03.01_PH-SUMMER SCHOOL

PH-CALCULATION – Climate data from Meteonorm

Composition: Bernhard OBERRAUCH
Language support: William GALLAGHER
Date: 2008-09-18

CONTENT OF THIS PRESENTATION:

In the PH-calculation software PHPP, not enough climate data files are included. For the missing places new files must be generated and imported.

This presentation has been prepared by
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The METEONORM climate data software

Description

METEONORM 6

comprehensive meteorological reference, incorporating a catalogue of meteorological data and calculation procedures for solar applications and system design at any desired location in the world. METEONORM 6 is mainly a climate database combined with a weather generator. METEONORM 6 is based on over 20 years of experience in the development of meteorological databases for energy applications.

Keywords

weather data, solar radiation, temperature, typical years, climate analysis

Validation/Testing

Theory handbook available at www.meteonorm.com.

Expertise Required

None.

Source: http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=520/pagename=alpha_list

The METEONORM climate data software

Description

Users
More than 1100 worldwide.

Audience
METEONORM addresses engineers, architects, teachers, planners and anyone interested in solar energy and climatology.

Input
Geographic definition of site. Users can enter custom monthly and hourly climate data.

Output
Monthly means in form of pdf and graphs. Monthly, daily, hourly and minute time resolution files in form of ASCII files (predefined formats for several building simulation tools like e.g. tm2 format).

Computer Platform
Window 2000, XP and Vista, 512 MB RAM, 700 MB disk space

Source: http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=520/pagename=alpha_list

The METEONORM climate data software
Description

Programming Language
Visual Basic.Net 2005

Strengths
Allows a user to create typical year data for any place on Earth. Gives a quick and relatively accurate overlook of weather information.

Weaknesses
Quality varies depending on region. Extreme events of more than 10 years recurrence period not included.

Contact
Company: Meteotest Switzerland
E-mail: office@meteotest.ch
Website: http://www.meteonorm.com
USD 520 (single license of full version)

Source: http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=520/pagename=alpha_list

Having it too cold or too warm... is not comfortable

We want to calculate the heating or cooling consumption and load correctly: we want a small and cheap generator, but on the other hand we do not accept freezing in winter and too much heat in summer.

Source:

Well sized or oversized generator ?

If we calculate the heating or cooling load correctly, the efficiency of the heating or cooling generation will be the best- we do not oversize or undersize it. To oversize means to have too high costs for the generator and low efficiency of it, to undersize means to freeze in winter or to be too hot in summer. The software Meteonorm (further called „MN“) can be used as a simple and efficient tool to get data for calculations with the PHPP already in its format.

Source:

15 steps of simulation

You simulate it and get the heating load $P_1 0$ of the basic variant. Then you add an opaque area with a constant value U*A (for example 0,5W/K), to get the maximal heating load $P_1 1$. The results Δ of temperature $=\varphi_{(intern)} - \varphi_{(extern,\ cold\ sunny)} = (P_1 1 - P_1 0)/(U*A)$.

You add a window on the south without shading with a known g-Value and area and get with simulation the maximal heating load $P_1 2$. This results in solar gains (south) = $(P_1 0 - P_1 2)/(g*A)$.

The same procedure you do with windows to the other directions east, west, north and horizontal, getting the results $P_1 3$, $P_1 4$, $P_1 5$, $P_1 6$. Now you have the values for the weather 1.

Now you simulate another basic case with many windows on south, nearly 80% of the southern front. You repeat the same to get the values $P_2 0$, $P_2 1$, $P_2 2$, $P_2 3$, $P_2 4$, $P_2 5$,$P_2 6$ for the weather 2 (warm and cloudy).

After having made these 14 simulations, you must analyse the results, if they correspond to the reality. Maybe the base of the hourly weather data was not good enough, or the building is not appropriate enough for this zone.
The cooling load is to be calculated in the same way.

heating load real building	P	H=U*A	Delta T	T_loading	step	
incl. Windows	1698,5					1
heating load						
case 1: cold & clear						
validation of Temperatur	P	H=U*A	Delta T	T_loading	step	
heating load basic case Transmission	3667,3	0				2
heating load PLUS h+	3737,3	3,55				3
Difference	69,9	3,55	19,69	0,31		

solar gain cold& clear	P	SDg=g*A	diff P	solar gain	
North	3610,3	2	57,08	28,54	4
East	3505,5	2	161,88	80,94	5
South	3540,7	2	126,67	63,33	6
West	3627,7	2	39,67	19,83	7
global	3511,5	2	155,79	77,90	8

case 2: warm& cloudy					
validation of solar radiation	P	H=U*A	Delta T	T_loading	step
heating load basic case Window	3073,5	0			9
heating load PLUS h+	3145,6	3,55			10
Difference	72,08	3,55	20,31	-0,31	

solar gain cloudy	P	SDg=g*A	diff P	solar gain	
North	3024,4	2	49,17	24,58	12
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South	3002,1	2	71,42	35,71	14
West	3028,3	2	45,25	22,63	15
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You add a window on south without shading with a known g-Value and area and get with simulation the maximal heating load P12. This results in solar gains (south) = (P10-P12)/(g*A).

The same procedure you do with windows to the other directions east, west, north and horizontal, getting the results P13, P14, P15, P16. Now you have the values for the weather 1.

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To get the monthly values could be rather easy. But to get good heating and cooling load climate data, until now a very long and complicated procedure was used to get them. You take a passive building (in every climate zone another one, depending if there is a warm or cold climate), with only a few windows.

Source:

Example of comparison

results of simulation

PHPP 2007

Udine200410m2 opake Fläche, 2m2 Fenster	heating load	°C or W/m2
extern temperature	0,3	-0,3
solar radiation North	19,8	22,6
solar radiation East	28,5	24,6
solar radiation South	80,9	57,4
solar radiation West	63,3	35,7
solar radiation global	77,9	53,0

results with Meteonnorm, corresponding also to graphics

Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	Udine2004
-1,2	6,3	27,1	°C
17	4	59	North
65	5	162	East
201	4	145	South
63	5	130	West
88	9	267	global
3d	3d	3d	
w1: 22/1	w2: 21/2	s: 21/7	

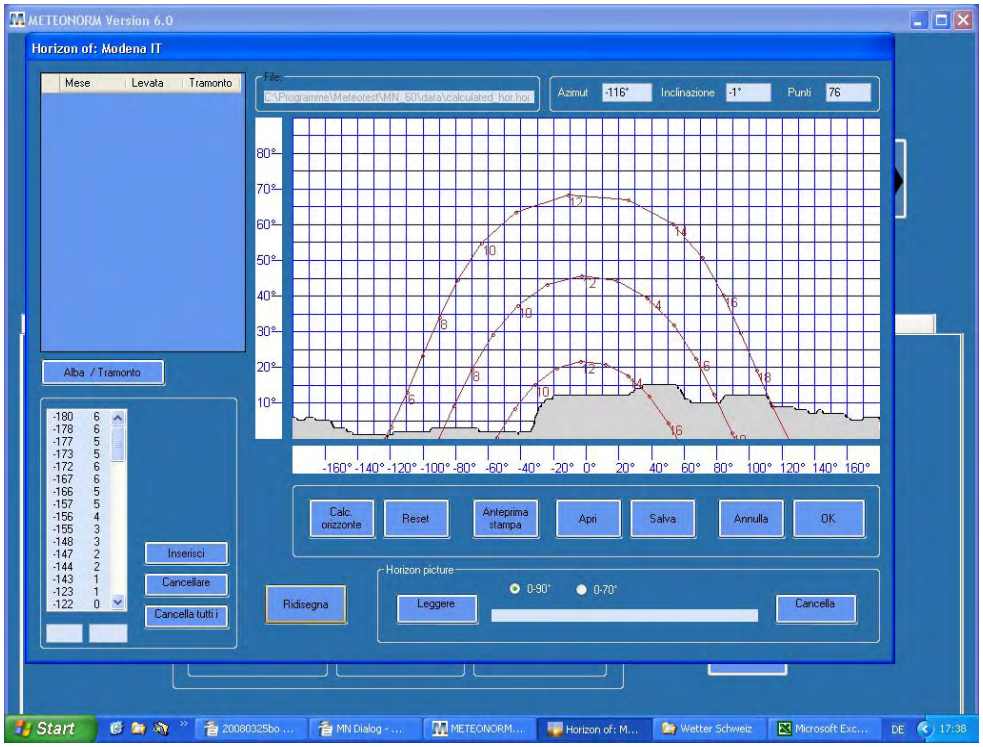
The results do not correspond...
Perhaps the building is not suitable enough for this zone.

confronto	temperatura media annuale	Σ radia-zione kWh/a	gg risc	gg raff.	rad.globale W/m2 invernale 1	rad.globale W/m2 invernale 2	rad.globale W/m2 estivo	Carico °C invernale 1	Carico °C invernale 2	Carico °Cestivo
1 Udine Rivolto anni1960 phpp m2	13,59	1.212	2.248	84	62	16	261	-1,20	8,50	26,60
2 Udine Rivolto anni2000 phpp m2	13,46	1.212	2.352	100	62	16	261	-1,30	6,50	27,50
3 Udine Rivolto anni2000 phpp nx1	13,65	1.261	2.698	253	32	11	178	-1,30	6,50	27,50
4 Udine Rivolto anni2000 phpp nx2	13,65	1.261	2.698	253	32	11	178	-1,30	6,50	27,50
5 Udine Rivolto anni2000 phpp nx3	13,65	1.261	2.698	253	42	32	178	-3,50	-4,30	30,50
6 Udine2004 phpp m2	13,22	1.261	2.351	80	88	9	267	-1,20	6,30	27,10

Comparing different climates through Meteonorm and imported the real year data of 2004 the new method seems to me more real and logical.

Source:

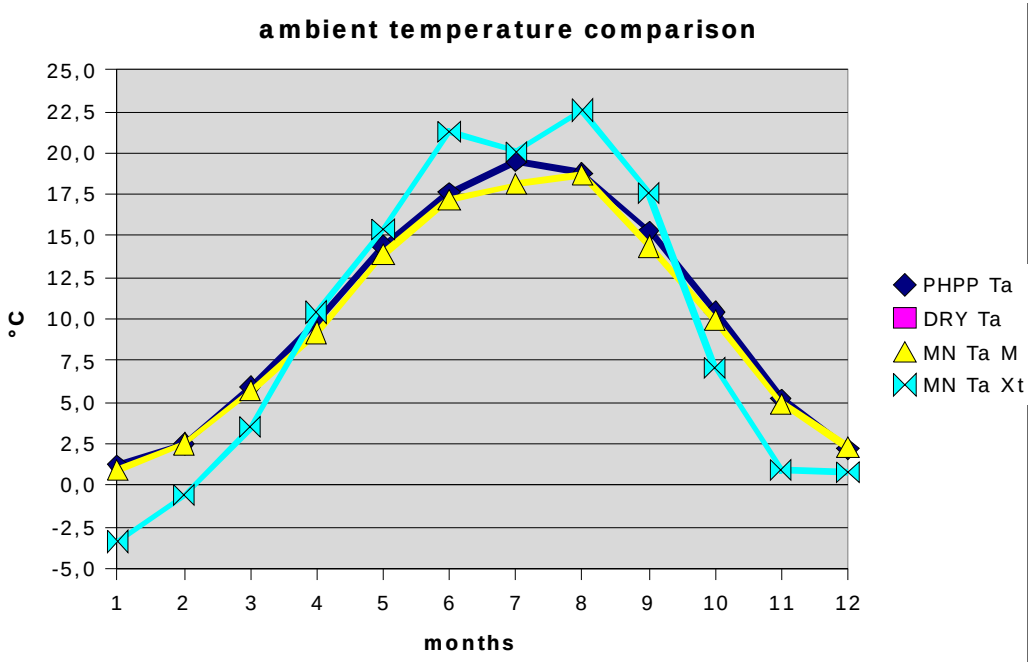
The horizon



We can modify the data by the input of a given horizon, given for example by mountains. There a many output formats, and now one of them is the „PHPP“-format which includes all the necessary information: monthly values of temperature, solar radiation and humidity, sky temperature, heating and cooling load temperatures and radiation values.

Source:

The monthly values



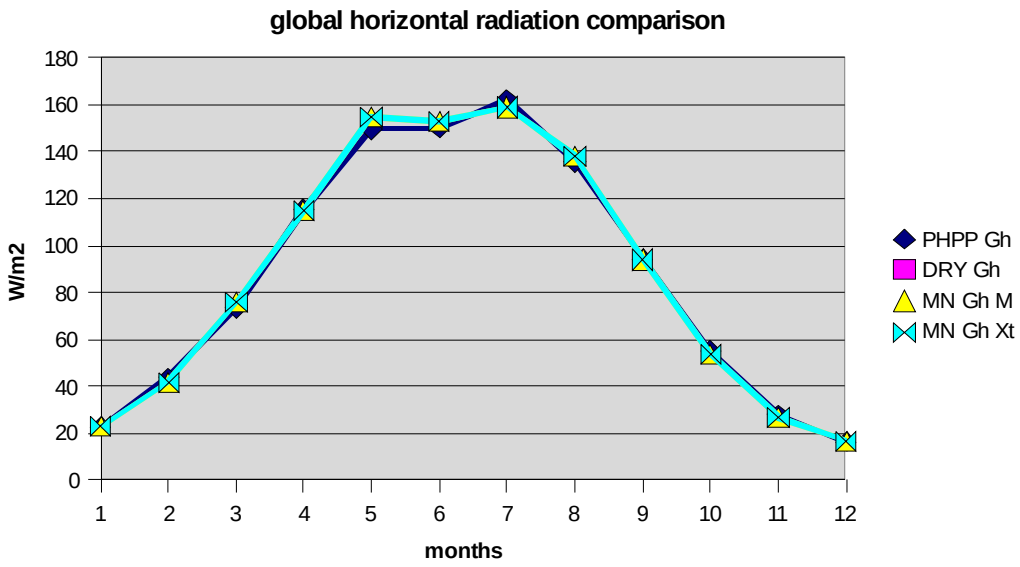
In the example of Mannheim (Frankfurt) the monthly values of temperature and solar radiation are very similar. If we generate the weather from meteonorm, we have to choose the „mean“ year, which corresponds to the „normal“ year of the DRY data.
In most cases in monthly results there isn't any significant difference between PHPP data and data generated from Meteonorm.

Mannheim (Frankfurt)

ambient temperature comparison	Temperature °C											
	1	2	3	4	5	6	7	8	9	10	11	12
PHPP Ta	1,2	2,5	5,9	9,9	14,4	17,6	19,5	18,8	15,3	10,4	5,2	2,2
DRY Ta												
MN Ta M	0,9	2,5	5,7	9,2	13,9	17,2	18,1	18,7	14,4	9,9	4,9	2,3
MN Ta Xt	-3,4	-0,6	3,5	10,4	15,4	21,3	20,1	22,6	17,6	7,1	0,9	0,8

Source:

The monthly values



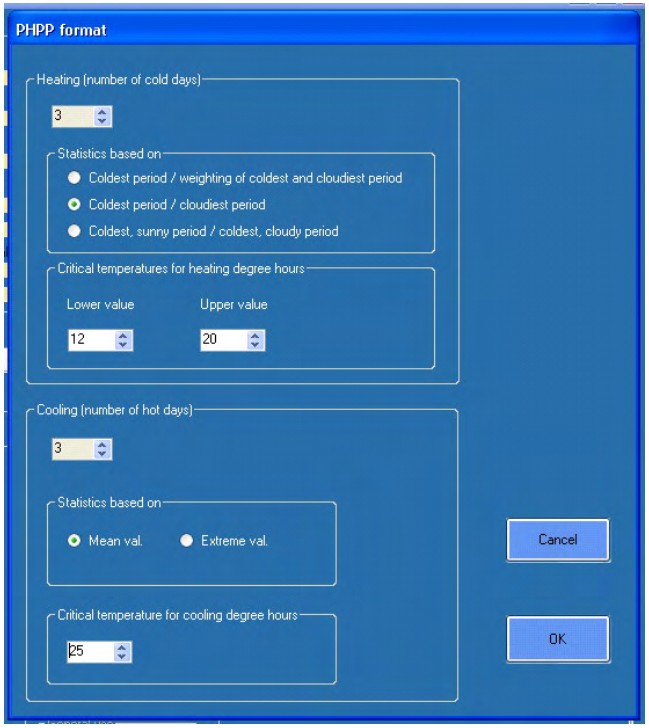
Meteonorm offers more method to get and work with climate data. If we don't have any values, MN generates them by itself based on more then 5000 weather stations with stored daily mean values and stored distribution curves. If we already have monthly average data, or even hourly data (of real years or DRY Design Reference Years), we can import them.

Mannheim (Frankfurt)
global radiation comparison horizontal W/m2

	1	2	3	4	5	6	7	8	9	10	11	12
PHPP Gh	23	44	74	115	150	150	162	135	94	55	28	16
DRY Gh												
MN Gh M	23	42	76	115	155	153	159	138	94	54	27	17
MN Gh Xt	23	42	76	115	155	153	159	138	94	54	27	17

Source: xxx

The heating and cooling load



coldest period / weighting of coldest and cloudiest period: analogue to SIA 2028 the cloudiest period is chosen by the empiric factor of the mean values of the period of (global radiation + 3* air temperature)

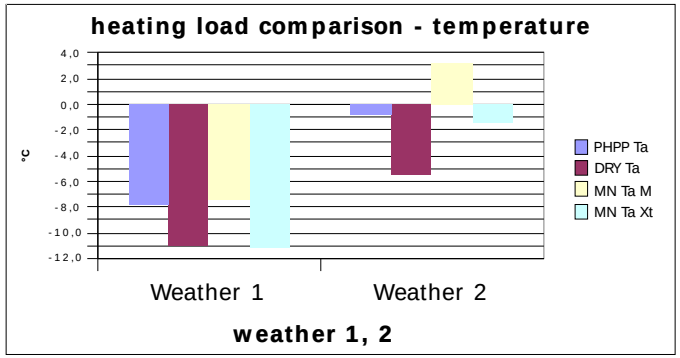
coldest period / cloudiest period: the mean values of the coldest period for the weather 1 and the cloudiest period for the weather 2. In my experience these values are the most useful.

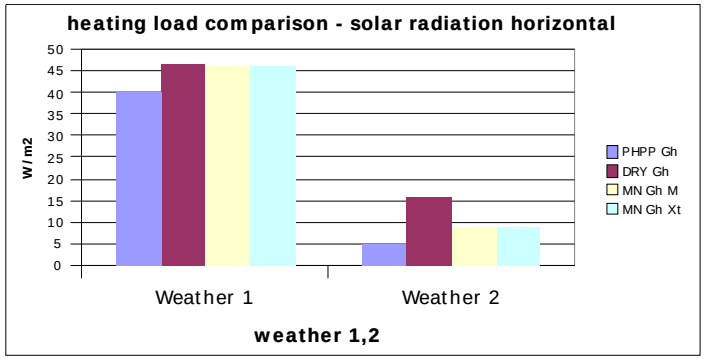
coldest, sunny period / coldest , cloudiest period: the coldest periods in the year are separated in sunny periods (the coldest of them will be the one of the weather 1) and in cloudy periods, the coldest one of which will be used for the weather 2.

With Meteonorm we choose for the load values the „extreme“ year, which corresponds to the combination of the „cold“ and the „warm“ year of the DRY data. In the winter months we take the 10-year minimum temperatures, for the summer months May - October we choose the 10 year maximum. In Italy the real year 2004 I consider a „normal“ year, 2006 a „cold winter“ year and 2003 a „hot summer“ year.

Source:

The heating and cooling load





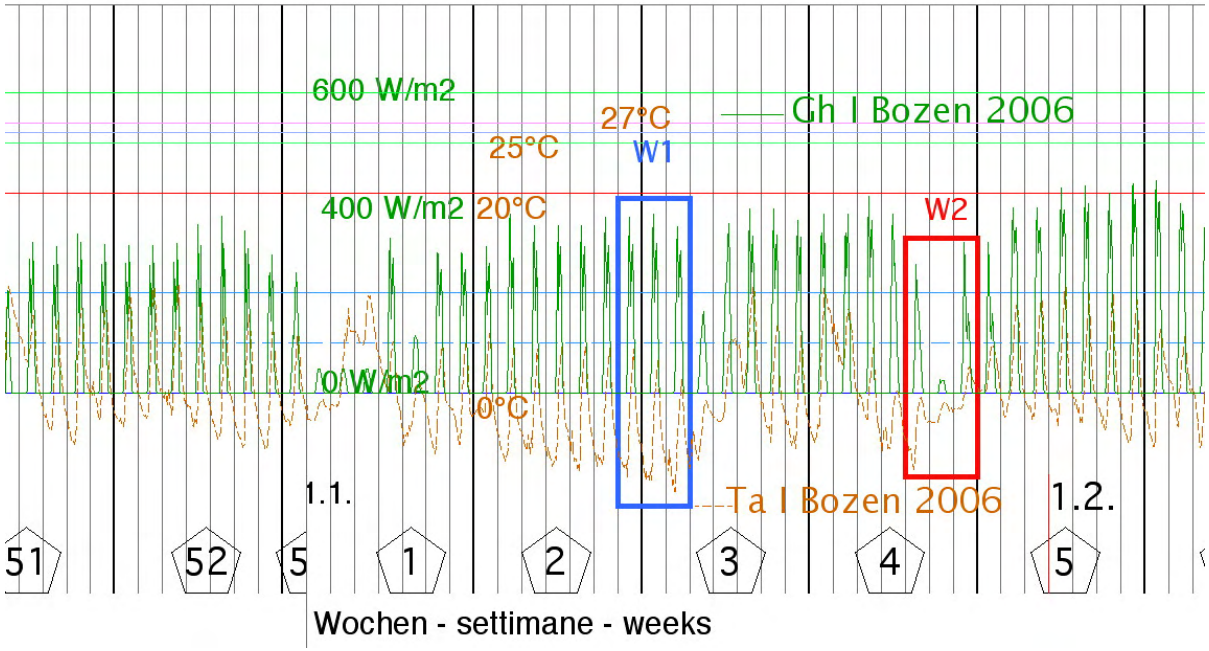
Mannheim (Frankfurt) heating load comparison	Temperature °C Weather 1	Weather 2
PHPP Ta	-7,7	-0,8
DRY Ta	-11,1	-5,6
MN Ta M	-7,5	3,2
MN Ta Xt	-11,2	-1,4

Mannheim (Frankfurt) heating load	hor. radiation W/m2 Weather 1	Weather 2
PHPP Gh	40	5
DRY Gh	47	16
MN Gh M	46	9
MN Gh Xt	46	9

Comparison of temperature and radiation results chosen by statistic 2 (coldest period/ cloudiest period) for a period duration of 3 days. The most similar result to the values in the PHPP in the temperature are those of the Meteonorm mean weather, while the MN extreme weather correspond to the DRY values. In the radiation values MN lies between PHPP and DRY.

Source:

The heating and cooling load



Measured year 2006 in Bozen/ Bolzano (Italy)
The most secure way is to control the hourly graphic manually, to choose the wanted period (in this example 3 days)

The manually chosen period „W1“ (weather winter 1: cold and sunny) and the period „W2“ (weather winter 2: warm and cloudy). The duration of the period depends on the thermal insulation and the thermal mass on the building. Some beginnings of calculation of this duration of period we find in the EN 832 and in [Kirschtig 2007], and even in the PHPP. For traditional houses I assume a value of 1 day, for passive houses a value of 3-7 days. The duration of period has to be explored more.

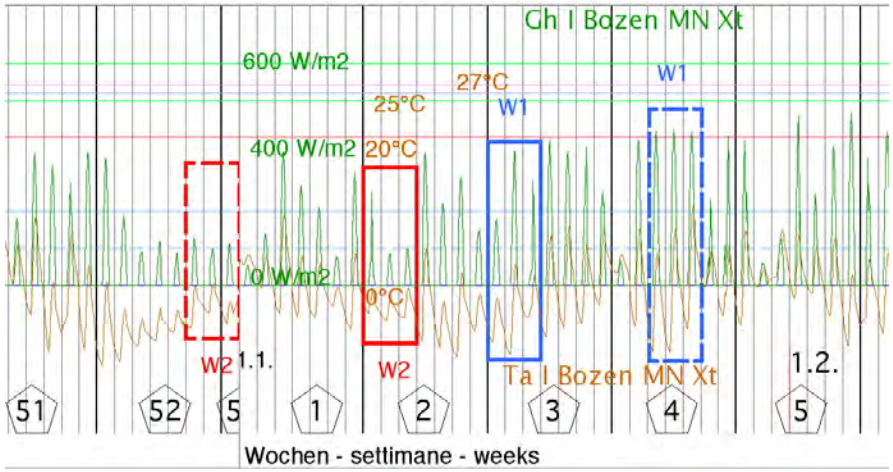
Source:

The heating and cooling load

Bozen 2006 heating load, choosen manually ("bo") and from Meteonorm ("MN")

The heating loads correspond exactly to the manually calculated values, and Meteonorm choose the periods better than I was able to.

		Ta	RH	Td	G_Gh	
Winter1 (3d)	14.-16.Jan	-4,82	66,76	-10,45	69,23	MN, BO
Winter2 (3d)	26.-28.Jan	-1,95	87,00	-4,02	34,84	MN
Winter1 (3d)						
Winter2 (3d)	18.-20.Feb	1,45	96,28	0,91	38,69	BO

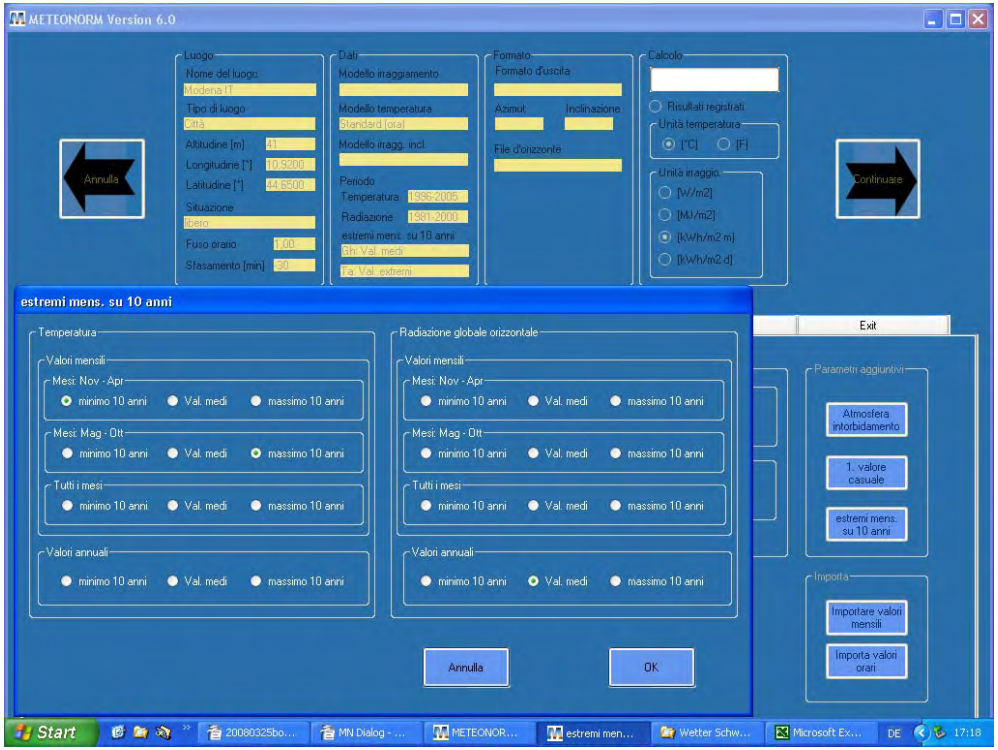


With Meteonorm generated estreme year in Bozen/ Bolzano (Italy)
The most secure way is to control the hourly graphic manually, to choose the wanted period (in this example 3 days)

Bozen MN Xtg phppnx													Heating Load	Cooling Load
Month	1	2	3	4	5	6	7	8	9	10	11	12	Weather 1	Weather 2	Radiation
Bolzano	Latitude:	46,47	Longitude ° E	11,33	Altitude m	241	ure Swing	Summer (K)		10,4	Radiation Data:	Wh/(m²*month	Radiation: W/m²		W/m²
Ambient Temp	-0,9	1,3	8,3	15	19,6	25,3	24,4	26	20,1	10,3	5,2	-1,4	-6,6	0,2	30,6
North	10	15	27	32	46	53	51	37	27	20	13	10	14	9	42
East	28	39	61	97	105	123	128	105	86	50	28	21	30	10	175
South	80	90	102	119	96	98	108	118	128	99	78	68	108	12	200
West	27	38	66	91	96	116	123	110	88	53	35	28	43	10	185
Global	39	58	99	153	169	204	212	178	134	77	45	32	49	19	292
Dew Point	-4,9	-4,3	0	4,3	10,2	13,3	14,6	15,3	11,2	8,7	1,4	-3,7			
Sky Temp	-13,8	-12,8	-6,8	-1,6	5,4	8,7	9,5	11,5	5,8	1,8	-6	-13,5			
hg h (12/20)	70641	KL h (25)	4939												

Source:

Sources



[MN]

www.meteonorm.com

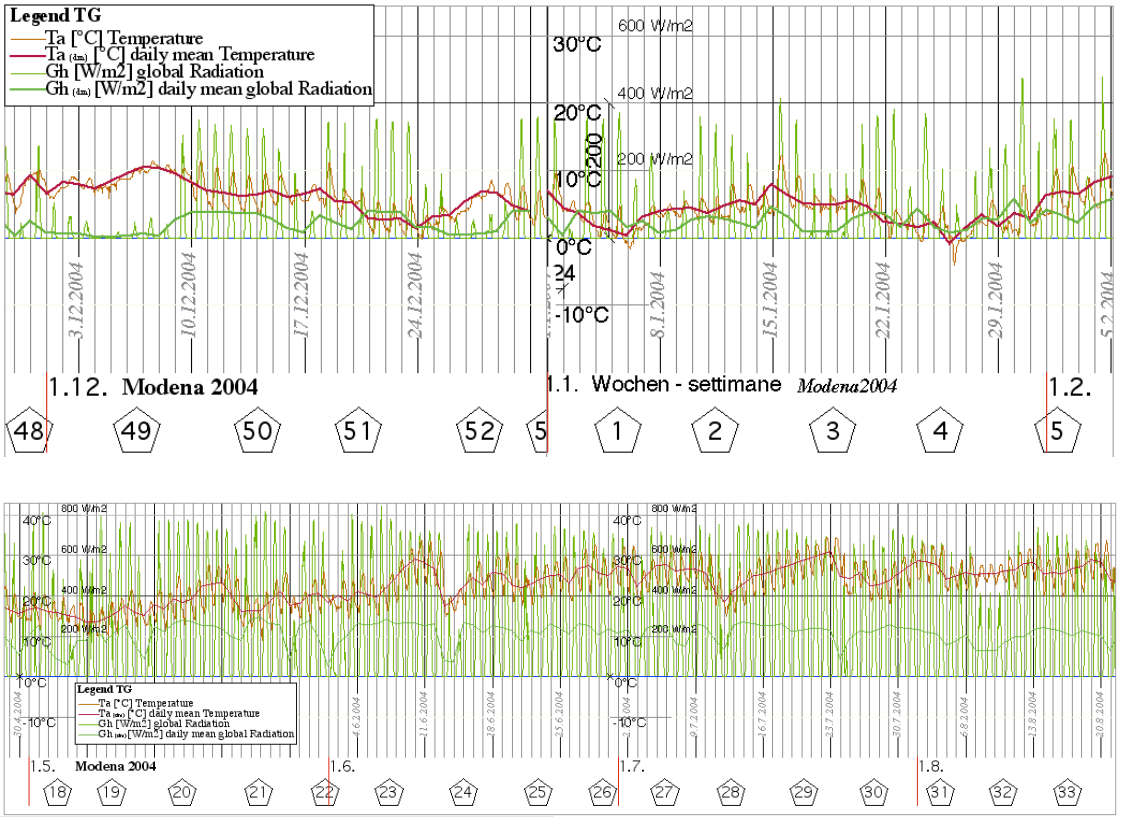
[Kirschtig 2007]

Kirschtig Thomas, Heizlastverfahren im Vergleich II, Tagungsband 11.Internationale Passivhaustagung, PH Institut Darmstadt 2007.

Meteonorm is easy to learn, flexible and useful. It is more comfortable and faster than the simulation, but is not perfect, you have in any case to use also your mind, you have to control the results also in situ. If you combine Meteonorm with measured data, it is a very secure tool. Its development goes on, and last but not leased, their programmer are well cooperating and open to new ideas.

Source:

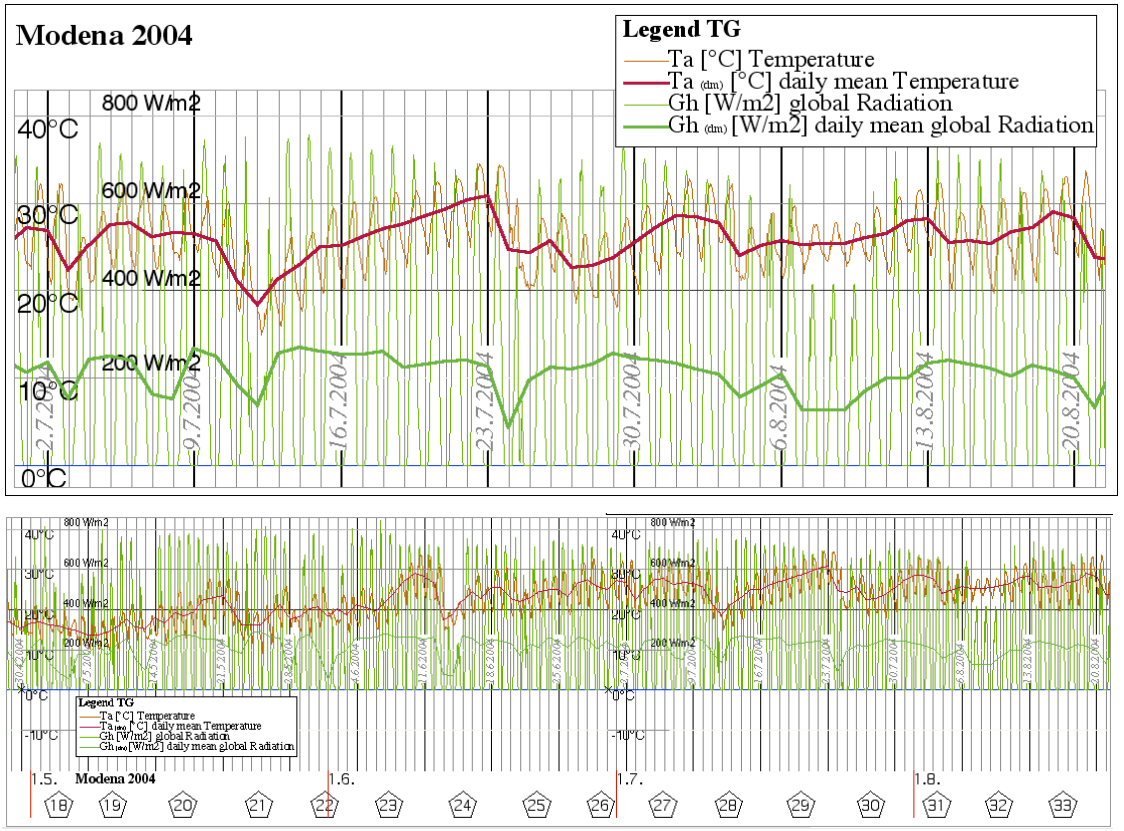
Relationship between global radiation and temperature



Modena 2004 winter: cold-sunny/ warm-cloudy

Source:

Relationship between global radiation and temperature



Modena 2004 summer:

Source:

Relationship between global radiation and temperature

confronto	temperatura media annuale	Σ radiazione kWh/a	gg risc	gg raff.	rad.globale W/m2 invernale 1	rad.globale W/m2 invernale 2	rad.globale W/m2 estivo	Carico °C invernale 1	Carico °C invernale 2	Carico °Cestivo
1 Modena IT, clima medio	14,19	1.254	2.245,6	161,6	38	18	188	-1,20	3,00	29,30
2 Modena IT, clima estremo temperatura	14,26	1.254	2.664,7	325,9	30	18	188	-3,40	0,50	32,80
3 Modena IT, clima estremo temperatura&radiazione nx2	14,26	1.254	2.664,7	325,9	30	18	188	-3,40	0,50	32,80
4 Modena IT phppnx1	14,26	1.328	2.650,5	317,5	13	12	277	-3,40	0,50	32,80
5 Modena IT phppnx2	14,26	1.328	2.650,5	317,5	13	8	277	-4,00	3,30	32,00
6 Modena IT phppnx3	14,26	1.328	2.650,5	317,5	80	13	277	-1,10	-4,00	32,00
7	#DIV/0!	0			0	0	0	0,00	0,00	0,00
8 Modena2004 m2	14,82	1.157	2.085,5	221,5	22	4	237	0,90	8,30	30,20

mese	1	2	3	4	10	11	12	Carico invernale 1	Carico invernale 2	Carico estivo
Modena2004 m2	Latitudine [°]		44650	ngitudine	10920		8,6	Valori dell'irr	Wh/(m²*Monat)	°C, W/m²	°C, W/m²	°C, W/m²
Temperatura aria esterna	3,6	5,5	8,6	13,8	16,6	9,9	6,3	0,9	8,3	30,2
Nord	11	13	23	31	18	12	8	9	2	68
Est	18	24	50	63	32	25	22	10	2	126
Sud	64	71	88	83	52	64	63	23	1	130
Ovest	30	36	53	71	30	25	20	21	2	122
Globale	37	48	88	116	54	40	29	22	4	237
Temperatura di rugiada	-0,7	1,4	3	7,3	11,9	4,6	1,3			
Temperatura cielo	-8,1	-5,5	-3,2	2,2	8,7	-0,6	-5,1			
riscaldamento gradi ore (12/20)	50052	raffr.°h (24)	5315							

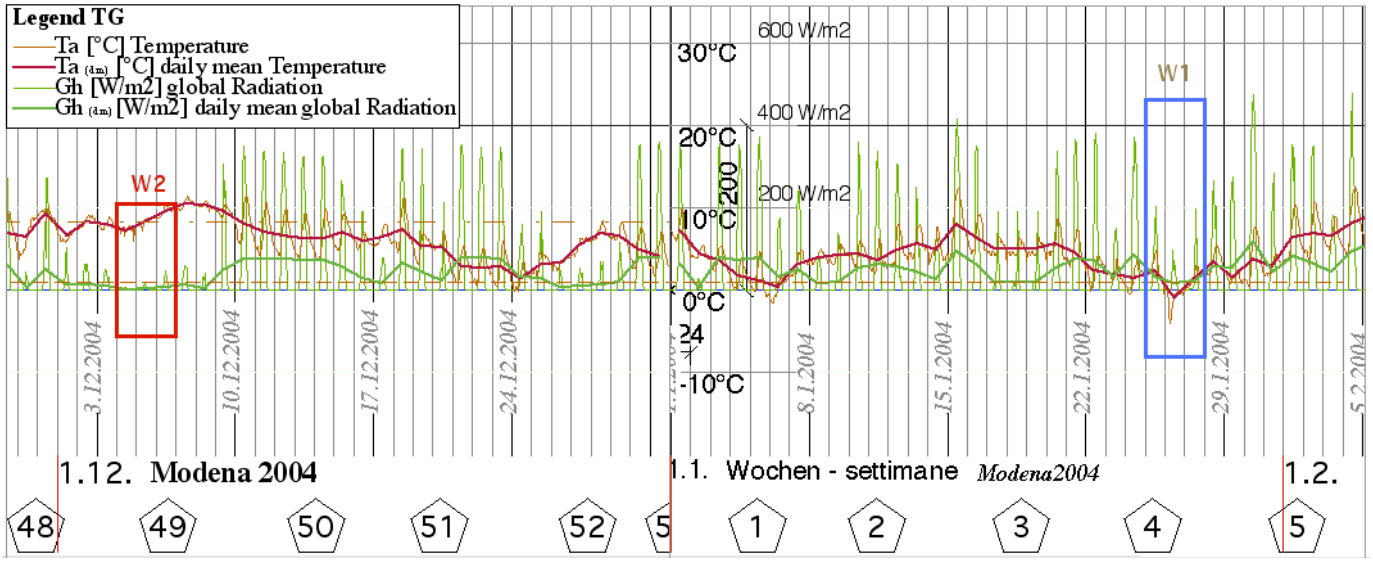
Inizio periodo freddo: 25.1., inizio periodo nebbioso 4.12., inizio periodo caldo: 21.7.
Riscaldamento / giorni freddi:: Le statistiche si basano sui: giorni più freddi/ più nebbiosi
Raffrescamento / giorni caldi:: Le statistiche si basano sui: Val. medi

Albedo = 0,2
Modello irraggiamento = Standard (ora); Modello temperatura = Standard (ora)
Modello irragg. incl. = Perez
Temperatura: Valori importati = 2005
Radiazione: Valori importati = 2005
Riscaldamento / giorni freddi: = 3
Raffrescamento / giorni caldi: = 3
Temperatura: Periodo nuovo = 1996-2005
Radiazione: Periodo nuovo = 1981-2000
Riscaldamento / giorni freddi: = 3
Raffrescamento / giorni caldi: = 3

Modena 2004 PHPP comparison

Source:

Relationship between global radiation and temperature

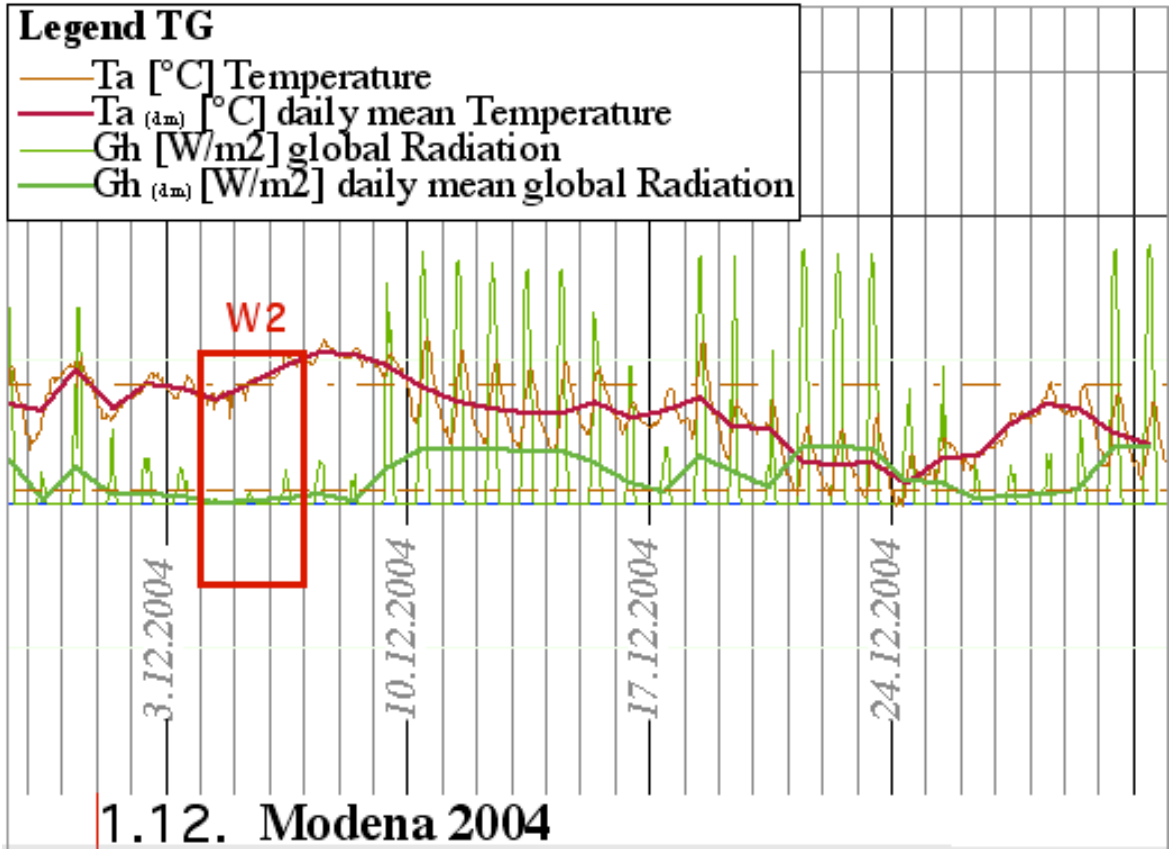


begin cold period: 25.1., begin cloudy perid 4.12., begin warm period: 21.7.
coldest period / cloudiest period: the mean values of the coldest period for the weather 1 and the cloudiest period for the weather 2. In my experience this values are the most useful.

Modena 2004 PHPP choose winter 1&2

Source:

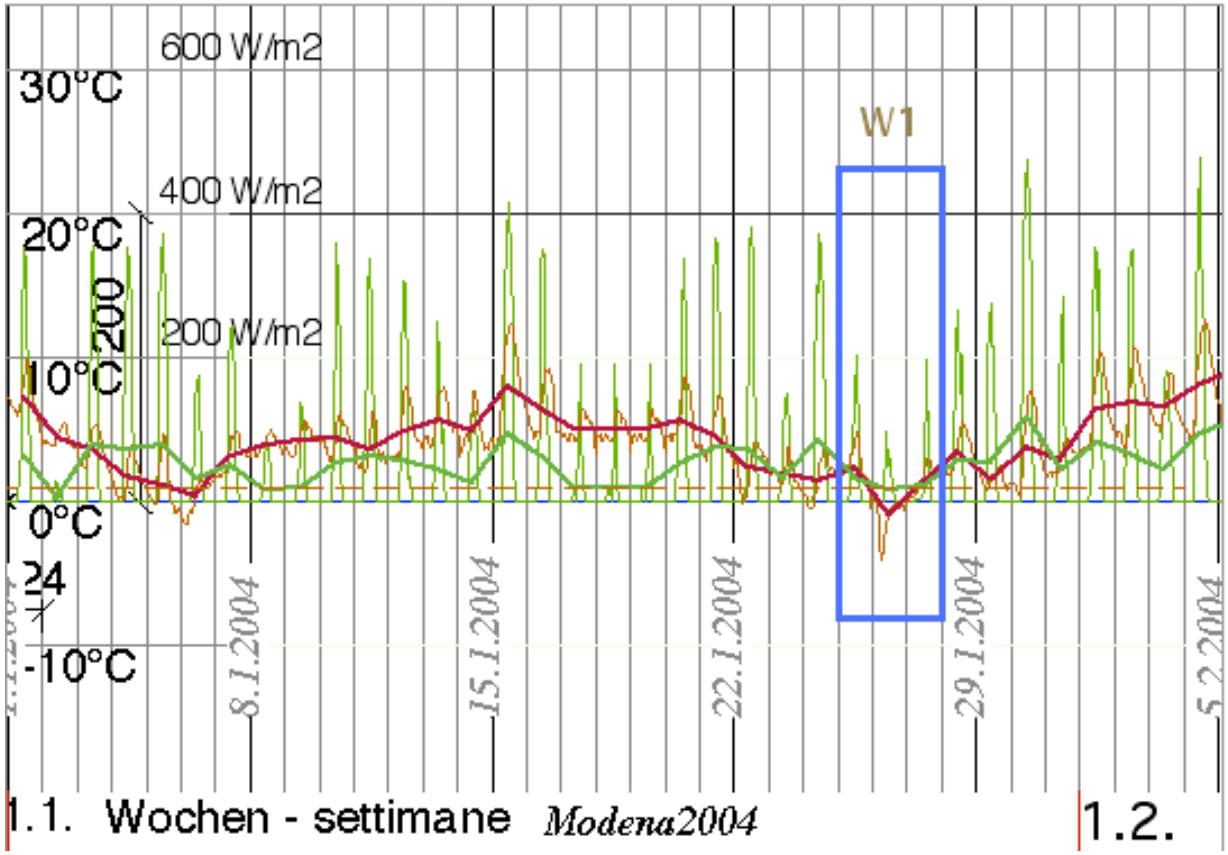
Relationship between global radiation and temperature



Modena 2004 PHPP choose winter 2

Source:

Relationship between global radiation and temperature



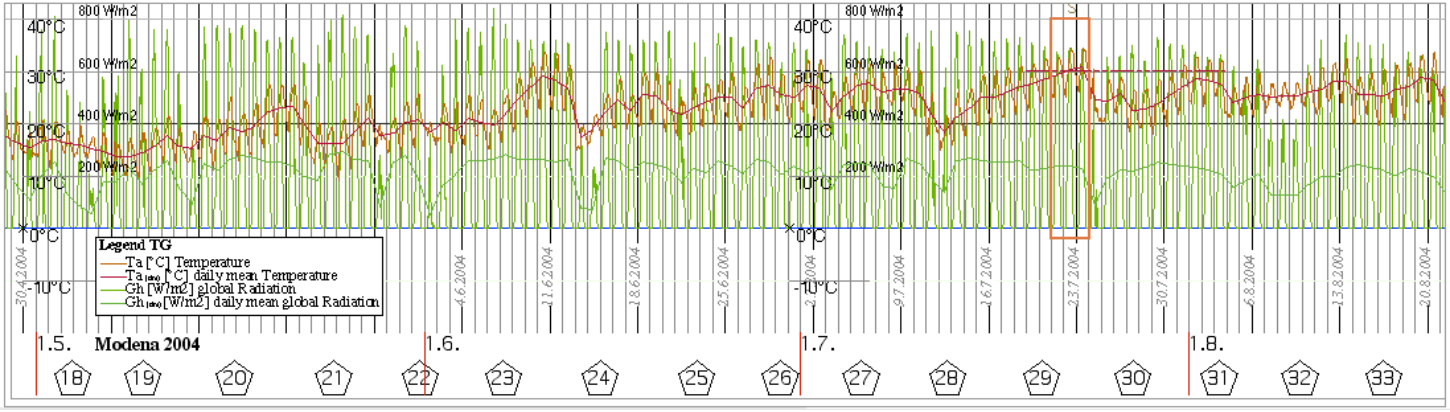
Modena 2004 PHPP choose winter 1

Source:

Relationship between global radiation and temperature

Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
0,9	8,3	30,2	Ta
9	2	68	north
10	2	126	east
23	1	130	south
21	2	122	west
22	4	237	global
3d	3d	3d	
w1: 25/1	w2; 4/12	s: 21/7	

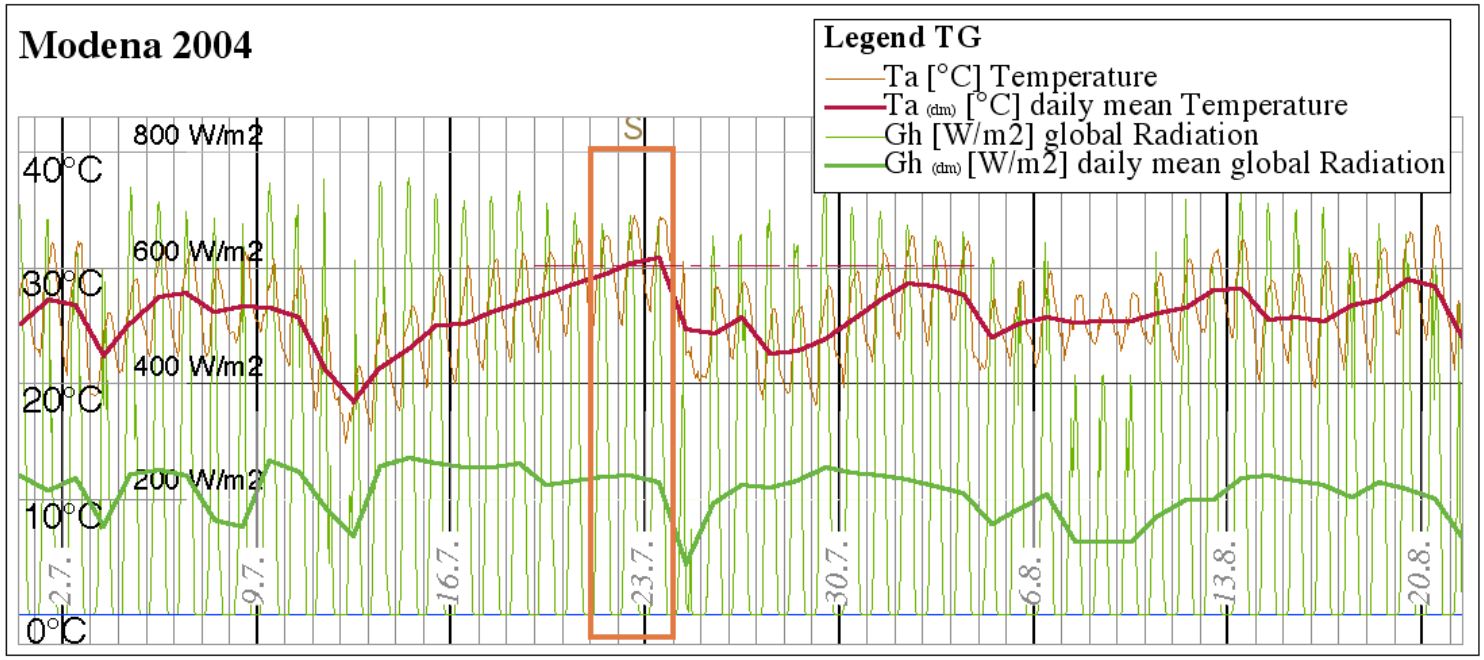
begin cold period: 25.1., begin cloudy perid 4.12., begin warm period: 21.7.
coldest period / cloudiest period: the mean values of the coldest period for the weather 1 and the cloudiest period for the weather 2. In my experience this values are the most useful.



Modena 2004 PHPP choose summer

Source:

Relationship between global radiation and temperature

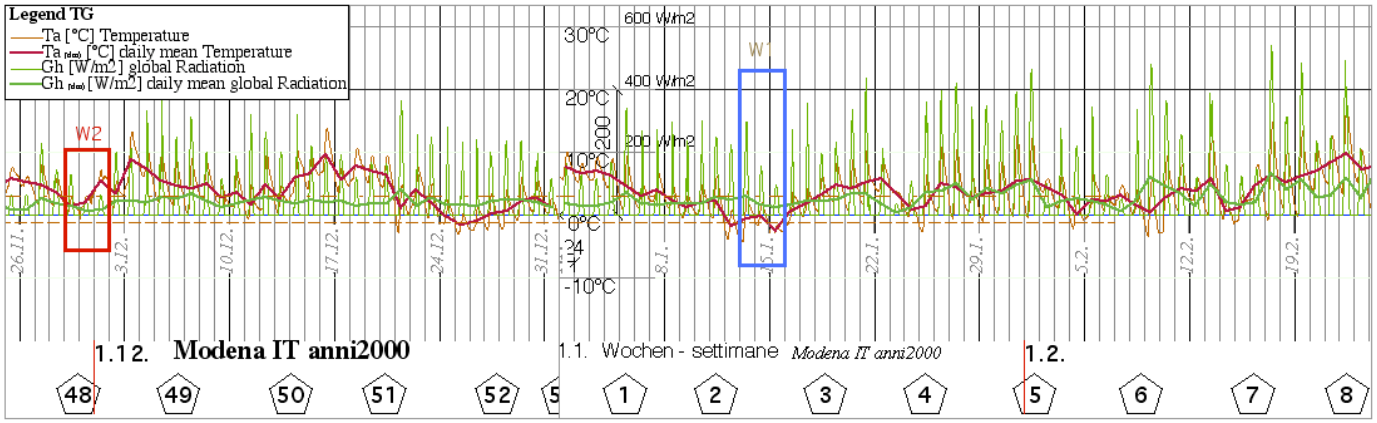


Modena 2004 PHPP choose summer July

Source:

Relationship between global radiation and temperature: MN chooses the right period

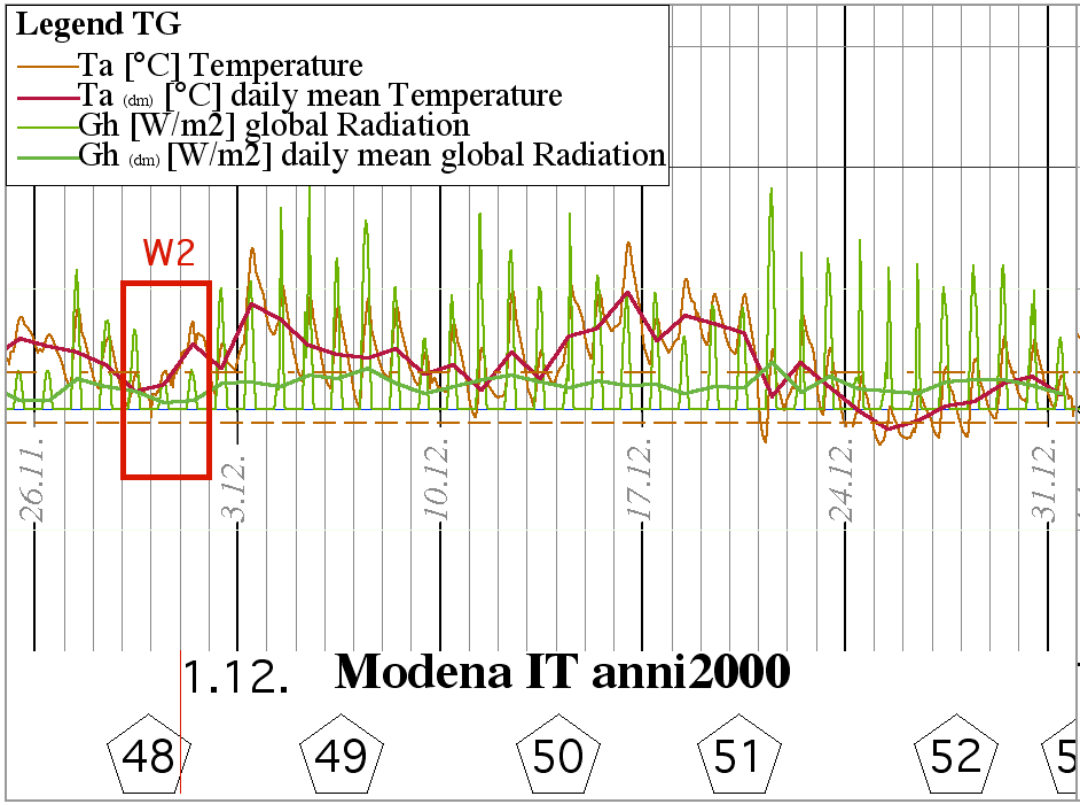
Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-1,2	3	29,3	Ta
15	9	54	north
23	9	98	east
45	10	118	south
21	9	135	west
38	18	188	global
3d	3d	3d	
w1: 13/1	w2: 29/11	s: 18/8	



Modena IT 2000: PHPP winter

Source:

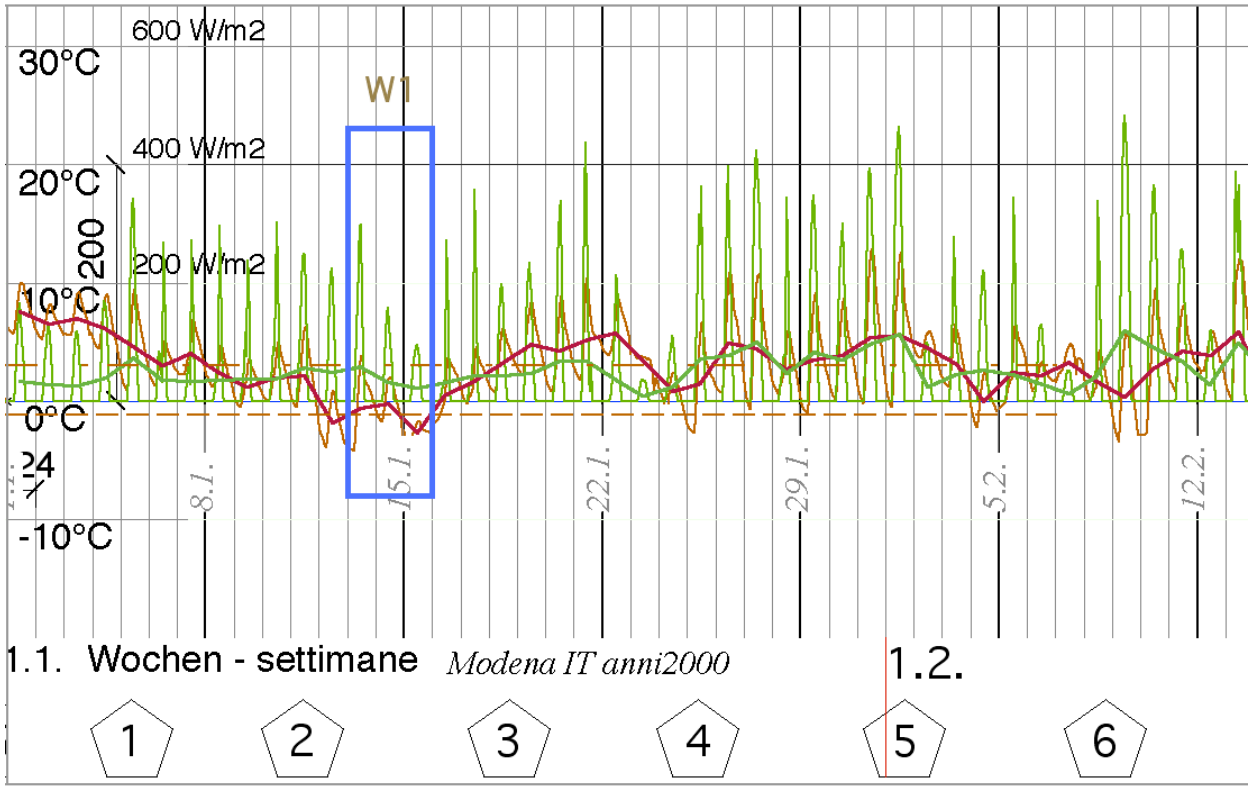
Relationship between global radiation and temperature: MN chooses the right period



Modena IT 2000: PHPP winter 2

Source:

Relationship between global radiation and temperature: MN chooses the right period

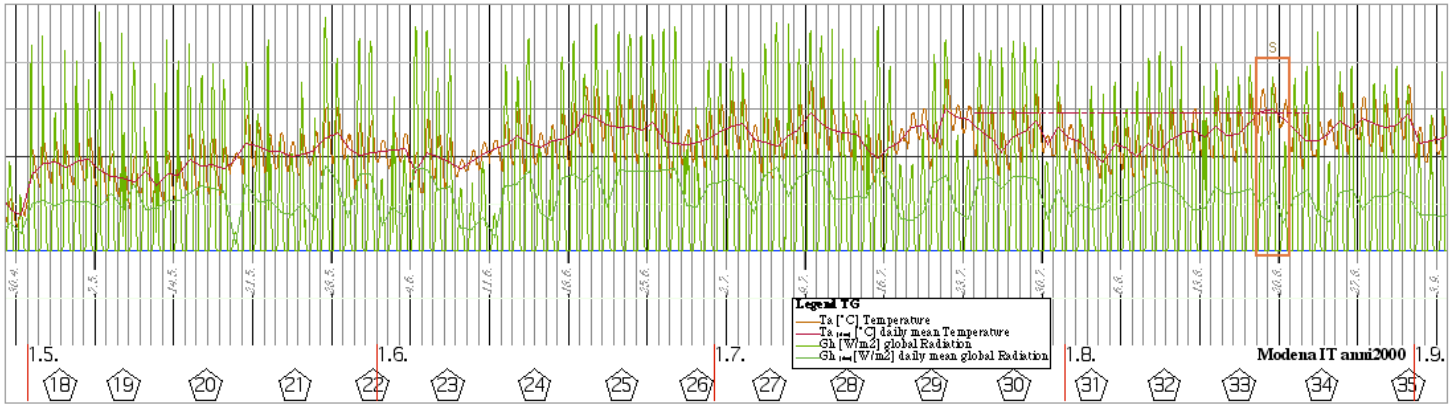


Modena IT 2000: PHPP winter 1

Source:

Relationship between global radiation and temperature: MN chooses the right period

Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-1,2	3	29,3	Ta
15	9	54	north
23	9	98	east
45	10	118	south
21	9	135	west
38	18	188	global
3d	3d	3d	
w1: 13/1	w2: 29/11	s: 18/8	

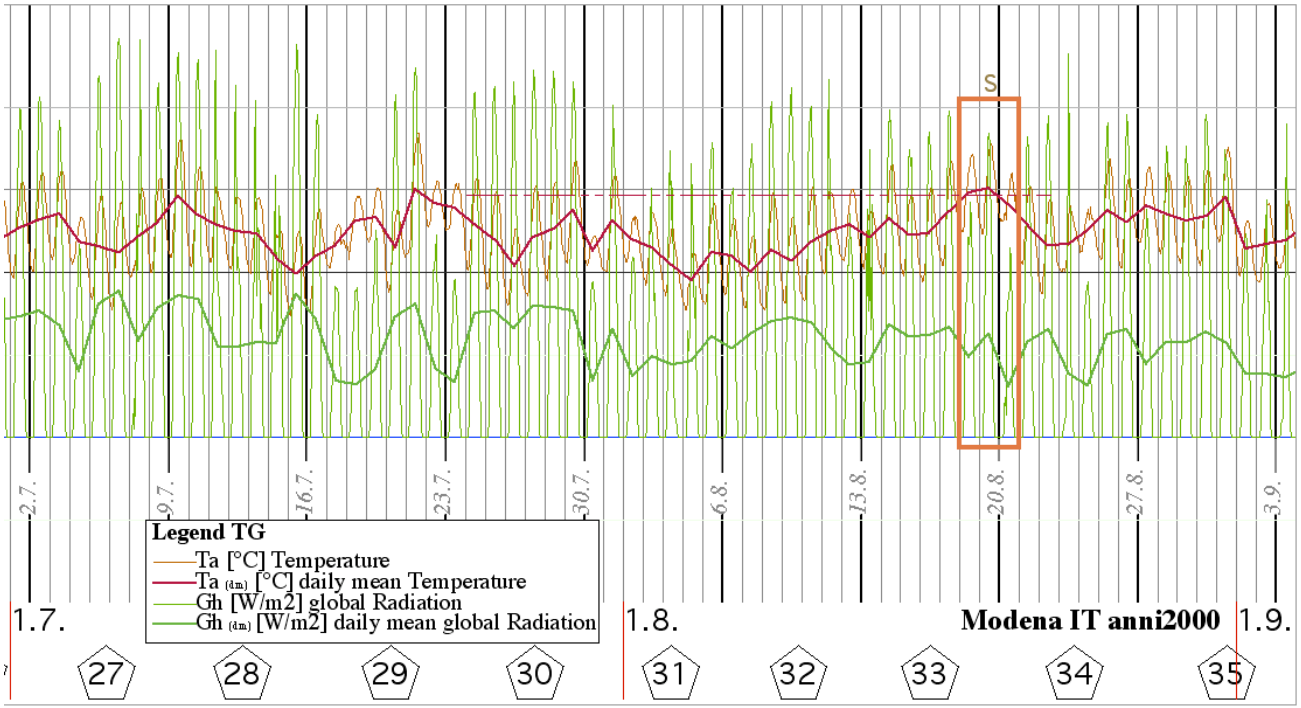


Modena IT 2000: PHPP summer

Source:

Relationship between global radiation and temperature: MN chooses the right period

Conclusion: Meteonorm is able to find the right heating loads, if it is based on the right clima dates.



Modena IT 2000: PHPP summer August

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

Modena IT: where is the weather station?

Source: Google-Map

Choose the right period of weather station: To be a prophet or historian

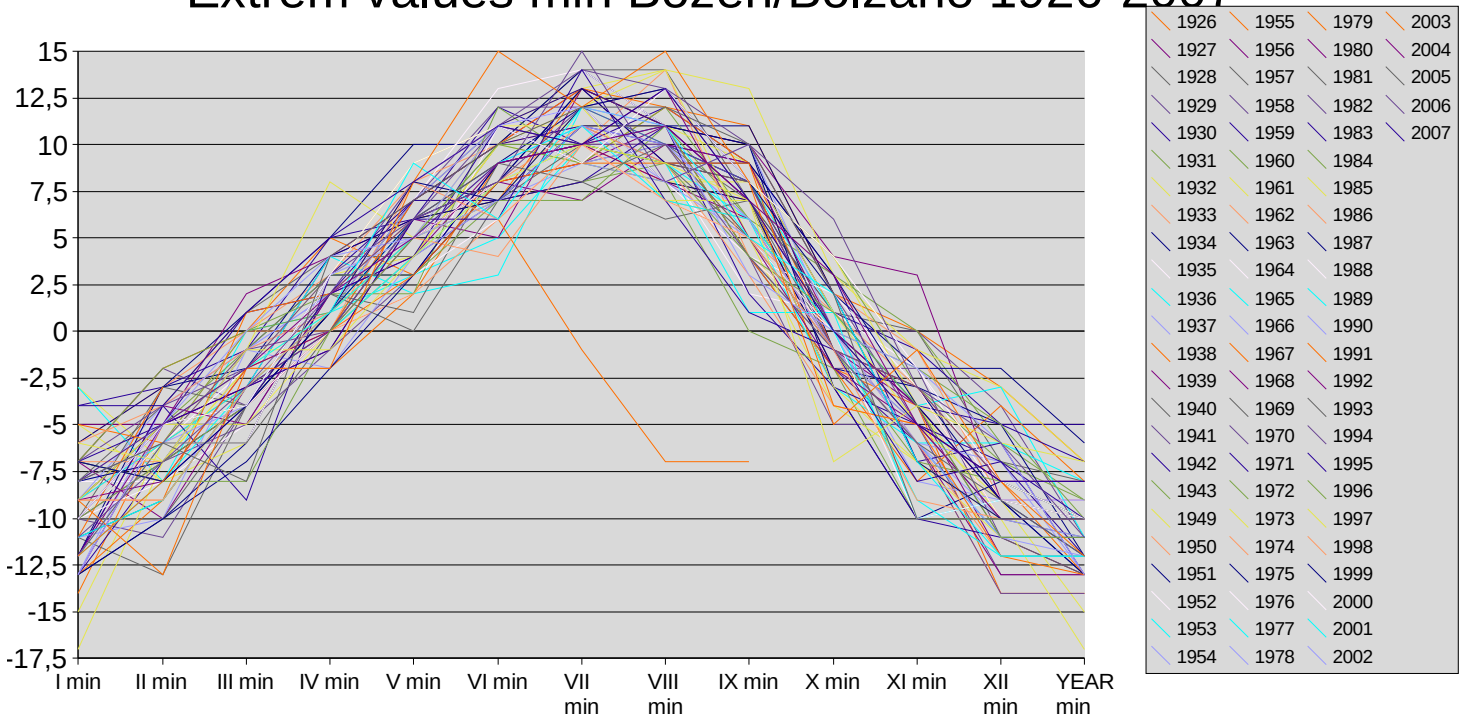
Bolzano	I		II		III		IV		V		VI		VII		VIII		IX		X		XI		XII		YEAR	
Bozen	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min
1971-1980	18	-12	19	-10	25	-9	25	-2	30	3	34	6	35	7	37	8	31	0	27	-4	20	-10	16	-11	37	-12
1981	12	-10	17	-10	24	-4	28	2	32	0	36	7	33	10	37	9	29	8	25	0	22	-5	14	-10	37	-10
1982	19	-7	17	-4	24	-2	25	3	32	6	35	11	40	14	34	13	32	10	27	2	20	-5	12	-8	40	-8
1983	13	-7	11	-8	21	-4	23	2	28	4	32	11	37	13	34	11	30	7	27	-3	17	-10	13	-11	37	-11
1984	10	-10	10	-7	17	-4	29	3	27	3	30	7	35	7	33	11	30	4	23	-1	17	-7	12	-8	35	-10
1985	11	-17	19	-7	18	-2	24	1	32	5	31	7	35	12	33	7	30	7	27	-3	18	-7	16	-10	35	-17
1986	14	-9	11	-9	21	-3	25	1	32	5	36	4	33	10	36	7	29	6	27	-1	19	-6	11	-12	36	-12
1987	14	-13	14	-10	20	-7	28	-2	27	3	32	8	32	13	34	9	31	9	22	3	18	-4	14	-9	34	-13
1988	12	-8	16	-6	20	-6	27	3	30	5	31	8	36	10	36	7	31	5	26	0	18	-10	16	-9	36	-10
1989	15	-11	18	-9	27	-3	22	1	30	5	30	9	35	11	35	7	31	6	24	0	20	-9	20	-12	35	-12
1990	14	-12	24	-6	28	-4	28	3	30	5	33	7	37	11	37	10	29	6	27	-1	17	-6	10	-11	37	-12
1981-1990	19	-17	24	-10	28	-7	29	-2	32	0	36	4	40	7	37	7	32	4	27	-3	22	-10	20	-12	40	-17
1991	11	-9	20	-13	23	-2	26	0	33	3	36	8	40	9	36	9	34	9	26	-4	17	-5	13	-12	40	-13
1992	16	-9	20	-8	24	-2	28	0	32	6	32	9	37	10	40	13	30	5	23	-2	22	-5	13	-10	40	-10
1993	13	-12	18	-6	29	-6	29	0	33	6	35	9	36	8	38	10	30	5	27	-1	20	-6	12	-9	38	-12
1994	13	-8	19	-6	27	-1	30	0	32	6	38	8	37	12	39	10	31	4	25	-1	20	-3	16	-8	39	-8
1995	12	-10	19	-5	24	-3	28	-1	33	6	34	6	38	14	36	7	27	1	27	-1	21	-8	12	-7	38	-10
1996	11	-7	17	-8	20	-8	27	0	31	5	38	10	35	10	33	9	28	4	25	1	20	-4	11	-11	38	-11
1997	13	-6	18	-7	25	-1	27	-1	32	4	33	8	33	10	35	9	34	7	30	-7	18	-4	14	-6	35	-7
1998	12	-9	24	-9	26	-3	26	1	33	8	35	6	37	10	37	7	30	5	22	-1	17	-9	16	-10	37	-10
1999	13	-7	18	-8	23	-4	26	1	32	8	35	7	36	12	35	13	31	8	25	2	20	-7	9	-10	36	-10
2000	18	-10	16	-5	23	-4	29	3	31	9	35	11	34	9	37	13	31	8	24	4	17	-2	12	-8	37	-10
1991-2000	18	-12	24	-13	29	-8	30	-1	33	3	38	6	40	8	40	7	34	1	30	-7	22	-9	16	-12	40	-13
2001	11	-8	19	-5	22	-2	25	1	35	9	35	6	37	12	36	11	27	5	26	2	20	-7	14	-12	37	-12
2002	14	-13	15	-5	27	0	25	4	30	5	36	11	34	12	33	11	29	3	24	0	18	-2	13	-6	36	-13
2003	14	-12	15	-8	23	-2	28	-2	32	8	37	15	36	12	40	15	29	8	24	-5	17	-1	12	-8	40	-12
2004	11	-8	16	-5	24	-2	26	2	31	5	35	9	35	10	35	11	32	7	25	3	21	-5	13	-8	35	-8
2005	11	-8	13	-6	27	-8	28	4	33	7	38	10	37	12	33	12	33	10	21	2	17	-10	9	-10	38	-10
2006	12	-11	12	-7	20	-3	24	2	31	6	34	8	37	15	30	8	32	10	26	6	20	-3	16	-6	37	-11
2007	19	-4	18	-4	23	1	29	5	32	8	33	11	37	10	32	13	28	7	25	0	17	-5	15	-8	37	-8
2008																										
2009																										
2010																										
2001-2010	19	-13	19	-8	27	-8	29	-2	35	5	38	6	37	10	40	8	33	3	26	-5	21	-10	16	-12	40	-13
P	19	-17	24	-13	29	-9	33	-2	35	0	38	3	40	7	40	6	34	0	30	-7	23	-10	20	-14	40	-17

Bozen/Bolzano IT: When is the right weather period?

Source: Hydrographisches Amt, Bozen http://www.provinz.bz.it/hydro/wetterdaten/index_d.htm

Choose the right period of weather station: To be a prophet or historian

Extrem values min Bozen/Bolzano 1926-2007

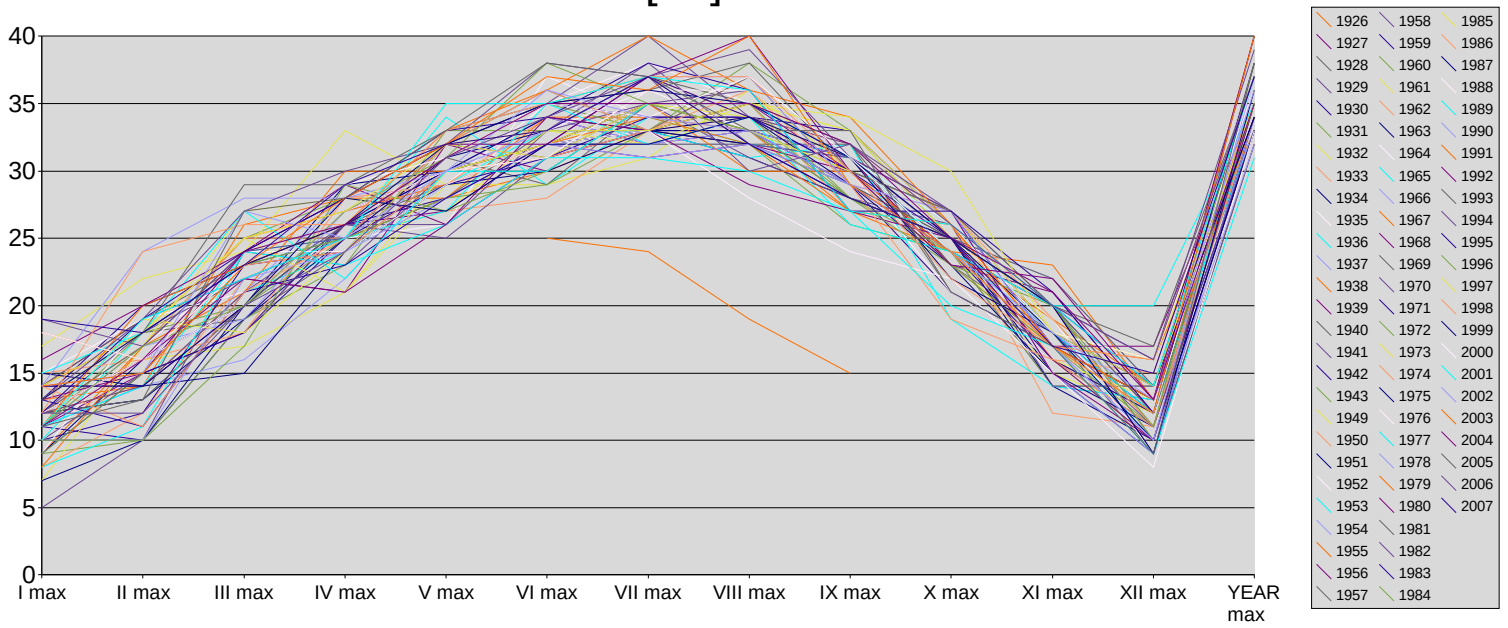


Bozen/Bolzano IT: when is the right weather period?

Source: Hydrographisches Amt, Bozen http://www.provinz.bz.it/hydro/wetterdaten/index_d.htm

Choose the right period of weather station: To be a prophet or historian

Extrem values max [°C] Bozen/Bolzano 1926-2007



Bozen/Bolzano IT: when is the right weather period?

Source: Hydrographisches Amt, Bozen http://www.provinz.bz.it/hydro/wetterdaten/index_d.htm

Choose the right period of weather station: To be a prophet or historian

Bolzano	I		II		III		IV		V		VI		VII		VIII		IX		X		XI		XII		YEAR	
Bozen	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min
1921-1930	14	-10	18	-11	24	-4	27	0	30	3	34	8	38	9	35	10	32	7	24	0	21	-1	16	-9	38	-11
1931-1940	13	-14	16	-13	26	-5	29	-2	33	2	37	5	34	9	36	8	32	2	26	-2	23	-6	14	-14	37	-14
1941-1950	17	-13	22	-8	25	-6	33	0	32	3	35	7	37	8	38	8	33	4	26	-5	19	-7	14	-13	38	-13
1951-1960	14	-12	20	-10	23	-5	30	-1	34	1	35	3	38	9	36	9	31	4	27	-2	22	-8	17	-12	38	-12
1961-1970	15	-15	19	-10	27	-6	29	-1	31	2	35	6	36	8	35	6	33	4	27	-3	20	-6	13	-14	36	-15
1971-1980	18	-12	19	-10	25	-9	25	-2	30	3	34	6	35	7	37	8	31	0	27	-4	20	-10	16	-11	37	-12
1981-1990	19	-17	24	-10	28	-7	29	-2	32	0	36	4	40	7	37	7	32	4	27	-3	22	-10	20	-12	40	-17
1991-2000	18	-12	24	-13	29	-8	30	-1	33	3	38	6	40	8	40	7	34	1	30	-7	22	-9	16	-12	40	-13
2001-2010	19	-13	19	-8	27	-8	29	-2	35	5	38	6	37	10	40	8	33	3	26	-5	21	-10	16	-12	40	-13
P	19	-17	24	-13	29	-9	33	-2	35	0	38	3	40	7	40	6	34	0	30	-7	23	-10	20	-14	40	-17

Bozen, in 2008 April 7:
it snowed like in deep winter
we can be only historian and not weather prophet

Idea for the PHPP:
insert a security factor for heating loads

Source: Hydrographisches Amt, Bozen http://www.provinz.bz.it/hydro/wetterdaten/index_d.htm

Relationship between global radiation and temperature: Choose the right position of weather station and the right period

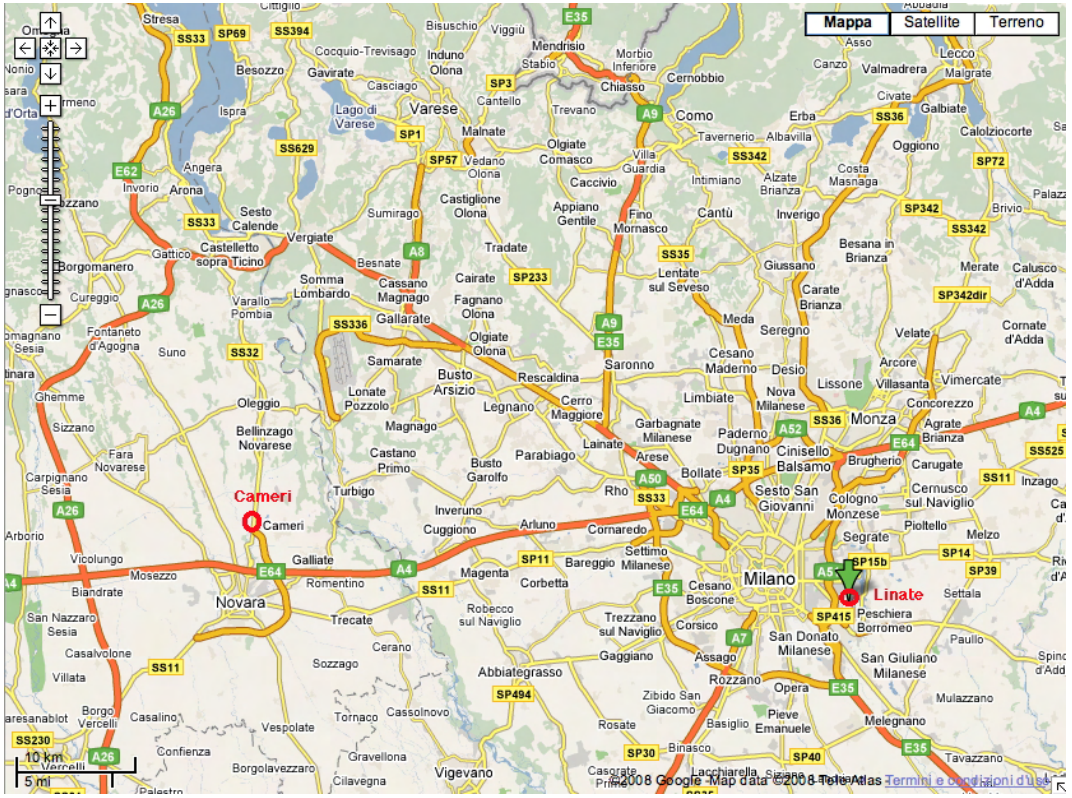
confronto	temperatura media annuale	Σ radiazione kWh/a	gg risc	gg raff.	rad.globale W/m2 invernale 1	rad.globale W/m2 invernale 2	rad.globale W/m2 estivo	Carico °C invernale 1	Carico °C invernale 2	Carico °Cestivo
1 Milano IT città anni1960 m	11,71	1.246	2.874,54	44,38	57	15	168	-2,80	5,20	26,10
2 Milano IT città anni2000 m	14,28	1.246	2.217,63	141,71	57	15	168	-0,90	7,10	28,90
3 Milano IT città anni2000 nx1	14,17	1.314	2.607,92	307,54	18	9	262	-0,90	7,10	28,90
4 Milano IT città anni2000 nx2	14,17	1.314	2.607,92	307,54	18	7	262	-0,90	7,10	28,90
5 Milano IT città anni2000 nx3	14,17	1.314	2.607,92	307,54	50	18	262	-2,50	-3,70	31,60
6 CAMERI (IT-AFB) anni 1960 Novara m2	11,58	1.239	2.885,38	47,42	47	25	309	-3,60	7,20	27,10
7 I - Milano (Cameri) PHI	11,71	1.252			45	10	340	-2,80	2,10	27,00

confronto	temperatura media annuale	Σ radiazione kWh/a
1 Milano IT città anni1960 m	11,71	1.246
2 Milano IT città anni2000 m	14,28	1.246
3 Milano IT città anni2000 nx1	14,17	1.314
4 Milano IT città anni2000 nx2	14,17	1.314
5 Milano IT città anni2000 nx3	14,17	1.314
6 CAMERI (IT-AFB) anni 1960 Novara m2	11,58	1.239
7 I - Milano (Cameri) PHI	11,71	1.252

Milano IT: where is the weather station?

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

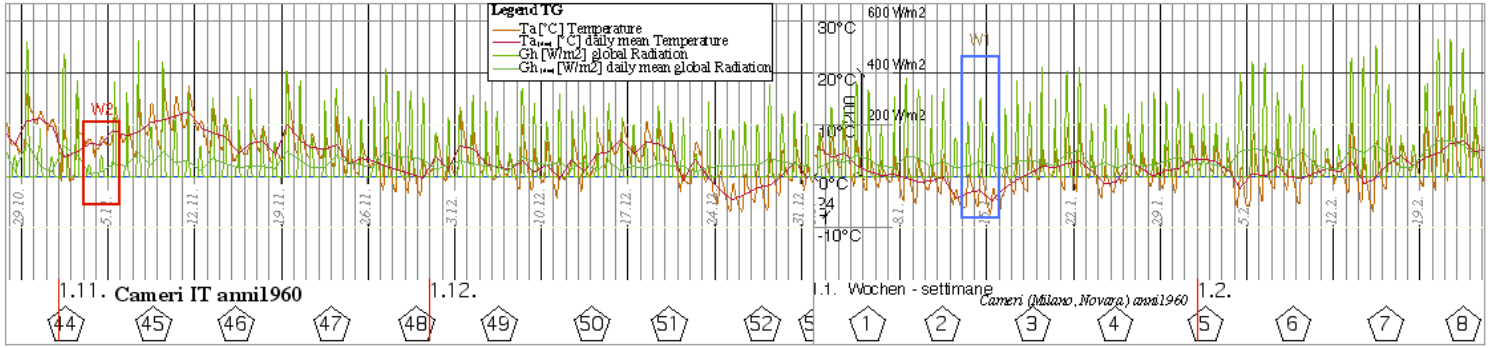


Milano IT: where is the weather station?

Source: Google-Map

Relationship between global radiation and temperature: Choose the right position of weather station

Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-3,6	7,2	27,1	Te
17	9	66	north
21	10	194	east
64	30	152	south
37	27	174	west
47	25	309	global
3d	3d	3d	
w1: 13/1	w2: 3/11	s: 21/7	

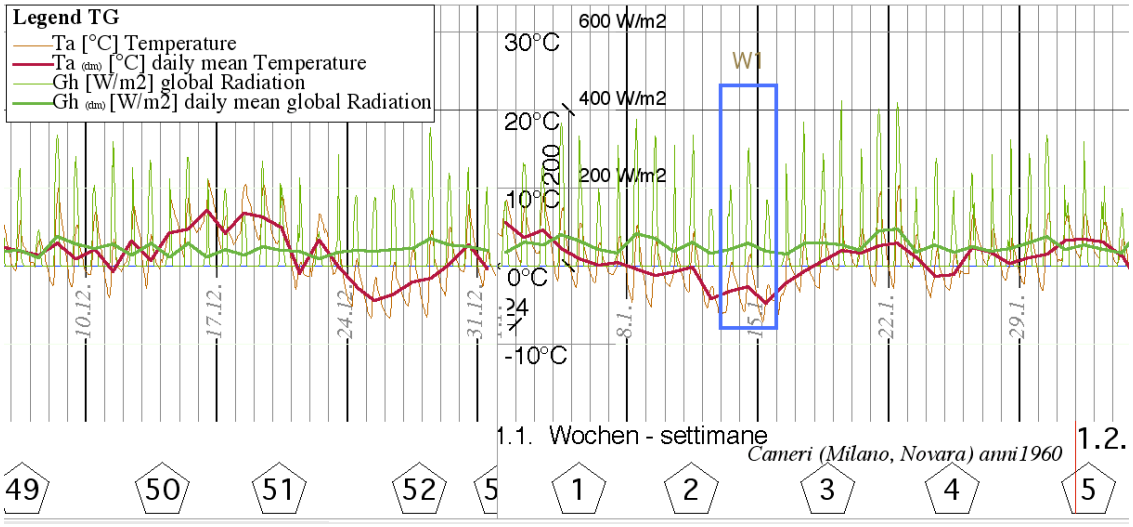


Milano Cameri 1960: winter

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-3,6	7,2	27,1	Te
17	9	66	north
21	10	194	east
64	30	152	south
37	27	174	west
47	25	309	global
3d	3d	3d	
w1: 13/1	w2: 3/11	s: 21/7	

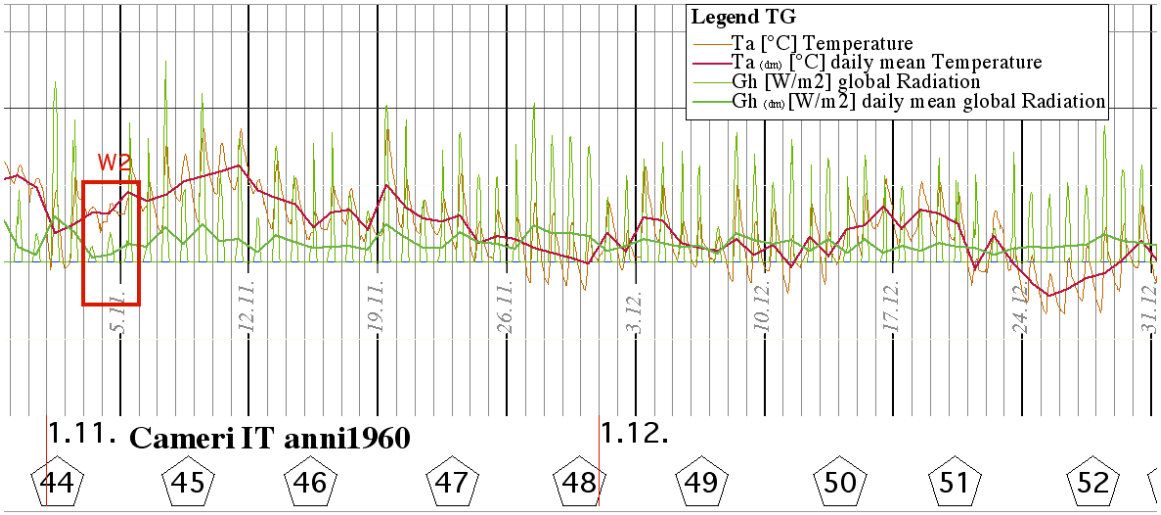


Milano Cameri 1960: w1

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-3,6	7,2	27,1	Te
17	9	66	north
21	10	194	east
64	30	152	south
37	27	174	west
47	25	309	global
3d	3d	3d	
w1: 13/1	w2: 3/11	s: 21/7	

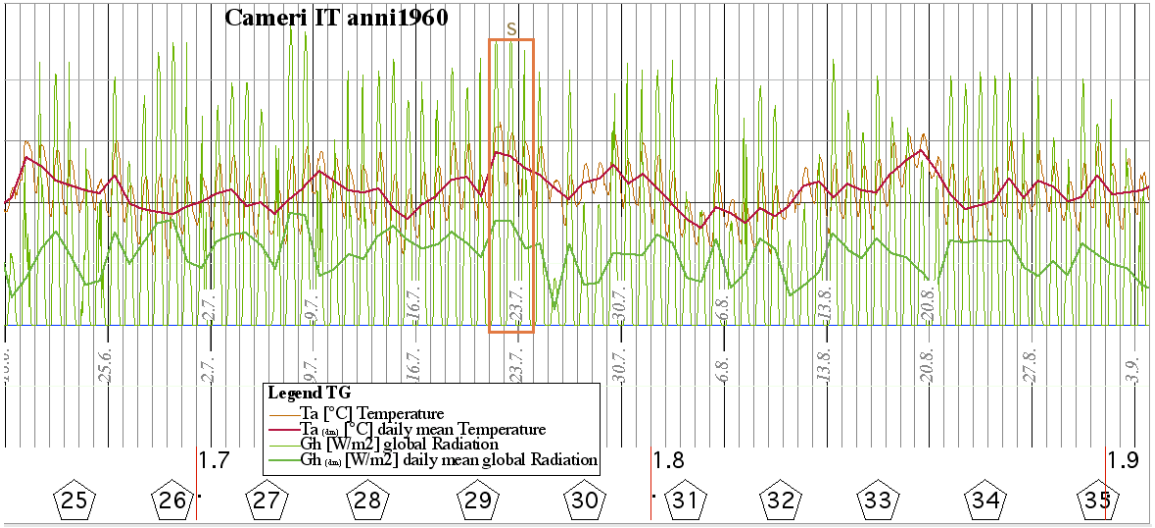


Milano Cameri 1960: w2

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-3,6	7,2	27,1	Te
17	9	66	north
21	10	194	east
64	30	152	south
37	27	174	west
47	25	309	global
3d	3d	3d	
w1: 13/1	w2: 3/11	s: 21/7	

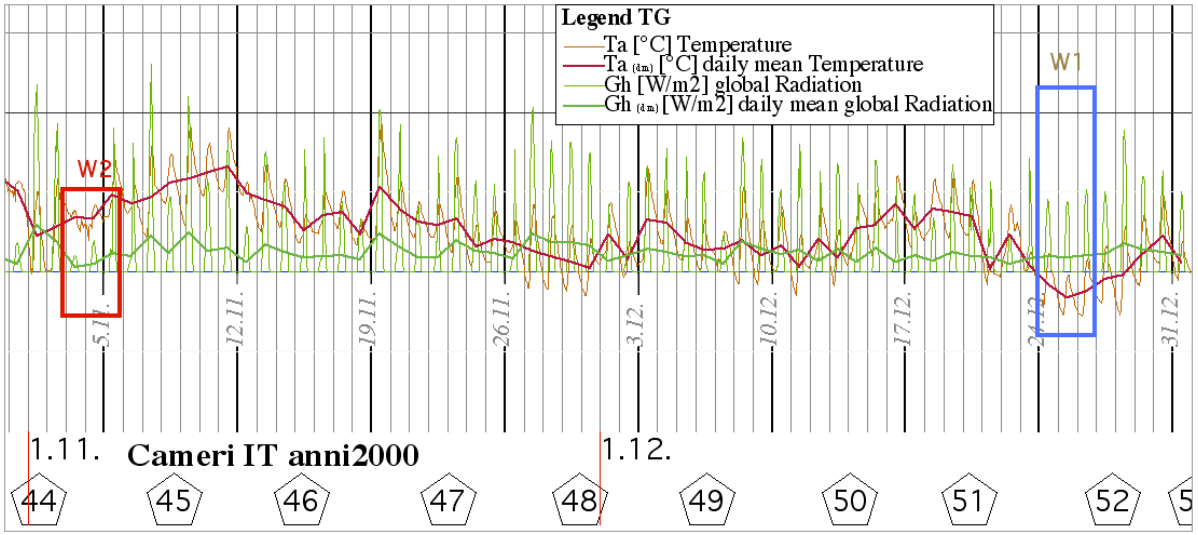


Milano Cameri 1960: summer

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

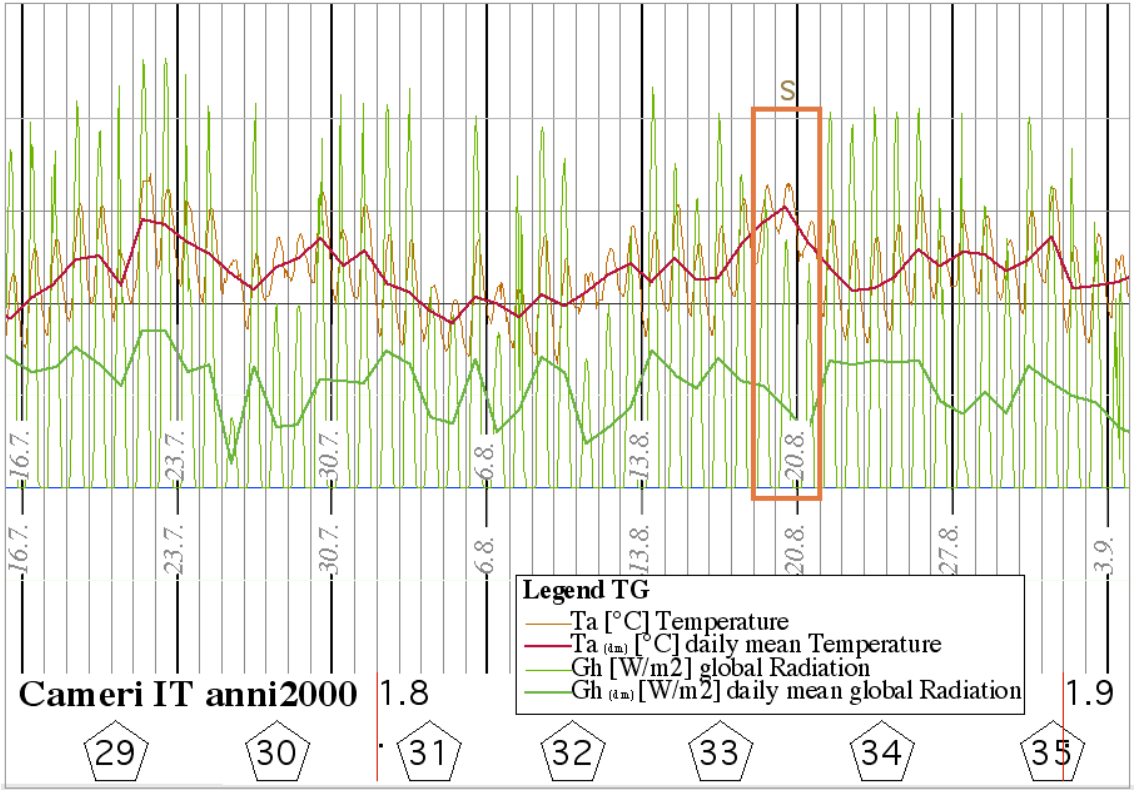
Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-2,3	7,8	28,6	Te
16	9	54	north
23	10	80	east
47	30	108	south
23	27	119	west
39	25	170	global
3d	3d	3d	
w1: 24/12	w2: 3/11	s: 18/8	



Milano Cameri 2000: winter

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

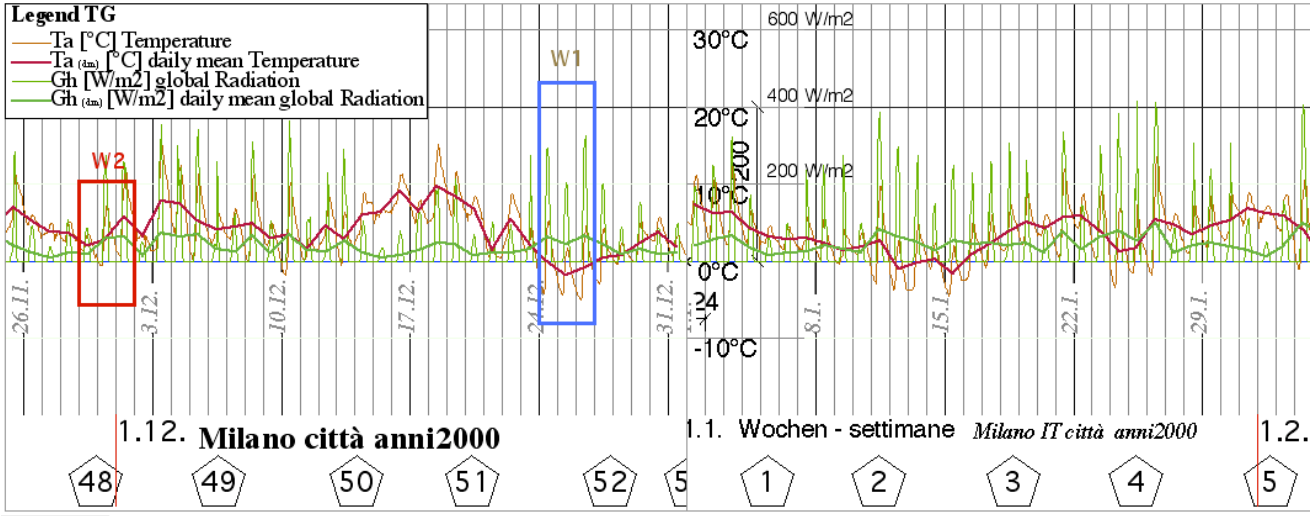


Milano Cameri 2000: summer

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

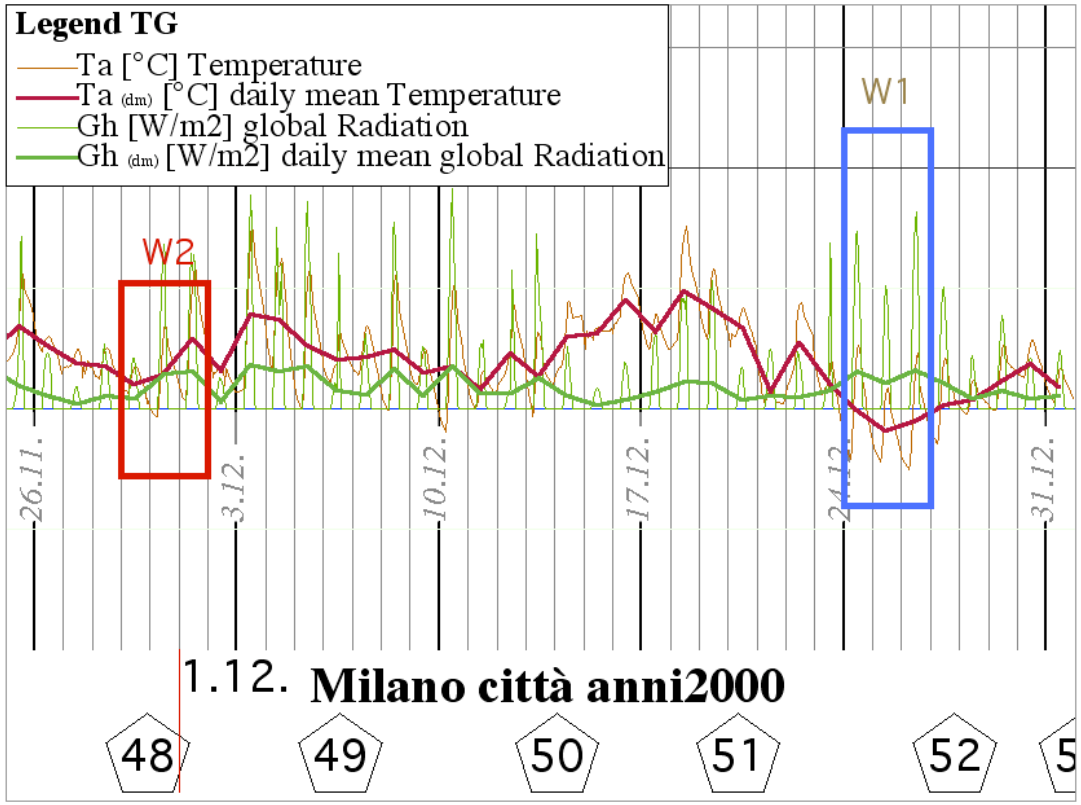
Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-0,9	7,1	28,9	Te
16	7	50	north
33	8	95	east
121	8	108	south
44	7	92	west
57	15	168	global
3d	3d	3d	
w1: 24/12	w2: 14/12	s: 18/8	



Milano city 2000 winter

Source:

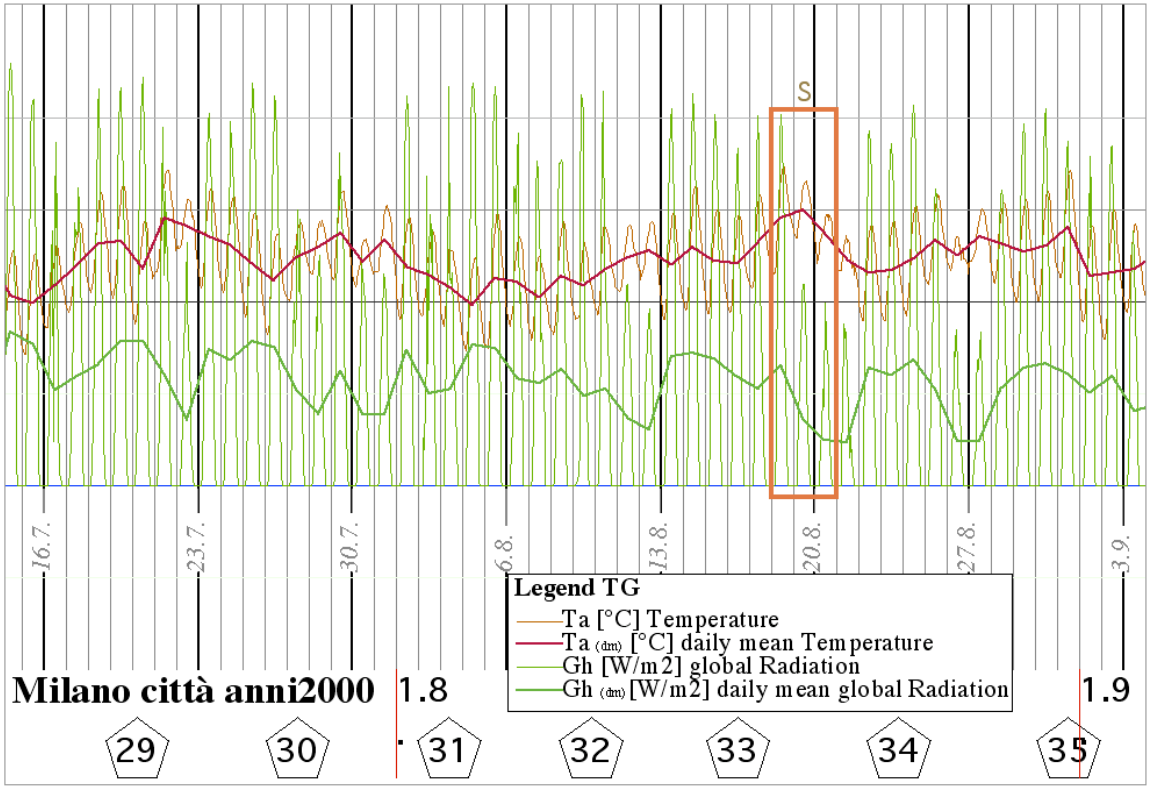
Relationship between global radiation and temperature: Choose the right position of weather station



Milano city 2000 winter 1,2

Source:

Relationship between global radiation and temperature: Choose the right position of weather station



Milano city 2000 summer

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

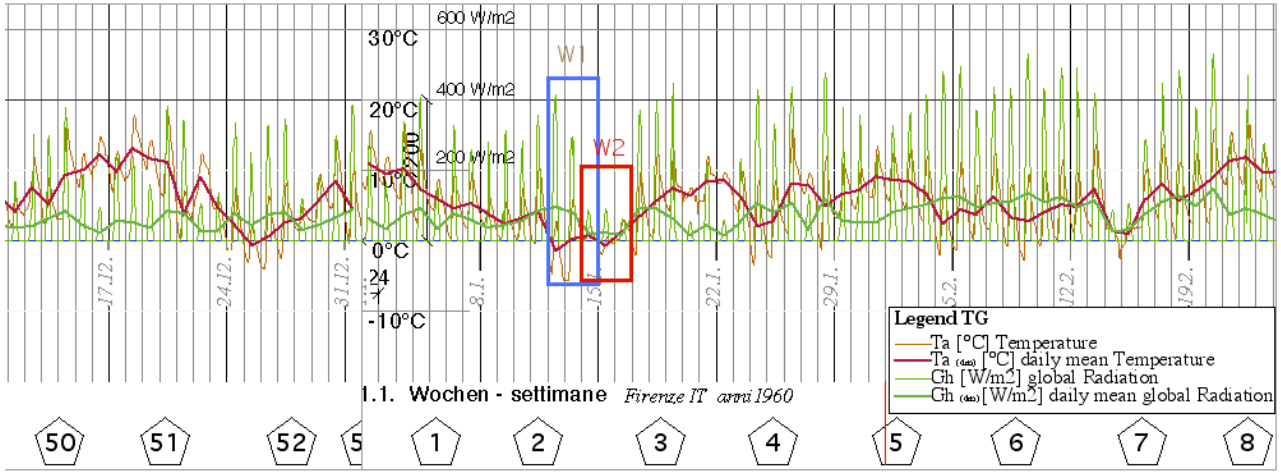
confronto	temperatura media annuale	Σ radia-zione kWh/a	gg risc	gg raff.	rad.globale W/m2 invernale 1	rad.globale W/m2 invernale 2	rad.globale W/m2 estivo	Carico °C invernale 1	Carico °C invernale 2	Carico °Cestivo
1 Firenze IT m anni60	14,53	1.381	1.947	121	64	18	274	-0,20	0,40	27,60
2 Firenze IT m1 anni2000	15,03	1.381	1.862	161	63	18	279	0,20	0,90	28,80
3 Firenze IT nx1	15,06	1.447	2.274	315	42	19	290	0,20	0,90	28,80
4 Firenze IT nx2	15,06	1.447	2.274	315	42	11	290	0,20	0,90	28,80
5 Firenze IT nx3	15,06	1.447	2.274	315	72	19	290	-0,80	-2,40	31,70

Firenze IT

Source: Google-Map

Relationship between global radiation and temperature: Choose the right position of weather station

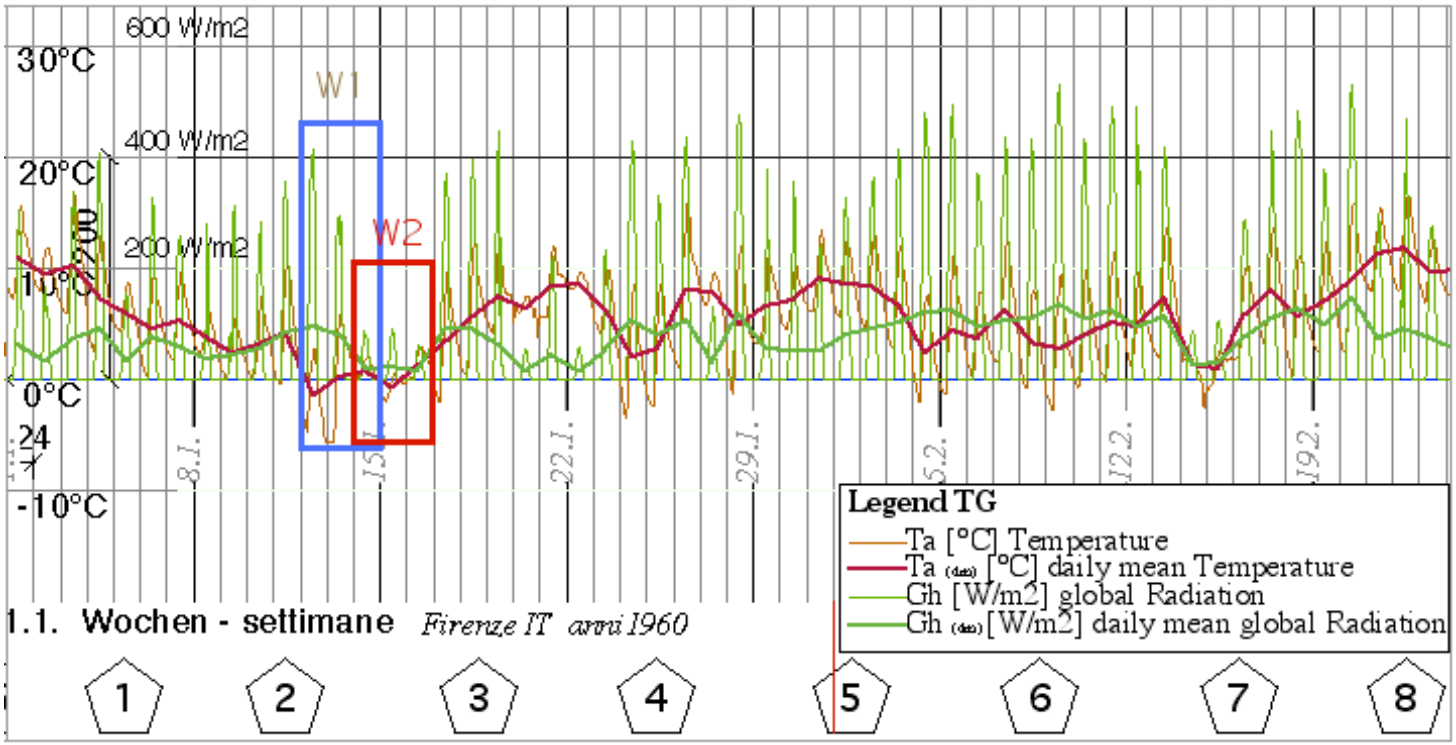
Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-0,2	0,4	27,6	Te
15	8	66	north
55	9	162	east
136	9	136	south
43	9	150	west
64	18	274	global
3d	3d	3d	
w1: 12/1	w2: 14/1	s: 21/7	



Firenze IT 1960: winter

Source:

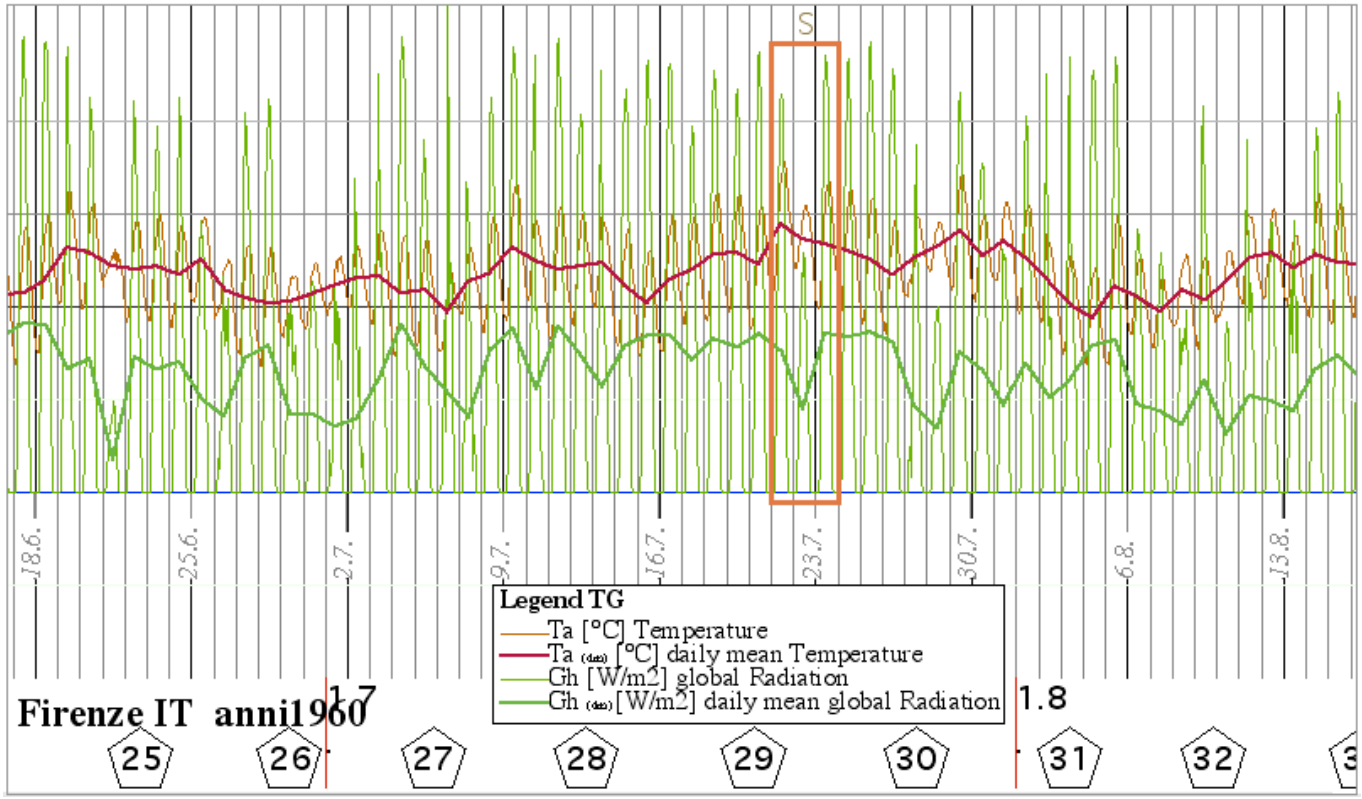
Relationship between global radiation and temperature: Choose the right position of weather station



Firenze IT 1960: winter 1,2

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

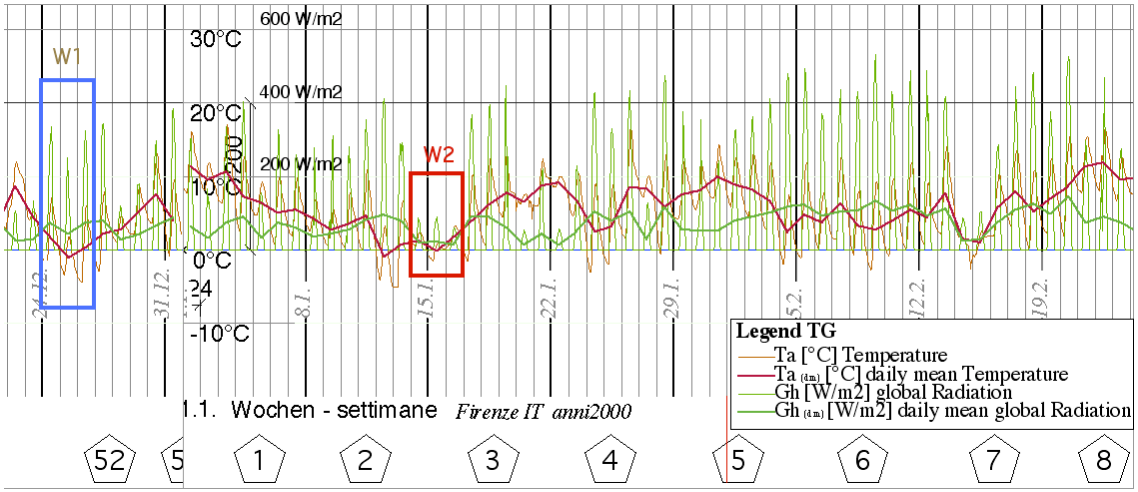


Firenze IT 1960: summer

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

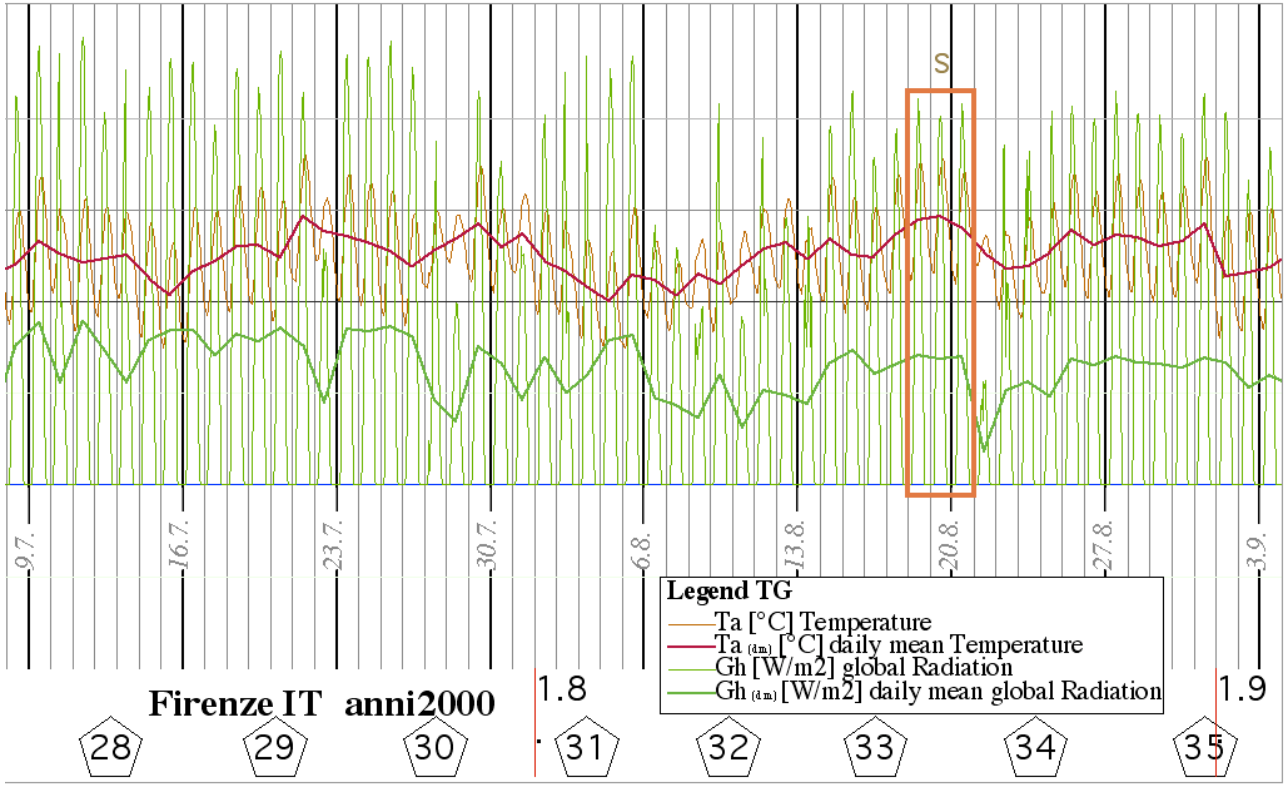
Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
0,2	0,9	28,8	Te
17	8	48	north
47	9	166	east
134	9	182	south
43	9	178	west
63	18	279	global
3d	3d	3d	
w1: 24/12	w2: 14/1	s: 18/8	



Firenze IT 2000: winter

Source:

Relationship between global radiation and temperature: Choose the right position of weather station



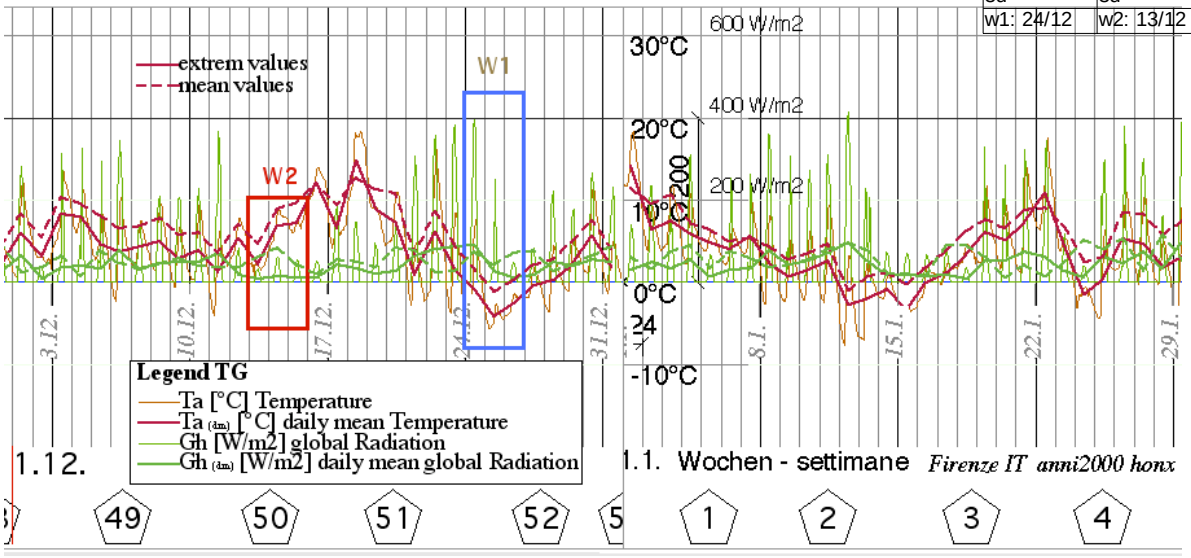
Firenze IT 2000: summer

Source:

Relationship between global radiation and temperature: Choose the right position of weather station

Idea for the PHPP:
insert a security factor for heating & cooling loads instead of using extrem weather files

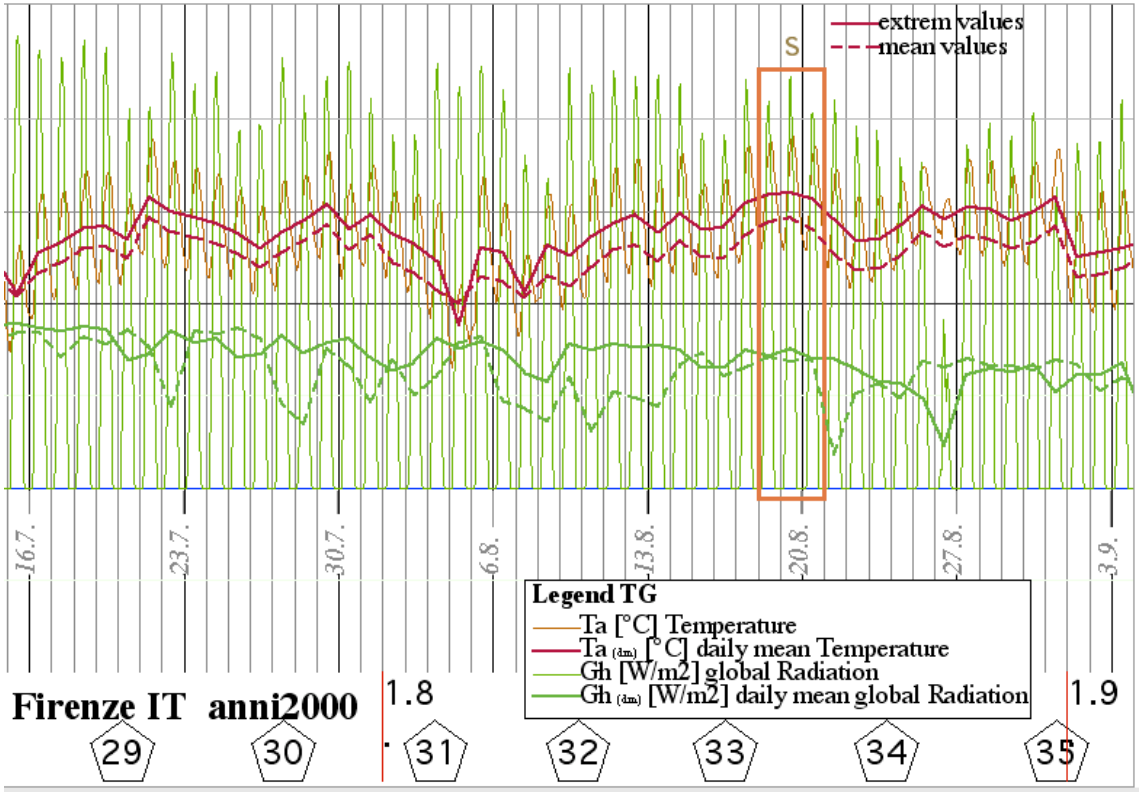
Carico invernale 1	Carico invernale 2	Carico estivo	
°C, W/m²	°C, W/m²	°C, W/m²	
-2,6	5,3	31,7	Te
10	5	45	north
30	5	170	east
96	5	186	south
33	5	185	west
42	11	290	global
3d	3d	3d	
w1: 24/12	w2: 13/12	s: 18/8	



Firenze IT 2000 honx: extrem winter

Source:

Relationship between global radiation and temperature: Choose the right position of weather station



Firenze IT 2000 honx: extrem summer

Source:

If we don't have measured weather for the exact place, we will have errors in the result anyways.
Choosing the right position of weather station and the right weather period is more important than doubting about the right valuation method.

Meteonorm is a valid valuation instrument if connected with intelligence.

Source: