InCRECA
Increasing Community Resilience in Climate Adaptation Process Project

KADIKÖY MUNICIPALITY & AIRQOON

AIR QUALITY
ASSESSMENT OF KADIKÖY

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Content

Particulate Matter

What is the particulate matter?

Air pollution can be defined as the presence of pollutants in the atmosphere in amounts that adversely affect biological life. Sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbons, and particulate materials are examples of pollutant types (Toros, 2000). Threshold values are determined by various institutions for the amounts of these pollutants. When the amount of pollutants exceeds these values, it can threaten the health of all living creatures. Particulate matter (PM), in its simplest definition, is particles in solid or liquid form with diameters varying between 0.1 and 100 µm in the atmosphere as aerosols with an aerodynamic diameter of 2.5 µm or less.

The Effect of Particulate Matter on Human Health

As the diameter of poses of particulate matter concentrations becomes smaller, is known to pose a greater danger to human health. Particulate matter contains cancer-causing organic chemicals that trigger diseases such as chronic asthma and bronchitis, primarily respiratory and cardiovascular systems (Koenig, 2000). As these particles with small diameters reach the lungs with respiration, they can cause shortness of breath and heart diseases in advanced stages and even premature birth by mixing with the blood (Şen, 2018). Based on epidemiological studies that have continued more than 20 years, scientists have revealed a strong relationship between particulate matter and respiratory death (Brunekeef & Holgate, 2002). scientists have revealed a strong relationship between particulate matter and respiratory death (Brunekeef & Holgate, 2002). Because it poses a threat to the health of living creatures, the threshold values of PM2.5 have been determined by the World Health Organization as an annual average of 10 µg / m³ and an hourly average of 25 µg / m³ per day (WHO, 2018).

Meteorological Data of Kadıköy District

According to the Kadıköy City Health Report, hot and low rainy summer seasons and warm and rainy winters are observed in the district. The average temperature values of the district during 2013-2017 years are 9 °C, 7 °C and 8.6 °C for December, January and February, respectively. In the same period and months, the average monthly precipitation was 95.4 kg / m2, 74.6 kg / m2 and 67.4 kg / m2, respectively, while the moisture content was 77.4%, 78.2% and 79.2% (2019). When the data obtained from CFSv2 between December 1, 2020 - March 1, 2021 is examined, the dominant wind direction of the district in this period is seen as south-southwest. As seen in Figure 1, it has been determined that the northeastern winds are also dominant in the district. It has been determined that light winds are more common in the district, and strong winds generally blow from the southwest and north directions.

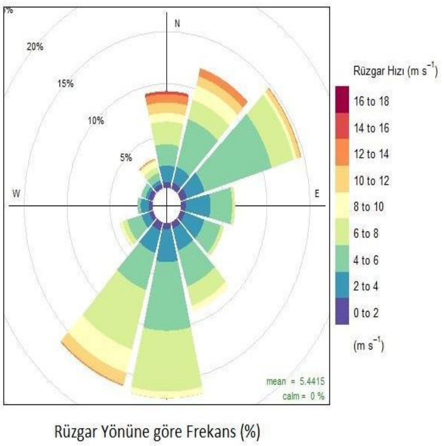

Figure 1.1: Hourly Wind Rose Between December 2020 - March 2021

Evaluation of Kadıköy in terms of Air Quality

Kadıköy is a district with an altitude of 120 m, located in the southwest of the Anatolian Side in the province of Istanbul. The population of the district is approximately half a million (Kadıköy Governorship, 2020). Due to the dense population, it can be expected that the warming emissions originating from the residential areas in the district will affect the air quality. In terms of transportation, the high voyage capacity of road and rail systems can be considered as a factor that increases emissions in the district. The fact that the district is located by the sea has made sea transportation an important part of daily life. The district also has a parking capacity of approximately 6500 vehicles.

Meteorological Data Used

The hourly CFSv2 data at 0.2° resolution of American National Environmental Centre (NCEP) were used in this report. CFSv2 data is a global data that gives values close to the measurement and it is the data created with the common re-estimation method (Reforecast) for use in places where there is no meteorological measurement. The main reason for using CFSRv2 data in the report is that wind strength and direction and pressure variables are of great importance in air pollution analysis. Temperature, pressure and wind data were used together in order not to compromise data integrity.

Air Quality Measurement Devices in Kadıköy

There are 22 measurement stations located at different points in Kadıköy. While determining the station types according to the locations of the devices, urbanization, rural, terrestrial and maritime and emission sources, the report prepared by the EU Commission with other stakeholders was taken as a basis (Geiger et al., 2014).

Nineteen of the stations are Urban-Residential in general; three of them measure particulate matter concentrations from Urban-Traffic emission. The 5123 coded station measures emissions from sea transport, unlike the other two UT-defined stations. The station with the code 43f9 is located in the park, unlike other UR defined stations.

Two different definitions are considered when determining station types:

Group 1: Urban, Suburban, Rural

Group 2: Transportation, Residential, Industrial

Locations and types of all stations in Kadıköy are given in green (UR) and red (UT) colours In figure 2

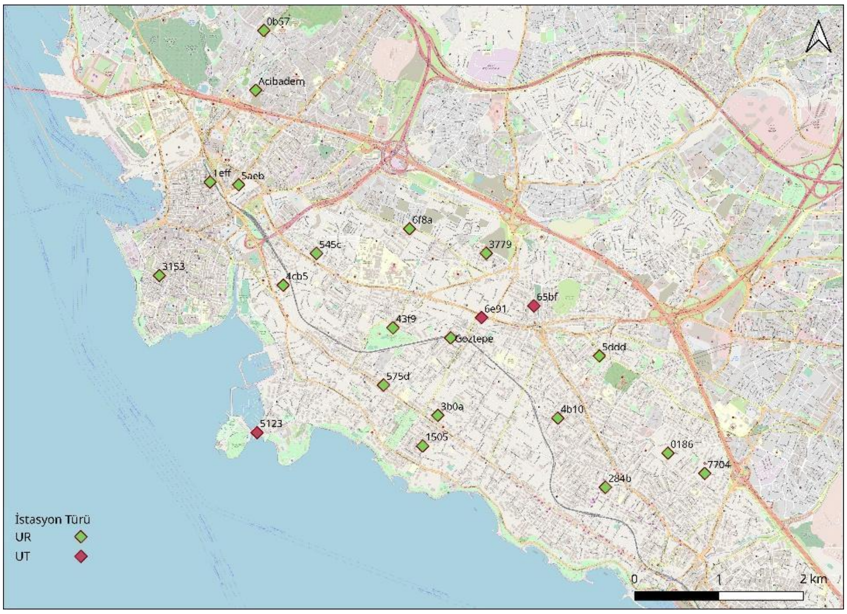

Figure 2: Location of Air Quality Measurement Devices and Devices Types

The Assesment of Data of Air Quality Measurement

The average data percentage of all stations for raw data was found to be 71%. The average of the average $PM_{2.5}$ value for all stations was calculated as 7.1 µg/m³. While the average of the measured average temperature values for all stations was 16 °C, the average of the average humidity values for all stations was found to be 59%.

For the extracted data, the average data percentage of all stations was found to be 68%. This value is calculated lower than the previous one, since the extracted data is not replaced. The average of the average $PM_{2.5}$ value for all stations was found to be 8.3 µg/m³. While the average of the measured average temperature values for all stations was 14 ° C, the average of the average humidity values for all stations was 58.5%.

After the extraction process, hourly average values of the data were obtained and descriptive statistical information of these values was calculated. In the hourly data, the average data percentage of all stations was found to be 87%. $PM_{2.5}$ average of all stations was calculated as 8.2 µg/m³. As meteorological data, temperature, pressure, wind speed and direction data belonging to CFSv2 were obtained. Hourly average of these data is calculated as 9.8 °C for temperature, 1013.2 hPa for pressure and 5.4 m/s for wind speed. Since the inclusion of stations with a data percentage below 80% for the parameter $PM_{2.5}$ examined for this report will disrupt the general behavior; Stations with codes 6e91, 6f8a, 0186 and 1505 are not considered.

Results

Figure 3 shows the time series for $PM_{2.5}$, wind speed, pressure and temperature values between December 1, 2020 and March 1, 2021, respectively. It can be seen that the average $PM_{2.5}$ values obtained from all stations in a period of 3 months reach intermediate peak values. It is observed that the wind speed decreases when these increases occur. This indicates that the pollutants are local and that there is no transport from anywhere. On the other hand, there are also transports in which the pollutant values do not decrease despite the increase in wind speed in some periods, but such cases were found very rarely in the period considered. In the relationship between pressure and pollutant, the presence of pollutant accumulation can be observed, generally under high pressure conditions. It can be said that pressure does not have a clear correlation with pollutant concentrations over the period under consideration. However, a clear relationship between temperature and $PM_{2.5}$ concentrations could not be determined.

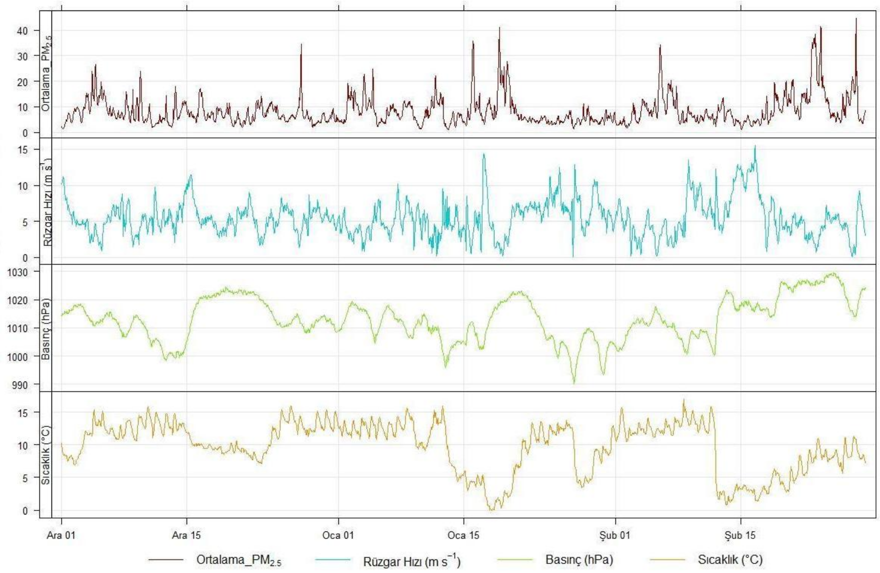

Figure 3.1: Time Series Hourly Measurements between 1 December 2020 - 1 March 2021

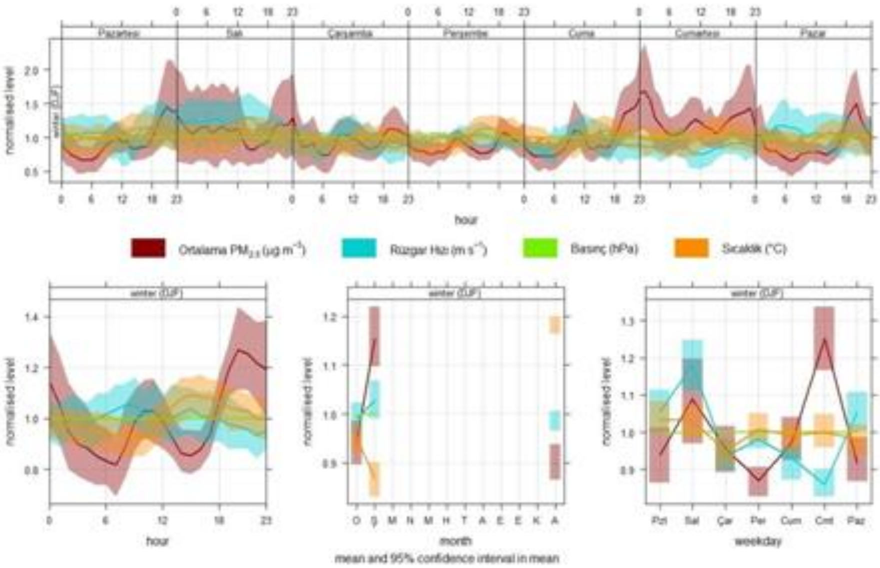

Figure 4.1: Weekly-Hourly Time Series of Variables between December 2020 - March 1, 2021

There is seen more pollution in hourly distributions, especially in the evening hours in Figure 4. It is thought that the reason for this is that the emissions of warming activities increase, especially in the hours after sunset, as the temperature decreases in the winter months. The reason for the increase in $PM_{2.5}$ in February on a monthly basis is thought to be due to the snowfall and low temperature trend in this month. On a weekly basis, the concentration increased the most on Saturdays and the day with the lowest concentrations is on Thursdays.

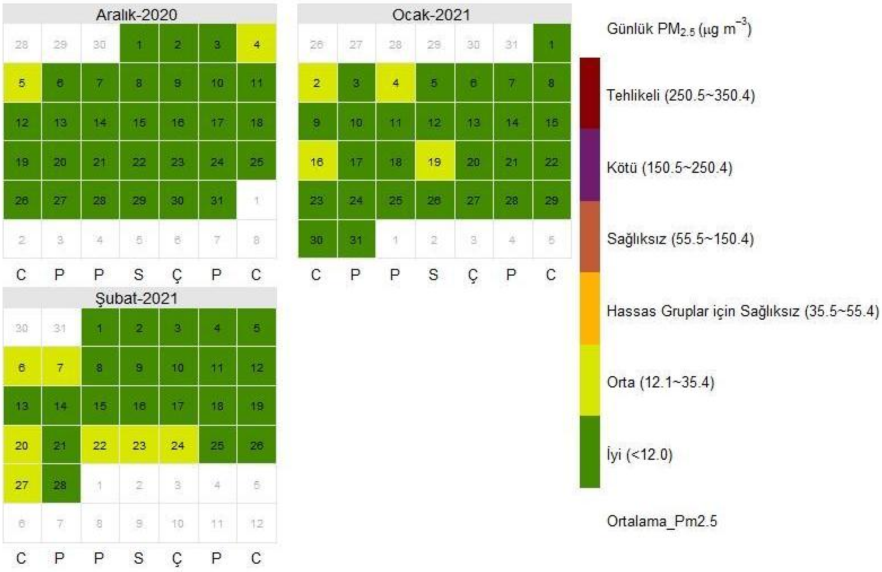

Figure 5.1: Air Quality Values for $PM_{2.5}$ between 1 December 2020 - 1 March 2021

The 24-hour $PM_{2.5}$ pollution schedule for the analyzed date range is given in Figure 5. The cutting points of Air Quality Values for PM2.5 were taken according to the evaluation of EPA (EPA, 2021). In this way, there were also 15 days with moderate air quality in the reference time frame. During these 15 days, 3 pollution episodes were detected on different dates. Of these episodes, 4-5 December 2020 and 6-7 February 2021 episodes are associated with low wind speeds; The 22-24 February 2021 episode lasted for three days and was associated with desert dust transport. Acıbadem and Göztepe are generally the dirtiest stations among the stations, while the stations coded 5aeb and 4b10 are the least polluted stations.

Correlation between stations and correlation of all stations with meteorological variables is given in Figure 6 by creating a matrix. It is striking that the Wind Speed has a negative correlation with all the stations, but the station coded 7704 with -0.49. It appears that there is no clear correlation between temperature, pressure and stations. The highest correlations between stations are found between 0.94 and 284b and 5ddd coded stations; It was found to be 0.92 at 3b0a and 575d coded stations. 3b0a ve 575d kodlu istasyonların aralarında yaklaşık olarak 750 m vardır.

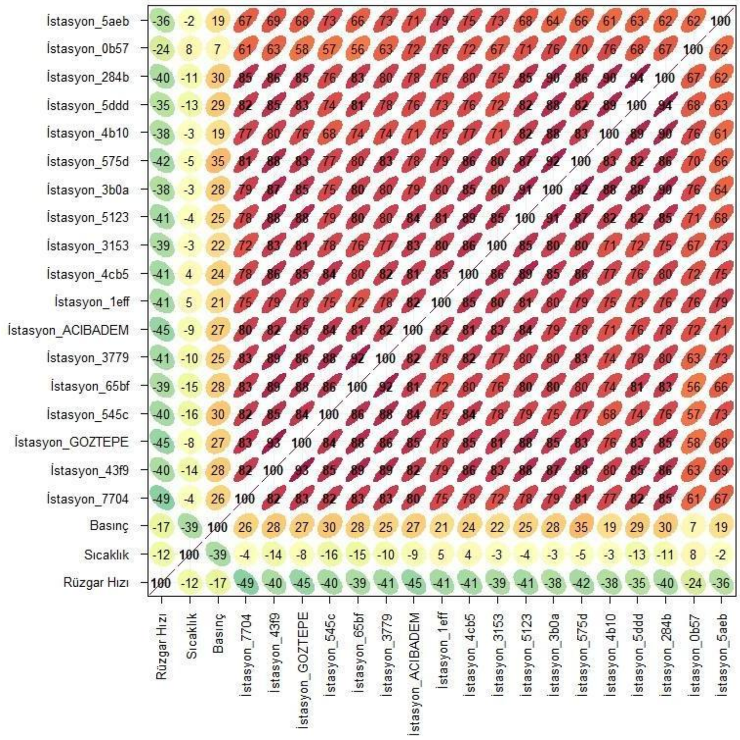

Figure 6: Air Quality Values for PM2.5 between December 2020 - March 1, 2021

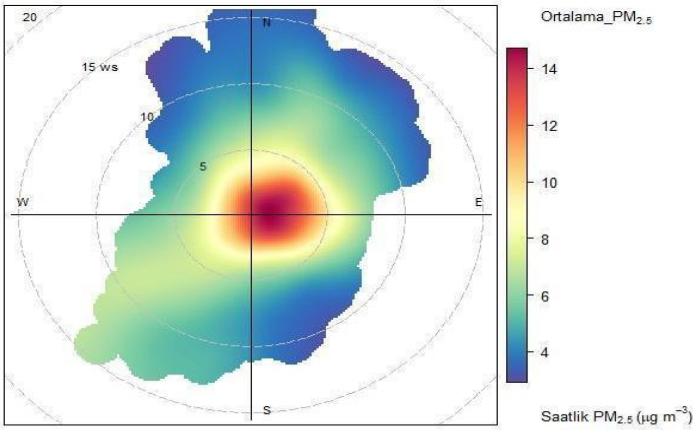

Figure 7: Air Pollution Source Map of Kadıköy District

Circles with dashed points in the pollution source map of the district given in Figure 7 indicate the wind speed, while coloring refers to the $PM_{2.5}$ pollutant. Here, the correlation of low wind speed with the pollutant indicates that the emission sources are within the district. At the same time, this coloration in the southwest indicates that one of the pollutant sources is sea transport. In the light of all this information, it has been analyzed that the emission sources for Kadıköy are generally emissions from heating and traffic.

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