PROBABILISTIC CLIMATE PROJECTIONS

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Uncertain about uncertainty?

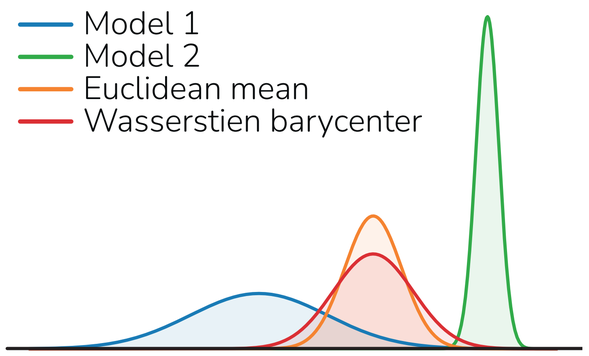
Why do we care about uncertainty?

- To communicate risk properly
- To better understand future outcomes
- Our current methods don't fully capture uncertainty

Why is the current ensembling standard (a multi-model mean) flawed?

A Euclidean mean (the multi-model mean) is not designed to properly capture uncertainty, as it considers points not distributions. It also wrongly assumes that climate models are independent and equally good.

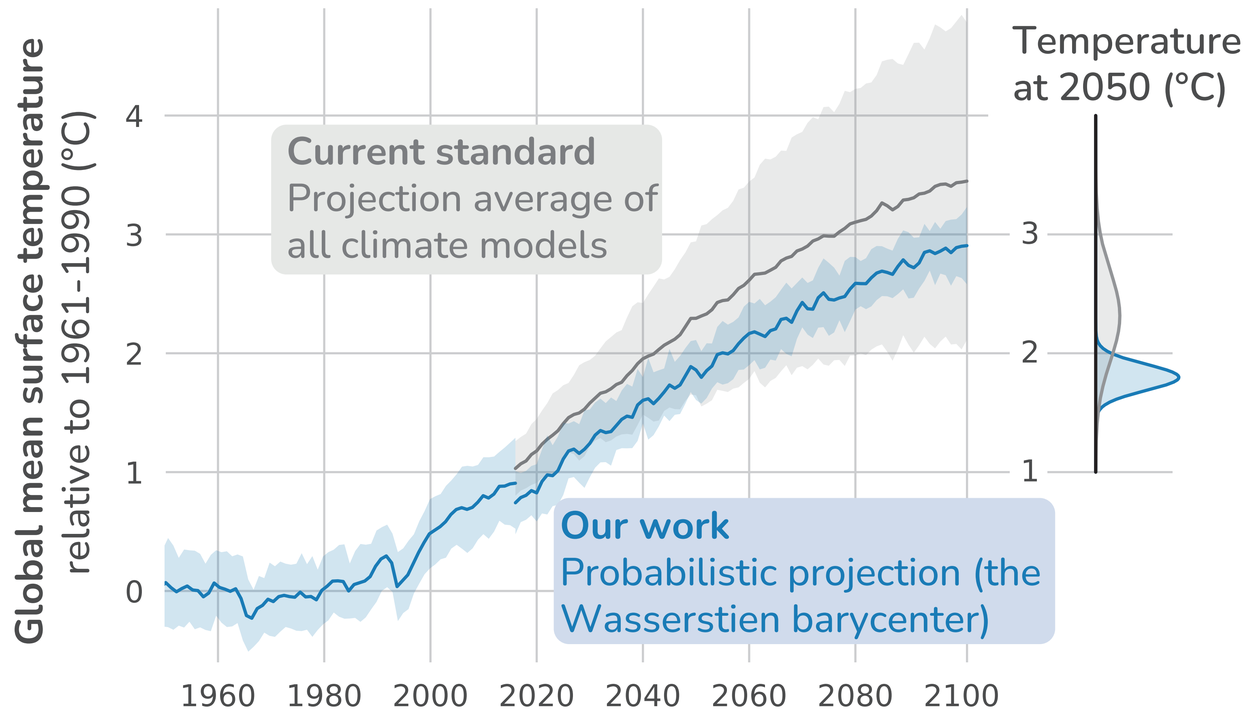
To average under the posteriors' uncertainty when ensembling models we can instead use a **Wasserstien Barycenter.** This probabilistically averages distributions.



See how the Wasserstien barycenter gives us a different 'average distribution', compared to the Euclidean (multi-model) mean.

1.5 - 2.2°C ***global temperature increase by 2050 using SSP245***
(95% credible interval)

Our method reduces the size of the credible interval



Definitions:

SSP245: A set of runs from multiple climate models, assuming a moderate climate scenario and medium greenhouse gas emissions.

Ensemble: A set of comparable simulations from multiple models.

Wasserstien Barycenter: The average probability distribution. More technically, the distribution which minimises the Wasserstien distance between itself and all other distributions.

The details...

1. Emulating climate models

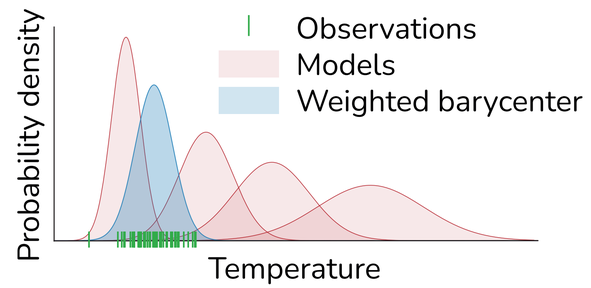
Climate models simulate multiple *realisations* to estimate the uncertainty in their projections.

We emulate the output of each climate model with a Gaussian process. This captures the *mean* and *standard deviation* of each model.

2. Weighting climate models

Once we have model posteriors (Gaussian processes) we construct weights for each model over an historic period (1850-2014) for which there are observations. Weights are calculated by finding the log-likelihood of the observations under each of the models' posterior distribution.

3. Aggregating climate models



We find the Wasserstien barycenter of all the models, using the weights found above.