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Comparison of magnetic sectors at mid-heliospheric latitudes in the late declining phases of solar cycles 22 and 23

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The Ulysses spacecraft moved through southerly mid-heliolatitudes in 1992-93 and in 2004-2006, at a phase of the solar activity cycle just prior to solar minimum. As a result, both periods were dominated by Corotating Interaction Regions. The magnetic sector structure was as expected, observed at low heliolatitudes in both cases and it disappeared at mid-latitudes to give rise to unipolar magnetic fields originating in the polar coronal holes. However, there were differences in the evolution of the sectors between the two solar cycles. Firstly, a two sector structure was observed in 1992-93, while a four sector structure was observed in 2004-2005, prior to the disappearance of the sectors. Secondly, in 1993, the structure disappeared at lower heliolatitudes than predicted by the extrapolated coronal neural line, while, in 2005, the azimuth angle of the magnetic field at Ulysses retained a trace of the sector structure for several solar rotations after its predicted disappearance. Thirdly, the very strong signature of an azimuthal drift (towards a longer rotation period) in the sector structure reported in 1993 is not repeated in the 2004 observations, it is even possible that an azimuthal drift of opposite sign can be detected in the observations. These three points of comparison are discussed in more detail in this paper, together with an investigation of the solar origins of the observations at Ulysses.