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Predicting space climate change.

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Observations of solar activity measures have shown that the minimum between solar cycles 23 and 24 was the longest and deepest since about 1900, making it the lowest mean solar activity level of the space age. Furthermore, despite the fact that the evolution of solar cycle 24 is such that its maximum is due to occur in late 2012/2013, solar activity is still comparatively low, as can be observed in sunspot number, the interplanetary magnetic field strength and cosmic ray fluxes. This scenario is consistent with recent predictions that the sun is due to exit the grand solar maximum (GSM) that has persisted throughout the space age. If this prediction is correct, then two interesting questions arise: How much will average solar activity levels decline? How quickly do we expect this to happen? One way to answer these questions, in the absence of a predictive model of the solar dynamo, is to produce analogue forecasts of long term space climate by studying past variations of solar activity. This is achieved by compositing previous declines in solar activity upon exiting 24 GSMs contained in a 9300-year record of the solar modulation potential derived from cosmogenic isotopes. We present predictions of probable future variations in the near-Earth interplanetary magnetic field (IMF) and sunspot number and examine the likelihood that the descent will take us back to Maunder Minimum levels of activity. Furthermore we consider the cycle to cycle persistence in group sunspot number and the heliospheric modulation potential and use this to show that given the recent variation in solar activity we are almost certainly exiting a GSM and that there is an estimated chance of at least 8% of returning to Maunder Minimum conditions in the next 40 years.