A COMPARISON OF AIR QUALITY AT PALESTINIAN AND ISRAELI RECEPTOR SITES

Ghassan Darwish, Abeer Safar, Jad Isaac - ARIJ
Daniel Pedersen, Menachem Luria – HUJI
Applied Research Institute-Jerusalem
ghassan@arij.org

ABSTRACT

Air quality is affected by many factors which are not limited to individual political entities, and therefore any attempt to understand its causes and control its effects on public health must be based on a regional approach. The political situation in the Middle East poses a particular challenge to obtain comparative data and to develop a comprehensive approach to the research of air quality problems and their solution. Our research objective was to establish a network of identical stations for long-term monitoring at Palestinian and Israeli receptor sites, in order to characterize air quality on both sides of the Green Line and track the evolution of air pollutants as they are transported through the region. An important accomplishment is the initiation of joint measurements and data analyses among Israeli and Arab air quality scientists, in order to create a consistent database of results.

Concentrations of photochemical pollutants were measured simultaneously during August 2003 in Bethlehem and at a site 20 km due west, using similar monitoring equipment. Winds were primarily from the northwest, with some southern and northern components. Average concentrations and time-of-day patterns were similar at both sites, with the ozone peak occurring later in Bethlehem. However, differences were observed in nitrogen oxide concentrations and patterns. Day-of-week patterns showed some dissimilarities, reflecting cultural differences among the

Christian, Muslim, and Jewish populations. These results are the initial steps towards an overall understanding of air quality in the region and cooperative measures for air pollution control.

INTRODUCTION

Simultaneous measurements of photochemical air pollutants and meteorological parameters were carried out in the West Bank and Israel using similar air quality monitoring analyzers and meteorological stations. The analyzers measure CO, O_3, SO_2, NO, NO_2 and NOx gases and the meteorological stations have sensors that measure temperature, relative humidity, wind direction and wind speed.

The measurements relevant to the West Bank were performed by the Applied Research Institute – Jerusalem (ARIJ) in Bethlehem City where the analyzers and meteorological station are operating on a continuous basis. The measurements relevant to Israel were performed by the Hebrew University of Jerusalem (HUJI) during a field campaign that took place in Kibbutz Netiv Halamed-He (NL), south of Beit Shean near the southern Green Line and during August 11 to September 4, 2003.

The interpretation of the measurements to identify the sources of photochemical air pollutants and the location of such sources was one of the key objectives of the conducted research. Concerning the pollutants sources, they can be identified using several methods. One of the methods is to compare the concentrations of compounds which are characteristic of emission sources such as SO_2 and NOX. SO_2 is characteristic of industrial sources and of diesel vehicles burning high sulfur fuel, while NOx are emitted by all combustion processes. Accordingly, high concentrations of SO_2 and NOx indicates that these pollutants were emitted by the combustion of high sulfur

fuels, whereas low concentrations of SO_2 and high concentration of NOx are mainly indicative of mobile sources.

The location of pollutants sources can be deduced by the age of pollutants and/or from the wind direction and speed data. Concerning the age of pollutants, this for example can be reflected from the relative concentrations of nitrogen oxides. NO doesn't require much time to be oxidized to NO_2, therefore high concentrations of NOx and low concentrations of NO indicate that emission sources are located at a significant distance of tens of kilometers or approximately 2 hours. When the concentrations of NOx are very close to those of NO, then the pollutants are emitted from nearby sources to the location of the monitoring analyzers.

The wind direction and speed data gives a first approximation of the direction to the pollutant sources. For example, the wind direction associated with high or low measurements of certain pollutants can indicate the direction from which there are high or low pollution sources.

AVERAGE CONCENTRATIONS

Table 1 presents the overall average concentrations for the 5-minute measurements at Applied Research Institute-Jerusalem (ARIJ) station in Bethlehem and at Netiv Halamed-He (NL) station in the west of Green Line for the duration of August 11 to September 4.

The standard deviations reflect the range of the measured concentrations.

Table.1	ARIJ-Bethlehem			Netiv Halamed He		
	average		stdv	average		stdv
NO	1.74	ppb	1.13	1.67	ppb	1.46
NO_2	6.39	ppb	2.46	23.29	ppb	3.50
NOx	8.13	ppb	3.54	24.97	ppb	4.65
O_3	34.40	ppb	4.46	25.82	ppb	3.80
SO_2	2.47	ppb	1.12	1.83	ppb	0.71
CO	0.78	ppm	0.14	0.79	ppm	0.18

Table1: average concentrations & standard deviation for overall measurements at ARIJ & NL

A comparison between the average concentrations at the two locations shows that during the same measurement period August 11 to September 4, Nitrogen Oxides were higher at Netiv Halamed station than at ARIJ station, except for NO, which was approximately the same at both sites.
In contrast, SO_2 was higher at ARIJ than Netiv Halamed, and Ozone also was higher at ARIJ than Netiv Halamed, while the average concentration of CO was the same at both sites, ARIJ and Netiv Halamed.

The pollutant concentrations for NO, NO_2 and NOx at Netiv Halamed tended to exhibit a much wider ranges than those at ARIJ, as indicated by their standard deviation while the pollutant concentrations ranges for Ozone and SO_2 are wider at ARIJ than those at Netiv Halamed.

SO_2 average concentrations were closer to each other with higher values at several times at ARIJ site than those at Netiv Halamed site. The averages are 5-minute average concentration. Most averages were lower than 10 ppb as shown in figure 1.

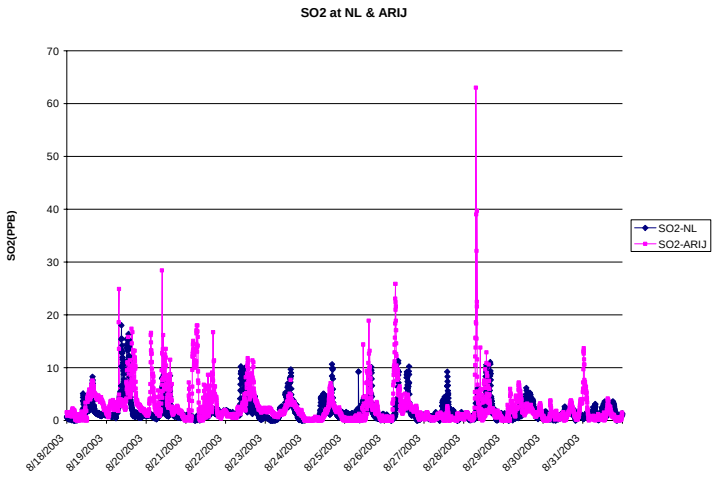

Figure1:SO_2 average concentrations at ARIJ & NL

A comparison between the average concentrations of the Nitrogen Oxides at the two sites shows that NO average concentrations at ARIJ and Netiv Halamed were low and no significant differences between two sites as shown in figure 2, while the average concentrations of NO_2 and NOx were higher at Netiv Halamed than ARIJ as shown in figure3 and figure 4.

The differences between the average concentrations between the NOx and NO were high at ARIJ station and much higher at Netiv Halamed which means that the source of pollution was out of ARIJ and Netiv Halamed areas and far much more from ARIJ site than Netiv Halamed site.

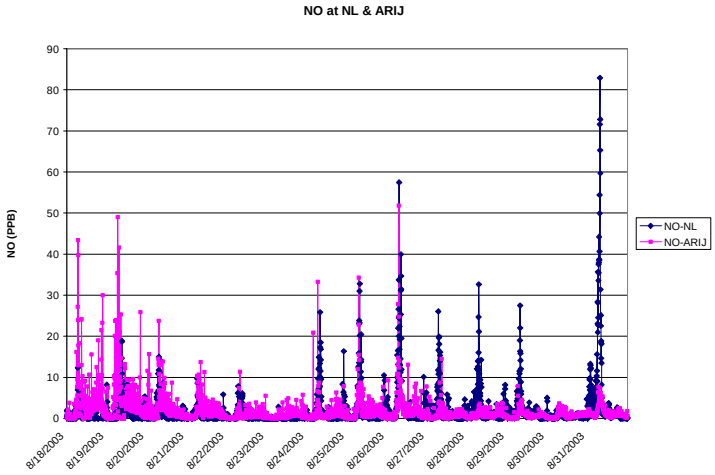

Figure 2: NO average concentrations at ARIJ & NL

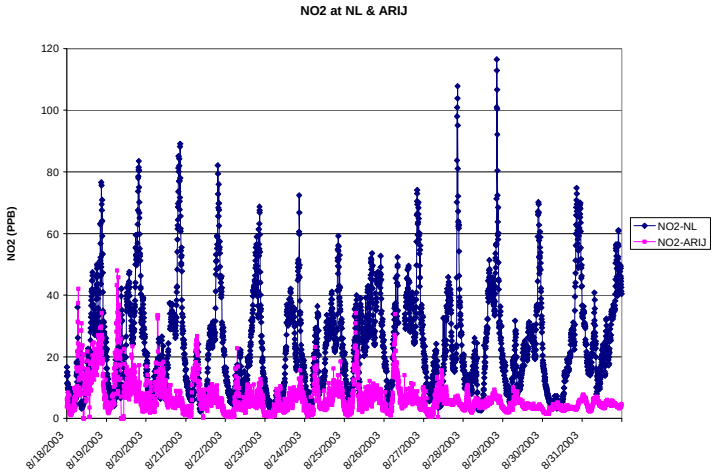

Figure 3: NO_2 average concentrations at ARIJ & NL

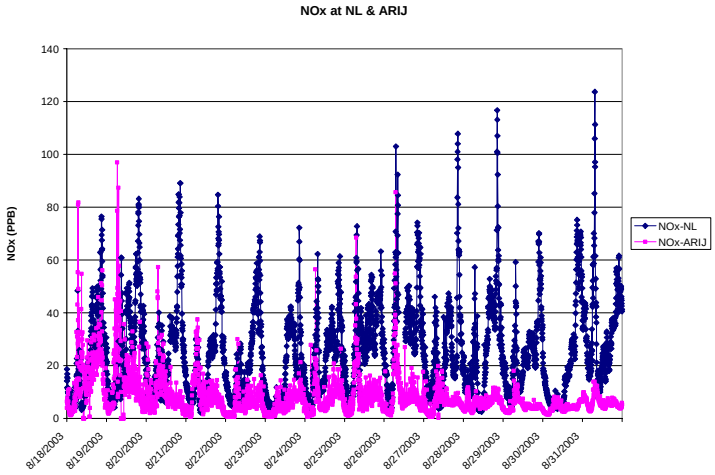

Figure 4: NOx average concentrations at ARIJ & NL

Ozone Concentrations

A comparison between average concentrations of Ozone O_3 at ARIJ and Netiv Halamed shows that the Ozone average concentrations at ARIJ were higher than the average concentrations at Netiv Halamed as shown in figure 5.

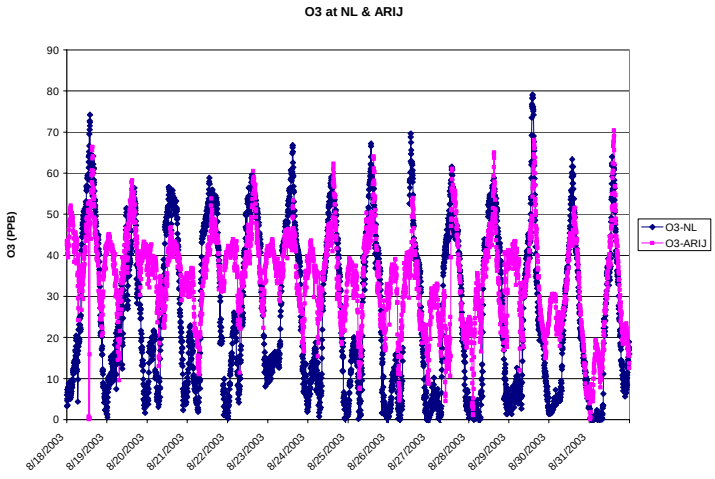

Figure 5: Ozone average concentration at ARIJ & NL

The peak values of Ozone were the same at ARIJ and Netiv Halamed sites and the maximum value was at 15:00 as shown in figure 6.

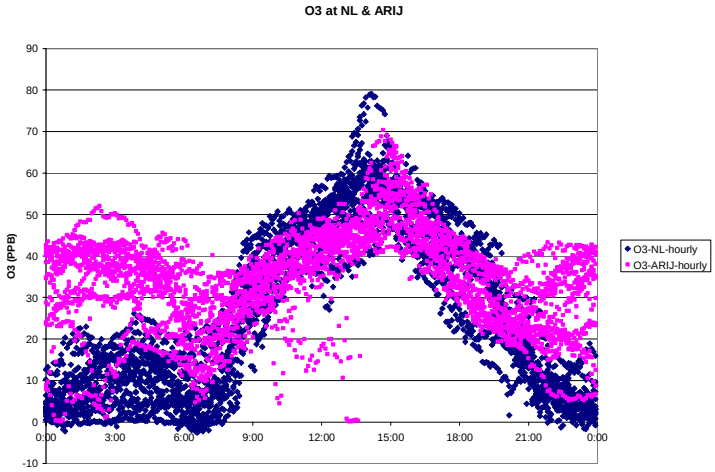

Figure 6: Hourly average concentration of Ozone at ARIJ & NL

Figure 7 shows the Ozone average concentrations at ARIJ and Netiv Halamed sites according to the days of the week, the maximum Ozone average concentration was on Monday and Friday at ARIJ while the maximum average concentration at Netiv Halamed was on Monday.

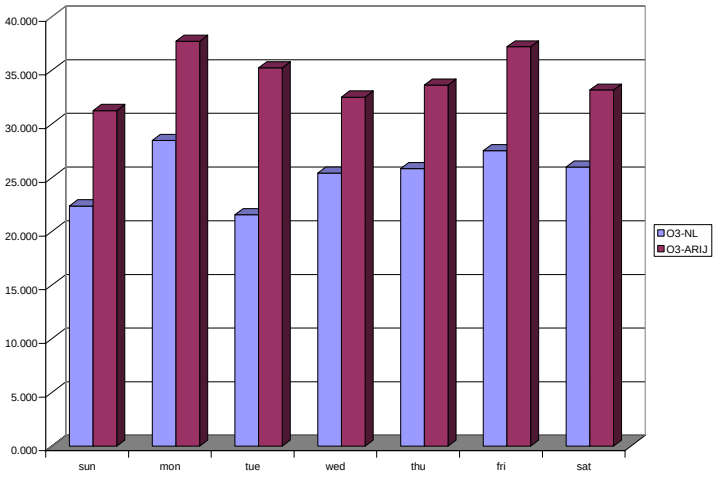

Figure 7: Weekly average concentration of Ozone at ARIJ & NL

Time of Day Analysis Pollutant Concentrations

The high values of SO_2 average concentrations were from 06:00 in the morning to 19:00 in the evening at ARIJ and also at Netiv Halamed, while the rest of the day were low except several times at ARIJ where there were high values in the night as shown in figure 8.
The high values of NOx average concentrations were from 06:00 to 09:00 in the morning only at ARIJ and the rest of the day were low, and at Netiv Halamed from 06:00 to 09:00 and from 12:00 to 00:00 with peak value at 21:00 as shown in figure 9.

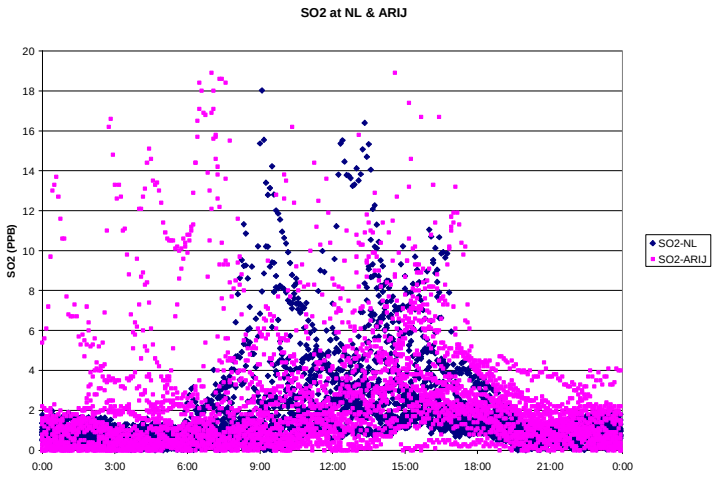

Figure 8: SO_2 hourly average concentrations at ARIJ & NL

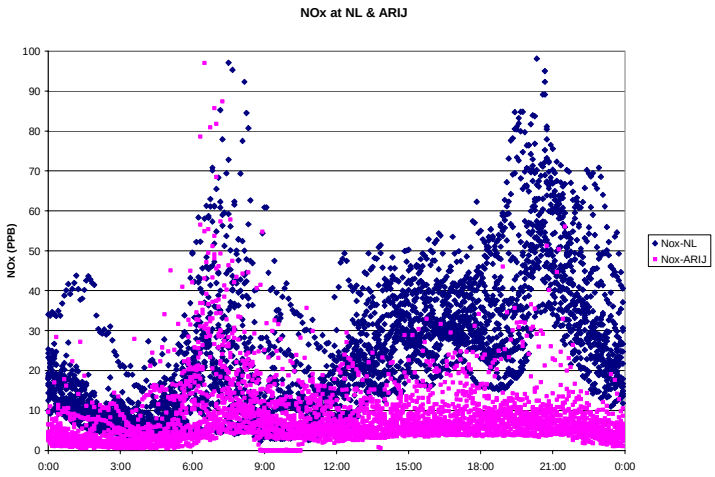

Figure 9: NOx hourly average concentrations at ARIJ & NL

Days of The Week Analysis Pollutant Concentrations

A comparison between the average concentrations of NOx at ARIJ and Netiv Halamed according to the days of the week shows that the average concentrations begins with high values at Netiv Halamed on Sunday the first day of the week in Israel and becomes lower on Saturday the weekend of Israel.

The average concentrations of NOx at ARIJ were from Monday to Thursday and lower on Friday the weekend of Muslim population in Bethlehem and on Sunday the weekend of Christian population in Bethlehem and also on Saturday the weekend of Jewish in Israel.

This conclusion is very clear as shown in figure 10 and proves that a part of the pollution which Bethlehem city is affected by is from Israel.

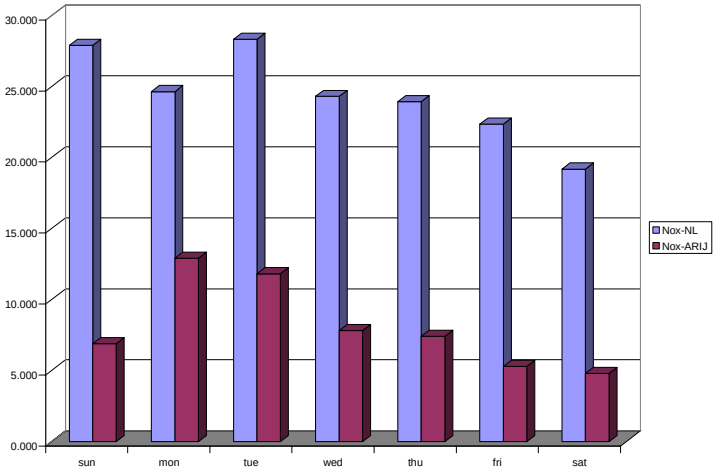

Figure 10: Weekly average concentrations of NOx at ARIJ & NL

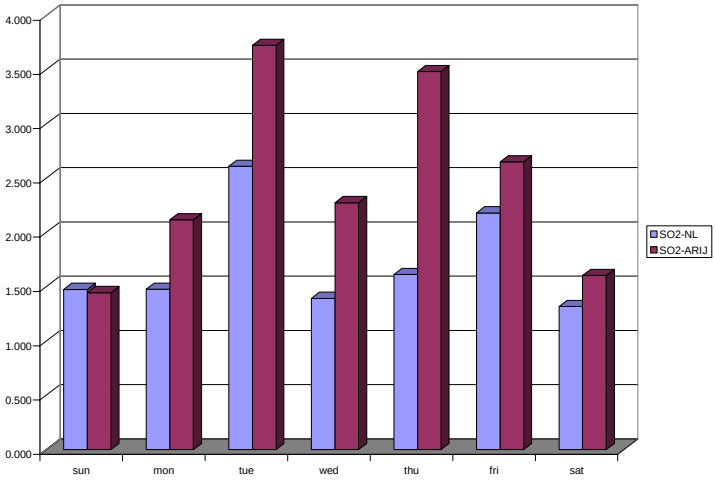

Figure 11: Weekly average concentrations of SO_2 at ARIJ & NL