

The Earth Climate at Deep Minima of the Solar Activity

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The recent extended and deep minimum of solar variability (cycles 23-34) and the extended minima in the 19th and 20th centuries (1810-1830 and 1900-1920) are consistent with minima of the Centennial Gleissberg Cycle (CGC), a 90-100 year variation of the amplitude of the 11-year sunspot cycle observed on the Sun, solar wind, and at the Earth. The CGC has been identified in the Total Solar Irradiance (TSI) reconstructed for over three centuries. The Earth's climate response to the prolonged low solar irradiance involves heat transfer to the deep ocean with a time lag longer than a decade.

The CGC minima, sometimes coincidentally in combination with volcanic forcing, are associated with severe weather extremes. Thus the 19th century CGC minimum, coexisted with volcanic eruptions, led to especially cold conditions in United States, Canada and Western Europe (called “a year without summer”). Using the reconstructed solar forcing and modeled and reconstructed Earth’s temperature data we identify the timing and spatial pattern of the Earth’s climate response to the Sun’s Grand Minima.