PROVIDE

Berlin Brandenburg urban heat study and the Climate Risk Dashboard

Inga Menke, Sylvia Schmidt

Humboldt Universität, Climate Analytics

Welcome

Your name

Your organisation

Interest

Inga Menke
Humboldt Universität
inga.menke@hu-berlin.de

Sylvia Schmidt
Climate Analytics
Sylvia.schmidt@climateanalytics.org

Today's outline

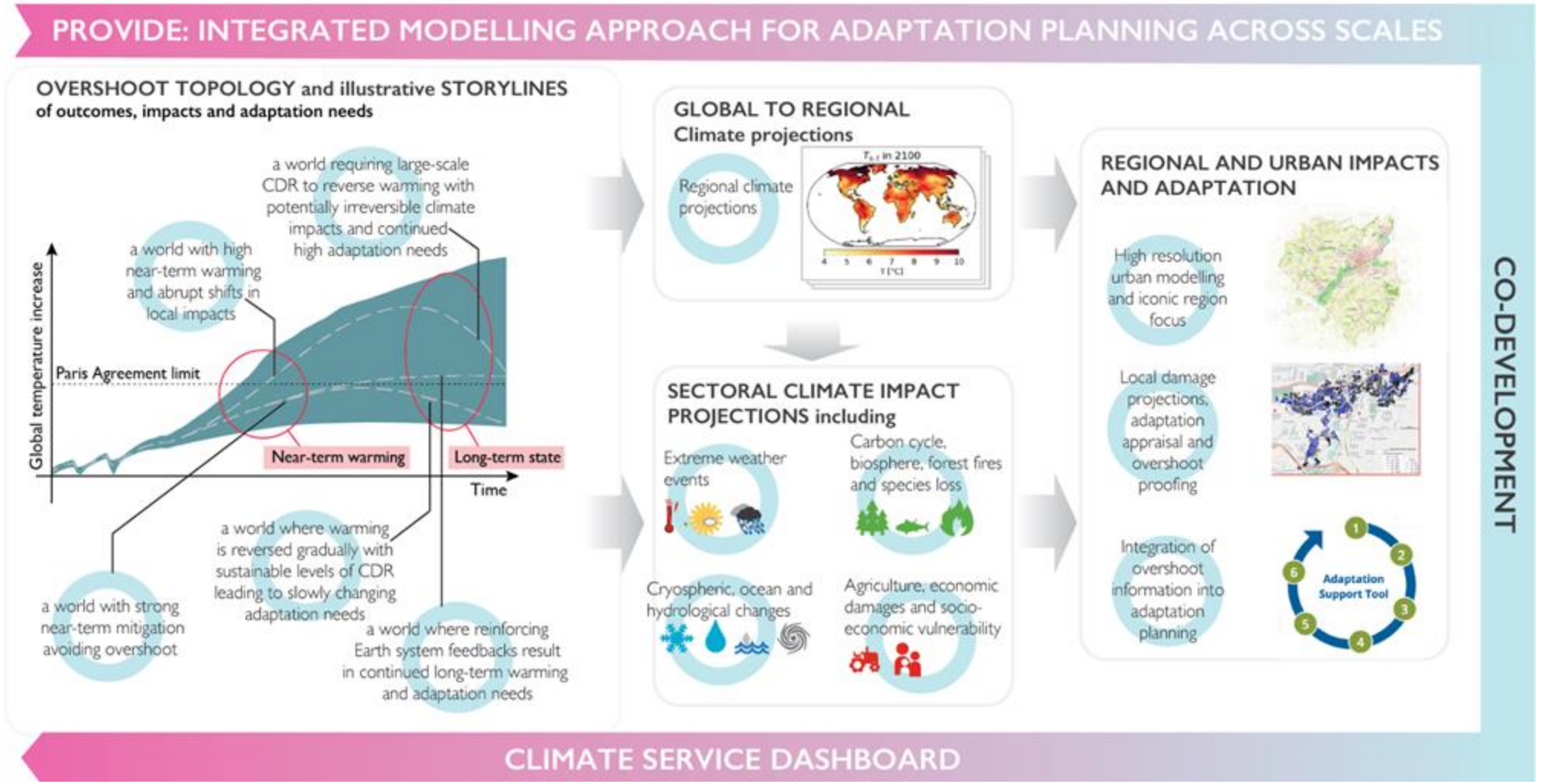
I. Introduction to the PROVIDE project
II. Local Berlin/Brandenburg study on heat stress
III. PROVIDE Climate Risk Dashboard
IV. Exploring the Climate Risk Dashboard
V. Group work
    a) Berlin-Brandenburg study and building types
    b) Urban adaptation and adaptation pathways

PROVIDE in a nutshell

Paris Agreement Overshooting-Reversibility, Climate Impacts and Adaptation Needs

- EU Horizon 2020
- Sep 2021-Dec 2024
- 17 partner organisations

Exploring overshoot implications across scales



Climate risk dashboard

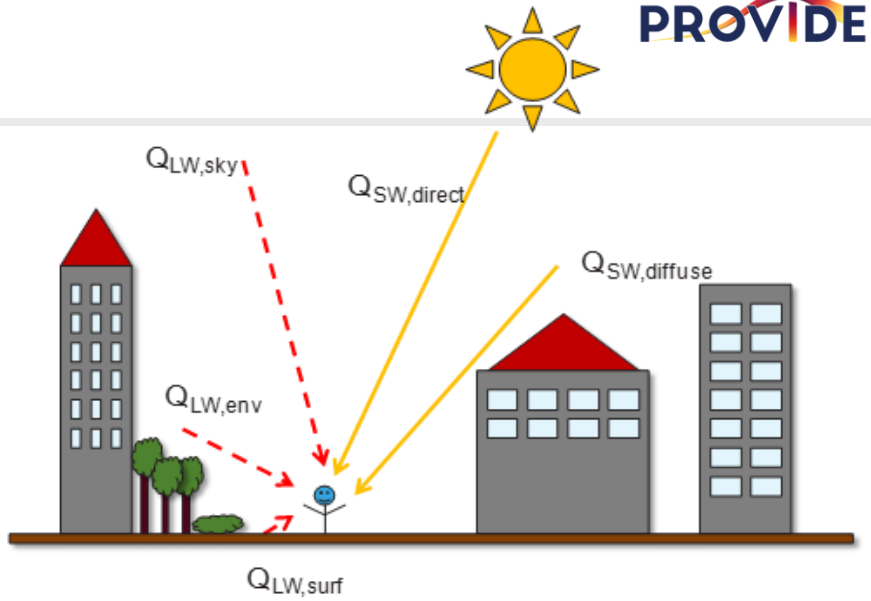
- PROVIDE develops the Climate risk dashboard
- Links global emissions pathways to regional sectoral impacts

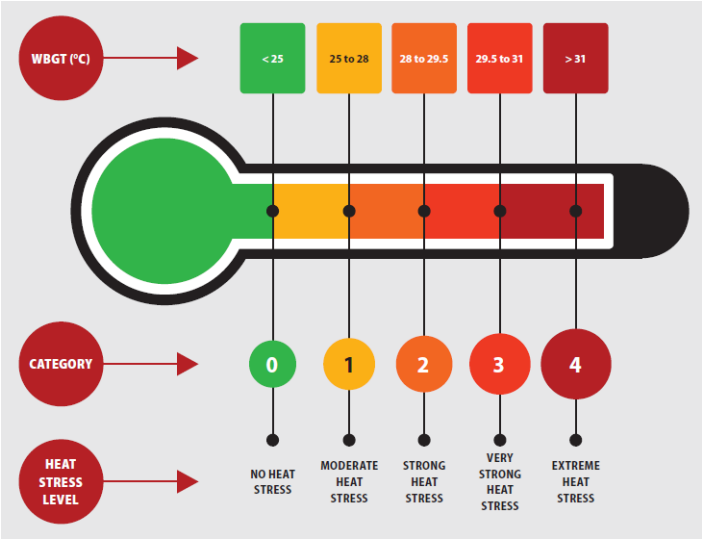
Berlin/Brandenburg study

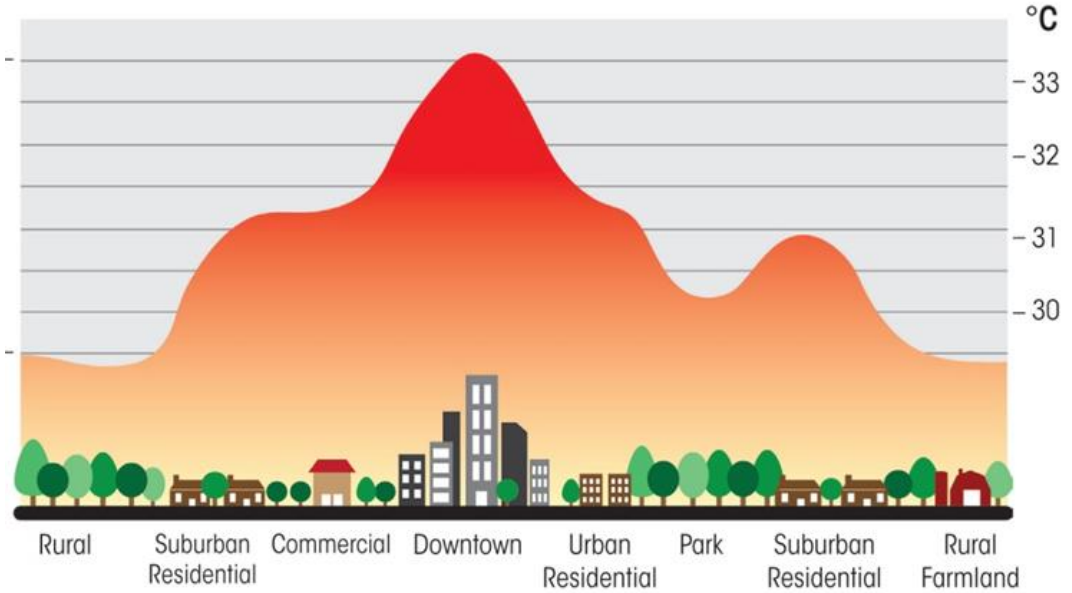
- 1 year project (end of 2022 – early 2024)
- Funding: Climate Change Centre Berlin Brandenburg
- Study based on PROVIDE methodology
- Aim: high resolution heat stress modelling with and without adaptation options for a specific area in Berlin
- Results:
  - Final report available in German
  - 1m x 1m map for heat stress in Berlin
  - Integration of 16 heat indicators for 100m x 100m in the Climate Risk Dashboard

What is heat stress?

- Urban Heat Island Effect – cities heat up faster
  - Increase in tropical nights
  - Increased health risk from heat stress
- Need for high resolution modelling
  - UrbCLIM
  - 30x30m
  - 1x1m







Local relevance

- Heat stress is an increasing problem in Berlin
  - An aging population
  - increasing heat stress due to climate change
  - Unequally distributed risk for the population
  - Need to plan adaptation measures now, to be effective in the future

- Interest of the Bezirksamts Pankow to cover a study on heat stress and health aspects
  - Agreed collaboration on a densification project
  - Thorough exchange throughout the project to identify relevant study area, integrate available data and share relevant results

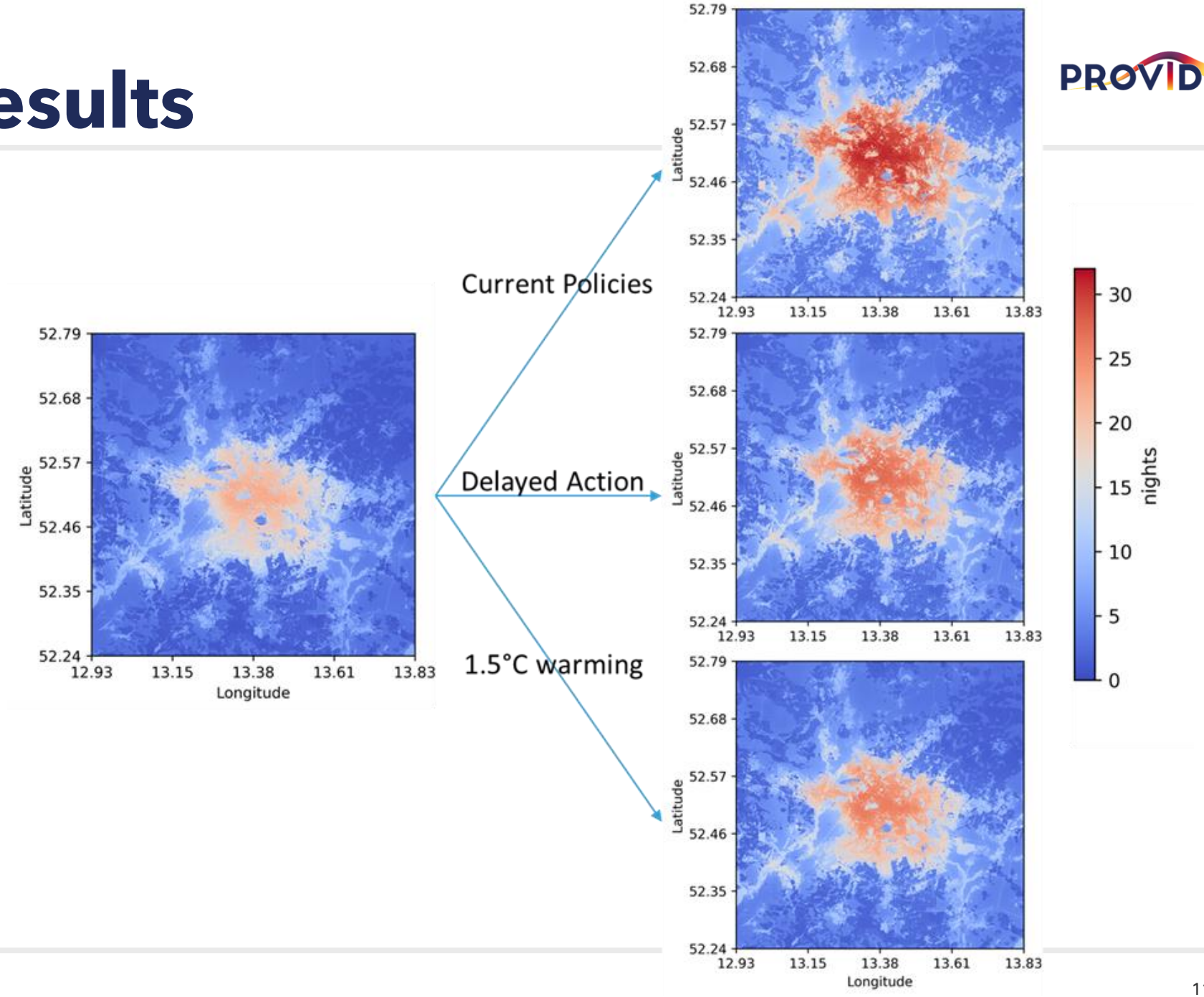
Results

- The report is available on the project page:
  - https://climateanalytics.org/projects/kunftige-klimaauswirkungen-und-anpassungsbedarf-fur-berlin-brandenburg

- 100m x 100 m resolution data is available in the Climate Risk Dashboard:
  - https://climate-risk-dashboard.climateanalytics.org

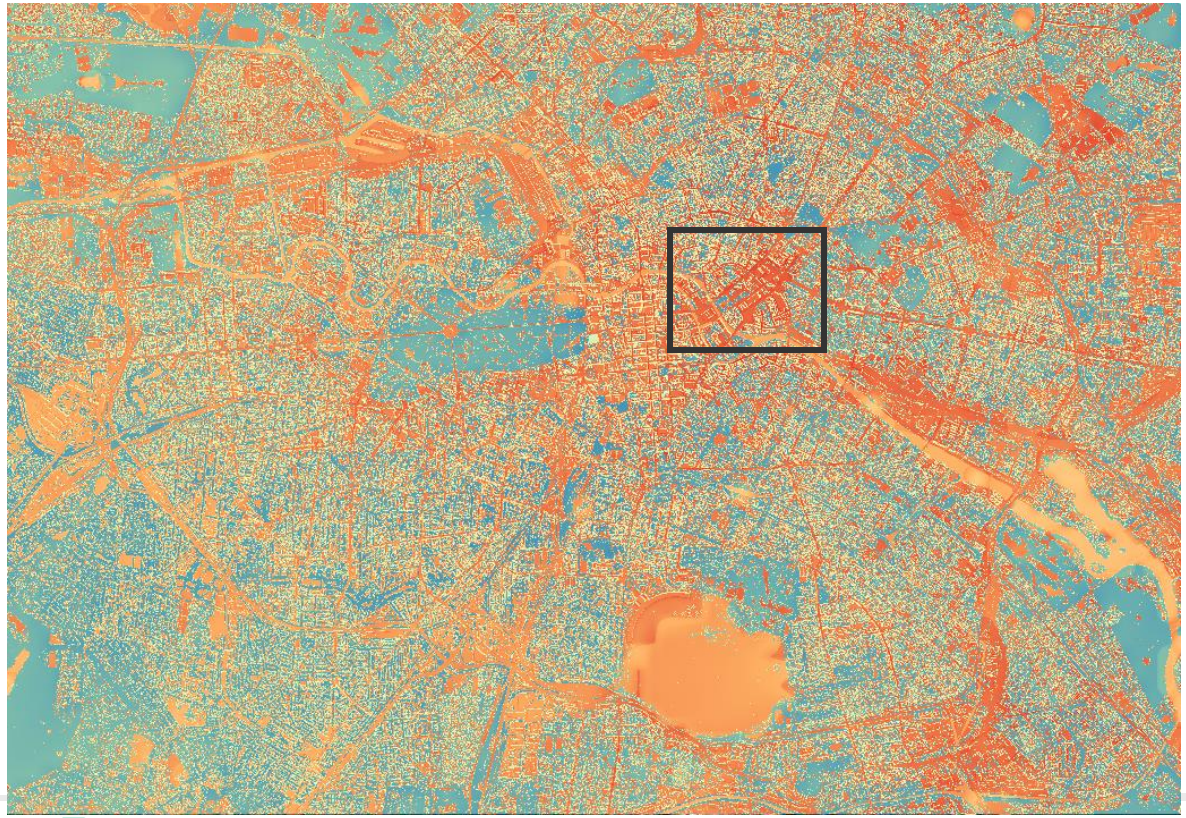
Modelling results

- Tropical nights(<20°C) in 2050 for 3 scenarios



High resolution modelling results

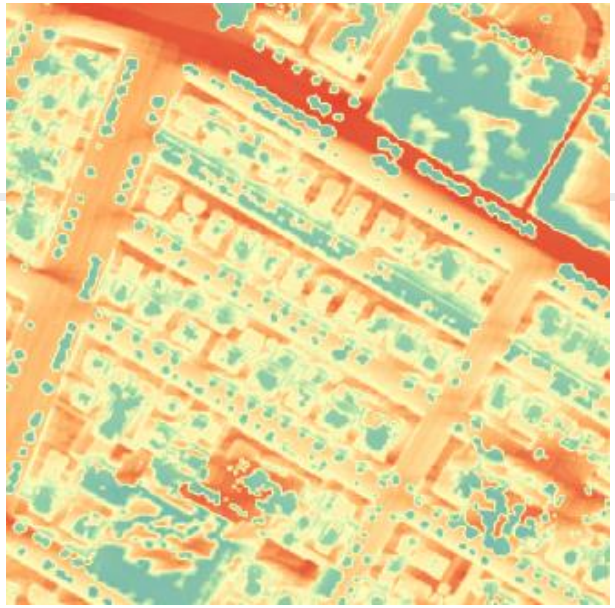
- Hotspots in the city: Alexanderplatz
- Map: Hottest hour of the day (WBGT)
- Green cover areas such as the Tiergarten are more than 3°C cooler



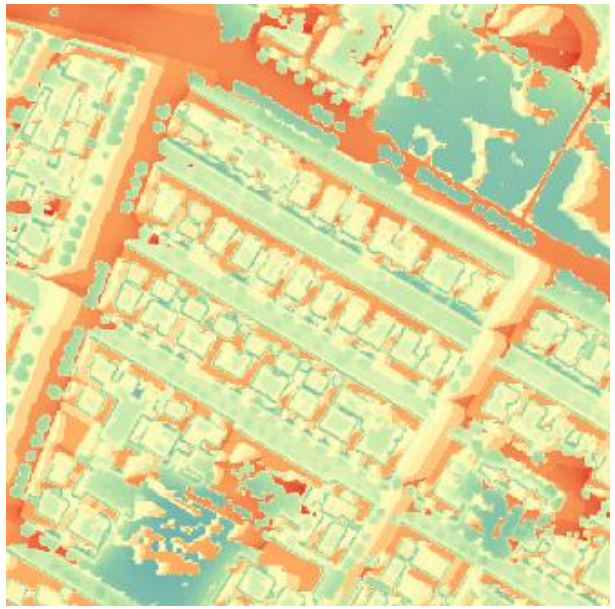
Alexanderplatz

very hot day – 25 July 2019, max temp.

Results for different types of building



Max temp.



Average temp.

High density and high degree of built surface is compensated by large trees and shadow the buildings create

Local hotspots are streets, open spaces without tree cover, but also playgrounds and schoolyards

Similar analysis exist for other building types in Berlin

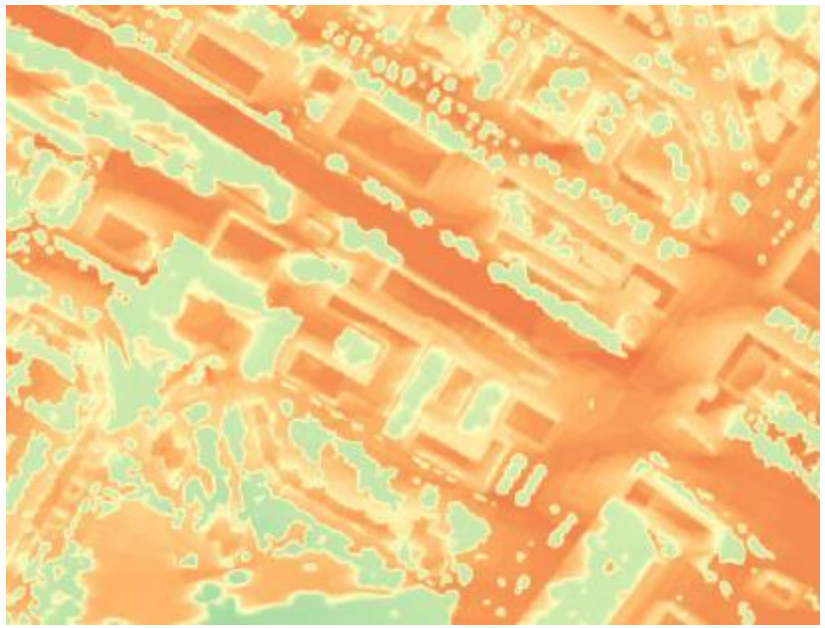
Results adaptation options

- Adaptation scenarios Greifswalder Straße

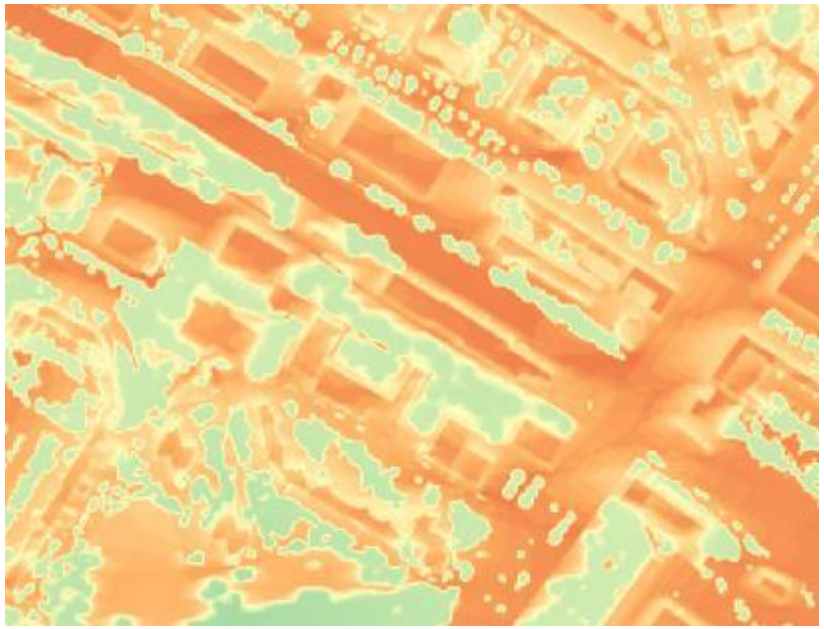
	OPTION 1	OPTION 2	OPTION 3
Heat stress	-	++	++
Acoustic quality	+	-	++
Ecologic quality	-	+	++
Economic feasibility	++	++	+
Spatial integration	+	-	+
Social quality	-	+	++

Modelling results with adaptation options

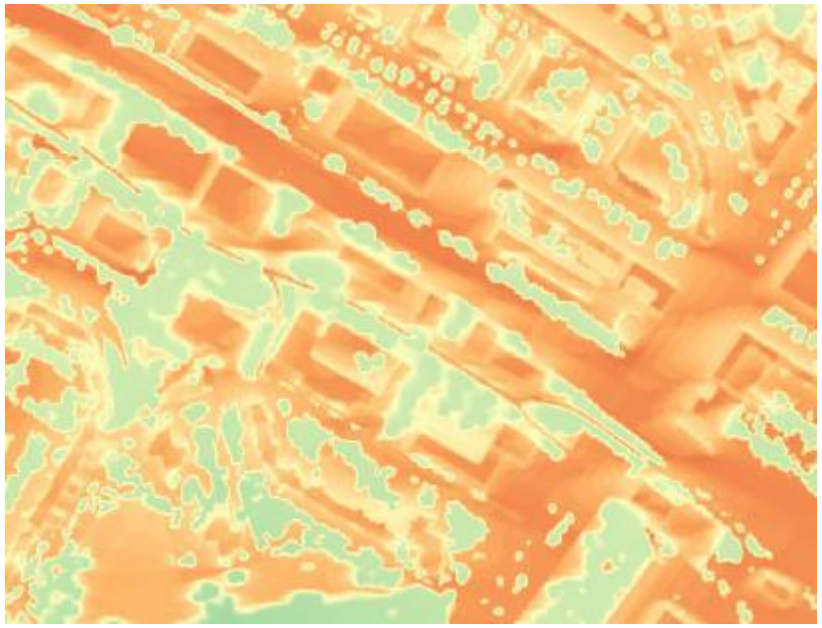
- Heat stress modelling Greifswalderstraße



- Scenario 1



Scenario 2



Scenario 3

Berlin-Brandenburg Report

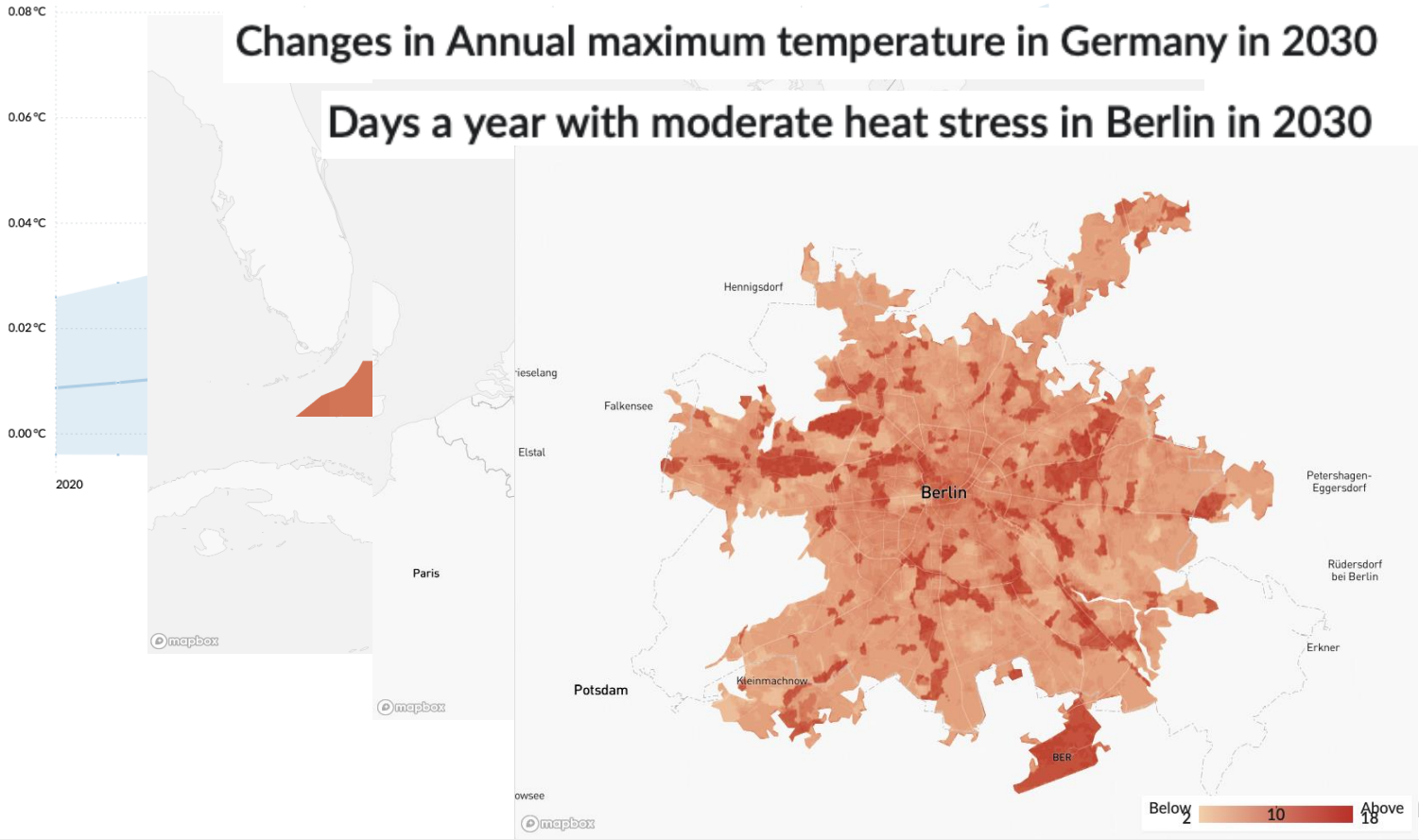
The Climate risk dashboard:
A public database for global-to-local climate impacts depending on mitigation outcomes

https://climate-risk-dashboard.climateanalytics.org/

“Future Impacts”: Impact projections across scales

Changes in Global annual mean temperature rise from peatland emissions in Northern Latitudes from 2020 to 2100

Changes in Sea surface temperature in Bahamas in 2030



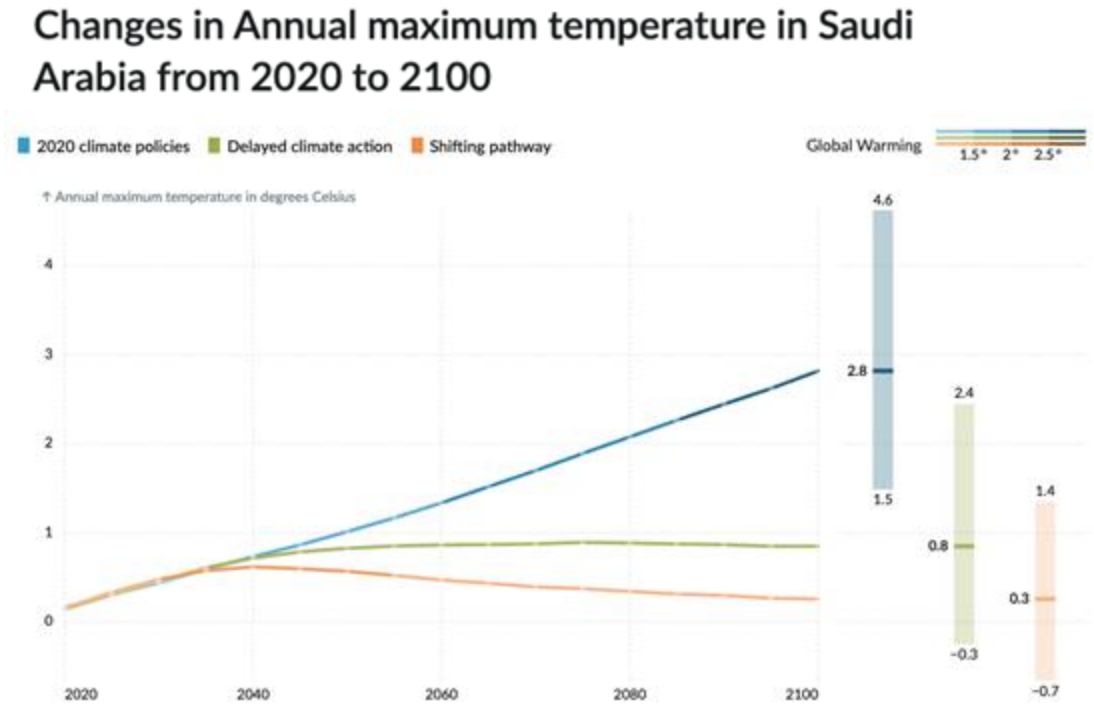
Indicators such as:

- Global Carbon Cycle indicators in northern latitudes
- Marine Climate in Exclusive Economic Zones
- Terrestrial Climate, Glacier Loss and Biodiversity Loss at country level
- Urban heat stress in 140 cities

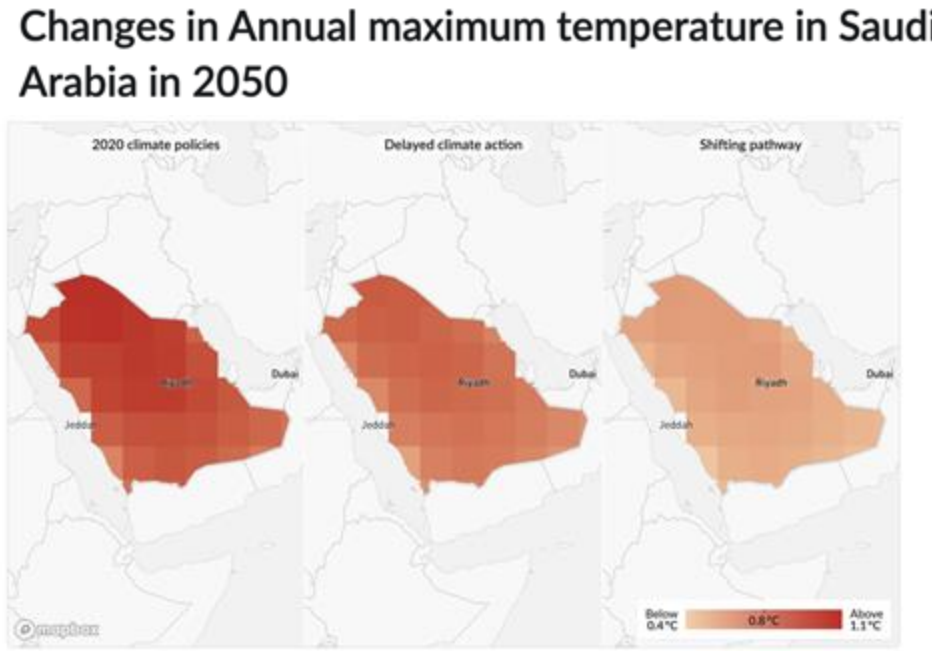
t https://climate-risk-dashboard.climateanalytics.org/

"Future Impacts": Time Series and Maps

- Which impacts will we get in case we respect the Paris Agreement, versus if we followed climate policies from 2020?



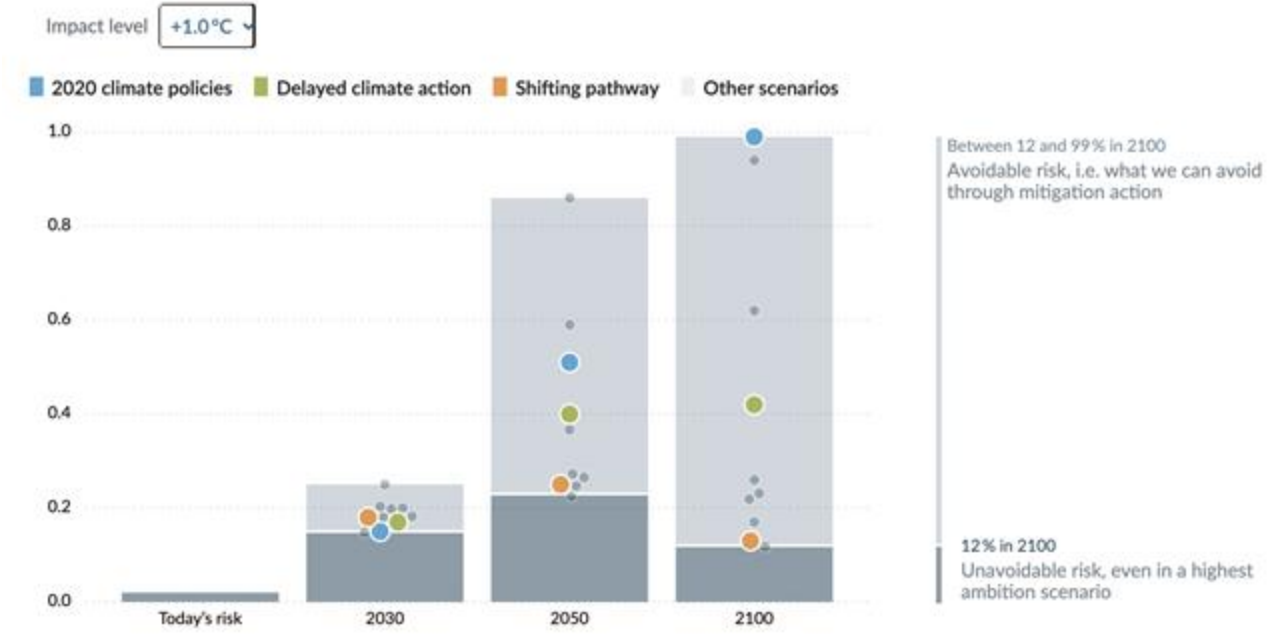
Time series plots



Maps

“Future Impacts”: Risk avoidable via mitigation vs. unavoidable

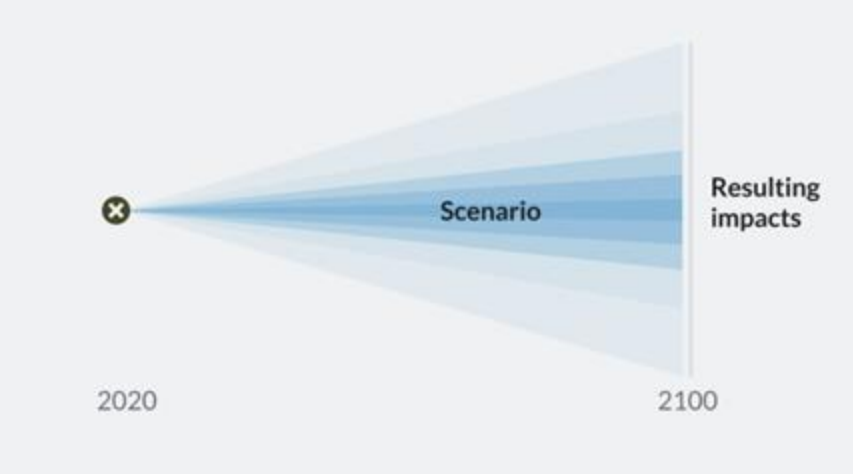
- Which impacts will we get in case we respect the Paris Agreement, versus if we followed climate policies from 2020?



Unavoidable vs. avoidable fraction of risk of Annual Maximum Temperature exceeding +1.0°C above the average of today’s levels (depending on global mitigation outcomes)

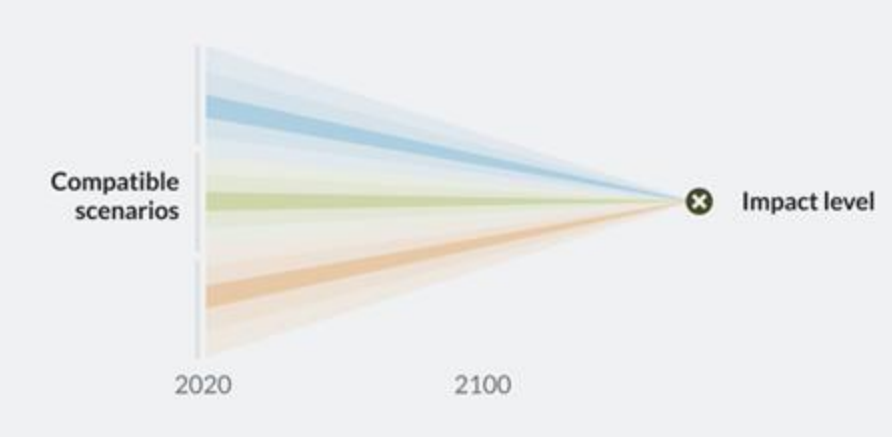
The reversal of the impact chain…

The scenario approach



Explore future impacts for different climate scenarios

Reversal of the impact chain



Explore how the risks of exceeding a local climate risks threshold evolve over time and what is required to avoid it

"Avoiding future impacts"

- based on a **reversal of the impact chain**, the mode shows
  - **whether impact levels could be exceeded under varying scenarios**
  - **how impacts vary across space**

1

INDICATOR

Days a year with moderate heat stress

Days a year with moderate heat stress

Number of days per year where wet bulb globe temperature goes over 25°C. Wet bulb globe temperature (WBGT) is a measure of heat stress in direct sunlight, which takes into account temperature, humidity, wind speed, sun angle and cloud cover (solar radiation).

What impacts are you trying to avoid?
Over the 2011-2020 period, the urban area of Berlin experienced on average 8 days a year with moderate heat stress.

LEVEL OF IMPACT 10 d/yr

0 d/yr — Level of interest — 69 d/yr

PROBABILITY

50 %

LOCATION

city average

Impact Level
When will the impact level be exceeded?

Locations
When will the impact level be exceeded across different locations?

2

IMPACT LEVEL

When will your impact level be exceeded?

To keep the chance that the urban area of Berlin will on average experience over 10 days a year with moderate heat stress below 50 %, one should pursue global emission pathways in line with limiting average global warming to 1.6°C.

This impact level will be exceeded
- in 2040 under the Delayed climate action scenario and
- in 2040 under the 2020 climate policies scenario.

This impact level would be avoided
- under the Shifting pathway scenario.

LOCATIONS

How does this vary across the urban environment?

For the average over the urban area as well as 6 locations indicated on the map, the table provides the levels to which the world should aim to limit Global Mean Temperature (GMT) so that the probability to exceed the selected level of impact (10 days a year with moderate heat stress) doesn't go over 50 %, as well as the years at which this would happen in the three considered emissions scenarios.

Study location	GMT	At what year in scenario...		
city average	1.6 °C	2040	never	2040
❶ urban hot spot	1.2 °C	already	already	already
❷ urban medium spot	1.4 °C	2030	2030	2030
❸ urban cool spot	1.8 °C	never	never	2050
❹ suburban hot spot	2.5 °C	never	never	2080
❺ suburban medium spot	1.2 °C	already	already	already
❻ suburban cool spot	1.2 °C	already	already	already

Delayed climate action | Shifting pathway | 2020 climate policies

“Adaptation”: Translating services for adaptation

1

How to use dashboard data in adaptation planning

Different frameworks already exist to illustrate steps in adaptation planning, including the Adaptation Support Tool and Adaptation Policy Framework. While such steps differ slightly between sources, most include the three simple elements listed below:

1. Assess the current context and risks for a specified area or group. This can include the current climate, as well as socioeconomic and development trends. Common sources for data could include governmental statistics. See examples
2. Assess future risks, including what current risks could be aggravated, or new risks introduced, in future scenarios. The climate risk dashboard's Future impacts mode, Avoid future impacts mode, and Overshoot policy self-assessment tool can inform this step. See examples
3. Identify adaptation options according to assessed risks. Dashboard data can inform the design of locally led studies to prioritise between options. Our team also can be commissioned to carry out urban level studies. See examples

2

CASE STUDIES

Nassau

Potential and limits of nature-based solutions to adapt to heat

Lisbon

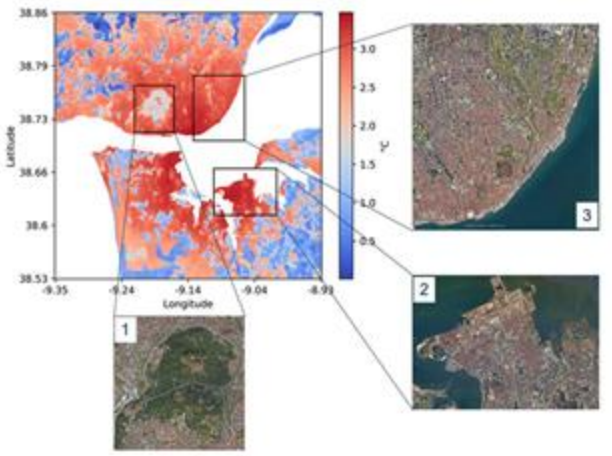
Potential and limits of greening for adaptation

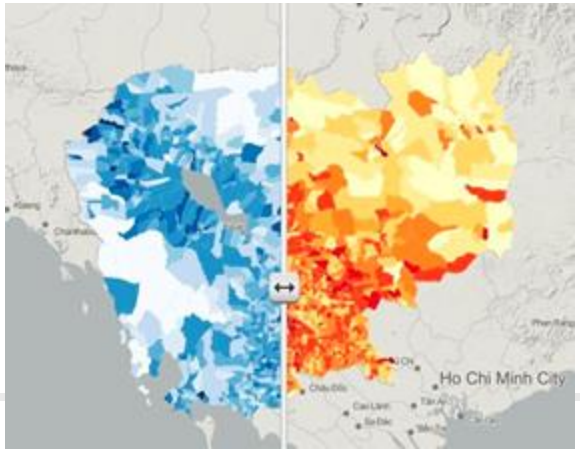
Islamabad

Adaptation needs, and the effectiveness of nature-based solutions

“Adaptation”: Case study examples

- Captures case study activities, including
  - City profiles (assessment of risk and challenges)
  - Evaluation of adaptation policies in light of assessed risks and challenges
  - High to very high resolution hazard modelling
  - Co-development of climate-smart urban plans
  - High to very high resolution modelling of the effectiveness of adaptation measures





"Adaptation": Translating services for adaptation

3 Overshoot Proofing Self-Assessment Tool

Are limits to adaptation identified?

(e.g. maximum number of days above x degrees during a heatwave)

Are uncertainty ranges linked to projected impact considered?

(e.g. 90% confidence interval for the range of models considered)

Are unavoidable impacts identified?

(e.g. committed sea level rise)

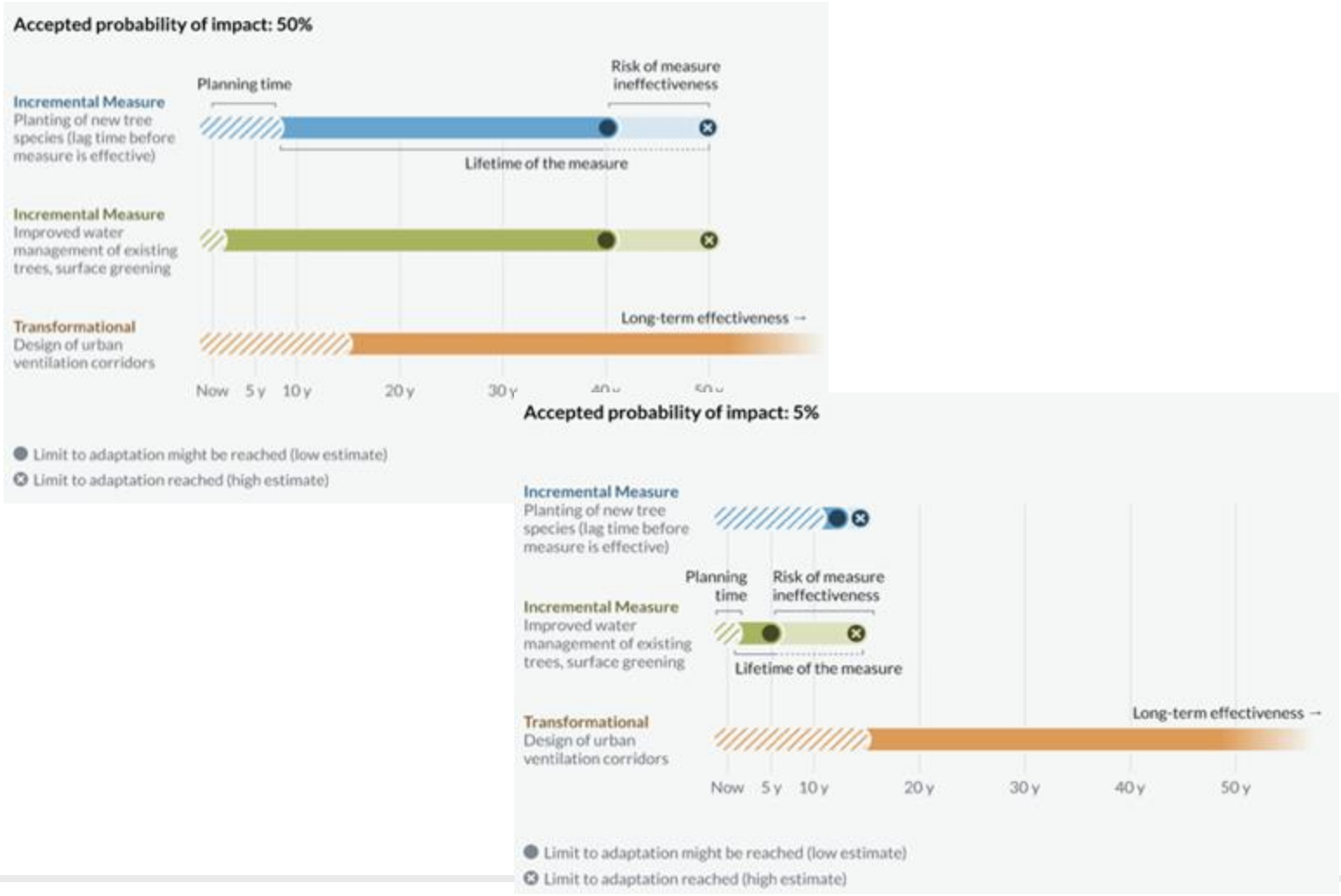
Are overshoot scenarios considered?

(i.e. where temperatures peak over 1.5°C to then descend towards that level again by 2100)

Is impact reversibility vs. irreversibility after overshoot considered?

(e.g. species extinction)

4 Illustrative adaptation pathways



Guidance

Scenario list

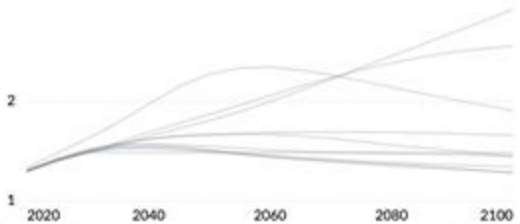
Compare and select up to three scenarios to display them in the scenario explorer.

Scenario	Peak GMT	2100 GMT	Cooling rate after peak	2050 emissions	2100 emissions
2020 climate policies	2.928 °C in 2100	2.928 °C	–	66.655 $GtCO_2eq/yr$	68.322 $GtCO_2eq/yr$
Delayed climate action	1.695 °C in 2080	1.663 °C	-0.016 °C / decade	17.282 $GtCO_2eq/yr$	-0.286 $GtCO_2eq/yr$
Shifting pathway	1.566 °C in 2040	1.295 °C	-0.045 °C / decade	10.199 $GtCO_2eq/yr$	-0.591 $GtCO_2eq/yr$
2020 climate targets	2.56 °C in 2100	2.56 °C	–	57.414 $GtCO_2eq/yr$	31.119 $GtCO_2eq/yr$
High negative emissions	1.673 °C in 2060	1.445 °C	-0.057 °C / decade	19.926 $GtCO_2eq/yr$	-6.051 $GtCO_2eq/yr$
High renewables	1.574 °C in 2040	1.462 °C	-0.019 °C / decade	11.337 $GtCO_2eq/yr$	6.589 $GtCO_2eq/yr$
Low demand	1.545 °C in 2040	1.348 °C	-0.033 °C / decade	9.26 $GtCO_2eq/yr$	1.434 $GtCO_2eq/yr$
SSP1-1.9	1.531 °C in 2040	1.283 °C	-0.041 °C / decade	9.257 $GtCO_2eq/yr$	-8.203 $GtCO_2eq/yr$
SSP5-3.4-OS	2.349 °C in 2060	1.911 °C	-0.11 °C / decade	62.089 $GtCO_2eq/yr$	-13.91 $GtCO_2eq/yr$
Stabilisation at 1.5°C	1.489 °C in 2030	1.489 °C	0 °C / decade	–	–

Scenario timelines

Select a scenario to see progress over time.

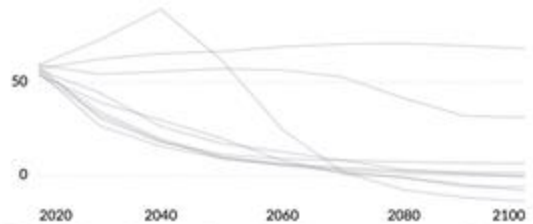
Global mean temperature in °C



The lines in the graph represent best estimates. Learn more about uncertainties here.

Model FaIR v1.6.4 Source Lamboll et al., 2022

Global greenhouse gas emissions in $GtCO_2eq/yr$



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Model FaIR v1.6.4 Source Lamboll et al., 2022

Scenario presets

Click on a research question and see the preselected scenarios that can answer it.

Pledges vs immediate action

What happens if governments implement their current climate pledges, versus if they strengthened them slightly, or if they acted in line with the Paris Agreement?

1.5°C compatible scenarios

What are the differences in climate impacts between various 1.5°C compatible pathways?

1.5°C vs 2°C compatible scenarios

What are the differences in climate impacts between 1.5°C and 2°C compatible scenarios?

Tutorial: how to use the PROVIDE Climate Risk Dashboard
346 views • 2 months ago

Explore urban heat futures: launching the PROVIDE Climate Risk Dashboard
114 views • 6 months ago

How to use the PROVIDE Climate risk dashboard
203 views • 7 months ago

Feedback

For clarification questions or suggestions on the tool, please contact:
climate.risk.dashboard@climateanalytics.org

Using the dashboard

SCENARIO

3 scenarios selected

Timing
How will this climate impact change?

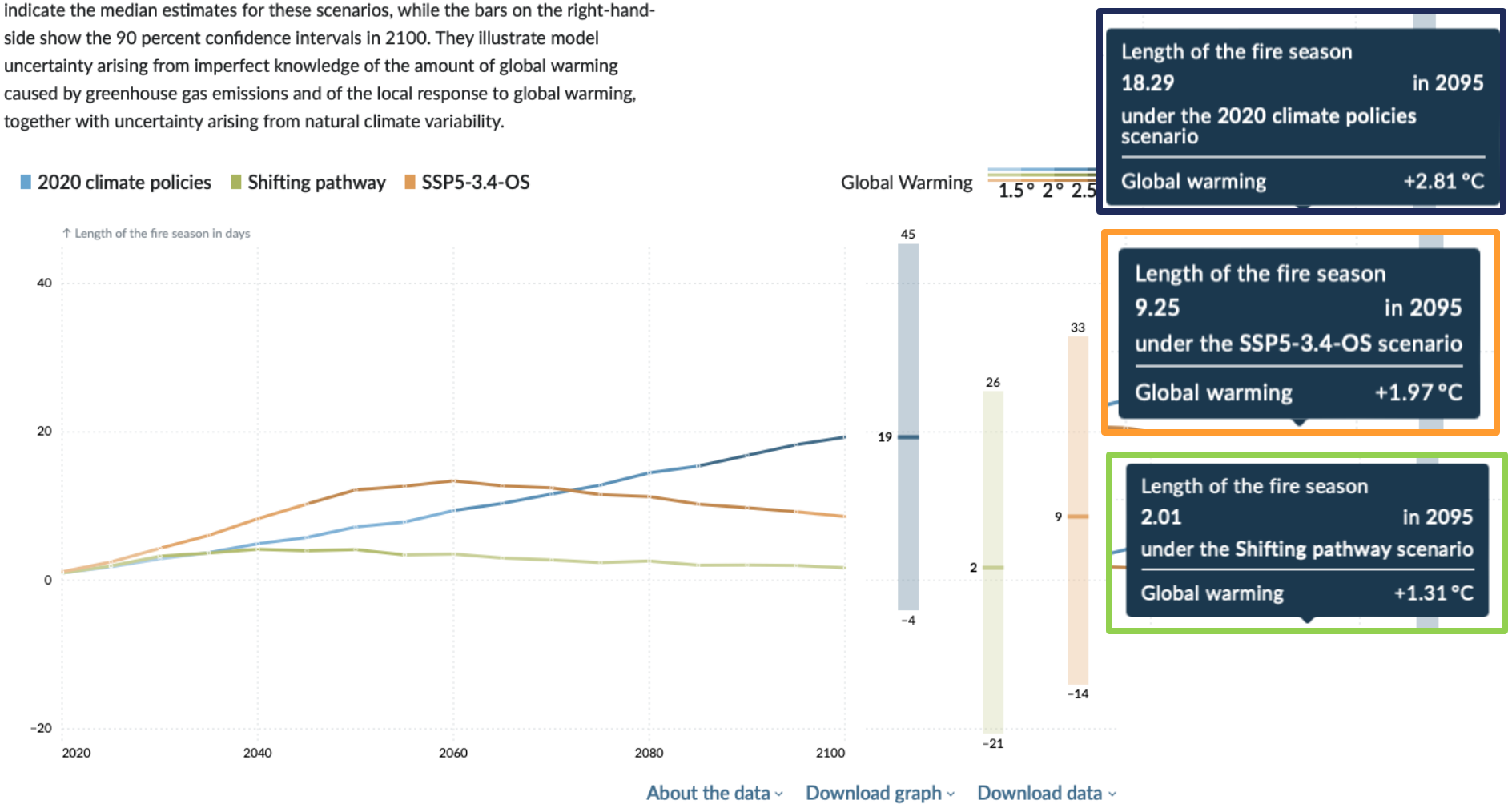
Location
Where will impacts hit the hardest?

(Un)avoidable risk
What can be avoided through emissions reductions?

TIMING

Changes in Length of the fire season in Greece from 2020 to 2100

This graph shows how changes in Length of the fire season (expressed in days) will play out over time in Greece compared to the reference period 2011-2020, according to the scenarios Shifting pathway, 2020 climate policies and SSP5-3.4-OS. The lines indicate the median estimates for these scenarios, while the bars on the right-hand-side show the 90 percent confidence intervals in 2100. They illustrate model uncertainty arising from imperfect knowledge of the amount of global warming caused by greenhouse gas emissions and of the local response to global warming, together with uncertainty arising from natural climate variability.



About the data · Download graph · Download data

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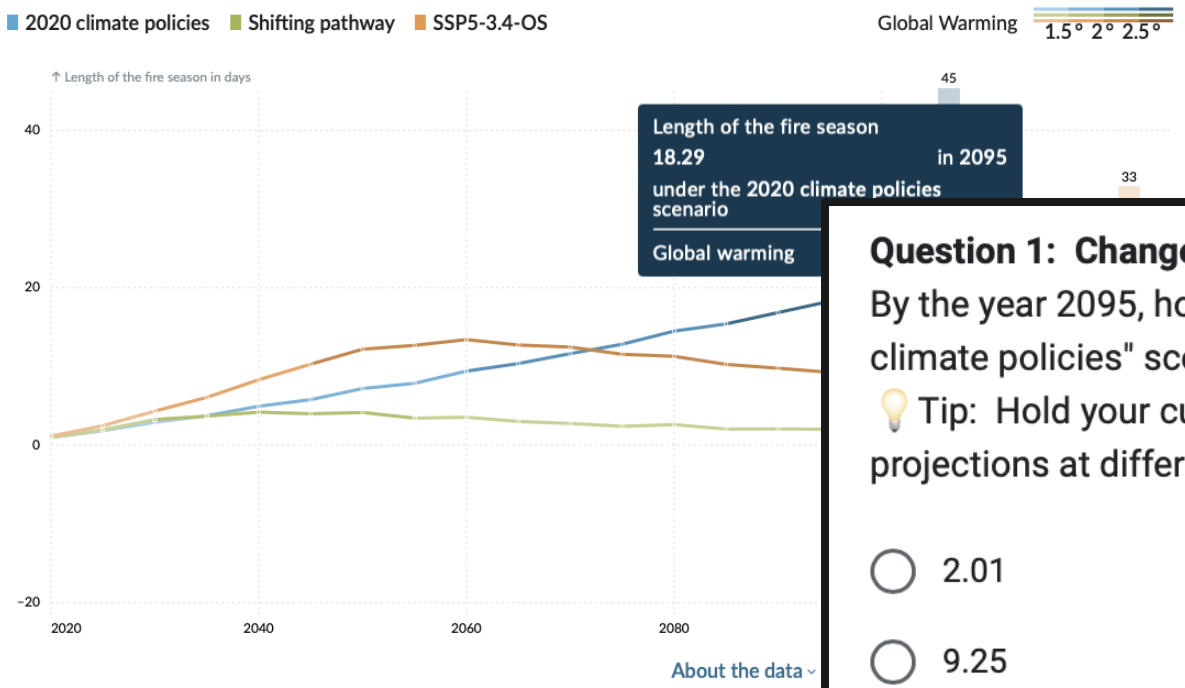

Question 1: Changes to the fire season by the end of the century

By the year 2095, how much longer will the fire season be under the "2020 climate policies" scenario?

💡Tip: Hold your cursor over the points along the trend line in order to view projections at different years.

- ○ 2.01
- ○ 9.25
- ◉ 18.29
- ○ 19

SCENARIO

3 scenarios selected

Timing
How will this climate impact change?

Location
Where will impacts hit the hardest?

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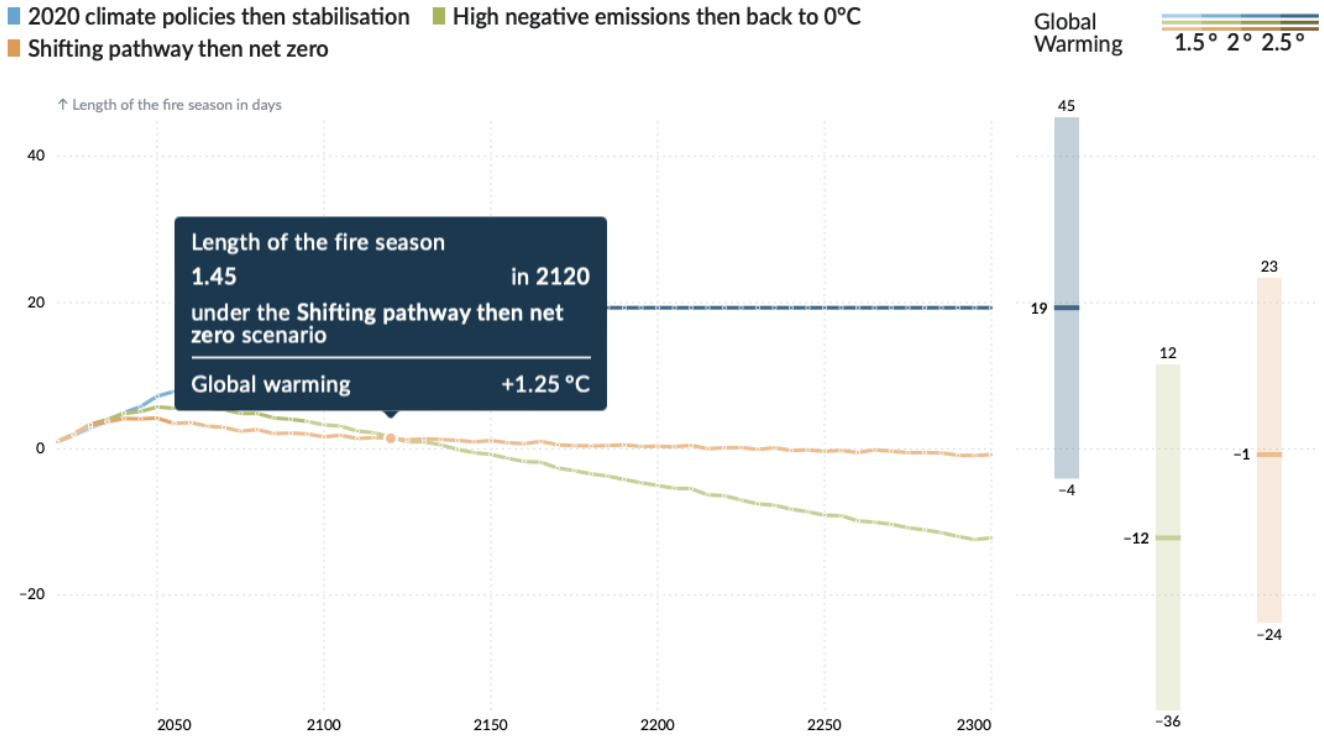
What can be avoided through emissions reductions?

TIMING

Changes in Length of the fire season in Greece from 2020 to 2300

This graph shows how changes in Length of the fire season (expressed in days) will play out over time in Greece compared to the reference period 2011-2020, according to the scenarios High negative emissions then back to 0°C, Shifting pathway then net zero and 2020 climate policies then stabilisation. The lines indicate the median estimates for these scenarios, while the bars on the right-hand-side show the 90 percent confidence intervals in 2100. They illustrate model uncertainty arising from imperfect knowledge of the amount of global warming caused by greenhouse gas emissions and of the local response to global warming, together with uncertainty arising from natural climate variability.



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SCENARIO

3 scenarios selected

Timing
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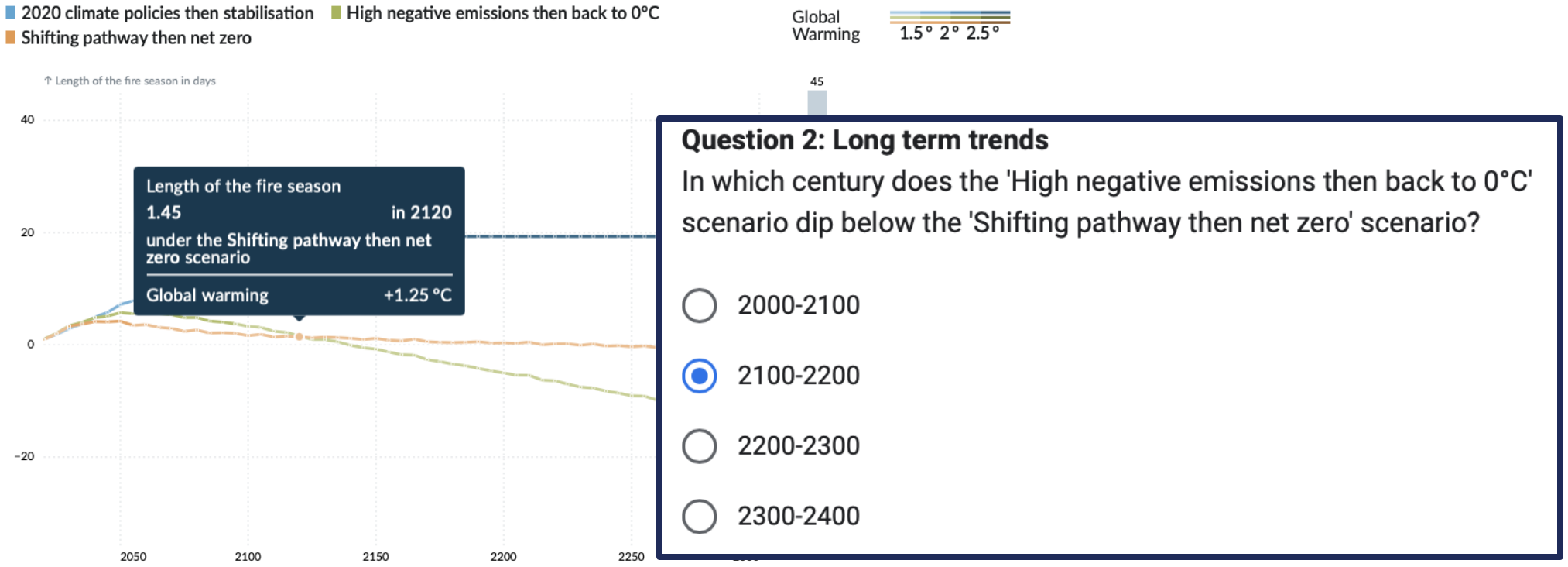


Question 2: Long term trends

In which century does the 'High negative emissions then back to 0°C' scenario dip below the 'Shifting pathway then net zero' scenario?

- ○ 2000-2100
- ◉ 2100-2200
- ○ 2200-2300
- ○ 2300-2400

About the data · Download graph · Download data

What impacts are you trying to avoid?
Over the 2011–2020 period, the urban area of Accra experienced on average 35 days a year with extreme heat stress.

LEVEL OF IMPACT 50 d/yr

0 d/yr Level of interest 290 d/yr

PROBABILITY

50 %

LOCATION

city average

IMPACT LEVEL

When will your impact level be exceeded?

To keep the chance that the urban area of Accra will on average experience over 50 days a year with extreme heat stress below 50 %, one should pursue global emission pathways in line with limiting average global warming to 1.4°C.

This impact level will be exceeded

- in 2030 under the Delayed climate action scenario and
- in 2030 under the 2020 climate policies scenario.

This impact level would be avoided

- under the Shifting pathway scenario.

LOCATIONS

How does this vary across the urban environment?

For the average over the urban area as well as 6 locations indicated on the map, the table provides the levels to which the world should aim to limit Global Mean Temperature (GMT) so that the probability to exceed the selected level of impact (50 days a year with extreme heat stress) doesn't go over 50 %, as well as the years at which this would happen in the three considered emissions scenarios.

Study location	GMT	At what year in scenario...		
city average	1.4 °C	2030	never	2030
❶ urban hot spot	1.6 °C	2040	never	2040
❷ urban medium spot	1.4 °C	2030	2030	2030
❸ urban cool spot	1.6 °C	2040	never	2040
❹ suburban hot spot	2.2 °C	never	never	2070
❺ suburban medium spot	2.2 °C	never	never	2070
❻ suburban cool spot	— °C	never	never	never

Delayed climate action Shifting pathway 2020 climate policies

What impacts are you trying to avoid?
Over the 2011–2020 period, the urban area of Accra experienced on average 35 days a year with extreme heat stress.

LEVEL OF IMPACT 50 d/yr

0 d/yr Level of interest 290 d/yr

PROBABILITY

50 %

LOCATION

city average

Impact Level
When will the impact level be exceeded?

Locations
When will the impact level be exceeded across different locations?

IMPACT LEVEL

When will your impact level be exceeded?

To keep the chance that the urban area of Accra will on average experience over 50 days a year with extreme heat stress below 50 %, one should pursue global emission pathways in line with limiting average global warming to 1.4°C.

This impact level will be exceeded

- in 2030 under the Delayed climate action scenario and
- in 2030 under the 2020 climate policies scenario.

This impact level would be avoided

- under the Shifting pathway scenario.

LOCATIONS

How does this vary across the urban environment?

For the average over the urban area as well as 6 locations indicated on the map, the table provides the levels to which the world should aim to limit Global Mean Temperature (GMT) so that the probability to exceed the selected level of impact (50 days a year with extreme heat stress) doesn't go over 50 %, as well as the years at which this would happen in the three considered emissions scenarios.

Study location	Delayed climate action	Shifting pathway	2020 climate policies
city average			
❶ urban hot spot			
❷ urban medium spot			
❸ urban cool spot			
❹ suburban hot spot			
❺ suburban medium spot			
❻ suburban cool spot			

Question 3: There is more than 50% chance that Accra will experience over 40 days a year with extreme heat stress, regardless of the climate scenario. This seems to be an unavoidable risk. Are there any climate scenario(s) that would avoid an impact of **50 days a year of extreme heat stress**?

Choose all that apply

- [ ] None
- [ ] Delayed climate action
- [ ] 2020 climate policies
- [x] Shifting pathway

What impacts are you trying to avoid?
Over the 2011–2020 period, the urban area of Accra experienced on average 35 days a year with extreme heat stress.

LEVEL OF IMPACT 50 d/yr

0 d/yr Level of interest 290 d/yr

PROBABILITY

5 %

LOCATION

city average

IMPACT LEVEL

When will your impact level be exceeded?

Due to unavoidable risk even in the scenario with the highest amount of emissions reductions there is a more than 5 % chance that the urban area of Accra will on average experience over 50 days a year with extreme heat stress.

This impact level will be exceeded

- before 2030 under the Delayed climate action scenario,
- before 2030 under the Shifting pathway scenario and
- before 2030 under the 2020 climate policies scenario.

LOCATIONS

How does this vary across the urban environment?

For the average over the urban area as well as 6 locations indicated on the map, the table provides the levels to which the world should aim to limit Global Mean Temperature (GMT) so that the probability to exceed the selected level of impact (50 days a year with extreme heat stress) doesn't go over 5 %, as well as the years at which this would happen in the three considered emissions scenarios.

Study location	GMT	At what year in scenario...		
city average	1.2 °C	already	already	already
❶ urban hot spot	1.2 °C	already	2030	already
❷ urban medium spot	1.2 °C	already	already	already
❸ urban cool spot	1.2 °C	already	already	already
❹ suburban hot spot	1.6 °C	2040	never	2040
❺ suburban medium spot	1.4 °C	2030	never	2040
❻ suburban cool spot	1.7 °C	2070	never	2060

Delayed climate action Shifting pathway 2020 climate policies

What impacts are you trying to avoid?
Over the 2011–2020 period, the urban area of Accra experienced on average 35 days a year with extreme heat stress.

LEVEL OF IMPACT 50 d/yr

0 d/yr Level of interest 290 d/yr

PROBABILITY

5 %

LOCATION

city average

Impact Level
When will the impact level be exceeded?

Locations
When will the impact level be exceeded across different locations?

IMPACT LEVEL

When will your impact level be exceeded?

Due to unavoidable risk even in the scenario with the highest amount of emissions reductions there is a more than 5 % chance that the urban area of Accra will on average experience over 50 days a year with extreme heat stress.

This impact level will be exceeded

- before 2030 under the Delayed climate action scenario,
- before 2030 under the Shifting pathway scenario and
- before 2030 under the 2020 climate policies scenario.

Question 4: How does switching to a 5% probability impact extreme heat stress in Accra?

- ○ No change
- ○ The selected impacts occur sooner, but can be avoided by some scenarios.
- ○ The selected impacts occur on the same timeframe, but can't be avoided.
- ◉ The selected impacts occur sooner and can't be avoided.

LOCATIONS

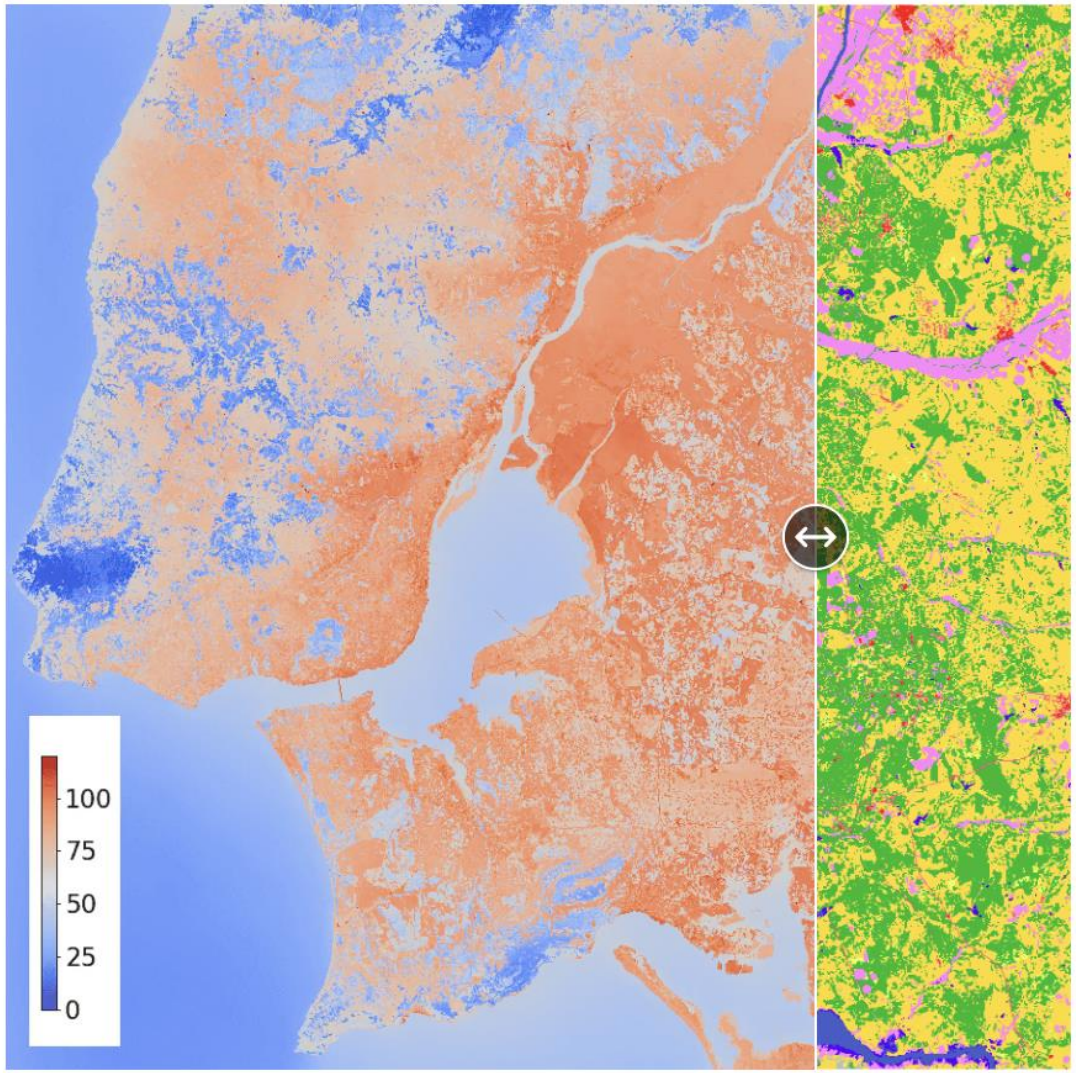
How does this vary across the urban environment?

For the average over the urban area as well as 6 locations indicated on the map, th table provides the levels to which the world should aim to limit Global Mean Temperature (GMT) so that the probability to exceed the selected level of impact (days a year with extreme heat stress) doesn't go over 5 %, as well as the years at which this would happen in the three considered emissions scenarios.

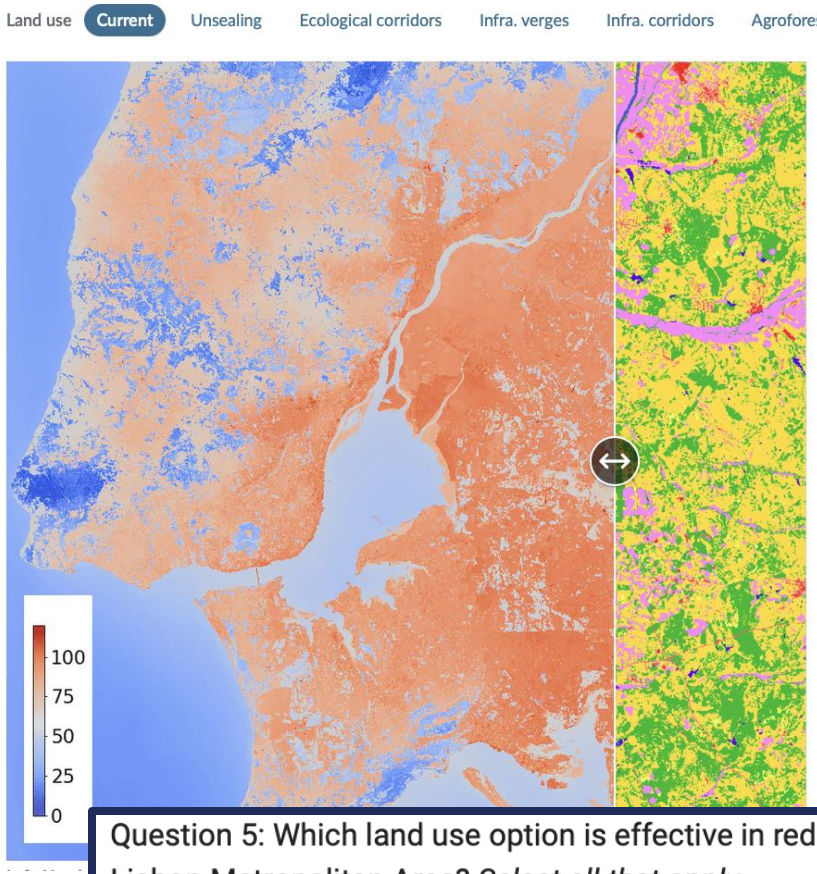
Study location	GMT	At what year in scenario...		
city average	1.2 °C	already	already	already
❶ urban hot spot	1.2 °C	already	2030	already
❷ urban medium spot	1.2 °C	already	already	already
❸ urban cool spot	1.2 °C	already	already	already
❹ suburban hot spot	1.6 °C	2040	never	2040
❺ suburban medium spot	1.4 °C	2030	never	2040
❻ suburban cool spot	1.7 °C	2070	never	2060

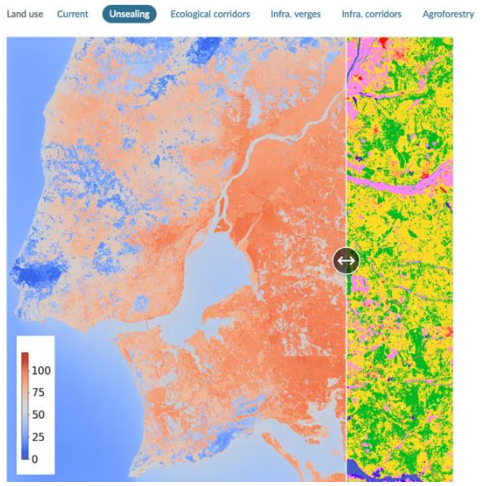
Delayed climate action Shifting pathway 2020 climate policies

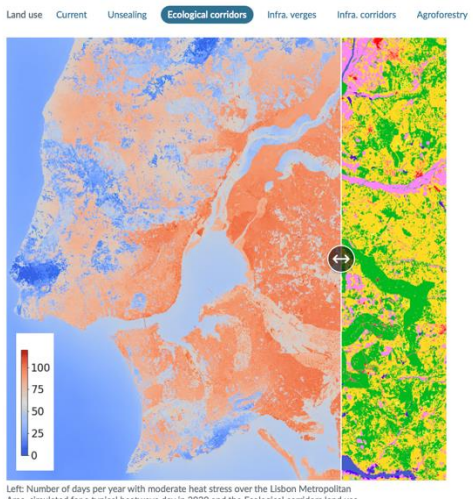
Land use | Current | Unsealing | Ecological corridors | Infra. verges | Infra. corridors | Agroforestry

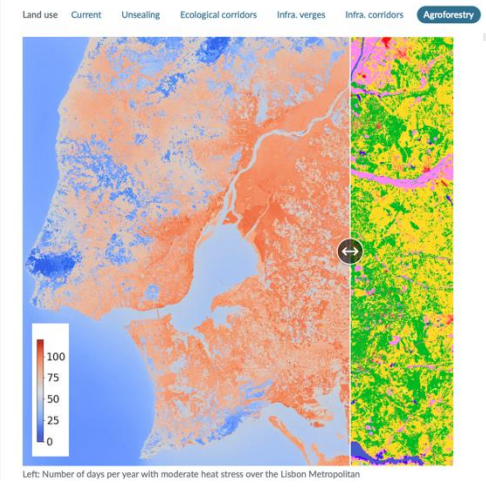


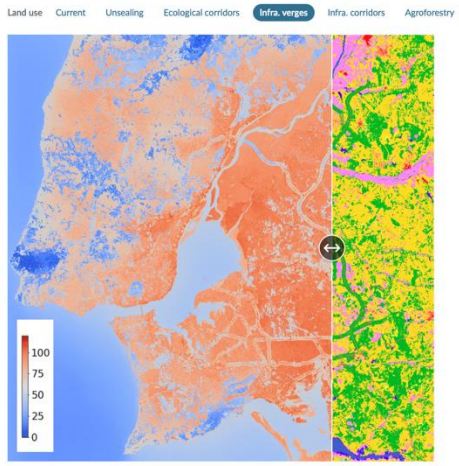
Left: Number of days per year with moderate heat stress over the Lisbon Metropolitan Area, simulated for a typical heatwave day in 2020 and the Agroforestry land use scenario.
Right: Land use map for the Agroforestry land use scenario.

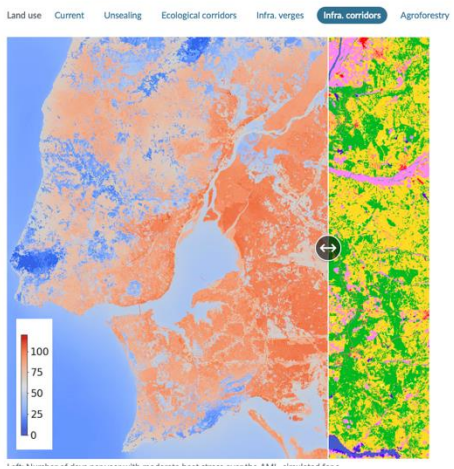












Question 5: Which land use option is effective in reducing heat stress in the Lisbon Metropolitan Area? *Select all that apply*

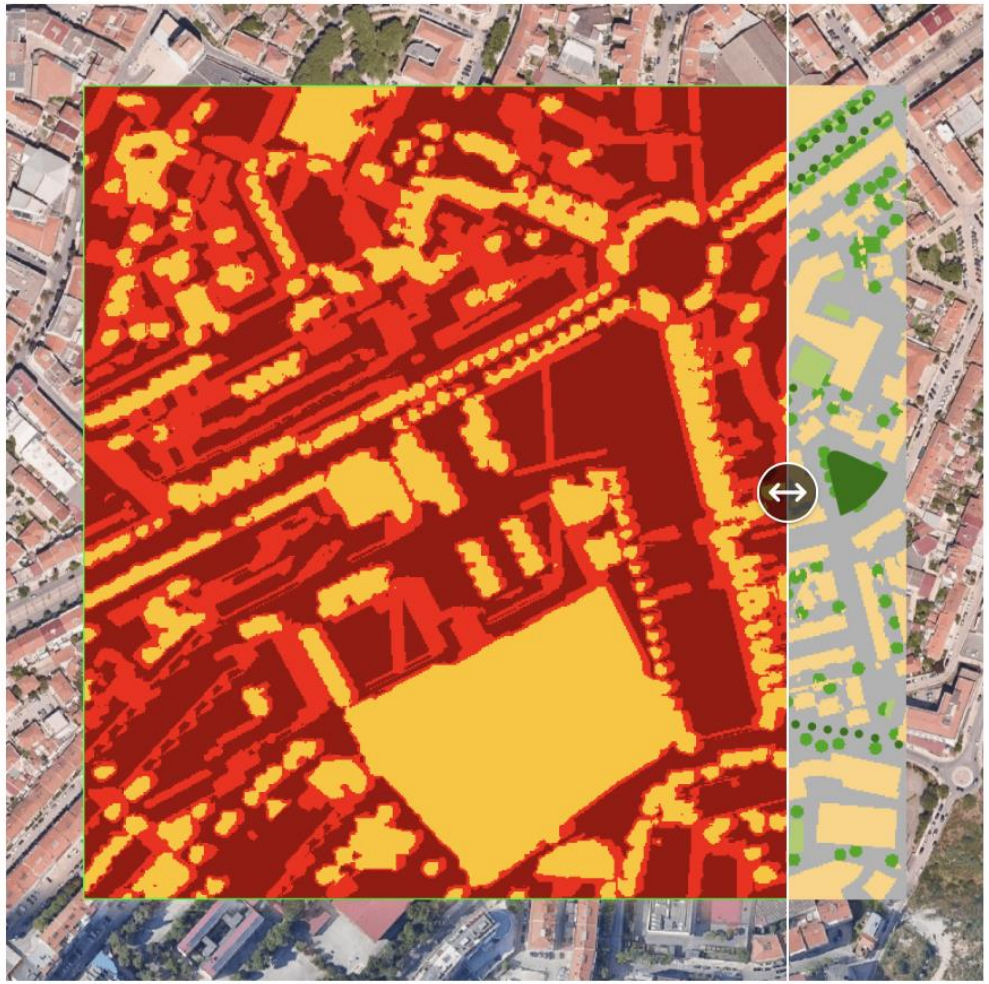
- [x] Unsealing
- [x] Ecological Corridors
- [x] Infrastructural Verges
- [x] Infrastructural Corridors
- [x] Agroforestry

Year 2020 2100 Land use map Current Adaptation

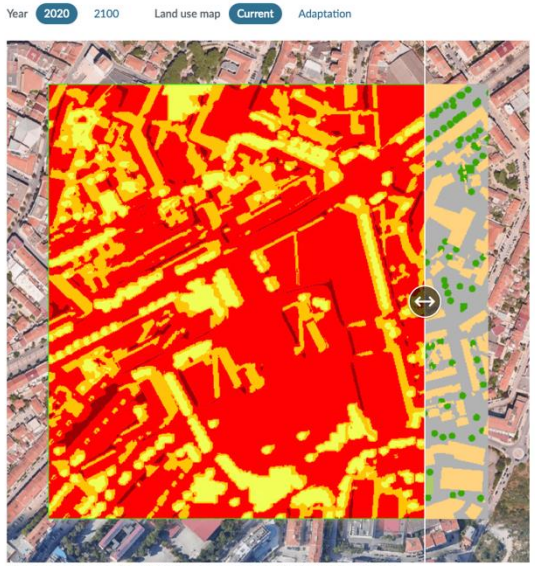
Heat stress levels over the urban hot spot in the municipality of Almada during the afternoon of a typical heatwave day in 2020, for the current land use map. Yellow = moderate heat stress, orange = high, red = very high, dark red = extreme.

PROVIDE

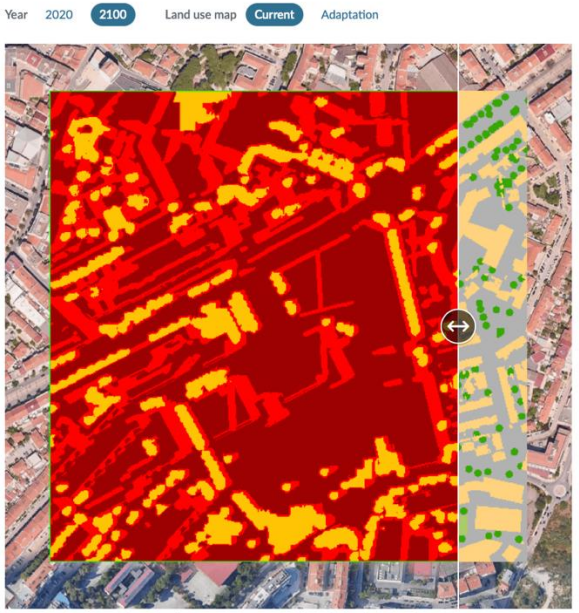
Year 2020 2100 Land use map Current Adaptation



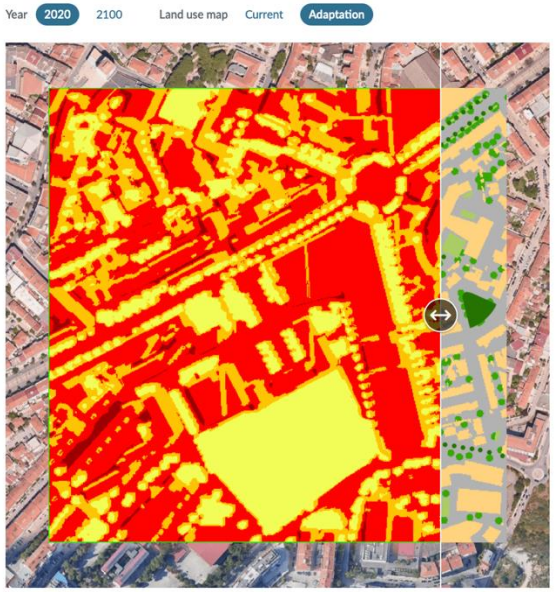
Heat stress levels over the urban hot spot in the municipality of Almada during the afternoon of a typical heatwave day in 2100, for the Adaptation land use scenario. Yellow = moderate heat stress, orange = high, red = very high, dark red = extreme.

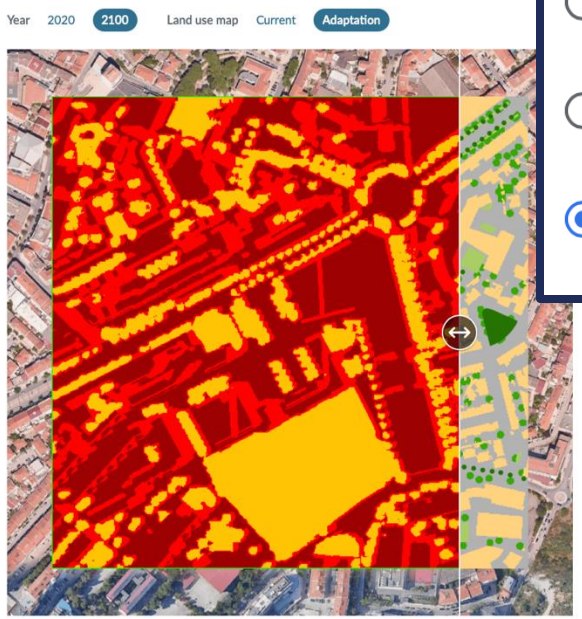


Heat stress levels over the urban hot spot in the municipality of Almada during the afternoon of a typical heatwave day in 2020, for the current land use map. Yellow = moderate heat stress, orange = high, red = very high, dark red = extreme.



Heat stress levels over the urban hot spot in the municipality of Almada during the afternoon of a typical heatwave day in 2100, for the current land use map. Yellow = moderate heat stress, orange = high, red = very high, dark red = extreme.





Heat stress levels over the urban hot spot in the municipality of Almada during the afternoon of a typical heatwave day in 2100, for the Adaptation land use scenario. Yellow = moderate heat stress, orange = high, red = very high, dark red = extreme.

After considering adaptation under current and future scenarios, what conclusion should one come to? * 1 point

- ○ There is no need to reduce emissions in the future, since adaptation options can sufficiently reduce urban heat.
- ○ Adaptation options are not effective in reducing urban heat and should therefore be abandoned.
- ○ Adaptation options will be more effective at reducing urban heat by 2100 than they are now.
- ◉ Adaptation options can reduce urban heat stress on the short and long-term, but might be less effective in the future.

Contact

Coordinator
Humboldt-Universität zu Berlin
Unter den Linden 6
10099 Berlin
Germany

Contact person
Dr. Carl-Friedrich Schleussner
carl-friedrich.schleussner@hu-berlin.de

Inga Menke
Humboldt Universität
inga.menke@hu-berlin.de

Sylvia Schmidt
Climate Analytics
Sylvia.schmidt@climateanalytics.org

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Thank you!

Climate.risk.dashboard@climateanalytics.org

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Tutorial