Modeling Economic and Climate Outcomes

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This is the introduction to MARGO, an climate-economic model that helps us understand possible pathways to limiting global warming [1].

The model is implemented in Julia, and the figures here were generated using MARGO's built-in plotting functions.

Margo models the future global temperature and carbon dioxide emissions and concentration in response to various control measures that can be deployed. The controls include: mitigation of greenhouse gas emissions, adaptation to climate impacts, removal of carbon dioxide (CDR), and Geoengineering by solar radiation modification (SRM).

The model optimizes the deployment of these controls given specific targets, such as keeping the global temperature to under 2.5 degrees of warming or budgetary requirements.
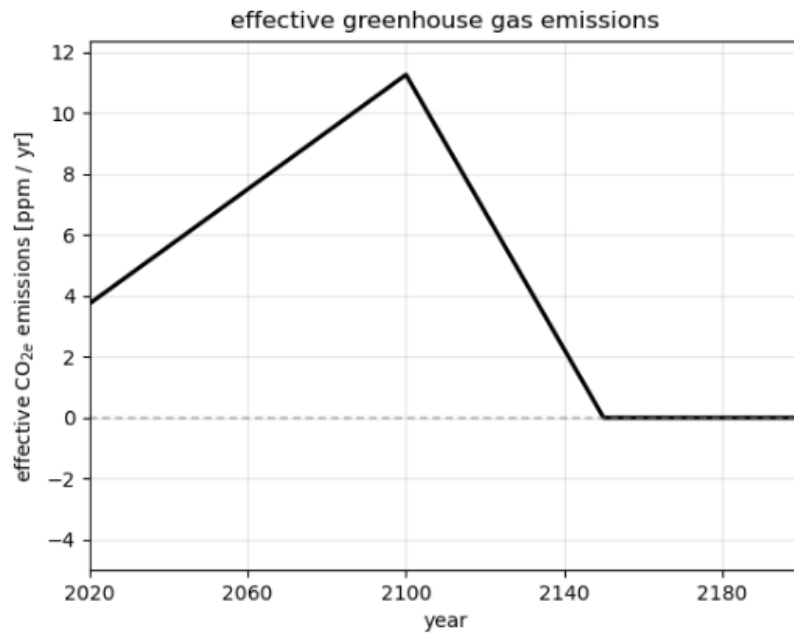
Here's an overview of MARGO's baseline scenario.

The temperature will continue to rise…

Margo Climate Model
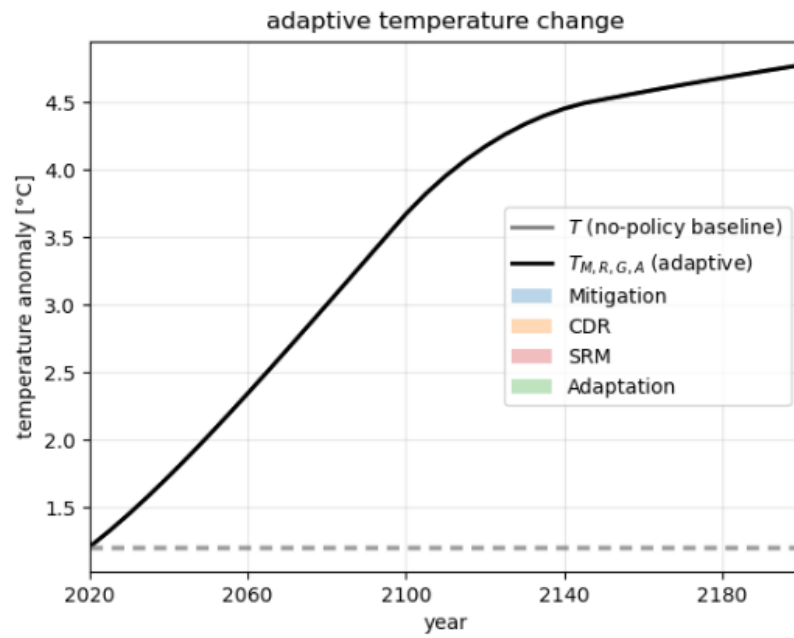
...nd each year we emit more carbon until 2100 when the trend reverses.

As that carbon dioxide is released into the atmosphere some of it will be drawn into natural CO2 sinks, like the ocean, while the rest remains in the atmosphere.

The overall concentration of CO2 in the atmosphere is expected to continue growing.

greenhouse gas concentrations
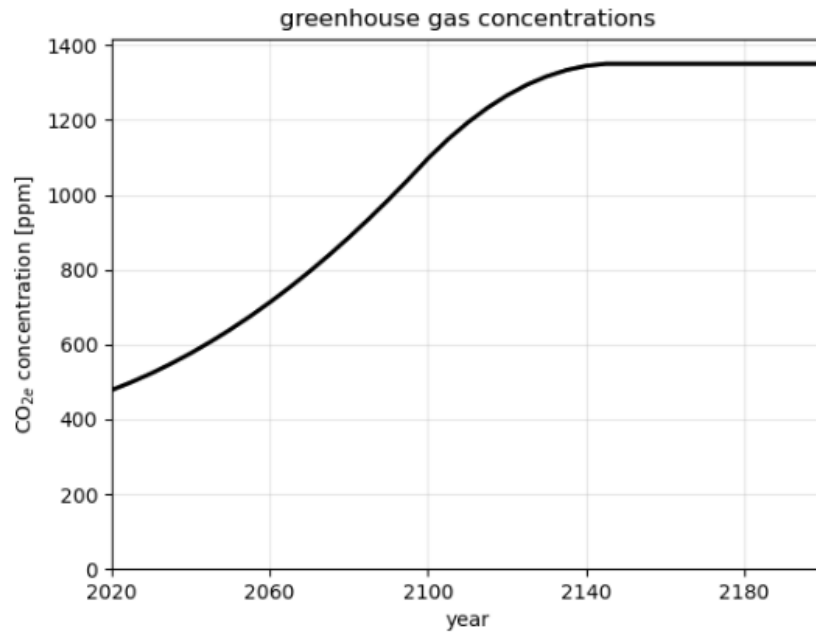
So what should we do? Margo suggests if we want to limit warming to under 2.5 degrees celsius we should deploy the mitigation strategies suggested in the visualization. Most notably, and intuitively, the model suggests our primary option should be mitigation, that is, not putting more CO2 into the atmposphere.

optimized control deployments
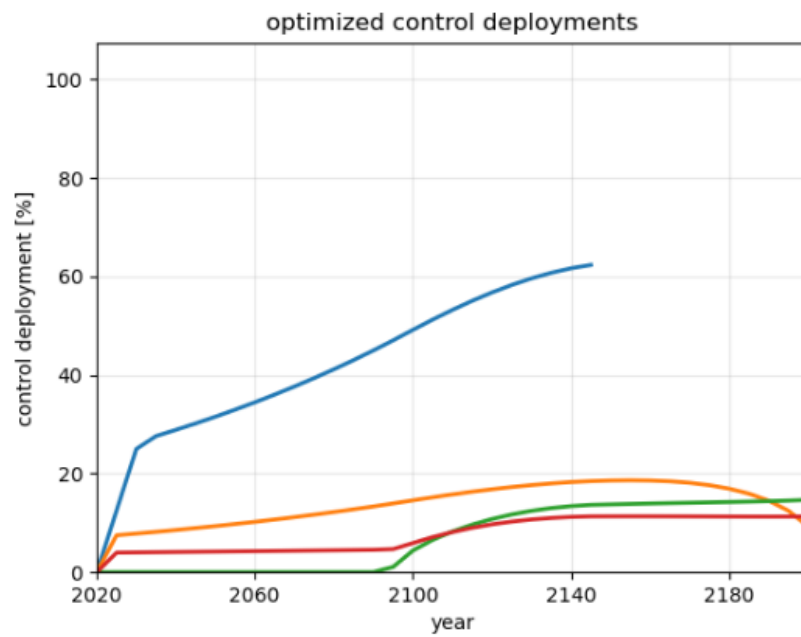
Here's what the emissions curve looks like with those controls in place.

effective greenhouse gas emissions
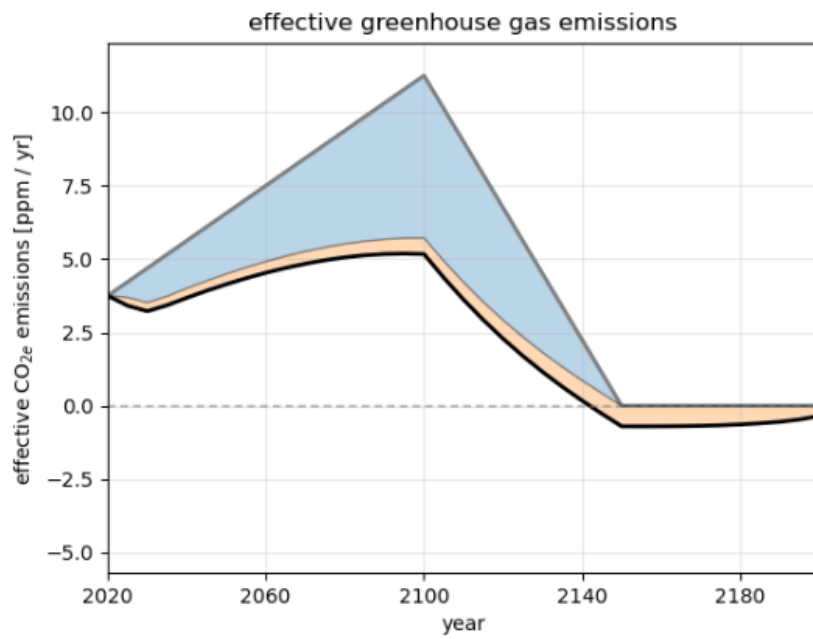
And the effect that each would have on the overall temperature.

adaptive temperature change
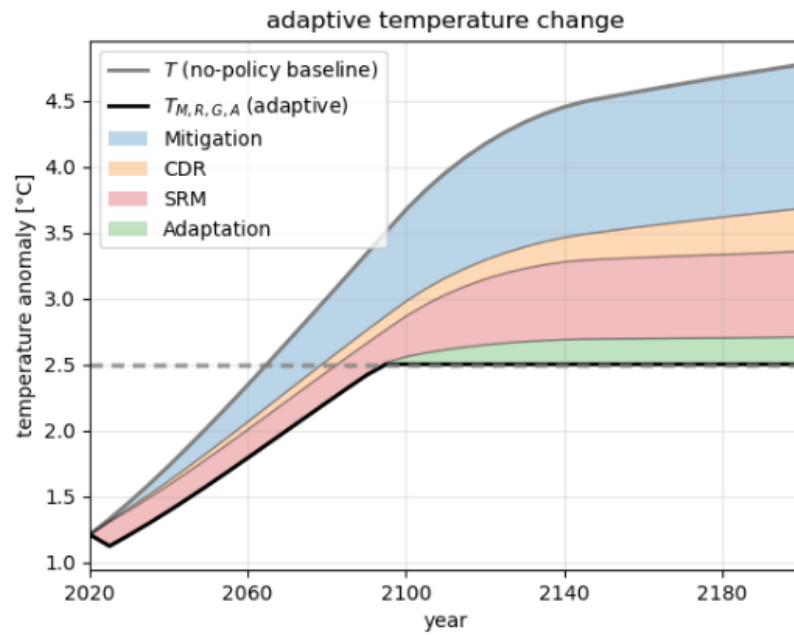
If we want to keep warming lower, say to 1.5 degrees, the amount of emissions reduction needs to increase sharply.

optimized control deployments
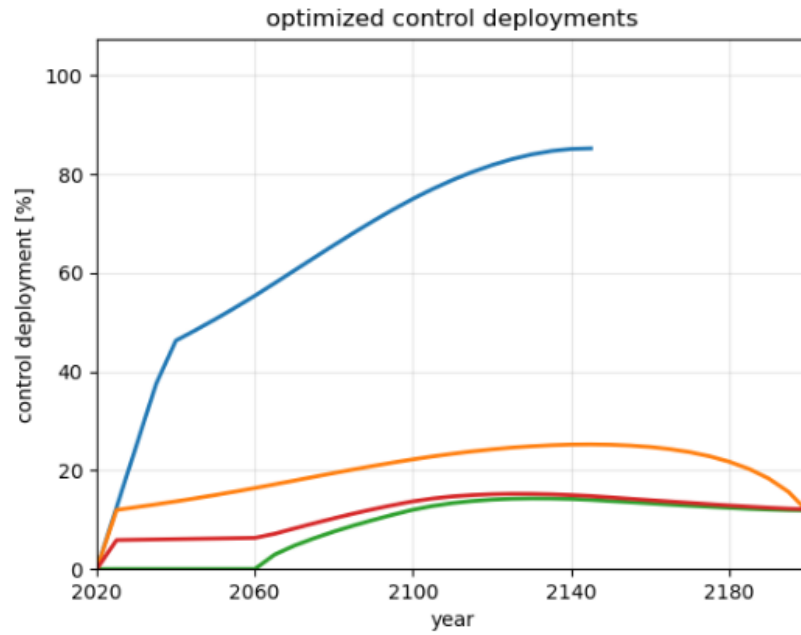
Now, you can see the entire model output. You can also change what exactly MARGO optimizes for. Optimizing for net-benefit considers the cost-benefit analysis; optimizing for temperature is optimizing only for limiting the warming under a certain temperature, while optimizing for `adaptiv_temp` is a slightly looser constraint that allows for adaptation to higher temperature.

Explore the Margo Climate Model
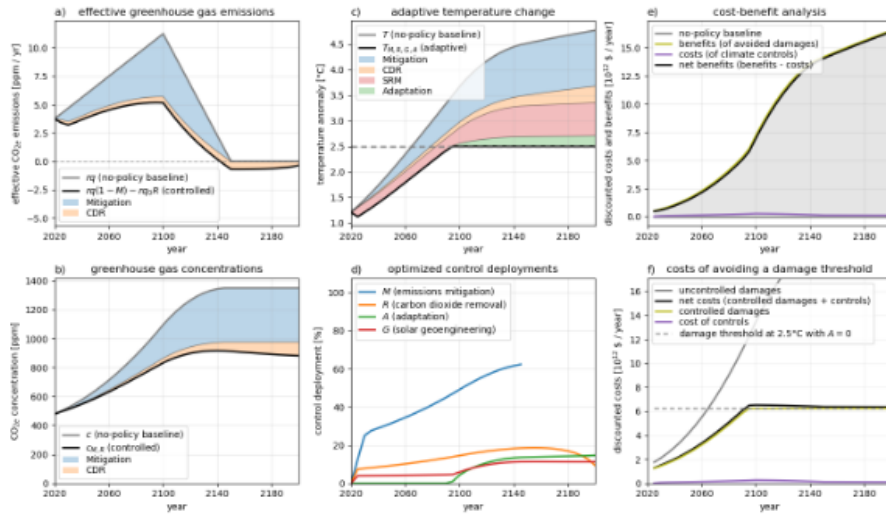
▶ Parameters

Use the controls to see what MARGO suggests is the best path to limiting warming to a specific temperature.
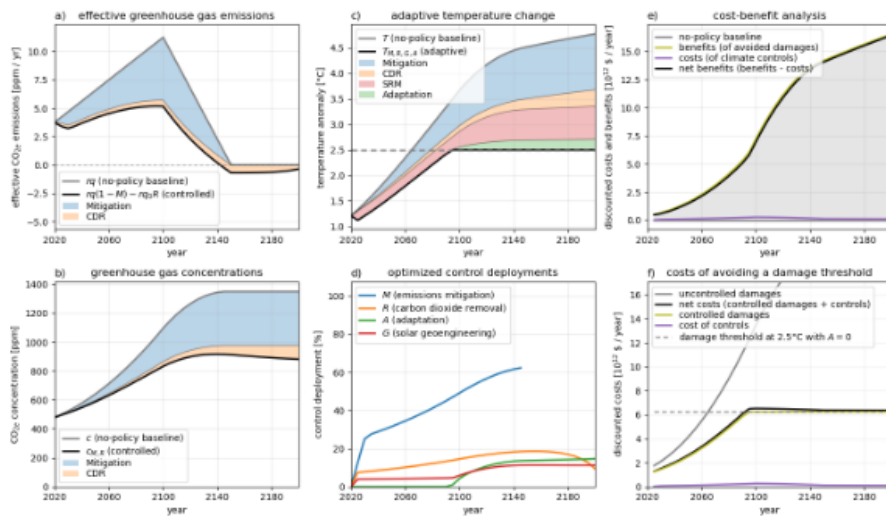
References

1. A multi-control climate policy process for a trusted decision maker, Drake, Henri F and Rivest, Ronald L and Deutch, John and Edelman, Alan. 2020.