About Accuracy of High Cloud Amount Detecting from Radiosonde Sounding

Irina V. Chernykh

All Russian Institute of Hydrometeorological Information – Word Data Center, Obninsk, Russia,
E-mail: civ@meteo.ru

Research of thin high cloud layers is especially important due problem of its true detection by satellite and surface observations, from radiosonde sounding data. Difficulties in thin clouds detection is one of the reasons of different cloudiness climatologies obtained on base different platform of observations (Poore et al., 1995; Rossow and Dueñas, 2004; Chernykh, 2001; Chernykh and Aldukhov, 2004).

According previous study (Chernykh, 2001), surface observations indicate that frequency of one-four thin cloud layers comes for some stations to 35% from all observations. But for high clouds, as it follows from Table 1 and Table 2, surface observations indicate that frequency of thin cloud layers comes to 86% from all high cloud observations with one reported cloud layer. Frequency of thin transparent high cloud layers foots up to 26% from all thin cloud layers (see No in Table 2). But big lag error of humidity sensor is the reason for a lack of methods, based on using of the measured values of humidity (Chernykh, Eskridge, 1996; Chernykh, Alduchov, 2002; Chernykh, Aldukhov, 2004).

Main goals of this study are: to evaluate the CE method (Chernykh and Eskridge, 1996; Chernykh and Aldukhov, 2004) ability of cloud layers prediction from temperature and humidity profiles for thick and thin high cloud layers for regions with different climatic conditions; to estimate the accuracy in predicting of cloud amount and the dependence of the results on the transparency of cloud layers.

Twice-daily radiosonde sounding data and surface-based cloud observations for 1975-80 period (NCDC, 1991) for eight stations, placed in regions with different climatic conditions are using for this research (for more details see Chernykh, 2001). The observations with one reported cloud layer were included in this study. Below, opaque part exceeds 50% of the cloud amount (the transparent part is less than 50% of the cloud amount) for thick cloud layers and for thin cloud layers vice versa (NCDC, 1991). In total 3843 cases were used for analysis: 537 cases of thick and 3306 cases for thin high cloud layers (see Table 1 and Table 2).

Statistics for observations with one observed layer that is thick or thin high cloud layer: the percent of correctly diagnosed cloud level reports; the percent of correctly diagnosed cloud level and cloud cover; the percents of correctly diagnosed cloud level and overestimated/underestimated cloud amount; average cloud amount (% of the sky) calculated from surface observations presented in Table 1 and Table 2. In addition, to estimate the dependence of the results on the transparency of cloud layers the same statistics were calculated in assumption that cloud cover equal to opaque. This results are presented in Table 3.

TABLE 1. Statistics for observations with one observed layer that is thick high cloud layer. P_l is the percent of correctly diagnosed cloud level reports; P_c is the percent of correctly diagnosed cloud level and cloud cover. The difference, d, between observed, A_o, and the predicted cloud amount interval (A_p1, A_p2) is defined as $d = A_o - A_p2$ if $A_p2 < A_o$, and $d = A_p1 - A_o$ if $A_o < A_p1$. P_u1 and P_u2 are the percents of correctly diagnosed cloud level and underestimated cloud amount: $A_p2 < A_o$ and $0 < d \le 20\%$ (for P_u1) or $d > 20\%$ (for P_u2). P_o1 and P_o2 are the percents of correctly diagnosed cloud level and overestimated cloud amount $A_o \le A_p1$ and $0 < d \le 20\%$ (for P_o1) or $d > 20\%$ (for P_o2). A_a is the average cloud amount (%) calculated from surface observations and N is the number of observations with one reported cloud layer. 1975 - 1980 years.

Station	P_l	P_c	P_u1	P_u2	P_o1	P_o2	A_a	N
Point Barrow	71.4	35.7	0	0	14.3	21.4	89	14
Spokane	90.9	42.4	3.0	33.4	12.1	0.0.	90	33
Albany	96.2	36.5	1.9	48.1	9.6	0.0	89	52
Medford	96.5	52.6	1.8	35.1	7.0	0.0	93	57
Ele	87.9	24.2	0.0	48.5	3.0	12.1	94	66
Cape Hatteras	89.8	51.6	0.0	30.5	7.8	0.0	94	128
Amarillo	96.7	53.8	0.0	38.5	4.4	0.0	93	91
Brownsville	96.9	61.5	1.0	21.8	12.5	0.0	86	96

TABLE 2 is the same as TABLE 1 but for one observed layer that is thin high layer.
No is the number of observations with transparent thin high cloud layer.

Station	P_l	P_c	P_u1	P_u2	P_o1	P_o2	A_a	N0	N
Point Barrow	74.9	29.1	9.1	6.9	5.2	24.6	42	66	175
Spokane	94.6	32.1	14.8	23.6	7.1	17.0	47	99	352
Albany	95.1	34.9	13.6	22.1	7.5	17.0	46	63	384
Medford	95.7	34.1	12.0	26.4	7.0	16.1	51	111	299
Ele	91.9	30.9	12.5	24.1	4.4	20.0	49	141	456
Cape Hatteras	93.8	31.6	10.7	24.1	6.2	21.2	53	114	661
Amarillo	97.5	34.8	13.9	24.5	7.2	17.0	46	202	652
Midway	82.8	17.3	13.8	24.1	3.5	24.1	50	6	29
Brownsville	96.3	28.2	12.4	15.4	11.3	29.2	42	54	298

TABLE 3 is the same as TABLE 1 but for one observed layer that is thin high layer
with opaque more than zero. P_c is the percent of correctly diagnosed cloud level and opaque
of cloud layer. A_a is the average cloud amount (%) for opaque of cloud layer,
calculated from surface observations.

Station	P_l	P_c	P_u1	P_u2	P_o1	P_o2	A_a	N
Point Barrow	70.6	21.1	4.6	0.0	4.6	40.4	20	109
Spokane	94.5	40.7	13.4	1.2	2.8	36.4	22	253
Albany	94.7	44.5	13.7	1.2	3.4	31.8	22	321
Medford	95.2	40.4	15.4	1.1	4.3	34.0	21	188
Ele	90.5	41.9	11.1	0.6	1.9	34.9	20	315
Cape Hatteras	93.2	34.7	12.6	2.4	4.0	39.5	22	547
Amarillo	97.1	44.2	12.7	0.7	2.9	36.7	21	450
Midway	87.0	34.8	13.0	0.0	0.0	39.1	22	23
Brownsville	96.3	34.4	10.7	1.2	4.9	45.1	21	244

Conclusion: Results, presented in Table1 – Table 3 for high clouds, have shown that frequency of correctly diagnosed cloud level and cloud cover P_c depends from transparency of cloud layer. The more opaque part of cloud layers the more frequency of correctly diagnosed cloud level and cloud cover $P_{c.}$ CE-method gives a possibility to enough realistic reflect thin high cloud layers forming: predicted cloud amount is greater than opaque, but less than total cloud cover, which includes transparent part of cloud layers.

Results can be used for modeling of atmospheric circulation and cloud modeling, for comparison with results obtained on base satellites.

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