North-south Asymmetry in Rieger-type Periodicity during Solar Cycles 19-23

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Abstract

Rieger-type periodicity has been detected in different activity indices over many solar cycles. It was recently shown that the periodicity correlates with solar activity having a shorter period during stronger cycles. Solar activity level is generally asymmetric between northern and southern hemispheres, which could suggest the presence of a similar behavior in the Rieger-type periodicity. We analyse the sunspot area/number and the total magnetic flux data for northern and southern hemispheres during solar cycles 19-23 which had remarkable north-south asymmetry. Using wavelet analysis of sunspot area and number during the north-dominated cycles (19-20) we obtained the periodicity of 160-165 days in the stronger northern hemisphere and 180-190 days in the weaker southern hemisphere. On the other hand, south-dominated cycles (21-23) display the periodicity of 155-160 days in the stronger southern hemisphere and 175-188 days in the weaker northern hemisphere. Therefore, the Rieger-type periodicity has the north-south asymmetry in sunspot area/number data during solar cycles with strong hemispheric asymmetry. We suggest that the periodicity is caused by magnetic Rossby waves in the internal dynamo layer. Using the dispersion relation of magnetic Rossby waves and observed Rieger periodicity we estimated the magnetic field strength in the layer as 45-50 kG in more active hemispheres (north during the cycles 19-20 and south during the cycles 21-23) and 33-40 kG in weaker hemispheres. The estimated difference in the hemispheric field strength is around 10 kG, which provides a challenge for dynamo models. Total magnetic flux data during the cycle 20-23 reveals no clear north-south asymmetry which needs to be explained in the future.