THE INFLUENCE OF TEMPERATURE AND HUMIDITY INVERSION ON CHANGE OF REFRACTION INDEX OF AIR AND CALCULATION OF RANGING CORRECTION TO EARTH ARTIFICIAL SATELLITES

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On basis of the aerological data, obtained at six stations of Ukraine in day- and night-time during a year, inversion of temperature t and of partial pressure of water vapour e in troposphere are investigated. The criterion of presence of inversion was the condition $(f_2 - f_1) \geq \Delta f$, where f_1 and f_2 are the measured parameters at lower and upper atmospheric layers, Δf – accuracy of measurement (or determination) of parameter f. Statistical data on inversions of t and e are given in Table 1. Inversions of t taking place in night occur about 2–3 time more often than in day, mainly at the expense of radiative inversions, which begins at the ground level. Inversions of t causes the corresponding inversions of e, but the place and the power (the thickness of layer) of these inversions do not always coincide. A majority of inversions of t and e in day are placed above the ground level. There are approximately the same quantity of inversions of e at day and night. Inversions of e causes the corresponding inversions of index refraction of water vapour N. The placing and the power of inversions of e and N are in good agreement. The range correction due to water vapour will be greater in case of existence of inversions of N. Results of wet range correction calculation both with inversions $(\Delta\rho)$ and without inversions $(\Delta\rho')$ are given in Table 2. In this table h_1 means the altitude, at which inversion begins, Δh is power of inversion, $\Delta e = e_2 - e_1$ and ΔN is inversion intensity of e and N, respectively. In Table 2 superscripts $^{1)}$ means Chernivci, night; $^{2)}$ means L'viv, night; $^{3)}$ means Kyiv, night. As one can see from Table 2, $\Delta\rho - \Delta\rho'$ is large, when Δe and corresponding ΔN are large. Also $\Delta\rho - \Delta\rho'$ increases, when Δh increases, although this dependence is not so evident. All calculations were done for zenith direction. The maximal contribution of inversion of e to range correction is 5 cm. This value is large enough because of the total wet range correction is equal to 20–40 cm in zenith direction. At larger zenith angles this contribution increases, but question arises whether we can use an assumption of spherical-symmetric atmosphere at large zenith angles.

Table 1: Statistical data of inversions of t and e

Station		number of dates	number of inversions		second layer inversions		ground level inversions	
			t	e	t	e	t	e
Kyiv	day	54	20	35	5	8	–	–
	night	140	59	61	6	14	7	2
Uzhgorod	day	53	7	19	1	2	–	–
	night	119	61	36	7	5	26	4
L'viv	day	63	19	27	–	4	–	–
	night	135	113	78	15	12	77	20
Shepetivka	day	32	17	19	1	4	2	–
	night	109	101	63	23	11	45	50
Chernivci	day	49	16	20	3	6	2	3
	night	104	92	61	21	12	75	38
Simpheropol	day	83	24	24	2	3	1	1

Table 2: Wet range corrections and characteristics of inversions at different dates

Date	h_1, km	Δh, km	Δe, mbar	ΔN	$\Delta\rho - \Delta\rho'$, m
23.03 $^{1)}$	0.21	0.18	2.45	11.10	0.017
25.06 $^{1)}$	0.21	0.30	5.91	14.33	0.039
26.05 $^{1)}$	0.21	0.33	6.60	27.29	0.027
03.08 $^{1)}$	0.21	0.45	8.04	30.28	0.034
16.10 $^{1)}$	0.21	0.59	9.33	39.10	0.050
22.08 $^{1)}$	3.88	0.06	0.45	2.30	0.002
15.05 $^{1)}$	4.60	0.40	0.62	3.66	0.007
20.03 $^{2)}$	0.33	0.17	0.82	3.79	0.009
26.03 $^{2)}$	0.33	0.33	0.86	3.89	0.011
02.01 $^{2)}$	1.26	1.14	1.27	6.84	0.025
02.11 $^{2)}$	3.00	1.65	0.56	3.80	0.016
07.08 $^{2)}$	4.00	1.00	1.02	6.10	0.030
02.02 $^{2)}$	4.00	1.24	0.20	1.39	0.020
12.02 $^{2)}$	4.50	0.90	0.35	2.24	0.013
10.09 $^{2)}$	5.00	1.00	0.44	2.76	0.018
29.04 $^{3)}$	0.50	0.17	1.32	6.30	0.037
18.05 $^{3)}$	1.25	0.22	1.19	6.30	0.025
26.02 $^{3)}$	4.00	1.00	0.06	0.48	0.005