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Research article
מאמר מחקר

Analysis of long-term bio-climatological measurements at the Dead Sea basin, Neve Zohar

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A B S T R A C T

An in-depth analysis of long-term bio-climatological measurements, initiated during 1994, in the Dead Sea basin at Neve Zohar has been performed. The parameters monitored during this time interval include the global, UVB and UVA irradiation on a horizontal surface, ambient temperature and barometric pressure. The monitoring of the relative humidity was initiated in August 2004. The statistical analysis was performed on all the individual monthly databases and included the following parameters: average, median, standard deviation, coefficient of variation, maximum and minimum monthly values. The three solar irradiation and ambient temperature monthly databases were also analyzed to determine if any trends, increasing/decreasing, exist for these parameters during the time interval of this study.

Keywords:
Global
UVB and UVA irradiation
UVB Index
Ambient temperature
Barometric pressure
Relative humidity
Dead Sea basin

ניתוח מדידות ביו-קלימטולוגיות ארוכות-טווח באגן ים המלח, נווה זוהר

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ת ק צ י ר

ניתוח עומק בוצע על נתונים ממדידות ביו-קלימטולוגיות בנווה זוהר, אגן ים המלח, החל משנת 1994. המשתנים שנמדדו בתקופה זו כללו קרינה גלובלית, אולטרה-סגול A, אולטרה-סגול B, אינדקס UVB, טמפרטורת הסביבה ולחץ ברומטרי. מדידות של הלחות היחסית החלו להתבצע רק באוגוסט 2004. ניתוח סטטיסטי בוצע על כל מסד נתונים חודשי בנפרד, וכלל ערכים של ממוצע, חציון, סטיית תקן, מקדם שונות, מקסימום ומינימום. ניתוח נוסף בוצע על כל מסד נתונים חודשי בנפרד, והתייחס לשלוש הקרינות ולטמפרטורת הסביבה במטרה לאתר מגמה של עלייה או ירידה בתקופת המחקר.

מילות מפתח:
קרינה גלובלית
אולטרה-סגול A ואולטרה-סגול B
אינדקס UVB
טמפרטורת הסביבה
לחץ ברומטרי
לחות יחסית
אגן ים המלח
נווה זוהר

1. Introduction

The Dead Sea basin is recognized internationally as a natural treatment facility for patients with psoriasis, atopic dermatitis, vitiligo and other skin and rheumatic diseases, cf., Dostrovsky and Sagher (1959), Avrach and Niordson (1974), Sukenik (1994) and Even-Paz, et al. (1996). Abels and Kipnis (1998) reported that for over 50 years patients, mainly those suffering from psoriasis, have been treated at the Dead Sea medical spas. The success rate measured in terms of excellent to complete clearance after 4 weeks of treatment exceeds 85%, cf., Abels and Kattan (1985) and Harari and Shani (1997). These clinical findings were presumed to be associated with a unique spectrum of ultraviolet irradiation present at the Dead Sea basin, cf., Kushelevsky and Slifkin (1975), Kushelevsky and Kudish (1996) and Abels, et al. (1996).

The Prof. Avraham Kushelevsky z"l Memorial Meteorological Station was established towards the end of 1994 with the specific aim of examining the ultraviolet irradiation at the Dead Sea but, also to study the other bio-climatological parameters within the Dead Sea basin. It is situated on the roof of the building housing the Tamar Regional Council at Neve Zohar. The purpose of this meteorological station is to measure and analyze the bio-climatological parameters characterizing the Dead Sea basin and to apply these findings to optimize the various treatment protocols of the medical spas operating in this region.

The Dead Sea basin is a unique site on the earth's surface. It is situated at the lowest terrestrial point on earth, about 400 m below mean sea level. It consists of the Dead Sea, which is a salt lake located between Israel and Jordan, and their surrounding shores. The Dead Sea is one of the saltiest bodies of water known on earth (345 g mineral salts per liter). The location of the Dead Sea basin at the lowest terrestrial point on earth manifests itself in the measured values of the incident solar irradiation, especially within the ultraviolet range, and the barometric pressure.

The solar irradiation intensity at the Dead Sea, especially that in the ultraviolet range, is of interest due to the uniqueness of this site. Stanhill (1970, 1987) and Stanhill and Ianetz (1997) have reported upon global irradiation intensity measurements at the Dead Sea basin. Kudish et al. (1997, 2000, 2005a, 2005b, 2009, 2012a, 2012b)) have reported upon ultraviolet, both UVB and UVA, and global irradiation measurements at the Dead Sea. These ultraviolet irradiation measurements are of special interest for the treatment of psoriasis, atopic dermatitis, vitiligo and other skin and rheumatic diseases, cf., Dostrovsky and Sagher (1959), Avrach and Niordson (1974), Abels and Kattan (1985), Sukenik (1994) and Kudish, Abels and Harari (2003). The global, UVB and UVA solar irradiation intensities have been monitored continuously at Neve Zohar since January 1995.

The barometric pressure exerted on a surface is affected by both meteorological and physical factors. It is a function of the air column height above the site, dry bulb temperature and humidity. The Dead Sea basin is expected, a priori, to have the highest terrestrial barometric pressure on the earth as a result of it having the tallest atmospheric air column above its surface. In recent years a number of research projects have been performed regarding the treatment at the Dead Sea of patients suffering from:

- chronic obstructive pulmonary diseases (COPD) and end-stage lung disease with chronic hypoxemia, cf., Kramer et al. (1994 and 1998);
- cystic fibrosis, especially children, cf., Berkovits et al. (1999) and Greenberg et al. (2000)
- coronary artery disease and congestive heart failure after healing of acute myocardial infarction, cf., Abinader et al. (1999a and 1999b)

This increase in barometric pressure at this lowest terrestrial site on earth relative to normal barometric pressure, resulting in an increase in molecular oxygen density at the Dead Sea, serves as a natural way to improve arterial oxygenation in these patients. The barometric pressure and dry bulb temperature have been monitored continuously at Neve Zohar since January 1995. Kudish and Evseev (2006) have previously published an analysis of these data.

The monitoring of the relative humidity was initiated during August 2004, consequently, the available database is significantly smaller than those available for the other meteorological parameters.

We believe that the results and analysis of these long-term measurements of the bio-climatological parameters at the Prof. Avraham Kushelevsky z"l Memorial Meteorological Station should be available to the scientific community at-large.

2. Measurement instrumentation

The meteorological station site parameters are as follows: latitude 31°9' N, longitude 35°22' E, altitude ~395 m mean sea level. It presently consists of the following instrumentation:

1. Kipp & Zonen CM11, Serial # CM 11903009- for measuring solar global irradiation on a horizontal surface;
2. Solar Light Model 501 UV-Biometer Detector/SN 1447- for measuring solar UVB irradiation on a horizontal surface;
3. Solar Light Model 501A UVA Detector/SN 1445- for measuring solar UVA irradiation on a horizontal surface;

4. Solar Light Model 501 UV-Biometer with collimator tube and Eppley Solar Tracker Model ST-1 for measuring normal incidence UVB beam irradiation;[1]
5. Met One Instruments, Model 083C - for measuring ambient temperature and relative humidity, located in a meteorological sunscreen enclosure 1.5 m above the ground level;
6. Met One Instruments, Model 090C barometric pressure sensor;
7. Campbell Scientific Instruments, CR21 datalogger- which scans the probes at 10 second intervals but records average values at 10 minute intervals located on the second floor of the Tamar Regional Council building;
8. Microcom, Model AX/2400c communication modem- for downloading data from the CR21 datalogger, located on the second floor of the Tamar Regional Council building.

3. Results and discussion

A statistical analysis was performed on all the individual databases and includes the following parameters: average, median, standard deviation, coefficient of variation, maximum and minimum monthly values.

3.1 Irradiation measurements

3.1.1 Global irradiation

The monthly average daily values for the global irradiation are reported in Tables 1. The maximum and minimum average daily global irradiation on a horizontal surface is 7941.9 and 2938.1 Wh/m^2 occurring in June and December, respectively. The coefficient of variation (defined as the ratio of the standard deviation and mean) is a measure of the spread of the individual daily values around the average. It is apparent from Table 1 that

Table 1: Monthly average daily global irradiation (Wh/m^2)

	Jan (573 d)	**Feb** (554 d)	**Mar** (677 d)	**Apr** (647 d)	**May** (671 d)	**June** (634 d)	**July** (641 d)	**Aug** (613 d)	**Sept** (644 d)	**Oct** (676 d)	**Nov** (598 d)	**Dec** (672 d)
Year	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)	Global irradiation (Wh/m^2)
1995	3259.9	3826.2	4630.4	6376.2	7493.2	8043.7	7528.7	7158.1	6002.3	4877.2	3620.9	2919.6
1996	2985.9		4745.8	6109.2	7325.8	7992.8	7393.3	7043.3	6083.9	4645.1		2730.7
1997	2973.3	3895.4	4713.5	6024.7	7552.6	7932.3	7708.4	6989.9	6052.9			2808.8
1998	2809.8	3824.9	5278.7	6402.4	6853.8	7951.6	7748.4		5858.3	4845.2	3483.8	
1999	2975.6	3410.6	4996.9	6390.9	7362.9	7675.7	7813.5	7215.9		4812.9	3635.1	3129.3
2000	2528.0	4039.9	5498.6	6450.1	7806.6	8126.1	7488.6	6906.4	5954.5	4337.9	3540.9	
2001			4982.2	6135.1	7133.2	8056.7	7821.2	6980.5	6075.2	4667.9	3545.6	
2002	2899.4	4110.5	4520.1	5883.7	7559.1	7976.2	7658.6	7058.1	6066.6	4437.8	3460.9	2651.6
2003			5507.9	6323.4	7482.0	8301.2	8077.3	7361.4	6411.8	4864.1	3715.8	2923.7
2004	2878.5		5294.4	6664.6	7168.5	8063.6	8063.1	7366.6	6400.4	4672.7	3320.2	3056.1
2005	3211.2	3902.2	5308.1	6219.4	7369.6	7904.3	7988.6	7251.1	6330.6	4960.3	3472.8	2976.6
2006		3678.0	5487.3	5922.7	7511.3	7953.2	7883.6	7185.7	6208.7	4667.4	3665.0	3063.4
2007	3285.0	3803.5	4907.2	6141.8	6783.5	7772.3	7736.2	7175.6	5954.3	4705.4	3695.0	3168.3
2008	2912.2	3984.9	5586.2	6651.1	7573.3	7985.1	8001.7	7118.2	5922.4	4563.4	3687.0	3098.1
2009	3410.6	4016.1	5462.5	6169.3	7125.9	8073.7	7780.6	7198.0	5953.0	4560.8	3556.1	2934.0
2010	3174.8	3938.2	5253.4	6610.7	7237.5	7773.6	7688.6	6991.8	5875.7	4714.9	3730.6	2945.3
2011	3174.8	3647.0	5570.0	6220.3	7164.3	7990.3	7816.7	7082.2	6030.8	4839.4	3465.5	3058.9
2012	3057.2	3784.0	4960.8	6587.8	7272.8	7810.5	7689.3	7104.8	6133.1	4605.0		2975.0
2013	2940.3	4157.6	5397.6	6575.5	7322.9	7972.4	7819.1	7248.6	6207.2	5021.5		2690.6
2014	3362.8	4361.1	4943.9	6690.8	7024.2	7790.6	6696.6	7139.6	6186.1	4697.8	3388.0	3033.6
2015	2901.6	3946.9	5309.2	6494.4	7399.3	7629.4	7766.1	6912.4	5404.5	4278.4	3274.5	3067.4
2016	3042.6	4206.0	5139.5	6582.8	7287.9	7946.3	7838.2	6699.8	6264.5	4927.3	3446.0	2951.2
Average	3041.2	3918.5	5158.8	6346.7	7309.6	7941.9	7727.6	7104.2	6065.6	4700.1	3539.1	2957.0
Median	2985.9	3920.2	5266.0	6383.6	7324.4	7962.8	7773.3	7118.2	6066.6	4697.8	3543.2	2975.0
Stdev	215.2	222.5	323.3	248.0	242.6	153.6	287.1	158.4	221.5	195.6	136.0	146.3
Cv%	7.08	5.68	6.27	3.91	3.32	1.93	3.72	2.23	3.65	4.16	3.84	4.95
Max	3410.6	4361.1	5586.2	6690.8	7806.6	8301.2	8077.3	7366.6	6411.8	5021.5	3730.6	3168.3
Min	2528.0	3410.6	4520.1	5883.7	6783.5	7629.4	6696.6	6906.4	5404.5	4278.4	3274.5	2651.6
p	0.219	0.080	0.060	0.028	0.286	0.100	0.893	0.413	0.725	0.937	0.193	0.268

1. The database presently available is not sufficient to justify a long-term analysis; consequently, it is not included in this communication. Nevertheless, results from the first year of measurements have been published, cf., Kudish et al., 2011a and b.

the individual daily values exhibit very little variation around the average during the summer months and the variability increases as one is further removed from the summer months. The % Cv varies between 1.93 and 7.08 for June and January, respectively, implying a relative narrow spread of the individual values around the average. Also, the monthly average and median values are very similar (± 2%), an indication that the individual values are evenly spread around the average value.

It is of interest to analyze the individual monthly databases in order to detect if any trends are observed during the time interval under investigation. Consequently, the p-values for the individual monthly databases were determined and are reported on the bottom line of Table 1. The p-values for all months exceed 0.005, thus implying that there is no statistical significance for a correlation depicting the global irradiation intensity as a function of time during this time interval, viz., no trend exists.

3.1.2 UVB irradiation

The monthly average daily UVB irradiation and its statistical analysis are reported in Table 2. The maximum and minimum average UVB irradiation on a horizontal surface occur during June and January/December and are 1.59 and 0.34/5 Wh/m^2, respectively. The variability within each monthly database is relatively large, viz., the % Cv exceeds 10% throughout the year. This may be attributed to the fact that the UVB irradiation is most strongly attenuated, by selective scattering, as a result of being the shortest wavelength range incident on the earth. As a result, UVB irradiation is most affected by local atmospheric conditions.

The monthly average and median values are of the same order of magnitude, i.e., differing by ± 3% with the exception of March, April and December, which differs by ± 5%, viz., the individual values are approximately evenly spread about the mean. The p-values for all months, once again, exceed 0.005, indicative of the absence of any correlation between UVB

Table 2: Monthly average daily UVB irradiation (Wh/m^2)

	Jan (494 d)	**Feb** (373 d)	**Mar** (648 d)	**Apr** (554 d)	**May** (633 d)	**June** (621 d)	**July** (632 d)	**Aug** (599 d)	**Sept** (594 d)	**Oct** (563 d)	**Nov** (470 d)	**Dec** (465 d)
Year	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)	UVB irradiation (Wh/m^2)
1995	0.45	0.56	0.64	1.22	1.51	1.66	1.43	1.34	1.05	0.73	0.44	0.30
1996	0.32		0.64	0.93	1.22	1.42	1.35	1.26	1.02	0.68		
1997	0.35	0.46	0.65	1.01	1.35	1.53	1.53	1.37	1.08			
1998	0.33	0.51	0.91	1.03	1.26	1.57	1.56		1.07	0.81	0.50	
1999	0.40	0.60	0.72	1.17	1.45	1.58	1.59	1.41		0.76	0.45	0.35
2000	0.29	0.54	0.87	1.01	1.39	1.57	1.41	1.28	1.07	0.68	0.48	
2001			0.79	1.08	1.27	1.60	1.55	1.34	1.12	0.74	0.47	
2002	0.35	0.59	0.68	1.02	1.38	1.57	1.50	1.26	1.09	0.68	0.41	0.28
2003			1.06	1.08	1.32	1.68	1.67	1.50	1.23	0.83	0.52	0.35
2004	0.34		1.06	1.34	1.60	1.93	1.86	1.70	1.38	0.88	0.51	0.40
2005			1.08	1.36	1.71	2.07	2.07	1.86	1.47	1.00	0.59	0.51
2006		0.51	0.86	0.99	1.36	1.61	1.54	1.39	1.12	0.73	0.46	
2007	0.40	0.51	0.80	1.05	1.36	1.70	1.69	1.54	1.20	0.83	0.54	0.39
2008	0.35	0.58	0.96	1.26	1.55	1.73	1.70	1.46	1.16	0.79	0.53	0.37
2009	0.40		0.81	1.02	1.24	1.52	1.52	1.36	1.06	0.70		0.29
2010	0.35	0.47	0.74	0.99	1.22	1.43	1.43	1.30	1.04	0.74		0.30
2011	0.30	0.43	0.72		1.17	1.42	1.35	1.15	0.91	0.68	0.37	0.30
2012	0.29	0.42	0.63		1.23							0.26
2013	0.31		1.05	1.15	1.23	1.43	1.40	1.23	1.08	0.68		0.32
2014	0.35	0.55	0.67	1.07	1.39	1.34	1.30	1.18	1.05	0.65	0.40	0.33
2015	0.27		1.00			1.50	1.48	1.25	0.89	0.69	0.44	
2016	0.37	0.59	0.78	1.04	1.28	1.49	1.52	1.28	1.12	0.77	0.45	0.35
Average	0.35	0.52	0.82	1.10	1.36	1.59	1.55	1.37	1.11	0.75	0.47	0.34
Median	0.35	0.52	0.79	1.05	1.35	1.57	1.52	1.34	1.08	0.73	0.47	0.33
Stdev	0.05	0.06	0.15	0.12	0.14	0.17	0.18	0.17	0.14	0.09	0.06	0.06
Cv%	13.55	11.32	18.75	11.04	10.38	10.80	11.62	12.59	12.17	11.48	12.21	18.07
Max	0.45	0.60	1.08	1.36	1.71	2.07	2.07	1.86	1.47	1.00	0.59	0.51
Min	0.27	0.42	0.63	0.93	1.17	1.34	1.30	1.15	0.89	0.65	0.37	0.26
p	0.191	0.556	0.346	0.876	0.277	0.250	0.648	0.343	0.491	0.507	0.405	0.625

irradiation intensity and time, viz., no trends were observed during this time interval.

The UVB irradiation measurements are the source for the calculating the UVB Index, which is used to inform the general public of the relative intensity of the erythema irradiation; the cause of sunburn. The UVB irradiation intensity, measured in Wh/m^2, is multiplied by 40 and rounded to the nearest integer, to arrive at the corresponding UVB Index. The UVB Index scale is a measure of the time it takes for incipient redness to appear on the skin and is as follows (WHO, 2002):

UVB Index	Category	Sunburn time (approximate)
> 9	Extreme	< 15 minutes
7-9	High	20 minutes
4-7	Moderate	30 minutes
< 4	Low	> 60 minutes

The monthly average hourly UVB Index as a function of time of day is plotted in Fig. 1. It is observed that the average hourly UVB Index at the Neve Zohar enters the high range only during the summer months at the midday hours, cf., Fig. 1. In addition, it enters into the extreme range only at midday during the month of June. This is a consequence of the enhanced selective attenuation of the erythemal UVB irradiation at the Dead Sea basin as a result of it being the lowest terrestrial site on the earth, cf., Kudish, et al. (1997, 2003).

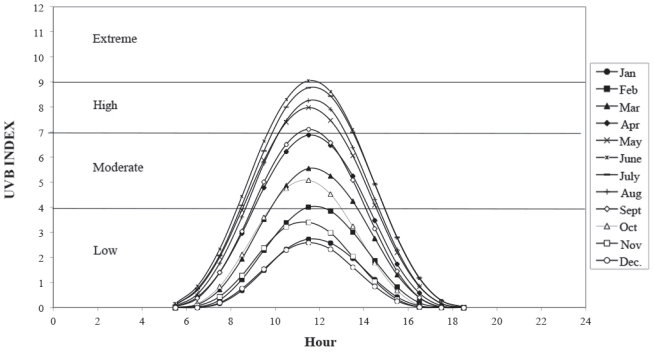

Figure 1: Monthly average hourly UVB Index

3.1.3 UVA irradiation

The results and statistical analysis for the UVA irradiation are reported in Table 3. The maximum and minimum average UVA

Table 3: Monthly average daily UVA irradiation (Wh/m^2)

	Jan (409 d)	**Feb** (401 d)	**Mar** (609 d)	**Apr** (555 d)	**May** (607 d)	**June** (595 d)	**July** (628 d)	**Aug** (606 d)	**Sept** (594 d)	**Oct** (643 d)	**Nov** (551 d)	**Dec** (486 d)
Year	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)	UVA irradiation (Wh/m^2)
1995							377.02	361.13	301.22	229.63	173.79	139.88
1996	143.53	238.08	238.08	303.92	365.03	405.22	373.28	355.05	303.60	219.14	165.38	134.85
1997	146.12	231.41	231.41	297.34	375.77	398.51	388.81	353.15	299.78	246.93	167.66	133.03
1998	139.44	237.37	237.37		361.79	418.51	406.05		304.65	248.77	174.49	
1999	145.40	258.83	258.83	319.10	368.02	396.76	392.88	359.81		222.75	180.79	153.04
2000	133.50	251.31	251.31	322.41	400.25	423.28	389.95	364.29	311.34	230.47	176.46	
2001		279.31	279.31	311.01	360.32	410.27	398.49	352.59	306.18	209.15	171.46	
2002	137.05	239.51	239.51	290.06	375.90	401.38	384.33	355.44	298.38	227.74	156.59	119.86
2003		211.60	211.60	288.53	339.54	395.66	386.43	350.45	303.57	211.92	167.59	130.45
2004		247.20	247.20	305.45	335.62	391.15	376.26	346.31	294.70	221.65	146.72	134.37
2005		244.24	244.24	286.73	347.61	384.35	379.24	344.05	289.32	226.16	154.82	136.96
2006		261.19	261.19	290.21	378.67	410.64	397.81	364.22	305.33	222.06	170.14	132.27
2007	149.21	228.10	228.10	293.80	335.75	396.99	385.81	356.34	292.02	223.97	178.48	
2008	134.07	267.09	267.09	320.73	390.08	412.30	405.10	353.77	292.31	217.27	175.36	138.64
2009	154.00	251.00	251.00	304.90	347.15	406.32	393.96	360.08	296.52	228.92		
2010	153.26	250.00	250.00	312.53	354.82	393.21	387.37	355.84	296.08	228.91	177.72	135.36
2011	138.95	260.36	260.36		349.32	402.03	386.37	353.43	296.62		164.66	138.83
2012	130.25	226.79	226.79		344.21					223.36		118.65
2013	130.96	242.96	242.96	297.31	312.87	379.23	376.83	349.14	279.15	206.68		131.17
2014		214.78	214.78	287.06	381.07	363.97	368.60	337.49	278.93	195.11	152.70	137.72
2015	115.79	258.70	258.70	323.45		397.32	402.69	352.96	259.18	238.81	147.06	
2016	143.46	200.77	251.60	326.48	423.32	404.80	406.69	353.66	316.56	238.18	160.62	137.79
Average	139.67	184.51	245.31	304.50	362.36	399.59	388.76	353.96	296.27	224.65	166.45	134.55
Median	139.44	185.64	247.20	304.41	361.05	399.94	387.37	353.71	297.50	223.97	167.66	135.10
Stdev	9.99	14.23	16.82	13.83	25.49	13.56	11.22	6.55	12.75	12.79	10.65	7.90
Cv%	7.15	7.71	6.86	4.54	7.03	3.39	2.89	1.85	4.31	5.69	6.40	5.87
Max	154.00	203.67	279.31	323.45	400.25	423.28	406.05	364.29	311.34	248.77	180.79	153.04
Min	115.79	158.72	211.60	286.73	312.87	363.97	368.60	337.49	259.18	195.11	146.72	118.65
p	0.276	0.796	0.949	0.575	0.857	0.052	0.538	0.102	0.025	0.053	0.075	0.523

irradiation on a horizontal surface is 399.59 and 134.55 Wh/m^2 occurring in June and December, respectively. The % Cv varies between 1.85 and 7.71 for August and February, respectively. Once again, the monthly average and median values are very similar, differing by ± 1%, indicative of relatively low variation of the individual values within the monthly databases. The p-values for all month exceed 0.005 indicating that no trends exist for monthly average daily UVA irradiation intensities as a function of time.

3.2 Ambient temperature

The results of the statistical analysis of the ambient temperature monthly databases are reported in Tables 4a and 4b. The monthly average hourly ambient temperatures are shown graphically in Fig. 2. The databases were divided into three subgroups, i.e., day, night and daily, which are defined as from 06:00-18:00, 18:00-06:00 and 00:00-24:00 Israel Standard Time, respectively. The maximum ambient temperatures are 36.2 (July), 32.8 (August) and 34.7 °C (July/August) corresponding to day, night and daily, respectively. The minimum temperatures occurring in January are 18.1, 16.4 and 17.5 °C for day, night and daily, respectively. The % Cv values range between 1.7 and 6.8% for all months with the exception of the month of June, which ranges from 9.3 to 16.8%. The monthly average and median values are very similar, ±1%, with, once again, the exception of June. Viz., for the month of June the % Cv is -3%, +10% and +6% corresponding to the day, night and daily values, respectively. The p-values indicate that a correlation expressing ambient temperature as a function of time is significant only for the months of May and June, i.e., a decreasing trend of ambient temperature with time.

Table 4a: Monthly average daily ambient temperature (°C)

	Jan (617 d)			**Feb** (553 d)			**Mar** (589 d)			**Apr** (561 d)			**May** (614 d)			**June** (584 d)		
Year	**Day*** (°C)	**Night**** (°C)	**Daily** (°C)	**Day*** (°C)	**Night**** (°C)	**Daily** (°C)	**Day*** (°C)	Night** (°C)	Daily (°C)	Day* (°C)	Night** (°C)	Daily (°C)	Day* (°C)	Night** (°C)	Daily (°C)	Day* (°C)	Night** (°C)	Daily (°C)
1995	17.8	16.7	17.6	19.4	17.8	18.7	22.8	20.7	21.9	25.4	22.8	24.3	30.8	27.3	29.4	34.9	31.1	33.3
1996	18.3	16.8	17.7	20.2	18.7	19.6												
1997	17.9	15.8	17.0	17.4	15.5	16.6	20.2	18.0	19.2	24.5	21.3	23.2	31.4	28.1	30.0	34.0	30.3	32.4
1998	18.1	16.4	17.4	19.5	17.5	18.6	21.5	18.9	20.4	27.7	24.6	26.4	31.0	27.5	29.5	33.7	29.9	32.1
1999	19.2	17.1	18.3	19.7	17.8	18.9	23.5	20.4	22.2	26.5	23.0	25.0	32.2	28.4	30.6	34.2	30.0	32.4
2000	17.7	14.6	16.4	19.4	17.1	18.4	21.2	18.7	20.2	27.4	24.1	26.0	31.0	26.9	29.3	34.8	30.7	33.0
2001	18.6	16.3	17.6	19.6	17.0	18.5	26.1	23.0	24.8	28.1	24.7	26.7	31.1	27.4	29.6	34.5	30.7	32.9
2002	17.3	15.6	16.6	20.8	18.2	19.7	24.1	21.3	22.9	26.6	22.6	25.0	31.0	26.0	28.9	34.8	29.6	32.6
2003																		
2004													30.0	26.4	29.5	33.3	33.4	34.0
2005	18.1	16.7	17.7	19.0	17.4	18.3	22.4	20.4	22.2	27.0	24.5	26.1	30.0	26.4	29.5	29.5	29.8	30.7
2006	19.1	17.9	18.7	20.1	18.6	19.5	23.2	20.6	22.8	25.6	23.2	24.8	29.9	26.3	29.3	31.7	31.9	32.6
2007	17.8	16.4	17.3	19.9	18.1	19.1	22.8	20.5	22.5	25.5	22.9	24.6	29.8	26.2	29.2	29.0	22.0	25.5
2008	14.8	13.5	14.4	19.0	17.3	18.2	24.9	22.3	24.5	27.9	25.4	27.1	29.7	26.1	29.2	29.3	22.5	25.9
2009	18.6	17.3	18.2	20.2	18.3	19.4	21.7	19.3	21.3	26.2	23.9	25.4	29.7	26.0	29.1	29.5	22.6	26.1
2010	20.2	17.9	19.5	22.6	18.9	21.1	24.6	22.0	24.2	27.1	24.3	26.1	29.5	25.9	29.0	29.3	23.1	26.2
2011	19.6	18.4	19.2	20.4	18.6	19.7	22.8	20.4	22.5	26.1	23.3	25.1	29.4	25.8	28.9	27.3	21.4	24.3
2012	17.3	15.8	16.8	19.1	17.5	18.4	21.5	19.1	21.1	27.1	24.4	26.2	29.4	25.7	28.9	29.4	22.5	25.9
2013	18.3	16.9	17.8	21.5	19.0	20.5	24.4	21.9	24.1	26.9	24.1	26.0	29.3	25.5	28.7	28.9	22.6	25.7
2014	18.9	17.4	18.4	20.8	18.6	19.8	23.4	21.2	23.1	27.9	25.1	26.9	29.0	25.4	28.5	28.6	22.0	25.3
2015	16.7	15.3	16.3	17.7	16.0	17.0	23.8	21.5	23.5	25.3	22.8	24.4	28.9	25.3	28.3	27.0	21.3	24.1
2016	16.9	15.5	16.3	20.9	18.8	19.9	22.4	20.2	21.5	28.7	26.0	27.6	30.9	27.5	29.5	35.6	32.3	34.3
Average	18.1	16.4	17.5	19.9	17.8	19.0	23	20.5	22.4	26.7	23.8	25.6	30.2	26.5	29.2	31.5	27.0	29.5
Median	18.1	16.5	17.6	19.8	18.0	19.0	22.8	20.5	22.5	26.9	24.1	26	29.9	26.2	29.3	30.6	29.7	31.4
Stdev	1.2	1.2	1.2	1.2	0.9	1.1	1.5	1.3	1.5	1.1	1.1	1.1	0.9	0.9	0.5	2.9	4.5	3.8
Cv%	6.4	7.2	6.7	6.0	5.3	5.6	6.3	6.5	6.8	4.2	4.8	4.3	3.0	3.4	1.8	9.3	16.8	13.0
Max	20.2	18.4	19.5	22.6	19.0	21.1	26.1	23.0	24.8	28.1	25.4	27.1	32.2	28.4	30.6	34.9	33.4	34.0
Min	14.8	13.5	14.4	17.4	15.5	16.6	20.2	18.0	19.3	24.5	21.3	23.2	28.9	25.3	28.3	27.0	21.3	24.1
p	0.733	0.796	0.983	0.216	0.194	0.199	0.368	0.198	0.096	0.274	0.052	0.080	0.000	0.000	0.001	0.001	0.002	0.001

* Day: 0600–1800

** Night: 1800–0600

Table 4b: Monthly average daily ambient temperature (°C)

	July (594 d)			**Aug** (642 d)			**Sept** (593 d)			**Oct** (619 d)			**Nov** (534 d)			**Dec** (586 d)		
Year	**Day*** (°C)	**Night**** (°C)	**Daily** (°C)	**Day*** (°C)	**Night**** (°C)	**Daily** (°C)	**Day*** (°C)	Night** (°C)	Daily (°C)	Day* (°C)	Night** (°C)	Daily (°C)	Day* (°C)	Night** (°C)	Daily (°C)	Day* (°C)	Night** (°C)	Daily (°C)
1995	35.7	32.4	34.2	35.6	32.2	34.2	33.8	30.8	32.5	29.6	27.2	28.6	22.9	21.1	22.2	19.1	17.8	18.6
1996	36.0	33.1	34.6	35.4	32.2	34.1	33.5	30.5	32.2	29.2	26.7	28.1	25.3	23.4	24.5	20.5	18.7	19.8
1997	35.7	32.1	34.1	34.2	30.5	32.7				29.3	26.8	28.3	25.0	23.0	24.2	19.7	17.8	18.9
1998	36.5	33.0	34.9	37.0	33.8	35.7	34.6	31.8	33.4	30.6	27.9	29.5	25.9	23.4	24.9	20.7	18.7	19.9
1999				36.5	33.2	35.1	34.0	30.8	32.6	30.3	27.9	29.3	24.8	22.3	23.8	19.5	16.8	18.4
2000	37.3	33.8	35.7	35.6	32.0	34.1	33.7	30.4	32.3	29.5	26.7	28.4	24.1	21.5	23.0	19.4	17.8	18.7
2001	36.2	32.5	34.5	36.4	32.9	34.9	34.2	31.3	33.0	27.8	24.9	26.6	22.5	20.1	21.5	19.2	17.2	18.4
2002	37.1	33.4	35.5	36.2	32.3	34.6	34.0	31.3	32.9									
2003																		
2004	35.6	32.7	34.4	35.7	32.9	34.8	32.8	30.6	32.1	30.7	28.4	29.8	24.6	23.2	24.0	17.7	16.3	17.2
2005	36.1	32.6	34.6	34.9	32.3	34.0	33.4	31.0	32.6	29.3	27.1	28.4	23.1	21.4	22.4	20.3	18.5	19.5
2006	35.3	31.8	33.8	35.6	32.9	34.7	33.7	31.2	32.9	30.0	27.6	29.0	23.2	21.6	22.5	17.7	16.0	17.0
2007	36.5	32.8	35.0	35.2	32.4	34.3	33.1	30.5	32.2	30.8	28.6	29.9	24.6	22.6	23.8	19.4	17.8	18.8
2008	36.0	32.5	34.6	36.0	33.2	35.1	33.6	31.3	32.8	29.4	27.2	28.5	25.0	23.4	24.4	20.8	19.2	20.1
2009	36.9	33.1	35.3	35.5	32.8	34.6	33.0	30.4	32.1	30.0	27.8	29.1	24.1	22.4	23.4	21.1	19.3	20.4
2010	36.0	32.3	34.5	37.2	34.2	36.2	34.4	32.0	33.6	31.9	29.5	30.9	26.3	24.0	25.3	20.7	18.2	19.6
2011	36.4	33.1	35.0	35.4	32.2	34.3	33.5	30.9	32.6	29.8	27.5	28.9						
2012	37.5	33.9	36.0	36.7	33.9	35.8	33.6	31.4	32.9	31.5	29.2	30.6	26.6	24.9	25.9	20.9	19.1	20.1
2013	35.3	31.4	33.7	35.6	32.7	34.7	33.2	30.4	32.2	28.9	26.6	27.9				18.8	17.2	18.1
2014	35.5	31.8	34.0	35.5	32.6	34.6	33.4	30.7	32.4	29.2	27.2	28.4	23.7	22.0	23.0	21.0	19.5	20.4
2015	35.4	32.3	34.1	36.5	34.0	35.7	35.1	33.1	34.4	30.6	28.7	29.8	25.4	24.1	24.9	18.1	16.6	17.5
2016	36.4	32.9	35.0	36.0	32.8	34.6	33.6	30.9	32.5	30.2	28.3	29.4	24.3	22.9	23.7	17.8	15.8	16.9
Average	36.2	32.7	34.7	35.8	32.8	34.7	33.7	31.1	32.7	29.9	27.6	29.0	24.5	22.6	23.7	19.6	17.8	18.9
Median	36.0	32.6	34.6	35.6	32.8	34.6	33.6	30.9	32.6	29.9	27.6	28.9	24.6	22.7	23.8	19.5	17.8	18.8
Stdev	0.7	0.7	0.6	0.7	0.8	0.8	0.6	0.7	0.6	0.9	1.1	1.0	1.2	1.2	1.2	1.2	1.1	1.2
Cv%	1.8	2.0	1.8	2.0	2.5	2.2	1.7	2.2	1.8	3.2	3.8	3.4	4.7	5.3	4.9	6.0	6.4	6.1
Max	37.5	33.9	36	37.2	34.2	36.2	35.1	33.1	34.4	31.9	29.5	30.9	26.6	24.9	25.9	21.1	19.5	20.4
Min	35.3	31.4	33.7	34.2	30.5	32.7	32.8	30.4	32.1	27.8	24.9	26.6	22.5	20.1	21.5	17.7	16	17
p	0.736	0.452	0.869	0.483	0.055	0.076	0.745	0.302	0.438	0.228	0.058	0.131	0.449	0.132	0.27	0.669	0.779	0.708

* Day: 0600–1800

** Night: 1800–0600

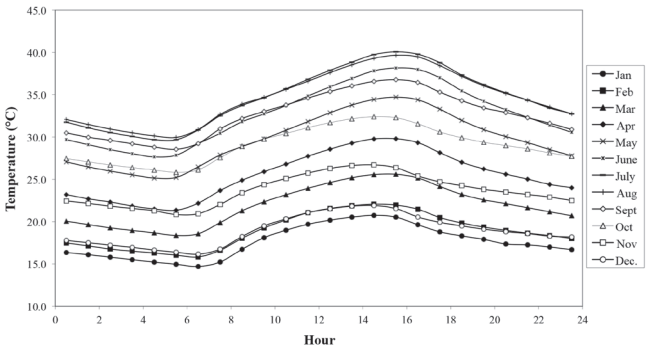

Figure 2: Monthly average hourly ambient temperature (°C)

3.3 Barometric pressure

The results of the statistical analysis of the barometric pressure monthly databases are reported in Table 5. The monthly average hourly barometric pressure and the monthly average % increase in barometric pressure above normal atmospheric pressure are shown in Figs. 3 and 4, respectively. The maximum and minimum barometric pressure values occur in January/December and July are 1065.6 and 1050.6, respectively. The barometric pressure exceeds the normal atmospheric barometric pressure at sea level (i.e., 1013.25 mbar) throughout the year. It exceeds normal atmospheric pressure at sea level during January and December by 5.2%, whereas during July it exceeds it by 3.7%. It is apparent from the data that the ideal time to bring patients suffering from chronic obstructive pulmonary diseases (COPD), end-stage lung disease with chronic hypoxemia, cystic fibrosis, coronary artery disease and congestive heart failure after healing of acute myocardial infarction is during the winter months.

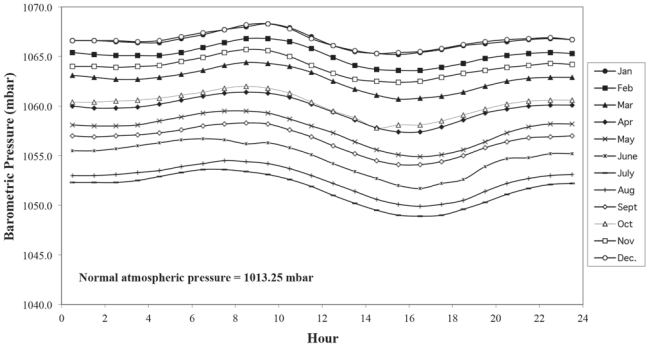

Figure 3: Monthly average hourly barometric pressure (mbar)

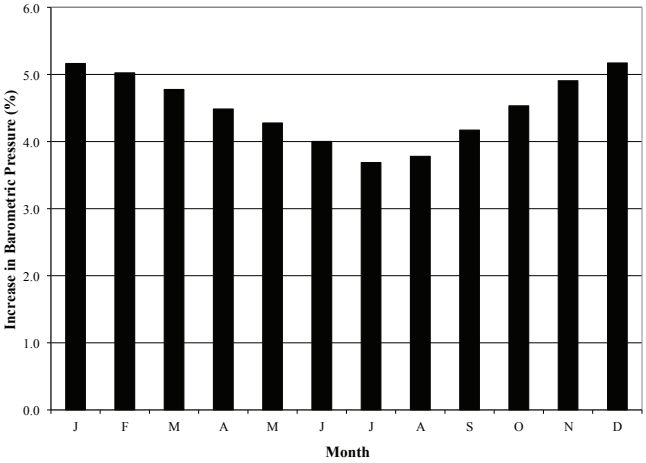

Figure 4: Monthly average daily percent increase of the barometric pressure above normal atmospheric barometric pressure at sea level

Table 5: Monthly average daily barometric pressure (mbar)

	Jan (679 d)	**Feb** (622 d)	**Mar** (682 d)	**Apr** (660 d)	**May** (682 d)	**June** (644 d)	**July** (673 d)	**Aug** (673 d)	**Sept** (622 d)	**Oct** (679 d)	**Nov** (600 d)	**Dec** (647 d)
Year	**Daily** (mbar)	**Daily** (mbar)	**Daily** (mbar)	**Daily** (mbar)	**Daily** (mbar)	**Daily** (mbar)	**Day*** (mbar)	Night** (mbar)	Daily (mbar)	Day* (mbar)	Night** (mbar)	Daily (mbar)
1995	1070.0	1066.3	1064.5	1060.8	1059.1	1056.8	1052.1	1054.0	1058.0	1062.0	1065.9	1068.5
1996	1064.6	1063.5	1061.5	1061.0	1057.4	1056.0	1052.8	1053.6	1057.9	1062.1	1064.3	1066.2
1997	1067.1	1070.0	1063.3	1061.8	1058.7	1054.3	1053.4	1056.3	1058.5	1060.8	1062.9	1066.8
1998	1066.6	1066.9	1063.8	1060.3	1058.2	1056.3	1051.2	1051.6	1055.7	1061.2	1063.1	1066.9
1999	1065.5	1065.0	1061.6	1062.5	1057.6	1054.8	1051.4	1052.3	1055.7	1060.3	1065.2	1067.6
2000	1066.0	1067.7	1065.8	1058.9	1057.8	1053.9	1050.3	1052.5	1056.1	1060.9	1063.7	1065.7
2001	1067.6	1065.4	1060.5	1059.5	1056.4	1054.0	1051.2	1053.1	1056.6	1060.4	1064.3	1065.5
2002	1068.4	1065.8	1060.5	1059.3	1057.7	1054.4	1052.2	1052.9	1057.6	1058.8	1063.5	1065.6
2003	1065.8	1063.7	1061.8	1059.1	1055.1	1053.3	1048.0	1052.0	1056.9	1059.8	1063.0	1065.2
2004	1062.1	1063.6	1059.0	1054.8	1057.1	1055.1	1050.6	1053.0	1056.4	1059.9	1062.3	1067.5
2005	1064.9	1063.5	1063.1	1060.1	1057.6	1054.7	1052.0	1051.9	1056.1	1060.6	1064.1	1064.8
2006	1065.4	1062.5	1061.7	1057.9	1057.5	1055.0	1051.9	1051.0	1055.5	1058.4	1063.8	1068.4
2007	1068.6	1061.8	1061.8	1058.4	1054.6	1052.0	1049.8	1050.9	1054.7	1059.3	1063.2	1066.0
2008	1066.3	1067.2	1059.0	1058.5	1056.6	1052.5	1049.6	1049.3	1054.3	1060.4	1063.0	1065.1
2009	1066.1	1061.8	1061.8	1058.3	1057.0	1052.6	1049.4	1050.3	1054.3	1055.7	1060.8	1061.5
2010	1063.2	1059.7	1060.5	1057.6	1054.6	1051.4	1049.3	1048.2	1052.8	1056.4	1059.9	1061.1
2011	1062.2	1060.1	1063.0	1055.9	1055.9	1052.1	1048.5	1049.5	1052.4	1058.0		
2012	1064.0	1062.2	1062.9	1056.3	1055.2	1051.0	1047.3	1049.6	1053.2	1056.6	1059.7	1062.4
2013	1063.0	1063.3	1058.9	1057.5	1053.9	1052.2	1049.9	1050.2	1054.8	1058.9		1065.4
2014	1064.5	1063.2	1058.9	1057.2	1056.3	1052.6	1050.8	1049.9	1054.3	1058.1	1061.9	1064.2
2015	1065.8	1061.0	1061.0	1059.6	1054.8	1053.7	1050.1	1051.0	1053.3	1056.5	1060.2	1067.4
2016	1066.2	1064.4	1059.3	1055.5	1055.6	1051.3	1048.7	1050.7	1054.4	1057.2	1062.1	1066.2
Average	1065.6	1064.0	1061.7	1058.8	1056.6	1053.7	1050.6	1051.6	1055.5	1059.3	1062.9	1065.6
Median	1065.8	1063.5	1061.7	1058.9	1057.0	1053.9	1050.6	1051.6	1055.7	1059.8	1063.1	1065.7
Stdev	2.1	2.6	1.9	1.9	1.5	1.6	1.6	1.9	1.8	1.9	1.7	2.1
Cv%	0.2	0.3	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Max	1070.0	1070.0	1065.8	1062.5	1059.1	1056.8	1053.4	1056.3	1058.5	1062.1	1065.9	1068.5
Min	1065.6	1064.0	1061.7	1058.8	1056.6	1053.7	1050.6	1051.6	1055.5	1059.3	1062.9	1065.6

The barometric pressure is a function of the ambient temperature, since heated air expands and consequently the density of the air is lowered reducing the barometric pressure. This interaction is shown clearly by performing a graphical inter-comparison between the average monthly values for barometric pressure and ambient temperature. Viz., the time interval of the maximum barometric pressure corresponds to that for the minimum ambient temperature and vise versa, cf., Fig.5. The same phenomenon is also observed regarding the fluctuations of the monthly average hourly values, cf., inter-comparison of Figs. 2 and 3.

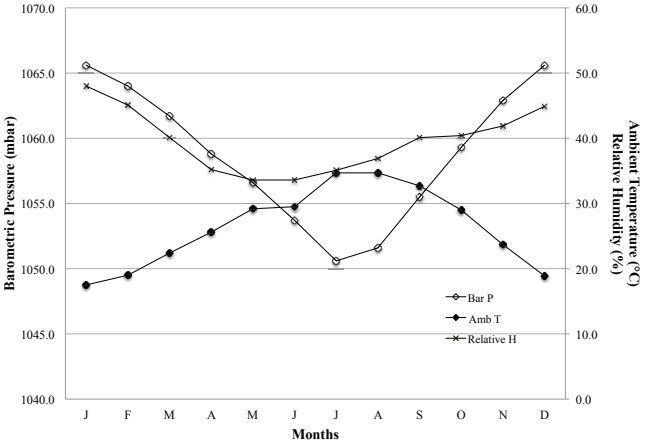

Figure 5: Inter-comparison of monthly average daily ambient temperature (°C), barometric pressure (mbar) and relative humidity (%)

3.4 Relative humidity

The databases available for the relative humidity are significantly smaller than those discussed above, viz., only 11-12 years. The databases were divided into three subgroups, i.e., day, night and daily, as defined previously. It is observed form Tables 6a, 6b and Fig. 6 that the relative humidity is lowest during the day and highest at night. This is the result of correlation between temperature and humidity, viz., the relative humidity increases with decreasing temperature, approaching 100% as the temperature approaches the dew point. This correlation is apparent from an inter-comparison of their average monthly values as shown in Fig. 5, i.e., the time interval of the maximum relative humidity corresponds to that for the minimum ambient temperature and vise versa. The lowest average relative humidity values are 30.5% (June), 37.5% (May) and 33.6% (May and June) for day, night and daily, respectively. The highest relative humidity values occurring in January are 46.2, 50.6 and 48.0% for day, night and daily, respectively. The monthly average and median values are very similar, differing by ± 2%, indicative of relatively low variation of the individual values within the monthly databases. These relative low relative humidity values throughout the year were expected for such a semi-arid site.

Table 6a: Monthly average day, night and daily relative humidity (%)

	Jan (341 d)			**Feb** (310 d)			**Mar** (341 d)			**Apr** (330 d)			**May** (340 d)			**June** (344 d)		
Year	**Day*** (%)	**Night**** (%)	**Daily** (%)	**Day*** (%)	**Night**** (%)	**Daily** (%)	**Day*** (%)	Night** (%)	Daily (%)	Day* (%)	Night** (%)	Daily (%)	Day* (%)	Night** (%)	Daily (%)	Day* (%)	Night** (%)	Daily (%)
2004																		
2005	46.2	50.6	48.0	43.1	46.7	44.6	42.9	45.9	42.9	31.3	35.2	32.9	31.3	38.3	34.2	32.5	41.3	36.1
2006	44.2	48.1	45.9	42.9	47.2	44.7	38.4	41.9	38.6	38.6	44.5	41.1	32.4	40.1	35.6	31.6	37.9	34.2
2007	45.6	50.8	47.8	46.2	50.9	48.2	43.0	46.6	43.0	34.1	41.2	37.1	32.5	38.4	35.0	31.4	40.0	35.0
2008	45.9	49.9	47.6	42.8	47.4	44.8	37.2	39.9	37.0	30.1	36.3	32.7	30.0	36.7	32.8	28.3	36.6	31.7
2009	37.7	39.5	38.4	40.6	46.3	42.9	42.0	45.7	42.2	33.0	39.0	35.5	30.7	37.7	33.6	27.8	34.1	30.4
2010	49.1	56.5	52.2	44.5	54.1	48.5	43.4	47.4	43.6	32.9	40.1	35.9	29.7	36.3	32.4	29.6	37.7	33.0
2011	45.0	49.2	46.7	48.3	54.4	50.9	37.6	41.9	37.7	34.5	41.9	37.6	31.6	39.4	34.8	32.8	42.0	36.6
2012	46.6	52.4	49.0	37.1	40.7	38.6	37.5	41.8	37.8	31.4	37.7	34.1	29.0	34.9	31.5	30.6	38.8	34.0
2013	46.6	50.8	48.4	43.0	48.6	45.4	36.8	40.0	36.5	30.2	37.3	33.1	27.6	34.2	30.4	29.1	37.3	32.5
2014	49.1	53.0	50.7	38.5	44.0	40.8	43.0	47.3	43.2	30.1	36.4	32.7	32.9	38.1	35.1	28.4	34.2	30.8
2015	52.3	56.3	54.0	43.6	49.1	45.9	40.0	43.2	39.9	34.6	40.3	37.0	30.8	37.4	33.5	33.8	42.4	37.4
2016	45.7	49.7	47.4	43.6	47.7	45.3	36.8	42.0	39.0	31.3	34.6	32.7	30.9	38.3	33.9	29.5	33.1	31.0
Average	46.2	50.6	48.0	42.9	48.1	45.1	39.9	43.6	40.1	32.7	38.7	35.2	30.8	37.5	33.6	30.5	37.9	33.6
Median	46.1	50.8	48.0	43.1	47.4	44.8	39.2	43.2	39.9	32.1	39.0	35.5	30.8	37.8	33.6	30.1	37.9	34.0
Stdev	3.5	4.4	3.8	3.1	3.9	3.3	2.8	2.8	2.7	2.5	3.0	2.6	1.5	1.7	1.6	2.0	3.1	2.4
Cv%	7.5	8.6	7.9	7.1	8.0	7.4	7.0	6.4	6.7	7.7	7.7	7.5	5.0	4.6	4.7	6.5	8.2	7.1
Max	52.3	56.5	54.0	48.3	54.4	50.9	43.4	47.4	43.6	38.6	44.5	41.1	32.9	40.1	35.6	33.8	42.4	37.4
Min	37.7	39.5	38.4	37.1	40.7	38.6	36.8	39.9	36.5	30.1	34.6	32.7	27.6	34.2	30.4	27.8	33.1	30.4

* Day: 0600–1800

** Night: 1800–0600

Table 6b: Monthly average day, night and daily relative humidity (%)

	July (338 d)			**Aug** (366 d)			**Sept** (357 d)			**Oct** (371 d)			**Nov** (330 d)			**Dec** (336 d)		
Year	**Day*** (%)	**Night**** (%)	**Daily** (%)	**Day*** (%)	**Night**** (%)	**Daily** (%)	Day* (%)	Night** (%)	Daily (%)	Day* (%)	Night** (%)	Daily (%)	Day* (%)	Night** (%)	Daily (%)	Day* (%)	Night** (%)	Daily (%)
2004				35.3	42.3	38.2	37.3	44.4	40.3	40.4	46.1	42.8	44.1	46.8	45.2	47.5	50.9	48.6
2005	31.7	39.0	34.7	35.4	43.0	38.5	35.1	41.2	37.6	35.9	40.7	37.9	41.4	44.1	42.5	45.1	48.1	46.1
2006	33.1	40.2	36.0	33.7	40.7	36.6	35.6	43.6	39.0	39.3	44.8	41.6	37.9	40.5	39.0	43.0	45.1	43.6
2007	30.5	37.2	33.3	35.9	43.8	39.2	40.3	48.9	43.9	41.5	47.9	44.1	40.8	44.5	42.4	46.1	48.8	47.0
2008	31.4	39.3	34.7	33.1	40.2	36.1	37.7	44.3	40.5	41.9	48.6	44.7	40.0	42.3	41.0	38.0	40.2	38.8
2009	29.7	37.6	33.0	33.5	41.9	37.0	37.1	45.4	40.5	35.8	40.2	37.6	42.8	46.7	44.4	46.7	50.4	47.9
2010	34.5	44.9	38.8	34.8	44.6	38.9	37.7	45.9	41.1	35.7	41.0	37.9	33.8	37.2	35.2	39.7	42.1	40.4
2011	30.2	36.8	33.0	33.0	42.3	36.9	37.2	45.3	40.5	37.0	42.6	39.3						
2012	30.6	38.6	34.0	28.9	35.5	31.7	37.1	43.9	39.9	36.8	41.8	38.8	42.1	46.0	43.7	44.5	47.8	45.5
2013	32.7	41.9	36.5	32.1	38.7	34.9	36.1	44.6	39.7	32.8	35.5	33.9				44.1	46.9	45.0
2014	33.2	41.4	36.6	33.4	42.3	37.1	36.5	44.1	39.6	40.2	45.7	42.5	43.1	46.8	44.6	49.8	52.9	50.8
2015	31.6	37.5	34.1	35.6	42.8	38.6	36.1	42.5	38.7	43.9	48.7	45.9	43.0	45.8	44.2	44.4	44.8	44.4
2016	33.4	40.8	36.5	38.5	47.0	42.0	37.0	42.3	39.2	38.0	41.8	39.6	33.5	35.6	34.4	47.6	52.7	49.8
Average	31.9	39.6	35.1	33.6	41.4	36.9	36.9	44.5	40.1	38.3	43.4	40.4	40.5	43.8	41.9	44.1	46.7	44.9
Median	31.6	39.2	34.7	33.6	42.3	37.0	37.1	44.3	39.9	37.0	42.6	39.3	41.4	44.5	42.5	44.5	47.3	45.3
Stdev	1.5	2.4	1.8	2.0	2.6	2.2	1.4	2.0	1.6	3.3	4.1	3.7	3.0	3.2	3.1	3.4	3.8	3.5
Cv%	4.7	6.0	5.2	5.9	6.2	5.9	3.8	4.4	4.0	8.8	9.6	9.1	7.5	7.4	7.4	7.6	8.1	7.8
Max	34.5	44.9	38.9	38.5	47.0	42.0	40.3	48.9	43.9	43.9	48.7	45.9	43.1	46.8	44.6	49.8	52.9	50.8
Min	29.7	36.8	33.0	28.9	35.5	31.7	35.1	41.2	37.7	32.8	35.5	33.9	33.5	35.6	34.4	38.0	40.2	38.8

* Day: 0600–1800

** Night: 1800–0600

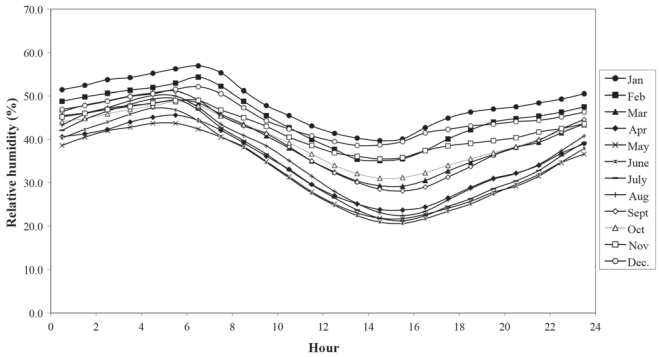

Figure 6: Monthly average hourly relative humidity (%)

4. Conclusions

An in-depth analysis of long-term measurements of bio-climatological measurements initiated towards the end of 1994 at Neve Zohar, located on the shores of the Dead Sea, has been presented.

The Dead Sea basin is an internationally recognized photoclimatherapy center for the treatment of psoriasis, atopic dermatitis, vitiligo and other skin and rheumatic diseases. This is based upon its unique UVB spectrum resulting from being located at the lowest terrestrial site on the earth; resulting in a relatively longer optical path length within the earth's atmosphere and an enhanced spectrally selective attenuation of the UVB irradiation. This attenuation is inversely proportional to the wavelength and the erythema range (~ 300 nm) is most strongly attenuated, whereas the therapeutic UVB range, e.g., for psoriasis (~311 nm), is attenuated to a much lesser degree, cf., Kudish, et al. (1997, 2003).

A second unique bio-climatological property of the Dead Sea basin is the highest terrestrial barometric pressure on the earth. It varies between 3.7 (July and August) and 5.2% (January and December) above that at mean sea level. Consequently, the Dead Sea basin is characterized as possessing the highest natural terrestrial oxygen density on the earth. It is an ideal location to bring patients suffering from chronic obstructive pulmonary diseases (COPD), end-stage lung disease with chronic hypoxemia, cystic fibrosis, coronary artery disease and congestive heart failure after healing of acute myocardial infarction, especially during the winter months.

The major purpose of this communication is to make such data, measured at this unique site, available to the scientific community at large.

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