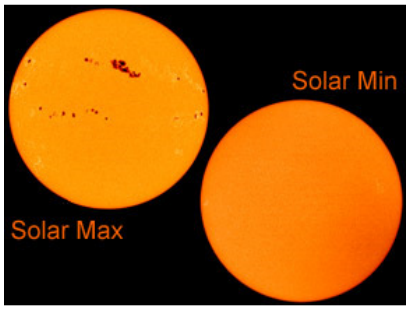
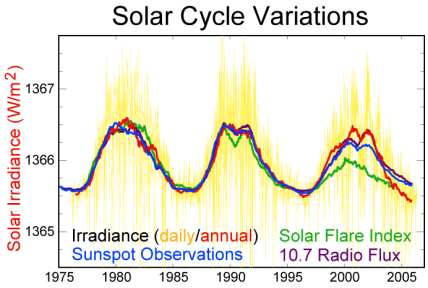
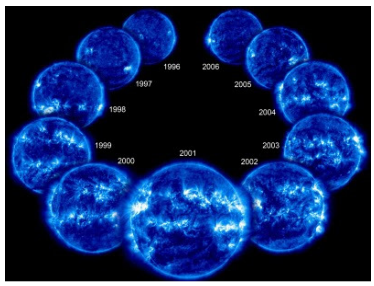
Sun – Part 23 - Solar cycle 2



Sunspot cycle



11 year solar cycle



Solar cycle in ultraviolet

Related solar phenomena Various phenomena follow the solar cycle, including sunspots and coronal mass ejections (CME). As stated in Part 1, it is the number of sunspots which identifies the stages of the solar cycle. Sunspot positions also vary across the cycle. As each cycle begins, sunspots appear at mid-latitudes and then closer to the equator until solar maximum. They are almost never seen lower than 5° or higher than 40° North or South.

There is a direct relationship between the solar cycle and solar luminosity. The photosphere radiates more actively when there are large sunspot numbers eg during maximum, although the presence of large groups can decrease luminosity for several days as they rotate across Earth's view. Solar irradiance output can increase by about 0.07% during maximum.

The numbers of eruptions of solar flares and CMEs are also higher during solar maximum than minimum. Large CMEs occur, on average, a few times a day at maximum but down to one every few days at minimum. The size of these events, however, does not depend on the phase of the solar cycle; large flares can occur near solar minimum.

While magnetic field changes are concentrated at sunspots, the whole Sun undergoes changes during the solar cycle, albeit of small magnitude.

Other solar cycles Cyclical solar activity with much longer periods have been proposed eg 210 year Suess cycle, 2,300 year Hallstatt cycle, an unnamed 6,000 year cycle. Carbon-14 analysis has also identified cycles of 105, 131, 232, 395, 504, 805 and 2,241 years, possibly matching cycles derived from other sources. However, understanding of longer cycles is limited.

Effects of solar cycle Understanding of the cycle is important because of the known effects of some of its features on human life and activities. For example, the radiation flux of high energy protons produced by CMEs can damage electronics and solar cells in satellites, pose health risks to astronauts in space, interfere with aircraft and other long distance radio communications, and cause widespread power outages.

A number of possible adverse effects on other factors have also been proposed. The amount of UVB reaching Earth varies by up to 400% over the solar cycle due to variations in the protective ozone layer. During solar minimum, the decrease in ultraviolet radiation from the Sun leads to fall in ozone concentration. This allows increased UVB to reach Earth's surface, with associated increased risks to human health.

Changes in ionisation affecting aerosol abundance, which serves as the condensation nucleus for cloud formation, could encourage formation of cloud types likely to produce

less precipitation. Links with regional weather patterns have also been hypothesised, with some research support. Also, both long and short term variations in solar activity have also been hypothesised to affect global climate, but quantification has proved very challenging eg trying to correlate solar activity with global temperatures.

Despite the value of predicting solar activity and the wealth of historical records, even advanced scientific efforts have, so far, proved to be highly inaccurate.

Sources: Ridpath, I (Ed) (2012) Oxford dictionary of astronomy 2nd ed rev, www.en.wikipedia.org, www.cse.ssl.berkley.edu