Mitigation policy cost and Uncertainty

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Motivation

Uncertainty and climate change

- Uncertainty about the response of the climate system and its consequences on the natural and human processes is wide.
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But mitigation costs are also uncertain

- Uncertainty of mitigation costs is wide and is increasing over time (Lemoine & McJeon, 2013; Drouet *et al.*, 2015).
- This has an important implication when taking decision under uncertainty:
  - ▷ Stringent policy implies a risk of a very costly mitigation.

Current knowledge on mitigation costs

IPCC AR5 scenario database

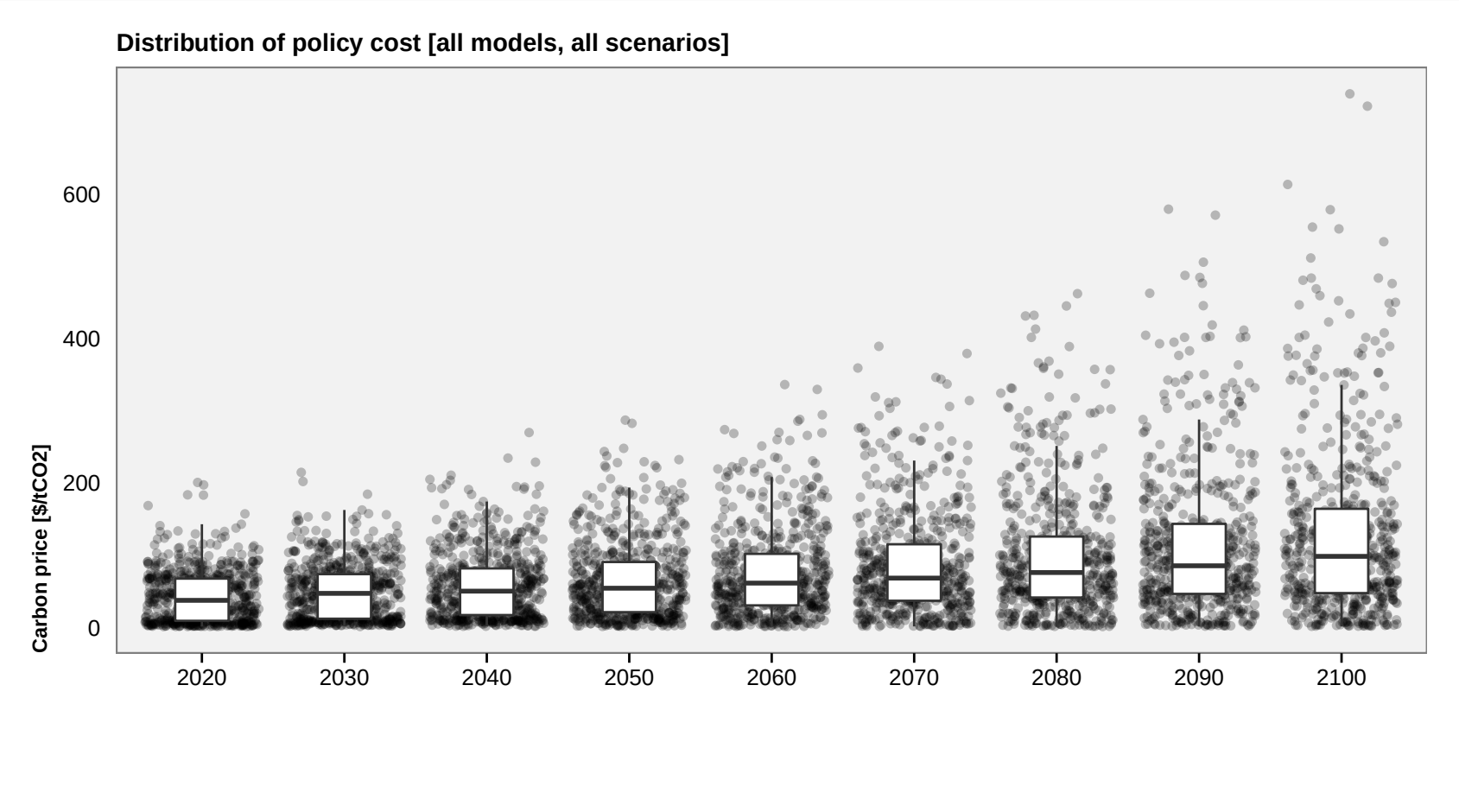
- created for the IAMC and is hosted by IIASA
- model outcomes reviewed by the AR5 WGIII of IPCC
- publicly available at

  `https://secure.iiasa.ac.at/web-apps/ene/AR5DB`

Dataset description

- 25’000 mitigation costs
- 9 model intercomparison projects
- time range: 2020–2100 (every 10 year)
- model versions [19]
- scenarios [157]

IPCC AR5 mitigation costs



Research question

What are the main drivers of uncertainty of our current knowledge of the climate change mitigation costs?

Main components

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Note

By construction, these components are not fully independent.

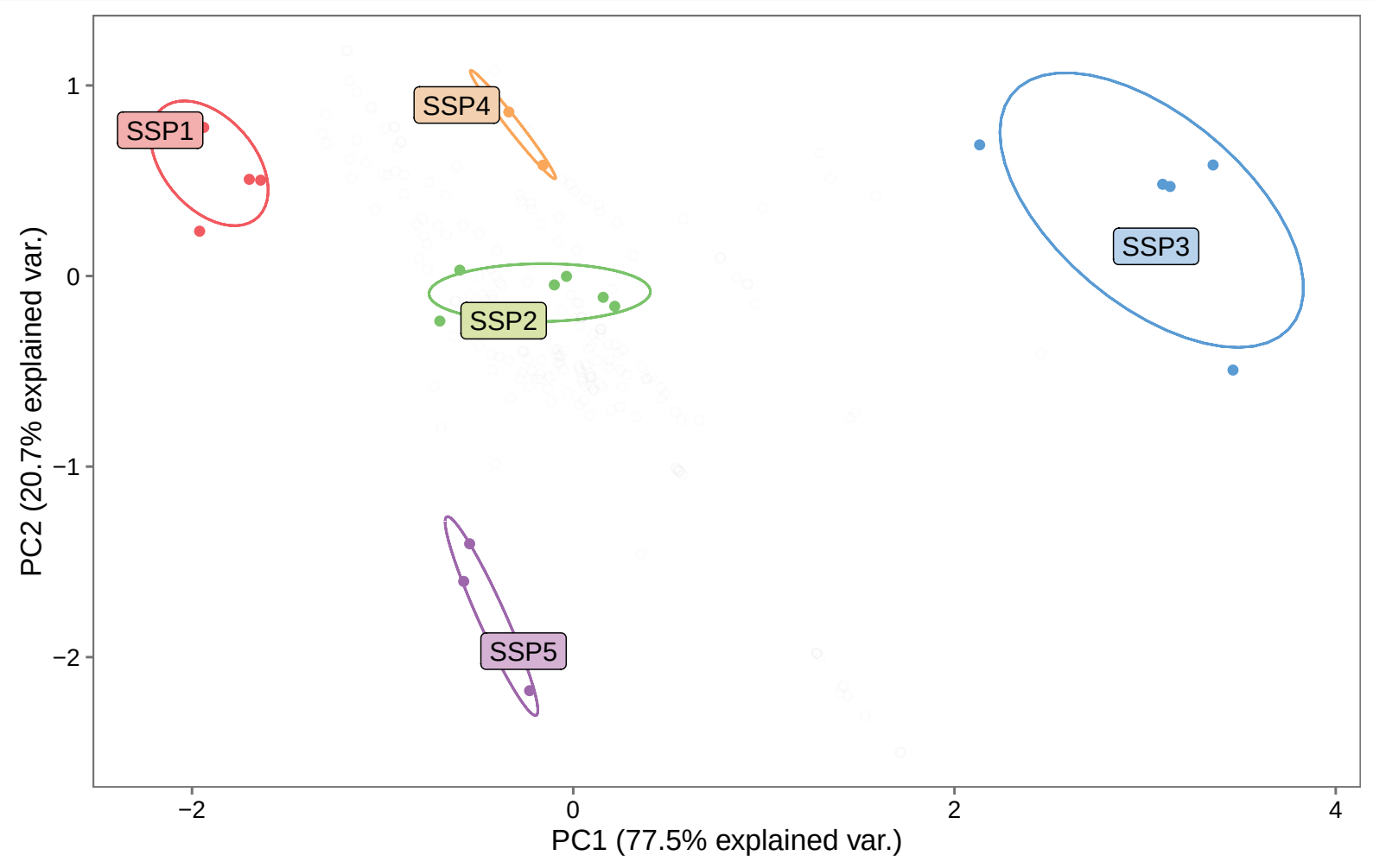
Baseline

Socio-economic pathways

The Shared Socio-economic Pathways (SSP)

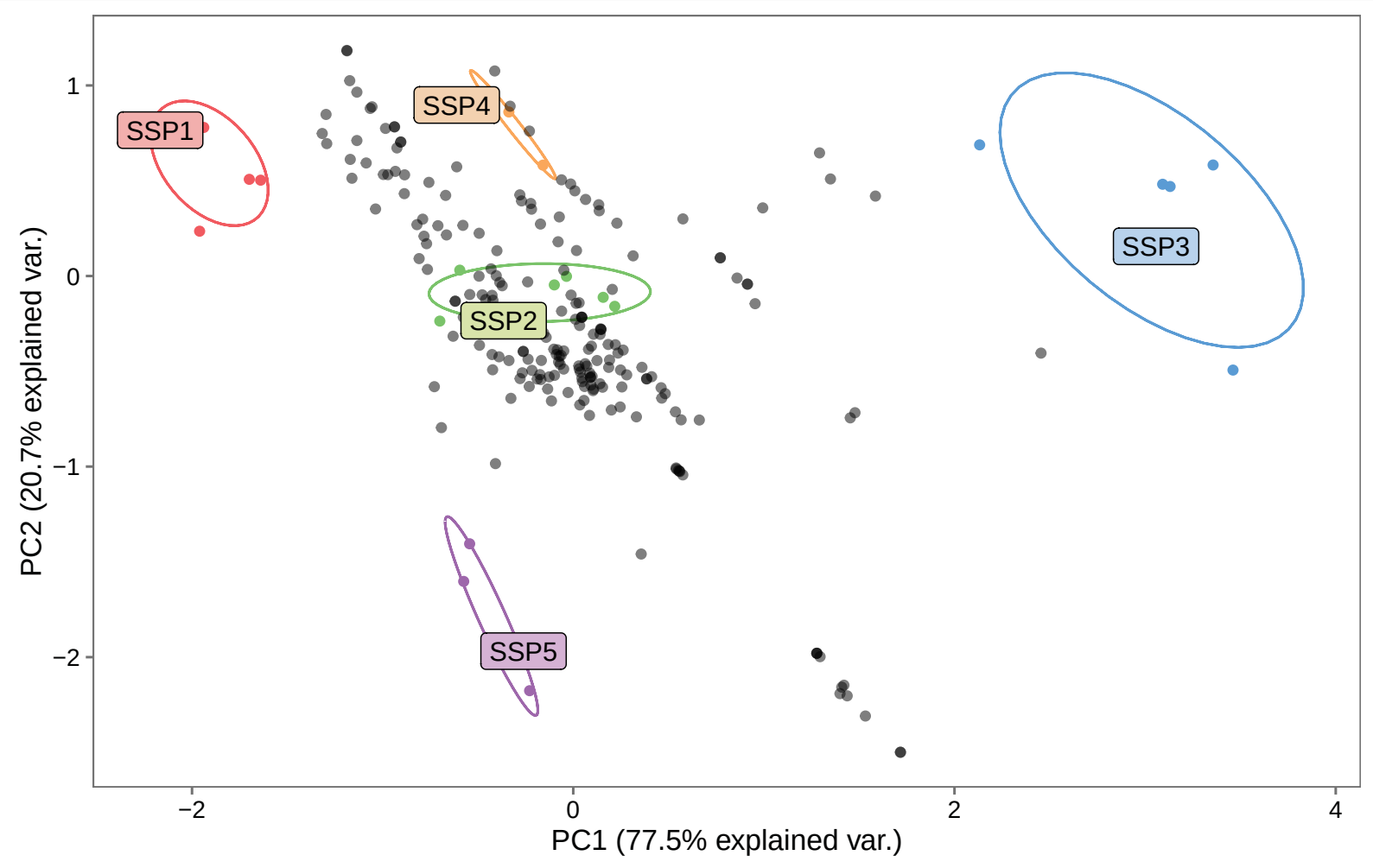
- The 5 narratives have been recently quantified by 6 models (Riahi *et al.*, 2016) and collected into the SSP database.
- We characterize the AR5 baseline scenarios with this new dataset.

SSP attribution



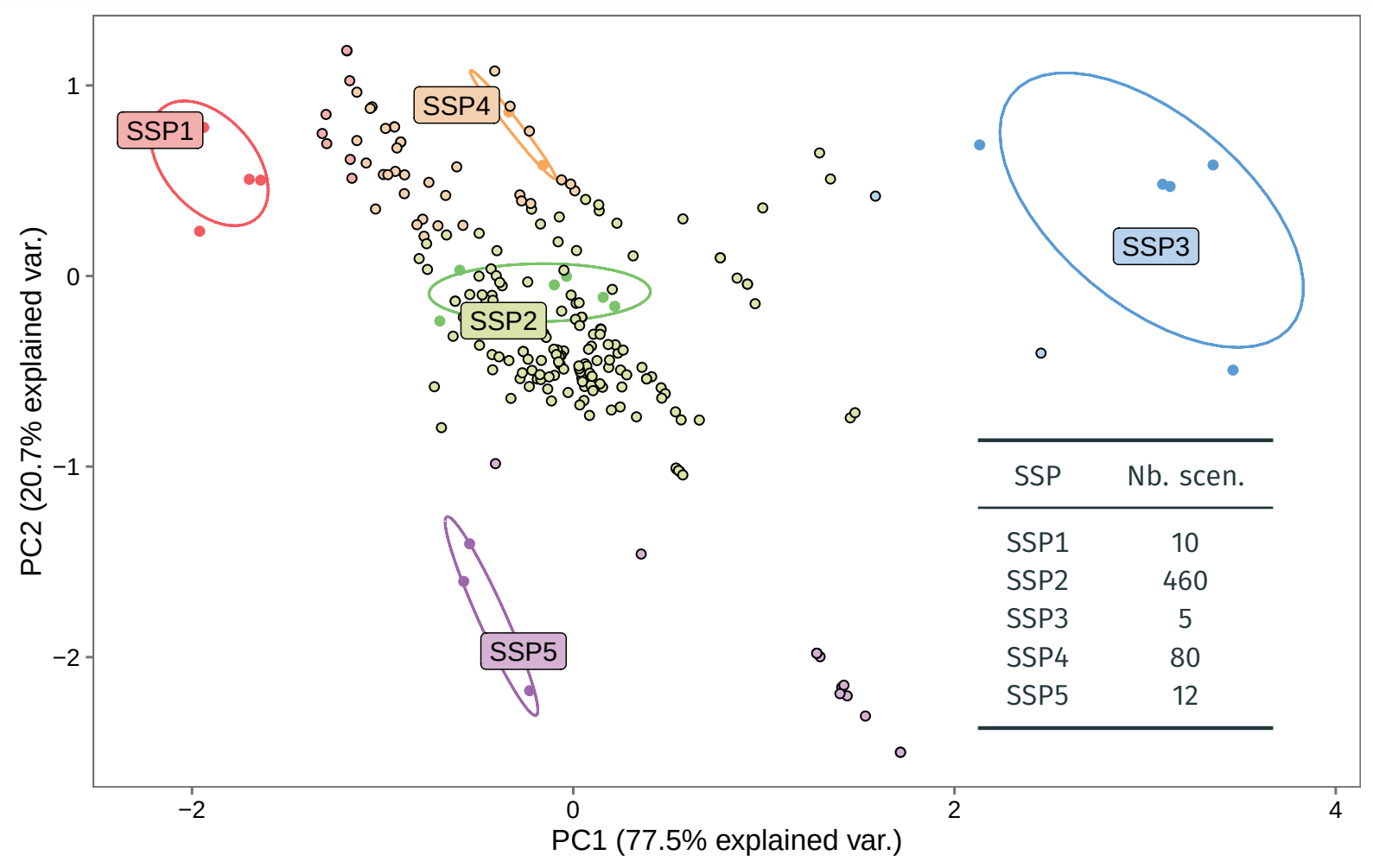
PCA on SSP reference scenarios using cumulative emissions, carbon intensity, energy intensity at world and region levels.

SSP attribution



Projection of the AR5 baseline scenarios: most of them are close to the SSP2 and SSP4 clusters.

SSP attribution



SSP	Nb. scen.
SSP1	10
SSP2	460
SSP3	5
SSP4	80
SSP5	12

Association of the AR5 scenarios to the SSPs.

Correlation ratio

Correlation ratio

How much of the variations in Y (mitigation cost) can be explained by the variations in a driver X_i, where $Y = Y(X_1, X_2, \ldots, X_n)$?

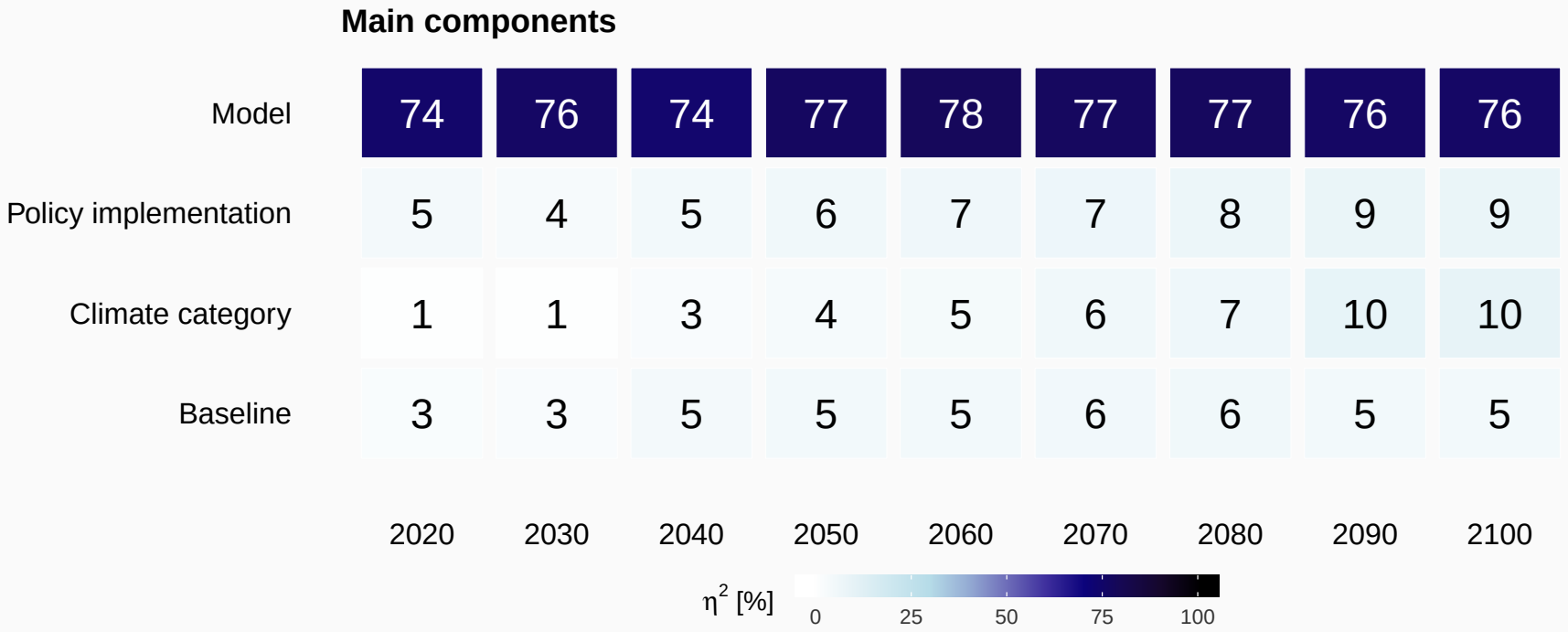
Correlation ratio η^2 (Pearson, 1926)

$$\eta^2(Y|X_i) = \frac{Var(E[Y|X_i])}{Var(Y)}$$

Based on the law of total variance, the correlation ratio does not require that the variables are independent or identically distributed.

Law of total variance: $Var(Y) = E(Var[Y|X_i]) + Var(E[Y|X_i])$

Uncertainty decomposition — Main components



Correlation ratio for mitigation costs expressed in $/tCO2

Uncertainty decomposition – Model

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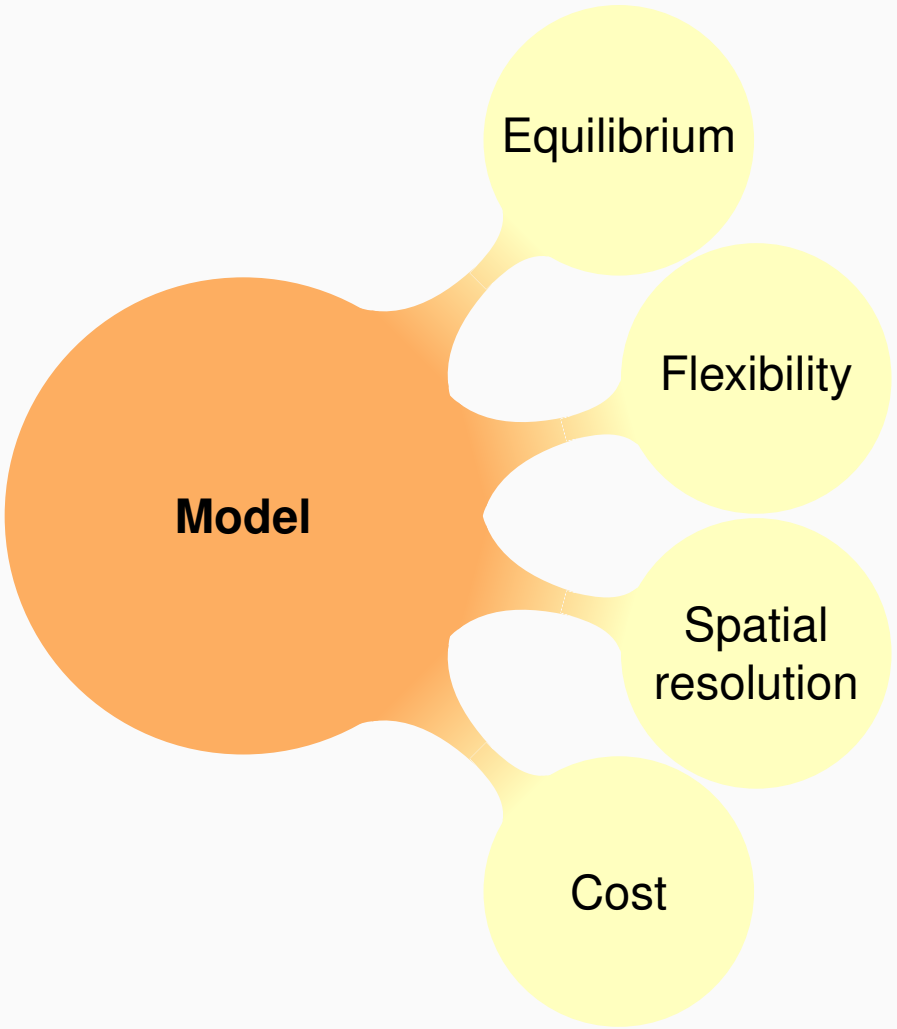
Model

Model characteristics



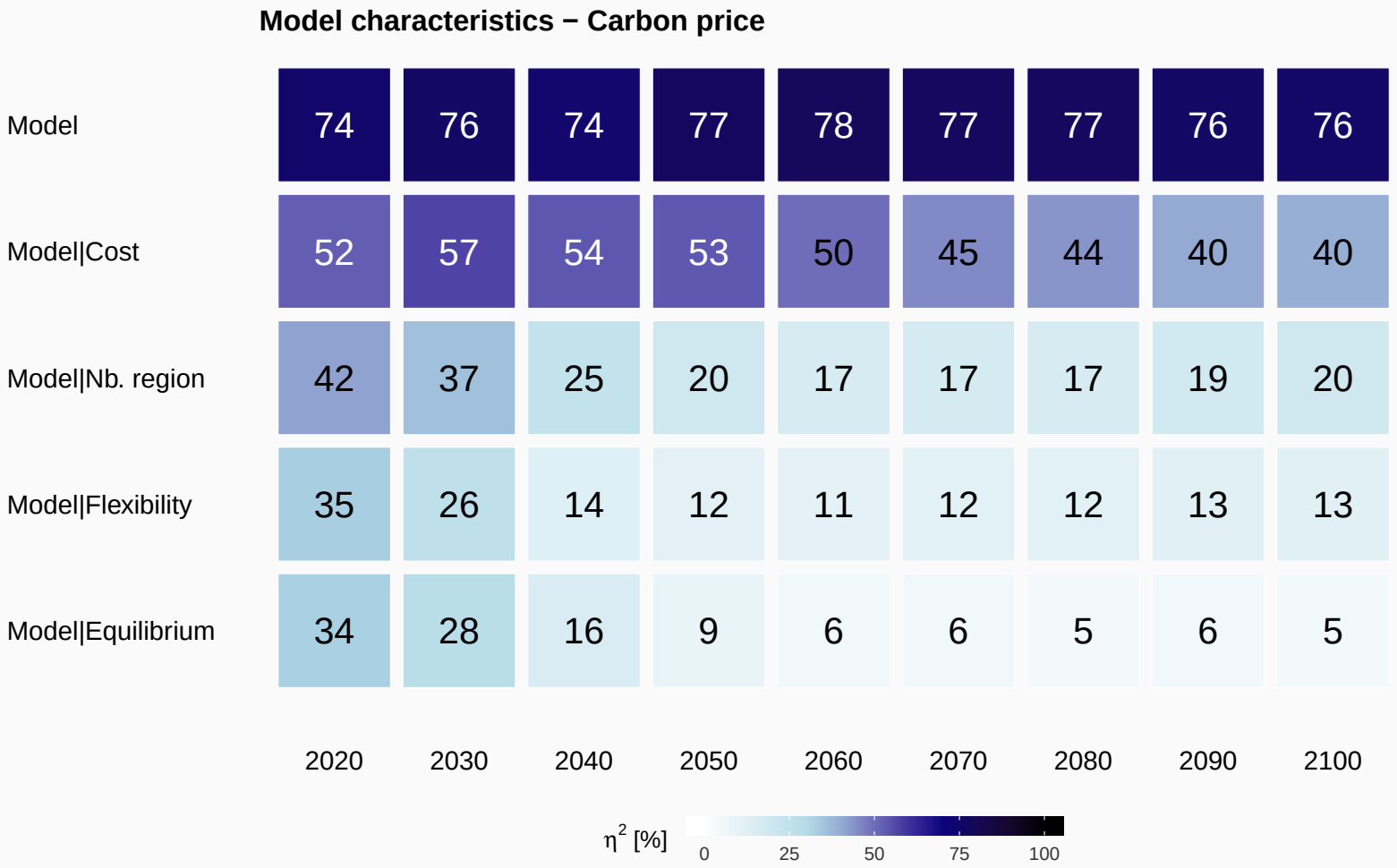
Partial/General equilibrium

AMPERE indicator (high, medium, low)

Number of regions (8–57)

GDP loss, MAC curves, energy system cost

Uncertainty decomposition — Model characteristics



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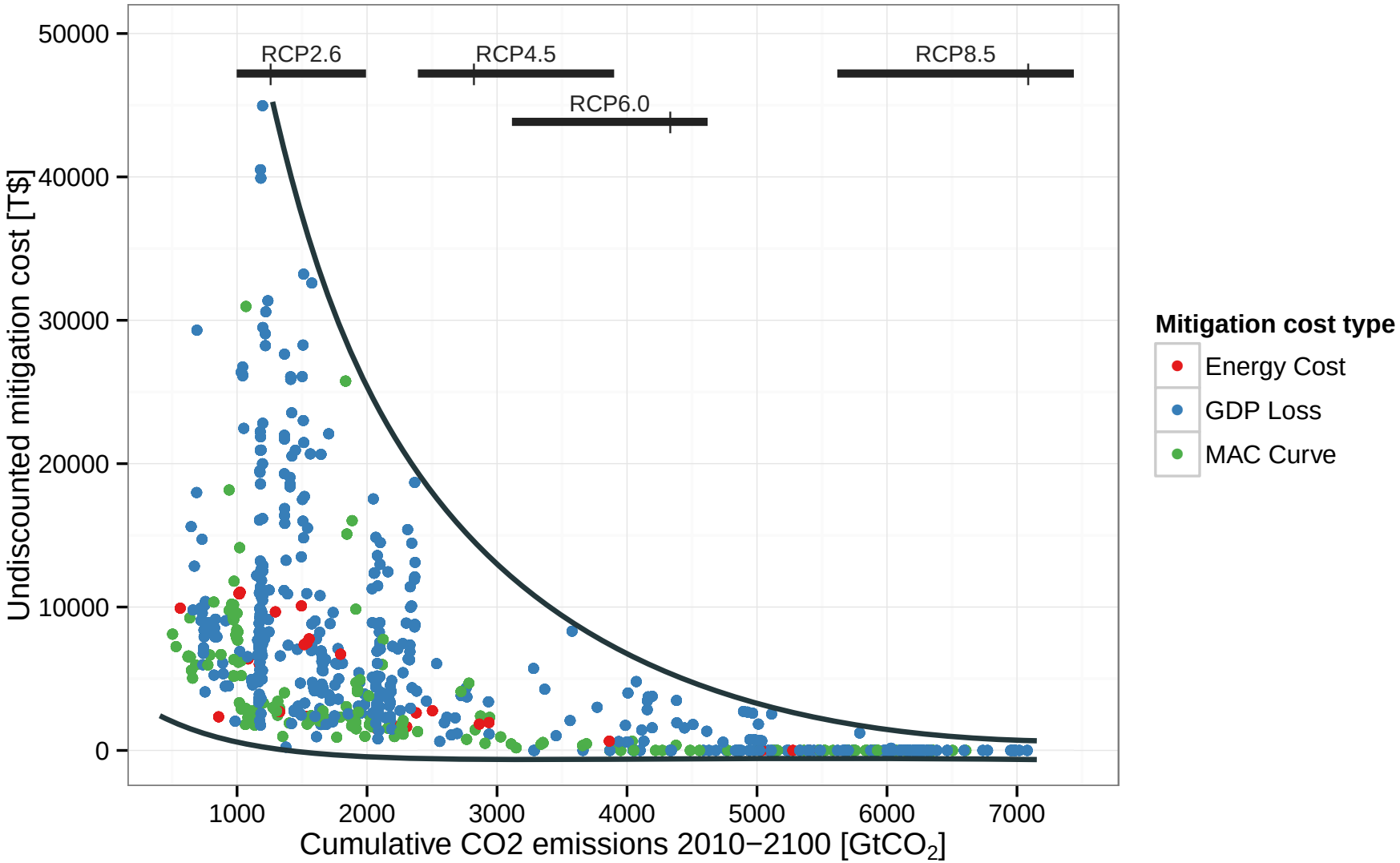
Mitigation cost estimates — Cost



Source: Drouet *et al.* (2015) from the IPCC AR5 scenario database

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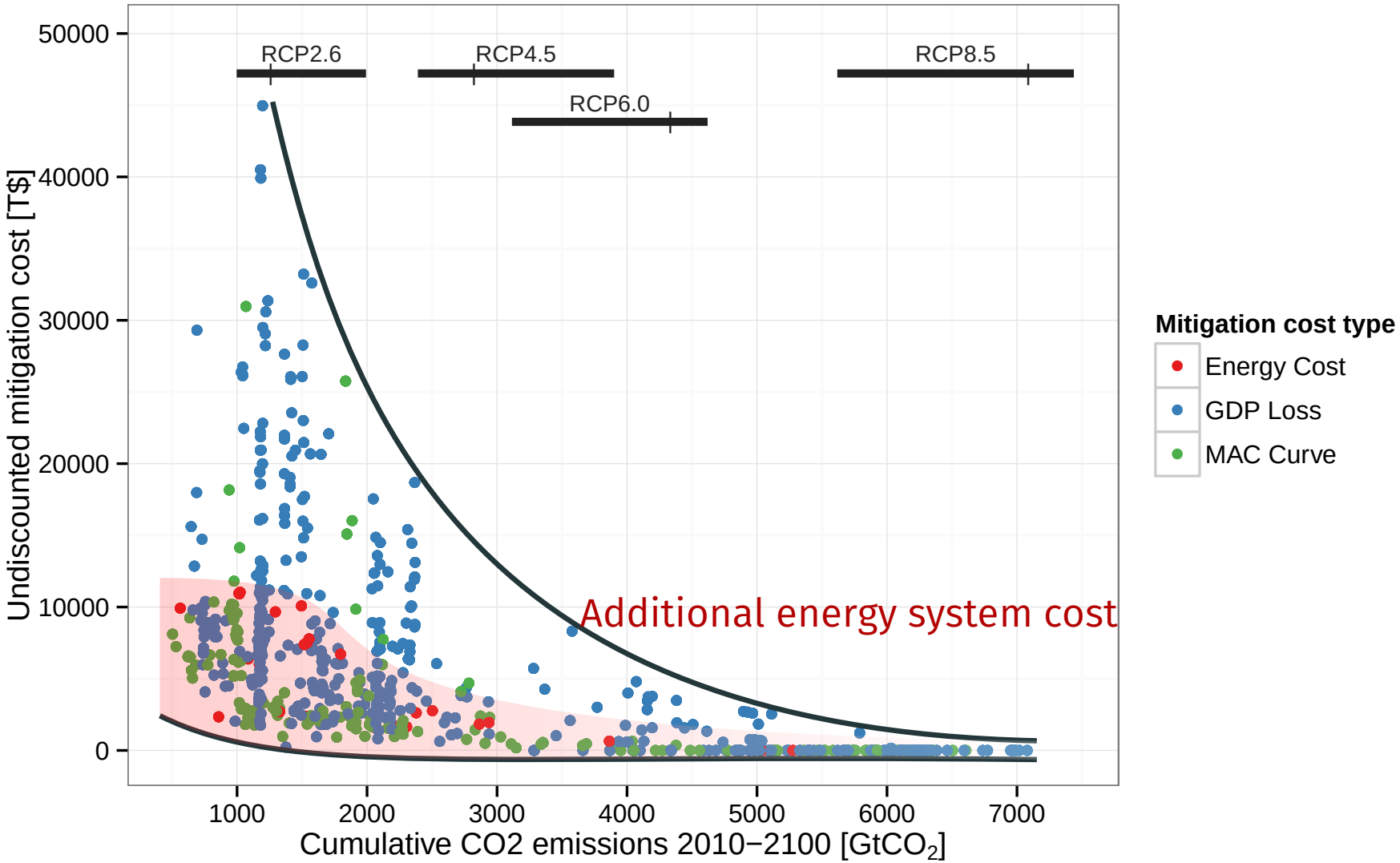

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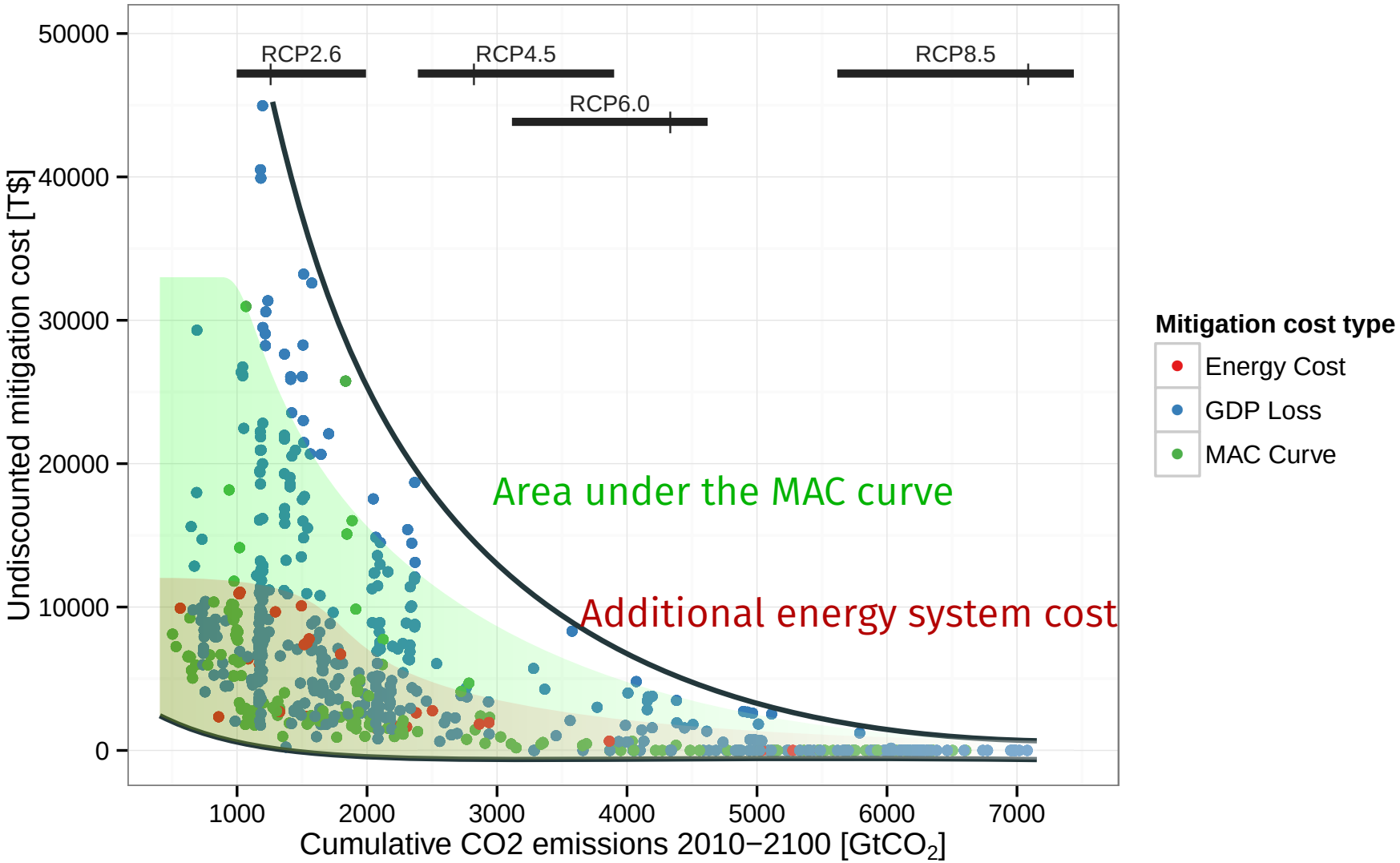

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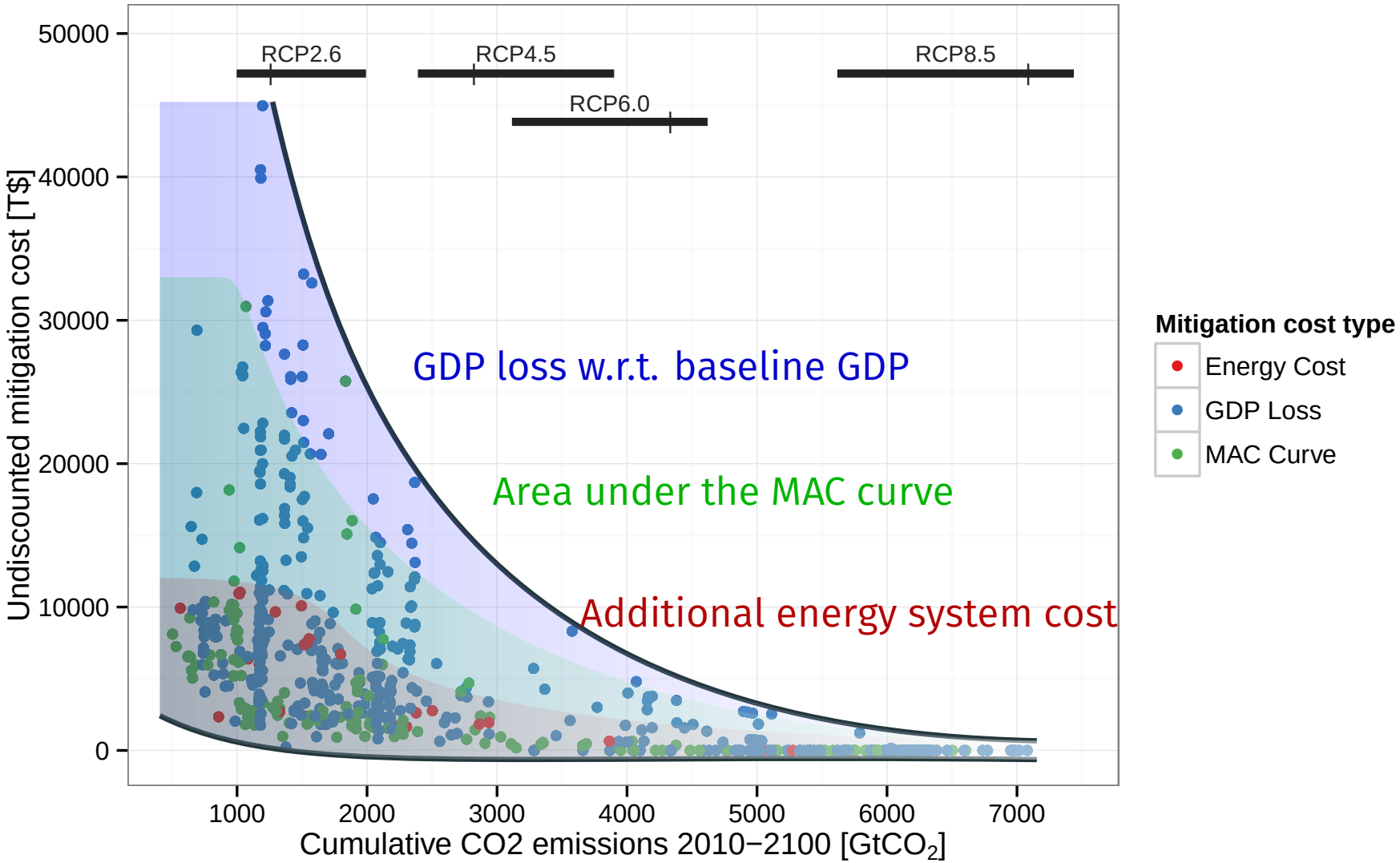

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Conclusions

Summary

- Mitigation costs are also uncertain.
- “Model” is the most important component to explain the variation of the mitigation costs reviewed by the IPCC AR5.
- “Baseline” component is not important.

Recommendations for future assessments

- The use of models of different nature is primordial.
- More baseline (SSP), but mitigation costs are harder to compare (Drouet and Emmerling, 2016).
- 1.5°C ?

Thanks

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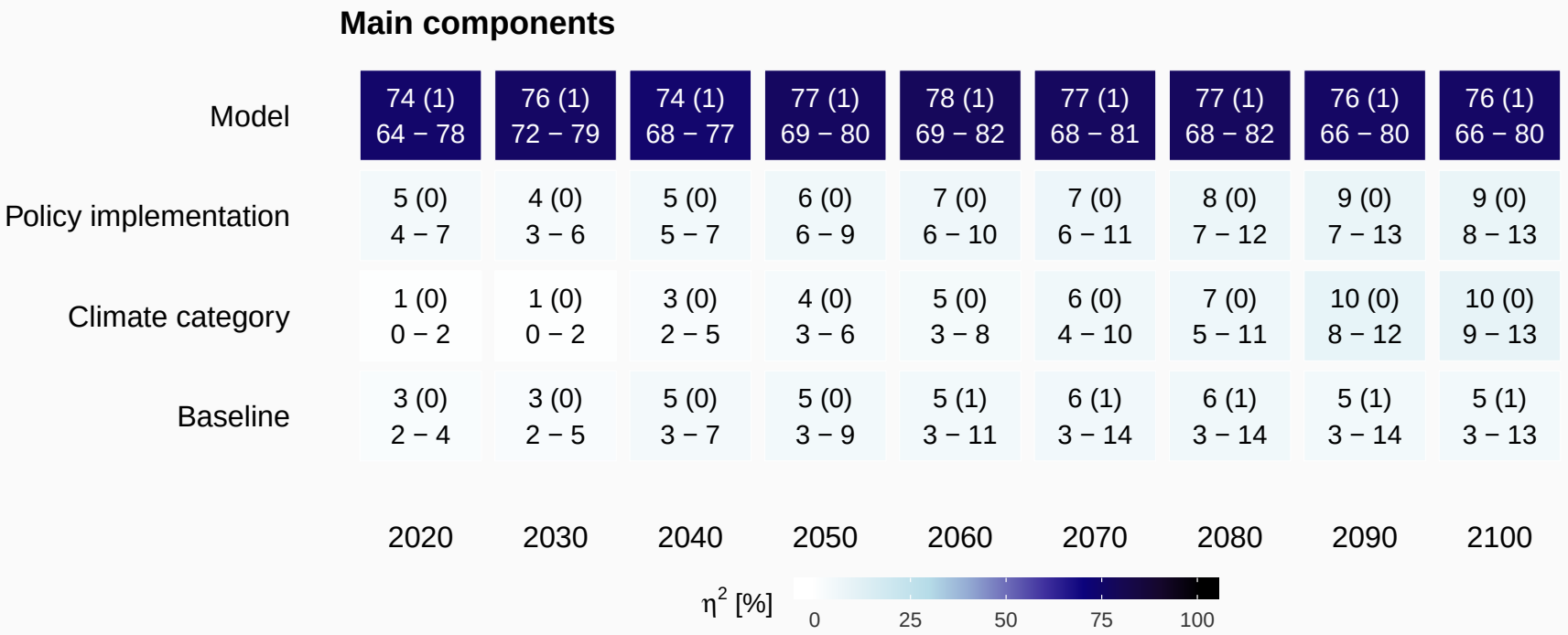
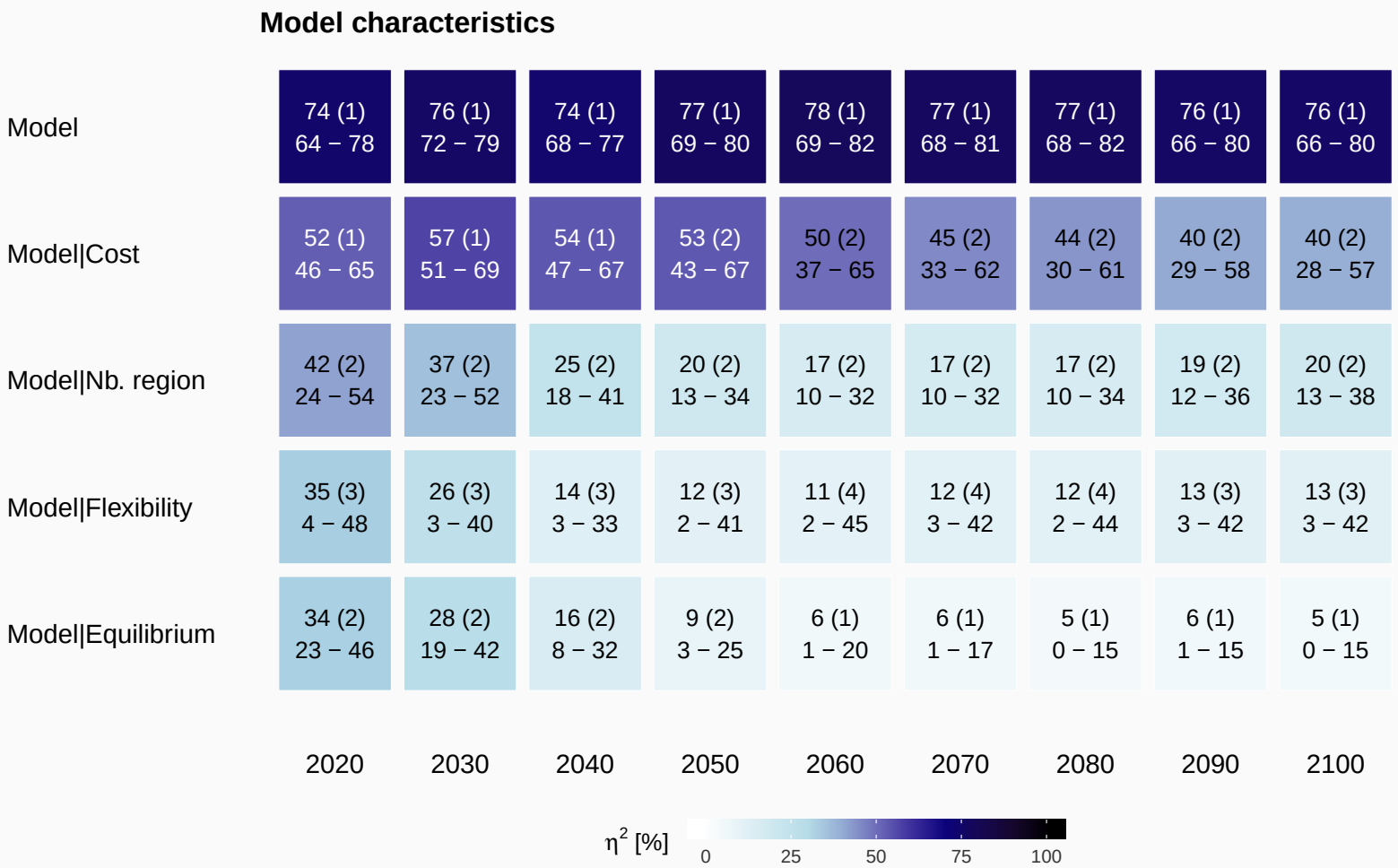


Correlation ratio for mitigation costs expressed in $/tCO2, standard deviation and min-max range in a jackknife resampling.

Uncertainty decomposition — Model characteristics



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