

# LONGTERM WEATHER DATA MEASUREMENTS FROM DANISH CLIMATE STATION

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## 1. Introduction

In connection with planning and optimization of energy efficient buildings and solar energy systems it is important to know the climatic data of the area where the buildings/systems are located. The weather data vary year by year, so it is useful to have measurements of global and direct solar radiation, solar diffuse radiation, ambient air temperature, wind speed, reflection, etc. for many years.

## 2. Climate Station

The climate station, figure 1, was placed on the roof of building 119 at Technical University of Denmark in Lyngby. Data measurements have been carried out since 1989 and they are recorded every 2 minutes either integrated over 2 minutes or instantaneous. From these 2 minutes data, half hourly and hourly values are created. [1]



Fig. 1: View on the climate station on the roof of building 119 at Technical University of Denmark

## 3. Weather Data Evaluation

Data were collected for more over than 20 years in 2 minutes time-steps by computer and stored to the 3.5" floppy disk for each single month. After the conversion data to „xls“ format, they were evaluated in the Excel sheets. On the figure 2 is a Pyranometer measuring the solar radiation.

Data evaluated from years 1989 to 2010:

- Ambient air temperature [°C]
- Diffuse radiation [W/m<sup>2</sup>]
- Global radiation [W/m<sup>2</sup>]
- Direct radiation [W/m<sup>2</sup>]
- Global mean radiation [W/m]
- Wind speed [m/s]



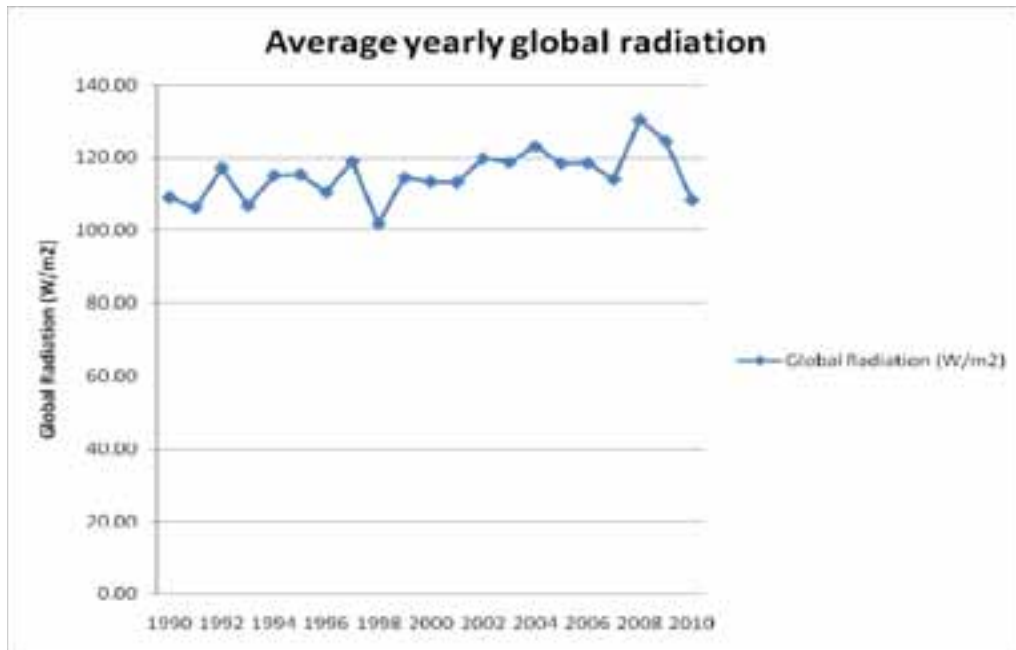
Fig. 2: Pyranometer measuring the solar radiation

#### 4. Results

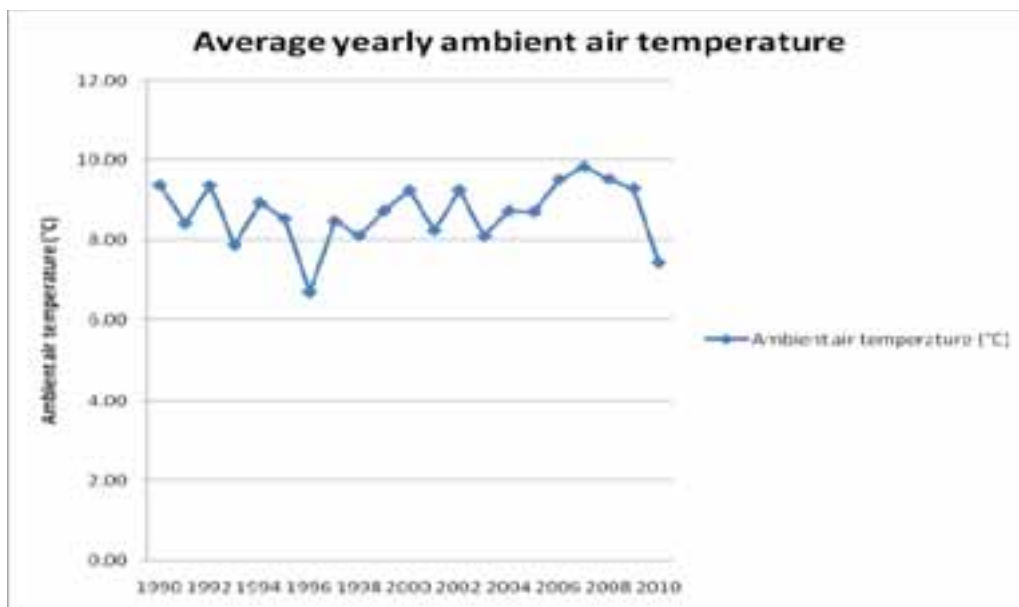
Due to maintenance, human factor and/or measuring device problems during the longterm measurement there are some missing data, e.g. from few minutes to whole day. In a table 1 there is a yearly average ambient air temperature and the yearly global radiation.

Tab. 1: Yearly average solar global radiation and ambient air temperature

Year	Solar global radiation (W/m <sup>2</sup> )	Ambient air temperature (°C)
2010	108.46	7.43
2009	124.61	9.29
2008	130.47	9.53
2007	114.14	9.84
2006	118.57	9.52
2005	118.44	8.71
2004	123.19	8.73
2003	118.81	8.09
2002	119.88	9.25
2001	113.30	8.23
2000	113.47	9.24
1999	114.53	8.74
1998	101.81	8.10
1997	119.05	8.47
1996	110.57	6.69
1995	115.44	8.53
1994	115.18	8.93
1993	106.87	7.87
1992	117.22	9.36
1991	106.29	8.41
1990	109.15	9.37



Graph 1: Average yearly global radiation

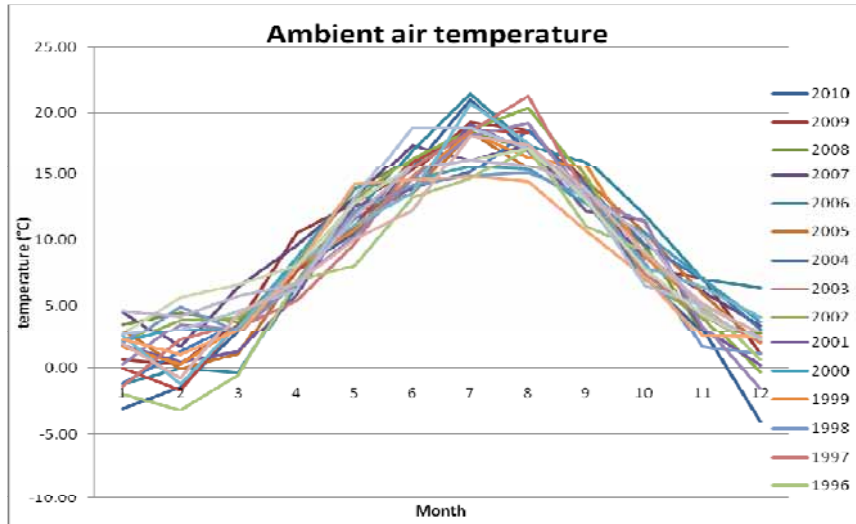


Graph 2: Average yearly ambient air temperature

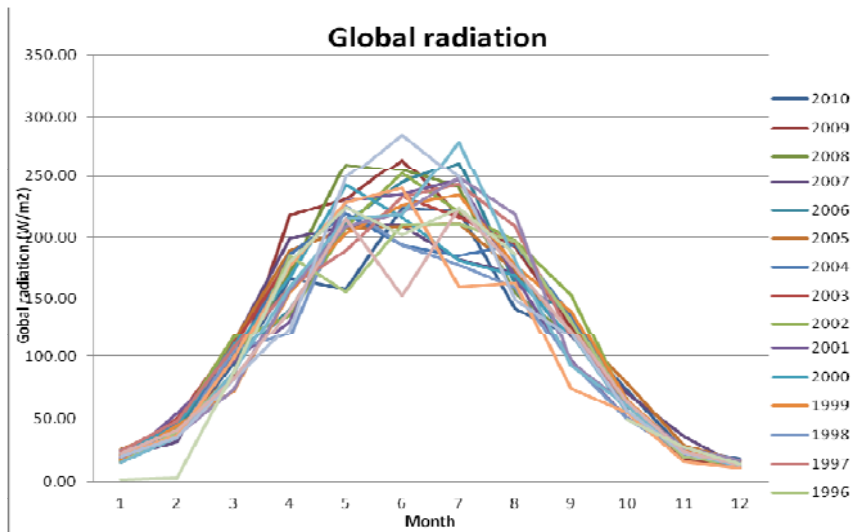
From graphs 1 to 6 and table 1 it can be seen the trend of average yearly global radiation, ambient air temperature and also temperatures, diffuse, direct and global radiation year by year measured by the Climate Station.

The results for the temperature and the solar radiation vary year by year but not ascending order by increasing years. It seems that over the years, the weather is not changing vastly. The average global solar radiation were increasing only in the years 2008 and 2009 more than the other years according to table 1 and graph 1.

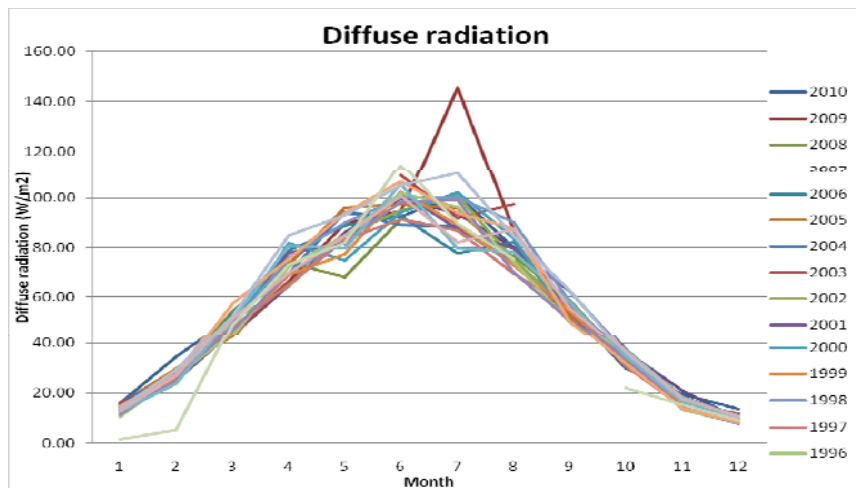
From table 2 to 23 there is shown the monthly values of ambient air temperature, diffuse, global, direct and global mean solar radiation and also wind speed.



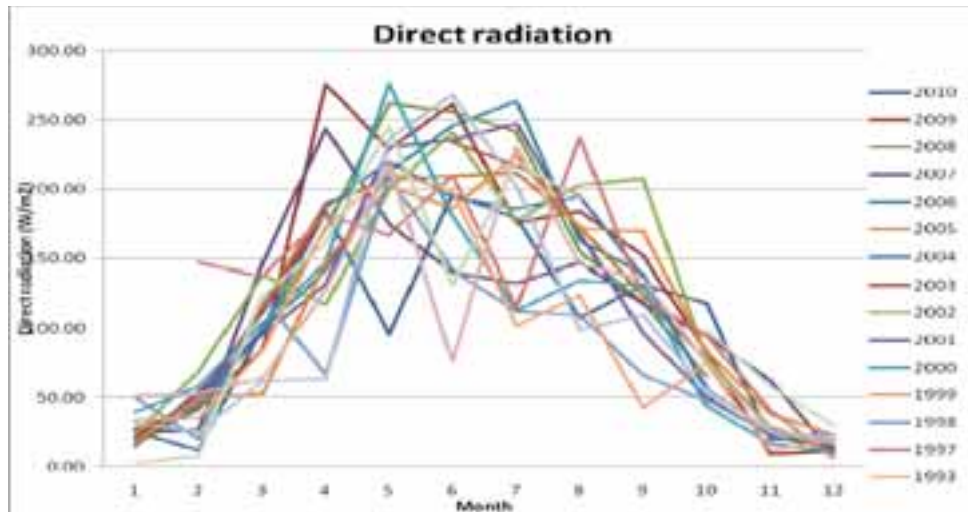
Graph 3: Ambient air temperature year by year



Graph 4: Global solar radiation year by year



Graph 5: Diffuse solar radiation year by year



Graph 6: Direct solar radiation year by year

Tab. 2: Results for the year 2010

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2010-1	-3.06	15.65	21.56	24.88	3.97	21.23
2010-2	-1.49	34.37	37.52	11.97	3.25	37.40
2010-3	2.77	50.47	94.22	100.22	3.18	93.57
2010-4	7.71	73.42	167.04	183.45	3.35	166.95
2010-5	10.52	93.95	158.13	95.59	2.92	157.94
2010-6	15.68	92.56	223.97	195.91	2.32	223.17
2010-7	20.97	101.30	221.84	178.49	2.43	220.00
2010-8	17.04	79.87	142.23	107.50	3.17	139.71
2010-9	13.00	53.37	119.83	131.07	2.99	117.66
2010-10	7.12	29.71	72.76	118.37	2.91	72.34
2010-11	2.96	19.39	24.51	19.90	3.72	23.64
2010-12	-4.06	13.51	17.96	18.83	3.43	17.14

Tab. 3: Results for the year 2009

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2009-1	0.62	14.44	17.59	27.12	4.19	15.61
2009-2	0.29	29.72	45.67	43.98	3.63	44.37
2009-3	3.56	45.83	84.92	84.53	3.63	84.59
2009-4	10.53	66.53	218.58	275.59	3.28	217.28
2009-5	12.81	89.89	231.20	228.51	2.94	231.02
2009-6	15.34	94.76	265.60	261.58	2.95	265.09
2009-7	19.24	145.65	217.46	175.87	2.62	216.77
2009-8	18.68	87.33	192.27	183.91	2.75	191.93
2009-9	14.43	52.11	126.81	152.04	2.67	126.32
2009-10	7.78	32.35	64.72	84.23	3.01	64.52
2009-11	7.12	13.86	16.66	9.35	4.18	16.10
2009-12	1.07	11.93	13.89	11.66	3.82	13.30

**Tab. 4: Results for the year 2008**

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2008-1	3.57	12.61	15.67	11.62	5.16	14.61
2008-2	4.49	27.68	43.51	50.24	4.77	42.74
2008-3	3.70	54.12	96.32	72.17	4.00	95.22
2008-4	8.23	73.98	171.31	166.06	2.93	170.48
2008-5	13.87	68.04	261.58	317.90	2.09	261.39
2008-6	16.16	91.36	255.26	231.89	3.03	254.29
2008-7	18.54	87.28	241.63	204.28	2.52	240.32
2008-8	17.20	76.61	154.79	121.71	2.90	152.06
2008-9	13.44	58.98	118.67	121.68	2.71	116.28
2008-10	9.55	34.57	65.35	59.24	3.24	62.69
2008-11						
2008-12	2.63	10.82	11.03	7.34	3.36	9.30

**Tab. 5: Results for the year 2007**

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2007-1	4.55	13.51	19.34	25.36	5.53	18.49
2007-2	1.60	24.79	31.69	26.70	4.89	30.90
2007-3	6.45	44.80	114.32	146.64	4.15	113.82
2007-4	9.62	64.58	199.13	243.58	3.81	197.75
2007-5	13.24	86.07	209.48	174.44	2.60	208.05
2007-6	17.45	99.79	209.41	140.69	2.27	209.05
2007-7	16.29	93.59	181.65	132.55	2.94	180.07
2007-8	17.53	80.25	170.74	147.17	2.58	169.10
2007-9	13.11	56.82	116.49	118.04	3.01	114.82
2007-10	8.66	36.75	70.06	94.90	2.22	69.33
2007-11	6.06	20.79	36.11	62.68	3.84	34.56
2007-12	3.48	9.68	11.26	9.96	3.71	10.27

**Tab. 6: Results for the year 2006**

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2006-1	-1.23	15.27	21.03	34.93	3.84	20.10
2006-2	-0.04	25.92	41.46	57.69	3.44	41.09
2006-3	-0.34	53.31	99.34	104.66	3.28	98.44
2006-4	6.51	78.54	141.97	105.30	3.27	140.88
2006-5	11.91	88.68	212.30	199.61	3.37	211.09
2006-6	17.08	92.66	245.50	227.99	2.57	244.61
2006-7	21.44	77.48	263.37	299.07	2.27	262.88
2006-8	17.46	82.18	162.55	129.69	2.23	162.55
2006-9	16.16	54.96	139.12	168.42	2.82	137.36
2006-10	11.90	36.42	56.13	45.65	3.16	55.15
2006-11	7.00	16.58	25.93	24.34	3.63	24.87
2006-12	6.35	10.90	14.11	11.54	4.66	12.93

Tab. 7: Results for the year 2005

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2005-1	2.91	15.37	25.26	50.36	2.70	24.53
2005-2	-0.10	29.61	44.42	55.46	1.87	44.11
2005-3	1.07	42.85	115.94	172.91	1.80	115.49
2005-4	7.69	73.24	189.32	212.08	1.76	187.47
2005-5	12.12	96.09	206.84	173.21	1.51	205.89
2005-6	13.53	97.61	209.08	171.92	1.58	208.72
2005-7	18.54	95.86	211.44	178.48	2.60	211.90
2005-8	15.70	73.29	172.90	171.28	2.82	171.49
2005-9	14.52	52.43	123.48	143.05	2.78	122.27
2005-10	10.60	31.17	78.00	126.38	3.15	76.32
2005-11	5.92	16.30	28.43	33.17	3.46	27.37
2005-12	1.97	11.52	16.16	31.09	3.80	14.89

Tab. 8: Results for the year 2004

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2004-1	-1.15	16.28	21.48	34.40	2.47	21.51
2004-2	1.29	27.32	48.00	74.23	2.40	47.97
2004-3	3.40	51.58	98.60	107.90	2.80	98.71
2004-4	7.82	69.66	186.47	212.22	2.54	186.49
2004-5	11.60	94.48	219.75	190.60	2.42	220.02
2004-6	13.98	89.08	193.77	163.96	2.37	193.41
2004-7	15.14	88.71	185.38	151.34	1.71	184.88
2004-8	18.67	73.30	194.56	207.21	0.52	194.57
2004-9	14.13	57.68	136.78	158.45	0.70	135.99
2004-10	9.65	31.93	57.74	75.48	1.67	56.93
2004-11						
2004-12	3.24	11.03	12.54	10.70	1.93	11.53

Tab. 9: Results for the year 2003

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2003-1	0.01	15.88	20.03	24.82	2.73	20.00
2003-2	-1.67	25.42	49.86	89.40	1.83	49.91
2003-3	3.47	45.07	111.86	142.94	2.48	112.02
2003-4	7.60	66.25	183.49	214.88	2.74	183.41
2003-5	11.00					
2003-6	16.16	109.42	233.71	180.96	2.41	233.85
2003-7	18.73	92.09	216.27	172.98	1.44	216.44
2003-8	18.46	97.75	194.83	210.80	1.58	194.96
2003-9						
2003-10	3.58	26.52	47.41	84.08	1.64	47.61
2003-11						
2006-12	6.35	10.90	14.11	11.54	4.66	12.93

**Tab. 10: Results for the year 2002**

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2002-1	2.05	12.80	17.15	24.27	3.11	17.07
2002-2	3.91	23.79	43.95	68.91	3.71	44.12
2002-3	4.10	50.66	115.80	138.16	2.95	116.22
2002-4	6.85	64.27	136.62	117.45	1.91	136.72
2002-5	12.97	84.89	208.63	199.18	1.86	208.68
2002-6	16.42	94.93	252.64	240.86	2.42	252.47
2002-7	18.71	100.76	220.40	177.32	1.59	220.30
2002-8	20.35	74.87	197.61	203.16	1.48	197.60
2002-9	14.81	54.98	153.34	207.34	1.37	153.16
2002-10	7.00	32.18	60.54	79.24	1.94	60.25
2002-11	4.08	15.61	21.24	28.41	2.15	21.26
2002-12	-0.29	10.04	10.58	10.54	2.46	10.55

**Tab. 11: Results for the year 2001**

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2001-1	1.71	12.88	15.28	13.81	2.47	15.35
2001-2	0.44	28.06	54.41	90.09	2.76	54.57
2001-3	1.22	50.64	95.78	104.76	2.53	95.96
2001-4	5.85	77.84	131.82	92.21	2.30	132.34
2001-5	12.58	81.44	230.04	248.13	2.03	230.40
2001-6	13.84	102.31	235.32	202.88	1.73	235.47
2001-7	19.09	87.30	246.93	249.47	1.55	246.55
2001-8	17.10	79.59	168.08	144.70	1.93	168.03
2001-9	12.18	62.31	96.58	62.07	1.65	96.44
2001-10	11.46	37.30	50.80	32.27	2.44	50.66
2001-11	3.06	14.85	21.97	36.95	2.10	21.96
2001-12	0.21	11.28	12.63	14.59	2.16	12.62

**Tab. 12: Results for the year 2000**

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
2000-1	2.07	13.92	22.00	39.31	3.56	22.12
2000-2	3.04	25.96	44.43	58.02	3.53	44.35
2000-3	3.31	47.19	108.78	103.87	2.66	108.41
2000-4	8.68	81.59	168.15	146.94	2.19	167.21
2000-5	13.98	74.55	242.96	275.82	2.73	242.27
2000-6	14.63	94.03	216.24	179.89	2.24	215.70
2000-7	15.58	102.17	181.39	112.54	1.45	181.09
2000-8	15.43	83.70	168.88	134.35	1.75	168.59
2000-9	12.76	50.12	118.05	130.40	2.24	118.11
2000-10	10.54	37.33	54.62	43.71	2.54	54.57
2000-11	7.09	18.22	23.15	16.42	2.32	23.11



Tab. 13: Results for the year 1999

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1999-1	1.57	13.02	16.91	17.65	1.27	17.03
1999-2	0.27	29.77	44.91	49.18	0.42	44.96
1999-3	3.12	45.85	72.37	53.10	2.46	72.27
1999-4	7.99	69.14	155.45	147.54	2.89	155.45
1999-5	10.77	77.33	203.52	201.86	2.19	203.91
1999-6	14.83	102.69	225.69	185.67	1.96	226.02
1999-7	18.48	89.29	234.55	223.78	1.70	235.07
1999-8	16.57	72.92	177.09	171.39	1.59	177.57
1999-9	15.74	54.53	139.50	168.88	1.97	139.37
1999-10	8.76	33.82	64.63	83.54	2.55	64.49
1999-11	4.84	15.91	25.07	38.10	2.24	25.20
1999-12	1.89	10.07	14.65	22.92	3.56	14.76

Tab. 14: Results for the year 1998

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1998-1	1.86	13.81	24.76	50.12	1.98	24.74
1998-2	4.96	26.21	34.60	19.71	3.50	34.30
1998-3	3.05	48.55	105.13	122.12	2.27	104.71
1998-4	6.70	76.00	118.86	66.61	2.06	118.56
1998-5	12.18	90.10	225.65	208.45	1.85	224.80
1998-6	14.17	100.08	193.90	141.71	1.82	194.25
1998-7	14.89	100.37	177.53	112.03	1.18	177.70
1998-8	15.14	90.40	159.37	109.58	1.56	160.32
1998-9	13.32	58.38	94.94	66.18	1.22	94.80
1998-10	8.26	31.61	50.00	48.08	3.33	49.70
1998-11	1.58	17.42	22.58	23.46	1.81	22.50
1998-12	1.07	9.94	14.36	23.49	1.37	14.34

Tab. 15: Results for the year 1997

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1997-1	-1.42	12.95	24.09		0.97	23.83
1997-2	2.16	25.23	48.33	147.40	3.95	48.30
1997-3	3.32	47.87	107.28	137.26	2.32	106.32
1997-4	5.37	64.96	159.88	180.65	2.26	160.25
1997-5	9.71	83.37	189.09	166.58	1.87	188.76
1997-6	15.75	91.47	232.69	209.89	1.46	232.34
1997-7	18.53	87.05	243.35	115.05	0.90	243.24
1997-8	21.26	69.45	209.07	237.19	0.52	209.05
1997-9	13.38	56.07	118.57	121.75	1.65	118.65
1997-10	7.37	30.72	62.38	95.11	1.43	62.28
1997-11	4.24	14.60	23.26	40.72	1.77	23.10

Tab. 16: Results for the year 1996

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1996-1	-1.95	10.41	14.95		4.33	14.68
1996-2	-3.17	26.58	39.58		4.56	39.30
1996-3	-0.51	44.12	86.68		4.35	85.36
1996-4	6.98	72.30	185.52		3.36	185.23
1996-5	8.04	84.80	155.87		3.82	154.50
1996-6	13.23	101.97	210.61		2.19	209.75
1996-7	14.65	96.48	211.13		1.95	210.43
1996-8	17.25	74.34	197.03		1.98	196.76
1996-9	11.03	49.87	131.98		1.98	131.94
1996-10	9.14	36.44	61.06		1.97	60.59
1996-11	5.01	13.39	18.84		3.38	18.67
1996-12	0.62	8.02	13.59		1.75	13.40

Tab. 17: Results for the year 1995

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1995-1	0.31	11.50	19.39		4.53	19.21
1995-2	3.54	26.43	36.72		5.22	36.52
1995-3	3.20	46.39	73.79		3.77	72.60
1995-4	6.77	69.86	157.39		4.44	157.67
1995-5	10.29	82.35	208.97		4.69	208.63
1995-6	14.65	98.25	219.99		4.74	219.74
1995-7	18.20	99.19	249.04		3.02	248.46
1995-8	19.18	70.18	219.14		2.46	219.02
1995-9	13.08	50.64	95.24		3.73	94.56
1995-10	11.38	34.05	61.35		3.30	61.15
1995-11	3.37	14.39	27.20		3.69	27.09
1995-12	-1.55	7.84	17.09		3.60	16.78

Tab. 18: Results for the year 1994

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1994-1	2.46	12.28	15.16	14.77	3.54	14.90
1994-2	-1.21	23.59	35.30	36.52	3.02	35.40
1994-3	3.34	50.93	87.60	54.82	3.82	87.26
1994-4	8.13	80.74	159.92	-3.02	2.59	158.46
1994-5	11.14	79.63	214.91	188.07	2.30	215.19
1994-6	13.56	105.79	218.95	172.41	2.65	218.84
1994-7	20.67	79.70	280.14	271.96	2.56	279.71
1994-8	17.61	78.20	181.22	157.23	4.03	180.00
1994-9	12.98	57.99	92.76		4.41	92.49
1994-10	7.90	34.53	60.76		4.24	59.62
1994-11	6.40	16.76	23.23		4.78	23.10

Tab. 19: Results for the year 1993

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1993-1	2.15	14.68	21.41	33.89	5.14	21.13
1993-2	1.00	27.36	36.86	34.79	3.90	36.51
1993-3	2.84	57.46	98.52	84.10	4.17	98.31
1993-4	7.88	75.49	177.53	172.58	3.88	177.29
1993-5	14.23	93.79	228.70	211.62	4.94	228.63
1993-6	14.49	106.74	240.57	198.32	2.08	240.39
1993-7	14.81	93.80	160.38	101.81	2.17	160.68
1993-8	14.41	87.62	162.88	123.72	1.89	161.63
1993-9	10.65	50.21	74.35	42.34	2.55	74.12
1993-10	7.16	31.91	55.02	74.47	2.14	54.57
1993-11	2.45	13.99	15.42	11.89	2.60	15.21
1993-12	2.39	8.36	10.75	19.12	3.43	10.53

Tab. 20: Results for the year 1992

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1992-1	2.56	13.84	19.75	31.92	3.34	19.48
1992-2	3.15	28.91	35.08	25.08	3.22	34.70
1992-3	4.56	52.50	81.50	62.29	2.96	81.00
1992-4	6.27	84.92	125.73	63.84	2.79	125.27
1992-5	13.21	92.97	249.35	235.89	2.71	249.05
1992-6	18.86	105.08	285.88	268.13	-6.71	284.70
1992-7	18.85	110.24	249.35	202.47	-1.62	247.78
1992-8	17.22	84.81	149.53	98.60	3.39	149.47
1992-9	13.29	62.65	118.94	109.67	3.43	118.44
1992-10	6.51	36.28	55.97	55.41	3.54	55.69
1992-11	4.99	17.63	22.48	26.40	4.13	22.23
1992-12	2.90	10.79	13.06	17.37	3.71	12.73

Tab. 21: Results for the year 1991

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1991-1	1.84	12.76	21.93	51.53	2.99	21.53
1991-2	-0.75	26.79	40.73	53.02	3.23	40.09
1991-3	4.35	51.28	81.82	63.78	2.78	80.89
1991-4	6.77	69.82	141.05	127.94	2.71	140.90
1991-5	10.03	84.66	215.09	218.02	6.06	214.75
1991-6	12.22	100.86	152.63	76.23	5.56	152.36
1991-7	18.21	81.97	223.85	230.84	2.02	223.56
1991-8	17.51	87.29	175.39	145.44	2.00	175.49
1991-9	13.74	55.28	123.18	135.38	2.13	122.86
1991-10	9.03	36.96	63.24	75.48	2.48	63.03
1991-11	5.14	18.06	23.52	26.09	2.77	22.96

**Tab. 22: Results for the year 1990**

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1990-1	2.86	1.61	1.44	2.40	-73.80	1.55
1990-2	5.60	5.20	2.87	7.74	-70.51	4.22
1990-3	6.63	48.62	87.36	123.61	-39.23	91.89
1990-4	8.04	73.14	180.29	161.52	-24.75	179.66
1990-5	12.81	81.91	224.70	245.20	-22.64	223.74
1990-6	15.64	114.30	202.74	130.98	-33.30	202.40
1990-7	16.32	89.62	224.32	218.82	-36.32	223.77
1990-8	17.26	75.41	186.74	193.57	-32.69	186.44
1990-9						
1990-10	7.83	22.00	49.41	99.18	2.50	48.61
1990-11	4.27	15.43	27.29	58.27	2.18	26.71
1990-12	2.17	9.29	13.45	29.54	2.99	13.01

**Tab. 23: Results for the year 1989**

Year	Ambient air temperature [°C]	Diffuse radiation [W/m <sup>2</sup> ]	Global radiation [W/m <sup>2</sup> ]	Direct radiation [W/m <sup>2</sup> ]	Wind speed [m/s]	Global mean radiation [W/m]
1989-1	4.61		108.95		-74.16	67.78
1989-2	4.17	3.68		40.65	-71.32	41.56
1989-3	5.72	8.92	68.86		-51.61	-51.20
1989-4	6.64	17.15	7.49	16.81	-49.64	15.29
1989-5	11.77	26.84	8.35	27.95	-41.86	26.34
1989-6	15.59	27.33	9.46	27.21	-26.56	26.07
1989-7	16.31	24.41	119.03	38.65	-36.03	22.86
1989-8	15.85	18.85	8.31	18.67	-37.62	17.38
1989-9	13.68	14.39	6.30	76.10	-18.64	12.34
1989-10	10.18	6.49	3.52		-49.16	6.04
1989-11	4.52	3.52			-34.66	3.07
1989-12	2.28				-48.55	1.59

## 5. Conclusion

From the results it can be seen that as was expected that over the years there will be a trend of increasing of ambient air temperature as well as global solar radiation, the results didn't show up this behavior. Results vary year by year and as can be seen from graphs 1 and 2 the behavior of ambient air temperature and global radiation is moreless sinusoid over the 20 years of measurement.

## 6. Reference

- [1] Andersen, E.: Solar Combi Systems, PhD Thesis, Department of Civil Engineering, Technical University of Denmark, 2007, ISBN 978-89-7877-228-2