Some Features of Temperature-Humidity Layering of Troposphere for Different Cloudy Conditions

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Study of temperature-humidity layering of troposphere (THLT) plays important role in research of atmosphere properties (Fridzon 2004; Chernykh and Aldukhov, 2004; Alduchov et al., 2005; Chernykh et al., 2005). Macro temperature-humidity layering can be visually detected, when such cloud types as stratus, stratocumulus, altostratus, altocumulus, cirrus present. More detailed THLT can be detected by CE-method of analysis of temperature and humidity profiles, obtained during standard radiosonde sounding of atmosphere (Chernykh and Eskridge, 1996; Chernykh and Aldukhov, 2004).

Main goal of this study is to present statistical analysis of THLT detecting by CE-method for different sky condition: with thick and thin cloud layer of stratocumulus, altocumulus and cirrus.

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. 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 6440 cases were used for analysis: 2919 cases of thick and 3521 cases for thin cloud layers.

Percent of correctly diagnosed cloud level (PL) by CE method, percent of diagnosed only observed cloud level (P1) and percent of diagnosed observed cloud level and predicted also higher humid layers (P2) for stratocumulus are presented in Table 1. PL for thick stratocumulus layer varies from 85 % to 98 % and for thin - from 71 % to 97 %. Results presented in Table 1 show that for condition with present of thick Sc layer THLT take place not only in low troposphere more often in comparison with thin Sc present. In reality, P1 for thick Sc layer varies from 12 % to 33 % and for thin - from 29 % to 61 %. P2 for thick Sc layer varies from 47 % to 72 % and for thin - from 18 % to 57 %.

TABLE 1. Percent of correctly diagnosed cloud level by CE method, PL. Percent of diagnosed only observed cloud level, P1. Percent of diagnosed observed cloud level and predicted also higher humid layers (greater than 20% coverage), P2. AV is average cloud cover in the tenth of the sky; N is the number of correspondent observations.

	One visible Stratocumulus thick layer					*One visible Stratocumulus thin layer*				
Station	PL	P1	P2	AV	N	PL	P1	P2	AV	N
Amarillo	93.6	22.3	63.1	9.6	157	71.8	41.0	20.5	2.5	39
Cape Hatteras	93.9	21.4	62.9	9.3	229	92.4	51.5	33.3	2.9	66
Brownswille	97.5	31.8	61.3	9.5	437	97.1	61.3	34.1	2.7	173
Albany	96.7	23.0	58.0	9.3	538	90.5	44.3	32.4	2.5	210
Spokane	96.8	11.7	72.3	9.5	94	86.4	45.5	18.2	2.4	22
Medford	97.9	32.8	58.4	9.3	341	89.6	52.2	32.8	2.9	67
Ele	85.2	19.0	46.5	8.8	142	72.3	38.3	26.6	2.9	94
Point Barrow	97.4	27.9	64.4	9.6	233	93.5	29.0	56.5	3.5	62

The same results for altocumulus layers are shown in Table 2. In additional percent of diagnosed observed cloud level and predicted also underlying moist layers (greater than 20% coverage and less than 600 m in total thickness), P3, is presented in Table 2. PL for thick altocumulus layer varies from 89 % to 100 % and for thin - from 89 % to 99 %.The results of this table show that THLT take place also in low and high troposphere more often for condition with present thick Ac layer in comparison with present thin Ac layer. In reality, P1 for thick Ac layer varies from 4 % to 29 % and for thin - from 6 % to 46 %. P2 for thick Ac layer varies from 9 % to 23 % and for thin - from 3 % to 14 %. P3 for thick Ac layer varies from 39 % to 84 % and for thin - from 34 % to 87 %.

Results for thin cirrus layers are shown in Table 3. PL for thin cirrus layer varies from 77 % to 99 %. P1 for thin Ci layer varies from 5 % to 22 % and P3 varies from 71 % to 88 %.

TABLE 2 is the same as TABLE 1, but for Altocumulus.
P3 - percent of diagnosed observed cloud level and predicted also underlying moist layers (greater than 20% coverage and less than 600 m in total thickness).

	One visible Altocumulus thick layer						*One visible Altocumulus thin layer*					
Station	PL	P1	P2	P3	AV	N	PL	P1	P2	P3	AV	N
Amarillo	92.2	21.6	21.6	41.2	8.9	102	97.0	43.9	12.1	37.9	2.3	66
Cape Hatteras	94.7	7.1	15.9	68.2	9.4	170	89.1	20.0	5.5	60.0	2.8	55
Brownswille	89.2	11.7	14.4	61.3	8.9	111	96.6	10.3	13.8	72.4	2.6	29
Albany	100	25.9	14.8	55.6	8.7	54	96.9	32.3	3.1	58.5	2.2	65
Spokane	99.1	23.0	11.5	59.3	8.9	113	98.5	25.9	7.4	61.5	2.4	135
Medford	95.8	15.3	17.8	60.2	9.4	118	96.6	32.8	13.8	48.3	2.5	58
Ele	96.8	29.0	22.6	38.7	8.7	31	96.9	46.2	9.2	33.8	2.8	65
Point Barrow	97.8	4.4	8.9	84.4	9.2	45	98.1	5.7	5.7	86.8	3.0	53

TABLE 3 is the same as TABLE 1, but for Cirrus thin layers.

	One visible Cirrus thin layer				
Station	PL	P1	P3	AV	N
Amarillo	98.6	21.0	76.6	3.9	499
Cape Hatteras	94.1	16.5	77.6	3.8	473
Brownswille	96.9	15.4	81.5	3.8	259
Albany	97.9	9.7	88.3	3.0	145
Spokane	95.8	16.3	79.6	4.3	289
Medford	95.9	21.6	74.3	4.0	222
Ele	92.3	9.7	82.6	4.0	298
Point Barrow	76.6	5.2	71.4	3.5	77

Conclusions: THLT can be detected on base radiosonde sounding data by CE method; temperature-humidity layering of troposphere takes place for different sky condition; thick and thin cloud layers are only visible part of the temperature-humidity layering of troposphere.

Results can be used for modeling of atmospheric circulation and cloud modeling.

Acknowledgment. Study was partly supported by Russian Basic Research Foundation (RBRF), project № 04-05-64681.

REFERENCES

Alduchov O.A., Aggarwal P.K., I.V. Chernykh, 2005: Isotope Ratios in Precipitation and Some Key Upper-Air of the Boundary Layer. Program and Abstract Book 5 th International Scientific Conference on the Global Energy and Water Cycle. GEWEX WCRP. 20-24 June 2005. Costa Mesa, California. P. 206.

Chernykh I.V., Aggarwal P.K., O.A. Alduchov, 2005: About Correlations of Isotope Ratios and Clouds Parameters. Program and Abstracts Book 5 th International Scientific Conference on the Global Energy and Water Cycle. GEWEX WCRP. 20-24 June 2005. Costa Mesa, California. P. 210.

Chernykh I.V. and R.E. Eskridge, 1996: Determination of cloud amount and level from radiosonde soundings. *J.Appl. Meteorol, **35**,* 1362-1369 pp.

Chernykh I.V. and O.A. Aldukhov, 2004: Vertical Distribution of Cloud Layers from Cloud Radiosounding Data. Izvestiya, Atmospheric and Oceanic Physics. Vol. 40, No 1, 2-004, pp. 41-53.

Fridzon M.B., 2004: Methods of electromagnetic transmission probing of atmosphere and reliability of measurements of temperature and humidity at altitudes up to 35-40 km. Doctoral Dissertation in Technics. Moscow. 2004.

NCDC, 1991: TD-3280 Surface Airways Hourly. Internal Report of the National Climate Data Center, 40pp.