

Evaluation framework for high-resolution regional climate simulations for urban studies

Benjamin Le Roy⁽¹⁾, Diana Rechid⁽¹⁾, Gaby Langendijk⁽²⁾

⁽¹⁾ Climate Service Center Germany (GERICS)

⁽²⁾ Deltares – Climate Adaptation and Disaster Risk

The CIRCE project – City-oriented Impacts of Regional Climate for Europe

1. Identification of innovative urban climate impacts indicators

- Tailored to the needs of public stakeholders and local decision-makers
- Adapted to the geographical and socioeconomic contexts of cities
- Focusing on extreme meteorological events

2. Evaluation of the best regional/urban climate modeling configuration

- Evaluation of a large ensemble of Convection-Permitting Regional Climate simulations (CPRCM)
- Comparison to the EURO-CORDEX Regional Climate simulations (RCM)
- Evaluation of Urban Canopy Parametrisations

3. Assessment of past and future impacts of regional climate over European cities

- Analyses of future trends in impact indicators and their driving mechanisms
- Assessment of the concordance between CPRCM and RCM projections.
- Development of a prototype Urban Climate Service

Evaluation framework for urban studies

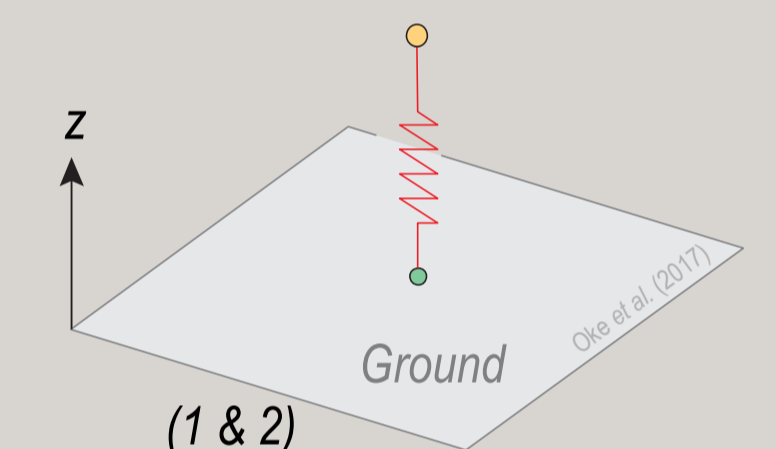
Convection-Permitting Regional Climate models ensemble* (Coppola et al. 2020)

Institute	Driving RCM	CPRCM	Res.	Urban Param.	Land Cover
AUTH-MC	WRF (Europe)	WRF381BG	3 km	Slab/Bulk (1)	MODIS Land Cover
BCCR	WRF (Europe)	WRF381BF	3 km	Slab/Bulk (1)	MODIS Land Cover
BCCR	WRF (Europe)	WRF381DA	3 km	Slab/Bulk (1)	MODIS Land Cover
CICERO	WRF (Europe)	WRF381BJ	3 km	Slab/Bulk (1)	MODIS Land Cover
FZJ-IBG3	WRF (Europe)	WRF381BB	3 km	Slab/Bulk (1)	MODIS Land Cover
IDL	WRF (Europe)	WRF381BH	3 km	Slab/Bulk (1)	MODIS Land Cover
IPSL	WRF (Europe)	WRF381BE	3 km	Slab/Bulk (1)	MODIS Land Cover
UCAN	WRF (Europe)	WRF381BI	3 km	Slab/Bulk (1)	MODIS Land Cover
UHOH	WRF (Europe)	WRF381BD	3 km	Slab/Bulk (1)	MODIS Land Cover
WEGC	WRF (Europe)	WRF381BL	3 km	Slab/Bulk (1)	MODIS Land Cover
GERICS	REMO (Europe)	REMO2015	3 km	Slab/Bulk (1)	LSPII - GLCCD
CLMcom-CMCC	CCLM (Europe)	CCLM5-0-9	3 km	TERRA-URB (2)	GLC2000
MOHC	None	UM10.1	2.2 km	JULES urban tile (2)	-
ICTP	RegCM4 (Europe)	RegCM4-7	3 km	CLMU (3)	MODIS / LandScan
CNRM	ALADIN (MED-CORDEX)	AROME41t1	2.5 km	TEB (3)	ECOCLIMAP I
HCLIMcom	HCLIM38-ALADIN (ALPS)	HCLIM38-AROME	3 km	TEB (3)	ECOCLIMAP II
KNMI	RACMO23E (West Central Europe)	HCLIM38h1-AROME	2.5 km	TEB (3)	ECOCLIMAP II

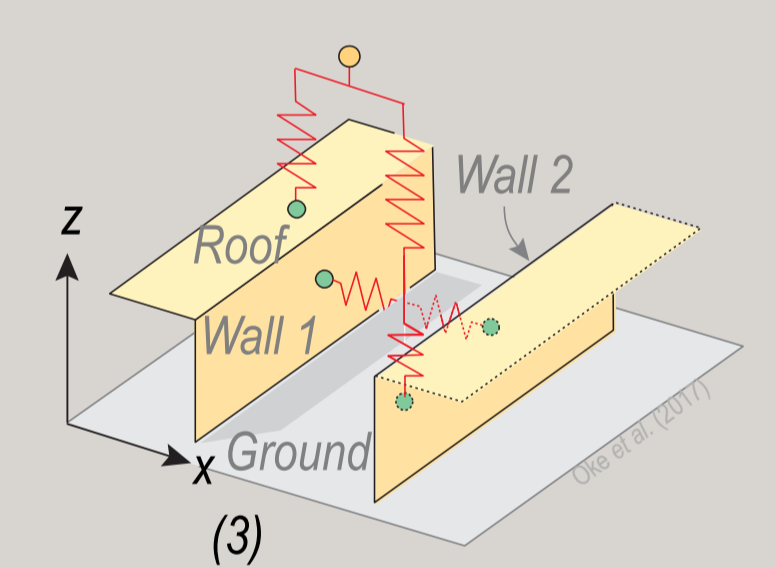
* Other CPRCM simulations are available that do not represent cities but instead replace them with natural covers

Urban Parametrisation of varying complexity

(1) **Slab/bulk:** natural surface with modified physical parameters (e.g. lower surface albedo, greater heat storage capacity, etc.)

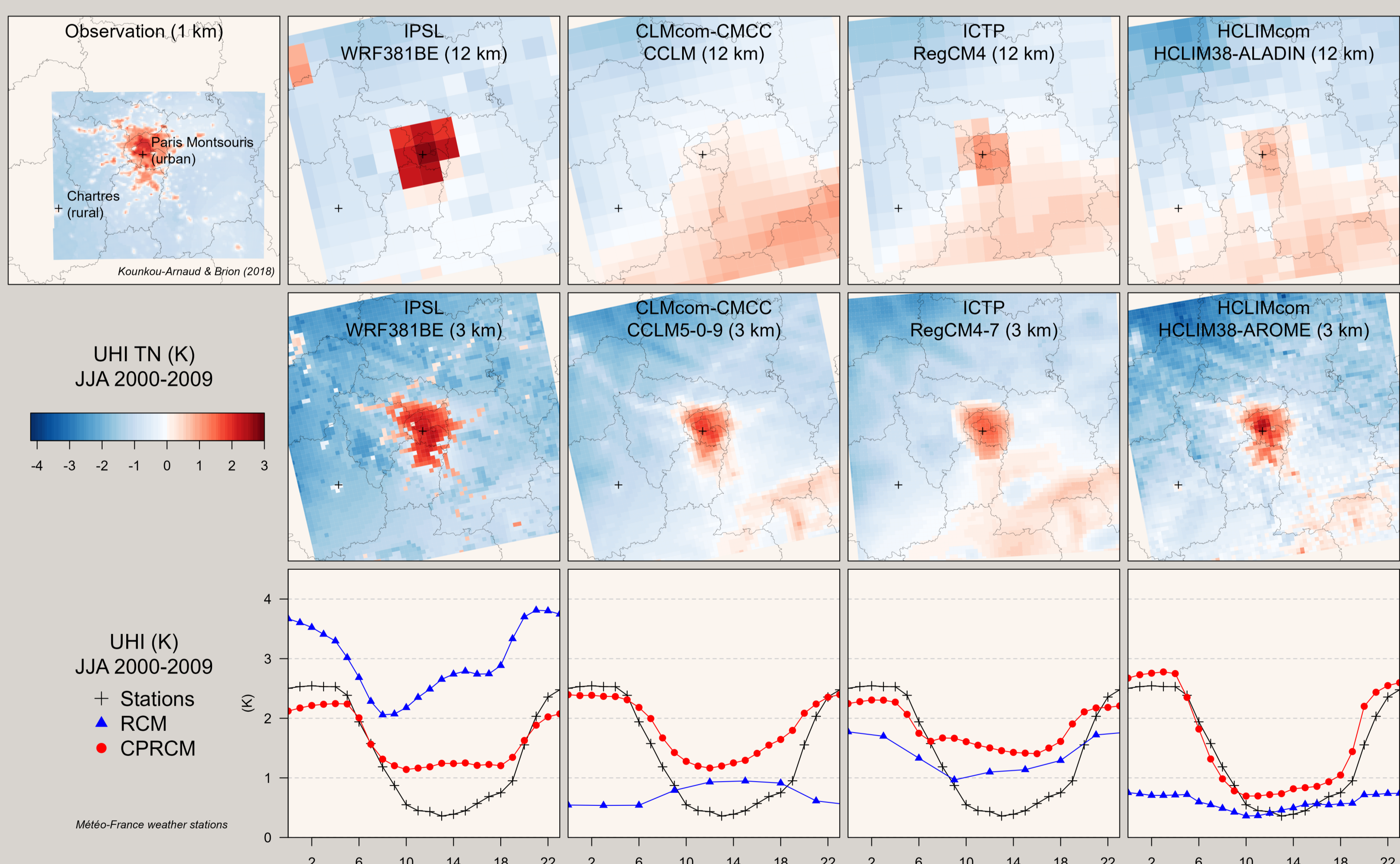


(2) **Urban slab:** separated urban surface with more sophisticated parameters (e.g. anthropogenic heat, water storage, etc.)



(3) **Single Layer Urban Canopy Model:** urban canyon of infinite length representing the effect of the city's geometry

Summer night-time urban heat islands



RCMs vs CPRCMs?

- Because of their coarse resolution, RCMs are particularly sensitive to the tiling approach
- Approaches based on dominant coverage overestimate the amount of city and, consequently, the urban heat island, whereas fractional approaches tend to do the opposite.

Slab/bulk vs Single Layer UCM?

- Slabs overestimate the flow of sensible heat during the day and, consequently, daytime temperatures and the urban heat island
- Urban night-time temperatures are sensitive to slab parameters: some underestimate ground heat flow and therefore temperatures
- The best results are obtained by combining detailed urban canopy models with appropriate land use databases