Climatic effects of a solar minimum

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An abrupt cooling in Europe together with an increase in humidity and particularly in windiness coincided with a sustained reduction in solar activity 2800 years ago. Scientists from the German Research Centre for Geosciences GFZ in collaboration with Swedish and Dutch colleagues provide evidence for a direct solar-climate linkage on centennial timescales. Using the most modern methodological approach, they analysed sediments from Lake Meerfelder Maar, a maar lake in the Eifel/Germany, to determine annual variations in climate proxies and solar activity.

The study published online in *Nature Geoscience* reports the climatic change that occurred at the beginning of the pre-Roman Iron Age and demonstrates that especially the so-called Grand Minima of solar activity can affect climate conditions in western Europe through changes in regional atmospheric circulation pattern. Around 2800 years ago, one of these Grand Solar Minima, the Homeric Minimum, caused a distinct climatic change in less than a decade in Western Europe.

The exceptional seasonally laminated sediments from the studied maar lake allow a precise dating even of short-term climate changes. The results show for a 200 year long period strongly increased springtime winds during a period of cool and wet climate in Europe. In combination with model studies they suggest a mechanism that can explain the relation between a weak sun and climate change. "The change and strengthening of the tropospheric wind systems likely is related to stratospheric processes which in turn are affected by the ultraviolet radiation" explains Achim Brauer (GFZ), the initiator of the study. "This

complex chain of processes thus acts as a positive feedback mechanism that could explain why assumingly too small variations in solar activity have caused regional climate changes."

Albeit those findings cannot be directly transferred to future projections because the current climate is additionally affected by anthropogenic forcing, they provide clear evidence for still poorly understood aspects of the climate system, emphasizes Achim Brauer. In particular, further investigations are required with a focus on the climatic consequences of changes in different wavelengths of the solar spectrum. Only when the mechanisms of solar-climate links are better understood a reliable estimate of the potential effects of the next Grand solar minimum in a world of anthropogenic climate change will be possible. In this respect, well-dated annually laminated lake sediments are also in future of crucial importance for these studies.

Therefore, scientists from the German Research Centre for Geosciences (GFZ) and other institutions search for such archives around the world in order to to obtain a more accurate approach to the solar-climate relationship and the different regional responses.

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