REACT

Remote sensing for Epidemiology in African CiTies

Implication of new urban canopy parameterization over scarcely documented regions. The case of Kampala.

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UNIVERSITÉ DE NAMUR FACULTÉ DES SCIENCES

KU LEUVEN

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COSMO User Seminar, 1st March 2018, Oscar Brousse

What can we get out of HRRS?

Land use and land cover information

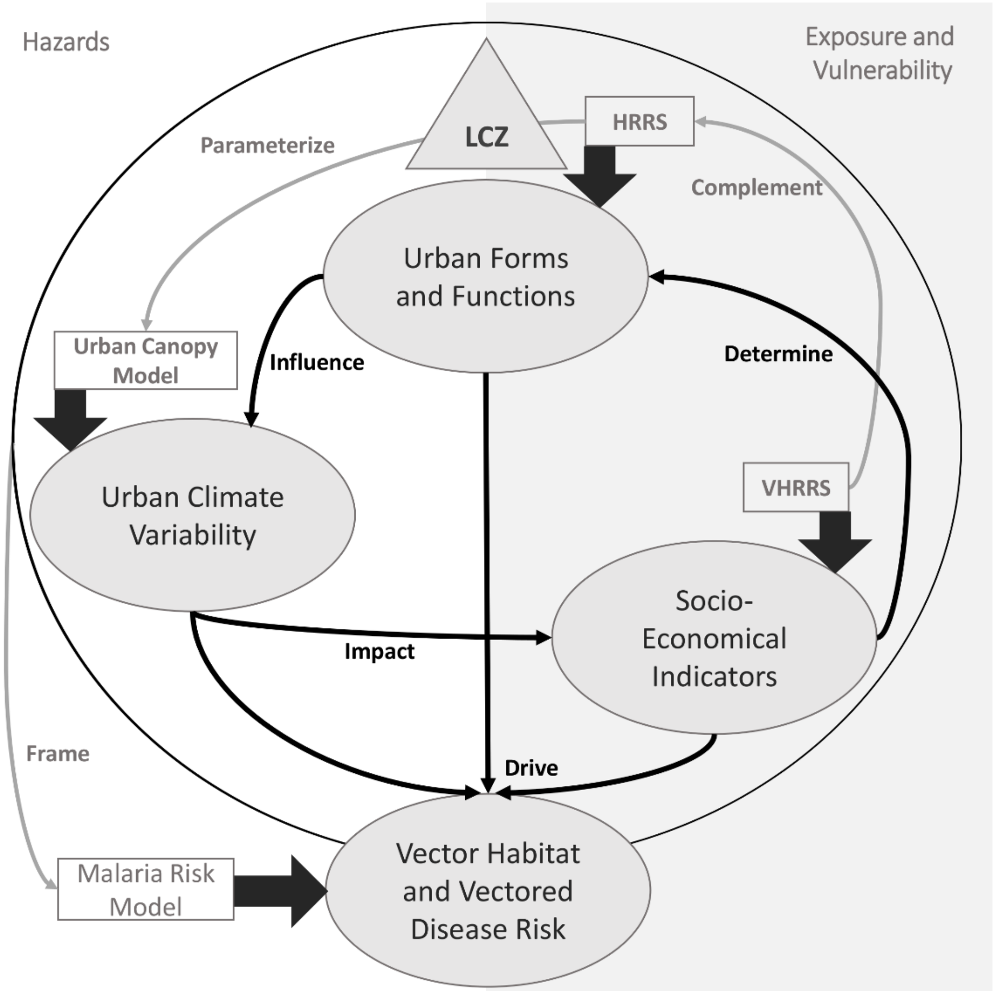
Indices for comparison of climate model output

Feedbacks and targets to/for VHRRS

Parameters for Urban Climate Model

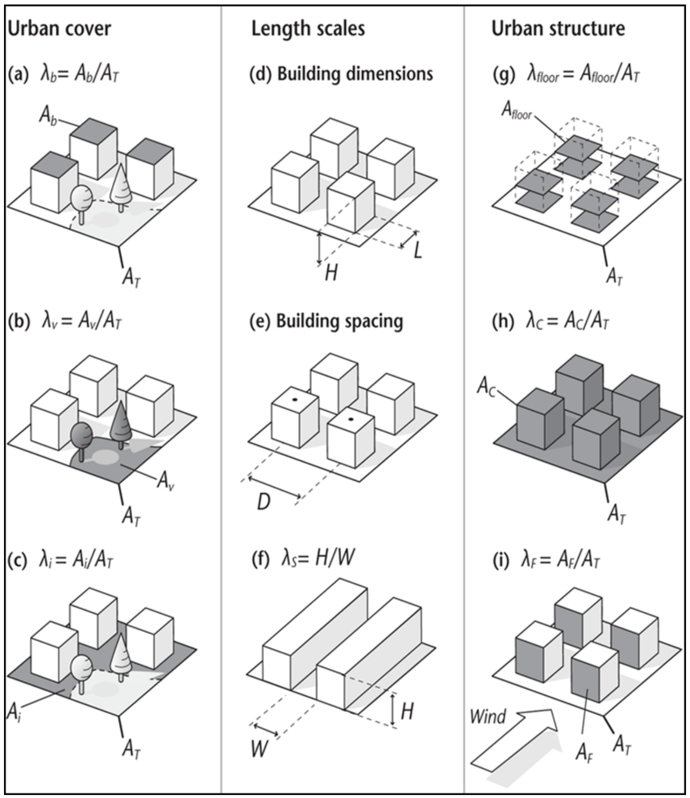
Common scale and framework for REACT

Local Climate Zones as a powerful tool



Source : Brousse et al. (2018)

What can we learn out of LCZs?



Source : Oke et al. (2017)

LCZ Type	SVF	Canyon Aspect Ratio (H/W)	Mean Height (m)	Terrain Roughness Class	Building Surface Fraction	Impervious Surface Fraction	Pervious Surface Fraction	Surface Albedo	QF (Wm^{-2})
1	0.2- 0.4	>2	>25	8	40-60%	40-60%	<10%	0.10-0.20	50-300
2	0.3-0.6	0.75-2	10-25	6-7	40-70%	30-50%	<20%	0.10-0.20	<75
3	0.2-0.6	0.75-1.5	3-10	6	40-70%	20-50%	<30%	0.10-0.20	<75
4	0.5-0.7	0.75-1.25	>25	7-8	20-40%	30-40%	30-40%	0.12-0.25	<50
5	0.5-0.8	0.3-0.75	10-25	5-6	20-40%	30-50%	20-40%	0.12-0.25	<25
6	0.6-0.9	0.3-0.75	3-10	5-6	20-40%	20-50%	30-60%	0.12-0.25	<25
7	0.2-0.5	1-2	2-4	4-5	60-90%	<20%	<30%	0.15-0.35	<35
8	>0.7	0.1-0.3	3-10	5	30-50%	40-50%	<20%	0.15-0.25	<50
9	>0.8	0.1-0.25	3-10	5-6	10-20%	<20%	60-80%	0.12-0.25	<10
10	0.6-0.9	0.2-0.5	5-15	5-6	20-30%	20-40%	40-50%	0.12-0.20	>300
A	<0.4	>1	3-30	8	<10%	<10%	>90%	0.10-0.20	0
B	0.5-0.8	0.25-0.75	3-15	5-6	<10%	<10%	>90%	0.15-0.25	0
C	0.7-0.9	0.25-1	<2	4-5	<10%	<10%	>90%	0.15-0.30	0
D	>0.9	<0.1	1	3-4	<10%	<10%	>90%	0.15-0.25	0
E	>0.9	<0.1	<0.25	1-2	<10%	>90%	<10%	0.15-0.30	0
F	>0.9	<0.1	<0.25	1-2	<10%	<10%	>90%	0.20-0.35	0
G	>0.9	<0.1	N/A	1	<10%	<10%	>90%	0.02-0.10	0

Source : Stewart and Oke, Appendix (2012)
Table by Benjamin Bechtel

What are Local Climate Zones?

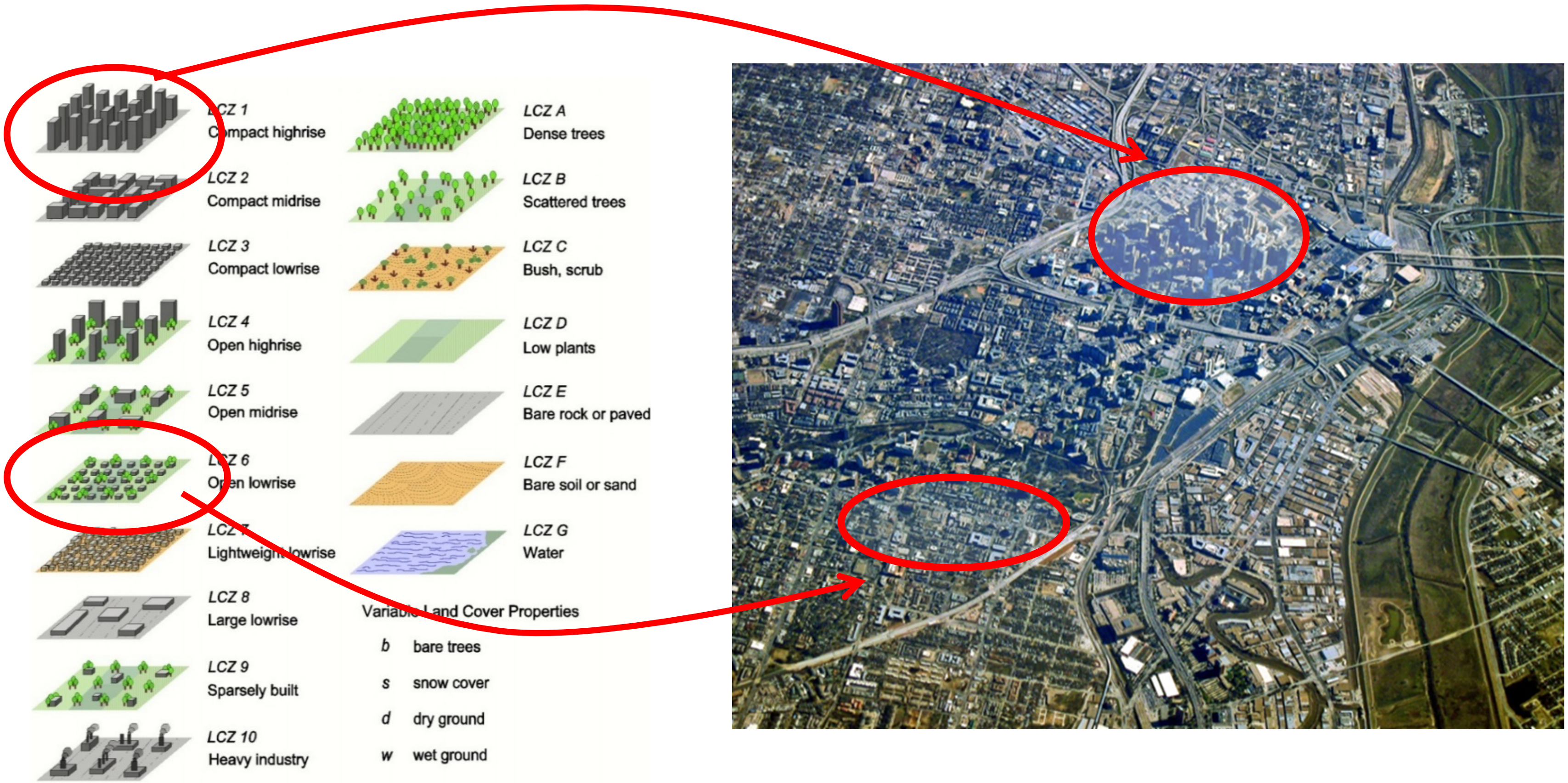


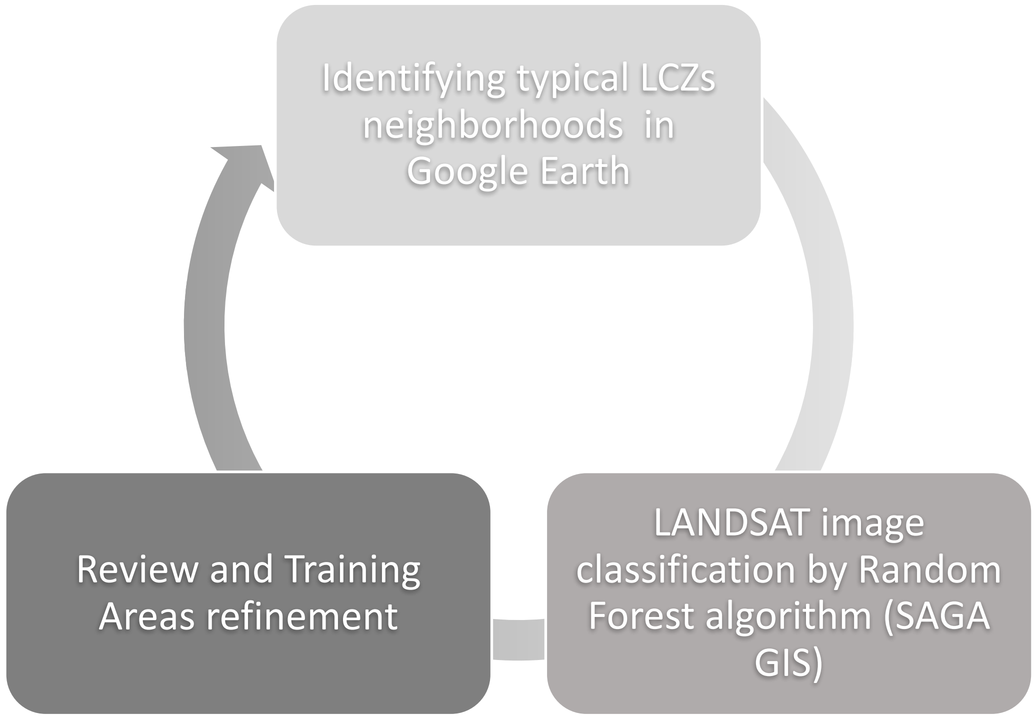
Image : Local Climate Zones from Stewart and Oke. (2012)

Figure by Gerald Mills

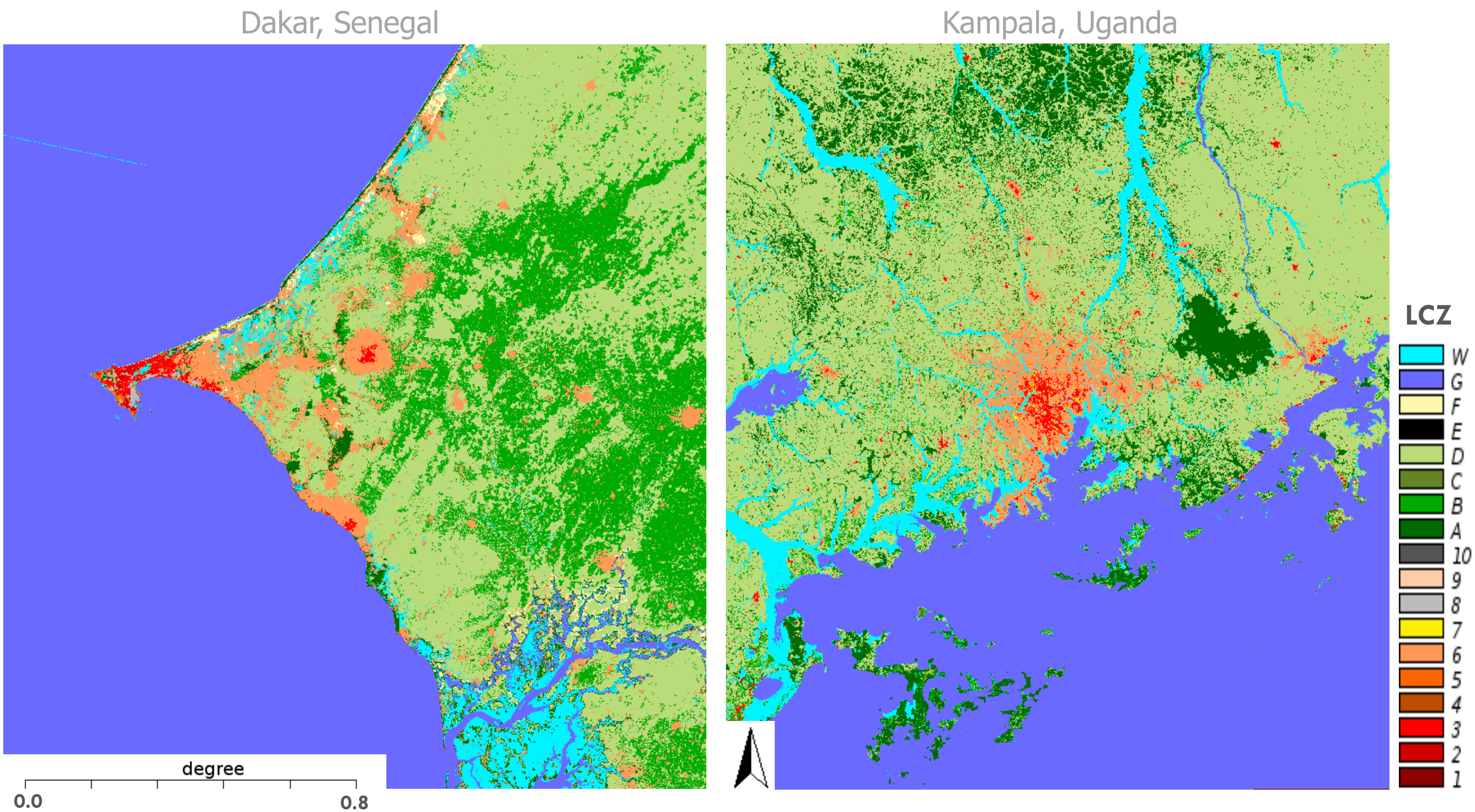
LCZs are “regions of uniform surface cover, structure, material and human activity” . - Stewart and Oke

How to map Local Climate Zones?

Follow the WUDAPT framework (Bechtel et al., 2015)



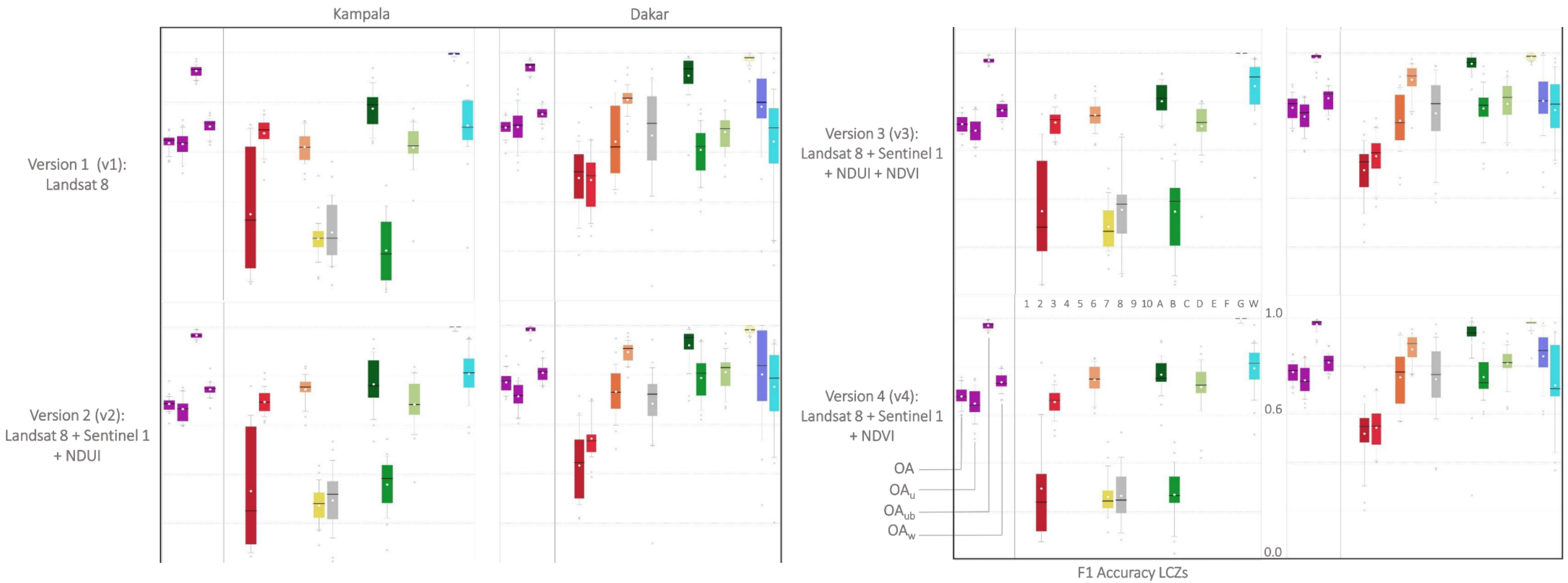
How to map Local Climate Zones?



Source : Brousse et al. (2018)

How to map Local Climate Zones?

Good overall accuracy…



Source : Brousse et al. (2018)

… Improve confusion in some LCZs by VHRRS

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Why do we study Kampala and Dakar?

Among the most populated areas in Eastern and Western Africa

Regions that need to adapt to climate change

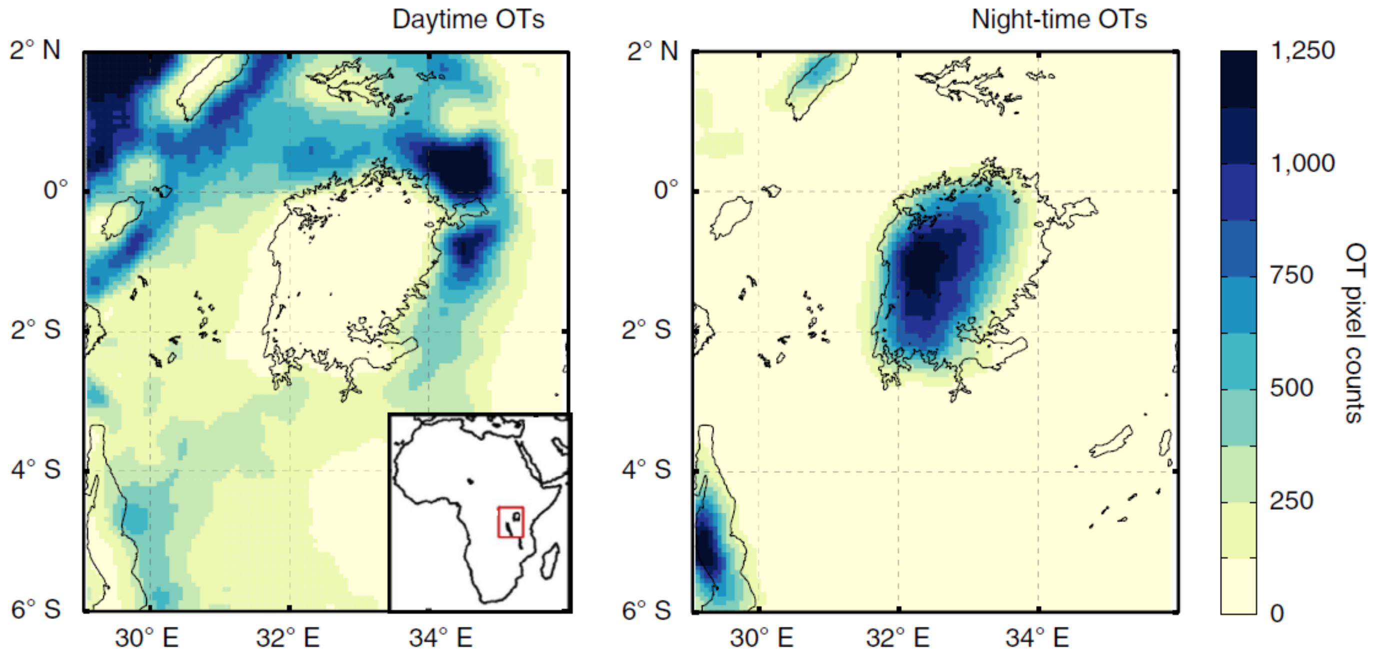
High rates of urbanization

Rapid land use change

Knowledge gap on complex region

Importance of the Regional Climate

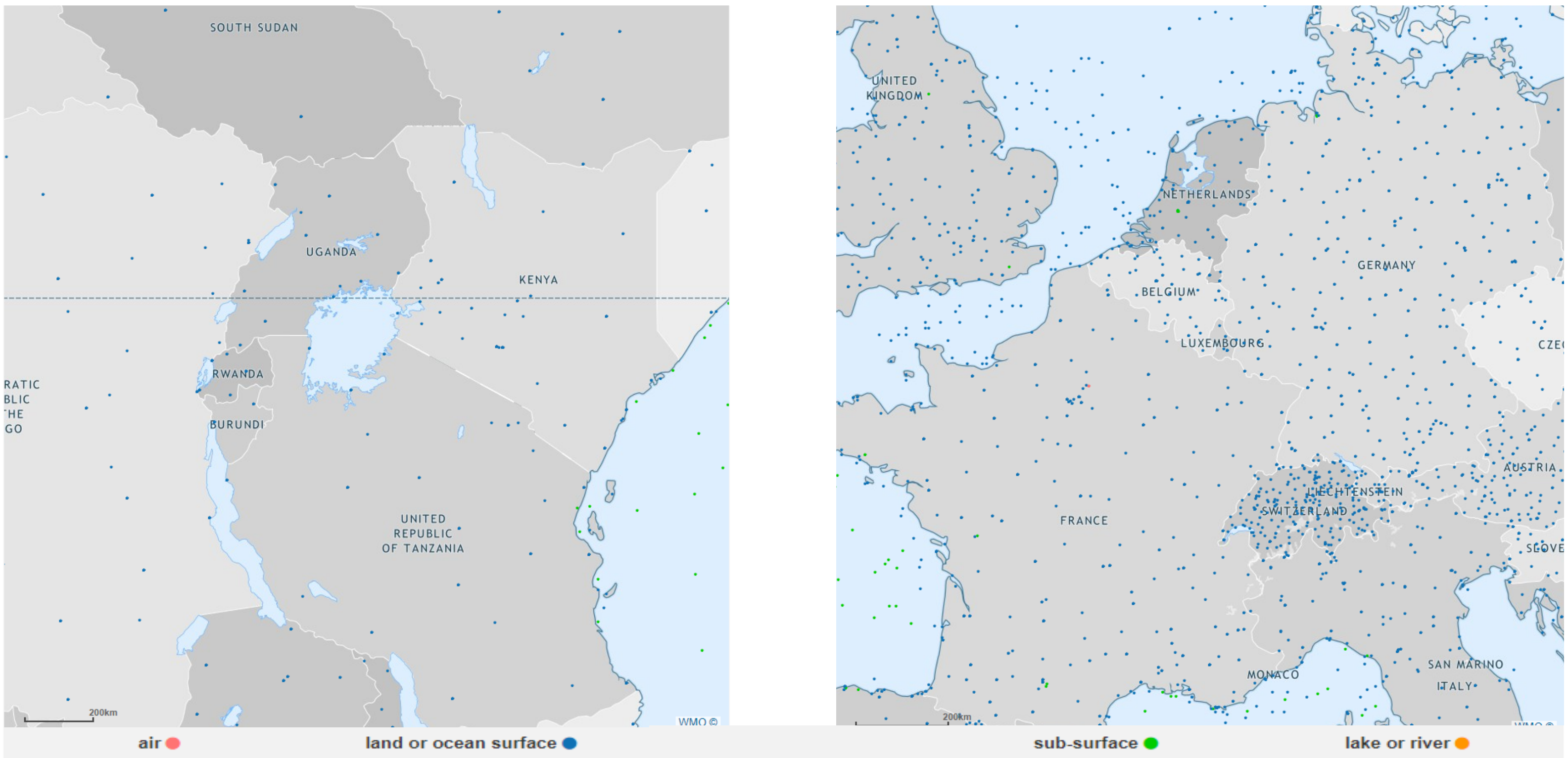
The African Great Lakes regulates diurnal precipitation patterns



Source: Thiery et al. (2016)

Drive important factors for intra-urban variability

Scarcely documented areas



Added value of satellite remote sensing for model evaluation

Using urban climate models

First attempt in Eastern and Western Subsaharan Africa

Regional climate needs to be well modelled

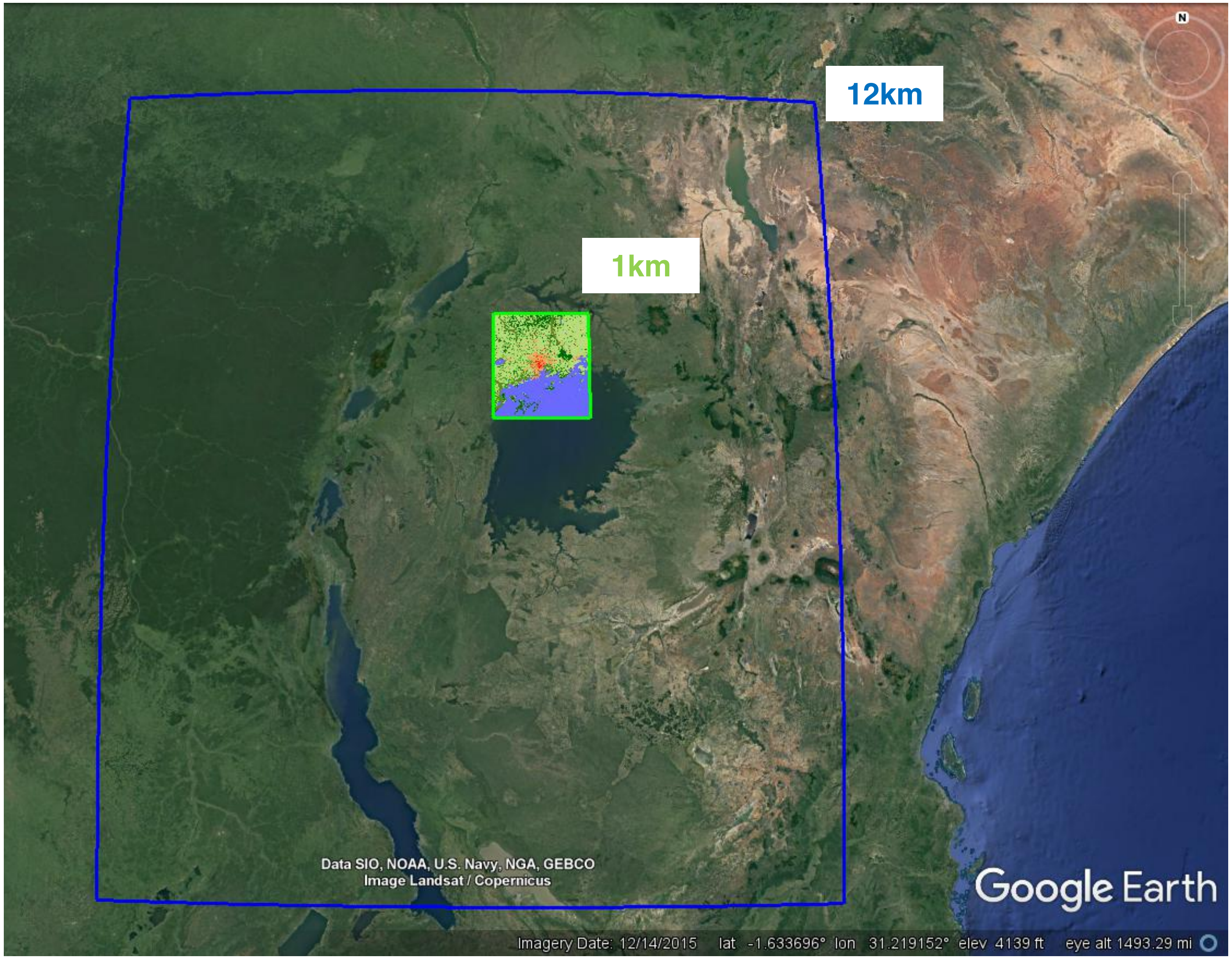
Spatio-temporal high resolution runs

Validation procedure requires innovation

Couple model outputs to remote sensing

Mitigation and understanding of key health issues (malaria)

Nesting strategies



80km

Two analysis: Outer (12km) and Inner (1km) domain

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Regional climate model evaluation: Overview

Main dynamics are realistically represented

Biases are still present

Data scarcity and validity leads to *grey zones*

Difficult to assess *what’s right or wrong*

Proper performance for nesting UCM

Going down at urban scale

Urban canopy model TERRA_URB turned on

Three sensitivity tests : impact of new UCPs out of LCZs

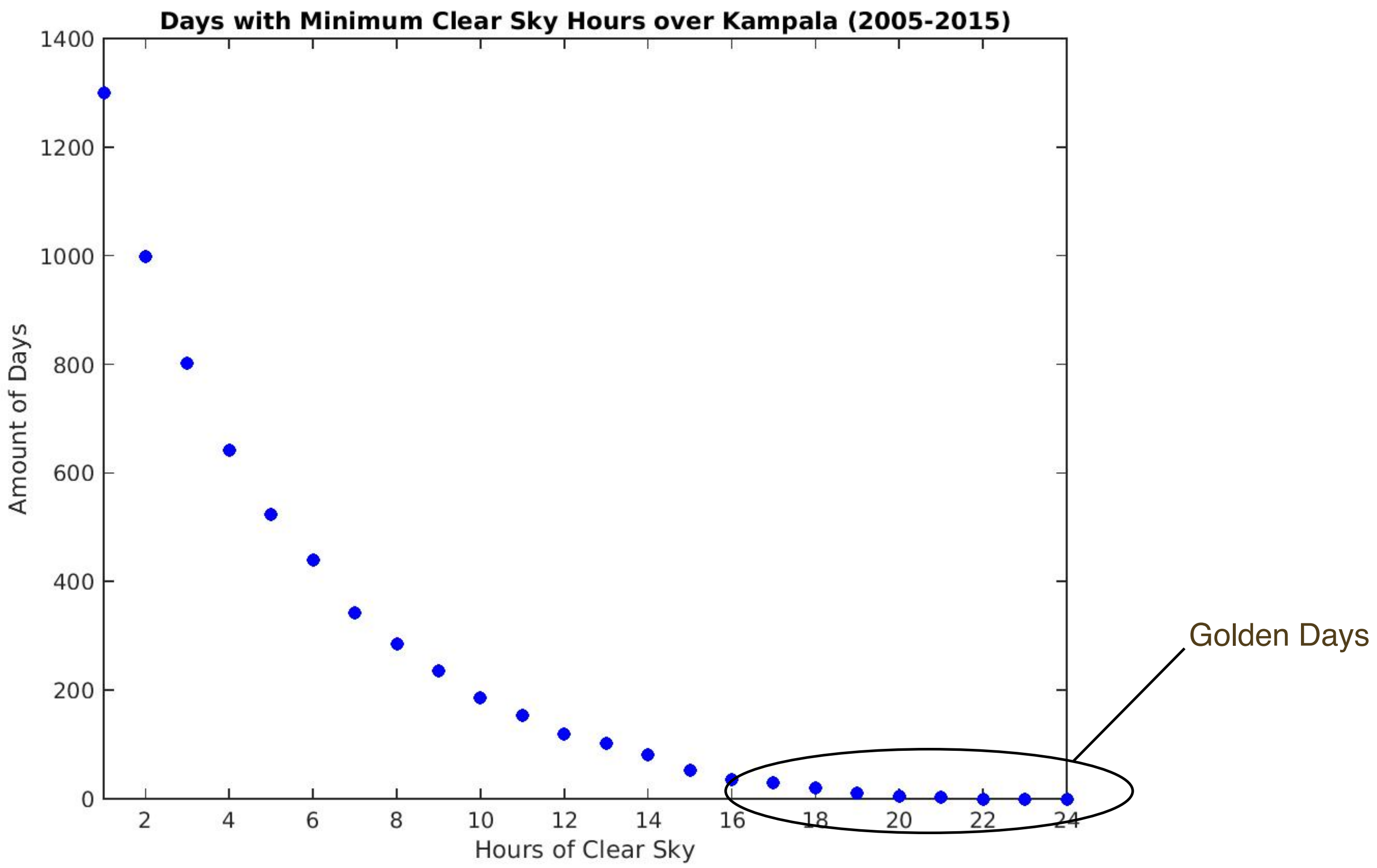
Modelling Golden Days only for LST comparison

First implementation of LCZs in COSMO

SUHI evaluation against MODIS

Impact evaluation on air temperature and wind flow

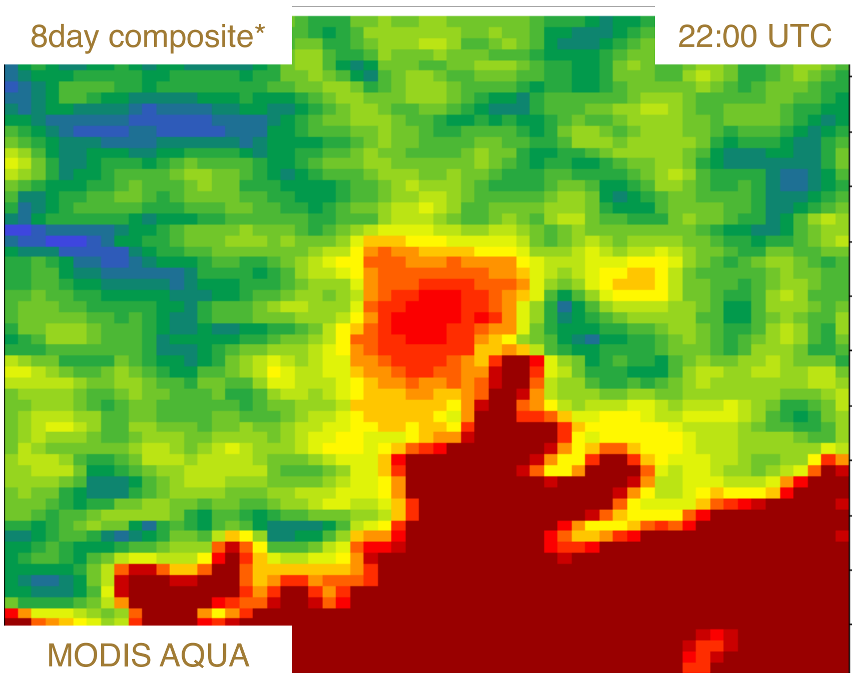
Using remote sensing for validation at urban scale

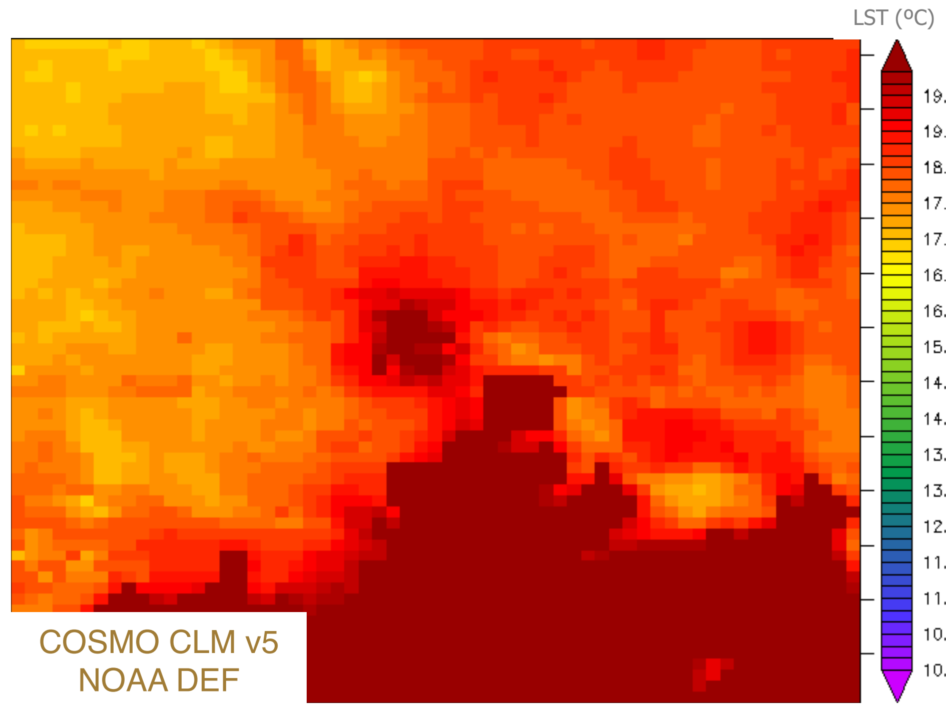


Validation through surface temperature under clear sky conditions

Using remote sensing for evaluation

Small bias of the model…



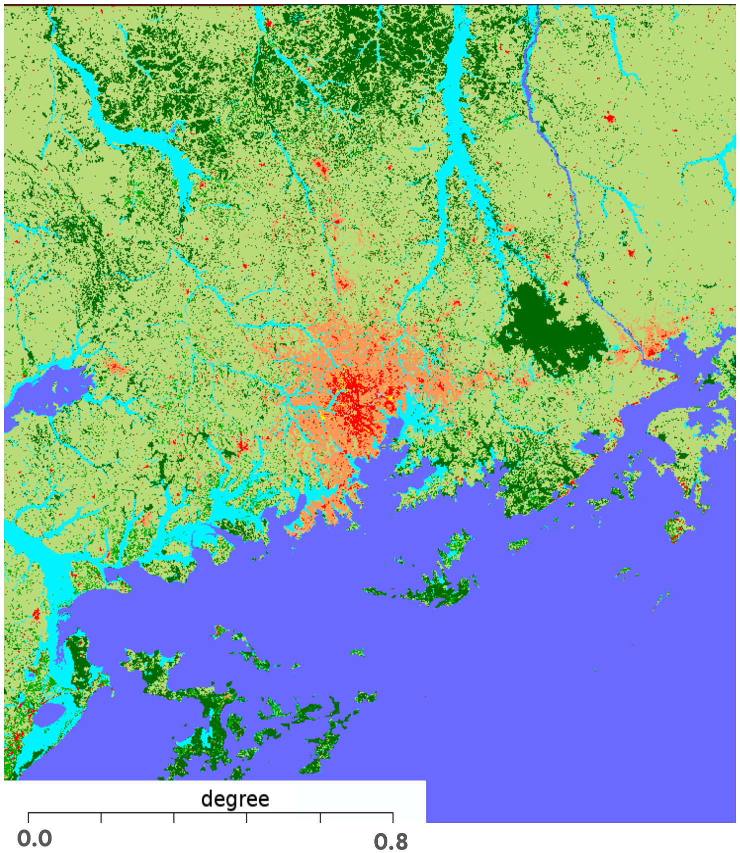


* 20-21 Feb 2005, 23-27 Jan 2006, 12-13 Dec 2008 and 31-1 Jan-Feb 2012

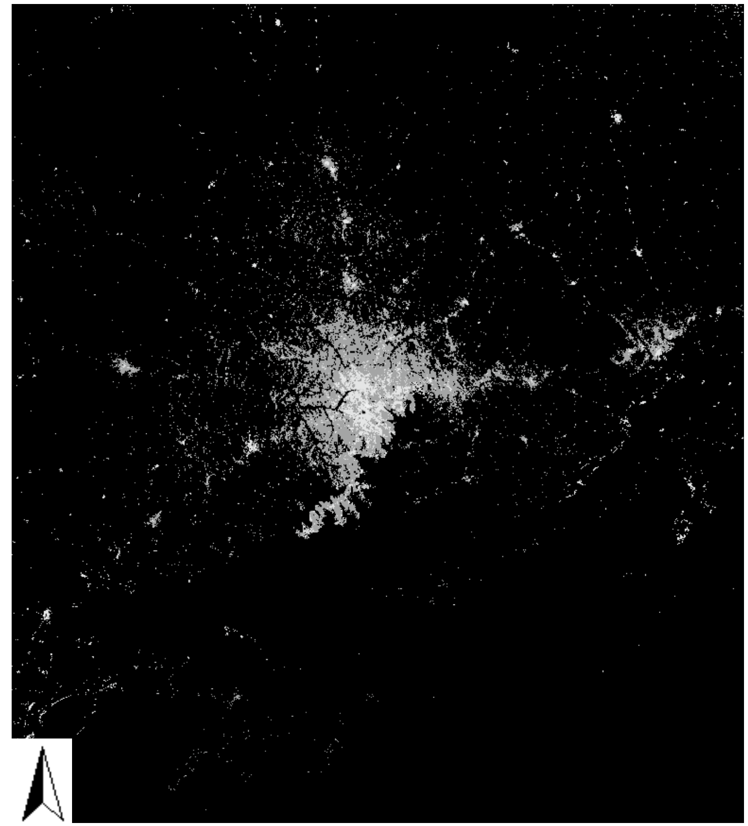
… Surface Urban Heat Island could be improved

How to improve models parameterization?

Local Climate Zones

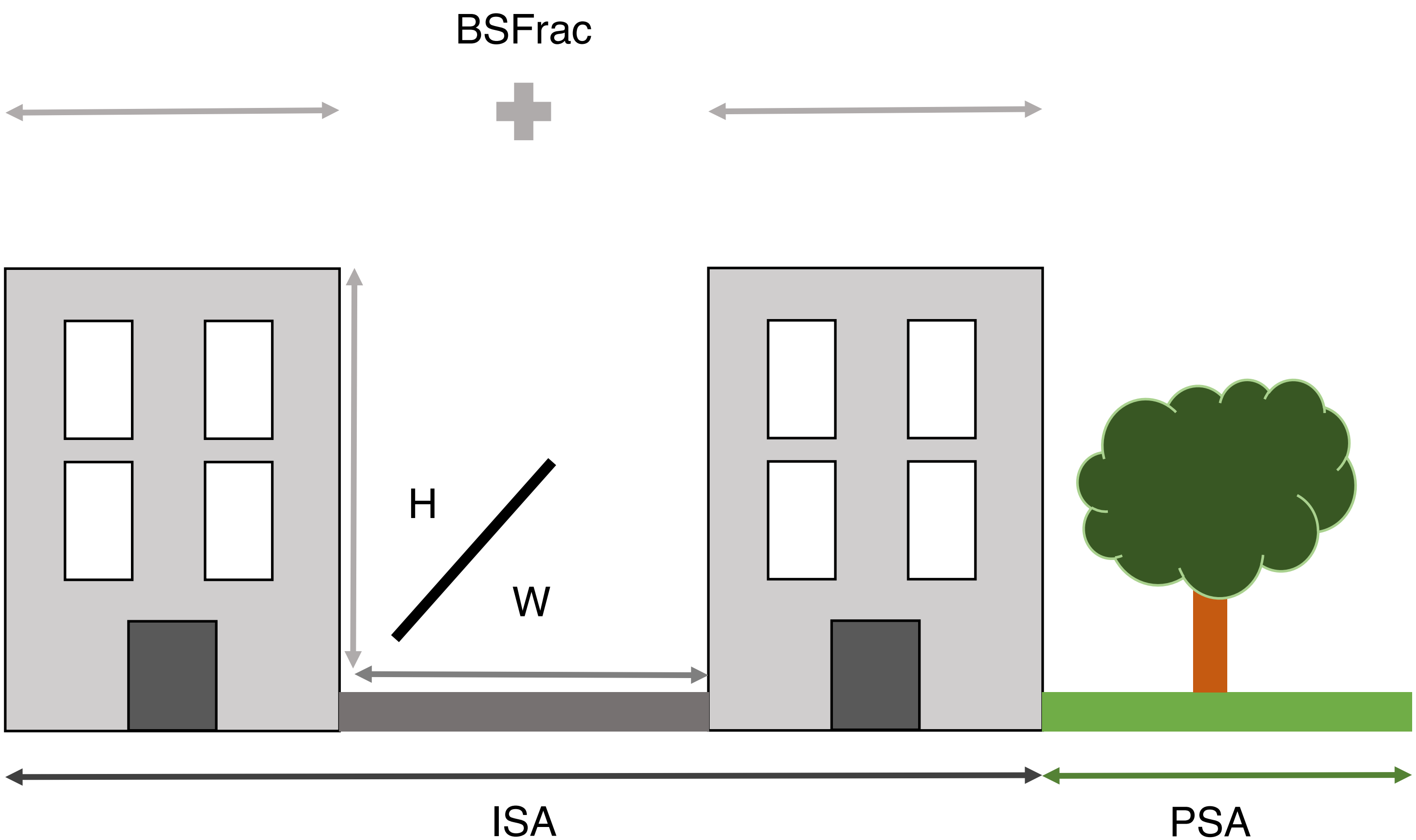


Urban Fraction



Urban Canopy Parameters from Local Climate Zones

How to improve models parameterization?



Parameterization of TERRA_URB v2.2 based on Local Climate Zones

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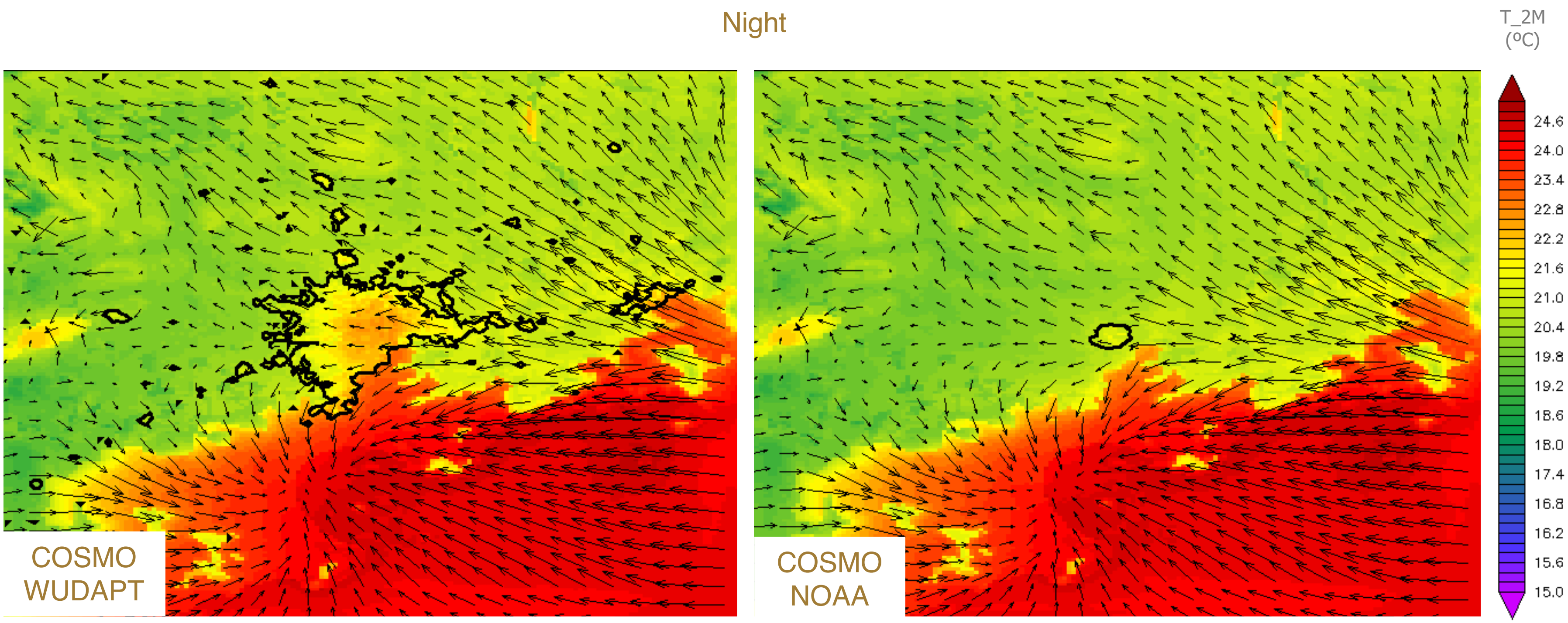
Sensitivity test to new UCPs

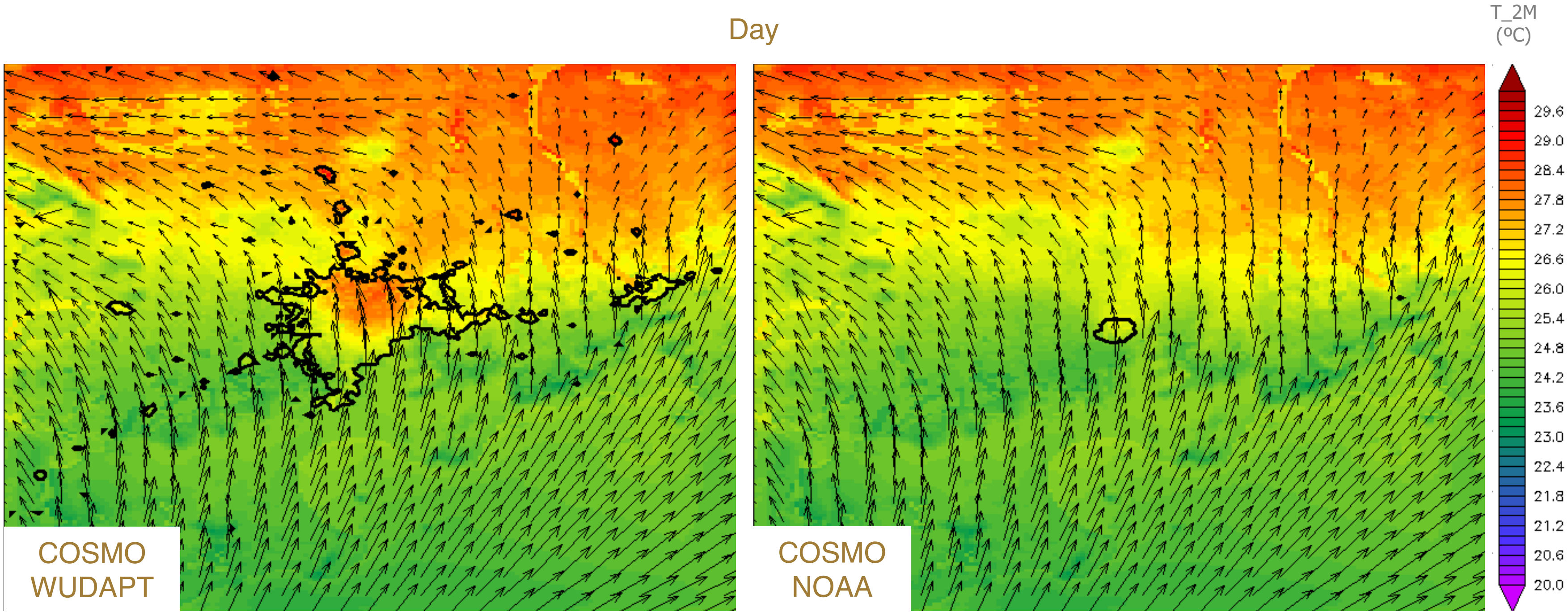
	NOAA DEF	WUDAPT	WUDAPT SPATVAR
Impervious Surface Area	0 – 0.67 NOAA 2002	0 – 0.9 LCZ 2017	0 – 0.9 LCZ 2017
H/W Ratio	1.5	0.65	0 – 1.11
Building Height	15m	6.5m	0 – 11.1m
Building Fraction	0.9	0.36	0 – 0.58
Anthropogenic Heat Fluxes	0 – 0.98 W/m2 Flanner 2009	0 – 0.96 W/m2 Flanner 2009	0 – 0.96 W/m2 Flanner 2009

Impact of Urban Areas on Lake Breeze



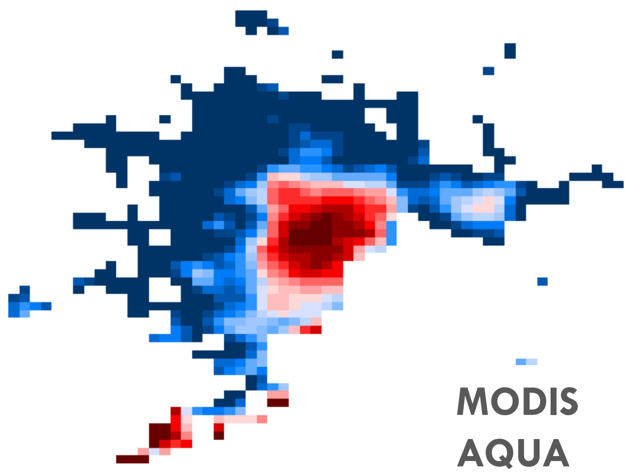
Strong impact of new UCPs on air temperature by night

Impact of Urban Areas on Lake Breeze

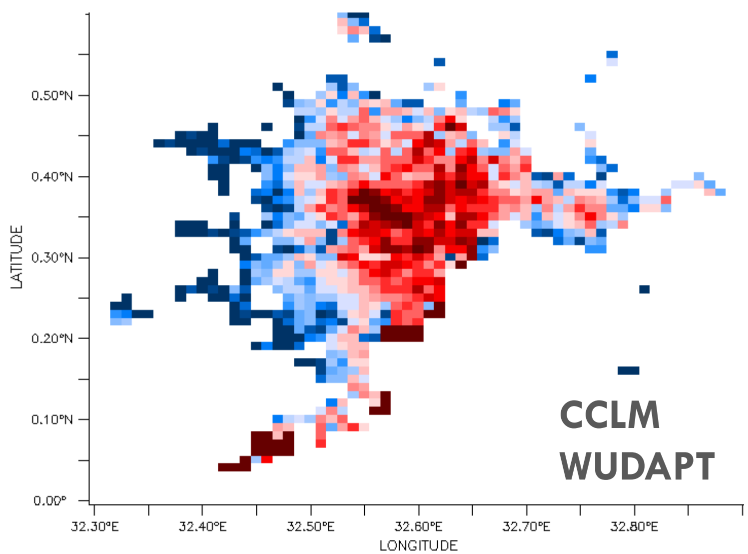


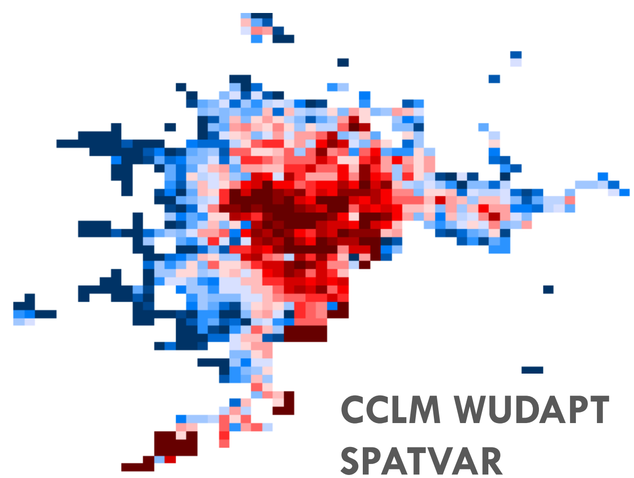
Strong impact of new UCPs on air temperature and wind speed by day

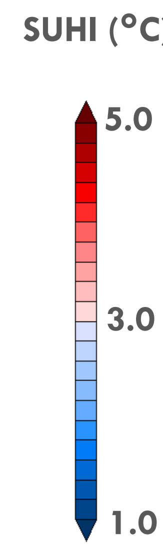
Impact of Urban Areas on Surface Temperature



Spatially variant parameters provide more realistic SUHI distribution. Careful with the use of MODIS data.







Urban climate model perspectives: Conclusions

Highly variant urban extensions

Strong impact of spatially variant UCPs

Check emissivity from remote sensing

Careful with viewing angle

Higher resolution as Landsat for new insight

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Thank you!

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