

Recent IAM studies focus on limited uncertainty sources regarding physical climate. We probed the uncertainties arising from physical and biogeochemical sources using sets of parameters and illustrated the significance of climate uncertainties in assessments of climate policies. We found that Carbon prices in 2100 are 482^{+250}_{-301} USD(2005)/tCO₂ and 713^{+301}_{-215} USD(2005)/tCO₂ for 2 °C and 1.5 °C targets, respectively.

Introduction

- The Paris Agreement aims at keeping the global temperature rise this century well below 2 °C relative to pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C.
- Considerable uncertainties surround IAMs regarding both socioeconomics and climate science.
- Recent IAM studies focus on limited uncertainty sources regarding physical climate.

Methodologies

- Model framework

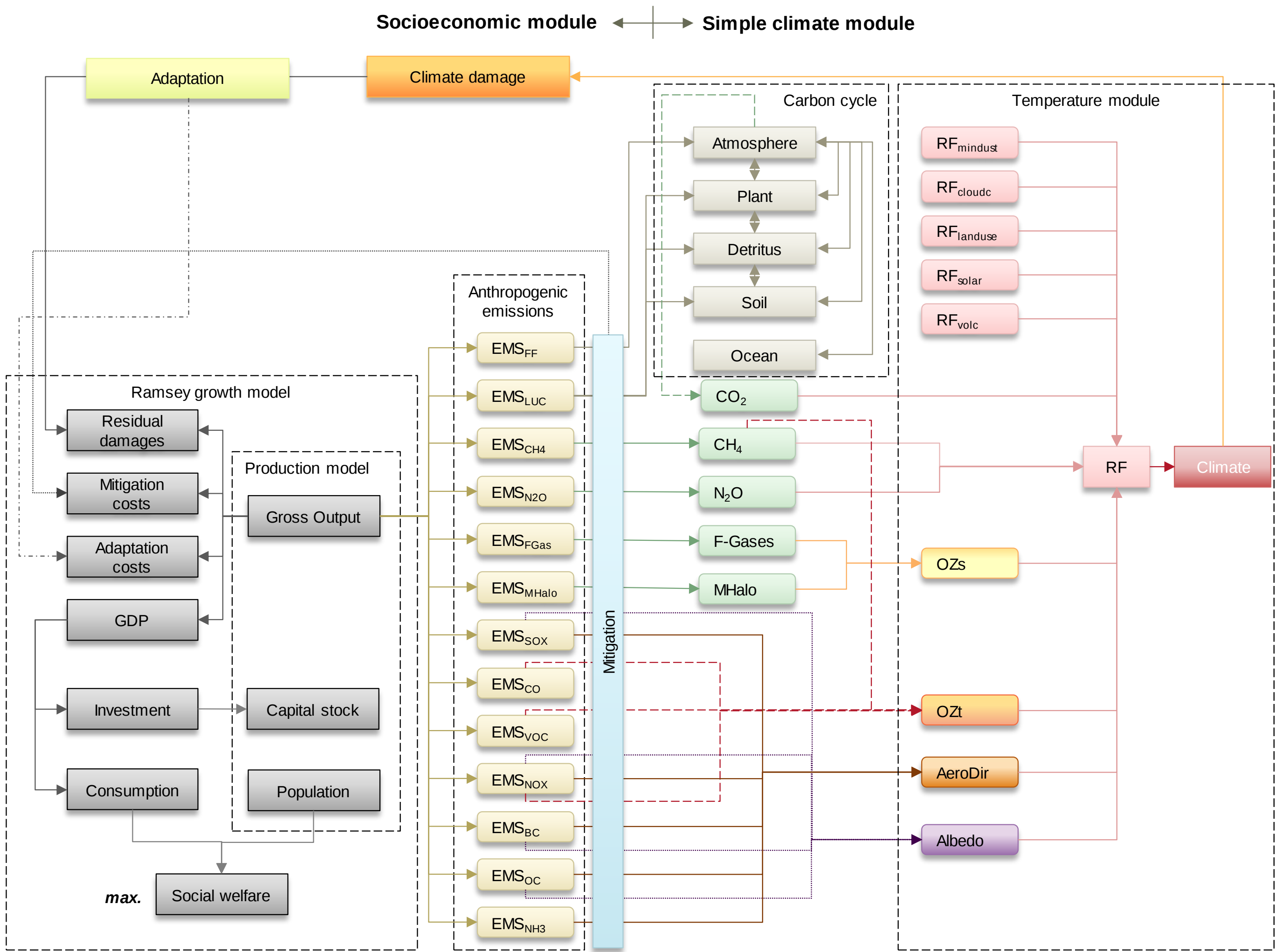


Figure 1: **SCM4OPT model structure.** AeroDir: direct forcing effects from aerosols; cloudc: cloud cover; FF: Fossil fuels; LUC: land use change; MHalo: Montreal Protocol gases; mindust: mineral dust; OZs: stratospheric ozone; OZt: tropospheric ozone; RF: radiative forcing; volc: volcanic.

- Simulation of climate uncertainties

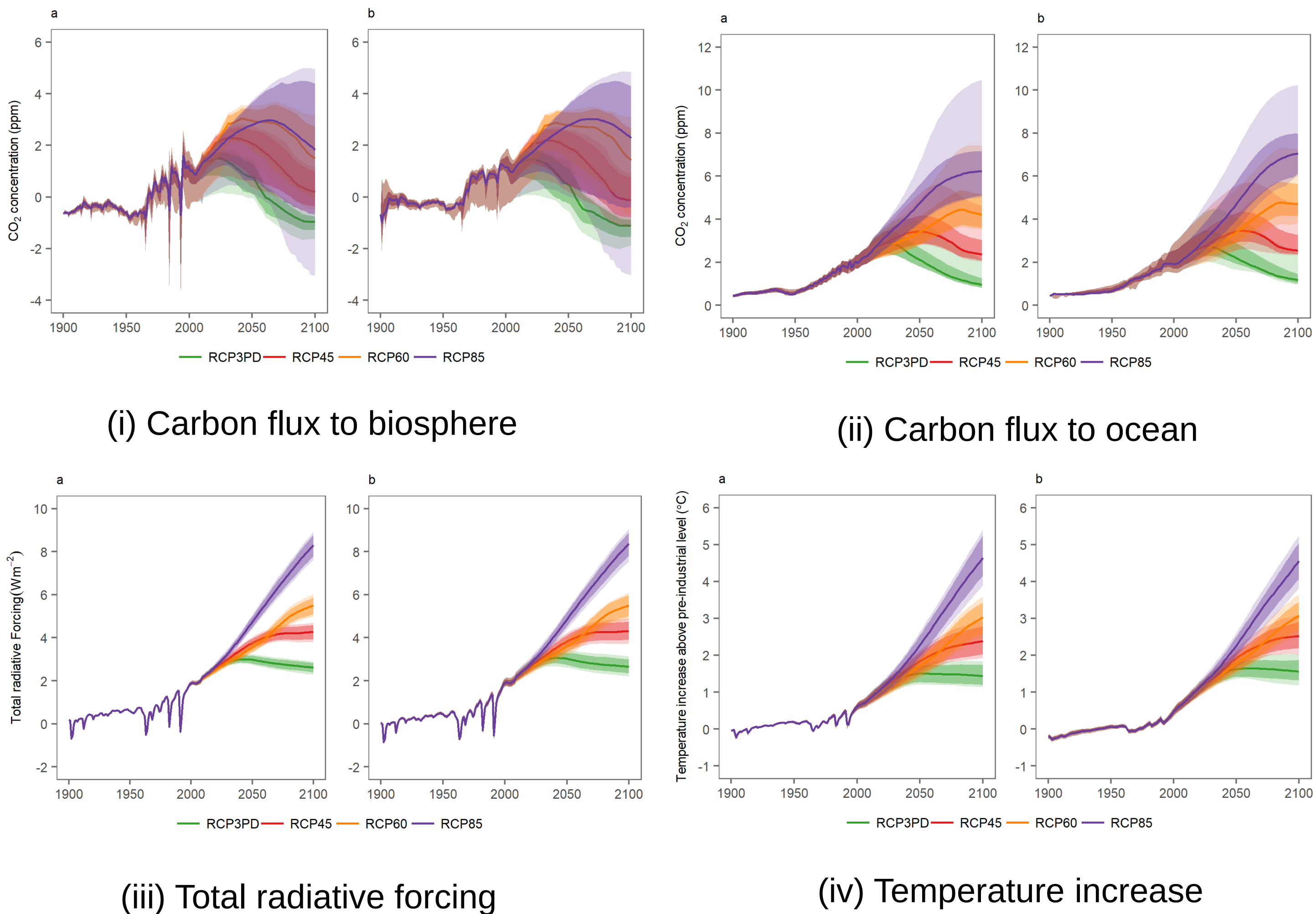


Figure 2: **Climate simulation between MAGICC 6.0 (a) and SCM4OPT (b), using 4 RCPs.**

- Definition of likelihood
 - Median: the median of the probability distribution;
 - Likely: 66% probability or the percentile of 17%-83%;
 - Extremely likely: 95% probability or the percentile of 2.5%-97.5%.

Results

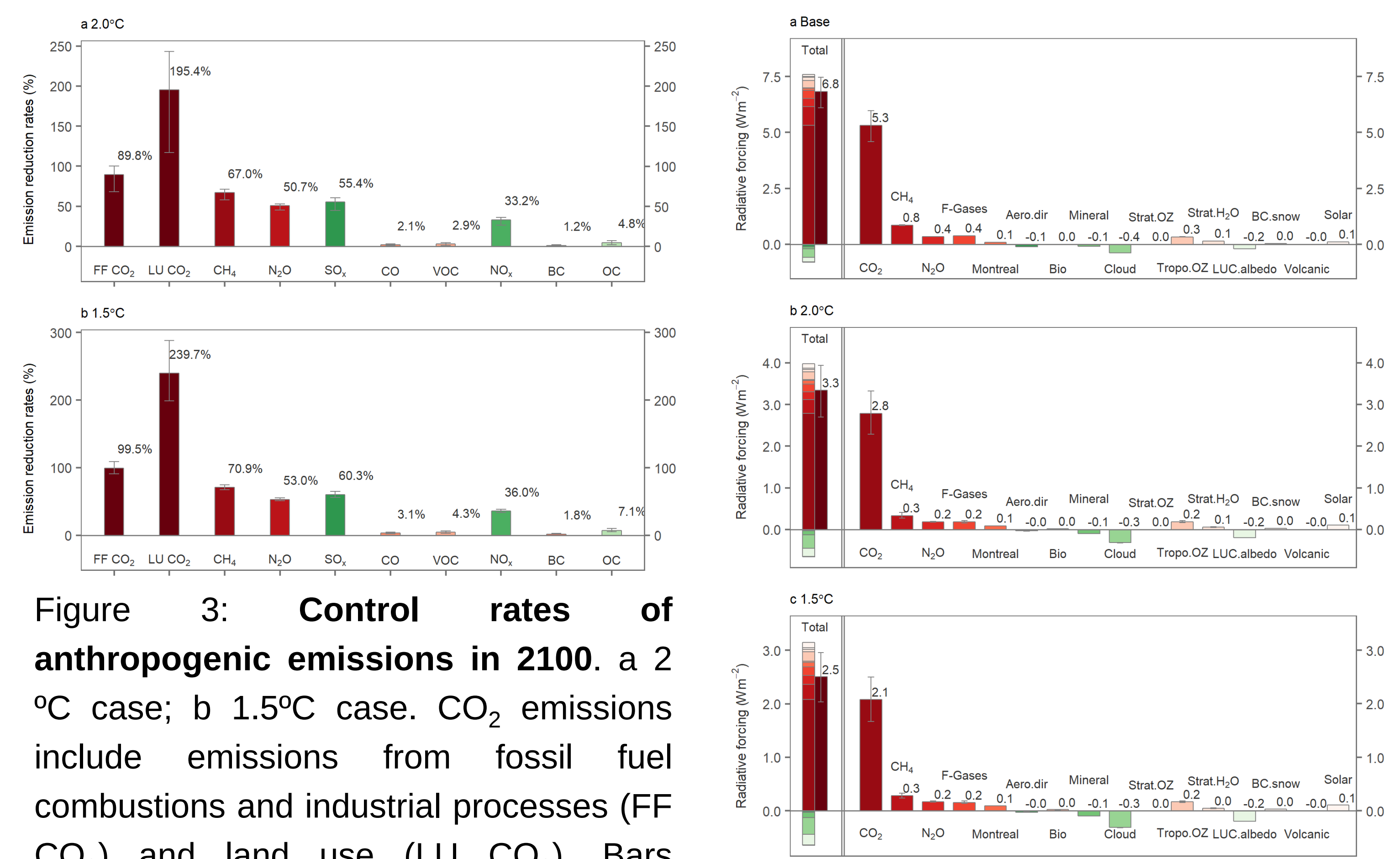


Figure 3: **Control rates of anthropogenic emissions in 2100.** a 2 °C case; b 1.5°C case. CO₂ emissions include emissions from fossil fuel combustions and industrial processes (FF CO₂) and land use (LU CO₂). Bars indicate median estimates; lower and upper bounds of the error bars are 17%-83% percentiles.

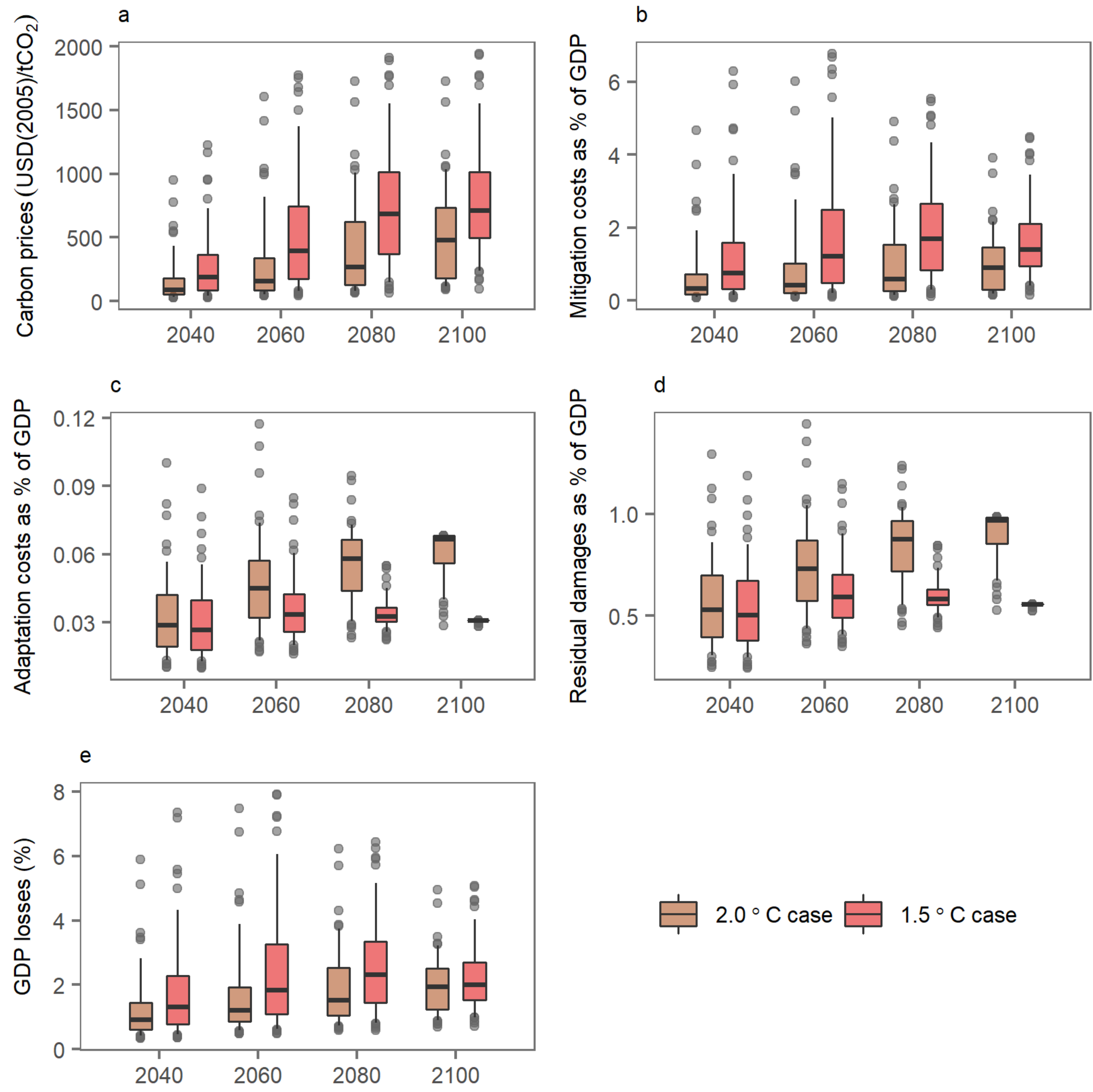


Figure 4: **Radiative forcing in 2100.** a Base case; b 2 °C case; c 1.5°C case.

Figure 5: **Economic costs of climate change.** a Carbon prices. b Mitigation costs. c Adaptation costs. d Residual damages. e GDP losses. Middle horizontal lines are medians; Ranges between lower and upper hinges show likely probabilities (17%-83% percentiles); Points represent outliers beyond likely ranges.

Conclusions

- The results illustrated the significance of climate uncertainties in the assessments of climate policies.
- The climate uncertainties lead to a difference of 20.5 GtCO₂ in 2100 CO₂ emission levels for 2 °C target, and 12.0 GtCO₂ for 1.5 °C target.
- The climate change costs are significantly affected by the climate uncertainties. To achieve 2 °C target, the carbon price is 482^{+250}_{-301} USD(2005)/tCO₂ in 2100, and 713^{+301}_{-215} USD(2005)/tCO₂ for 1.5 °C target. The GDP losses in 2100 is estimated to be $1.9^{+0.6}_{-0.7}$ % of total gross output for the 2 °C target, and $2.0^{+0.7}_{-0.5}$ % for the 1.5 °C target.