# Climate Change Research Priorities During and After Coronavirus Disease in 2019 (COVID-19) Pandemic

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## Editorial

During the first few months of 2020, the global pandemic of coronavirus disease 2019 (COVID-19) spread swiftly over the world. Most developed countries were forced to implement "suppression tactics" against COVID-19, with the goal of drastically reducing virus transmission, limiting mortality, and reducing the demand for critical care services. These suppression techniques have necessitated significant decreases in human-to-human interaction rates, sometimes through legally obligatory remedies such as "lockdown" restrictions in urban areas. As a result of these countermeasures, human mobility reduced considerably, resulting in a significant reduction in commuting due to work-from-home policies (i.e., remote or telework). Domestic and international travel, as well as other modes of transportation, has all significantly decreased. The widespread use of specific COVID-19 prevention (e.g., vaccination) and treatment (e.g., combination therapy using antivirals and steroids) is expected to begin soon; however, the virus that causes COVID-19, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is expected to continue circulating widely in the Northern Hemisphere at least through the 2020/2021 winter season. The scientific community has never had a better chance to investigate climate change because of such profound and artificial changes in communities around the world. For a limited time, global air pollution and carbon dioxide (CO2) emissions were lowered instantly [2], providing a critical opportunity for the general population to enjoy improved air quality and lower CO2 emissions. Nonetheless, COVID-19's impact on climate change has both positive and negative aspects, as many COVID-19 responses have had serious economic consequences [1]. Furthermore, the "new normal" lifestyles have a significant impact on mitigation and adaptation plans.

Beginning in fiscal year 2020, the Environmental Restoration and Conservation Agency of Japan (ERCA) has launched a strategic financial support program, the Environment Research and Technology Development Fund, under the direction of the Ministry of the Environment of Japan, to support "Integrated Research on Climate Change Impact Assessment and Adaptation Plans" (S-18; project leader: Nobuo Mimura). The project's goal is to provide up-to-date scientific knowledge to aid decision-making on government policies for climate change adaptation planning. Our planned study program should be flexible enough to measure the scientific aspects of the interaction between COVID-19 and climate change as life under the new normal conditions unfolds around the world. We hope to outline the research agenda for this particular relationship in this editorial. Concerning the impact of climate change on COVID-19, two concerns must be addressed. First, we've begun to grasp how changes in temperature might affect human-to-human COVID-19 transmission and how cold weather can boost SARS-CoV-2 secondary transmission [2]. At this time, cold weather is quite likely to accelerate the spread of COVID-19. This epidemiological conclusion is in line with current experimental findings that suggests lower transmission levels in warmer and more humid conditions.

During the summer season, countries in temperate zones have gradually suffered second epidemic waves, with a steady supply of people susceptible to infection with the novel coronavirus. In the absence of interventions, we found a clear negative correlation between the effective reproduction number (i.e., the average number of secondary cases generated by a single primary case) and daily average temperature when analyzing confirmed case data in Japan during autumn 2020 in four urban cities (Sapporo, Miyagi, Tokyo, and Osaka). A well-designed time allocation study in labor economics emphasized that workers are more prone to spend time indoors on chilly days as a possible mechanism of enhanced transmission. Physical mechanisms, in addition to behavioral alterations in cold environments, could establish a causal link [3]. Although the facts listed above have gradually become scientific evidence, it is safe to infer that the impact of changing weather conditions on COVID-19 transmission is yet unknown. Warmer weather alone will not be enough to stop the spread of COVID-19 infections. Second, the COVID-19 pandemic provides a unique chance for researchers to look into the rising frequency of new infectious diseases across time. The majority of novel human diseases originate in animals, particularly wild animals, and the risk of emergence is known to be linked to human exposure at the human-animal interface. To date, plausible explanations for the rising frequency of novel pathogen emergence include (i) increased local and international travel, (ii) increased risk of exposure to wild animals that may harbor novel human pathogens, and (iii) wild animal habitat loss due to expanded agricultural land use and urbanization. Climate change has the potential to trigger disease emergence since it can lead to species extinction, habitat alterations, and wild animal movement, such as to Polar Regions to avoid rising temperatures. However, such mechanisms are still mainly a matter of scientific discussion, and objective demonstration of such events in a bottom-up approach has yet to be accomplished [4].

Many adaptation strategies should be considered if the relevance of climate change is scientifically confirmed, to limit the risk of the introduction of new human illnesses with pandemic potential. Reverse causal effects (e.g., climate change issues) have had both beneficial and harmful consequences in the aftermath of the COVID-19 epidemic. The ensuing reduced level of CO2 emissions during 2020, which represents a pivotal time in terms of countermeasures to combat climate change, is a crucially essential beneficial consequence. Reduced CO2 emissions and improved air quality have directly benefited the world population. However, CO2 emissions reductions due to the COVID-19 epidemic account for just a small percentage of the intended reduction objective, necessitating a wider acceptance of drastic remedies by communities. Of course, global warming mitigation initiatives that offer unique solutions aimed at reducing CO2 emissions should be encouraged. Furthermore, the post-pandemic phase provides a significant opportunity to apply adaptive measures and re-establish public trust. People now have a better understanding of the danger of global warming; as a result, within this window of opportunity, preparedness against the negative effects of climate change can be reinforced [5]. The COVID-19 pandemic might have a number of detrimental effects on climate change. COVID-19 and climate change disproportionately affect persons with underlying comorbidities and those with lower incomes. As a result, the physical impact of the COVID-19 pandemic, combined with climate change, is worse in low-income countries and populations. By preserving solidarity with these countries, global society can defend these vulnerable communities from this double burden. COVID-19 has had a major financial impact on climate change, and it has become obvious that the global economy is not very robust. This is poor news for continuing and expanding climate change responses, which involve numerous expensive measures like switching to renewable energy sources, electrifying transportation networks, and using other clean technology [6]. At the very least, policymakers in developed countries should strive towards climate-resilient recovery during the post-pandemic era. It's also important to realize that social changes brought on by COVID-19 can complicate future adaption.

To avoid unwanted close contact in cramped areas, care providers' time and frequency with old people has been drastically decreased. This situation, on the other hand, may result in lesser levels of care and monitoring in elderly populations in order to avoid problems like heat stroke, where older people may need to be reminded to drink water and utilize air conditioning. During the epidemic, such important points should be thoroughly investigated. In terms of climate change, we have briefly discussed the study agenda surrounding the COVID-19 pandemic. Climate change research in 2020 has slowed due to the epidemic, with researchers compelled to work remotely. However, because of the increased understanding of the COVID-19 pandemic's and climate change's mutual influence, significant changes have occurred as a result of physical, financial, and social situations changing during the pandemic. On this subject, concerted study efforts are required.

As COVID-19 spreads over the world, it's becoming more crucial to understand the elements that drive its dissemination. The transmission intensity of various coronaviruses has been found to be affected by seasonal variation caused by reactions to changing environmental conditions. The impact of the environment on SARS-CoV-2, on the other hand, is largely unclear, and seasonal variation remains a source of uncertainty in SARS-CoV-2 transmission projections [7]. We investigate the relationship between temperature, humidity, UV radiation, and population density and transmission rate estimates in this paper. Using data from the United States of America, we use comparative regression and integrative epidemiological modeling to investigate transmission correlates across states. We discovered that policy intervention ('lockdown') and restrictions on individual mobility are the most important predictors of SARS-CoV-2 transmission rates, but that in the absence of these factors, lower temperatures and higher population densities are linked to increased SARS-CoV-2 transmission. Our findings suggest that while summer weather cannot be used to replace mitigation strategies, lower fall and winter temperatures can lead to an increase in transmission intensity in the absence of policy interventions or behavioral changes. We discuss how this knowledge can help with COVID-19 predictions, future seasonal dynamics, and intervention policies [8].

SARS-CoV-2 appears to be transmitted predominantly by aerosols, and recent investigations have demonstrated that SARS-CoV-2 can remain infectious in airborne particles for more than 3 hours. The function of fomites in the current epidemic has yet to be fully identified, while they have been hypothesized as a possible mechanism of transmission, as evidenced by WHO's and national control plans' high emphasis on hand-washing. Viruses have been proven to be easily transferred between contaminated skin and a fomite surface, with high-contact surfaces such as smartphone touchscreens, bank ATMs, airport check-in kiosks, and grocery self-serve kiosks all operating as fomites for virus transmission. Fomite transmission has previously been proven to be a highly efficient method, with transmission efficiencies of 33% for bacteria and phages transferred from fomite to hand and fingertip to mouth [9]. Because fomite transfer is so efficient, the persistence of SARS-CoV-2 on ambient surfaces is an important consideration when considering the virus's fomite transmission potential. The survival of SARS-CoV-2 is currently in dispute, with data varying from 3 to 14 days at ambient temperature for a single surface type, stainless steel. This research intends to offer SARS-CoV-2 environmental stability data for a variety of common surfaces under regulated temperature and humidity settings. While SARS-CoV-2 appears to be distributed mostly through aerosols and respiratory droplets, fomites may possibly play a role in virus transmission. Fomite transmission has been shown to play a role in the spread of several coronaviruses, including swine epidemic diarrhea virus and the Middle East Respiratory Syndrome coronavirus, human coronavirus 229E and OC43, and SARS-CoV-2. SARS-CoV-2, at a beginning viral load and in a fluid matrix similar to that excreted by infected individuals, was found to be viable for at least 28 days when dried onto non-porous surfaces at 20°C and 50% relative humidity in the current investigation [10].

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