Cidades

Dr Giuliano Maselli Locosselli

Passos da co-criação

- Definir o desafio
- Identificar os problemas e oportunidades
- Conhecer questões associadas
- Definir as equipes
- Elaborar as propostas e os protótipos
- Testar as ideias
- Escrutinar as melhores ideias

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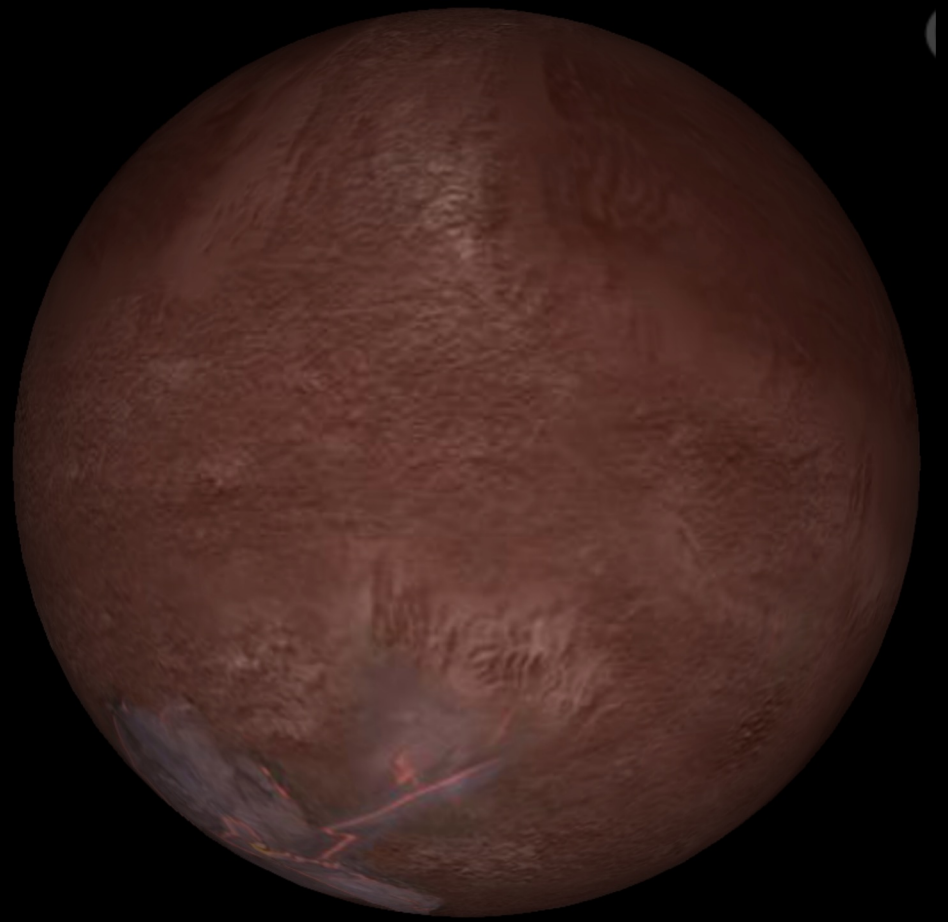
smithsonianmag.com

4.6 bilhões de anos atrás



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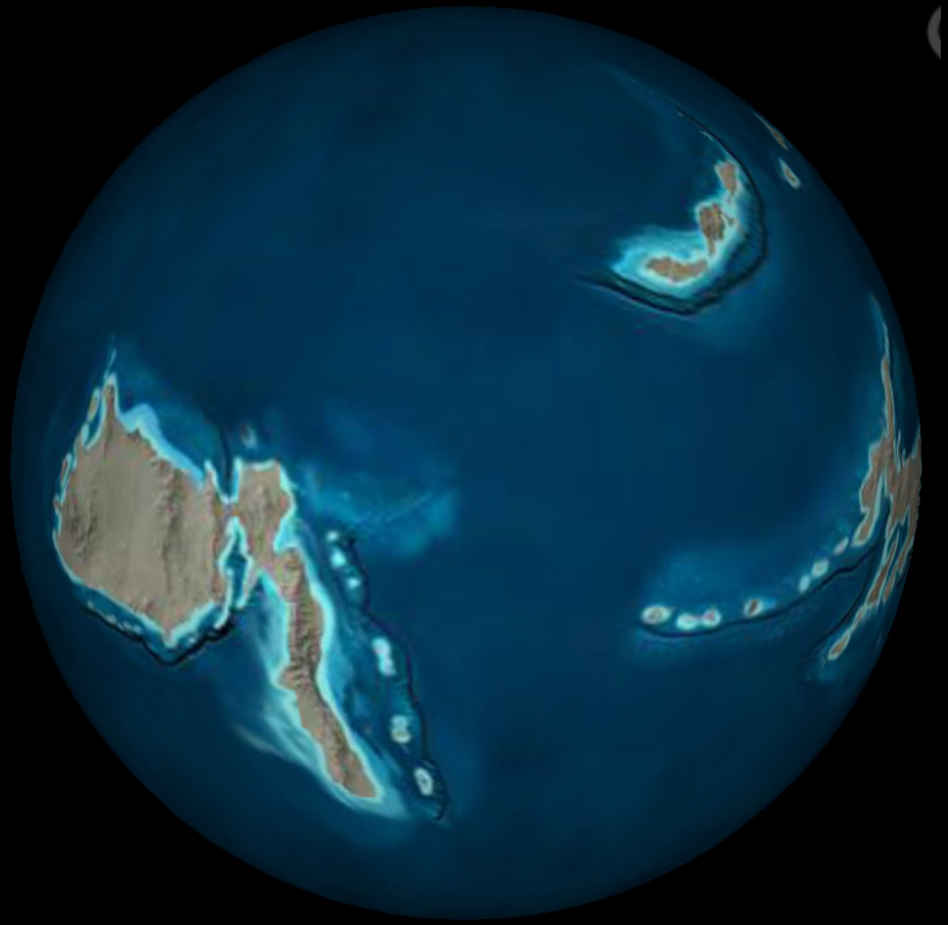
2.8 bilhões de anos atrás - Proterozóico

ucmp.berkeley.edu/



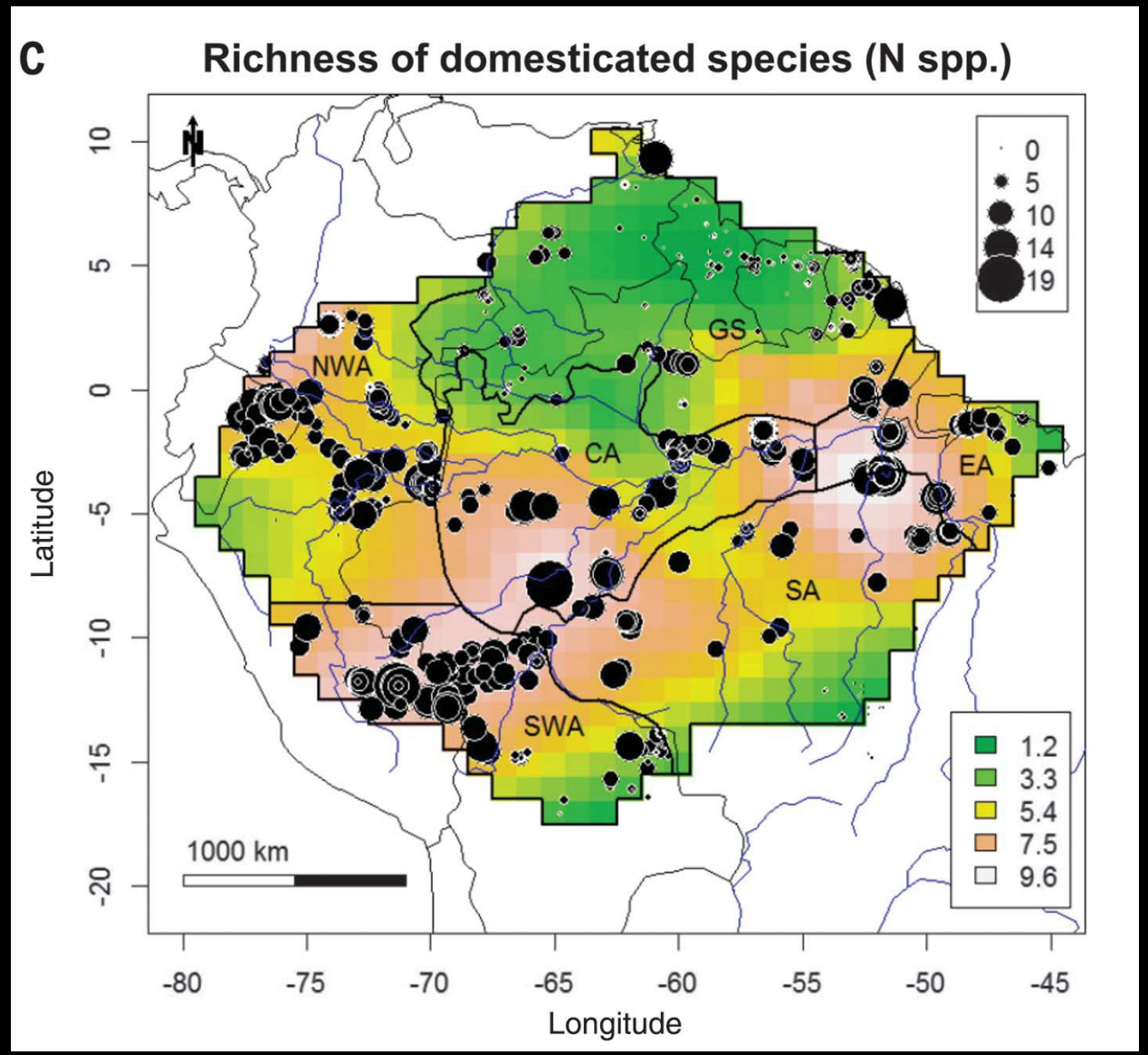
smithsonianmag.com

315 mil anos atrás

smithsonianmag.com

315 mil anos atrás

8 mil anos atrás

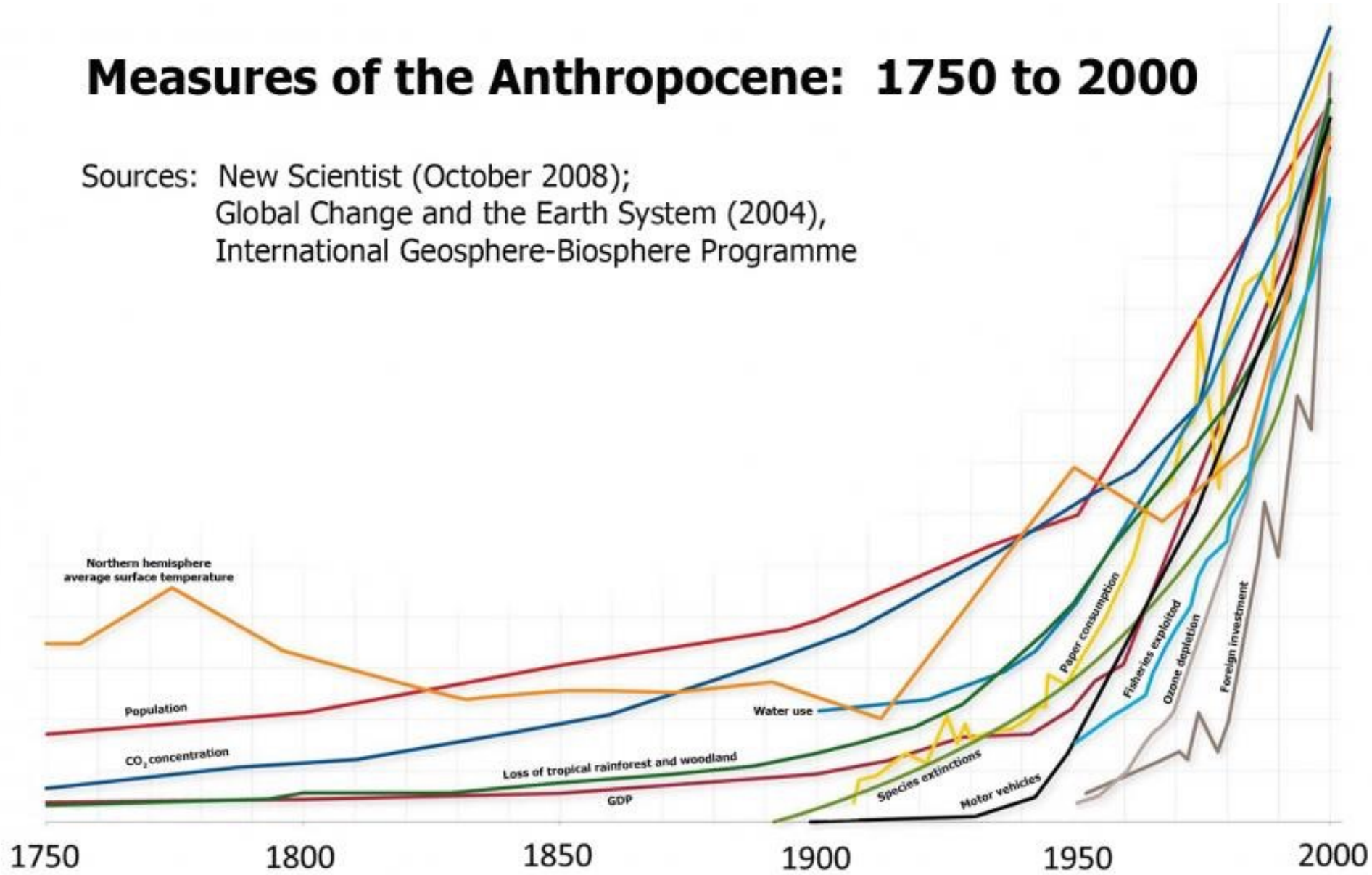


Levis et al. 2017 Science

Castanheira

amazon.co.uk

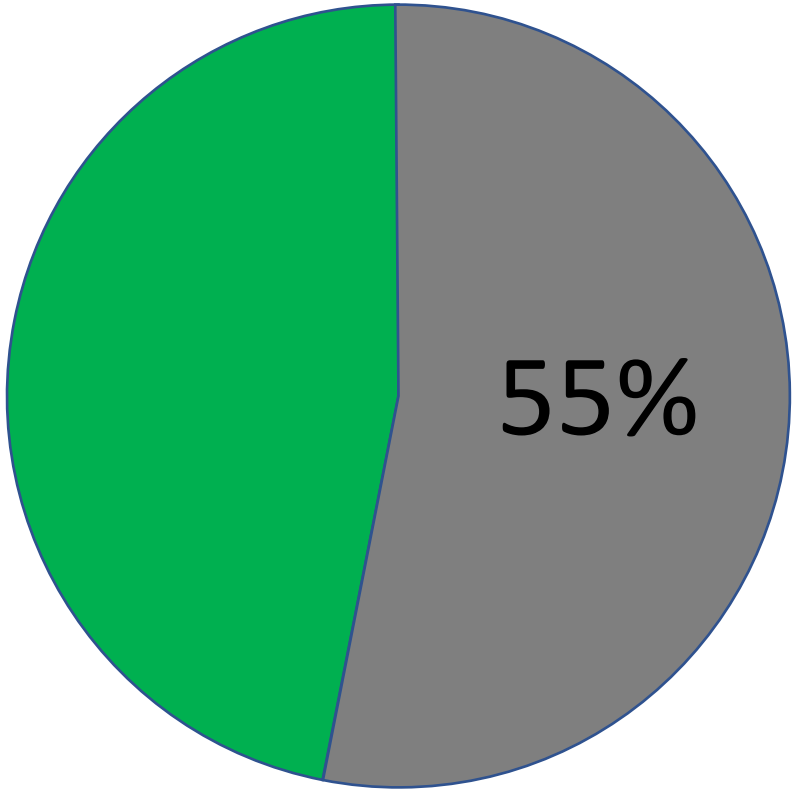
Antropoceno



Locosselli and Buckeridge (2023) 37: 1-7

Locosselli and Buckeridge (2023) 37: 1-7

Mundo



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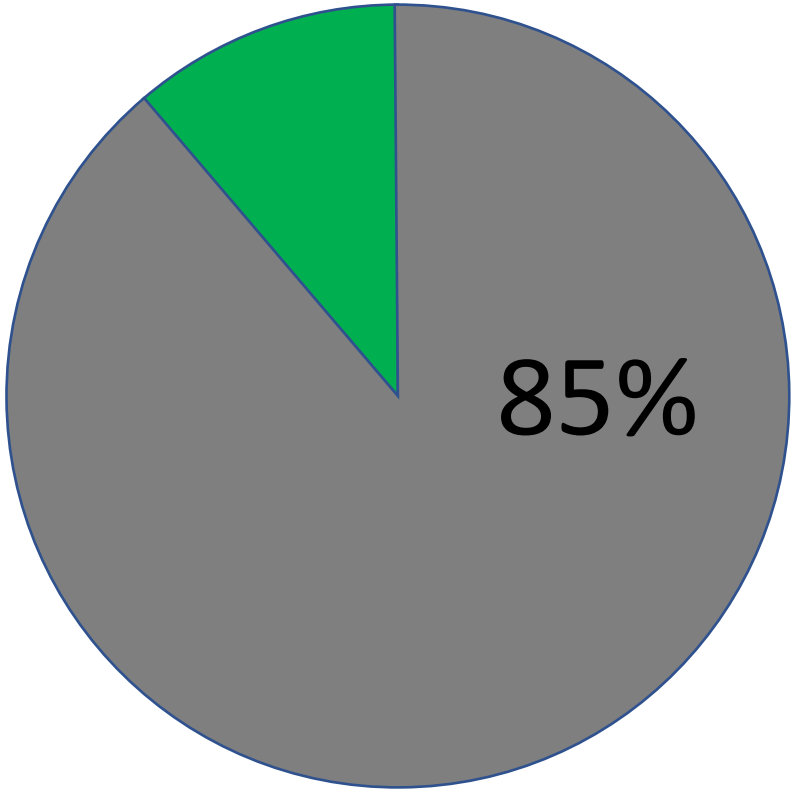
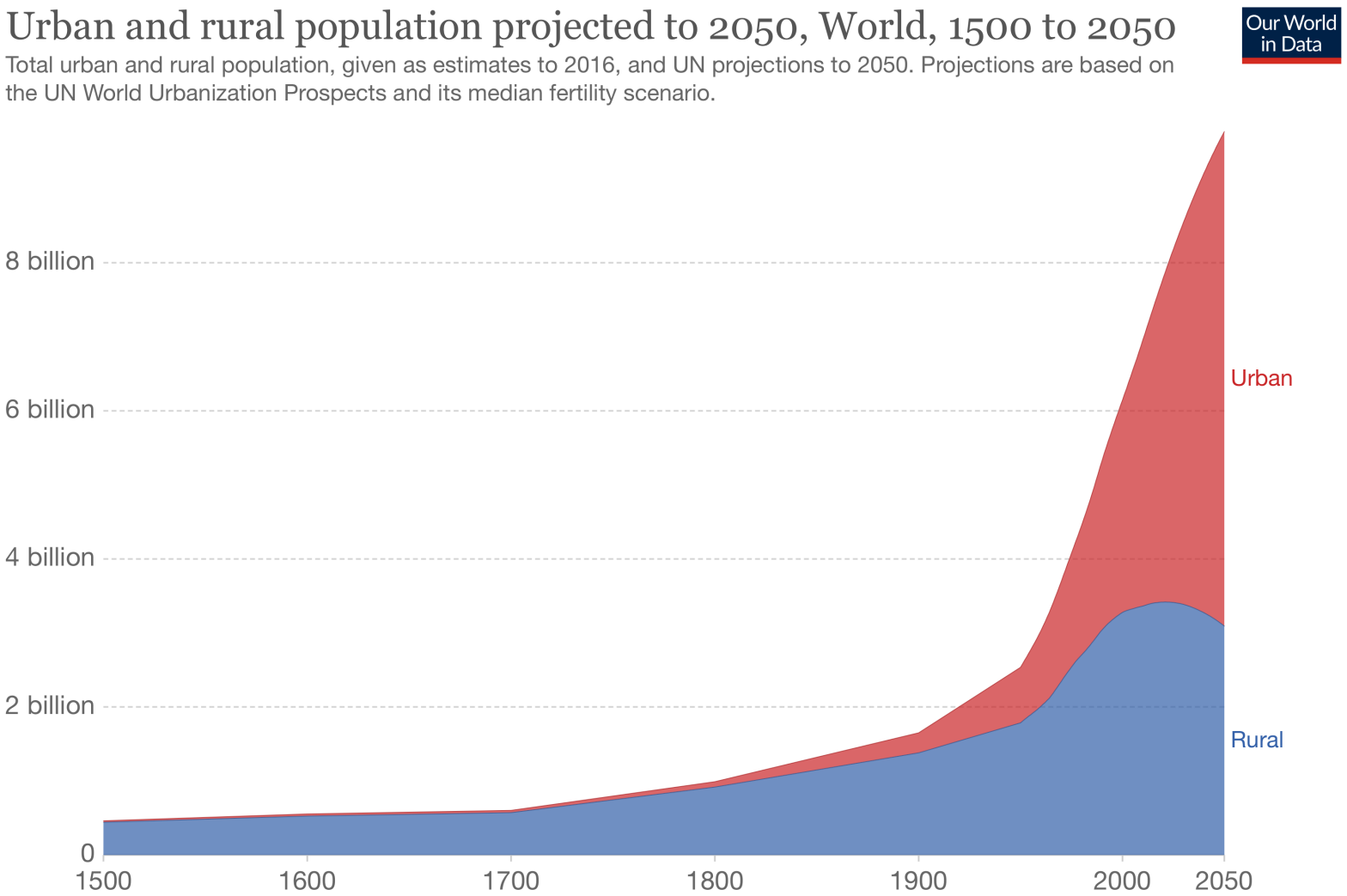


Urbanização



Pegada urbana

Fora das cidades

- 70% emissão de CO_2
- 75% recursos naturais
- 56-76% energia global

Dentro das cidades

- ↓ áreas verdes
- ↓ biodiversidade
- ↓ permeabilidade
- ↑ ilhas de calor
- ↑poluição

Locosselli and Buckeridge (2023) 37: 1-7

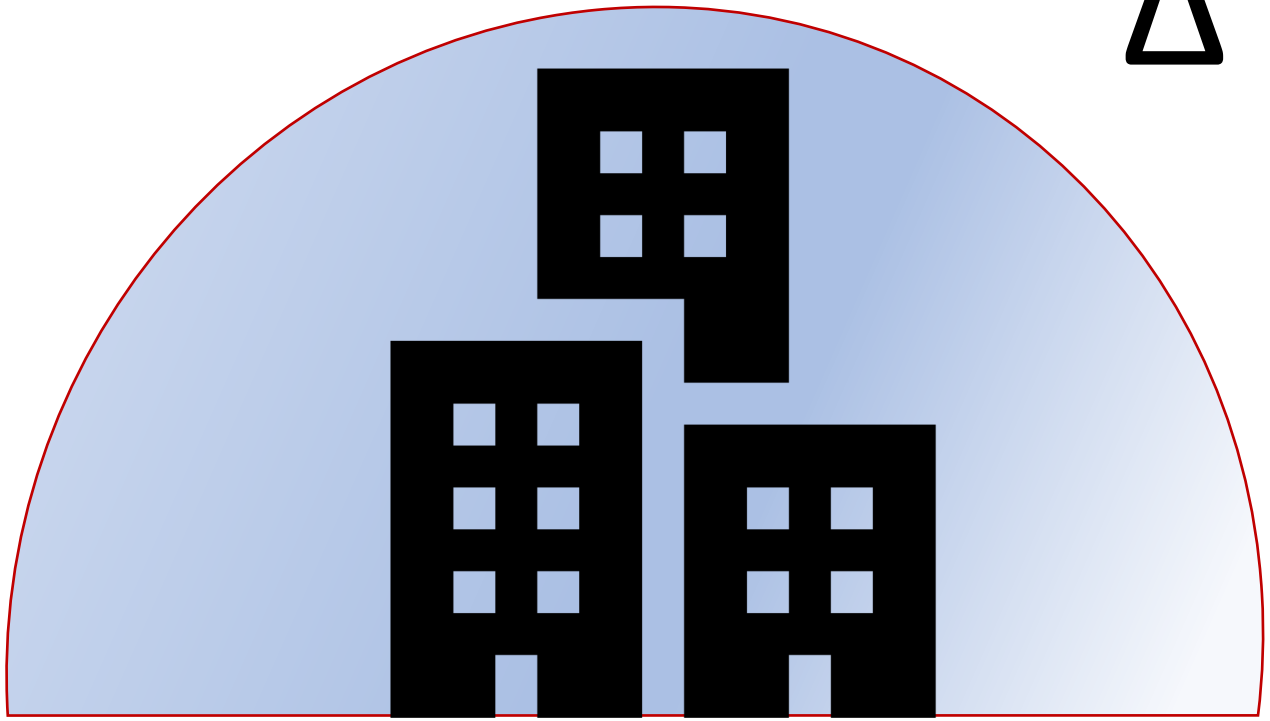
Urbanizacao

www.metroworldnews.com.br

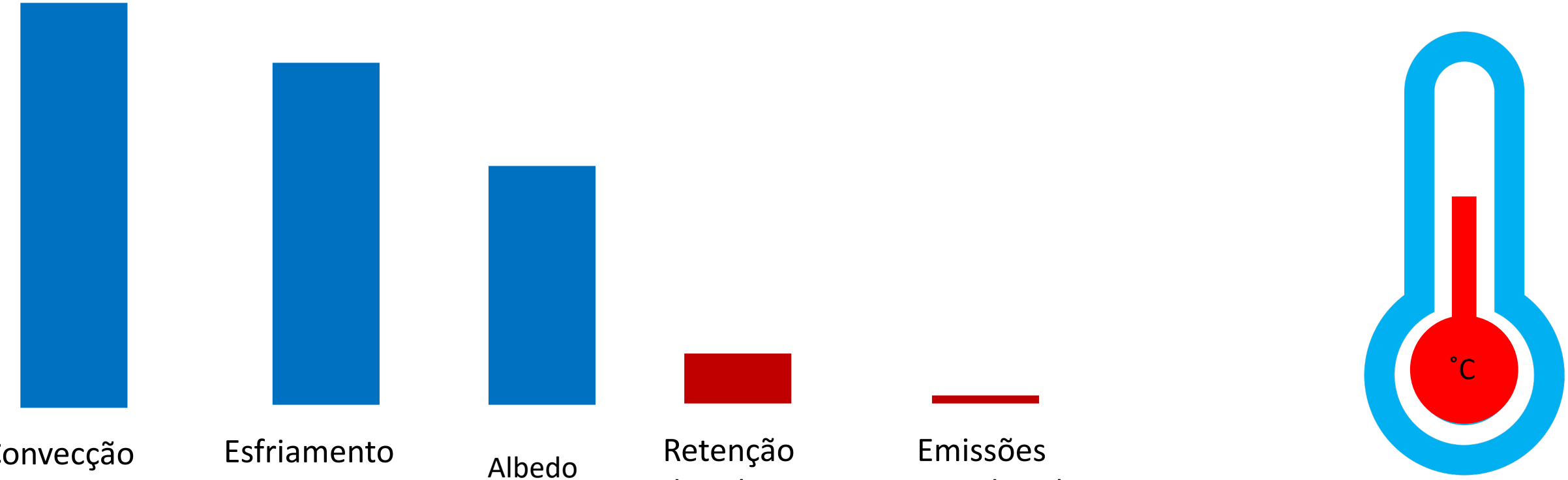
Problemas ambientais urbanos

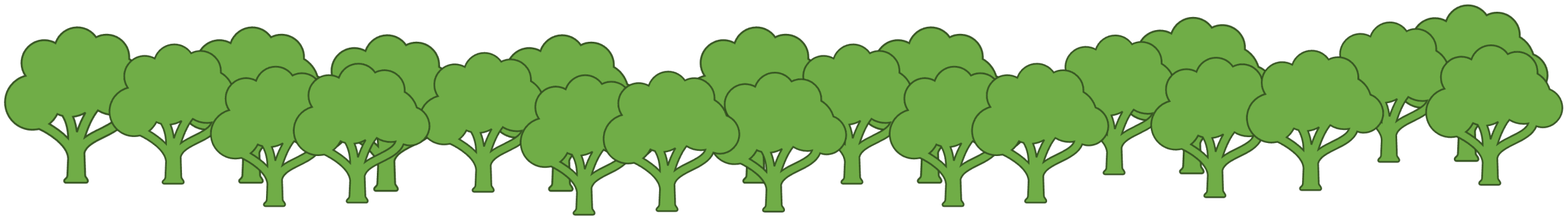
- Ilhas de calor urbanas – Urban heat island

Δt_s



- Ilhas de calor





Zhao et al 2014 Nature 511: 216-219. / Manoli et al 2019 Nature 573: 55-60

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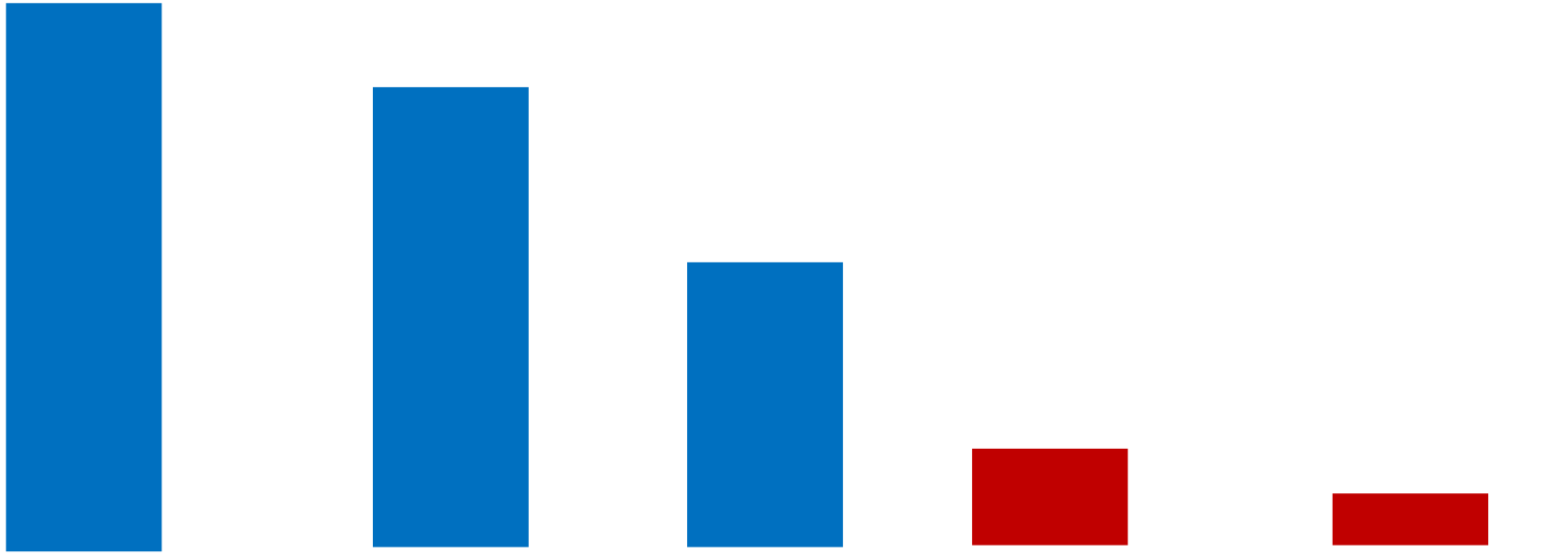


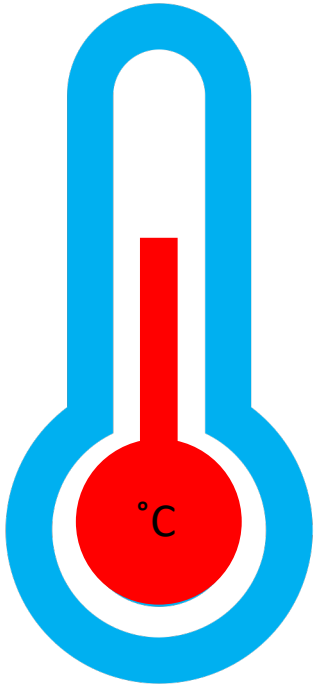
Convecção turbulência

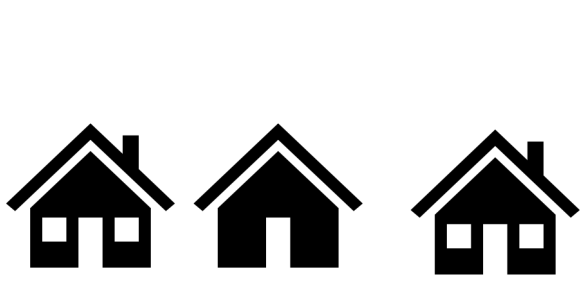
Esfriamento evaporativo

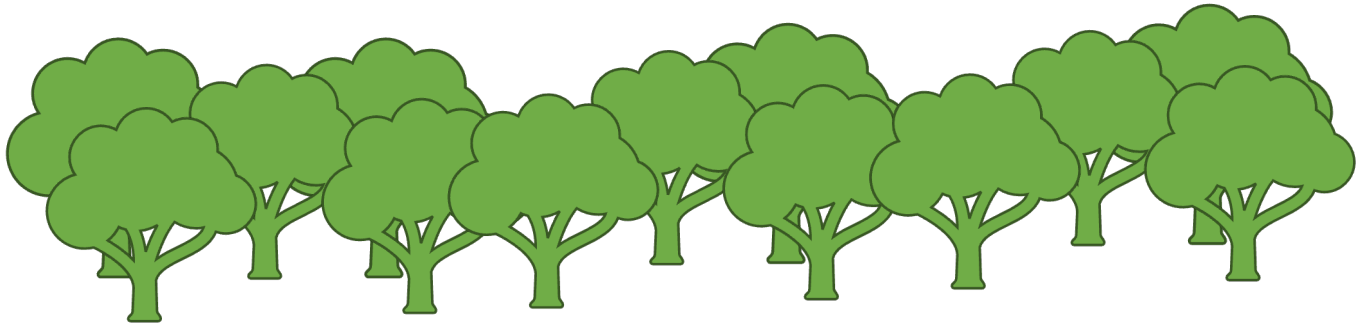
Albedo

Retenção de calor

Emissões antrop.de calor



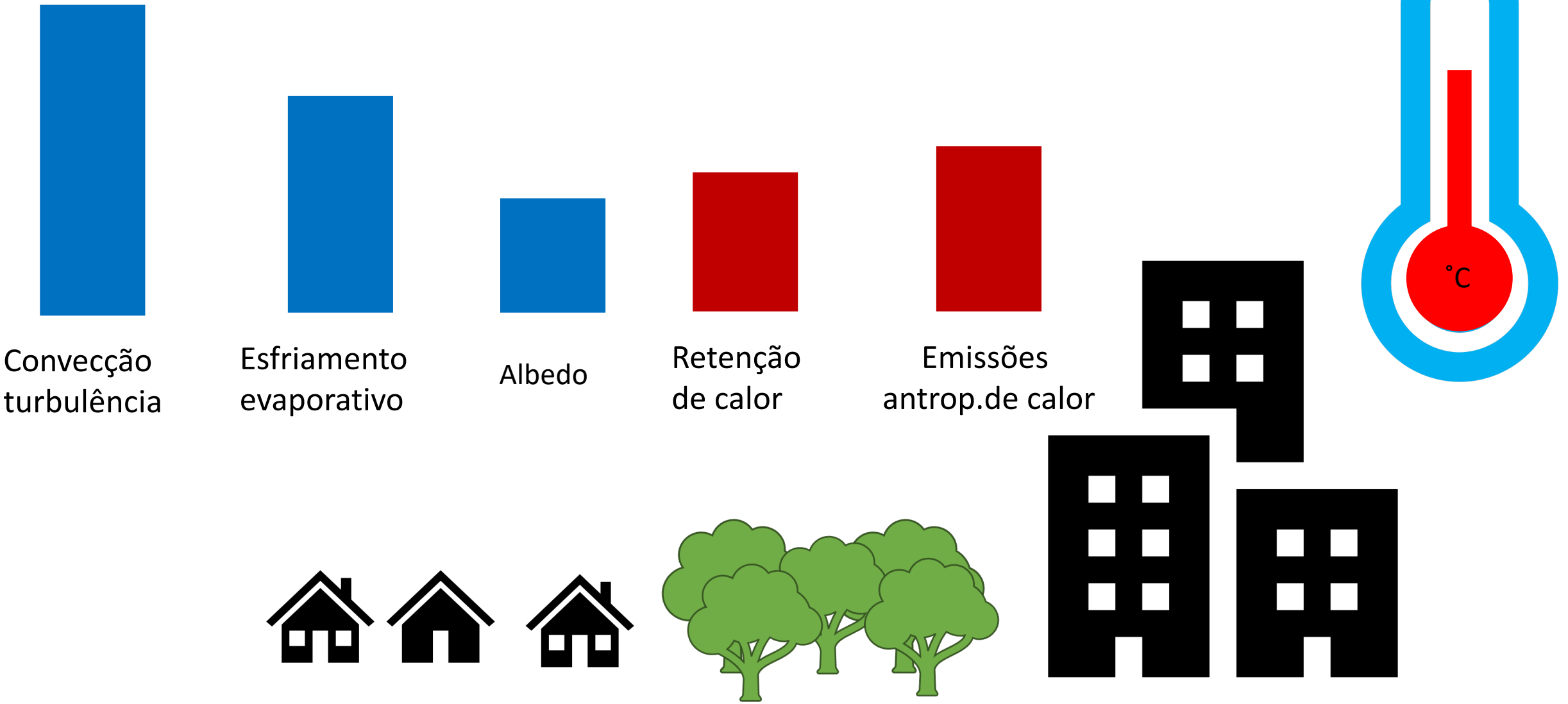




Zhao et al 2014 Nature 511: 216-219. / Manoli et al 2019 Nature 573: 55-60

- Ilhas de calor

+Ilhas de calor



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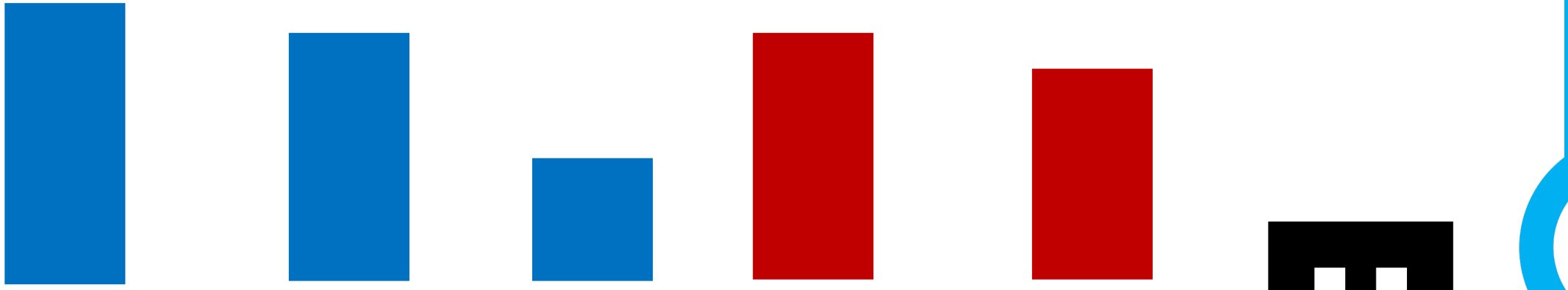

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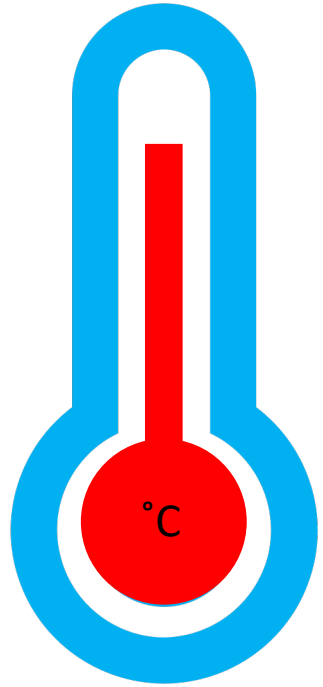

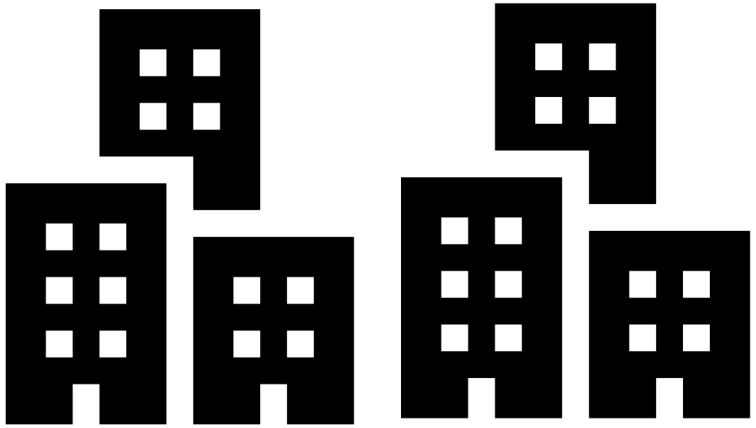

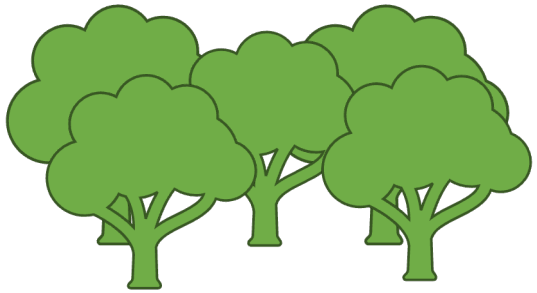

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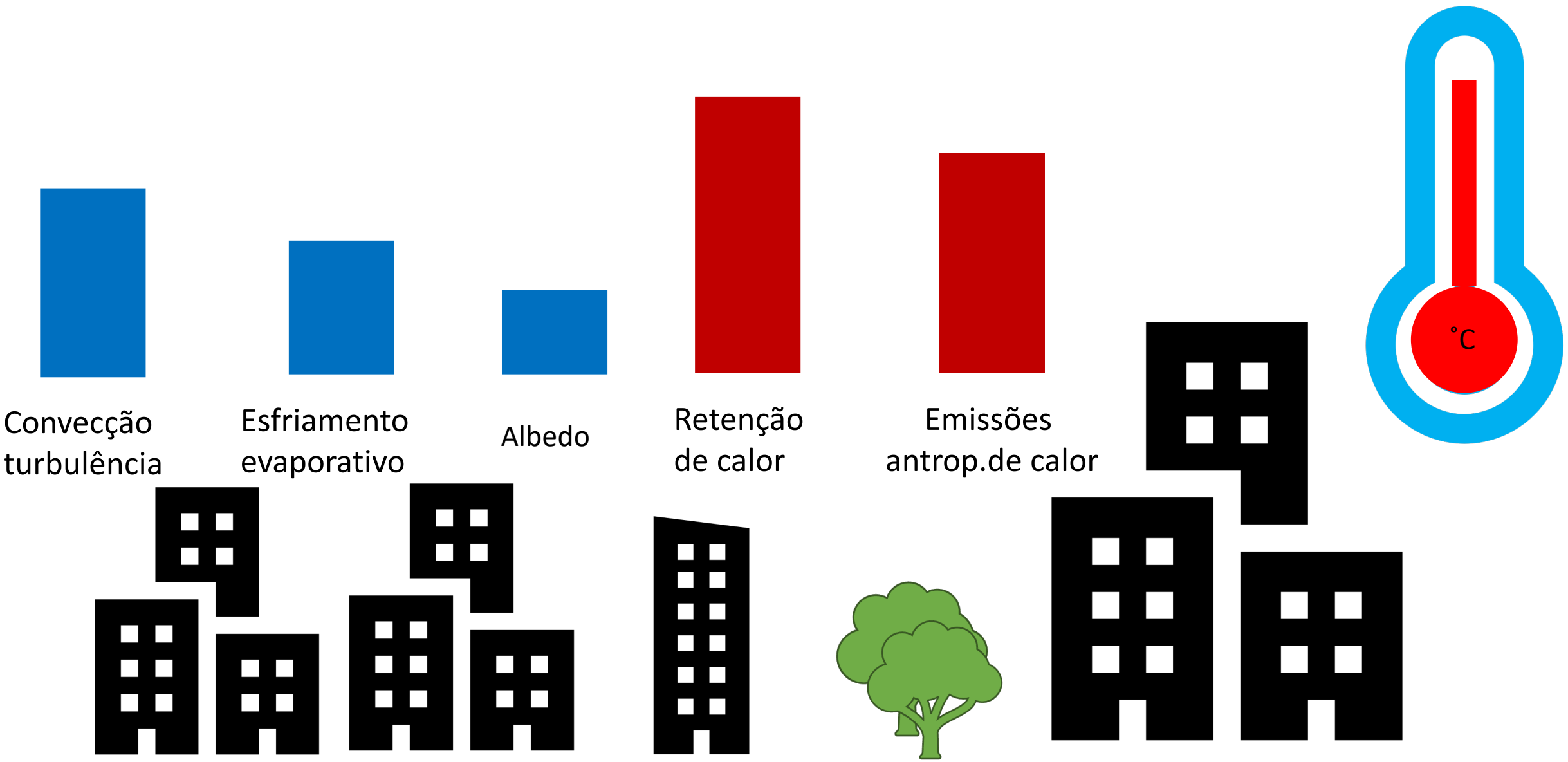

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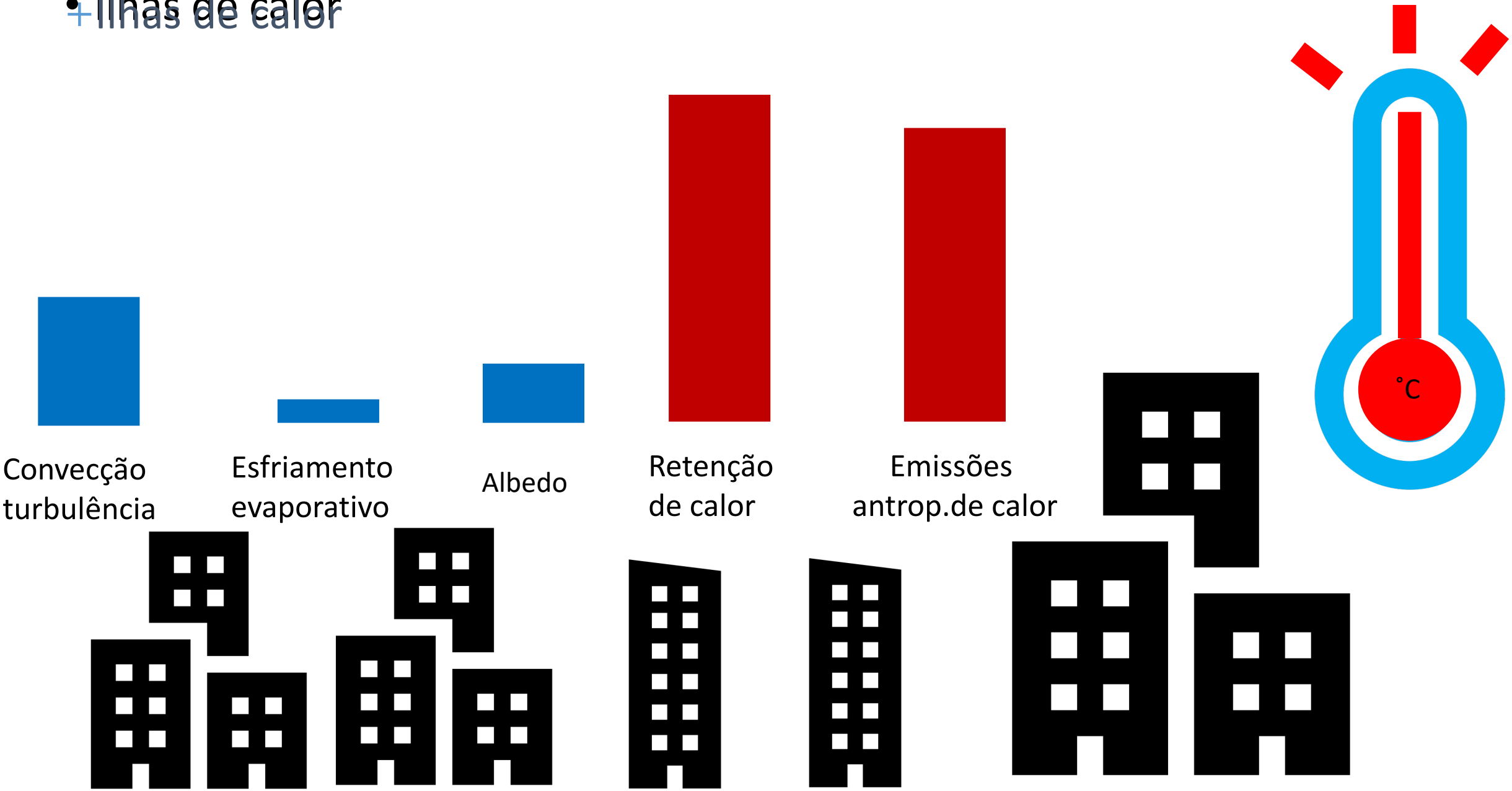

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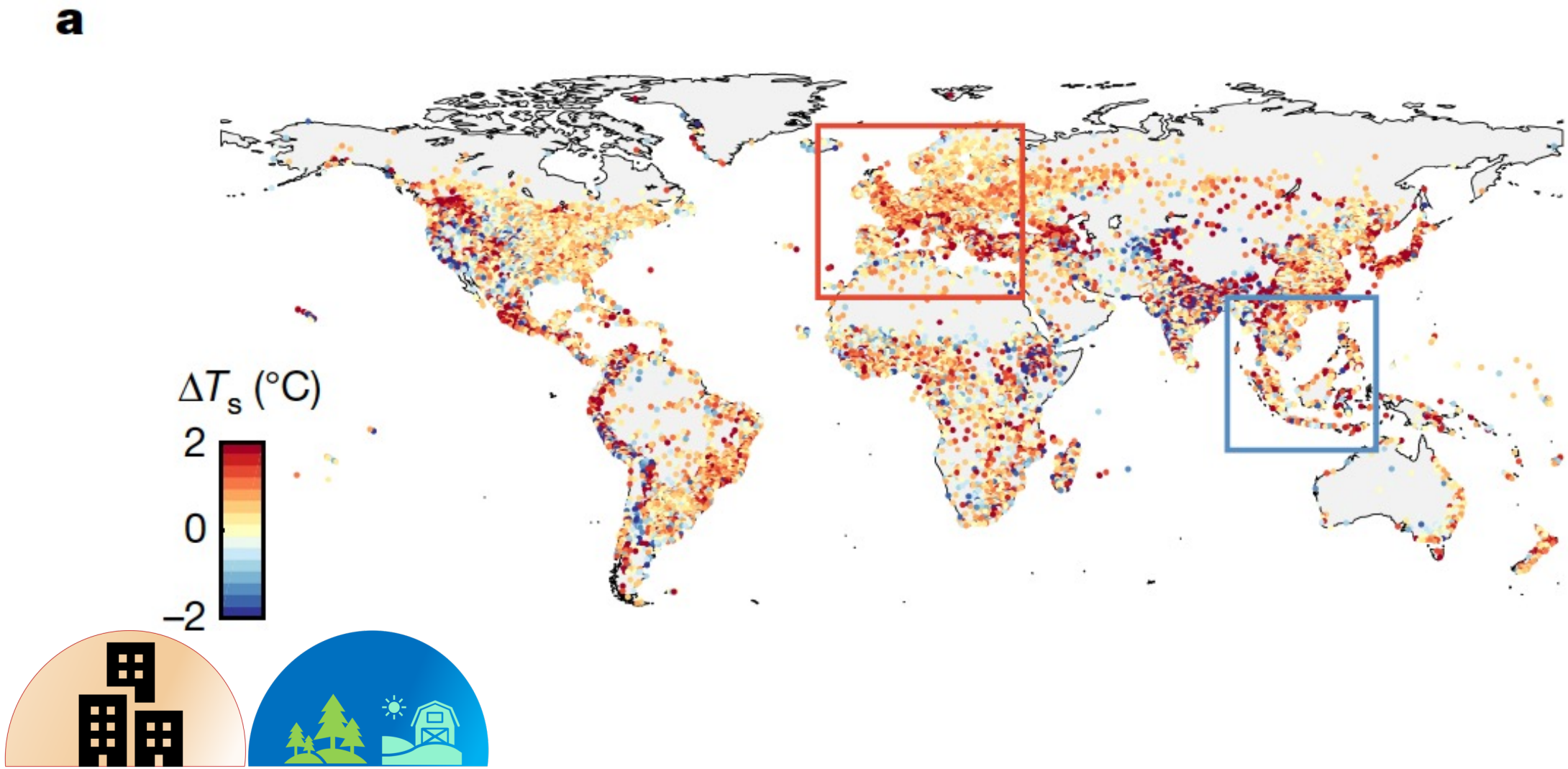

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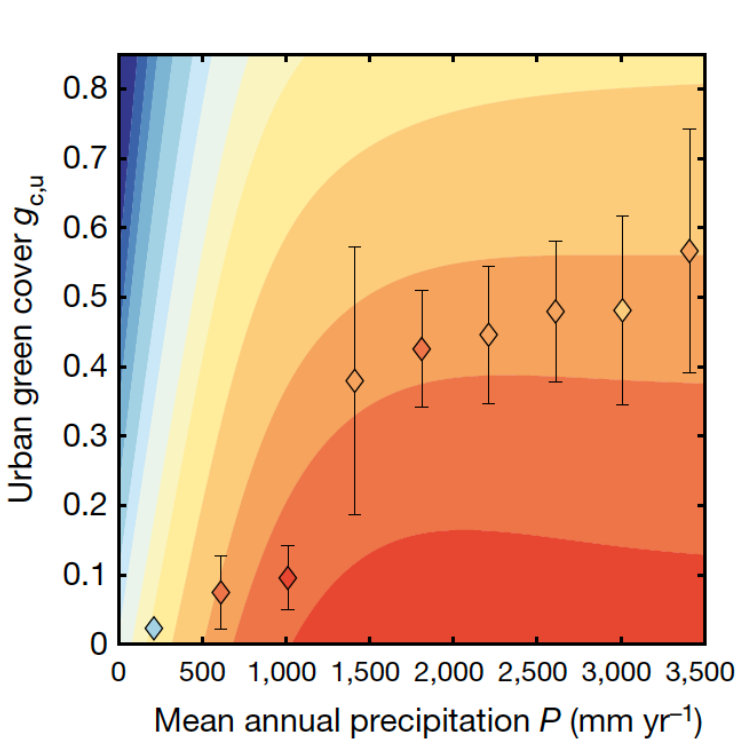

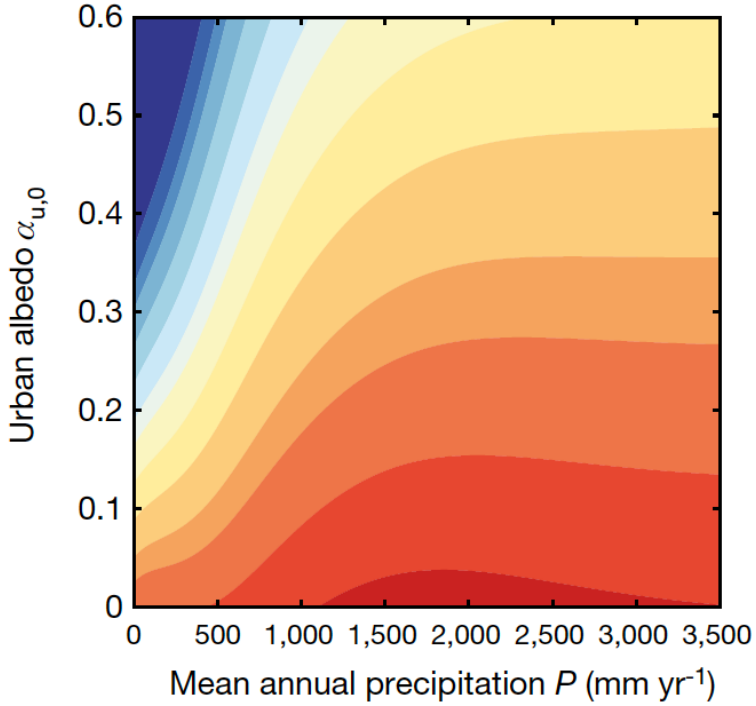

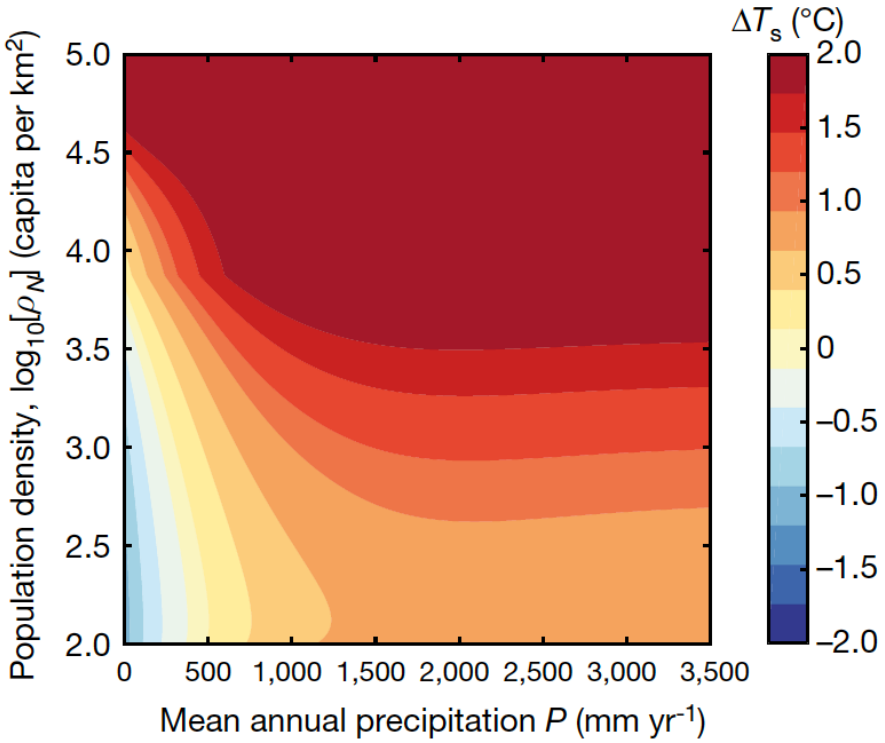

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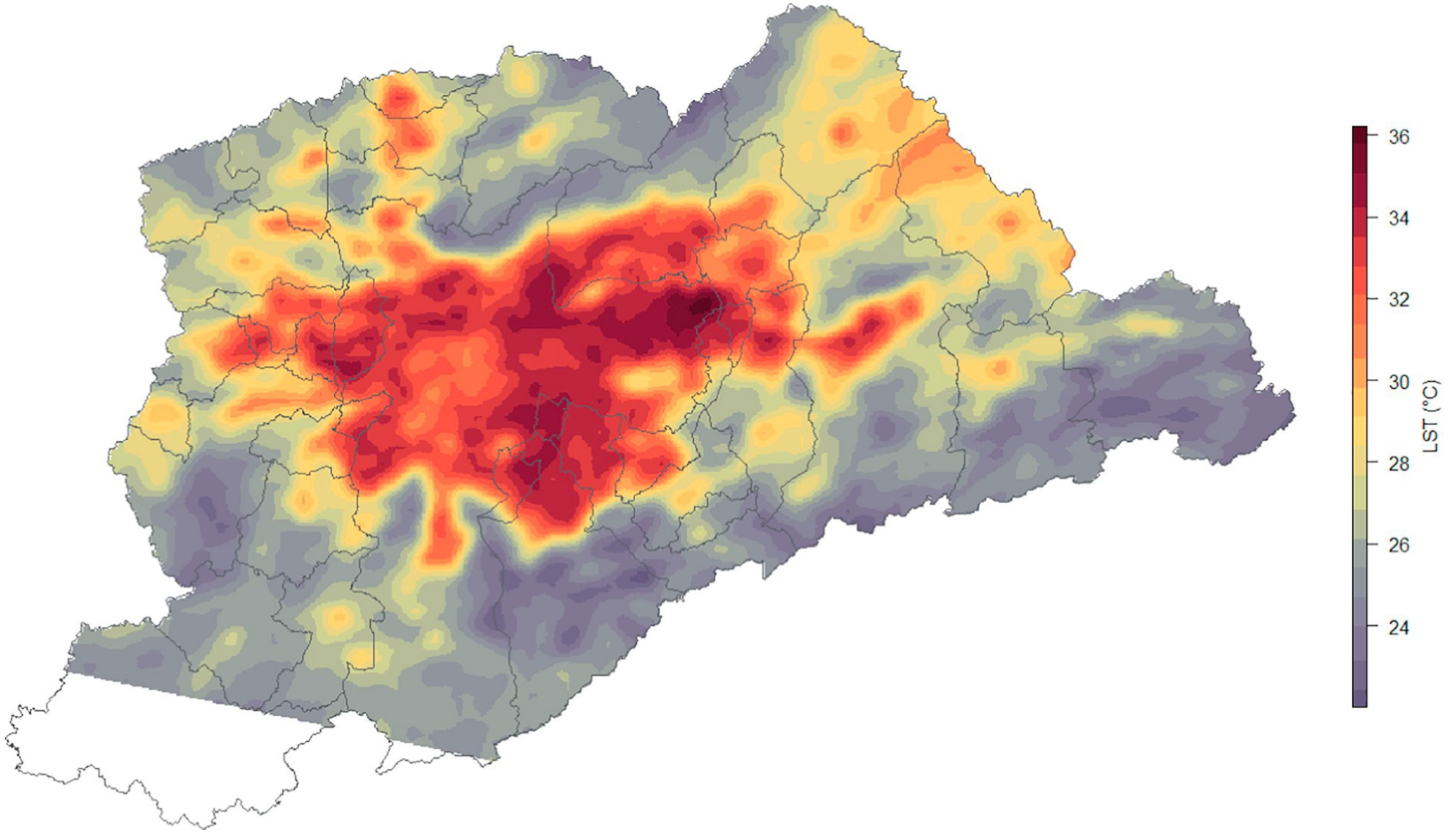
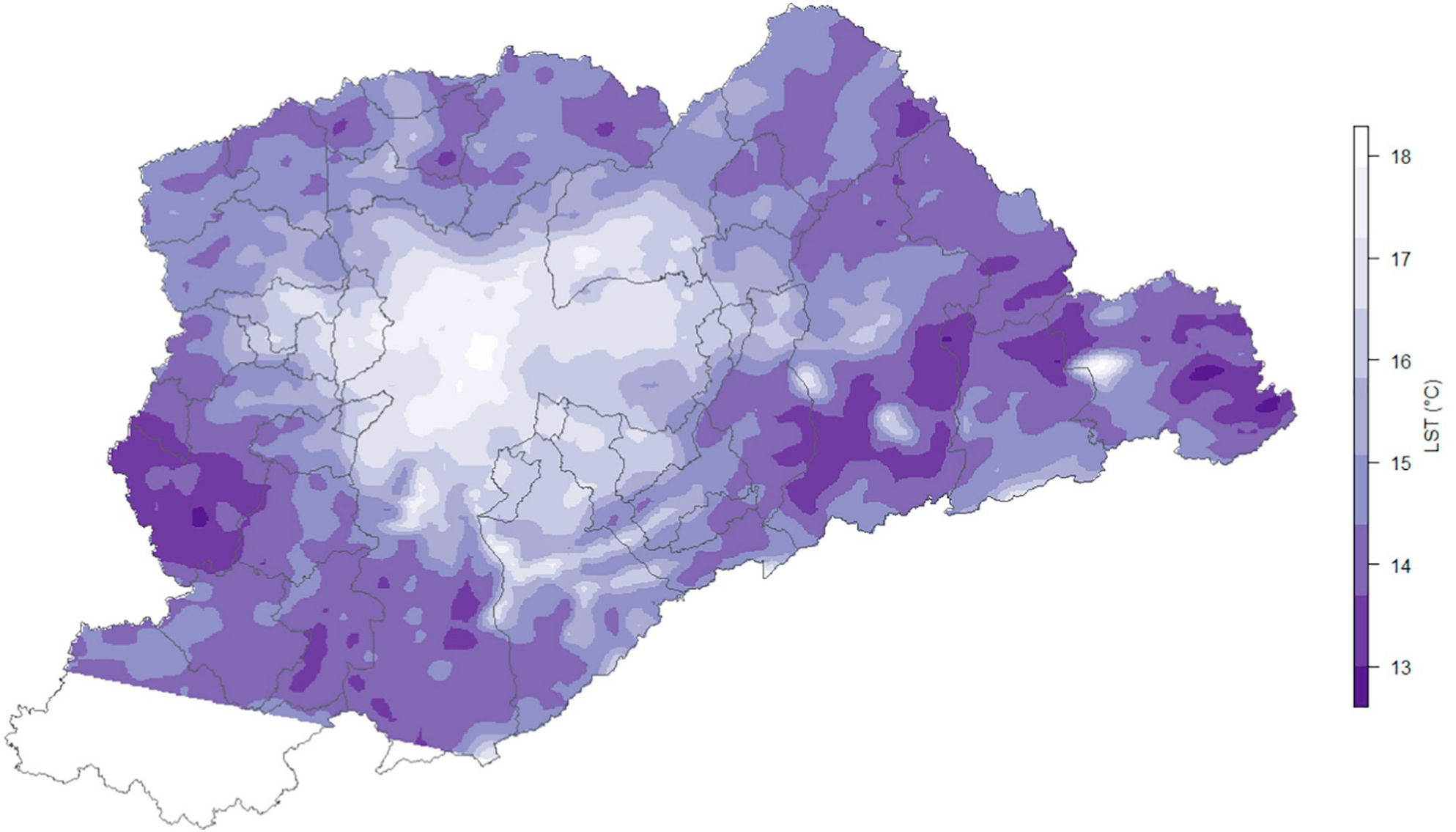


Ferreira and Duarte 2019 Urban Climate 27: 105-123

+Ilhas de calor

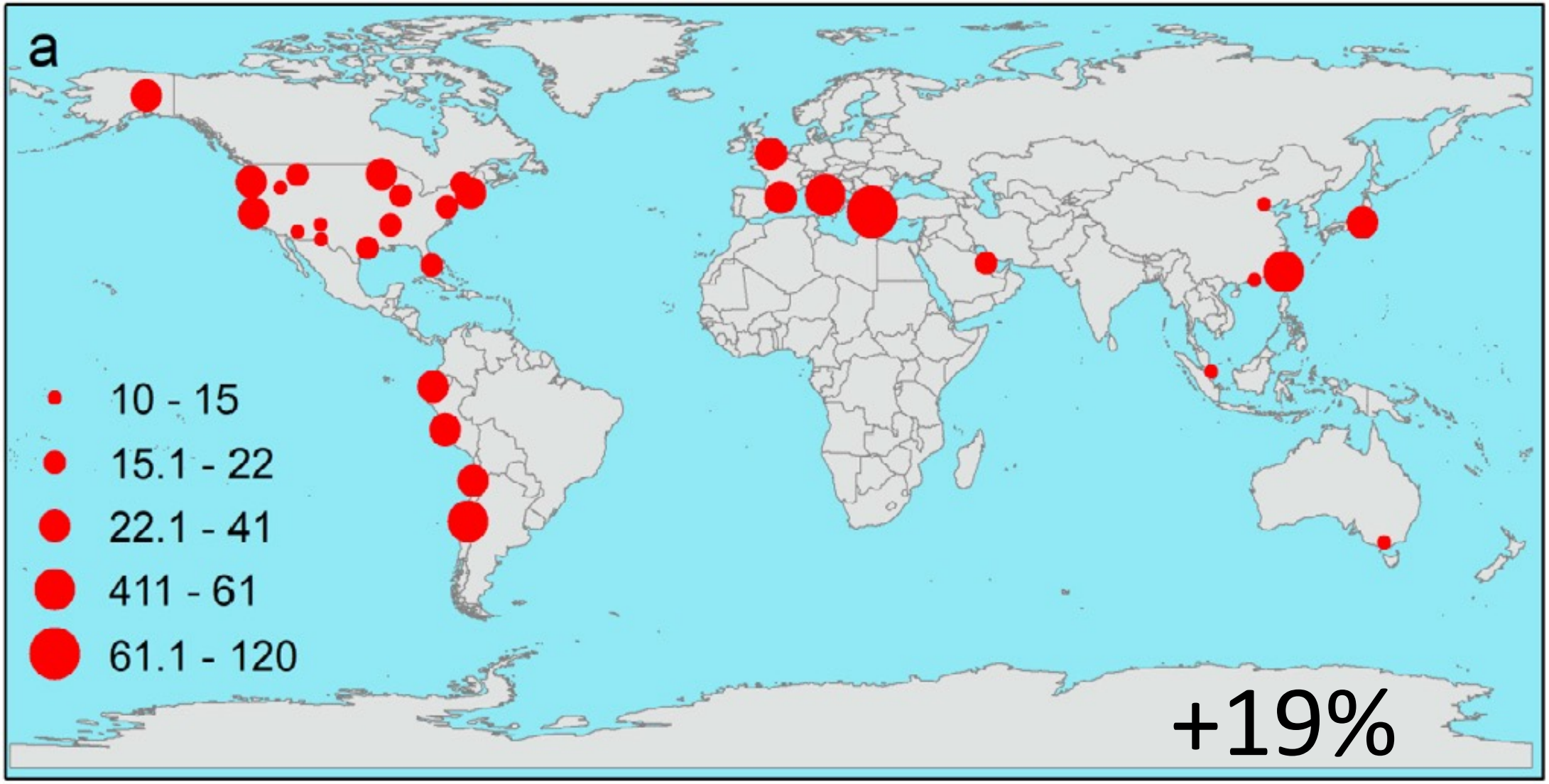


Ferreira and Duarte 2019 Urban Climate 27: 105-123

+Ilhas de calor

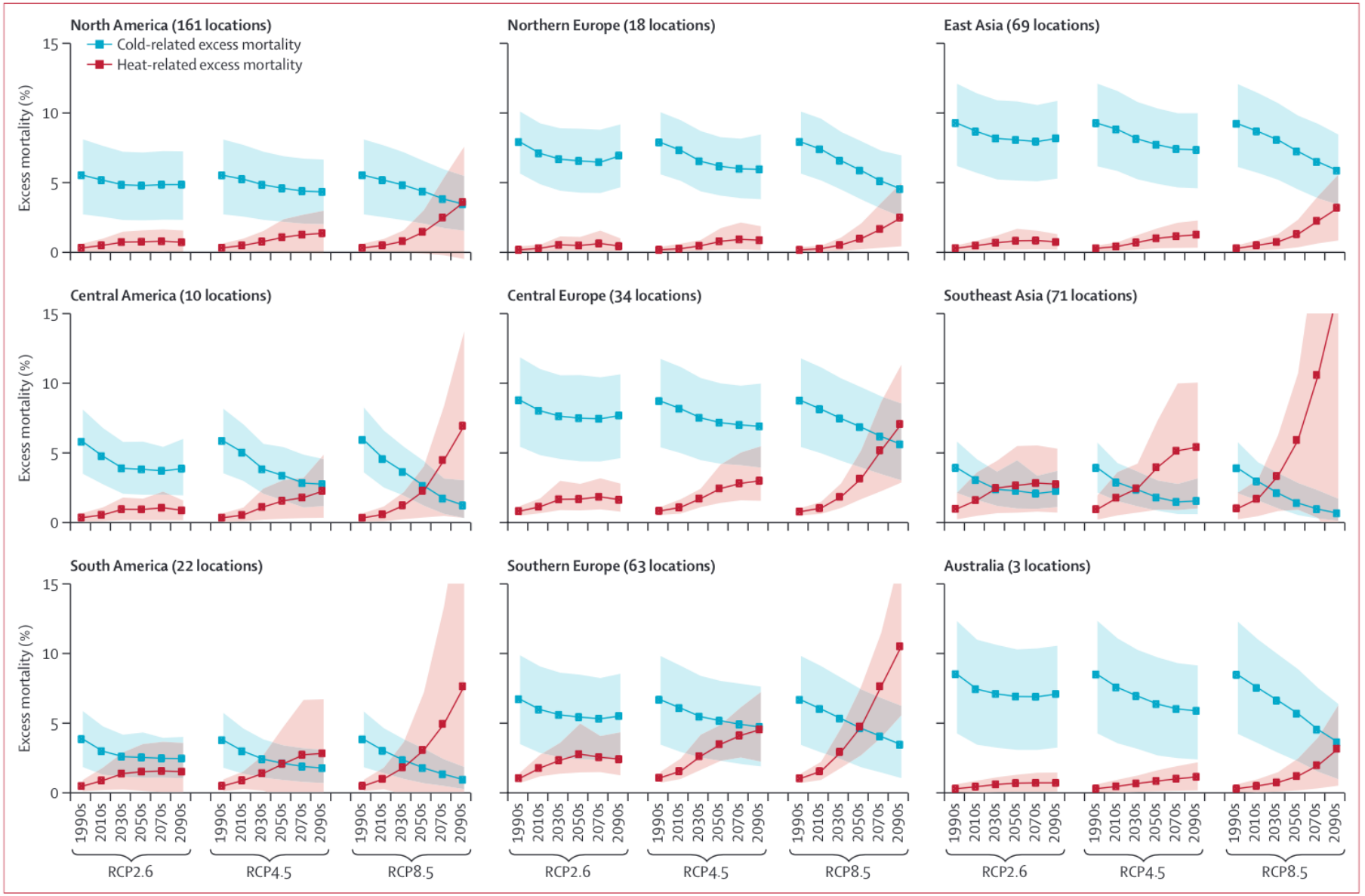
+Ilhas de calor

+Aumento do consumo de energia para climatização (%)



Li et al 2019 Energy 174: 407-419

+Ilhas de calor



Gasparrini et al 2017 The Lancet Planetary Health 1: e360

Urbanização

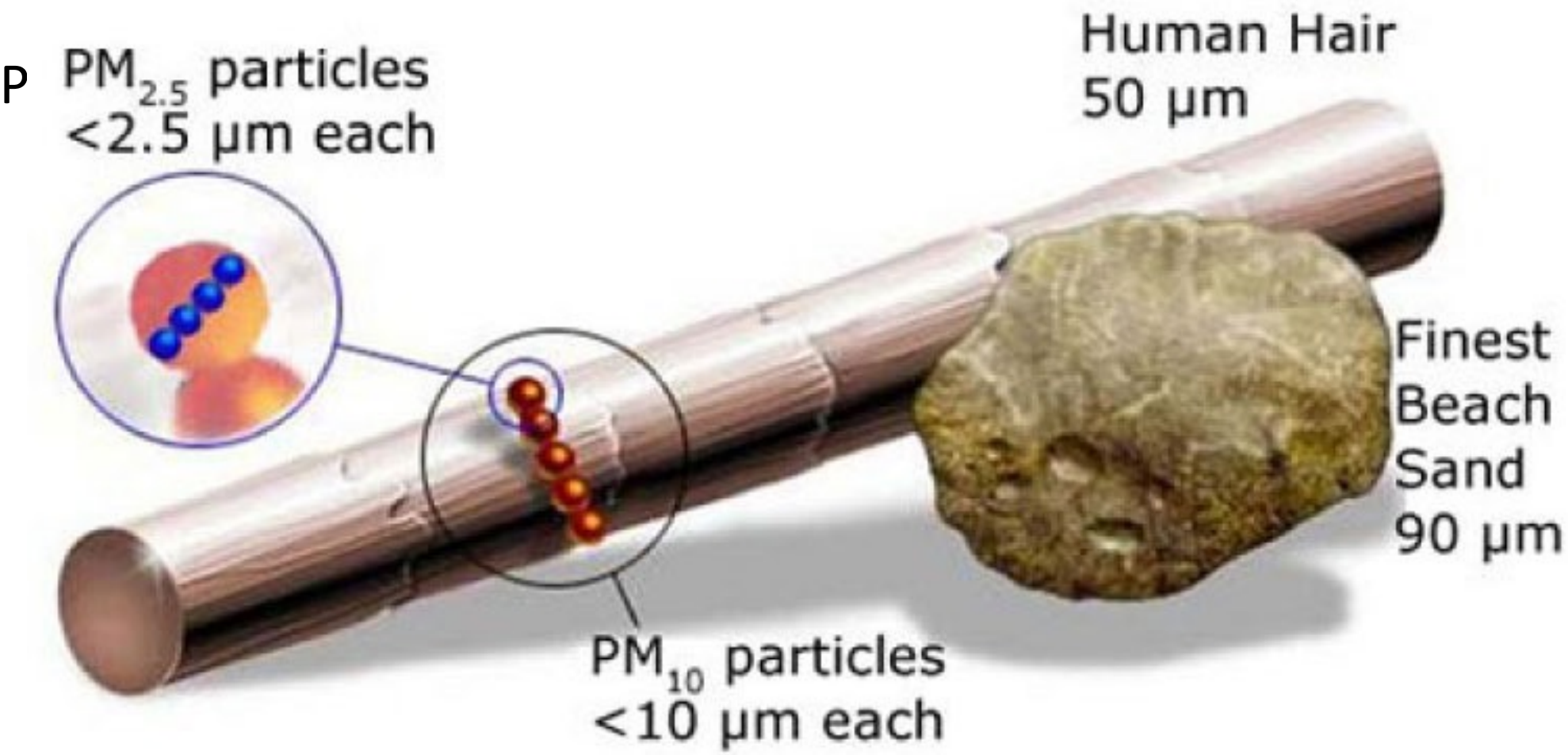
informacidade.com.b

Problemas ambientais urbanos

- Poluição do ar

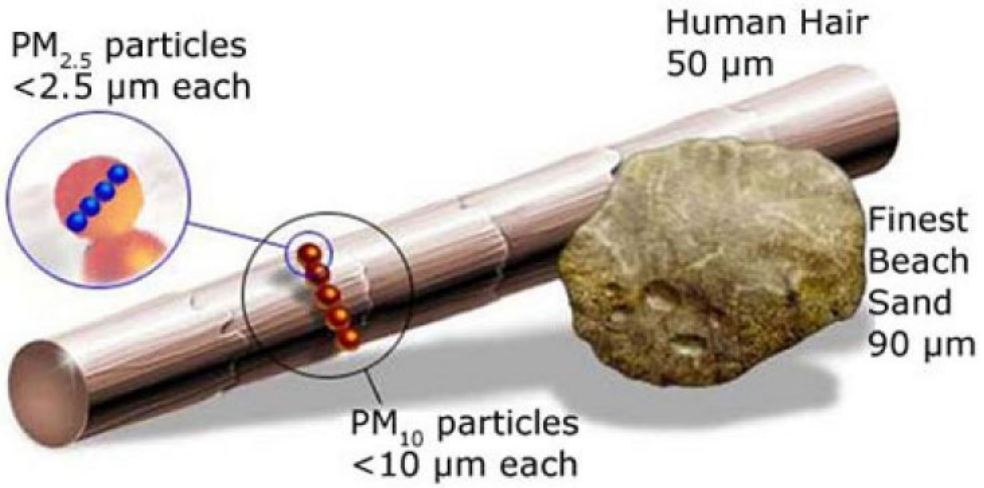
IHME 2020 State of Global Air

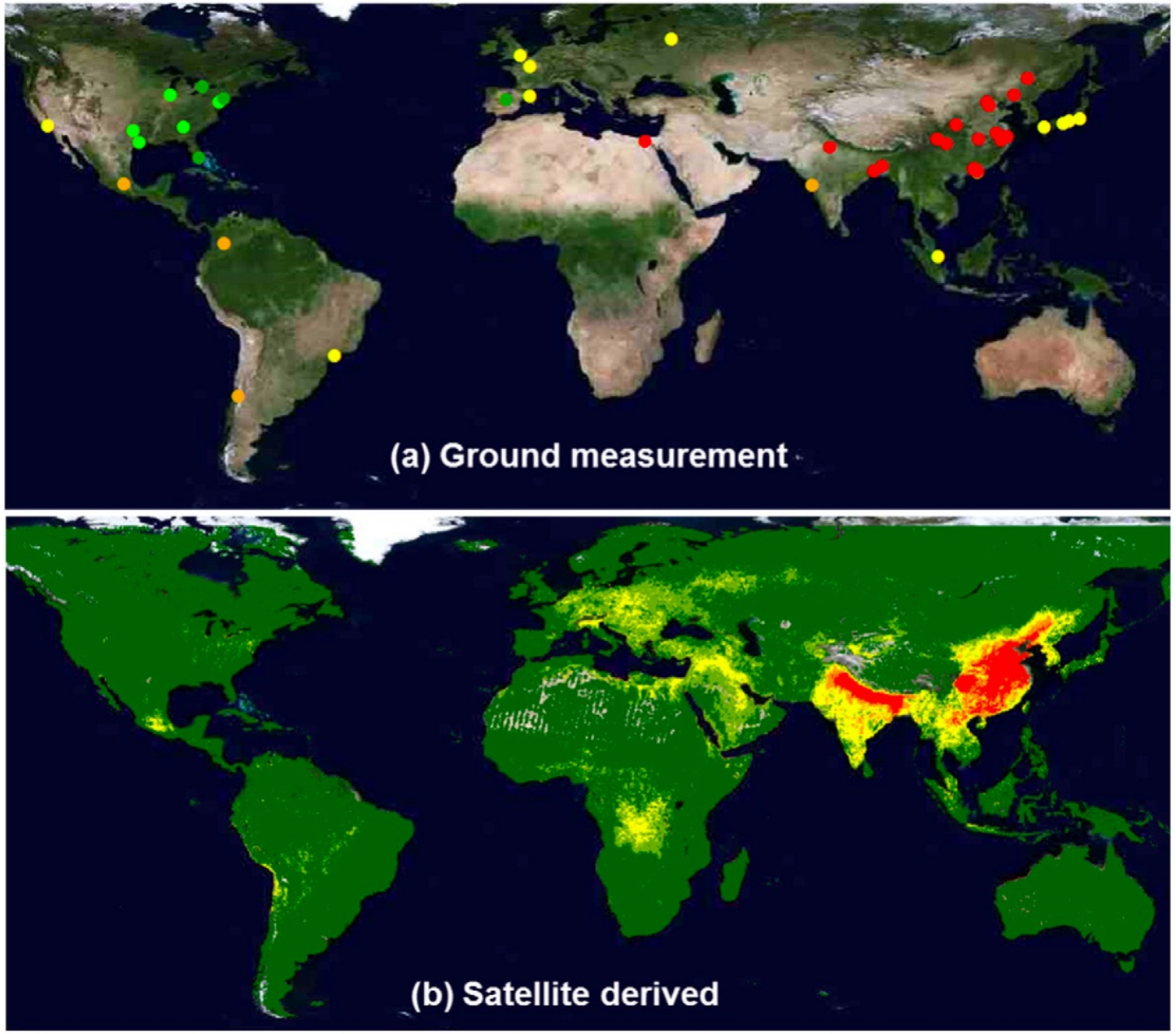
- P



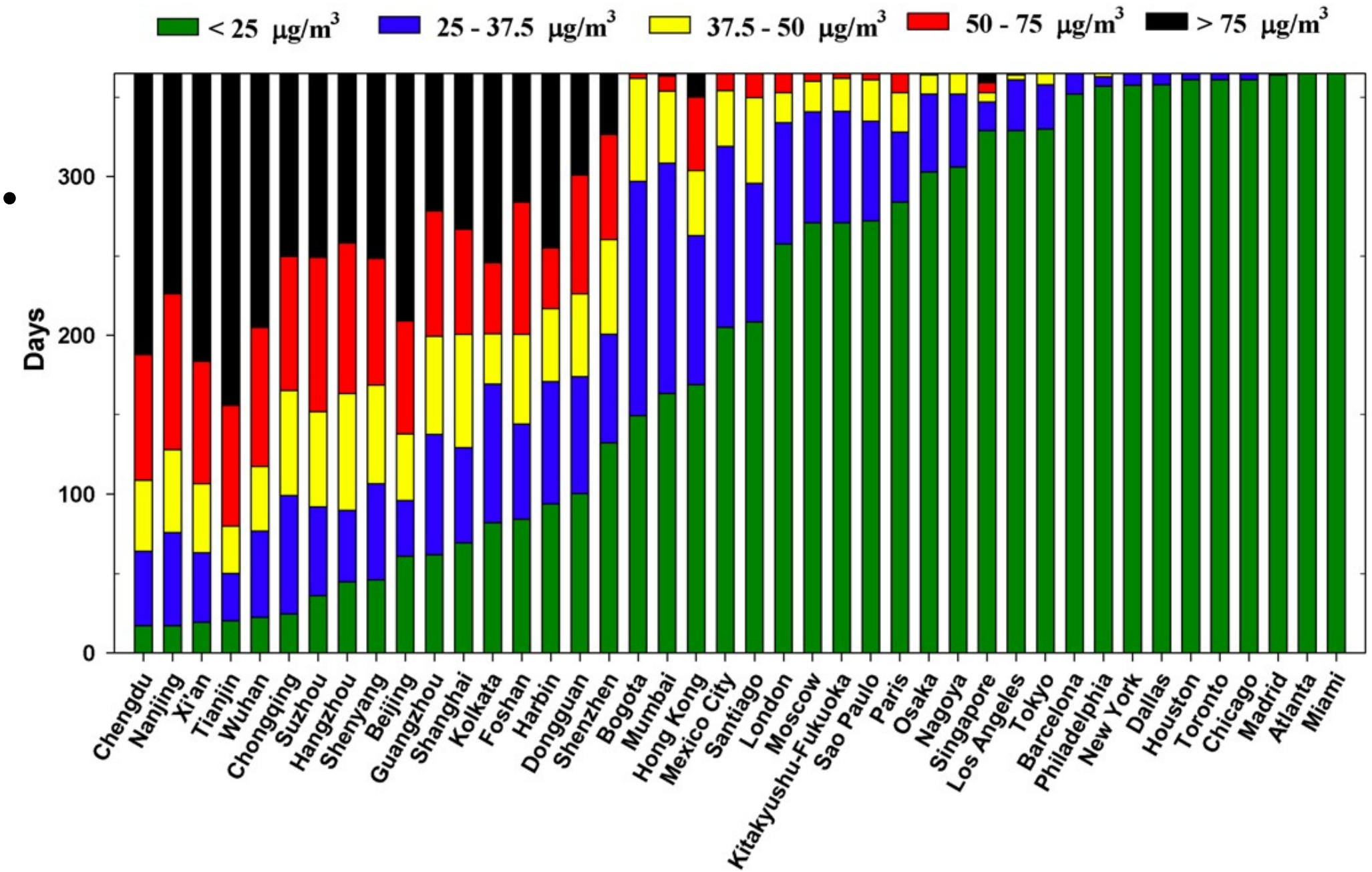
Cheng et al 2016 Environmental Internation

Poluente primário





Cheng et al 2016 Environmental Internation



Cheng et al 2016 Environmental Internation

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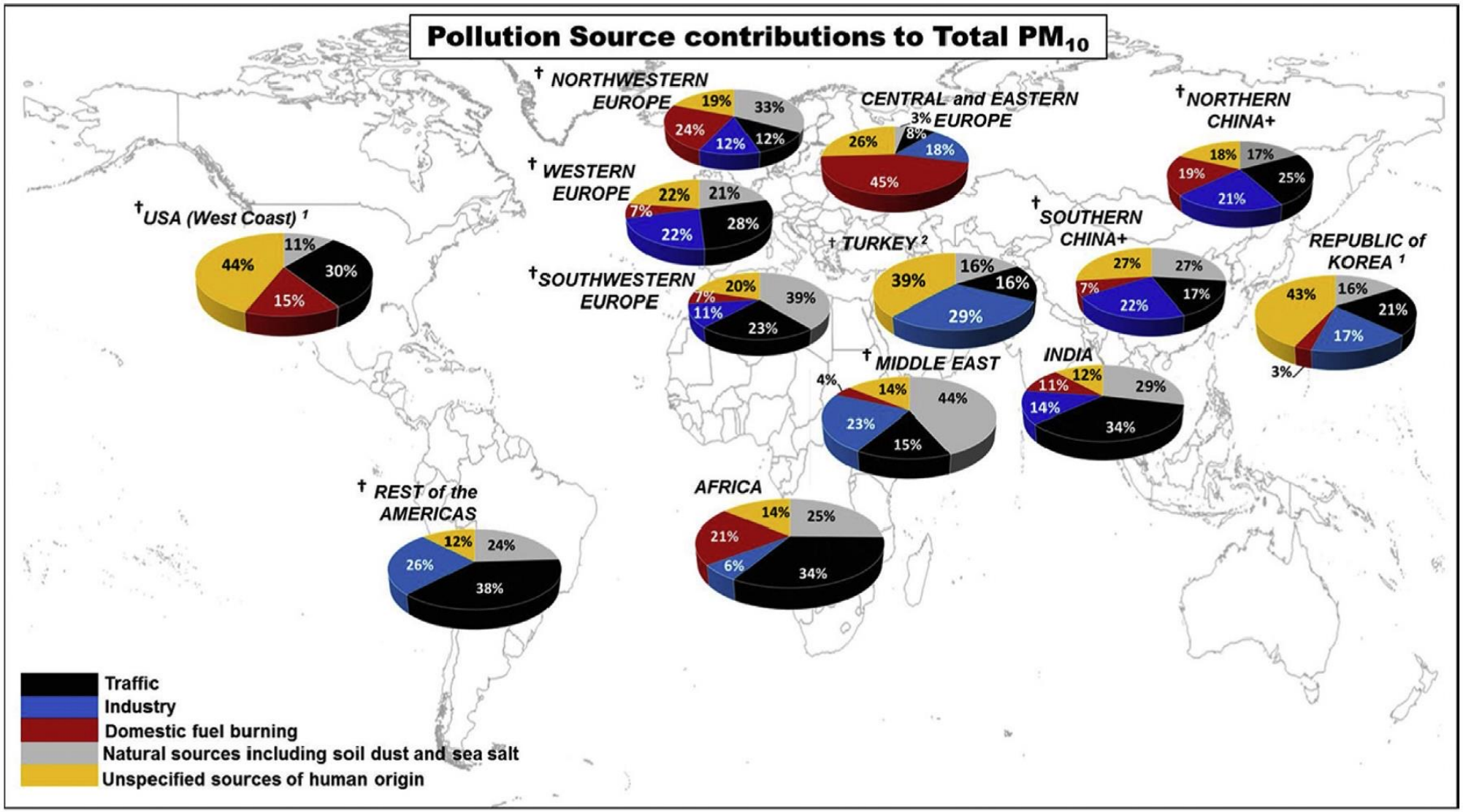

ec.europa.eu

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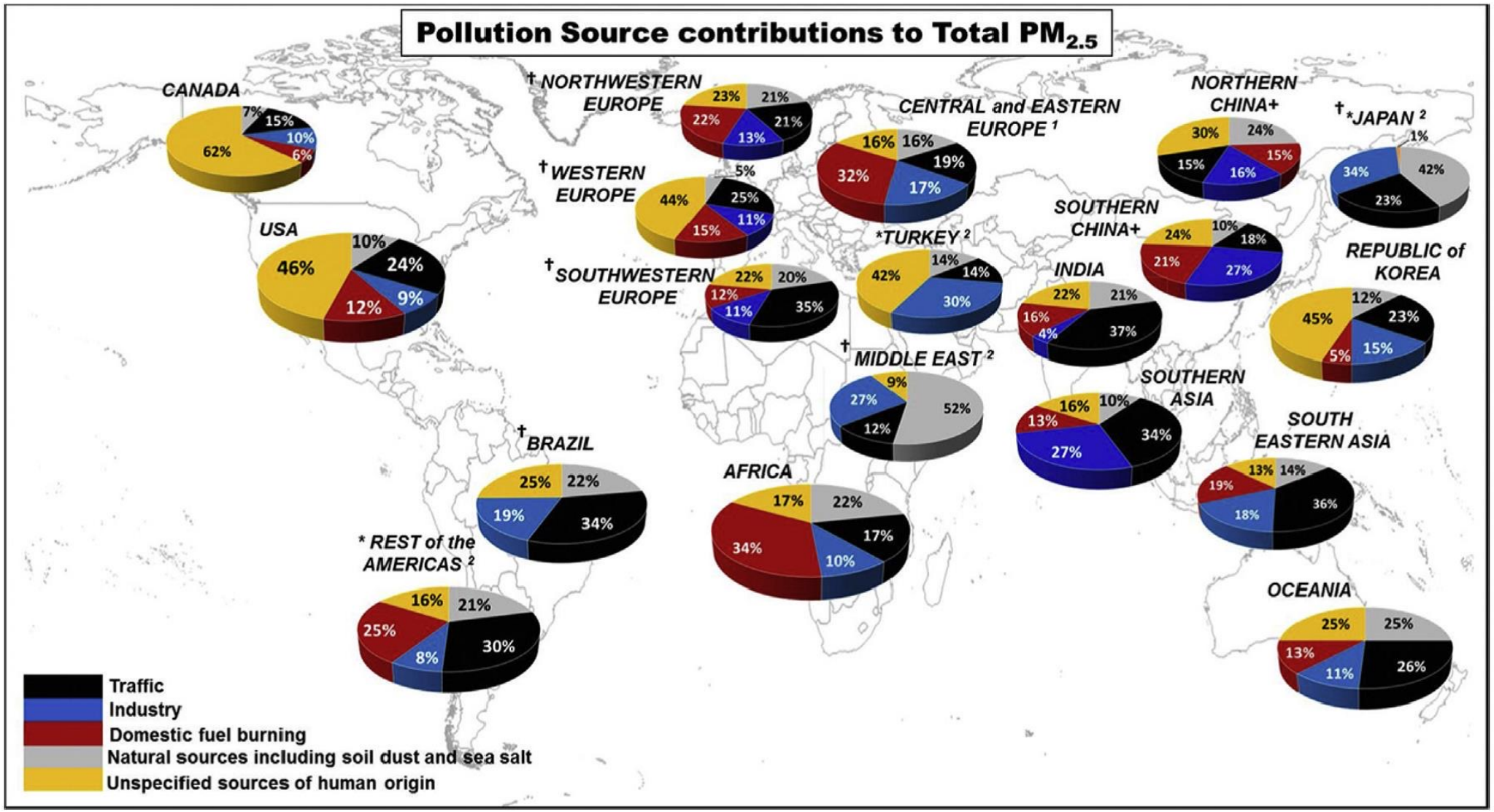

ec.europa.eu

COMPOSITION of PARTICULATE MATTER (PM)

PRIMARY AEROSOLS – METALS & ELEMENTS

K — POTASSIUM (biomass)

Na — SODIUM (sea salt)

Ca — Calcium (cement)

Al Se Co As — ALUMINIUM, SELENIUM, COBALT, ARSENIC (coal burning)

Fe Zn Cu Pb etc — IRON, ZINC, COPPER, LEAD, and OTHERS (ferrous and othr non-ferrous industries)

Al Si Ca — ALUMINIUM, SILICON, CALCIUM (soil and road dust)

V Ni Mn Fe — VANADIUM, NICKEL, MANGANESE, IRON (oil burning)

EC OC — ELE. & ORG. CARBON (biomass, diesel, petrol)

K Zn Pb — POTASSIUM, ZINC, LEAD (refuse incineration)

SECONDARY AEROSOLS – GAS to AEROSOL CHEMICAL CONVERSIONS

SO_4

SULFATES
origin - SO_2 emissions
(diesel and coal combustion)

NO_3

NITRATES
origin - NO_x emissions
(high temperature combustion (eg. vehicles, heavy industry)

NH_4

AMMONIUM
origin – NH_3 emissions
(fertilizer usage and animal husbandry)

SOA

ORGANIC AEROSOL
origin – VOC emissions
(biomass, diesel, petrol, & gas combustion)

Despite overlaps, these are some key marker metals, elements, and compounds associated with major sources.
Ratio of these markers and other species vary significantly between sources.
Chemical composition of PM is complex and changes with time and place.
Statistical apportionment between source & sample profiles can provide new information on emission sources and some quantitative estimate.

UE info

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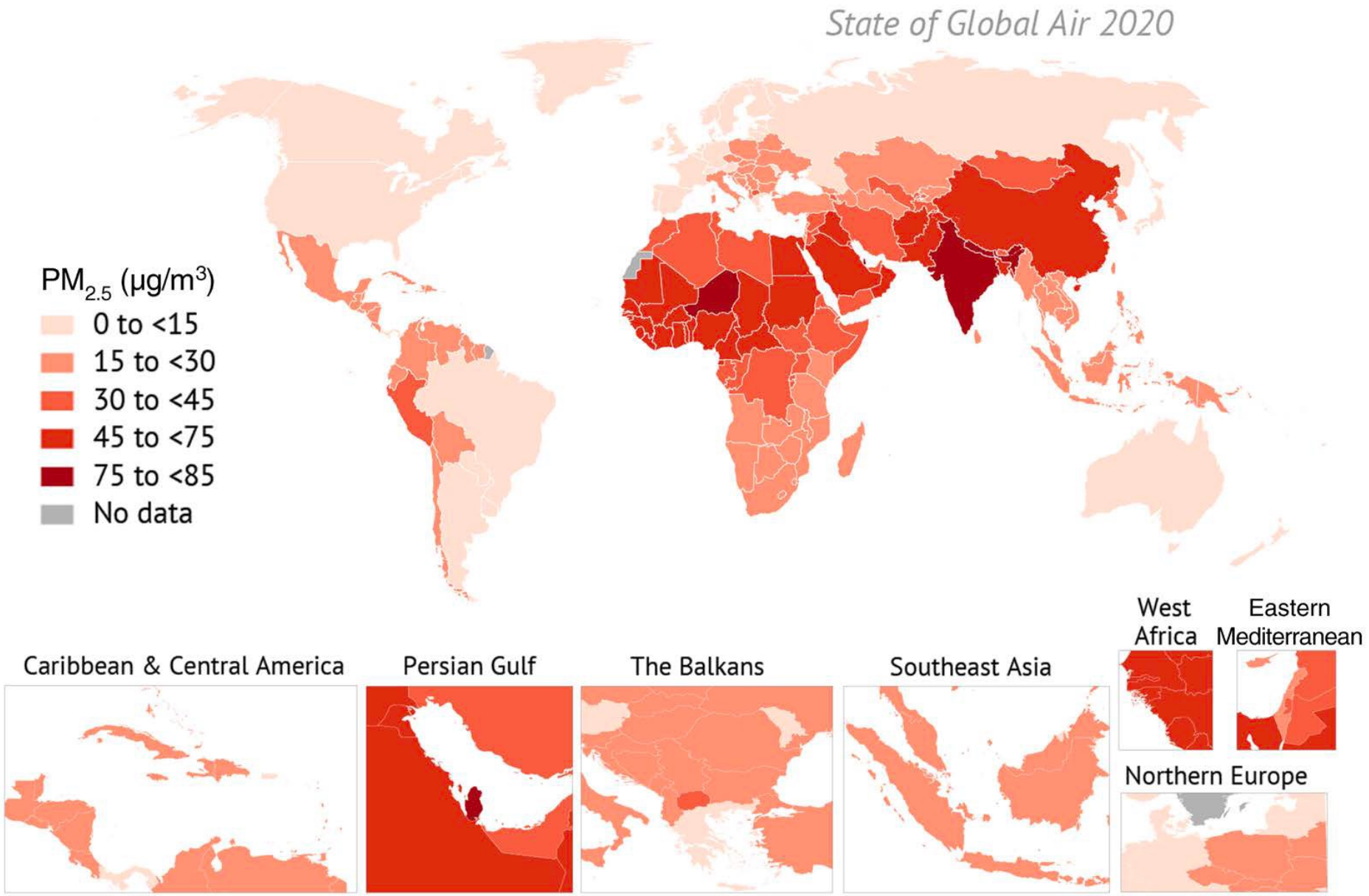
- Poluição do ar



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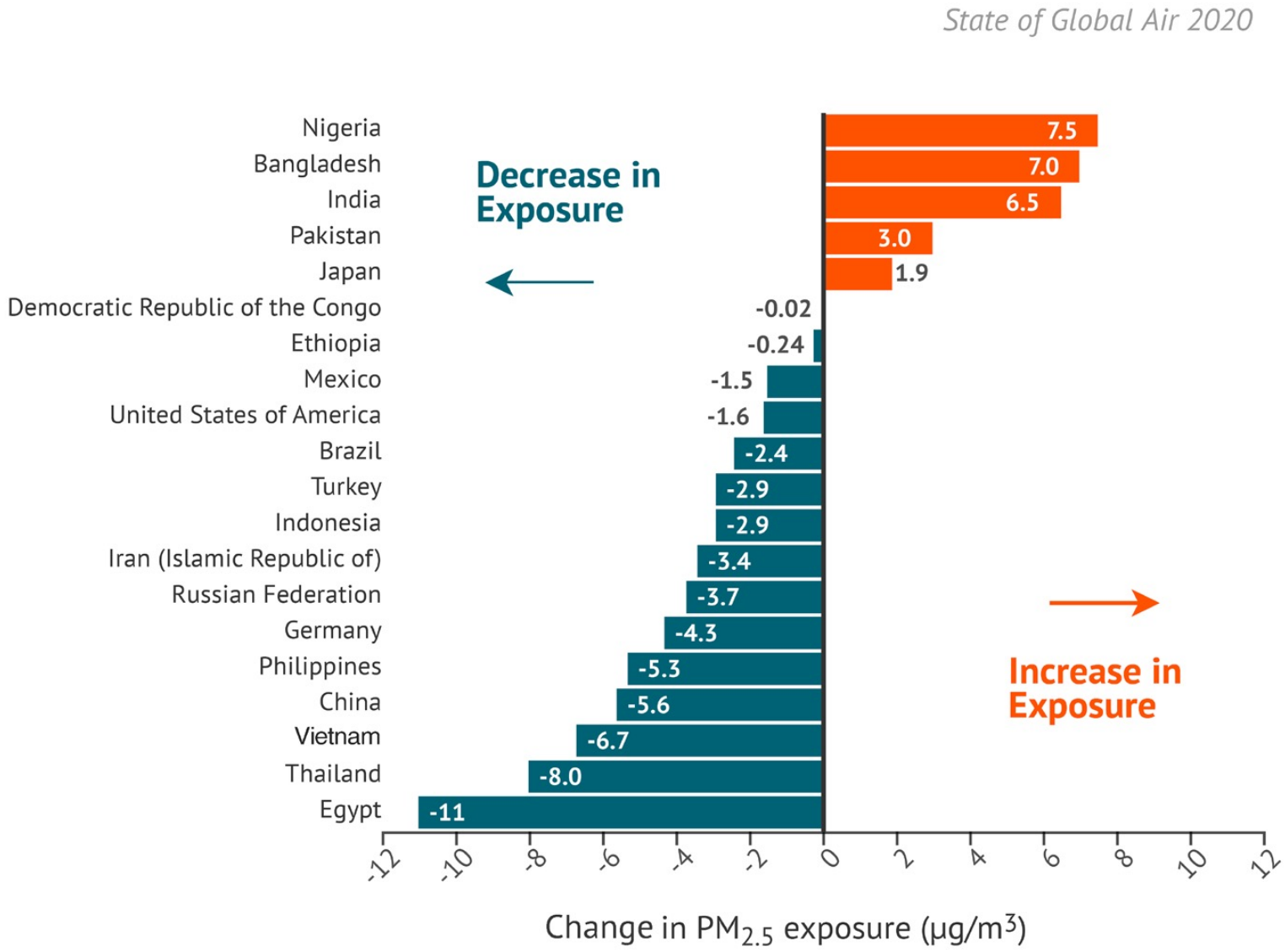
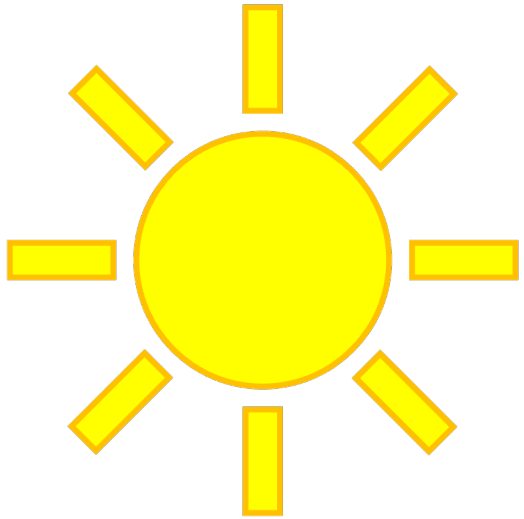


- Poluição do ar

Poluente secundário

- Poluição do ar

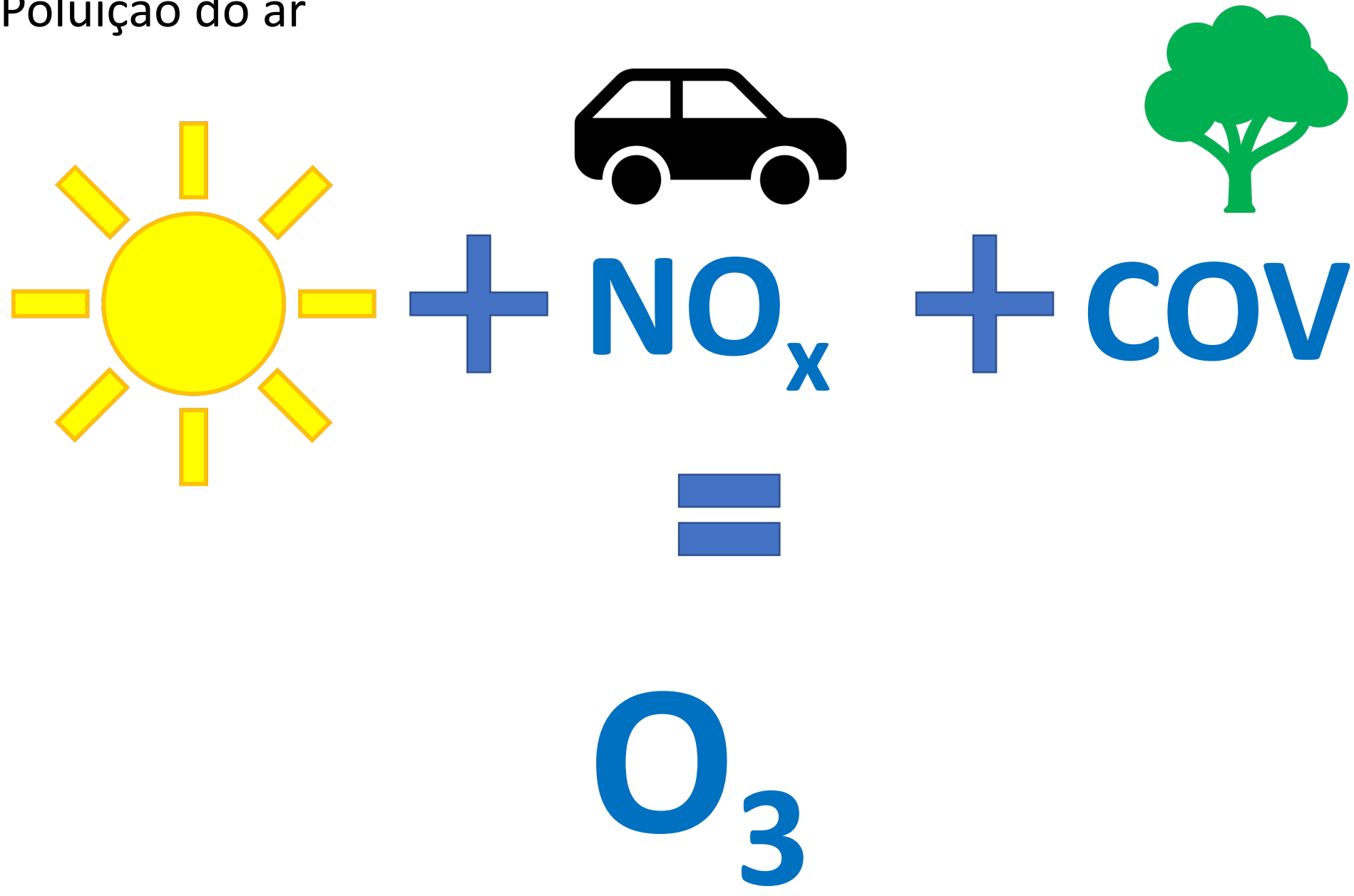


$+ NO_x + COV$

$=$

O_3

- Poluição do ar



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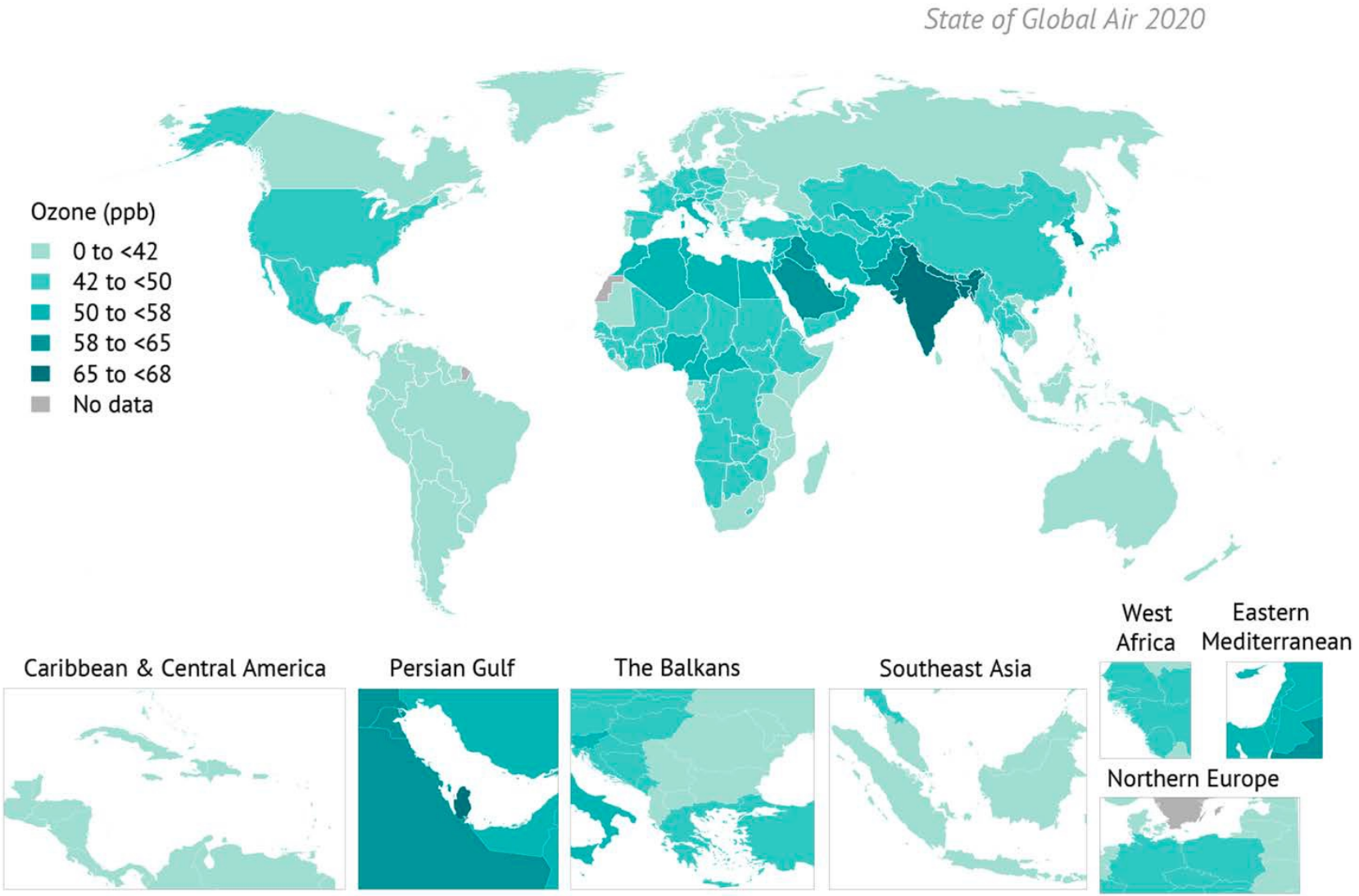

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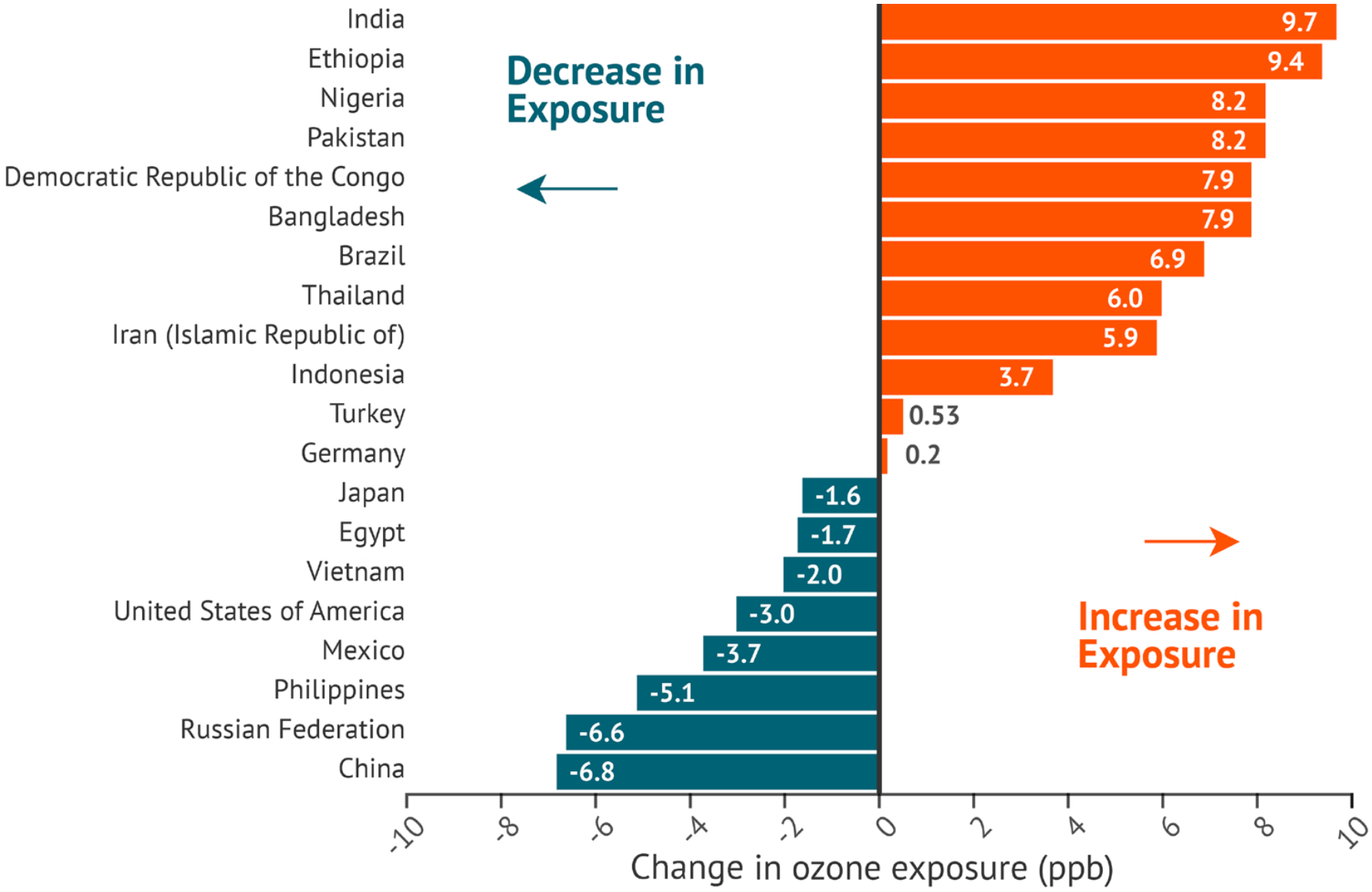

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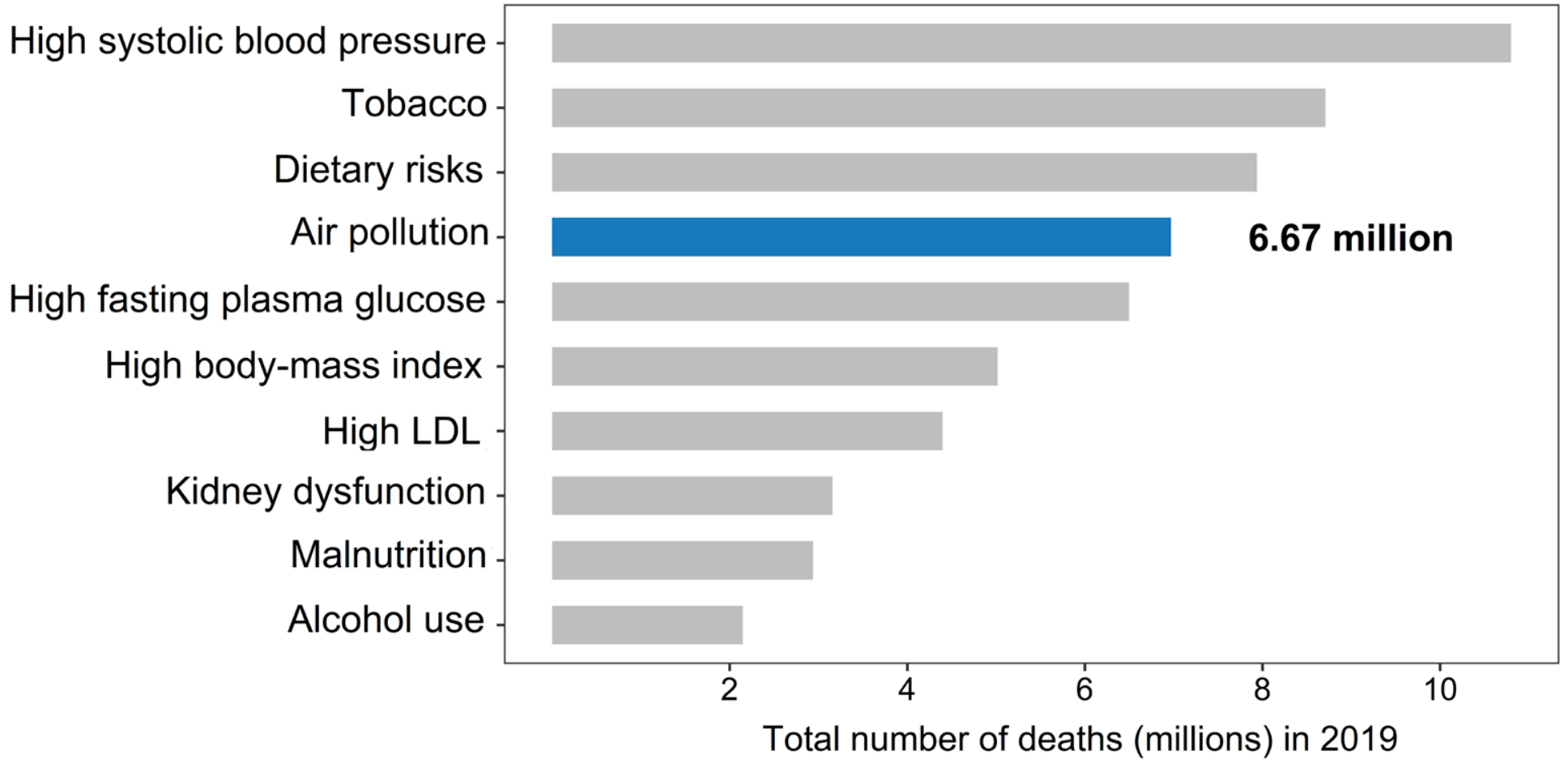

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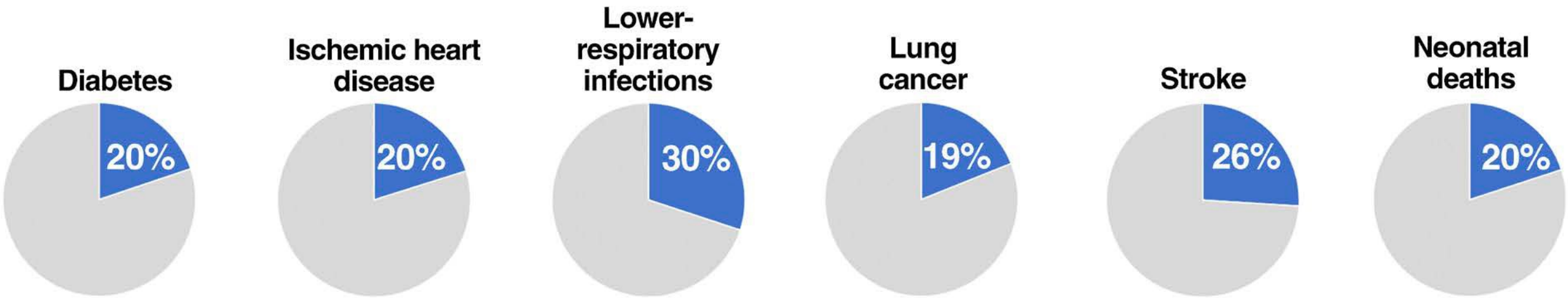

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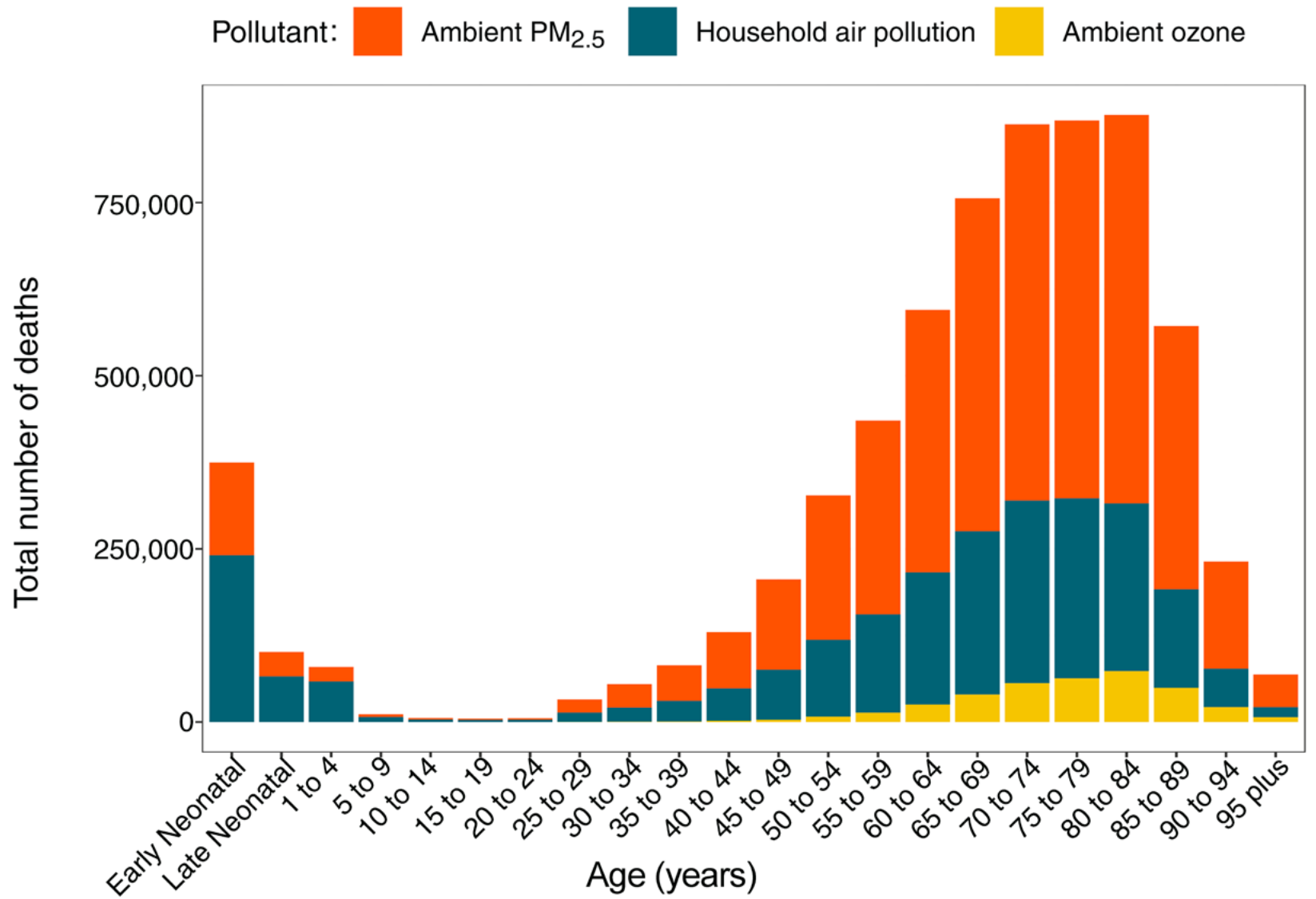

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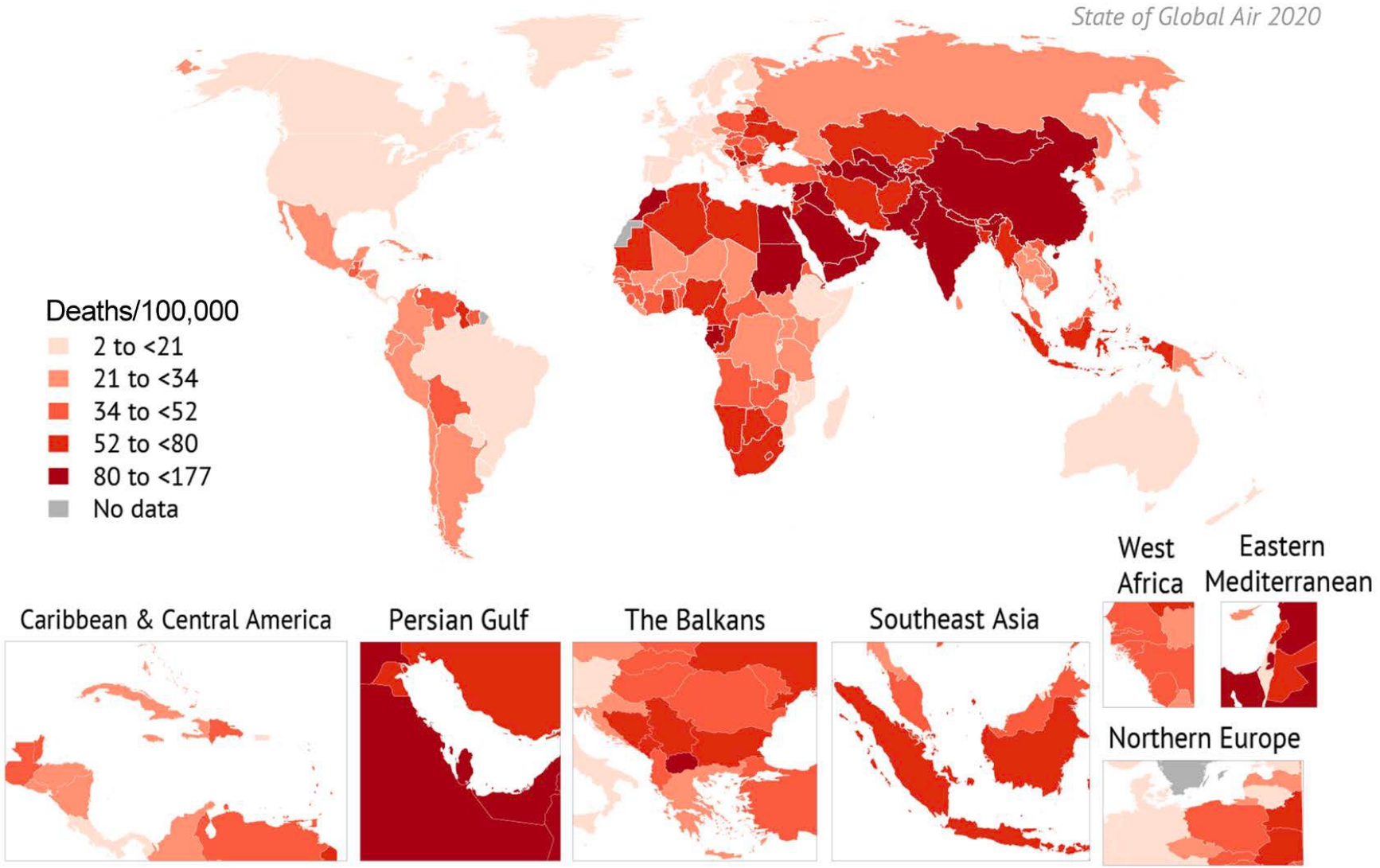

IHME 2020 State of Global Air

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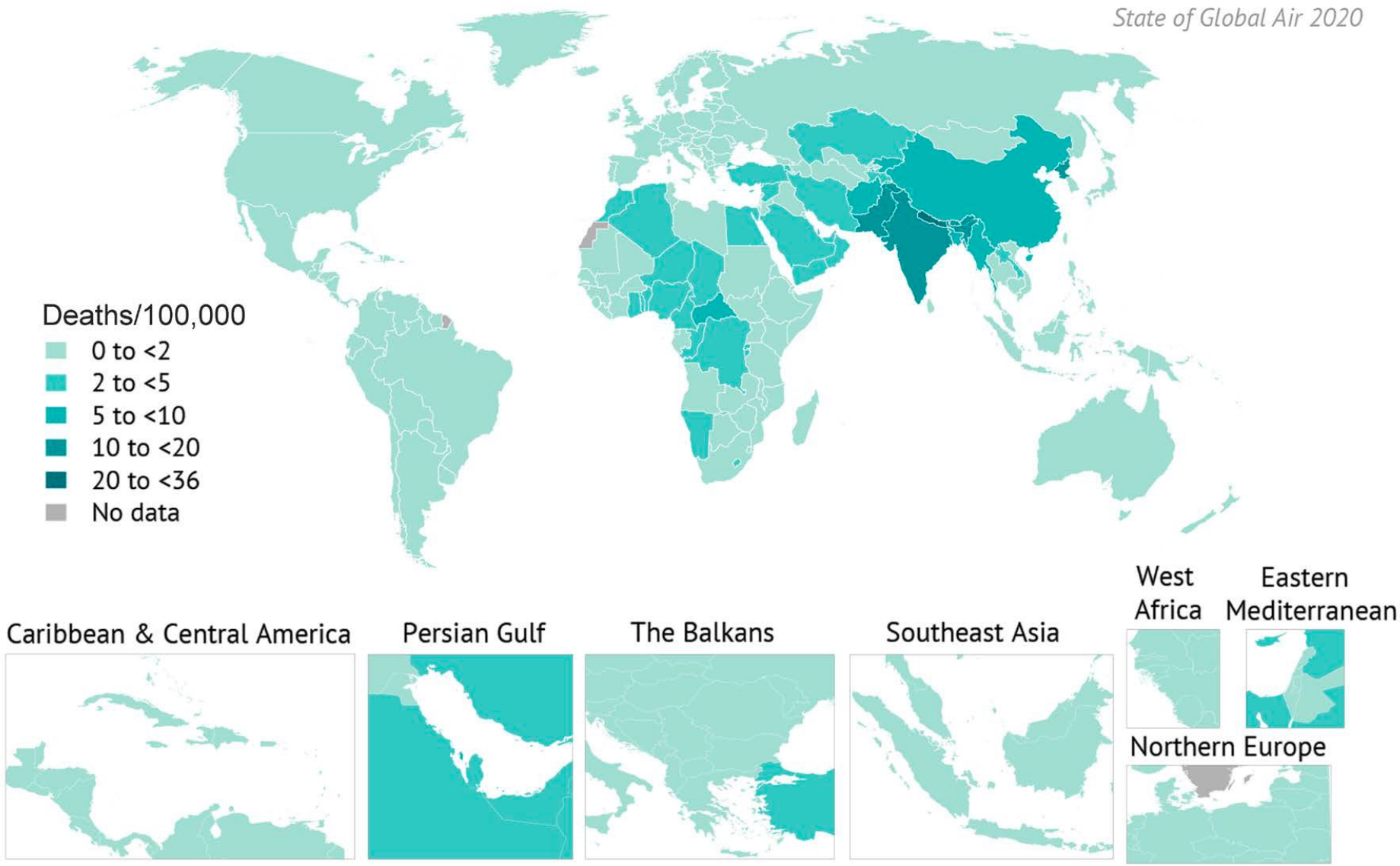

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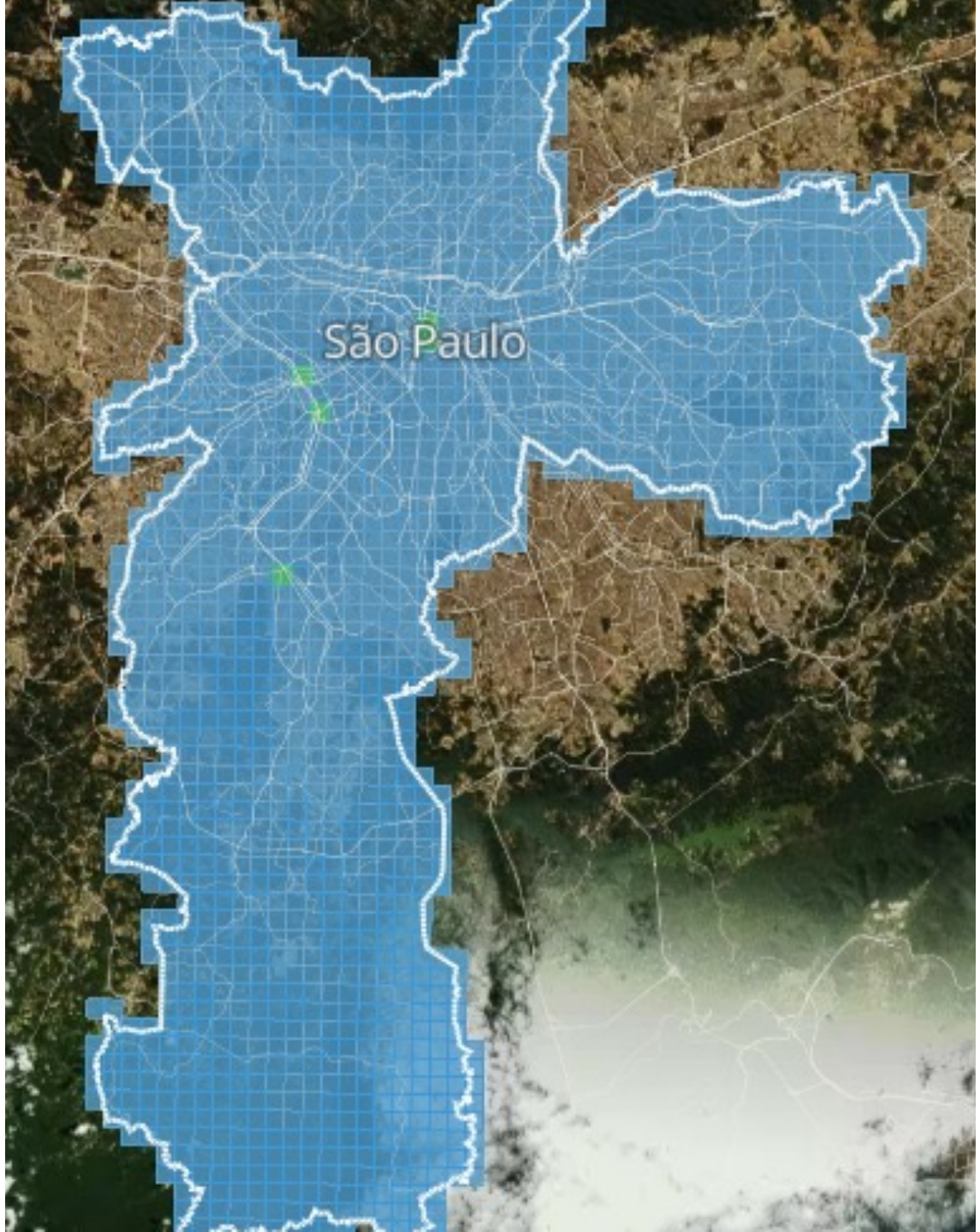

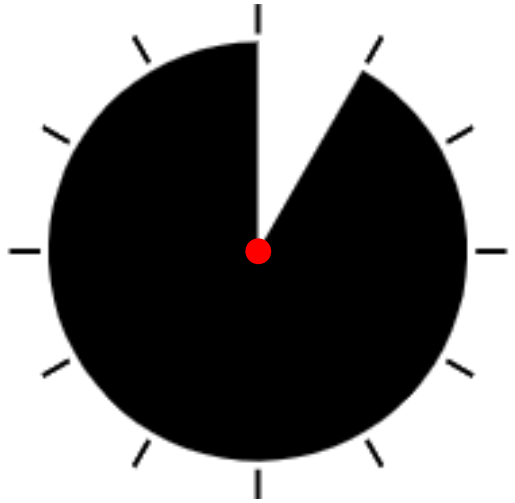

Particulate matter total ($kg/h.km^2$)

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- 0,419 a 0,727
- 0,728 a 1,364

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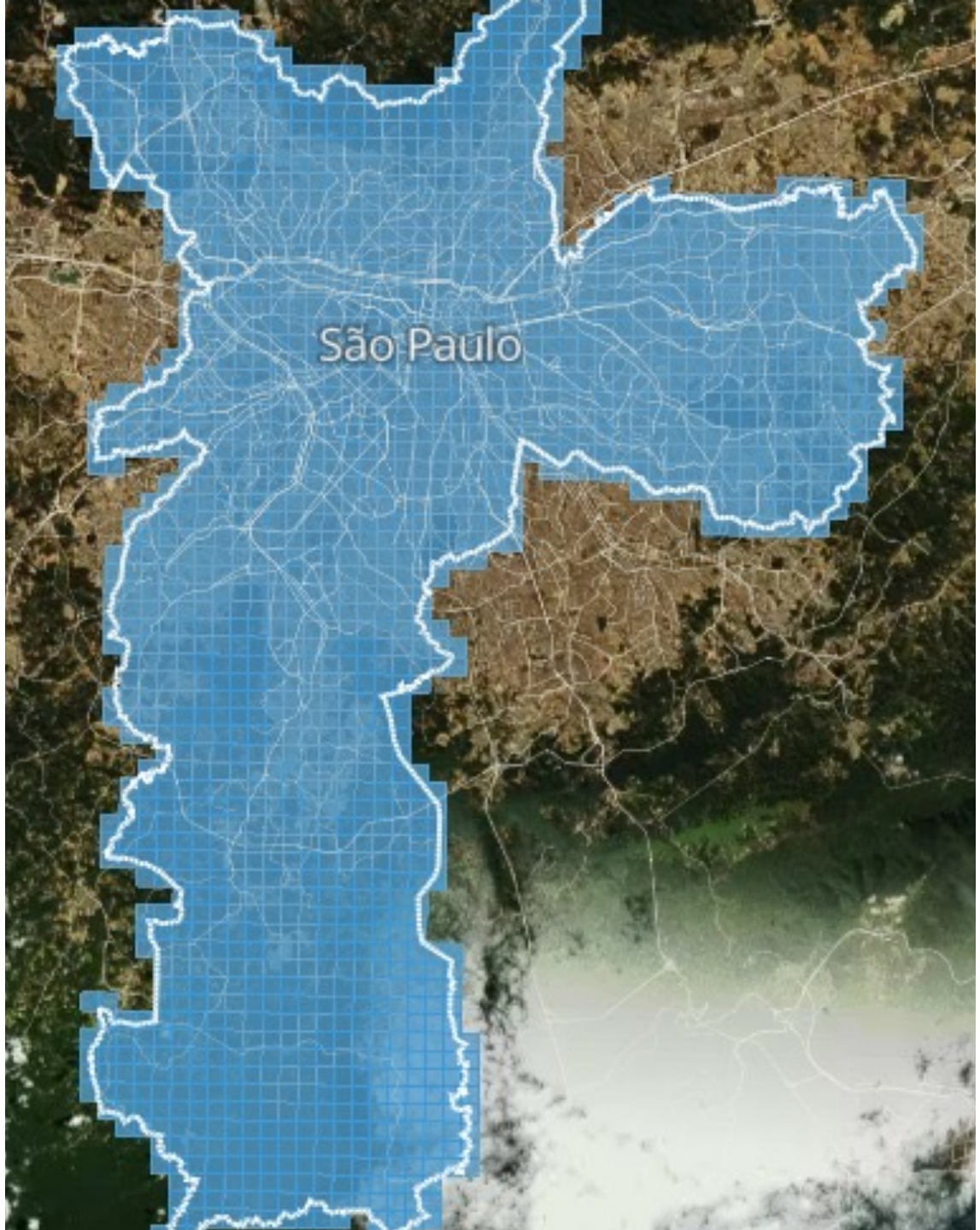

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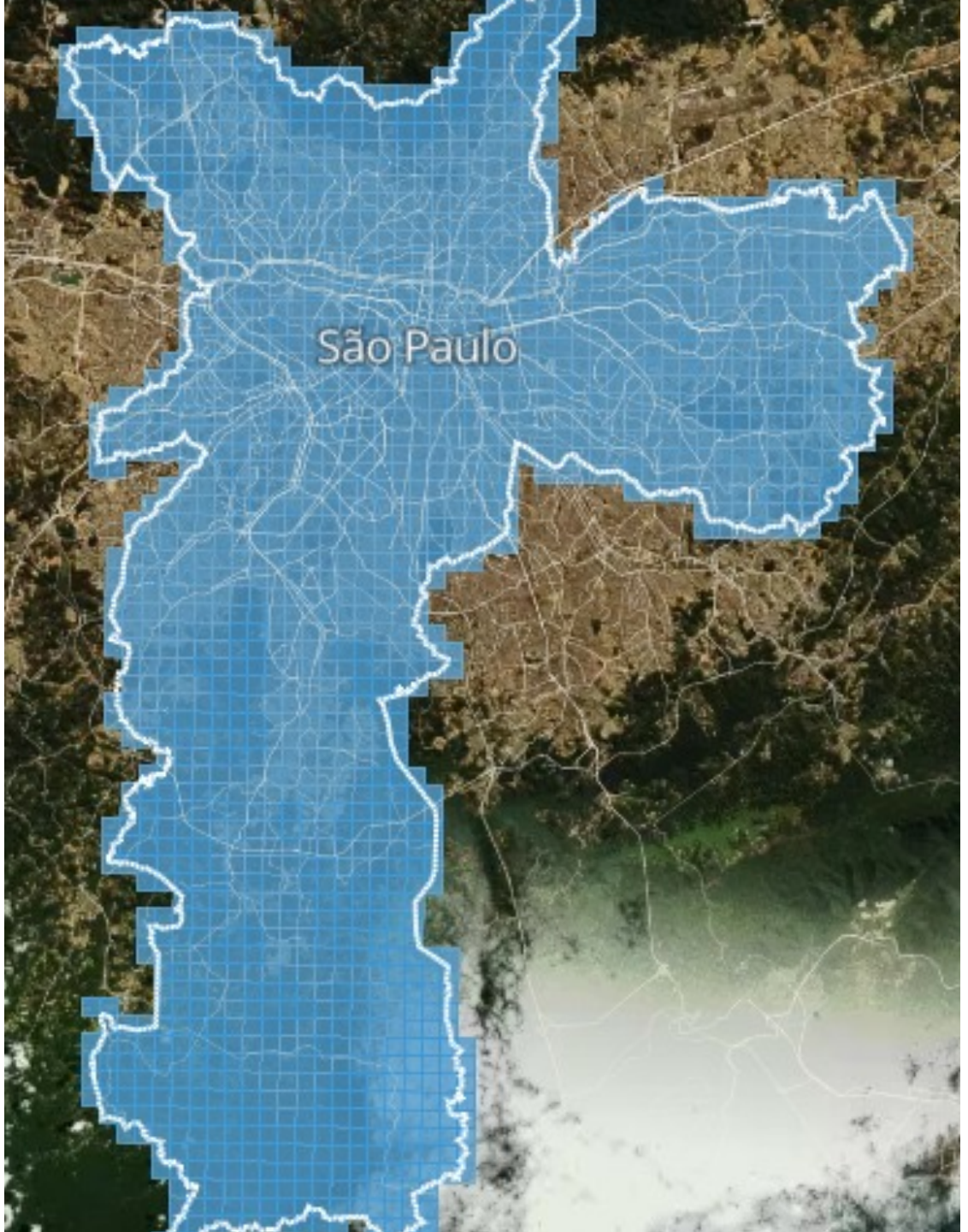

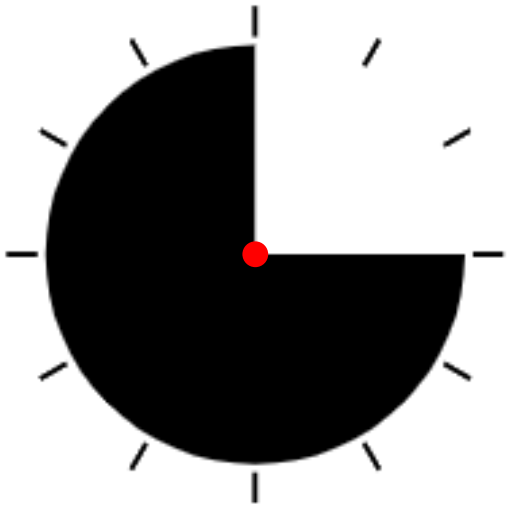

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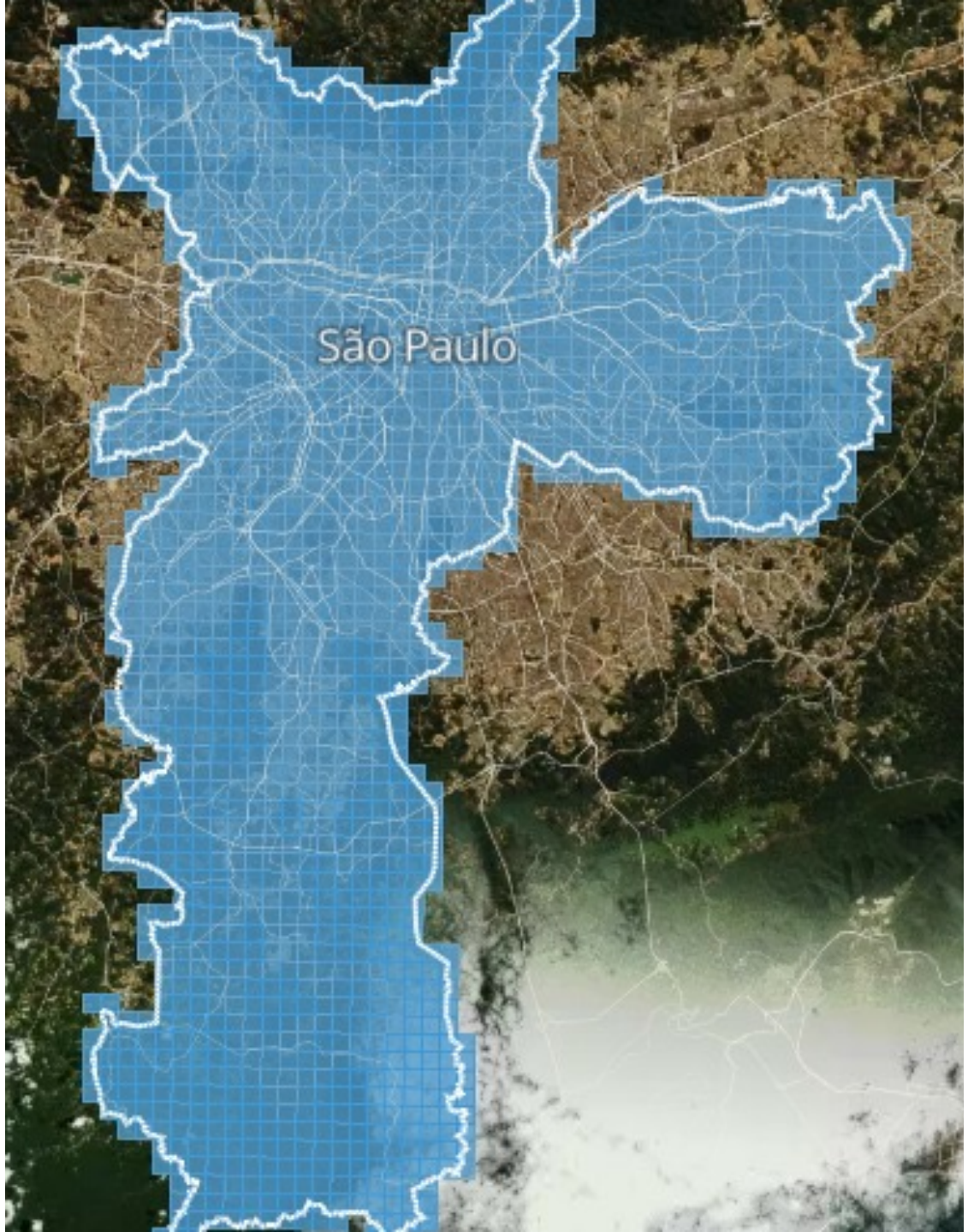

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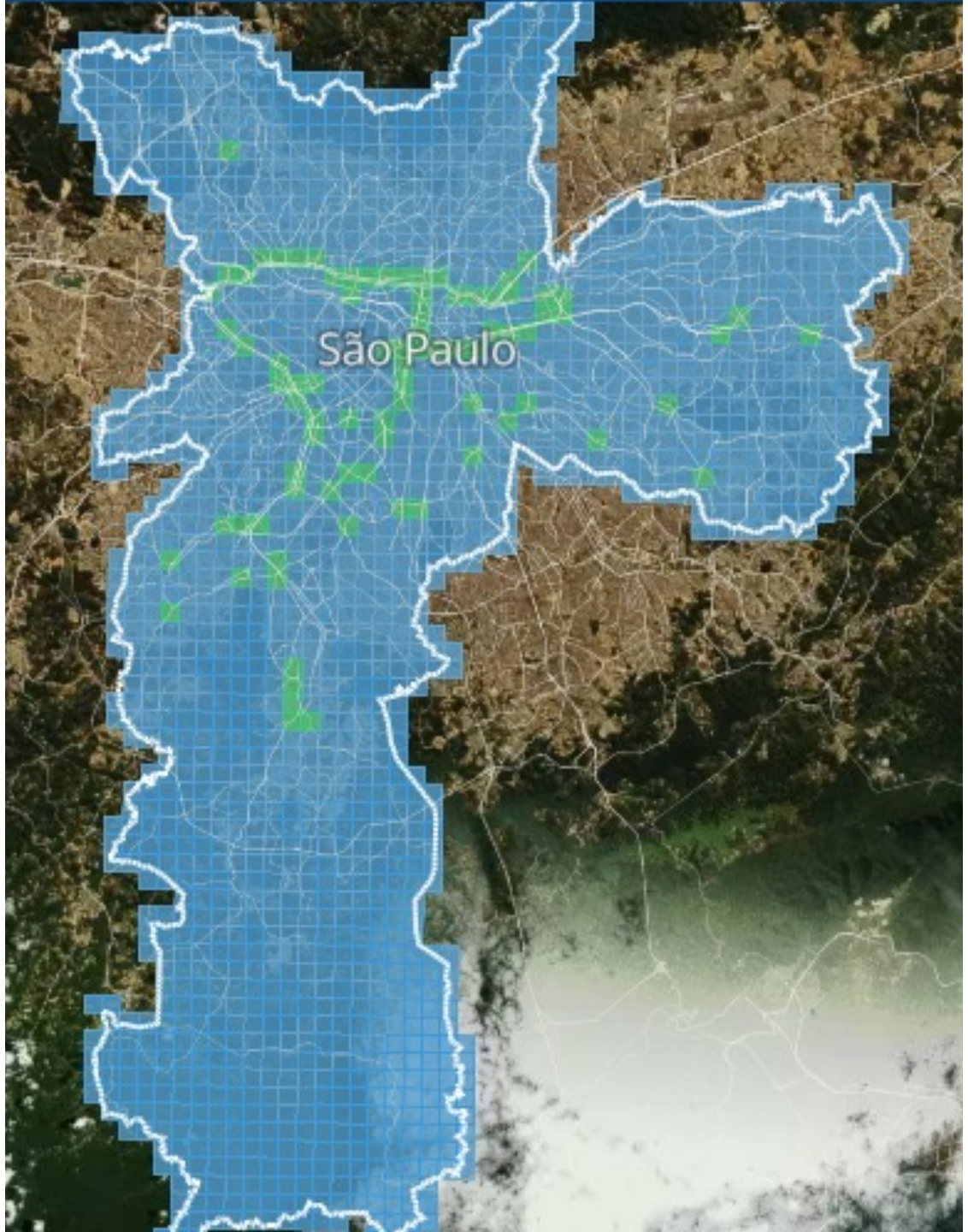

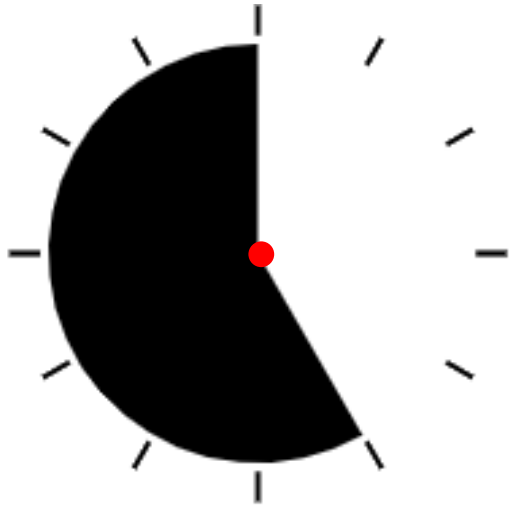

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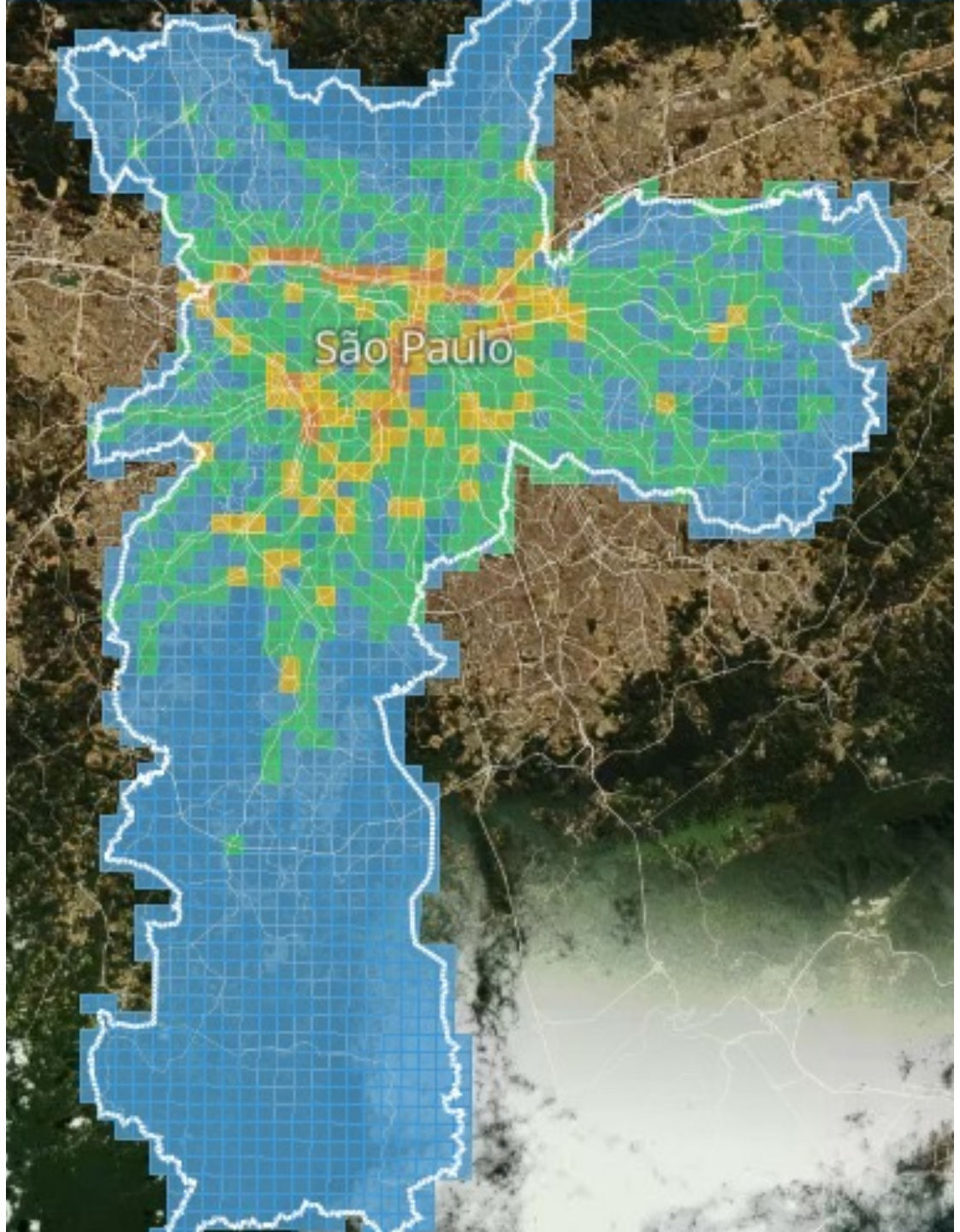

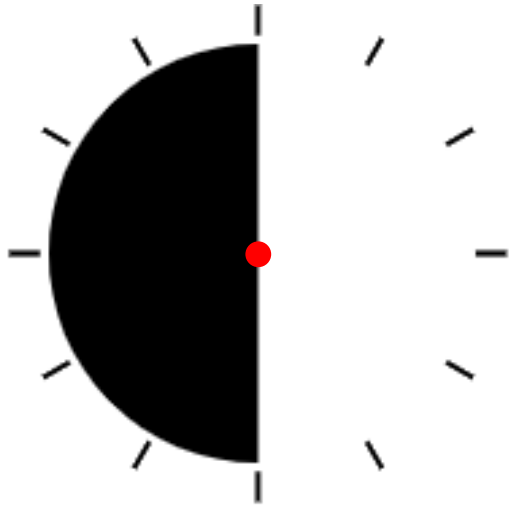

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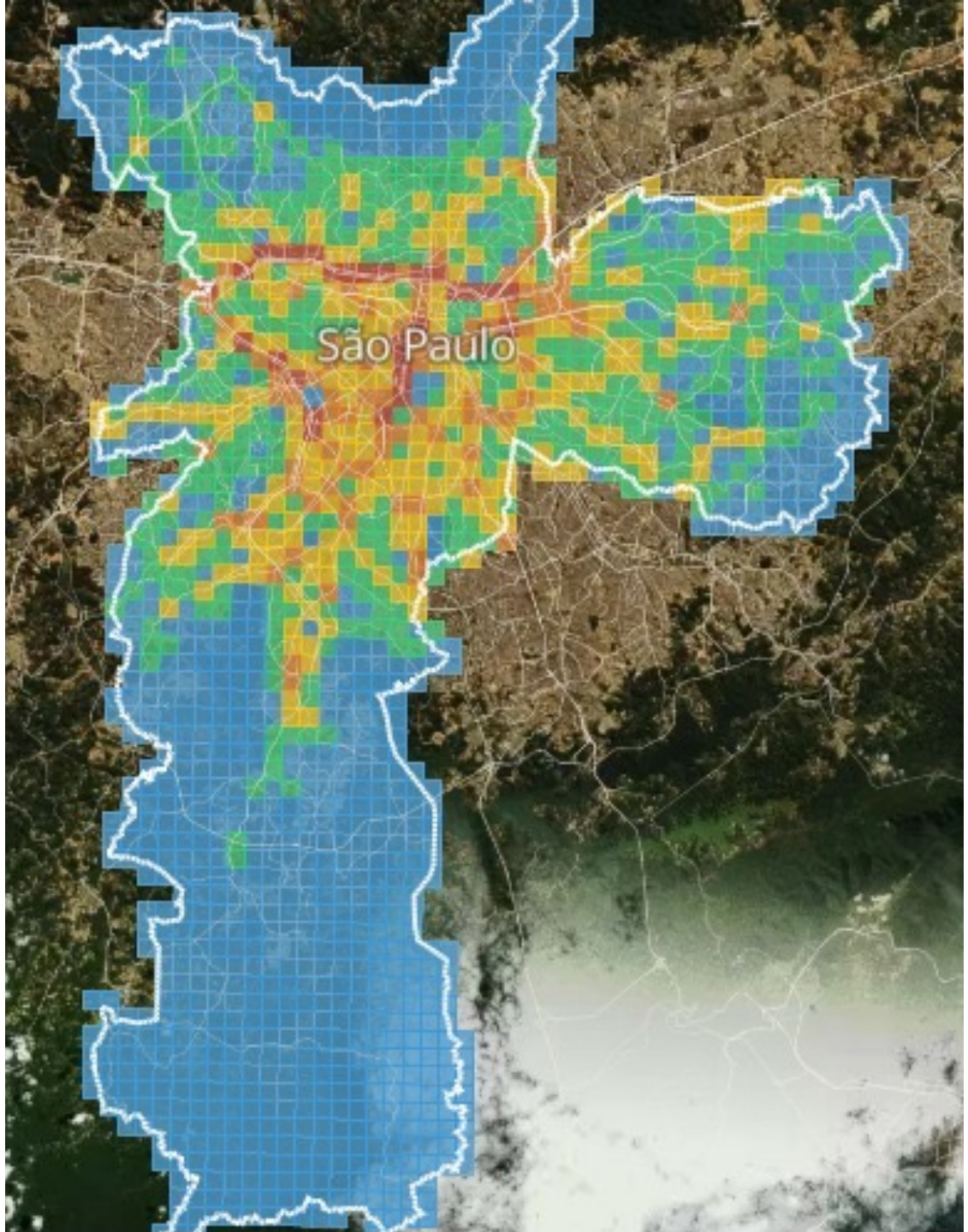

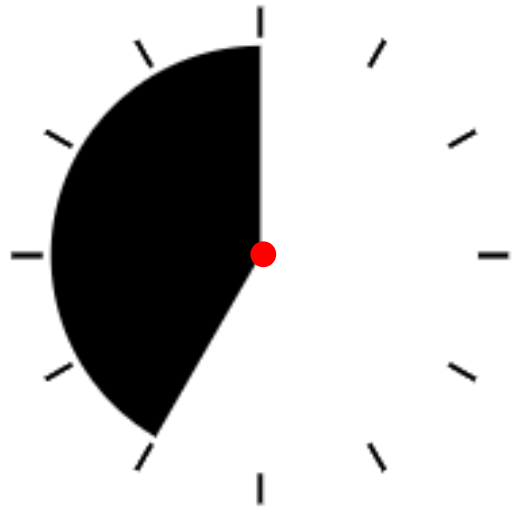

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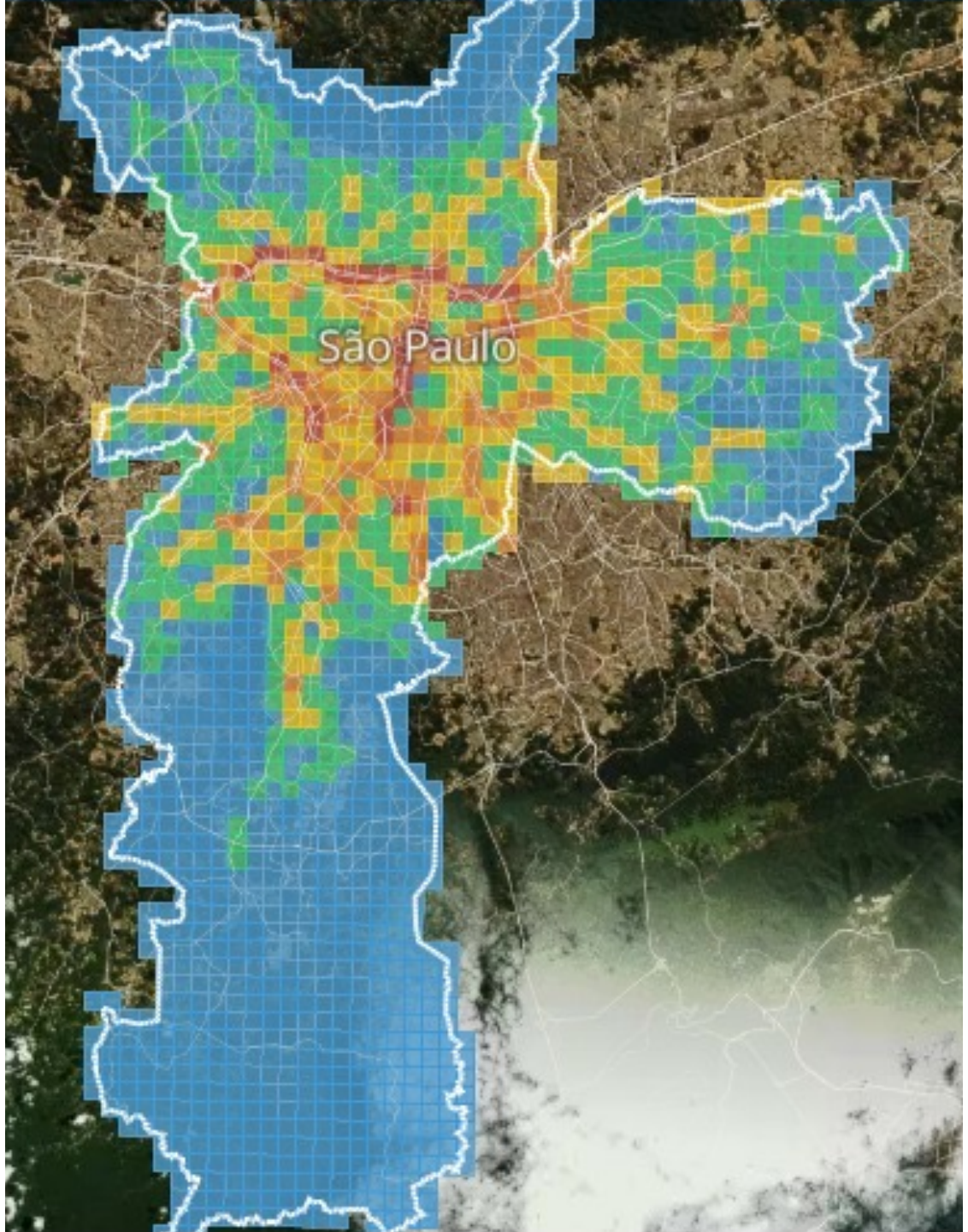

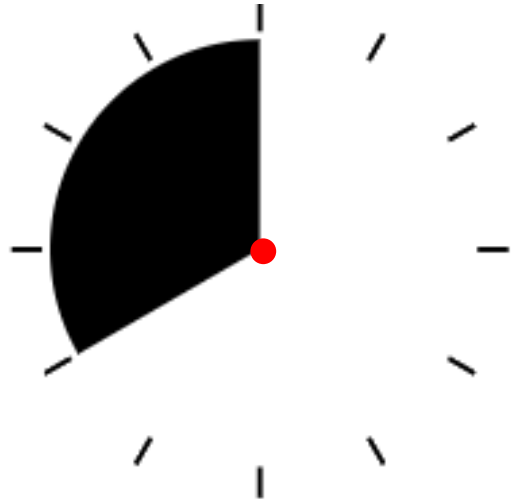

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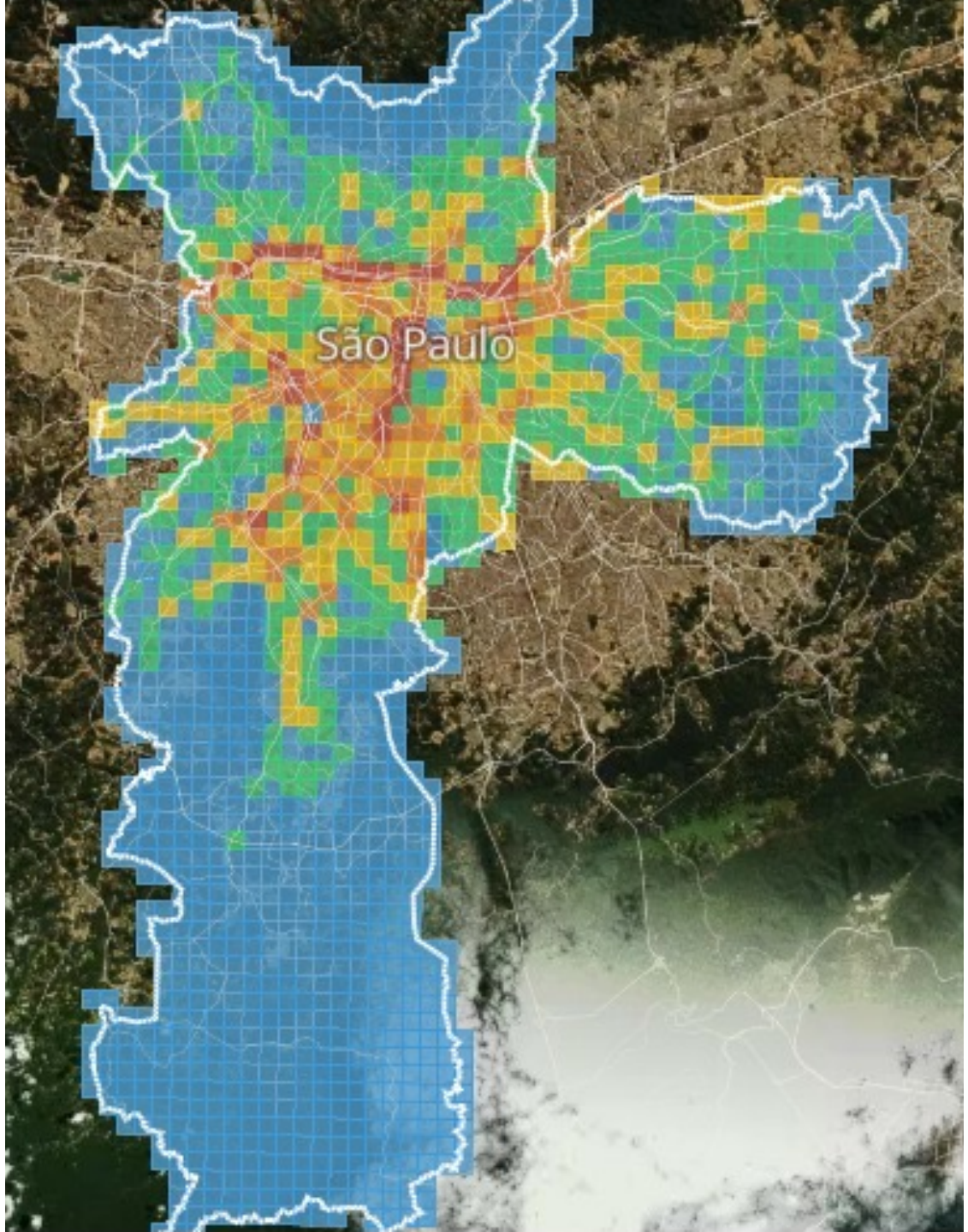

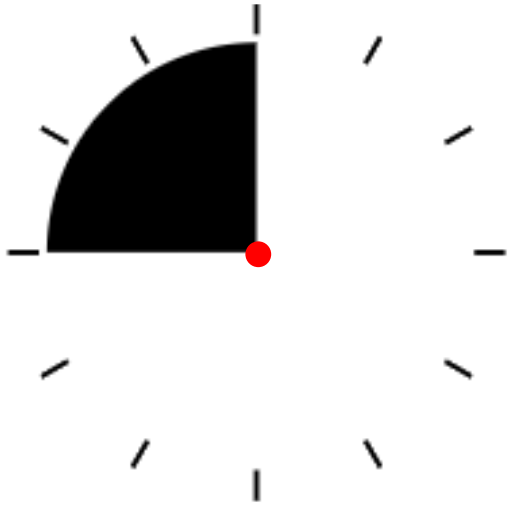

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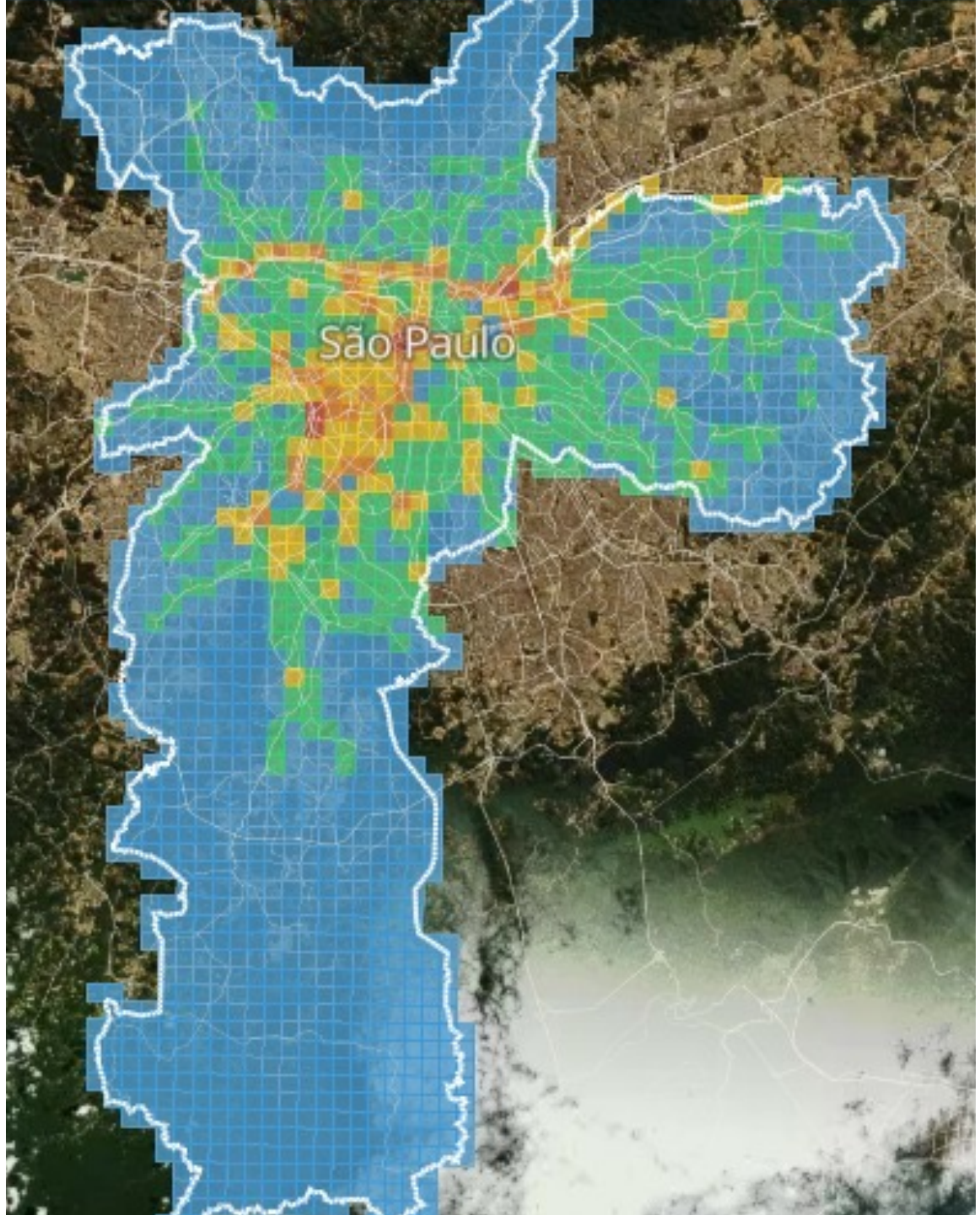

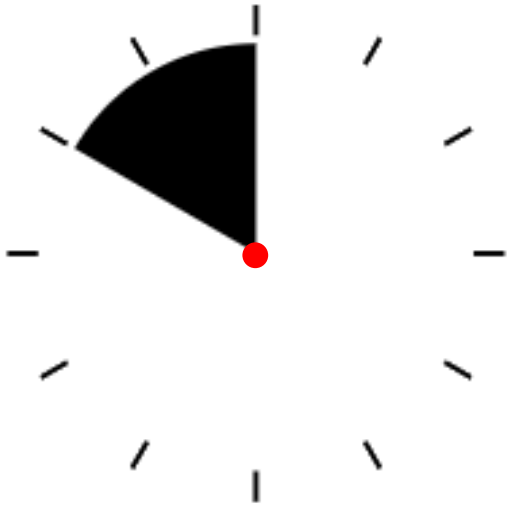

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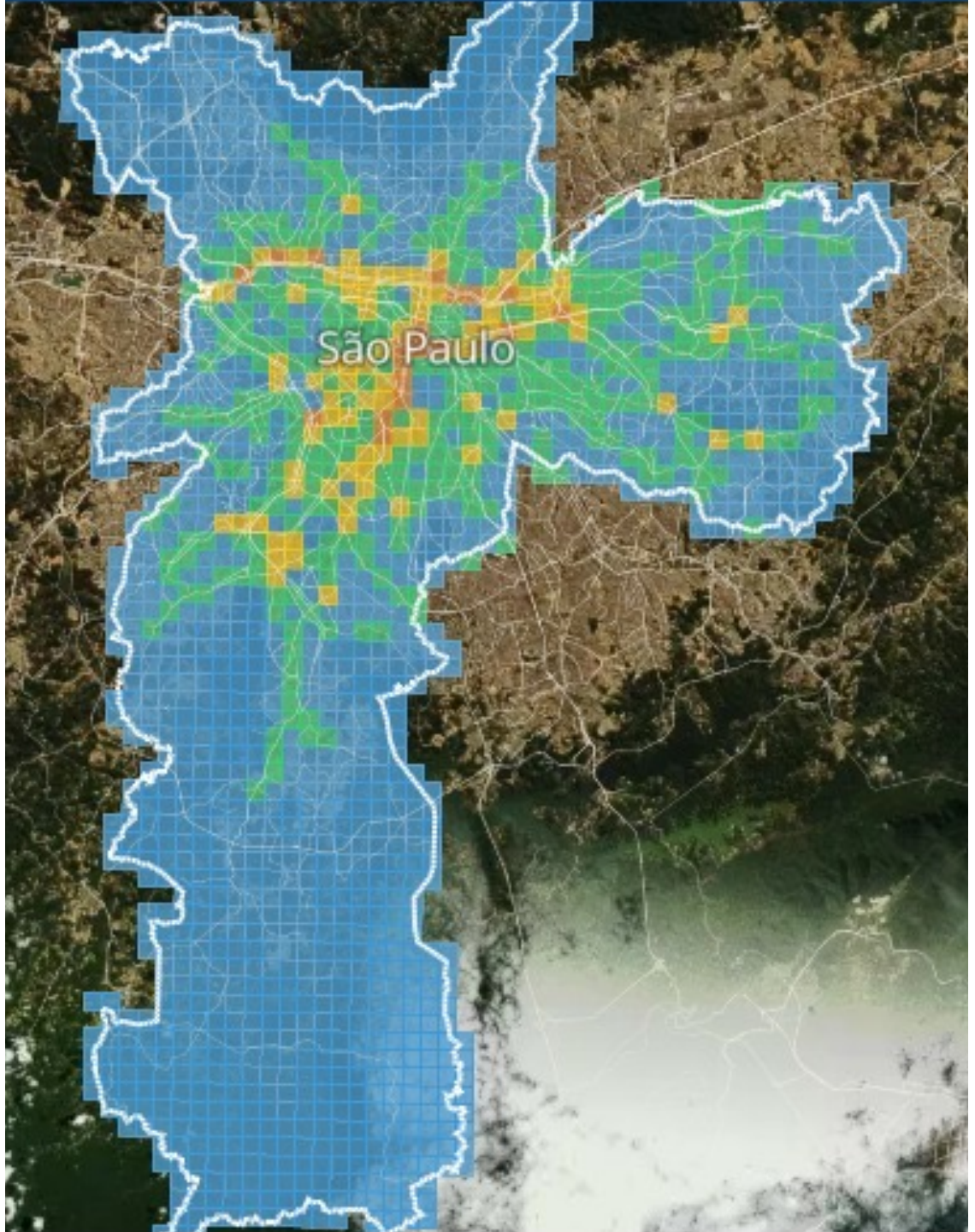

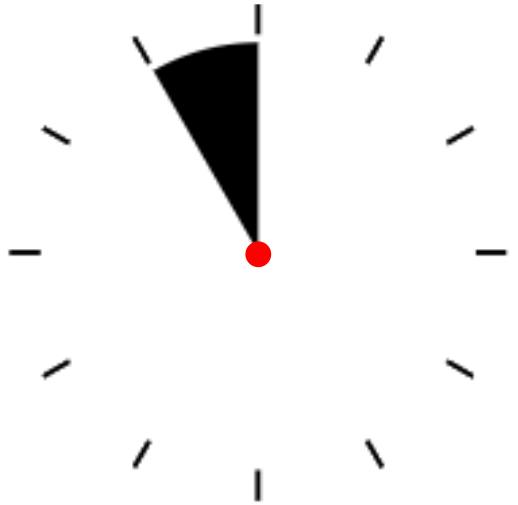

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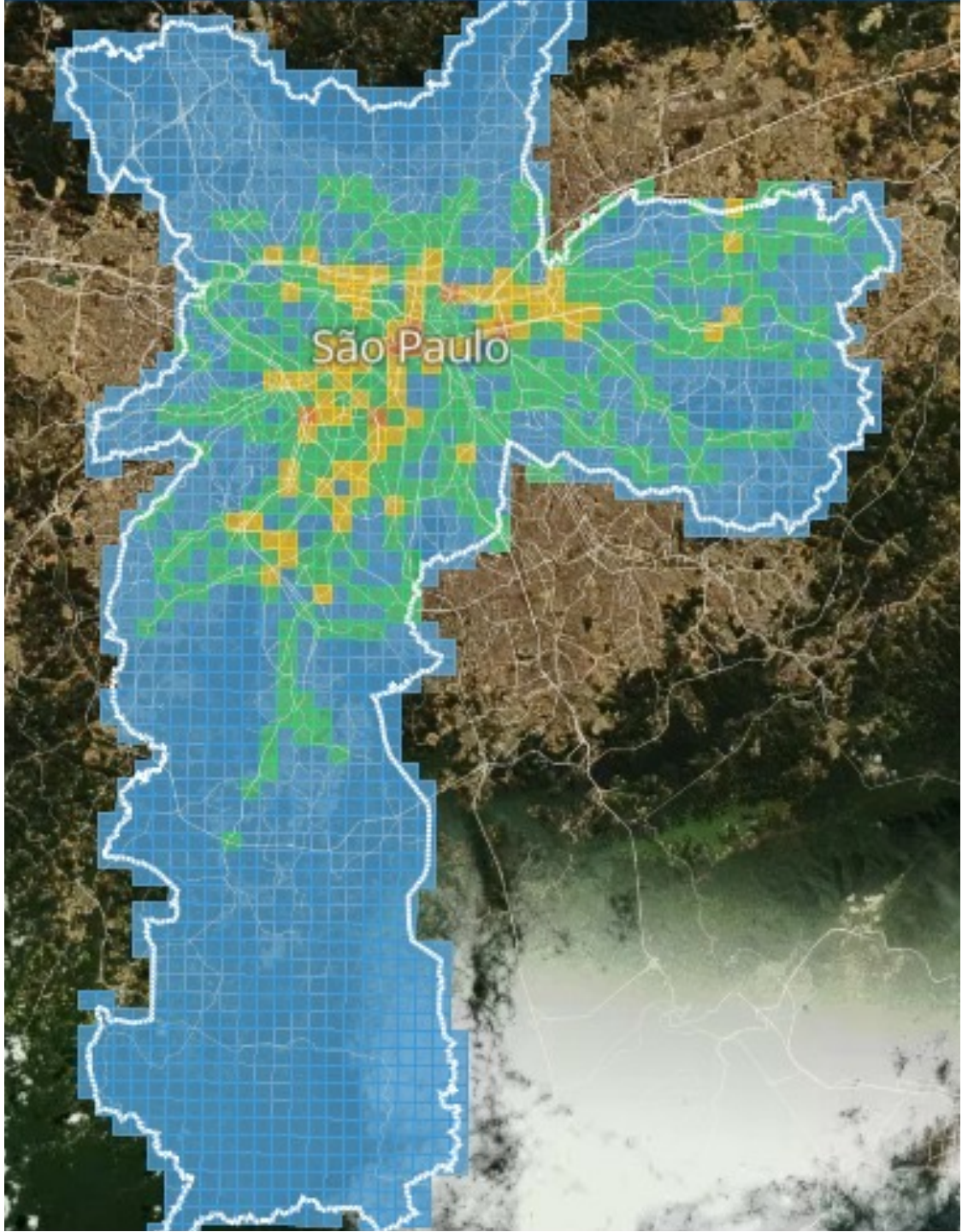

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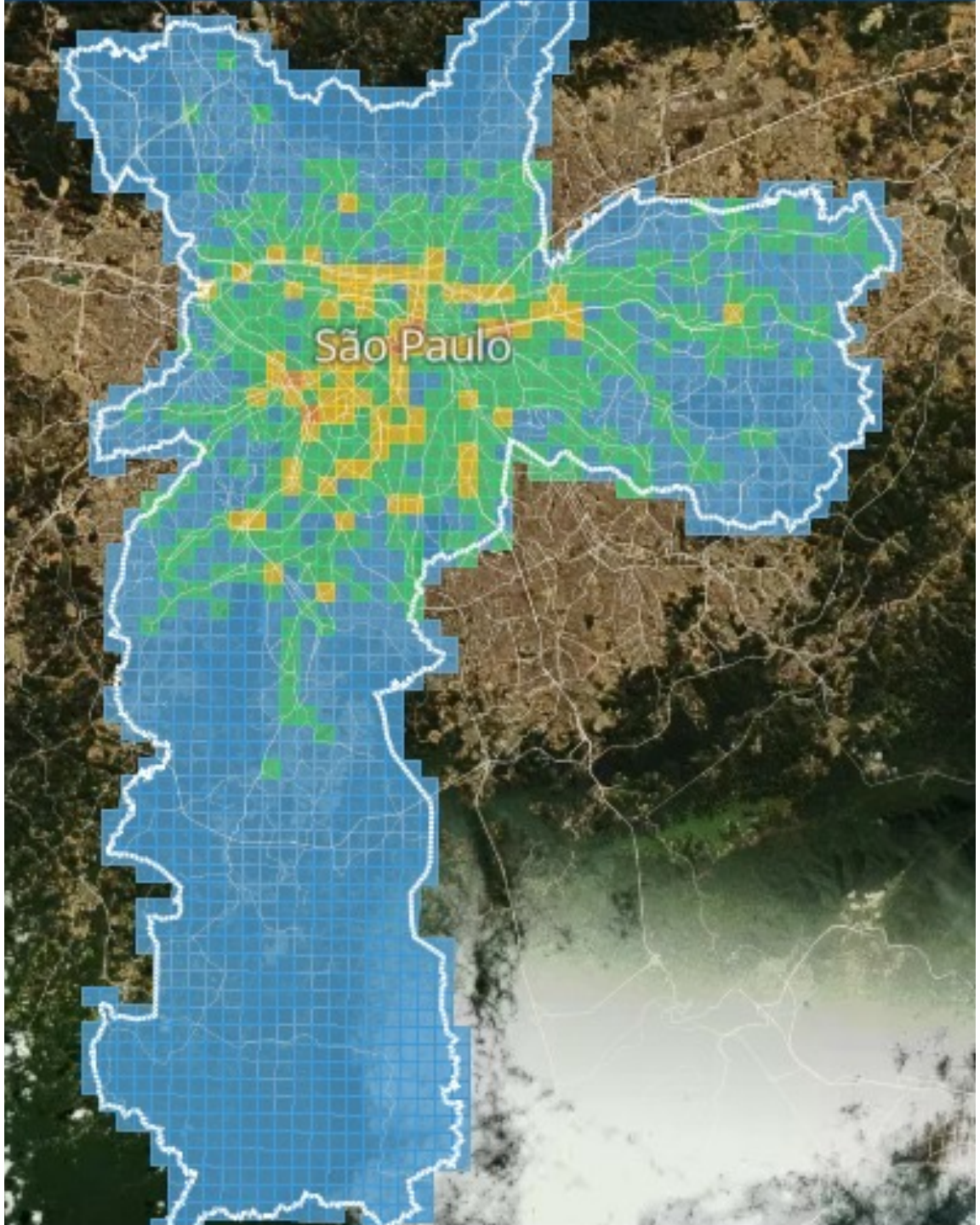

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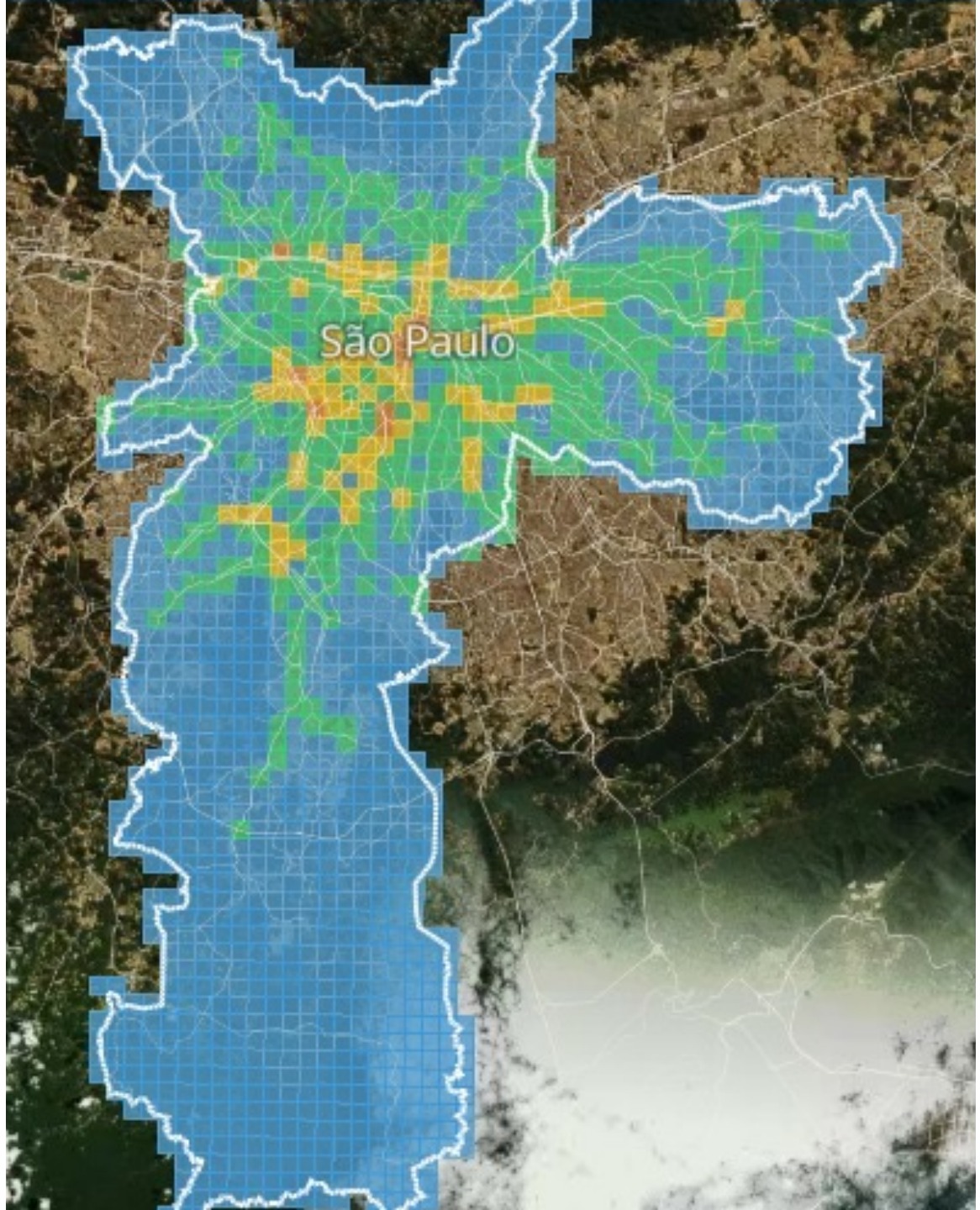

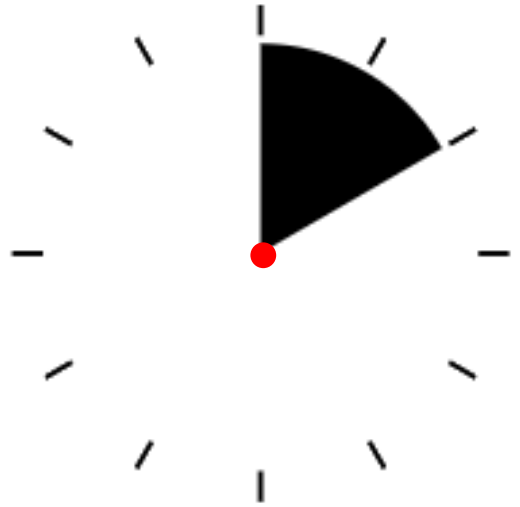

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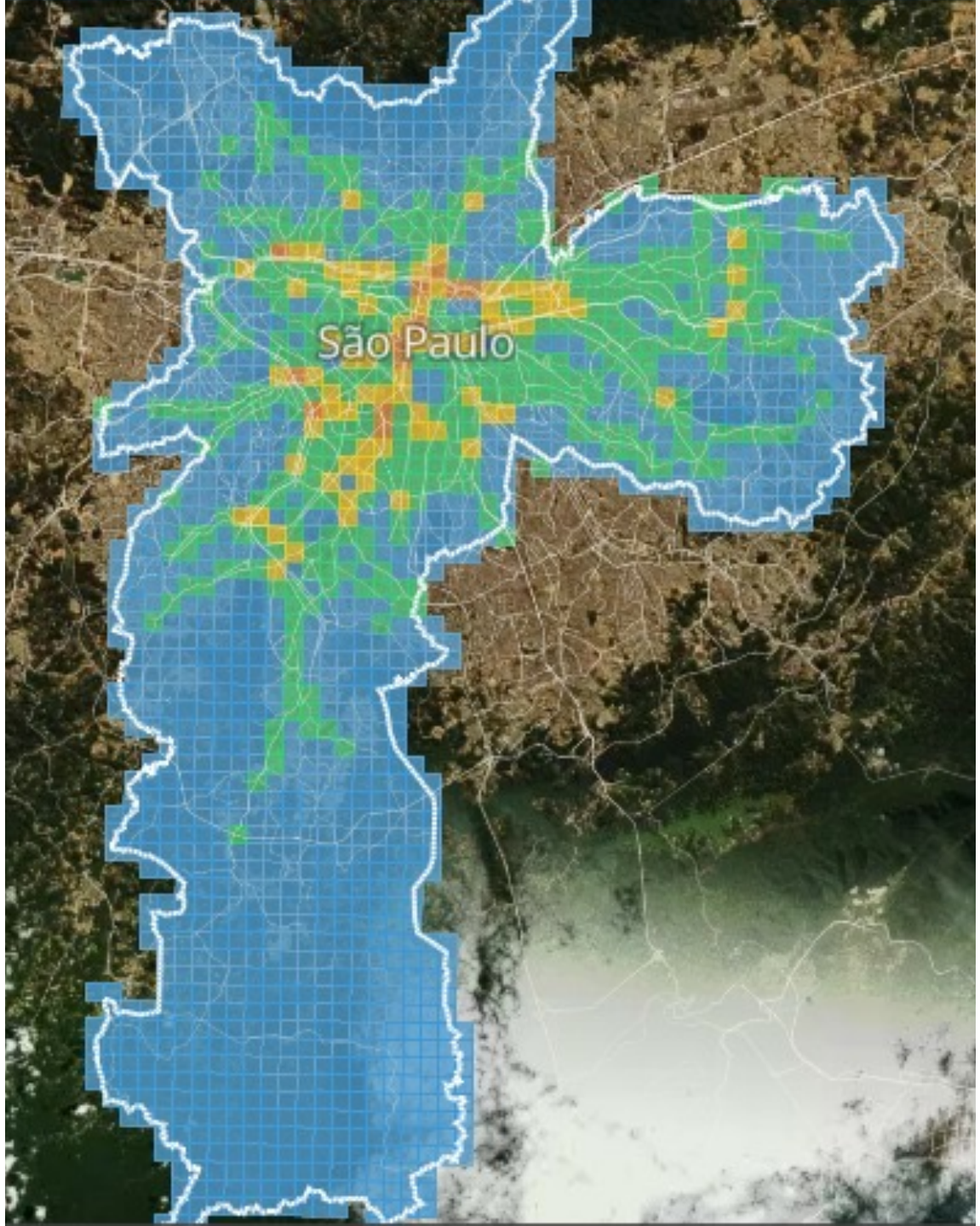

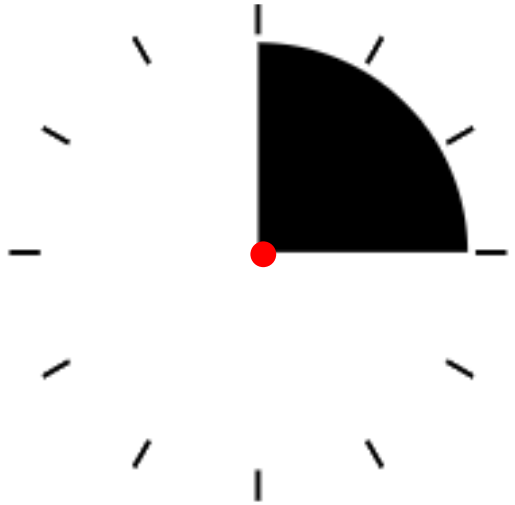

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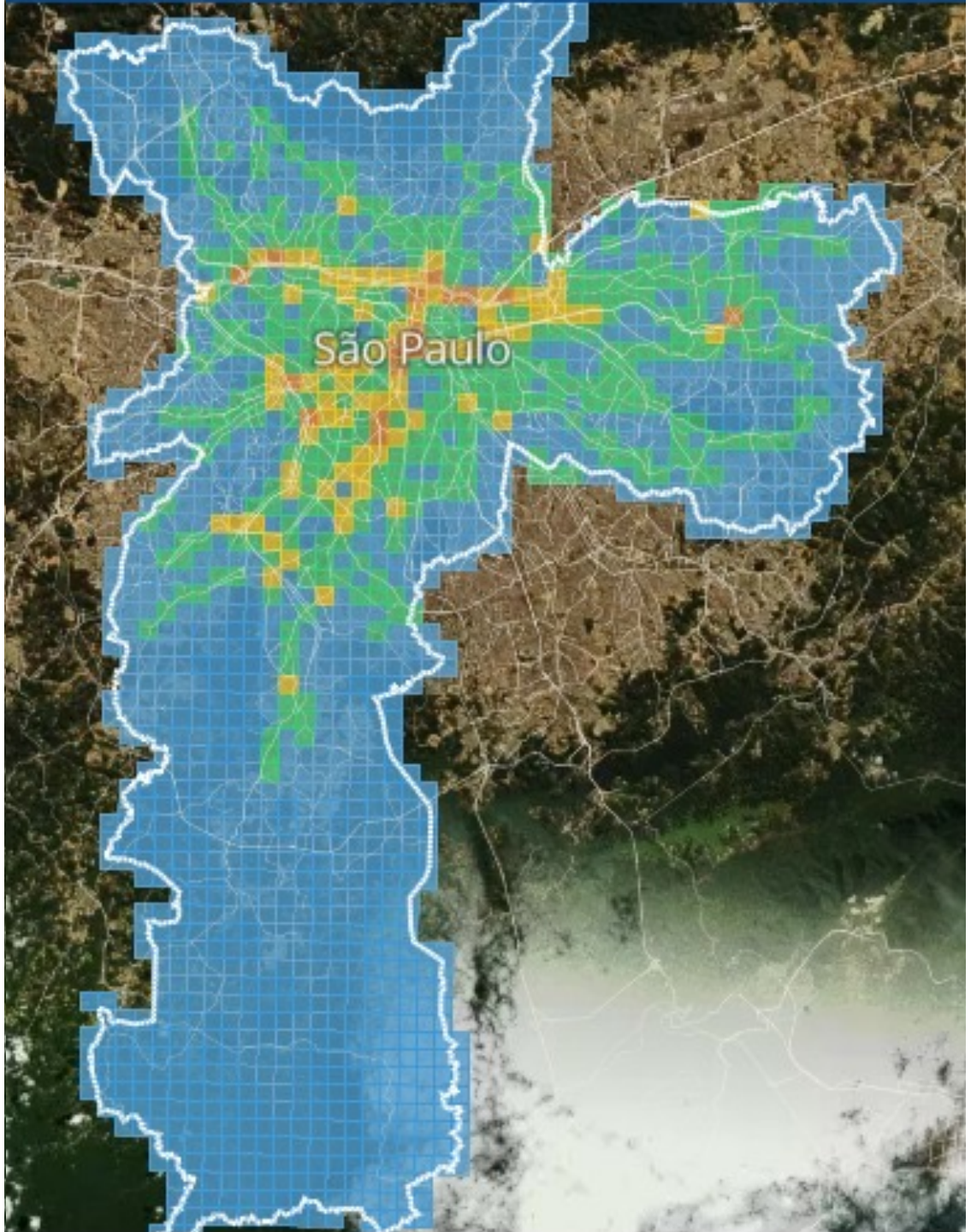

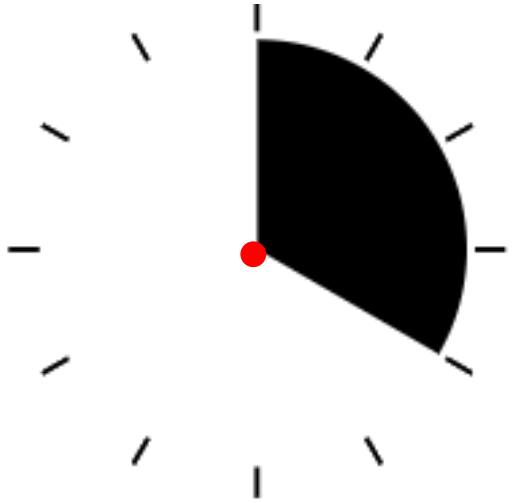

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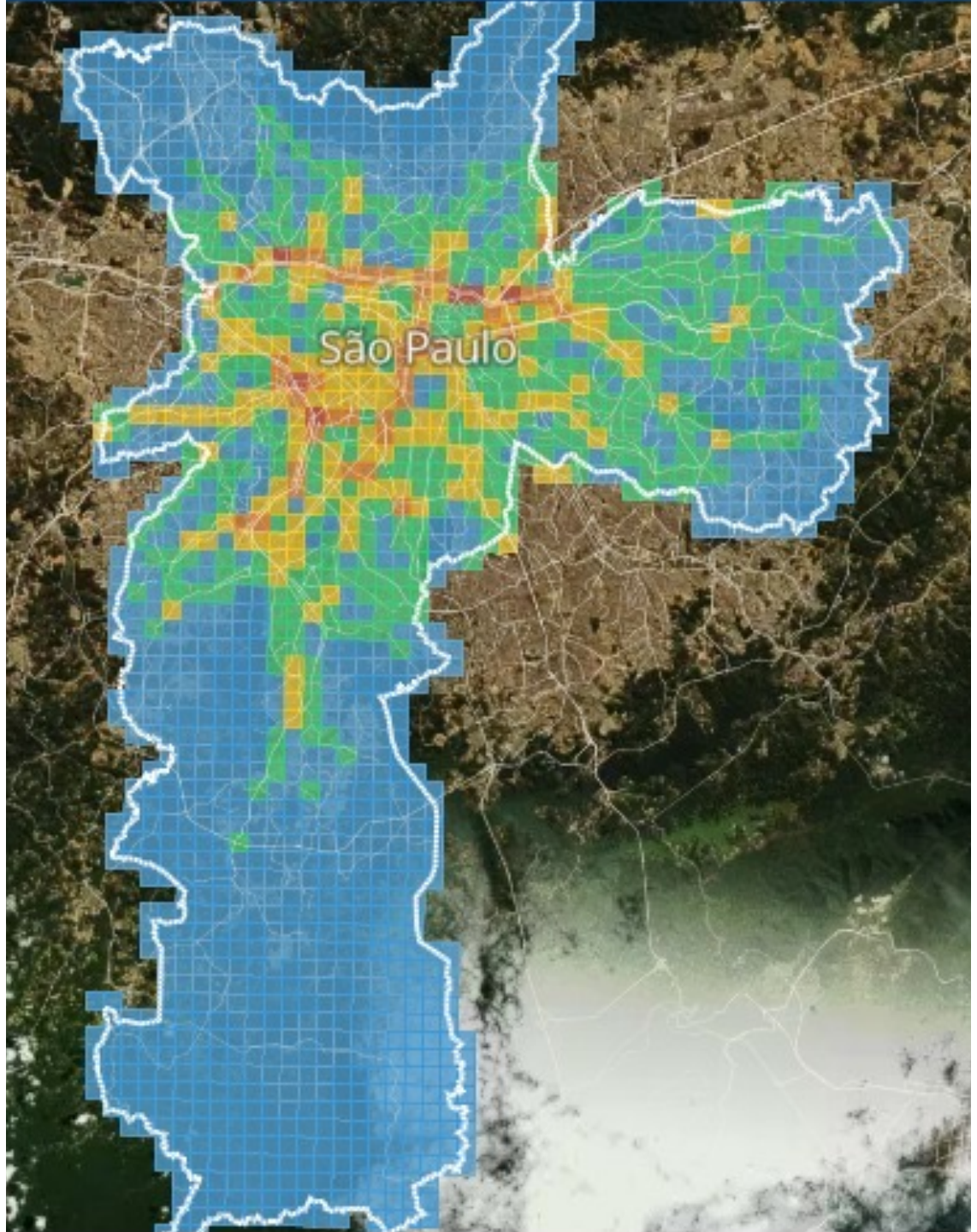

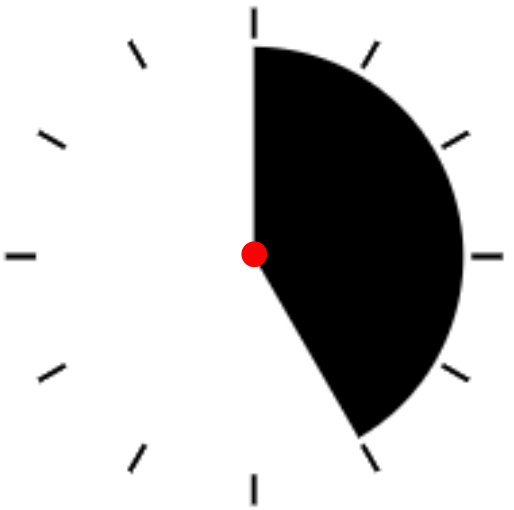

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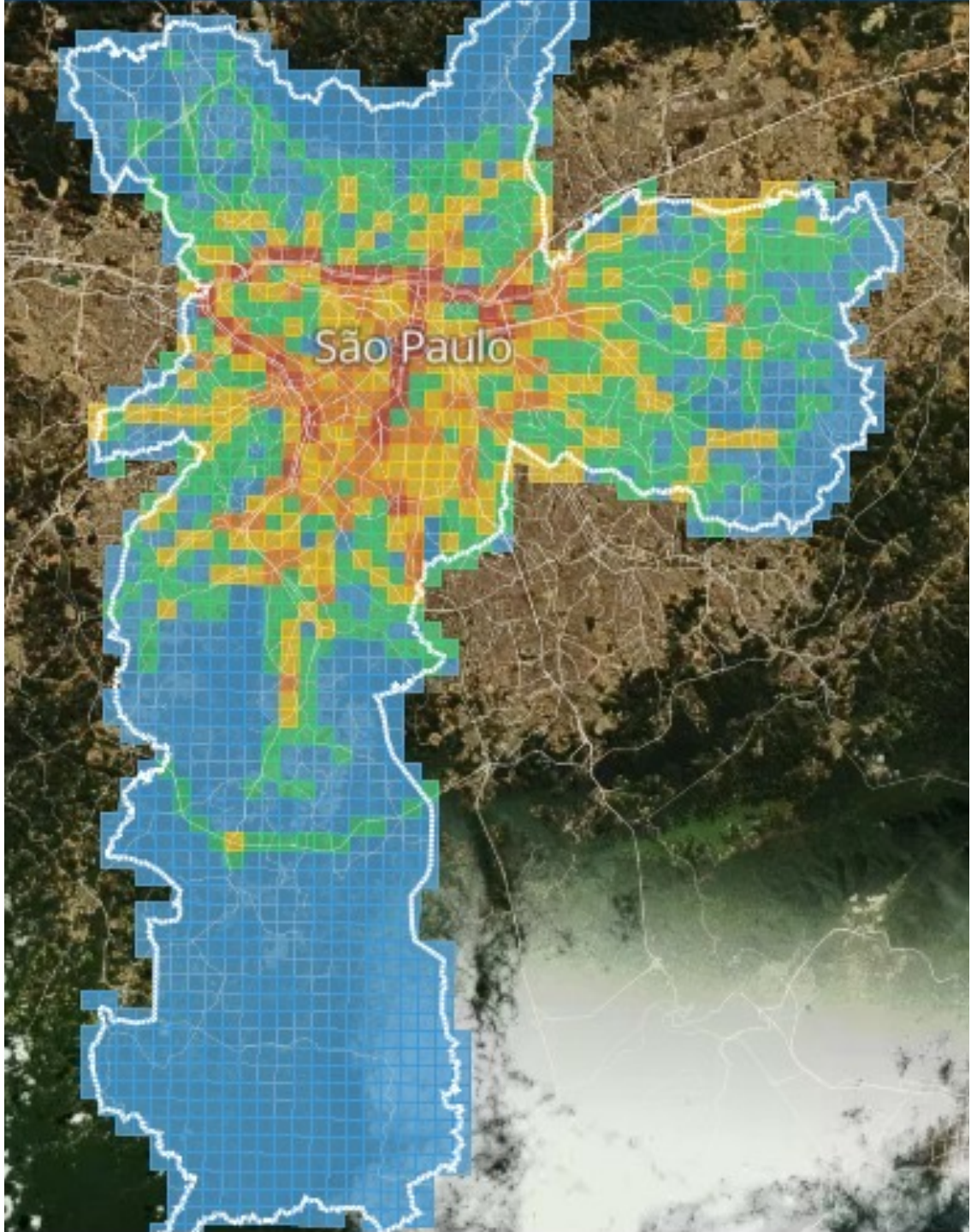

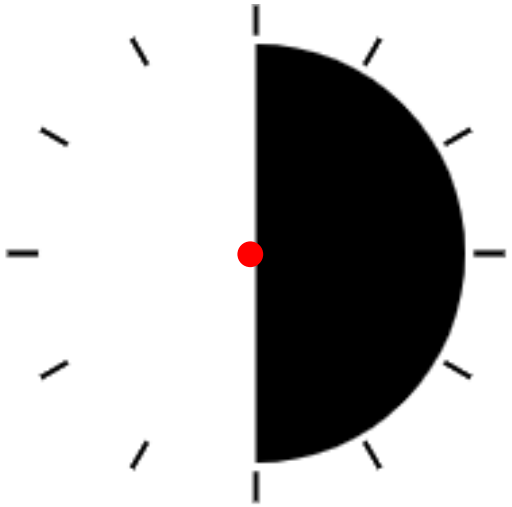

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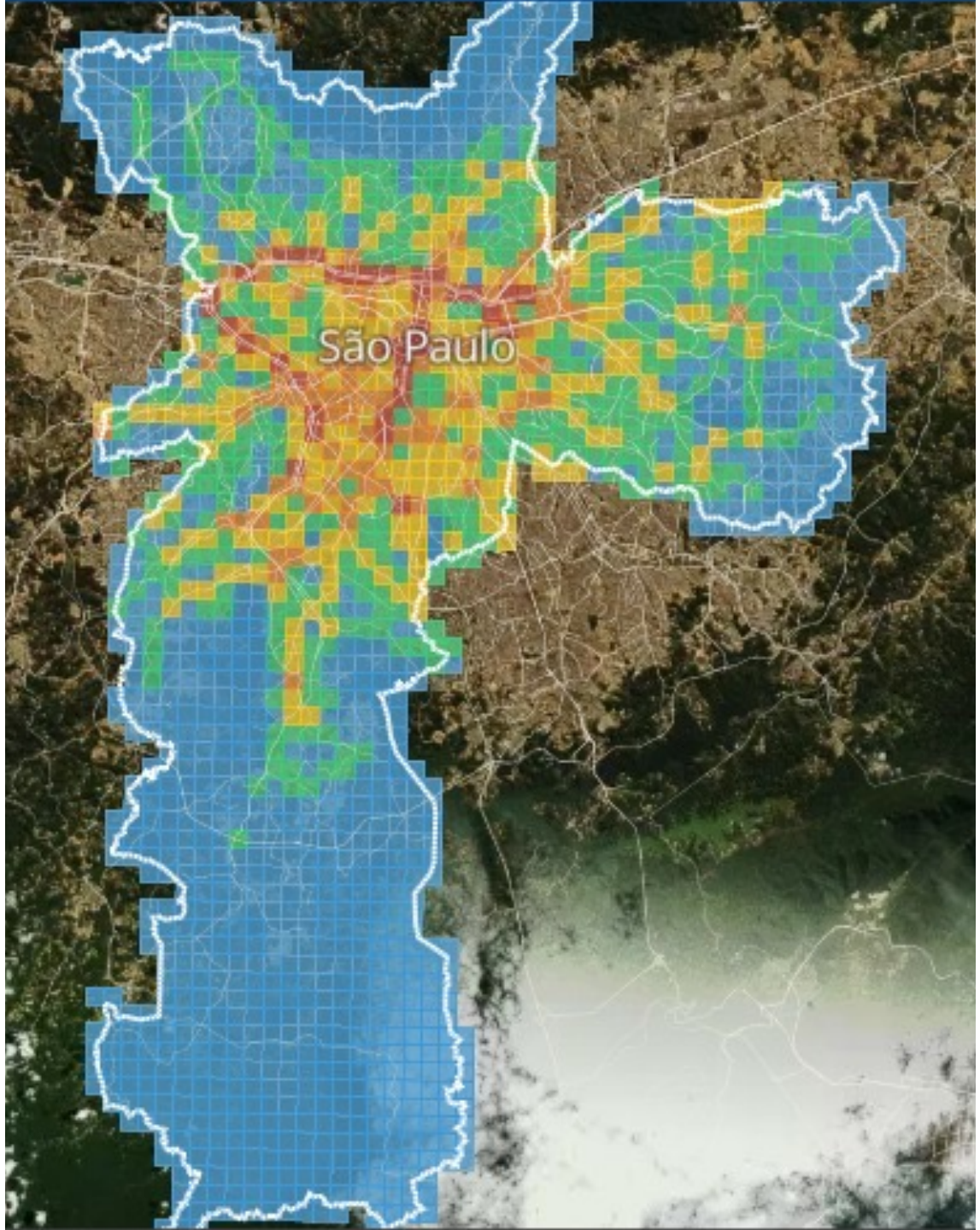

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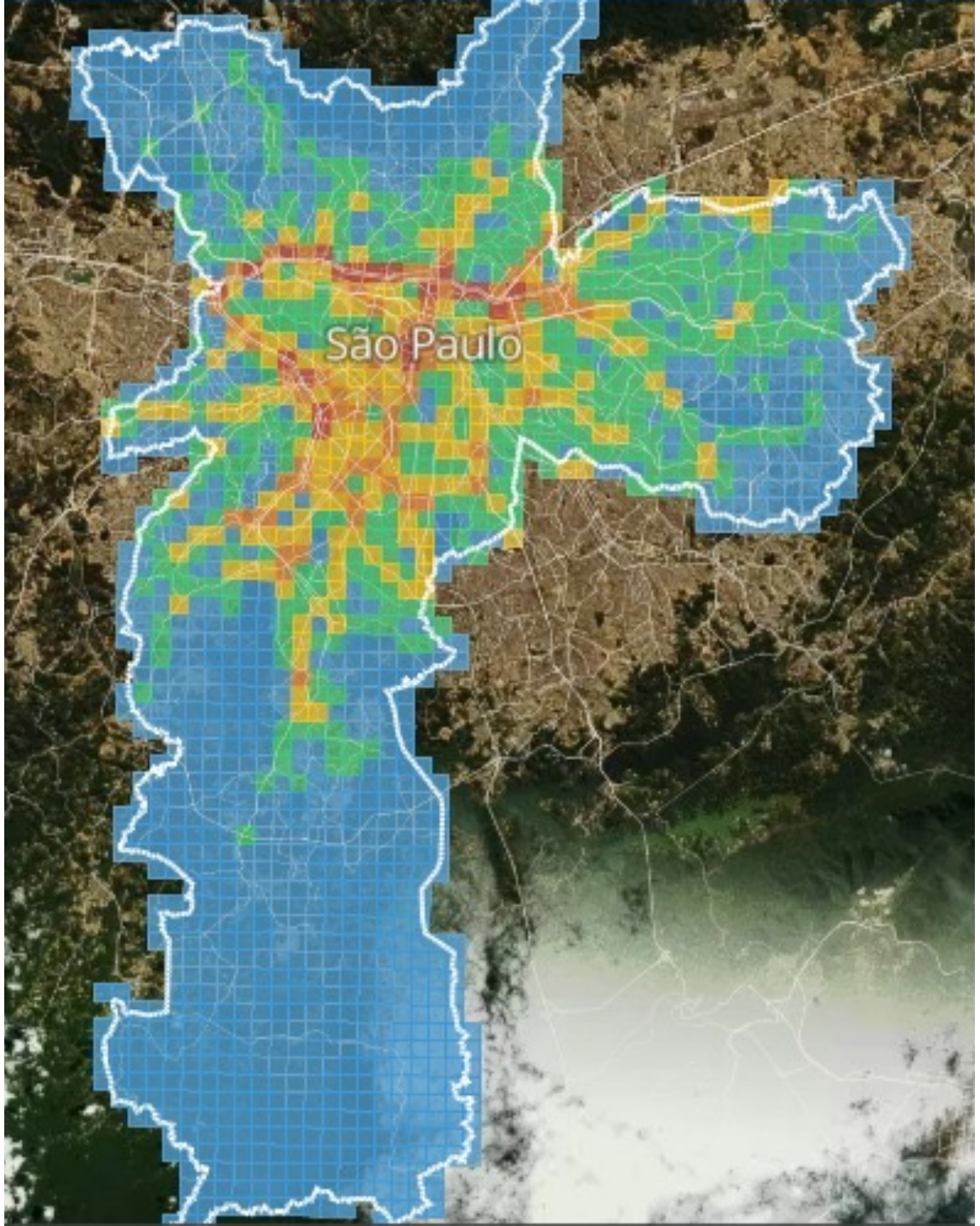

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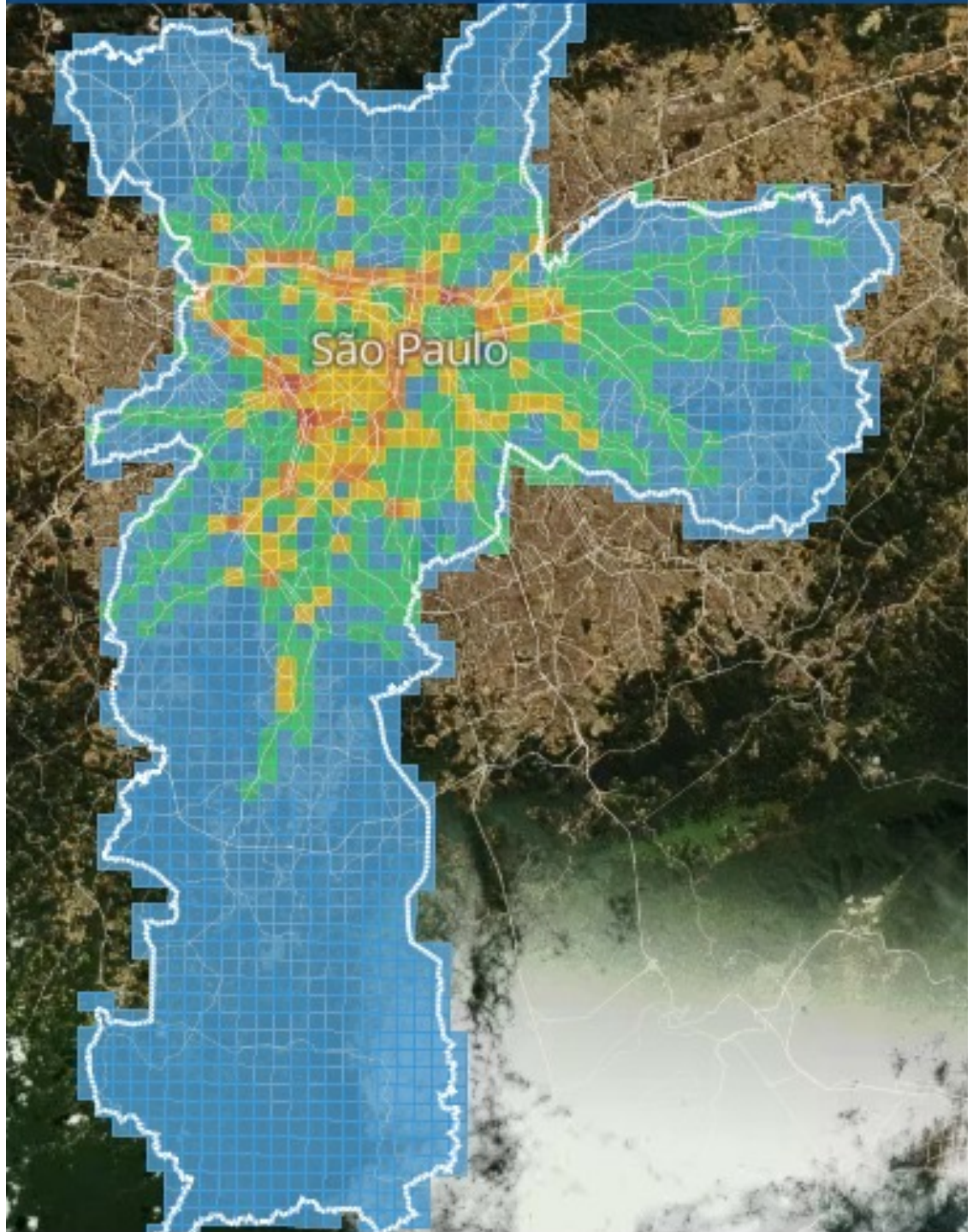

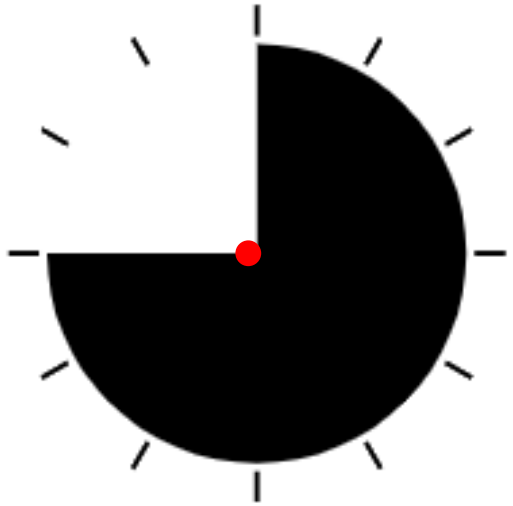

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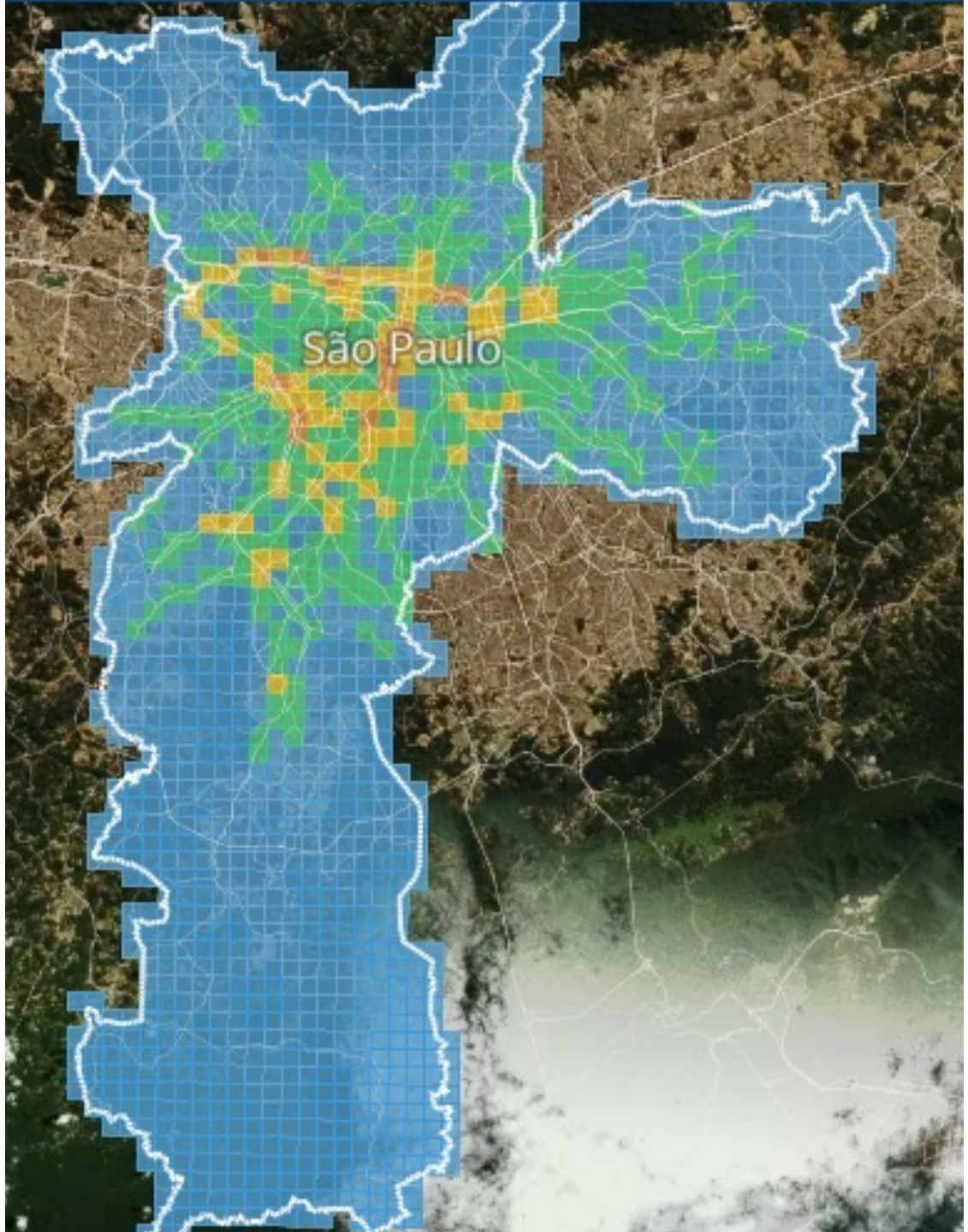

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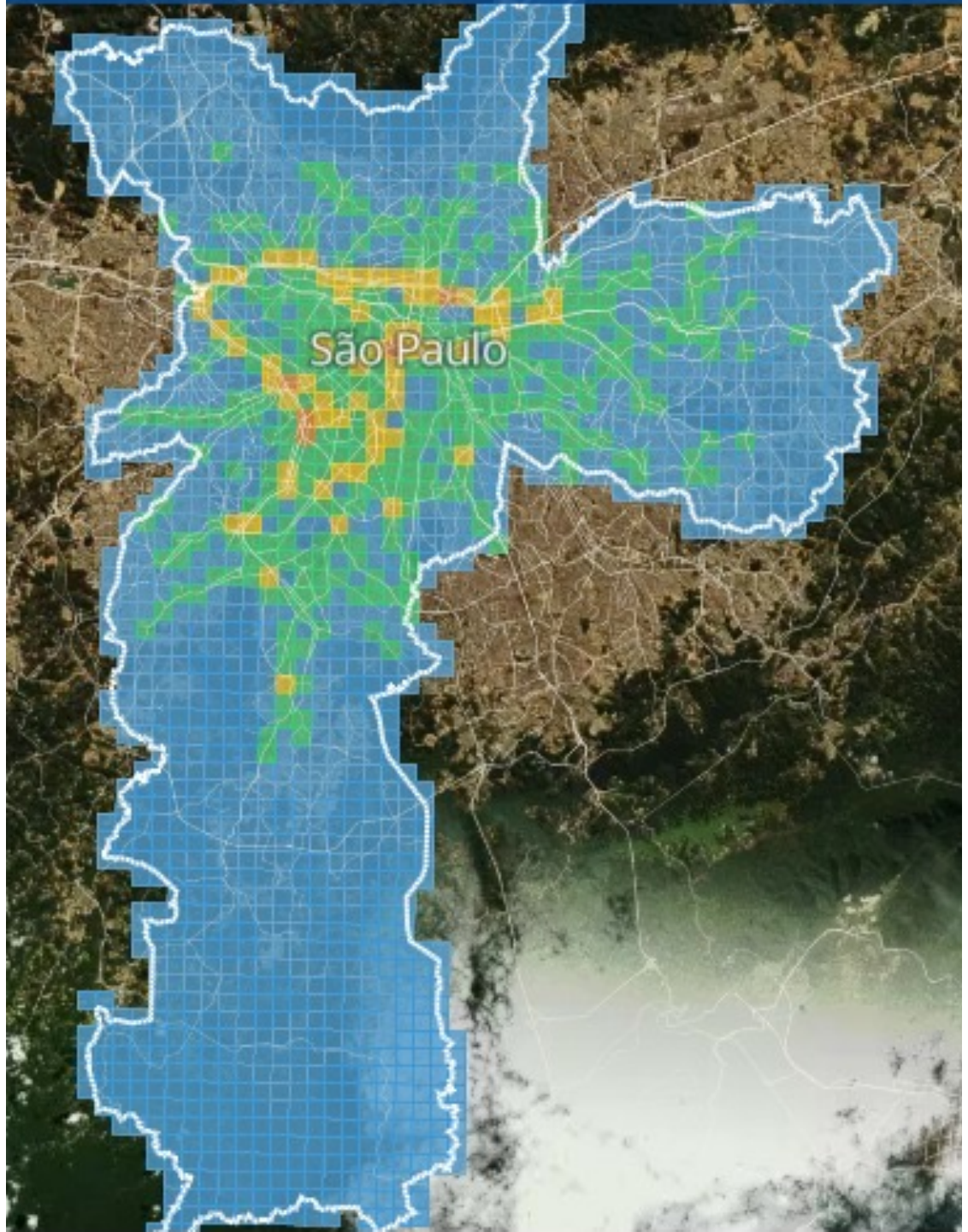

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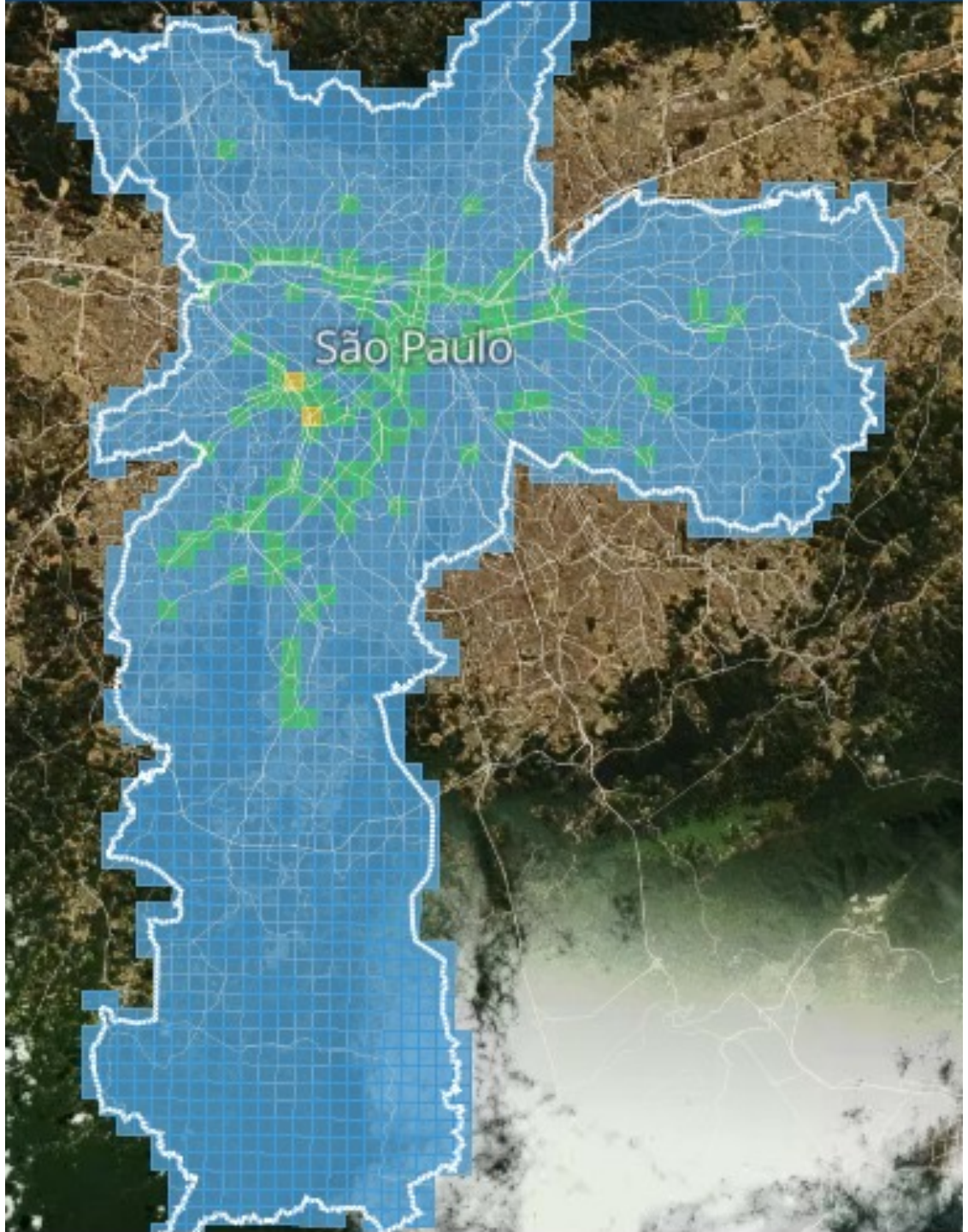

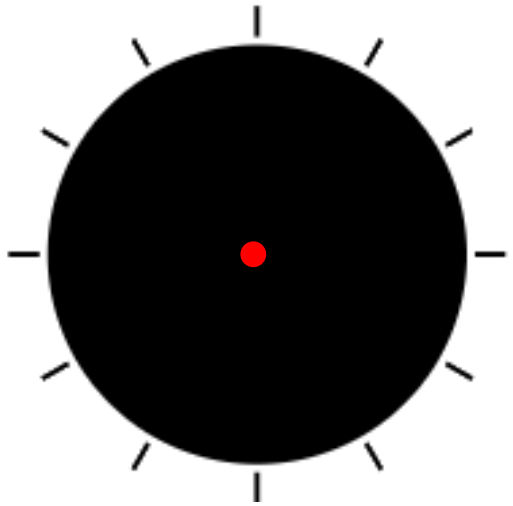

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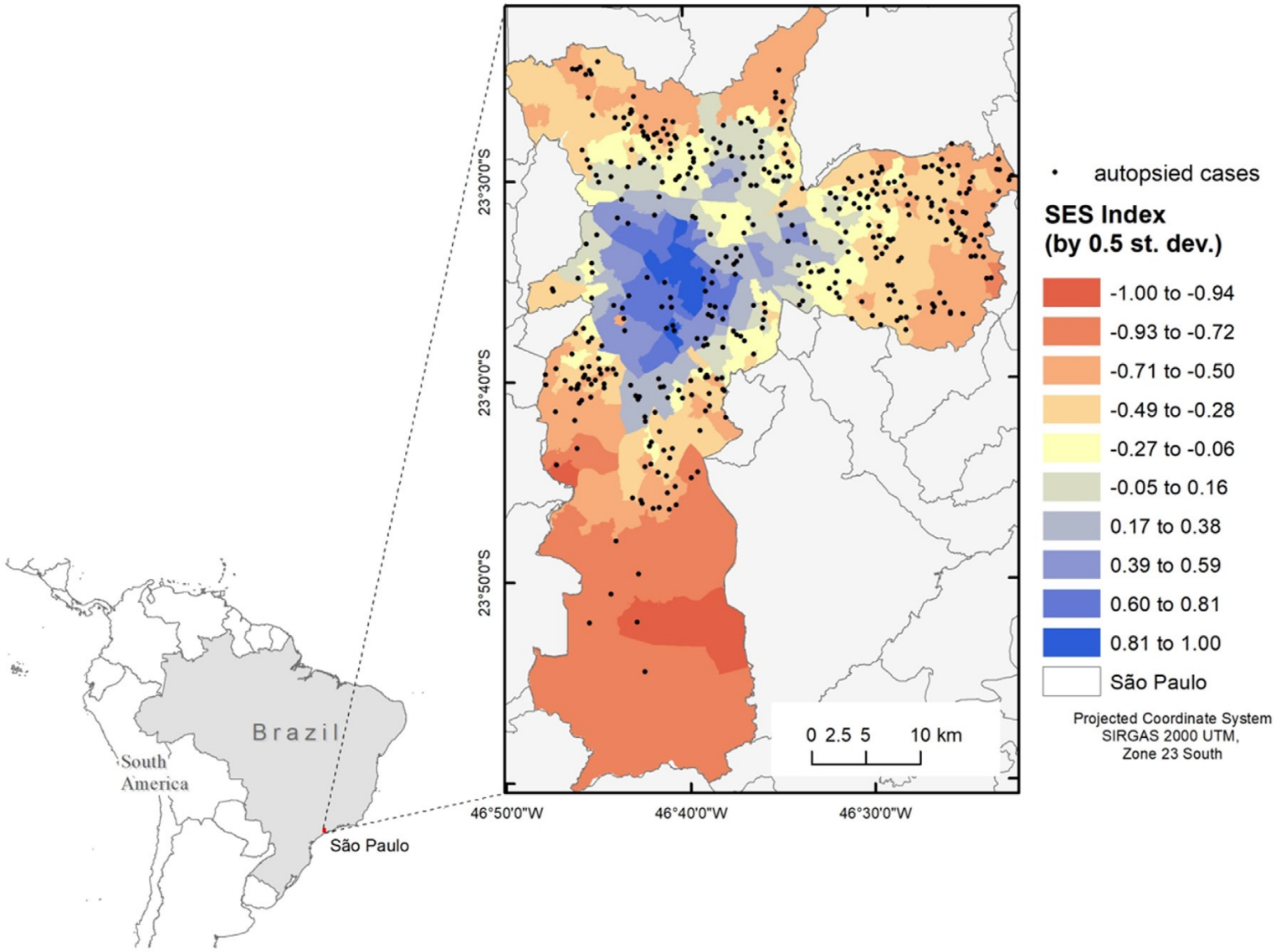
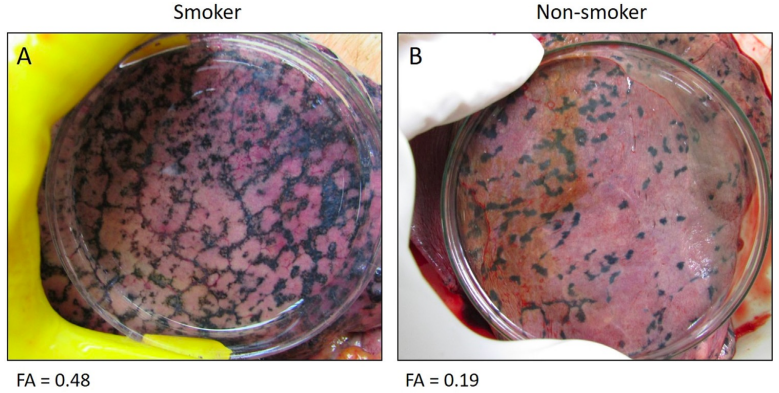


Pleural anthracosis



- Hours spent in daily commuting;
- Tabaco equivalent doses of

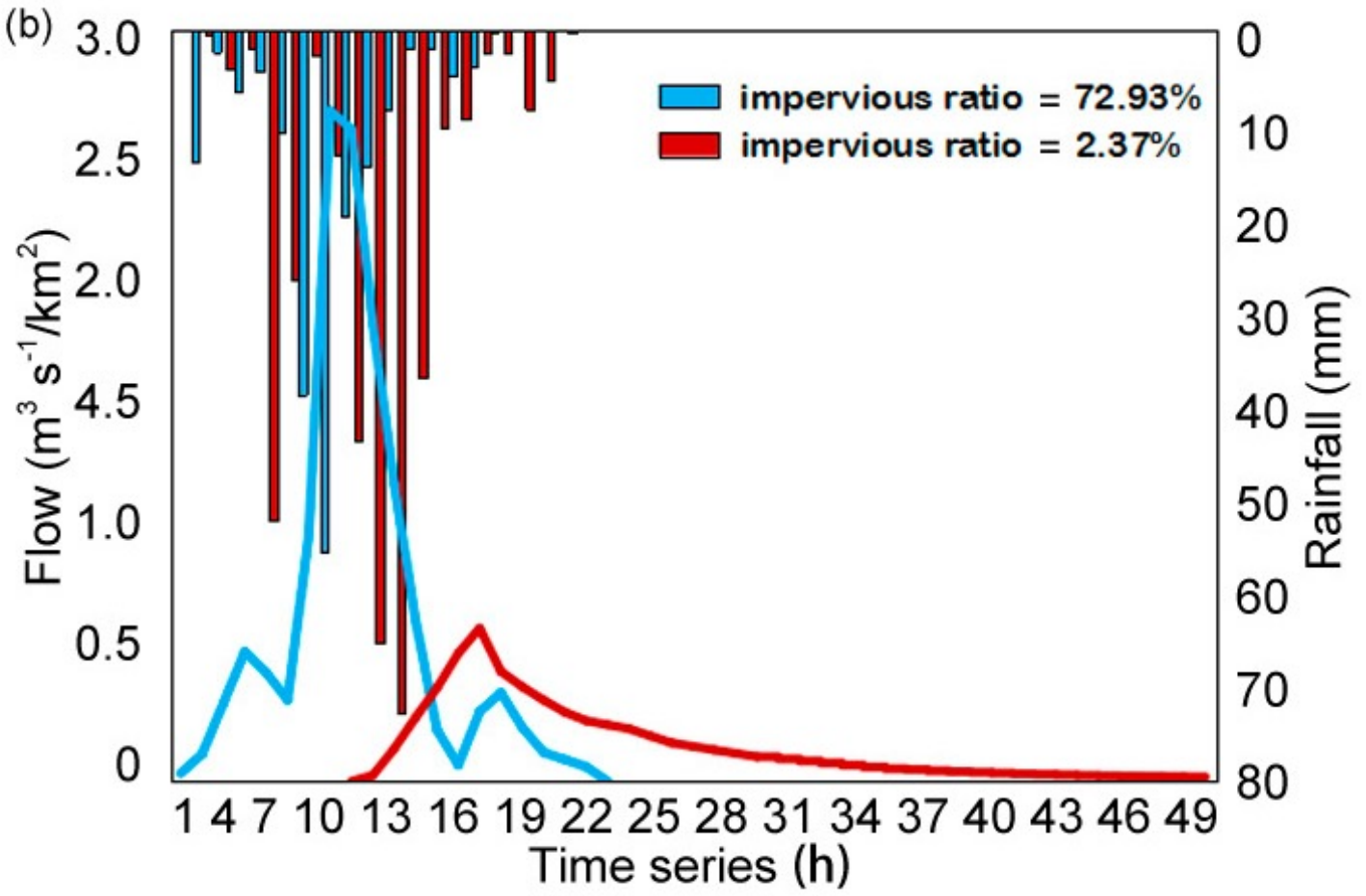
5 cigarettes per day in cities where annual PM2.5 = 25 □g/m^3.

Takano et al. 2019 Environmental International

Urbanização

retratoocular.wordpress.com

- Drenagem



Hu et al 2020 Land 9: 17

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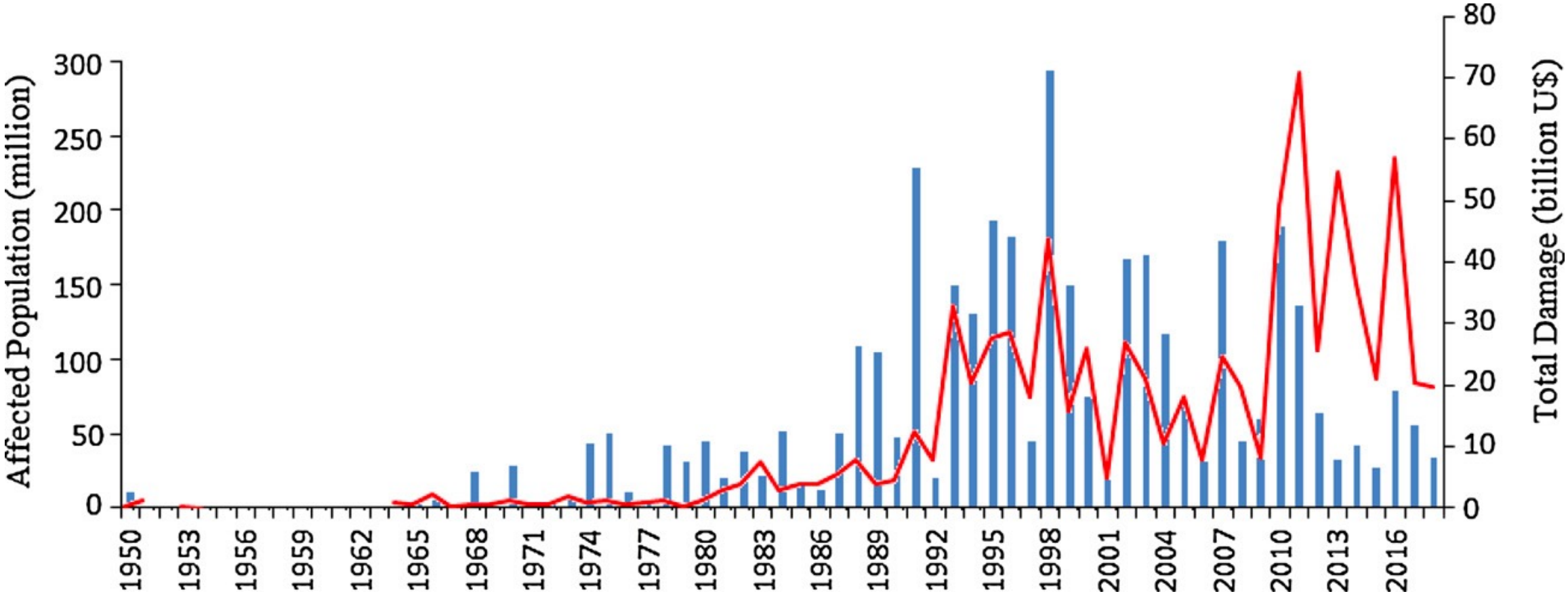

EM-Dat 2019 / Pour et al 2020 Sustainable Cities and Society 62: 102373

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Table 1
A list of recent rainfall driven urban flood and their impacts.

Date	Infrastructure and population Damage	Description
Sept 9, 2009	More than 100 people died	Heavy rainfall caused a flash flood in Jeddah, Saudi Arabia
Jan 12, 2011	Affected half million people and caused $879 million economic losses	Heavy rainfall caused worst flood in Jakarta, Indonesia
July 21, 2012	Affected 1.6 million people and caused an economic loss of $1.6 billion	A rainfall driven flash flood hit Beijing, China
Oct 29, 2015	At least 58 people killed due to direct and indirect causes of flood	Heavy rainfall caused a flash flood in Baghdad, Iraq
Nov 5, 2015	3 people died	A 30-minute long severe thunderstorm caused flash floods in Amman, Jordan
Jul 14, 2017	Disruption of urban activities	A 19-mm rainfall caused a flood in Moscow, Russia, even the city has an excellent drainage system
Aug 29, 2017	Confirmed death of 14 people	Heavy rain caused a flash flood in Mumbai, India which was called as one of the worst regional humanitarian crises by Red Cross
Nov 15, 2017	Caused significant damage to property and death of 24 people	A heavy rainfall-driven flash flood occurred in Athens, Greece
Mar 21, 2018	Death of 3 people and displacement of thousands	A heavy rainstorm (50 mm) caused a flash flood event in São Paulo, Brazil
May 27, 2018	Huge losses in property and death of 1 person	1000-year flash flood in Ellicott City, Maryland due to heavy rainfall (100 mm/hour), USA
Mar 1, 2019	20 people died and many houses collapsed	97 mm rainfall in 30 h caused a huge flash flood, Kandahar, Afghanistan
Jun 27, 2019	Death of 32 people and massive transport disruption	Heaviest one-day rainfall in a decade caused a severe flash flood in the city of Mumbai, India

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Leptospirose

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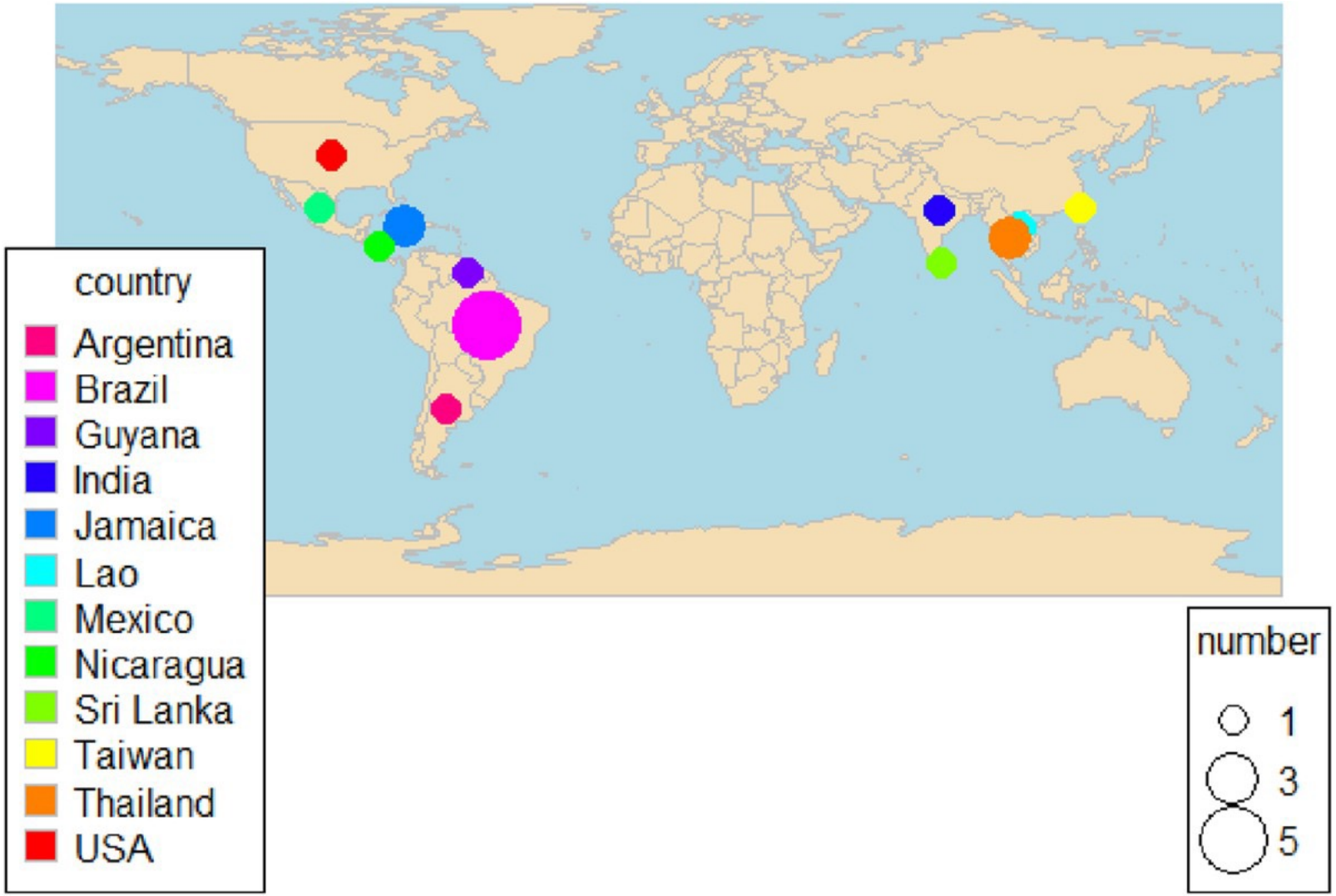

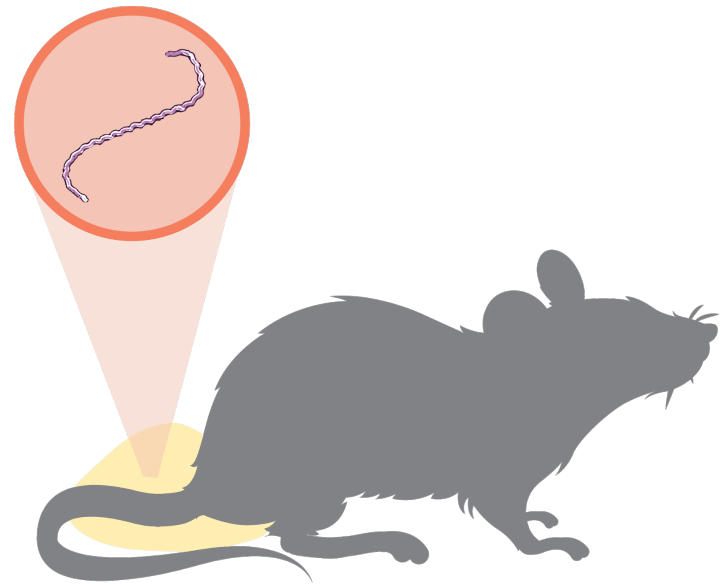

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Naing et al 2018 Plos One 14(5): e0217643

- Drenagem

Study or Subgroup	log[Odds Ratio]	SE	Weight	Odds Ratio IV, Random, 95% CI
4.3.1 Case-control designCC				
Bharadwaj,2008 [27]	1.9	0.399	6.8%	6.69 [3.06, 14.61]
Chusri, 2014 [31]	3.6	0.75	4.0%	36.60 [8.42, 159.17]
Keenan,2010 [15]	-1.4	0.83	3.6%	0.25 [0.05, 1.25]
Sarkar,2002[24]	1.108	0.38	6.9%	3.03 [1.44, 6.38]
Vanasco, 2008[12]	1.5	0.686	4.4%	4.48 [1.17, 17.19]
Subtotal (95% CI)			**25.7%**	**4.01 [1.26, 12.72]**
Heterogeneity: Tau² = 1.36; Chi² = 22.09, df = 4 (P = 0.0002); I² = 82%				
Test for overall effect: Z = 2.36 (P = 0.02)				
4.3.2 Other design				
Agampodi,2014 [30]	-1.42	0.829	3.6%	0.24 [0.05, 1.23]
Barcellos,2001 [23]	0.756	0.23	8.2%	2.13 [1.36, 3.34]
Dechet,2012 [29]	-0.04	0.27	7.9%	0.96 [0.57, 1.63]
Dias,2006[14]	0.095	0.147	8.8%	1.10 [0.82, 1.47]
Felzemburg, 2014 [32]	-0.05	0.5	5.9%	0.95 [0.36, 2.53]
Karande,2003 [25]	2.08	0.47	6.1%	8.00 [3.19, 20.11]
Kawaguchi,2008 [28]	0.75	0.27	7.9%	2.12 [1.25, 3.59]
Ko, 1999 [19]	0.722	0.229	8.2%	2.06 [1.31, 3.22]
Leal-Castellanos,2003 [11]	0.39	0.14	8.8%	1.48 [1.12, 1.94]
Suwanpakdee,2015 [34]	1.39	0.144	8.8%	4.01 [3.03, 5.32]
Subtotal (95% CI)			**74.3%**	**1.77 [1.18, 2.65]**
Heterogeneity: Tau² = 0.32; Chi² = 68.30, df = 9 (P < 0.00001); I² = 87%				
Test for overall effect: Z = 2.78 (P = 0.005)				
Total (95% CI)			**100.0%**	**2.19 [1.48, 3.24]**
Heterogeneity: Tau² = 0.43; Chi² = 102.66, df = 14 (P < 0.00001); I² = 86%				
Test for overall effect: Z = 3.92 (P < 0.0001)				
Test for subgroup differences: Chi² = 1.72, df = 1 (P = 0.19), I² = 41.8%				

Odds Ratio
IV, Random, 95% CI

0.01 0.1 1 10 100

decreased risk with flood increased risk with flood

Naing et al 2018 Plos One

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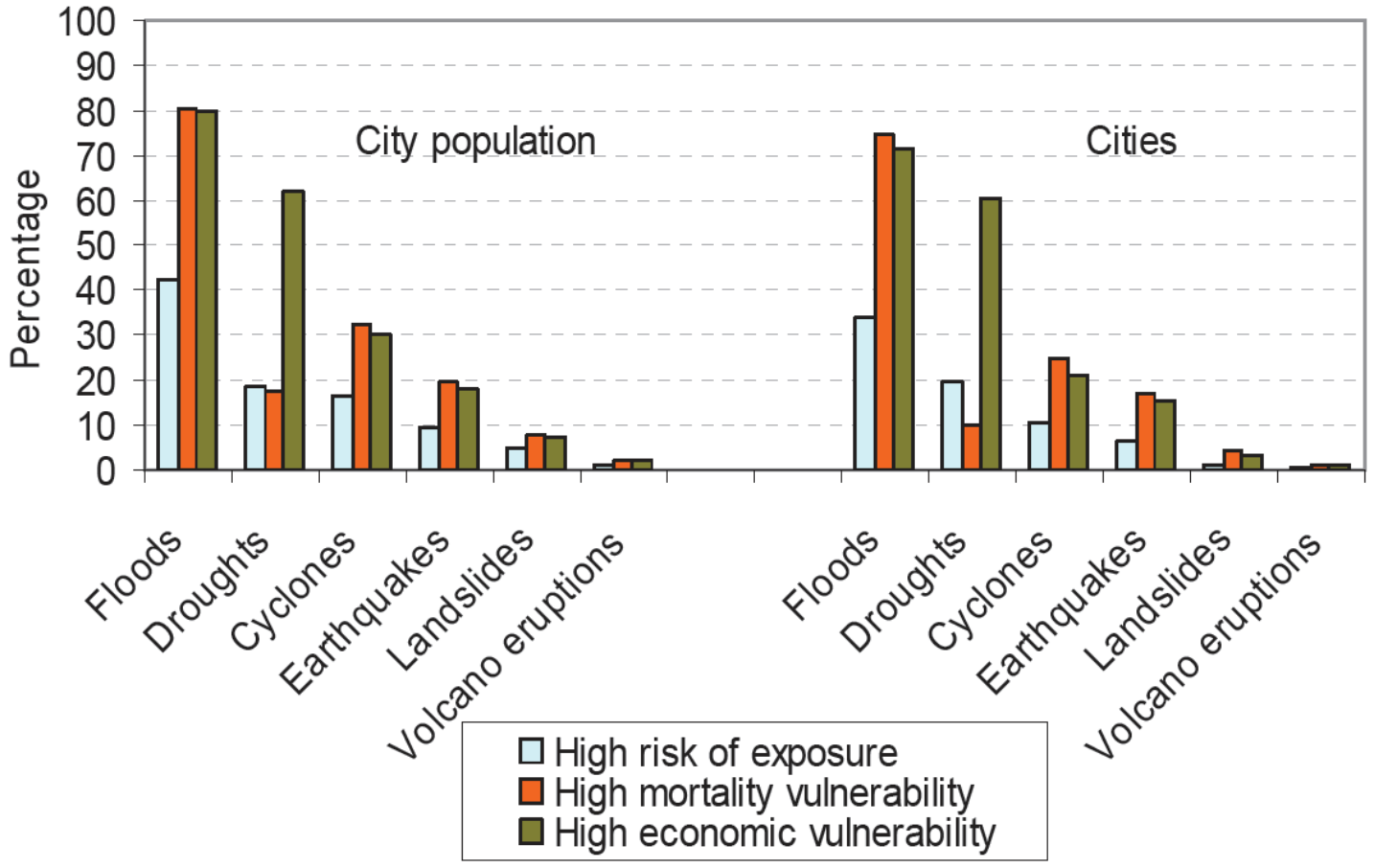


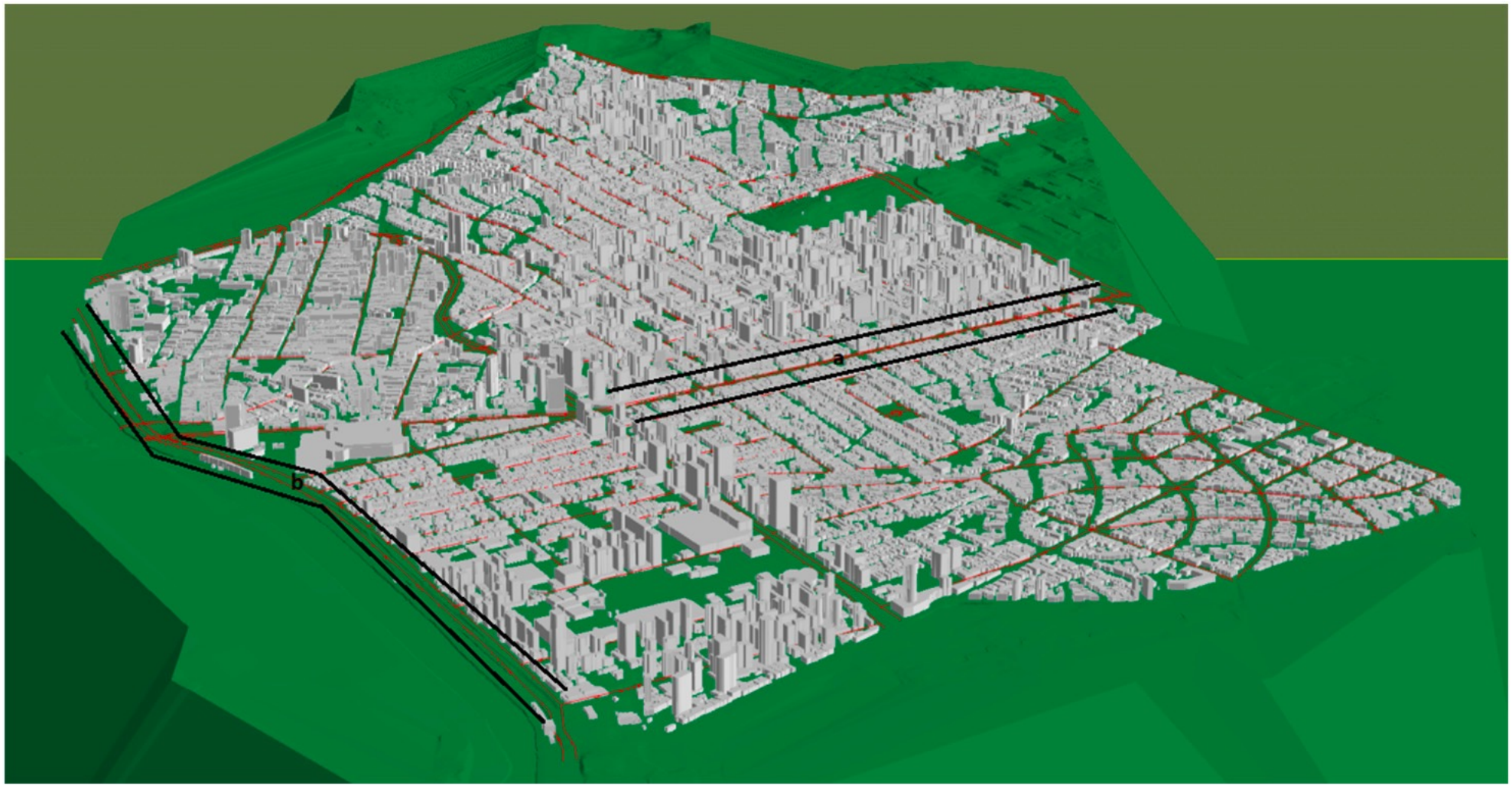
Gu et al 2015 UM Technical Paper 2015/2

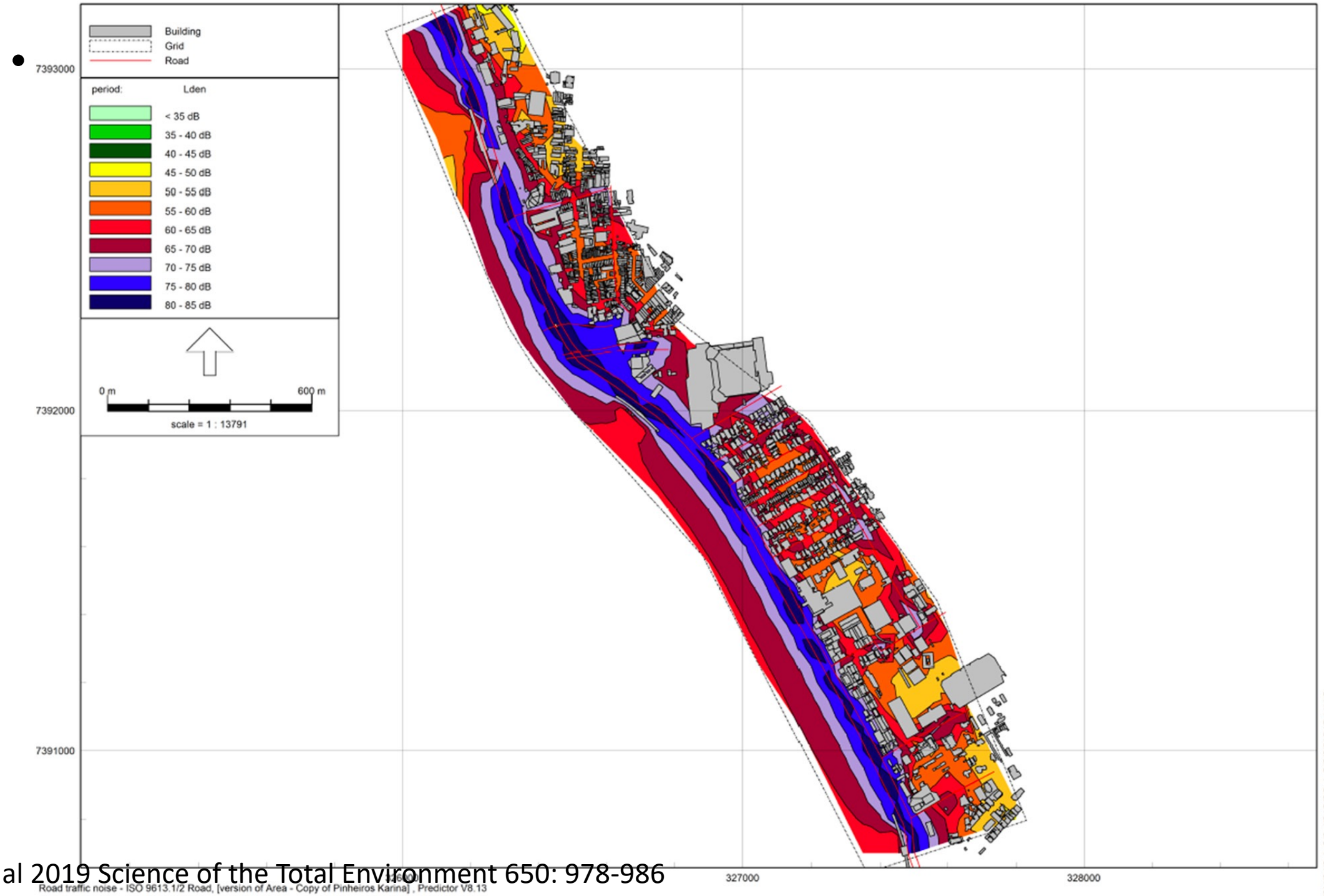
Problemas ambientais urbanos

- Poluição sonora

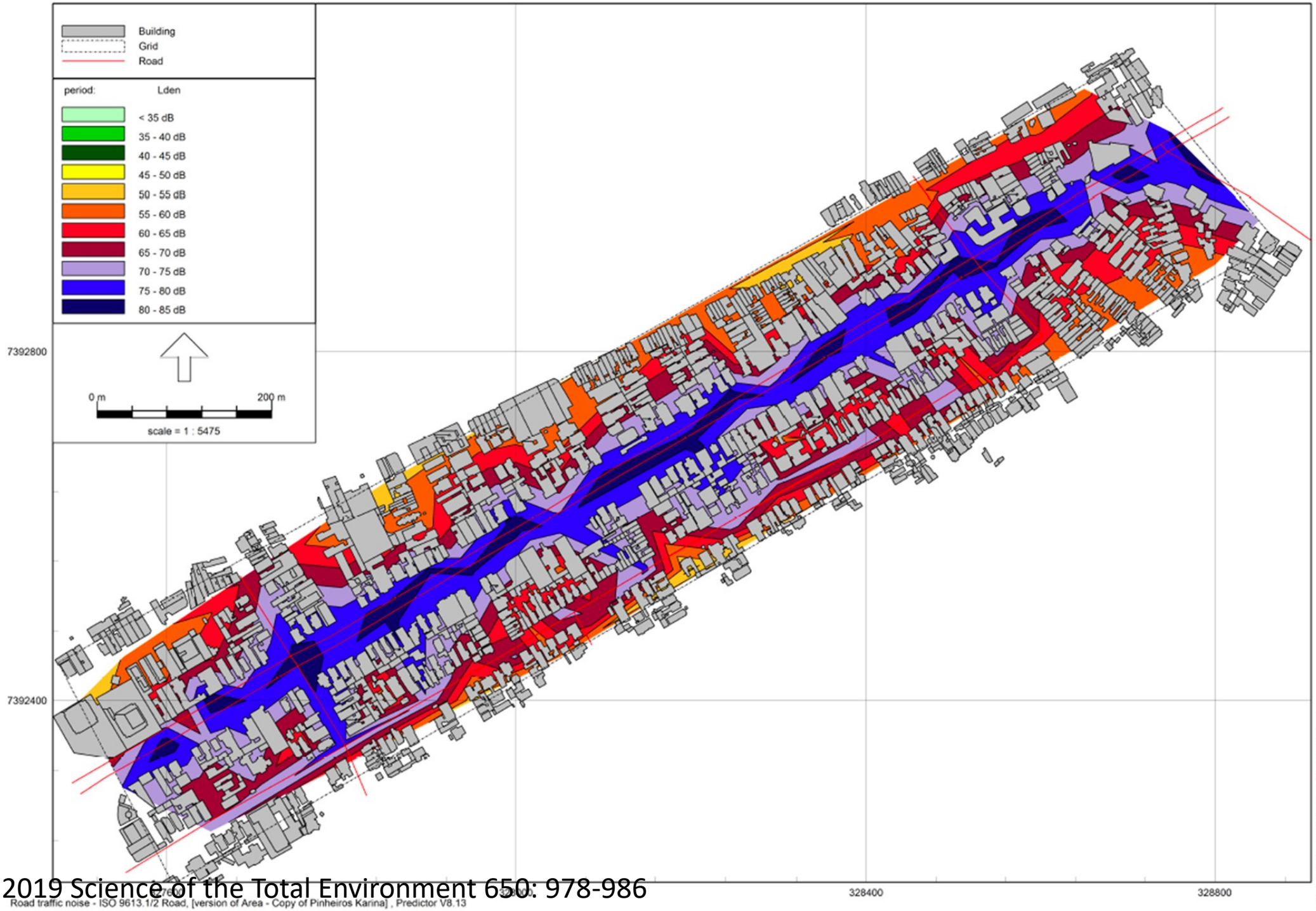
Paiva et al 2019 Science of the Total Environment 650: 978-986

- Poluição sonora



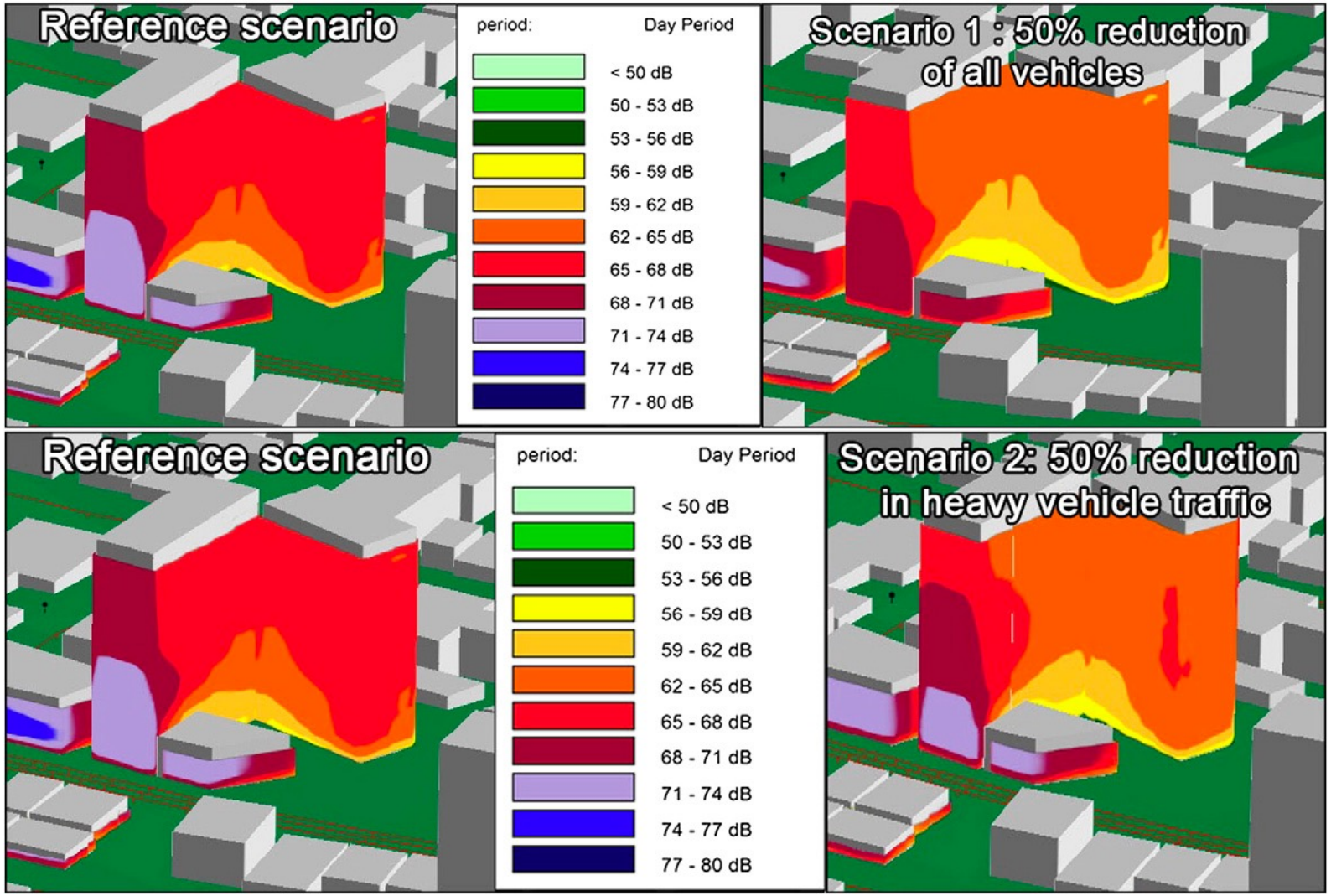


Paiva et al 2019 Science of the Total Environment 650: 978-986



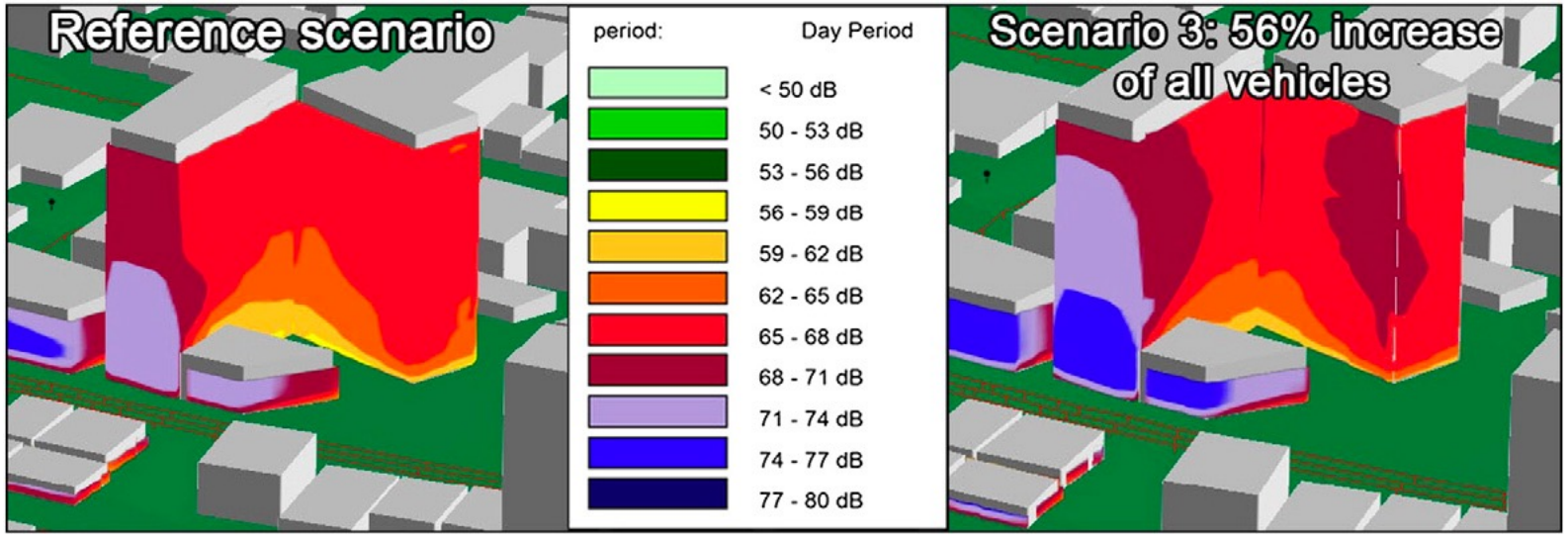
Paiva et al 2019 Science of the Total Environment 650: 978-986

- Poluição sonora



Fiedler and Zannin 2015 Environmental Impact Assessment Review 51: 1-9

- Poluição sonora



Fiedler and Zannin 2015 Environmental Impact Assessment Review 51: 1-9

- Poluição sonora
- Aborrecimento
- Problemas cardiovasculares
- Hipertensão
- Problemas mentais

Singh et al 2017 Fluctuation and Noise Letters 17: 1830001

Problemas ambientais urbanos

- Impactos sobre a biodiversidade

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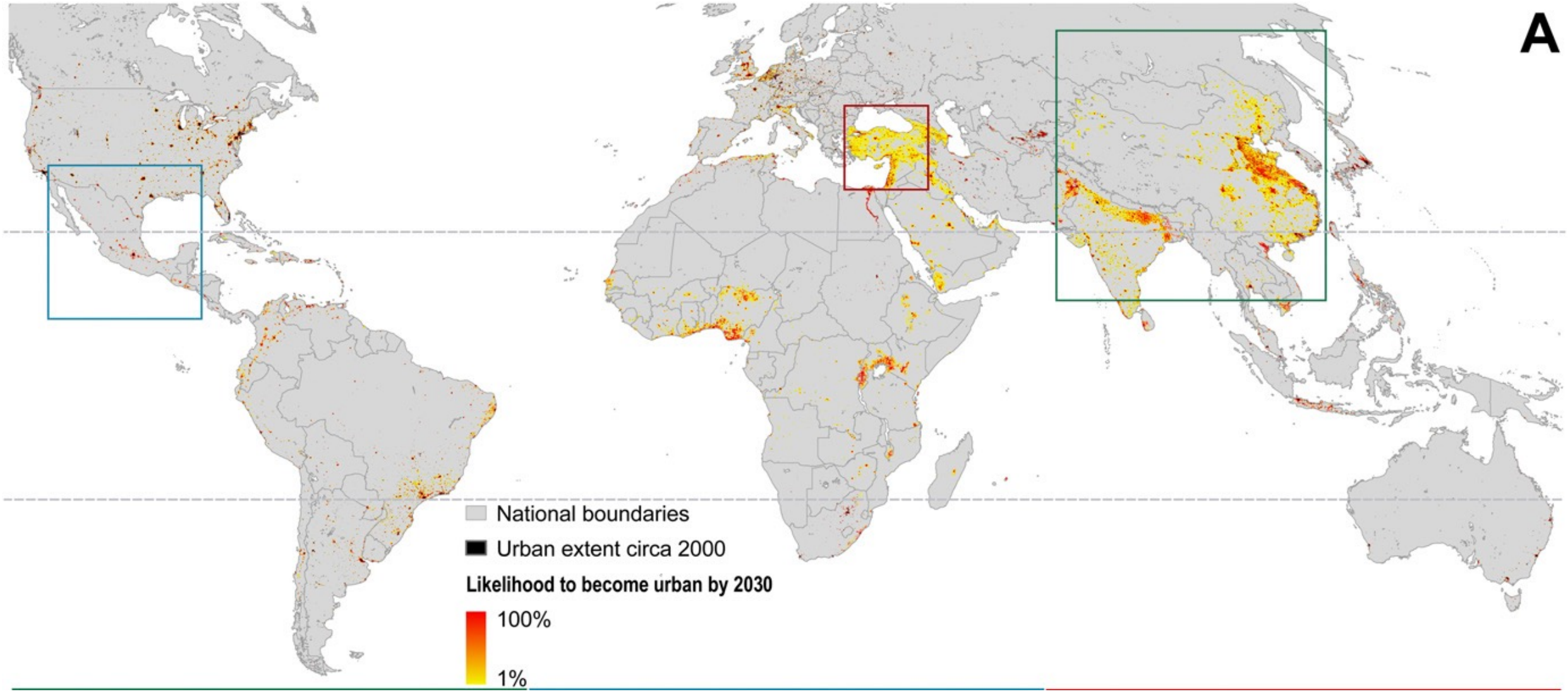
- Impactos sobre a biodiversidade



Seto et al 2012 PNAS: 109: 16083-16088

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Table 2. Biodiversity hotspots threatened by forecasted urban expansion, 2030

Biodiversity hotspot (10, 16)	Hotspot area not threatened by urban expansion (km^2) (percentage of hotspot)	Urban expansion in hotspot (km^2) by probability quartile range (percentage of hotspot)*				Urban extent in hotspots *ca.* 2000 (km^2) (percentage of hotspot)
		>0–25	>25–50	>50–75	>75–100	
Atlantic Forest	1,060,700 (85.0)	103,775 (8.3)	11,350 (0.9)	5,850 (0.5)	40,975 (3.3)	25,100 (2.0)
California Floristic Province	261,625 (88.2)	8,700 (2.9)	1,500 (0.5)	350 (0.1)	9,675 (3.3)	14,750 (5.0)
Cape Floristic Region	80,400 (97.4)	175 (0.2)	25 (0.0)	0 (0.0)	1,100 (1.3)	875 (1.1)
Caribbean Islands	201,525 (88.1)	9,700 (4.2)	2,900 (1.3)	1,825 (0.8)	8,825 (3.9)	3,900 (1.7)
Caucasus	374,825 (70.4)	126,700 (23.8)	8,800 (1.7)	6,400 (1.2)	6,325 (1.2)	9,425 (1.8)
Cerrado	2,011,875 (97.4)	30,025 (1.5)	2,975 (0.1)	1,250 (0.1)	10,750 (0.5)	8,400 (0.4)
Chilean Winter Rainfall and Valdivian Forests	381,200 (95.3)	8,200 (2.0)	1,075 (0.3)	575 (0.1)	5,200 (1.3)	3,850 (1.0)
Coastal Forests of Eastern Africa	287,575 (94.6)	9,775 (3.2)	275 (0.1)	300 (0.1)	5,350 (1.8)	800 (0.3)
East Melanesian Islands	102,650 (99.8)	100 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	125 (0.1)
Eastern Afromontane	902,950 (86.2)	99,775 (9.5)	8,400 (0.8)	6,500 (0.6)	28,400 (2.7)	1,500 (0.1)
Guinean Forests of West Africa	482,775 (75.1)	101,950 (15.9)	5,800 (0.9)	3,775 (0.6)	43,675 (6.8)	4,725 (0.7)
Himalaya	729,425 (95.6)	21,375 (2.8)	1,225 (0.2)	1,425 (0.2)	8,600 (1.1)	1,225 (0.2)
Horn of Africa	1,597,450 (95.7)	57,275 (3.4)	2,650 (0.2)	4,650 (0.3)	5,300 (0.3)	1,575 (0.1)
Indo-Burma	2,164,150 (91.1)	130,650 (5.5)	4,775 (0.2)	5,400 (0.2)	50,950 (2.1)	19,650 (0.8)
Irano-Anatolian	705,050 (77.7)	178,300 (19.7)	2,850 (0.3)	3,025 (0.3)	12,075 (1.3)	6,075 (0.7)
Japan	318,150 (85.5)	6,000 (1.6)	4,250 (1.1)	3,700 (1.0)	20,850 (5.6)	19,250 (5.2)
Madagascar and the Indian Ocean Islands	590,525 (98.5)	6,050 (1.0)	350 (0.1)	75 (0.0)	2,100 (0.4)	275 (0.0)
Madrean Pine-Oak Woodlands	510,275 (98.1)	1,725 (0.3)	400 (0.1)	550 (0.1)	5,850 (1.1)	1,100 (0.2)
Maputaland-Pondoland-Albany	260,125 (93.7)	6,300 (2.3)	1,375 (0.5)	1,475 (0.5)	7,225 (2.6)	1,075 (0.4)
Mediterranean Basin	1,687,550 (79.6)	302,825 (14.3)	23,750 (1.1)	16,650 (0.8)	54,675 (2.6)	33,450 (1.6)
Mesoamerica	1,078,325 (96.9)	8,200 (0.7)	2,050 (0.2)	2,575 (0.2)	17,175 (1.5)	4,425 (0.4)
Mountains of Central Asia	816,700 (94.0)	18,200 (2.1)	1,275 (0.1)	1,725 (0.2)	17,925 (2.1)	12,750 (1.5)
Mountains of Southwest China	280,650 (97.7)	6,375 (2.2)	25 (0.0)	75 (0.0)	0 (0.0)	275 (0.1)
New Caledonia	18,975 (98.8)	75 (0.4)	0 (0.0)	50 (0.3)	50 (0.3)	50 (0.3)
New Zealand	259,250 (98.1)	1,625 (0.6)	500 (0.2)	950 (0.4)	750 (0.3)	1,075 (0.4)
Philippines	276,625 (92.7)	6,275 (2.1)	975 (0.3)	650 (0.2)	10,825 (3.6)	2,900 (1.0)
Polynesia-Micronesia	37,300 (96.6)	175 (0.5)	0 (0.0)	0 (0.0)	725 (1.9)	400 (1.0)
Southwest Australia	357,500 (99.3)	250 (0.1)	150 (0.0)	550 (0.2)	550 (0.2)	1,100 (0.3)
Succulent Karoo	105,050 (99.9)	0 (0.0)	0 (0.0)	0 (0.0)	25 (0.0)	50 (0.0)
Sundaland	1,447,600 (96.4)	11,700 (0.8)	2,750 (0.2)	2,825 (0.2)	23,475 (1.6)	12,825 (0.9)
Tropical Andes	1,515,250 (95.4)	35,825 (2.3)	5,025 (0.3)	2,000 (0.1)	23,250 (1.5)	7,450 (0.5)
Tumbes-Choco-Magdalena	247,850 (90.8)	15,450 (5.7)	2,050 (0.8)	900 (0.3)	5,375 (2.0)	1,375 (0.5)
Wallacea	340,050 (99.2)	450 (0.1)	150 (0.0)	375 (0.1)	650 (0.2)	1,275 (0.4)
Western Ghats and Sri Lanka	174,700 (89.1)	11,250 (5.7)	1,075 (0.5)	750 (0.4)	7,500 (3.8)	825 (0.4)
All hotspots	21,666,625 (91.0)	1,325,225 (5.6)	100,750 (0.4)	77,200 (0.3)	436,175 (1.8)	203,900 (0.9)

Table 2. Biodiversity hotspots threatened by forecasted urban expansion, 2030

Biodiversity hotspot (10, 16)	Hotspot area not threatened by urban expansion (km^2) (percentage of hotspot)	Urban expansion in hotspot (km^2) by probability quartile range (percentage of hotspot)*				Urban extent in hotspots *ca.* 2000 (km^2) (percentage of hotspot)
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California Floristic Province	261,625 (88.2)	8,700 (2.9)	1,500 (0.5)	350 (0.1)	9,675 (3.3)	14,750 (5.0)
Cape Floristic Region	80,400 (97.4)	175 (0.2)	25 (0.0)	0 (0.0)	1,100 (1.3)	875 (1.1)
Caribbean Islands	201,525 (88.1)	9,700 (4.2)	2,900 (1.3)	1,825 (0.8)	8,825 (3.9)	3,900 (1.7)
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Eastern Afromontane	902,950 (86.2)	99,775 (9.5)	8,400 (0.8)	6,500 (0.6)	28,400 (2.7)	1,500 (0.1)
Guinean Forests of West Africa	482,775 (75.1)	101,950 (15.9)	5,800 (0.9)	3,775 (0.6)	43,675 (6.8)	4,725 (0.7)
Himalaya	729,425 (95.6)	21,375 (2.8)	1,225 (0.2)	1,425 (0.2)	8,600 (1.1)	1,225 (0.2)
Horn of Africa	1,597,450 (95.7)	57,275 (3.4)	2,650 (0.2)	4,650 (0.3)	5,300 (0.3)	1,575 (0.1)
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Mediterranean Basin	1,687,550 (79.6)	302,825 (14.3)	23,750 (1.1)	16,650 (0.8)	54,675 (2.6)	33,450 (1.6)
Mesoamerica	1,078,325 (96.9)	8,200 (0.7)	2,050 (0.2)	2,575 (0.2)	17,175 (1.5)	4,425 (0.4)
Mountains of Central Asia	816,700 (94.0)	18,200 (2.1)	1,275 (0.1)	1,725 (0.2)	17,925 (2.1)	12,750 (1.5)

Urbanização

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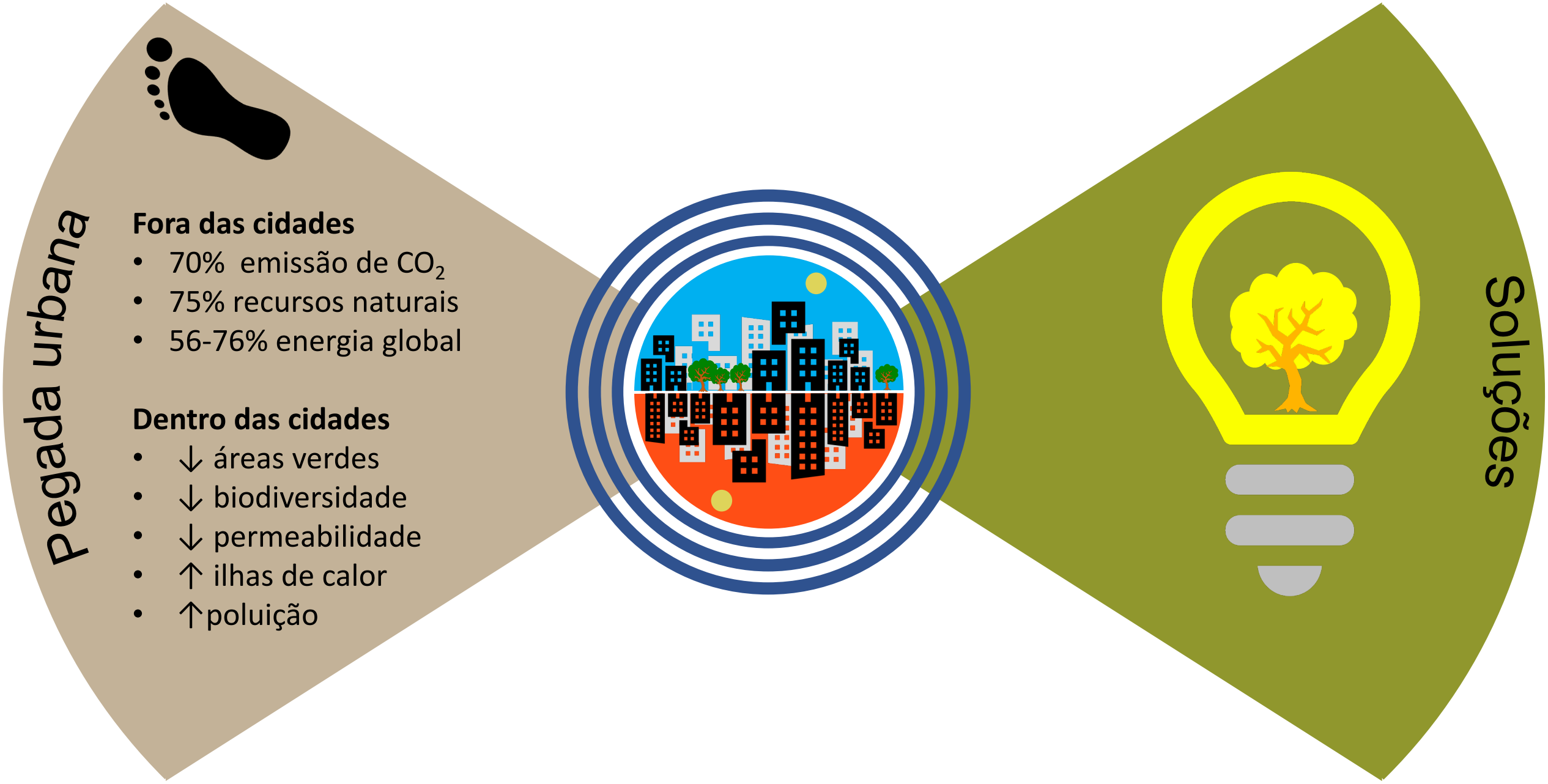
Passos da co-criação

- Definir o desafio
- Identificar os problemas e oportunidades
- Conhecer questões associadas
- Definir as equipes ?
- Elaborar as propostas e os protótipos
- Testar as ideias
- Escrutinar as melhores ideias



Locosselli and Buckeridge (2023) 37: 1-7