A SOLAR CYCLE TIMING PREDICTOR –
THE LATITUDE OF ACTIVE REGIONS*

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Abstract. The Schatten and Sofia (1987) ‘dynamo theory’ prediction for the amplitude of smoothed annual sunspot number in the present solar cycle, No. 22, of 170 ± 25 was predicted to peak in 1990 ± 1 year. This peak was earlier and larger than most other estimates made in early 1987. New observational evidence shows sunspot values rising very rapidly, generally supporting the ‘exceptionally large’ cycle predicted, however, solar cycle 22 appears even more exceptional than expected, in that the early cycle rise has exceeded all previous cycle increases. We use a ‘Spörer butterfly’ method to examine solar cycle 22. We show from the latitude of active regions, that the cycle can now be expected to peak near November 1989 ± 8 months, basically near the latter half of 1989.

1. Introduction

The ‘dynamo theory’ method (see Schatten et al., 1978; hereafter SSSW) to predict sunspot number, relies upon the Babcock (1959) dynamo theory and basically utilizes the magnitude of the Sun’s polar field, from which the toroidal field and sunspots form.

The dynamo method appears to work reasonably well in providing the solar cycle amplitude, but provides no information about solar cycle timing. Heretofore, we have relied upon average characteristics, and the official timing of the sunspot minimum, etc., to set our timing, and have awarded a generous ± 1 year uncertainty to the predicted solar maximum timing. With solar cycle durations varying between 8 and 17 years, the timing uncertainty is a serious drawback. The present paper suggests using Spörer’s (1874) law (the butterfly diagram) to ascertain the progression of the cycle, and thereby obtain a better peak timing. This can be done only after the cycle starts, however, it does appear to offer hope in obtaining a good value for the timing. We outline how the method works, and then utilize it, thereby providing a test of the method when a future comparison is made. We refer to the technique we outline, as the ‘Spörer butterfly’ method (hereafter SB method) after Spörer who was primarily responsible for developing Carrington’s (1859) ideas of how sunspots drift equatorward in latitude as the cycle progresses.

2. Spörer Butterfly Cycle Timing Method

Figure 1 shows the general equatorward drift of sunspots as a cycle progresses (after Waldmeier, 1939). Note that the SB drift depends strongly upon the smoothed maximum sunspot number, shown on the individual curves. This trend is also seen in more recent data. Figure 2 shows the ‘butterfly diagram’ beyond 1939, when Waldmeier

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SOLAR ROTATIONS FROM SOLAR MAXIMUM

Fig. 1. Migration of spot zone for different $R_o$ (heights of sunspot maximum). *Abscissa*: time measured in solar rotation from sunspot maximum; *ordinate*: latitude (Waldmeier, 1939).

Fig. 2. The Spörer butterfly diagram is shown for solar cycles 12–20. One can notice the Waldmeier relation, found for sunspots before 1939, appears to be generally obeyed in that the spots in the larger cycles start at higher latitudes than those for the smaller cycles.

finished these studies. Note that for cycle 19 (the largest cycle in recorded history), for example, the cycle begins at higher latitudes than for the smaller cycles 13–15, which are relatively flat, in the latitude diagram—supporting the Waldmeier relationship. The dependence upon solar activity complicates matters, since to predict the solar cycle