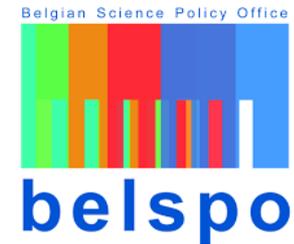
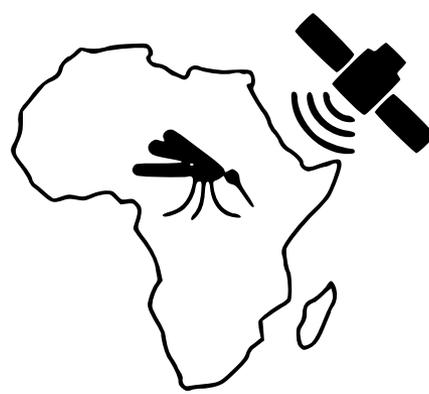


REACT



REACT: Remote sensing for Epidemiology in African Cities

Eléonore Wolff, ULB (ewolff@ulb.ac.be)

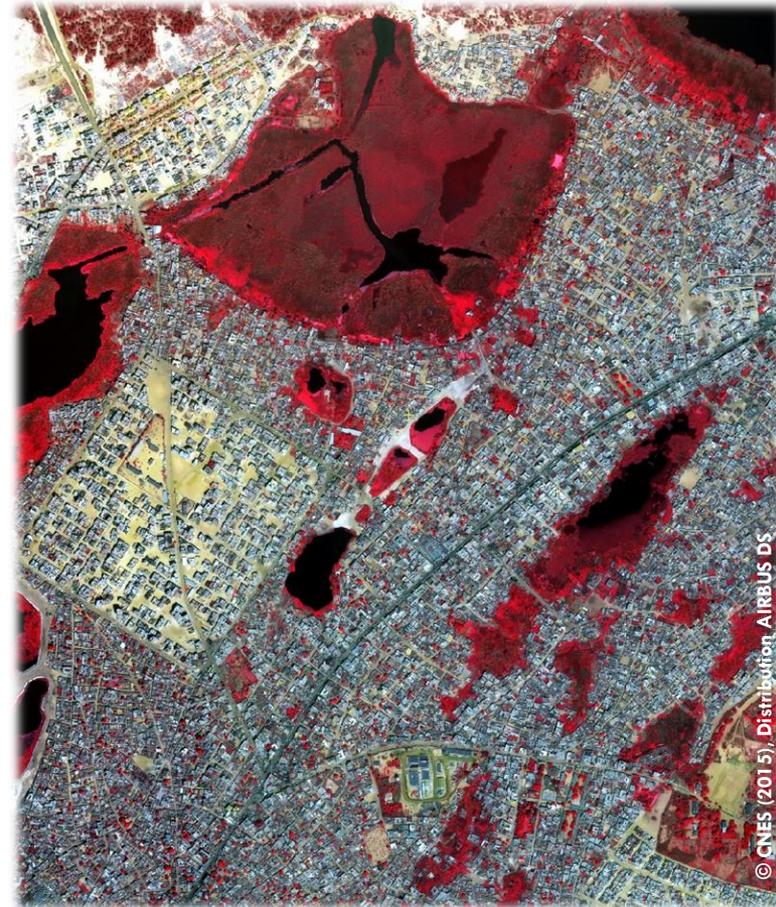


BEODAY, Beersel, 30/01/2018



Rationale

- Urban malaria in sub-Saharan Africa is a major health problem
- Malaria intervention remains focussed on rural, highly endemic communities
- The heterogeneity of **intra-urban malaria risk** has not been captured in continental risk-mapping initiatives
- The **inter-urban risk variations** have never been taken into account in malaria risk modelling



There is a need to fill the gap



■ Interdisciplinary partnership

ULB

- VHRRS & OBIA
- Urban morphology and dynamics in Africa
- Population patterns in African cities
- Socioeconomic component, notably in vulnerability analysis
- Sub-Saharan Africa

UNamur

- HRRS
- Spatial epidemiology of human diseases (in particular vector-borne)
- Spatial statistical modelling
- Population distribution in Africa

REACT

UMAINE

- Spatio-temporal analysis of large HR and L/MRRS time series
- Land-cover change - extraction of trends and abrupt changes
- Environmental change monitoring

KU Leuven

- Advanced HR regional urban climate models
- Land-atmosphere interaction, especially in urban areas
- African climate (e.g., Sahel, Congo basin, Great Lakes)



Objectives

HARNESSING THE POTENTIAL OF REMOTE SENSING AND SPATIAL MODELLING AT DIFFERENT SPATIAL AND TEMPORAL SCALES



IMPROVING OUR SPATIAL UNDERSTANDING OF URBAN HEALTH INEQUALITIES IN SUB-SAHARAN AFRICA

MODELLING THE INTRA-URBAN MALARIA INFECTION RISK VARIATION
(4 CITIES > 750K INHAB.)

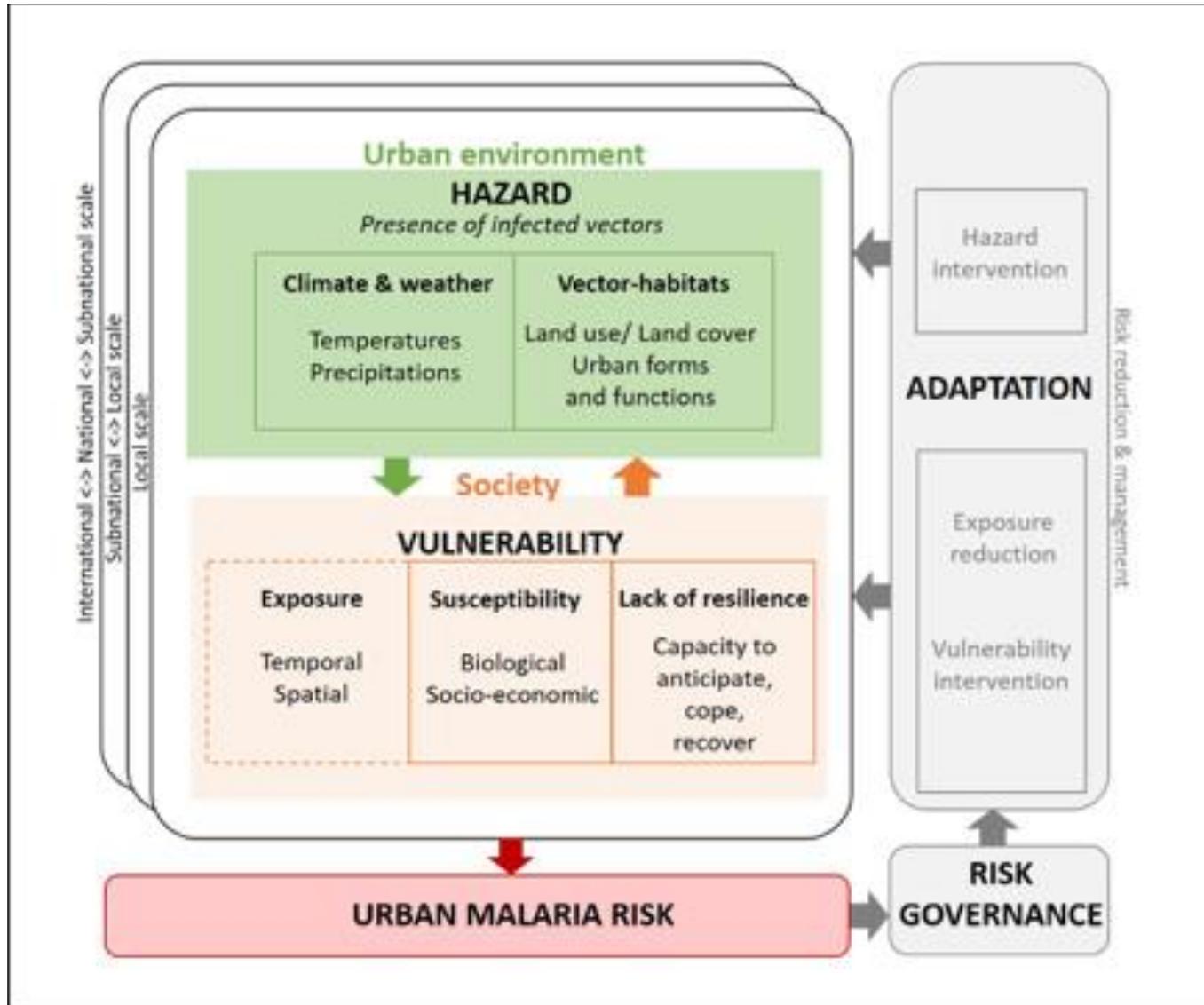
MODELLING THE INTER-URBAN MALARIA INFECTION RISK VARIATION
(20 CITIES > 750K INHAB.)



DEVELOPING TOOLS AND METHODS FOR FASTER AND LESS LABOUR-INTENSIVE ALTERNATIVE FOR TARGETED AND EFFECTIVE DISEASE CONTROL

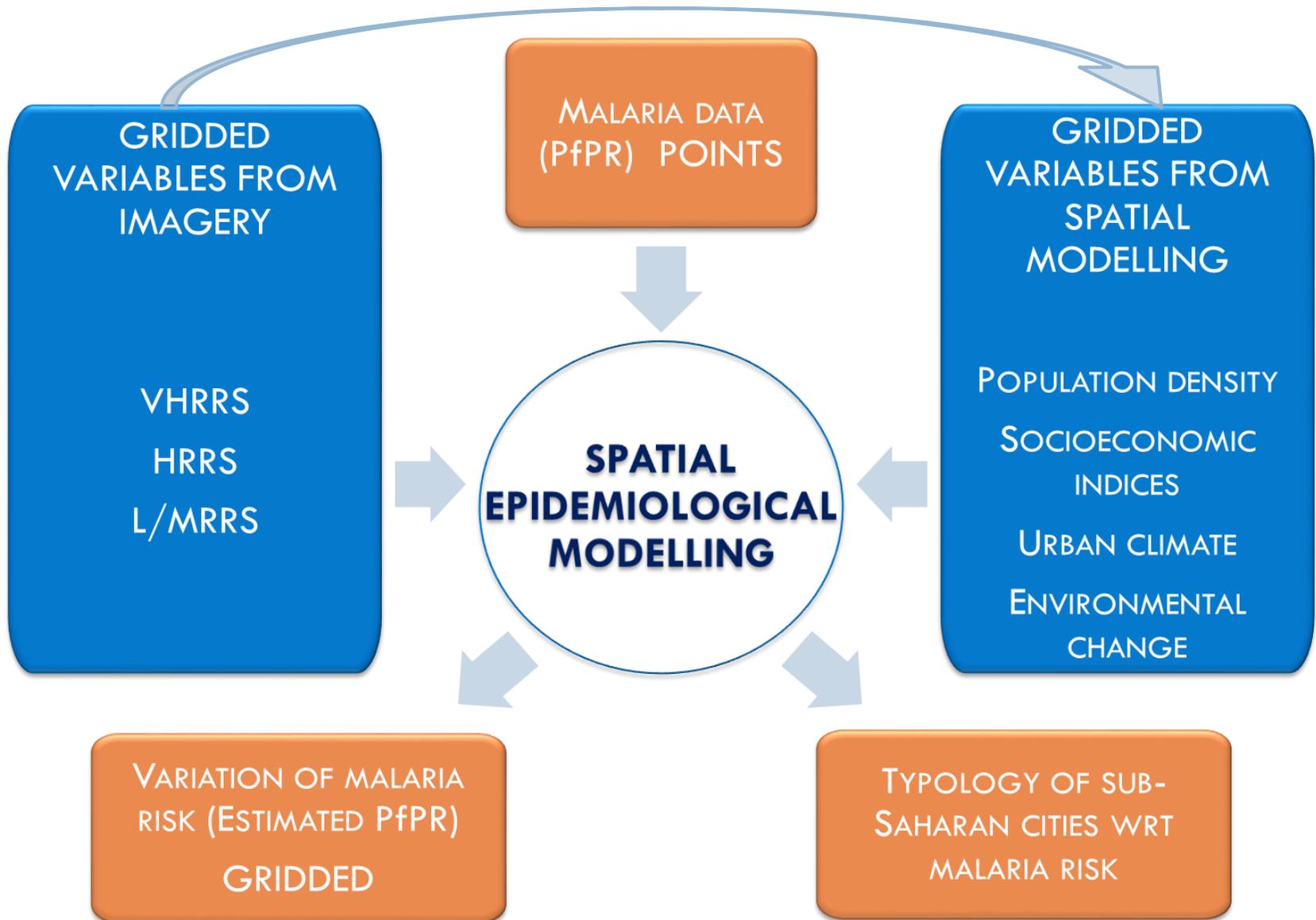


Factors influencing the malaria risk





Methodology





Gridded variables from imagery

Very-High Resolution (single date)



Elevation, Land cover, Land use, Ratios, Indices (vegetation, wetness), Density, Distance, Landscape metrics...

High Resolution (time series)



Land Surface Temperature, Albedo, NDVI, NDWI, EBBI, Brightness, Wetness, Greenness Indices, Cloudiness, Imperviousness...

Low/Medium Resolution (time series)



NDVI, Temperature, Cloudiness, Night Light Use, Imperviousness, Albedo...

FINE SCALE

e.g., 30m * 30m

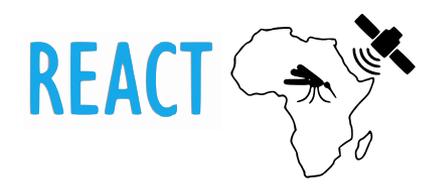
Within cities



COARSE SCALE

e.g., 1km * 1km

Across cities

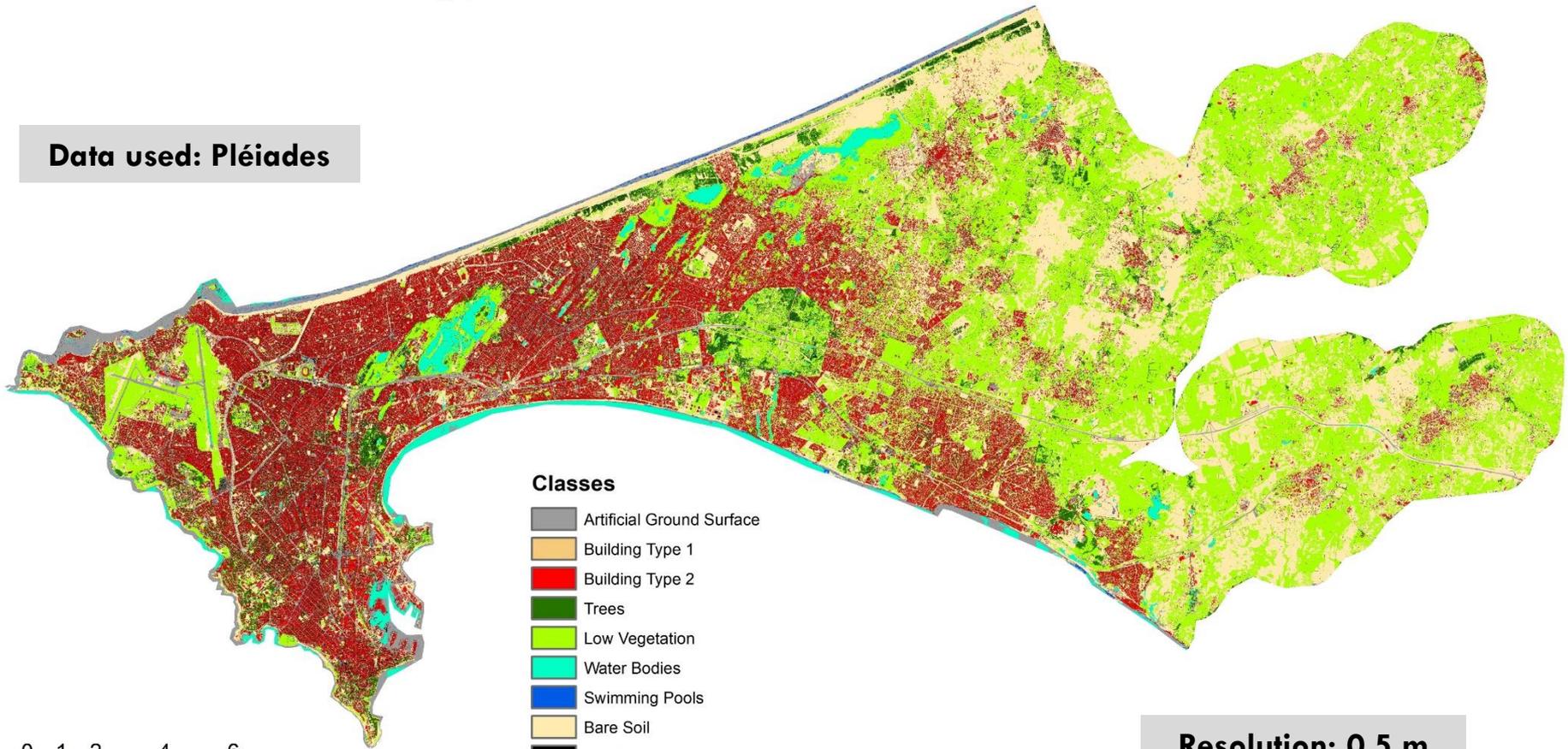


First results



Prototype Land Use/ Land Cover of Dakar

Data used: Pléiades

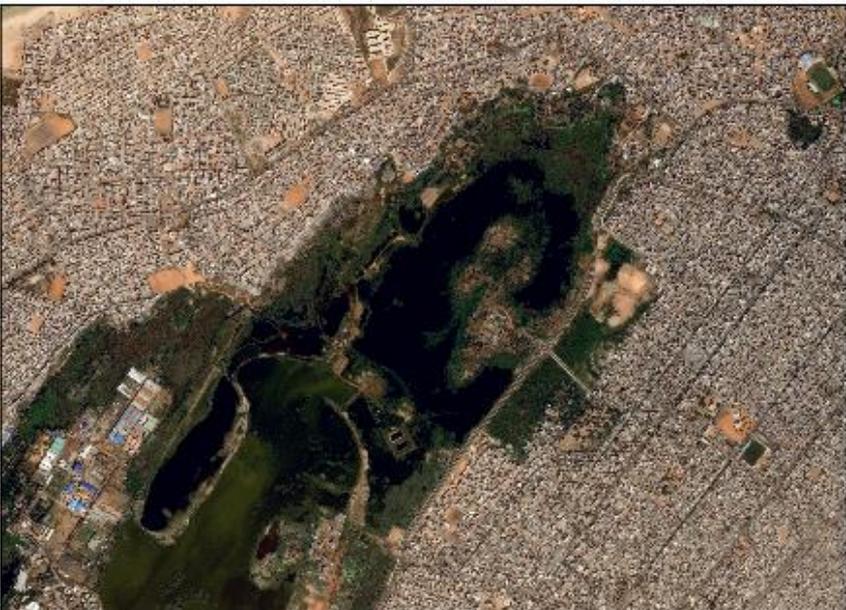


Classes

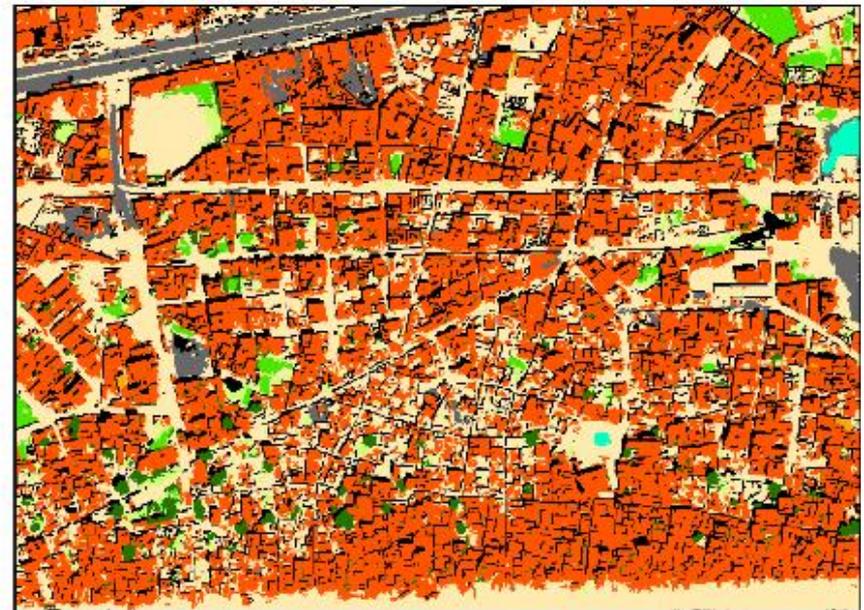
- Artificial Ground Surface
- Building Type 1
- Building Type 2
- Trees
- Low Vegetation
- Water Bodies
- Swimming Pools
- Bare Soil
- Shadows

Resolution: 0.5 m

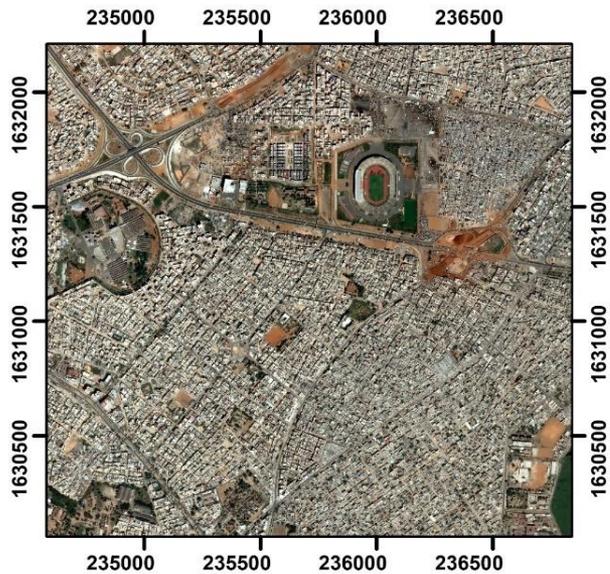
Wetlands and Water Bodies



Unplanned coastal high built-up density areas



RGB composite (Pléiades)



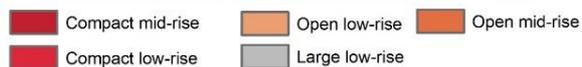
nDSM



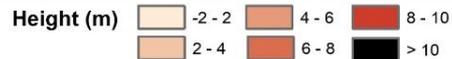
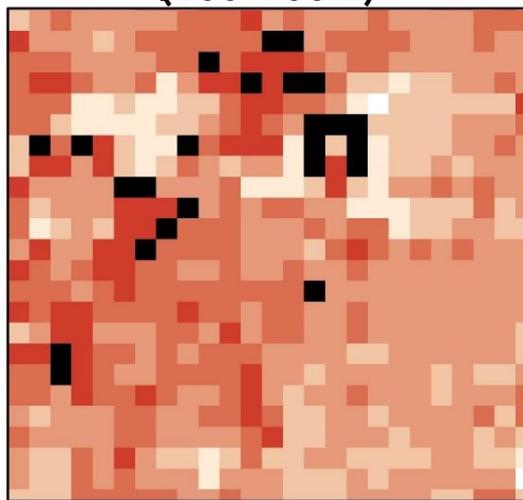
Land cover map



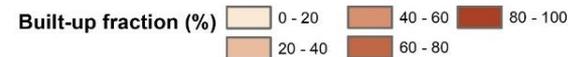
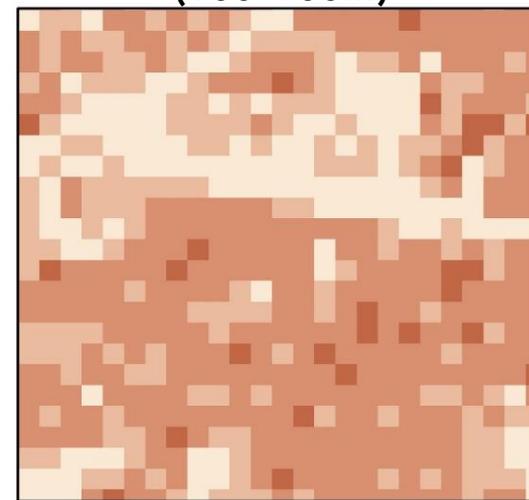
Local Climate Zones (100*100m)

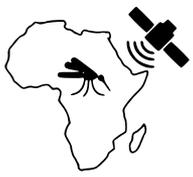


Mean building height (100*100m)



Built-up fraction (100*100m)





Goals

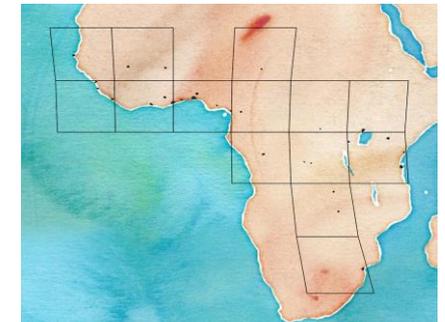
- Extracting climate and environmental variables
- Temporal dimension of summary RS variables (long term **trends, cyclical and abrupt changes**)

Data collected and pre-processed



Variable	Product	Temporal Resolution	Spatial Resolution	Period	Status
LST Day (Terra)	MOD11A2	8 day	1km ²	2004 - 2016	Complete
LST Night (Terra)	MOD11A2	8 day	1km ²	2004 - 2016	Complete
LST Day (Aqua)	MYD11A2	8 day	1km ²	2004 - 2016	In Progress
LST Night (Aqua)	MYD11A2	8 day	1km ²	2004 - 2016	In Progress
Nighttime lights	DMSP-OLS	Yearly	1km ²	2004 - 2016	In Progress
NDVI	MOD13A2	16 day	1km ²	2004 - 2016	Complete

Spatial footprint of MODIS tiles



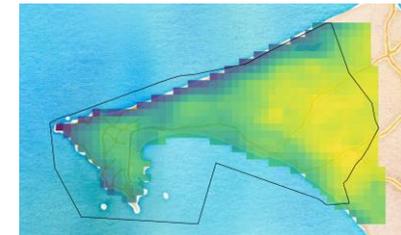
Processing in progress

- LST-> Cloudiness
- Derive and make compatible data for other processing (1 and 12 res km)
 - Surface Reflectance (MOD09 series) to derive Wetness
 - Albedo
 - NLU-DMSP & SUOMI NPP

LST nighttime by city (2004-2016)

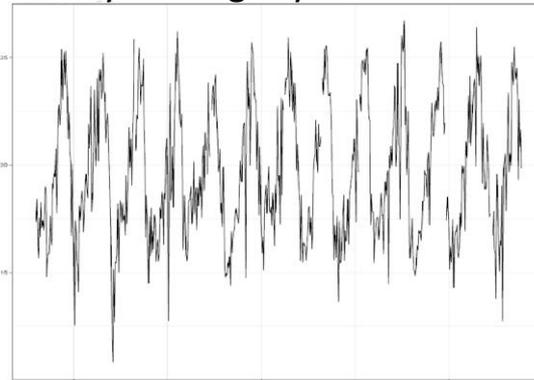
city	mean	min	max	variance	Missing Cells
Kinshasa	24.01	22.88	24.89	0.14	433497
Dar es Salaam	22.54	12.31	25.82	3.03	1032879
Bamako	17.21	12.09	20.73	4.22	469460
Kigali	14.68	11.86	16.97	2.66	165871
Kampala	18.16	10.40	23.92	2.78	959607
Lagos	23.84	20.84	25.99	1.02	1518368
Mombasa	23.42	21.83	25.59	0.48	128288
Lome	23.89	22.26	24.71	0.66	201313
Dakar	17.22	11.91	21.18	6.06	246061
Accra	22.27	20.06	25.18	0.90	911905
Conakry	20.83	17.58	24.33	3.44	232332
Maputo	19.95	17.03	22.73	1.30	527317
N'Djamena	15.34	12.12	18.27	1.78	174519
Ouagadougou	17.63	13.62	21.96	3.78	282065
Freetown	19.43	16.75	22.13	1.06	145452
Aba	23.63	22.03	24.52	0.38	159861
Lusaka	17.73	15.12	19.26	1.45	264401
Nairobi	14.55	8.33	16.96	3.21	509141
Mbuji-Mayi	23.25	21.36	25.01	0.94	77172
Kumasi	20.43	18.48	24.38	2.16	426710
Kananga	--	--	--	--	109787
Monrovia	22.28	19.37	24.88	1.35	277074
Yaounde	20.44	19.15	21.51	0.34	202619
Douala	23.60	22.29	24.41	0.26	200218
Lubumbashi	17.54	13.19	19.63	0.96	301065
Abidjan	22.66	19.89	24.52	0.66	325261
Ibadan	23.45	21.85	24.42	0.30	572179
Kisangani	20.17	19.89	20.87	0.07	79840

Tabular and Graphic Summaries at different temporal resolutions by city (Example LST)

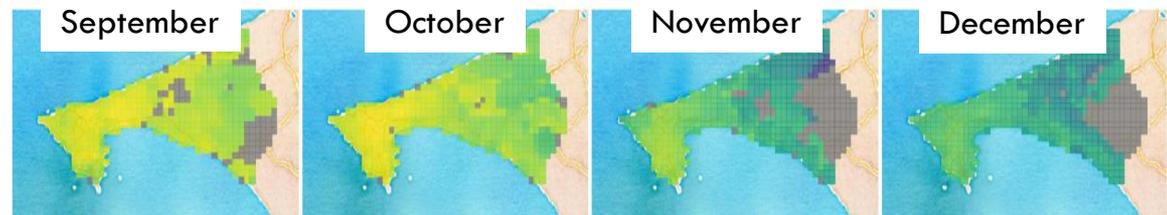
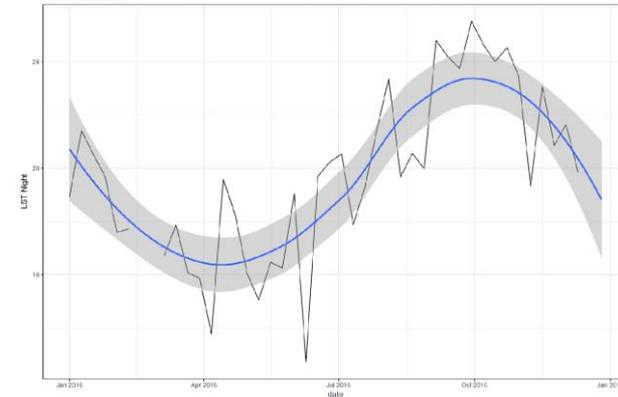


2004-2016 mean LST

8-day LST Nightly for 2004-2016



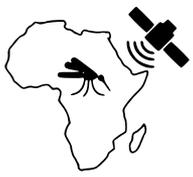
8-day LST Nightly for year 2016



Monthly LST

Low High

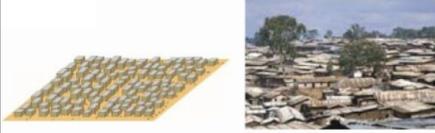
Grey = missing cell



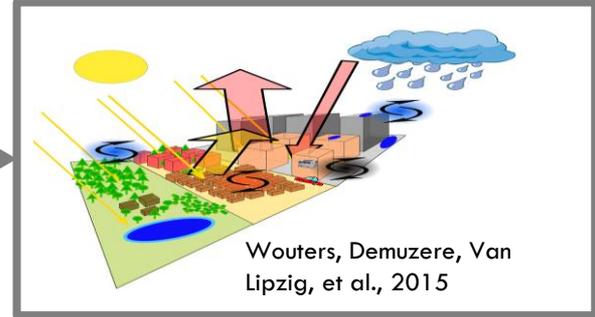
Urban climate modelling

VHRRS/HRRS

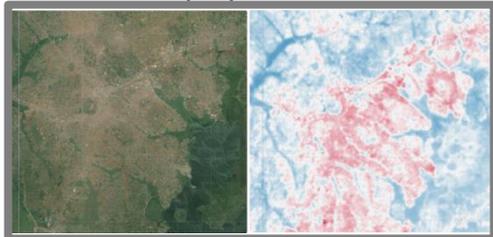
WUDAPT (Stewart Oke, 2012)
 Characteristics of urban surfaces,
 geometry, land use



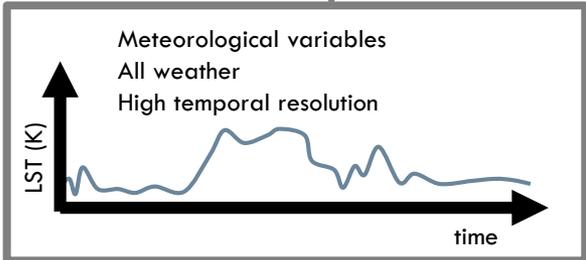
Urban Climate Model



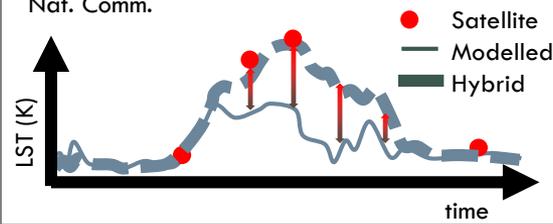
HRRS/L/MRRS

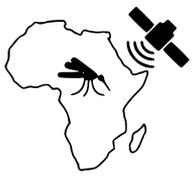


Model output



Method: Van Tricht, Van Lipzig, et al., 2016,
 Nat. Comm.

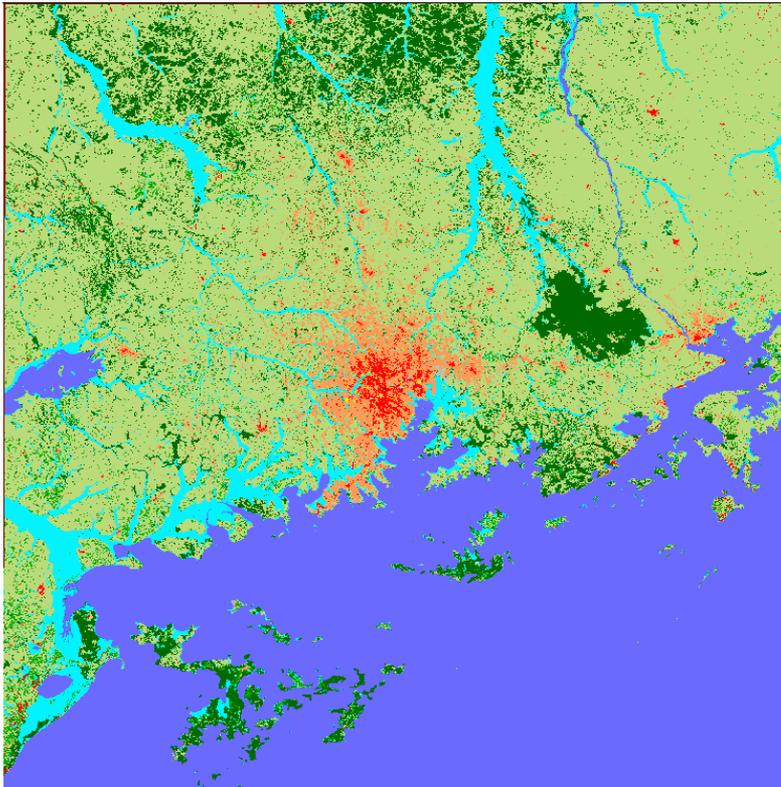




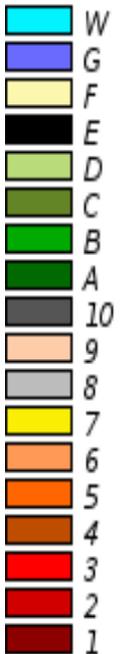
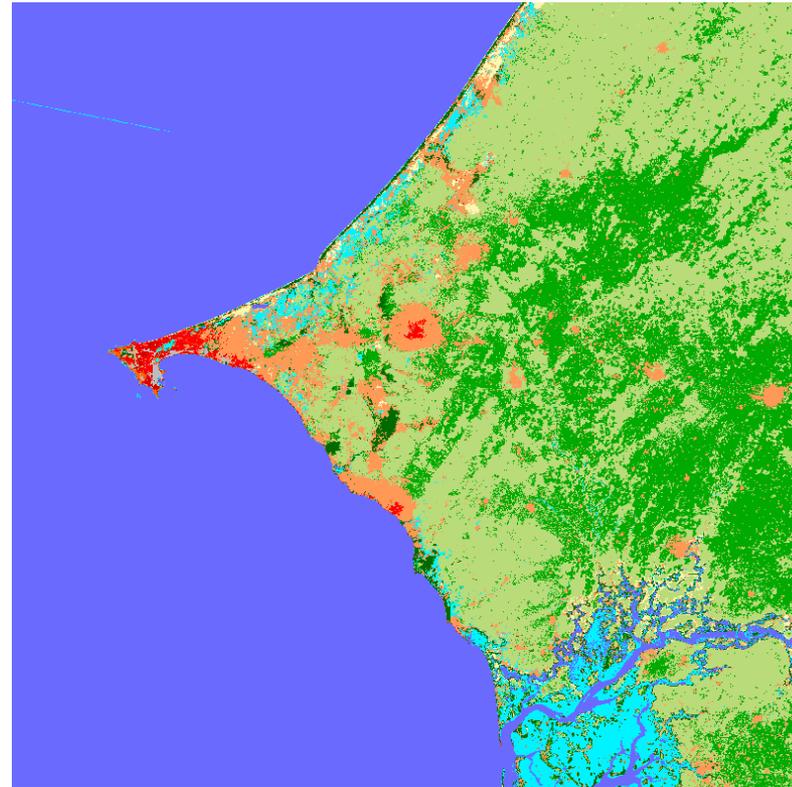
Urban climate modelling

Local Climate Zones (LCZs)

Kampala



Dakar



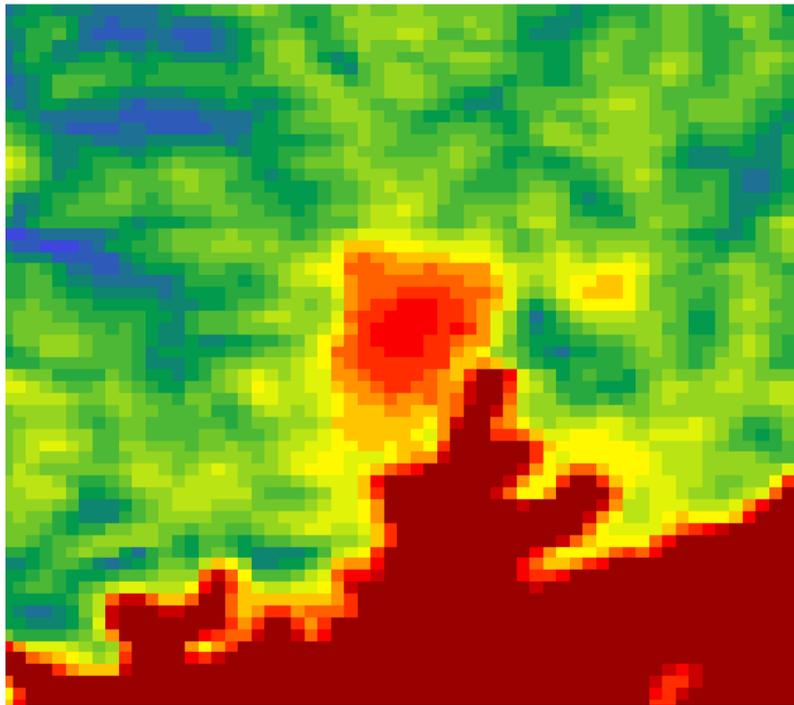
Resolution: 100 m



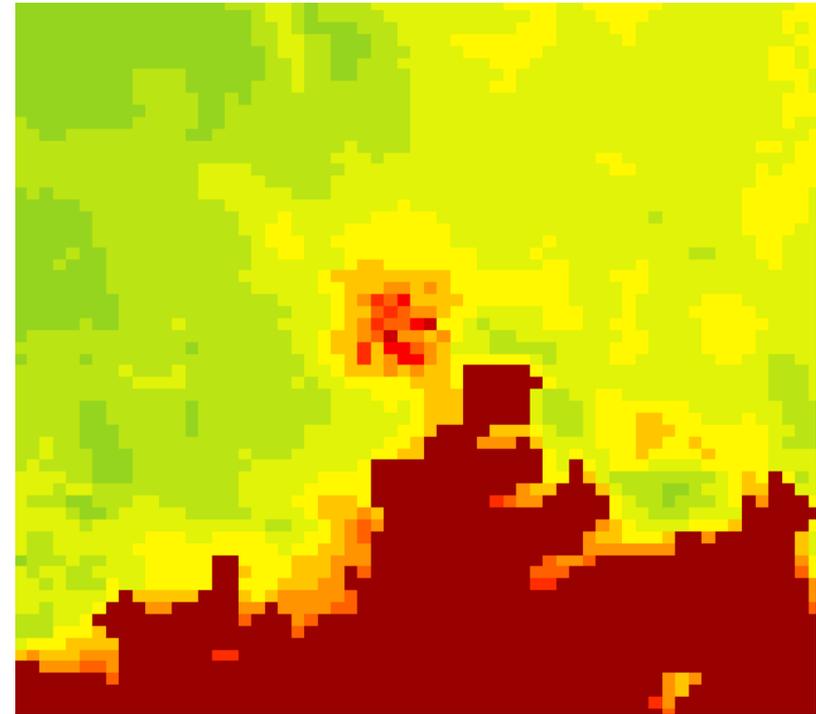
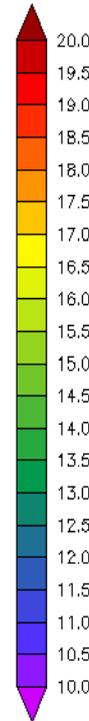
Urban climate modelling

Nightly Land Surface Temperature of Kampala 8day Golden Days Composite

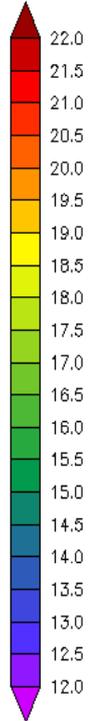
Resolution: 1 km



RECORDED BY MODIS AQUA

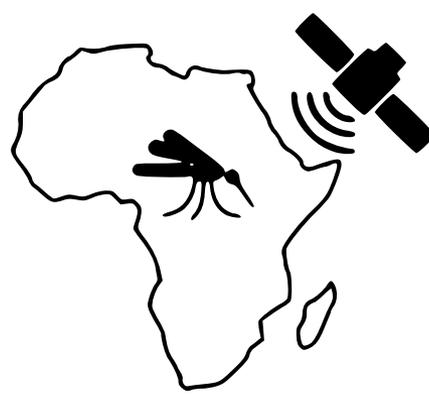


COSMO-CLM MODEL

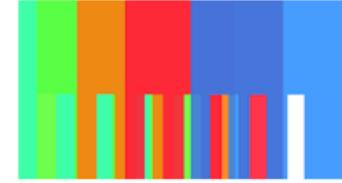


Hot bias (2°C) and SUHI intensity to be improved => LCZs need to be implemented

REACT



Belgian Science Policy Office



belspo

Thank you! Questions?

<http://react.ulb.be>



BEODAY, Beersel, 30/01/2018