20ᵗʰ International Geography Olympiad

Maynooth, Ireland

19–24 August 2024

WRITTEN RESPONSE TEST

Resource Booklet

Do NOT open the Booklet before instructed to do so by a supervisor.

Do NOT write any of your answers in this Booklet.

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Section A: Plastic pollution in oceans

Figure A1: Ocean gyres in the world: 1 – North Pacific Gyre, 2 – Indian Ocean Gyre, 3 – South Pacific Gyre, 4 – South Atlantic Gyre, 5 – North Atlantic Gyre
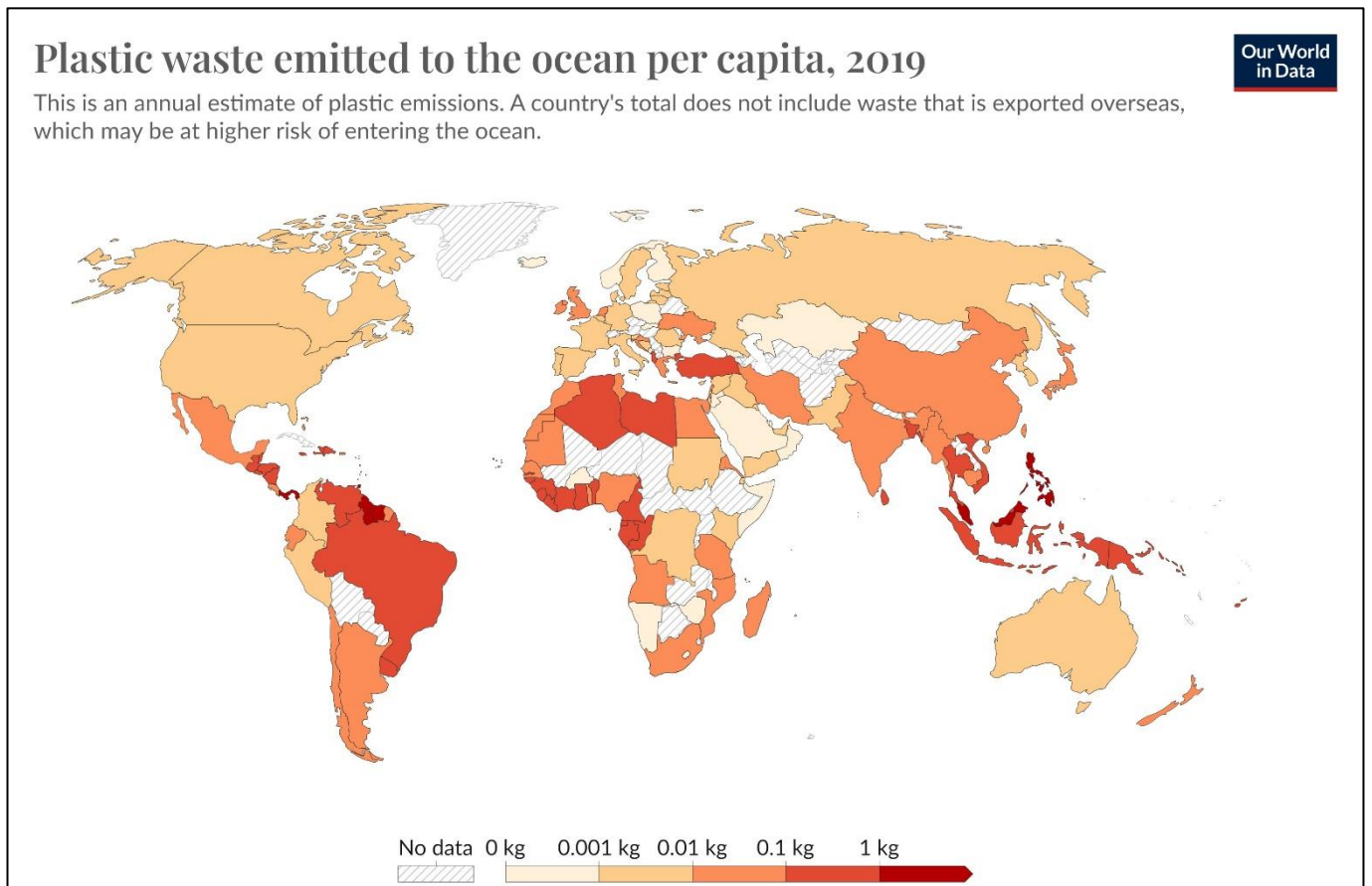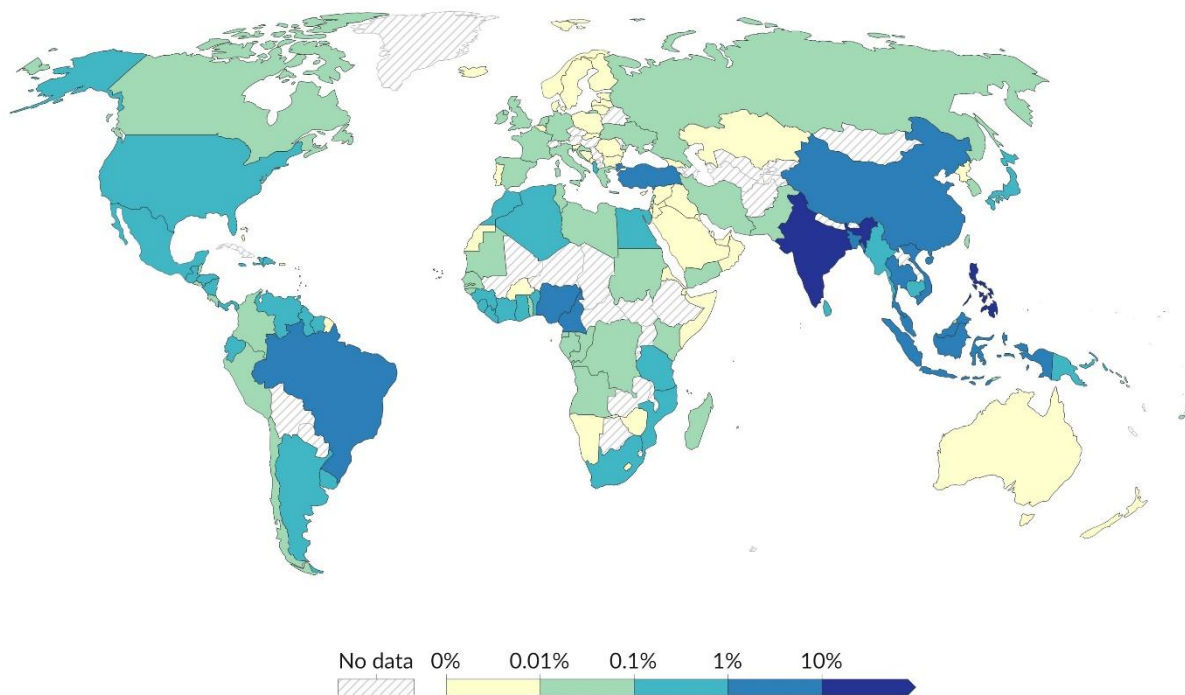(https://theoceancleanup.com/great-pacific-garbage-patch/)

Figure A2: Plastic waste emitted to the ocean per capita by country in 2019
(Meijer et al., 2021)

Figure A3: Share of global plastic waste emitted to the ocean by country in 2019
(Meijer et al., 2021)

Section B: Amazon forest ecosystem
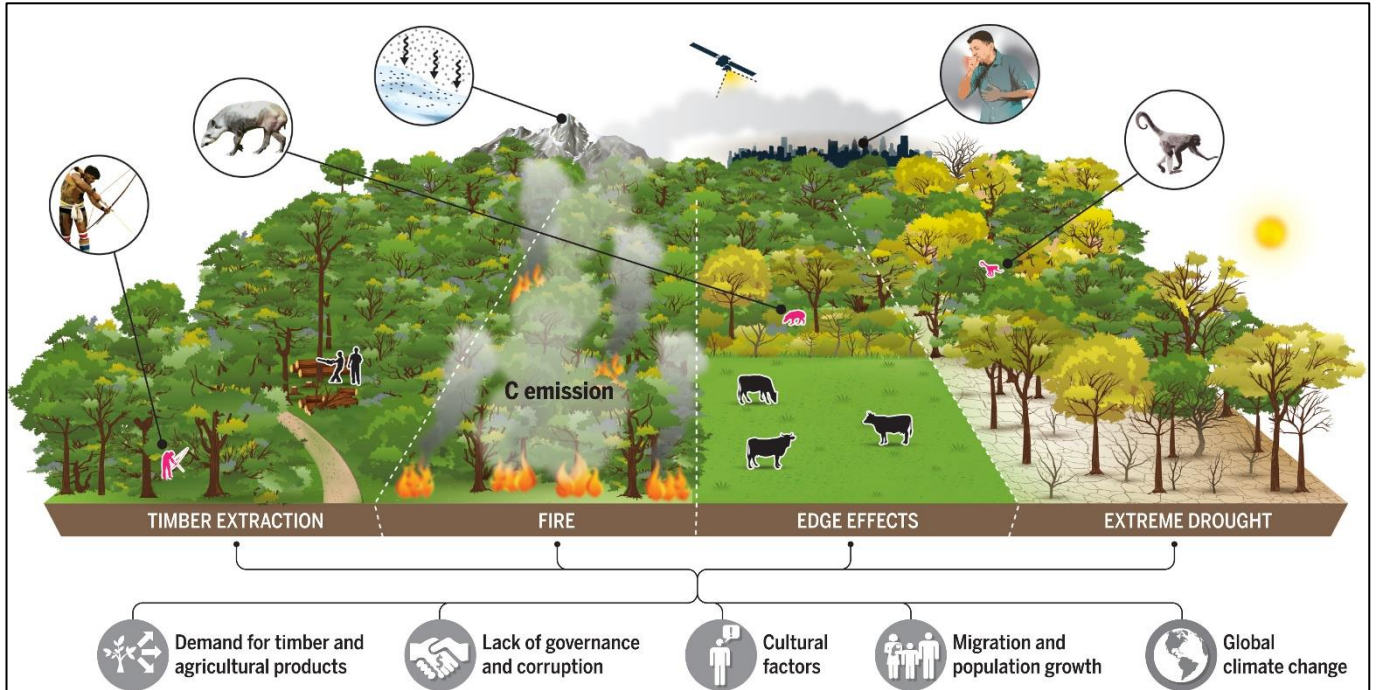
Figure B1: An overview of tropical forest degradation processes in the Amazon
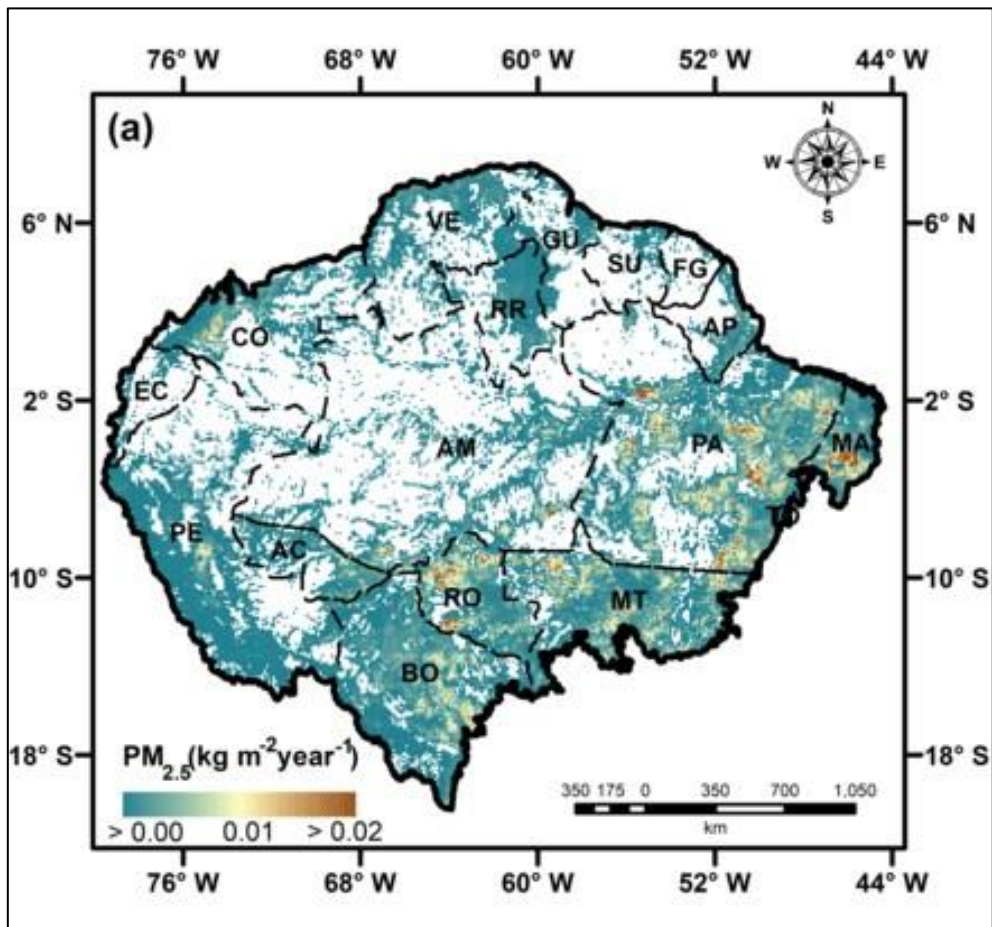(https://www.science.org/doi/10.1126/science.abp8622)

Figure B2. The distribution of PM2.5 persistent organic pollutants in the atmosphere
NOTE: PM2.5 – fine particles in the air that are 2.5 microns or less in diameter
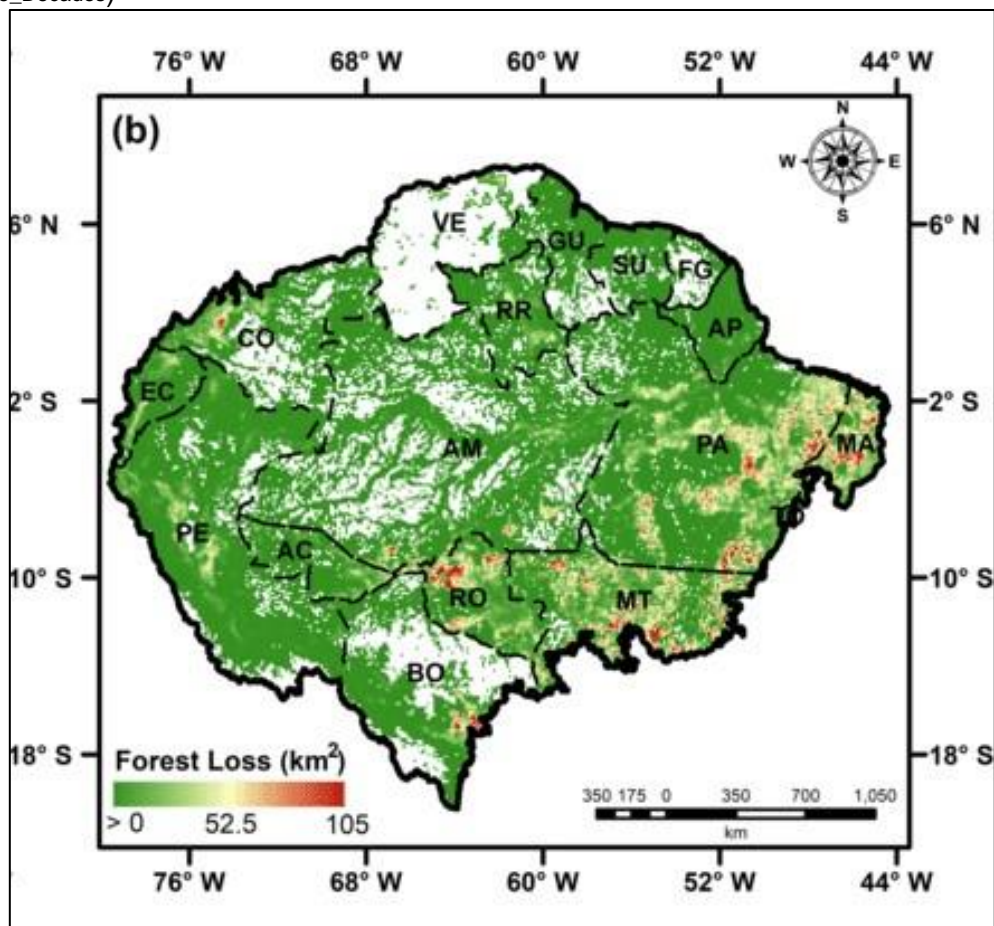
Figure B3. The extent of deforestation in the Amazon Forest.

Section C: Monsoon and weather phenomena in Dubai

Table C1. Climate data of Kathmandu and Dubai

(https://en.climate-data.org/)

Month	Average Temperature (°C)		Precipitation (mm)		Humidity (%)		Rainy Days	
	Kathmandu	Dubai	Kathmandu	Dubai	Kathmandu	Dubai	Kathmandu	Dubai
January	9.2	19.4	44	17	73%	61%	5	2
February	11.3	20.7	56	15	69%	57%	7	2
March	14.6	23.3	59	16	57%	52%	8	2
April	17.9	27.7	79	4	54%	45%	10	0
May	19.1	31.8	205	0	72%	42%	16	0
June	20.5	33.8	460	0	85%	47%	19	0
July	20.3	35.6	778	2	92%	47%	22	0
August	20.3	35.7	643	0	91%	46%	22	0
September	19.5	33.2	334	0	88%	52%	20	0
October	16.8	30.0	98	1	80%	54%	12	0
November	13.6	25.5	30	3	75%	57%	6	1
December	10.7	21.3	26	10	76%	61%	4	1
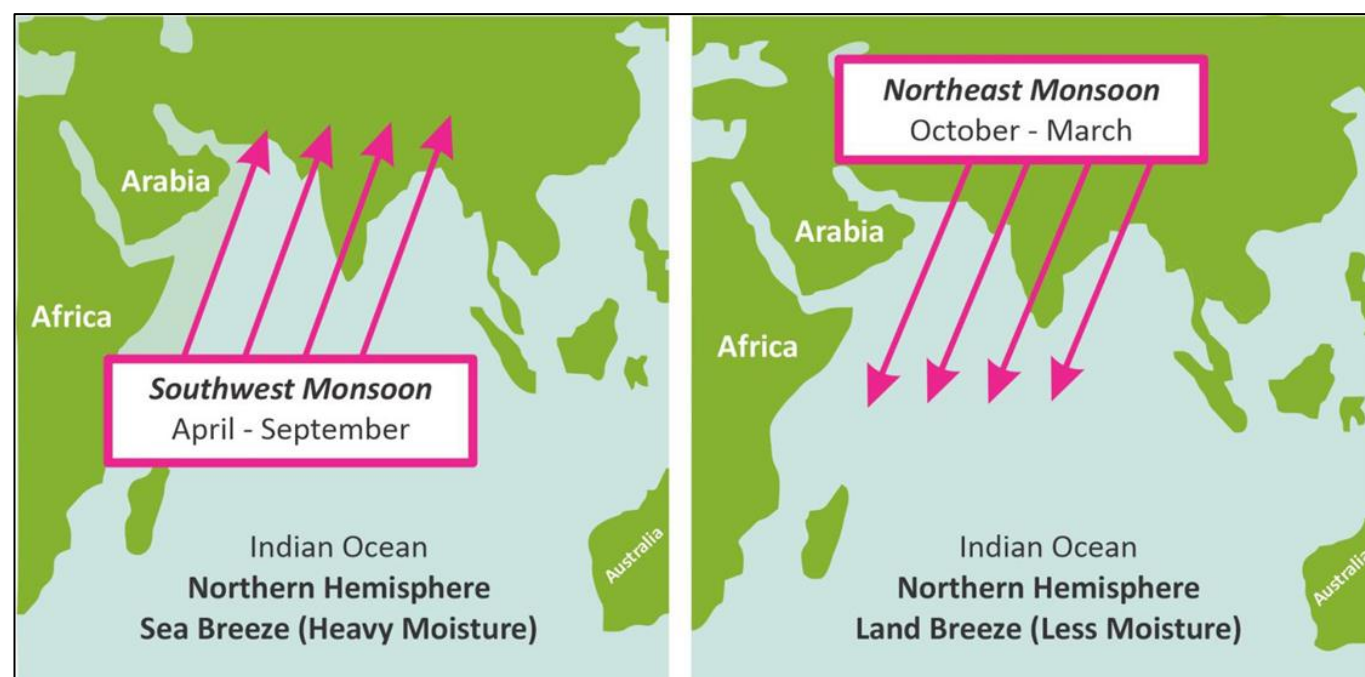
Figure C1. Monsoon system mechanism in Indian ocean and surrounding continents

(https://plutusias.com/monsoon-shocks/)

Text box C1. Flood after a rainstorm in Dubai on 19 April 2024

On 19 April 2024, Dubai experienced an unprecedented weather event with record-breaking rainfall of 259.5 mm, causing widespread flooding and the heaviest rainfall since records began in 1949. The impact of this historic storm had a profound effect on traffic and daily life in Dubai, particularly at Dubai International Airport. There were hundreds of flight cancellations and delays, and commuters were stranded for more than 12 hours in some cases. The heavy rainfall overwhelmed the infrastructure and raised the question of how prepared the city is for such extreme weather events.

Satellite image of Dubai, April 3, 2024. NASA

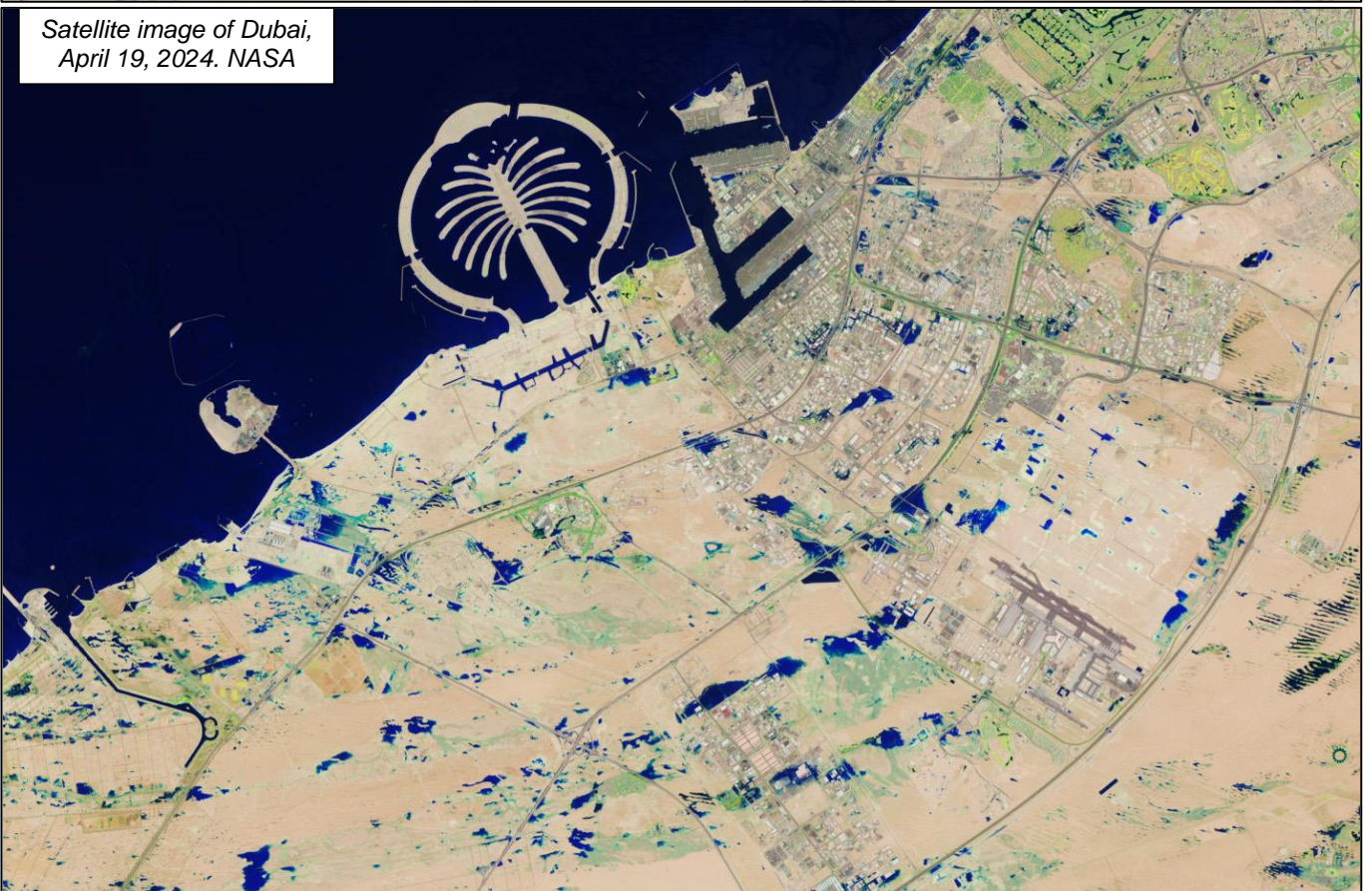Satellite image of Dubai, April 19, 2024. NASA

Figure C2. Deluge in the United Arab Emirates in April 2024
(https://earthobservatory.nasa.gov/images/152703/deluge-in-the-united-arab-emirates)

Figure C3. Flooded road and airport after a rainstorm in Dubai on 19 April 2024
(https://www.reuters.com/, https://moodiedavittreport.com)

Section D: Periglacial landscape and climate change
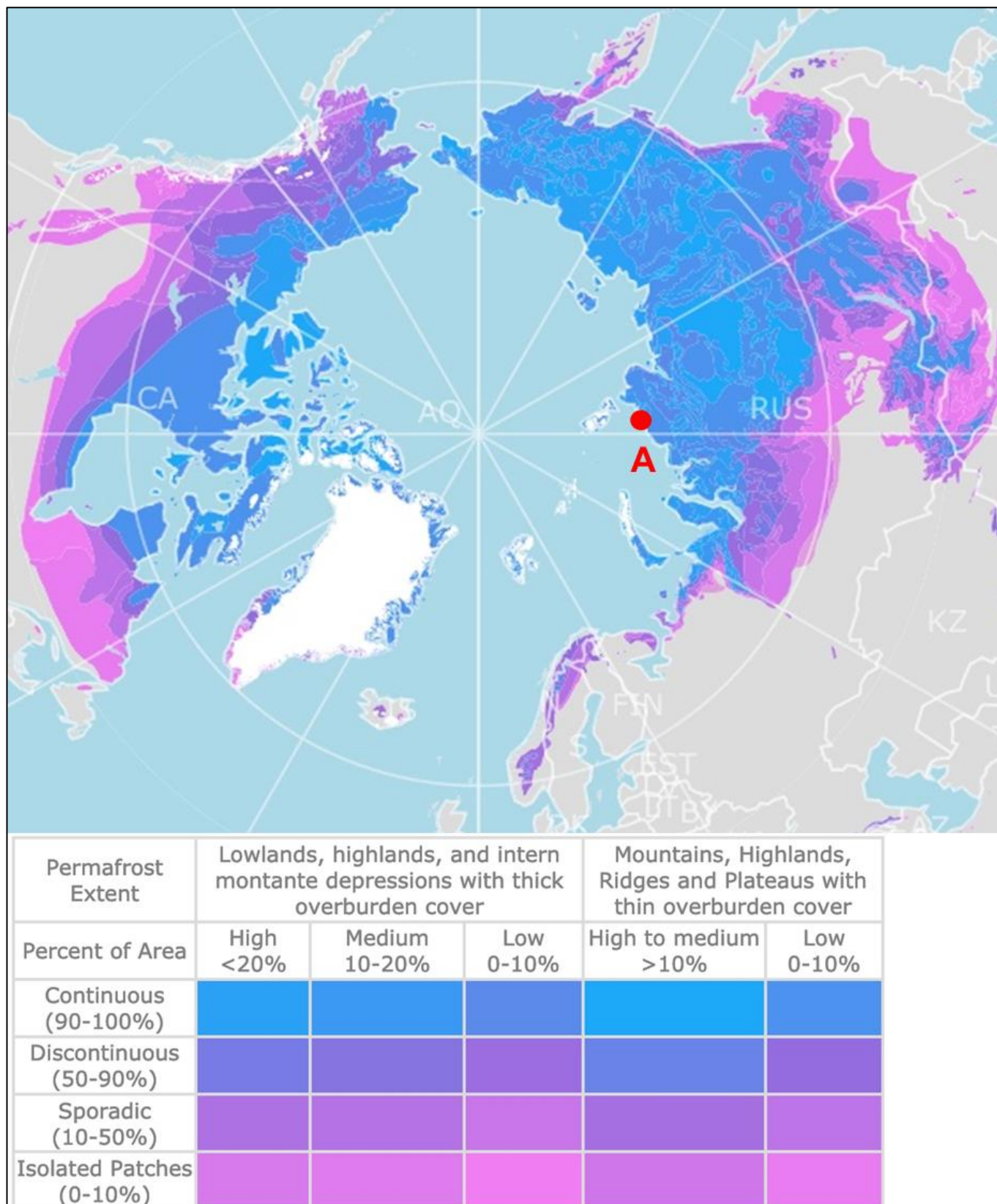
Figure D1. Permafrost zones in the Arctic area (point A represents the site in Figure D2)

(https://databayou.com/arctic/permafrost.html)

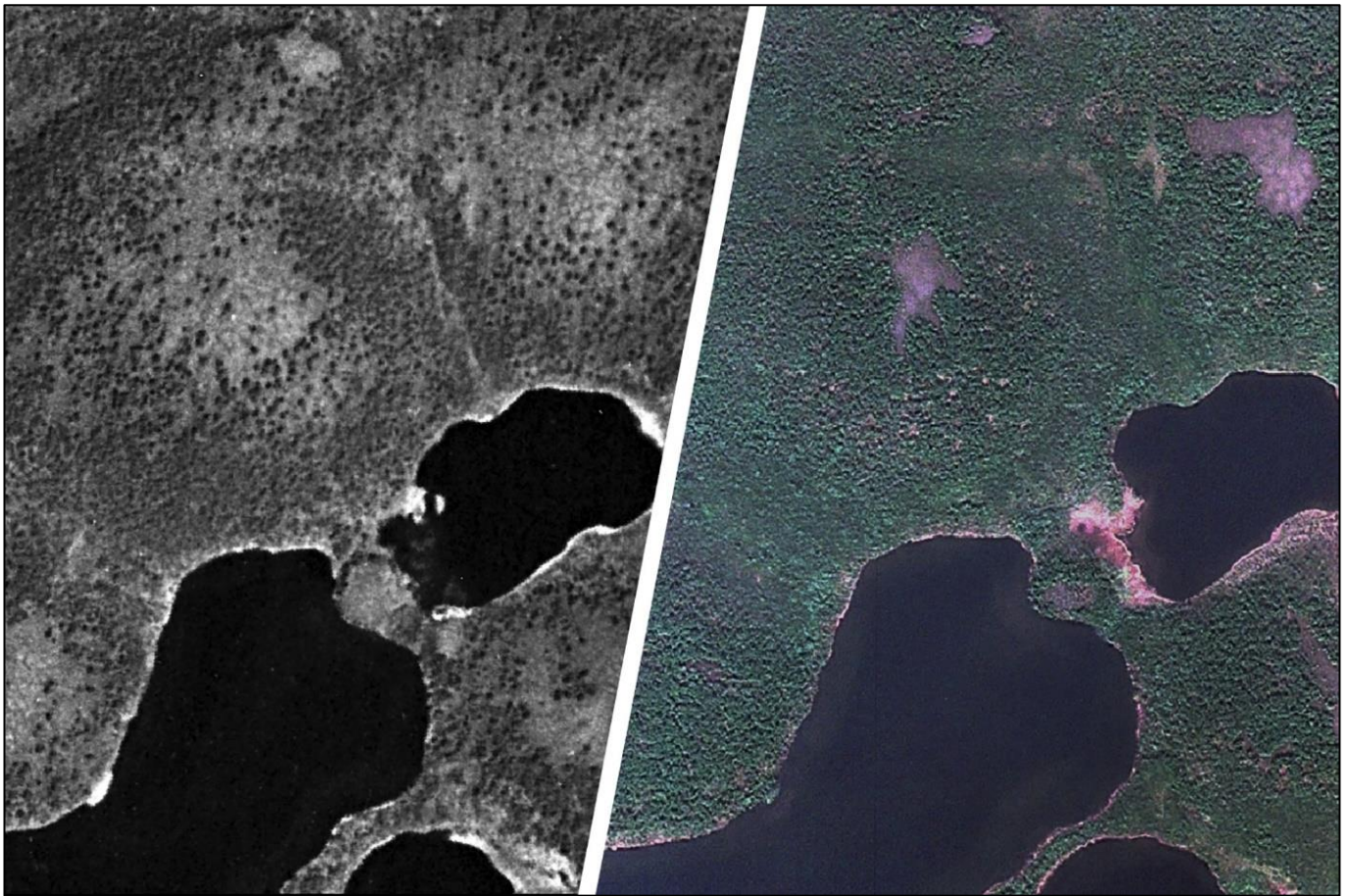| Permafrost Extent	Lowlands, highlands, and intern montante depressions with thick overburden cover			Mountains, Highlands, Ridges and Plateaus with thin overburden cover	
Percent of Area	High <20%	Medium 10-20%	Low 0-10%	High to medium >10%	Low 0-10%
Continuous (90-100%)					
Discontinuous (50-90%)					
Sporadic (10-50%)					
Isolated Patches (0-10%)					

Figure D2. Satellite image of the site on Taymyr Island in Russian Siberia in July 1966 (left) and July 2009 (right), marked with point A in Figure D1
(https://news.virginia.edu/content/cold-war-era-spy-satellite-images-reveal-possible-effects-climate-change)

Table D1. Data on main greenhouse gasses in the atmosphere
(https://css.umich.edu/publications/factsheets/climate-change/greenhouse-gases-factsheet)

Compound	Pre-industry Concentration	Concentration in 2019	Atmospheric Lifetime (years)	Main Human Activity Source	GWP**
Carbon dioxide (CO_2)	278 ppm	416 ppm*	Variable	Fossil fuels, cement production, land use change	1
Methane (CH_4)	729 ppb	1908 ppb*	12	Fossil fuels, Rice paddies, waste dumps, livestock	30 (fossil fuel), 27 (non fossil fuel)
Nitrous Oxide (N_2O)	270 ppb	335 ppb*	109	Fertilizers, combustion industrial processes	273
HFC-134a (CF_3CH_2F)	0 ppt	108 ppt	14	Refrigerant	1,526
HFC-32 (CH_2F_2)	0 ppt	20 ppt	5	Refrigerant	771
CFC-11 (CCl_3F)	0 ppt	226 ppt	52	Refrigerant	6,226
PFC-14 (CF_4)	34 ppt	86 ppt	50,000	Aluminum production	7,380

*Concentration in 2021; ** GWP – 100-year global warming potential; PPM – parts per million; PPB – parts per billion
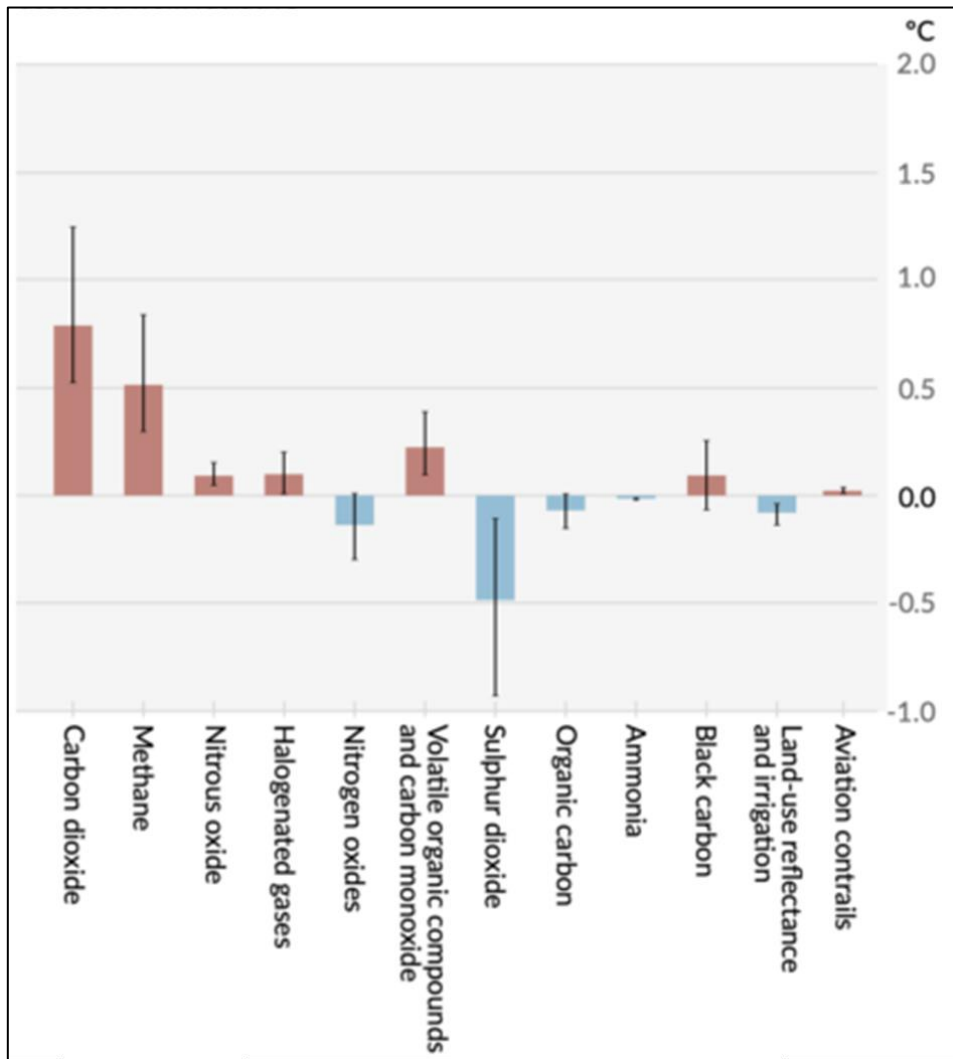
Figure D3. Contribution of greenhouse gases to global temperature rise (2010-2019 compared to 1850-1900)

(https://www.realclimate.org/index.php/archives/2021/09/the-definitive-co2-ch4-comparison-post/)
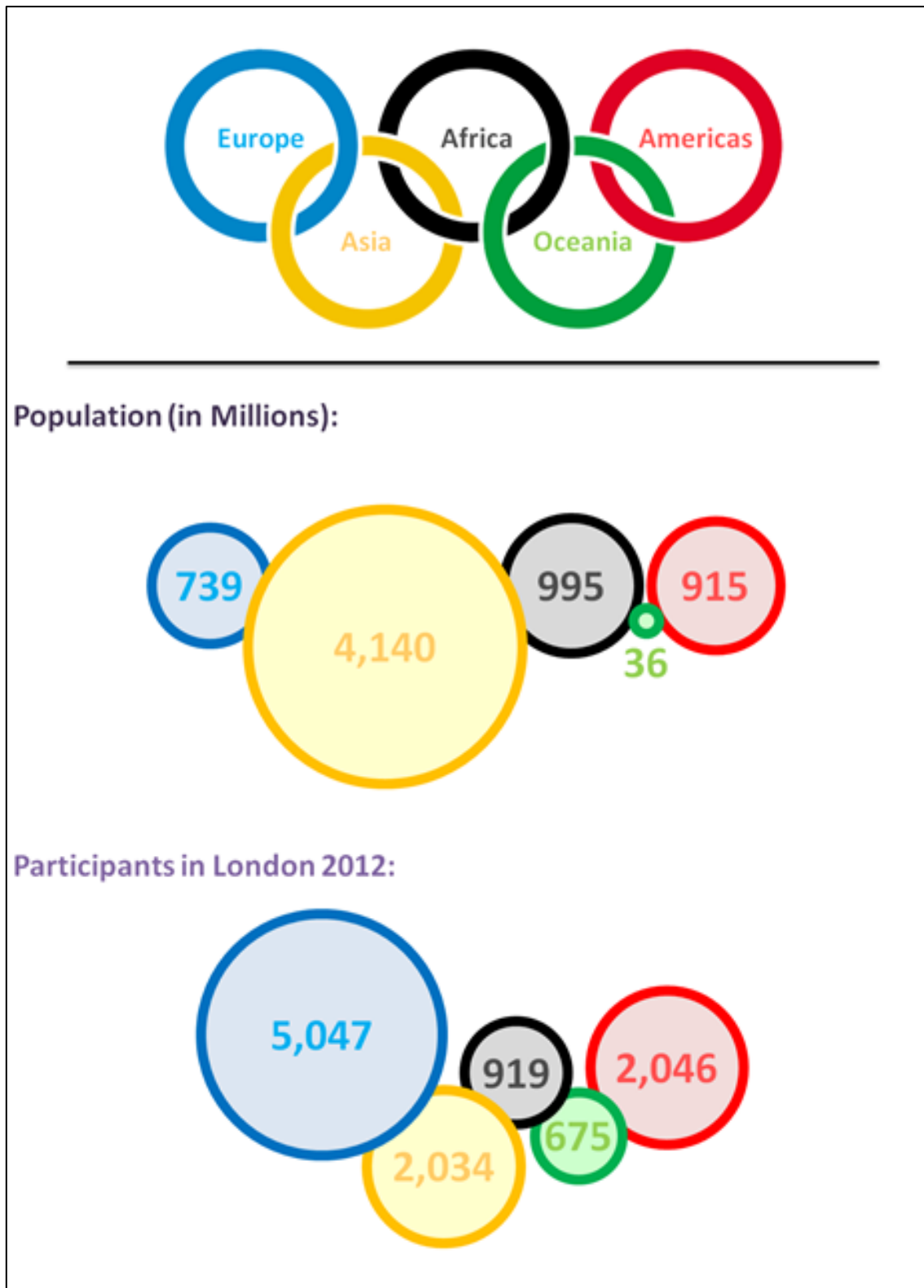
Section E: Olympic games

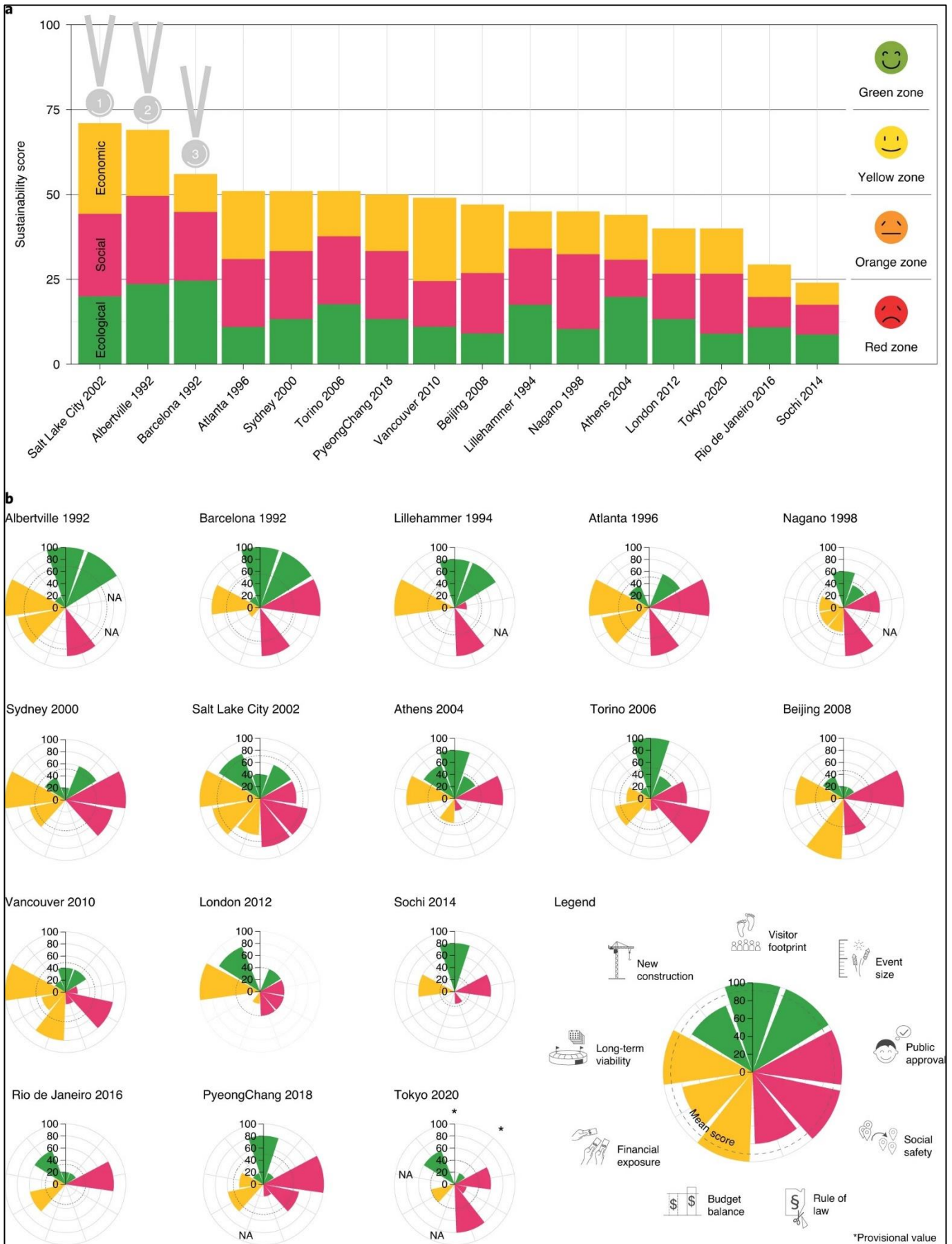**Figure E1. Population and number of participants in London Summer Olympic Games in 2012 per continent**
(http://www.ativaesporte.com/curiosities/olympic-geography/attachment/olympics/)

Figure E2. Ranking of Olympic cities according to ecological, social and economic sustainability
(https://www.nature.com/articles/s41893-021-00696-5#additional-information)

Figure E3. Aerial imagery of the site of the Olympic Village of Poblenou in Barcelona in 1977 (top image) and in 2022 (bottom image)

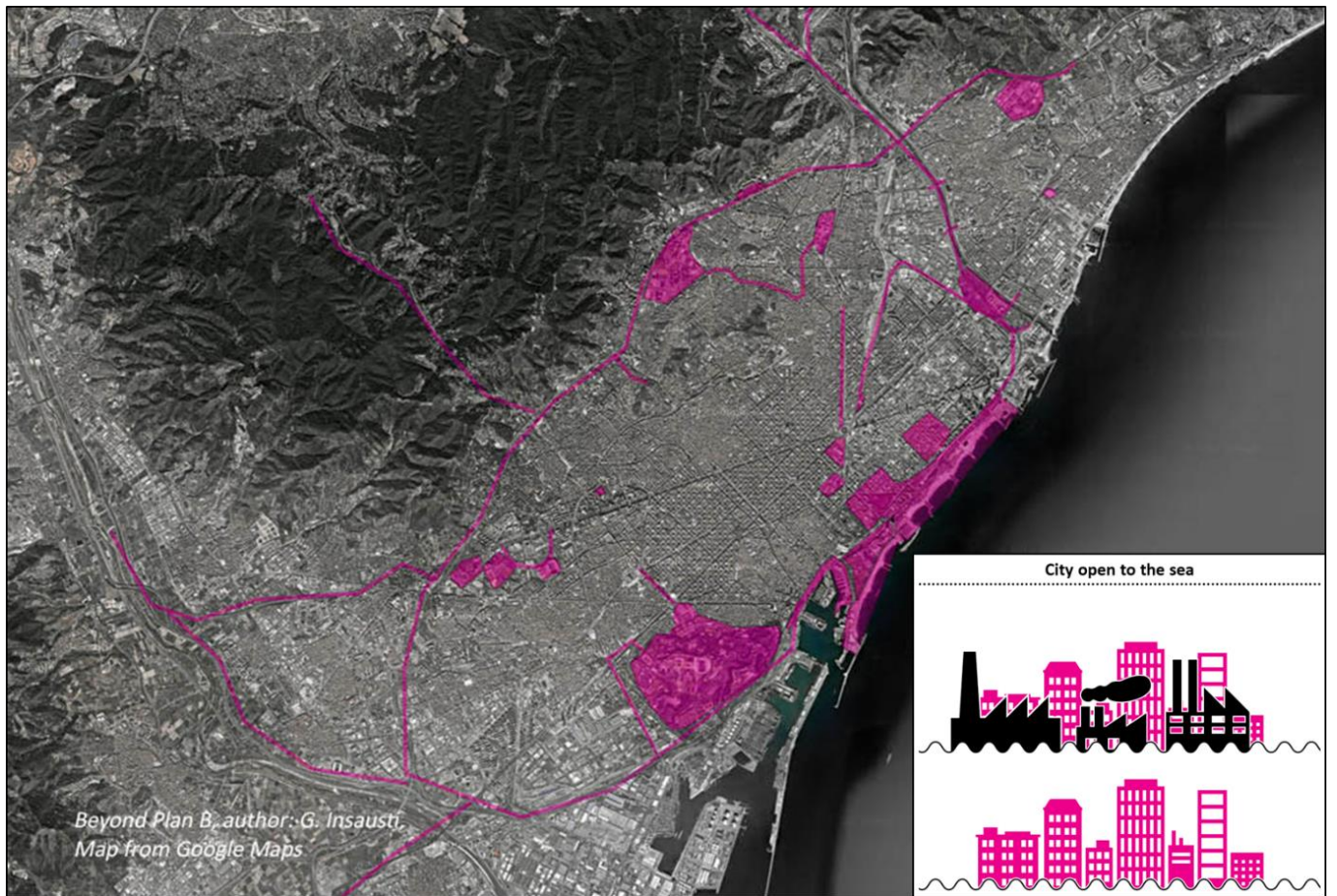(https://soar.earth/maps?pos=41.3896825636242%2C2.1963317950353645%2C16.54)

Figure E4. Barcelona urban regeneration project 1986-1992 (remodelled areas are marked in pink)
(https://beyondplanb.eu/projects/project_barcelona_a_92_olympic.html#3)
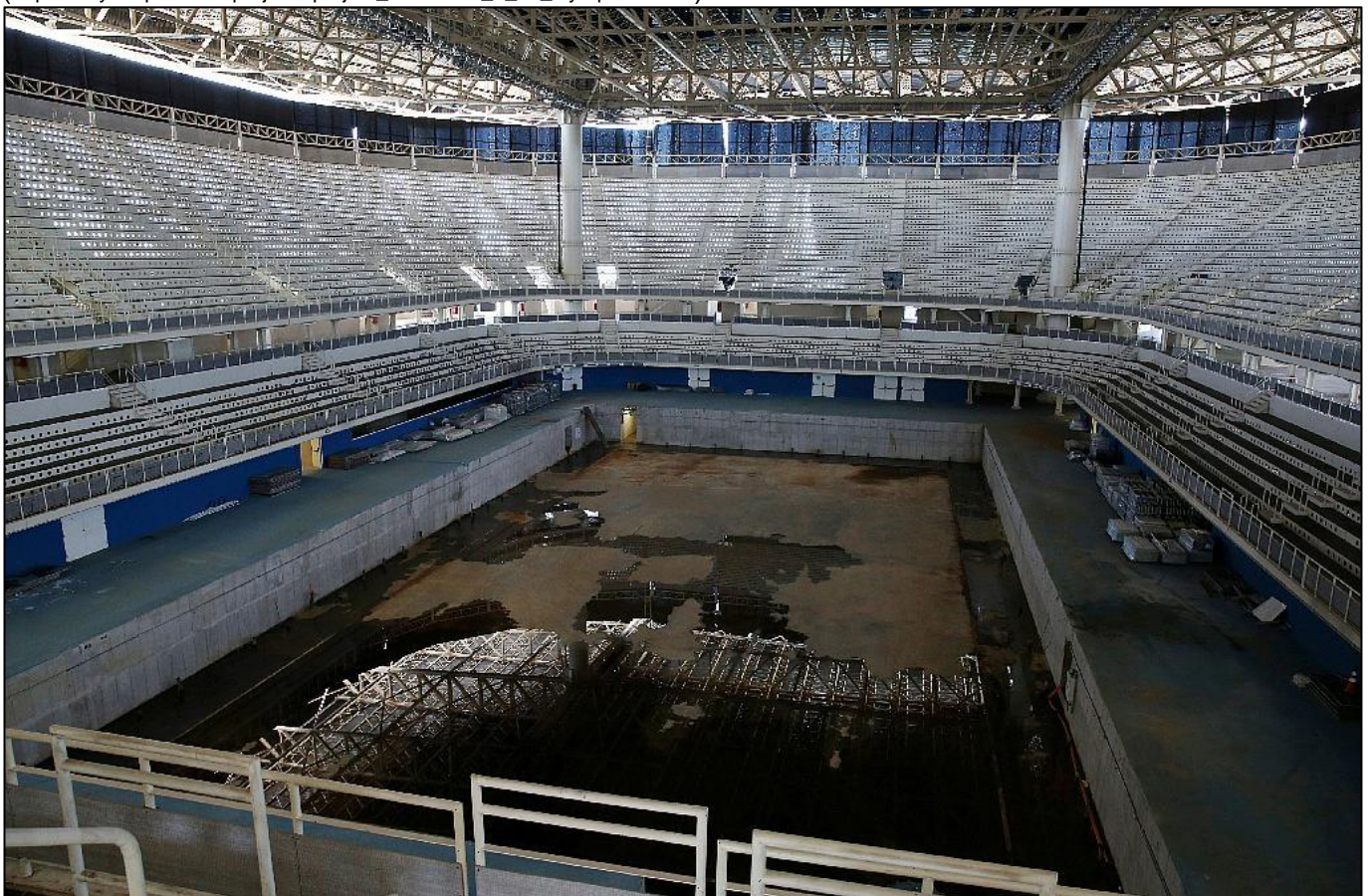

Figure E5. The condition of one of the venues after the Olympic Games in Rio de Janeiro
(https://www.rtvslo.si/zabava-in-slog/ture-avanture/novice/foto-olimpijski-objekti-v-riu-ze-po-enem-letu-v-zalostnem-stanju/429544)

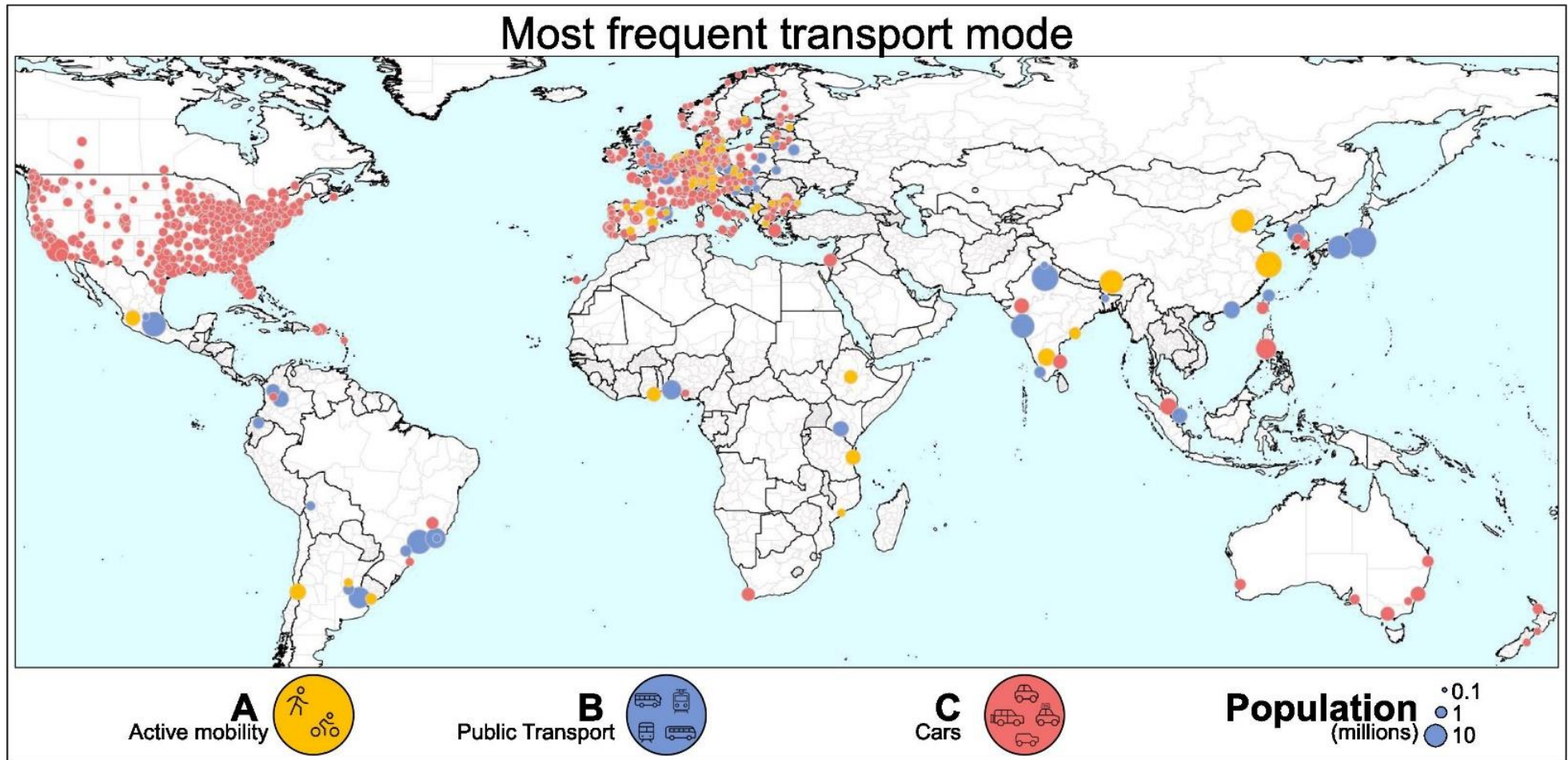## Section F: Commuting mobility in the cities

Figure F1: The most frequent mode of transport for selected World cities

NOTE: Each dot represents a city. The size of each dot is proportional to the population of the city.
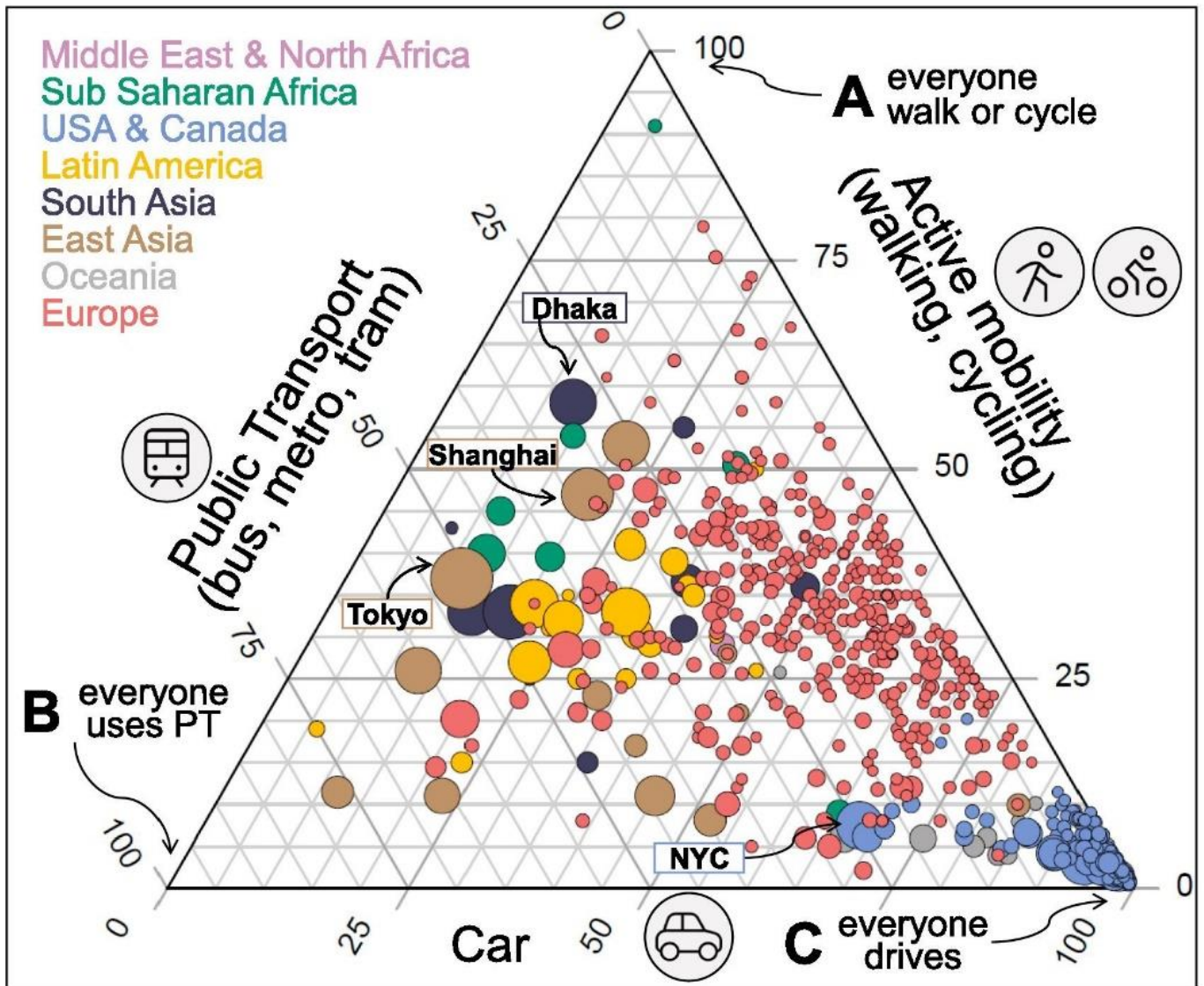
(Source: https://www.sciencedirect.com/science/article/pii/S0160412024001272)

Figure F2: ABC modal share for selected 794 World cities
The size of the disc is proportional to the city's population, and the colour corresponds to the region.
(Source: https://www.sciencedirect.com/science/article/pii/S0160412024001272)