Urban SIS: a Climate Service for European Cities

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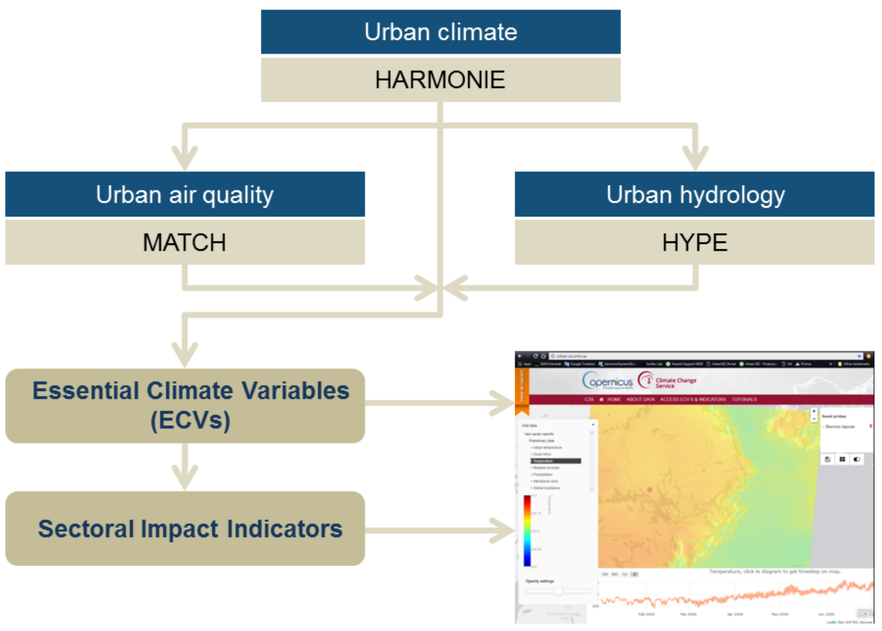
The concept and the methods

Urban SIS is a proof-of-concept project within ***Copernicus Climate Change Service*** (C3S 441 Lot 3) providing **city specific climate data and impact indicators** useful for consultants, urban planners, engineers and scientists dealing with intense rainfall, heat waves, and air pollution hazards. The **demonstration** of Urban SIS methods and results is made over 3 European metropolitan areas:

Stockholm, **Bologna** and **Amsterdam/Rotterdam**.

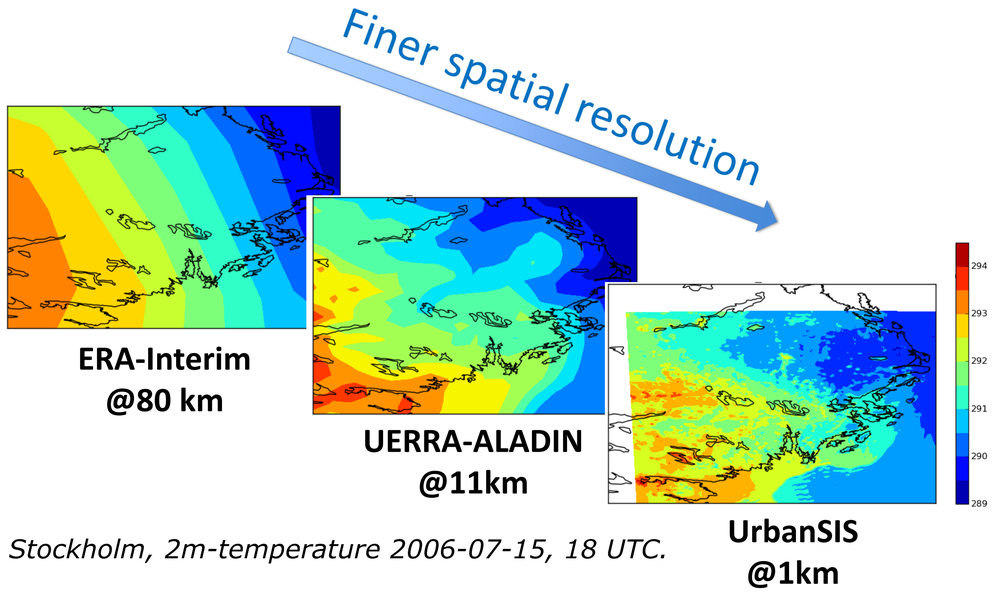
The Urban SIS information is based on climate re-analysis and climate scenario data, downscaled to **1x1km² spatial resolution**. 3 time windows of 5 years each allow to represent **historical, present and future conditions**.



Flowchart of the dynamical downscaling approach in UrbanSIS.

The urban climate downscaling is performed with HARMONIE:

- in NWP mode (**HARMONIE-AROME**) for the historical period (with boundary conditions from the UERRA-ALADIN reanalysis at 11 km resolution using global data from ERA-Interim, and surface observations retrieved from the ECMWF MARS archive),
- and in a climate setting (**HCLIM**) for the present state and future scenario (boundaries from HARMONIE at 20x20 km² downscaled from the GCM EC-Earth model with RCP8.5).



Stockholm, 2m-temperature 2006-07-15, 18 UTC.

Urban SIS has strongly refined the urban physiography characterization based on Urban Atlas (Copernicus Land Monitoring Services), OpenStreetMap and Leaf Area Index (Copernicus Global Land Service) products.

To complete the modelling cascade, the air quality dispersion model **MATCH** and the hydrological model **HYPE** use HARMONIE downscaled data as meteorological forcing. In order to assure full consistency between all ECVs, the boundary conditions for MATCH and HYPE are produced by pan-European model runs performed prior to the urban downscaling.

The products

All the information and data is freely available through the Urban SIS portal at http://urbansis.climate.copernicus.eu/.

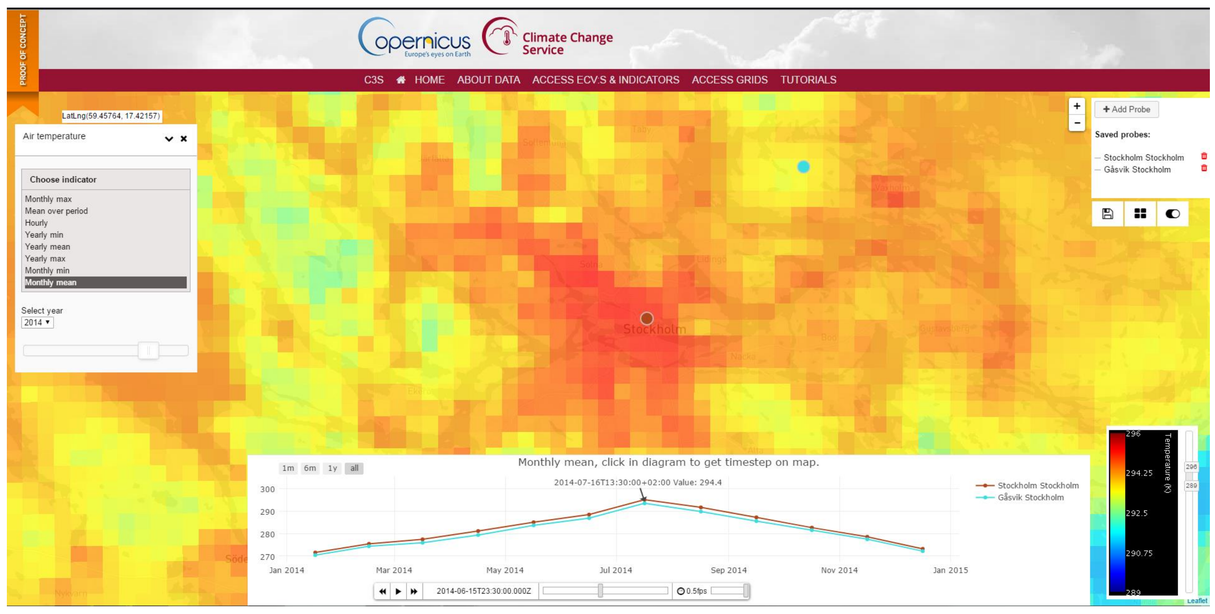
Urban SIS delivers **26** ***Essential Climate Variables*** (ECVs) that can be visualized and downloaded as hourly (or 15 min for precipitation) 1x1km² resolution fields (110x100 km² area size) or time series at specified coordinates. In addition, Urban SIS offers a series of ***statistical indicators*** for each ECV, e.g. daily/monthly/annual averages and extreme values.

65 ***Sectoral Impact Indicators***, specified by end-users and experts from the infrastructure and health sectors, are also offered:

sector	area	type	number
Health indicators	*Air quality*	EU limit values: concentrations	7
		EU limit/WHO guideline values: exposure	10
		Mortality long-term exposure	6
		Mortality short-term exposure	2
	Heat stress	Number of hot days	1
		Heat wave duration	1
		Heat induced mortality	2
	Discomfort	Thom Discomfort index	2
		Universal Thermal Climate Index	4
		Frequency of tropical nights	2
Energy indicators	*Energy consumption*	Heating degree days	1
		Cooling degree days	1
	Solar energy	Shortwave solar insolation	1
		Monthly shortwave solare insolation	1
Infrastructure indicators	*Flooding*	Extreme precipitation	8
		Extreme precipitation: intensity/duration	(1)
	Soil	Soil temperature	1
	Green infrastructure	Growing season length	5
		Drought periods	1
	Transport infrastructure	Frost days	1
		Ice days	1
		Zero-crossings	1
Non-sector specific indicators		Daily max/min/mean air temperature	4
		Snow cover	2

Example of the on-line visualization of an ECV statistical output

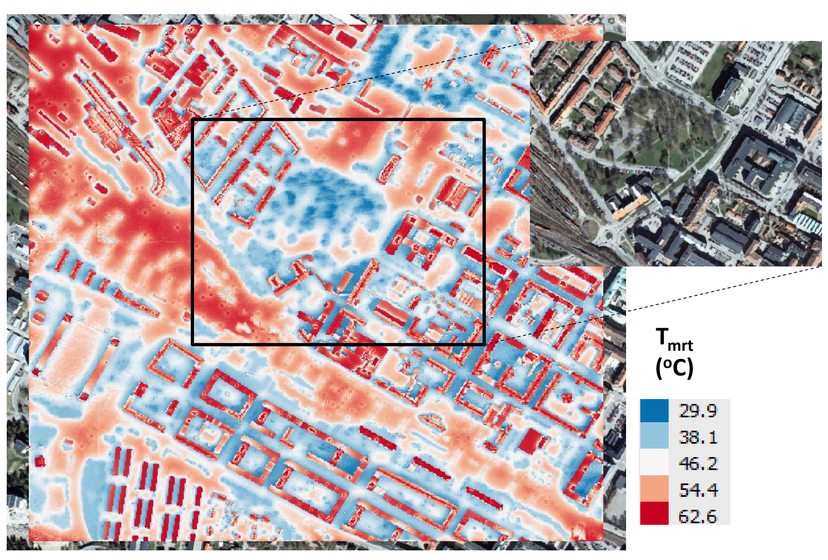
Revealing the Urban Heat Island (UHI):



Monthly mean air temperature (at 2 m high) in July 2014 over Stockholm, as captured by HARMONIE-AROME.

Example of the further exploitation of Urban SIS data

Detailed understanding of the heat stress in the urban environment:



Daily average T_{mrt} in July 26 2014 over central Eskilstuna, Sweden, as simulated by Solweig at 2 m resolution with boundary conditions from HARMONIE-AROME.

Mean radiant temperature (T_{mrt}) maps allow to identify critical outdoor places during a heat wave, and to assess the paths and the proximity to **cooler areas**, such as **urban parks**.

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