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# Study of Particulate Matter in Kırklareli, Turkey with Meteorological Factors

B. O. Akkoyunlu<sup>1</sup>, R. M. Flores<sup>2</sup>, H. Ozdemir<sup>3</sup>, M. Tayanç<sup>\*2</sup>

<sup>1</sup> Marmara University, Department of Physics, Istanbul, Turkey, [bulentoktay@marmara.edu.tr](mailto:bulentoktay@marmara.edu.tr)

<sup>2</sup> Marmara University, Department of Environmental Eng., Istanbul, Turkey, [mtayanca@marmara.edu.tr](mailto:mtayanca@marmara.edu.tr),  
[rflores@marmara.edu.tr](mailto:rflores@marmara.edu.tr)

<sup>3</sup> Istanbul Technical University, Maslak, 34469, Istanbul, Turkey, [ozdemirhuseyin@itu.edu.tr](mailto:ozdemirhuseyin@itu.edu.tr)

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# Introduction and Methods

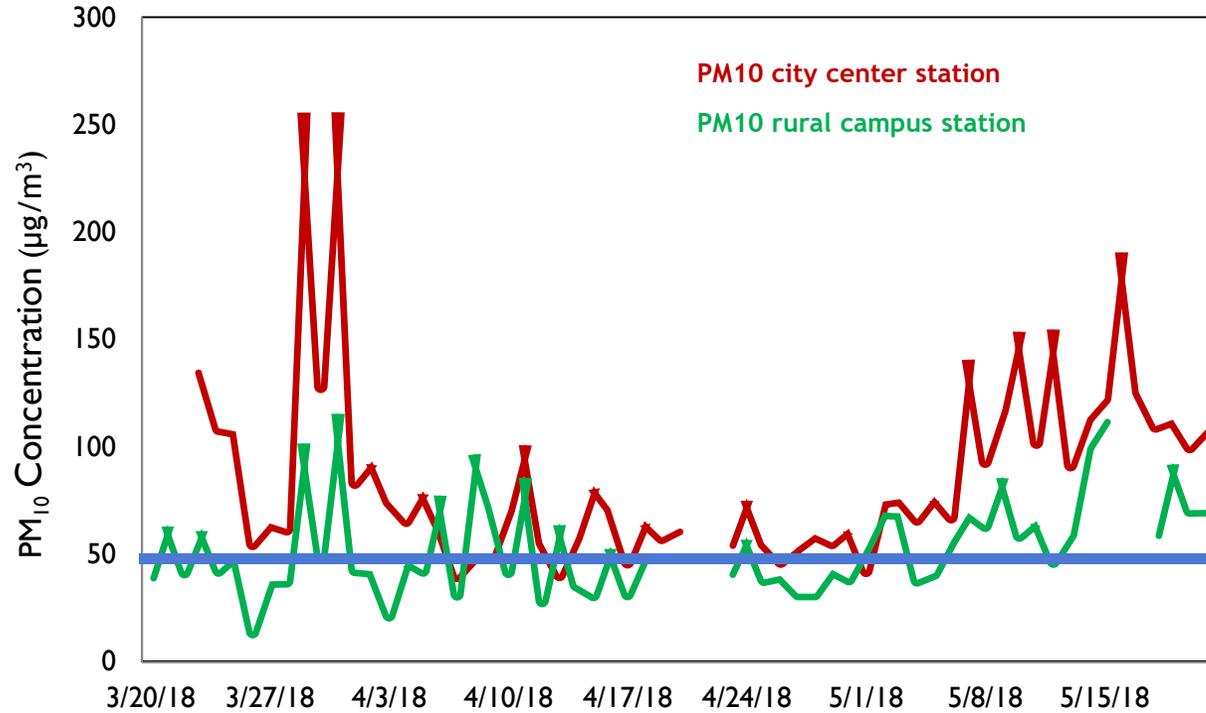
- Fine particles can be primary but mostly are secondary pollutants that can originate from the combustion in vehicles/stationary sources, undergo chemical reactions and then condense in the atmosphere. These fine particles can easily pass through the nose and trachea reaching to lungs causing important health problems. Studies based on particulates are not at the desired level and number in Turkey and this situation is limiting our information on the levels and composition of these pollutants.



- In this study,  $PM_{2.5}$  and  $PM_{10}$  measurements have been done in the 20.03.2018 – 21.05.2018 period via two stations in Kırklareli; one located in the city center and the other one located in a rural area to represent the background concentration.
- The role of Saharan dust advection for an episode of unexpectedly high particulate levels observed in Kırklareli is investigated. The study is based on observations and atmospheric model outputs including DREAM, WRF and HYSPLIT backtrajectory models.

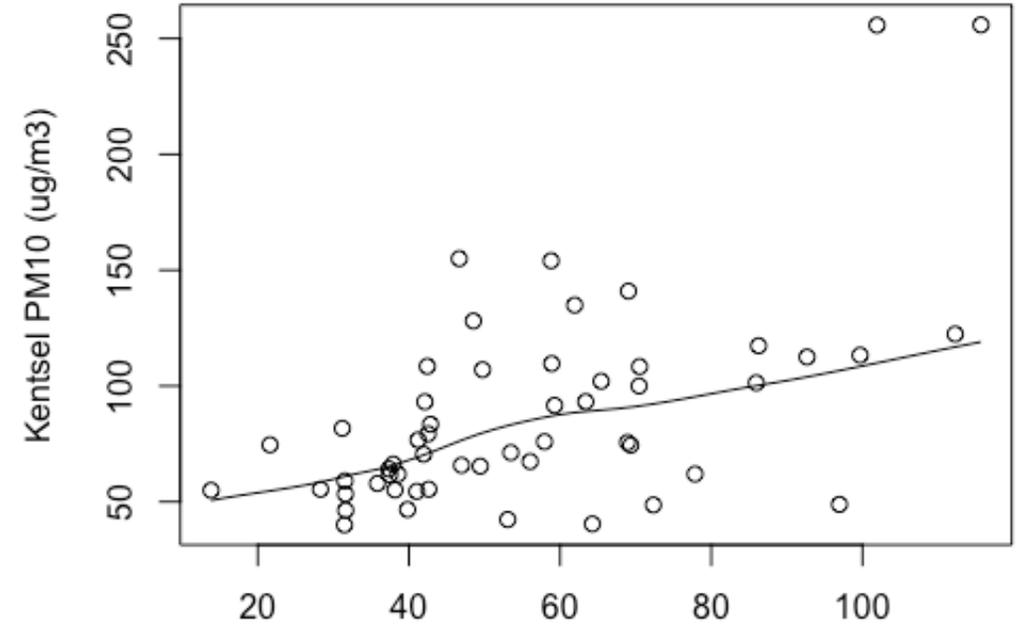
# Results

## PM<sub>10</sub> Variability in Kırklareli in the Period of 20 March 2018 – 21 May 2018



### WHO Guidelines

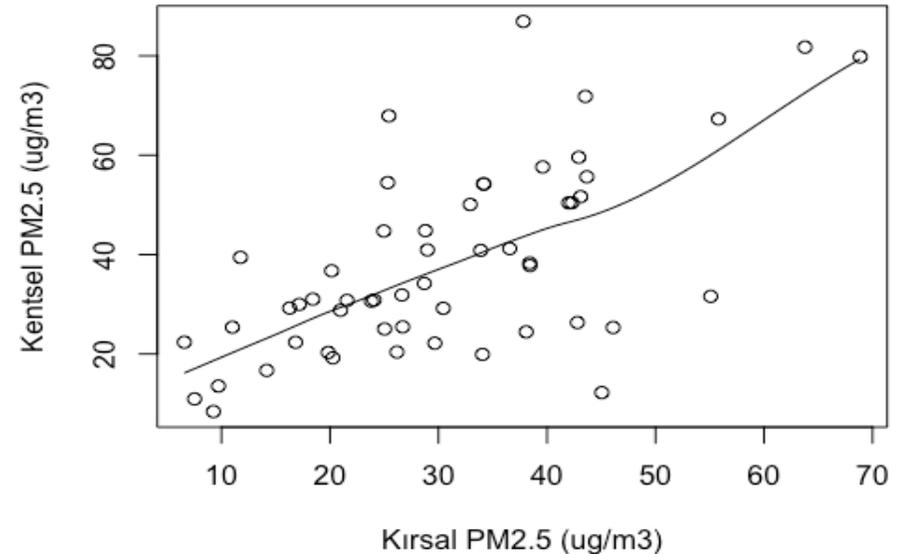
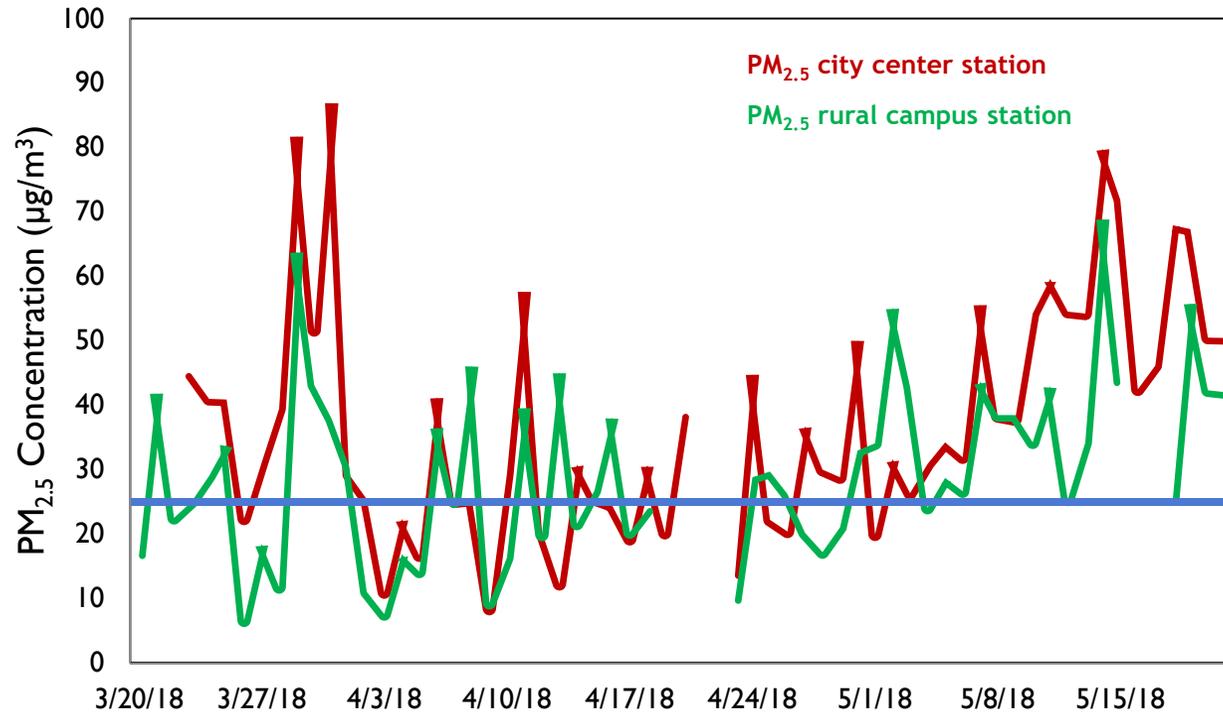
PM <sub>2.5</sub> : 10 [g/m <sup>3</sup> annual mean	25 [g/m <sup>3</sup> 24-hour mean
PM <sub>10</sub> : 20 [g/m <sup>3</sup> annual mean	50 [g/m <sup>3</sup> 24-hour mean



Correlation graph of PM<sub>10</sub> concentrations between the city center and rural background.

Kırklareli city center PM<sub>10</sub> values are generally higher than those of the rural campus station.

# PM<sub>2.5</sub> Variability in Kırklareli in the Period of 20 March 2018 – 21 May 2018



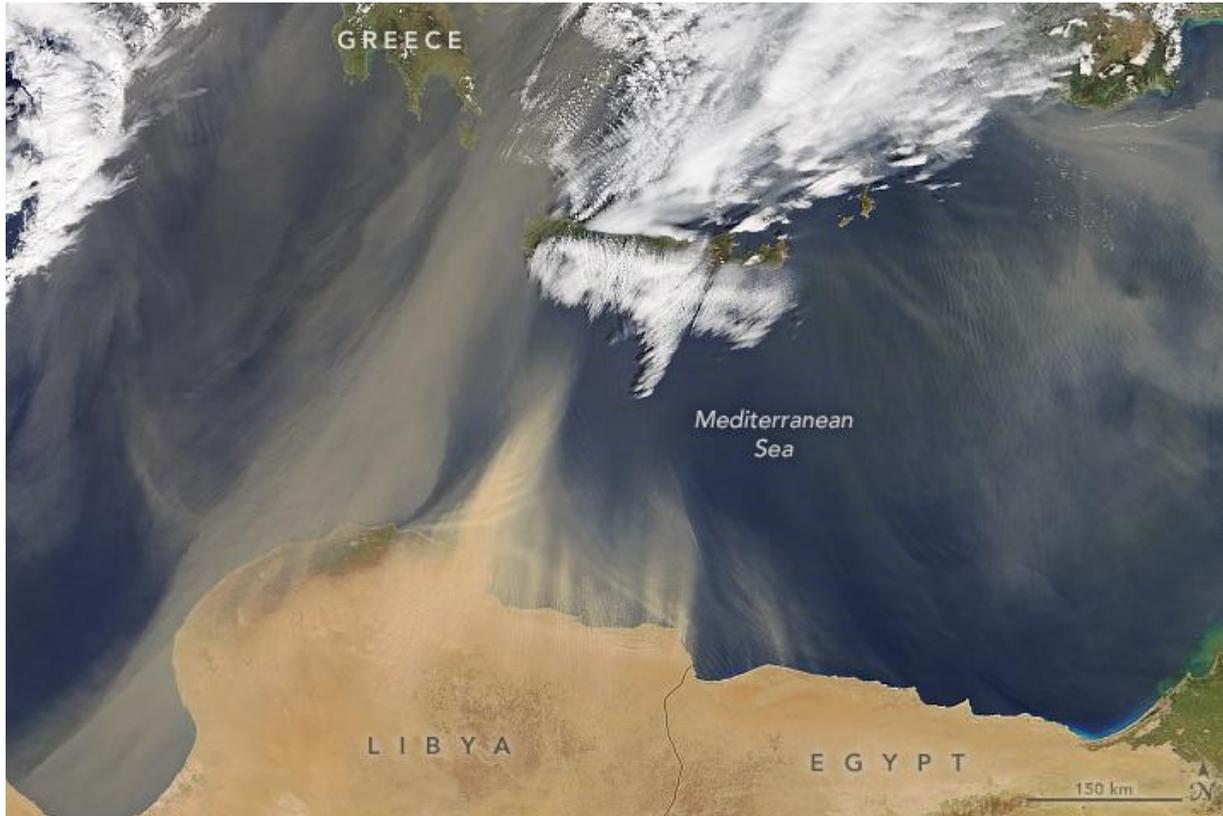
Correlation graph of PM<sub>2.5</sub> concentrations between the city center and rural background.

## WHO Guidelines

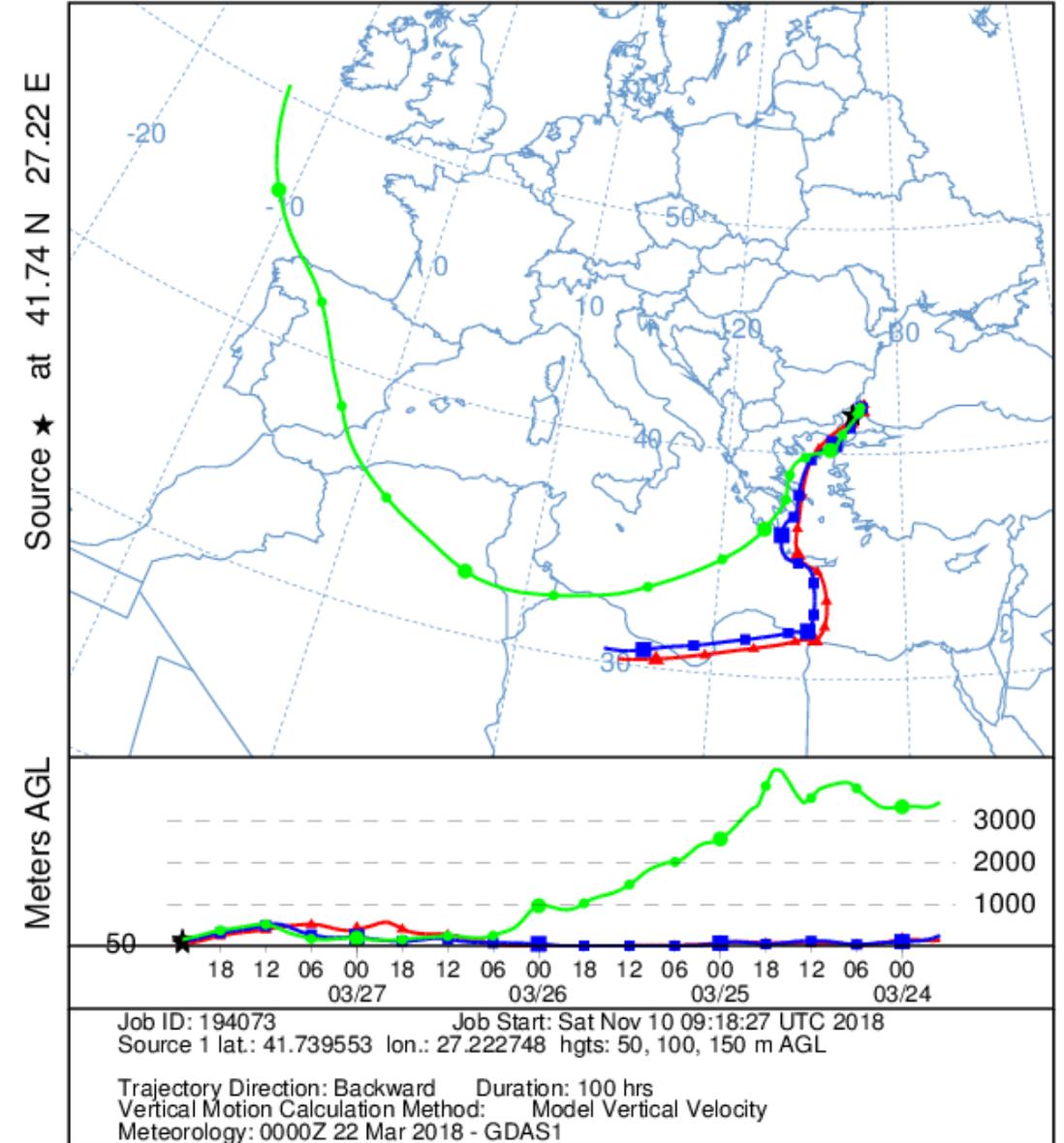
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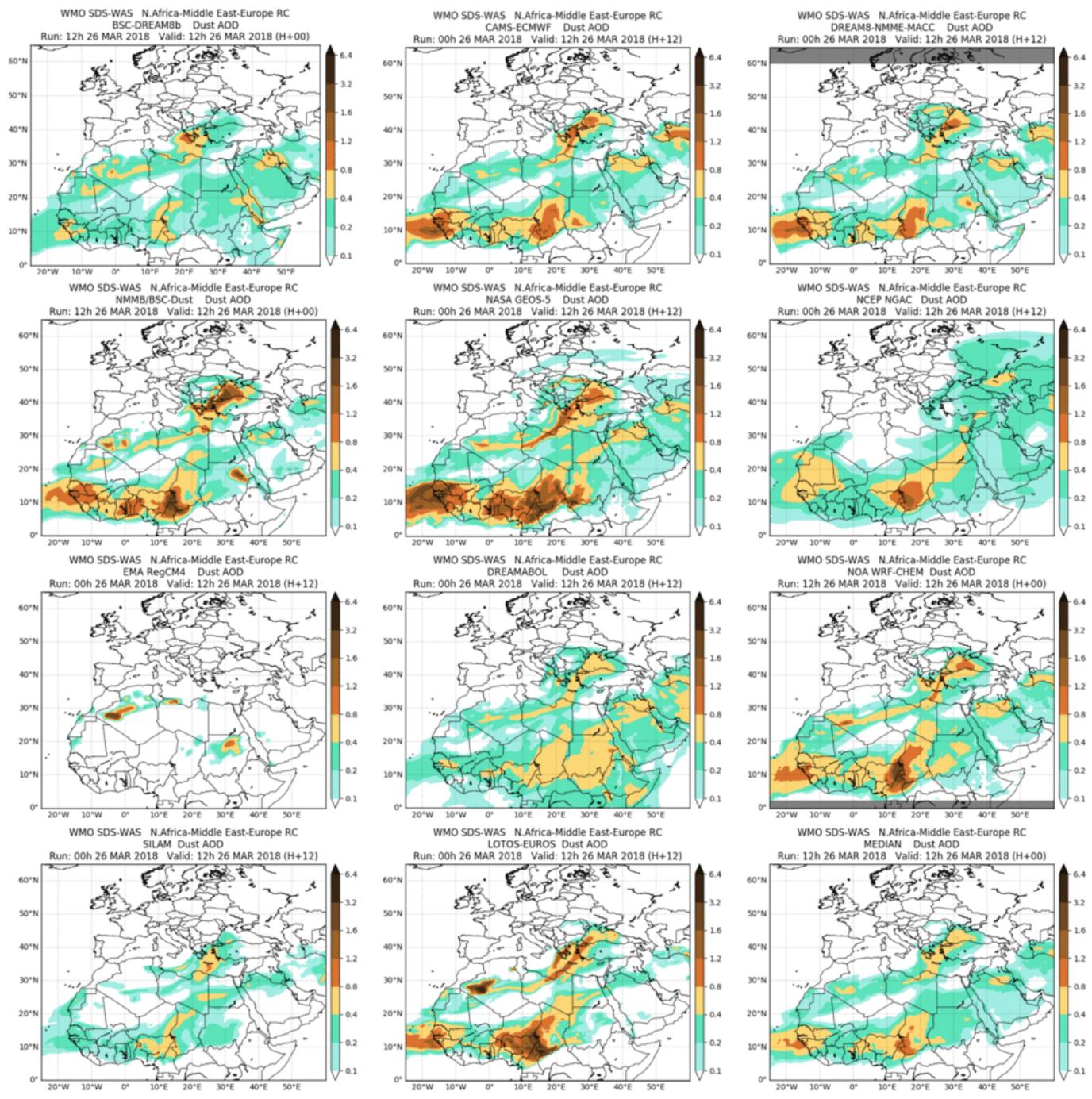
Kırklareli city center PM 2.5 values are generally higher than those of the rural campus station.

NASA image: March 26, 2018



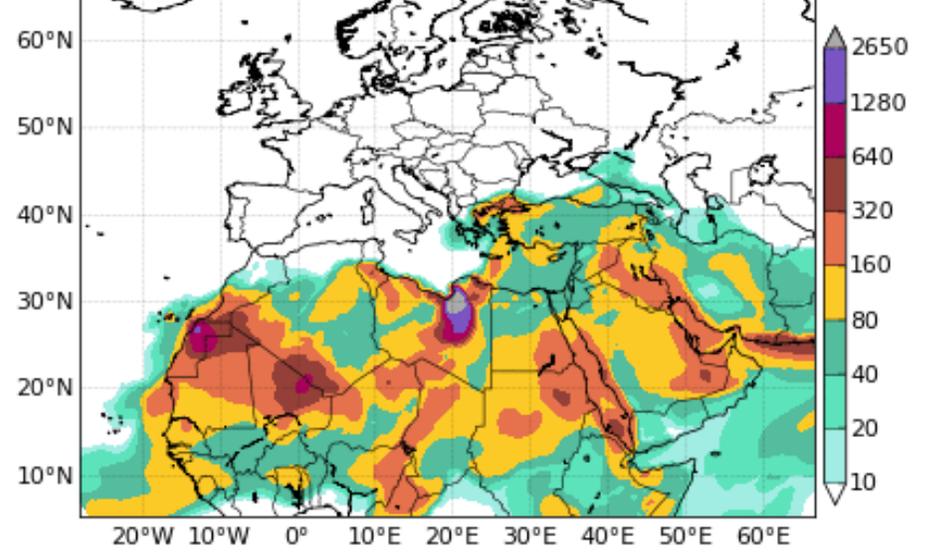
NOAA HYSPLIT MODEL  
Backward trajectories ending at 2300 UTC 27 Mar 18  
GDAS Meteorological Data





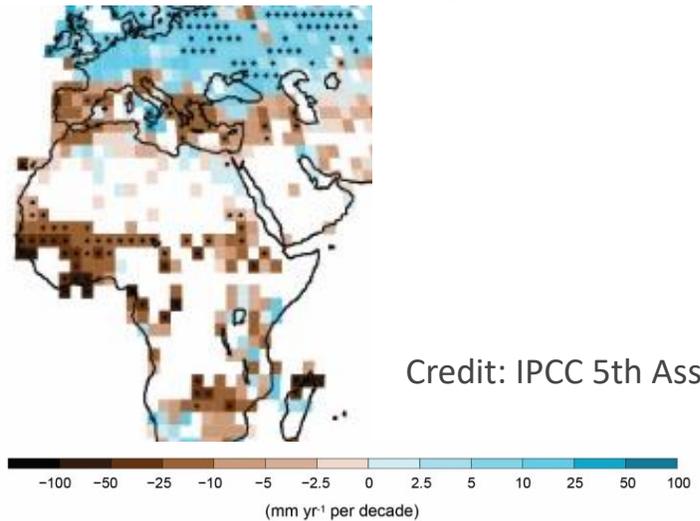
BSC-DREAM8b v2.0 Dust Low Level Conc. ( $\mu\text{g}/\text{m}^3$ )  
12h forecast for 00UTC 28 Mar 2018

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>



Credit: WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)

Observed changes in precipitation in 1951-2010



Credit: IPCC 5th Assessment Report, 2013

Measurement Station	Kırklareli Center	Kırklareli Rural
Numbers of days that the Daily PM <sub>10</sub> concentration exceeded 50 µg/m <sup>3</sup> WHO Daily Limit Value and its corresponding percentage	51(58)	27 (57)
	87.90%	47.36%
Mean value of the period (µg/m <sup>3</sup> )	89.26	55.28
Median of PM <sub>10</sub> values (µg/m <sup>3</sup> )	75.095	49.43
Range of PM <sub>10</sub> concentrations (µg/m <sup>3</sup> )	40-256	14-116
Standard Deviation (µg/m <sup>3</sup> )	45.57	22.74

Concentrations of PM<sub>10</sub> are found to exceed the WHO Daily Limit Value of 50 µg/m<sup>3</sup> by 51 cases out of 58 samplings in the city center and by 27 cases out of 57 samplings in the rural area of Kırklareli, that produce 87.90% and 47.36% exceedance percentages, in order.

Measurement Station	Kırklareli Center	Kırklareli Rural
Numbers of days that the Daily PM <sub>2.5</sub> concentration exceeded 25 µg/m <sup>3</sup> WHO Daily Limit Value and its corresponding percentage	44(58)	36 (57)
	75.86%	63.16%
Mean value of the period (µg/m <sup>3</sup> )	37.99	30.35
Median of PM <sub>2.5</sub> values (µg/m <sup>3</sup> )	33.02	28.79
Range of PM <sub>2.5</sub> concentrations (µg/m <sup>3</sup> )	8-87	7-69
Standard Deviation (µg/m <sup>3</sup> )	18.26	13.75

Measured PM<sub>10</sub> values ranged between 40-256 µg/m<sup>3</sup> in the city center and 14-116 µg/m<sup>3</sup> in the rural area. The measured values of PM<sub>2.5</sub> are lower than PM<sub>10</sub> as expected, ranging from 8 µg/m<sup>3</sup> to 87 µg/m<sup>3</sup> in the city and 7 µg/m<sup>3</sup> to 69 µg/m<sup>3</sup> in the rural area.

**Note that the 24-hour average PM<sub>2.5</sub> values exceeded the 25 µg/m<sup>3</sup> WHO Daily Limit Value more than 50 % for both the Kırklareli center and rural stations**

# Conclusions

- Statistics of measurements show the frequent violation of WHO limit values that are mainly caused by domestic emission sources such as industry, coal combustion for heating purposes and traffic.
- Under specific conditions dust loaded air parcels travel towards northeastern Mediterranean and Kırklareli. Critical conditions occur when a strong low pressure system exists over middle Mediterranean Sea extending towards Africa. Strong instability over Sahara can generate convection zones lifting the dust. On the other hand, strong pressure gradient between low and high pressure systems generate high wind speeds and advection. These coupled processes can generate dust storms over the Sahara and transfer particle loaded air masses thousands of kilometers away, towards Europe as well as towards America.
- Drying of the land is generating more frequent and stronger dust storms leading to elevated levels of particulates.

## Acknowledgements:

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**Thank you**