MEERTALK

COVID AEROSOLS ANALYSIS

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SUMMARY

As a result of the 2020 lockdowns, global greenhouse gas emissions dropped precipitously. Despite this drop, there was a notable increase in climate-related disasters. Why?

The reason for this lies in the difference between short and long-lived anthropogenic emissions. Long-lived emissions, such as carbon dioxide, tend to act predominantly as greenhouse gases, storing heat. Short-lived emissions, however, act as a counterveiling force and reflect shortwave radiation, resulting in a cooling effect. Under "normal" conditions, these short-lived emissions mask the greenhouse effects of longer lived emissions.

The COVID-19 induced lockdowns resulted in an immediate decline in short-lived aerosol pollution. Although long-lived emissions, most notably CO2, also decreased, this did little to affect the overall stock of emissions in the atmosphere. Consequently, the net effect of the lockdown was to unmask this cooling effect, resulting in an increase in temperature. This increase in temperature led to an increased rate of evaporation of water, as well as changes in circulation.

These changes were perhaps most pronounced in Asia, which received a dramatic increase in the amount of sunlight. Relative to the historical average, insolation in India was observed to have increase by as much as 8% across the subcontinent. In China, a land temperature increase of 0.5C (+/- 0.2C) was observed.

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SUMMARY

Despite some minor uncertainty, it is clear that this was directly caused by changes in aerosols.

The current generation of climate models have a challenging time incorporating the masking effect created by short-lived aerosols. Simulations which take this effect into account predict higher levels of warming as compared to others, in large part because as we decarbonize our economies, these pollutants will inevitably abate. In the examples described so far, 1/3 of the observed climate anomalies can be attributed to aerosol effects, with a negligible contribution from long-lived greenhouse gases.

This is significant, since it suggests that the impacts of local radiative forcing will be heterogeneous. The largest impacts will occur in frontline communities in Asia, South East Asia, and parts of Africa that have high levels of pollution, and hence aerosol cooling. These findings should inform policy makers and put a renewed emphasis on the importance of developed nations in accelerating their own decarbonization efforts while, at the same time, helping developing nations with climate mitigation and adaptation.

MEER is continuing to work on identifying materials that can assist in creating sufficient quantities of reflective surfaces to help restore earth's radiative imbalance through the rejection of shortwave solar radiation. Dr. Tao finds that landfills can more than satisfy these material requirements:

- Landfill aluminum can meet 700% of the materials needs for mirrors.
- Landfill plastic can meet over 100% of the materials needs for mirrors.
- Landfill glass can meet approximately 10% of the materials needs for mirrors.

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MEER URBAN ADAPTATION

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SUMMARY

Heatwaves began as early as February in 2022 in India. March was the 5th warmest on record, despite the cooling effects from La Niña. April was also the hottest on record. For 6 weeks, average temperatures stayed 4°C above the historic average: the longest period in recorded history. Many thought that these effects would be years away, but they have already happened, with devastating effects on public health, the environment, and women, who are particularly disadvantaged by the inability to work at home amid stifling levels of heat.

The aim of MEER Urban is to make buildings more livable in regions where people are suffering. Extreme heat kills more people than any other climate effect. With over 1 billion people lacking any means of cooling their homes at all, and inadequate infrastructure and building materials making things worse, MEER is working with partner cities in Ahmedabad and Freetown to pilot the use of solar reflectors on rooftops and ensure that communities that would otherwise be unable to access these resources can find relief from the heat. Made of various materials to suit different local conditions, solar reflectors are expected to reject about 93% of light, making urban environments more tolerable in the process.

MEER is at the beginning of an effort to build a network of partner cities suffering from thermal intolerance. In this spirit, climate justice is social justice, as these communities did next to nothing to create the current conditions which are making their lives increasingly difficult.

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SHORT-CIRCUITING THE GREENHOUSE EFFECT

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- LEAD INVESTIGATOR OF MEER'S FIELD EXPERIMENTATION

SUMMARY

Even with the most optimistic decarbonization and afforestation assumptions, the world is still likely to warm to a devastating degree. The conclusion is simple: we need more time. More time to decarbonize our economies. More time to advance energy efficiency. More time to identify effective carbon capture and removal methods. More time to slow the pace of climate change.

The earth already has a number of surfaces which naturally reflect sunlight, including deserts, ice, and snow. Increasing the amount of light reflected by earth via the introduction of artificial reflectors, while simultaneously working to decrease the amount of heat retained by greenhouse gases, could be our most effective path forward to limit the impacts of climate change. It must be emphasized that reflectivity solutions only buy time and by no means eliminate the problem of greenhouse gas emissions. That said, surface reflectivity solutions are amenable to technological solutions which do not immediately require behavioral changes, political decisions: important changes that will take time, education, and concerted effort to realize.

To be clear, there are downsides as well. Vast areas of land would be needed, all across the globe. Further study must be done to test the concepts and determine how many mirrors are needed for a change in local temperature. Additionally, the public must be convinced that this is not a threatening solution. While significant, this is something that we can do. It is also something we can easily undo, which may not be the case for other forms of albedo modification involving the injection of aerosols.

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SHORT-CIRCUITING THE GREENHOUSE EFFECT CONTD

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SUMMARY

So far, mirror field experiments have been conducted in New Hampshire. Early results have demonstrated a significant cooling effect on the order of 3-4° Celsius. The goal is to one day test entire fields of mirrors, particularly as the solar angle changes through the mid-latitudes. This upcoming summer, Dr. Hoffman and his team will investigate soil temperature and soil moisture. This summer, they will also try to measure the amount of cooling that comes from different densities of mirrors comprised of various materials and placed at a multitude of heights.