

ABSTRACT

Heat wave events enhanced by human-induced climate change have recently caused thousands of dead in the Euro-Mediterranean region. We have calculated heat wave events over the western Türkiye based on simulations of the EURO-CORDEX project which are produced by five different regional climate models that forced four GCMs. The definition of heat waves has been made by the EuroHEAT project as days in which the maximal apparent temperature (Tappmax) exceeds the threshold (90th percentile of Tappmax for each month) and the minimum temperature (Tmin) exceeds its threshold (90th percentile of Tmin for each month) for at least two days. The calculation period for heat waves is only limited to the summer months. The heat wave analyses in three different periods have been conducted with 16 metropolitan cities in western Türkiye for the RCP4.5 and RCP8.5 scenarios. The total population of these 16 metropolitan cities is over 47 million and constitutes 55% of the entire population of Türkiye. In terms of the RCP8.5 scenario, the heat wave events increased nearly five times in Istanbul in the 2021-2050 period compared to the reference period (1976-2005), while it increased 12 times in the 2051-2080 period. For İzmir, a tourism city located near the Aegean Sea, the increases in the same periods were 4.5 times and 10 times (corresponding to 52 days), respectively. For the RCP4.5 scenario, on the other hand, the number of heat wave days in the same periods is reduced by almost half in all metropolitan cities. The number of heat wave days for the future in other metropolitan cities also indicates similar change rates to those in Istanbul and İzmir.

MATERIAL & METHOD

Climate Data Store → EURO-CORDEX, Health related dataset

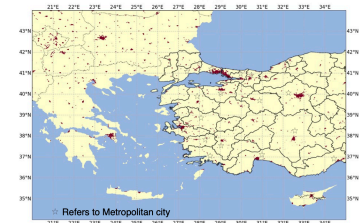
Scenario	Period	Global Model (GCM)	
		RCM	Global Model (GCM)
RCP4.5	1971-2100	WRF31F1	IPSL-IPSL-CM5A-MR
		ARPEGE51	CNRM-CERFACS-CNRM-CM5
		HIRHAM5	ICHEC-EC-EARTH
		RACMO22E	ICHEC-EC-EARTH
RCP8.5	RCA4	IPSL-IPSL-CM5A-MR	IPSL-IPSL-CM5A-MR
		CNRM-CERFACS-CNRM-CM5	CNRM-CERFACS-CNRM-CM5
		ICHEC-EC-EARTH	ICHEC-EC-EARTH
		MPI-M-NPI-ESM-LR	MPI-M-NPI-ESM-LR

- WHO → Maximum & Minimum temperature will exceed 90% June to August → at least 2 days
- Resolution → 0.1° x 0.1° over Europe
- RCP4.5 and RCP8.5 → From 1986 to 2085
- Data reference period → 1971-2000
- Reference Period → 1976-2005
- ERA5 Reanalysis → For reference period
- $T_{app} = -2.653 + 0.994T_{air} + 0.0153(T_{dew})^2$

- 2 Climatological Period → 2021-2050 & 2051-2080
- 16 Metropolitan cities → The RCP4.5 and RCP8.5 scenarios were compared by plotting time plots of mean and ± 1 standard deviation.

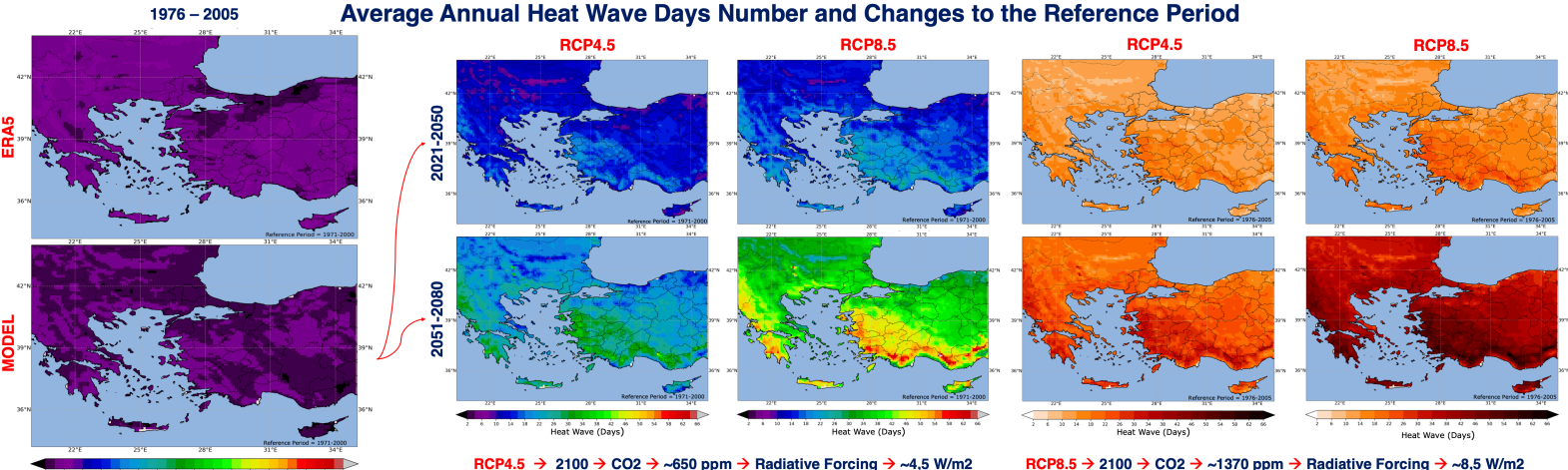
STUDY AREA

GHS-SMOD City Areas & Study Area



- Climatological Analyses → 20 – 35 E & 34 – 44 N
- GHS Settlement (GHS-SMOD) → 16 Metropolitan city urbanized areas in Western Anatolia

Average Annual Heat Wave Days Number and Changes to the Reference Period



Increase between 2021-2050

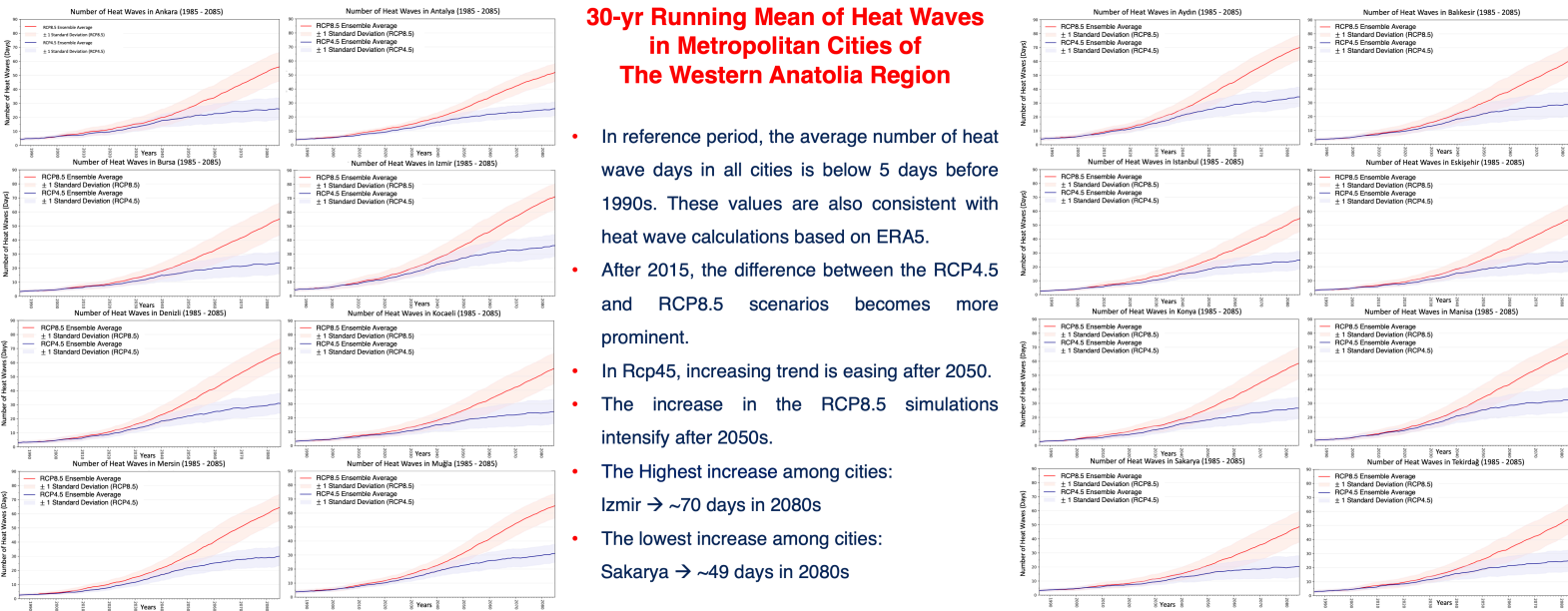
- Maximum → Southwest Anatolia → ~10 to 18 ↔ 14 - 22 days
- Minimum → Bulgaria and northern parts of Turkey → ~2-10 ↔ ~2-10 days

Increase between 2051 - 2080

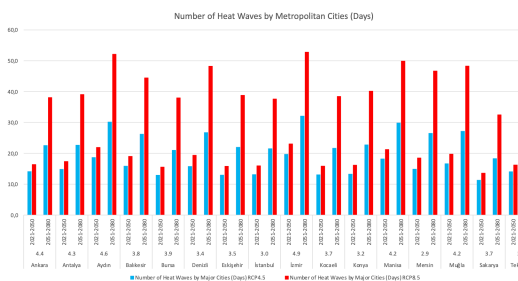
- Maximum → Aegean and Mediterranean (except coastal areas) → 30 to 50 ↔ 55 - 66 days
- Minimum → Black Sea and Bulgaria → ~10 - 20 ↔ 18 to 30 days.

30-yr Running Mean of Heat Waves in Metropolitan Cities of The Western Anatolia Region

- In reference period, the average number of heat wave days in all cities is below 5 days before 1990s. These values are also consistent with heat wave calculations based on ERA5.
- After 2015, the difference between the RCP4.5 and RCP8.5 scenarios becomes more prominent.
- In Rcp45, increasing trend is easing after 2050.
- The increase in the RCP8.5 simulations intensify after 2050s.
- The Highest increase among cities: İzmir → ~70 days in 2080s
- The lowest increase among cities: Sakarya → ~49 days in 2080s



Future Changes in Heat Wave Days for Metropolitan Cities



- In the 1976-2005 period, the lowest number of heatwave days found in Mersin and the highest one in Izmir.
- The distribution of the number of heat wave days in 2021-2050 and 2051-2080 periods is similar.
- According to RCP8.5, the highest number of heat wave days in the 2051-2080 period is 52.8 days in Izmir and the lowest is 32.5 days in Sakarya.

Conclusions and Discussion

- In the Reference Period, the number of heat wave days obtained from the ERA5 dataset is less in the northern parts, while the distribution of the model is more homogenous.
- While the gap between RCP4.5 and RCP8.5 is quite tight until 2021-2050, the gap widens in the following period.
- While the amount of increase in the southern regions is 30 - 38 days for RCP4.5, it is between 54 - 62 days in the southwestern regions in the RCP8.5 scenario, and between 18 - 24 days in RCP4.5 and 22 - 34 days in RCP8.5 in the northern regions.