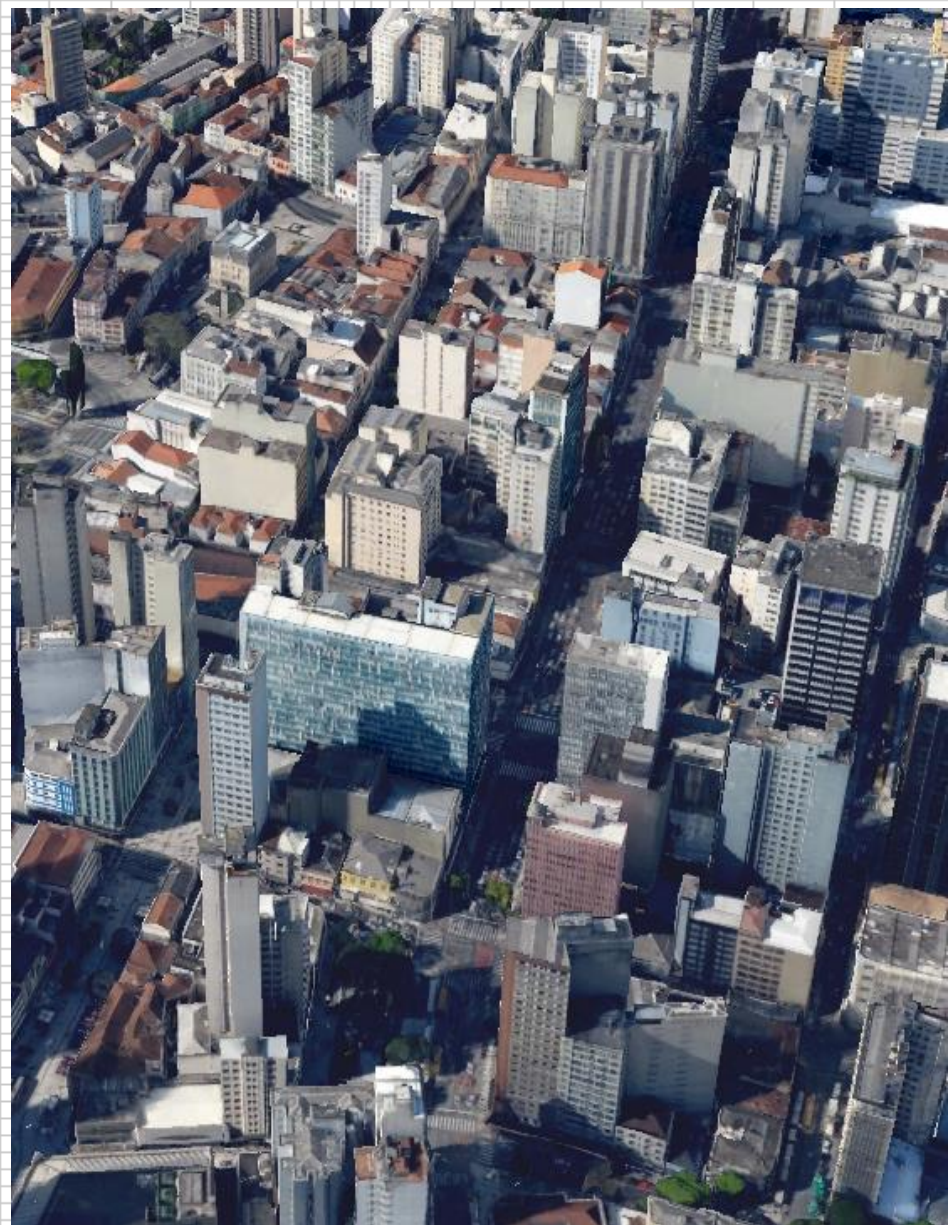


# Urban SIS - Climate Information for European Cities

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*EMS, Trieste, 12-16 Sept. 2016*





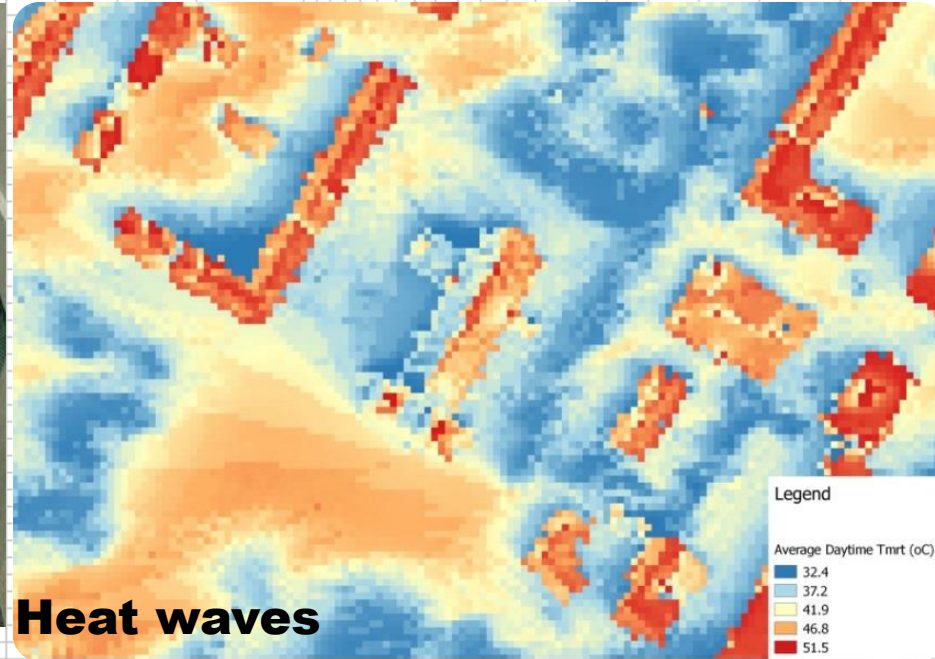
# Motivation

# SMHI



**Flash floods**

(Picture by [Jonasosthassel](#) on flickr [CC by 2.0](#))

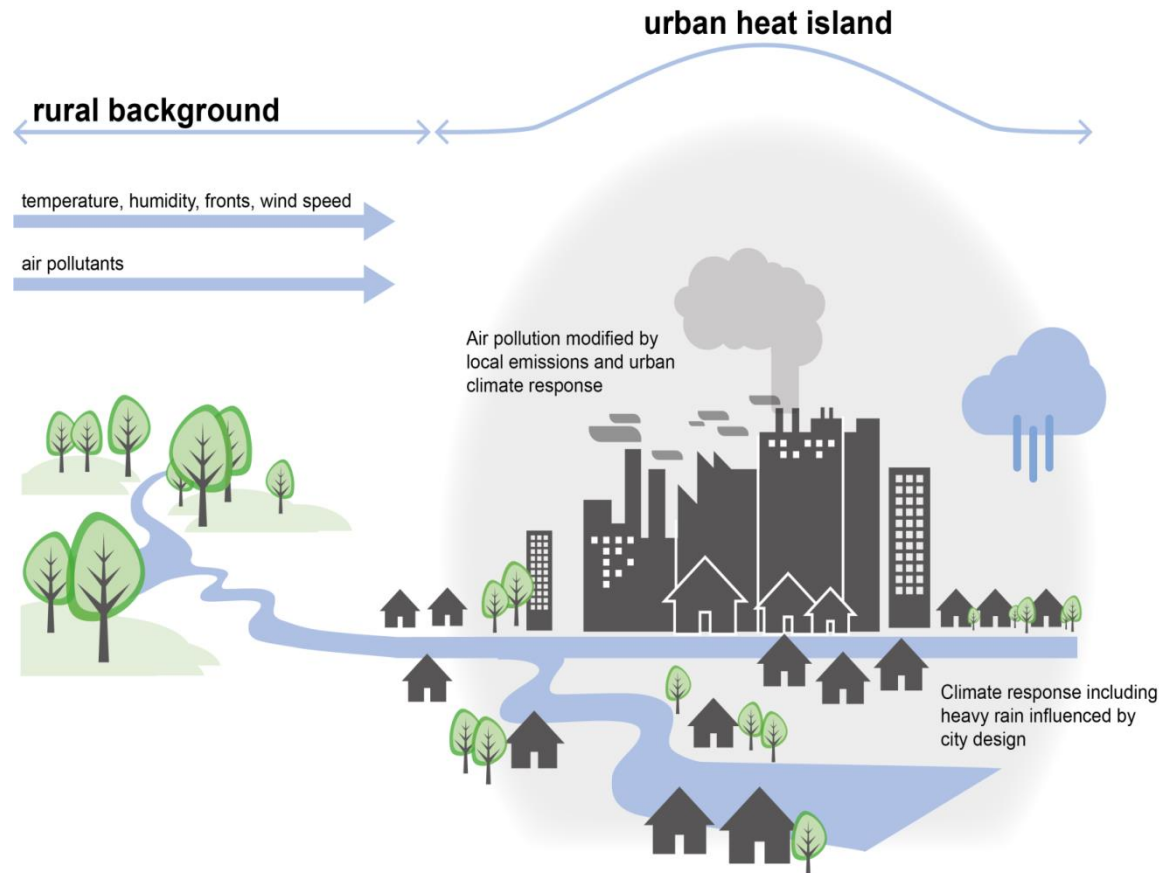


**Heat waves**

## Urban air quality



**Existing climate data** are relevant at the regional scale,  
but less informative on **intra-city gradients**



Need to accurately account for **urban fluxes** aiming to better understand how different cities react to climate signals and what planning actions can be taken to meet **climate change adaptation**

# Urban SIS concept: Downscaling climate and impact indicators to urban scale

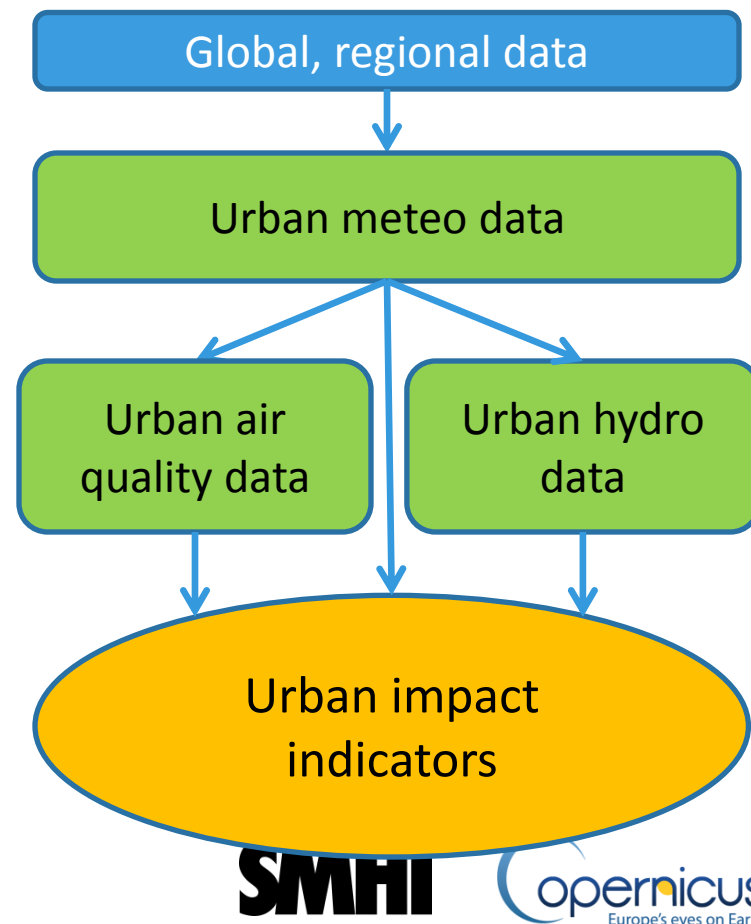


Essential Climate Variables (ECV) form basis for impact indicators:

- ★ Precipitation (and snow), water vapour
- ★ Temperature, wind speed and direction
- ★ Surface radiation budget
- ★ urban air quality (NO<sub>2</sub>, O<sub>3</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>)
- ★ soil moisture and river discharge

Hourly 1x1 km<sup>2</sup> gridded information for 5-10 year windows for historical and future conditions.

**Impact indicators** tailored for urban infrastructure and health (e.g.: heat/air pollution-related deaths, max/min summer/winter temperature, precipitation Intensity-Duration-Frequency (IDF) curves...)

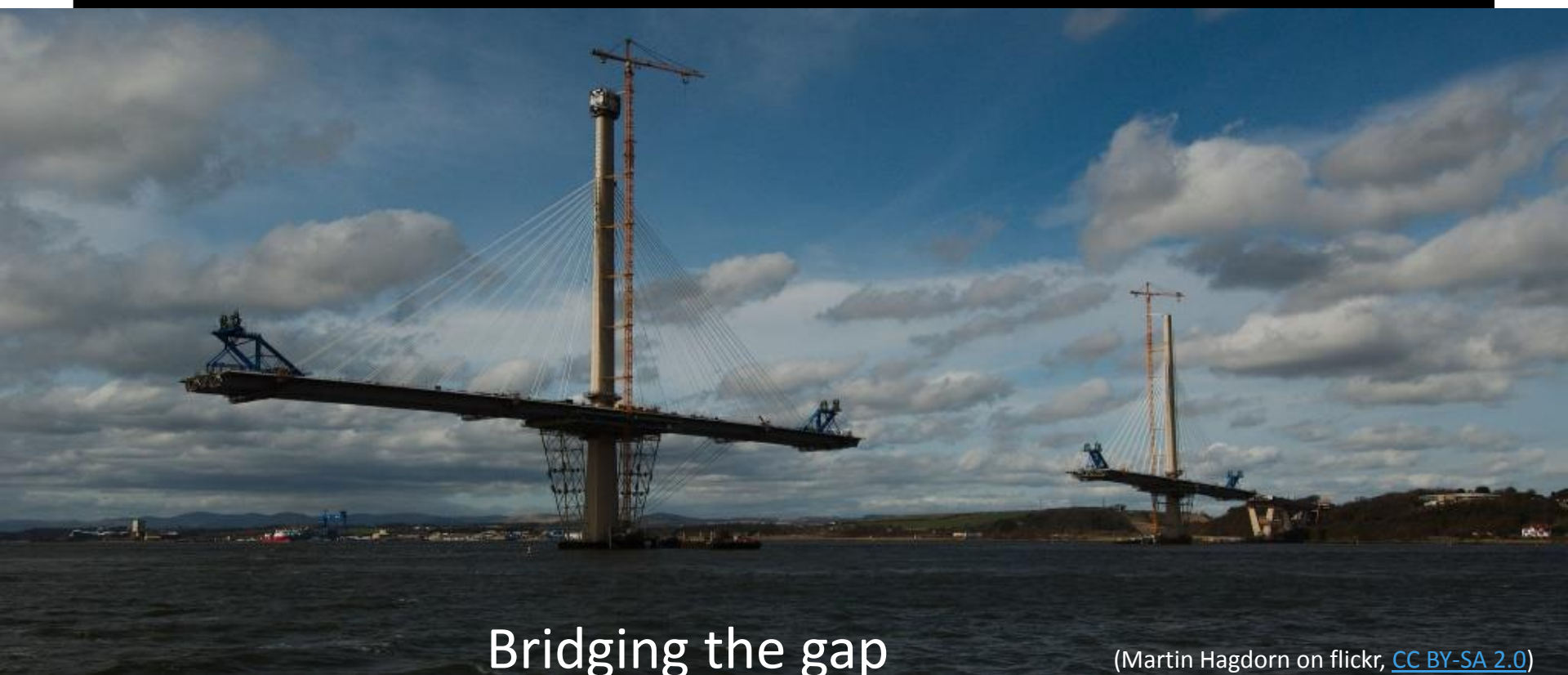




# Urban SIS :: steps



- **Dynamical downscaling** of climate data to spatial resolution of  $1 \times 1 \text{ km}^2$ :
  - For meteorology (HARMONIE-AROME)
  - For air quality (MATCH)
  - For hydrology (HYPE)
- **3 pilot cities** : Stockholm, Bologna, Amsterdam/Rotterdam
- **Time windows** of 5-10 years, representing ‘historical’ and ‘present/future’ climate
- Produce  **$1 \times 1 \text{ km}^2$  urban ECVs**
- Post-process the urban ECVs aiming to generate **urban impact indicators**



## Bridging the gap

(Martin Hagdorn on flickr, [CC BY-SA 2.0](#))

between researchers of different fields,  
stakeholders and end users with user  
workshops in Stockholm and Bologna

# Urban SIS: Targeted end users

Advanced end users (consultants, urban engineers, modellers):

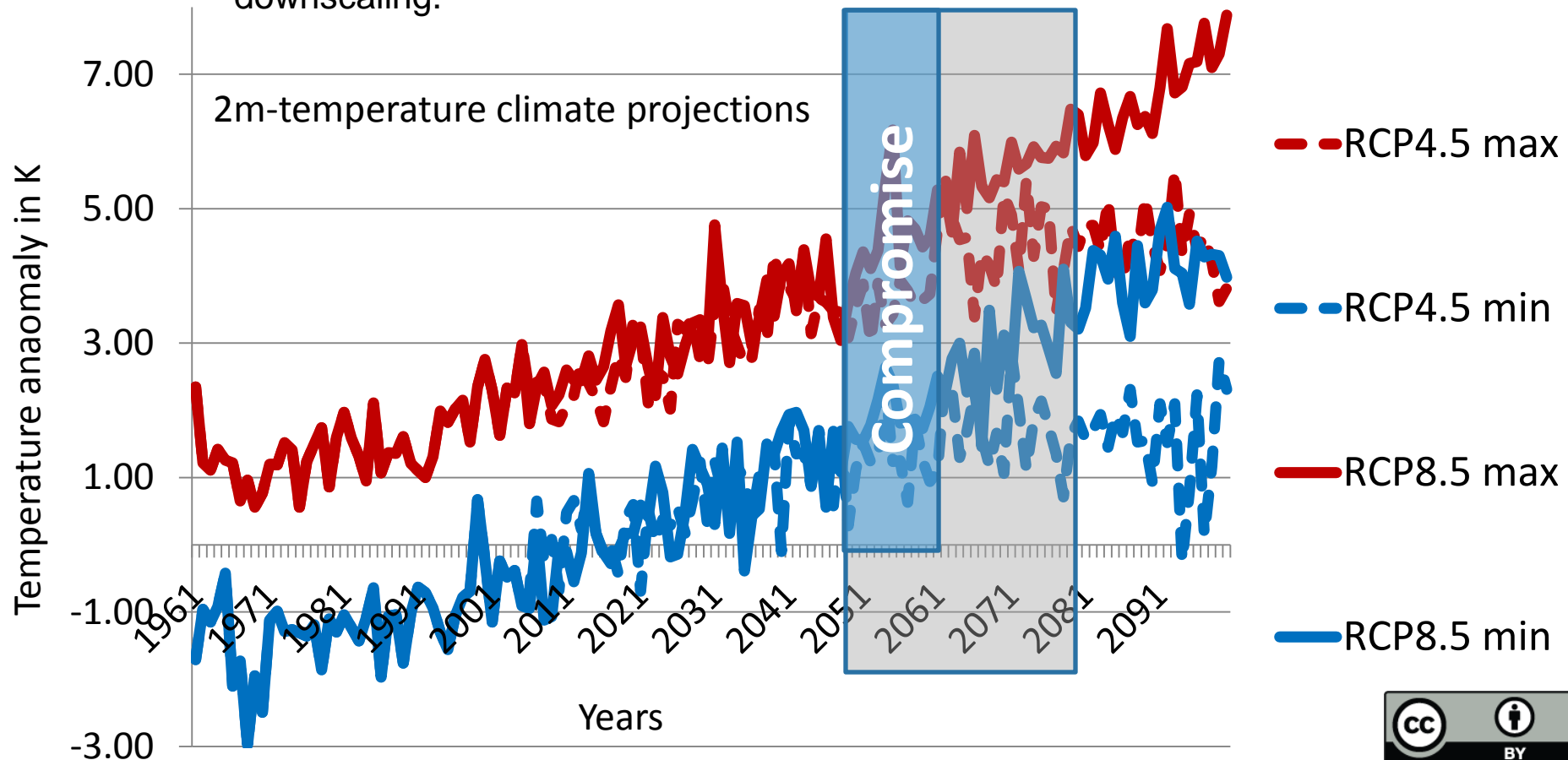
- ★ improved input data to run local impact models
- ★ both historical periods and future climate projections

Urban planners in general:

- ★ selected impact indicators for infrastructure sector:
  - Intensity-Duration-Frequency curves (precipitation)
  - design storms, storm movements
  - wind speed averages and extremes
  - .....
- ★ selected impact indicators for health sector:
  - heat wave frequency / duration /number of tropical nights
  - average heat-related deaths
  - number of people exposed for air pollution above WHO guidelines
  - .....

## Challenge: which future time window?

- Conflict:
  - User planning horizon for next 20-30 years
  - Global and regional climate model data stored with sufficient detail for downscaling.





Open-access databases and products used for enriching ECOCLIMAP II:

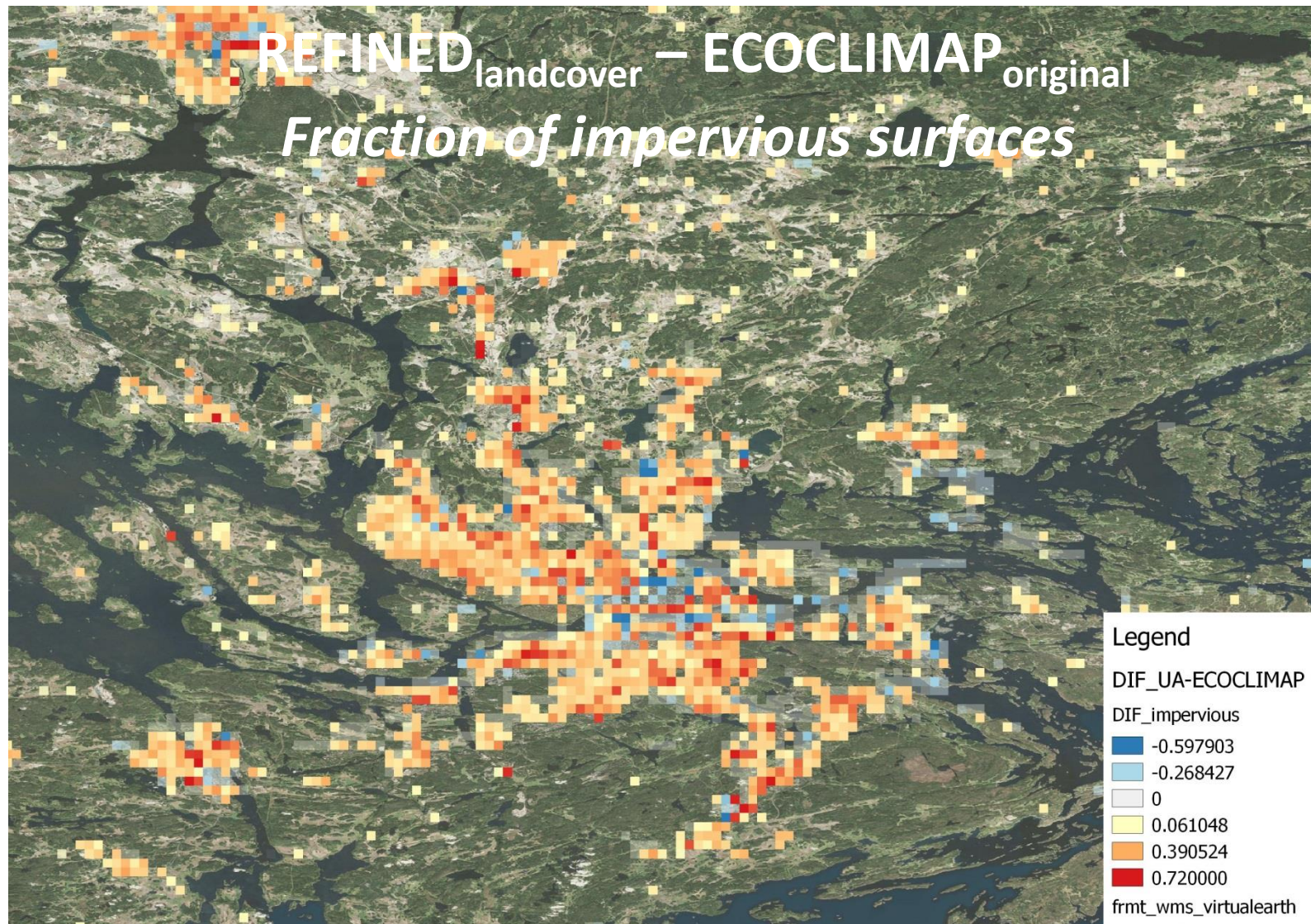
Input data type	Product	Spatial resolution (m)	Source data type	Webpage
Spatial coverage of land cover types	Copernicus Land Monitoring Services: Urban Atlas 2012	100	Satellite data PROBAV v1.4	<a href="http://land.copernicus.eu/local/urban-atlas">http://land.copernicus.eu/local/urban-atlas</a>
Building polygons	OpenStreetMap	nd	Different sources	<a href="https://www.openstreetmap.org">https://www.openstreetmap.org</a>
Building/tree heights	Swedish Forest Agency	12.5	Lidar measurements	<a href="http://www.skogsstyrelsen.se/Myndigheten/Om-oss/Oppna-data/">http://www.skogsstyrelsen.se/Myndigheten/Om-oss/Oppna-data/</a>
Time-series of LAI	Copernicus Global Land Service	1000	Satellite data	<a href="http://land.copernicus.eu/global/themes/vegetation">http://land.copernicus.eu/global/themes/vegetation</a>

Selection criteria for the data sources:

\*Accuracy/reliability

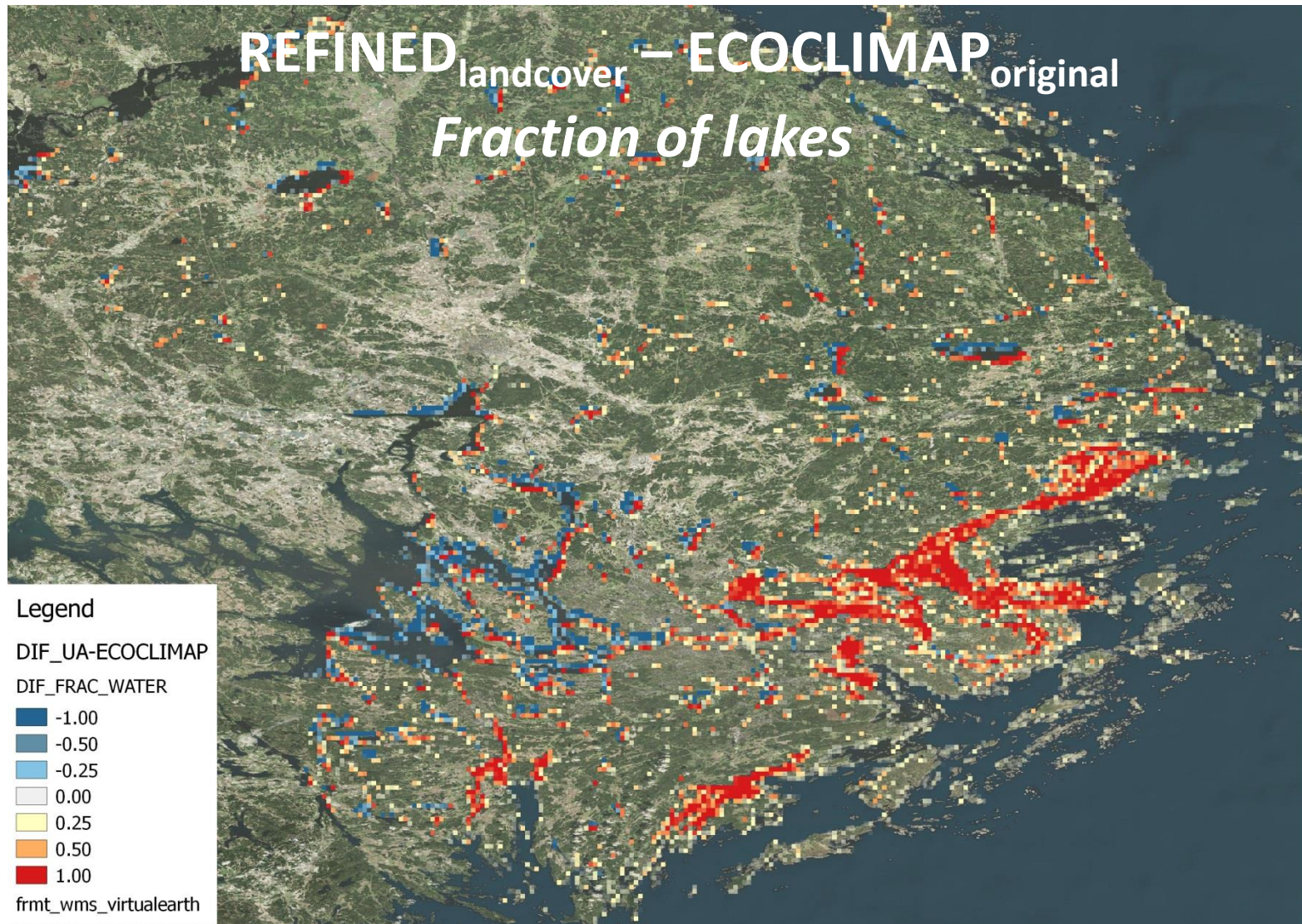
\*Spatial (& time) resolution

\*Availability



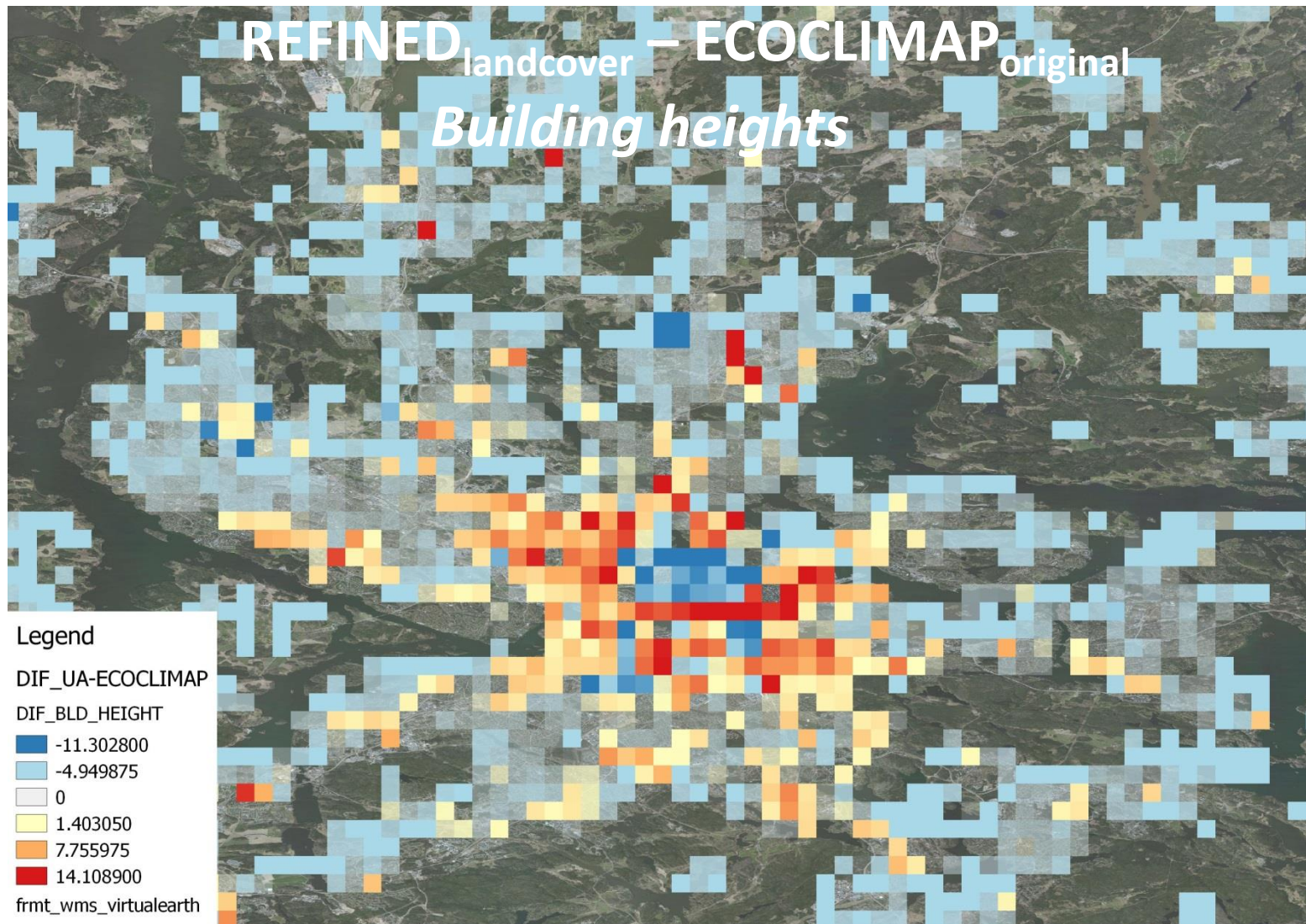
- Increased sealing of surfaces





- In the archipelago: landcover changed from SEA to LAKE (FLAKE model)
- In the Stockholm lakes: finer description of the shoreline





- better description of buildings height based on real data

urban park station :: Stockholm Observatoriet

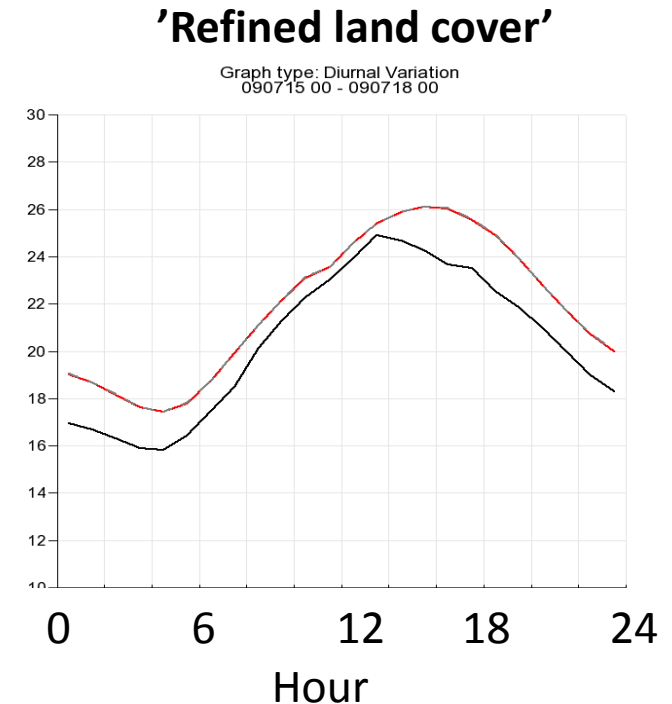
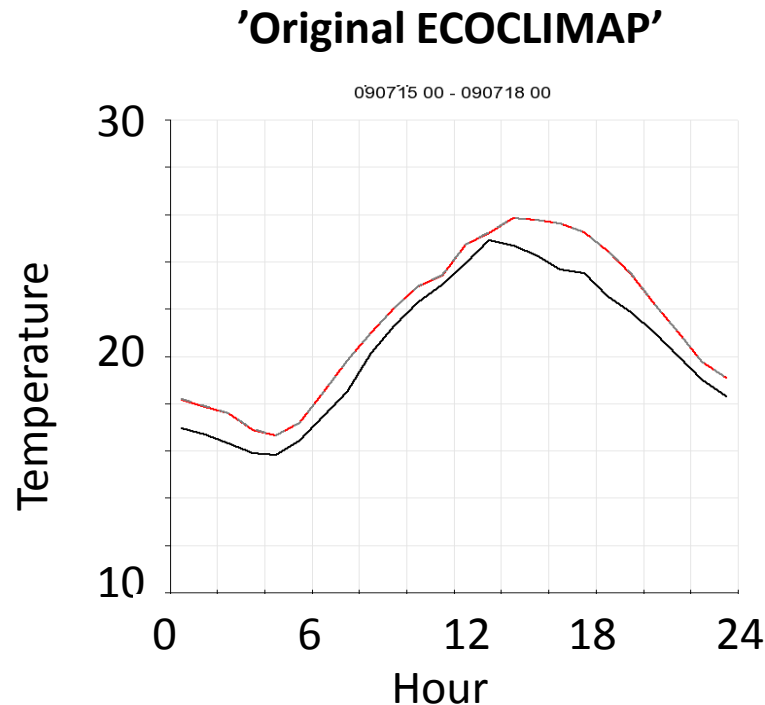
July 15-17  
2009

T@2m

Obs

Model Nature

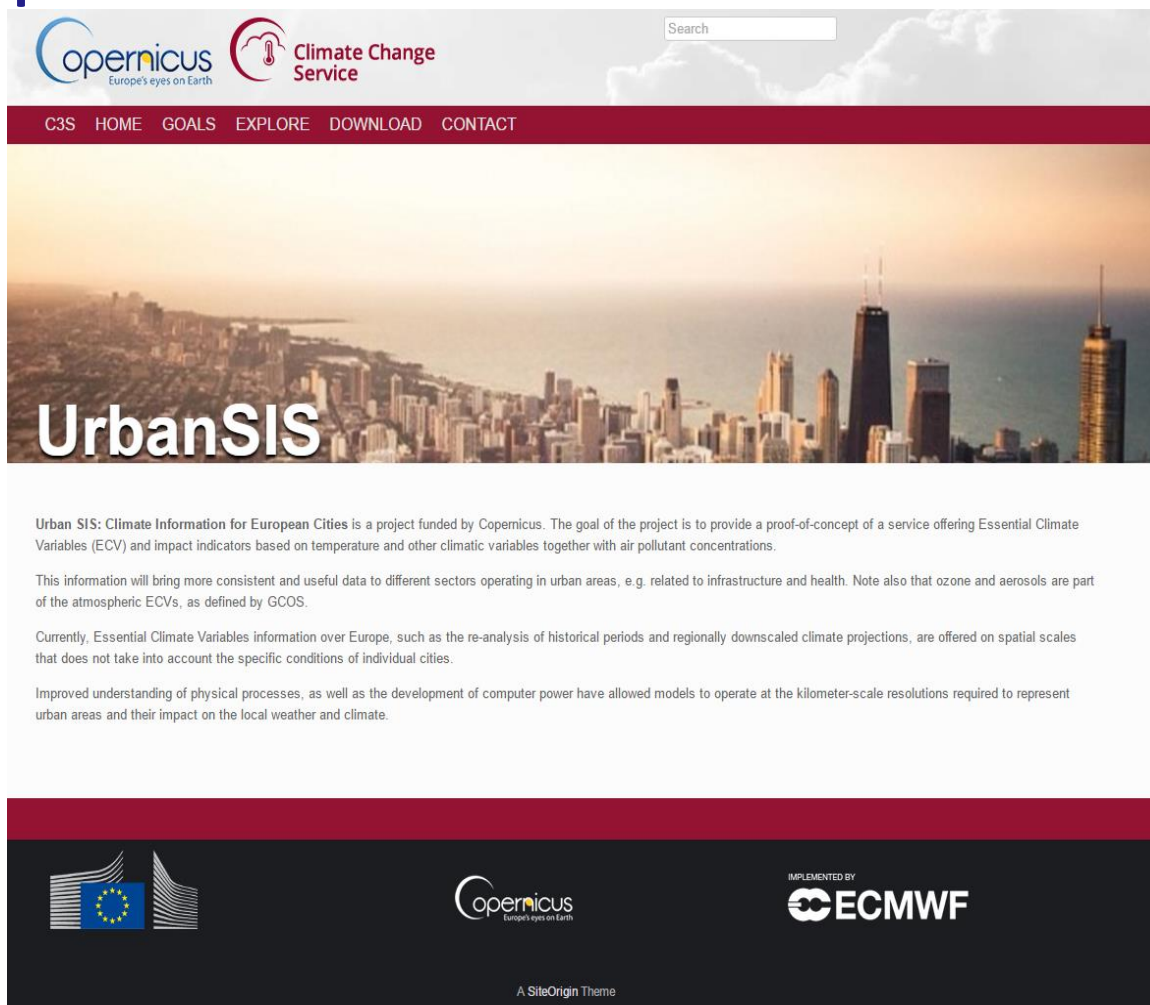
Model Town



- Underestimation of nighttime air temp with ROCK, while in TEB it is overestimated
- Excess of heat stored in buildings during daytime possibly explaining the nighttime overestimation

## Challenge: portal and GUI

<http://urbansis.climate.copernicus.eu/explore>  
<http://urban-sis.smhi.se>



**Copernicus** Europe's eyes on Earth **Climate Change Service**

Search

C3S HOME GOALS EXPLORE DOWNLOAD CONTACT




# UrbanSIS

Urban SIS: Climate Information for European Cities is a project funded by Copernicus. The goal of the project is to provide a proof-of-concept of a service offering Essential Climate Variables (ECV) and impact indicators based on temperature and other climatic variables together with air pollutant concentrations.

This information will bring more consistent and useful data to different sectors operating in urban areas, e.g. related to infrastructure and health. Note also that ozone and aerosols are part of the atmospheric ECVs, as defined by GCOS.

Currently, Essential Climate Variables information over Europe, such as the re-analysis of historical periods and regionally downscaled climate projections, are offered on spatial scales that does not take into account the specific conditions of individual cities.

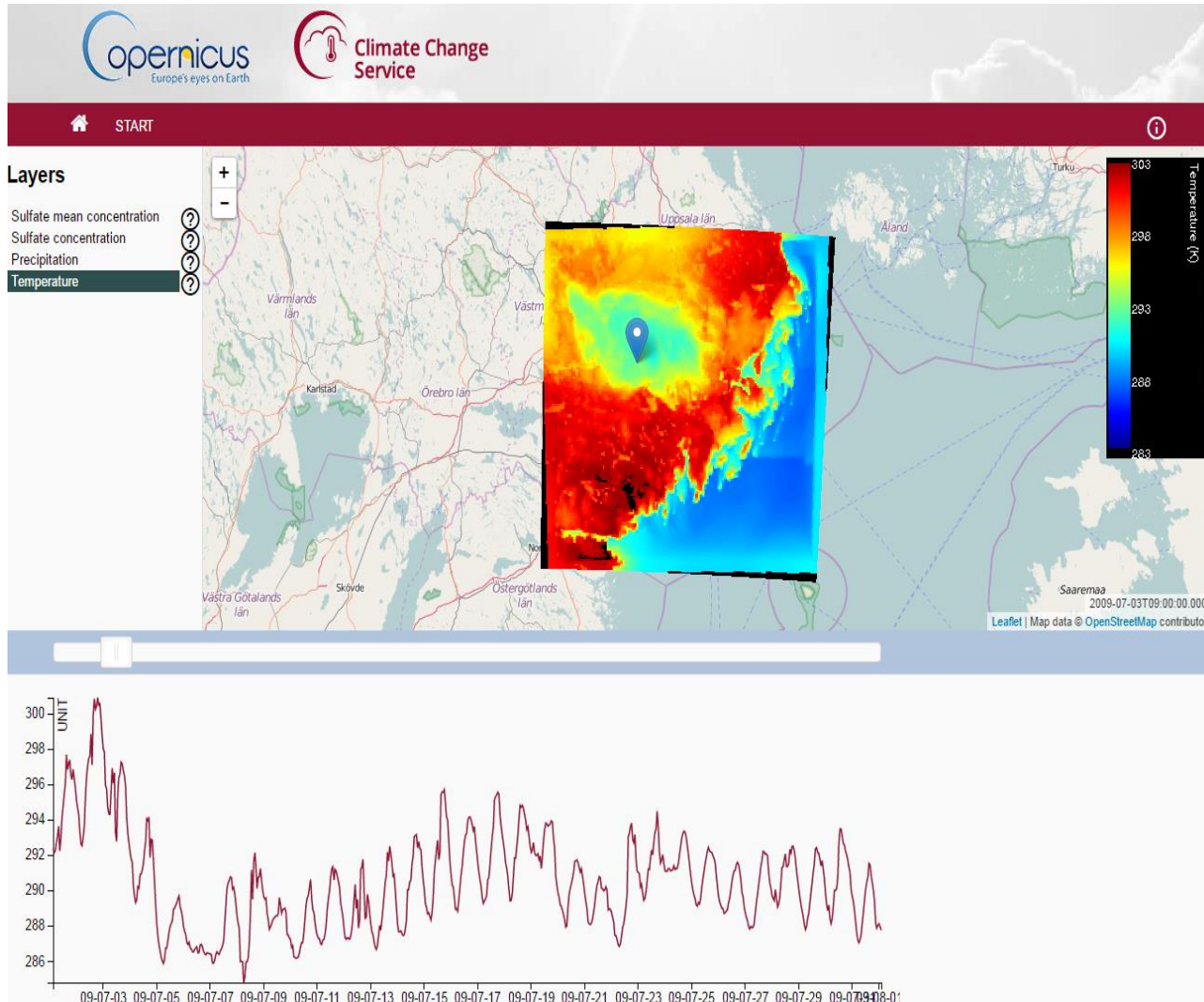
Improved understanding of physical processes, as well as the development of computer power have allowed models to operate at the kilometer-scale resolutions required to represent urban areas and their impact on the local weather and climate.



 IMPLEMENTED BY 

A SiteOrigin Theme



## Example: visualization and download of ECV data



Download single  
or time series of:

- ★ grids
- ★ parts of grids
- ★ Pointwise

Format: NetCDF  
or ASCII

Metadata:

Short information  
in NetCDF file.  
Complete meta-  
data in separate  
file/link attached to  
data (html?)

## Summary

- Urban SIS will provide high-resolution urban Essential Climate Variables and impact indicators aiming at the sectors of Health and Infrastructure.
- User interaction needed to design a "useful" service.
- High computational and storage costs put constraints on service.
- High-resolution physiography data from Urban Atlas is implemented in ECOCLIMAP II, but needs fine tuning in the meteorological model.

<http://urbansis.climate.copernicus.eu/explore>

<http://urban-sis.smhi.se>



Urban SIS

**Thank you for your attention!**