

## Studying the start of the Maunder Minimum to understand the current situation

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To investigate whether we now enter a Maunder-like grand minimum, we have to compare the current situation with the time around the start of the Maunder minimum. Sunspot observations in the 1610s are of particular importance and relevance, because they are shortly before the start of the Maunder Grand Minimum. While the Maunder Minimum it is usually dated from 1645 to 1715, Vaquero & Trigo (2015) argue that what they call the "Extended Maunder Minimum" would have started in 1618 during or around a Schwabe cycle minimum around that time. We have therefore studied the sunspot record of that time in detail.

Hoyt & Schatten (1998) compiled for all known telescopic observers a list of their observations; recent solar activity studies for the past four centuries are based on their compilation. In addition to 12 observers listed by Hoyt & Schatten (1998) for the 1610s, we list six more observers with datable spot observations. Furthermore, while Hoyt & Schatten (1998) argue that Simon Marius would have observed from mid 1617 to the end of 1618 almost every day, but would have never seen a spot, we can show with the original reports by Marius that he observed from Aug 1611 to spring 1619 with a lot of sunspot detections. Similar, while Hoyt & Schatten (1998) argue that Giovanni Riccioli would have observed on almost every day in 1618, but would have never seen a spot, he did not report any own observations at all that year, but quoted Argoli for that there were no spots during the periods with comets in 1618. The data base by Hoyt Schatten (1998) has several more errors in the 1610s, as we show also for the observations by Harriot, Scheiner, Malapert, Saxonius, and Tarde. We also compare drawings from Jungius with the observations by Harriot, Galilei, and Marius. In contrast to what is specified in Hoyt Schatten (1998), after Harriot, the two Fabricius (father and son), Scheiner and Cysat, Marius and Schmidnerus are among the earliest datable telescopic sunspot observers (1611 Aug 3, Julian). It is very important to go back to the original drawings and observational reports (written often in Latin or German).

The active day fractions was high from 1611 to 1616 (1.0 to 0.9), but then dropped to much lower values 1617 to 1620. Sunspots records by Malapert from 1618 to 1621 show that the last low-latitude spot was seen in Dec 1620, while the first high-latitude spots were noticed in June and Oct 1620 (we show his drawings), so that the turnover from one Schwabe cycle to the next (minimum) took place around that time, also seen in longer periods without naked-eye and telescopic spots nor any likely true aurorae.

Did the Maunder Minimum start with or right after this Schwabe cycle minimum in the second half of 1620 or one or two cycles later? We will then compare the start of the Maunder minimum with the current situation.