

Visualizing the Consequences of Climate Change with AI

Executive Summary

We propose to develop an interactive website to depict accurate, vivid, and personalized outcomes of climate change. The technology required is complex and will combine machine learning, climate science, and behavioral science in a way that has never been done before. The result will bring the future closer in the mind of the viewer and will demonstrate specific actions they can take to improve the environment. We propose to initiate an inclusive effort to develop a personalized interactive decision calculator that shows individuals—for the first time—accurate and vivid renderings of the future outcomes of climate change as they are likely to affect that individual, as a function of individual and collective choices. Our goal is to enable individuals to make deeply informed choices about their climate future. By creating a more visceral understanding of the effects of climate change, we aim to strengthen public support for necessary actions. This inclusive project is led by Yoshua Bengio (Mila, scientific director) and Jennifer Chayes (Microsoft Research, managing director for Montreal, New York and New England). We would greatly appreciate engagement with the Canadian government on issues including gaining access to necessary climate data, convening potential climate scientists and other collaborators, and raising public awareness of the ultimate tool.

A Personalized, Interactive Simulator for Climate Change

It is difficult to downplay the importance of combating climate change. A recent [report](#) from the Intergovernmental Panel on Climate Change has determined that dramatic and rapid changes to the global economy are required in order to avoid increasing climate-related risks for natural and human systems. Necessary system overhauls require governmental interventions, which are difficult without strong public support.

Public awareness of and concern about climate change often do not match the magnitude of its threat to humans and our environment [1, 2]. One reason for this disagreement is that it is difficult for people to mentally simulate the effects of climate change, which is an inherently complex process with probabilistic outcomes [6]. Another reason is that people often discount the impact that their actions will have on the future, especially if the consequences are long-term, abstract, and at odds with current behavior and identity [3]. To overcome these challenges, an easily accessible tool is needed to help the public understand - both rationally and viscerally - the consequences of not taking sufficient action against climate change.

Researchers at Microsoft Research have shown that behaviors and attitudes can be affected by interactions with decision calculators that visually depict the future consequences of actions taken today. For instance, we have found that young participants tend to save considerably more money when presented with a decision calculator that projects their income in retirement and is accompanied with an age-progressed photograph of themselves at retirement age [4]. Likewise, older employees intend to save more for retirement when their nest egg is made more

vivid as a monthly amount to live on [5]. It is clear from the above studies that when people are given accurate depictions of how actions today affect outcomes tomorrow, they often change their behavior. In particular, they often behave more like people who have thought about the issues at length. This “decision aiding” approach maintains credibility by drawing on unbiased projections of the future and leaving freedom of choice to the (now better informed) individual.

We propose to develop technology showing the effect of climate change on a particular individual, such as their income, health, and visual predictions of their local environment (for example, showing an individual the frequency and impact of events like fires or floods at an address of their choice). The individual would be able to “turn knobs” in the simulator, showing them visually [7] the impact of personal choices, such as deciding to use more public transportation, as well as the impact of broader policy decisions, such as raising the price of carbon.

The effects of an individual turning these knobs would be based on our best projections. These projections would be modeled by combining expertise in machine learning, behavioral science and climate with data and models of collaborating researchers. Examples of techniques that will be used include:

- **Statistical machine learning** combined with the outputs of state-of-the-art physics-based climate models to deliver our best estimates of disaster likelihoods and severities, along with appropriate measures of uncertainty.
- **Deep generative models**, that can be used to produce visuals that bring home climate impacts, for example by synthesizing realistic images that depict specific places under future climate scenarios; and
- **Behavioral science** will be used to design experiments that will measure the impact of these decision aids and determine the most effective ways to present information to decision makers.

Once completed, the development team will need assistance with publicizing the availability of this tool and encouraging its use. In addition, this collaborative effort clearly requires the contributions of climate scientists, as well as access to essential climate data and models. Specifically, we are asking for the Canadian government’s help to provide:

- Access to critical climate data, for example from Environment Canada and Ouranos;
- Assistance with convening climate scientists appropriate to this effort; and
- Assistance with the publicity surrounding the completed tool.

We intend for this initiative to be an inclusive effort. We look forward to discussing it further with the Canadian government and developing more details around access to specific data sets, the scope of collaborations and creative approaches to dissemination and publicity.

Works Cited

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