



COMMUNICATION

# Regarding the Montreal Protocol communication after the Kigali Amendment

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## Abstract

The Kigali Amendment introduced a new family of chemical compounds, which do not contribute to stratospheric ozone depletion but present a high global warming potential, under the watch of the Montreal Protocol in 2016. Earlier this year, a press note from the World Meteorological Organization entitled “Ozone layer recovery is on track, helping avoid global warming by 0.5°C” caught our attention because of the wrong conclusions that can be potentially drawn by laypersons due to an apparent linkage of ozone depletion and global warming problems. Public communication of the Montreal Protocol since the Kigali Amendment should be more careful than ever to avoid lessening the social perception of the threat of climate change, particularly considering that society already has a distorted representation of these problems, assuming causal relations between ozone depletion and climate change, that could lead to unfounded optimism towards the climate crisis.

**Keywords:** social representations; climate change; global warming; ozone depletion

The Montreal Protocol was universally ratified by the United Nations in 1987 to phase out ozone-depleting halogenated hydrocarbons – used as refrigerants, propellants and solvents – after the unquestionable scientific evidence that linked the emissions of several species of chlorofluorocarbons (CFCs) with a dramatic decay of stratospheric ozone (Molina & Rowland, 1974). However, the prohibition of these ozone-depleting substances led to the appearance of hydrofluorocarbons (HFCs) as substitutes, a family of halogenated compounds whose emissions do not contribute to ozone depletion but have a considerable effect as greenhouse gases. Scientific awareness towards the global warming potential of HFCs (Xu et al., 2013), contributed to the modification of the Montreal Protocol with the so-called Kigali Amendment in 2016, in which the phaseout of HFCs production is integrated together with the previously banned ozone-depleting chemicals (Heath, 2017).

## The diffusion of a World Meteorological Organization press note

The coordinated actions under the umbrella of the Montreal Protocol have been remarkably successful for the recovery of the ozone layer according to the quadrennial assessment report published in October 2022 by the Scientific Assessment Panel to the Montreal Protocol on Ozone-Depleting Substances (WMO, 2022). Aiming to share the promising results of this global effort

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and raise public awareness, the World Meteorological Organization (WMO) released a press note in January 2023 entitled “Ozone layer recovery is on track, helping avoid global warming by 0.5°C” (WMO, 2023). Although the note is, of course, scientifically correct, it might be confusing for a non-expert audience because of how the information was chosen to be presented as well as how the origin of ozone layer depletion and the anthropogenic modification of climate are linked.

At first glance, the title could certainly lead readers who are not familiarized with the historical evolution of the Protocol to assume that ozone layer recovery is directly linked to a reduction of the planetary temperature projections for the end of the century. In the same vein, the first sentence of the note states: “The ozone layer is on track to recover within four decades, with the global phaseout of ozone-depleting chemicals already benefitting efforts to mitigate climate change,” apparently implying a causal link between both events without further explanation. It is not until the fifth paragraph – which is part of a subsequent subsection – where the note clearly states that “HFCs do not directly deplete ozone, but are powerful climate change gases” and thus clarifying the fact that the ozone-depleting substances scheduled to phase out since 1987 are different from the gases contributing to global warming controlled under the Kigali Amendment in 2016, even though they are both monitored under the Montreal Protocol.

After the publication of the press note, the information was spread and reproduced by other organizations and media groups on their Internet sites. By performing a simple search in the Google engine using the terms “Kigali Amendment” plus “WMO” and refining the search for results published after the WMO press note, five relevant articles were found within the first fifteen results. Two of the articles belong to specialized institutions, i.e., the Red Cross Climate Centre (Climate Centre, 2023) and a Swiss Federal Laboratory (Empa, 2023). The information contained in these notes mimics the structure of the press note of the WMO, initially linking ozone recovery and mitigation of climate change and explaining later in the text that Kigali agreement does not deal with ozone-depleting chemicals.

However, the other three articles that belong to non-specialized newspapers or other general media sites are more concerning. In this case, two of the articles, from German (Braun, 2023) and Chinese (Robinson, 2023) sites, mention the fact that the HFCs are gases that contribute to the increase of global greenhouse effect but fail to explain that are not dangerous for the stratospheric ozone. The last article, which belongs to a British newspaper (Sundaravelu, 2023), actually mentions that the HFCs do not contribute to the ozone layer destruction, but the text shows other misconceptions assuming a causal relation between the effects of ozone recovery and the global warming, such as: “By recovering the ozone layer in the upper stratosphere, humans will face less exposure to harmful ultraviolet rays from the sun and global warming will be reduced by 0.5 degrees Celsius.”

### Misconceptions in the common culture

The extensive news coverage of ozone layer and climate change – both involving Earth’s atmosphere – have made them become linked in the public mind, regardless of educational level (Kempton, 1997), reporting to either affect the public understanding by a straightforward confusion of ozone depletion and climate change or by spreading misleading cultural models. Ungar (2000) explained how climate change remains in a “public limbo” and is unable to break through the veil of scientific ignorance, unlike the so-called ozone hole. In this work, it is hypothesized that there could be two main reasons for the penetration of ozone depletion in society, as it was able to bring easy-to-understand metaphors derived from the popular culture and implied a sense of immediate and concrete risk with everyday relevance.

The misconceptions about the relationship between ozone depletion and climate change in the common culture are well-known and have been previously addressed by many authors. As an example among all the works that can be found in the literature, a longitudinal study of educated

people in the United States investigated mental models about climate change, with the application of the same survey in 1992 and 2009, to discover that the mental models regarding the conflation of climate change and stratospheric ozone depletion have changed very little (Reynolds et al., 2010). As of today, these misconceptions are far from being resolved. As an additional example, a study among secondary school students in Spain and Italy showed that the social representations of climate change are pretty similar to other population groups, concluding that, among other reasons, school textbooks share the same biased and reductionist representations of climate change as traditional media (García-Vinuesa et al., 2022). In this work, it is shown that a vast majority of the students believe that climate change is a consequence of the hole in the ozone layer and, at the same time, present a confusion about the role of carbon dioxide in the atmosphere, correctly linking it to climate change but incorrectly linking it to the deterioration of the ozone layer.

The theory of social representations is often regarded as one of the most appropriate tools to investigate public understanding of science. Social representations were defined by Moscovici (1963) as the elaboration of a social object by the community for the purpose of behaving and communicating. Media influence on the generation of representations in society is on the heart of the theory of social representations since it was first conceived by Moscovici. The communications revolution, first through books and newspapers, and later through mass media, facilitated the dissemination of images and notions created by science to become part of the intellectual baggage of the lay man and women. In this regard, media plays a key role in the public understanding of science, acting as intermediaries between the scientific community and society.

As specialized knowledge needs to be assimilated by non-specialists, scientific and ordinary knowledge present differences in intellectual processes and terminological incompatibilities, but there is a further obstacle, the difficulty of visualizing scientific phenomena that are far from practical experience (Moscovici, 1988). The crucial point is that social representations directly impact the social behavior and organization of the society and can even modify the cognitive functioning itself (Jodelet, 1986), so scientists need to be aware of the difference between science and the social representations of science in order to communicate effectively with members of the general public (Farr, 1993).

Any scientific “object,” especially those that are relevant to the development of a society, will be subjected to processes of collective re-elaboration and interpretation. This process of social appropriation is inevitable once scientific representations of issues that generate social interest – or controversy – are disseminated and integrated into common culture. We believe that these cultural processes of “representation” must be given special attention by scientific communication, dissemination and education; as they can be as important as rigorous scientific communication when it comes to triggering – or inhibiting – a collective reaction to confront the issues identified by science.

### **Ozone layer depletion and global warming: different origins and diverging remedies**

The Montreal Protocol was proven to be a successful tool to alleviate the anthropogenic effects on the depletion of the ozone layer, so adding the HFCs to the list of controlled substances under the auspices of the Protocol undoubtedly constitutes a reasonable maneuver for their regulation and monitorization. However, ozone layer protection only involved the strict control of a certain family of chemical compounds that had direct substitutes with similar physicochemical properties. The control of global warming within acceptable levels, on the other hand, will require a drastic reduction of emissions in all the economic sectors involving radical socioeconomic responses to change production and consumption patterns that will affect the lifestyle of the most advanced societies and will require social and cultural transformations that are even hard to imagine. The IPCC (2018) has recognized the need for an accelerated “systemic transition” in our current societies to try to contain global warming to 1.5°C by the end of this century.

In this regard, the IPCC itself informed in their most recent Synthesis Report that the containment of global warming to 1.5°C by the end of the century would require a global reduction, compared to 2019 emission levels, of 43% of the greenhouse gases by 2030 (IPCC, 2023). In this scenario, the positive contribution of the phaseout of HFCs plays a small role in limiting the temperature increase, especially when recent estimations pointed out to a HFC contribution in the reduction of 0.28–0.44°C to global warming by 2100 instead of the previous estimates above 0.5°C (Velders et al., 2022).

Linking the success of the ozone layer recovery to a small portion of the required efforts to bend down the emissions of gases contributing to global warming, does not seem a good idea considering the existing beliefs in the common culture regarding the causal relation of greenhouse and ozone depletion effects. Amongst all of the misconceptions and prejudices described by González-Gaudio and Meira-Cartea (2019), it is argued that social representations of climate change – as it is the way in which we apply socially established knowledge to make it intelligible – can be a major obstacle to its understanding due to easiness to create new representations rather than modify an already established one.

In conclusion, considering the preexistent misconceptions in the common culture regarding the relation between the ozone layer and global warming, as well as the observed diffusion of inaccurate or partial information originated by the analyzed WMO press note, it is recommended that the future communications regarding the Montreal Protocol should be carefully elaborated to avoid lessening the social perception of the threat of climate change. Whoever reads the press note may come to think that climate change is on the way to being reversed as a result of ozone layer recovery, when both problems respond to different causal processes, although they both affect the equilibrium of the composition of the atmosphere and are caused by human actions.

The recovery of the ozone layer is indeed excellent news and must be celebrated as a prime example of how ambitious goals can be achieved through international collaboration. However, this celebration should not result in unfounded optimism making society lose the focus on the urgent and drastic measures required to control global warming. An already-loose focus due to the incongruency of public policies considering the urgency of the required measures, together with the hegemonic techno-optimistic promises of a better future.

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