

## Distribution of thunderstorms over the world

K. P. RAMAKRISHNAN and D. S. V. RAO

*Meteorological Office, Poona*

*(Received 8 October 1954)*

### 1. General

Maps showing distribution of thunderstorms are of particular interest to workers on spheres and electrical engineers who deal with breakdown of electric power besides being of general use for meteorologists and climatologists.

Brooks (1925) presented maps showing the percentage frequencies of thunderstorms over both land and sea areas, using all data then available, for the whole year and for two halves of it. Further statistics of thunderstorms have accumulated in the 30 years that have since elapsed. Normal frequencies for each month for the four quarters and for the year as a whole in respect of the land areas of the globe have recently been given in a pamphlet issued by the WMO (1953). Utilising these data and supplementing them by other available information for land and sea areas, revised maps, showing the distribution of the number of days with thunderstorms over the whole world (both land and sea) have been prepared by the present writers.

### 2. Source of data and method of preparation of maps

The information for the land areas contained in the WMO publication was supplemented by data for the U.S.S.R. and Mongolia from publications mentioned in the second and eighth references at the end of this note. For sea areas, the data of days of "lightning observed" given in London M.O. and Naval Meteorological Service charts (*vide references*) have been utilised. The frequencies over the sea may be over-estimations, as lightning may be more frequent than the thunderstorms associated with them. Even so, the thunderstorm frequency con-

sidered as equal to that of lightning is found to be much less than over land, owing perhaps to the general scantiness of observations over the sea. The charts for the whole year and for its four quarters, December to February, March to May, June to August and September to November are shown in Figs. 1 to 5.

The procedure adopted in preparing the maps was as follows:—

For the land areas, numbers of days at all individual observatories falling within each square of  $5^\circ$  Lat. and  $5^\circ$  Long. were first averaged and this number was plotted in the square. For sea areas, from existing maps numbers for each  $5^\circ$  square were interpolated and plotted. With values plotted for both land and sea areas, isobronts or lines of equal numbers of days of thunder were drawn for 10, 25, 50, 100 and 150. (In the maps for the quarters, Figs. 2-5, lines were drawn for 10, 20, 30, 40 and 50 days per quarter). Over land areas the numbers of reporting stations in different  $5^\circ$  squares varied from 1 to over 150. Just a small number of squares have gone un-represented. A sharp difference was usually noticed in most places at the transitions from sea to coast and from ocean to small islands. At those places, where land was the main feature, the coastal values were given greater weight; and over stray islands, the ocean values were given greater weight.

### 3. Main features of the maps

*Annual map (Fig. 1)*—The large preponderance of thunderstorms over land as compared to sea areas is of course, the most striking feature in the picture. The land

areas apparently produce a 'hot pan' effect and favour convection. The principal maxima over land are—

- (1) Interior of Africa between latitudes  $15^{\circ}\text{N}$  and  $15^{\circ}\text{S}$  mostly  $>100$ ,
- (2) Interior of South America between latitudes  $0^{\circ}$  and  $20^{\circ}\text{S}$  considerable area with  $>100$  days,
- (3) Southeast United States (Florida area) between  $25^{\circ}$  and  $40^{\circ}\text{N}$  (51-100),
- and (4) Southeast Asia between  $30^{\circ}\text{N}$  and  $10^{\circ}\text{S}$ , (26-50).

The prominent areas over the sea are—

- (1) A patch of the southwest Atlantic off South America from  $25^{\circ}$  to  $40^{\circ}\text{S}$  (51-100)
- and (2) A belt in the Pacific extending in latitude from  $0^{\circ}$  to  $25^{\circ}\text{S}$  and in longitudes from  $150^{\circ}\text{E}$  to  $135^{\circ}\text{W}$ , (26-50).

*Seasonal maps*—The seasonal maps in Figs. 2 to 5 (pp. 173-175) bring out prominently how the main areas of thunderstorms shift northwards and southwards practically following the sun. For instance, in December-February, there are hardly any thunderstorms north of the equator, anywhere in the world. The area of largest frequency (shaded dark), which is entirely south of the equator in December-February shifts slightly to north of Equator in March-May and a bit more in the quarter June-August. In this quarter there are hardly any thunderstorms in the southern hemisphere. The shift southward begins again and in September to November the main areas are distributed almost equally on either side of the equator.

#### 4. Acknowledgement

We are grateful to Dr. L. A. Ramdas, for suggesting the work and to Shri S. Parthasarathy for valuable assistance in collecting the material.

#### REFERENCES

- |  |      |  |
|--|------|--|
| Brooks, C.E.P.                               | 1925 | <i>Geophys. Mem.</i> , 3, 24, p. 145.  |
| Köppen, W., Graz und Geiger, R.              | 1932 | <i>Hanbuch der Klimatologie</i> , Band 3, Teil M.  |
| London M.O. 422/1                            | 1945 | Monthly Meteorological Charts of the Western Pacific Ocean (Revised).                                      |
| London M.O. 518                              | 1950 | Monthly Meteorological Charts of the Eastern Pacific Ocean.  |
| London M.O. 519                              | 1949 | Monthly Meteorological Charts of the Indian Ocean.   |
| London M.O. 394                              | 1950 | Monthly Meteorological Charts of the Western North Atlantic.   |
| Naval Meteorological Service                 | 1941 | Supplement to Vol. 2 of Weather of the coasts of southern Africa: Climatic charts of the adjoining oceans. |
| Pub. Weath. Res. Centre, A.A.F. H.Q., U.S.A. | 1942 | Climate and Weather of Asiatic portion of the U.S.S.R. and of its air approaches, 3, 4.                    |
| WMO/OMM, 21, TP 6                            | 1953 | World distribution of thunderstorm days, Pt. 1—Tables.   |

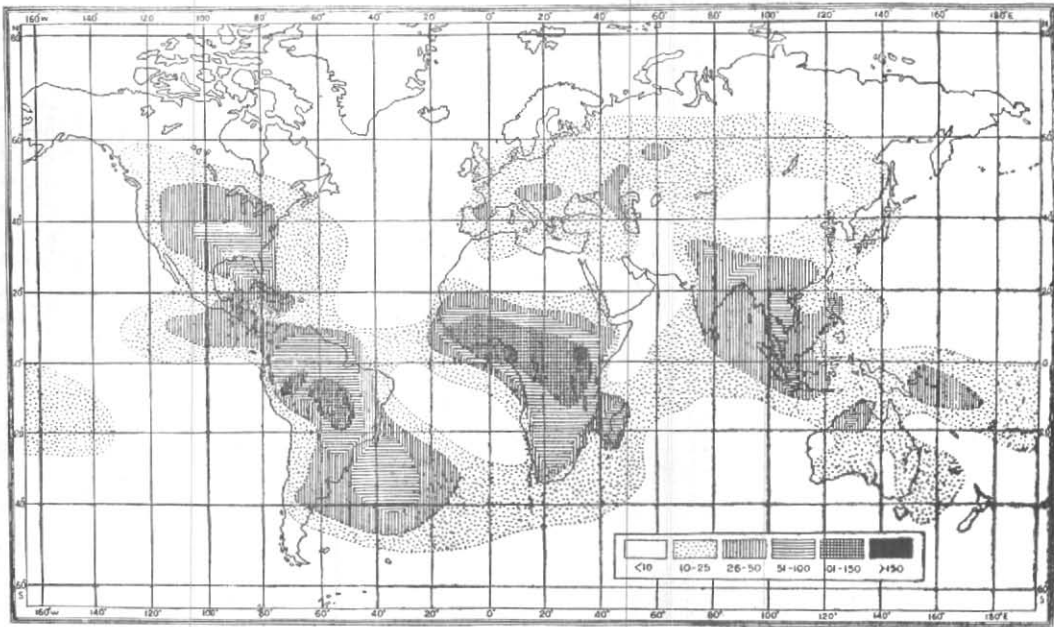


Fig. 1. Average number of days with thunderstorm per year

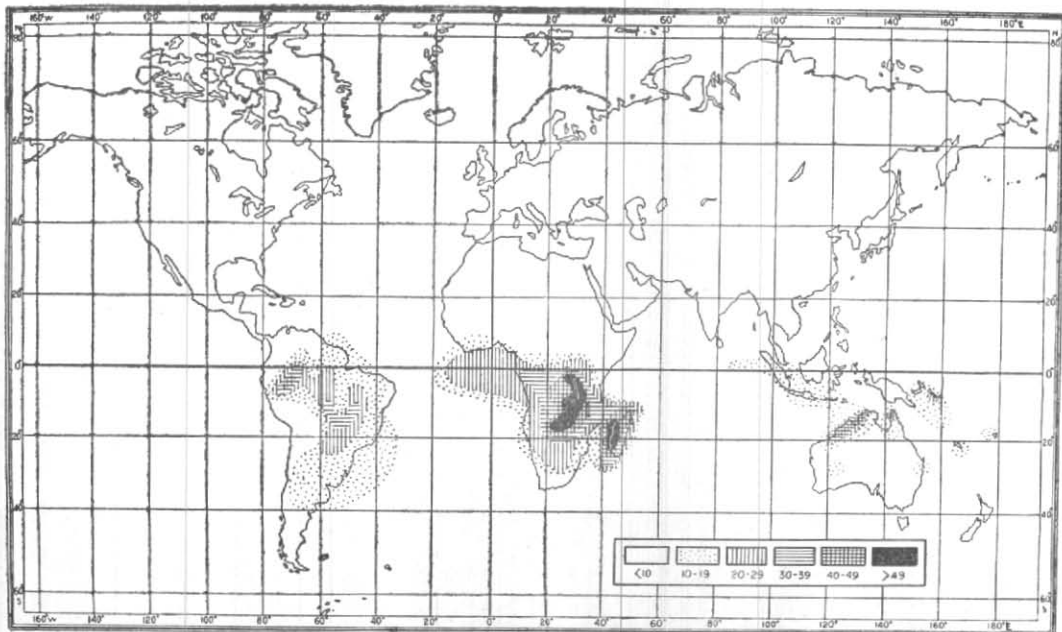


Fig. 2. Average number of days with thunderstorm in quarter—December, January and February

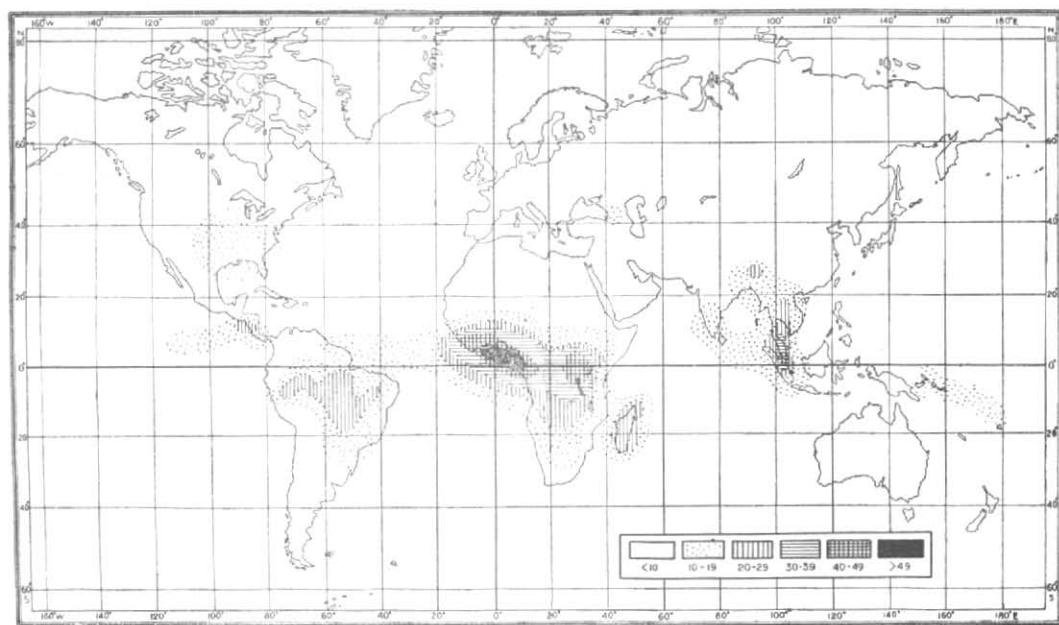


Fig. 3. Average number of days with thunderstorm in quarter—March, April and May

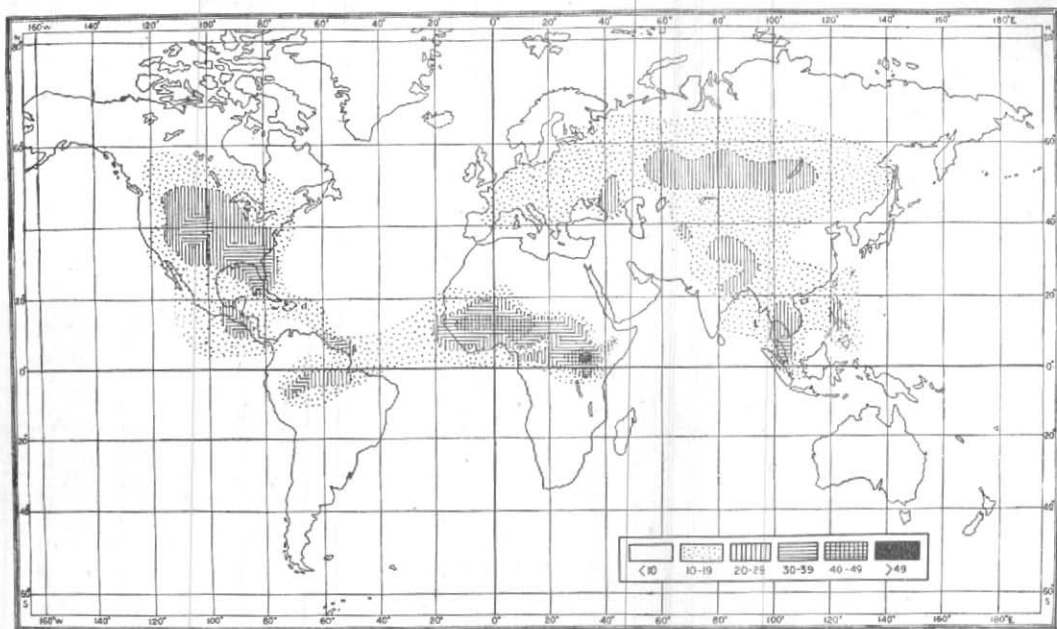


Fig. 4. Average number of days with thunderstorm in quarter—June, July and August

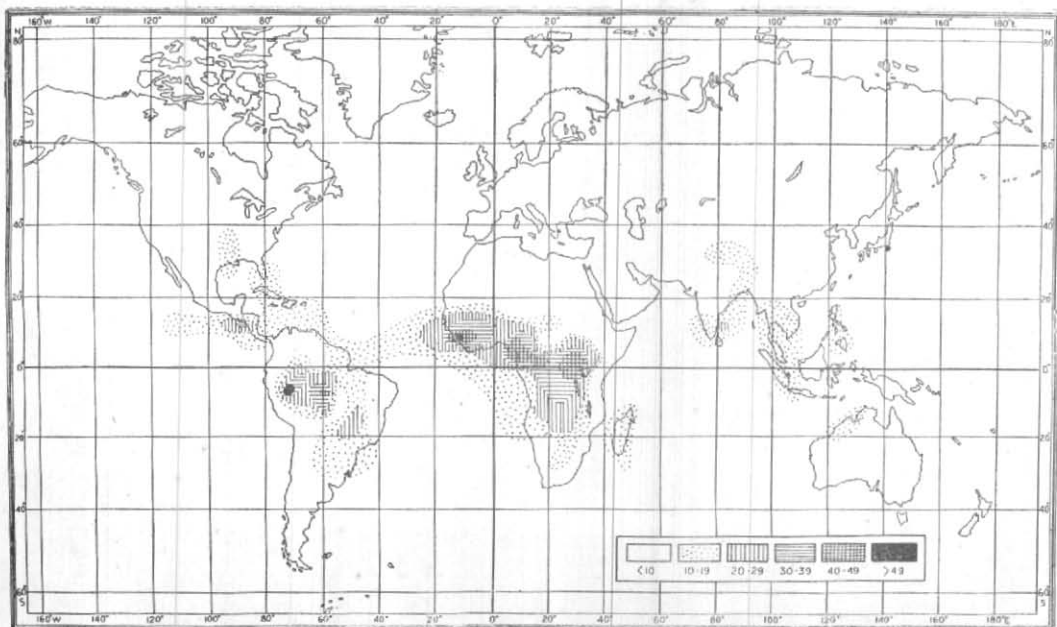


Fig. 5. Average number of days with thunderstorm in quarter—September, October and November