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RELATIONSHIPS BETWEEN RADIO PROPAGATION DISTURBANCE AND CENTRAL MERIDIAN PASSAGE OF SUNSPOTS GROUPED BY DISTANCE FROM CENTER OF DISC.

The superposed epoch method was used to compare the North Atlantic radio propagation quality figures, prepared as described in report IRPL-R13, where 1 = useless to 9 = excellent, with the central meridian passage of sunspots, grouped by distance from center of disc, as reported by the U.S. Naval Observatory, Washington, D.C. The period studies was October 1943 through June 1945. The radio propagation quality figures were compared for seven days before and seven days after the central meridian passage of the sunspots, i.e., for the period that the sunspots were passing across the solar disc. There were comparatively few sunspot groups during the period studied, so that the results cannot be considered highly significant; some general tendencies, however, can be found. The results are shown graphically in Figs. 1 through 4, where the subdivisions are as follows: (a) sunspot groups within 10° of center of disc at central meridian passage; (b) groups 10°-20° from center of disc; (c) groups 20°-30° from center of disc; (d) groups 30°-40° from center of disc.

Fig. 1 shows a comparison of all sunspot groups, regardless of size, that passed central meridian, compared with those whose area was greater than 200 millionths of the sun's disc at central meridian passage, for the total period October 1943 through June 1945. For each of the cases more radio propagation disturbance was associated with the groups closer to the center of disc. As the groups were farther and farther from center of disc, less radio propagation disturbance was evident; in fact, for the groups 30°-40° from center of disc, radio conditions were essentially quiet. Comparison of the larger sunspot groups with all groups at the same distance from center of disc, for subdivisions (a), (b), and (c), indicated that more radio propagation disturbance was associated with the larger groups. In (d) there was no disturbance evident in either case. There was also a more pronounced tendency for radio propagation disturbance to occur at central meridian passage of the sunspots for the large spots of classes (b) and (c). The graphs showed a dip in each case for the period two days before to two days after central meridian passage of the sunspots. For the cases of all groups, no one period while the groups were on the sun tended to be more disturbed, but the general level of the graphs showed more dis-

(over)

turbance when the groups were nearer to the center of disc. Thus, in forecasting radio propagation disturbance from the appearance of a sunspot group at east limb, more weight might be given the larger sunspot groups and especially those that will be near to the center of the solar disc at the time of central meridian passage.

Fig. 2, using all sunspot groups, illustrates the difference in the general level of radio propagation disturbance for the period of the end of the last sunspot cycle and the period of the beginning of the present sunspot cycle. October 1943 through May 1944 was associated with the decreasing side of the one cycle, and June 1944 through June 1945 was associated with the increasing side of the other cycle. It will be noted, in comparing the corresponding subdivisions, that far more radio propagation disturbance was associated with the earlier period, i.e., the decreasing side of the last sunspot cycle. Again, there was more disturbance in each case for the groups closer to center of disc. It is interesting to find that the groups 30°-40° from center of disc, which, as shown in Fig. 1, were associated with quiet radio conditions, all belonged to the new sunspot cycle. One of the criteria for estimating when sunspot minimum occurs is the appearance of sunspots at high solar latitudes. Thus less disturbance should be expected in the period following sunspot minimum, since the sunspot groups are then farther from center of disc.

The sunspot groups were divided by season in Fig. 3. An inspection of the graph will show that radio propagation disturbance was associated with the equinoctial period and winter rather than with the summer. In fact the level for the summer cases was definitely that of quiet radio propagation conditions. There was somewhat more evidence of disturbance during the equinoctial period than during the winter. There was a little greater tendency for disturbance while the sunspots were between east limb and the central meridian in the equinoctial cases.

Finally, in Fig. 4, the sunspot groups were divided into the cases where the groups were on the northern and southern hemispheres of the sun. The total period October 1943 through June 1945 was used. It will be noted from the graph that more radio propagation disturbance was associated with the northern groups than with the southern groups, except for case (c), 20°-30° from center of disc, where the level was approximately the same for both. Also, with the northern groups, there was somewhat more tendency for radio propagation disturbance to be associated with the time the sunspot was between east limb and central meridian. The difference in the effect of the northern and southern groups might be explained by the relation shown in Fig. 2, since almost all of the southern groups belonged to the later period, June 1944 through June 1945, which was associated with less radio propagation disturbance.

The following general conclusions might be drawn from the above:

a. The end of the decreasing sunspot cycle was accompanied by more radio propagation disturbance than the beginning of the current increasing cycle.

b. In all cases, the closer the sunspot group was to center of disc at central meridian passage, the more radio propagation disturbance there was.

c. More radio propagation disturbance was associated with the larger sunspot groups and the tendency for the radio propagation disturbance to occur at central meridian passage of the sunspots was more evident.

d. More disturbed radio propagation conditions might be expected during the equinoctial period and winter rather than during the summer, at least in the northern hemisphere of the world.

e. Northern sunspot groups appeared to have more radio propagation disturbance associated with them than did southern sunspot groups.

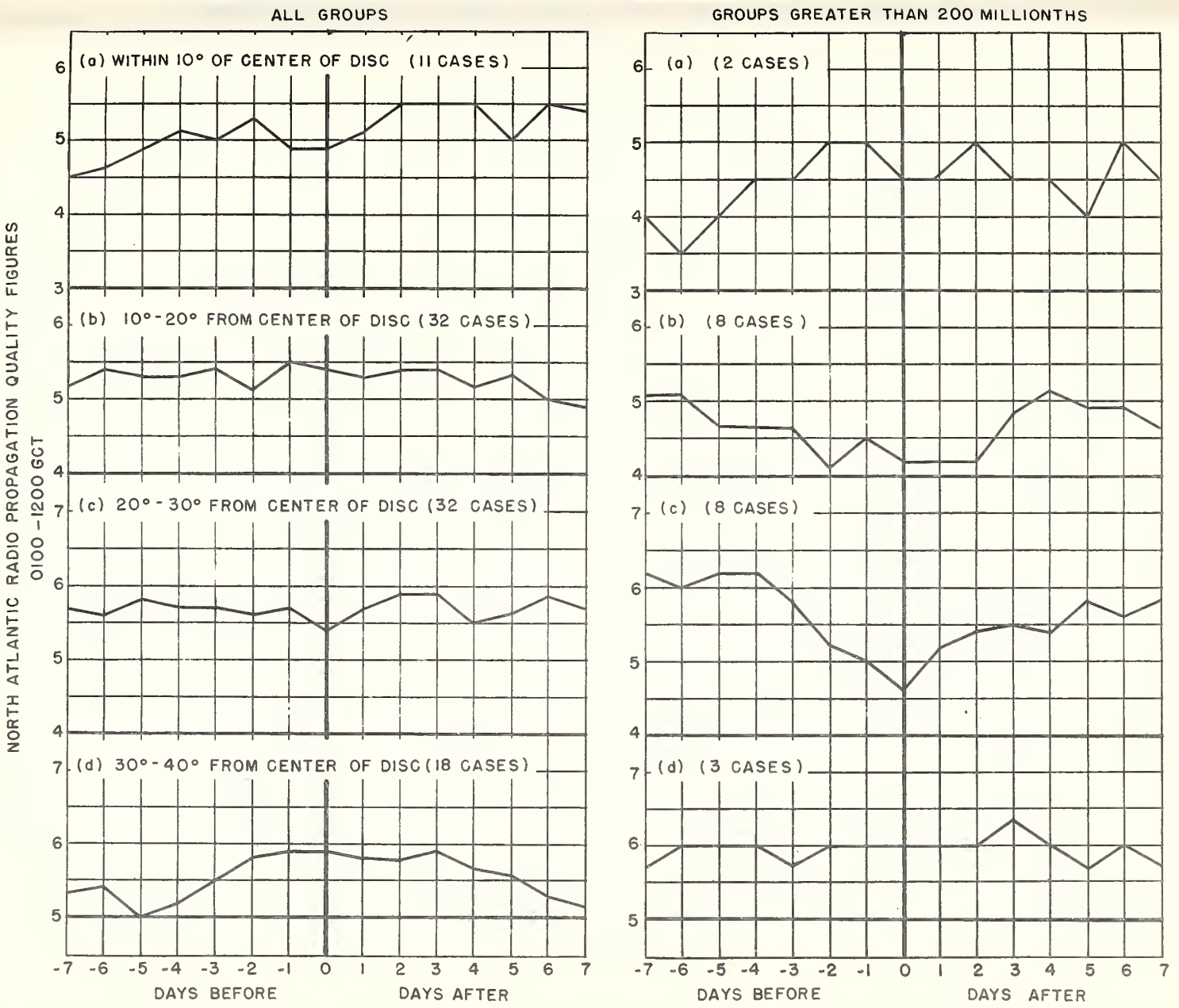

Fig. 1. RELATION BETWEEN NORTH ATLANTIC RADIO PROPAGATION QUALITY FIGURES AND CENTRAL MERIDIAN PASSAGE OF SUNSPOTS OCTOBER 1943 THROUGH JUNE 1945.

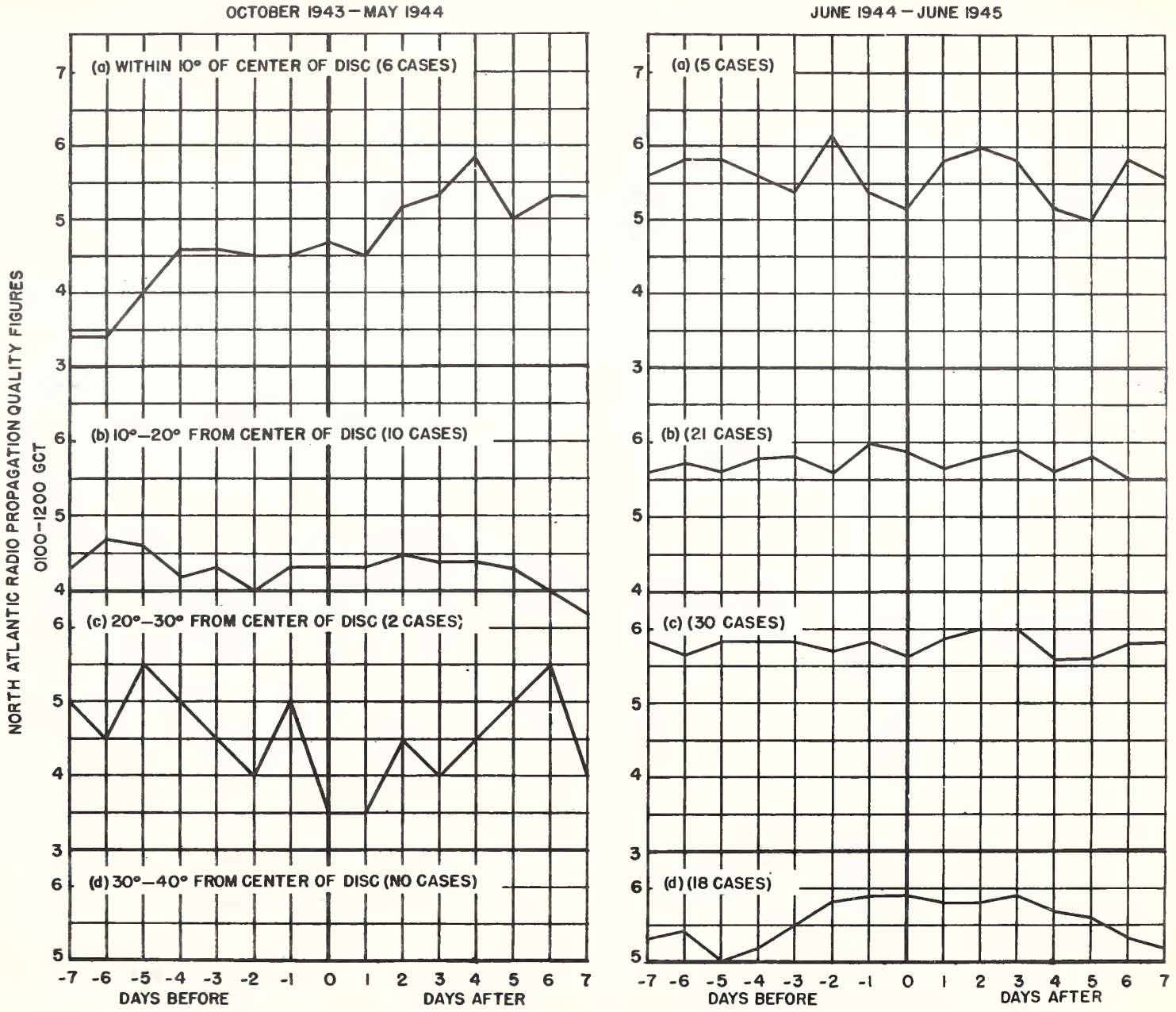

Fig.2. RELATION BETWEEN NORTH ATLANTIC RADIO PROPAGATION QUALITY FIGURES AND CENTRAL MERIDIAN PASSAGE OF SUNSPOTS THROUGH END OF CYCLE AND BEGINNING OF NEW CYCLE.

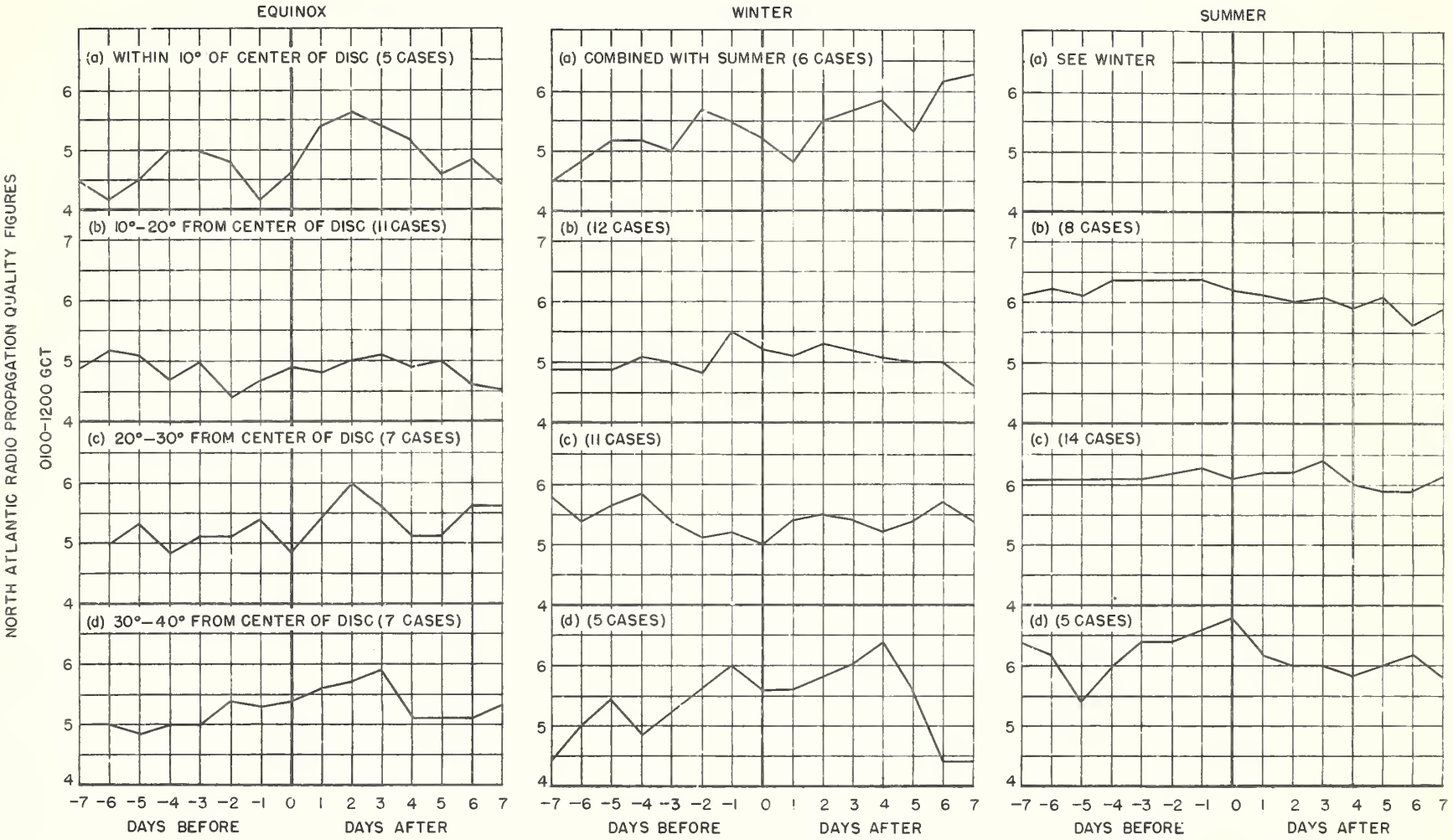

Fig. 3. RELATION BETWEEN NORTH ATLANTIC RADIO PROPAGATION QUALITY FIGURES AND CENTRAL MERIDIAN PASSAGE OF SUNSPOTS BY SEASON OCTOBER 1943 THROUGH JUNE 1944.

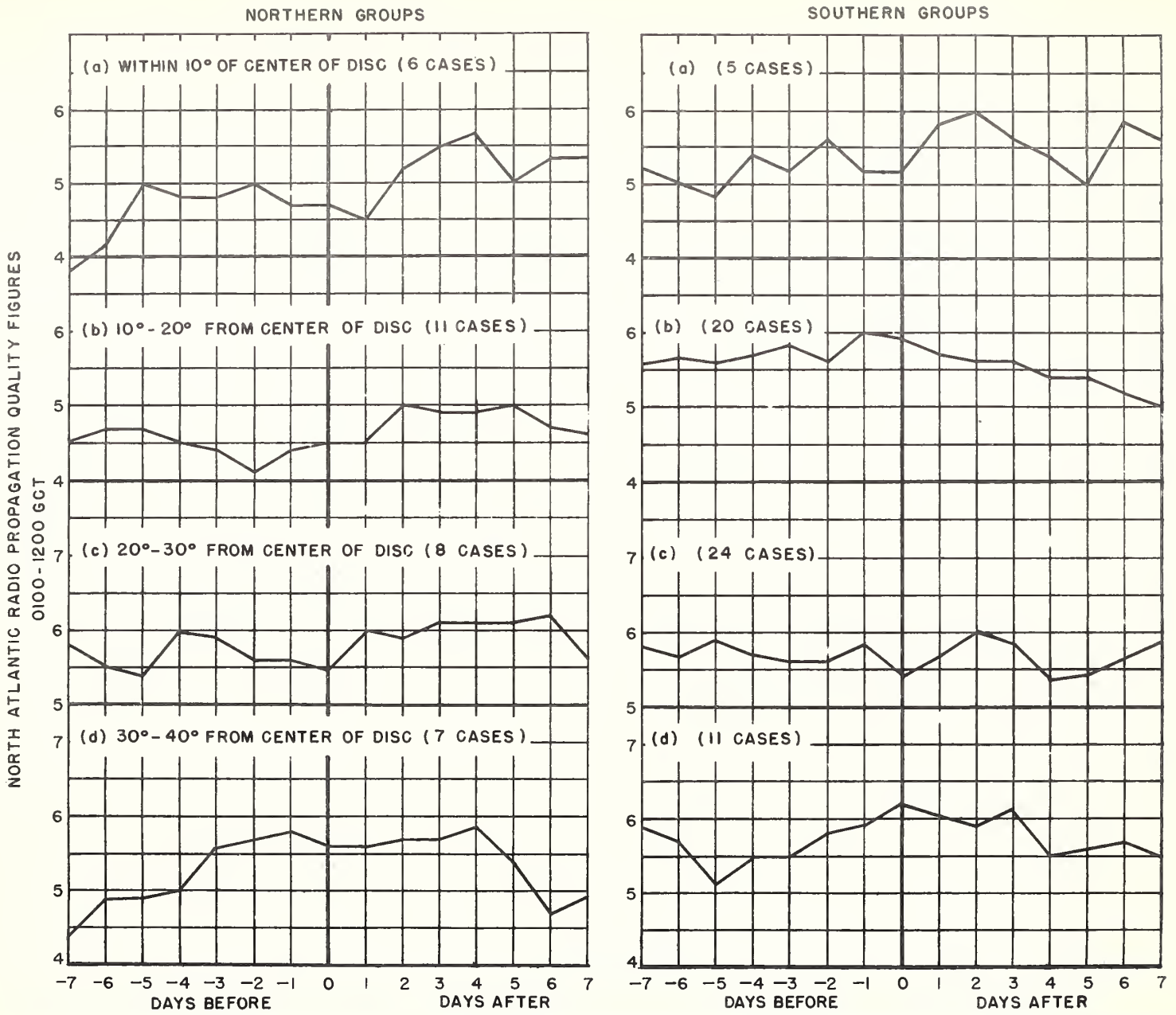

Fig. 4. RELATION BETWEEN NORTH ATLANTIC RADIO PROPAGATION QUALITY FIGURES AND CENTRAL MERIDIAN PASSAGE OF SUNSPOTS BY HEMISPHERE POSITION ON SUN OCTOBER 1943 – JUNE 1945.