Climate Change Effect and the Utilization Pattern of Micromobility – The Case of Selected European Cities

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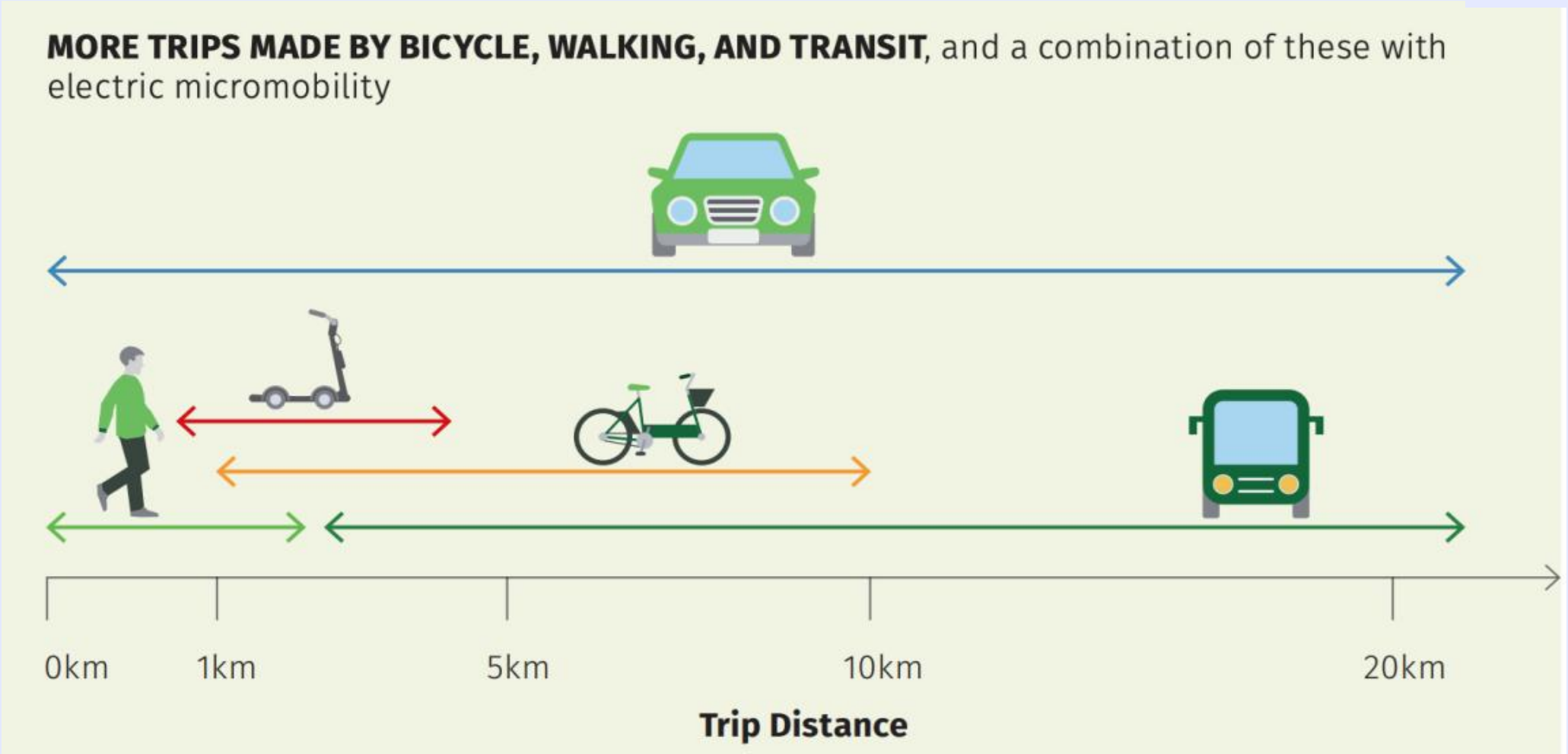
What is Sustainability?

The concept of **sustainability** can be summarized as spending resources without depleting the resources of future generations.

The **Brundtland Report**, better known as Our Common Future, published in 1987, was the first to clearly articulate the concept of sustainability.

Sustainability by Buses as Public Transport Mode

What is Micromobility?



Statistics in Europe

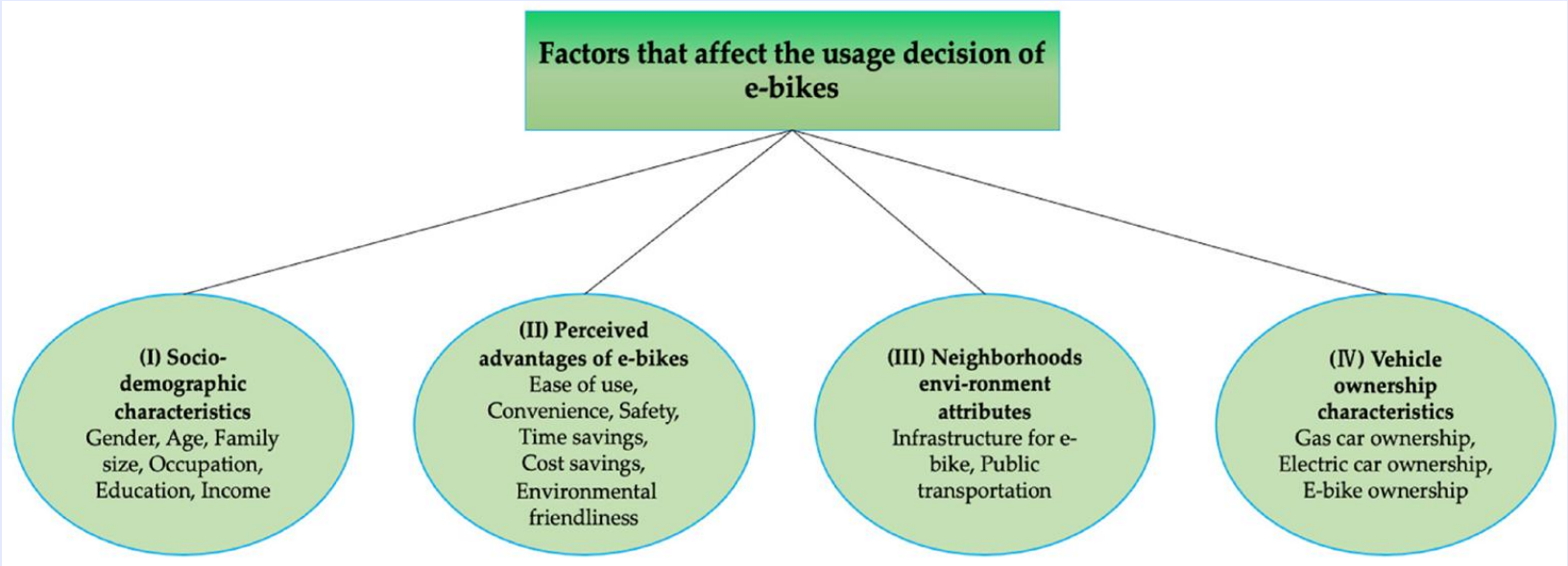
Metric	Value / Trend	Source / Note
EuroVelo network usage growth (2023 → 2024)	~ **6 % increase**	Based on 540 bike-counting sites across Europe. (Eco-Counter)
Bicycle ridership in Q1 2022 (selected countries)	Average **+16 % increase** year-on-year	Across 9 countries; +34 % in France, +12 % in Sweden. (Eco-Counter)
Impact of pop-up bike lanes on cycling	+0.6 % increase in cycling per extra km of pop-up lanes	From a study of 106 European cities using 736 counters. (arXiv)
Cycling tourism in Germany	37.7 million adults cycled on vacations or day trips in 2023	From ADFC Bicycle Travel report. (EuroVelo)
Regular (weekly) cycling in EU	~ **29 %** report cycling at least once a week	Eurobarometer-derived survey data. (euronews)
Cycling infrastructure	ECF tracks data across 37 countries, >460,000 km of existing cycle infrastructure	From ECF's 2023 Annual Report on cycling infrastructure coverage. (ECF)
German cycling intensity	~29 % of cyclists travel more than 30 km per week	From "Cycling Monitor Germany 2023" report. (BMV)
Growth in urban cycling in France	Utilization up 7 % during weekdays, 6 % in urban context	Compared to 2022; includes conventional + e-bikes. (ITS International)

Micromobility Climate Change Relation

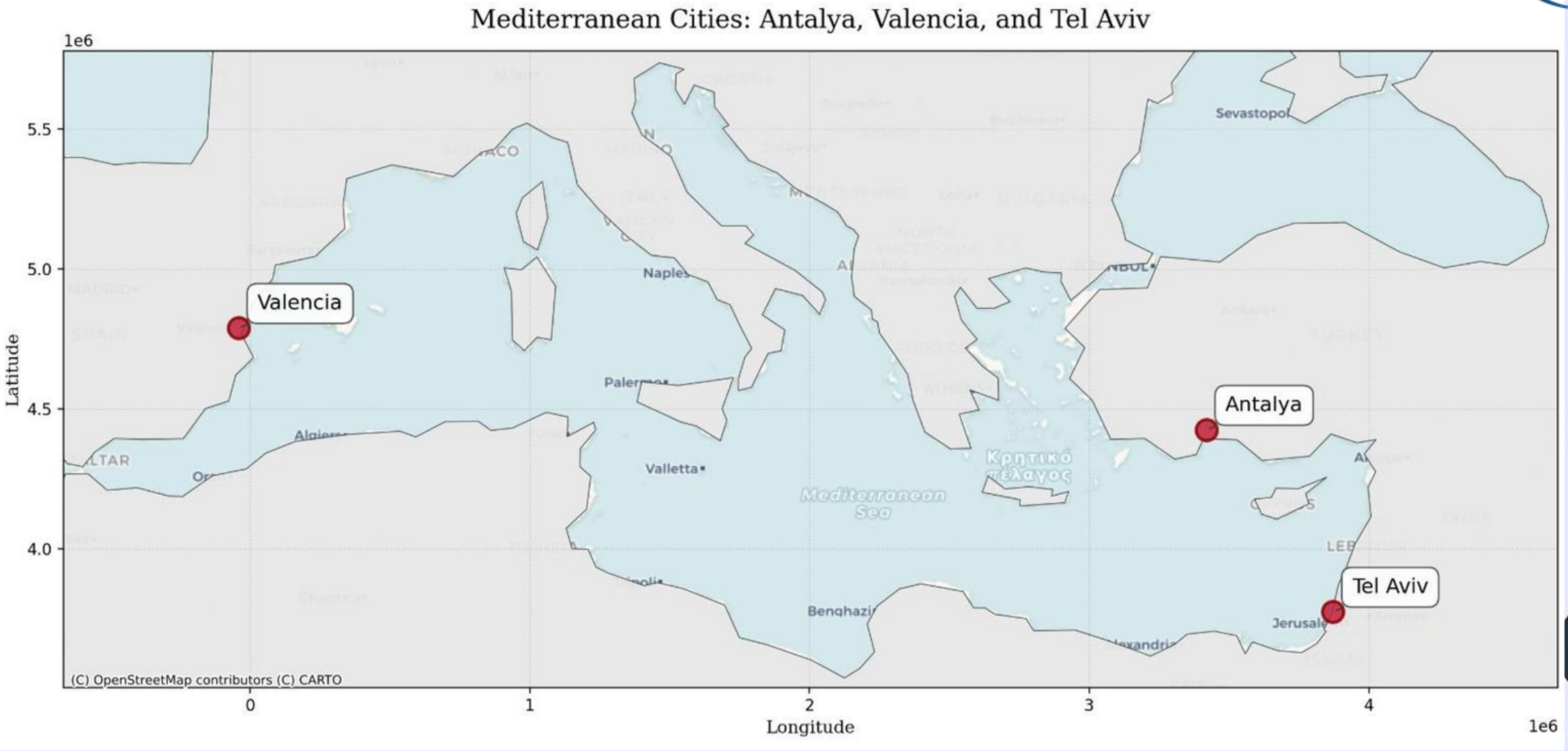
- Micromobility is impacted by temperature and precipitation.
- Micromobility increases as it gets warmer, but decreases as it gets rainy (*Bertini et al., 2023; Pazdan, 2020*).

Objective

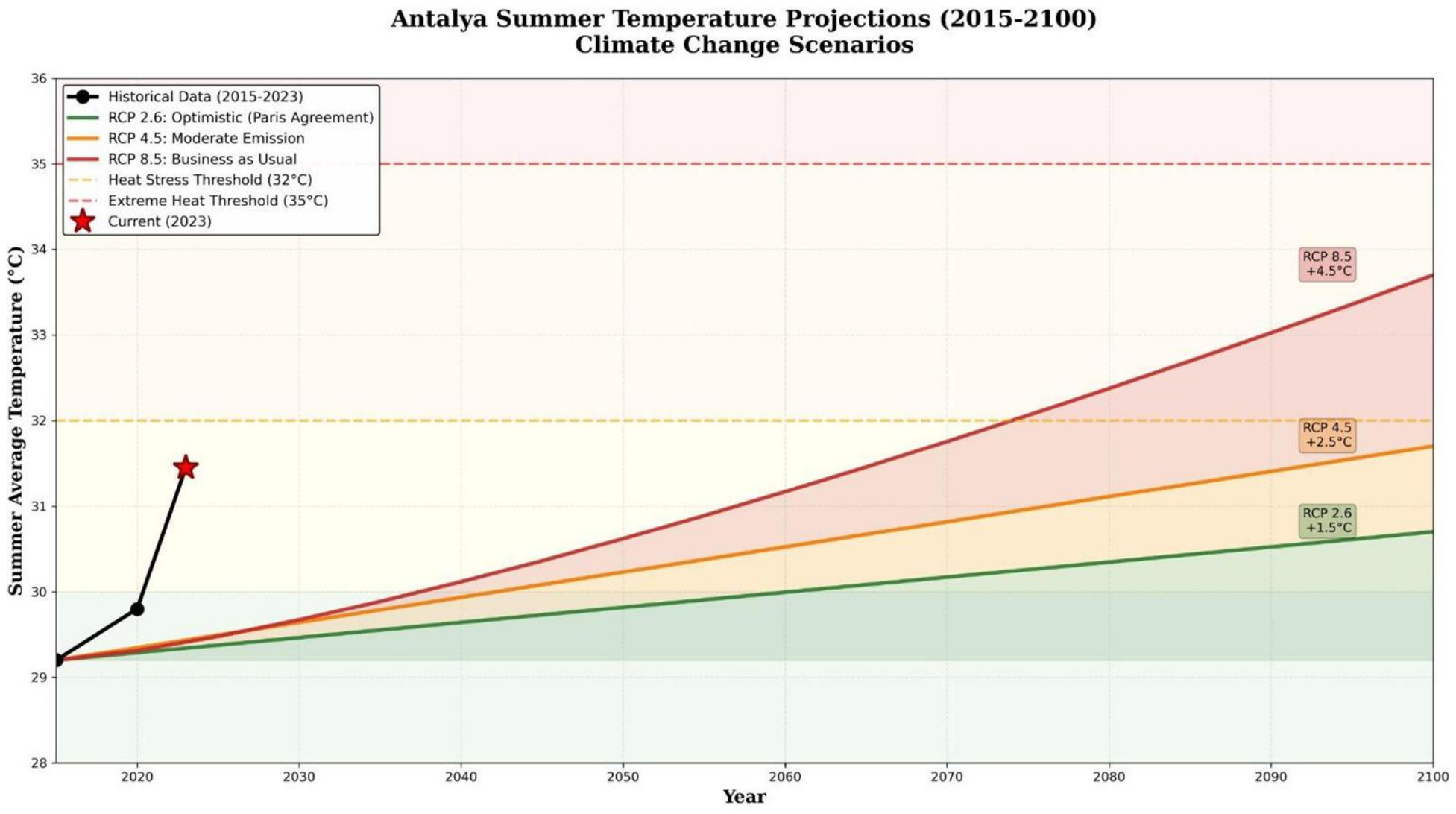
To understand the change in usage patterns of micromobility considering climate change in European cities, which socio-economic groups are impacted the most, and how.



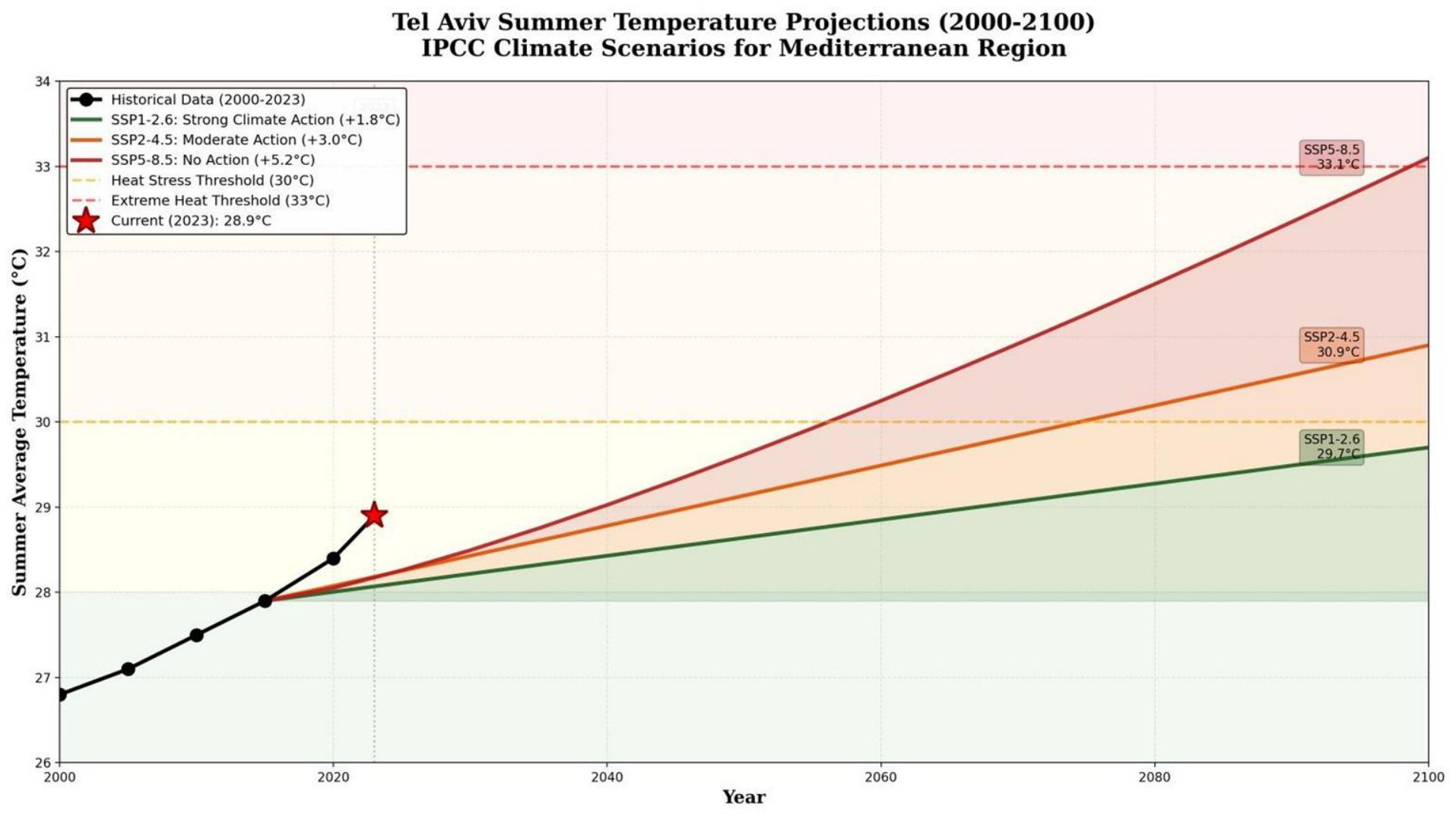
Pilot Cities



Temperature Projections (Antalya)



Temperature Projections (Tel Aviv)



Temperature Projections (Valencia)

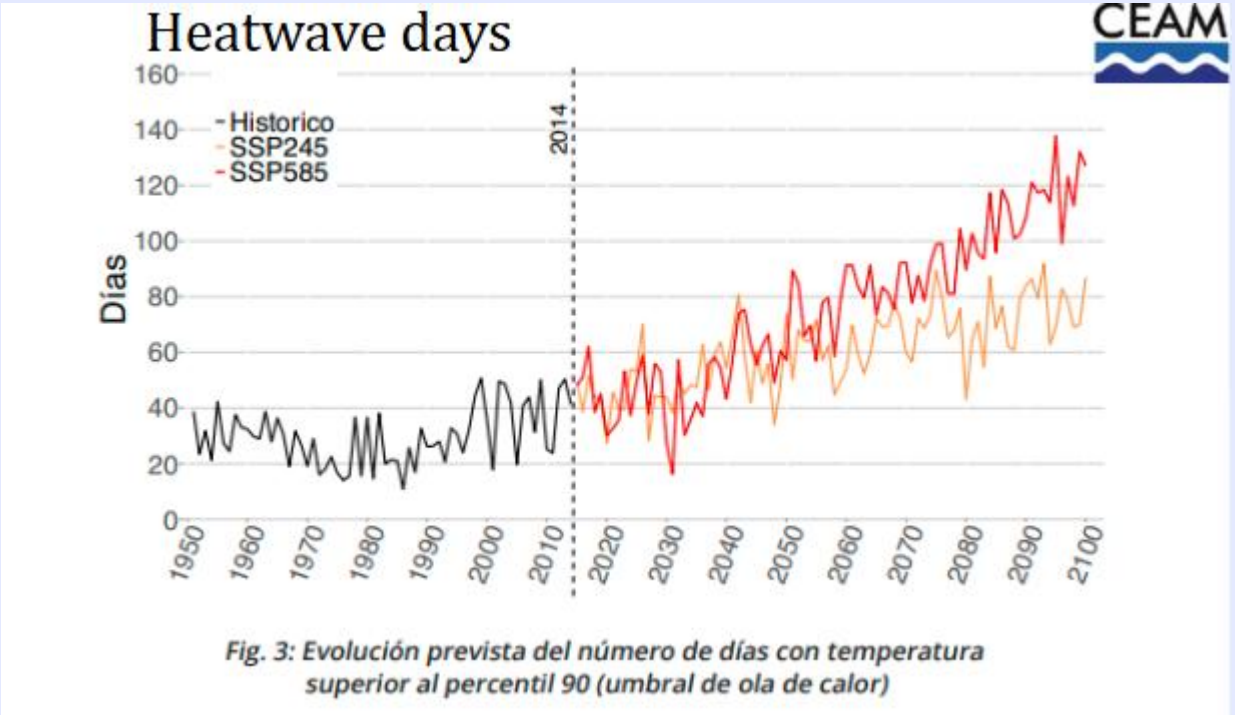


Fig. 3: Evolución prevista del número de días con temperatura superior al percentil 90 (umbral de ola de calor)

Expected evolution of days >P90th maximum temperature in the Valencian Region (ROCIO-IBEB data used)

https://ceammev.es/ceam/index.html?lng=es&view=divulgative

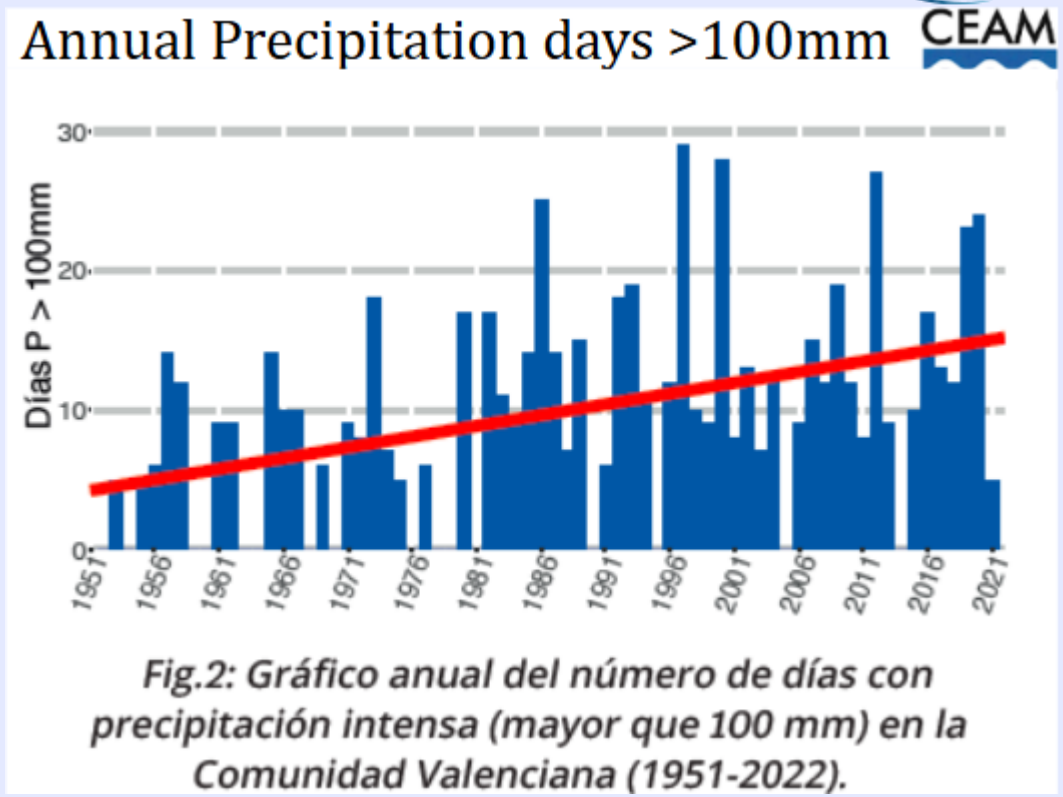


Fig.2: Gráfico anual del número de días con precipitación intensa (mayor que 100 mm) en la Comunidad Valenciana (1951-2022).

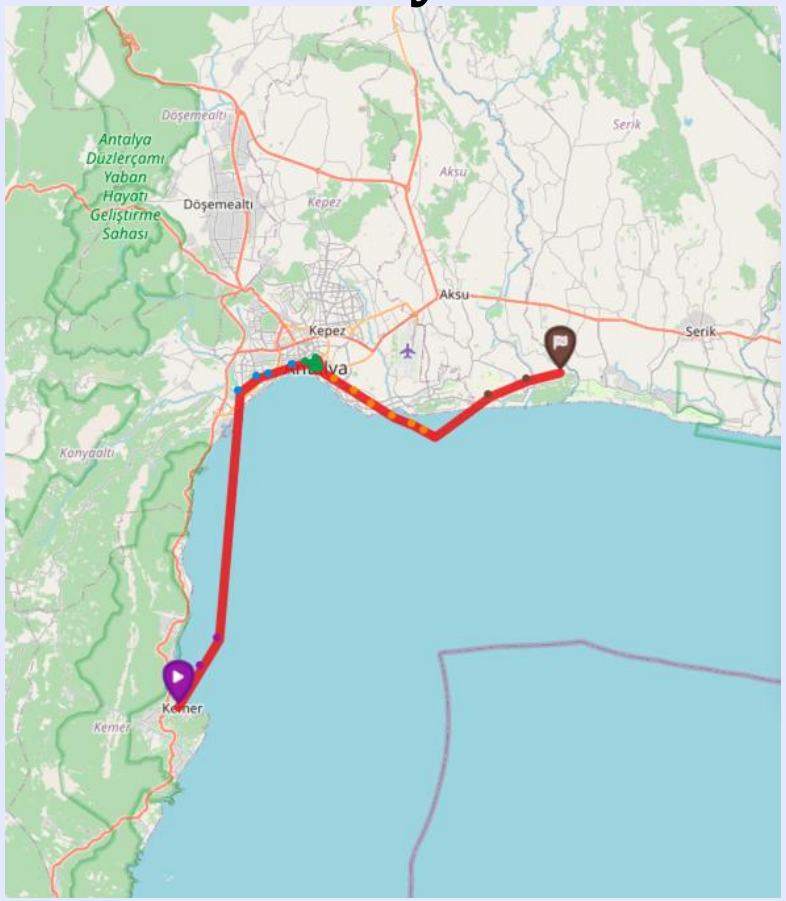
Precipitation days >100 mm trend in the Valencian Region (ROCIO-IBEB data used)

https://ceammev.es/ceam/index.html?lng=es&view=divulgative

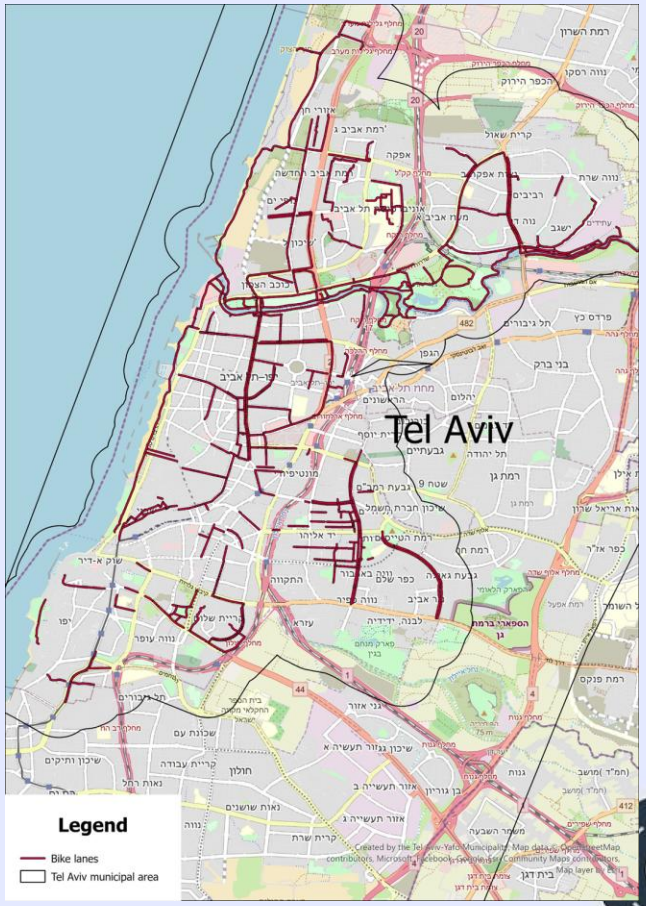
Bike Roads in Pilot Cities

Valencia

Antalya



Tel Aviv



Data Collection

City	Category	Data Type	Source / Organization
Valencia (Spain)	Climate & Environmental	Climate projections (temperature rise, precipitation trends)	Spanish Meteorological Agency (AEMET)
	Micromobility	Micromobility Data	Valencia City Council and Ajuntament de València Open Data Portal: (GIS data on bike lanes, public transport, parking.) Autoridad de Transporte Metropolitano de Valencia (Regional transport authority) for integration data. Valenbisi Local bike-sharing system publishes station data, sometimes via open APIs. Valencia Sustainable Urban Mobility Plan and Master Transportation Plan
	Socio-economic & Demographic	Population, age distribution, gender, household income	(Seems misattributed: currently listed as Turkish Statistical Institute – should this be Spanish Statistical OffiValencia City Council and Ajuntament de València Open Data Portal: (GIS data on bike lanes, public transport, parking.) Autoridad de Transporte Metropolitano de Valencia (Regional transport authority) for integration data. Valenbisi Local bike-sharing system publishes station data, sometimes via open APIs. Valencia Sustainable Urban Mobility Plan and Master Transportation Plance (INE)?)
		Tourism intensity (seasonal population changes)	Valencia City Council / Regional Tourism Reports (to be confirmed)
		Socio-economic inequality and urban growth data	Valencia SUMP & Urban Master Plan
Antalya (Türkiye)	Climate & Environmental	Climate data (temperature, rainfall, heatwave, flood risks)	Turkish State Meteorological Service (MGM)
		Local climate projections	Antalya Climate Change Adaptation Strategy (if available)
	Socio-economic & Demographic	Population, age distribution, gender, household income	Turkish Statistical Institute (TÜİK)
		Tourism intensity (seasonal population changes)	Antalya Metropolitan Municipality Tourism Reports
		Socio-economic inequality and urban growth data	Antalya SUMP & Master Transportation Plan
	Micromobility	Micromobility Data	ANTBİS (bike-sharing system), Martı, Binbin and Volt Bike-Sharing Companies Antalya Sustainable Urban Mobility Plan and Master Transportation Plan
Tel Aviv (Israel)	Climate & Environmental	Climate risk projections (sea-level rise, heatwaves, flooding)	Israel Meteorological Service (IMS)
	Micromobility	Micromobility Data	Tel Aviv-Yafo Municipality Open Data Portal Tel-O-Fun (bike-sharing system) mobility-related datasets, including cycling networks and some shared mobility indicators (Israel Ministry of Transport)
	Socio-economic & Demographic	Population, migration, household income, employment	Israel Central Bureau of Statistics

Analysis Methods

Variable Type	Variable Name	Measurement
Dependent Variable	Micromobility	Probability use the services
Independent Variables	Heatwave	Heatwave Day Intensity (°C)
	Precipitation	Extreme Heatwave Intensity (mm)
	Season	Spring/Summer/Fall/Winter
	Infrastructure Quality	Bike lane density (km/km^2)
	Age	Years
	Gender	Male/Female/Other
	Education Level	Categorical (High school/Bachelor/Graduate)
	Income	Monthly income (€)
	City	Valencia/Antalya/Tel Aviv
Outcome Variables (Control Variables)	CO_2 Emissions Reduction	Kilograms per trip
	NOx Emissions Reduction	Grams per trip

$$P(U_{it}) = \beta_0 + \beta_1 T_{ct} + \beta_2 P_{ct} + \gamma' S_{ct} + \delta I_{ct} + \theta' D_{ict} + \varphi' C_c + \lambda' Z_t + \varepsilon_{ict}$$

T_ct: temperature; P_ct: precipitation; S_ct: season dummies; I_ct: infrastructure quality; D_ict: demographics vector; C_c: city ; Z_t: time controls.

Expected Outputs

- Pattern between climate change and micromobility during different climatic extremes,
- User's profil (age, gender, education, income level etc.),
- The proportion of micromobility in total transportation for current situation
- Differences between selected european cities in terms of micromobility,
- How climate change effect the micromobility utilisation pattern,

Mainly, this paper assists urban planners, policy makers and adaptation planners how to develop microbility based on the usage patterns of local communities under developing climatic uncertainty

Baby Zeus Team

Thank you ☺