

Climate variation during the Maunder Minimum driven by the galactic cosmic rays

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The Sun holds several long-term cyclic variations in addition to the 11-year sunspot activity cycle and the 22-year cycle in the polarity reversals. The 88-year and the 208-year quasi cyclic variations of the Sun have caused several long-lasting sunspot minima such as the Maunder Minimum (1645-1715 AD).

By measuring the content of cosmogenic nuclide in annual tree-rings, we have investigated the change of the characteristics of the eleven-year and twenty-two-year solar cycles in association with the long-term variations of solar activity level, and have found that the “eleven-year” solar cycle has tendency to be lengthened as the level of the long-term solar activity level is suppressed. The length of the “eleven-year” and the “twenty-two-year” cycles had been ~ 14 and ~ 28 years during the Maunder Minimum, while they had been ~ 9 and ~ 18 years during the Early Medieval Maximum Period (9-10th century).

The records of solar cycles in the past are useful when discussing the possible mechanism of solar influence on climate change. The crucial difference in the variations of Total Solar Irradiance / solar Ultra Violet (UV) and the Galactic Cosmic Rays (GCRs) is the presence of the 22-year variation. The flux of GCRs is controlled by solar activity change with 11-year period and the magnetic polarity reversals with 22-year period, while, solar radiations are controlled only by the activity change. We investigated the variation of the reconstructed temperature during the Maunder Minimum, and found that the temperature had varied with significant “22-year” period during then. It suggests that GCRs are playing important role in climate variation.