A coupled social-climate model with country-level structure

Amrita Punnavajhala (PhD candidate)
Co-supervised by Drs. Chris Bauch and Madhur Anand

UNIVERSITY OF WATERLOO | FACULTY OF MATHEMATICS
Department of Applied Mathematics

Overview

Coupled social-climate models

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Coupled social-climate model with country-level structure: what and why

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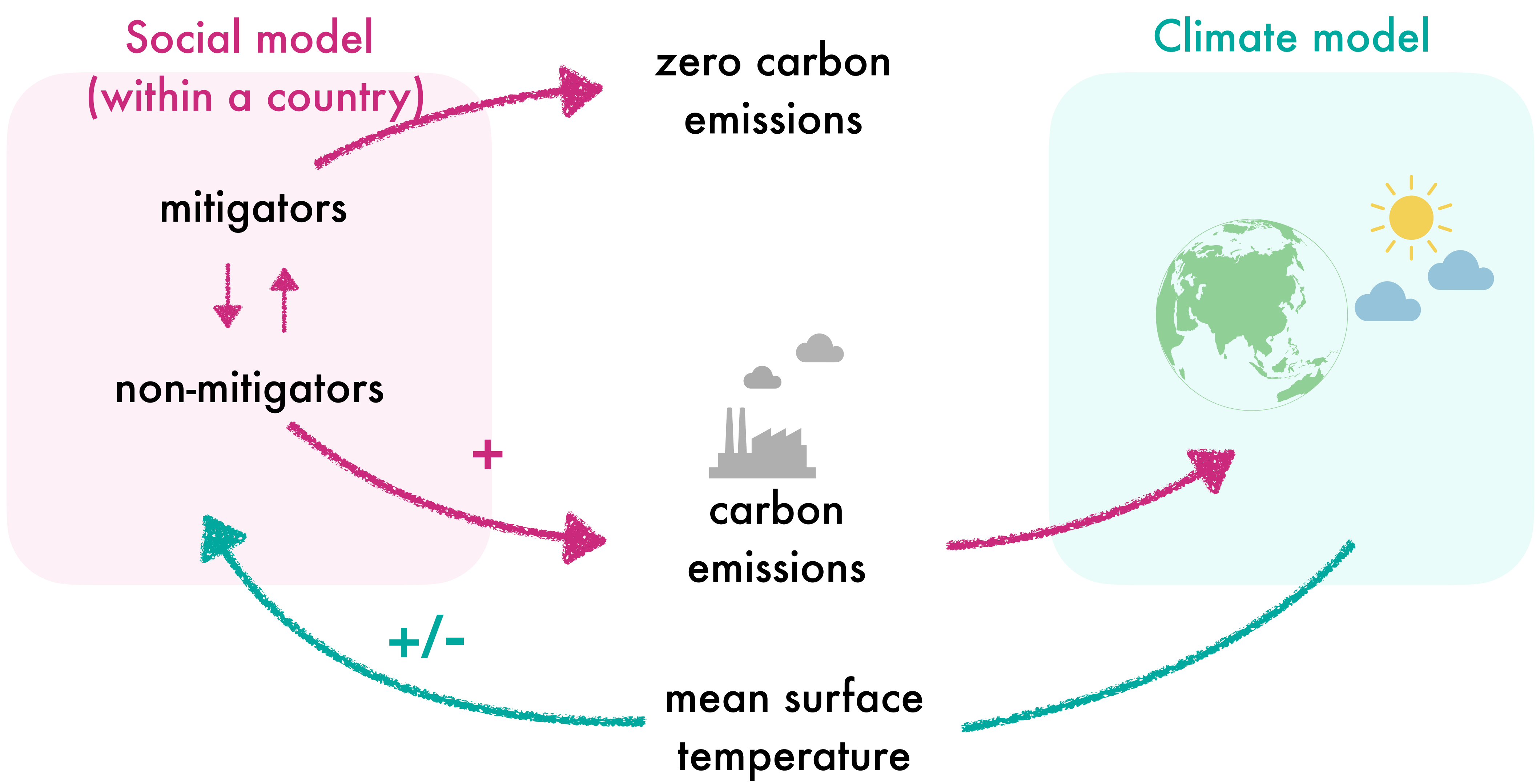
Results

Coupled social-climate models: mathematical models of climate change that account for two-way feedback between social dynamics and climate change

1. They show us how social dynamics can alter climate change projections
2. They predict outcomes not seen in isolated climate models
3. They provide a quantitative backing to psychological and sociological theories of climate change mitigation

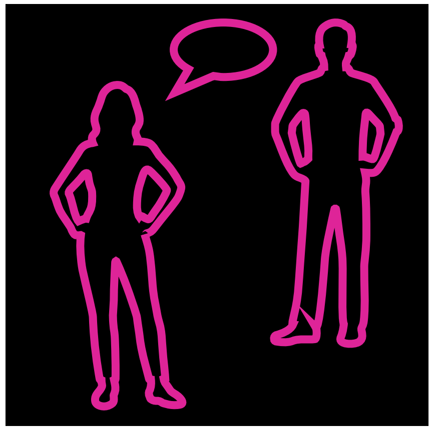

Social model
(within a country)
zero carbon
emissions
Climate model
mitigators
non-mitigators
+
carbon
emissions
+/-
mean surface
temperature

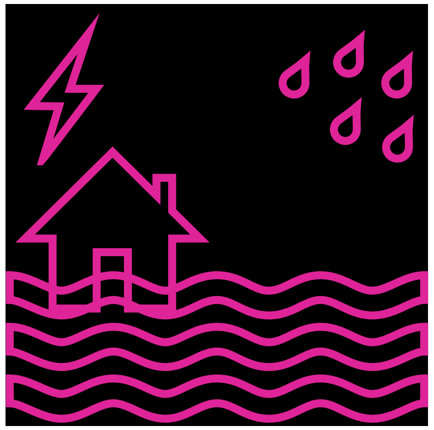
Why country-level structure?

- Realistic representation of the world
- Heterogenous human behaviour
- Country-specific policy interventions
- Can be scaled up
- Data available easily (relatively)

What influences behaviour?

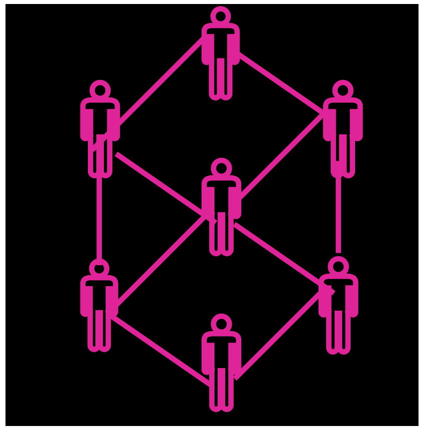
Social learning





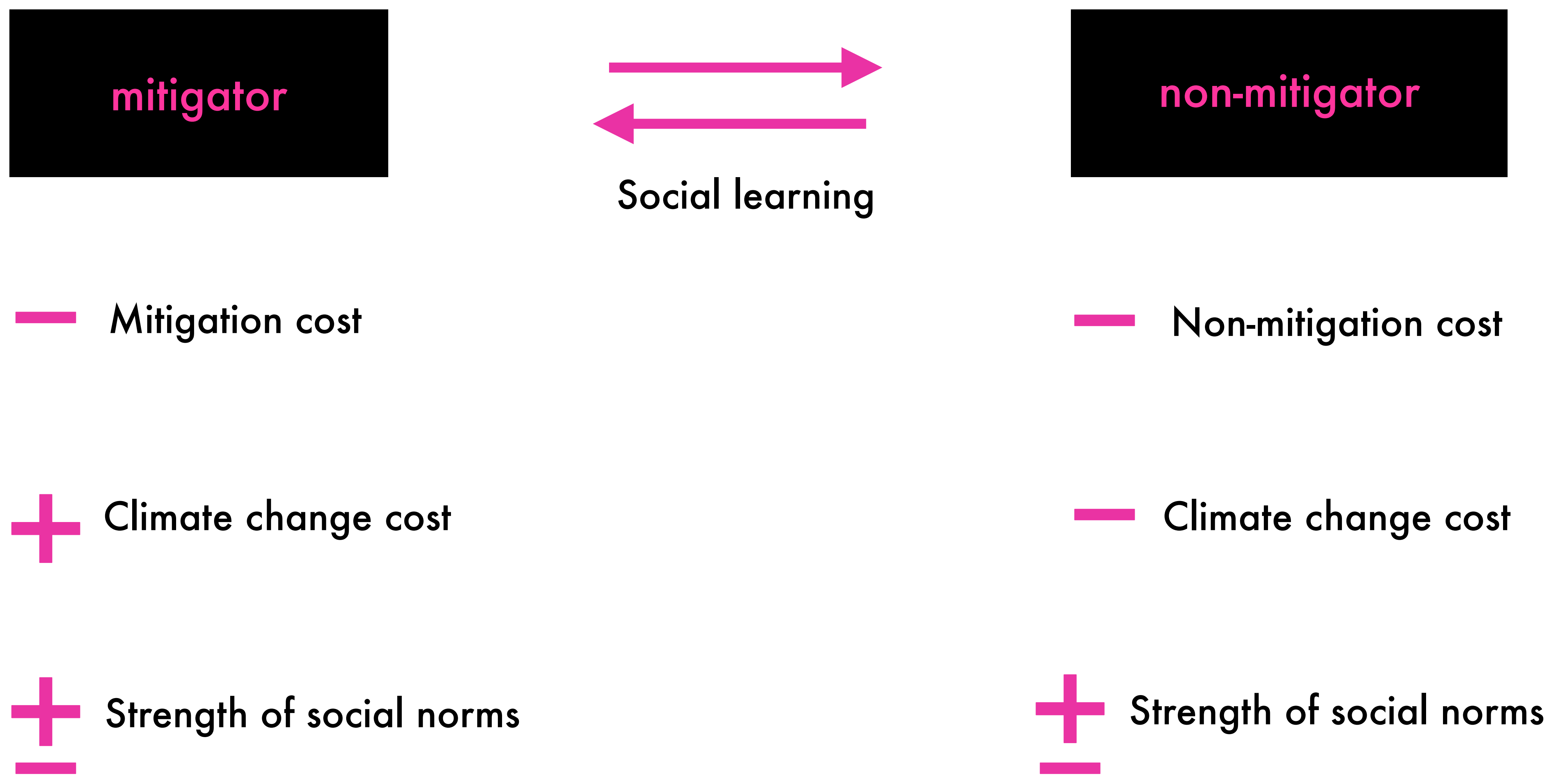
(Perceived) cost of climate change

Social norms



Cost of mitigation

You can choose either to be a ‘mitigator’ or ‘non-mitigator’



Model equations

$$\frac{dx_i}{dt} = \kappa_i x_i(1 - x_i)[-1 + f_i(T_f) + \delta_i(2x_i - 1)]$$

$$\frac{dC_{at}}{dt} = \sum_i [\epsilon_i(t)(1 - x_i)] - P(C_{at}, T) + R_{veg}(T, C_{veg}) + R_{so}(T, C_{so}) - F_{oc}(T, C_{at}, C_{oc})$$

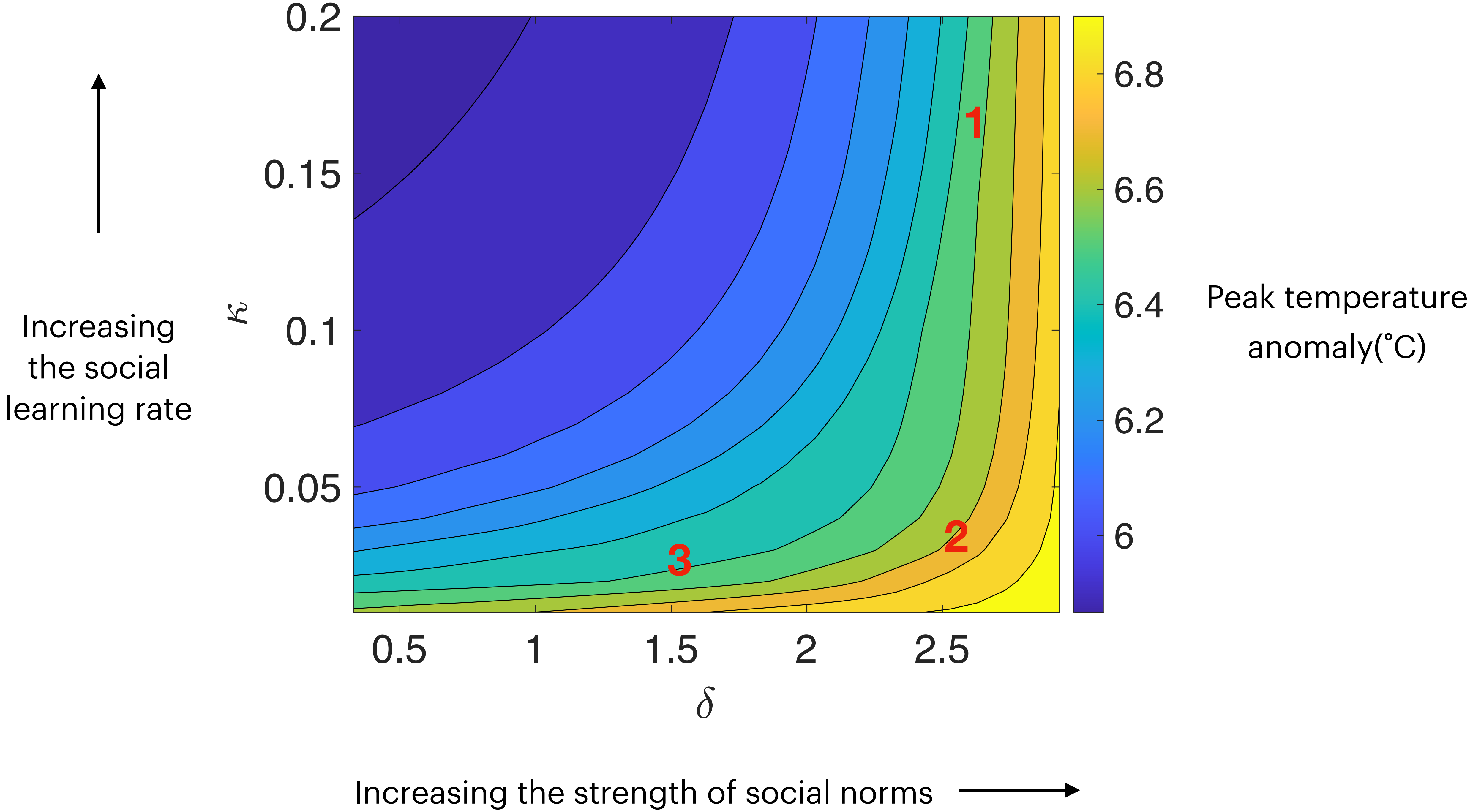
$$\frac{dC_{oc}}{dt} = F_{oc}(T, C_{at}, C_{oc})$$

$$\frac{dC_{veg}}{dt} = P(C_{at}, T) - R_{veg}(T, C_{veg}) - L(C_{veg})$$

$$\frac{dC_{so}}{dt} = L(C_{veg}) - R_{so}(T, C_{so})$$

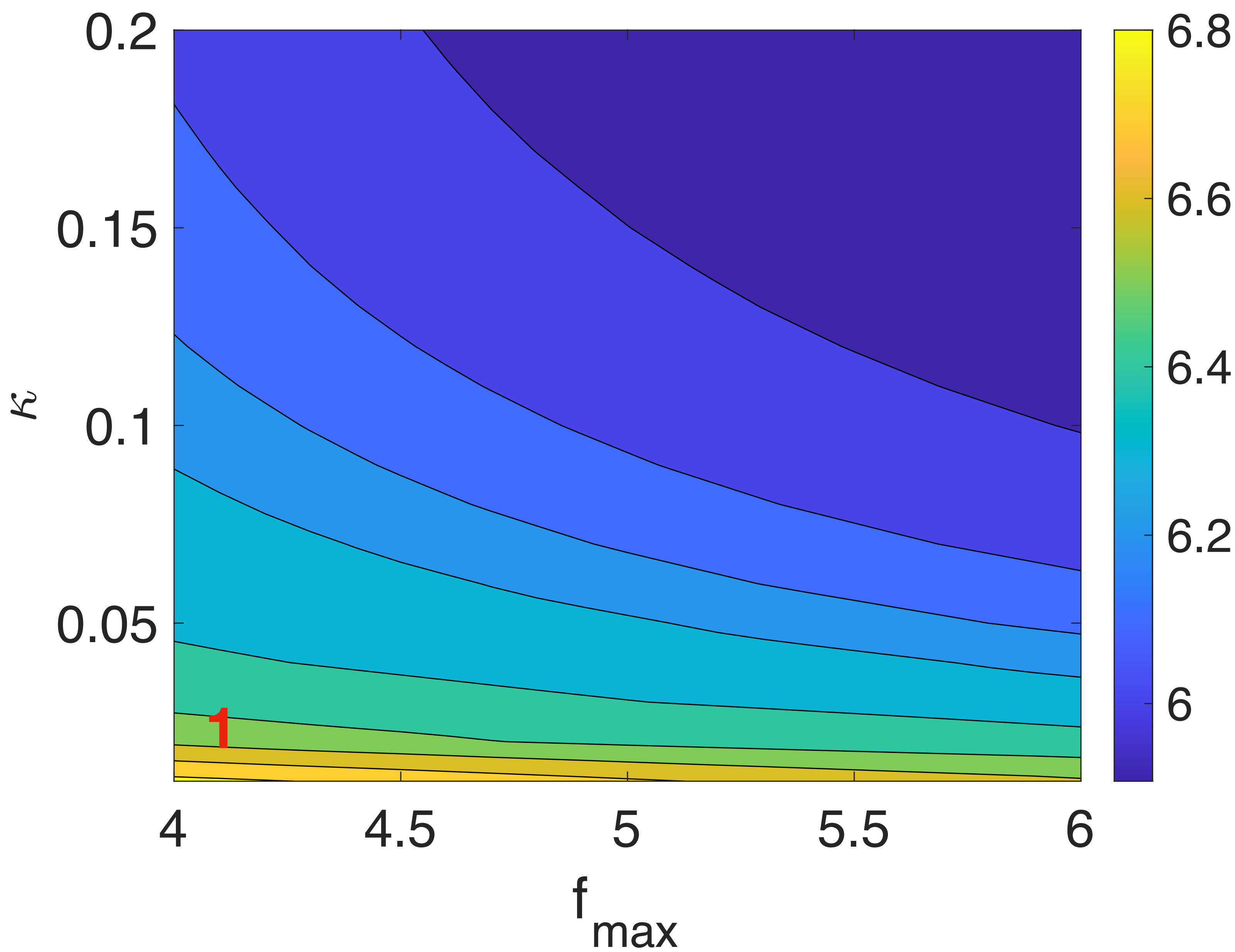
$$\frac{dT}{dt} = \frac{a_E[(F_d(C_{at}, T) - \sigma(T + T_0)^4]}{C}$$

Learning vs norms



Learning vs climate change cost

Increasing the social learning rate



Peak temperature anomaly(°C)

Increasing the max cost of climate change

Conclusions

- The best mitigation strategy depends on where we're starting from
- This starting point could look very different for different countries
- Social/behavioural interventions can significantly impact the peak temperature anomaly