## LONG-TERM TRENDS IN HEATING AND COOLING DEGREE DAYS AT MEDITERRANEAN CITIES, IN THE CONTEXT OF CLIMATE CHANGE

I. Kaza (1), D. Founda (2), C. Giannakopoulos (2) and D. Kolokotsa (1)

(1) School of Environmental Engineering, Technical University of Crete, Greece (2) Institute for Environmental Research and Sustainable Development, National Observatory of Athens, Greece

# **DATA AND METHODOLOGY**

### **SELECTED MEDITERRANEAN CITIES**



## **DATA& METHODS**

#### **Data**

- Observed temperature data over the period 1975-2017.
- For the future simulation, Regional Climate Model RCA4 driven by the global climate model MPI-ESM-LR, was used in the EURO-CORDEX modeling experiment (http://www.euro-cordex.net).Future temperatures values are simulated under Representative Concentration Pathway (RCP) scenarios 4.5 and 8.5, for the period 1970-2100.

#### **Methods**

 $HDD = \sum_{1}^{z} (Tbase - Tmean)$  $CDD = \sum_{1}^{z} (Tmean - Tbase)$ 

- T<sub>mean</sub>: the average daily ambient temperature
- z: the number of the days in a month or year
- Tbase for HDD = $18.3 \, {}^{\circ}\text{C}$
- Tbase for  $CDD = 26 \, {}^{0}C$



## RESULTS

20,5 20,0 19,5 19,0 18,5 18,0

18,0

1980

## **ANNUAL TRENDS IN TREMPERATURE-OBSERVATIONS** 1975-2017











SEVILLE

1990

YEAR

y = 0,0499x + 18,054

MMMM

2000





# ANNUAL TRENDS IN HEATING DEGREE DAYS (HDD) & COOLING DEGREE DAYS (CDD)-OBSERVATIONS 1975-2017

#### HDD TRENDS





# ANNUAL TRENDS IN HEATING DEGREE DAYS (HDD) & COOLING DEGREE DAYS (CDD)-OBSERVATIONS 1975-2017

### CDD TRENDS





# SIMULATED ANNUAL TRENDS IN HDD & CDD UNDER RCP 4.5 AND RCP 8.5 (1970-2100)

### HDD/YEAR

City	Rcp4.5	Rcp8.5
Athens	-3.26	-7.11
Madrid	-4.81	-8.77
Montpellier	-3.80	-7.11
Nicosia	-2.53	-6.09
Rome	-3.87	-7.85
Palma	-3.43	-6.35
Seville	-3.37	-6.28

### CDD/YEAR

City	Rcp4.5	Rcp8.5
Athens	1.64	4.14
Madrid	0.78	2.75
Montpellier	0.31	1.30
Nicosia	1.94	4.88
Rome	0.55	1.55
Palma	0.73	2.33
Seville	1.95	4.94



# **CONCLUSIONS**

- Increased temperature trends at rates between 0.3 (Madrid) to 0.4 (Seville) Celsius degrees per decade, for the referenced period 1975-2017.
- Negative trend in HDD reaching up to -11 degree days/year while CDD illustrate rising trends up to 6 degree days/year (metric system).
- Projected trends in HDD and CDD for the period 1970 to 2100 show similar results with the observed period .Moderate rcp4.5 scenario gives a maximum decreased HDD trend at -4 degree days/year, in contrast with rcp 8.5 that declined trend reaches up to 8. At the same time CDD increasing trends range from 0.3 (Montpellier- rcp4.5) to 4.8 (Nicosia- rcp8.5).

