Estimates of Cloud Layers Number from Global Atmospheric Radiosounding Data

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The number of cloud layers is one of the main parameters of cloudiness vertical macrostructure [1]. In this study, the number of cloud layers with cloud amounts of 0–20, 20–60, 60–80, 80–100, 0–100% of the sky covered are estimated for the Globe. Calculations were conducted for the atmospheric layer 0–10 km above the surface level and annual means were found.

In this research we used the CE-method for cloud boundaries and cloud amount reconstruction [2, 3] and radiosonde sounding data for 965 aerological stations from global dataset CARDS [4] supplemented by current data from datasets AROCTAB [5] and AROCTAC [6] for the 1964-2017 period. To compute the statistics for the stations, only observations including both temperature and humidity data from the surface to the height of 10 km were applied. The existence of several cloud layers with different cloud amounts was allowed. We did not consider cloud layers for which the CE-method gave thickness less than 50 m. We used the weighted anisotropic interpolation method for interpolating the statistical characteristic to 2°×2° grid.

The global annual mean cloud layer numbers for different cloud amount gradations and their standard deviations are presented in the Table for atmospheric layer of 0–10 km over the surface level. The second and the third columns show globally averaged values while the regional ranges of variations of the cloud layer numbers are presented in columns four and five. The geographic distribution of the annual mean numbers of cloud layers with 0–100% cloud amounts and their standard deviations are shown in Figure for the atmospheric layer considered in the study.

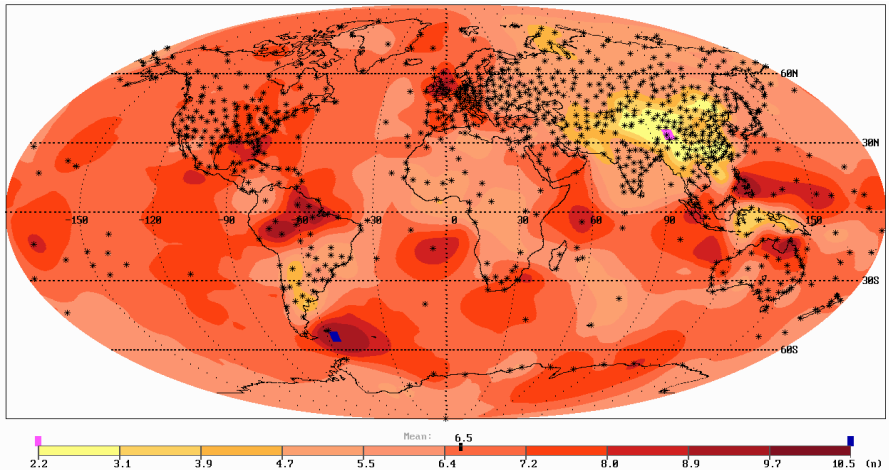
Table.

The global annual mean cloud layer numbers and their standard deviations with taking into account the cloud amount gradation and their regional variations ranges for atmospheric layer of 0–10 km over the surface level. 1964–2017. See text for details.

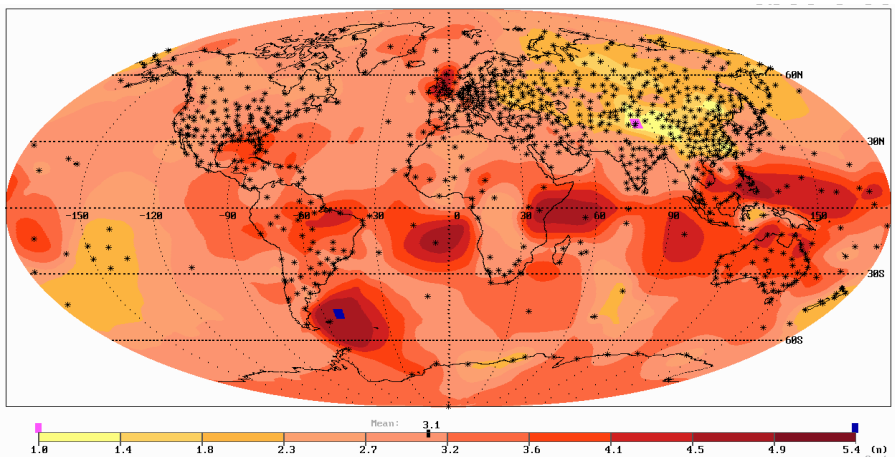
The cloud amount gradation, % of the sky surface	Mean	σ	Mean	σ	Number of observations, thousands
0–20	4,2	2,5	1,7–7,3	0,8–4,2	1,2–36,3
20–60	1,5	0,8	1,1–2,0	0,4–1,2	0,5–21,6
60–80	1,2	0,4	1,0–1,4	0,2–0,6	0,3–13,1
80–100	2,6	1,8	1,4–4,5	0,7–3,5	0,7–31,6
0–100	6,5	3,1	2,2–10,5	1,0–5,4	1,5–37,9

The presented results demonstrate that the mean cloud layer numbers and their standard deviations depend on the cloud amount gradation, 0–20, 20–60, 60–80, 80–100% of the sky surface. Their values for the gradations 0–20 and 80–100% are several times higher than for the gradations 20–60, 60–80%. The geographic distributions of the annual mean numbers of cloud layers with 0–100% cloud amounts and their standard deviations for atmospheric layer 0–10 km are uniform enough over most part of the Globe. The minimum is detected over Tibet while the maximum is found near the southern point of South America.

a)



b)



*The geographic distribution of the annual mean numbers of cloud layers with 0–100% cloud amounts (a) and their standard deviations (b) for the atmospheric layer of 0–10 km over the surface. * – 965 stations. 1964–2017.*

Long-term estimations of cloud layer number may be useful for studying the atmospheric radiation energy, for assessing propagation conditions of electromagnetic waves, for supporting the aviation operation, for interpretation of cloud parameters determined by other methods.

References

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