

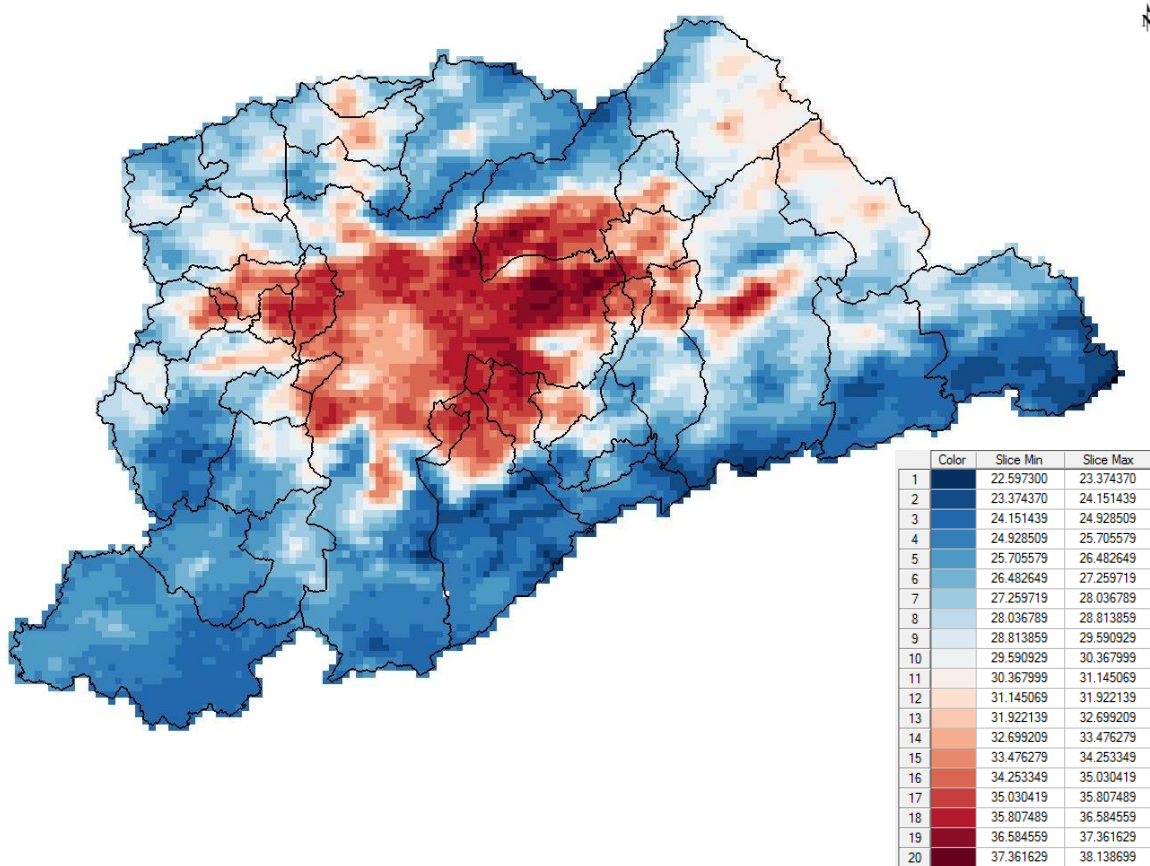
Urban Green Infrastructure

AUT0225 – Conforto Ambiental em Espaços Urbanos Abertos

Prof. Dra. Denise Duarte, Prof. Dr. Leonardo Monteiro, Prof. Dra. Ranny Michalski

Contrasts day x night

Average image of diurnal surface temperature
AQUA MODIS



Average image of nocturnal surface temperature
AQUA MODIS

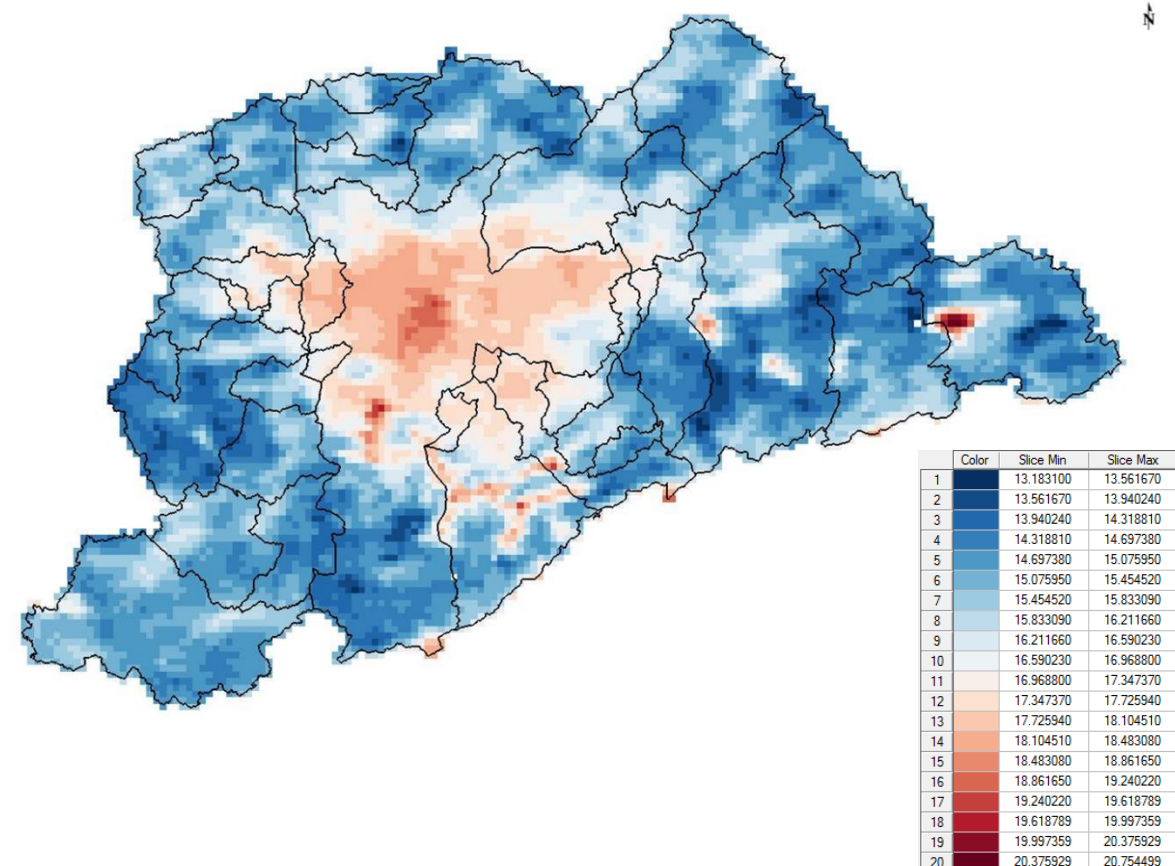


Imagem média da temperatura de superfície composta por imagens médias de 8 dias tomadas as 13h30. Novembro de 2013 a Fevereiro de 2015 (total 61 imagens). Resolução espacial: 1km

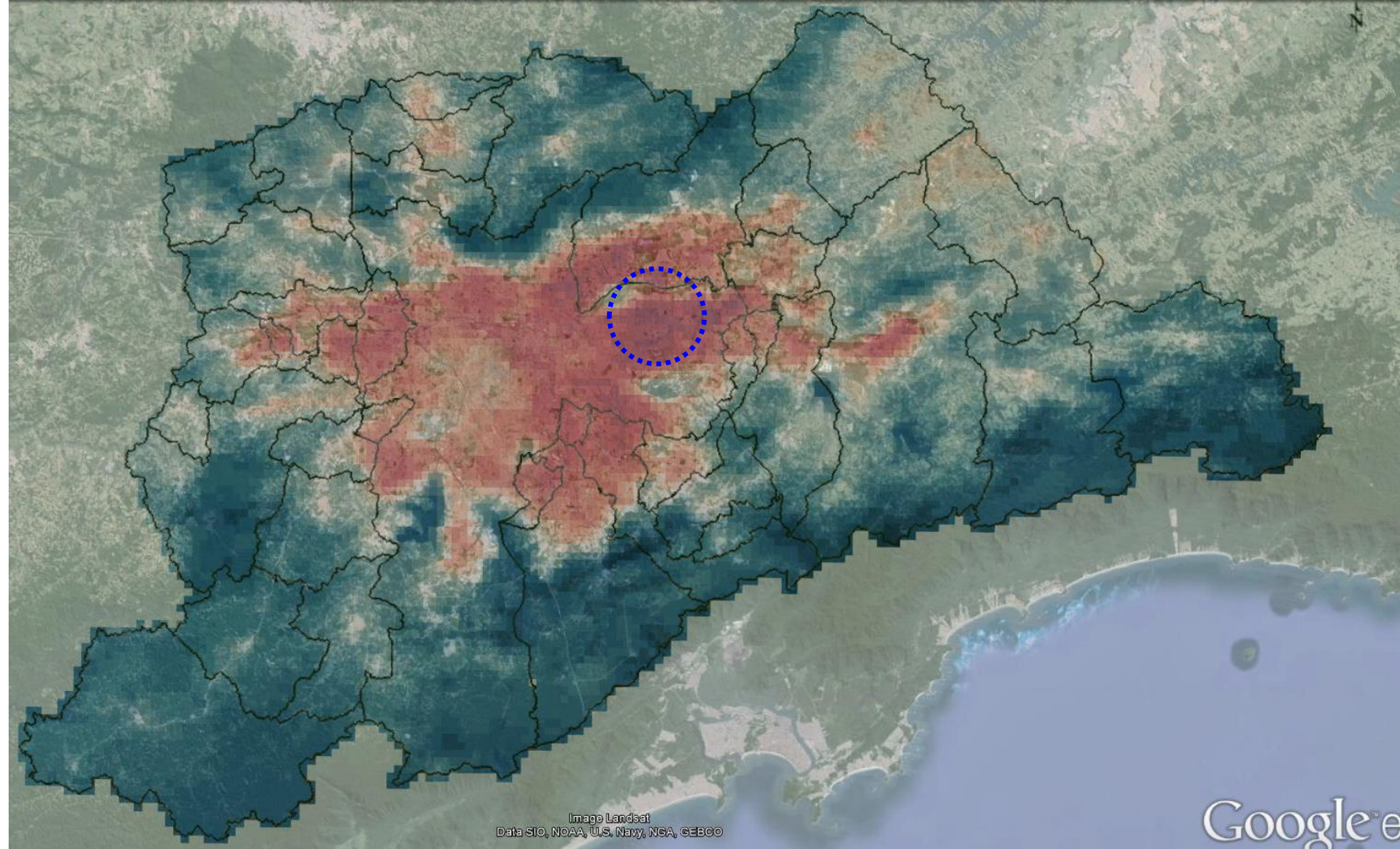
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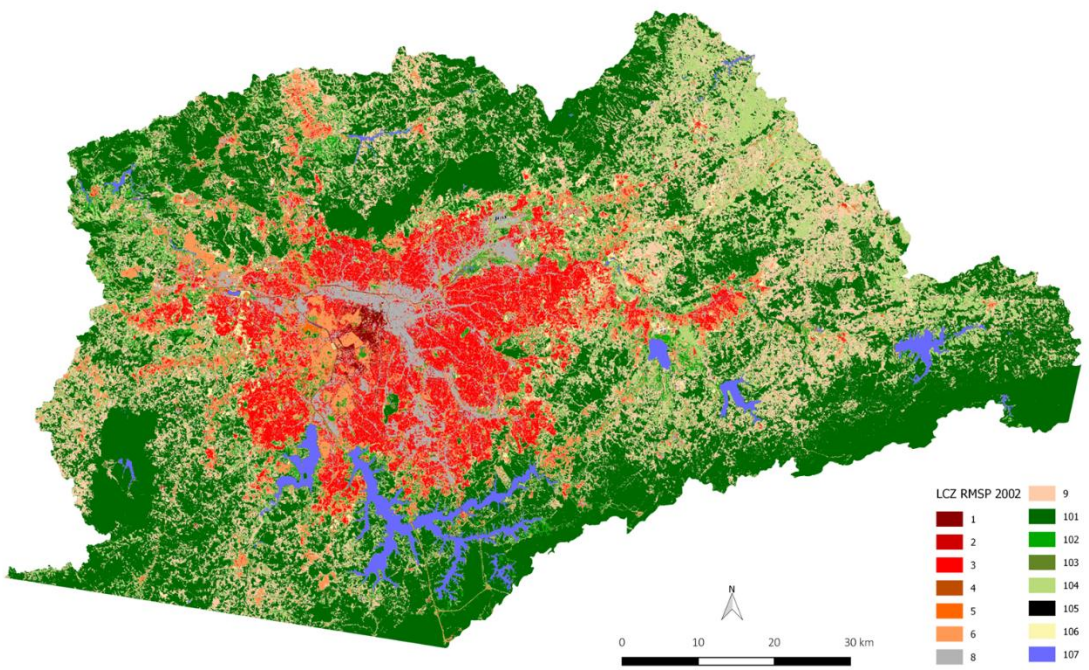
Surface Temperature x Land Use

Average image of diurnal surface temperature. AQUA MODIS over Google Earth

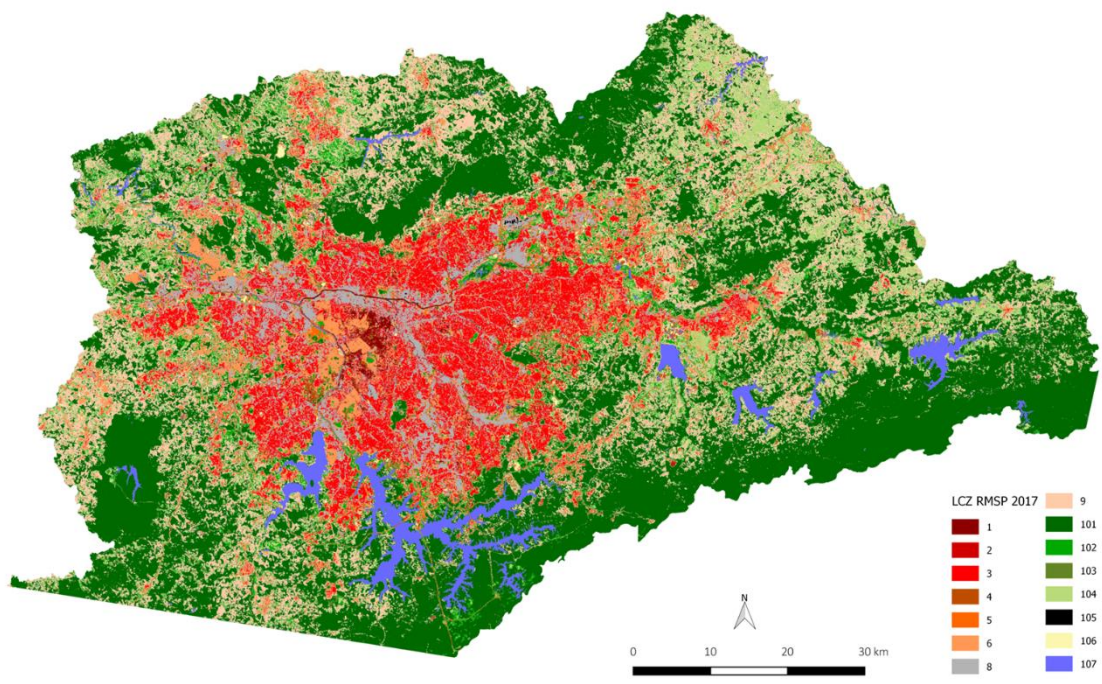


Zona Leste de São Paulo. Vila Curuçá
Padrão horizontal com pouca vegetação

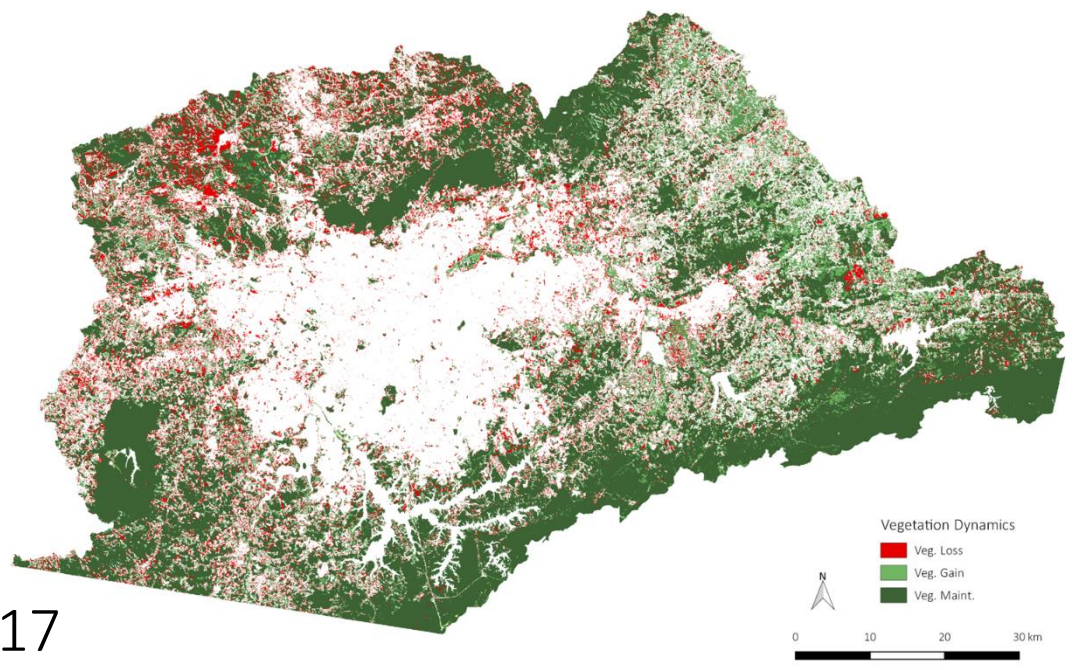




2002

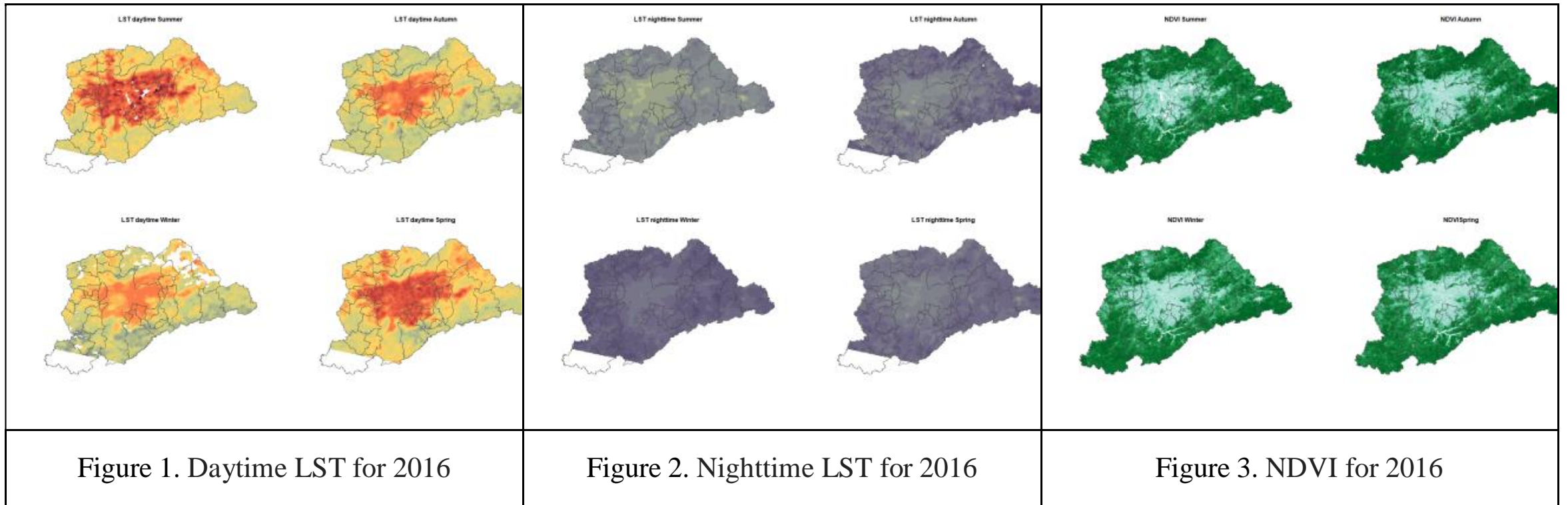


2017



Change detection 2002-2017

Satellite thermal images from 2002 to 2017 (Modis), vegetation indices (NVDI/EVI) and mapping techniques (LCZ/WUDAPT), exploring daytime and nighttime effects and relating this results to the urban morphology and vegetation, feeding other ongoing investigations in the group.



Urban density and microclimate amenities











Environmental off-set / environmental compensation



LOADING
PLEASE WAIT...



Environmental off-set in São Paulo adopting green walls (not in force anymore)

“Art. 1º A Secretaria Municipal do Verde e do Meio Ambiente – SVMA poderá celebrar termo de cooperação com a iniciativa privada que tenha por objeto a execução e manutenção, ou a manutenção, de jardins verticais.”





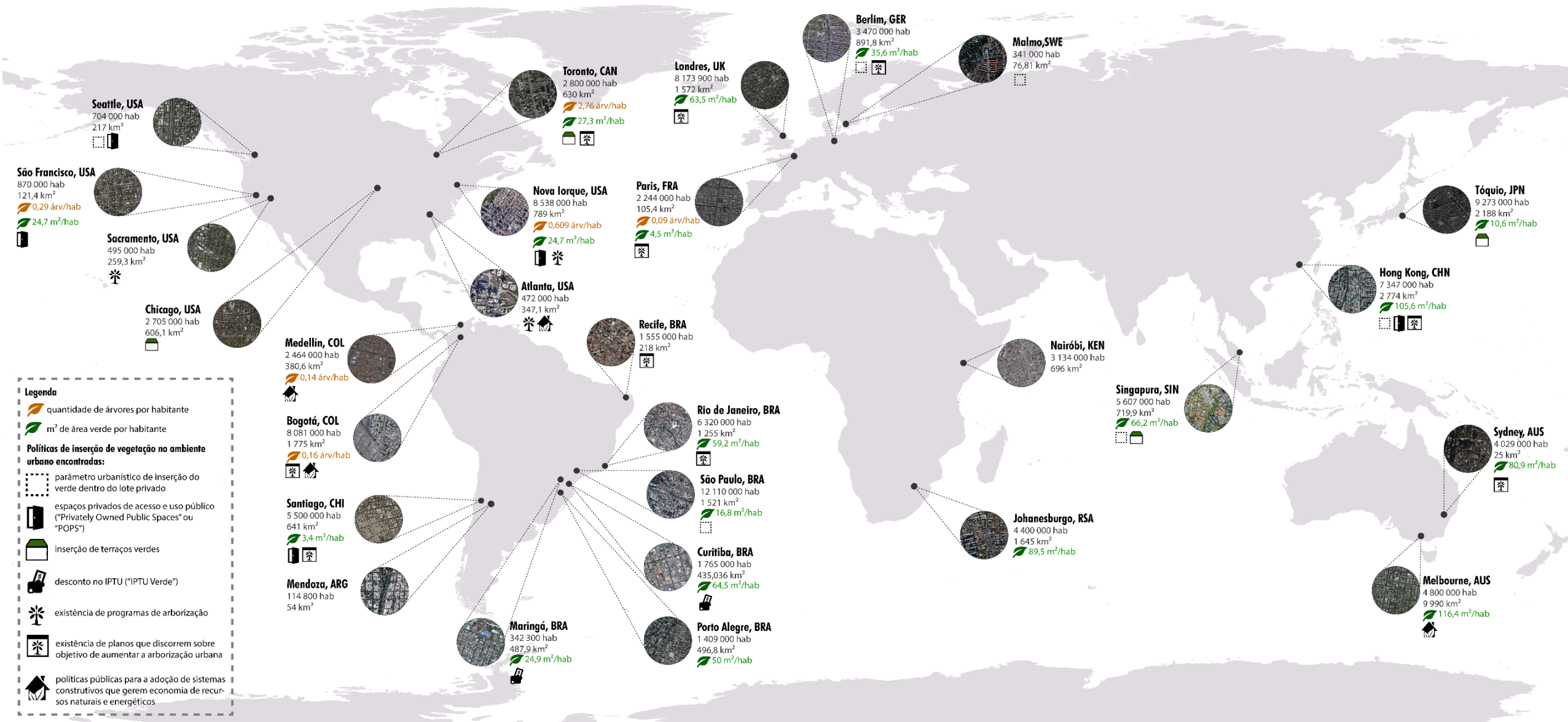


Authorized vegetation clearance for urban development



Example of compensatory planting

Green indicators in different cities of the world



LAI adopted as the parameter for GPR – Green Plot Ratio (Singapore)

- LAI has practical applications in planning, e.g. in the concept of *Green Plot Ratio* – GPR;
- GPR combines LAI with building plot ratio – BPR (or FAR – Floor area ratio);
- For grass, LAI=1 and the correspondent GPR is 1:1; for shrubs, GPR=3.1, for trees GPR =5:1
- GPR is equivalent to the ratio between the total area of leaves and the floor area
- GPR is more effective than vegetation cover, because it is directly related to the leaves that process photosynthesis (Ong, 2002).

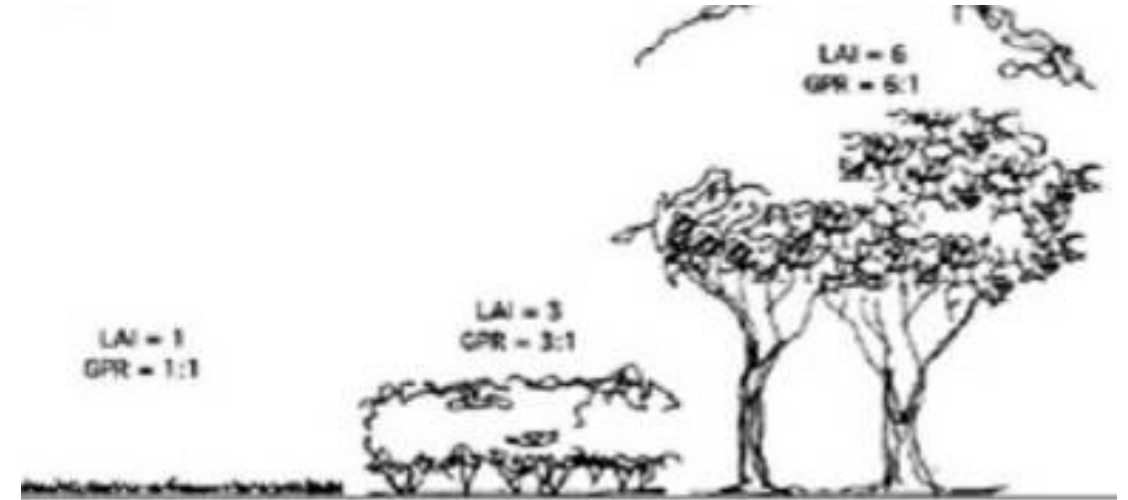


Fig-2



Public Policies / adoption of GPR – Green Plot Ratio





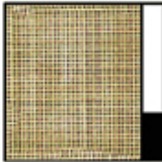

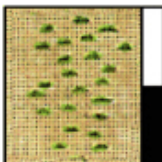


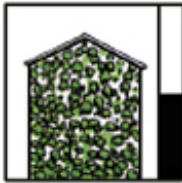

Newton Suites

Fonte: WOHA. Disponível em: < www.woha-architects.com/



Hotel ParkRoyal | Fonte: Blogs Design You Trust e Wall Street Jornal

Biotope Area Factor – BAF / Berlin and other German cities

Weighting factor / per m ² of surface type	Description of surface types			
 <p>Sealed surfaces 0.0</p>	Surface is impermeable to air and water and has no plant growth (e.g., concrete, asphalt, slabs with a solid subbase)	 <p>Surfaces with vegetation, unconnected to soil below 0.7</p>	Surfaces with vegetation that have no connection to soil below but with more than 80 cm of soil covering	
 <p>Partially sealed surfaces 0.3</p>	Surface is permeable to water and air; as a rule, no plant growth (e.g., clinker brick, mosaic paving, slabs with a sand or gravel subbase)	 <p>Surfaces with vegetation, connected to soil below 1.0</p>	Vegetation connected to soil below, available for development of flora and fauna	
 <p>Semi-open surfaces 0.5</p>	Surface is permeable to water and air; infiltration; plant growth (e.g., gravel with grass coverage, wood-block paving, honeycomb brick with grass)	 <p>Rainwater infiltration per m² of roof area 0.2</p>	Rainwater infiltration for replenishment of groundwater; infiltration over surfaces with existing vegetation	
 <p>Surfaces with vegetation, unconnected to soil below 0.5</p>	Surfaces with vegetation on cellar covers or underground garages with less than 80 cm of soil covering	 <p>Vertical greenery up to a maximum of 10 m in height 0.5</p>	Greenery covering walls and outer walls with no windows; the actual height, up to 10 m, is taken into account	
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> $\text{BAF} = \frac{\text{ecologically-effective surface areas}}{\text{total land area}}$ </div>		 <p>Greenery on rooftop 0.7</p>	Extensive and intensive coverage of rooftop with greenery	

AEE = Área x Fator de ponderação

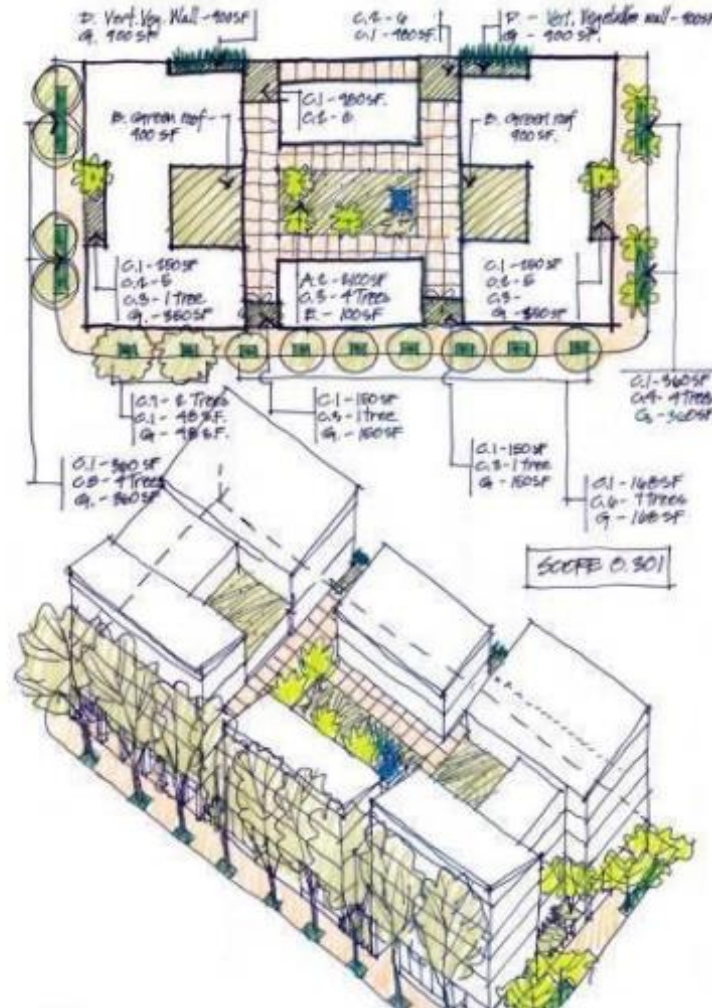
Public Policies

Seattle Green Factor (SGF)

Mandatory since 2006 to all uses, except single-family buildings

Similar to the Biotope Area Factor (BAF), the Seattle Green Factor (SGF) adopted different weighting factors according to the subtract characteristics, the existence of green cover and permeability of external pavements. But it goes beyond the BAF introducing other aspects related to the canopy spread and to the existence of biorretention systems that increase the infiltration capacity of stormwater.

What is Seattle Green Factor?



Zoning Code with Branding

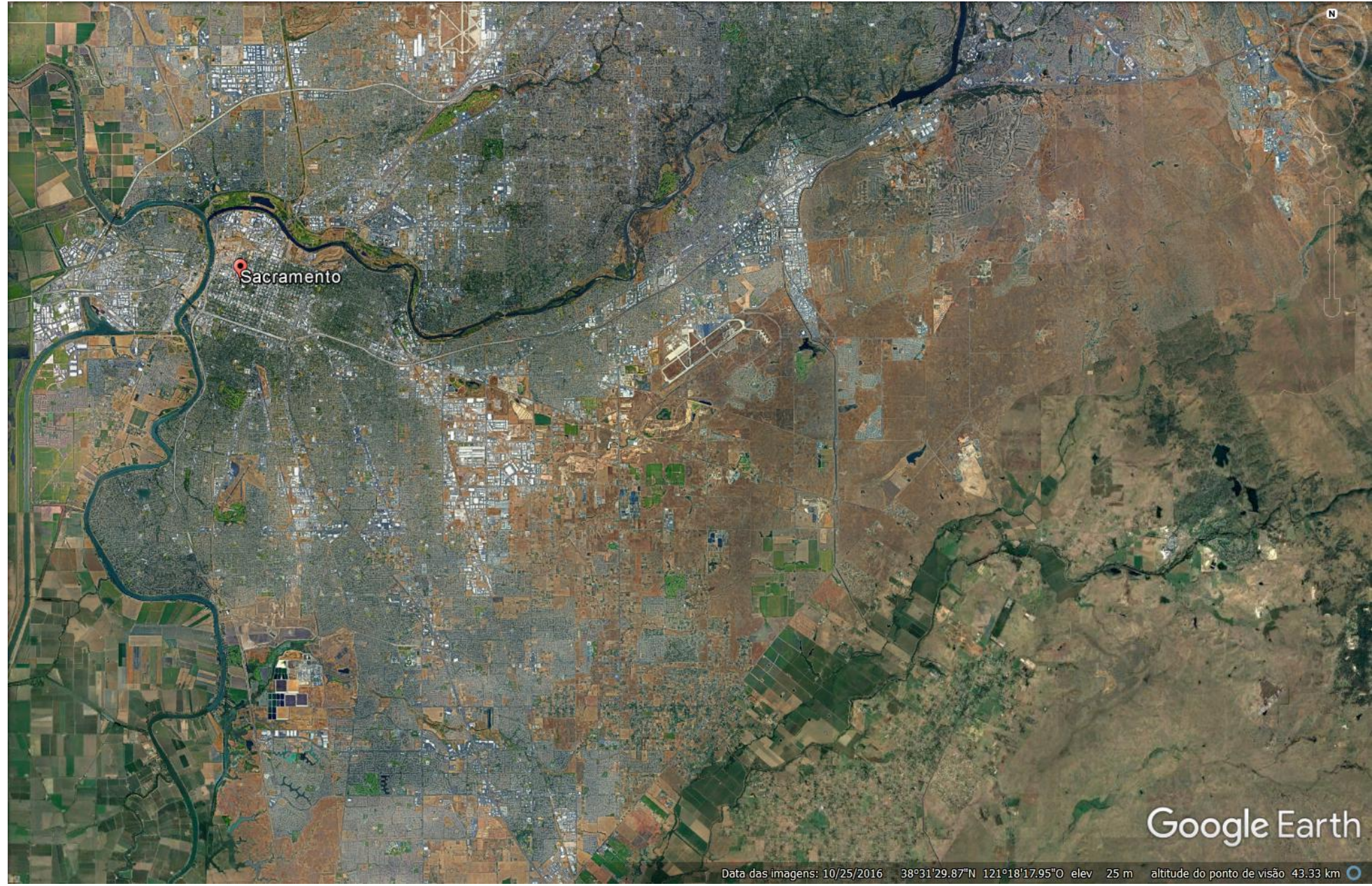
- **Code Requirement in updated Zones**
- **Requires minimum 'Score' by Zone type:**

▪ C / NC:	0.30
▪ MR / HR:	0.50
▪ LR:	0.60
▪ South DT Area:	0.30
▪ IC in Urban Centers:	0.30
- **'Score' correlates to % of site that should be 'Green', i.e.:**
C/NC → 0.30 → 30% 'green'



Public Policies

Sacramento Shade



Public Policies

Sacramento Shade



Public Policies

Sacramento Shade



Image © 2005 Sanborn

© 2005 Google

Pointer 38°37'21.59" N 121°29'23.49" W elev 16 ft

Streaming ||||| 100%

Eye alt 5438 ft

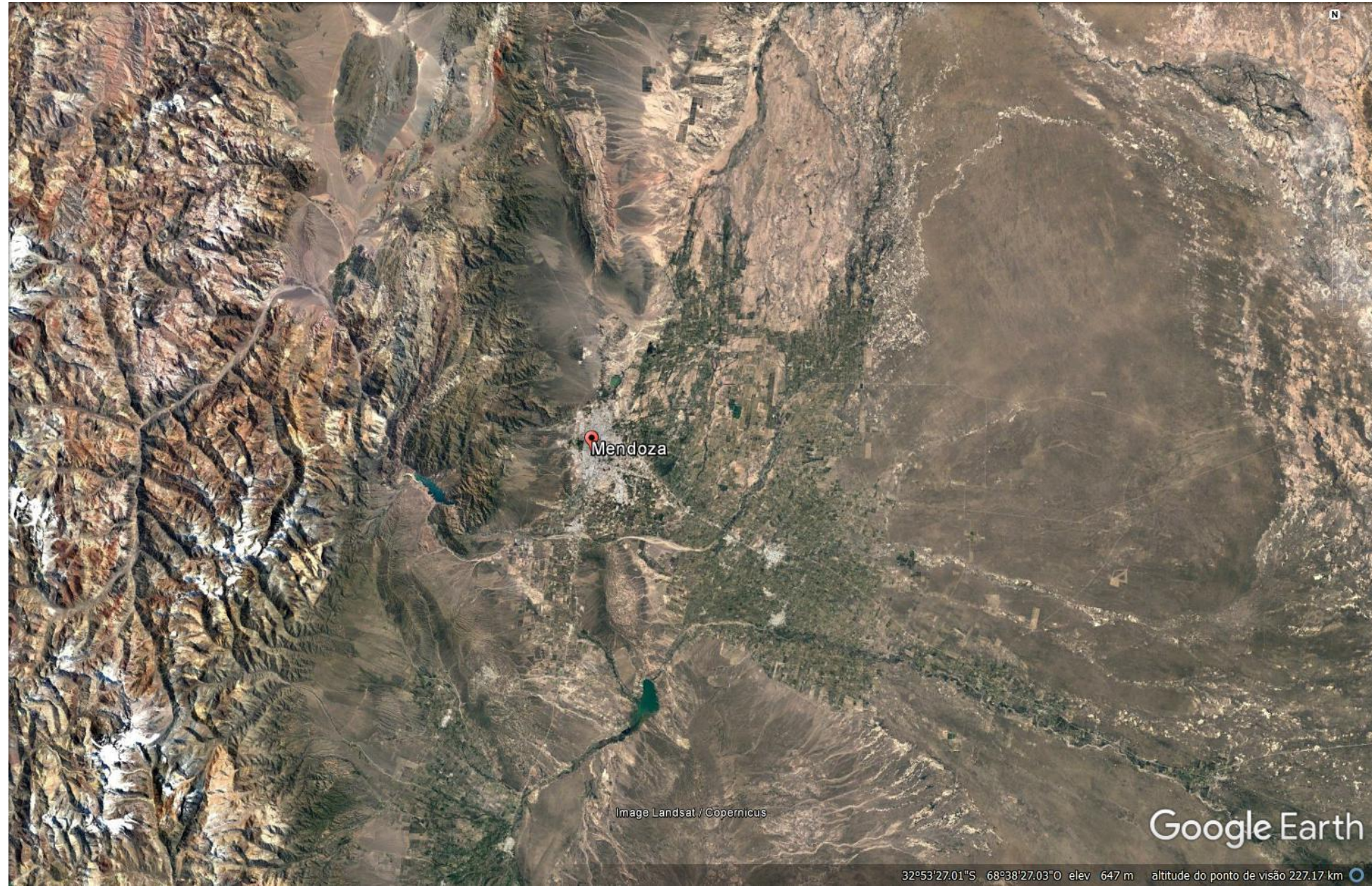
Public Policies

Sacramento Shade



Public Policies

Mendoza, Argentina



Public Policies

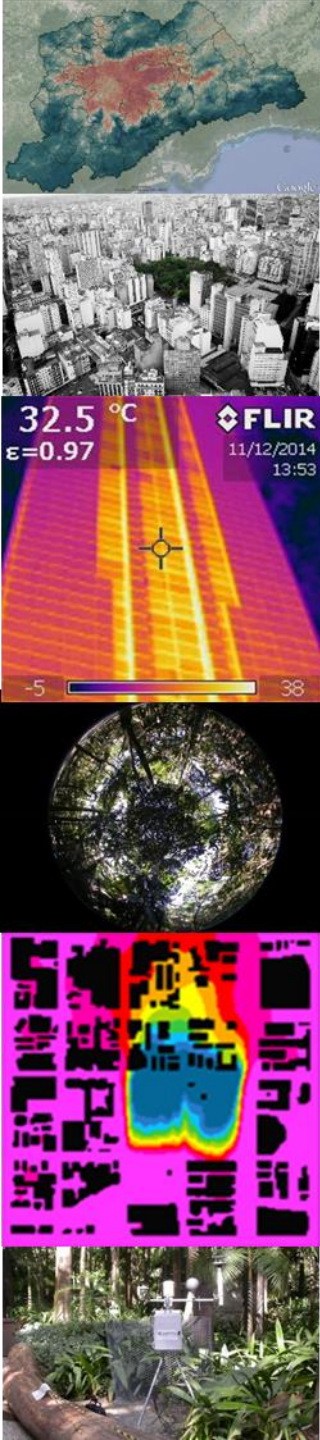
Mendoza, Argentina



Public Policies

Mendoza, Argentina





FINAL CONSIDERATIONS

Urban density can be compatible with microclimate amenities; green infrastructure is part of the strategy.

Adopt not only historical climate data, but recent past and future climate predictions.

Adaptation to urban climate is an urgency to be addressed; mitigation only will not be sufficient.

Go further in predictive studies that can contribute to the results' assimilation in public policies, resulting in socio environmental benefits for people.

Urban strategic plans can incorporate climate risks and vulnerabilities, and evaluations have to be available for this kind of plans.

There is a lack of proposals for a network of climate amenity spaces spread all over the city, mainly in public spaces, as well as for building adaptation to climate change, alternatively to the air conditioning dependency.

Leituras recomendadas

- FERREIRA, Luciana S. Vegetação, temperatura de superfície e morfologia urbana: um retrato da região metropolitana de São Paulo. Tese (Doutorado em Arquitetura e Urbanismo). FAUUSP: São Paulo, 2019 (<https://www.researchgate.net/publication/336014528>).
- FERREIRA, Luciana S. Vegetation Management in São Paulo, Brazil: Clearing of Urban Vegetation and Environmental Compensation. In: Trees, People and the Built Environment, Birmingham, UK (<https://www.researchgate.net/publication/279177981>)
- Ong, B. L., Ho, A., & Ho, D. K. H. (2012). Green Plot Ratio - Past, Present & Future. In iNTA2012 - Tropics 2050. Conference Paper, Singapore (<http://www.inta2012.org/>)