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Global analysis of active longitudes of sunspots and solar flares

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The longitudinal distribution of sunspots and solar flares has been shown to favor two persistent active longitudes separated by roughly 180 degrees. We study active longitudes of sunspots and solar X-ray flares using an improved version of a dynamic, differentially rotating coordinate system. We find the optimum values of rotation parameters of active longitudes of sunspots and solar X-ray flares for the two solar hemispheres and for different time intervals. Generally, the improved treatment enhances the level of rotational asymmetry. We find that the optimum rotation parameters for sunspots are in a good agreement with those obtained for the three classes of X-ray flares over the common time interval. The refined method emphasizes hemispheric differences in rotation. Over the whole 136-year interval of sunspots, the mean rotation in the southern hemisphere is slower than in the north. The optimum rotation parameters depict considerable variability in time. Interestingly, the long-term variation (trend and residual oscillation) of solar rotation is roughly opposite in the northern and southern hemispheres. Both sunspots and flares show that the northern hemisphere rotated considerably faster but the southern hemisphere slightly slower than the Carrington rotation rate during the last three solar cycles.