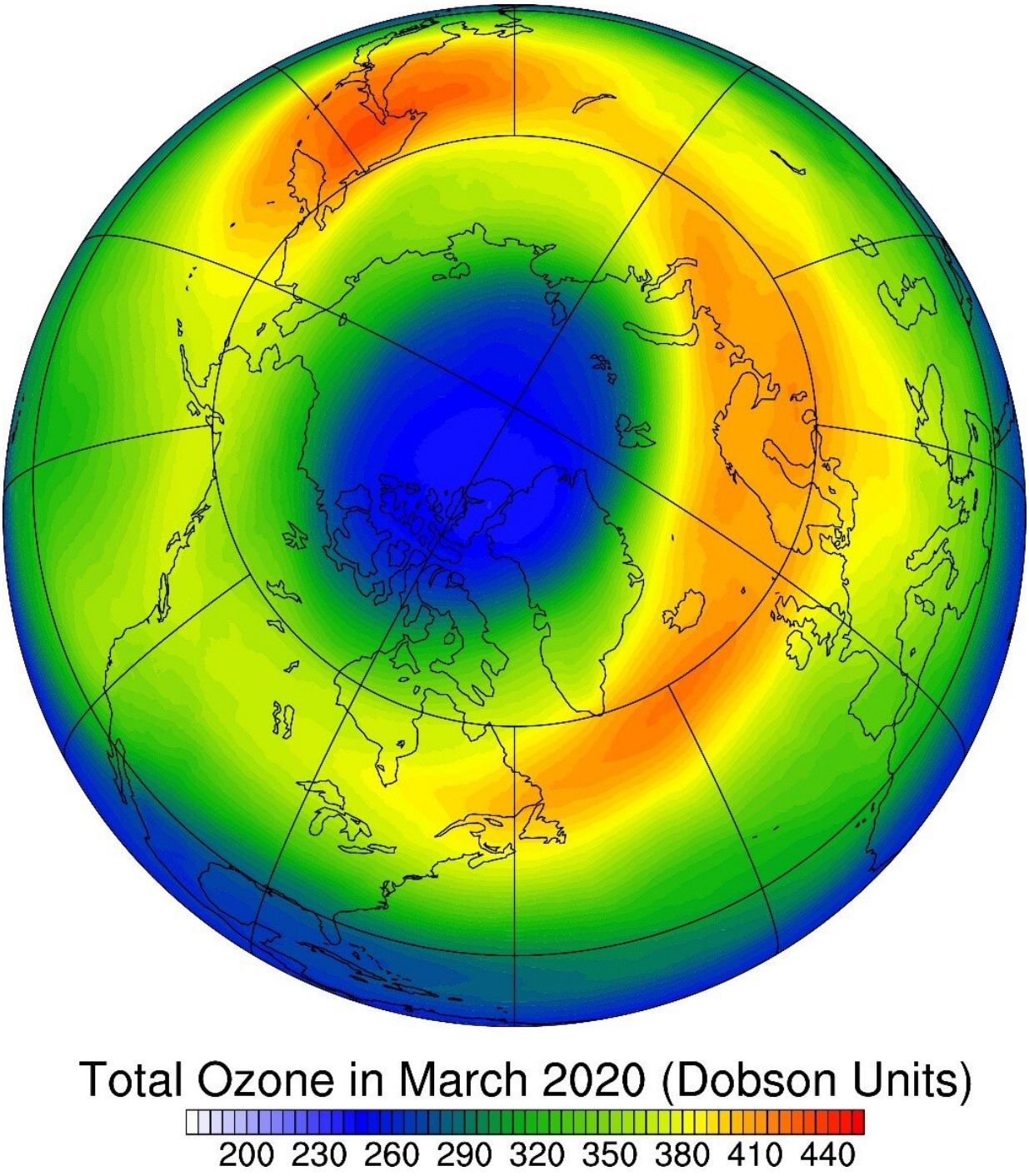
Spring 2020 Arctic 'ozone hole' likely caused by record-high north Pacific Ocean surface temperatures

September 21 2021



Arctic “ozone hole” during March 2020. Credit: Yan Xia

Unlike the Antarctic ozone hole that develops annually during austral

spring (September, October, and November), Arctic ozone levels usually stay well above the ozone hole threshold. The Arctic stratospheric vortex is typically too warm for polar stratospheric clouds to form, which are a key ingredient in severe ozone depletion processes. Much stronger planetary wave activity occurs in the Northern Hemisphere than in the Southern Hemisphere, which generates stronger dynamical heating to warm the stratospheric Arctic vortex. Despite this, polar meteorologists reported a record-breaking Arctic "ozone hole" during spring 2020, prompting a research inquiry into what caused this unusual phenomenon.

Scientists from the Department of Atmospheric and Oceanic Sciences, School of Physics at Peking University, led by Prof. Yongyun Hu, found that that the Arctic ozone hole in spring 2020 was likely caused by record-high North Pacific sea surface temperatures (SST). They published their full analysis in *Advances of Atmospheric Sciences*.

Using real observed data, results show that a weakened wavenumber-1 wave is responsible for the anomalously cold Arctic stratospheric vortex. This weakening is associated with record-high sea surface temperatures during late winter and early boreal spring.

"The record-high North Pacific sea surface temperatures during February and March 2020 led to a large reduction of wavenumber-1 wave activity by modifying the Aleutian low." Prof. Hu explained. "The reduction of planetary wave activity caused the extremely cold and persistent stratospheric polar vortex between February and April 2020, which provided the necessary conditions for severe ozone loss."

To reach this conclusion, Dr. Hu and his team designed several sensitivity experiments using a long-range climate model. Performing multiple experiments and iterations were necessary to provide a comprehensive picture of the effects that record-breaking North Pacific sea surface temperatures had on the Arctic stratospheric vortex.

"The formation of the record Arctic ozone loss in spring 2020 indicates that present-day ozone-depleting substances are still sufficient to cause severe springtime ozone depletion in the Arctic stratosphere." said Prof. Hu. "These results suggest that severe ozone loss is likely to occur in the near future as long as North Pacific warm SST anomalies or other dynamical processes are sufficiently strong."

More information: Yan Xia et al, Record Arctic Ozone Loss in Spring 2020 is Likely Caused by North Pacific Warm Sea Surface Temperature Anomalies, *Advances in Atmospheric Sciences* (2021). DOI: 10.1007/s00376-021-0359-9

Provided by Chinese Academy of Sciences