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Possible ScenarioMIP design - considerations on the basis of earlier presentations

(or musical chairs)

Detlef van Vuuren, Brian O'Neill – using insights from many other ScenarioMIP members

Objectives of the ScenarioMIP scenarios

Objective 1, supporting a broad range of research with general purpose scenarios, is top priority

- Many more users, larger impact than targeted scenarios
- Potentially larger need; without them, there may be no climate information available

Some combination with Objective 2 may be possible

- However: relevant targeted questions might be better addressed by other MIPs

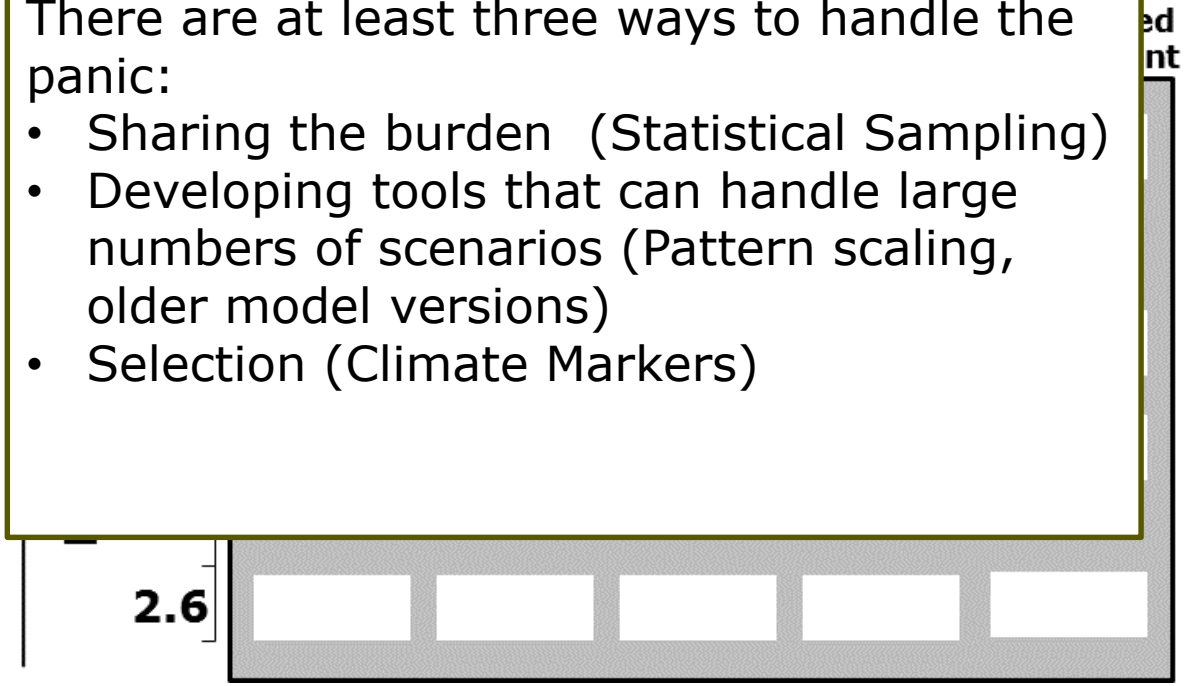
ScenarioMIP should focus on plausible future scenarios rather than idealized experiments

Scenario design for CMIP6

Shared Socioeconomic Pathways

There are at least three ways to handle the panic:

- Sharing the burden (Statistical Sampling)
- Developing tools that can handle large numbers of scenarios (Pattern scaling, older model versions)
- Selection (Climate Markers)



We can use this to:

- Look at overshoot

Possible Scenario Sets

1. Scenario sampling
2. Running more cells using older model version
3. Updated RCPs (4 forcing pathways similar to RCPs)
4. 2-stream mitigation (Some new, some similar pathways)
5. Baseline/new mitigation (4 new forcing pathways)
6. Bounding scenarios?
7. Scenario pairs?

Statistical sampling

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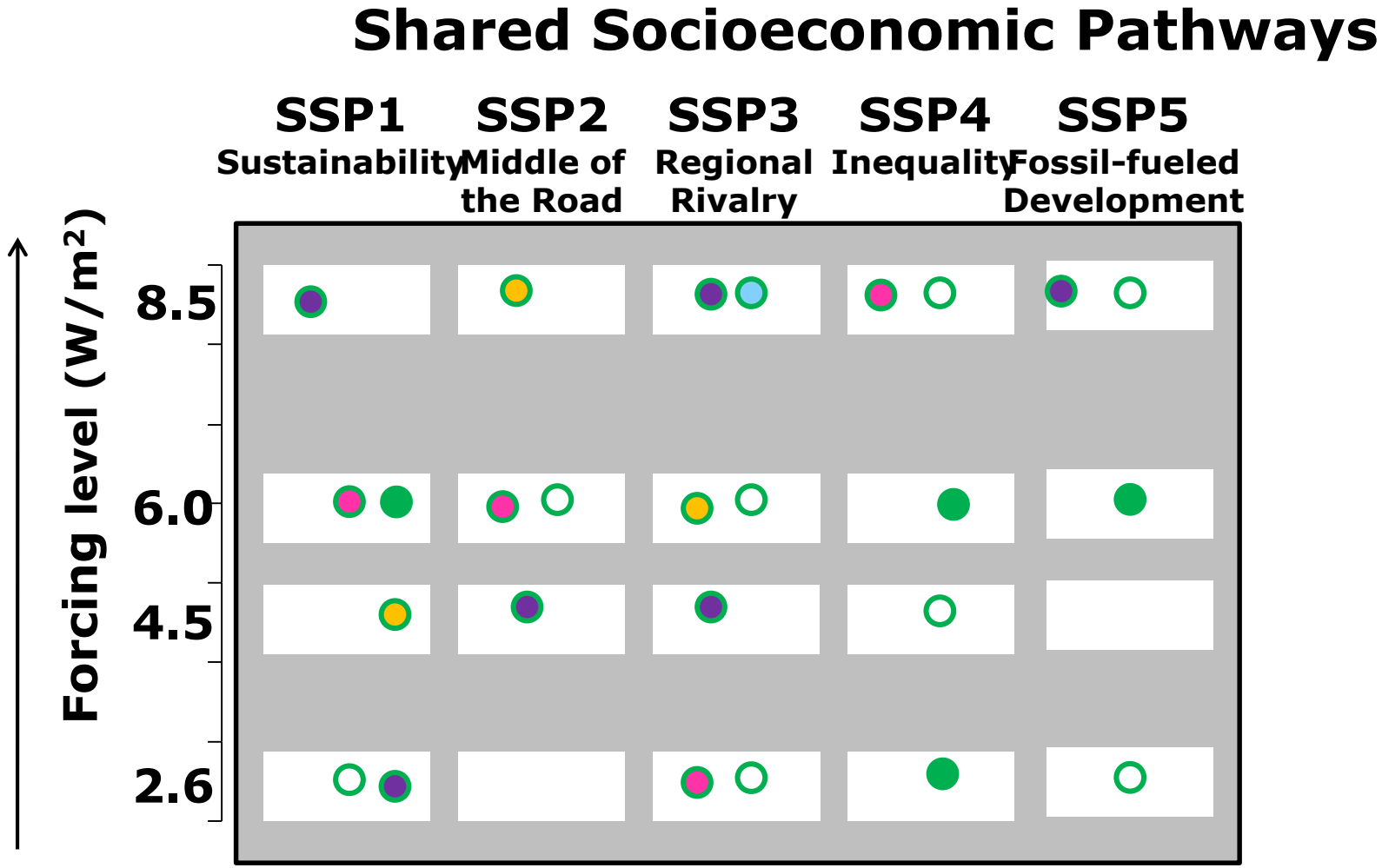
- Different models



Statistical sampling

Pros

- Would allow
- Innovative r

Cons

- Complex
- Comparison plicated by the presence of different models, many other dimensions etc. mplicated for impact assessment
- Institutionally icult

Use previous generation models

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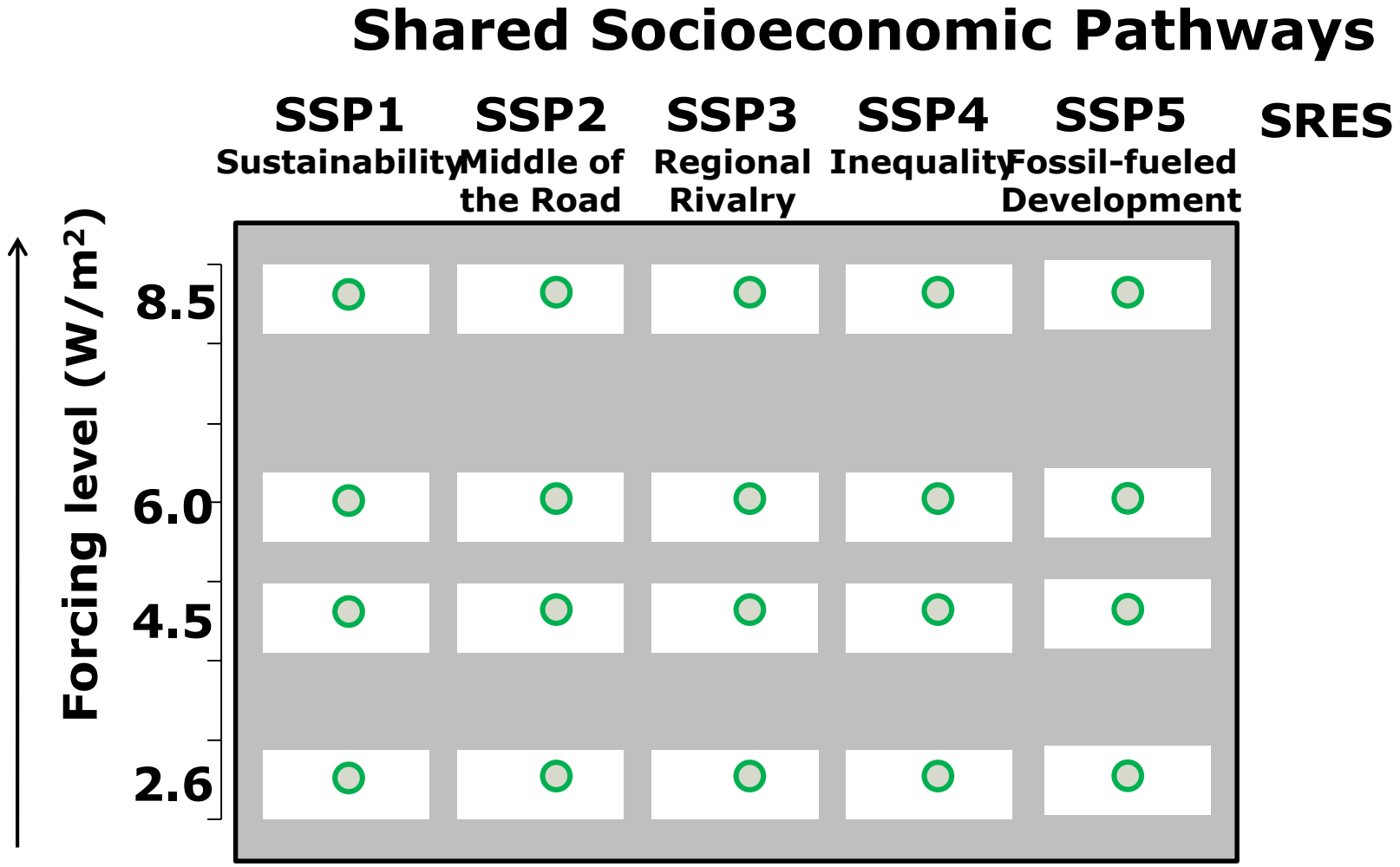
- Same model



Use previous generation models

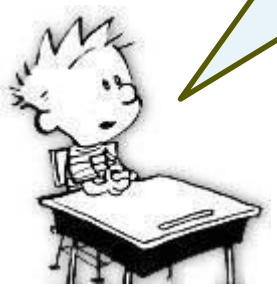
Pros

- Would allow filli
- Provides very c cells

Cons

- Not the "latest a models
- Maybe not feasi aintained

Interesting to combine with other options to fill in cells. But probably not an alternative to them.



Pattern scaling

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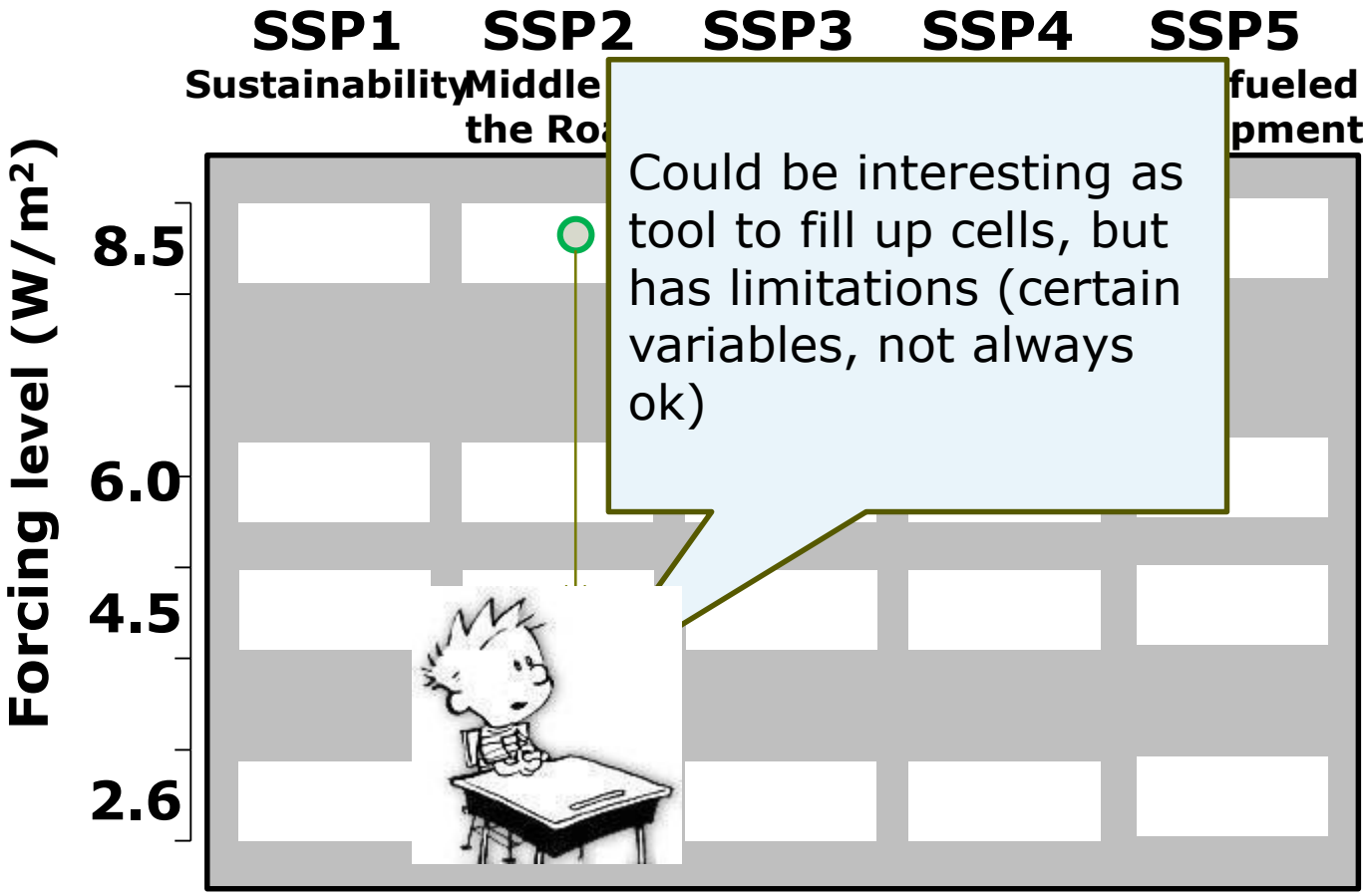
Shared Socioeconomic Pathways



See presentation Claudia

Possible Scenario Sets

Scenario sampling

Running more cells using older model version

Other proposals are all based on selection

Updated RCPs (4 forcing pathways similar to RCPs)

Baseline/new mitigation (4 new forcing pathways)

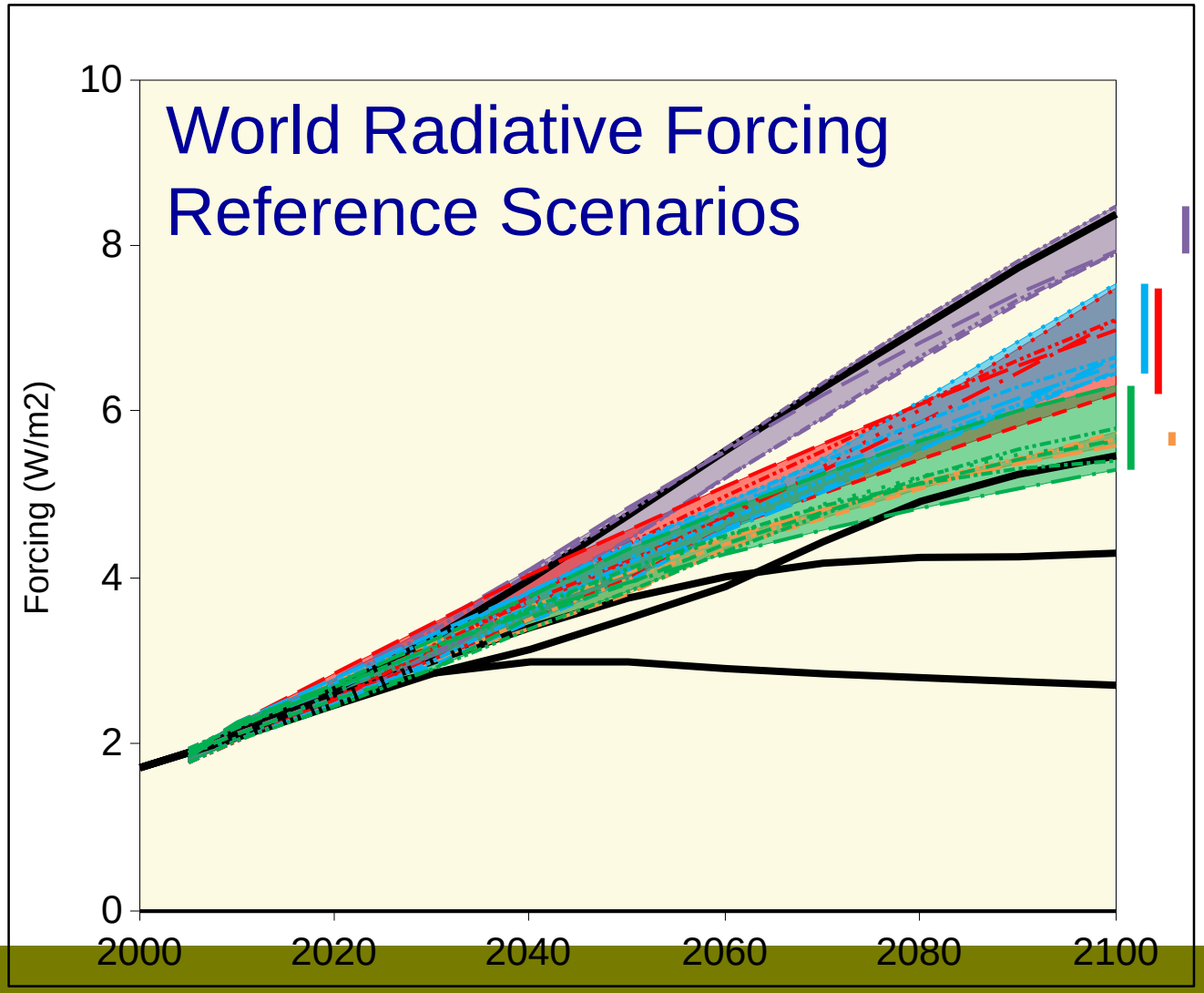
2-stream mitigation (Some new, some similar pathways)

Bounding scenarios?

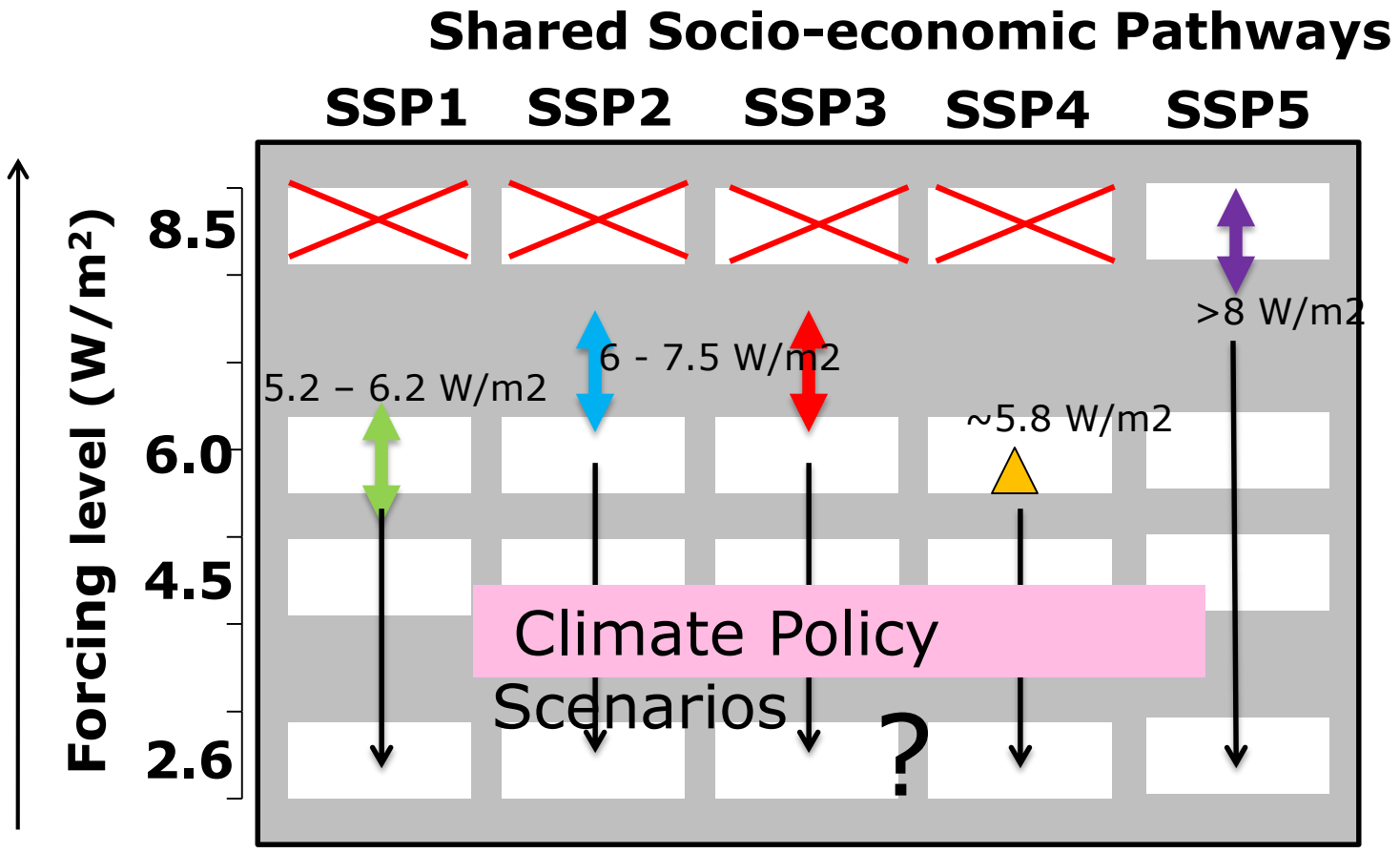
Scenario pairs?

Some considerations regarding selection based methods

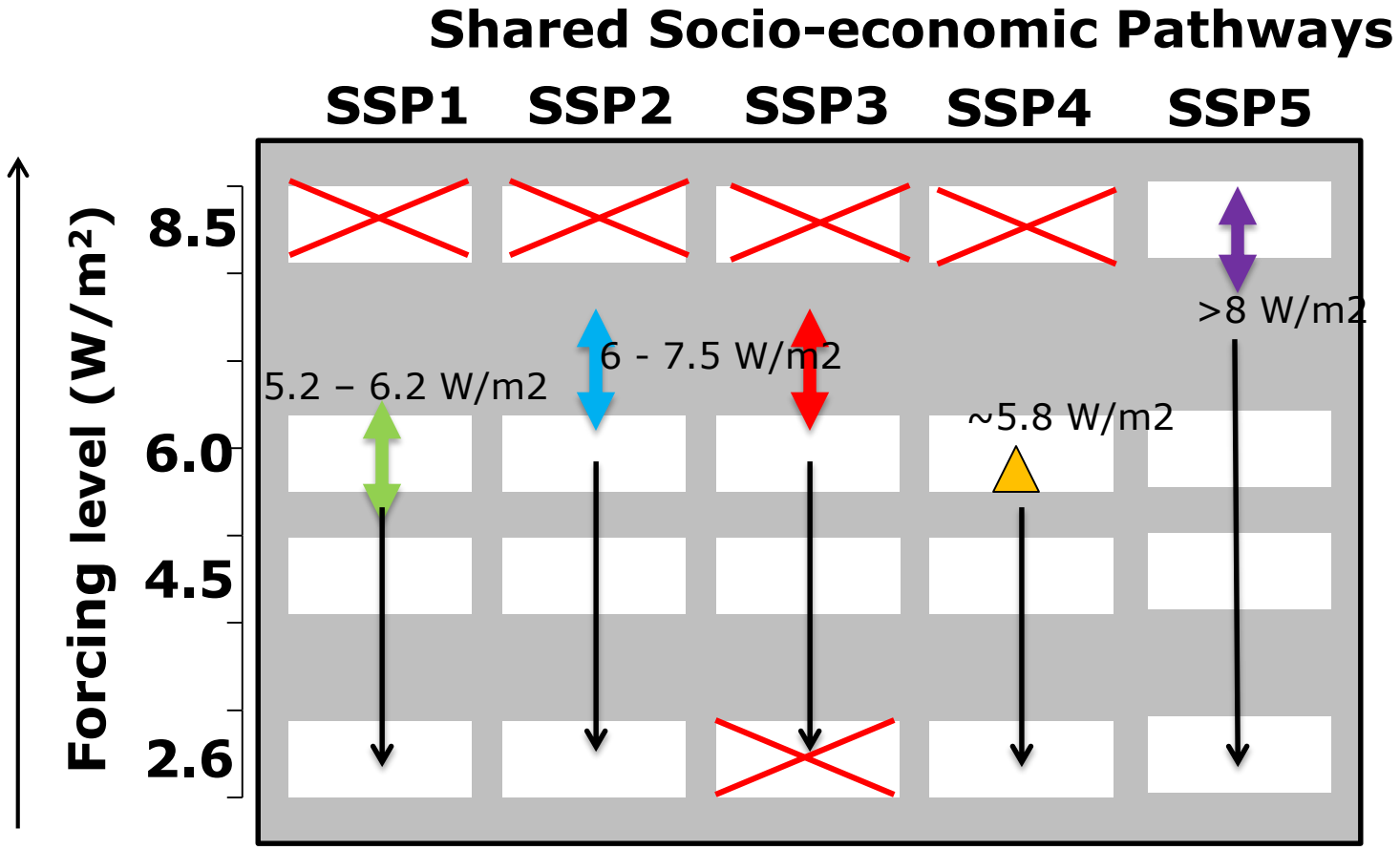
- If we select only four scenarios, this becomes pretty much a game of musical chairs: we have lots of wishes but only a limited set of options
- Scenarios need to be reasonably apart (around 1 W/m2 at least)
- Select scenarios that can be used as representation of a wider range of cases


World Radiative Forcing
Reference Scenarios
Forcing (W/m2)
10
8
6
4
2
0
2000
2020
2040
2060
2080
2100
SSP5
SSP3, SSP2
SSP1, SSP4
AIM/CGE
GCAM
IMAGE
MESSAGE-GLOBIOM
REMIND-MAGPIE
SSP1
SSP2
SSP3
SSP4
SSP5

SSP/RCP combinations based on reference IAM scenarios



SSP/RCP combinations based on reference IAM scenarios



World Emissions|Sulfur
SSP Reference Scenarios

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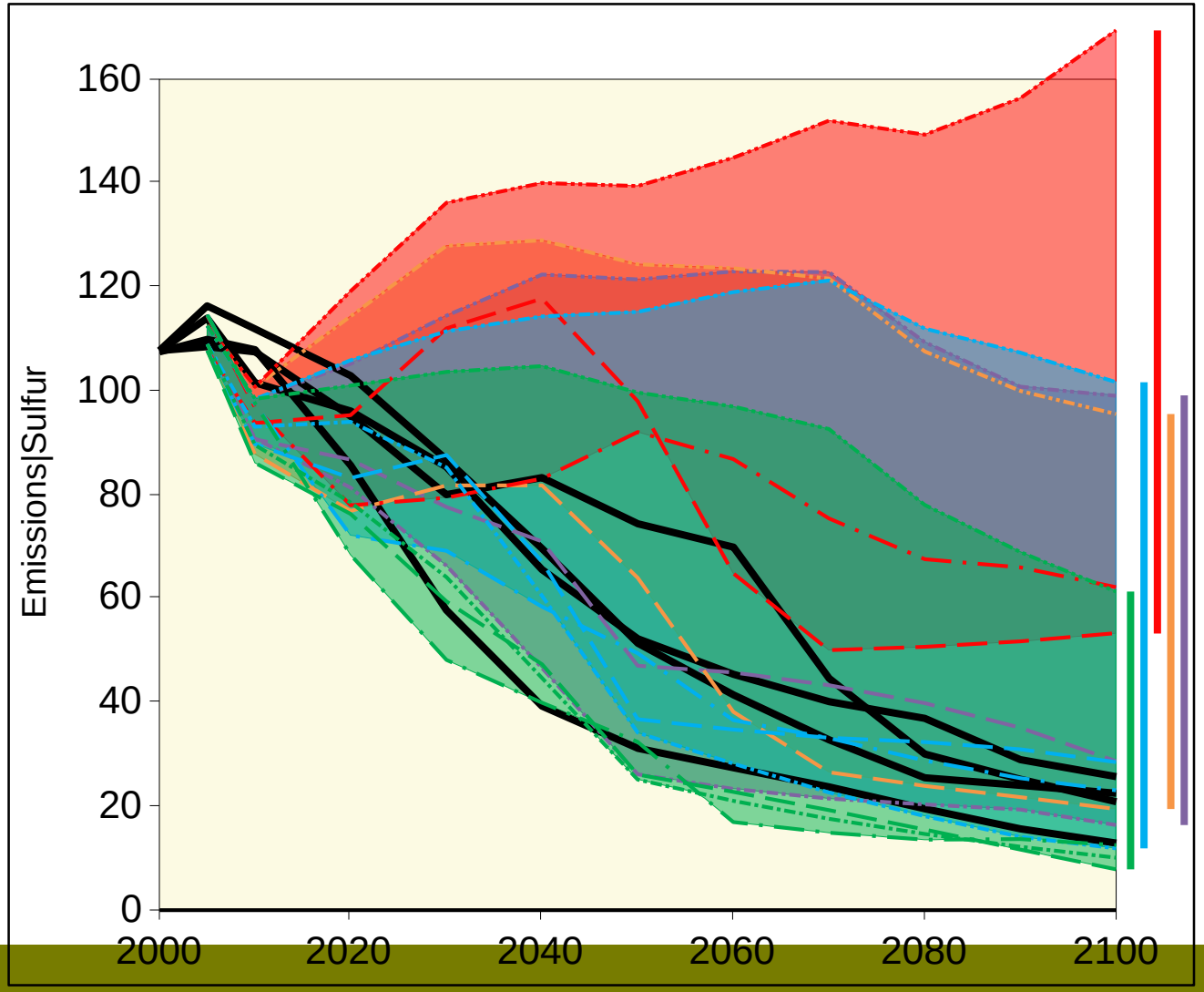
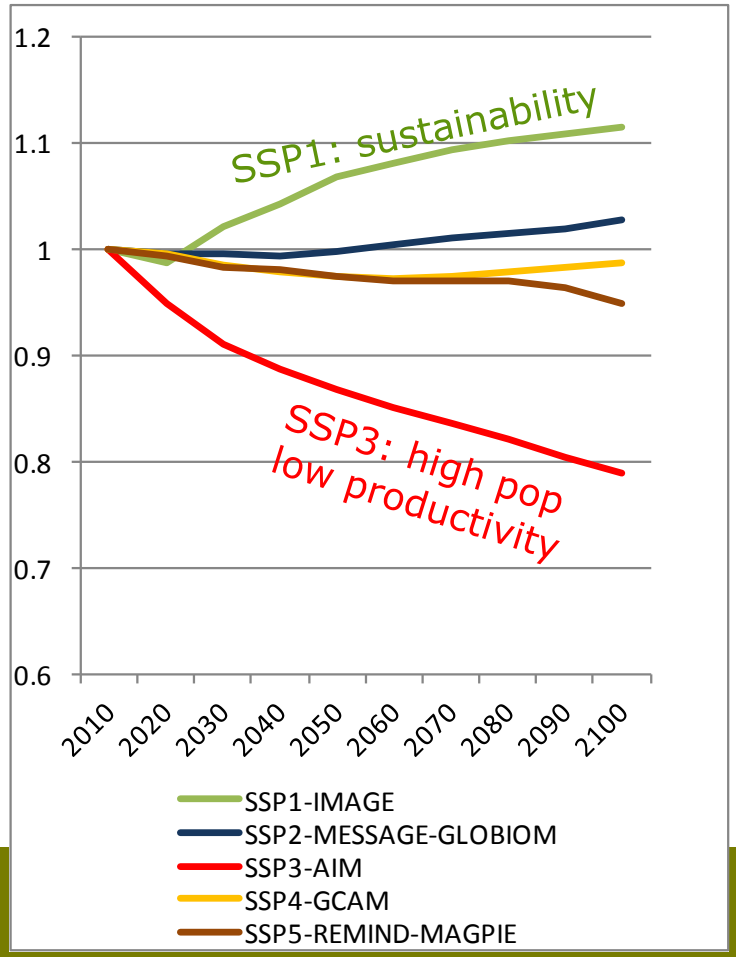


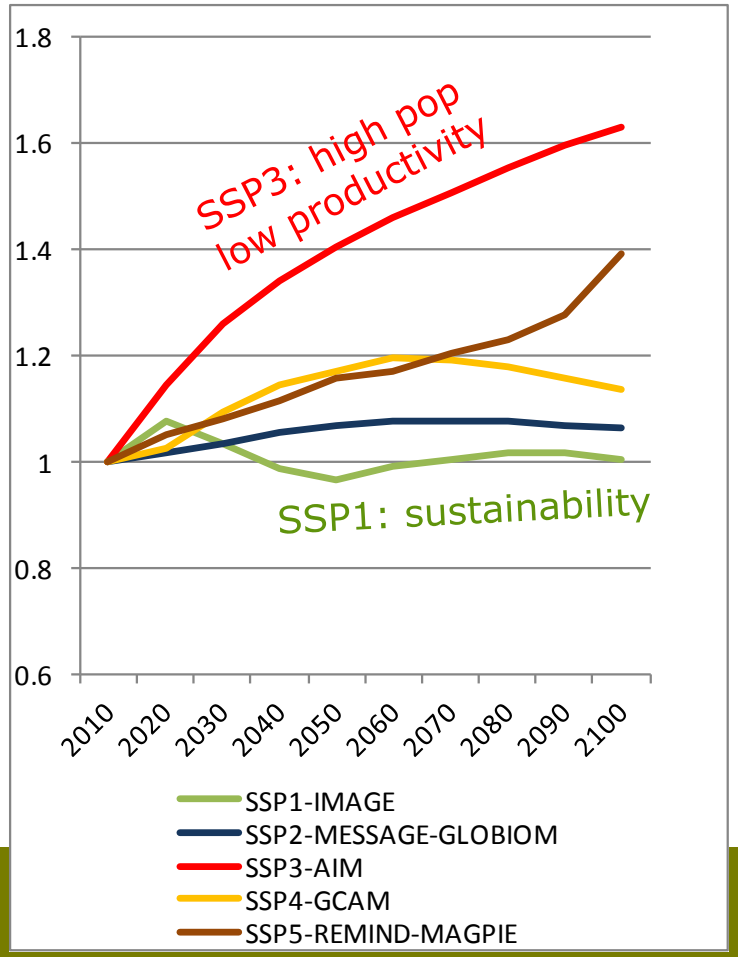
- High SO2 emissions mostly in SSP3, also somewhat in SSP5
- High SO2 will offset somewhat GHG signal

Land-use Change (index 1=2010)

Forest land



Cropland



Deforestation signal highest in SSP3 (mostly in tropical region?)

Reforestation in SSP1 (mostly in developed?)

Updated RCPs

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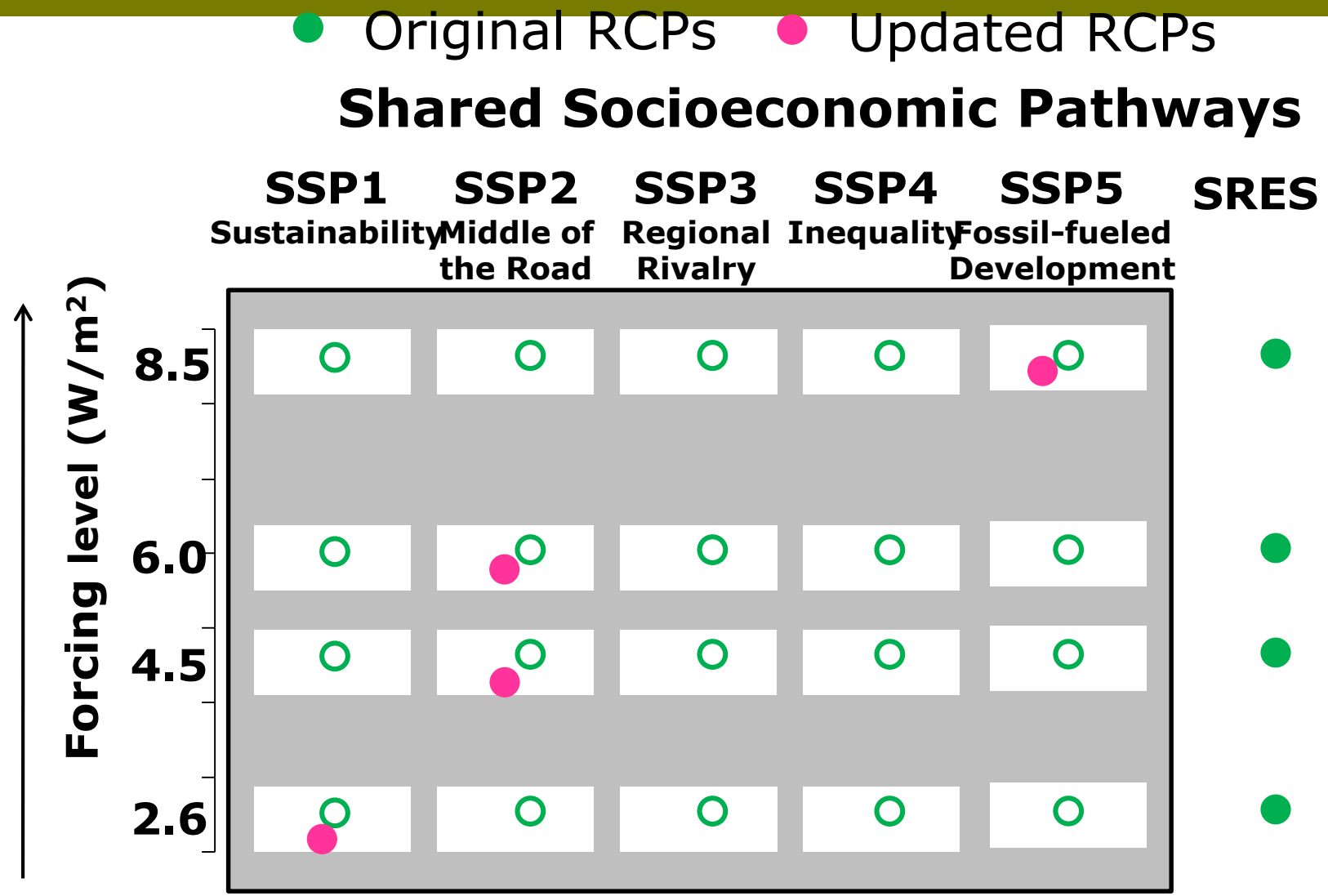

Updated RCPs

Pros

- RCPs based on SSPs rather than SRES
- updated IAM (and climate) models
- consistency between new climate outcomes and new SSP-based IAM scenarios
- More clever selection of land use/aerosol impacts possible

Cons

- unclear whether updated RCPs will differ significantly from current RCPs
- won't be able to learn from climate differences between CMIP5 and CMIP6 RCPs (too many things changed at same time)

2-stream mitigation

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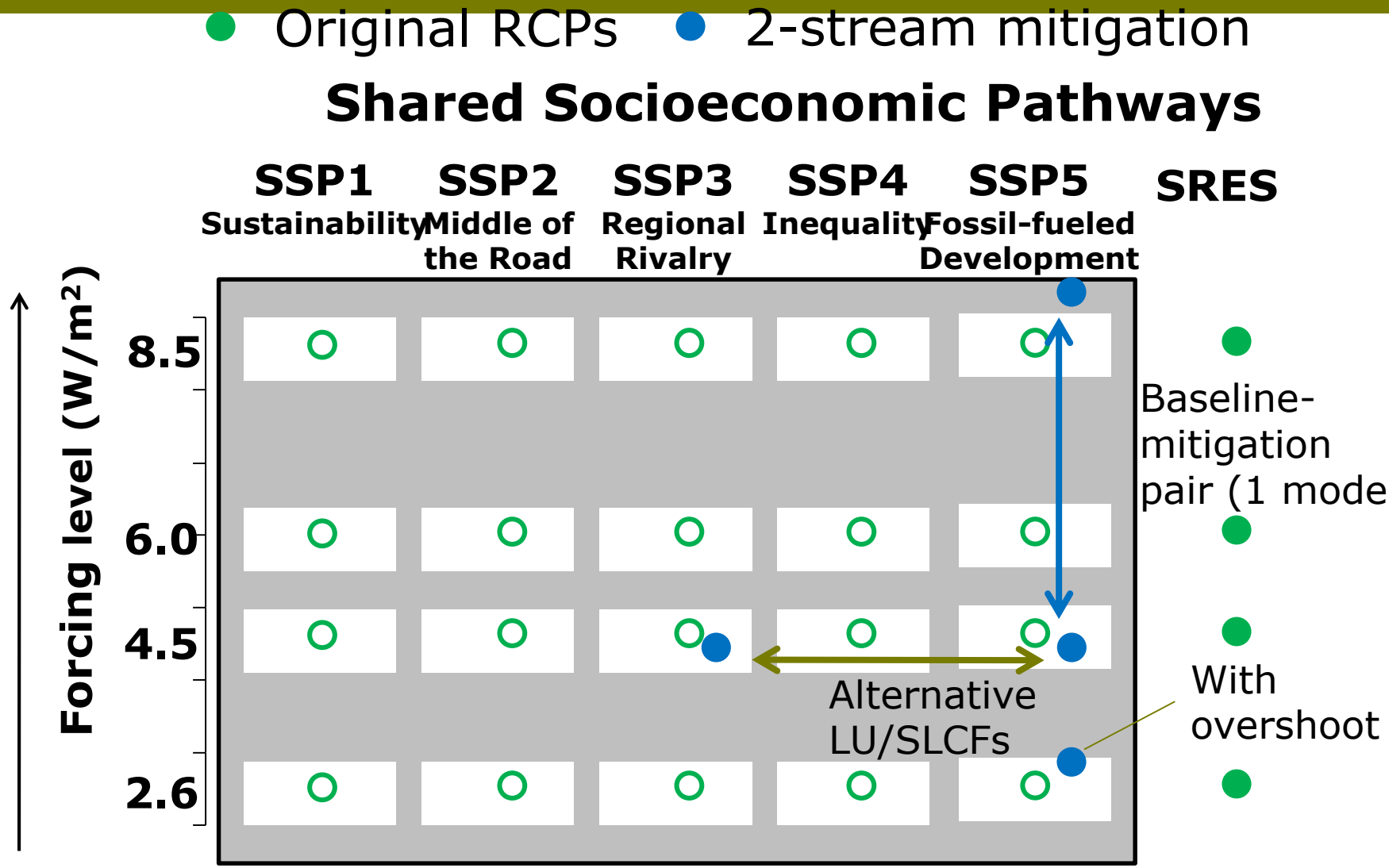

2-stream mitigation

Pros

- Provides climate information for (at least) one SSP baseline
- Provides climate information for one new mitigation scenario (overshoot)
- Baseline-mitigation pair
- Mitigation-mitigation pair to evaluate sensitivity to how forcing level is achieved

Cons

- Not a clean comparison of land use or SLCF influences
- Are two updated RCPs significantly different from existing RCPs?
- Misses several SSPs (reduction of uncertainty)

New baseline/new mitigation

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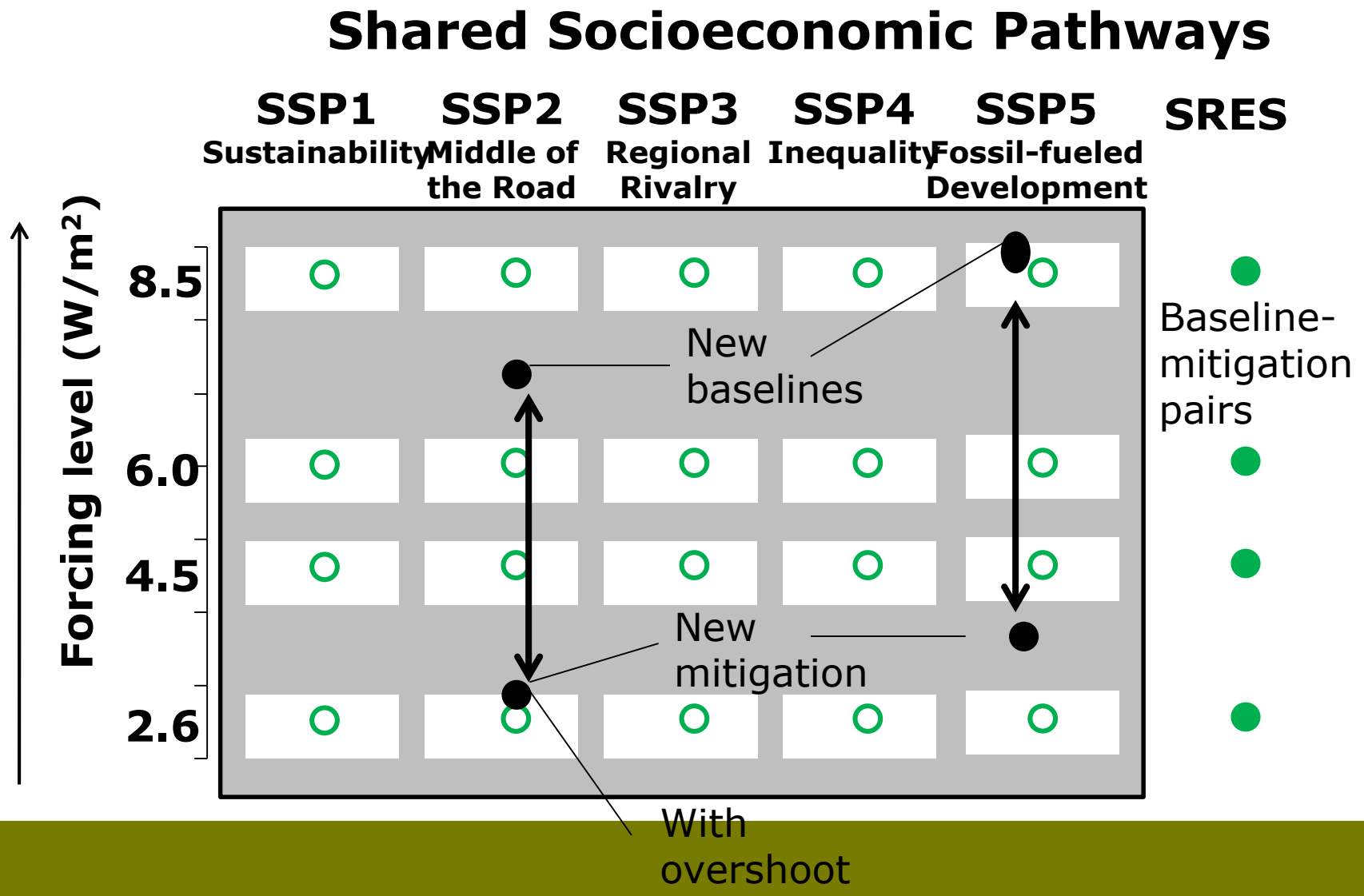
● Original RCPs ● Baseline + new mitigation



Baselines/new mitigation

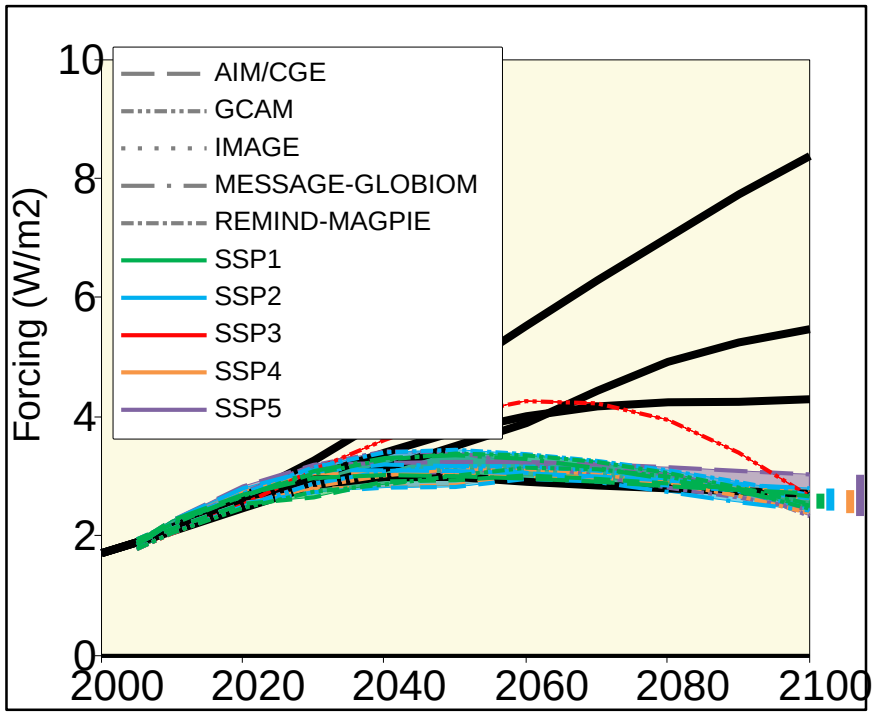
Pros

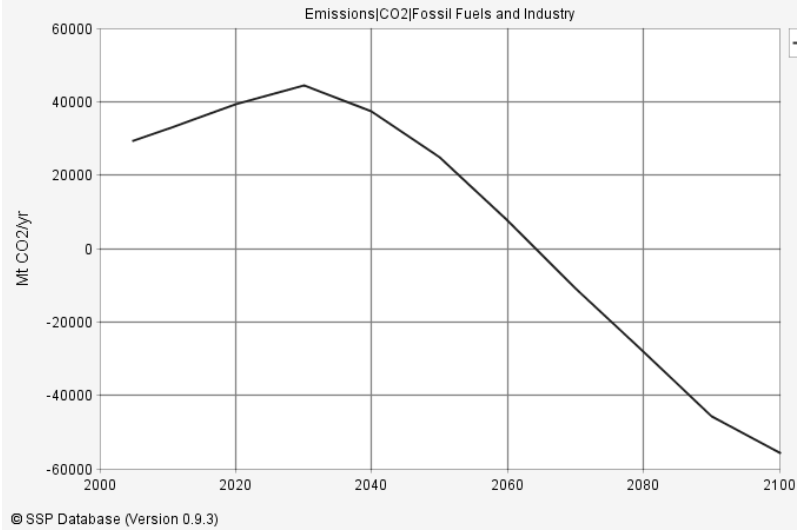
- Provides climate information for (at least some) SSP baselines
- Provides climate information for mitigation scenarios not previously covered, including overshoot
- Baseline-mitigation pairs support avoided impacts work
- RCP3.7

Cons

- No explicit focus on land use or SLCF issues
- Are baseline and mitigation scenarios significantly different than existing RCPs? (do not comply to 1 W/m2)
- No new runs for RCP levels (not the latest and greatest models)

Overshoot scenario





Interesting for science and policy reasons – but question whether overshoot should be this large.

- Original RCPs
- Updated RCPs
- 2-stream mitigation
- Baseline + new mitigation

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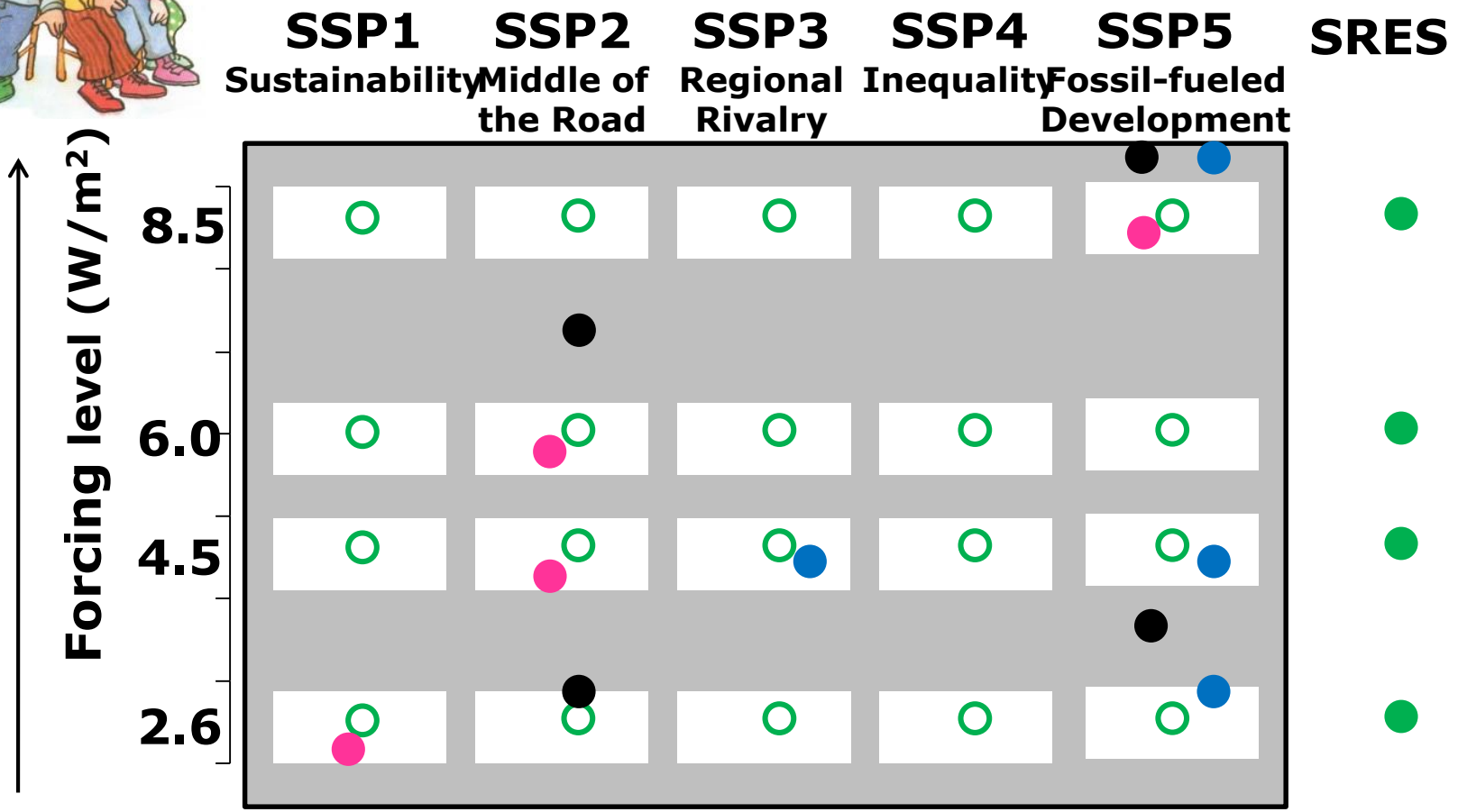
Shared Socioeconomic Pathways



- What are the implications of the highest and lowest plausible forcing scenarios?
- What impacts are avoided by mitigation?
- What are the relative contributions to uncertainty in outcomes (climate, impacts) of societal pathway (SSP), IAM model, impact model, climate model, model parameters?

Outcome of musical chairs

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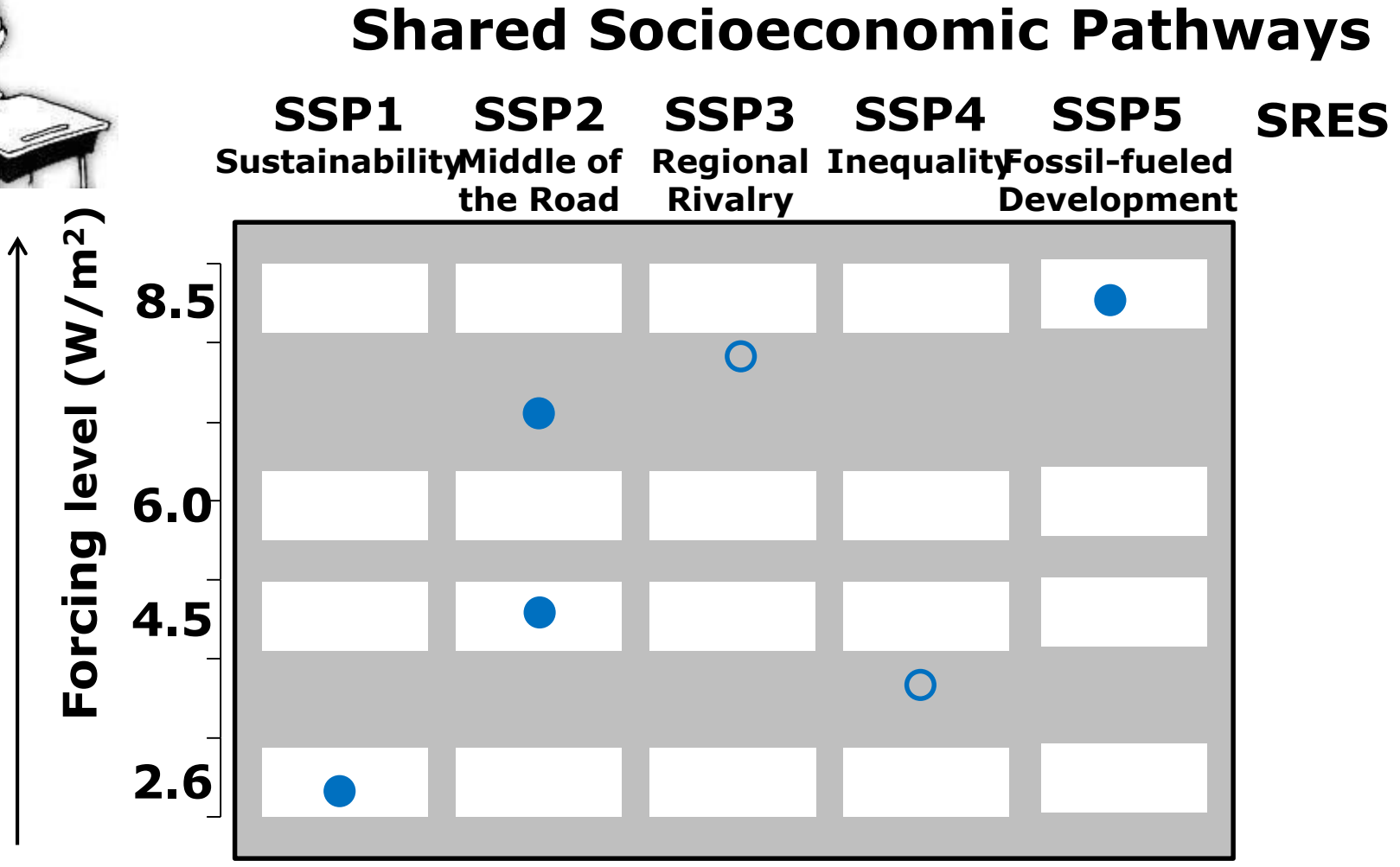
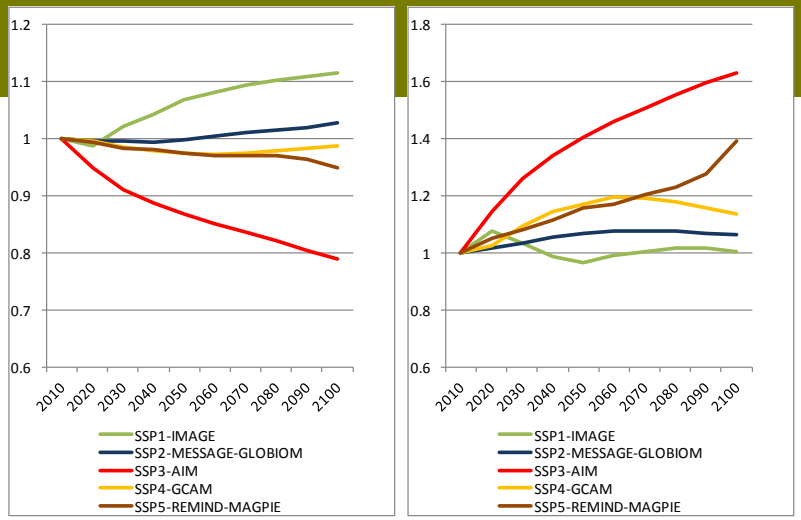
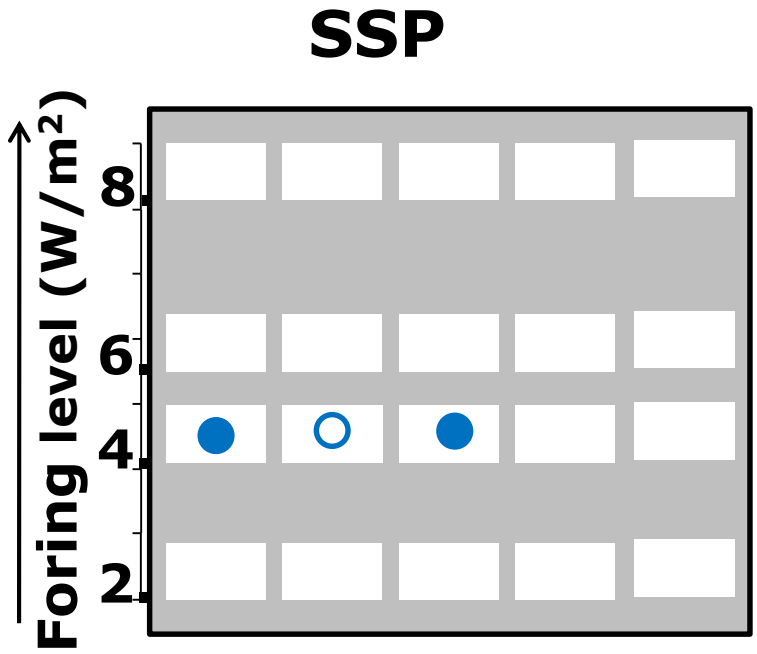


Relation to LUMIP

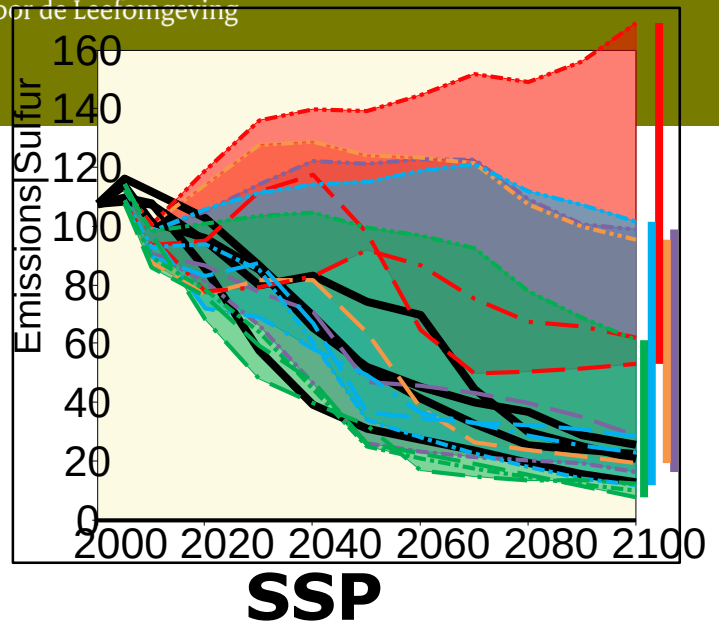
- Select intentionally 2 scenarios with extreme land use – but same forcing (but if from marker-matrix one also varies ghg-signal, air pollution, model)
- Combine 2 extreme land use patterns with 1 GHG/air pollution forcing path
- Combine idealised land use pattern with 1 GHG/air pollution forcing path.

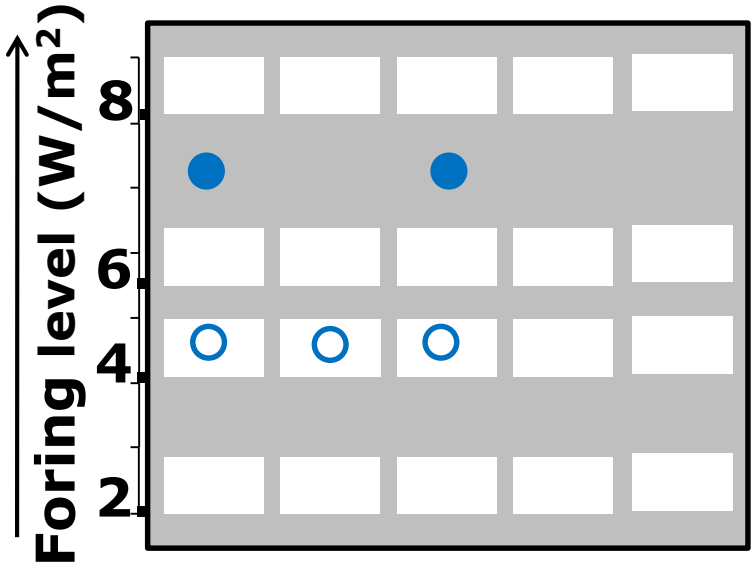




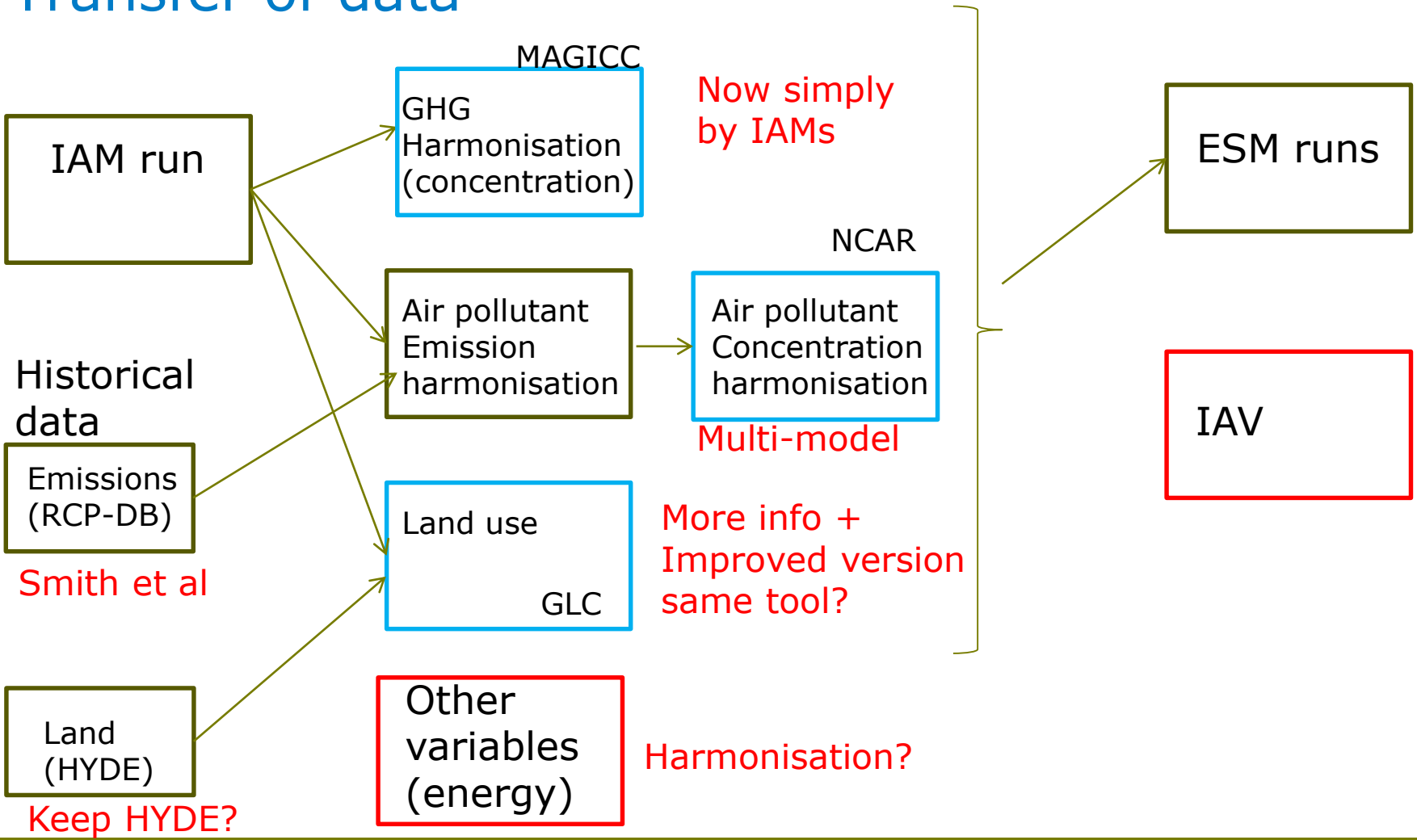
Relation to aerosol mip

- Select intentionally 2 scenarios with low / high aerosol emissions – but same forcing
- Combine 2 extreme aerosol emission pathways with 1 GHG/air pollution forcing path
- Combine idealised aerosol pattern with 1 GHG/air pollution forcing path.
- Run specifically designed SLFC scenario.





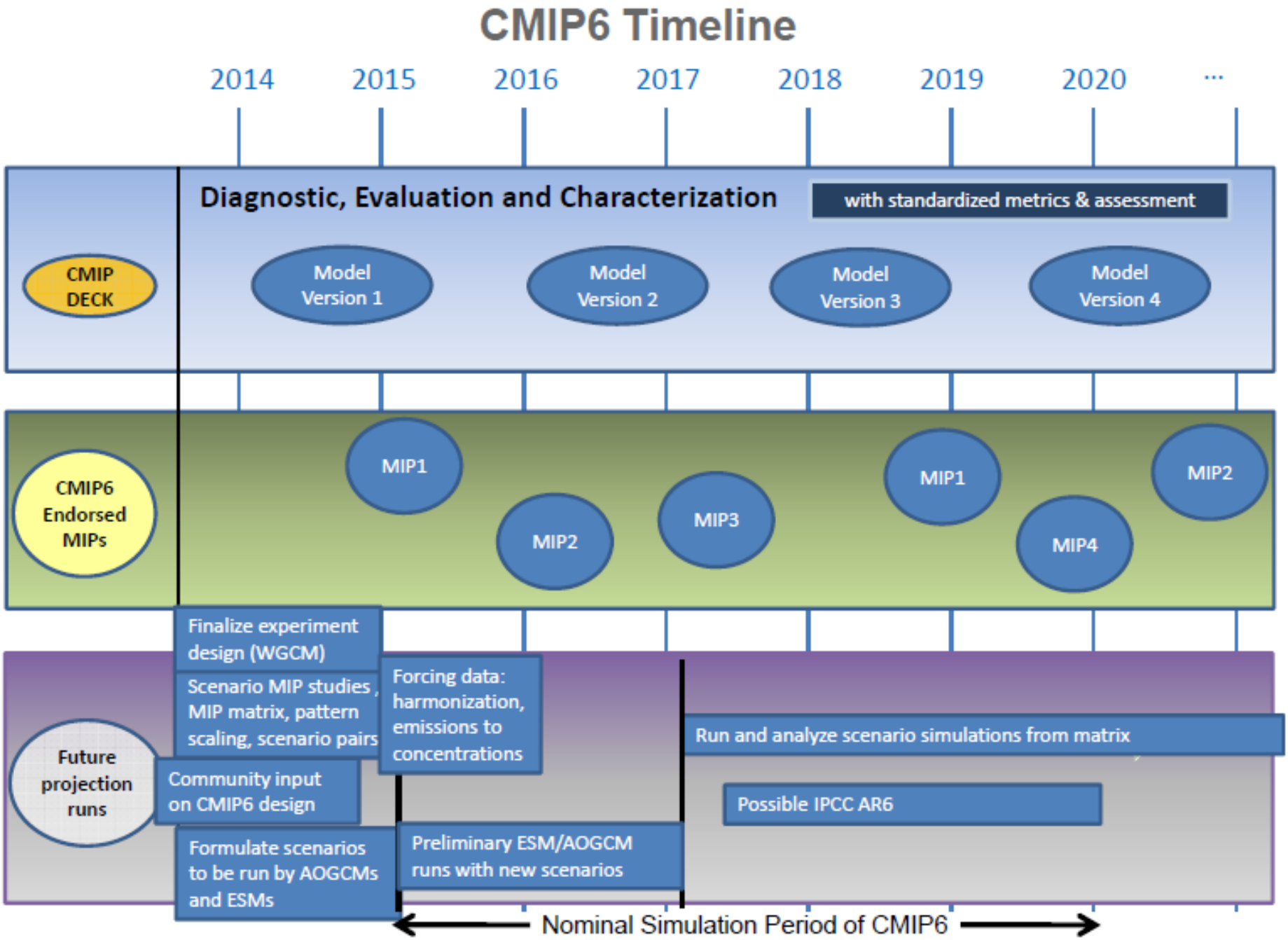
Transfer of data



Additional issues

- Interest of IAV/Climate modelling community: Run ensembles for 1 cell
- Use of priority and non-priority runs
- Further development of pattern scaling

- Detailed evaluation of RCP runs (what land use was run? Did air pollution forcing work well? Etc)


CMIP6 Timeline
2014
2015
2016
2017
2018
2019
2020
...
Diagnostic, Evaluation and Characterization
with standardized metrics & assessment
CMIP DECK
Model Version 1
Model Version 2
Model Version 3
Model Version 4
CMIP6 Endorsed MIPs
MIP1
MIP2
MIP3
MIP1
MIP4
MIP2
Finalize experiment design (WGCM)
Scenario MIP studies, MIP matrix, pattern scaling, scenario pairs
Forcing data: harmonization, emissions to concentrations
Future projection runs
Community input on CMIP6 design
Run and analyze scenario simulations from matrix
Possible IPCC AR6
Formulate scenarios to be run by AOGCMs and ESMs
Preliminary ESM/AOGCM runs with new scenarios
Nominal Simulation Period of CMIP6

Conclusions

- Selection seems to be best strategy
  - Get enough spread in runs (highest / lowest)
  - Use other runs to address other issues (influence of overshoot, land-use/sulphur, intermediate levels
- Combine with further development pattern scaling and fast ESM model runs
- Delay final selection – do some further experiments to help making optimal choice.

Additional slides

Objectives session

- Provide an opportunity for IAM/IAV discussion of priorities for scenario experiments to be run in the CMIP6 process, as inputs to the AGCI session the next week to continue developing CMIP6.

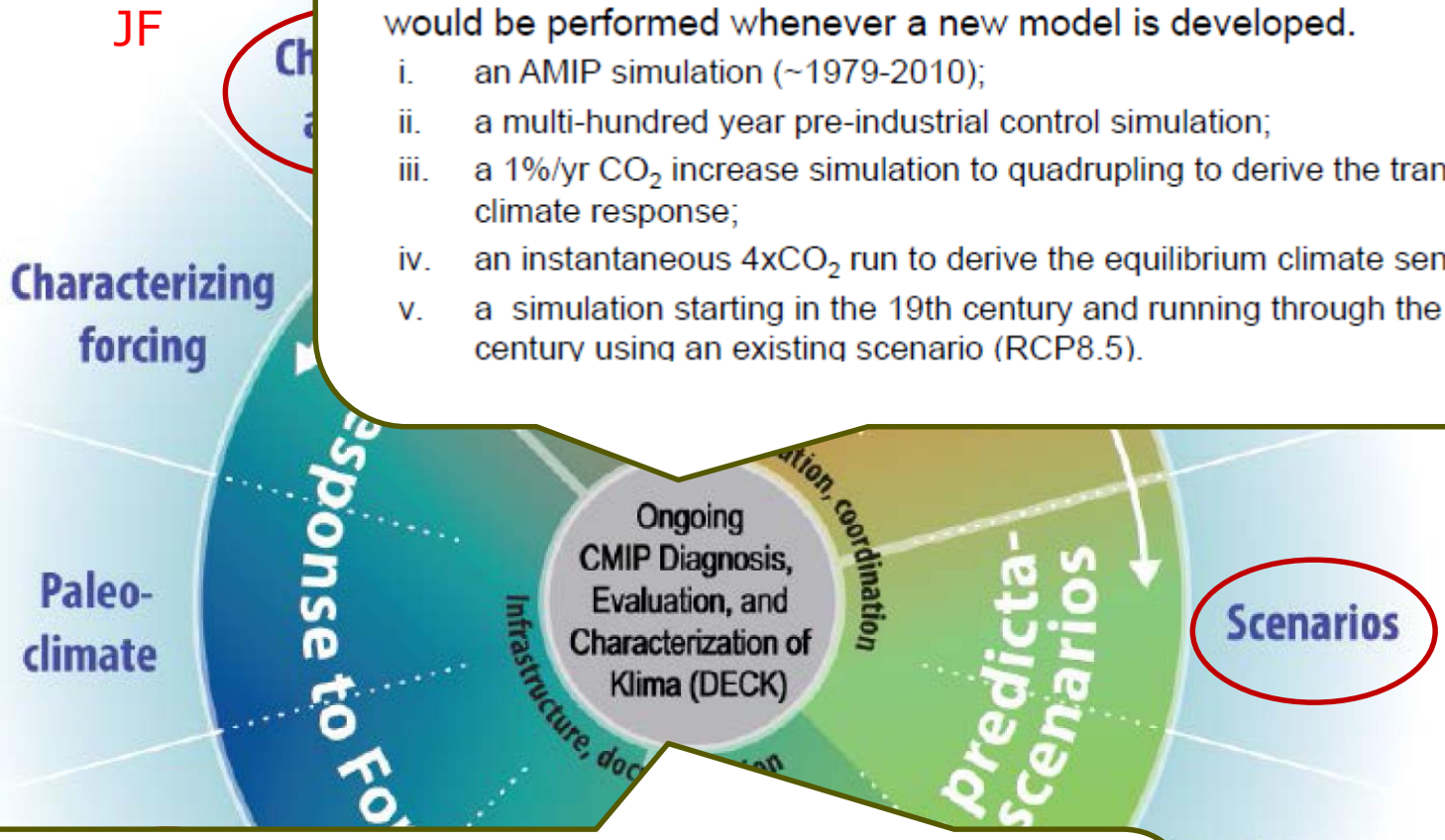
- Among the topics that could be addressed are:
  - Which scenarios should be run by ESM models
  - Would there be advantages to focusing on specific time frames, e.g. to mid-century
  - Would it be especially valueable to improve understanding of particular attributes of climate, e.g. extreme events
  - Is there interest in 'overshoot' or other scenario types?

CMIP6

JF

Ongoing CMIP Diagnostic, Evaluation and Characterization of Klima (DECK) experiments: a small set of standardized experiments that would be performed whenever a new model is developed.

i. an AMIP simulation (~1979-2010);
ii. a multi-hundred year pre-industrial control simulation;
iii. a 1%/yr CO_2 increase simulation to quadrupling to derive the transient climate response;
iv. an instantaneous 4xCO_2 run to derive the equilibrium climate sensitivity;
v. a simulation starting in the 19th century and running through the 21st century using an existing scenario (RCP8.5).



- **CMIP6-Endorsed MIPs** would propose additional experiments, and modeling groups could choose a subset of these to run according to their interest, computing and/or human resources and funding constraints.

Kate

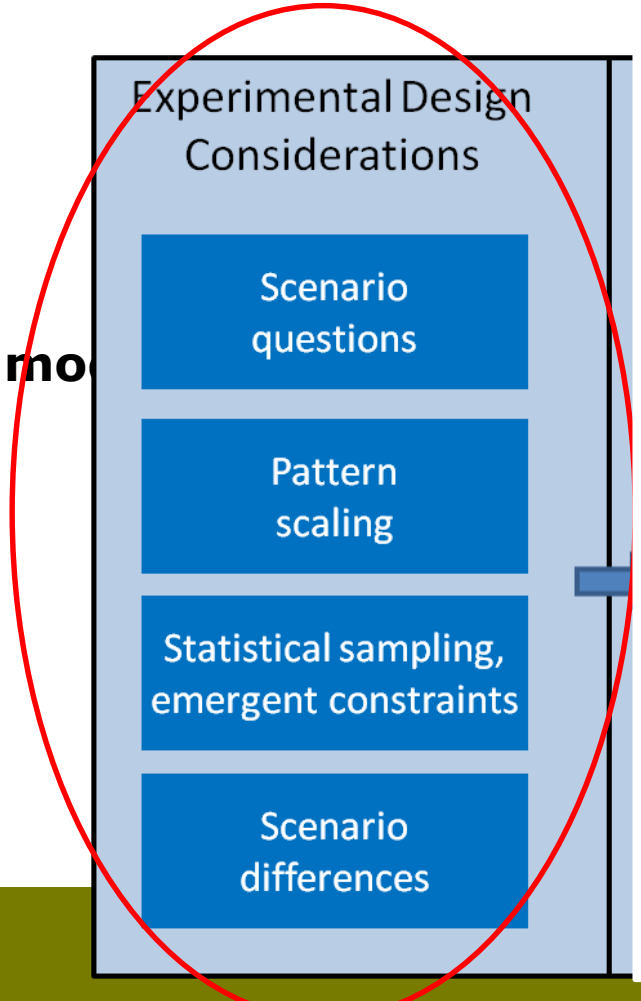
- The MIPs would also likely have additional experiments that would not be part of CMIP6 but would be of interest and relevant to their respective communities.

World Climate Research Programme

cmip Coupled Model Intercomparison Project

Tasks ScenarioMIP

experimental design



Key questions that needed to be answered before design choices could be made:

- What are actually the questions that we are addressing? — Brian
- How important is the range of new scenarios? Could pattern scaling help? — Claudia
- Could statistical sampling help in designing scenarios? — Claudia
- How different would scenarios need to be before there are interesting for climate research? Radiative forcing, land use, air pollution? — Claudia