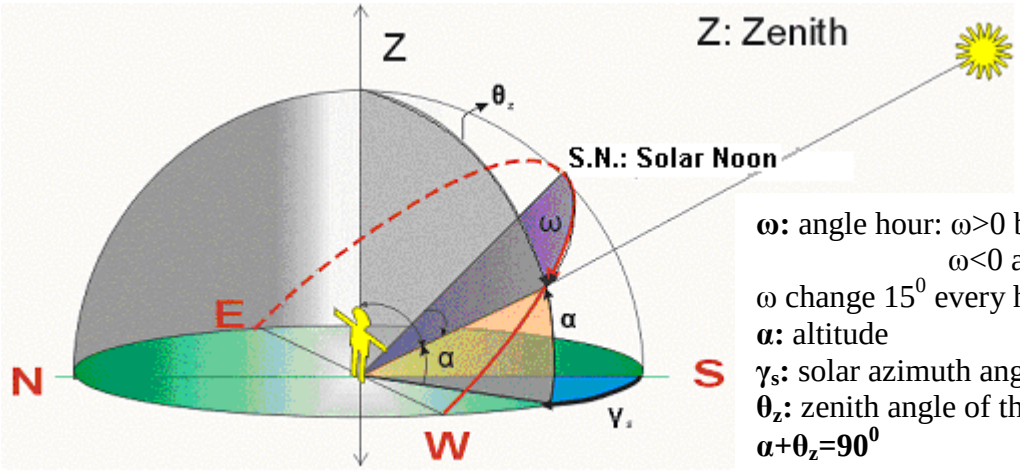
Appendix I

1. Schematic configuration of the sun trajectory for a day. The important angles: **ω, α, γ_s, θ_z** to determine sun's position in the sky are shown.
Angles **γ_s** and **α** are enough to determine sun's position**.**



ω: angle hour: ω>0 before solar noon
ω<0 after solar noon
ω change 15^0 every hour
α: altitude
γ_s: solar azimuth angle
θ_z: zenith angle of the sun:
$\alpha+\theta_z=90^0$

Figure I.1: *The figure shows a daily orbit trajectory of the sun. The position S.N. is for the **S**olar **N**oon. We determine as the solar true time 12.00hours. Then, the hour angle, **ω**, is 0^0.*

2. Declination angle, δ, Solar Time, (S.T.), and Watch Time, (W.T.)

Declination angle, **δ**, is the angular position of the sun at solar noon with the respect to the plane of the equator. **δ** is positive from spring equinox (21.03) to autumn equinox (22.09). Generally, holds:
$-23.45^0 \leq \delta \leq +23.45^0$

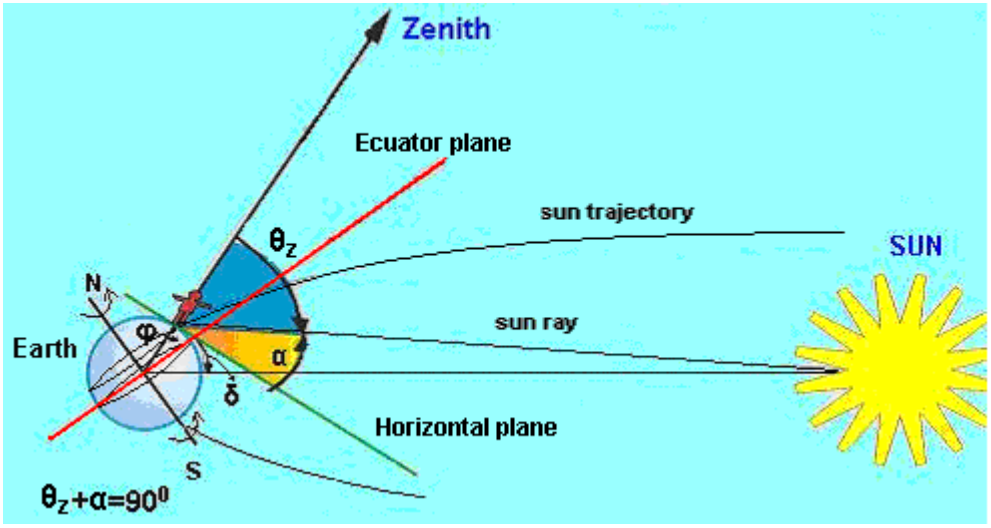


Figure I.2: *Schematically presentation of the sun, the earth, the site and its horizontal surface for the better understanding of the angles: **δ** (declination), **θ_z** (azimuth angle), **α** (altitude of the sun).*

Note:

*1.The observer watches the sun aver the horizontal surface by the an angle which equals to **α***

2. The figure shows the winter period for the north Hemisphere

*3. **δ**, the declination has a negative value, in figure I.2.*

Solar Time, **S.T.,** is the time based on the apparent angular motion of the sun across the sky, with **Solar Noon** (**S.N.**), the time the sun crosses the meridian of the observer.
Solar time is the time, which is measured according to the sun position, and the starting point is taken at solar noon. Then S.T.=12.00h
According to this, the hour angle,**ω**(negative in the morning, positive in the afternoon), which is the angular displacement of the sun east or west of the local meridian due to rotation of the earth on its axis at 15^0 per hour, measured from the S.N. It increases every hour with 15^0. For one full rotation (every/day): **ω**=(15^0/h)×24h=360^0, which is obvious.

Finally,
when **ω=0** the Solar Time is 12.00 h.

- **δ,** changes from **-23.45^0** in winter solstice (22nd of December) up to **$+23.45^0$** in summer solstice (22nd of June).

δ=0, in equinox (21st of March and 23rd of September).

$$\delta = 23.45^{o} \times \sin\left(360 \times \frac{284+n}{365}\right) \qquad \text{(I.1)}$$

Where **n,** is the day of the year counted from the 1st of January .

For example lets take 1st of April:
n=31+28+31+1=91 .

Table I.1: *Some typical dates and declination,* ***δ,*** *values*

Declination (δ)	*Dates*
+23.27°	22 June
+20°	21 March, 24 June
+15°	1 May, 12 August
+10°	16 April, 28 August
+5°	3 April, 10 September
0°	21 March, 23 September
-5°	8 march, 6 October
-10°	23 February, 20 October
-15°	9 February, 3 November
-20°	21 January, 22 November

It holds:

S.T. = W.T. –(4min/degree)×(L_{st} - L_{loc}) + E (I.2)

S.T.: Solar Time;
W.T.: Watch Time, which is conditioned by the Greenwich meridian; and the summer or winter conditioned time
L_{st}: is the standard meridian for the local time zone;
L_{loc}: is the longitude of the location in question in degrees;
E: is the equation of time:
Let us make a convention to measure **L** towards East, as positive.

E=9.87sin2B-7.53cosB-1.5sinB, (I.3)

where:
B=[360×(n-81)] / 364; **n** = the day of the year, 1≤ **n** ≤ 365 (I.4)
Note:*In solar studies the time used is the Solar Time, unless differently specified.*

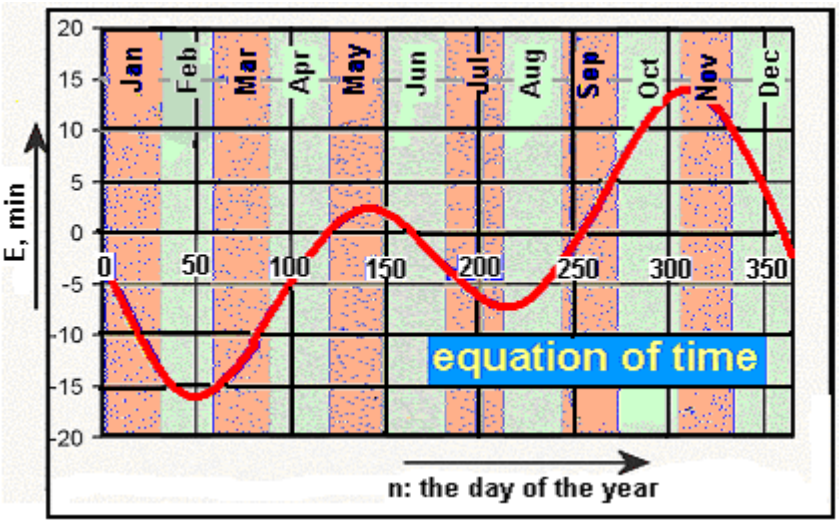


Figure I.3: *The equation of time, **E**, in minutes, as a function of time of year*

3. Important relationships between angles

Let's have a PV-panel with and angle, **β,** to the horizontal and its azimuth angle**, γ,** see figure below placed in a region with latitude**, φ.**

Task: Determine the angle of incidence, **θ,** of the sun direct beam on the PV-panel for the 10th of June, at solar noon (solar time, **S.T**., is **12.00** and that hour angle **ω** is **0^0**).

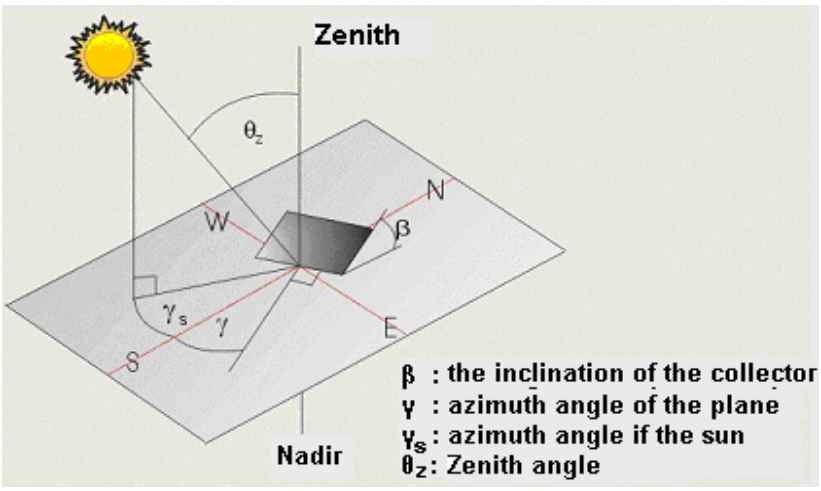


Figure I.4: *Figures shows the configuration of important angles*
Note**: see the difference between **γ** and **γ_s

- The general equation which relates the angle of incidence, **θ,** to the plane and the other angles, is the following:

$$\cos\theta = \sin\delta \times \sin\varphi \times \cos\beta - \sin\delta \times \cos\varphi \times \sin\beta \times \cos\gamma + \cos\delta \times \cos\varphi \times \cos\beta \times \cos\omega + \cos\delta \times \sin\varphi \times \sin\beta \times \cos\gamma \times \cos\omega + \cos\delta \times \sin\beta \times \sin\gamma \times \sin\omega \quad \text{(I.5)}$$

- When **β=0,** then **$\theta=\theta_z$** and **for γ=0.** Then the above equation become:

$$\cos\theta_z = \cos\delta \times \cos\varphi \times \cos\omega + \sin\varphi \times \sin\delta \quad \text{(I.6)}$$

- The solar azimuth angle, γ_s, is given by the relationship below**:**

$$\gamma_s = \frac{\cos\delta \times \sin\omega}{\sin\theta_z} \quad \text{(I.7)}$$

- When a surface is facing the south, **γ=0**, then the relationship (I.5) becomes:

$$\cos\theta = \cos(\varphi-\beta) \times \cos\delta \times \cos\omega + \sin(\varphi-\beta) \times \sin\delta \quad \text{(I.8)}$$

- To determine the angle **β** for normal incidence of the direct sun beam to a tilted PV-panel, i.e. **θ=0**, during the solar noon, **ω=0**, equation (I.8) becomes:

$$\cos\theta = \cos(\varphi-\beta) \times \cos\delta \times \cos\omega + \sin(\varphi-\beta) \times \sin\delta$$

$$\Rightarrow \cos\theta = \cos(\varphi-\beta) \times \cos\delta \times 1 + \sin(\varphi-\beta) \times \sin\delta$$

$$\cos\theta = \cos[(\varphi-\beta)-\delta]$$

$$\Rightarrow \boxed{\theta = (\varphi-\beta)-\delta} \quad \text{(I.9)}$$

Set **θ=0**, and solve for **β**: $\boxed{\beta = \varphi-\delta}$

- To find the solar angle of the sunset or sunrise, we put $\theta_z = 90^0$ or $\alpha = 0^0$ in equation (I.6) which now becomes:

$$\cos\omega = -\tan\varphi \times \tan\delta \quad \Rightarrow \quad \omega_s = \cos^{-1}(-\tan\varphi \times \tan\delta) \quad \text{(I.10)}$$

ω_s: is the sunset hour angle, in degrees, at horizontal.
The sunset hour angle, **ω_s'**, for an inclined surface, is given by the relationship below:

$$\omega_s' = \min[\omega_s, \cos^{-1}(-\tan(\varphi-\beta) \times \tan\delta)] \quad \text{(I.11)}$$

ω_s' is the smaller value chosen between the **ω_s** and **$\cos^{-1}(-\tan(\varphi-\delta)\tan\delta)$.**

Appendix II

Important formulae of the **(i,V)** characteristic of PV-cells & PV-panels

$$i = i_{ph} - I_r\left\{\exp\left[\left(V + iR_S \Big/ AV_T\right)\right] - 1\right\}$$

$$i_{ph} = i_{ph,c} \cdot N_p$$

$$I_r = I_{r,c} \cdot N_p$$

$$R_S = r_S \cdot N_S / N_p \quad .$$

$$V_T = N_S \cdot kT/q$$

$$A : ideality..factor$$

$$i_{ph} = i_m + I_r\left\{e^{2 i_m \cdot R_S \Big/ AV_T + \frac{i_m}{i_{ph} - i_m + I_r}} - 1\right\} \quad .$$

- Solve via Newton - Raphson for i_m

  - V_m=?

$$V_m = A \cdot V_T \cdot \ln\left[\left(i_{ph} - i_m + I_r / I_r\right)\right] - i_m \cdot R_S \quad ,$$

Then,

$$P = i \cdot A \cdot V_T \cdot \ln\left[\left(i_{ph} - i + I_r / I_r\right)\right] - i^2 \cdot R_S \quad .$$

1. **(i ~ v)** from PV-generator is given by:

$$i = i_{ph} - I_S \cdot \left[e^{\frac{V + i \cdot R_S}{m \cdot V_T}} - 1\right] - \frac{V + i \cdot R_S}{R_{sh}} \qquad \textbf{(1),}$$

Important parameters to be known for PV-generator are i_{ph}, I_S, R_S, R_{sh}, **m** and they may be determined from V_{0C}, i_{sh}, V_m, i_m, $R_{S,0}$, R_{sh}.

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2. Another way of expressing PV-generator

$$i = i_{ph,STC} \cdot I_T\left(kW/m^2\right) - I_0\left[e^{\frac{V + i \cdot R_S}{V_T}} - 1\right] - \frac{V + i \cdot R_S}{R_{sh}} \qquad \textbf{(2),}$$

V_T : Thermal Voltage of the PV-array

Here i_{ph} **&** I_t **,** $i_{ph,STC}$ multiplied by I_t provides i_{ph} for I_t insolation.

Solar Energy vol.53 no.4 Oct. 1994 pp. 369-377

3.

$$i = i_L - I_0\left[e^{\frac{V + i \cdot R_S}{V_T}} - 1\right] - \frac{V}{R_{sh}} \qquad \textbf{(3),}$$

i_L = illumination

$$V_T = kT/q$$

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4.

$$\mathbf{i} = \mathbf{i_L} - \left[\frac{\mathbf{i_L} - \frac{\mathbf{V_{0C}}}{\mathbf{R_p}}}{\mathbf{exp}(\mathbf{ektV_{0C}}) - \mathbf{1}} \right] \cdot \left[\mathbf{e}^{\mathbf{ekt}(\mathbf{V}+\mathbf{i}\cdot\mathbf{R_S})} - \mathbf{1} \right] - \frac{\mathbf{V}+\mathbf{i}\cdot\mathbf{R_S}}{\mathbf{R_p}} \qquad \textbf{(4),}$$

$$\mathbf{ekt} = \frac{\mathbf{q}}{\mathbf{m}\cdot\mathbf{k}\cdot\mathbf{T}} \quad , \quad \mathbf{R_p} \equiv \mathbf{R_{sh}}$$

Solar Energy vol.54 no.3 March 1995 pp. 165-171

5. PV-cells

$$\mathbf{i} = \mathbf{i_{ph}} - \mathbf{I_{0,1}} \cdot \left[\mathbf{e}^{\frac{\mathbf{V}+\mathbf{iR_S}}{\mathbf{n_1}\cdot\mathbf{V_T}}} - \mathbf{1} \right] - \mathbf{I_{0,2}} \cdot \left[\mathbf{e}^{\frac{\mathbf{V}+\mathbf{iR_S}}{\mathbf{n_2}\cdot\mathbf{V_T}}} - \mathbf{1} \right] - \frac{\mathbf{V}}{\mathbf{R_{sh}}} \quad , \qquad \textbf{(5),}$$

PV-array: let $\mathbf{iR_S << 1}$, then **(5)** gives:

$$\mathbf{i} = \mathbf{i_{ph}} - \mathbf{I_{0,1}} \cdot \left[\mathbf{e}^{\frac{\mathbf{V}}{\mathbf{N_S}\cdot\mathbf{n_1}\cdot\mathbf{V_T}}} - \mathbf{1} \right] - \mathbf{I_{0,2}} \cdot \left[\mathbf{e}^{\frac{\mathbf{V}}{\mathbf{N_2}\cdot\mathbf{n_2}\cdot\mathbf{V_T}}} - \mathbf{1} \right] - \frac{\mathbf{V}}{\mathbf{R_{sh}}} \quad , \qquad \textbf{(6),}$$

Equation **(6)** is for an PV-array with $\mathbf{N_S}$: no. of cells in series

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6.

PV-array: let **i** be array's current

$$\mathbf{i} = \mathbf{M}\cdot\mathbf{i_{ph}} - \mathbf{M}\cdot\mathbf{I_0}\left[\mathbf{e}^{\mathbf{q}\frac{\mathbf{N}\cdot\mathbf{V}+\mathbf{i_{ph}}\cdot\mathbf{R_S}\cdot\mathbf{N}/\mathbf{M}}{\mathbf{N}\cdot\mathbf{A}\cdot\mathbf{k}\cdot\mathbf{T_p}}} - \mathbf{1} \right] - \frac{\mathbf{N}\cdot\mathbf{V}+\mathbf{i_p}\cdot\mathbf{R_S}\cdot\mathbf{N}/\mathbf{M}}{\mathbf{N}\cdot\mathbf{R_{sh}}/\mathbf{M}}, \qquad \textbf{(7),}$$

M: module's strings in parallel
N: no. of cells in series
i-v of an PV-generator

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7. PV-array

$\mathbf{N_S}$ PV-panels series
$\mathbf{N_P}$ PV-panels parallel
$\mathbf{R_{sh}} \longrightarrow$ neglect

$$\mathbf{V} = \mathbf{A}\cdot\mathbf{V_T}\cdot\mathbf{ln}\left[\left(\mathbf{i_{ph}} - \mathbf{i} + \mathbf{i_r}\right)/\mathbf{i_r}\right] - \mathbf{i}\cdot\mathbf{R_S}$$

$$\mathbf{i_{ph}} = \mathbf{i_{ph,1}}\cdot\mathbf{N_P} \qquad , \qquad \textbf{(8),}$$

$$e^{\frac{V+i\cdot R_S}{A\cdot V_T}} = \frac{i_{ph}-i}{i_r}+1$$

$$I_r = I_S \cdot N_P \qquad \frac{i_{ph}-i}{i_r} = \left[e^{\frac{V+i\cdot R_S}{A\cdot V_T}} - 1 \right] ,$$

$$R_S = R_C \cdot N_S / N_P \quad , \qquad i = i_{ph} - i_r \cdot \left[e^{\frac{V+i\cdot R_S}{A\cdot V_T}} - 1 \right]$$

$$A \cdot V_T = N_S \cdot \frac{A \cdot k \cdot T}{q}$$

neglect : $V + i \cdot R_S / R_{sh}$

$$i = i_{ph,1} \cdot N_P - I_0 \cdot N_P \cdot \left[e^{\frac{V+i\cdot R_S}{A\cdot V_T}} - 1 \right] ,$$

$$R_S = R_C \cdot N$$

Solar Energy vol.53 no.5 1994 pp. 403-409

8.

$$V = -\frac{R_S \cdot N_S \cdot i}{N_P} + \frac{N_S \cdot A \cdot k \cdot T}{e} \cdot \ln \frac{N_P \cdot i_{ph} + N_P \cdot I_0 - i}{N_P \cdot I_0} \quad , \qquad \textbf{(9).}$$

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Appendix III

Table III.1: *Electrical characteristics of Siemens PV-panels*									
PV-type	SR100		SR90		SR50		SP75	SP70	
PV-cells in series	36	18	36	18	36	18	36	18	36
Peak power, Watts (W_p)	100	100	90	90	50	50	75	75	70
Mean power, Watts	90	90	80	80	45	45	70	70	65
V_{OC}	22.0	11 0	21.6	10.8	21.6	10.8	21.7	10.85	21.4
i_{sc}	6.3	12.6	61	12.2	3.2	6.4	4.8	9.6	4.7
V under load	17.7	8.85	17.0	8.5	17.0	8.5	17.0	8.5	16.5
i under load	5.6	11 2	5.4	10.8	2.95	5.9	4.4	8.8	4.25
Semiconductor type	$Mono^+$	$Mono^+$	$Mono^+$	$Mono^+$	$Mono^+$	$Mono^+$	$Mono^+$	$Mono^+$	$Mono^+$
Max V_{OC} of the whole PV-system	600	600	600	600	600	600	600	600	600
Diode	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Table III.2: *Types of Batteries*

Manufacturer and Type	**Model**	**Nominal Capacity (Ah)**	**Nominal Voltage (V)**	**DOD (%)**	**Life Cycles**	**Total to be delivered Energy (kWh)**
GNB Absolyte	638	42	6	50	1000	126
	1260	59	12	50	1000	359
	6 – 35A09	202	12	50	3000	3636
	3 – 75A25	1300	6	50	3000	1700
Exide Tubular Modular	6E120 – 5	192	12	15 20	4100 3900	1417 1797
	6E120 – 9	538	12	15 20	4100 3900	3970 5036
	3E120 – 21	1346	6	15 20	4100 3900	4967 6299
Delco – Remy Photovoltaic	2000	105	12	10 15 20	1800 1250 850	227 236 214
Global Solar Reserve gel Cell	3SSSSRC –125G	125	6	10	2000	150
	SRC – 250C	250	2	10	2000	100
	SRC – 375G	375	2	10	2000	150
Globe	GC12 – 800-38	80 80	12 12	20 80	1500 250	288 240
GNB Absolyte	638	40	6	80	500	96
	1260	56	12	80	500	269
	6 – 35A09	185	12	80	1500	2664
	3 – 75A25	1190	6	80	1500	8568

Table III.3: *Basic/Fundamental Loads-Demand for a typical house*					
LOAD	**Installed Power** (W) (1)	**Mean Daily operation time** (h) (2)	**Mean Daily consumption** Wh/day (3)=(2)×(1)	**Mean Montly consumption** kWh/month (4)=(3)×no of days	**Mean annual consumption** Wh/year (5)=(4)×12
Lighting Lamps 16 points×15W	240	2	480	14.4	170
TV color 24” TV B/W 17” Video	~100 ~40 ~30	1 5 1	100 200 30	3 6 1	36 72 12
Kitchen fan	~70	0.4	30	1	12
Fan	~50	1.4	70	2	24
Hot water pump	~70	2	140	4	48
PC	~180	0.55	100	3	36
Refrigeration with freezer	~150	9.3	1400	42	500
Washing machine	500	0.5	250	7.5	90
Vacuum cleaner	800	0.1	80	7.5	282
Electric kitchen	3700	0.4	1480	50	540
Iron	1100	0.3	1100×0.3×50%= 165	165×30.5=5	60
Oven	2600	0.5	2600×0.5h×25% =325	9.8	117.6
Air conditioning per room	860	10	10d/month (in summer)	86	1032
Total	**10490W**			**199.7kWh**	**2770.6 kWh**

Table III.4: *Characteristics of commercial PV-panels: mono or poly Si*					
No	Peak Power PV-panel with 30 up to 44 PV-cells in series (W) (1)	Mean Daily Charge Delivered Q (Ah) (2)	Mean Voltage (V_m) at MPP Volts (3)	Mean daily Delivered Energy (Wh) (4)=(3)×(2)	Mean annually delivered energy by the PV-panel (kWh) (5)=(4) ×365
1	~22	5.9	~15	88	32
2	~35	9.3	~15	140	51
3	~38	10.0	~16	160	58
4	~42	11.5	~15	170	62
5	~45	12.0	~15	180	65
6	~51	12.0	~17	200	73
7	~53	12.0	~17.5	210	75
8	~63	12.0	~20	240	87

Table III.5: *Best large-area thin film modules (standard conditions, aperture area) (Solar-photovoltaic: a 2001 device overview by Lawrence L. Kazmerski)*

Company	Device	Size (cm^2)	Efficiency (%)	Power (W)	Date
BP Solarex	CdS/CdTe	8670	10.6	91.5	5/'00
United Solar	a-Si/ a-SiGe/ a-SiGe/SS	9276	7.6 (stabilized)	70.8	9/'97
First Solar	CdTe/ CdS	6728	9.1	61.3	6/'96
Matsushita	CdS/CdTe	5413	11.0	59.0	6/'00
BP Solarex	a-Si/ a-SiGe	7417	7.6 (stabilised)	56.0	9/'96
BP Solarex	CdS/CdTe	4874	10.8	53.9	4/'00
Siemens Solar	CdS/CIS-alloy	3651	12.1	44.3	3/'99
KaneKa	a-Si/ x-Si/glass	3738	10.0 (est, stable)	38.0 (est.)	9/'00
Global Solar	CIS/SS	7495	4.9	36.5	2/'01
United Solar	a-Si triple	4519	7.9 (stabilized)	35.7	6/'97
Global Photon	CdS/CdTe	3366	9.2	31.0	4/'97

Appendix IV

Table IV.1: Cities from Romania, Europe
(Data from METEONORM program)

City	Code	Altitude [m]	Latitude φ [^{0}]	Longitude L [^{0}]	Type of site	Climatic zone	Situation
Bucuresti	15420	88	44.45	-26.09	City	III, 3	Open
Cluj - Napoca	15120	410	46.47	-23.34	Stations	III, 3	Open
Constanta	15480	13	44.13	-28.38	Stations	III, 9	Sea/lake
Craiova	15450	190	44.14	-23.52	Stations	III, 3	Open
Galati	15310	71	45.3	-28.01	Stations	III, 4	Open
Iasi	15090	104	47.1	-27.36	Stations	III, 4	Open
Timisoara	15247	86	45.46	-21.15	Stations	III, 3	Open

Figure IV.1: *The map of Romania.*

Table of formulae used to calculate the quantities and parametres in this Appendix

1. The data of the following quantities were taken from METEONORM (monthly values):

$\overline{\mathbf{H}}$: Irradiation of global radiation horizontal [**kWh / m^2**] and [**MJ/m^2**]

$\overline{\mathbf{H}}_{\mathbf{d}}$: Irradiation of diffuse radiation horizontal [**kWh / m^2**] and [**MJ/m^2**]

$\overline{\mathbf{H}}_{\mathbf{b}}$: Irradiation of direct radiation horizontal [**kWh / m^2**] and [**MJ/m^2**]

Ta: air temperature [^{0}**C**] **RH**: Relative humidity **WS**: Wind speed [**m/s**]
WD: Wind direction **RR**: Precipitation [**mm**]

2.

a. $\overline{\mathbf{H}}_{\mathbf{ext}}$ - daily extraterrestrial radiation :

$$\overline{\mathbf{H}}_{\mathbf{ext}}(\mathbf{n}) = \frac{\mathbf{24}\times\mathbf{3600}}{\boldsymbol{\pi}\times\mathbf{1000}}\times\mathbf{I_{sc}}\times\left[\mathbf{1}+\mathbf{0.033}\times\mathbf{cos}\left(\frac{\mathbf{360}\times\mathbf{n}}{\mathbf{365}}\right)\right]\times\left[\mathbf{cos}\varphi\times\mathbf{cos}\boldsymbol{\delta}\times\mathbf{sin}\boldsymbol{\omega}_{\mathbf{S}}+\frac{\boldsymbol{\pi}\times\boldsymbol{\omega}_{\mathbf{S}}}{\mathbf{180}}\times\mathbf{sin}\varphi\times\mathbf{sin}\boldsymbol{\delta}\right]$$

where $\mathbf{I_{sc}}$ =1353 kW/m^2

The results of the monthly extraterrestrial radiation, $\overline{\mathbf{H}}_{\mathbf{ext}}$ **,** shown in the tables hereafter were calculated using the mean day of the month (**n**; the representative day of the month: 17 Jan., 15 Feb., 16 Mar., 15 Apr., 15 May., 11 Jun., 17 Jul., 16 Aug., 16 Sep., 16 Oct., 15 Nov., 11 Dec.) in the above formula and then the result was multiplied by the number of days of the month.

b. The monthly extraterrestrial radiation, $\overline{\mathbf{H}}_{\mathbf{ext}}$ **,** can also be calculated by :

$$\sum_{\mathbf{n}=\mathbf{1}}^{\mathbf{N}}\overline{\mathbf{H}}_{\mathbf{ext}} = \frac{\mathbf{24}\times\mathbf{3600}}{\boldsymbol{\pi}\times\mathbf{1000}}\times\mathbf{I_{sc}}\times\left[\mathbf{1}+\mathbf{0.033}\times\mathbf{cos}\left(\frac{\mathbf{360}\times\mathbf{n}}{\mathbf{365}}\right)\right]\times\left[\mathbf{cos}\varphi\times\mathbf{cos}\boldsymbol{\delta}\times\mathbf{sin}\boldsymbol{\omega}_{\mathbf{S}}+\frac{\boldsymbol{\pi}\times\boldsymbol{\omega}_{\mathbf{S}}}{\mathbf{180}}\times\mathbf{sin}\varphi\times\mathbf{sin}\boldsymbol{\delta}\right]$$

where **N** is the number of days of the month; $\boldsymbol{\omega}_{\mathbf{S}}$, $\boldsymbol{\delta}$ and **n** depend on the day according to formulae in Appendix I.

c. $\overline{\mathbf{K}}_{\mathbf{t}}$ - the monthly average clearness index : $\overline{\mathbf{K}}_{\mathbf{t}}=\overline{\mathbf{H}}/\overline{\mathbf{H}}_{\mathbf{ext}}$; $\overline{\mathbf{H}}$ was taken from METEONORM.

d. $\overline{\mathbf{H}}_{\mathbf{d}}/\overline{\mathbf{H}}$ was calculated using data from METEONORM.

e. **PSH**: Peak Solar Hour: $\overline{H}(kWh/m^2)/[(1kW/m^2)\times N(no.\ \ days\ \ of\ \ the\ \ month)]$

f. $$\mathbf{R_b} = \frac{\mathbf{cos}\boldsymbol{\theta}}{\mathbf{cos}\boldsymbol{\theta}_{\mathbf{z}}}$$

$\mathbf{R_b}$-ratio of beam solar insolation on tilted surface ($\mathbf{I_T}$) to that on horizontal surface ($\mathbf{I_h}$): $\mathbf{I_T/I_h}$
This is the instant $\mathbf{R_b}$

g. $$\overline{\mathbf{R}}_{\mathbf{b}} = \frac{\mathbf{cos}(\varphi-\boldsymbol{\beta})\times\mathbf{cos}(\delta)\times\mathbf{sin}(\omega'_{\mathbf{s}})+(\boldsymbol{\pi}/\mathbf{180})\times\boldsymbol{\omega}'_{\mathbf{s}}\times\mathbf{sin}(\varphi-\boldsymbol{\beta})\times\mathbf{sin}(\delta)}{\mathbf{cos}(\varphi)\times\mathbf{cos}(\delta)\times\mathbf{sin}(\omega_{\mathbf{s}})+(\boldsymbol{\pi}/\mathbf{180})\times\boldsymbol{\omega}_{\mathbf{s}}\times\mathbf{sin}(\varphi)\times\mathbf{sin}(\delta)}$$

$\boldsymbol{\omega}'_{\mathbf{s}}$, $\boldsymbol{\omega}_{\mathbf{s}}$, $\boldsymbol{\delta}$ are defined in Appendix I.

Table IV.2: Monthly Average Daily Extraterrestrial Radiation, $\bar{H}_o$, MJ/m², for I_{sc} = 1353 W/m²

	Average Daily Extraterrestrial Radiation											
Latitude	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
60	3.5	8.2	16.7	27.3	36.3	40.6	38.4	30.6	20.3	10.7	4.5	2.3
55	6.1	11.2	19.6	29.3	37.2	40.8	39.0	32.2	22.9	13.6	7.2	4.8
50	9.1	14.2	22.3	31.2	38.1	41.1	39.6	33.7	25.3	16.6	10.2	7.6
45	12.1	17.2	24.8	32.9	38.8	41.3	40.0	35.0	27.5	19.4	13.2	10.5
40	15.1	20.1	27.2	34.3	39.3	41.3	40.2	36.1	29.5	22.1	16.2	13.6
35	18.1	22.8	29.3	35.5	39.5	41.1	40.2	36.9	31.3	24.7	19.1	16.7
30	21.1	25.5	31.2	36.4	39.6	40.7	40.0	37.5	32.9	27.1	22.0	19.7
25	23.9	27.9	32.9	37.1	39.4	40.0	39.6	37.8	34.2	29.3	24.8	22.6
20	26.7	30.2	34.4	37.5	38.9	39.1	38.9	37.8	35.3	31.3	27.4	25.5
15	29.3	32.3	35.5	37.6	38.1	38.0	37.9	37.6	36.1	33.1	29.8	28.2
10	31.7	34.1	36.4	37.5	37.1	36.6	36.7	37.1	36.6	34.6	32.1	30.8
5	33.9	35.7	37.1	37.1	35.9	35.0	35.3	36.3	36.8	35.9	34.1	33.1
0	35.9	37.0	37.4	36.4	34.4	33.2	33.6	35.3	36.8	36.9	36.0	35.3
−5	37.6	38.1	37.5	35.4	32.7	31.1	31.7	34.1	36.5	37.7	37.5	37.3
−10	39.1	38.9	37.3	34.2	30.7	28.9	29.6	32.6	35.9	38.1	38.9	39.0
−15	40.4	39.4	36.8	32.7	28.6	26.5	27.4	30.8	35.0	38.3	39.9	40.4
−20	41.4	39.6	36.0	31.0	26.3	23.9	24.9	28.8	33.9	38.2	40.7	41.7
−25	42.1	39.6	35.0	29.0	23.8	21.3	22.3	26.7	32.5	37.8	41.3	42.6
−30	42.5	39.3	33.7	26.9	21.2	18.5	19.7	24.3	30.9	37.2	41.5	43.3
−35	42.7	38.7	32.1	24.5	18.4	15.7	16.9	21.8	29.0	36.3	41.5	43.8
−40	42.7	37.8	30.3	22.0	15.6	12.8	14.0	19.2	27.0	35.1	41.3	44.0
−45	42.4	36.7	28.3	19.4	12.8	9.9	11.2	16.5	24.7	33.7	40.8	44.0
−50	41.9	35.3	26.1	16.6	9.9	7.1	8.3	13.6	22.2	32.0	40.1	43.8
−55	41.3	33.8	23.6	13.7	7.1	4.5	5.6	10.8	19.6	30.2	39.2	43.5
−60	40.6	32.1	21.0	10.8	4.4	2.1	3.1	7.9	16.8	28.1	38.3	43.2

METEO DATA "Bucuresti"

Latitude:44.4536^0,
Longitude:-26.0978^0,
Altitude :88 m,

Table IV.3

Month	$\overline{H}$		$\overline{H}_b$		$\overline{H}_d$		$\overline{H}_{ext}$		$\overline{K}_t$	PSH
	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2		h
Jan	41	147.6	18	64.8	23	82.8	106.3	382.8	0.39	1.32
Feb	55	198.0	25	90.0	30	108.0	138.0	496.9	0.40	1.96
Mar	89	320.4	41	147.6	48	172.8	215.5	775.6	0.41	2.87
Apr	133	478.8	71	255.6	63	226.8	274.8	989.3	0.48	4.43
May	168	604.8	91	327.6	76	273.6	334.5	1204.2	0.50	5.41
Jun	192	691.2	115	414.0	77	277.2	344.4	1239.8	0.56	6.40
Jul	196	705.6	118	424.8	78	280.8	345.3	1243.2	0.57	6.32
Aug	176	633.6	108	388.8	68	244.8	304.1	1094.8	0.58	5.68
Sep	122	439.2	69	248.4	54	194.4	233.4	840.2	0.52	4.06
Oct	84	302.4	44	158.4	40	144.0	172.1	619.4	0.49	2.71
Nov	42	151.2	18	64.8	24	86.4	114.0	410.4	0.37	1.40
Dec	28	100.8	11	39.6	18	64.8	94.2	339.3	0.30	0.90
Year	1322	4773.6	726	2613.6	597	2149.2	2676.7	9635.9	0.50	3.63

Table IV.4

Month	RH	WS (m/s)	WD (degrees)	RR (mm)	$\overline{H}_d/\overline{H}$	Ta (^{0}C)
Jan	88	2.4	225	40	0.56	-2.4
Feb	85	2.7	36	36	0.55	-0.1
Mar	78	2.8	36	38	0.54	4.8
Apr	75	2.6	36	46	0.47	11.3
May	74	2.1	36	70	0.45	16.7
Jun	76	1.7	36	77	0.40	20.2
Jul	74	1.6	36	64	0.40	22.0
Aug	73	1.4	36	58	0.39	21.2
Sep	73	1.5	36	42	0.44	16.9
Oct	78	1.7	36	32	0.48	10.8
Nov	87	2.2	225	49	0.57	5.2
Dec	90	2.2	225	43	0.64	0.2
Year	79	2.1	31	595	5.89	10.6

METEO DATA "Cluj-Napoca"

Latitude:46.47^0,
Longitude:-23.34^0,
Altitude :410 m,

Table IV.5

Month	$\overline{H}$		$\overline{H}_b$		$\overline{H}_d$		$\overline{H}_{ext}$		$\overline{K}_t$	PSH
	KWh/m^2	KWh/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2		h
Jan	40	144.0	15	54.0	25	90.0	95.8	344.8	0.42	1.29
Feb	63	226.8	31	111.6	32	115.2	128.8	463.7	0.49	2.25
Mar	105	378.0	54	194.4	51	183.6	207.1	745.5	0.51	3.39
Apr	138	496.8	73	262.8	65	234.0	269.4	969.8	0.51	4.60
May	174	626.4	95	341.0	79	284.4	332.3	1196.4	0.52	5.61
Jun	143	514.8	54	194.4	88	316.8	344.1	1238.8	0.42	4.76
Jul	195	702.0	119	428.4	76	273.6	344.1	1238.8	0.57	6.29
Aug	175	630.0	111	399.6	63	226.8	299.8	1079.2	0.58	5.65
Sep	117	421.2	62	223.2	55	198.0	226.2	814.3	0.52	3.90
Oct	86	309.6	46	165.6	40	144.0	162.4	584.8	0.53	2.77
Nov	39	140.4	12	43.2	27	97.2	103.8	373.7	0.38	1.30
Dec	25	90.0	5	18.0	20	72.0	83.7	301.3	0.30	0.81
Year	1296	4665.6	676	2433.6	619	2228.4	2597.5	9351.0	0.50	3.55

Table IV.6

Month	RH	WS (m/s)	WD (degrees)	RR (mm)	$\overline{H}_d/\overline{H}$	Ta (^{0}C)
Jan	86	2.6	45	41	0.63	-3.3
Feb	80	2.6	45	30	0.51	-1.7
Mar	72	2.6	45	33	0.49	4.4
Apr	72	4.6	315	55	0.47	9.4
May	75	2.6	225	75	0.45	14.4
Jun	78	2.6	225	96	0.62	16.7
Jul	76	2.6	225	85	0.39	18.3
Aug	75	2.1	225	67	0.36	18.3
Sep	76	2.1	225	45	0.47	15.0
Oct	78	2.6	45	41	0.47	9.4
Nov	85	2.6	45	44	0.69	2.8
Dec	88	2.6	45	45	0.80	-1.1
Year	78	2.7	353	660	6.34	8.6

METEO DATA "Constanta"

Latitude: 44.13^0,
Longitude:- 28.38^0,
Altitude :13 m,

Table IV.7

Month	$\overline{H}$		$\overline{H}_b$		$\overline{H}_d$		$\overline{H}_{ext}$		$\overline{K}_t$	PSH
	KWh/m^2	KWh/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2		h
Jan	41	147.6	14	50.4	27	97.2	107.9	388.4	0.38	1.32
Feb	58	208.8	23	82.8	35	126.0	139.4	502.0	0.42	2.07
Mar	102	367.2	47	169.2	55	198.0	217.0	781.2	0.47	3.29
Apr	150	540.0	86	309.6	65	234.0	275.4	991.4	0.54	5.00
May	194	698.4	120	432.0	74	266.4	334.8	1205.3	0.58	6.26
Jun	204	734.4	130	468.0	74	266.4	344.4	1239.8	0.59	6.80
Jul	213	766.8	142	511.2	71	255.6	345.3	1243.2	0.62	6.87
Aug	188	676.8	125	450.0	63	226.8	304.7	1097.0	0.62	6.06
Sep	132	475.2	77	277.2	55	198.0	234.3	843.5	0.56	4.40
Oct	89	320.4	45	162.0	43	154.8	173.6	625.0	0.51	2.87
Nov	47	169.2	18	64.8	29	104.4	115.5	415.8	0.41	1.57
Dec	32	115.2	9	32.4	23	82.8	95.8	344.8	0.33	1.03
Year	1445	5202.0	833	2998.8	613	2206.8	2688.2	9677.4	0.54	3.96

Table IV.8

Month	RH	WS (m/s)	WD (degrees)	RR (mm)	$\overline{H}_d/\overline{H}$	Ta (^{0}C)
Jan	85	5.5	270	30	0.66	0.5
Feb	84	5.5	36	29	0.60	1.6
Mar	85	5.0	45	26	0.54	4.6
Apr	83	4.4	135	30	0.43	9.9
May	81	3.9	135	38	0.38	15.5
Jun	79	3.8	270	40	0.36	20.0
Jul	78	3.7	270	30	0.33	22.0
Aug	78	3.7	270	33	0.34	21.8
Sep	79	4.2	270	29	0.42	18.3
Oct	82	4.8	36	31	0.48	13.1
Nov	86	4.8	270	42	0.62	8.0
Dec	88	5.3	270	38	0.72	3.2
Year	82	4.6	291	396	5.88	11.5

METEO DATA "Craiova"

Latitude: 44.14^0,
Longitude:- 23.52^0,
Altitude :190 m,

Table IV.9

Month	$\bar{H}$		$\bar{H}_b$		$\bar{H}_d$		$\bar{H}_{ext}$		$\bar{K}_t$	PSH
	KWh/m^2	KWh/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2		h
Jan	48	172.8	20	72.0	28	100.8	107.9	388.4	0.44	1.55
Feb	61	219.6	26	93.6	35	126.0	139.4	502.0	0.44	2.18
Mar	106	381.6	51	183.6	54	194.4	217.0	781.2	0.49	3.42
Apr	148	532.8	83	298.8	65	234.0	275.4	991.4	0.54	4.93
May	190	684.0	115	414.0	76	273.6	334.8	1205.3	0.57	6.13
Jun	173	622.8	89	320.4	84	302.4	344.4	1239.8	0.50	5.77
Jul	206	741.6	132	475.2	74	266.4	345.3	1243.2	0.60	6.65
Aug	165	594.0	94	338.4	72	259.2	304.7	1097.0	0.54	5.32
Sep	119	428.4	61	219.6	58	208.8	234.3	843.5	0.51	3.97
Oct	89	320.4	46	165.6	43	154.8	173.6	625.0	0.51	2.87
Nov	51	183.6	22	79.2	29	104.4	115.5	415.8	0.44	1.70
Dec	38	136.8	14	50.4	24	86.4	95.8	344.8	0.40	1.23
Year	1393	5014.8	749	2696.4	641	2307.6	2688.2	9677.4	0.52	3.98

Table IV.10

Month	RH	WS (m/s)	WD (degrees)	RR (mm)	$\bar{H}_d / \bar{H}$	Ta (^{0}C)
Jan	89	3.1	270	38	0.58	-2.3
Feb	85	3.6	90	39	0.57	-0.1
Mar	79	4.0	90	41	0.51	4.7
Apr	75	4.3	90	52	0.44	11.1
May	75	3.7	90	64	0.40	16.6
Jun	77	3.4	270	74	0.49	19.8
Jul	74	3.1	270	55	0.36	21.9
Aug	73	3.2	90	46	0.44	21.3
Sep	72	3.0	90	37	0.49	17.4
Oct	78	3.1	90	36	0.48	11.1
Nov	87	3.2	270	53	0.57	5.0
Dec	91	2.9	270	47	0.63	0.1
Year	80	3.4	90	582	5.96	10.6

METEO DATA "Galati"

Latitude: 45.3^0,
Longitude:- 28.01^0,
Altitude :71 m,

Table IV.11

Month	$\overline{H}$		$\overline{H}_b$		$\overline{H}_d$		$\overline{H}_{ext}$		$\overline{K}_t$	PSH
	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2		h
Jan	39	140.4	17	61.2	22	79.2	102.0	367.2	0.38	1.29
Feb	54	194.4	25	90.0	29	104.4	134.1	482.8	0.40	1.93
Mar	84	302.4	38	136.8	46	165.6	212.0	763.3	0.40	2.71
Apr	132	475.2	70	252.0	62	223.2	272.4	980.6	0.48	4.40
May	165	594.0	89	320.4	76	273.6	333.6	1200.8	0.49	5.32
Jun	187	673.2	109	392.4	78	280.8	344.4	1239.8	0.54	6.23
Jul	195	702.0	117	421.2	77	277.2	344.7	1241.0	0.57	6.29
Aug	176	633.6	109	392.4	67	241.2	302.3	1088.1	0.58	5.68
Sep	121	435.6	68	244.8	53	190.8	230.4	829.4	0.53	4.03
Oct	86	309.6	47	169.2	39	140.4	168.0	604.9	0.51	2.77
Nov	41	147.6	18	64.8	23	82.8	109.8	395.3	0.37	1.37
Dec	26	93.6	9	32.4	17	61.2	89.9	323.6	0.29	0.83
Year	1305	4701.6	715	2574	590	2124	2643.6	9517.0	0.50	42.8

Table IV.12

Month	RH	WS (m/s)	WD (degrees)	RR (mm)	$\overline{H}_d/\overline{H}$	Ta (^{0}C)
Jan	87	5.2	225	29	0.56	-2.5
Feb	84	5.3	36	32	0.54	-0.6
Mar	79	5.1	36	27	0.55	4.0
Apr	74	5.1	36	38	0.47	10.8
May	74	4.5	36	51	0.46	16.6
Jun	75	4.3	36	68	0.42	20.2
Jul	73	4.3	36	46	0.39	22.0
Aug	72	4.0	36	46	0.38	21.4
Sep	74	3.8	36	42	0.44	17.2
Oct	77	4.1	36	27	0.45	11.1
Nov	86	4.5	225	36	0.56	5.3
Dec	89	4.9	225	35	0.65	0.2
Year	79	4.6	31	477	5.88	10.5

METEO DATA "Iasi"

Latitude: 47.1^0,
Longitude:- 27.36^0,
Altitude :104 m,

Table IV.13

Month	$\overline{H}$		$\overline{H}_b$		$\overline{H}_d$		$\overline{H}_{ext}$		$\overline{K}_t$	PSH
	KWh/m^2	KWh/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2		h
Jan	34	122.4	14	50.4	20	72.0	92.4	332.6	0.37	1.10
Feb	50	180.0	23	82.8	28	100.8	126.0	453.6	0.40	1.79
Mar	82	295.2	37	133.2	45	162.0	204.3	735.4	0.40	2.65
Apr	128	460.8	67	241.2	61	219.6	267.6	963.4	0.48	4.27
May	165	594.0	90	324.0	75	270.0	331.4	1193.0	0.50	5.32
Jun	189	680.4	111	399.6	78	280.8	343.8	1237.7	0.55	6.30
Jul	187	673.2	109	392.4	78	280.8	343.8	1237.6	0.54	6.03
Aug	174	626.4	107	385.2	67	241.2	298.5	1074.7	0.58	5.61
Sep	112	403.2	61	219.6	52	187.2	223.8	805.7	0.50	3.73
Oct	77	277.2	40	144.0	37	133.2	159.3	573.6	0.48	2.48
Nov	35	126.0	14	50.4	21	75.6	100.5	361.8	0.35	1.16
Dec	23	82.8	8	28.8	15	54.0	80.6	290.2	0.29	0.74
Year	1253	4510.8	679	2444.4	575	2070	2572.0	9259.3	0.49	3.43

Table IV.14

Month	RH	WS (m/s)	WD (degrees)	RR (mm)	$\overline{H}_d/\overline{H}$	Ta (^{0}C)
Jan	85	3.8	315	32	0.59	-3.7
Feb	85	4.2	315	31	0.56	-1.8
Mar	78	4.0	315	31	0.55	3.0
Apr	66	4.1	315	53	0.48	10.3
May	71	3.4	315	63	0.45	16.1
Jun	71	3.1	315	101	0.41	19.2
Jul	66	2.9	315	83	0.42	20.5
Aug	71	2.8	315	56	0.39	19.9
Sep	71	2.7	315	48	0.46	15.9
Oct	75	2.9	315	25	0.48	10.0
Nov	86	3.3	315	35	0.60	4.3
Dec	88	3.5	315	31	0.65	-0.6
Year	76	3.4	315	589	6.04	9.4

METEO DATA "Timisoara"

Latitude: 45.46^0,
Longitude:- 21.15^0,
Altitude: 86 m,

Table IV.15

Month	$\overline{H}$		$\overline{H}_b$		$\overline{H}_d$		$\overline{H}_{ext}$		$\overline{K}_t$	PSH
	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2	KWh/m^2	MJ/m^2		h
Jan	33	118.8	13	46.8	20	72.0	101.1	363.8	0.33	1.07
Feb	53	190.8	24	86.4	29	104.4	133.6	480.8	0.40	1.89
Mar	99	356.4	51	183.6	48	172.8	211.4	761.1	0.47	3.19
Apr	134	482.4	72	259.2	62	223.2	272.1	979.6	0.49	4.47
May	178	640.8	102	367.2	76	273.6	333.3	1199.7	0.53	5.74
Jun	176	633.6	98	352.8	78	280.8	344.4	1239.8	0.51	5.87
Jul	193	694.8	115	414.0	78	280.8	344.7	1241.0	0.56	6.23
Aug	170	612.0	102	367.2	68	244.8	301.9	1087.0	0.56	5.48
Sep	120	432.0	67	241.2	53	190.8	229.8	827.3	0.52	4.00
Oct	78	280.8	40	144.0	38	136.8	167.4	602.6	0.47	2.51
Nov	39	140.4	16	57.6	23	82.8	108.9	392.0	0.36	1.30
Dec	29	104.4	11	39.6	18	64.8	89.0	320.3	0.33	0.94
Year	1296	4665.6	709	2552.4	890	3204	2637.5	9495.1	0.50	42.7

Table IV.16

Month	RH	WS (m/s)	WD (degrees)	RR (mm)	$\overline{H}_d / \overline{H}$	Ta (^{0}C)
Jan	91	2.0	315	40	0.61	-1.6
Feb	87	2.3	180	36	0.55	1.2
Mar	81	2.6	315	37	0.48	5.8
Apr	80	2.6	315	48	0.46	11.2
May	77	2.3	315	65	0.43	16.3
Jun	79	2.2	315	76	0.44	19.4
Jul	74	2.1	315	64	0.40	21.1
Aug	75	1.9	315	50	0.40	20.4
Sep	76	1.8	315	40	0.44	16.5
Oct	85	1.9	315	39	0.49	11.0
Nov	92	2.2	180	48	0.59	5.6
Dec	89	2.1	180	50	0.62	0.8
Year	82	2.2	297	593	5.91	10.6

Iasi

Latitude:47.1^0
Longitude: 27.36^0
Altitude: 104 m
Calculations for: a. the 22^{nd} June: WT is from $6^{30}$to 22^{30} for summer time or equivalent 5^{30} to 21^{30} for winter time which is the proper time to be used for WT
b. the 22^{nd} December: WT is from 6^{30} to 18^{30}.
For 22.06 $\Rightarrow$ n=173 and for 22.12 $\Rightarrow$ n=356.

B	E	L_{st}	L_{loc}	WT*	WT	ST	ω	δ
For 22.06	(minutes)			Summer Time	Winter Time			
90.99	-1.70	30	27.36	6h30'	5h30'	5h18'	-100.50	23.45
90.99	-1.70	30	27.36	7h30'	6h30'	6h18'	-85.50	23.45
90.99	-1.70	30	27.36	8h30'	7h30'	7h18'	-70.50	23.45
90.99	-1.70	30	27.36	9h30'	8h30'	8h18'	-55.50	23.45
90.99	-1.70	30	27.36	10h30'	9h30'	9h18'	-40.50	23.45
90.99	-1.70	30	27.36	11h30'	10h30'	10h18'	-25.50	23.45
90.99	-1.70	30	27.36	12h30'	11h30'	11h18'	-10.50	23.45
90.99	-1.70	30	27.36	13h30'	12h30'	12h18'	4.50	23.45
90.99	-1.70	30	27.36	14h30'	13h30'	13h18'	19.50	23.45
90.99	-1.70	30	27.36	15h30'	14h30'	14h18'	34.50	23.45
90.99	-1.70	30	27.36	16h30'	15h30'	15h18'	49.50	23.45
90.99	-1.70	30	27.36	17h30'	16h30'	16h18'	64.50	23.45
90.99	-1.70	30	27.36	18h30'	17h30'	17h18'	79.50	23.45
90.99	-1.70	30	27.36	19h30'	18h30'	18h18'	94.50	23.45
90.99	*-1.70*	*30*	*27.36*	*20h30'*	*19h30'*	*19h18'*	*109.50*	*23.45*
90.99	*-1.70*	*30*	*27.36*	*21h30'*	*20h30'*	*20h18'*	*124.50*	*23.45*
90.99	*-1.70*	*30*	*27.36*	*22h30'*	*21h30'*	*21h18'*	*139.50*	*23.45*
For 22.12								
271.98	*0.62*	*30*	*27.36*		*6h30'*	*6h20'*	*-85.00*	*-23.45*
271.98	*0.62*	*30*	*27.36*		*7h30'*	*7h20'*	*-70.00*	*-23.45*
271.98	0.62	30	27.36		8h30'	8h20'	-55.00	-23.45
271.98	0.62	30	27.36		9h30'	9h20'	-40.00	-23.45
271.98	0.62	30	27.36		10h30'	10h20'	-25.00	-23.45
271.98	0.62	30	27.36		11h30'	11h20'	-10.00	-23.45
271.98	0.62	30	27.36		12h30'	12h20'	5.00	-23.45
271.98	0.62	30	27.36		13h30'	13h20'	20.00	-23.45
271.98	0.62	30	27.36		14h30'	14h20'	35.00	-23.45
271.98	0.62	30	27.36		15h30'	15h20'	50.00	-23.45
271.98	*0.62*	*30*	*27.36*		*16h30'*	*16h20'*	*65.00*	*-23.45*
271.98	*0.62*	*30*	*27.36*		*17h30'*	*17h20'*	*80.00*	*-23.45*
271.98	*0.62*	*30*	*27.36*		*18h30'*	*18h20'*	*95.00*	*-23.45*

* WT: Watch Time: the conventional time the watch shows.

For **β=0:** $\cos\theta \equiv \cos\theta_z$

$\omega_s \equiv \omega'_s$

$R_b = 1$

φ	β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06								
47.1	10	117.84	109.18	6h30'	5h18'	0.1071	0.1779	0.6018
47.1	10	117.84	109.18	7h30'	6h18'	0.2978	0.3408	0.8740
47.1	10	117.84	109.18	8h30'	7h18'	0.4846	0.5002	0.9688
47.1	10	117.84	109.18	9h30'	8h18'	0.6547	0.6454	1.0144
47.1	10	117.84	109.18	10h30'	9h18'	0.7966	0.7665	1.0392
47.1	10	117.84	109.18	11h30'	10h18'	0.9006	0.8553	1.0529
47.1	10	117.84	109.18	12h30'	11h18'	0.9595	0.9056	1.0595
47.1	10	117.84	109.18	13h30'	12h18'	0.9695	0.9142	1.0606
47.1	10	117.84	109.18	14h30'	13h18'	0.9298	0.8803	1.0563
47.1	10	117.84	109.18	15h30'	14h18'	0.8432	0.8063	1.0457
47.1	10	117.84	109.18	16h30'	15h18'	0.7154	0.6973	1.0261
47.1	10	117.84	109.18	17h30'	16h18'	0.5553	0.5606	0.9906
47.1	10	117.84	109.18	18h30'	17h18'	0.3737	0.4056	0.9215
47.1	10	117.84	109.18	19h30'	18h18'	0.1830	0.2428	0.7539
47.1	*10*	*117.84*	*109.18*	*20h30'*	*19h18'*	*-0.0038*	*0.0833*	*-0.0461**
47.1	*10*	*117.84*	*109.18*	*21h30'*	*20h18'*	*-0.1741*	*-0.0621*	*2.8043***
47.1	*10*	*117.84*	*109.18*	*22h30'*	*21h18'*	*-0.3162*	*-0.1834*	*1.7243***
For 22.12								
47.1	*10*	*62.25*	*62.25*	*6h30'*	*6h20'*	*-0.1755*	*-0.2363*	*0.7425***
47.1	*10*	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.0109*	*-0.0772*	*-0.1418****
47.1	10	62.25	62.25	8h30'	8h20'	0.1803	0.0674	2.6759
47.1	10	62.25	62.25	9h30'	9h20'	0.3211	0.1875	1.7120
47.1	10	62.25	62.25	10h30'	10h20'	0.4236	0.2751	1.5399
47.1	10	62.25	62.25	11h30'	11h20'	0.4810	0.3241	1.4842
47.1	10	62.25	62.25	12h30'	12h20'	0.4893	0.3312	1.4775
47.1	10	62.25	62.25	13h30'	13h20'	0.4480	0.2959	1.5140
47.1	10	62.25	62.25	14h30'	14h20'	0.3599	0.2207	1.6308
47.1	10	62.25	62.25	15h30'	15h20'	0.2309	0.1106	2.0881
47.1	*10*	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.0699*	*-0.0269*	*-2.6012****
47.1	*10*	*62.25*	*62.25*	*17h30'*	*17h20'*	*-0.1122*	*-0.1823*	*0.6155***
47.1	*10*	*62.25*	*62.25*	*18h30'*	*18h20'*	*-0.3030*	*-0.3452*	*0.8778***

Cases	**cosθ**	**$\cos\theta_z$**	Observations
*	-	+	The sun is above the horizon. This combination implies that the sun faces the collector/PV-panel from the back surface. There is no sense to consider **R_b**.
**	-	-	The sun is below the horizon. **R_b** should not be taken into account.
***	+	-	The sun is below the horizon. Theoretically, the "sun beam" faces the collector since **cosθ>0.** **R_b** has no sense as no real beam impinges on.

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
15	117.84	105.82	6h30’	5h18’	0.0703	0.1779	0.3950
15	117.84	105.82	7h30’	6h18’	0.2729	0.3408	0.8007
15	117.84	105.82	8h30’	7h18’	0.4712	0.5002	0.9421
15	117.84	105.82	9h30’	8h18’	0.6519	0.6454	1.0100
15	117.84	105.82	10h30’	9h18’	0.8026	0.7665	1.0470
15	117.84	105.82	11h30’	10h18’	0.9130	0.8553	1.0675
15	117.84	105.82	12h30’	11h18’	0.9756	0.9056	1.0773
15	117.84	105.82	13h30’	12h18’	0.9862	0.9142	1.0788
15	117.84	105.82	14h30’	13h18’	0.9441	0.8803	1.0725
15	117.84	105.82	15h30’	14h18’	0.8521	0.8063	1.0567
15	117.84	105.82	16h30’	15h18’	0.7164	0.6973	1.0274
15	117.84	105.82	17h30’	16h18’	0.5463	0.5606	0.9746
15	117.84	105.82	18h30’	17h18’	0.3535	0.4056	0.8716
15	117.84	105.82	19h30’	18h18’	0.1509	0.2428	0.6217
15	*117.84*	*105.82*	*20h30’*	*19h18’*	*-0.0475*	*0.0833*	*-0.5706**
15	*117.84*	*105.82*	*21h30’*	*20h18’*	*-0.2283*	*-0.0621*	*3.6779***
15	*117.84*	*105.82*	*22h30’*	*21h18’*	*-0.3792*	*-0.1834*	*2.0681***
For 22.12							
15	*62.25*	*62.25*	*6h30’*	*6h20’*	*-0.1429*	*-0.2363*	*0.6048***
15	*62.25*	*62.25*	*7h30’*	*7h20’*	*0.0551*	*-0.0772*	*-0.7132****
15	62.25	62.25	8h30’	8h20’	0.2349	0.0674	3.4866
15	62.25	62.25	9h30’	9h20’	0.3844	0.1875	2.0498
15	62.25	62.25	10h30’	10h20’	0.4933	0.2751	1.7934
15	62.25	62.25	11h30’	11h20’	0.5543	0.3241	1.7103
15	62.25	62.25	12h30’	12h20’	0.5631	0.3312	1.7003
15	62.25	62.25	13h30’	13h20’	0.5193	0.2959	1.7547
15	62.25	62.25	14h30’	14h20’	0.4256	0.2207	1.9288
15	62.25	62.25	15h30’	15h20’	0.2887	0.1106	2.6104
15	*62.25*	*62.25*	*16h30’*	*16h20’*	*0.1177*	*-0.0269*	*-4.3789****
15	*62.25*	*62.25*	*17h30’*	*17h20’*	*-0.0757*	*-0.1823*	*0.4154***
15	*62.25*	*62.25*	*18h30’*	*18h20’*	*-0.2784*	*-0.3452*	*0.8064***

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
20	117.84	102.86	6h30’	5h18’	0.0330	0.1779	0.1853
20	117.84	102.86	7h30’	6h18’	0.2458	0.3408	0.7214
20	117.84	102.86	8h30’	7h18’	0.4543	0.5002	0.9082
20	117.84	102.86	9h30’	8h18’	0.6441	0.6454	0.9980
20	117.84	102.86	10h30’	9h18’	0.8024	0.7665	1.0469
20	117.84	102.86	11h30’	10h18’	0.9185	0.8553	1.0739
20	117.84	102.86	12h30’	11h18’	0.9843	0.9056	1.0869
20	117.84	102.86	13h30’	12h18’	0.9955	0.9142	1.0889
20	117.84	102.86	14h30’	13h18’	0.9512	0.8803	1.0805
20	117.84	102.86	15h30’	14h18’	0.8545	0.8063	1.0597

continued

20	117.84	102.86	16h30’	15h18’	0.7119	0.6973	1.0210
20	117.84	102.86	17h30’	16h18’	0.5332	0.5606	0.9512
20	117.84	102.86	18h30’	17h18’	0.3305	0.4056	0.8150
20	117.84	102.86	19h30’	18h18’	0.1177	0.2428	0.4849
20	*117.84*	*102.86*	*20h30’*	*19h18’*	*-0.0908*	*0.0833*	*-1.0908**
20	*117.84*	*102.86*	*21h30’*	*20h18’*	*-0.2808*	*-0.0621*	*4.5235***
20	*117.84*	*102.86*	*22h30’*	*21h18’*	*-0.4394*	*-0.1834*	*2.3962***
For 22.12							
20	*62.25*	*62.25*	*6h30’*	*6h20’*	*-0.1093*	*-0.2363*	*0.4625***
20	*62.25*	*62.25*	*7h30’*	*7h20’*	*0.0987*	*-0.0772*	*-1.2792****
20	62.25	62.25	8h30’	8h20’	0.2877	0.0674	4.2707
20	62.25	62.25	9h30’	9h20’	0.4448	0.1875	2.3720
20	62.25	62.25	10h30’	10h20’	0.5593	0.2751	2.0331
20	62.25	62.25	11h30’	11h20’	0.6234	0.3241	1.9234
20	62.25	62.25	12h30’	12h20’	0.6326	0.3312	1.9102
20	62.25	62.25	13h30’	13h20’	0.5865	0.2959	1.9820
20	62.25	62.25	14h30’	14h20’	0.4882	0.2207	2.2121
20	62.25	62.25	15h30’	15h20’	0.3442	0.1106	3.1128
20	*62.25*	*62.25*	*16h30’*	*16h20’*	*0.1645*	*-0.0269*	*-6.1234****
20	*62.25*	*62.25*	*17h30’*	*17h20’*	*-0.0387*	*-0.1823*	*0.2122***
20	*62.25*	*62.25*	*18h30’*	*18h20’*	*-0.2516*	*-0.3452*	*0.7289***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
25	*117.84*	*100.18*	*6h30’*	*5h18’*	*-0.0046*	*0.1779*	*-0.0259**
25	117.84	100.18	7h30’	6h18’	0.2169	0.3408	0.6366
25	117.84	100.18	8h30’	7h18’	0.4339	0.5002	0.8674
25	117.84	100.18	9h30’	8h18’	0.6314	0.6454	0.9783
25	117.84	100.18	10h30’	9h18’	0.7962	0.7665	1.0387
25	117.84	100.18	11h30’	10h18’	0.9170	0.8553	1.0721
25	117.84	100.18	12h30’	11h18’	0.9855	0.9056	1.0882
25	117.84	100.18	13h30’	12h18’	0.9971	0.9142	1.0907
25	117.84	100.18	14h30’	13h18’	0.9510	0.8803	1.0803
25	117.84	100.18	15h30’	14h18’	0.8504	0.8063	1.0546
25	117.84	100.18	16h30’	15h18’	0.7020	0.6973	1.0068
25	117.84	100.18	17h30’	16h18’	0.5160	0.5606	0.9205
25	117.84	100.18	18h30’	17h18’	0.3051	0.4056	0.7523
25	117.84	100.18	19h30’	18h18’	0.0836	0.2428	0.3443
25	*117.84*	*100.18*	*20h30’*	*19h18’*	*-0.1334*	*0.0833*	*-1.6026**
25	*117.84*	*100.18*	*21h30’*	*20h18’*	*-0.3312*	*-0.0621*	*5.3347***
25	*117.84*	*100.18*	*22h30’*	*21h18’*	*-0.4962*	*-0.1834*	*2.7061***
For 22.12							
25	*62.25*	*62.25*	*6h30’*	*6h20’*	*-0.0748*	*-0.2363*	*0.3167***

continued

25	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.1417*	*-0.0772*	*-1.8355****
25	62.25	62.25	8h30'	8h20'	0.3384	0.0674	5.0223
25	62.25	62.25	9h30'	9h20'	0.5019	0.1875	2.6762
25	62.25	62.25	10h30'	10h20'	0.6210	0.2751	2.2575
25	62.25	62.25	11h30'	11h20'	0.6877	0.3241	2.1219
25	62.25	62.25	12h30'	12h20'	0.6973	0.3312	2.1055
25	62.25	62.25	13h30'	13h20'	0.6494	0.2959	2.1943
25	62.25	62.25	14h30'	14h20'	0.5470	0.2207	2.4786
25	62.25	62.25	15h30'	15h20'	0.3972	0.1106	3.5916
25	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.2102*	*-0.0269*	*-7.8213****
25	*62.25*	*62.25*	*17h30'*	*17h20'*	*-0.0014*	*-0.1823*	*0.0074***
25	*62.25*	*62.25*	*18h30'*	*18h20'*	*-0.2230*	*-0.3452*	*0.6459***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
30	*117.84*	*97.71*	*6h30'*	*5h18'*	*-0.0421*	*0.1779*	*-0.2369**
30	117.84	97.71	7h30'	6h18'	0.1864	0.3408	0.5469
30	117.84	97.71	8h30'	7h18'	0.4102	0.5002	0.8200
30	117.84	97.71	9h30'	8h18'	0.6140	0.6454	0.9513
30	117.84	97.71	10h30'	9h18'	0.7840	0.7665	1.0227
30	117.84	97.71	11h30'	10h18'	0.9085	0.8553	1.0622
30	117.84	97.71	12h30'	11h18'	0.9792	0.9056	1.0812
30	117.84	97.71	13h30'	12h18'	0.9912	0.9142	1.0842
30	117.84	97.71	14h30'	13h18'	0.9436	0.8803	1.0719
30	117.84	97.71	15h30'	14h18'	0.8398	0.8063	1.0415
30	117.84	97.71	16h30'	15h18'	0.6867	0.6973	0.9849
30	117.84	97.71	17h30'	16h18'	0.4949	0.5606	0.8828
30	117.84	97.71	18h30'	17h18'	0.2773	0.4056	0.6838
30	117.84	97.71	19h30'	18h18'	0.0488	0.2428	0.2011
30	*117.84*	*97.71*	*20h30'*	*19h18'*	*-0.1750*	*0.0833*	*-2.1023**
30	*117.84*	*97.71*	*21h30'*	*20h18'*	*-0.3790*	*-0.0621*	*6.1054***
30	*117.84*	*97.71*	*22h30'*	*21h18'*	*-0.5493*	*-0.1834*	*2.9954***
For 22.12							
30	*62.25*	*62.25*	*6h30'*	*6h20'*	*-0.0398*	*-0.2363*	*0.1684***
30	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.1836*	*-0.0772*	*-2.3779****
30	62.25	62.25	8h30'	8h20'	0.3865	0.0674	5.7358
30	62.25	62.25	9h30'	9h20'	0.5551	0.1875	2.9600
30	62.25	62.25	10h30'	10h20'	0.6780	0.2751	2.4646
30	62.25	62.25	11h30'	11h20'	0.7468	0.3241	2.3042
30	62.25	62.25	12h30'	12h20'	0.7567	0.3312	2.2849
30	62.25	62.25	13h30'	13h20'	0.7072	0.2959	2.3899
30	62.25	62.25	14h30'	14h20'	0.6016	0.2207	2.7262
30	62.25	62.25	15h30'	15h20'	0.4471	0.1106	4.0431
30	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.2542*	*-0.0269*	*-9.4597****
30	*62.25*	*62.25*	*17h30'*	*17h20'*	*0.0360*	*-0.1823*	*-0.1974****

30	*62.25*	*62.25*	*18h30'*	*18h20'*	*-0.1926*	*-0.3452*	*0.5579***

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
35	*117.84*	*95.38*	*6h30'*	*5h18'*	*-0.0794*	*0.1779*	*-0.4460**
35	117.84	95.38	7h30'	6h18'	0.1544	0.3408	0.4531
35	117.84	95.38	8h30'	7h18'	0.3833	0.5002	0.7663
35	117.84	95.38	9h30'	8h18'	0.5918	0.6454	0.9170
35	117.84	95.38	10h30'	9h18'	0.7657	0.7665	0.9989
35	117.84	95.38	11h30'	10h18'	0.8932	0.8553	1.0443
35	117.84	95.38	12h30'	11h18'	0.9655	0.9056	1.0660
35	117.84	95.38	13h30'	12h18'	0.9777	0.9142	1.0695
35	117.84	95.38	14h30'	13h18'	0.9291	0.8803	1.0554
35	117.84	95.38	15h30'	14h18'	0.8228	0.8063	1.0205
35	117.84	95.38	16h30'	15h18'	0.6663	0.6973	0.9555
35	117.84	95.38	17h30'	16h18'	0.4700	0.5606	0.8385
35	117.84	95.38	18h30'	17h18'	0.2474	0.4056	0.6101
35	117.84	95.38	19h30'	18h18'	0.0137	0.2428	0.0564
35	*117.84*	*95.38*	*20h30'*	*19h18'*	*-0.2153*	*0.0833*	*-2.5861**
35	*117.84*	*95.38*	*21h30'*	*20h18'*	*-0.4240*	*-0.0621*	*6.8296***
35	*117.84*	*95.38*	*22h30'*	*21h18'*	*-0.5981*	*-0.1834*	*3.2619***
For 22.12							
35	*62.25*	*62.25*	*6h30'*	*6h20'*	*-0.0045*	*-0.2363*	*0.0189***
35	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.2240*	*-0.0772*	*-2.9021****
35	62.25	62.25	8h30'	8h20'	0.4316	0.0674	6.4056
35	62.25	62.25	9h30'	9h20'	0.6041	0.1875	3.2214
35	62.25	62.25	10h30'	10h20'	0.7298	0.2751	2.6530
35	62.25	62.25	11h30'	11h20'	0.8002	0.3241	2.4690
35	62.25	62.25	12h30'	12h20'	0.8104	0.3312	2.4468
35	62.25	62.25	13h30'	13h20'	0.7597	0.2959	2.5673
35	62.25	62.25	14h30'	14h20'	0.6517	0.2207	2.9531
35	62.25	62.25	15h30'	15h20'	0.4936	0.1106	4.4638
35	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.2963*	*-0.0269*	*-11.0262****
35	*62.25*	*62.25*	*17h30'*	*17h20'*	*0.0731*	*-0.1823*	*-0.4008****
35	*62.25*	*62.25*	*18h30'*	*18h20'*	*-0.1608*	*-0.3452*	*0.4657***

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
40	*117.84*	*93.14*	*6h30'*	*5h18'*	*-0.1160*	*0.1779*	*-0.6518**
40	117.84	93.14	7h30'	6h18'	0.1213	0.3408	0.3559
40	117.84	93.14	8h30'	7h18'	0.3536	0.5002	0.7069
40	117.84	93.14	9h30'	8h18'	0.5652	0.6454	0.8757
40	117.84	93.14	10h30'	9h18'	0.7417	0.7665	0.9676
40	117.84	93.14	11h30'	10h18'	0.8710	0.8553	1.0184
40	117.84	93.14	12h30'	11h18'	0.9444	0.9056	1.0428
40	117.84	93.14	13h30'	12h18'	0.9568	0.9142	1.0466

continued

40	117.84	93.14	14h30'	13h18'	0.9074	0.8803	1.0308
40	117.84	93.14	15h30'	14h18'	0.7996	0.8063	0.9917
40	117.84	93.14	16h30'	15h18'	0.6407	0.6973	0.9189
40	117.84	93.14	17h30'	16h18'	0.4416	0.5606	0.7877
40	117.84	93.14	18h30'	17h18'	0.2157	0.4056	0.5318
40	*117.84*	*93.14*	*19h30'*	*18h18'*	*-0.0215*	*0.2428*	*-0.0887**
40	*117.84*	*93.14*	*20h30'*	*19h18'*	*-0.2539*	*0.0833*	*-3.0501**
40	*117.84*	*93.14*	*21h30'*	*20h18'*	*-0.4657*	*-0.0621*	*7.5019***
40	*117.84*	*93.14*	*22h30'*	*21h18'*	*-0.6425*	*-0.1834*	*3.5037***
For 22.12							
40	*62.25*	*62.25*	*6h30'*	*6h20'*	*0.0309*	*-0.2363*	*-0.1307****
40	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.2628*	*-0.0772*	*-3.4043****
40	62.25	62.25	8h30'	8h20'	0.4734	0.0674	7.0267
40	62.25	62.25	9h30'	9h20'	0.6485	0.1875	3.4582
40	62.25	62.25	10h30'	10h20'	0.7761	0.2751	2.8213
40	62.25	62.25	11h30'	11h20'	0.8475	0.3241	2.6150
40	62.25	62.25	12h30'	12h20'	0.8579	0.3312	2.5902
40	62.25	62.25	13h30'	13h20'	0.8065	0.2959	2.7252
40	62.25	62.25	14h30'	14h20'	0.6968	0.2207	3.1576
40	62.25	62.25	15h30'	15h20'	0.5364	0.1106	4.8506
40	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.3361*	*-0.0269*	*-12.5089****
40	*62.25*	*62.25*	*17h30'*	*17h20'*	*0.1096*	*-0.1823*	*-0.6011****
40	*62.25*	*62.25*	*18h30'*	*18h20'*	*-0.1277*	*-0.3452*	*0.3700***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
45	*117.84*	*90.96*	*6h30'*	*5h18'*	*-0.1517*	*0.1779*	*-0.8526**
45	117.84	90.96	7h30'	6h18'	0.0872	0.3408	0.2559
45	117.84	90.96	8h30'	7h18'	0.3212	0.5002	0.6421
45	117.84	90.96	9h30'	8h18'	0.5343	0.6454	0.8278
45	117.84	90.96	10h30'	9h18'	0.7120	0.7665	0.9288
45	117.84	90.96	11h30'	10h18'	0.8422	0.8553	0.9847
45	117.84	90.96	12h30'	11h18'	0.9161	0.9056	1.0116
45	117.84	90.96	13h30'	12h18'	0.9286	0.9142	1.0158
45	117.84	90.96	14h30'	13h18'	0.8789	0.8803	0.9984
45	117.84	90.96	15h30'	14h18'	0.7703	0.8063	0.9554
45	117.84	90.96	16h30'	15h18'	0.6103	0.6973	0.8753
45	117.84	90.96	17h30'	16h18'	0.4098	0.5606	0.7310
45	117.84	90.96	18h30'	17h18'	0.1823	0.4056	0.4495
45	*117.84*	*90.96*	*19h30'*	*18h18'*	*-0.0566*	*0.2428*	*-0.2332**
45	*117.84*	*90.96*	*20h30'*	*19h18'*	*-0.2907*	*0.0833*	*-3.4910**
45	*117.84*	*90.96*	*21h30'*	*20h18'*	*-0.5039*	*-0.0621*	*8.1172***
45	*117.84*	*90.96*	*22h30'*	*21h18'*	*-0.6819*	*-0.1834*	*3.7188***
For 22.12							
45	*62.25*	*62.25*	*6h30'*	*6h20'*	*0.0660*	*-0.2363*	*-0.2794****

45	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.2996*	*-0.0772*	*-3.8806****

continued

45	62.25	62.25	8h30'	8h20'	0.5117	0.0674	7.5945
45	62.25	62.25	9h30'	9h20'	0.6880	0.1875	3.6688
45	62.25	62.25	10h30'	10h20'	0.8165	0.2751	2.9681
45	62.25	62.25	11h30'	11h20'	0.8884	0.3241	2.7412
45	62.25	62.25	12h30'	12h20'	0.8988	0.3312	2.7139
45	62.25	62.25	13h30'	13h20'	0.8471	0.2959	2.8624
45	62.25	62.25	14h30'	14h20'	0.7367	0.2207	3.3381
45	62.25	62.25	15h30'	15h20'	0.5751	0.1106	5.2005
45	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.3734*	*-0.0269*	*-13.8965***
45	*62.25*	*62.25*	*17h30'*	*17h20'*	*0.1453*	*-0.1823*	*-0.7968****
45	*62.25*	*62.25*	*18h30'*	*18h20'*	*-0.0937*	*-0.3452*	*0.2715***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
50	*117.84*	*88.79*	*6h30'*	*5h18'*	*-0.1863*	*0.1779*	*-1.0470**
50	117.84	88.79	7h30'	6h18'	0.0525	0.3408	0.1540
50	117.84	88.79	8h30'	7h18'	0.2863	0.5002	0.5724
50	117.84	88.79	9h30'	8h18'	0.4993	0.6454	0.7735
50	117.84	88.79	10h30'	9h18'	0.6769	0.7665	0.8830
50	117.84	88.79	11h30'	10h18'	0.8070	0.8553	0.9436
50	117.84	88.79	12h30'	11h18'	0.8809	0.9056	0.9726
50	117.84	88.79	13h30'	12h18'	0.8934	0.9142	0.9773
50	117.84	88.79	14h30'	13h18'	0.8437	0.8803	0.9584
50	117.84	88.79	15h30'	14h18'	0.7352	0.8063	0.9118
50	117.84	88.79	16h30'	15h18'	0.5753	0.6973	0.8251
50	117.84	88.79	17h30'	16h18'	0.3748	0.5606	0.6687
50	117.84	88.79	18h30'	17h18'	0.1475	0.4056	0.3637
50	*117.84*	*88.79*	*19h30'*	*18h18'*	*-0.0912*	*0.2428*	*-0.3759**
50	*117.84*	*88.79*	*20h30'*	*19h18'*	*-0.3251*	*0.0833*	*-3.9053**
50	*117.84*	*88.79*	*21h30'*	*20h18'*	*-0.5383*	*-0.0621*	*8.6708***
50	*117.84*	*88.79*	*22h30'*	*21h18'*	*-0.7162*	*-0.1834*	*3.9056***
For 22.12							
50	*62.25*	*62.25*	*6h30'*	*6h20'*	*0.1007*	*-0.2363*	*-0.4259****
50	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.3340*	*-0.0772*	*-4.3274****
50	62.25	62.25	8h30'	8h20'	0.5461	0.0674	8.1044
50	62.25	62.25	9h30'	9h20'	0.7223	0.1875	3.8514
50	62.25	62.25	10h30'	10h20'	0.8507	0.2751	3.0923
50	62.25	62.25	11h30'	11h20'	0.9225	0.3241	2.8465
50	62.25	62.25	12h30'	12h20'	0.9329	0.3312	2.8169
50	62.25	62.25	13h30'	13h20'	0.8812	0.2959	2.9778
50	62.25	62.25	14h30'	14h20'	0.7709	0.2207	3.4931
50	62.25	62.25	15h30'	15h20'	0.6094	0.1106	5.5108

50	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.4078*	*-0.0269*	*-15.1784****
50	*62.25*	*62.25*	*17h30'*	*17h20'*	*0.1799*	*-0.1823*	*-0.9865****
50	*62.25*	*62.25*	*18h30'*	*18h20'*	*-0.0590*	*-0.3452*	*0.1709***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
55	*117.84*	*86.60*	*6h30'*	*5h18'*	*-0.2195*	*0.1779*	*-1.2333**
55	117.84	86.60	*7h30'*	6h18'	0.0173	0.3408	0.0509
55	117.84	86.60	8h30'	7h18'	0.2493	0.5002	0.4983
55	117.84	86.60	9h30'	8h18'	0.4605	0.6454	0.7134
55	117.84	86.60	10h30'	9h18'	0.6366	0.7665	0.8305
55	117.84	86.60	11h30'	10h18'	0.7657	0.8553	0.8953
55	117.84	86.60	12h30'	11h18'	0.8389	0.9056	0.9264
55	117.84	86.60	13h30'	12h18'	0.8514	0.9142	0.9313
55	117.84	86.60	14h30'	13h18'	0.8021	0.8803	0.9111
55	117.84	86.60	15h30'	14h18'	0.6945	0.8063	0.8613
55	117.84	86.60	16h30'	15h18'	0.5359	0.6973	0.7685
55	117.84	86.60	17h30'	16h18'	0.3371	0.5606	0.6013
55	117.84	86.60	18h30'	17h18'	0.1116	0.4056	0.2752
55	*117.84*	*86.60*	*19h30'*	*18h18'*	*-0.1252*	*0.2428*	*-0.5157**
55	*117.84*	*86.60*	*20h30'*	*19h18'*	*-0.3572*	*0.0833*	*-4.2899**
55	*117.84*	*86.60*	*21h30'*	*20h18'*	*-0.5686*	*-0.0621*	*9.1584***
55	*117.84*	*86.60*	*22h30'*	*21h18'*	*-0.7450*	*-0.1834*	*4.0627***
For 22.12							
55	*62.25*	*62.25*	*6h30'*	*6h20'*	*0.1345*	*-0.2363*	*-0.5692****
55	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.3660*	*-0.0772*	*-4.7413****
55	62.25	62.25	8h30'	8h20'	0.5763	0.0674	8.5528
55	62.25	62.25	9h30'	9h20'	0.7510	0.1875	4.0048
55	62.25	62.25	10h30'	10h20'	0.8784	0.2751	3.1930
55	62.25	62.25	11h30'	11h20'	0.9496	0.3241	2.9302
55	62.25	62.25	12h30'	12h20'	0.9600	0.3312	2.8985
55	62.25	62.25	13h30'	13h20'	0.9087	0.2959	3.0706
55	62.25	62.25	14h30'	14h20'	0.7992	0.2207	3.6217
55	62.25	62.25	15h30'	15h20'	0.6391	0.1106	5.7793
55	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.4392*	*-0.0269*	*-16.3450****
55	*62.25*	*62.25*	*17h30'*	*17h20'*	*0.2131*	*-0.1823*	*-1.1687****
55	*62.25*	*62.25*	*18h30'*	*18h20'*	*-0.0238*	*-0.3452*	*0.0690***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
60	*117.84*	*84.35*	*6h30'*	*5h18'*	*-0.2510*	*0.1779*	*-1.4103**
60	*117.84*	*84.35*	*7h30'*	*6h18'*	*-0.0179*	*0.3408*	*-0.0526**
60	117.84	84.35	8h30'	7h18'	0.2103	0.5002	0.4205
60	117.84	84.35	9h30'	8h18'	0.4182	0.6454	0.6479
60	117.84	84.35	10h30'	9h18'	0.5915	0.7665	0.7717

60	117.84	84.35	11h30’	10h18’	0.7186	0.8553	0.8401
60	117.84	84.35	12h30’	11h18’	0.7906	0.9056	0.8730
60	117.84	84.35	13h30’	12h18’	0.8028	0.9142	0.8782
60	117.84	84.35	14h30’	13h18’	0.7544	0.8803	0.8569

continued

60	117.84	84.35	15h30’	14h18’	0.6485	0.8063	0.8042
60	117.84	84.35	16h30’	15h18’	0.4924	0.6973	0.7062
60	117.84	84.35	17h30’	16h18’	0.2967	0.5606	0.5293
60	117.84	84.35	18h30’	17h18’	0.0748	0.4056	0.1846
60	*117.84*	*84.35*	*19h30’*	*18h18’*	*-0.1582*	*0.2428*	*-0.6516**
60	*117.84*	*84.35*	*20h30’*	*19h18’*	*-0.3865*	*0.0833*	*-4.6419**
60	*117.84*	*84.35*	*21h30’*	*20h18’*	*-0.5945*	*-0.0621*	*9.5764***
60	*117.84*	*84.35*	*22h30’*	*21h18’*	*-0.7681*	*-0.1834*	*4.1890***
For 22.12							
60	*62.25*	*62.25*	*6h30’*	*6h20’*	*0.1674*	*-0.2363*	*-0.7082****
60	*62.25*	*62.25*	*7h30’*	*7h20’*	*0.3952*	*-0.0772*	*-5.1192****
60	62.25	62.25	8h30’	8h20’	0.6021	0.0674	8.9361
60	62.25	62.25	9h30’	9h20’	0.7741	0.1875	4.1277
60	62.25	62.25	10h30’	10h20’	0.8994	0.2751	3.2695
60	62.25	62.25	11h30’	11h20’	0.9695	0.3241	2.9916
60	62.25	62.25	12h30’	12h20’	0.9797	0.3312	2.9581
60	62.25	62.25	13h30’	13h20’	0.9292	0.2959	3.1401
60	62.25	62.25	14h30’	14h20’	0.8215	0.2207	3.7227
60	62.25	62.25	15h30’	15h20’	0.6639	0.1106	6.0039
60	*62.25*	*62.25*	*16h30’*	*16h20’*	*0.4672*	*-0.0269*	*-17.3872***
60	*62.25*	*62.25*	*17h30’*	*17h20’*	*0.2447*	*-0.1823*	*-1.3420***
60	*62.25*	*62.25*	*18h30’*	*18h20’*	*0.0116*	*-0.3452*	*-0.0335***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
70	*117.84*	*79.49*	*6h30’*	*5h18’*	*-0.3080*	*0.1779*	*-1.7309**
70	*117.84*	*79.49*	*7h30’*	*6h18’*	*-0.0877*	*0.3408*	*-0.2575**
70	117.84	79.49	8h30’	7h18’	0.1279	0.5002	0.2558
70	117.84	79.49	9h30’	8h18’	0.3244	0.6454	0.5026
70	117.84	79.49	10h30’	9h18’	0.4882	0.7665	0.6369
70	117.84	79.49	11h30’	10h18’	0.6083	0.8553	0.7112
70	117.84	79.49	12h30’	11h18’	0.6764	0.9056	0.7469
70	117.84	79.49	13h30’	12h18’	0.6879	0.9142	0.7525
70	117.84	79.49	14h30’	13h18’	0.6421	0.8803	0.7294
70	117.84	79.49	15h30’	14h18’	0.5420	0.8063	0.6722
70	117.84	79.49	16h30’	15h18’	0.3945	0.6973	0.5658
70	117.84	79.49	17h30’	16h18’	0.2096	0.5606	0.3739
70	*117.84*	*79.49*	*18h30’*	*17h18’*	*-0.0001*	*0.4056*	*-0.0002**
70	*117.84*	*79.49*	*19h30’*	*18h18’*	*-0.2203*	*0.2428*	*-0.9076**
70	*117.84*	*79.49*	*20h30’*	*19h18’*	*-0.4361*	*0.0833*	*-5.2377**
70	*117.84*	*79.49*	*21h30’*	*20h18’*	*-0.6327*	*-0.0621*	*10.1914***

70	*117.84*	*79.49*	*22h30'*	*21h18'*	*-0.7968*	*-0.1834*	*4.3452***
For 22.12							
70	*62.25*	*62.25*	*6h30'*	*6h20'*	*0.2290*	*-0.2363*	*-0.9690****
70	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.4443*	*-0.0772*	*-5.7556****

continued

70	62.25	62.25	8h30'	8h20'	0.6399	0.0674	9.4966
70	62.25	62.25	9h30'	9h20'	0.8024	0.1875	4.2787
70	62.25	62.25	10h30'	10h20'	0.9208	0.2751	3.3474
70	62.25	62.25	11h30'	11h20'	0.9871	0.3241	3.0458
70	62.25	62.25	12h30'	12h20'	0.9967	0.3312	3.0095
70	62.25	62.25	13h30'	13h20'	0.9490	0.2959	3.2070
70	62.25	62.25	14h30'	14h20'	0.8472	0.2207	3.8392
70	62.25	62.25	15h30'	15h20'	0.6983	0.1106	6.3146
70	*62.25*	*62.25*	*16h30'*	*16h20'*	*0.5124*	*-0.0269*	*-19.0683****
70	*62.25*	*62.25*	*17h30'*	*17h20'*	*0.3021*	*-0.1823*	*-1.6568****
70	*62.25*	*62.25*	*18h30'*	*18h20'*	*0.0817*	*-0.3452*	*-0.2368****

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
80	*117.84*	*73.76*	*6h30'*	*5h18'*	*-0.3557*	*0.1779*	*-1.9989**
80	*117.84*	*73.76*	*7h30'*	*6h18'*	*-0.1549*	*0.3408*	*-0.4546**
80	117.84	73.76	8h30'	7h18'	0.0417	0.5002	0.0834
80	117.84	73.76	9h30'	8h18'	0.2208	0.6454	0.3420
80	117.84	73.76	10h30'	9h18'	0.3701	0.7665	0.4828
80	117.84	73.76	11h30'	10h18'	0.4796	0.8553	0.5607
80	117.84	73.76	12h30'	11h18'	0.5416	0.9056	0.5981
80	117.84	73.76	13h30'	12h18'	0.5522	0.9142	0.6040
80	117.84	73.76	14h30'	13h18'	0.5104	0.8803	0.5798
80	117.84	73.76	15h30'	14h18'	0.4192	0.8063	0.5198
80	117.84	73.76	16h30'	15h18'	0.2847	0.6973	0.4083
80	117.84	73.76	17h30'	16h18'	0.1161	0.5606	0.2072
80	*117.84*	*73.76*	*18h30'*	*17h18'*	*-0.0750*	*0.4056*	*-0.1850**
80	*117.84*	*73.76*	*19h30'*	*18h18'*	*-0.2758*	*0.2428*	*-1.1360**
80	*117.84*	*73.76*	*20h30'*	*19h18'*	*-0.4724*	*0.0833*	*-5.6744**
80	*117.84*	*73.76*	*21h30'*	*20h18'*	*-0.6517*	*-0.0621*	*10.4970***
80	*117.84*	*73.76*	*22h30'*	*21h18'*	*-0.8012*	*-0.1834*	*4.3695***
For 22.12							
80	*62.25*	*62.25*	*6h30'*	*6h20'*	*0.2837*	*-0.2363*	*-1.2003****
80	*62.25*	*62.25*	*7h30'*	*7h20'*	*0.4799*	*-0.0772*	*-6.2173****

80	62.25	62.25	8h30’	8h20’	0.6582	0.0674	9.7688
80	62.25	62.25	9h30’	9h20’	0.8064	0.1875	4.2999
80	62.25	62.25	10h30’	10h20’	0.9143	0.2751	3.3237
80	62.25	62.25	11h30’	11h20’	0.9747	0.3241	3.0077
80	62.25	62.25	12h30’	12h20’	0.9835	0.3312	2.9696
80	62.25	62.25	13h30’	13h20’	0.9400	0.2959	3.1765
80	62.25	62.25	14h30’	14h20’	0.8472	0.2207	3.8392
80	62.25	62.25	15h30’	15h20’	0.7115	0.1106	6.4337
80	*62.25*	*62.25*	*16h30’*	*16h20’*	*0.5420*	*-0.0269*	*-20.1705****
80	*62.25*	*62.25*	*17h30’*	*17h20’*	*0.3503*	*-0.1823*	*-1.9212****
80	*62.25*	*62.25*	*18h30’*	*18h20’*	*0.1494*	*-0.3452*	*-0.4329****

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
90	*117.84*	*66.30*	*6h30’*	*5h18’*	*-0.3926*	*0.1779*	*-2.2063**
90	*117.84*	*66.30*	*7h30’*	*6h18’*	*-0.2174*	*0.3408*	*-0.6380**
90	*117.84*	*66.30*	*8h30’*	*7h18’*	*-0.0458*	*0.5002*	*-0.0916**
90	117.84	66.30	9h30’	8h18’	0.1104	0.6454	0.1711
90	117.84	66.30	10h30’	9h18’	0.2408	0.7665	0.3141
90	117.84	66.30	11h30’	10h18’	0.3363	0.8553	0.3931
90	117.84	66.30	12h30’	11h18’	0.3904	0.9056	0.4311
90	117.84	66.30	13h30’	12h18’	0.3996	0.9142	0.4371
90	117.84	66.30	14h30’	13h18’	0.3632	0.8803	0.4125
90	117.84	66.30	15h30’	14h18’	0.2836	0.8063	0.3517
90	117.84	66.30	16h30’	15h18’	0.1662	0.6973	0.2384
90	117.84	66.30	17h30’	16h18’	0.0191	0.5606	0.0341
90	*117.84*	*66.30*	*18h30’*	*17h18’*	*-0.1477*	*0.4056*	*-0.3641**
90	*117.84*	*66.30*	*19h30’*	*18h18’*	*-0.3228*	*0.2428*	*-1.3299**
90	*117.84*	*66.30*	*20h30’*	*19h18’*	*-0.4945*	*0.0833*	*-5.9389**
90	*117.84*	*66.30*	*21h30’*	*20h18’*	*-0.6509*	*-0.0621*	*10.4841***
90	*117.84*	*66.30*	*22h30’*	*21h18’*	*-0.7814*	*-0.1834*	*4.2612***
For 22.12							
90	*62.25*	*62.25*	*6h30’*	*6h20’*	*0.3298*	*-0.2363*	*-1.3953****
90	*62.25*	*62.25*	*7h30’*	*7h20’*	*0.5010*	*-0.0772*	*-6.4902****
90	62.25	62.25	8h30’	8h20’	0.6566	0.0674	9.7445
90	62.25	62.25	9h30’	9h20’	0.7858	0.1875	4.1905
90	62.25	62.25	10h30’	10h20’	0.8801	0.2751	3.1992
90	62.25	62.25	11h30’	11h20’	0.9328	0.3241	2.8782
90	62.25	62.25	12h30’	12h20’	0.9404	0.3312	2.8395
90	62.25	62.25	13h30’	13h20’	0.9025	0.2959	3.0497
90	62.25	62.25	14h30’	14h20’	0.8215	0.2207	3.7226
90	62.25	62.25	15h30’	15h20’	0.7031	0.1106	6.3575
90	*62.25*	*62.25*	*16h30’*	*16h20’*	*0.5551*	*-0.0269*	*-20.6605****
90	*62.25*	*62.25*	*17h30’*	*17h20’*	*0.3879*	*-0.1823*	*-2.1274****

90	*62.25*	*62.25*	*18h30'*	*18h20'*	*0.2126*	*-0.3452*	*-0.6159****

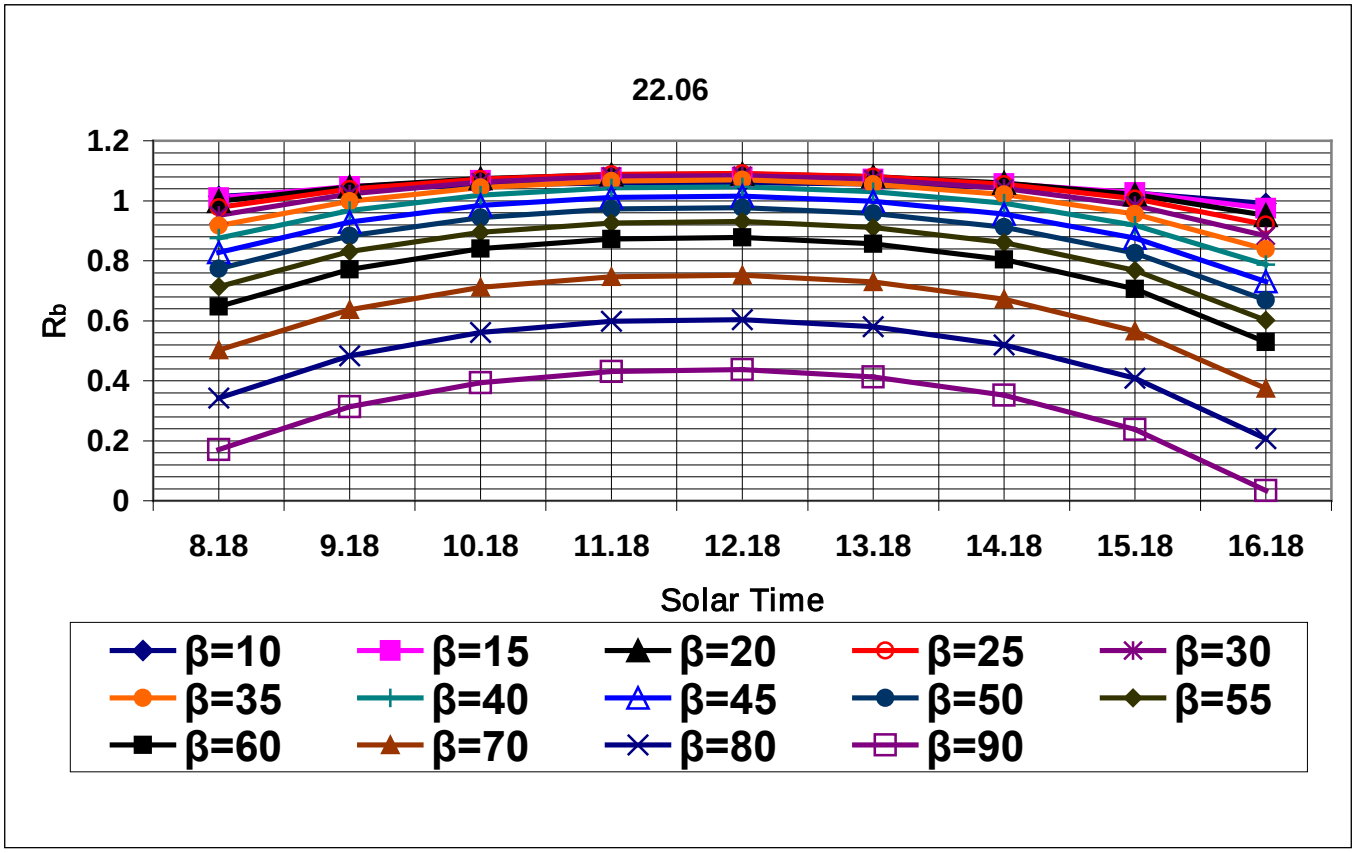

Figure IV.2: *The diagram of R_b, for **ST**, at various **β**. This is for 22.06.*

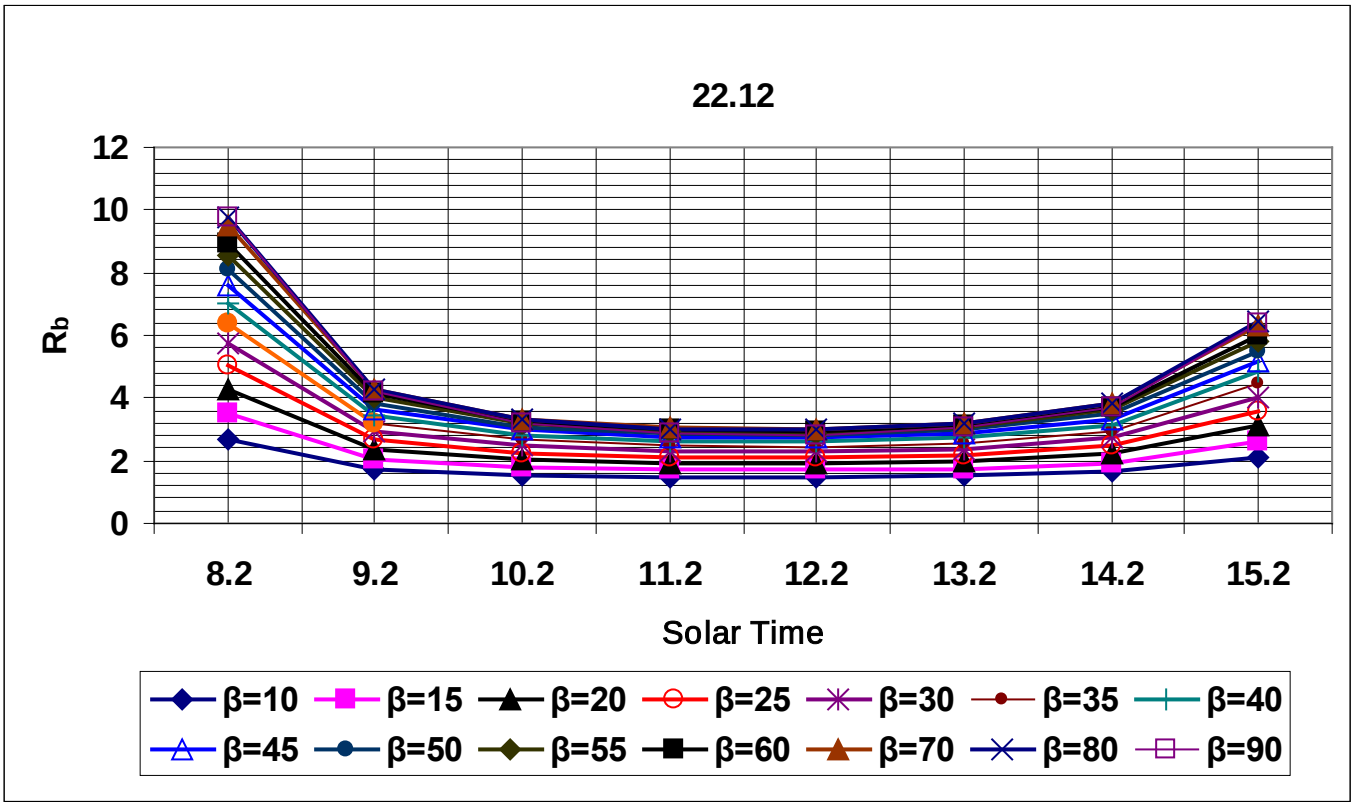

Figure IV.3: *The diagram of R_b, for **ST**, at various **β**. This is for 22.12.*

Cluj-Napoca

Latitude: 46.47^0
Longitude: 23.34^0
Altitude: 410 m
Calculations for: a. the 22nd June: WT is from $6^{30}$to 22^{30} for summer time or equivalent 5^{30} to 21^{30} for winter time which is the proper time to be used for WT
b. the 22 nd December: WT is from 6^{30} to 18^{30}.

For 22.06 $\Rightarrow$ n=173 and for 22.12 $\Rightarrow$ n=356.

B	E	L_{st}	L_{loc}	WT	WT	ST	ω	δ
For 22.06	(minutes)			Summer Time	Winter Time			
90.99	-1.70	30	23.34	6h30'	5h30'	5h2'	-104.50	23.45
90.99	-1.70	30	23.34	7h30'	6h30'	6h2'	-89.50	23.45
90.99	-1.70	30	23.34	8h30'	7h30'	7h2'	-74.50	23.45
90.99	-1.70	30	23.34	9h30'	8h30'	8h2'	-59.50	23.45
90.99	-1.70	30	23.34	10h30'	9h30'	9h2'	-44.50	23.45
90.99	-1.70	30	23.34	11h30'	10h30'	10h2'	-29.50	23.45
90.99	-1.70	30	23.34	12h30'	11h30'	11h2'	-14.50	23.45
90.99	-1.70	30	23.34	13h30'	12h30'	12h2'	0.50	23.45
90.99	-1.70	30	23.34	14h30'	13h30'	13h2'	15.50	23.45
90.99	-1.70	30	23.34	15h30'	14h30'	14h2'	30.50	23.45
90.99	-1.70	30	23.34	16h30'	15h30'	15h2'	45.50	23.45
90.99	-1.70	30	23.34	17h30'	16h30'	16h2'	60.50	23.45
90.99	-1.70	30	23.34	18h30'	17h30'	17h2'	75.50	23.45
90.99	-1.70	30	23.34	19h30'	18h30'	18h2'	90.50	23.45
90.99	*-1.70*	*30*	*23.34*	*20h30'*	*19h30'*	*19h2'*	*105.50*	*23.45*
90.99	*-1.70*	*30*	*23.34*	*21h30'*	*20h30'*	*20h2'*	*120.50*	*23.45*
90.99	*-1.70*	*30*	*23.34*	*22h30'*	*21h30'*	*21h2'*	*135.50*	*23.45*
For 22.12								
271.98	*0.62*	*30*	*23.34*		*6h30'*	*6h4'*	*-89.00*	*-23.45*
271.98	*0.62*	*30*	*23.34*		*7h30'*	*7h4'*	*-74.00*	*-23.45*
271.98	0.62	30	23.34		8h30'	8h4'	-59.00	-23.45
271.98	0.62	30	23.34		9h30'	9h4'	-44.00	-23.45
271.98	0.62	30	23.34		10h30'	10h4'	-29.00	-23.45
271.98	0.62	30	23.34		11h30'	11h4'	-14.00	-23.45
271.98	0.62	30	23.34		12h30'	12h4'	1.00	-23.45
271.98	0.62	30	23.34		13h30'	13h4'	16.00	-23.45
271.98	0.62	30	23.34		14h30'	14h4'	31.00	-23.45
271.98	0.62	30	23.34		15h30'	15h4'	46.00	-23.45
271.98	0.62	30	23.34		16h30'	16h4'	61.00	-23.45
271.98	*0.62*	*30*	*23.34*		*17h30'*	*17h4'*	*76.00*	*-23.45*
271.98	*0.62*	*30*	*23.34*		*18h30'*	*18h4'*	*91.00*	*-23.45*

φ	β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06								
46.47	10	117.19	108.73	6h30’	5h2’	0.0522	0.1305	0.3999
46.47	10	117.19	108.73	7h30’	6h2’	0.2433	0.2943	0.8269
46.47	10	117.19	108.73	8h30’	7h2’	0.4340	0.4576	0.9484
46.47	10	117.19	108.73	9h30’	8h2’	0.6112	0.6094	1.0030
46.47	10	117.19	108.73	10h30’	9h2’	0.7629	0.7393	1.0319
46.47	10	117.19	108.73	11h30’	10h2’	0.8787	0.8386	1.0479
46.47	10	117.19	108.73	12h30’	11h2’	0.9508	0.9003	1.0561
46.47	10	117.19	108.73	13h30’	12h2’	0.9743	0.9204	1.0585
46.47	10	117.19	108.73	14h30’	13h2’	0.9475	0.8975	1.0557
46.47	10	117.19	108.73	15h30’	14h2’	0.8723	0.8331	1.0471
46.47	10	117.19	108.73	16h30’	15h2’	0.7538	0.7316	1.0304
46.47	10	117.19	108.73	17h30’	16h2’	0.6001	0.5999	1.0004
46.47	10	117.19	108.73	18h30’	17h2’	0.4216	0.4470	0.9432
46.47	10	117.19	108.73	19h30’	18h2’	0.2305	0.2833	0.8137
6.47	10	117.19	108.73	20h30’	19h2’	0.0398	0.1199	0.3317
46.47	*10*	*117.19*	*108.73*	*21h30’*	*20h2’*	*-0.1376*	*-0.0320*	*4.2977***
46.47	*10*	*117.19*	*108.73*	*22h30’*	*21h2’*	*-0.2894*	*-0.1621*	*1.7854***
For 22.12								
46.47	*10*	*62.90*	*62.90*	*6h30’*	*6h4’*	*-0.2229*	*-0.2767*	*0.8053***
46.47	*10*	*62.90*	*62.90*	*7h30’*	*7h4’*	*-0.0324*	*-0.1136*	*0.2855***
46.47	10	62.90	62.90	8h30’	8h4’	0.1441	0.0376	3.8312
46.47	10	62.90	62.90	9h30’	9h4’	0.2947	0.1667	1.7686
46.47	10	62.90	62.90	10h30’	10h4’	0.4092	0.2647	1.5458
46.47	10	62.90	62.90	11h30’	11h4’	0.4798	0.3252	1.4755
46.47	10	62.90	62.90	12h30’	12h4’	0.5016	0.3438	1.4588
46.47	10	62.90	62.90	13h30’	13h4’	0.4731	0.3194	1.4810
46.47	10	62.90	62.90	14h30’	14h4’	0.3964	0.2537	1.5623
46.47	10	62.90	62.90	15h30’	15h4’	0.2765	0.1511	1.8306
46.47	10	62.90	62.90	16h30’	16h4’	0.1218	0.0185	6.5779
46.47	*10*	*62.90*	*62.90*	*17h30’*	*17h4’*	*-0.0573*	*-0.1349*	*0.4248***
46.47	*10*	*62.90*	*62.90*	*18h30’*	*18h4’*	*-0.2486*	*-0.2988*	*0.8321***

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
15	117.19	105.43	6h30’	5h2’	0.0123	0.1305	0.0941
15	117.19	105.43	7h30’	6h2’	0.2150	0.2943	0.7306
15	117.19	105.43	8h30’	7h2’	0.4172	0.4576	0.9117
15	117.19	105.43	9h30’	8h2’	0.6051	0.6094	0.9930
15	117.19	105.43	10h30’	9h2’	0.7660	0.7393	1.0361
15	117.19	105.43	11h30’	10h2’	0.8889	0.8386	1.0600
15	117.19	105.43	12h30’	11h2’	0.9653	0.9003	1.0722
15	117.19	105.43	13h30’	12h2’	0.9902	0.9204	1.0758
15	117.19	105.43	14h30’	13h2’	0.9618	0.8975	1.0717
15	117.19	105.43	15h30’	14h2’	0.8820	0.8331	1.0588
15	117.19	105.43	16h30’	15h2’	0.7564	0.7316	1.0339
15	117.19	105.43	17h30’	16h2’	0.5933	0.5999	0.9891
15	117.19	105.43	18h30’	17h2’	0.4040	0.4470	0.9039
15	117.19	105.43	19h30’	18h2’	0.2014	0.2833	0.7108
15	*117.19*	*105.43*	*20h30’*	*19h2’*	*-0.0009*	*0.1199*	*-0.0075**
15	*117.19*	*105.43*	*21h30’*	*20h2’*	*-0.1890*	*-0.0320*	*5.9037***
15	*117.19*	*105.43*	*22h30’*	*21h2’*	*-0.3500*	*-0.1621*	*2.1593***
For 22.12							
15	*62.90*	*62.90*	*6h30’*	*6h4’*	*-0.1933*	*-0.2767*	*0.6984***
15	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.0087*	*-0.1136*	*-0.0763****
15	62.90	62.90	8h30’	8h4’	0.1959	0.0376	5.2084
15	62.90	62.90	9h30’	9h4’	0.3557	0.1667	2.1341
15	62.90	62.90	10h30’	10h4’	0.4771	0.2647	1.8022
15	62.90	62.90	11h30’	11h4’	0.5519	0.3252	1.6973
15	62.90	62.90	12h30’	12h4’	0.5750	0.3438	1.6724
15	62.90	62.90	13h30’	13h4’	0.5448	0.3194	1.7055
15	62.90	62.90	14h30’	14h4’	0.4634	0.2537	1.8267
15	62.90	62.90	15h30’	15h4’	0.3364	0.1511	2.2266
15	62.90	62.90	16h30’	16h4’	0.1723	0.0185	9.3024
15	*62.90*	*62.90*	*17h30’*	*17h4’*	*-0.0177*	*-0.1349*	*0.1312***
15	*62.90*	*62.90*	*18h30’*	*18h4’*	*-0.2206*	*-0.2988*	*0.7383***

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
20	*117.19*	*102.51*	*6h30’*	*5h2’*	*-0.0277*	*0.1305*	*-0.2123**
20	117.19	102.51	7h30’	6h2’	0.1850	0.2943	0.6287
20	117.19	102.51	8h30’	7h2’	0.3972	0.4576	0.8681

20	117.19	102.51	9h30’	8h2’	0.5945	0.6094	0.9755
20	117.19	102.51	10h30’	9h2’	0.7633	0.7393	1.0324
20	117.19	102.51	11h30’	10h2’	0.8922	0.8386	1.0640
20	117.19	102.51	12h30’	11h2’	0.9725	0.9003	1.0801
20	117.19	102.51	13h30’	12h2’	0.9986	0.9204	1.0849
20	117.19	102.51	14h30’	13h2’	0.9688	0.8975	1.0794

continued

20	117.19	102.51	15h30’	14h2’	0.8851	0.8331	1.0624
20	117.19	102.51	16h30’	15h2’	0.7532	0.7316	1.0296
20	117.19	102.51	17h30’	16h2’	0.5821	0.5999	0.9703
20	117.19	102.51	18h30’	17h2’	0.3834	0.4470	0.8578
20	117.19	102.51	19h30’	18h2’	0.1707	0.2833	0.6026
20	*117.19*	*102.51*	*20h30’*	*19h2’*	*-0.0416*	*0.1199*	*-0.3467**
20	*117.19*	*102.51*	*21h30’*	*20h2’*	*-0.2389*	*-0.0320*	*7.4649***
20	*117.19*	*102.51*	*22h30’*	*21h2’*	*-0.4080*	*-0.1621*	*2.5167***
For 22.12							
20	*62.90*	*62.90*	*6h30’*	*6h4’*	*-0.1622*	*-0.2767*	*0.5862***
20	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.0497*	*-0.1136*	*-0.4376****
20	62.90	62.90	8h30’	8h4’	0.2462	0.0376	6.5461
20	62.90	62.90	9h30’	9h4’	0.4139	0.1667	2.4834
20	62.90	62.90	10h30’	10h4’	0.5413	0.2647	2.0448
20	62.90	62.90	11h30’	11h4’	0.6198	0.3252	1.9062
20	62.90	62.90	12h30’	12h4’	0.6441	0.3438	1.8733
20	62.90	62.90	13h30’	13h4’	0.6124	0.3194	1.9171
20	62.90	62.90	14h30’	14h4’	0.5270	0.2537	2.0772
20	62.90	62.90	15h30’	15h4’	0.3936	0.1511	2.6056
20	62.90	62.90	16h30’	16h4’	0.2214	0.0185	11.9561
20	*62.90*	*62.90*	*17h30’*	*17h4’*	*0.0220*	*-0.1349*	*-0.1634****
20	*62.90*	*62.90*	*18h30’*	*18h4’*	*-0.1909*	*-0.2988*	*0.6389***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
25	*117.19*	*99.86*	*6h30’*	*5h2’*	*-0.0675*	*0.1305*	*-0.5172**
25	117.19	99.86	7h30’	6h2’	0.1536	0.2943	0.5221
25	117.19	99.86	8h30’	7h2’	0.3742	0.4576	0.8178
25	117.19	99.86	9h30’	8h2’	0.5793	0.6094	0.9506
25	117.19	99.86	10h30’	9h2’	0.7548	0.7393	1.0209
25	117.19	99.86	11h30’	10h2’	0.8888	0.8386	1.0599
25	117.19	99.86	12h30’	11h2’	0.9722	0.9003	1.0799
25	117.19	99.86	13h30’	12h2’	0.9994	0.9204	1.0858
25	117.19	99.86	14h30’	13h2’	0.9684	0.8975	1.0790
25	117.19	99.86	15h30’	14h2’	0.8814	0.8331	1.0580
25	117.19	99.86	16h30’	15h2’	0.7443	0.7316	1.0174
25	117.19	99.86	17h30’	16h2’	0.5664	0.5999	0.9442
25	117.19	99.86	18h30’	17h2’	0.3599	0.4470	0.8051
25	117.19	99.86	19h30’	18h2’	0.1387	0.2833	0.4898

25	*117.19*	*99.86*	*20h30'*	*19h2'*	*-0.0819*	*0.1199*	*-0.6832**
25	*117.19*	*99.86*	*21h30'*	*20h2'*	*-0.2871*	*-0.0320*	*8.9693***
25	*117.19*	*99.86*	*22h30'*	*21h2'*	*-0.4628*	*-0.1621*	*2.8550***
For 22.12							
25	*62.90*	*62.90*	*6h30'*	*6h4'*	*-0.1299*	*-0.2767*	*0.4695***
25	*62.90*	*62.90*	*7h30'*	*7h4'*	*0.0904*	*-0.1136*	*-0.7955****

continued

25	62.90	62.90	8h30'	8h4'	0.2947	0.0376	7.8340
25	62.90	62.90	9h30'	9h4'	0.4690	0.1667	2.8139
25	62.90	62.90	10h30'	10h4'	0.6014	0.2647	2.2718
25	62.90	62.90	11h30'	11h4'	0.6830	0.3252	2.1007
25	62.90	62.90	12h30'	12h4'	0.7082	0.3438	2.0599
25	62.90	62.90	13h30'	13h4'	0.6753	0.3194	2.1141
25	62.90	62.90	14h30'	14h4'	0.5865	0.2537	2.3119
25	62.90	62.90	15h30'	15h4'	0.4479	0.1511	2.9649
25	62.90	62.90	16h30'	16h4'	0.2689	0.0185	14.5190
25	*62.90*	*62.90*	*17h30'*	*17h4'*	*0.0616*	*-0.1349*	*-0.4567****
25	*62.90*	*62.90*	*18h30'*	*18h4'*	*-0.1597*	*-0.2988*	*0.5346***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
30	*117.19*	*97.41*	*6h30'*	*5h2'*	*-0.1068*	*0.1305*	*-0.8181**
30	117.19	97.41	7h30'	6h2'	0.1211	0.2943	0.4115
30	117.19	97.41	8h30'	7h2'	0.3484	0.4576	0.7614
30	117.19	97.41	9h30'	8h2'	0.5597	0.6094	0.9184
30	117.19	97.41	10h30'	9h2'	0.7405	0.7393	1.0016
30	117.19	97.41	11h30'	10h2'	0.8786	0.8386	1.0478
30	117.19	97.41	12h30'	11h2'	0.9646	0.9003	1.0714
30	117.19	97.41	13h30'	12h2'	0.9926	0.9204	1.0784
30	117.19	97.41	14h30'	13h2'	0.9606	0.8975	1.0704
30	117.19	97.41	15h30'	14h2'	0.8710	0.8331	1.0455
30	117.19	97.41	16h30'	15h2'	0.7297	0.7316	0.9974
30	117.19	97.41	17h30'	16h2'	0.5464	0.5999	0.9109
30	117.19	97.41	18h30'	17h2'	0.3336	0.4470	0.7463
30	117.19	97.41	19h30'	18h2'	0.1057	0.2833	0.3733
30	*117.19*	*97.41*	*20h30'*	*19h2'*	*-0.1216*	*0.1199*	*-1.0145**
30	*117.19*	*97.41*	*21h30'*	*20h2'*	*-0.3331*	*-0.0320*	*10.4055***
30	*117.19*	*97.41*	*22h30'*	*21h2'*	*-0.5141*	*-0.1621*	*3.1716***
For 22.12							
30	*62.90*	*62.90*	*6h30'*	*6h4'*	*-0.0967*	*-0.2767*	*0.3493***
30	*62.90*	*62.90*	*7h30'*	*7h4'*	*0.1304*	*-0.1136*	*-1.1474****
30	62.90	62.90	8h30'	8h4'	0.3409	0.0376	9.0623
30	62.90	62.90	9h30'	9h4'	0.5205	0.1667	3.1229
30	62.90	62.90	10h30'	10h4'	0.6570	0.2647	2.4816
30	62.90	62.90	11h30'	11h4'	0.7411	0.3252	2.2791

30	62.90	62.90	12h30’	12h4’	0.7670	0.3438	2.2309
30	62.90	62.90	13h30’	13h4’	0.7331	0.3194	2.2950
30	62.90	62.90	14h30’	14h4’	0.6416	0.2537	2.5290
30	62.90	62.90	15h30’	15h4’	0.4988	0.1511	3.3016
30	62.90	62.90	16h30’	16h4’	0.3143	0.0185	16.9714
30	*62.90*	*62.90*	*17h30’*	*17h4’*	*0.1007*	*-0.1349*	*-0.7466****
30	*62.90*	*62.90*	*18h30’*	*18h4’*	*-0.1274*	*-0.2988*	*0.4263***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
35	*117.19*	*95.09*	*6h30’*	*5h2’*	*-0.1453*	*0.1305*	*-1.1128**
35	117.19	95.09	7h30’	6h2’	0.0876	0.2943	0.2977
35	117.19	95.09	8h30’	7h2’	0.3199	0.4576	0.6991
35	117.19	95.09	9h30’	8h2’	0.5358	0.6094	0.8793
35	117.19	95.09	10h30’	9h2’	0.7206	0.7393	0.9747
35	117.19	95.09	11h30’	10h2’	0.8618	0.8386	1.0277
35	117.19	95.09	12h30’	11h2’	0.9496	0.9003	1.0548
35	117.19	95.09	13h30’	12h2’	0.9782	0.9204	1.0628
35	117.19	95.09	14h30’	13h2’	0.9456	0.8975	1.0536
35	117.19	95.09	15h30’	14h2’	0.8539	0.8331	1.0251
35	117.19	95.09	16h30’	15h2’	0.7096	0.7316	0.9699
35	117.19	95.09	17h30’	16h2’	0.5223	0.5999	0.8706
35	117.19	95.09	18h30’	17h2’	0.3048	0.4470	0.6819
35	117.19	95.09	19h30’	18h2’	0.0719	0.2833	0.2539
35	*117.19*	*95.09*	*20h30’*	*19h2’*	*-0.1604*	*0.1199*	*-1.3381**
35	*117.19*	*95.09*	*21h30’*	*20h2’*	*-0.3765*	*-0.0320*	*11.7626***
35	*117.19*	*95.09*	*22h30’*	*21h2’*	*-0.5615*	*-0.1621*	*3.4640***
For 22.12							
35	*62.90*	*62.90*	*6h30’*	*6h4’*	*-0.0627*	*-0.2767*	*0.2264***
35	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.1694*	*-0.1136*	*-1.4906****
35	62.90	62.90	8h30’	8h4’	0.3845	0.0376	10.2217
35	62.90	62.90	9h30’	9h4’	0.5680	0.1667	3.4083
35	62.90	62.90	10h30’	10h4’	0.7075	0.2647	2.6726
35	62.90	62.90	11h30’	11h4’	0.7934	0.3252	2.4402
35	62.90	62.90	12h30’	12h4’	0.8200	0.3438	2.3850
35	62.90	62.90	13h30’	13h4’	0.7853	0.3194	2.4584
35	62.90	62.90	14h30’	14h4’	0.6918	0.2537	2.7269
35	62.90	62.90	15h30’	15h4’	0.5458	0.1511	3.6132
35	62.90	62.90	16h30’	16h4’	0.3573	0.0185	19.2949
35	*62.90*	*62.90*	*17h30’*	*17h4’*	*0.1391*	*-0.1349*	*-1.0307****
35	*62.90*	*62.90*	*18h30’*	*18h4’*	*-0.0940*	*-0.2988*	*0.3147***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
40	*117.19*	*92.86*	*6h30’*	*5h2’*	*-0.1826*	*0.1305*	*-1.3991**

40	117.19	92.86	7h30’	6h2’	0.0535	0.2943	0.1817
40	117.19	92.86	8h30’	7h2’	0.2890	0.4576	0.6316
40	117.19	92.86	9h30’	8h2’	0.5079	0.6094	0.8334
40	117.19	92.86	10h30’	9h2’	0.6953	0.7393	0.9404
40	117.19	92.86	11h30’	10h2’	0.8384	0.8386	0.9998
40	117.19	92.86	12h30’	11h2’	0.9274	0.9003	1.0301
40	117.19	92.86	13h30’	12h2’	0.9564	0.9204	1.0391

continued

40	117.19	92.86	14h30’	13h2’	0.9233	0.8975	1.0288
40	117.19	92.86	15h30’	14h2’	0.8304	0.8331	0.9968
40	117.19	92.86	16h30’	15h2’	0.6840	0.7316	0.9351
40	117.19	92.86	17h30’	16h2’	0.4941	0.5999	0.8238
40	117.19	92.86	18h30’	17h2’	0.2736	0.4470	0.6122
40	117.19	92.86	19h30’	18h2’	0.0376	0.2833	0.1326
40	*117.19*	*92.86*	*20h30’*	*19h2’*	*-0.1980*	*0.1199*	*-1.6516**
40	*117.19*	*92.86*	*21h30’*	*20h2’*	*-0.4171*	*-0.0320*	*13.0302***
40	*117.19*	*92.86*	*22h30’*	*21h2’*	*-0.6047*	*-0.1621*	*3.7302***
For 22.12							
40	*62.90*	*62.90*	*6h30’*	*6h4’*	*-0.0282*	*-0.2767*	*0.1018***
40	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.2071*	*-0.1136*	*-1.8224****
40	62.90	62.90	8h30’	8h4’	0.4251	0.0376	11.3034
40	62.90	62.90	9h30’	9h4’	0.6112	0.1667	3.6677
40	62.90	62.90	10h30’	10h4’	0.7527	0.2647	2.8432
40	62.90	62.90	11h30’	11h4’	0.8398	0.3252	2.5828
40	62.90	62.90	12h30’	12h4’	0.8667	0.3438	2.5209
40	62.90	62.90	13h30’	13h4’	0.8316	0.3194	2.6032
40	62.90	62.90	14h30’	14h4’	0.7368	0.2537	2.9040
40	62.90	62.90	15h30’	15h4’	0.5888	0.1511	3.8973
40	62.90	62.90	16h30’	16h4’	0.3976	0.0185	21.4716
40	*62.90*	*62.90*	*17h30’*	*17h4’*	*0.1763*	*-0.1349*	*-1.3071****
40	*62.90*	*62.90*	*18h30’*	*18h4’*	*-0.0600*	*-0.2988*	*0.2007***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
45	*117.19*	*90.68*	*6h30’*	*5h2’*	*-0.2186*	*0.1305*	*-1.6747**
45	117.19	90.68	7h30’	6h2’	0.0189	0.2943	0.0643
45	117.19	90.68	8h30’	7h2’	0.2559	0.4576	0.5592
45	117.19	90.68	9h30’	8h2’	0.4761	0.6094	0.7813
45	117.19	90.68	10h30’	9h2’	0.6646	0.7393	0.8990
45	117.19	90.68	11h30’	10h2’	0.8086	0.8386	0.9643
45	117.19	90.68	12h30’	11h2’	0.8982	0.9003	0.9976
45	117.19	90.68	13h30’	12h2’	0.9274	0.9204	1.0075
45	117.19	90.68	14h30’	13h2’	0.8941	0.8975	0.9962
45	117.19	90.68	15h30’	14h2’	0.8006	0.8331	0.9610
45	117.19	90.68	16h30’	15h2’	0.6533	0.7316	0.8931
45	117.19	90.68	17h30’	16h2’	0.4623	0.5999	0.7706

45	117.19	90.68	18h30’	17h2’	0.2404	0.4470	0.5379
45	117.19	90.68	19h30’	18h2’	0.0029	0.2833	0.0103
45	*117.19*	*90.68*	*20h30’*	*19h2’*	*-0.2341*	*0.1199*	*-1.9524**
45	*117.19*	*90.68*	*21h30’*	*20h2’*	*-0.4545*	*-0.0320*	*14.1989***
45	*117.19*	*90.68*	*22h30’*	*21h2’*	*-0.6432*	*-0.1621*	*3.9679***
For 22.12							
45	*62.90*	*62.90*	*6h30’*	*6h4’*	*0.0065*	*-0.2767*	*-0.0236****

continued

45	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.2432*	*-0.1136*	*-2.1404****
45	62.90	62.90	8h30’	8h4’	0.4626	0.0376	12.2992
45	62.90	62.90	9h30’	9h4’	0.6498	0.1667	3.8992
45	62.90	62.90	10h30’	10h4’	0.7921	0.2647	2.9921
45	62.90	62.90	11h30’	11h4’	0.8798	0.3252	2.7057
45	62.90	62.90	12h30’	12h4’	0.9069	0.3438	2.6376
45	62.90	62.90	13h30’	13h4’	0.8715	0.3194	2.7281
45	62.90	62.90	14h30’	14h4’	0.7761	0.2537	3.0591
45	62.90	62.90	15h30’	15h4’	0.6272	0.1511	4.1518
45	62.90	62.90	16h30’	16h4’	0.4349	0.0185	23.4851
45	*62.90*	*62.90*	*17h30’*	*17h4’*	*0.2123*	*-0.1349*	*-1.5735****
45	*62.90*	*62.90*	*18h30’*	*18h4’*	*-0.0255*	*-0.2988*	*0.0852***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
50	*117.19*	*88.51*	*6h30’*	*5h2’*	*-0.2529*	*0.1305*	*-1.9376**
50	*117.19*	*88.51*	*7h30’*	6h2’	*-0.0158*	*0.2943*	*-0.0536**
50	117.19	88.51	8h30’	7h2’	0.2208	0.4576	0.4826
50	117.19	88.51	9h30’	8h2’	0.4407	0.6094	0.7232
50	117.19	88.51	10h30’	9h2’	0.6289	0.7393	0.8507
50	117.19	88.51	11h30’	10h2’	0.7727	0.8386	0.9214
50	117.19	88.51	12h30’	11h2’	0.8621	0.9003	0.9576
50	117.19	88.51	13h30’	12h2’	0.8912	0.9204	0.9683
50	117.19	88.51	14h30’	13h2’	0.8580	0.8975	0.9560
50	117.19	88.51	15h30’	14h2’	0.7647	0.8331	0.9179
50	117.19	88.51	16h30’	15h2’	0.6176	0.7316	0.8443
50	117.19	88.51	17h30’	16h2’	0.4269	0.5999	0.7116
50	117.19	88.51	18h30’	17h2’	0.2054	0.4470	0.4595
50	*117.19*	*88.51*	*19h30’*	18h2’	*-0.0317*	*0.2833*	*-0.1120**
50	*117.19*	*88.51*	*20h30’*	*19h2’*	*-0.2684*	*0.1199*	*-2.2385**
50	*117.19*	*88.51*	*21h30’*	*20h2’*	*-0.4884*	*-0.0320*	*15.2595***
50	*117.19*	*88.51*	*22h30’*	*21h2’*	*-0.6769*	*-0.1621*	*4.1755***
For 22.12							
50	*62.90*	*62.90*	*6h30’*	*6h4’*	*0.0412*	*-0.2767*	*-0.1488****
50	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.2775*	*-0.1136*	*-2.4421****
50	62.90	62.90	8h30’	8h4’	0.4965	0.0376	13.2014
50	62.90	62.90	9h30’	9h4’	0.6835	0.1667	4.1010
50	62.90	62.90	10h30’	10h4’	0.8255	0.2647	3.1184

50	62.90	62.90	11h30'	11h4'	0.9131	0.3252	2.8081
50	62.90	62.90	12h30'	12h4'	0.9401	0.3438	2.7343
50	62.90	62.90	13h30'	13h4'	0.9048	0.3194	2.8324
50	62.90	62.90	14h30'	14h4'	0.8096	0.2537	3.1909
50	62.90	62.90	15h30'	15h4'	0.6609	0.1511	4.3748
50	62.90	62.90	16h30'	16h4'	0.4689	0.0185	25.3200
50	*62.90*	*62.90*	*17h30'*	*17h4'*	*0.2466*	*-0.1349*	*-1.8279****
50	*62.90*	*62.90*	*18h30'*	*18h4'*	*0.0092*	*-0.2988*	*-0.0309****

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
55	*117.19*	*86.32*	*6h30'*	*5h2'*	*-0.2853*	*0.1305*	*-2.1857**
55	*117.19*	*86.32*	*7h30'*	6h2'	*-0.0503*	*0.2943*	*-0.1710**
55	117.19	86.32	8h30'	7h2'	0.1841	0.4576	0.4023
55	117.19	86.32	9h30'	8h2'	0.4020	0.6094	0.6596
55	117.19	86.32	10h30'	9h2'	0.5885	0.7393	0.7959
55	117.19	86.32	11h30'	10h2'	0.7309	0.8386	0.8716
55	117.19	86.32	12h30'	11h2'	0.8195	0.9003	0.9102
55	117.19	86.32	13h30'	12h2'	0.8483	0.9204	0.9217
55	117.19	86.32	14h30'	13h2'	0.8154	0.8975	0.9086
55	117.19	86.32	15h30'	14h2'	0.7230	0.8331	0.8678
55	117.19	86.32	16h30'	15h2'	0.5773	0.7316	0.7891
55	117.19	86.32	17h30'	16h2'	0.3883	0.5999	0.6472
55	117.19	86.32	18h30'	17h2'	0.1688	0.4470	0.3777
55	*117.19*	*86.32*	*19h30'*	18h2'	*-0.0662*	*0.2833*	*-0.2336**
55	*117.19*	*86.32*	*20h30'*	*19h2'*	*-0.3006*	*0.1199*	*-2.5075**
55	*117.19*	*86.32*	*21h30'*	*20h2'*	*-0.5187*	*-0.0320*	*16.2041***
55	*117.19*	*86.32*	*22h30'*	*21h2'*	*-0.7054*	*-0.1621*	*4.3514***
For 22.12							
55	*62.90*	*62.90*	*6h30'*	*6h4'*	*0.0755*	*-0.2767*	*-0.2729****
55	*62.90*	*62.90*	*7h30'*	*7h4'*	*0.3096*	*-0.1136*	*-2.7253****
55	62.90	62.90	8h30'	8h4'	0.5267	0.0376	14.0033
55	62.90	62.90	9h30'	9h4'	0.7119	0.1667	4.2717
55	62.90	62.90	10h30'	10h4'	0.8527	0.2647	3.2209
55	62.90	62.90	11h30'	11h4'	0.9394	0.3252	2.8891
55	62.90	62.90	12h30'	12h4'	0.9662	0.3438	2.8102
55	62.90	62.90	13h30'	13h4'	0.9312	0.3194	2.9150
55	62.90	62.90	14h30'	14h4'	0.8368	0.2537	3.2985
55	62.90	62.90	15h30'	15h4'	0.6895	0.1511	4.5644
55	62.90	62.90	16h30'	16h4'	0.4993	0.0185	26.9625
55	*62.90*	*62.90*	*17h30'*	*17h4'*	*0.2791*	*-0.1349*	*-2.0685****
55	*62.90*	*62.90*	*18h30'*	*18h4'*	*0.0439*	*-0.2988*	*-0.1468****

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
60	*117.19*	*84.06*	*6h30'*	*5h2'*	*-0.3156*	*0.1305*	*-2.4172**

60	*117.19*	*84.06*	*7h30'*	6h2'	*-0.0845*	*0.2943*	*-0.2872**
60	117.19	84.06	8h30'	7h2'	0.1459	0.4576	0.3189
60	117.19	84.06	9h30'	8h2'	0.3601	0.6094	0.5910
60	117.19	84.06	10h30'	9h2'	0.5435	0.7393	0.7351
60	117.19	84.06	11h30'	10h2'	0.6835	0.8386	0.8151
60	117.19	84.06	12h30'	11h2'	0.7707	0.9003	0.8560
60	117.19	84.06	13h30'	12h2'	0.7990	0.9204	0.8681

continued

60	117.19	84.06	14h30'	13h2'	0.7666	0.8975	0.8542
60	117.19	84.06	15h30'	14h2'	0.6757	0.8331	0.8111
60	117.19	84.06	16h30'	15h2'	0.5325	0.7316	0.7279
60	117.19	84.06	17h30'	16h2'	0.3467	0.5999	0.5779
60	117.19	84.06	18h30'	17h2'	0.1309	0.4470	0.2929
60	*117.19*	*84.06*	*19h30'*	18h2'	*-0.1001*	*0.2833*	*-0.3533**
60	*117.19*	*84.06*	*20h30'*	*19h2'*	*-0.3306*	*0.1199*	*-2.7574**
60	*117.19*	*84.06*	*21h30'*	*20h2'*	*-0.5449*	*-0.0320*	*17.0256***
60	*117.19*	*84.06*	*22h30'*	*21h2'*	*-0.7285*	*-0.1621*	*4.4941***
For 22.12							
60	*62.90*	*62.90*	*6h30'*	*6h4'*	*0.1093*	*-0.2767*	*-0.3949****
60	*62.90*	*62.90*	*7h30'*	*7h4'*	*0.3395*	*-0.1136*	*-2.9877****
60	62.90	62.90	8h30'	8h4'	0.5529	0.0376	14.6987
60	62.90	62.90	9h30'	9h4'	0.7349	0.1667	4.4099
60	62.90	62.90	10h30'	10h4'	0.8733	0.2647	3.2990
60	62.90	62.90	11h30'	11h4'	0.9586	0.3252	2.9481
60	62.90	62.90	12h30'	12h4'	0.9849	0.3438	2.8647
60	62.90	62.90	13h30'	13h4'	0.9505	0.3194	2.9756
60	62.90	62.90	14h30'	14h4'	0.8578	0.2537	3.3810
60	62.90	62.90	15h30'	15h4'	0.7129	0.1511	4.7194
60	62.90	62.90	16h30'	16h4'	0.5259	0.0185	28.3999
60	*62.90*	*62.90*	*17h30'*	*17h4'*	*0.3094*	*-0.1349*	*-2.2933****
60	*62.90*	*62.90*	*18h30'*	*18h4'*	*0.0782*	*-0.2988*	*-0.2616****

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
70	*117.19*	*79.17*	*6h30'*	*5h2'*	*-0.3686*	*0.1305*	*-2.8235**
70	*117.19*	*79.17*	*7h30'*	6h2'	*-0.1507*	*0.2943*	*-0.5121**
70	117.19	79.17	8h30'	7h2'	0.0666	0.4576	0.1456
70	117.19	79.17	9h30'	8h2'	0.2686	0.6094	0.4408
70	117.19	79.17	10h30'	9h2'	0.4416	0.7393	0.5972
70	117.19	79.17	11h30'	10h2'	0.5736	0.8386	0.6840
70	117.19	79.17	12h30'	11h2'	0.6558	0.9003	0.7284
70	117.19	79.17	13h30'	12h2'	0.6825	0.9204	0.7415
70	117.19	79.17	14h30'	13h2'	0.6520	0.8975	0.7265
70	117.19	79.17	15h30'	14h2'	0.5663	0.8331	0.6797
70	117.19	79.17	16h30'	15h2'	0.4312	0.7316	0.5894
70	117.19	79.17	17h30'	16h2'	0.2559	0.5999	0.4267

70	117.19	79.17	18h30’	17h2’	0.0525	0.4470	0.1174
70	*117.19*	*79.17*	*19h30’*	18h2’	*-0.1654*	*0.2833*	*-0.5839**
70	*117.19*	*79.17*	*20h30’*	*19h2’*	*-0.3828*	*0.1199*	*-3.1927**
70	*117.19*	*79.17*	*21h30’*	*20h2’*	*-0.5849*	*-0.0320*	*18.2749***
70	*117.19*	*79.17*	*22h30’*	*21h2’*	*-0.7581*	*-0.1621*	*4.6764***
For 22.12							
70	*62.90*	*62.90*	*6h30’*	*6h4’*	*0.1741*	*-0.2767*	*-0.6290****

continued

70	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.3911*	*-0.1136*	*-3.4426****
70	62.90	62.90	8h30’	8h4’	0.5924	0.0376	15.7499
70	62.90	62.90	9h30’	9h4’	0.7641	0.1667	4.5850
70	62.90	62.90	10h30’	10h4’	0.8946	0.2647	3.3794
70	62.90	62.90	11h30’	11h4’	0.9750	0.3252	2.9987
70	62.90	62.90	12h30’	12h4’	0.9999	0.3438	2.9082
70	62.90	62.90	13h30’	13h4’	0.9674	0.3194	3.0285
70	62.90	62.90	14h30’	14h4’	0.8800	0.2537	3.4684
70	62.90	62.90	15h30’	15h4’	0.7434	0.1511	4.9208
70	62.90	62.90	16h30’	16h4’	0.5670	0.0185	30.6177
70	*62.90*	*62.90*	*17h30’*	*17h4’*	*0.3628*	*-0.1349*	*-2.6890****
70	*62.90*	*62.90*	*18h30’*	*18h4’*	*0.1447*	*-0.2988*	*-0.4843****

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
80	*117.19*	*73.35*	*6h30’*	*5h2’*	*-0.4105*	*0.1305*	*-3.1441**
80	*117.19*	*73.35*	*7h30’*	6h2’	*-0.2123*	*0.2943*	*-0.7215**
80	*117.19*	*73.35*	*8h30’*	7h2’	*-0.0147*	*0.4576*	*-0.0321**
80	117.19	73.35	9h30’	8h2’	0.1690	0.6094	0.2773
80	117.19	73.35	10h30’	9h2’	0.3262	0.7393	0.4412
80	117.19	73.35	11h30’	10h2’	0.4463	0.8386	0.5322
80	117.19	73.35	12h30’	11h2’	0.5210	0.9003	0.5787
80	117.19	73.35	13h30’	12h2’	0.5453	0.9204	0.5925
80	117.19	73.35	14h30’	13h2’	0.5176	0.8975	0.5767
80	117.19	73.35	15h30’	14h2’	0.4396	0.8331	0.5277
80	117.19	73.35	16h30’	15h2’	0.3168	0.7316	0.4330
80	117.19	73.35	17h30’	16h2’	0.1574	0.5999	0.2624
80	*117.19*	*73.35*	*18h30’*	17h2’	*-0.0276*	*0.4470*	*-0.0617**
80	*117.19*	*73.35*	*19h30’*	18h2’	*-0.2257*	*0.2833*	*-0.7967**
80	*117.19*	*73.35*	*20h30’*	*19h2’*	*-0.4234*	*0.1199*	*-3.5311**
80	*117.19*	*73.35*	*21h30’*	*20h2’*	*-0.6072*	*-0.0320*	*18.9694***
80	*117.19*	*73.35*	*22h30’*	*21h2’*	*-0.7646*	*-0.1621*	*4.7166***
For 22.12							
80	*62.90*	*62.90*	*6h30’*	*6h4’*	*0.2336*	*-0.2767*	*-0.8440****
80	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.4309*	*-0.1136*	*-3.7930****
80	62.90	62.90	8h30’	8h4’	0.6139	0.0376	16.3229

80	62.90	62.90	9h30’	9h4’	0.7701	0.1667	4.6208
80	62.90	62.90	10h30’	10h4’	0.8888	0.2647	3.3573
80	62.90	62.90	11h30’	11h4’	0.9619	0.3252	2.9582
80	62.90	62.90	12h30’	12h4’	0.9845	0.3438	2.8633
80	62.90	62.90	13h30’	13h4’	0.9550	0.3194	2.9895
80	62.90	62.90	14h30’	14h4’	0.8754	0.2537	3.4506
80	62.90	62.90	15h30’	15h4’	0.7512	0.1511	4.9728

continued

80	62.90	62.90	16h30’	16h4’	0.5908	0.0185	31.9062
80	*62.90*	*62.90*	*17h30’*	*17h4’*	*0.4052*	*-0.1349*	*-3.0031****
80	*62.90*	*62.90*	*18h30’*	*18h4’*	*0.2069*	*-0.2988*	*-0.6924****

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
90	*117.19*	*65.73*	*6h30’*	*5h2’*	*-0.4399*	*0.1305*	*-3.3693**
90	*117.19*	*65.73*	*7h30’*	6h2’	*-0.2675*	*0.2943*	*-0.9090**
90	*117.19*	*65.73*	*8h30’*	7h2’	*-0.0956*	*0.4576*	*-0.2089**
90	117.19	65.73	9h30’	8h2’	0.0642	0.6094	0.1053
90	117.19	65.73	10h30’	9h2’	0.2010	0.7393	0.2718
90	117.19	65.73	11h30’	10h2’	0.3054	0.8386	0.3642
90	117.19	65.73	12h30’	11h2’	0.3704	0.9003	0.4114
90	117.19	65.73	13h30’	12h2’	0.3916	0.9204	0.4254
90	117.19	65.73	14h30’	13h2’	0.3674	0.8975	0.4094
90	117.19	65.73	15h30’	14h2’	0.2996	0.8331	0.3597
90	117.19	65.73	16h30’	15h2’	0.1928	0.7316	0.2635
90	117.19	65.73	17h30’	16h2’	0.0541	0.5999	0.0903
90	*117.19*	*65.73*	*18h30’*	17h2’	*-0.1068*	*0.4470*	*-0.2389**
90	*117.19*	*65.73*	*19h30’*	18h2’	*-0.2791*	*0.2833*	*-0.9854**
90	*117.19*	*65.73*	*20h30’*	*19h2’*	*-0.4511*	*0.1199*	*-3.7623**
90	*117.19*	*65.73*	*21h30’*	*20h2’*	*-0.6110*	*-0.0320*	*19.0882***
90	*117.19*	*65.73*	*22h30’*	*21h2’*	*-0.7479*	*-0.1621*	*4.6137***
For 22.12							
90	*62.90*	*62.90*	*6h30’*	*6h4’*	*0.2860*	*-0.2767*	*-1.0334****
90	*62.90*	*62.90*	*7h30’*	*7h4’*	*0.4577*	*-0.1136*	*-4.0282****
90	62.90	62.90	8h30’	8h4’	0.6169	0.0376	16.4005
90	62.90	62.90	9h30’	9h4’	0.7527	0.1667	4.5165
90	62.90	62.90	10h30’	10h4’	0.8559	0.2647	3.2332
90	62.90	62.90	11h30’	11h4’	0.9195	0.3252	2.8280
90	62.90	62.90	12h30’	12h4’	0.9392	0.3438	2.7316
90	62.90	62.90	13h30’	13h4’	0.9135	0.3194	2.8597
90	62.90	62.90	14h30’	14h4’	0.8443	0.2537	3.3280
90	62.90	62.90	15h30’	15h4’	0.7363	0.1511	4.8739
90	62.90	62.90	16h30’	16h4’	0.5968	0.0185	32.2262
90	*62.90*	*62.90*	*17h30’*	*17h4’*	*0.4353*	*-0.1349*	*-3.2261****
90	*62.90*	*62.90*	*18h30’*	*18h4’*	*0.2628*	*-0.2988*	*-0.8794****

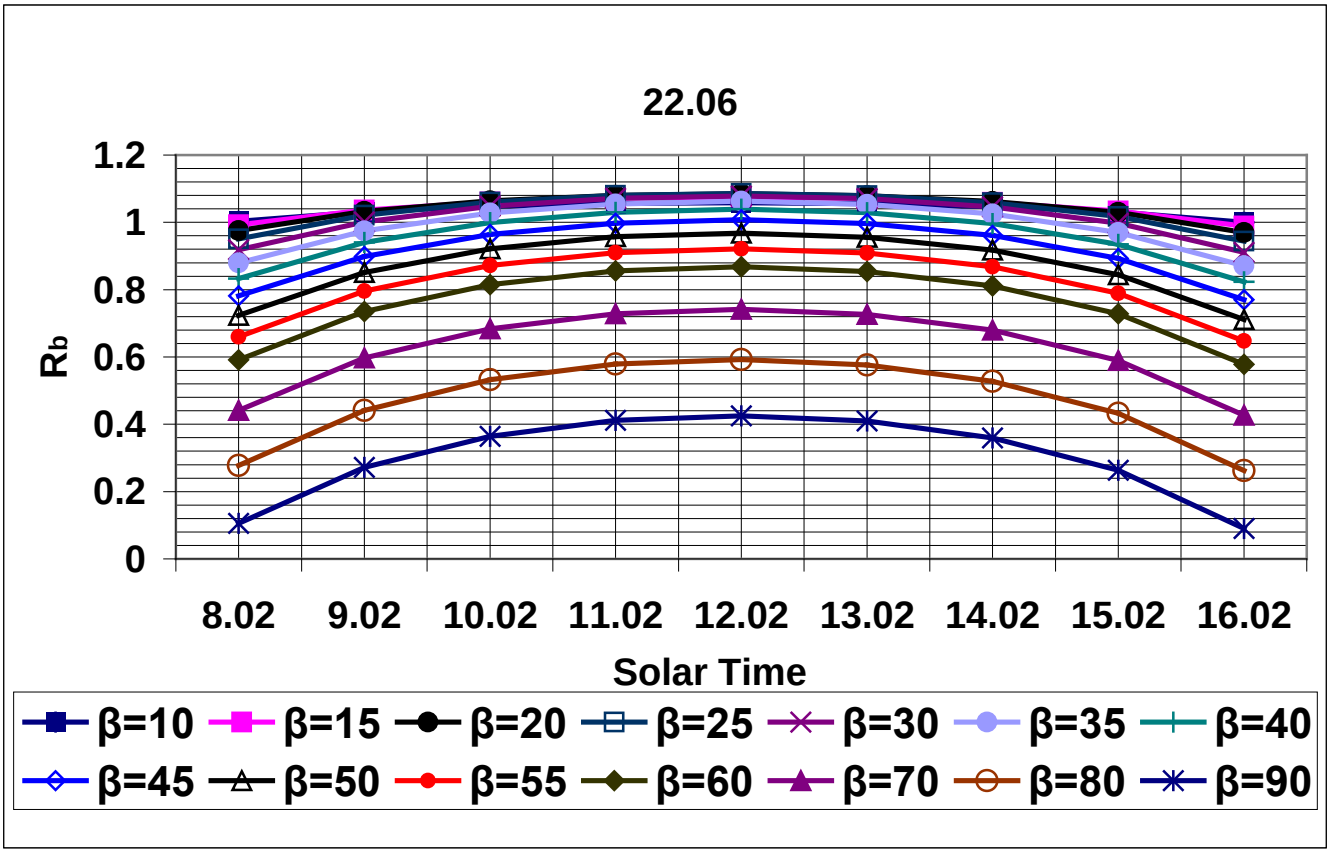

Figure IV.4: The diagram of $\mathbf{R_b}$, for **ST**, at various **β**. This is for 22.06.

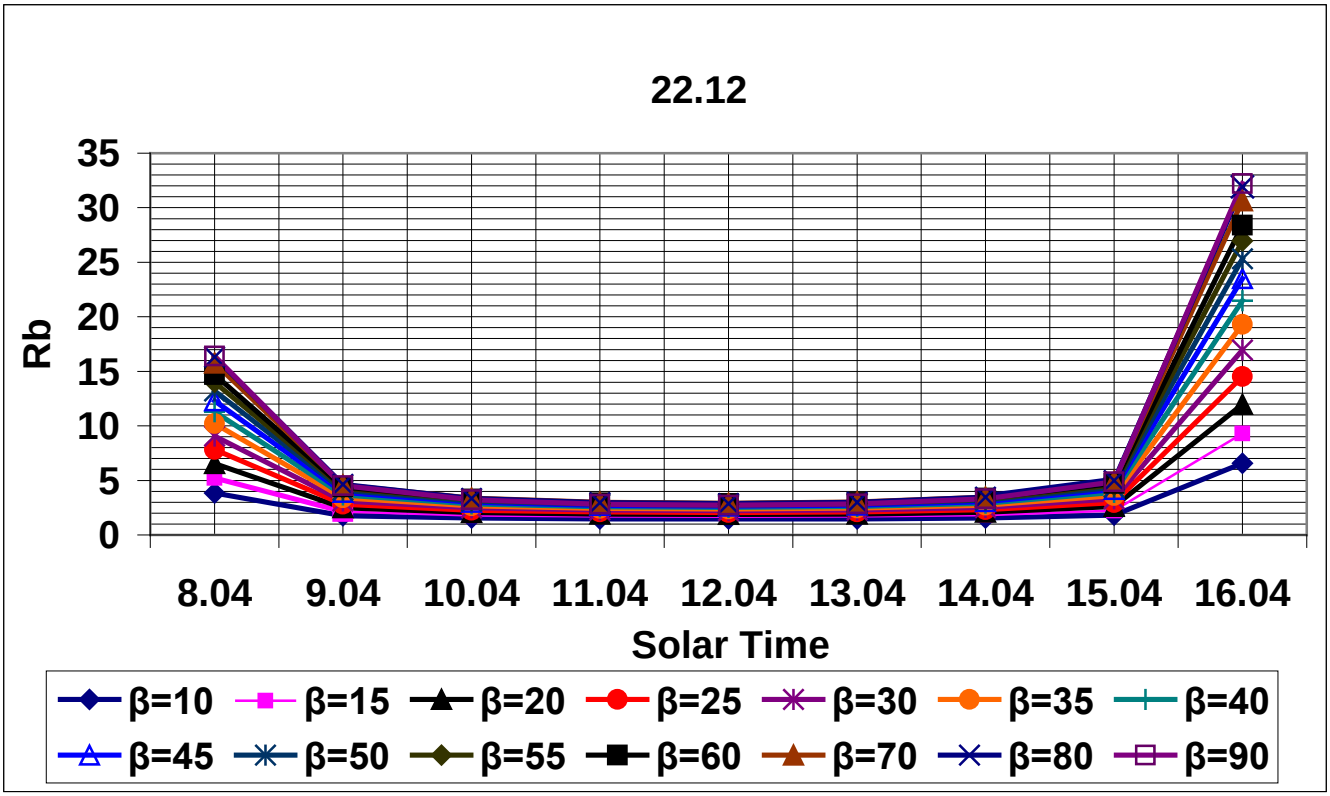

Figure IV.5: *The diagram of R_b, for **ST**, at various **β**. This is for 22.12.*

Bucuresti

Latitude: 44.45^0
Longitude: 26.09^0
Altitude: 88m
Calculations for: a. the 22nd June: WT is from 6^{30} to 22^{30} for summer time or equivalent 5^{30} to 21^{30} for winter time which is the proper time to be used for WT
b. the 22 nd December: WT is from 6^{30} to 18^{30}.

For 22.06 $\Rightarrow$ n=173 and for 22.12 $\Rightarrow$ n=356.

B	E	L_{st}	L_{loc}	WT	WT	ST	ω	δ
For 22.06	(minutes)			Summer Time	Winter Time			
90.99	-1.70	30	26.09	6 h 30’	5 h 30’	5 h 13’	-101.75	23.45
90.99	-1.70	30	26.09	7 h 30’	6 h 30’	6 h 13’	-86.75	23.45
90.99	-1.70	30	26.09	8 h 30’	7 h 30’	7 h 13’	-71.75	23.45
90.99	-1.70	30	26.09	9 h 30’	8 h 30’	8 h 13’	-56.75	23.45
90.99	-1.70	30	26.09	10 h 30’	9 h 30’	9 h 13’	-41.75	23.45
90.99	-1.70	30	26.09	11 h 30’	10 h 30’	10 h 13’	-26.75	23.45
90.99	-1.70	30	26.09	12 h 30’	11 h 30’	11 h 13’	-11.75	23.45
90.99	-1.70	30	26.09	13 h 30’	12 h 30’	12 h 13’	3.25	23.45
90.99	-1.70	30	26.09	14 h 30’	13 h 30’	13v13’	18.25	23.45
90.99	-1.70	30	26.09	15 h 30’	14 h 30’	14 h 13’	33.25	23.45
90.99	-1.70	30	26.09	16 h 30’	15 h 30’	15 h 13’	48.25	23.45
90.99	-1.70	30	26.09	17 h 30’	16 h 30’	16 h 13’	63.25	23.45
90.99	-1.70	30	26.09	18 h 30’	17 h 30’	17 h 13’	78.25	23.45

90.99	-1.70	30	26.09	19 h 30’	18 h 30’	18 h 13’	93.25	23.45
90.99	-1.70	30	26.09	20 h 30’	19 h 30’	19 h 13’	108.25	23.45
90.99	*-1.70*	*30*	*26.09*	*21 h 30’*	*20 h 30’*	*20 h 13’*	*123.25*	*23.45*
90.99	*-1.70*	*30*	*26.09*	*22 h 30’*	*21 h 30’*	*21h13’*	*138.25*	*23.45*
For 22.12								
271.98	*0,62*	*30*	*26.09*		*6h30’*	*6h15’*	*-86.75*	*-23.45*
271.98	*0,62*	*30*	*26.09*		*7h30’*	*7h15’*	*-71.75*	*-23.45*
271.98	0,62	30	26.09		8h30’	8h15’	-56.75	-23.45
271.98	0,62	30	26.09		9h30’	9h15’	-41.75	-23.45
271.98	0,62	30	26.09		10h30’	10h15’	-26.75	-23.45
271.98	0,62	30	26.09		11h30’	11h15’	-11.75	-23.45
271.98	0,62	30	26.09		12h30’	12h15’	3.25	-23.45
271.98	0,62	30	26.09		13h30’	13h15’	18.25	-23.45
271.98	0,62	30	26.09		14h30’	14h15’	33.25	-23.45
271.98	0,62	30	26.09		15h30’	15h15’	48.25	-23.45
271.98	0,62	30	26.09		16h30’	16h15’	63.25	-23.45
271.98	*0,62*	*30*	*26.09*		*17h30’*	*17h15’*	*78.25*	*-23.45*
271.98	*0,62*	*30*	*26.09*		*18h30’*	*18h15’*	*93.25*	*-23.45*

φ	β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06								
44.45	10	115.2059	107.34	6 h 30’	5h13’	0.1055	0.1456	0.7245
44.45	10	115.2059	107.34	7 h 30’	6h13’	0.2588	0.3161	0.8186
44.45	10	115.2059	107.34	8 h 30’	7h13’	0.4097	0.4840	0.8465
44.45	10	115.2059	107.34	9 h 30’	8h13’	0.5481	0.6380	0.8592
44.45	10	115.2059	107.34	10 h 30’	9h13’	0.6645	0.7674	0.8659
44.45	10	115.2059	107.34	11 h 30’	10h13’	0.7509	0.8636	0.8696
44.45	10	115.2059	107.34	12 h 30’	11h13’	0.8016	0.9199	0.8714
44.45	10	115.2059	107.34	13 h 30’	12h13’	0.8130	0.9326	0.8717
44.45	10	115.2059	107.34	14 h 30’	13h13’	0.7843	0.9007	0.8708
44.45	10	115.2059	107.34	15 h 30’	14h13’	0.7176	0.8265	0.8682
44.45	10	115.2059	107.34	16 h 30’	15h13’	0.6173	0.7149	0.8634
44.45	10	115.2059	107.34	17 h 30’	16h13’	0.4903	0.5737	0.8547
44.45	10	115.2059	107.34	18 h 30’	17h13’	0.3453	0.4123	0.8374
44.45	10	115.2059	107.34	19 h 30’	18h13’	0.1920	0.2418	0.7940
44.45	10	115.2059	107.34	20 h 30’	19h13’	0.0410	0.0738	0.5550
44.45	10	115.2059	107.34	21 h 30’	20h13’	-0.0975	-0.0802	1.2155**
44.45	10	115.2059	107.34	22 h 30’	21h13’	-0.2141	-0.2099	1.0200**
For 22.12								
44,45	10	64,8854	64,89	6h30’	6h15’	-0,1911	-0,2408	0,7935**
44,45	10	64,8854	64,89	7h30’	7h15’	-0,0401	-0,0728	0,5504**
44,45	10	64,8854	64,89	8h30’	8h15’	0,0983	0,0811	1.2121
44,45	10	64,8854	64,89	9h30’	9h15’	0,2147	0,2106	1.0196

44,45	10	64,8854	64,89	10h30’	10h15’	0,3011	0,3067	0.9818
44,45	10	64,8854	64,89	11h30’	11h15’	0,3518	0,3631	0.9689
44,45	10	64,8854	64,89	12h30’	12h15’	0,3632	0,3757	0.9666
44,45	10	64,8854	64,89	13h30’	13h15’	0,3345	0,3439	0.9728
44,45	10	64,8854	64,89	14h30’	14h15’	0,2678	0,2696	0.9932
44,45	10	64,8854	64,89	15h30’	15h15’	0,1675	0,1581	1.0596
44,45	10	64,8854	64,89	16h30’	16h15’	0,0405	0,0168	2.4101
44,45	10	64,8854	64,89	17h30’	17h15’	-0,1046	-0,1446	0,7233**
44,45	10	64,8854	64,89	18h30’	18h15’	-0,2578	-0,3150	0,8184**

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
15	115.2059	104.21	6 h 30’	5h13’	0.0694	0.1456	0.4765
15	115.2059	104.21	7 h 30’	6h13’	0.2312	0.3161	0.7315
15	115.2059	104.21	8 h 30’	7h13’	0.3906	0.4840	0.8070
15	115.2059	104.21	9 h 30’	8h13’	0.5367	0.6380	0.8414
15	115.2059	104.21	10 h 30’	9h13’	0.6596	0.7674	0.8596
15	115.2059	104.21	11 h 30’	10h13’	0.7509	0.8636	0.8695
15	115.2059	104.21	12 h 30’	11h13’	0.8044	0.9199	0.8744
15	115.2059	104.21	13 h 30’	12h13’	0.8164	0.9326	0.8754
15	115.2059	104.21	14 h 30’	13h13’	0.7862	0.9007	0.8728
15	115.2059	104.21	15 h 30’	14h13’	0.7157	0.8265	0.8660
15	115.2059	104.21	16 h 30’	15h13’	0.6098	0.7149	0.8530
15	115.2059	104.21	17 h 30’	16h13’	0.4757	0.5737	0.8293
15	115.2059	104.21	18 h 30’	17h13’	0.3225	0.4123	0.7823
15	115.2059	104.21	19 h 30’	18h13’	0.1607	0.2418	0.6646
15	115.2059	104.21	20 h 30’	19h13’	0.0013	0.0738	0.0171
15	115.2059	104.21	21 h 30’	20h13’	-0.1450	-0.0802	1.8072**
15	115.2059	104.21	22 h 30’	21h13’	-0.2680	-0.2099	1.2772**
For 22.12							
15	64.8854	64.89	6h30’	6h15’	-0.1597	-0.2408	0.6634**
15	64.8854	64.89	7h30’	7h15’	-0.0003	-0.0728	0.0045**
15	64.8854	64.89	8h30’	8h15’	0.1458	0.0811	1.7980

15	64.8854	64.89	9h30’	9h15’	0.2687	0.2106	1.2761
15	64.8854	64.89	10h30’	10h15’	0.3600	0.3067	1.1736
15	64.8854	64.89	11h30’	11h15’	0.4135	0.3631	1.1388
15	64.8854	64.89	12h30’	12h15’	0.4255	0.3757	1.1324
15	64.8854	64.89	13h30’	13h15’	0.3952	0.3439	1.1494
15	64.8854	64.89	14h30’	14h15’	0.3248	0.2696	1.2045
15	64.8854	64.89	15h30’	15h15’	0.2189	0.1581	1.3846
15	64.8854	64.89	16h30’	16h15’	0.0848	0.0168	5.0447
15	64.8854	64.89	17h30’	17h15’	-0.0684	-0.1446	0.4731**
15	64.8854	64.89	18h30’	18h15’	-0.2302	-0.3150	0.7308**

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
20	115.2059	101.41	6 h 30’	5h13’	0.0327	0.1456	0.2248
20	115.2059	101.41	7 h 30’	6h13’	0.2019	0.3161	0.6388
20	115.2059	101.41	8 h 30’	7h13’	0.3686	0.4840	0.7614
20	115.2059	101.41	9 h 30’	8h13’	0.5213	0.6380	0.8171
20	115.2059	101.41	10 h 30’	9h13’	0.6498	0.7674	0.8467
20	115.2059	101.41	11 h 30’	10h13’	0.7452	0.8636	0.8629
20	115.2059	101.41	12 h 30’	11h13’	0.8011	0.9199	0.8708
20	115.2059	101.41	13 h 30’	12h13’	0.8137	0.9326	0.8725
20	115.2059	101.41	14 h 30’	13h13’	0.7820	0.9007	0.8682

continued

20	115.2059	101.41	15 h 30’	14h13’	0.7084	0.8265	0.8571
20	115.2059	101.41	16 h 30’	15h13’	0.5977	0.7149	0.8360
20	115.2059	101.41	17 h 30’	16h13’	0.4575	0.5737	0.7975
20	115.2059	101.41	18 h 30’	17h13’	0.2974	0.4123	0.7213
20	115.2059	101.41	19 h 30’	18h13’	0.1282	0.2418	0.5303
20	115.2059	101.41	20 h 30’	19h13’	-0.0385	0.0738	-0.5209*
20	115.2059	101.41	21 h 30’	20h13’	-0.1913	-0.0802	2.3851**
20	115.2059	101.41	22 h 30’	21h13’	-0.3200	-0.2099	1.5247**
For 22.12							
20	64.8854	64.89	6h30’	6h15’	-0.1272	-0.2408	0.5283**
20	64.8854	64.89	7h30’	7h15’	0.0394	-0.0728	-0.5415***
20	64.8854	64.89	8h30’	8h15’	0.1922	0.0811	2.3701
20	64.8854	64.89	9h30’	9h15’	0.3207	0.2106	1.5229
20	64.8854	64.89	10h30’	10h15’	0.4161	0.3067	1.3566
20	64.8854	64.89	11h30’	11h15’	0.4720	0.3631	1.3000
20	64.8854	64.89	12h30’	12h15’	0.4846	0.3757	1.2897
20	64.8854	64.89	13h30’	13h15’	0.4529	0.3439	1.3172
20	64.8854	64.89	14h30’	14h15’	0.3793	0.2696	1.4067
20	64.8854	64.89	15h30’	15h15’	0.2686	0.1581	1.6991
20	64.8854	64.89	16h30’	16h15’	0.1284	0.0168	7.6410
20	64.8854	64.89	17h30’	17h15’	-0.0317	-0.1446	0.2194**
20	64.8854	64.89	18h30’	18h15’	-0.2009	-0.3150	0.6376**

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
25	115.2059	98.85	6 h 30’	5h13’	-0.0042	0,1456	-0,0286*
25	115.2059	98.85	7 h 30’	6h13’	0.1711	0,3161	0,5412
25	115.2059	98.85	8 h 30’	7h13’	0.3437	0,4840	0,7101
25	115.2059	98.85	9 h 30’	8h13’	0.5019	0,6380	0,7867
25	115.2059	98.85	10 h 30’	9h13’	0.6350	0,7674	0,8274
25	115.2059	98.85	11 h 30’	10h13’	0.7338	0,8636	0,8497
25	115.2059	98.85	12 h 30’	11h13’	0.7917	0,9199	0,8606
25	115.2059	98.85	13 h 30’	12h13’	0.8047	0,9326	0,8629
25	115.2059	98.85	14 h 30’	13h13’	0.7720	0,9007	0,8571
25	115.2059	98.85	15 h 30’	14h13’	0.6957	0,8265	0,8417
25	115.2059	98.85	16 h 30’	15h13’	0.5810	0,7149	0,8127
25	115.2059	98.85	17 h 30’	16h13’	0.4358	0,5737	0,7597
25	115.2059	98.85	18 h 30’	17h13’	0.2700	0,4123	0,6548
25	115.2059	98.85	19 h 30’	18h13’	0.0948	0,2418	0,3918
25	115.2059	98.85	20 h 30’	19h13’	-0.0779	0,0738	-1,0549*
25	115.2059	98.85	21 h 30’	20h13’	-0.2362	-0,0802	2,9449**
25	115.2059	98.85	22 h 30’	21h13’	-0.3695	-0,2099	1,7606**
For 22.12							
25	64.8854	64.89	6h30’	6h15’	-0.0937	-0,2408	0,3891**
25	64.8854	64.89	7h30’	7h15’	0.0789	-0,0728	-1,0833***

continued

25	64.8854	64.89	8h30’	8h15’	0.2371	0,0811	2.9243
25	64.8854	64.89	9h30’	9h15’	0.3702	0,2106	1.7582
25	64.8854	64.89	10h30’	10h15’	0.4690	0,3067	1.5292
25	64.8854	64.89	11h30’	11h15’	0.5269	0,3631	1.4514
25	64.8854	64.89	12h30’	12h15’	0.5400	0,3757	1.4371
25	64.8854	64.89	13h30’	13h15’	0.5072	0,3439	1.4750
25	64.8854	64.89	14h30’	14h15’	0.4309	0,2696	1.5982
25	64.8854	64.89	15h30’	15h15’	0.3163	0,1581	2.0007
25	64.8854	64.89	16h30’	16h15’	0.1711	0,0168	10.1791
25	64.8854	64.89	17h30’	17h15’	0.0052	-0,1446	-0,0360***
25	64.8854	64.89	18h30’	18h15’	-0.1700	-0,3150	0,5396**

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
30	115.2059	96.46	6 h 30’	5h13’	-0.0410	0.1456	-0.2817*
30	115.2059	96.46	7 h 30’	6h13’	0.1389	0.3161	0.4396
30	115.2059	96.46	8 h 30’	7h13’	0.3162	0.4840	0.6533
30	115.2059	96.46	9 h 30’	8h13’	0.4787	0.6380	0.7503
30	115.2059	96.46	10 h 30’	9h13’	0.6153	0.7674	0.8018
30	115.2059	96.46	11 h 30’	10h13’	0.7168	0.8636	0.8301
30	115.2059	96.46	12 h 30’	11h13’	0.7763	0.9199	0.8439
30	115.2059	96.46	13 h 30’	12h13’	0.7897	0.9326	0.8467
30	115.2059	96.46	14 h 30’	13h13’	0.7560	0.9007	0.8394

30	115.2059	96.46	15 h 30’	14h13’	0.6777	0.8265	0.8199
30	115.2059	96.46	16 h 30’	15h13’	0.5599	0.7149	0.7832
30	115.2059	96.46	17 h 30’	16h13’	0.4108	0.5737	0.7161
30	115.2059	96.46	18 h 30’	17h13’	0.2405	04123	0.5833
30	115.2059	96.46	19 h 30’	18h13’	0.0606	0.2418	0.2505
30	115.2059	96.46	20 h 30’	19h13’	-0.1167	0.0738	-1.5810*
30	115.2059	96.46	21 h 30’	20h13’	-0.2793	-0.0802	3.4823**
30	115.2059	96.46	22 h 30’	21h13’	-0.4162	-0.2099	1.9831**
For 22.12							
30	64.8854	64.89	6h30’	6h15’	-0.0595	-0.2408	0.2470**
30	64.8854	64.89	7h30’	7h15’	0.1178	-0.0728	-1,6169***
30	64.8854	64.89	8h30’	8h15’	0.2803	0.0811	3.4562
30	64.8854	64.89	9h30’	9h15’	0.4169	0.2106	1.9801
30	64.8854	64.89	10h30’	10h15’	0.5184	0.3067	1.6902
30	64.8854	64.89	11h30’	11h15’	0.5779	0.3631	1.5917
30	64.8854	64.89	12h30’	12h15’	0.5913	0.3757	1.5736
30	64.8854	64.89	13h30’	13h15’	0.5576	0.3439	1.6216
30	64.8854	64.89	14h30’	14h15’	0.4793	0.2696	1.775
30	64.8854	64.89	15h30’	15h15’	0.3615	0.1581	2.2871
30	64.8854	64.89	16h30’	16h15’	0.2124	0.0168	12.6399
30	64.8854	64.89	17h30’	17h15’	0.0421	-0.1446	-0.2912***
30	64.8854	64,89	18h30’	18h15’	-0.1378	-0.3150	0.4375**

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
35	115.2059	94.18	6 h 30’	5h13’	-0.0776	0.1456	-0.5328*
35	115.2059	94.18	7 h 30’	6h13’	0.1058	0.3161	0.3346
35	115.2059	94.18	8 h 30’	7h13’	0.2863	0.4840	0.5915
35	115.2059	94.18	9 h 30’	8h13’	0.4518	0.6380	0.7082
35	115.2059	94.18	10 h 30’	9h13’	0.5910	0.7674	0.7701
35	115.2059	94.18	11 h 30’	10h13’	0.6944	0.8636	0.8041
35	115.2059	94.18	12 h 30’	11h13’	0.7550	0.9199	0.8207
35	115.2059	94.18	13 h 30’	12h13’	0.7686	0.9326	0.8242
35	115.2059	94.18	14 h 30’	13h13’	0.7343	0.9007	0.8153
35	115.2059	94.18	15 h 30’	14h13’	0.6545	0.8265	0.7919
35	115.2059	94.18	16 h 30’	15h13’	0.5346	0.7149	0.7477
35	115.2059	94.18	17 h 30’	16h13’	0.3827	0.5737	0.6671
35	115.2059	94.18	18 h 30’	17h13’	0.2092	0.4123	0.5074
35	115.2059	94.18	19 h 30’	18h13’	0.0259	0.2418	0.1072
35	115.2059	94.18	20 h 30’	19h13’	-0.1547	0.0738	-2.0950*
35	115.2059	94.18	21 h 30’	20h13’	-0.3203	-0.0802	3.9932**
35	115.2059	94.18	22 h 30’	21h13’	-0.4597	-0.2099	2.1906**
For 22.12							
35	64.8854	64.89	6h30’	6h15’	-0.0248	-0.2408	0.1030**
35	64.8854	64.89	7h30’	7h15’	0.1558	-0.0728	-2.1381***
35	64.8854	64.89	8h30’	8h15’	0.3213	0.0811	3.9618

35	64.8854	64.89	9h30’	9h15’	0.4605	0.2106	2.1869
35	64.8854	64.89	10h30’	10h15’	0.5639	0.3067	1.8383
35	64.8854	64.89	11h30’	11h15’	0.6244	0.3631	1.7199
35	64.8854	64.89	12h30’	12h15’	0.6380	0.3757	1.6982
35	64.8854	64.89	13h30’	13h15’	0.6038	0.3439	1.7559
35	64.8854	64.89	14h30’	14h15’	0.5240	0.2696	1.9434
35	64.8854	64.89	15h30’	15h15’	0.4040	0.1581	2.5560
35	64.8854	64.89	16h30’	16h15’	0.2522	0.0168	15.0045
35	64.8854	64.89	17h30’	17h15’	0.0787	-0.1446	-0.5441***
35	64.8854	64.89	18h30’	18h15’	-0.1046	-0.3150	0.3321**

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
40	115.2059	91.98	6 h 30’	5h13’	-0.1135	0.1456	-0.7797*
40	115.2059	91.98	7 h 30’	6h13’	0.0718	0.3161	0.2270
40	115.2059	91.98	8 h 30’	7h13’	0.2542	0.4840	0.5253
40	115.2059	91.98	9 h 30’	8h13’	0.4215	0.6380	0.6607
40	115.2059	91.98	10 h 30’	9h13’	0.5622	0.7674	0.7326
40	115.2059	91.98	11 h 30’	10h13’	0.6667	0.8636	0.7720
40	115.2059	91.98	12 h 30’	11h13’	0.7279	0.9199	0.7913
40	115.2059	91.98	13 h 30’	12h13’	0.7417	0.9326	0.7953
40	115.2059	91.98	14 h 30’	13h13’	0.7071	0.9007	0.7850

continued

40	115.2059	91.98	15 h 30’	14h13’	0.6264	0.8265	0.7579
40	115.2059	91.98	16 h 30’	15h13’	0.5052	0.7149	0.7066
40	115.2059	91.98	17 h 30’	16h13’	0.3517	0.5737	0.6130
40	115.2059	91.98	18 h 30’	17h13’	0.1763	0.4123	0.4276
40	115.2059	91.98	19 h 30’	18h13’	-0.0089	0.2418	-0.0369*
40	115.2059	91.98	20 h 30’	19h13’	-0.1915	0.0738	-2.5931*
40	115.2059	91.98	21 h 30’	20h13’	-0.3589	-0.0802	4.4738**
40	115.2059	91.98	22 h 30’	21h13’	-0.4998	-0.2099	2.3814**
For 22.12							
40	64.8854	64.89	6h30’	6h15’	0.0101	-0.2408	-0.0418***
40	64.8854	64.89	7h30’	7h15’	0.1926	-0.0728	-2.6432***
40	64.8854	64.89	8h30’	8h15’	0.3598	0.0811	4.4373
40	64.8854	64.89	9h30’	9h15’	0.5005	0.2106	2.3771
40	64.8854	64.89	10h30’	10h15’	0.6050	0.3067	1.9725
40	64.8854	64.89	11h30’	11h15’	0.6662	0.3631	1.8350
40	64.8854	64.89	12h30’	12h15’	0.6800	0.3757	1.8098
40	64.8854	64.89	13h30’	13h15’	0.6454	0.3439	1.8768
40	64.8854	64.89	14h30’	14h15’	0.5647	0.2696	2.0944
40	64.8854	64.89	15h30’	15h15’	0.4435	0.1581	2.8056
40	64.8854	64.89	16h30’	16h15’	0.2900	0.0168	17.2551
40	64.8854	64.89	17h30’	17h15’	0.1146	-0.1446	-0.7929***
40	64.8854	64.89	18h30’	18h15’	-0.0706	-0.3150	0.2242**

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
45	115,2059	89,81	6 h 30’	5h13’	-0.1486	0.1456	-1.0208*
45	115,2059	89,81	7 h 30’	6h13’	0.0372	0.3161	0.1177
45	115,2059	89,81	8 h 30’	7h13’	0.2202	0.4840	0.4550
45	115,2059	89,81	9 h 30’	8h13’	0.3880	0.6380	0.6082
45	115,2059	89,81	10 h 30’	9h13’	0.5291	0.7674	0.6895
45	115,2059	89,81	11 h 30’	10h13’	0.6339	0.8636	0.7341
45	115,2059	89,81	12 h 30’	11h13’	0.6953	0.9199	0.7559
45	115,2059	89,81	13 h 30’	12h13’	0.7091	0.9326	0.7604
45	115,2059	89,81	14 h 30’	13h13’	0.6744	0.9007	0.7487
45	115,2059	89,81	15 h 30’	14h13’	0.5935	0.8265	0.7181
45	115,2059	89,81	16 h 30’	15h13’	0.4719	0.7149	0.6601
45	115,2059	89,81	17 h 30’	16h13’	0.3180	0.5737	0.5543
45	115,2059	89,81	18 h 30’	17h13’	0.1421	0.4123	0.3446
45	115,2059	89,81	19 h 30’	18h13’	-0.0437	0.2418	-0.1808*
45	115,2059	89,81	20 h 30’	19h13’	-0.2268	0.0738	-3.0715*
45	115,2059	89,81	21 h 30’	20h13’	-0.3947	-0.0802	4.9204*
45	115,2059	89,81	22 h 30’	21h13’	-0.5360	-0.2099	2.5541**
For 22.12							
45	64.8854	64.89	6h30’	6h15’	0.0448	-0.2408	-0.1863***
45	64.8854	64.89	7h30’	7h15’	0.2279	-0.0728	-3.1281***

continued

45	64.8854	64.89	8h30’	8h15’	0.3957	0.0811	4.8791
45	64.8854	64.89	9h30’	9h15’	0.5368	0.2106	2.5492
45	64.8854	64.89	10h30’	10h15’	0.6416	0.3067	2.0917
45	64.8854	64.89	11h30’	11h15’	0.7030	0.3631	1.9362
45	64.8854	64.89	12h30’	12h15’	0.7168	0.3757	1.9077
45	64.8854	64.89	13h30’	13h15’	0.6820	0.3439	1.9835
45	64.8854	64.89	14h30’	14h15’	0.6011	0.2696	2.2295
45	64.8854	64.89	15h30’	15h15’	0.4796	0.1581	3.0338
45	64.8854	64.89	16h30’	16h15’	0.3256	0.0168	19.3745
45	64.8854	64.89	17h30’	17h15’	0.1497	-0.1446	-1.0357***
45	64.8854	64.89	18h30’	18h15’	-0.0361	-0.3150	0.1145**

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
50	115.2059	87.63	6 h 30’	5h13’	-0.1826	0.1456	-1.2541*
50	115.2059	87.63	7 h 30’	6h13’	0.0024	0.3161	0.0076
50	115.2059	87.63	8 h 30’	7h13’	0.1846	0.4840	0.3813
50	115.2059	87.63	9 h 30’	8h13’	0.3516	0.6380	0.5511
50	115.2059	87.63	10 h 30’	9h13’	0.4920	0.7674	0.6411
50	115.2059	87.63	11 h 30’	10h13’	0.5963	0.8636	0.6905
50	115.2059	87.63	12 h 30’	11h13’	0.6575	0.9199	07147
50	115.2059	87.63	13 h 30’	12h13’	0.6712	0.9326	0.7197
50	115.2059	87.63	14 h 30’	13h13’	0.6366	0.9007	0.7068

50	115.2059	87.63	15 h 30’	14h13’	0.5561	0.8265	0.6728
50	115.2059	87.63	16 h 30’	15h13’	0.4351	0.7149	0.6086
50	115.2059	87.63	17 h 30’	16h13’	0.2818	0.5737	0.4913
50	115.2059	87.63	18 h 30’	17h13’	0.1068	0.4123	0.2590
50	115.2059	87.63	19 h 30’	18h13’	-0.0782	0.2418	-0.3232*
50	115.2059	87.63	20 h 30’	19h13’	-0.2604	0.0738	-3.5265*
50	115.2059	87.63	21 h 30’	20h13’	-0.4275	-0.0802	5.3295**
50	115.2059	87.63	22 h 30’	21h13’	-0.5682	-0.2099	2.7073**
For 22.12							
50	64.8854	64.89	6h30’	6h15’	0.0793	-0.2408	-0.3293***
50	64.8854	64.89	7h30’	7h15’	0.2615	-0.0728	-3.5893***
50	64.8854	64.89	8h30’	8h15’	0.4285	0.0811	5.2838
50	64.8854	64.89	9h30’	9h15’	0.5689	0.2106	2.7020
50	64.8854	64.89	10h30’	10h15’	0.6732	0.3067	2.1949
50	64.8854	64.89	11h30’	11h15’	0.7344	0.3631	2.0227
50	64.8854	64.89	12h30’	12h15’	0.7481	0.3757	1.9911
50	64.8854	64.89	13h30’	13h15’	0.7135	0.3439	2.0751
50	64.8854	64.89	14h30’	14h15’	0.6330	0.2696	2.3477
50	64.8854	64.89	15h30’	15h15’	0.5120	0.1581	3.2389
50	64.8854	64.89	16h30’	16h15’	0.3587	0.0168	21.3466
50	64.8854	64.89	17h30’	17h15’	0.1837	-0.1446	-1.2706***
50	64.8854	64.89	18h30’	18h15’	-0.0013	-0.3150	0.0040**

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
55	115.2059	85.41	6 h 30’	5h13’	-0.2151	0.1456	-1.4778*
55	115.2059	85.41	7 h 30’	6h13’	-0.0324	0.3161	-0.1027*
55	115.2059	85.41	8 h 30’	7h13’	0.1475	0.4840	0.3047
55	115.2059	85.41	9 h 30’	8h13’	0.3124	0.6380	0.4898
55	115.2059	85.41	10 h 30’	9h13’	0.4512	0.7674	0.5879
55	115.2059	85.41	11 h 30’	10h13’	0.5542	0.8636	0.6418
55	115.2059	85.41	12 h 30’	11h13’	0.6146	0.9199	0.6681
55	115.2059	85.41	13 h 30’	12h13’	0.6282	0.9326	0.6736
55	115.2059	85.41	14 h 30’	13h13’	0.5940	0.9007	0.6595
55	115.2059	85.41	15 h 30’	14h13’	0.5145	0.8265	0.6225
55	115.2059	85.41	16 h 30’	15h13’	0.3949	0.7149	0.5524
55	115.2059	85.41	17 h 30’	16h13’	0.2436	0.5737	0.4246
55	115.2059	85.41	18 h 30’	17h13’	00707	0.4123	0.1714
55	115.2059	85.41	19 h 30’	18h13’	-0.1120	0.2418	-0.4632*
55	115.2059	85.41	20 h 30’	19h13’	-0.2920	0.0738	-3.9547*
55	115.2059	85.41	21 h 30’	20h13’	-0.4571	-0.0802	5.6981**
55	115.2059	85.41	22 h 30’	21h13’	-0.5960	-0.2099	2.8400**
For 22.12							
55	64.8854	64.89	6h30’	6h15’	0.1131	-0.2408	-0.4698***
55	64.8854	64.89	7h30’	7h15’	0.2931	-0.0728	-4.0231***
55	64.8854	64.89	8h30’	8h15’	0.4580	0.0811	5.6483

55	64.8854	64.89	9h30’	9h15’	0.5968	0.2106	2.8342
55	64.8854	64.89	10h30’	10h15’	0.6998	0.3067	2.2815
55	64.8854	64.89	11h30’	11h15’	0.7602	0.3631	2.0938
55	64.8854	64.89	12h30’	12h15’	0.7737	0.3757	2.0593
55	64.8854	64.89	13h30’	13h15’	0.7396	0.3439	2.1509
55	64.8854	64.89	14h30’	14h15’	0.6600	0.2696	2.4481
55	64.8854	64.89	15h30’	15h15’	0.5405	0.1581	3.4195
55	64.8854	64.89	16h30’	16h15’	0.3891	0.0168	23.1564
55	64.8854	64.89	17h30’	17h15’	0.2162	-0.1446	-1.4958***
55	64.8854	64.89	18h30’	18h15’	0.0336	-0.3150	-0.1065***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
60	115.2059	83.12	6 h 30’	5h13’	-0.2461	0.1456	-1.6903*
60	115.2059	83.12	7 h 30’	6h13’	-0.0670	0.3161	-0.2121*
60	115.2059	83.12	8 h 30’	7h13’	0.1093	0.4840	0.2258
60	115.2059	83.12	9 h 30’	8h13’	0.2709	0.6380	0.4247
60	115.2059	83.12	10 h 30’	9h13’	0.4069	0.7674	0.5302
60	115.2059	83.12	11 h 30’	10h13’	0.5079	0.8636	0.5881
60	115.2059	83.12	12 h 30’	11h13’	0.5670	0.9199	0.6164
60	115.2059	83.12	13 h 30’	12h13’	0.5803	0.9326	0.6223
60	115.2059	83.12	14 h 30’	13h13’	0.5469	0.9007	0.6071

continued

60	115.2059	83.12	15 h 30’	14h13’	0.4689	0.8265	0.5674
60	115.2059	83.12	16 h 30’	15h13’	0.3518	0.7149	0.4920
60	115.2059	83.12	17 h 30’	16h13’	0.2034	0.5737	0.3546
60	115.2059	83.12	18 h 30’	17h13’	0.0340	0.4123	0.0825
60	115.2059	83.12	19 h 30’	18h13’	-0.1450	0.2418	-0.5997*
60	115.2059	83.12	20 h 30’	19h13’	-0.3214	0.0738	-4.3529*
60	115.2059	83.12	21 h 30’	20h13’	-0.4832	-0.0802	6.0234**
60	115.2059	83.12	22 h 30’	21h13’	-0.6193	-0.2099	2.9511**
For 22.12							
60	64.8854	64.89	6h30’	6h15’	0.1461	-0.2408	-0.6068***
60	64.8854	64.89	7h30’	7h15’	0.3225	-0.0728	-4.4264***
60	64.8854	64.89	8h30’	8h15’	0.4841	0.0811	5.9699
60	64.8854	64.89	9h30’	9h15’	0.6201	0.2106	2.9448
60	64.8854	64.89	10h30’	10h15’	0.7210	0.3067	2.3507
60	64.8854	64.89	11h30’	11h15’	0.7802	0.3631	2.1489
60	64.8854	64.89	12h30’	12h15’	0.7935	0.3757	2.1119
60	64.8854	64.89	13h30’	13h15’	0.7600	0.3439	2.2103
60	64.8854	64.89	14h30’	14h15’	0.6821	0.2696	2.5298
60	64.8854	64.89	15h30’	15h15’	0.5649	0.1581	3.5740
60	64.8854	64.89	16h30’	16h15’	0.4166	0.0168	24.7901
60	64.8854	64.89	17h30’	17h15’	0.2472	-0.1446	-1.7097***
60	64.8854	64.89	18h30’	18h15’	0.0681	-0.3150	-0.2163***

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
70	115.2059	78.09	6 h 30’	5h13’	-0.3021	0.1456	-2.0753*
70	115.2059	78.09	7 h 30’	6h13’	-0.1344	0.3161	-0.4254*
70	115.2059	78.09	8 h 30’	7h13’	0.0307	0.4840	0.0634
70	115.2059	78.09	9 h 30’	8h13’	0.1821	0.6380	0.2854
70	115.2059	78.09	10 h 30’	9h13’	0.3094	0.7674	0.4032
70	115.2059	78.09	11 h 30’	10h13’	0.4040	0.8636	0.4678
70	115.2059	78.09	12 h 30’	11h13’	0.4594	0.9199	0.4994
70	115.2059	78.09	13 h 30’	12h13’	0.4719	0.9326	0.5060
70	115.2059	78.09	14 h 30’	13h13’	0.4405	0.9007	0.4891
70	115.2059	78.09	15 h 30’	14h13’	0.3675	0.8265	0.4447
70	115.2059	78.09	16 h 30’	15h13’	0.2578	0.7149	0.3606
70	115.2059	78.09	17 h 30’	16h13’	0.1189	0.5737	0.2072
70	115.2059	78.09	18 h 30’	17h13’	-0.0398	0.4123	-0.0966*
70	115.2059	78.09	19 h 30’	18h13’	-0.2075	0.2418	-0.8579*
70	115.2059	78.09	20 h 30’	19h13’	-0.3727	0.0738	-5.0471*
70	115.2059	78.09	21 h 30’	20h13’	-0.5242	-0.0802	6.5345**
70	115.2059	78.09	22 h 30’	21h13’	-0.6517	-0.2099	3.1053**
For 22.12							
70	64.8854	64.89	6h30’	6h15’	0.2085	-0.2408	-0.8659***
70	64.8854	64.89	7h30’	7h15’	0.3737	-0.0728	-5.1292***
70	64.8854	64.89	8h30’	8h15’	0.5250	0.0811	6.4747

continued

70	64.8854	64.89	9h30’	9h15’	0.6524	0.2106	3.0983
70	64.8854	64.89	10h30’	10h15’	0.7469	0.3067	2.4352
70	64.8854	64.89	11h30’	11h15’	0.8024	0.3631	2.2099
70	64.8854	64.89	12h30’	12h15’	0.8148	0.3757	2.1686
70	64.8854	64.89	13h30’	13h15’	0.7835	0.3439	2.2785
70	64.8854	64.89	14h30’	14h15’	0.7105	0.2696	2.6350
70	64.8854	64.89	15h30’	15h15’	0.6008	0.1581	3.8005
70	64.8854	64.89	16h30’	16h15’	0.4618	0.0168	27.4812
70	64.8854	64.89	17h30’	17h15’	0.3031	-0.1446	-2.0969***
70	64.8854	64.89	18h30’	18h15’	0.1355	-0.3150	-0.4300***

β	ω_s	ω'_s	WT	ST	cosθ	$\cos\theta_z$	R_b
For 22.06							
80	115.2059	72.00	6 h 30’	5h13’	-0.3490	0.1456	-2.3973*
80	115.2059	72.00	7 h 30’	6h13’	-0.1978	0.3161	-0.6257*
80	115.2059	72.00	8 h 30’	7h13’	-0.0488	0.4840	-0.1008*
80	115.2059	72.00	9 h 30’	8h13’	0.0877	0.6380	0.1375
80	115.2059	72.00	10 h 30’	9h13’	0.2026	0.7674	0.2639
80	115.2059	72.00	11 h 30’	10h13’	0.2879	0.8636	0.3333
80	115.2059	72.00	12 h 30’	11h13’	0.3378	0.9199	0.3672
80	115.2059	72.00	13 h 30’	12h13’	0.3491	0.9326	0.3743
80	115.2059	72.00	14 h 30’	13h13’	0.3208	0.9007	0.3562
80	115.2059	72.00	15 h 30’	14h13’	0.2549	0.8265	0.3085

80	115.2059	72.00	16 h 30’	15h13’	0.1560	0.7149	0.2182
80	115.2059	72.00	17 h 30’	16h13’	0.0307	0.5737	0.0535
80	115.2059	72.00	18 h 30’	17h13’	-0.1124	0.4123	-0.2727*
80	115.2059	72.00	19 h 30’	18h13’	-0.2636	0.2418	-1.0902*
80	115.2059	72.00	20 h 30’	19h13’	-0.4126	0.0738	-5.5882*
80	115.2059	72.00	21 h 30’	20h13’	-0.5493	-0.0802	6.8472**
80	115.2059	72.00	22 h 30’	21h13’	-0.6643	-0.2099	3.1653**
For 22.12							
80	64.8854	64.89	6h30’	6h15’	0.2646	-0.2408	-1.0987***
80	64.8854	64.89	7h30’	7h15’	0.4135	-0.0728	-5.6763***
80	64.8854	64.89	8h30’	8h15’	0.5500	0.0811	6.7831
80	64.8854	64.89	9h30’	9h15’	0.6649	0.2106	3.1577
80	64.8854	64.89	10h30’	10h15’	0.7502	0.3067	2.4458
80	64.8854	64.89	11h30’	11h15’	0.8002	0.3631	2.2039
80	64.8854	64.89	12h30’	12h15’	0.8114	0.3757	2.1595
80	64.8854	64.89	13h30’	13h15’	0.7831	0.3439	2.2775
80	64.8854	64.89	14h30’	14h15’	0.7173	0.2696	2.6603
80	64.8854	64.89	15h30’	15h15’	0.6183	0.1581	3.9117
80	64.8854	64.89	16h30’	16h15’	0.4930	0.0168	29.3381
80	64.8854	64.89	17h30’	17h15’	0.3499	-0.1446	-2.4205***
80	64.8854	64.89	18h30’	18h15’	0.1987	-0.3150	-0.6307***

β	**ω_s**	**ω'_s**	**WT**	**ST**	**cosθ**	**$\cos\theta_z$**	**R_b**
For 22.06							
90	115.2059	63.83	6 h 30’	5h13’	-0.3853	0.1456	-2.6464*
90	115.2059	63.83	7 h 30’	6h13’	-0.2551	0.3161	-0.8070*
90	115.2059	63.83	8 h 30’	7h13’	-0.1269	0.4840	-0.2621*
90	115.2059	63.83	9 h 30’	8h13’	-0.0093	0.6380	-0.0146*
90	115.2059	63.83	10 h 30’	9h13’	0.0895	0.7674	0.1167
90	115.2059	63.83	11 h 30’	10h13’	0.1630	0.8636	0.1887
90	115.2059	63.83	12 h 30’	11h13’	0.2060	0.9199	0.2239
90	115.2059	63.83	13 h 30’	12h13’	0.2157	0.9326	0.2313
90	115.2059	63.83	14 h 30’	13h13’	0.1913	0.9007	0.2124
90	115.2059	63.83	15 h 30’	14h13’	0.1346	0.8265	0.1629
90	115.2059	63.83	16 h 30’	15h13’	0.0495	0.7149	0.0692
90	115.2059	63.83	17 h 30’	16h13’	-0.0584	0.5737	-0.1018*
90	115.2059	63.83	18 h 30’	17h13’	-0.1816	0.4123	-0.4405*
90	115.2059	63.83	19 h 30’	18h13’	-0.3118	0.2418	-1.2893*
90	115.2059	63.83	20 h 30’	19h13’	-0.4401	0.0738	-5.9596*
90	115.2059	63.83	21 h 30’	20h13’	-0.5577	-0.0802	6.9521**
90	115.2059	63.83	22 h 30’	21h13’	-0.6567	-0.2099	3.1291**
For 22.12							
90	64.8854	64.89	6h30’	6h15’	0.3126	-0.2408	-1.2982***
90	64.8854	64.89	7h30’	7h15’	0.4408	-0.0728	-6.0510***

90	64.8854	64.89	8h30’	8h15’	0.5584	0.0811	6.8855
90	64.8854	64.89	9h30’	9h15’	0.6572	0.2106	3.1213
90	64.8854	64.89	10h30’	10h15’	0.7306	0.3067	2.3821
90	64.8854	64.89	11h30’	11h15’	0.7737	0.3631	2.1309
90	64.8854	64.89	12h30’	12h15’	0.7833	0.3757	2.0848
90	64.8854	64.89	13h30’	13h15’	0.7590	0.3439	2.2073
90	64.8854	64.89	14h30’	14h15’	0.7023	0.2696	2.6048
90	64.8854	64.89	15h30’	15h15’	0.6171	0.1581	3.9042
90	64.8854	64.89	16h30’	16h15’	0.5093	0.0168	30.3045
90	64.8854	64.89	17h30’	17h15’	0.3861	-0.1446	-2.6705***
90	64.8854	64.89	18h30’	18h15’	0.2559	-0.3150	-0.8122***

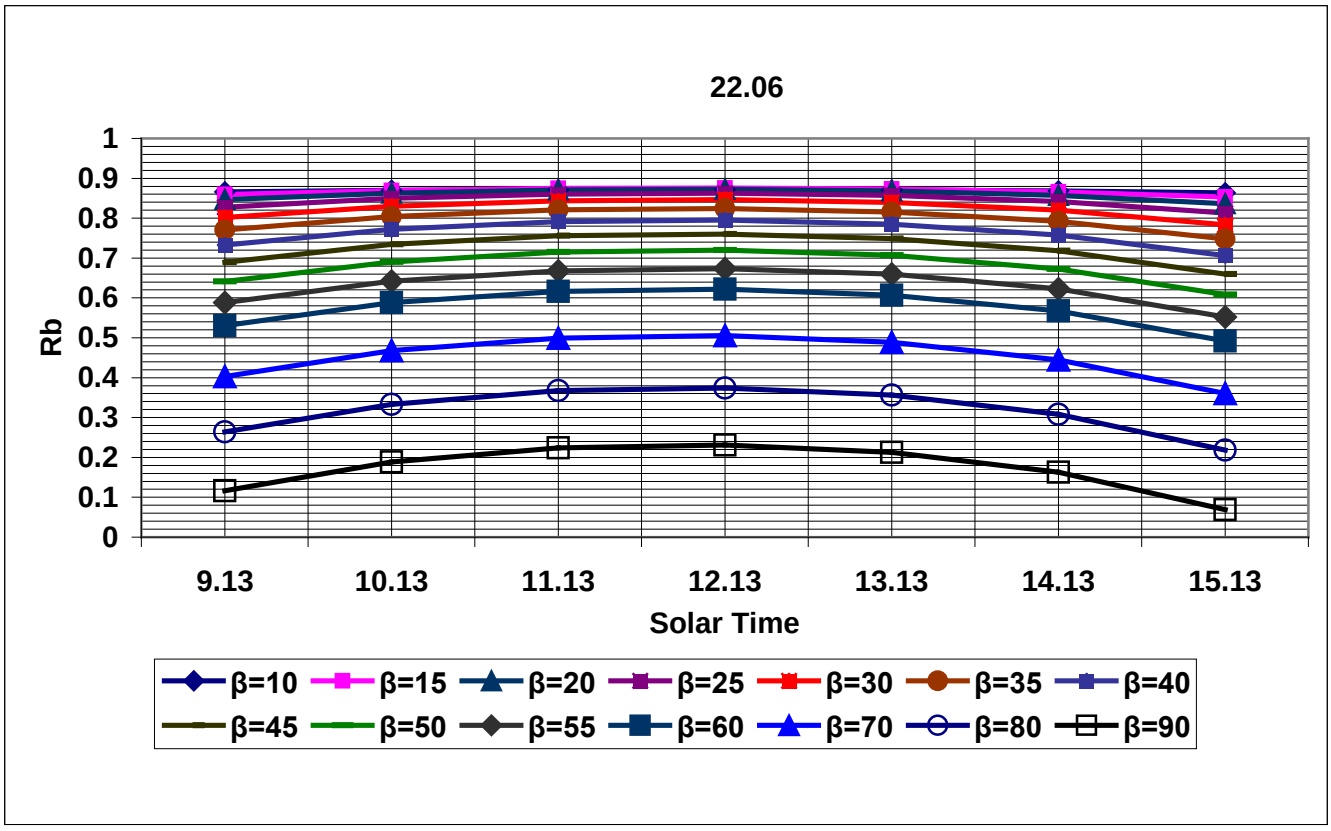

Figure IV.6: *The diagram of R_b, for **ST**, at various **β**. This is for 22.06.*

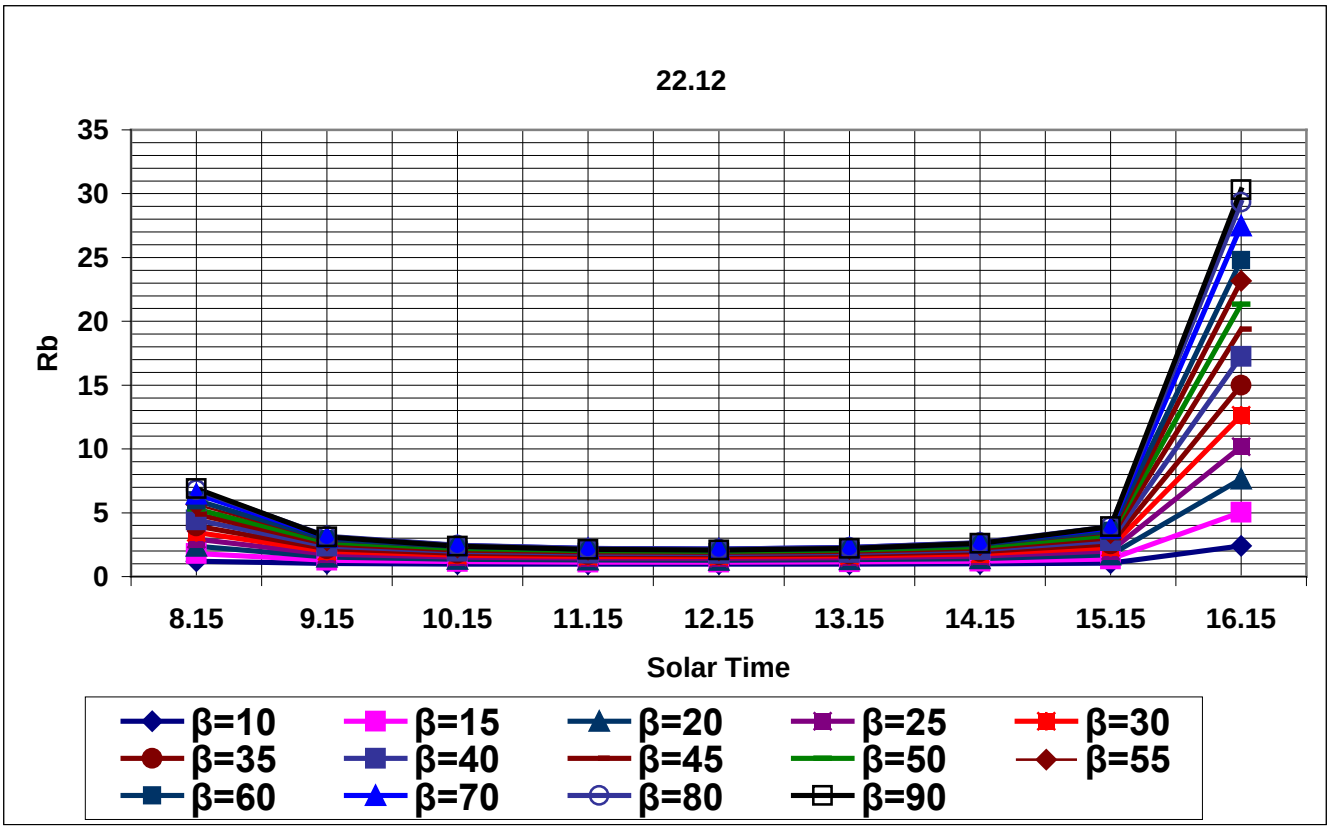

Figure IV.7: *The diagram of R_b, for **ST**, at various **β**. This is for 22.06.*

3. Determination of $\frac{\overline{H}_d}{\overline{H}}$ and $\overline{R}$ for various cities in Romania.

In this case three equations to determine $\frac{\overline{H}_d}{\overline{H}}$ are available:

(a) Liu and Jordan model:

$$\frac{\overline{H}_d}{\overline{H}} = 1.39 - 4.03 \times \overline{K}_t + 5.53 \times \overline{K}_t^2 - 3.11 \times \overline{K}_t^3$$

(b) Page model:

$$\frac{\overline{H}_d}{\overline{H}} = 1.00 - 1.13 \times \overline{K}_t$$

(c) Collares-Pereira model :

$$\frac{\overline{H}_d}{\overline{H}} = 0.775 + 0.00653 \times (\omega_s - 90) - [0.505 + 0.00455 \times (\omega_s - 90)] \times \cos(115 \times \overline{K}_t - 103)$$

and

$$\overline{R}_b = \frac{\cos(\varphi - \beta) \times \cos(\delta) \times \sin(\omega_s') + (\pi/180) \times \omega_s' \times \sin(\varphi - \beta) \times \sin(\delta)}{\cos(\varphi) \times \cos(\delta) \times \sin(\omega_s) + (\pi/180) \times \omega_s \times \sin(\varphi) \times \sin(\delta)}$$

$$\overline{R} = \left(1 - \frac{\overline{H}_d}{\overline{H}}\right)\overline{R}_b + \frac{\overline{H}_d}{\overline{H}}\left(\frac{1+\cos\beta}{2}\right) + r\left(\frac{1-\cos\beta}{2}\right)$$

Table IV.17

$\frac{\overline{H}_d}{\overline{H}}$ for **IASI**												
Mean Monthly Day	17 Jan	15 Feb	16 Mar	15 Apr	15 May	11 Jun	17 Jul	16 Aug	16 Sep	16 Oct	15 Nov	11 Dec
n	17	46	75	105	135	162	198	228	259	289	319	345
(a)	0.50	0.46	0.46	0.39	0.37	0.33	0.34	0.31	0.37	0.39	0.52	0.61
(b)	0.58	0.55	0.55	0.46	0.44	0.38	0.39	0.34	0.44	0.46	0.60	0.67
(c)	0.42	0.44	0.49	0.47	0.49	0.47	0.47	0.41	0.43	0.40	0.45	0.46

Table IV.18

$\overline{R}$ for **IASI**												
Mean Monthly Day	**n**	**β**	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
17 Jan	17	(a)	1.00	1.27	1.53	1.76	1.95	2.10	2.20	2.26	2.26	2.22
		(b)	1.00	1.23	1.44	1.63	1.78	1.90	1.99	2.03	2.03	1.99
		(c)	1.00	1.32	1.61	1.87	2.10	2.27	2.40	2.46	2.47	2.43
15 Feb	46	(a)	1.00	1.19	1.37	1.52	1.64	1.73	1.78	1.80	1.78	1.73
		(b)	1.00	1.16	1.31	1.43	1.53	1.61	1.65	1.66	1.64	1.59
		(c)	1.00	1.20	1.38	1.54	1.67	1.76	1.82	1.84	1.82	1.77
16 Mar	75	(a)	1.00	1.11	1.19	1.25	1.29	1.30	1.29	1.25	1.18	1.09
		(b)	1.00	1.09	1.16	1.21	1.23	1.24	1.22	1.18	1.11	1.03
		(c)	1.00	1.10	1.18	1.24	1.27	1.28	1.27	1.22	1.16	1.07
15 Apr	105	(a)	1.00	1.06	1.09	1.11	1.10	1.08	1.03	0.96	0.88	0.79
		(b)	1.00	1.05	1.08	1.09	1.08	1.05	1.01	0.95	0.87	0.78
		(c)	1.00	1.05	1.08	1.09	1.08	1.05	1.00	0.94	0.86	0.78
15 May	135	(a)	1.00	1.02	1.02	1.00	0.97	0.92	0.86	0.79	0.70	0.61
		(b)	1.00	1.01	1.01	1.00	0.97	0.92	0.86	0.79	0.71	0.62
		(c)	1.00	1.01	1.01	0.99	0.96	0.92	0.86	0.79	0.71	0.63
11 Jun	162	(a)	1.00	1.00	0.98	0.95	0.91	0.84	0.77	0.68	0.59	0.50
		(b)	1.00	1.00	0.98	0.95	0.91	0.85	0.77	0.69	0.60	0.51
		(c)	1.00	1.00	0.98	0.95	0.91	0.85	0.78	0.69	0.62	0.53

		(a)	1.00	1.01	1.00	0.97	0.93	0.87	0.80	0.71	0.62	0.52
		(b)	1.00	1.01	1.00	0.97	0.93	0.87	0.80	0.72	0.63	0.53
17 Jul	198	(c)	1.00	1.00	0.99	0.97	0.93	0.87	0.80	0.72	0.64	0.55
		(a)	1.00	1.04	1.06	1.06	1.04	1.00	0.94	0.86	0.76	0.65
		(b)	1.00	1.04	1.06	1.06	1.03	0.99	0.93	0.85	0.76	0.65
16 Aug	228											

$\frac{\overline{H_d}}{\overline{H}}$ for **Bucuresti**

Mean Monthly Day	17 Jan	15 Feb	16 Mar	15 Apr	15 May	11 Jun	17 Jul	16 Aug	16 Sep	16 Oct	15 Nov	11 Dec
n	17	46	75	105	135	162	198	228	259	289	319	345
$\frac{\overline{H_d}}{\overline{H}}$	0.47	0.46	0.45	0.39	0.37	0.32	0.31	0.31	0.35	0.38	0.50	0.59

		(c)	1.00	1.03	1.05	1.05	1.02	0.99	0.92	0.84	0.76	0.65
		(a)	1.00	1.10	1.17	1.22	1.25	1.25	1.22	1.17	1.09	1.00
		(b)	1.00	1.09	1.15	1.19	1.21	1.21	1.18	1.13	1.06	0.96
16 Sep	259	(c)	1.00	1.09	1.15	1.20	1.22	1.21	1.19	1.13	1.06	0.97
		(a)	1.00	1.18	1.34	1.47	1.56	1.63	1.65	1.63	1.58	1.49
		(b)	1.00	1.16	1.30	1.41	1.49	1.54	1.56	1.54	1.48	1.40
16 Oct	289	(c)	1.00	1.18	1.33	1.46	1.55	1.61	1.63	1.62	1.56	1.48
		(a)	1.00	1.23	1.44	1.62	1.76	1.87	1.93	1.94	1.92	1.84
		(b)	1.00	1.19	1.36	1.51	1.62	1.70	1.74	1.75	1.72	1.65
15 Nov	319	(c)	1.00	1.27	1.51	1.72	1.90	2.02	2.10	2.13	2.10	2.03
		(a)	1.00	1.24	1.47	1.67	1.84	1.97	2.07	2.12	2.12	2.09
		(b)	1.00	1.20	1.39	1.56	1.70	1.81	1.89	1.92	1.93	1.89
11 Dec	345	(c)	1.00	1.34	1.65	1.93	2.17	2.36	2.50	2.57	2.59	2.55

Values are obtained by:

$$\frac{\overline{H_d}}{\overline{H}} = \mathbf{1.39} - \mathbf{4.03} \times \overline{K_t} + \mathbf{5.53} \times \overline{K_t^2} - \mathbf{3.11} \times \overline{K_t^3}$$ (by Liu and Jordan)

Table IV.19

Table IV.20

$\overline{R}$ for **Bucuresti**

Mean Monthly Day	β / n	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
17 Jan	17	1.00	1.25	1.48	1.69	1.86	1.99	2.08	2.12	2.12	2.07
15 Feb	46	1.00	1.17	1.33	1.46	1.56	1.64	1.68	1.69	1.67	1.61
16 Mar	75	1.00	1.10	1.17	1.23	1.26	1.26	1.24	1.20	1.13	1.04
15 Apr	105	1.00	1.05	1.08	1.09	1.08	1.05	1.00	0.93	0.85	0.75

15 May	135	1.00	1.01	1.01	0.99	0.95	0.90	0.84	0.76	0.68	0.59
11 Jun	162	1.00	1.00	0.98	0.94	0.89	0.83	0.75	0.66	0.56	0.47
17 Jul	198	1.00	1.00	0.99	0.96	0.91	0.85	0.77	0.69	0.59	0.49

$\frac{\overline{H_d}}{\overline{H}}$ for **Cluj-Napoca**

Mean Monthly Day	17 Jan	15 Feb	16 Mar	15 Apr	15 May	11 Jun	17 Jul	16 Aug	16 Sep	16 Oct	15 Nov	11 Dec
n	17	46	75	105	135	162	198	228	259	289	319	345
$\frac{\overline{H_d}}{\overline{H}}$	0.44	0.38	0.36	.036	0.35	0.44	0.31	0.31	0.35	0.34	0.49	0.59

16 Aug	228	1.00	1.04	1.05	1.05	1.02	0.97	0.91	0.82	0.72	0.62
16 Sep	259	1.00	1.09	1.16	1.20	1.22	1.21	1.18	1.13	1.05	0.95
16 Oct	289	1.00	1.17	1.31	1.42	1.50	1.55	1.57	1.55	1.49	1.40
15 Nov	319	1.00	1.21	1.41	1.57	1.70	1.79	1.84	1.84	1.81	1.73
11 Dec	345	1.00	1.22	1.42	1.60	1.75	1.86	1.94	1.98	1.98	1.94

Table IV.21

Table IV.22

$\overline{R}$ for **Cluj-Napoca**

Mean Monthly Day	β / n	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
17 Jan	17	1.00	1.30	1.57	1.81	2.02	2.18	2.29	2.35	2.36	2.31
15 Feb	46	1.00	1.22	1.42	1.59	1.73	1.83	1.89	1.91	1.90	1.84
16 Mar	75	1.00	1.12	1.23	1.30	1.35	1.37	1.36	1.31	1.25	1.15
15 Apr	105	1.00	1.06	1.09	1.11	1.10	1.08	1.03	0.96	0.88	0.78
15 May	135	1.00	1.02	1.02	1.00	0.97	0.92	0.86	0.78	0.70	0.61
11 Jun	162	1.00	1.00	0.98	0.95	0.91	0.85	0.77	0.69	0.61	0.52

17 Jul	198	1.00	1.01	1.00	0.97	0.93	0.87	0.79	0.71	0.61	0.51
16 Aug	228	1.00	1.04	1.06	1.06	1.04	0.99	0.93	0.85	0.75	0.64
16 Sep	259	1.00	1.10	1.17	1.22	1.25	1.25	1.22	1.17	1.09	0.99

$\frac{\overline{H_d}}{\overline{H}}$ for **Constanta**

Mean Monthly Day	17 Jan	15 Feb	16 Mar	15 Apr	15 May	11 Jun	17 Jul	16 Aug	16 Sep	16 Oct	15 Nov	11 Dec
n	17	46	75	105	135	162	198	228	259	289	319	345
$\frac{\overline{H_d}}{\overline{H}}$	0.49	0.44	0.39	0.34	0.31	0.30	0.28	0.28	0.32	0.36	0.45	0.55

16 Oct	289	1.00	1.19	1.35	1.49	1.59	1.65	1.68	1.66	1.61	1.52
15 Nov	319	1.00	1.24	1.46	1.65	1.80	1.91	1.97	1.99	1.96	1.89
11 Dec	345	1.00	1.24	1.47	1.67	1.84	1.97	2.07	2.12	2.12	2.08

Table IV.23

Table IV.24

$\overline{R}$ for **Constanta**

Mean Monthly Day	**β** / **n**	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
17 Jan	17	1.00	1.24	1.46	1.66	1.82	1.95	2.03	2.08	2.07	2.02
15 Feb	46	1.00	1.18	1.34	1.47	1.58	1.66	1.70	1.71	1.69	1.63
16 Mar	75	1.00	1.11	1.19	1.25	1.29	1.30	1.28	1.23	1.16	1.07
15 Apr	105	1.00	1.05	1.09	1.10	1.09	1.06	1.01	0.94	0.85	0.75
15 May	135	1.00	1.01	1.01	0.99	0.95	0.90	0.83	0.76	0.67	0.57
11 Jun	162	1.00	1.00	0.98	0.94	0.89	0.82	0.74	0.65	0.56	0.46

17 Jul	198	1.00	1.00	0.99	0.96	0.91	0.85	0.77	0.68	0.58	0.48
16 Aug	228	1.00	1.04	1.05	1.05	1.02	0.97	0.90	0.82	0.72	0.61
16 Sep	259	1.00	1.09	1.16	1.21	1.23	1.22	1.19	1.14	1.05	0.95
16 Oct	289	1.00	1.17	1.31	1.43	1.51	1.56	1.58	1.55	1.50	1.40
15 Nov	319	1.00	1.23	1.44	1.61	1.75	1.85	1.91	1.92	1.89	1.81

$\frac{\overline{H_d}}{\overline{H}}$ for **Craiova**

Mean Monthly Day	17 Jan	15 Feb	16 Mar	15 Apr	15 May	11 Jun	17 Jul	16 Aug	16 Sep	16 Oct	15 Nov	11 Dec
n	17	46	75	105	135	162	198	228	259	289	319	345
$\frac{\overline{H_d}}{\overline{H}}$	0.42	0.42	0.38	0.34	0.31	0.37	0.29	0.34	0.36	0.36	0.42	0.46

11 Dec	345	1.00	1.24	1.46	1.65	1.82	1.94	2.03	2.08	2.08	2.03

Table IV.25

Table IV.26

$\overline{R}$ for **Craiova**

Mean Monthly Day	**β** / **n**	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
17 Jan	17	1.00	1.27	1.52	1.75	1.93	2.07	2.17	2.22	2.22	2.17
15 Feb	46	1.00	1.18	1.35	1.49	1.60	1.68	1.73	1.74	1.72	1.66
16 Mar	75	1.00	1.11	1.20	1.26	1.30	1.31	1.29	1.25	1.17	1.08
15 Apr	105	1.00	1.05	1.09	1.10	1.09	1.06	1.01	0.94	0.85	0.75
15 May	135	1.00	1.01	1.01	0.99	0.95	0.90	0.83	0.76	0.67	0.57
11 Jun	162	1.00	1.00	0.98	0.94	0.89	0.83	0.75	0.66	0.57	0.48
17 Jul	198	1.00	1.00	0.99	0.96	0.91	0.85	0.77	0.68	0.58	0.48

16 Aug	228	1.00	1.03	1.05	1.04	1.01	0.96	0.90	0.82	0.72	0.61

$\frac{\overline{H_d}}{\overline{H}}$ for **Galati**												
Mean Monthly Day	17 Jan	15 Feb	16 Mar	15 Apr	15 May	11 Jun	17 Jul	16 Aug	16 Sep	16 Oct	15 Nov	11 Dec
n	17	46	75	105	135	162	198	228	259	289	319	345
$\frac{\overline{H_d}}{\overline{H}}$	0.49	0.46	0.46	0.39	0.38	0.34	0.31	0.31	0.34	0.36	0.50	0.61

16 Sep	259	1.00	1.09	1.15	1.20	1.21	1.21	1.17	1.12	1.04	0.94
16 Oct	289	1.00	1.17	1.31	1.43	1.51	1.56	1.58	1.55	1.50	1.40
15 Nov	319	1.00	1.24	1.46	1.65	1.80	1.91	1.97	1.98	1.95	1.87
11 Dec	345	1.00	1.29	1.55	1.78	1.98	2.14	2.25	2.30	2.31	2.26

Table IV.27

Table IV.28

$\overline{R}$ for **Galati**											
Mean Monthly Day	**β** / **n**	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
17 Jan	17	1.00	1.26	1.49	1.70	1.88	2.01	2.11	2.15	2.15	2.11
15 Feb	46	1.00	1.18	1.34	1.48	1.59	1.67	1.71	1.72	1.70	1.65
16 Mar	75	1.00	1.10	1.18	1.23	1.26	1.27	1.25	1.21	1.14	1.05
15 Apr	105	1.00	1.05	1.08	1.09	1.09	1.06	1.01	0.94	0.86	0.76
15 May	135	1.00	1.01	1.01	0.99	0.96	0.91	0.85	0.77	0.69	0.60
11 Jun	162	1.00	1.00	0.98	0.95	0.90	0.83	0.76	0.67	0.58	0.48
17 Jul	198	1.00	1.00	0.99	0.96	0.92	0.86	0.78	0.69	0.60	0.50
16 Aug	228	1.00	1.04	1.05	1.05	1.03	0.98	0.91	0.83	0.74	0.63

16 Sep	259	1.00	1.09	1.17	1.21	1.24	1.23	1.20	1.15	1.07	0.97

$\frac{\overline{H_d}}{\overline{H}}$ for **Timisoara**												
Mean Monthly Day	17 Jan	15 Feb	16 Mar	15 Apr	15 May	11 Jun	17 Jul	16 Aug	16 Sep	16 Oct	15 Nov	11 Dec
n	17	46	75	105	135	162	198	228	259	289	319	345
$\frac{\overline{H_d}}{\overline{H}}$	0.55	0.46	0.39	0.38	0.34	0.36	0.32	0.32	0.35	0.39	0.51	0.55

16 Oct	289	1.00	1.18	1.33	1.45	1.54	1.60	1.62	1.60	1.54	1.45
15 Nov	319	1.00	1.22	1.42	1.59	1.73	1.83	1.88	1.89	1.86	1.78
11 Dec	345	1.00	1.22	1.42	1.60	1.75	1.87	1.95	1.99	1.99	1.95

Table IV.29

Table IV.30

$\overline{R}$ for **Timisoara**											
Mean Monthly Day	**β** / **n**	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
17 Jan	17	1.00	1.23	1.43	1.62	1.77	1.89	1.97	2.01	2.00	1.96
15 Feb	46	1.00	1.18	1.34	1.48	1.59	1.67	1.72	1.73	1.71	1.65
16 Mar	75	1.00	1.11	1.20	1.27	1.31	1.32	1.31	1.26	1.19	1.10
15 Apr	105	1.00	1.05	1.08	1.10	1.09	1.06	1.01	0.94	0.86	0.77
15 May	135	1.00	1.01	1.01	1.00	0.96	0.91	0.85	0.77	0.69	0.59
11 Jun	162	1.00	1.00	0.98	0.95	0.90	0.83	0.76	0.67	0.58	0.49
17 Jul	198	1.00	1.00	0.99	0.96	0.92	0.86	0.78	0.70	0.60	0.50

16 Aug	228	1.00	1.04	1.05	1.05	1.02	0.98	0.91	0.83	0.74	0.63
16 Sep	259	1.00	1.09	1.16	1.21	1.23	1.23	1.20	1.15	1.07	0.97
16 Oct	289	1.00	1.17	1.31	1.43	1.51	1.56	1.58	1.56	1.50	1.42
15 Nov	319	1.00	1.22	1.42	1.58	1.72	1.81	1.86	1.87	1.84	1.77
11 Dec	345	1.00	1.26	1.49	1.70	1.88	2.02	2.12	2.17	2.18	2.13