Global and regional cloudiness changes by satellite data: Relationship with temperature and El Nino effects

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There is uncertainty in the sign of changes in cloudiness accompanying global temperature changes (global warming, in particular) from observations and simulations (Mokhov and Chernokulsky, 2003). We present estimates of the relationship between cloudiness from ISCCP data (Rossow and Duenas, 2004) and surface air temperature (Parker et al., 2004) for the Northern and Southern Hemispheres for the period 1983-2004. Both for annual mean regime, and for various seasons regions dominate with negative trends of total cloud amount and negative correlation between cloudiness and surface air temperature. (Table 1, 2).

Positive trends of total cloud amount and positive correlation between total cloud amount and surface air temperature have been revealed in some regions: mid-latitude belt of Eurasia; subtropical and middle latitudes of Northern America, Australia, Aleutian Low and the El Nino formation regions.

Table 1. Trends of annual-mean cloudiness and corresponding coefficient of correlation

Averaging zone		Trend ($Year^{-1}$) ± standard deviation	Coefficient of correlation
With polar latitudes (90°S – 90°N)	Land + Ocean	-0.0018 ± 0.0002	-0.89
	Ocean	-0.0019 ± 0.0003	-0.88
	Land	-0.0016 ± 0.0002	-0.86
Without polar latitudes (60°S – 60°N)	Land + Ocean	-0.0020 ± 0.0003	-0.88
	Ocean	-0.0021 ± 0.0003	-0.88
	Land	-0.0017 ± 0.0003	-0.82
Tropical latitudes (30°S – 30°N)	Land + Ocean	-0.0028 ± 0.0003	-0.91
	Ocean	-0.0030 ± 0.0004	-0.90
	Land	-0.0022 ± 0.0003	-0.86

Table 2. Results of linear regression of cloudiness to temperature

Averaging zone		Coefficient of regression (K^{-1}) ± standard deviation	Coefficient of correlation
With polar latitudes (90°S – 90°N)	Land + Ocean	-0.054 ± 0.015	-0.68
	Ocean	-0.059 ± 0.017	-0.68
	Land	-0.043 ± 0.015	-0.59
Without polar latitudes (60°S – 60°N)	Land + Ocean	-0.062 ± 0.018	-0.67
	Ocean	-0.066 ± 0.018	-0.68
	Land	-0.048 ± 0.017	-0.58
Tropical latitudes (30°S – 30°N)	Land + Ocean	-0.088 ± 0.022	-0.71
	Ocean	-0.095 ± 0.025	-0.70
	Land	-0.066 ± 0.021	-0.63

It should be noted, that significant uncertainty of spatial distribution and temporal changes of cloudiness can be related with nonhomogeneity of ISCCP data.

Relationship between interannual variations of cloudiness and El Nino events has been analyzed. The most significant differences in cloudiness between El Nino phases (years with largest positive anomalies of Nino 3 SST (5°N-5°S 150°W-120°W)) and La Nina phases

(years with largest negative anomalies of Nino 3 SST) are noted over equatorial Pacific Ocean (Fig. 1). Statistically significant correlation between sea surface temperature in the Nino3 region and total cloudiness has been noted in subtropical and tropical latitudes in western part of Pacific Ocean (positive correlation) and in equatorial latitudes of Pacific Ocean (negative correlation) (Fig. 2).

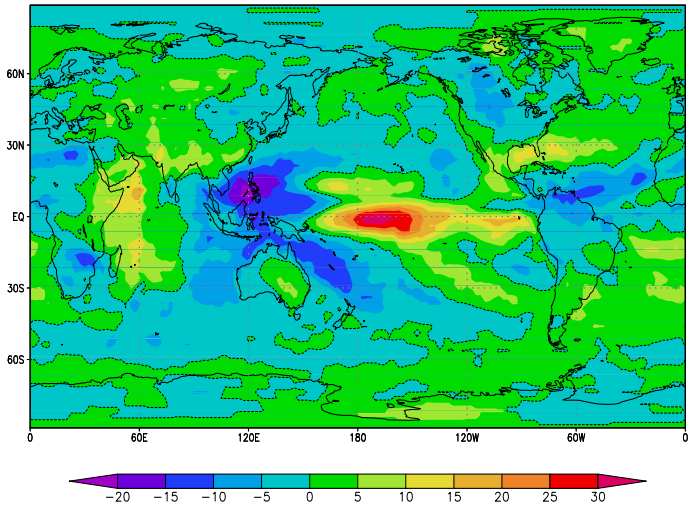

Figure 1. Difference for cloudiness in December-January-February between 5-year-means with largest positive (1986-87, 1991-92, 1994-95, 1997-98, 2002-03) and negative (1984-85, 1985-86, 1989-90, 1998-99, 1999-2000) anomalies of Nino 3 SST.

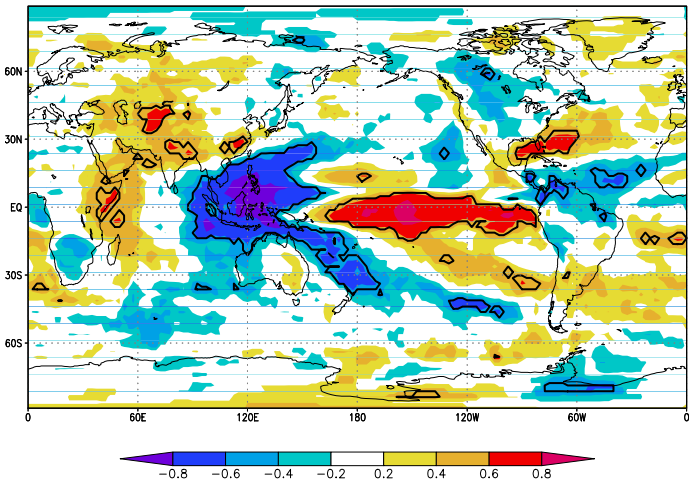

Figure 2. Correlation between cloudiness and Nino 3 SST anomalies in December-January-February (Black thick line: 95% significance level).

This work was partly supported by the Russian Foundation for Basic Research and Program of the Russian Academy of Sciences.

References

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