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Adaptation Modelling Framework for Heat Stress Exposure

To support the assessment of different adaptation strategies to minimize heat stress impacts on health.

tecnal:a

MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE



vito

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Energy, Climate and Urban Transition*

Gipuzkoa bakes records at 42 degrees on a day with 16 hospitalizations in the Basque Country due to the heat

Osakidetza has attended a total of 35 people due to high temperatures in the three territories and another torrid night is expected.



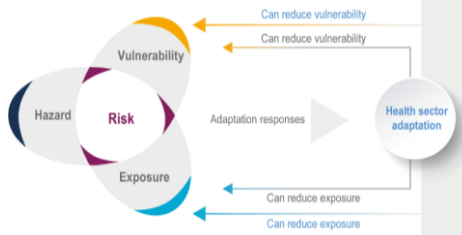
At 9:45 p.m. this thermometer in a pharmacy in Tolosa showed 30 degrees Celsius

Bizkaia experience a ten-hour warm-up at more than 40 degrees.

The province is roasting with extreme temperatures that touch several records.



How can adaptation strategies minimize the heat-related health risks?



Heat Health Warning System

Heat-Health Thresholds Warning & Public Awareness Heat Health Action Plan

Health manager



Territorial level interventions

Green infrastructure, land use management and NBS.

Territorial planner



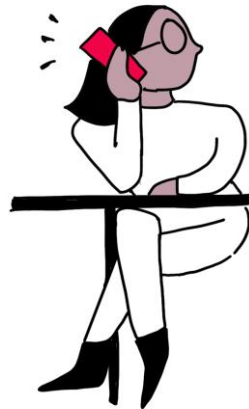
Adaptation Modelling System for Heat Stress

to support the planning of adaptation strategies to minimize heat-related health impacts

Health manager



How to better design HHWS to be as effective as possible in reducing health impacts?



heat-health indicators to support the HHWS and inform the population, to minimize the impacts.

Territorial planner



How would **green roofs/ reflective roofs** reduce health impacts in our territory in a +2° or +4° world?



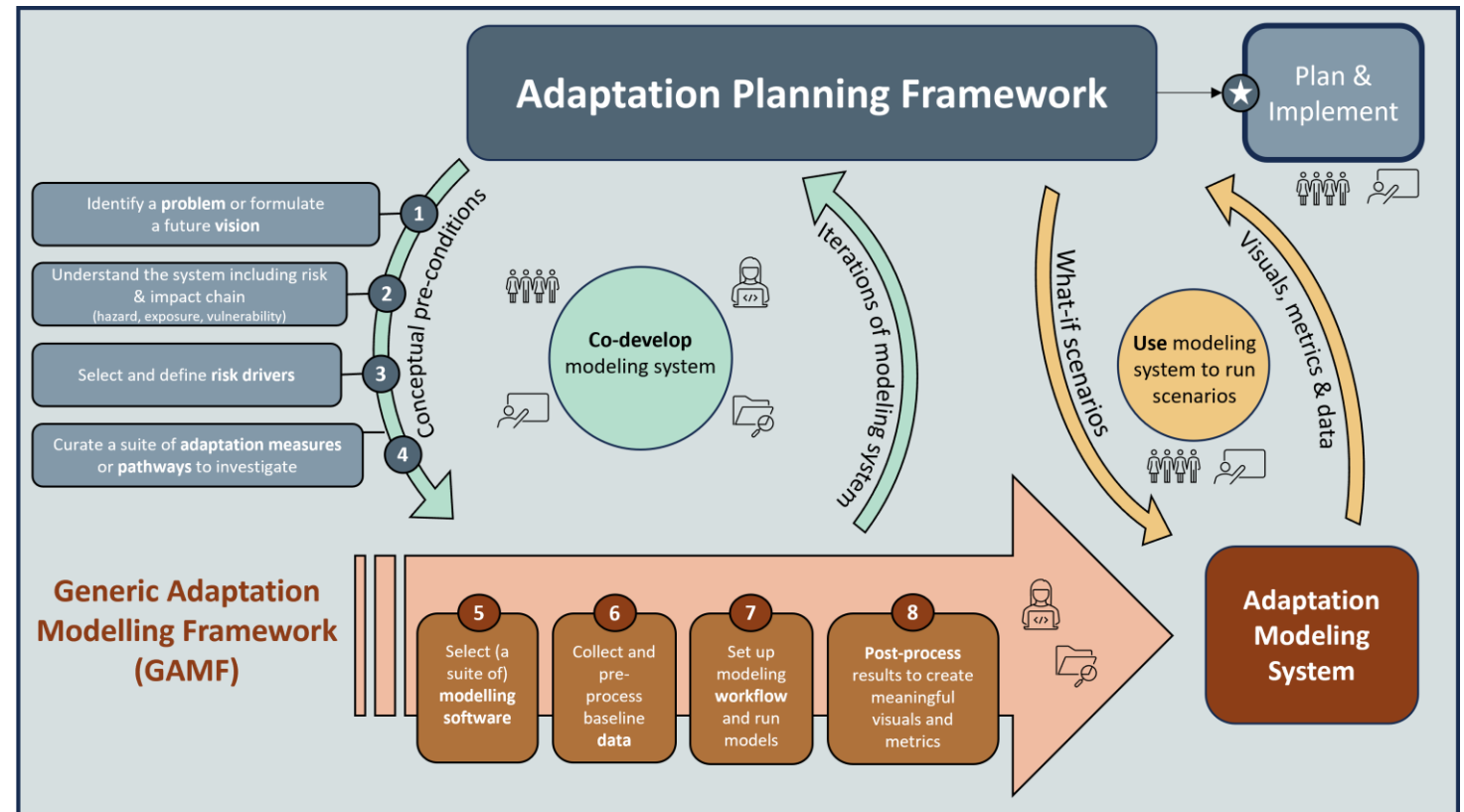
higher resolution assessment of the heat stress considering different adaptation measures to prioritize areas of interventions

Generic Adaptation Modelling Framework (GAMF)

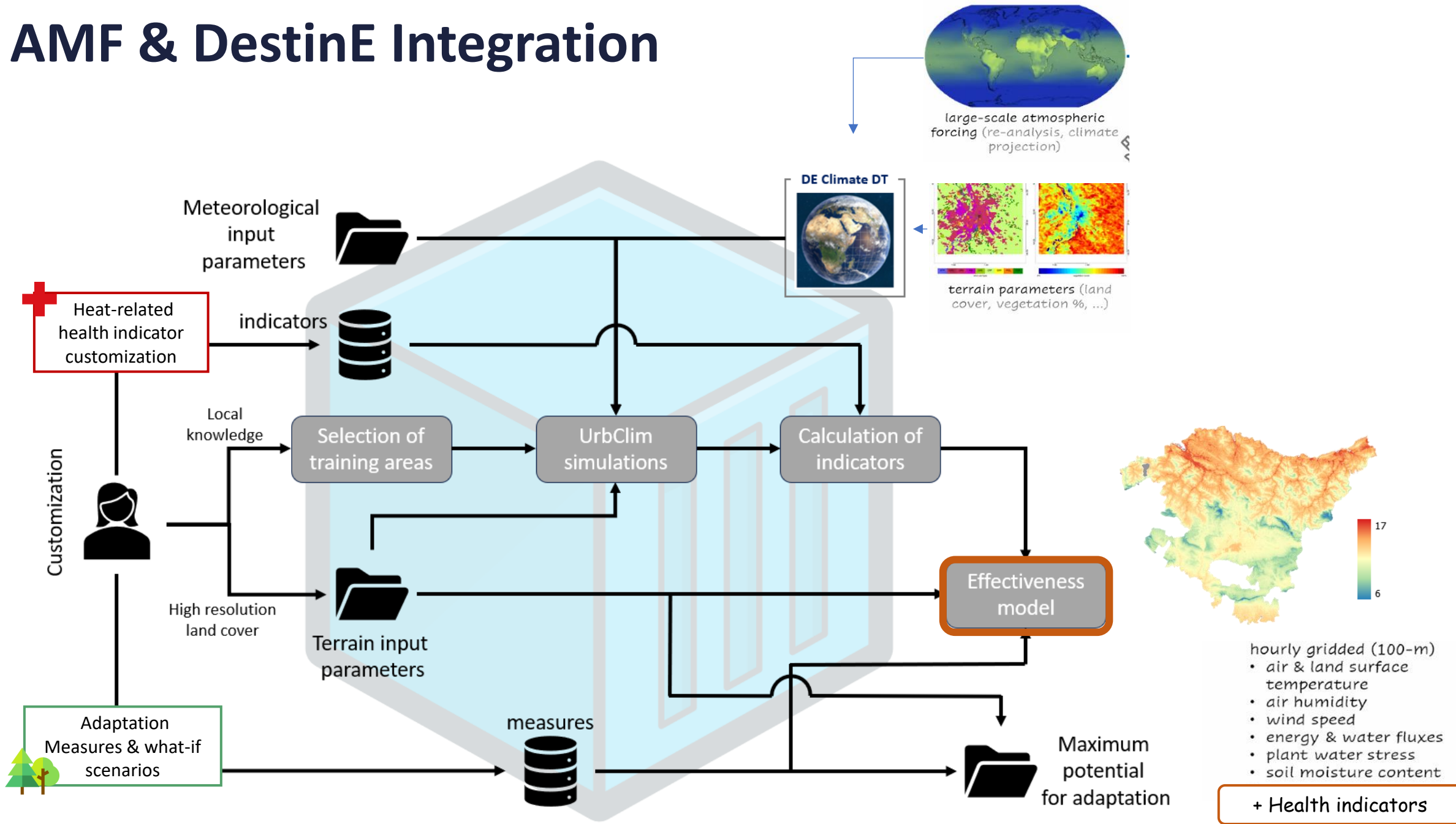
It describes **the process to develop an adaptation modelling system** by leveraging state-of-the-art developments from Destination Earth.

Central to this GAMF are two feedback loops:

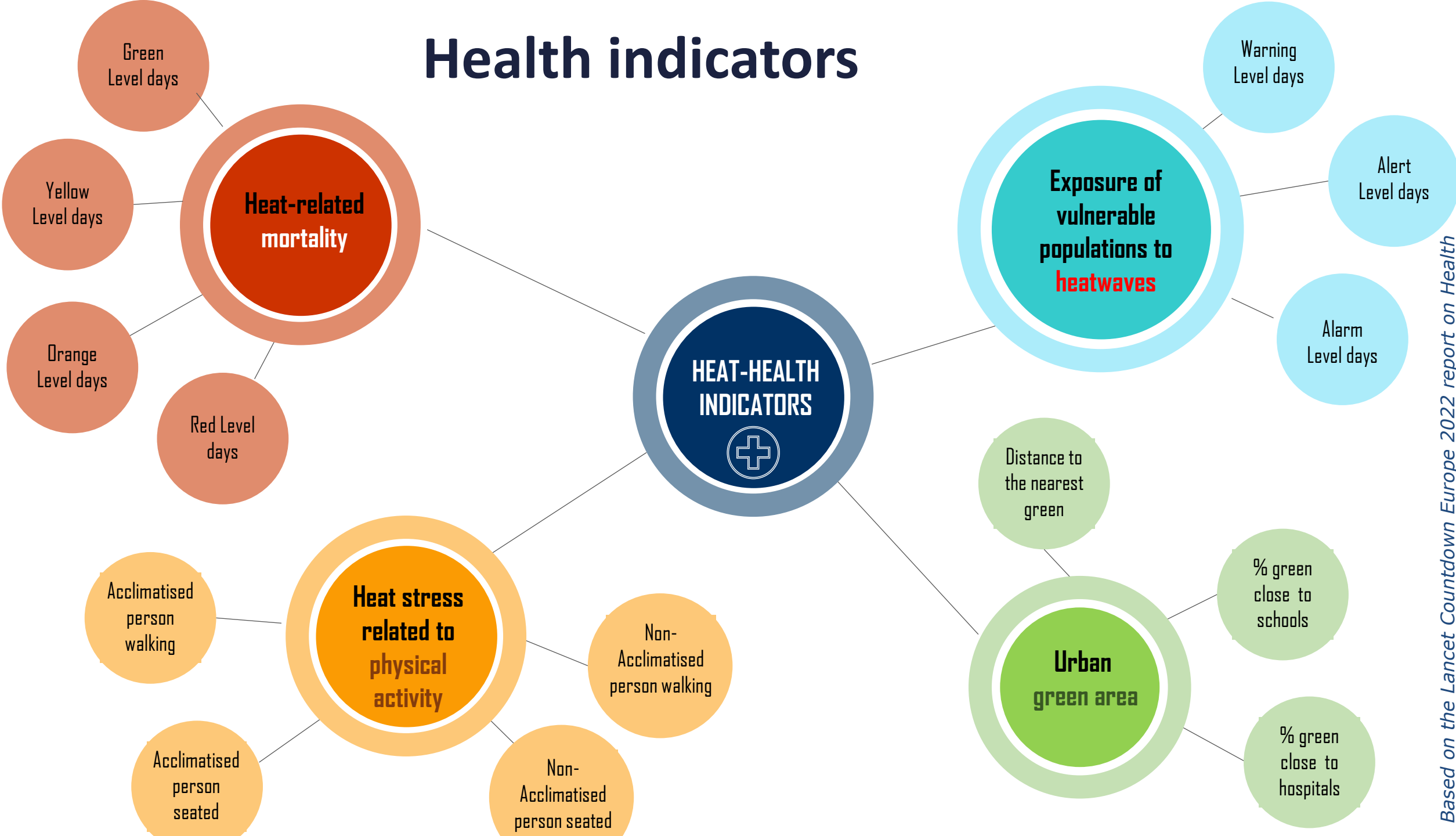
1. The **co-development of an adaptation modelling system** including developers, configurators, and policy-makers.
2. The **use of the adaptation modelling system in scenario modelling**, by providing quantitative information about risk, and future what-if scenarios **to facilitate end-users moving towards planning and implementation.**



AMF & DestinE Integration



Health indicators





Health Manager

Vector file providing Spatial units for indicators



Heat-Health Indicator ▼

Exposure of vulnerable populations to heatwaves

Heat-related mortality

Green Level days

Yellow Level days

Orange Level days

Red Level days

Indicator Description

This indicator refers to the increased risk of heat-related mortality that occur as a direct result of exposure to high temperatures.

Temperature-mortality dependency is defined as exposure-lag-response association, which is modelled through the extension of distributed lag non-linear models(). Based on this location-specific maximum temperature thresholds are established for temperature-mortality. (See Default Values defined for Basque Region based on Carlos III Health institute).*

Considering these thresholds, this indicator tracks the number of the days where the maximum temperature is above a given threshold and apply the next decision algorithm, to compute the risk:

Indicator Configuration

Regional thresholds can also be applied to the heatwave definition by setting the minimum and maximum temperature thresholds

+ 2
+ 1,5
+ 1
+ 0,5

Maximum Temp. Threshold ▲ °C

Default Values ?

Isoclimatic areas thresholds for Tmax based on Carlos III Health Institute

Area	Minimum Temperature (°C)
Bizkaia Litoral	30,2
Bizkaia interior	32,8
Gipuzkoa Litoral	31
Gipuzkoa Interior	30
Alava – Cuenca del Nervión	32,5
Alava - Llanada Alavesa	32,2
Alava - Rioja çAlavesa	33,8

Cancel

Apply



Heat-Health Indicator

Select the indicator you want to see represented in the map.

Exposure of vulnerable populations to heatwaves ^

Heat related mortality v

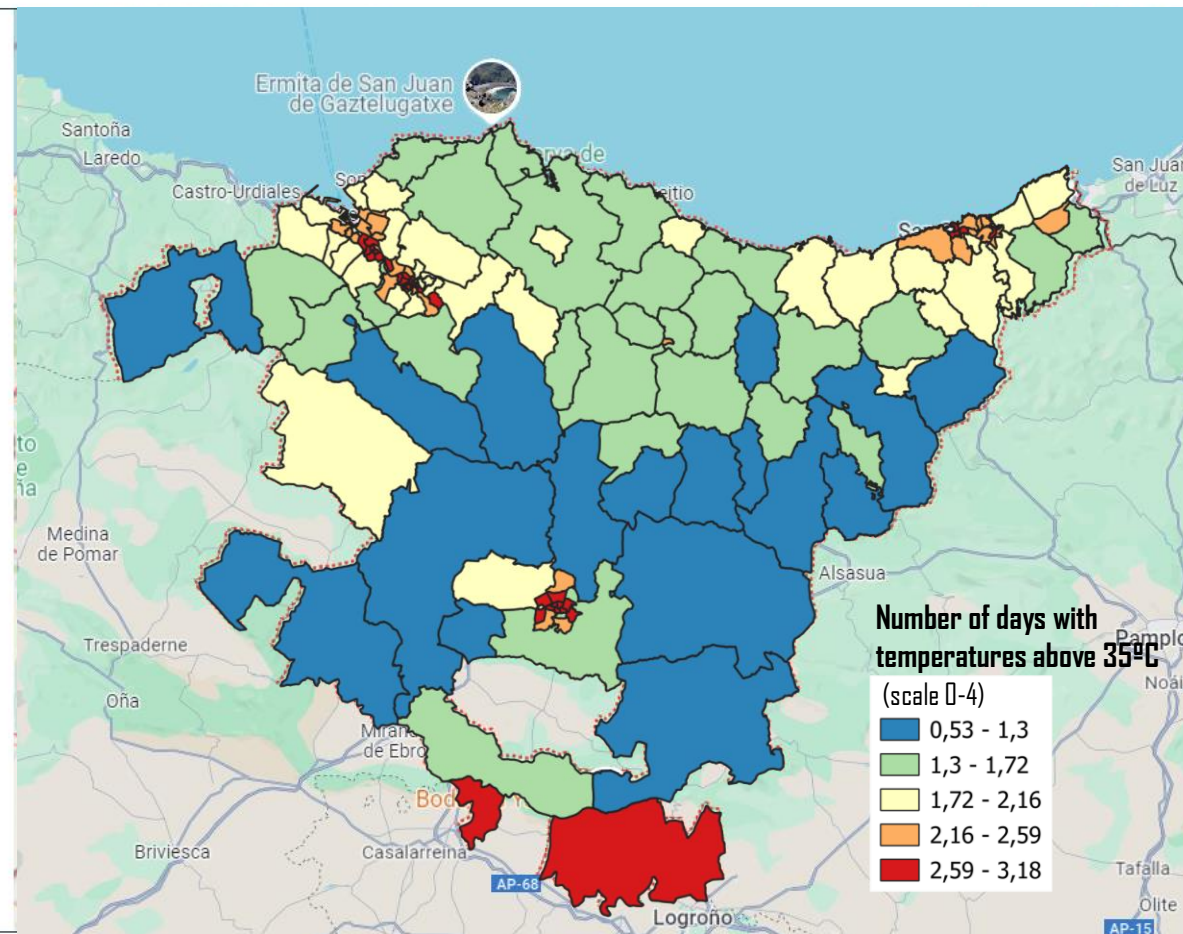
- Green Level days
- Yellow Level days
- Orange Level days
- Red Level days

Indicator Description

Heat related mortality

This indicator refers to the increased risk of heat-related mortality that occur as a direct result of exposure to high temperatures.

Temperature-mortality dependency is defined as exposure-lag-response association, which is modelled through the extension of distributed lag non-linear models(*). Based on this





Heat-Health Indicator

Select the indicator you want to see represented in the map.

Exposure of vulnerable populations to heatwaves

- Warning Level exposure
- Alert Level exposure
- Alarm Level exposure

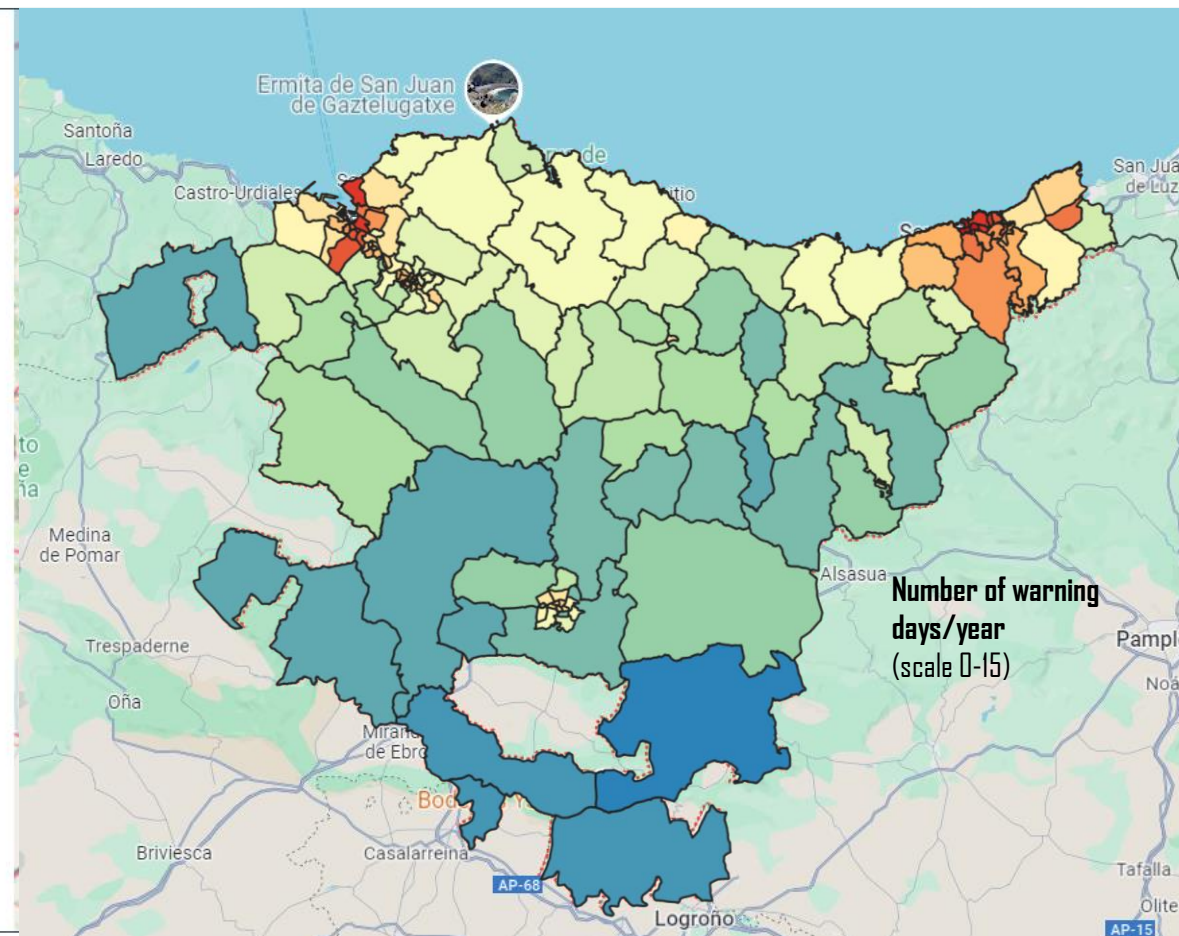
Heat related mortality

Indicator Description

Exposure of vulnerable populations to heatwaves

This indicator tracks the increased risk (*) vulnerable population faces during climatological heatwaves

"Vulnerable population" include elderly as they are more susceptible to heat-related illnesses due to age-related physiological changes and children as they are less able to regulate body temperature





Heat-Health Indicator

Select the indicator you want to see represented in the map.

Exposure of vulnerable populations to heatwaves ^

Heat related mortality ^

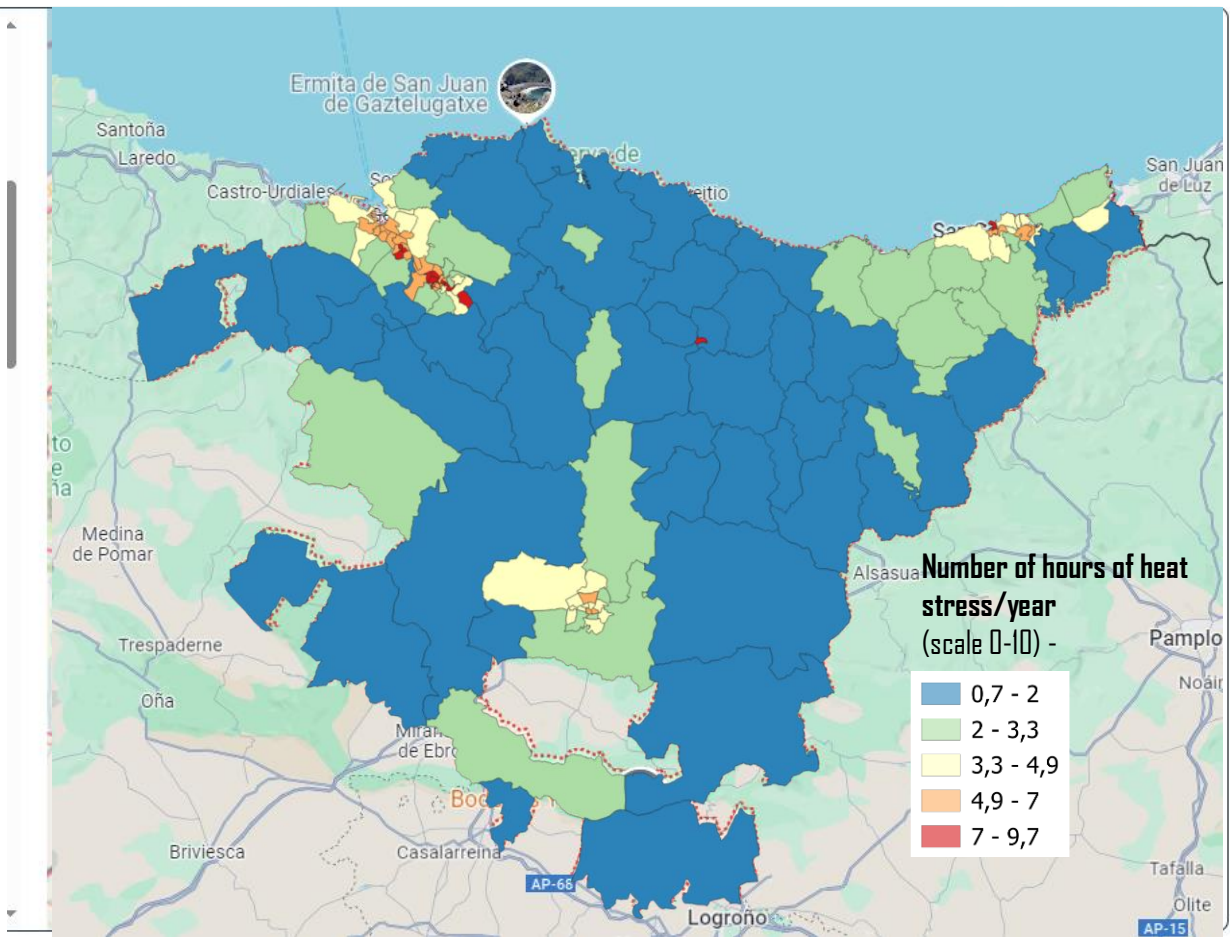
Heat stress related to physical activity v
Heat stress for an acclimatised person walking

Indicator Description

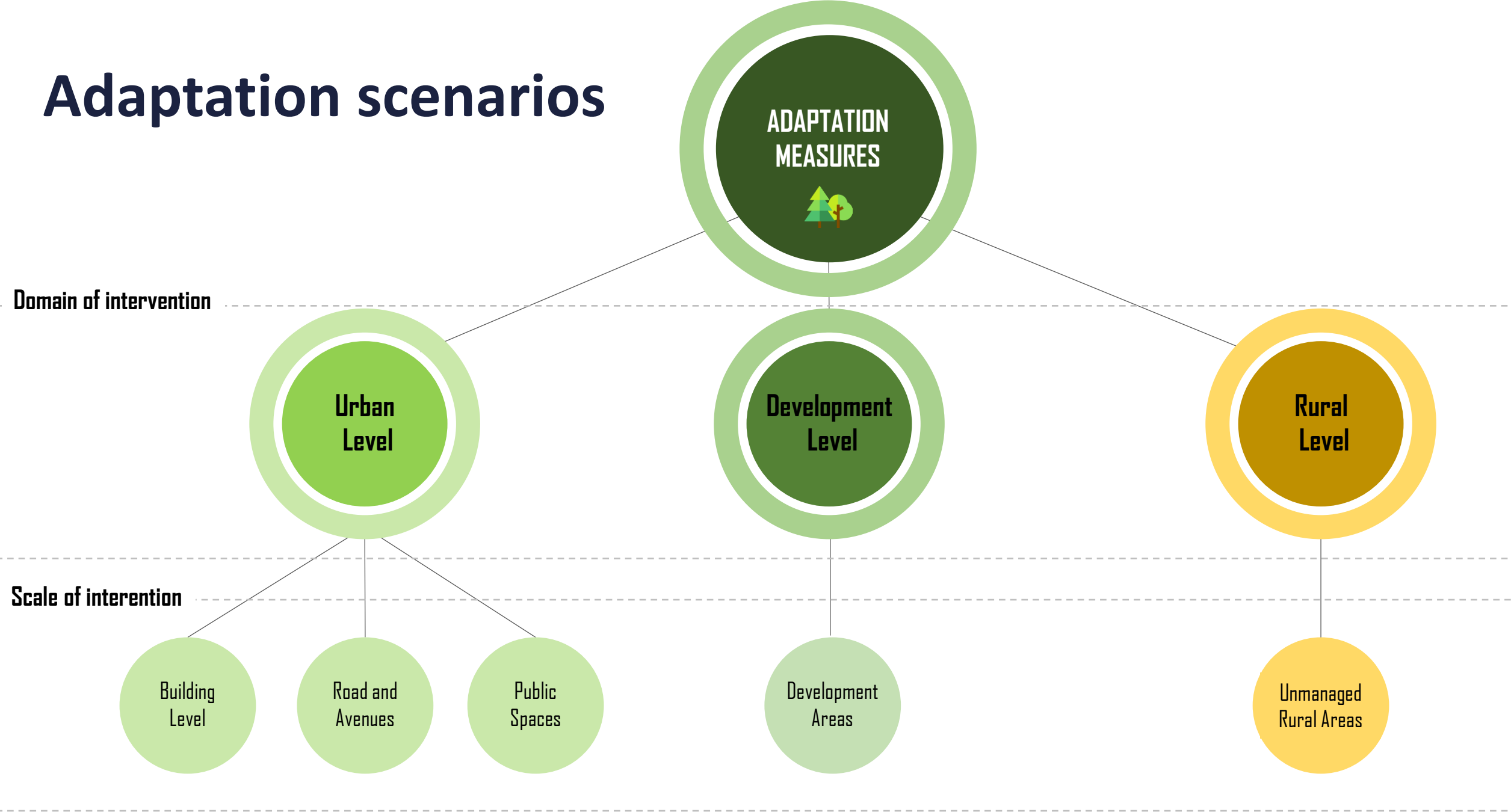
Heat stress related to physical activity

This indicator tracks the number of the risky hours per person and per year by considering the WBGT index as a way to measure the heat stress risk.

The risk of heat stress depends on the heat production of the organism as a result of his physical activity and the characteristics of the surrounding environment.



Adaptation scenarios





Adaptation Measures

Adaptation measure	Domain of intervention	Scale of intervention
Green roofs	Urban	Building Level
Reflective roofs and facades	Urban	Building Level
Artificial shade	Urban	Roads and avenues
Street trees and avenue trees (high vegetation)	Urban	Roads and avenues
Low green in streets and avenues	Urban	Roads and avenues
Urban parks - based on high vegetation	Urban	Open spaces
Naturalization of open spaces based on low vegetation	Urban	Open spaces
Water elements (fountains, ponds)	Urban	Open spaces
Water elements (artificial lakes, ponds)	Development	development areas
Peri-urban parks - based on high vegetation	Development	development areas
Naturalization of open spaces based on low vegetation	Development	development areas
Rural land management - based on high vegetation	Rural	unmanaged rural areas
Rural land management - based on low vegetation	Rural	unmanaged rural areas



Adaptation Measures and Scenarios

Vector file providing the urban and development areas.



Possible Adaptation Measures

Domain of intervention ?

Select a value

- Urban Level
- Development Level
- Rural Level

Scale of interention ?

Select a value

- Building
- Roads and avenues
- Public spaces
- Unmanaged rural area
- Developmment areas

Measure ?

Select a measure

- Green roofs
- Reflective roofs and facades

Add to Scenario 1

Add to Scenario 2

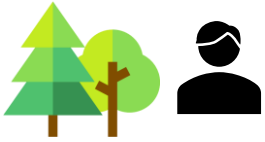
Scenario 1

Measure	Domain	Scale	%	Prioritization						
Green roofs	Urban	Building	15%	Hotest area	●	●		●	● ●	
Street trees and avenue trees	Urban	Building	20%	Vulnerable area						
Low green in streets and avenues										
Urban parks - based on high vegetation										
Naturalization of open spaces										

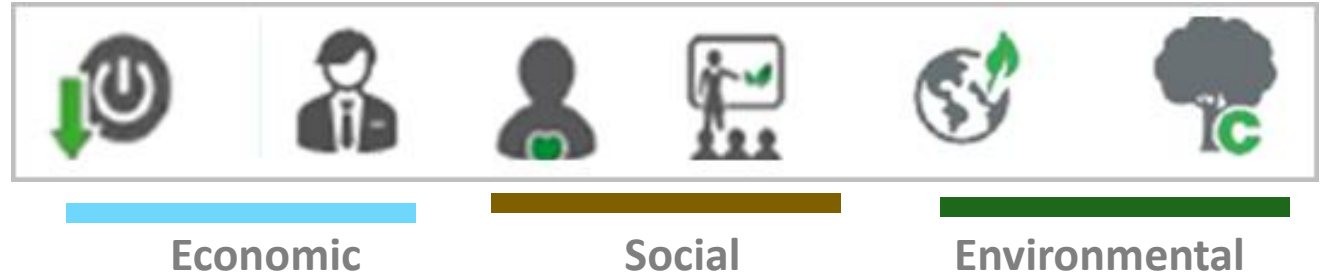
Scenario 2

Measure	Domain	Scale	%	Prioritization						
Green roofs	Urban	Building	15%	Hotest area	●	●		●	● ●	
				Vulnerable area						

Simulate



Co-benefits



Social co-benefits:

- Regeneration of degraded areas and better connectivity
- Recreation and environmental education

Economic co-benefits:

- Reduction of energy demand
- Lost working hours

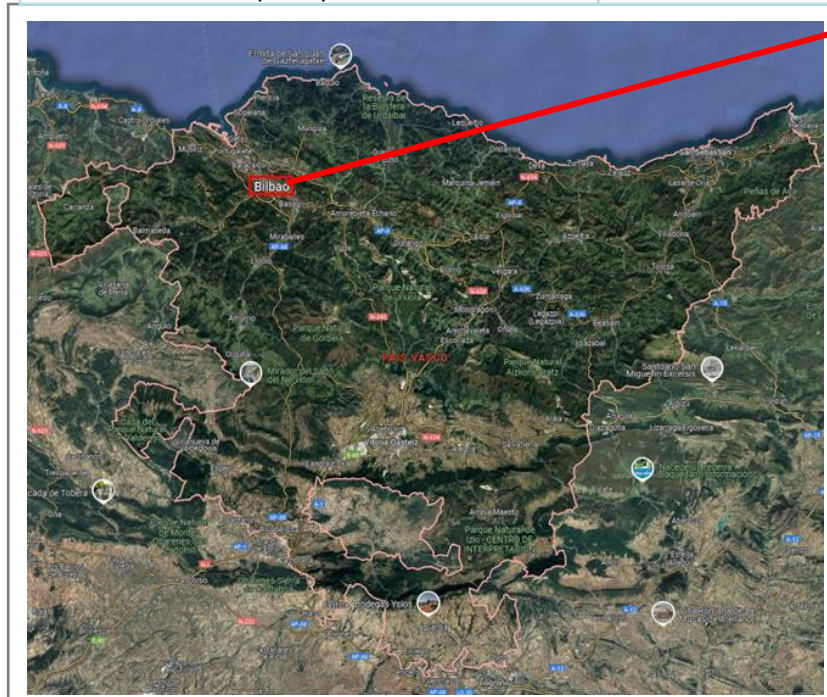
Environmental co-benefits:

- Biodiversity
- Carbon storage

Illustrative scenario for adaptation

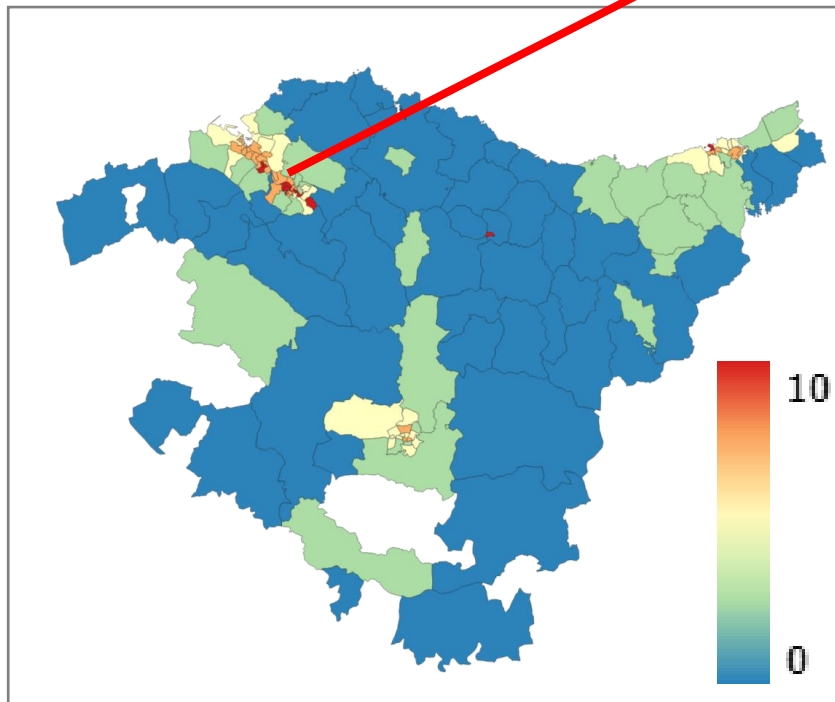
- An increase to 50% vegetation in the in Bilbao city:

Adaptation measure	Domain of intervention
Green roofs	Urban
Street trees and avenue trees	Urban
Low green in streets and avenues	Urban
Urban parks - based on high vegetation	Urban
Naturalization of open spaces	Urban

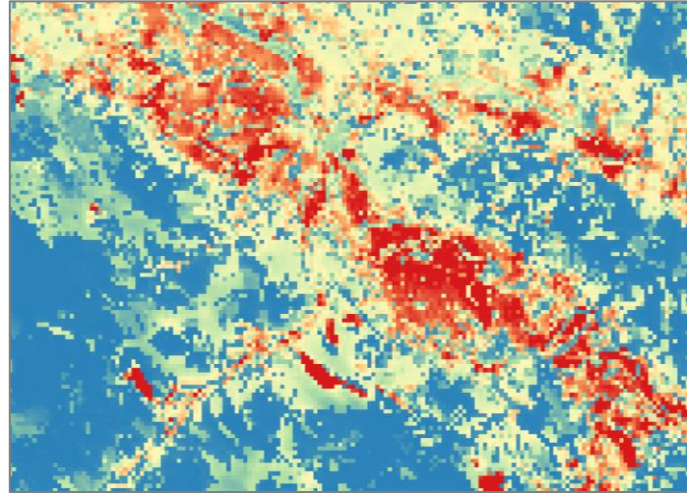


Number of hours of heat stress/year

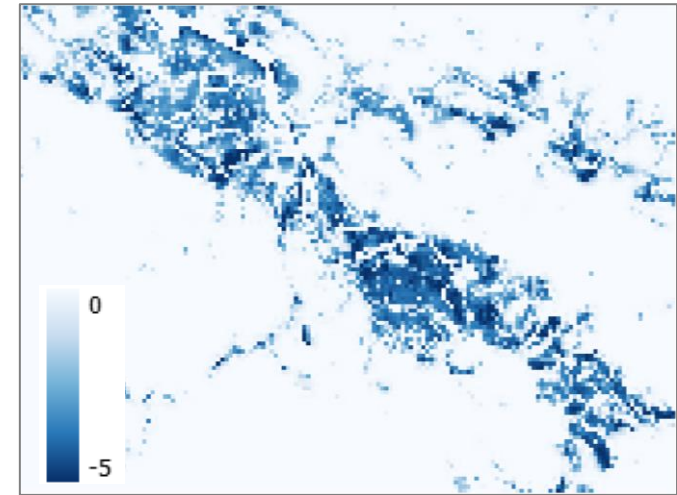
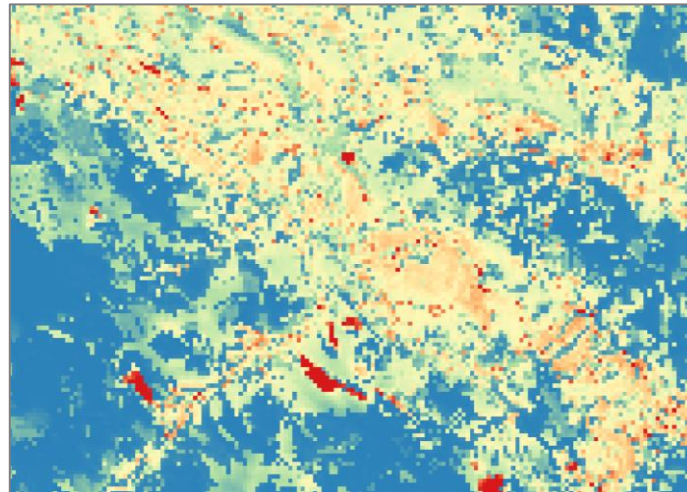
(scale 0-10) - Acclimatised person walking



Baseline



Adapted scenario



Next Steps

- Validation of the model outcomes with stakeholders
- Feedback for improvement of the Adaptation Modelling System for Heat Stress Adaptation
- Pre-operational system connected to DestinE
- Final version of the GAMF in collaboration with Deltares
- Dissemination and communication through user stories