# Record sunshine during first COVID-19 lockdown largely caused by unusual weather

February 16 2021

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Dry and cloudless weather was mainly responsible for the unusually high solar irradiance in western Europe during the spring of 2020, not the reduction in aerosol emissions due to the first lockdown. This was the

result of an international meteorological study, in which scientists from the University of Cologne participated. The results have been published in the current issue of *Nature Communications Earth & Environment*.

A large part of western Europe experienced exceptionally sunny and dry weather from March 23 to the end of May 2020. New sunshine extremes were reported in the United Kingdom, Belgium, Germany, and the Netherlands, coupled with exceptionally deep blue skies. At the same time, these countries had gone into lockdown in response to the coronavirus pandemic. The hypothesis was that higher solar irradiance at the Earth's surface was caused by reduced emissions of aerosols from industry and traffic.

The research team's analyses show that the reduced aerosols and contrails due to COVID-19 measures were far less influential in the spring of 2020 than the dry and—more importantly—largely cloud-free weather. The study was conducted by an international team that included Professor Dr. Stephanie Fiedler of the Institute of Geophysics and Meteorology at the University of Cologne. Also involved were researchers from the Netherlands from Wageningen University & Research and "Koninklijk Nederlands Meteorologisch Instituut" (KNMI), as well as from Switzerland from the "Physikalisch-Meteorologisches Observatorium Davos" of the World Radiation Center (PMOD-WRC).

Spring 2020 broke sunshine records across western Europe. The Netherlands recorded the highest solar irradiance since 1928, surpassing the previous extreme value of 2011 by 13 percent. The diffuse component of solar radiation reached a record low value (38 percent). The coincidence of the extreme value of solar irradiance with a reduction in pollution caused by humans due to COVID-19 measures led to the hypothesis that cleaner-than-usual air contributed to the record. Lower transportation and industrial activities led to reductions in

nitrogen oxide, sulfur dioxide, and carbon dioxide emissions of several percent with corresponding changes in atmospheric composition and radiation. The objective of this study was therefore to quantify the respective contributions of weather and aerosols to extreme solar irradiance in Western Europe.

Based on analyses of ground- and satellite-based observations and experiments with a radiative transfer model, the researchers estimate a 1.3 percent increase in solar radiation from the 2010-2019 mean due to the lower mean aerosol optical depth, a measure of aerosol burden in the atmosphere, and a 17.6 percent increase due to some exceptionally dry days and very low cloud cover. "The analyses show that the reduced aerosols and contrails due to COVID-19 measures are less important for the solar irradiation record than the dry and especially cloud-free weather," explained Professor Stephanie Fiedler.

Rather, the main reasons for the increased solar irradiance are weather patterns with persistent northerly to easterly flow over western Europe and weak winds at the center of high-pressure systems. As a result, there were more days with little and no cloud cover, which allowed for greater solar irradiance.

Using an objective weather type classification, a method of describing weather situations based on grid point data, the team showed that 2020 had about ten more spring days with dry weather associated with a high-pressure system compared to the mean for 1980-2019. The amount of precipitation also shows the unusual weather. Thus, spring 2020 is amongst the drier years on record (2004-2020), with the very dry period beginning on March 21, 2020.

Aerosol emissions caused by humans are relatively low in Europe compared to other world regions. "If anthropogenic aerosol emissions continue to be rather small in the future, or if they further decrease, like

scenarios from the Intergovernmental Panel on Climate Change suggest, weather will be the most important factor in setting new records for solar irradiance in spring," said Stephanie Fiedler. "Currently, however, many regions of the world are more affected by aerosols than western Europe. More significant regional impacts of aerosol reduction on solar irradiance from COVID-19 lockdowns have already been documented in such locations."

Future research will examine the extent to which aerosol changes can affect weather patterns, for example. Climate scientists are currently working on a new international project to compare climate simulations with emission datasets adapted to the COVID-19 pandemic to answer such questions. In this context, Fiedler is compiling datasets for human-caused aerosols that will enable such model simulations.

**More information:** van Heerwaarden, C.C., Mol, W.B., Veerman, M.A. et al. Record high solar irradiance in Western Europe during first COVID-19 lockdown largely due to unusual weather. *Commun Earth Environ* 2, 37 (2021). doi.org/10.1038/s43247-021-00110-0

Provided by University of Cologne