

Maunder's Butterfly Diagram in the 21st Century

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E. Walter Maunder created his first "Butterfly Diagram" showing the equatorward drift of the sunspot latitudes over the course of each of two solar cycles in 1903. This diagram was constructed from data obtained through the Royal Greenwich Observatory (RGO) starting in 1874. The RGO continued to acquire data up until 1976. Fortunately, the US Air Force (USAF) and the US National Oceanic and Atmospheric Administration (NOAA) have continued to acquire similar data since that time. This combined RGO/USAF/NOAA dataset on sunspot group positions and areas now extends virtually unbroken from the 19th century to the 21st century. The data represented in the Butterfly Diagram contain a wealth of information about solar activity and the solar cycle.

Solar activity (as represented by the sunspots) appears at mid-latitudes at the start of each cycle. The bands of activity spread in each hemisphere and then drift toward the equator as the cycle progresses. Although the equator itself tends to be avoided, the spread of activity reaches the equator at about the time of cycle maximum. The cycles overlap at minimum with old cycle spots appearing near the equator while new cycle spots emerge in the mid-latitudes. Large amplitude cycles tend to have activity starting at higher latitudes with the activity spreading to higher latitudes as well. Large amplitude cycles also tend to be preceded by earlier cycles with faster drift rates. These drift rates may be tied to the Sun's meridional circulation - a component in many dynamo theories for the origin of the sunspot cycle. The Butterfly Diagram must be reproduced in any successful dynamo model for the Sun.