

SHADOW - Main Result

Calculation: Varjutus_real case_300m_tuulikud_21tk
Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

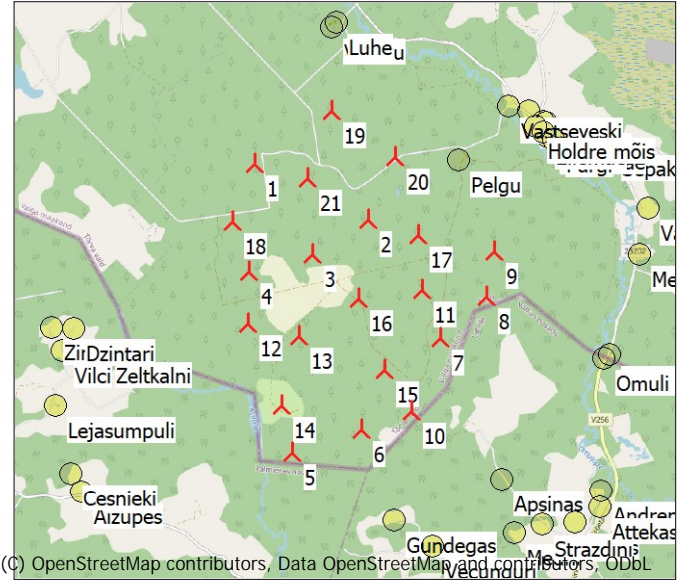
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1,09 2,33 4,53 6,36 8,50 8,58 8,67 7,34 5,07 2,56 1,00 0,78

Operational time
N NE E SE S SW W NW Sum
670 1 025 670 828 1 143 1 577 1 262 710 7 885

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Tõrva_1.wpo (12)
Receptor grid resolution: 1,0 m

All coordinates are in
Estonian Lambert L-EST97-EST97 (EE)



WTGs

No	East	North	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM
1	599 374	6 423 251	97,6	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
2	600 903	6 422 551	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
3	600 172	6 422 074	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
4	599 334	6 421 821	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
5	599 965	6 419 437	80,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
6	600 884	6 419 773	85,9	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
7	601 897	6 421 003	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
8	602 495	6 421 568	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
9	602 579	6 422 166	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
10	601 535	6 420 032	89,8	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
11	601 640	6 421 636	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
12	599 346	6 421 133	87,3	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
13	600 016	6 420 989	88,1	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
14	599 818	6 420 055	80,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
15	601 163	6 420 566	89,9	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
16	600 796	6 421 505	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
17	601 572	6 422 362	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
18	599 108	6 422 477	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
19	600 375	6 423 982	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
20	601 226	6 423 379	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-
21	600 077	6 423 076	90,0	Teoreetiline 300 tipukõrgus...	Yes	Teoreetiline	300 tipukõrgus-7 000	7 000	200,0	200,0	1 932	-

Shadow receptor-Input

No.	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]		[m]
Aizupes	597 179	6 418 851	82,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Andreni	604 078	6 419 041	80,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Apsinas	602 764	6 419 153	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Attekas	604 069	6 418 822	80,5	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Cesnieki	597 040	6 419 079	81,6	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Dzintari	597 036	6 421 015	91,3	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Ellemäe	603 193	6 423 768	81,2	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Elli	603 232	6 423 891	83,8	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Gundegas	601 343	6 418 569	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0

To be continued on next page...

SHADOW - Main Result

Calculation: Varjutus_real case_300m_tuulikud_21tk

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No.	East	North	Z	Width	Height	Elevation	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l.	window		(ZVI) a.g.l.
						[m]	[°]		[m]
Holdre kordon	604 157	6 420 850	86,9	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Holdre mõis	603 084	6 423 839	81,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Jaanimäe	603 252	6 423 712	81,1	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Lejasumpuli	596 820	6 419 987	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Lindmäe	603 334	6 423 785	82,3	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Luhe	600 411	6 425 148	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Medni	602 941	6 418 446	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Mekro	604 502	6 422 180	83,1	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Männiku	603 191	6 423 913	83,5	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Omuli RPP	604 068	6 420 796	80,5	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Pargi	603 336	6 423 667	81,4	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Pelgu	602 085	6 423 368	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Rozas	603 738	6 418 615	84,2	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Sepakõrtsi	604 083	6 423 642	88,1	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Silla	602 990	6 424 034	83,1	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Strazdini	603 305	6 418 570	87,1	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Vanaveski	604 600	6 422 801	85,3	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Vastseveski	602 725	6 424 099	80,7	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Vecunguri	601 866	6 418 237	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Vilci	596 891	6 420 717	100,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Viltaku	600 348	6 425 085	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Zeltkalni	597 432	6 420 732	90,0	10,0	10,0	1,0	0,0	"Green house mode"	1,0
Zimelnieki	596 738	6 421 013	94,6	10,0	10,0	1,0	0,0	"Green house mode"	1,0

Calculation Results

Shadow receptor

No.	Shadow, worst case			Shadow, expected values	
	Shadow hours	Shadow days	Max shadow	Shadow hours	
	per year	per year	hours per day	per year	
	[h/year]	[days/year]	[h/day]	[h/year]	
Aizupes	0:00	0	0:00	0:00	
Andreni	0:00	0	0:00	0:00	
Apsinas	19:27	48	0:30	5:03	
Attekas	0:00	0	0:00	0:00	
Cesnieki	0:00	0	0:00	0:00	
Dzintari	0:00	0	0:00	0:00	
Ellemäe	29:45	66	0:31	2:19	
Elli	24:20	58	0:29	1:52	
Gundegas	32:41	70	0:32	8:26	
Holdre kordon	19:47	56	0:28	4:53	
Holdre mõis	34:42	89	0:30	4:08	
Jaanimäe	32:46	72	0:31	2:36	
Lejasumpuli	0:00	0	0:00	0:00	
Lindmäe	30:07	70	0:29	2:24	
Luhe	52:48	80	0:45	4:17	
Medni	0:00	0	0:00	0:00	
Mekro	10:25	32	0:25	2:23	
Männiku	22:48	56	0:29	1:45	
Omuli RPP	29:58	90	0:29	7:32	
Pargi	33:48	78	0:30	2:44	
Pelgu	225:10	240	1:40	33:34	
Rozas	0:00	0	0:00	0:00	
Sepakõrtsi	0:00	0	0:00	0:00	
Silla	23:27	72	0:26	3:00	
Strazdini	0:00	0	0:00	0:00	
Vanaveski	0:00	0	0:00	0:00	
Vastseveski	13:45	36	0:29	2:17	
Vecunguri	0:00	0	0:00	0:00	
Vilci	0:00	0	0:00	0:00	
Viltaku	84:13	86	1:14	6:35	
Zeltkalni	0:00	0	0:00	0:00	
Zimelnieki	0:00	0	0:00	0:00	

SHADOW - Main Result

Calculation: Varjutus_real case_300m_tuulikud_21tk

Total amount of flickering on the shadow receptors caused by each WTG

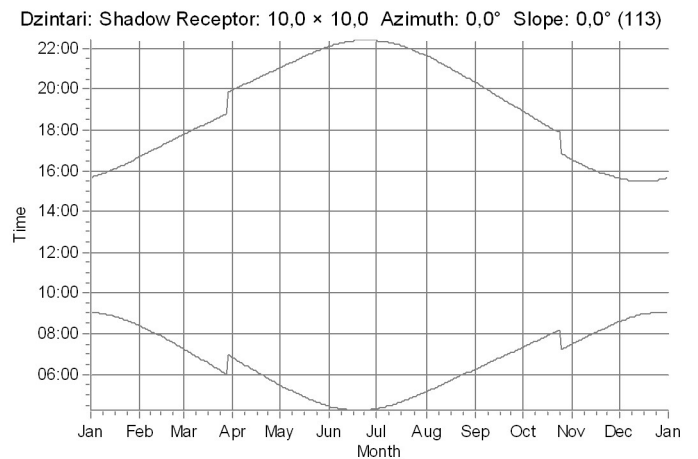
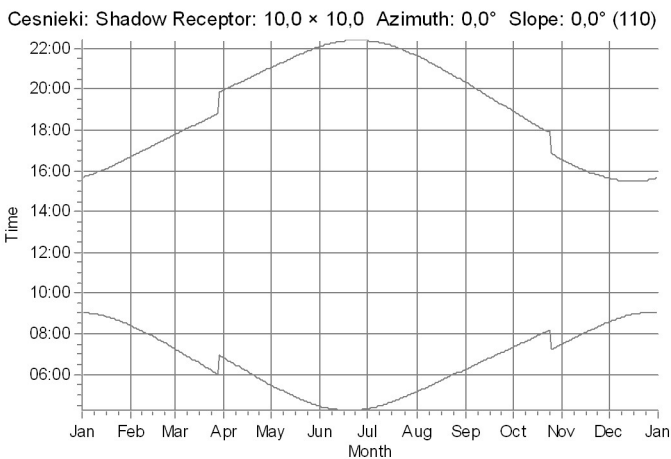
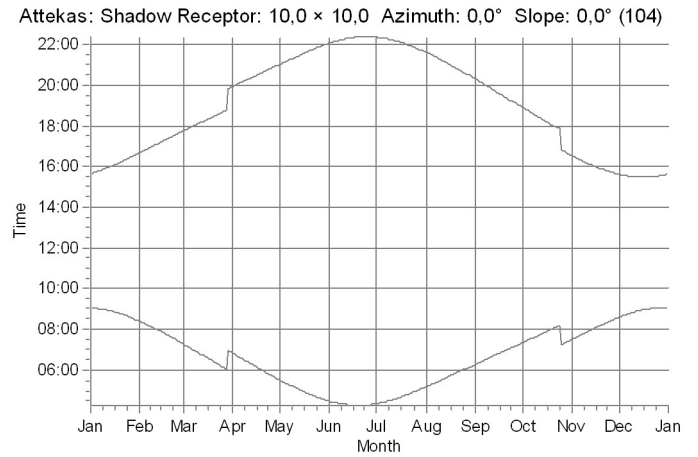
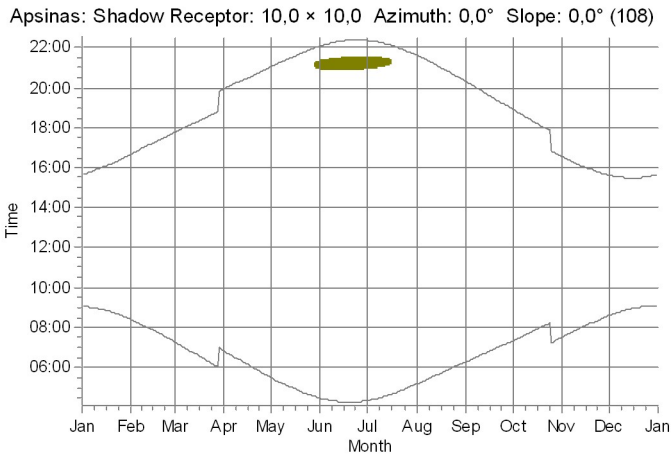
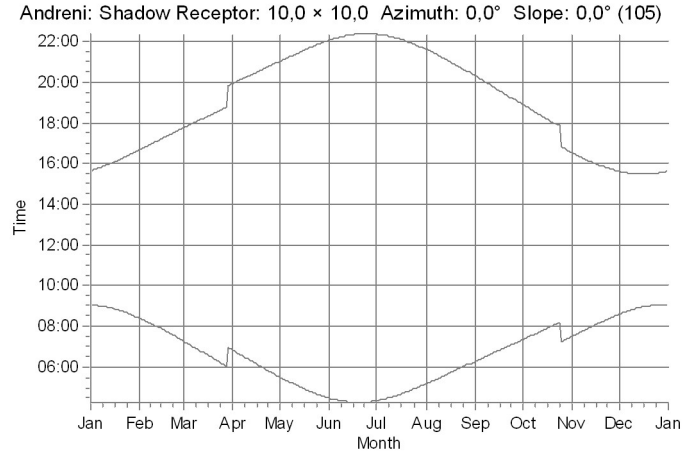
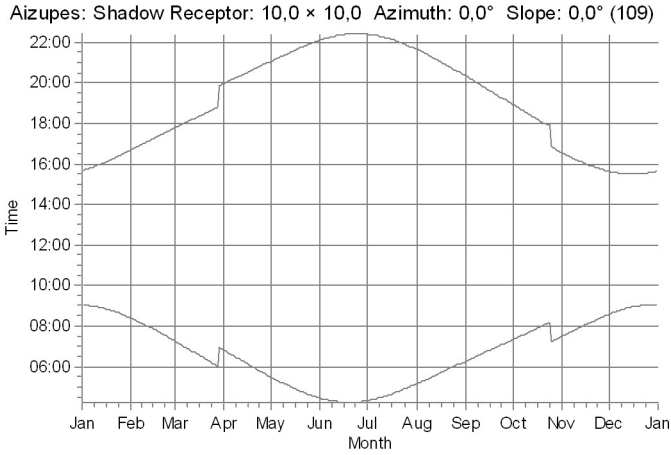
No.	Name	Worst case [h/year]	Expected [h/year]
1	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (111)	0:00	0:00
2	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (112)	19:34	3:01
3	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (113)	0:00	0:00
4	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (114)	0:00	0:00
5	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (115)	32:41	8:26
6	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (116)	0:00	0:00
7	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (117)	0:00	0:00
8	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (118)	50:26	10:37
9	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (119)	144:15	12:45
10	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (120)	19:27	5:03
11	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (121)	18:39	1:26
12	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (122)	0:00	0:00
13	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (123)	0:00	0:00
14	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (124)	0:00	0:00
15	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (125)	0:00	0:00
16	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (126)	0:00	0:00
17	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (127)	51:08	4:49
18	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (128)	0:00	0:00
19	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (129)	91:22	9:59
20	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (130)	116:41	22:58
21	Teoreetiline 300 tipukõrgus 7000 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (131)	0:00	0:00

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

SHADOW - Calendar, graphical

Calculation: Varjutus_real case_300m_tuulikud_21tk

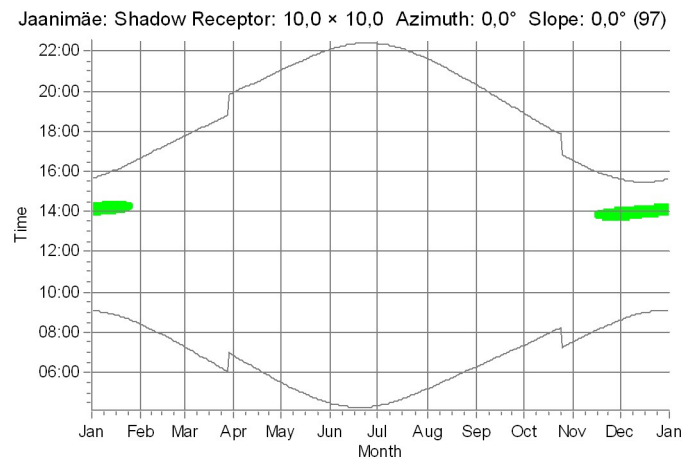
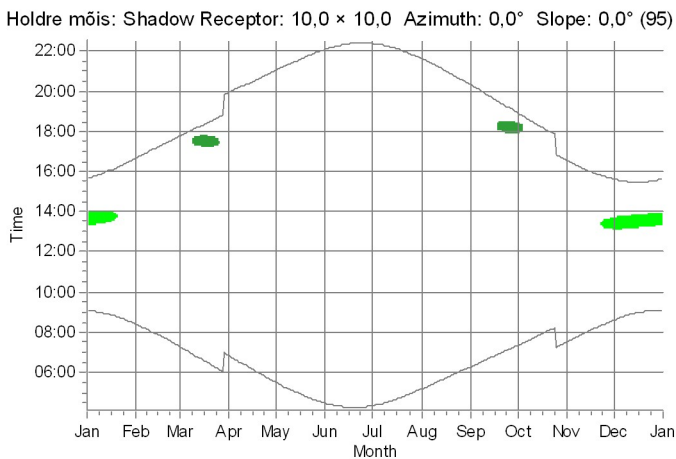
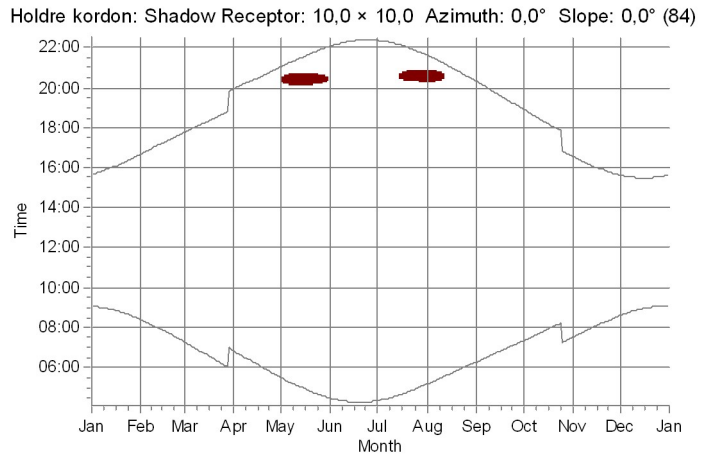
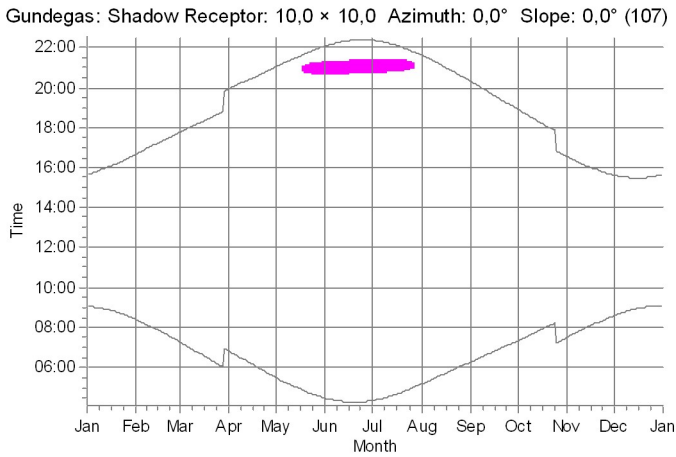
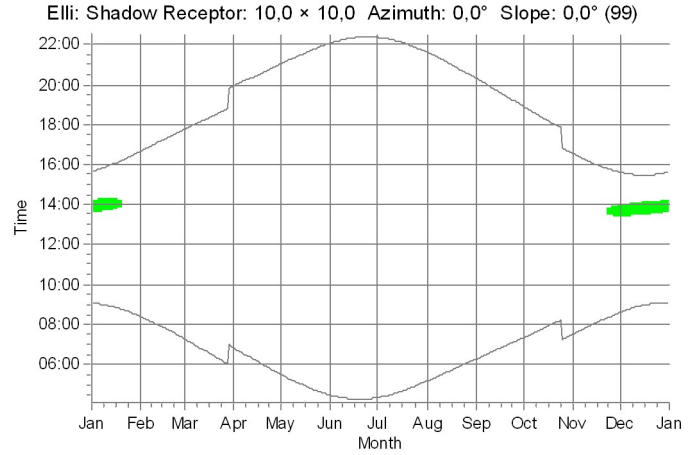
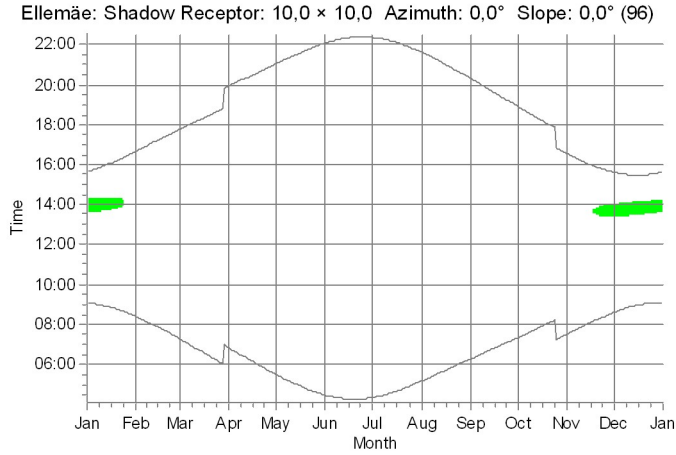


WTGs

10: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (120)

SHADOW - Calendar, graphical

Calculation: Varjutus_real case_300m_tuulikud_21tk



WTGs

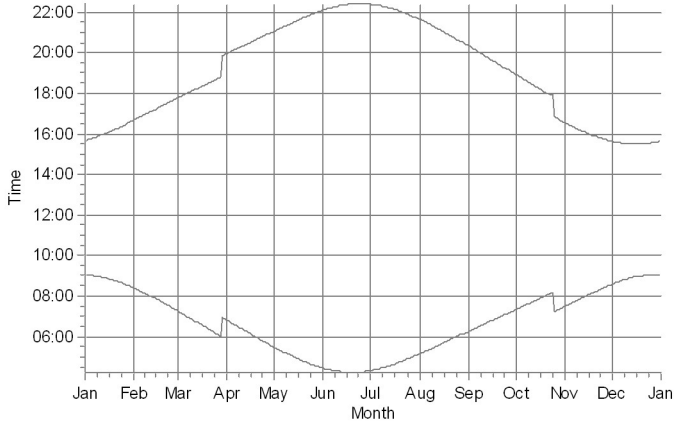
- 5: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (115)
- 8: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (118)

- 9: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (119)
- 20: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (130)

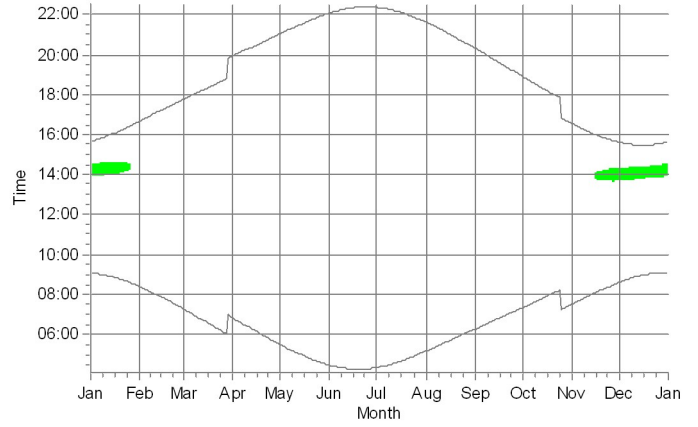
SHADOW - Calendar, graphical

Calculation: Varjutus_real case_300m_tuulikud_21tk

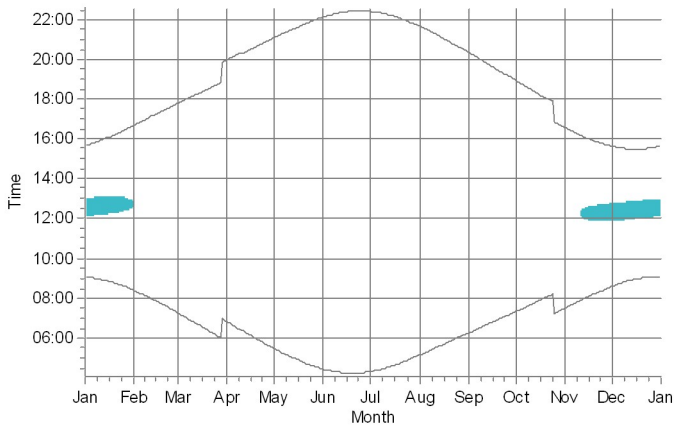
Lejasumpuli: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (111)



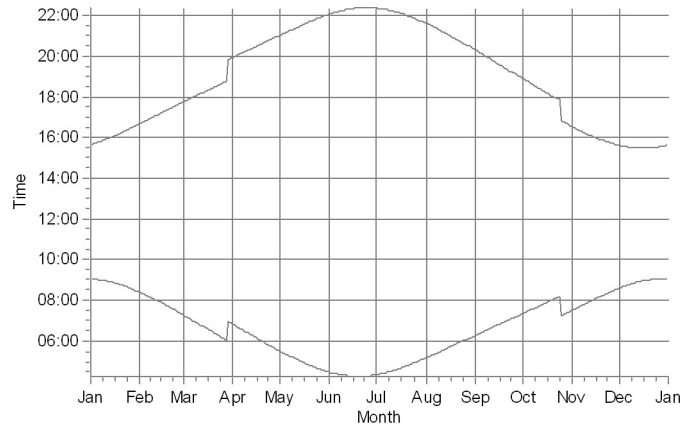
Lindmäe: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (89)



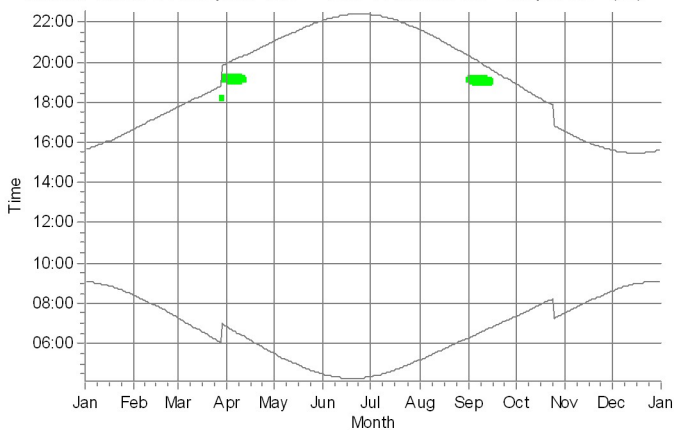
Luhe: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (94)



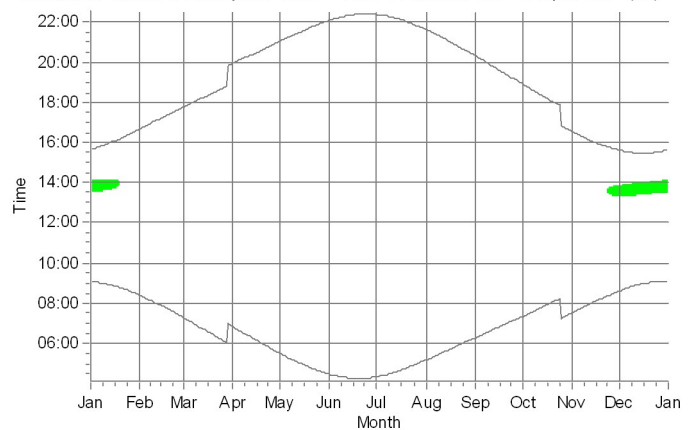
Medni: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (102)



Mekro: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (85)



Männiku: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (88)



WTGs

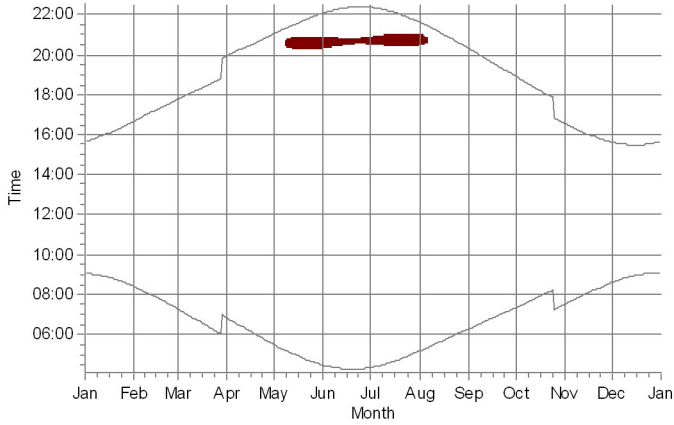
9: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (119)

19: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (129)

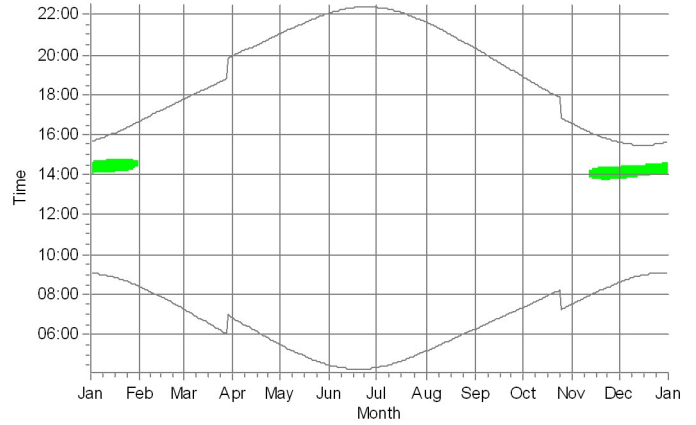
SHADOW - Calendar, graphical

Calculation: Varjutus_real case_300m_tuulikud_21tk

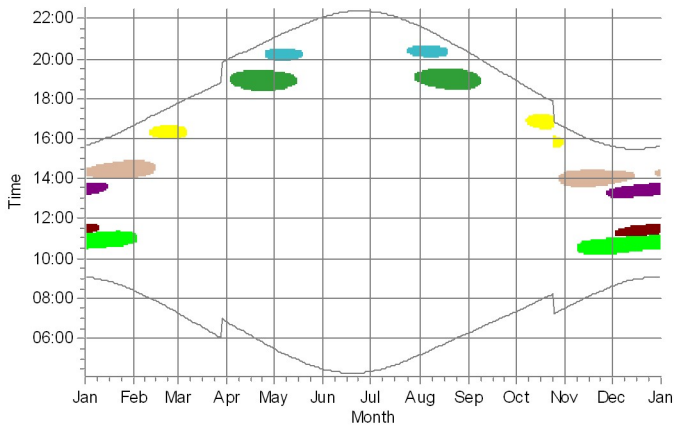
Omuli RPP: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (100)



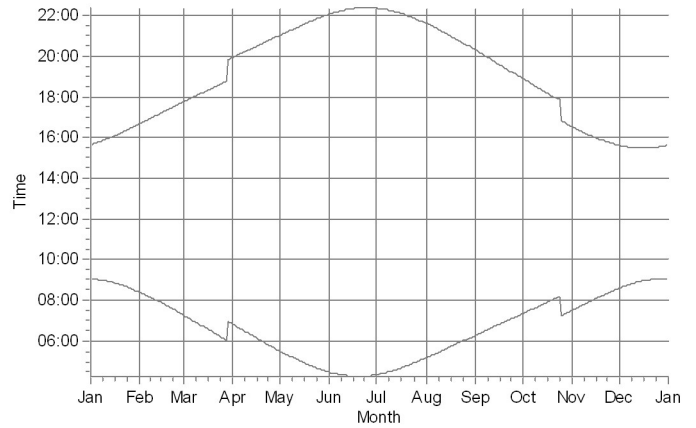
Pargi: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (98)



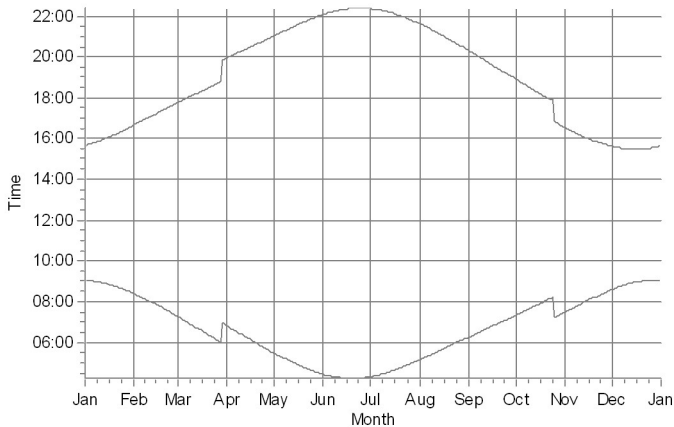
Pelgu: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (92)



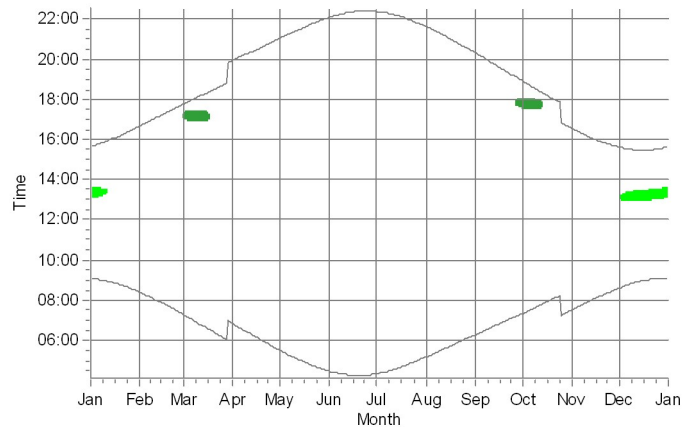
Rozas: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (103)



Sepakõrtsi: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (87)



Silla: Shadow Receptor: 10,0 × 10,0 Azimuth: 0,0° Slope: 0,0° (90)



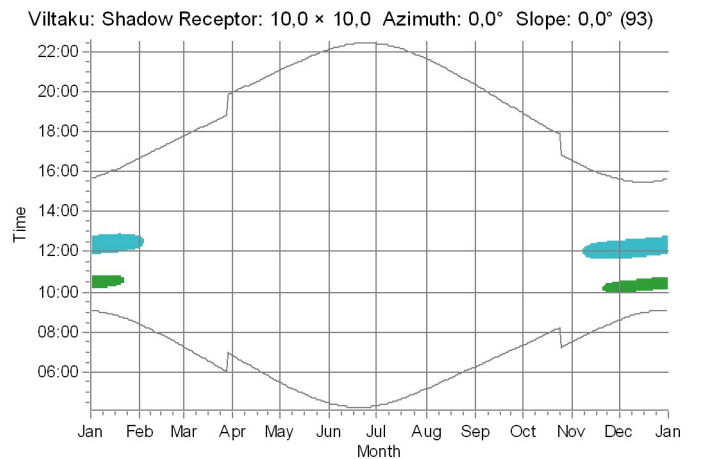
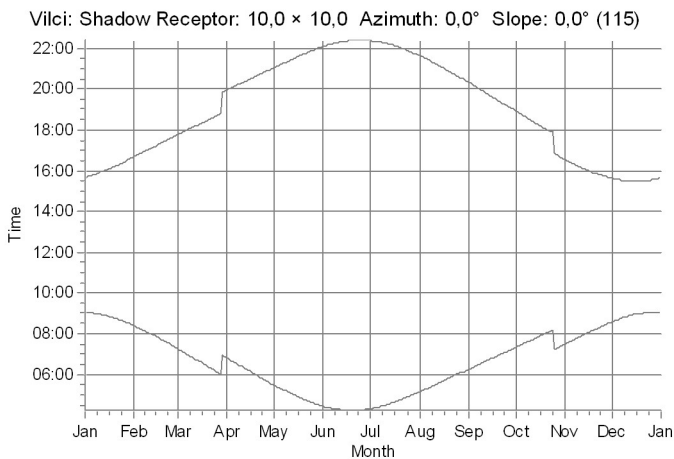
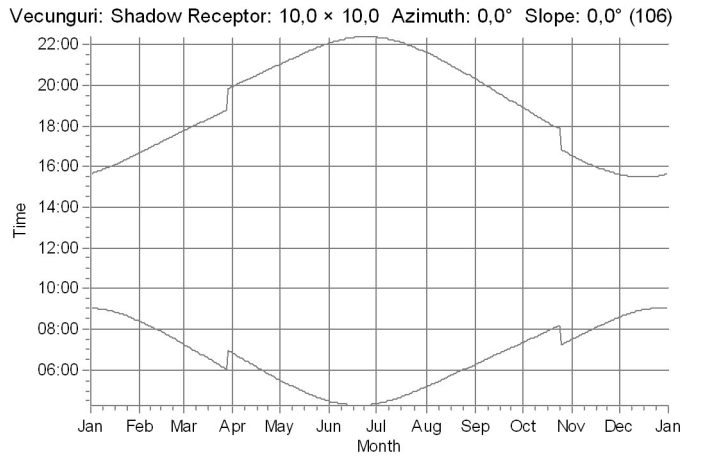
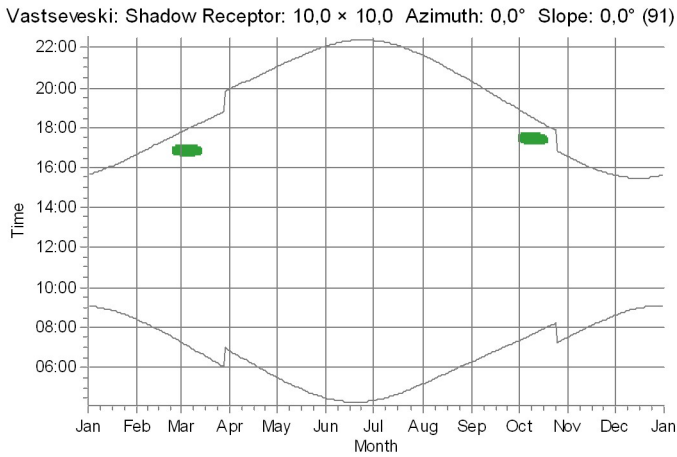
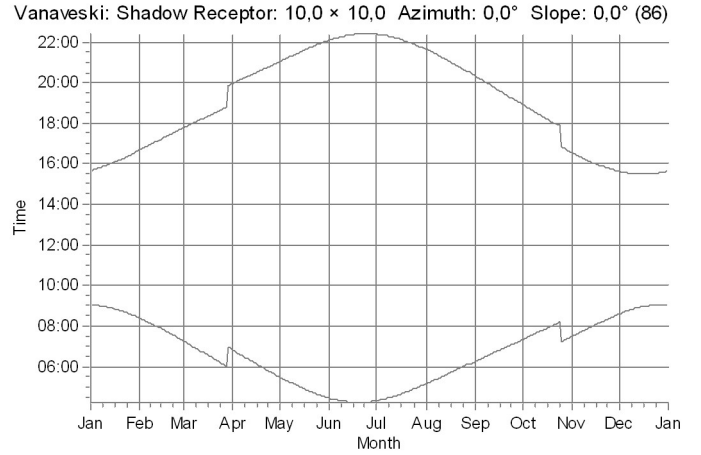
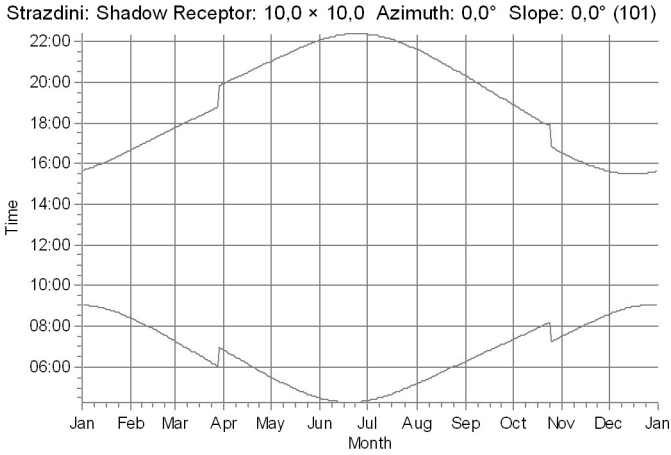
WTGs

- 2: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (112)
- 8: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (118)
- 9: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (119)
- 11: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (121)

- 17: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (127)
- 19: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (129)
- 20: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (130)

SHADOW - Calendar, graphical

Calculation: Varjutus_real case_300m_tuulikud_21tk



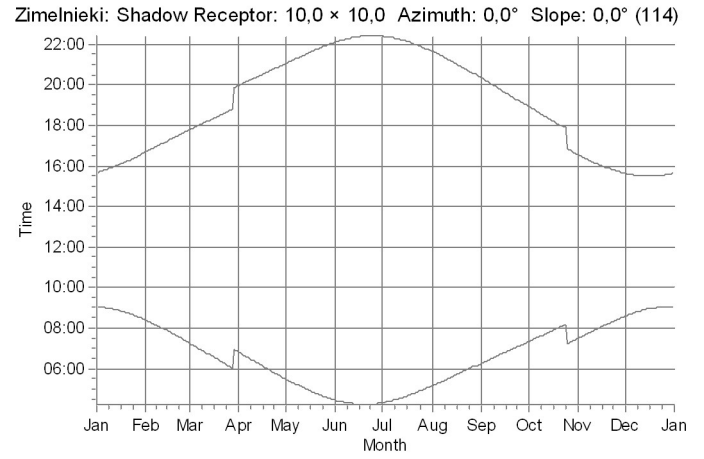
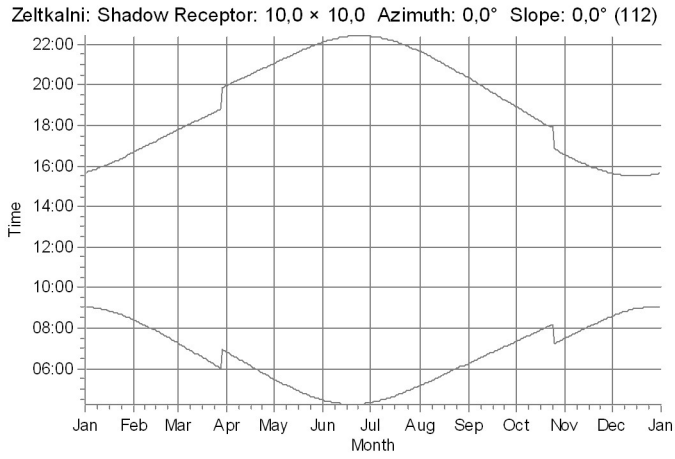
WTGs

19: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (129)

20: Teoreetiline 300 tipukõrgus 7000 200,0 IOI hub: 200,0 m (TOT: 300,0 m) (130)

SHADOW - Calendar, graphical

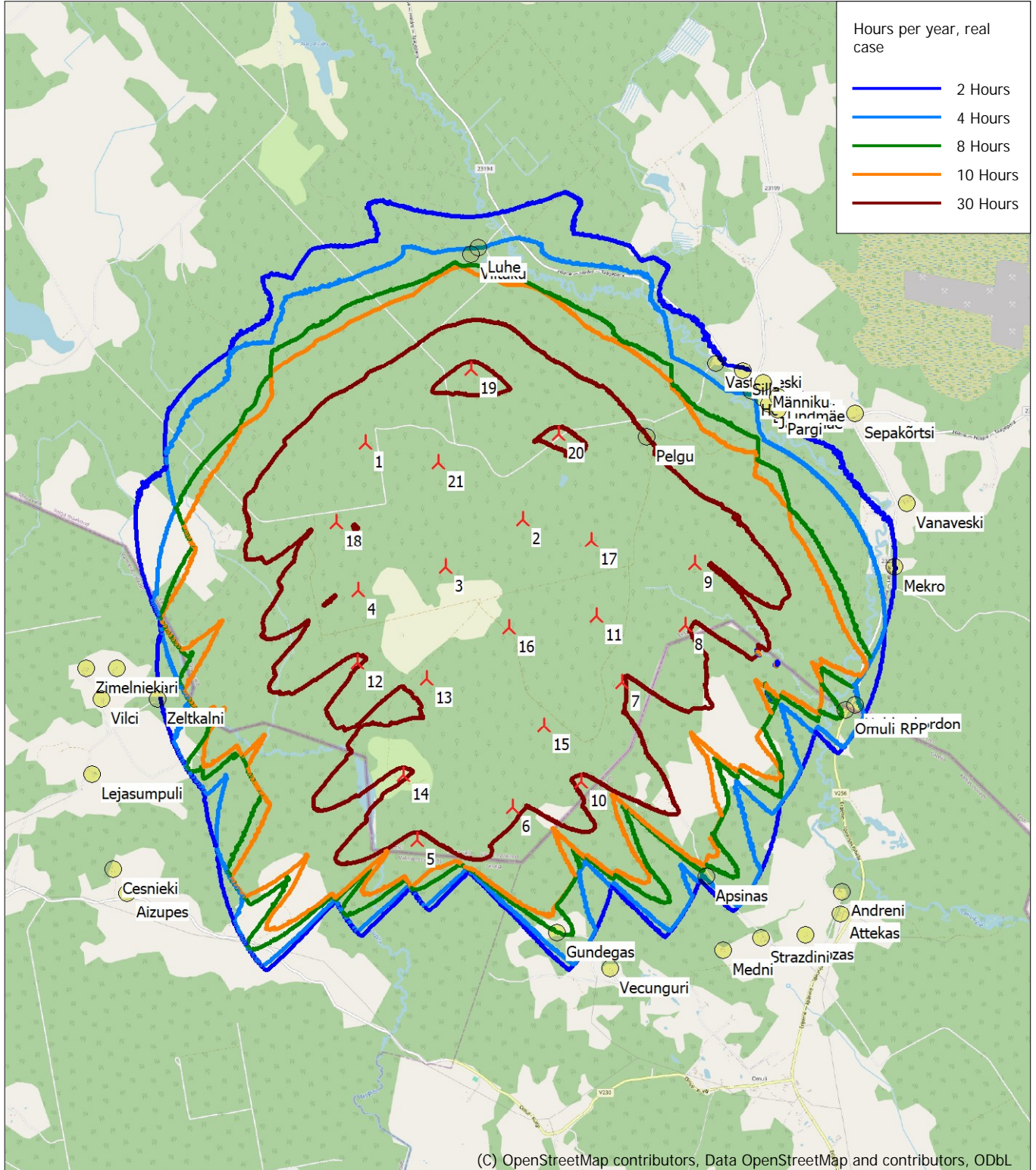
Calculation: Varjutus_real case_300m_tuulikud_21tk



WTGs

SHADOW - Map

Calculation: Varjutus_real case_300m_tuulikud_21tk



Map: EMD OpenStreetMap , Print scale 1:55 000, Map center Estonian Lambert L-EST97-EST97 (EE) East: 600 960 North: 6 422 010
New WTG Shadow receptor
Flicker map level: Height Contours: CONTOURLINE_Tõrva_1.wpo (12)
Time step: 2 minutes, Day step: 3 days, Map resolution: 10 m, Visibility resolution: 5 m, Eye height: 1,5 m