THE TOTAL WATER CONTENT OF CLOUDS IN THE SOUTHERN HEMISPHERE

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Considering the water balance of the atmosphere most calculations take into account only the content of water vapour, generally given as precipitable water. But the atmosphere contains also some water substance in the fluid and solid state, and it might be of interest to determine whether these states contribute importantly to the total amount of water substance in the atmosphere. The data for precipitable water in 10° latitude rings have been derived from a recently published table (Newton, 1972) (Table 1).

Table 1 Amount of precipitable water

	Latitude °S								
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Precipitable water ($g\ cm^{-2}$)	3.79	2.92	2.36	1.90	1.40	1.02	0.60	0.24	0.10
Zonal ring ($10^{17} cm^2$)	4.45	4.30	4.04	3.65	3.13	2.56	1.88	1.15	0.40
Total precipitable water ($10^{17} g$)	16.8	12.5	9.5	6.9	4.4	2.6	1.1	0.28	0.04

The total amount of precipitable water vapour in the southern hemisphere is $5.4 \times 10^{18} g$ or 5.4 Tt, equal to 2.1 cm of water over the whole surface, slightly less than given by Sutcliffe (Newton, Table 6.1).

The water content of clouds derives from Table 2.2 of the monograph. Table 2 gives the percentage frequencies of the principal cloud types. From them and from the sizes of the zonal rings the surfaces covered by the different cloud types are calculated.

Table 2 Extension of different cloud types, southern hemisphere

Cloud surface $\times 10^6 km^2$	Latitude °S									
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	0-90
Ci	5.8	5.2	4.8	4.7	4.4	4.1	2.8	1.3	0.3	33.4
Alto	2.7	2.6	2.0	1.8	1.5	1.8	1.9	1.8	0.7	16.8
Cu	6.2	6.0	5.3	4.7	4.4	3.3	1.7	0.5	0.1	32.2
St	3.1	3.0	3.6	4.7	5.6	5.3	3.9	1.7	0.4	31.3
Cb	1.8	1.7	1.2	1.5	1.3	1.3	0.7	0.2	0.0	9.7
Ns	2.2	1.7	2.0	2.5	3.8	3.8	3.0	1.4	0.3	20.7
All	21.8	20.2	18.9	19.9	21.0	19.6	14.0	6.9	1.8	144.2

Table 3 contains the total water and ice content of the different cloud types under reasonable assumptions regarding their average thicknesses and water contents. The mean cloud cover for the hemisphere is 56%, in agreement with Sasamori's *et al* result (Newton, 1972).

The water content per unit surface combined with the extent of the cloud type from Table 2 gives the total water held in the different types, and by summation the content of all clouds of the southern hemisphere is obtained.

Table 3 Water content of clouds, southern hemisphere

	Type of cloud					
	Ci	Alto	Cu	St	Cb	Ns
Thickness (m)	3600	600	1000	500	6000	2000
Content (g m^{-3})	0.05	0.1	1.0	0.25	1.5	0.5
Load (t km^{-2})	30	60	1000	125	9000	1000
Total mass (t 10^7)	100	100	1220	400	8700	2070

The estimates of mean cloud thickness and water content, taken from different observations in temperate and tropical climates, are somewhat uncertain; but they are probably rather high. The water held in the clouds over the southern hemisphere is 146 Mt. This is only 2.7% of the total water vapour content of the southern hemisphere atmosphere, 5,400 Mt. In view of the uncertainty of the amount of precipitable water the actual water and ice in the clouds can be neglected in large-scale considerations of the atmospheric water balance.

REFERENCE

Newton, C.W. (ed.) 1972. Meteorology of the southern hemisphere. *Met. Monographs, 13-35.* Am. Met. Soc.