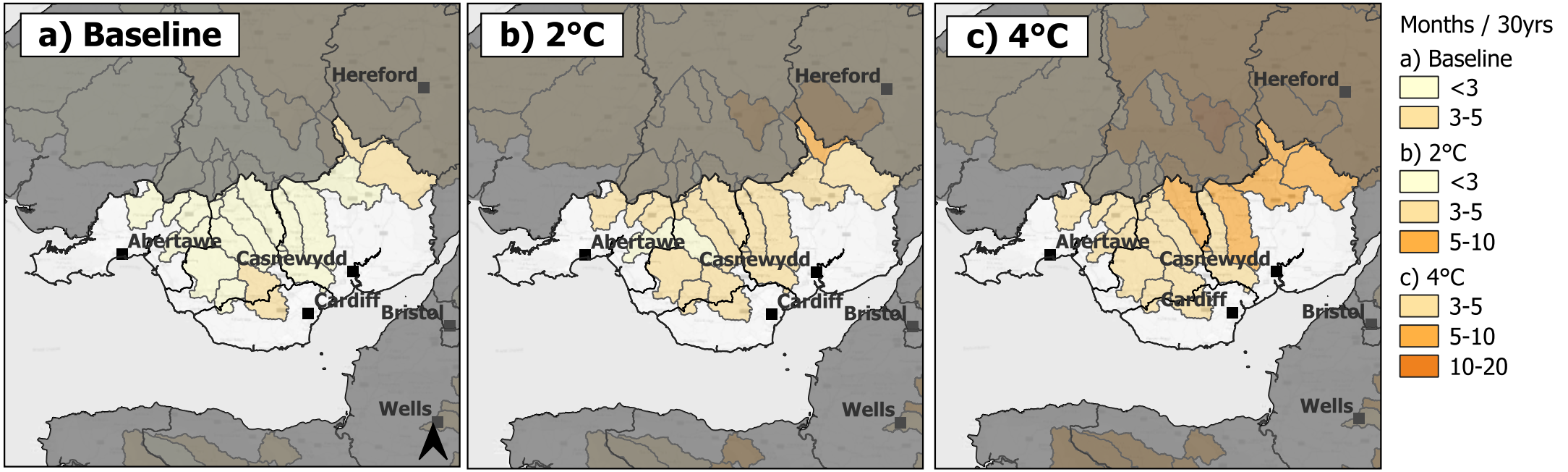
	Baseline		SSP4 2050 2°C			SSP4 2080 4°C		
County	**Mean**	**Cumulative**	**Mean**	**Cumulative**	**Difference**	**Mean**	**Cumulative**	**Difference**
Gwent	0.7	13.5	3.1	59.5	2.4	8.5	162.4	7.8
South Glamorgan	1.7	12.1	7.8	54.4	6	20.5	143.5	18.8
Mid Glamorgan	0.8	10.5	3.6	46.8	2.8	10.2	132.2	9.4
West Glamorgan	0.8	7.6	3.2	32.2	2.5	9.3	92.8	8.5

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**
Gwent	3	0.1 - 14.4	3.1	0.1 - 15.1	8.5	0.3 - 36.1
South Glamorgan	7.4	1.9 - 17.4	7.8	1.9 - 18.4	20.5	5.4 - 47.9
Mid Glamorgan	3.5	0 - 11.9	3.6	0 - 12.6	10.2	0.1 - 32.6
West Glamorgan	3.1	0.4 - 12.2	3.2	0.4 - 12.7	9.3	1.2 - 34.7

The OpenCLIM project was funded by the UK Climate Resilience Program. For more information visit openclim.science

South Wales | 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 South Wales, and the percentage change from baseline for a 2°C and 4°C warming scenario.

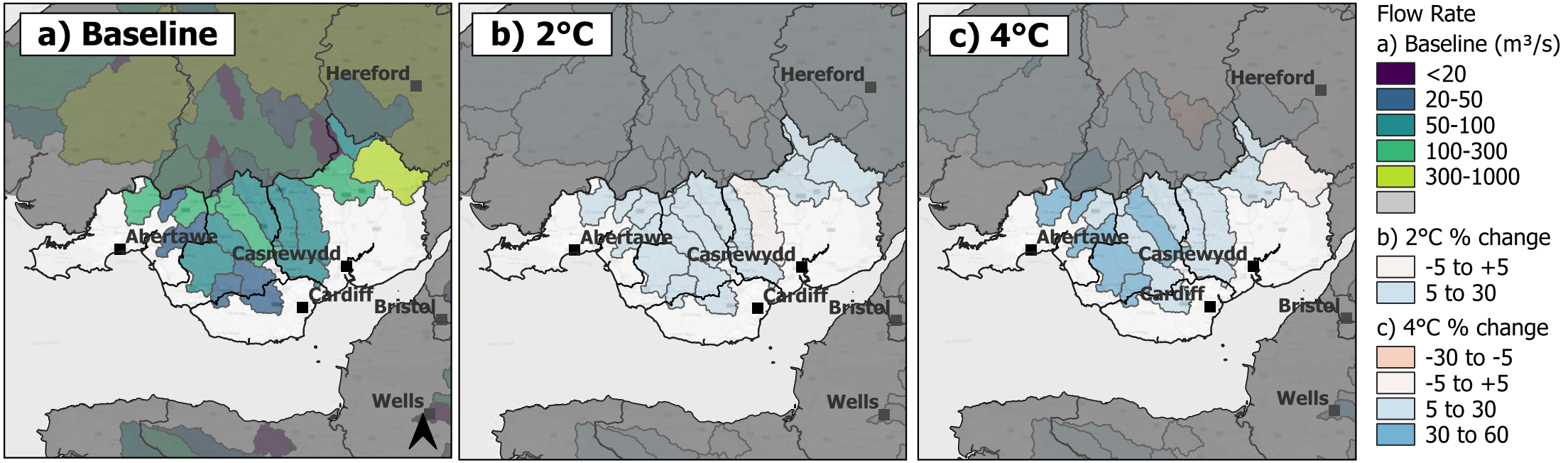
	Median			Minimum			Maximum		
County	**Baseline**	**2°C**	**4°C**	**Baseline**	**2°C**	**4°C**	**Baseline**	**2°C**	**4°C**
Gwent	2.9	3.9	5.5	2.8	3.3	4.1	3.9	6	8.6
South Glamorgan	2.9	3.4	4.3	2.8	3.3	4.1	3.1	3.6	4.4
Mid Glamorgan	2.8	3.3	4.1	2.5	2.9	3.4	3.1	3.7	5.3
West Glamorgan	2.6	3.1	3.8	2.5	2.9	3.4	2.9	3.5	4.5

Median drought duration (months/30-yr) for baseline scenario in South 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 Median**	**10th - 90th percentile**	**4°C Median**	**10th - 90th percentile**
Gwent	2.9	2.1 - 4.7	3.9	2.4 - 5.5	5.5	3 - 7.7
South Glamorgan	2.9	2.6 - 3.6	3.4	2.7 - 4.4	4.3	3.4 - 6
Mid Glamorgan	2.8	2 - 4.9	3.3	2.5 - 5.2	4.1	3.1 - 7.5
West Glamorgan	2.6	2.1 - 3.3	3.1	2.5 - 4.4	3.8	3.1 - 6.1

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

South Wales | 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 South Wales, and the percentage change from baseline for a 2°C and 4°C warming scenario.

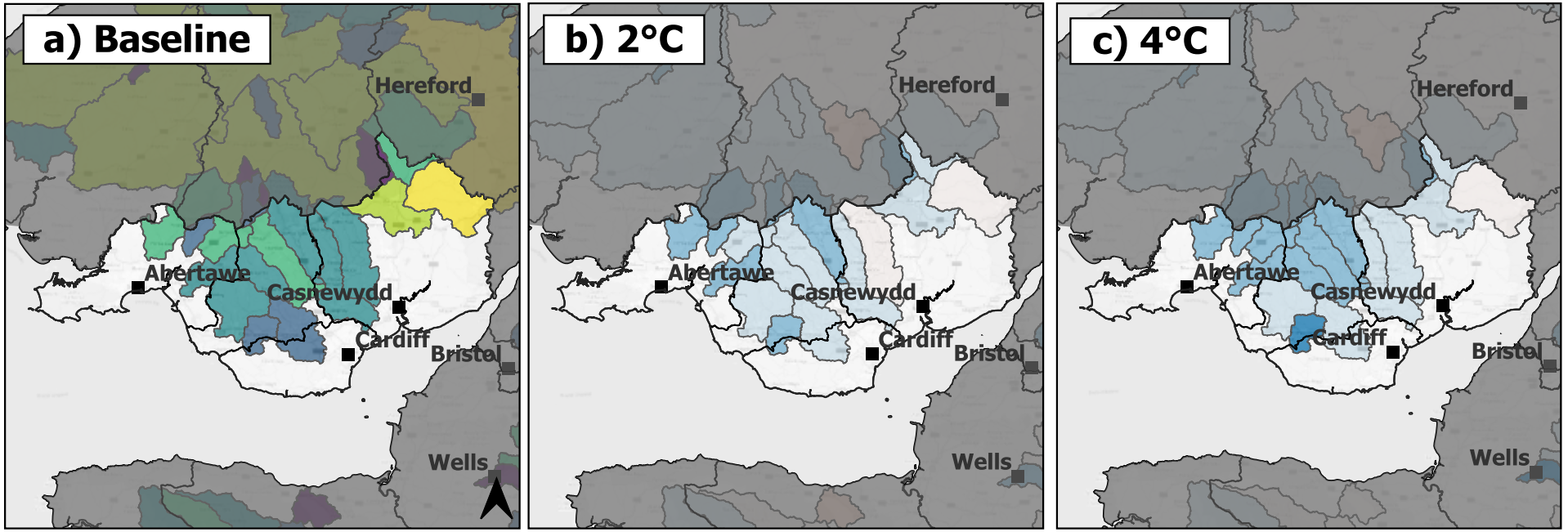
	Median	% change		Minimum			Maximum		
County	**Baseline**	**2°C**	**4°C**	**Baseline**	**2°C**	**4°C**	**Baseline**	**2°C**	**4°C**
Gwent	76	12.1	21.4	13.8	4.5	4.9	667.7	16.3	34.1
South Glamorgan	35.9	15.4	27	21.6	13.4	25.3	59.2	28.9	43.6
Mid Glamorgan	57.9	16.2	29.2	21.6	13.4	25.3	202.9	28.9	43.6
West Glamorgan	66.1	21.3	34.1	21	14.3	26.4	202.9	26.5	38.6

Median flow rate (m3/s) for baseline scenario in South 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**
Gwent	76	11.3 - 837.1	12.1	21.4
South Glamorgan	35.9	18.8 - 67.5	15.4	27
Mid Glamorgan	57.9	18.8 - 233.4	16.2	29.2
West Glamorgan	66.1	20.2 - 233.4	21.3	34.1

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

South Wales | 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 South Wales, and the percentage change from baseline for a 2°C and 4°C warming scenario.

	Median	% change		Minimum			Maximum		
County	**Baseline**	**2°C**	**4°C**	**Baseline**	**2°C**	**4°C**	**Baseline**	**2°C**	**4°C**
Gwent	111.4	17	25.9	23.6	0.4	-1.4	902	36.9	50
South Glamorgan	44.5	28.6	28.8	21.9	13.3	26.9	93	54.6	68.1
Mid Glamorgan	76.6	28.6	34.9	21.9	13.3	26.9	294.2	54.6	68.1
West Glamorgan	80.7	29	38.5	33.1	23	26.9	294.2	43.9	44.5

Median flow rate (m3/s) for baseline scenario in South 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**
Gwent	111.4	12.8 - 1323	17	25.9
South Glamorgan	44.5	21.3 - 88.8	28.6	28.8
Mid Glamorgan	76.6	21.3 - 306.2	28.6	34.9
West Glamorgan	80.7	22.9 - 306.2	29	38.5

The OpenCLIM project was funded by the UK Climate Resilience Program. For details visit openclim.science

Further information

OpenCLIM disclaimer / intended use statement

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 sub-national 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

Front cover image credits: Don Lodge and Bruno Martins on Unsplash.com.

Maps contain public sector information (administrative boundaries) licensed under the Open Government Licence v3.0.

University of East Anglia

Tyndall Centre for Climate Change Research

Open Climate Impacts Modelling Framework