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Air quality and climate comfort Indices over the eastern Mediterranean:
The case of Rhodes city during the summer of 2021

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The Mediterranean a region is region prone to climate change. Additionally, high level of pollution, due to anthropogenic activities (tourism, traffic emission etc), can affect climate change and vice versa. Previous studies have already shown that environmental conditions influence the comfort scenes and human health. The bad air quality and adverse comfort conditions negatively affect the urban population and strengthen the Urban Heat Island phenomenon.

The city of Rhodes is located in southeastern Mediterranean - one of the most significant tourist destination due to the temperate climate, the mild weather, the sandy beaches as well as the rich cultural heritage. The old city of Rhodes has been registered as an UNESCO World Heritage Site attracting a large number of tourists every year.

In the summer of 2021 the wildfires over southeast Mediterranean significantly affect the air quality over the city center of Rhodes. At the same time, high traffic emissions due to tourism activity seem to be associated with the fluctuations in concentration of particle matter.

<u>The aim of this study</u> is to enhance our understanding of climate comfort and air quality by providing some evidence of the benefits of implementing a sustainable development policy in such tourist areas in Southeastern Aegean Sea.

DATA

Hourly Data			
Mobile Air Quality System (**AQMS**; Haz-Scanner™ model HIM-6000)	**ERA5 reanalysis**		
• Particulate matter < 2.5 μm ($\mathbf{PM_{2.5}}$; in μg/m³)	• Boundary Layer Height (**BLH**; in m)	• Precipitation (**pr**; in mm/day)	• Wind speed (**WS**; in m/s)
• Nitrogen Oxides ($\mathbf{NO_X}$; in ppm)	• Wind direction (**Wdir**; in °)	• Cloud Cover (**cv**; in fraction %)	• Temperature at 2m (**T**; in °C)
• Ozone ($\mathbf{O_3}$; in ppm)	• Relative humidity (**RH**; in %)		

Methods

✓ **In order to study the impact of climate conditions in Air quality we calculate the:**

- composite difference maps between a:
  - high (*13/7-31/8, 2021*; **HP**) tourist period and
  - low (*22/9 -3/10, 2021*; **LP**) tourist period.
- Odd Ratio (OR) of the low height of BLH and the concentration of pollutants are calculated.

ECMWF

✓ **To investigate the impact of climate condition to general population we calculate the climate indices**:

- Discomfort Index (DI)
- Holiday Climate Index (HCI)

following the methodology of Poupkou et al. 2011 and Demiroglu et al.2020

❖ The concentration of Pollutants – The evolution during the summer of 2021

➢ LP vs HP

- $\mathbf{PM_{2.5}}$ reduces about 9 μg/m³.
- $\mathbf{NO_X}$ reduces about 10 ppm.
- $\mathbf{O_3}$ does not change significantly.

- **Wind speed** during the LP reduces compared to the HP.
- **Wind direction** does not change significantly and
- **Temperature** reduces during LP.

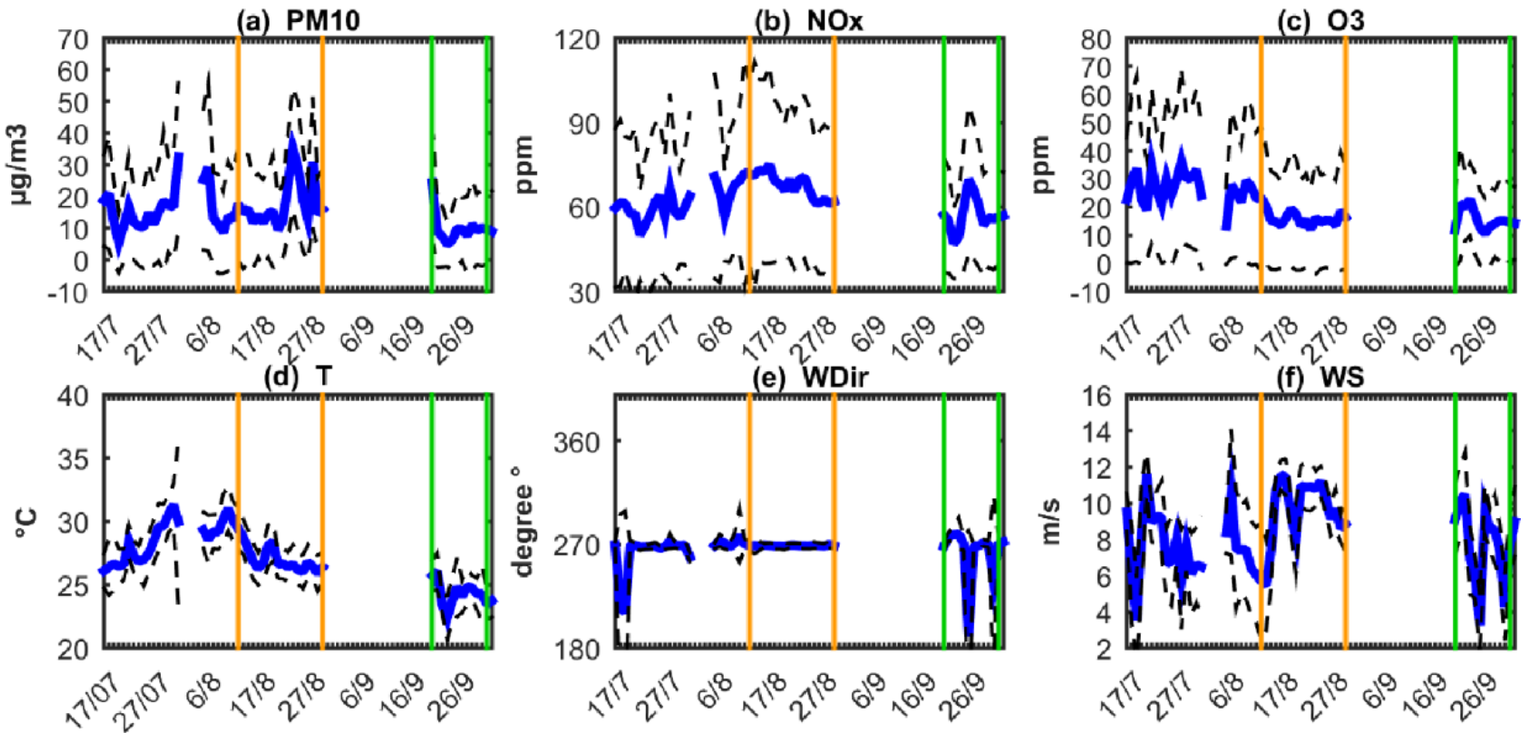


Figure 2. Timeseries of (a-c) the concentration of pollutants $PM_{2.5}$, NO_X and O_3 and (d-f) the metrological factors T, WDir and WS. The orange/ (green) lines denote the high/ (low) emissions period.

❖ The impact of climate conditions in the air quality of Rhodes city

The analysis shows that :

- BLH presents a lower height during HP compared to LP.
- The differentiation of pr between HP and LP is insignificant around Rhodes Island.
- WS decreases over the central Aegean and over the region eastern of Crete Island during HP.

Table 1. The ORs between low height of BLH and high concentration of pollutants

Pollutants	Odd Ratios (ORs)	CI (95%)
$PM_{2.5}$	11	7.6 - 15.9
NO_X	17.8	11.7 - 27.1
O_3	20.8	13.6 - 31.7

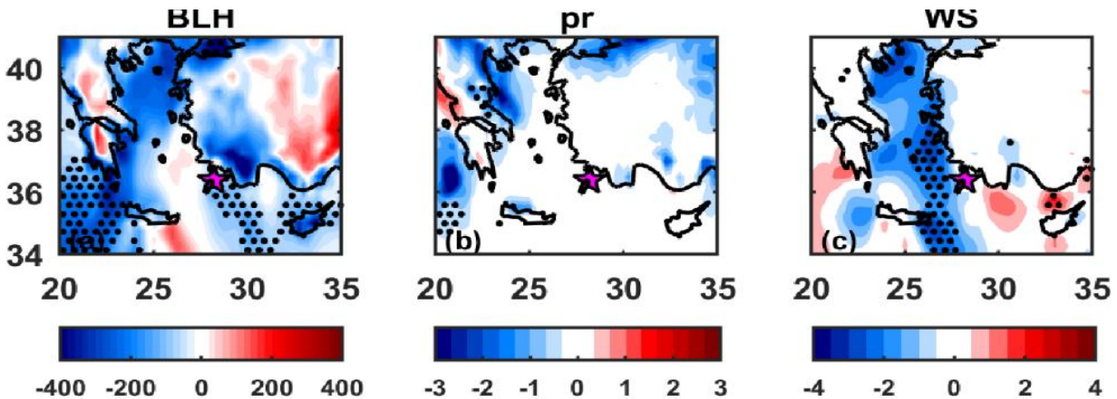


Figure 3. Composite difference between HP and LP for the (a) boundary layer height, (b) precipitation, (c) wind speed. The dotted region represents the statistically significant difference at 95%, as estimated using a Student's t test.

There is an association between low BHL and increased concentration of pollutants over the Rhodes city.

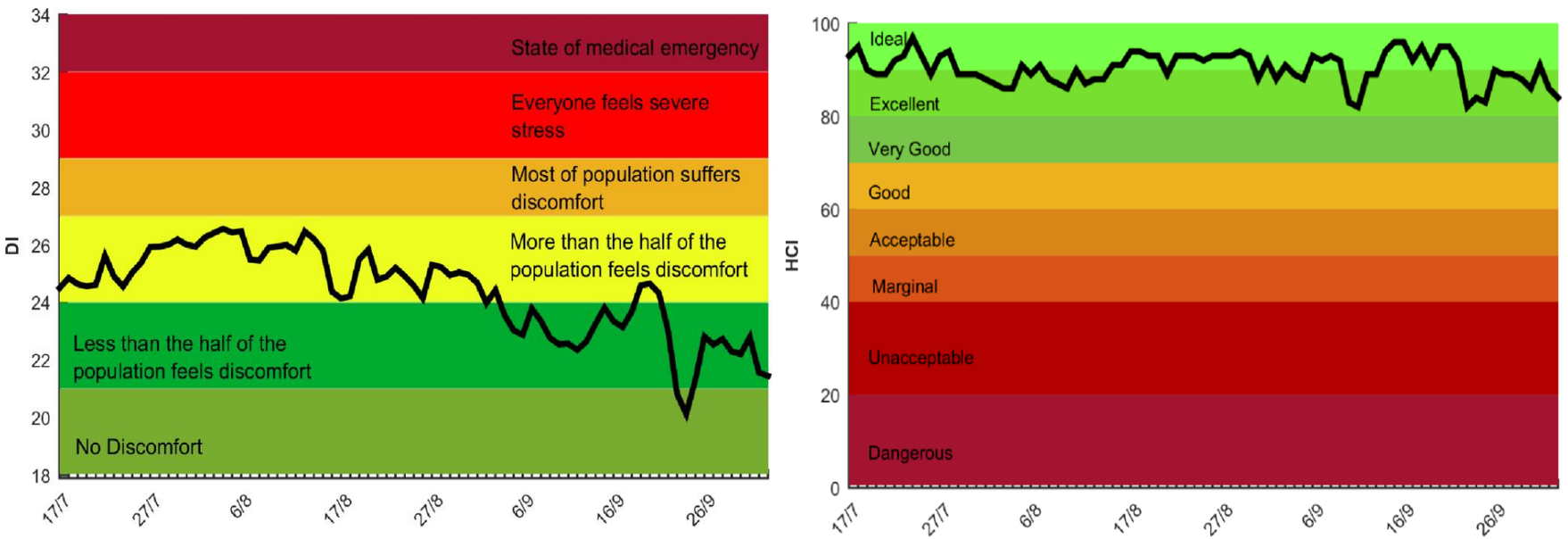
❖ Climate Indices

From 17/7 to 5/9:

- DI values show that more than half of the population feels discomfort.
- The concentration of pollutants is increased compared to the last period

The regression coefficient of DI with the concentration of PM2.5, NOx and O3 is significantly positive

The combination of high DI with the increased concentration of pollutants (PM2.5) increases human health risk.



- HCI shows that the climate conditions are classified as excellent and ideal.

Figure 4. (a) Discomfort Index and (b) Holiday Climate Index for the city of Rhodes during the summer period of 2021.

- High tourist activity is related to poor air quality due to high traffic emissions and human activities.

- At the same time the air quality degrades and the discomfort feeling increases.
  - This combined effect could have an impact on the comfort sense and health risk of the population

- Rhodes is classified as a sustainable tourist destination in terms of climate conditions (Holiday Climate Index)

Thank you

https://elektron-project.gr/

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