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Cycle-to-Cycle Variations in the Diurnal Variation of Galactic Cosmic Rays

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We examine mean profiles of the diurnal variations in galactic cosmic ray flux using a number of neutron monitors at different magnetic latitudes and longitudes. By splitting all of the hourly neutron monitor data by the solar magnetic polarity and analysing the mean normalised neutron monitor count rates between these, we see that the diurnal variation changes phase by 1-2 hours between the two polarity states for the majority of non-polar neutron monitors. The intensity and variability of a heliospheric magnetic field is analysed for every day and found not to be the cause of the phase change. Some polar neutron monitors, however, show different, smaller amplitude variations in phase between polarity cycles. Time series of the time of the maximum in the diurnal variation are presented between 1965 and 2013. Our results agree with previous work by confirming the presence of a 22-year variation in the peak time of the diurnal variation and a 11-year variation in the amplitude, but also show that not all neutron monitors show the same trend. An analysis of the magnetic latitude dependence of the diurnal variation shows that the time-of-day of the peak and trough of this variation gives opposing changes to the amplitude of the 22-year change. We suggest that this could be due to changes in the configeration of the heliospheric magnetic field for consecutive cycles.