Global cloudiness: Tendencies of change from ISCCP data

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One of the important but as yet unsolved problems in climate research is the effect of clouds on radiation and temperature conditions as well as the dependence of clouds on temperature and circulation conditions (Houghton et al., 2001). Due to the treatment of clouds and cloud feedback effects in climate models there is a significant uncertainty about the sensitivity of the climate system to anthropogenic forcing (Mokhov, 1981; Schlesinger and Mitchell, 1986; Houghton et al., 2001). There is uncertainty even in the sign of changes in cloudiness accompanying global temperature changes (global warming, in particular) from observations and simulations (Mokhov, 1985; Henderson-Sellers, 1986; Mokhov, 1991a,b; Mokhov and Love, 1995; Rossow and Schiffer, 1999; Houghton et al., 2001).

We present here some estimates of the global scale relationship between cloudiness from ISCCP data (Rossow and Schiffer, 1999) and surface air temperature from (Jones, 1999) for the Northern (NH) and Southern (SH) Hemispheres. Table 1 shows the results of linear regressions (coefficients of regression with their standard deviations in brackets and coefficients of correlation) of the total cloud amount to the global or hemispheric surface air temperature by annual-mean data for the period 1984-1999. Coefficients of regressions in Table 1 characterize the temperature sensitivity of global and hemispheric cloudiness and also for different latitudinal belts.

Table 1.

Cloudiness : surface air temperature		Regression coefficient, K^{-1}	Correlation coefficient
With polar latitudes	Global	-0.031 (±0.013)	-0.55
	NH	-0.034 (±0.012)	-0.61
	SH	-0.009 (±0.018)	-0.13
Without polar latitudes (<60°)	NH+SH	-0.052 (±0.018)	-0.63
	NH	-0.045 (±0.014)	-0.66
	SH	-0.041 (±0.029)	-0.36
Tropical latitudes (<30°)	NH+SH	-0.076 (±0.024)	-0.65
	NH	-0.063 (±0.019)	-0.67
	SH	-0.056 (±0.042)	-0.34
Middle latitudes (60°-30°)	NH	-0.027 (±0.011)	-0.56
	SH	-0.021 (±0.016)	-0.33

Figure 1 illustrates the appropriate linear regressions of the NH tropical and extrapolar cloudiness to the NH surface air temperature.

Negative correlation of cloudiness and temperature characterizes the appropriate relationship as a positive climate feedback.

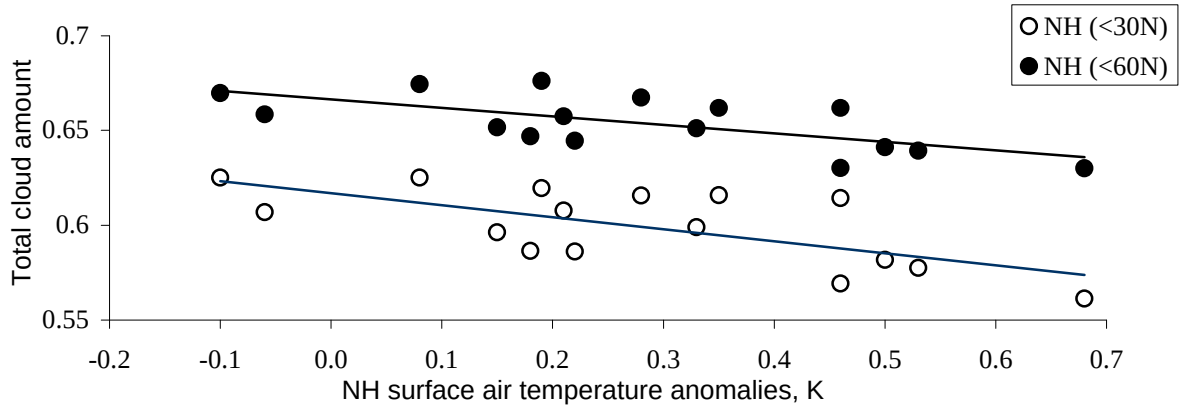

Fig. 1

This work was partly supported by the Russian Foundation for Basic Research.

References

Henderson-Sellers, A., 1986: Increasing cloud in a warmer world. Clim. Change, 9, 267-309.

Houghton, J.T., et al. (editors), 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge Univ. Press, Cambridge, 881 pp.

Jones P.D., New M., Parker D.E. et al. Surface air temperature and its changes over the past 150 years // Rev. Geophys. 1999. V.37. P.173-199.

Mokhov, I. I., 1981: Effect of CO_2 on the thermal regime of the Earth's climatic system, Sov. Meteorol. Hydrol., 4, 17-26.

Mokhov, I.I., 1985: Global relationship between cloudiness and temperature as revealed by data on their interannual variability, Izvestiya, Atmos. Oceanic Phys., 21, 700-704.

Mokhov, I.I., 1991: Global Cloudiness: Tendencies of change. ISPP-7 "Piero Caldirola", Controlled Active Global Experiments (CAGE). E. Sindoni and A.Y. Wong (Eds.), Societa Italiana di Fisica, Bologna,19-37.

Mokhov, I.I., 1991: Trends in global and polar cloudiness from satellite data. Proc. Intern.Conf. on the Role of the Polar Regions in Global Change. Vol. I. G. Weller, C.L. Wilson and B.A.B. Severin (Eds.). GIUAF/ CGCASR Univ. of Alaska Fairbanks, Fairbanks, 176-182.

Mokhov I.I., Schlesinger M.E. Analysis of global cloudiness. 2. Comparison of ground-based and satellite-based cloud climatologies. J. Geophys. Res., 1994, 99D, 17045-17065.

Mokhov, I.I., and P.K. Love, 1995: Diagnostics of cloudiness evolution in the annual cycle and interannual variability in the AMIP (Cloudiness Diagnostics Subproject 13). Proc. First Int. AMIP Sci. Conf., Monterrey, CA, U.S. Department of Energy and World Climate Programme, WMO/TD-752, 49-53.

Rossow, W.B., and R.A. Schiffer, 1999: Advances in understanding clouds from ISCCP. Bull. Amer. Meteor. Soc., 80(11), 2261-2287.

Schlesinger, M.E., and J.F.B. Mitchell, 1986: Model projections of the equilibrium climate response to increased carbon dioxide. Projecting the Climatic Effects of Increasing Carbon Dioxide, M.C. MacCracken and F.M. Luther, Eds., U.S. Department of Energy, Washington, D.C., 81-147.