News on TERRA_URB, the urban land-surface parametrization of the COSMO(-CLM) model

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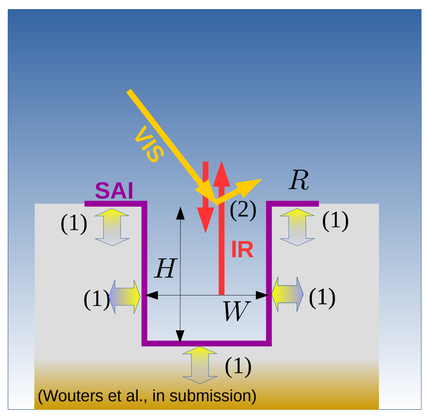
Urban canopy parameters

parameter name	symbol	default value
substrate albedo	α	0.101
substrate emissivity	ϵ	0.86
substrate heat conductivity	λ_s	0.777 W m^{-1} K^{-1}
substrate heat capacity	$C_{v,s}$	1.25 10^{6}J m^{-3} K^{-1}
building height	H	15 m
canyon height-to-width ratio	$\frac{H}{W}$	1.5
roof fraction	R	0.67

Semi-empirical Urban canopY parametrization SURY



"Translation of urban canopy parameters into bulk parameters"

1. 'SAI'-integrated substrate heat transport
2. Approximation of Fortuniak (2007) for albedo reduction depening on $\frac{H}{W}$-ratio
3. Surface roughness from building height (Sarkar and De Ridder, 2010)

as easy as

for any atmospheric model!

Local Climate Zones classification (Stewart and Oke, 2012)

Bulk parameters

parameter name	symbol
albedo (snow-free)	α_{bulk}
emissivity (snow-free)	ϵ_{bulk}
aerodynamic roughness length	z_0
bulk heat conductivity	λ_{bulk}
bulk heat capacity	$C_{\text{v,bulk}}$

References

Wouters, H., M. Demuzere, K. De Ridder, and N. P. van Lipzig, 2015: The impact of impervious water-storage parametrization on urban climate modelling. *Urban Climate*, **11**, 24–50, 10.1016/j.uclim.2014.11.005.

Wouters, H., M. Demuzere, U. Blahak, N. P. van Lipzig, B. Maiheu, K. Fortuniak, J. Camps, and D. Tielemans: Efficient urban canopy parametrization for atmospheric modelling: evaluation for a Belgian summer with the COSMO(-CLM) model. *(in submission)*

TERRA_URB

"Intrinsic representation of urban physics in the COSMO(-CLM) model with modifications to the input data, soil module and land-atmospheric interactions"

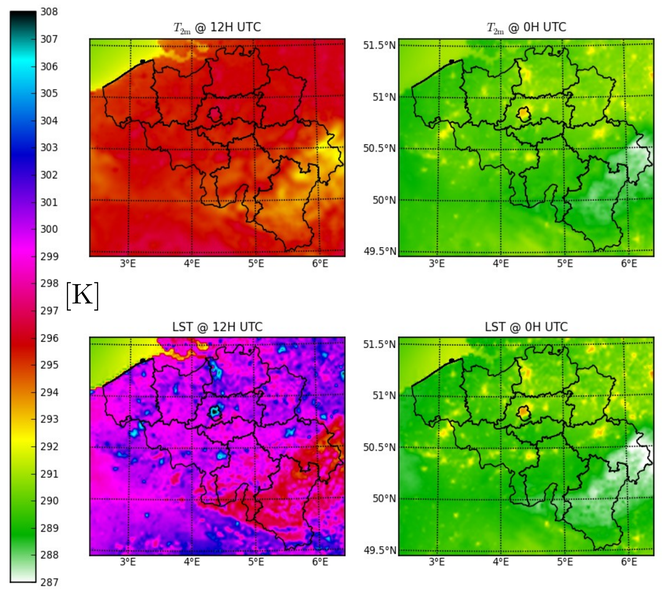
– *Since version 1 → Development Version in COSMO [May 2014]* –

- Bulk representation of the urban canopy (De Ridder et al., 2012)
- Anthropogenic heat emission (Flanner, 2009)
- 'Bluff-body' thermal roughness length parametrization (Brutsaert et al., 1982; Kanda et al., 2006)
- Impervious water storage based on a density distribution of water puddles (Wouters et al., 2015)
- Poorman's tile approach

– *Since version 2 → Test Version in COSMO [February 2016]* –

- Application of SURY (Wouters et al., in submission)→ see upper-right box
- Application of TURBTRAN
- Buildings and pavements are represented on top of natural soil instead of seperate soiltype → Consistent representation impervious surfaces, bare soil, vegetation and snow in a single tile

The COSMO - CLM model

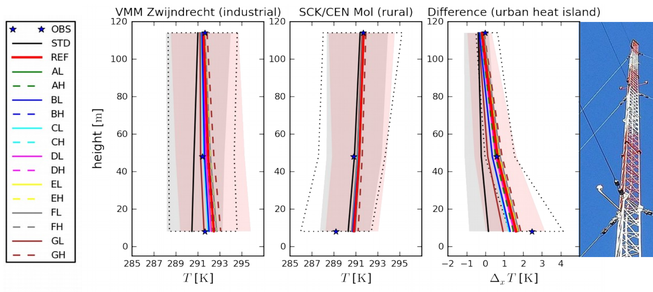


Example for Belgium averaged fields for mid-summer 2012 @ 2.8km resolution

EXTPAR

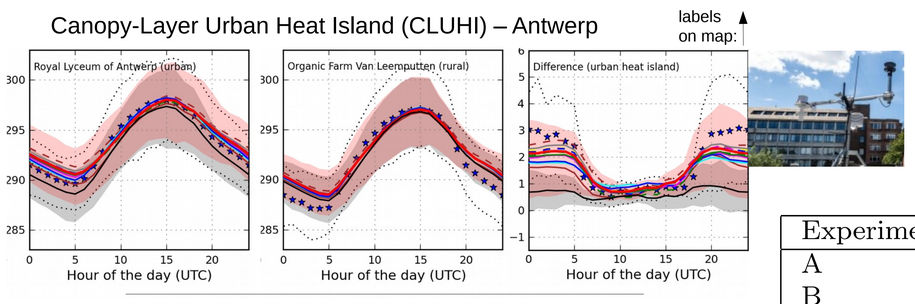
– In DWD version 2.4 and COSMO consortium version 3.0 –

- New field: Impervious Surface Area (ISA)
- New field: Annual-mean Anthropogenic Heat Flux (AHF)



Example for ISA over Belgium (2.8km resolution)

Canopy-Layer Urban Heat Island (CLUHI) – Antwerp



Nocturnal Boundary-Layer Heat Island (BLUHI) – Antwerp

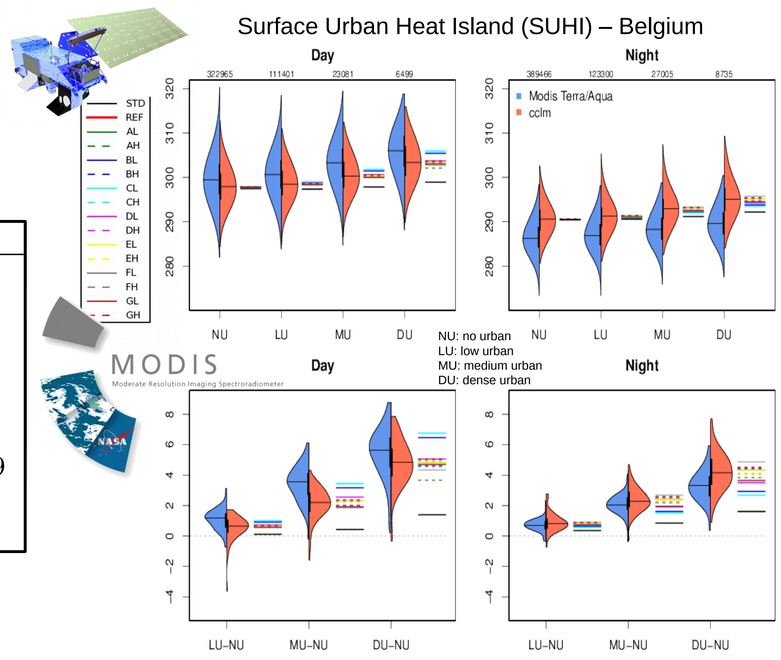
Urban canopy parameter sensitivity

– for the Belgian area and the city of Antwerp –

Experiment ID	urban canopy parameter	L	H
A	α	0.10	0.25
B	λ_s [W m^{-1} K^{-1}]	0.200	0.968
C	$C_{\text{v,s}}$ [10^{6}J m^{-3} K^{-1}]	0.321	1.56
D	$\frac{H}{W}$	0.75	2.0
E	H [m]	3	30
F	R	0.40	0.70
G	AHF	0	2 × FL09

Ranges are adopted from the Local Climate Zones of 'compact mid-rise' and 'compact low rise' (Stewart and Oke, 2012)

Surface Urban Heat Island (SUHI) – Belgium



NU: no urban
LU: low urban
MU: medium urban
DU: dense urban