Modelling Earth System and Human interactions (MESH) working group

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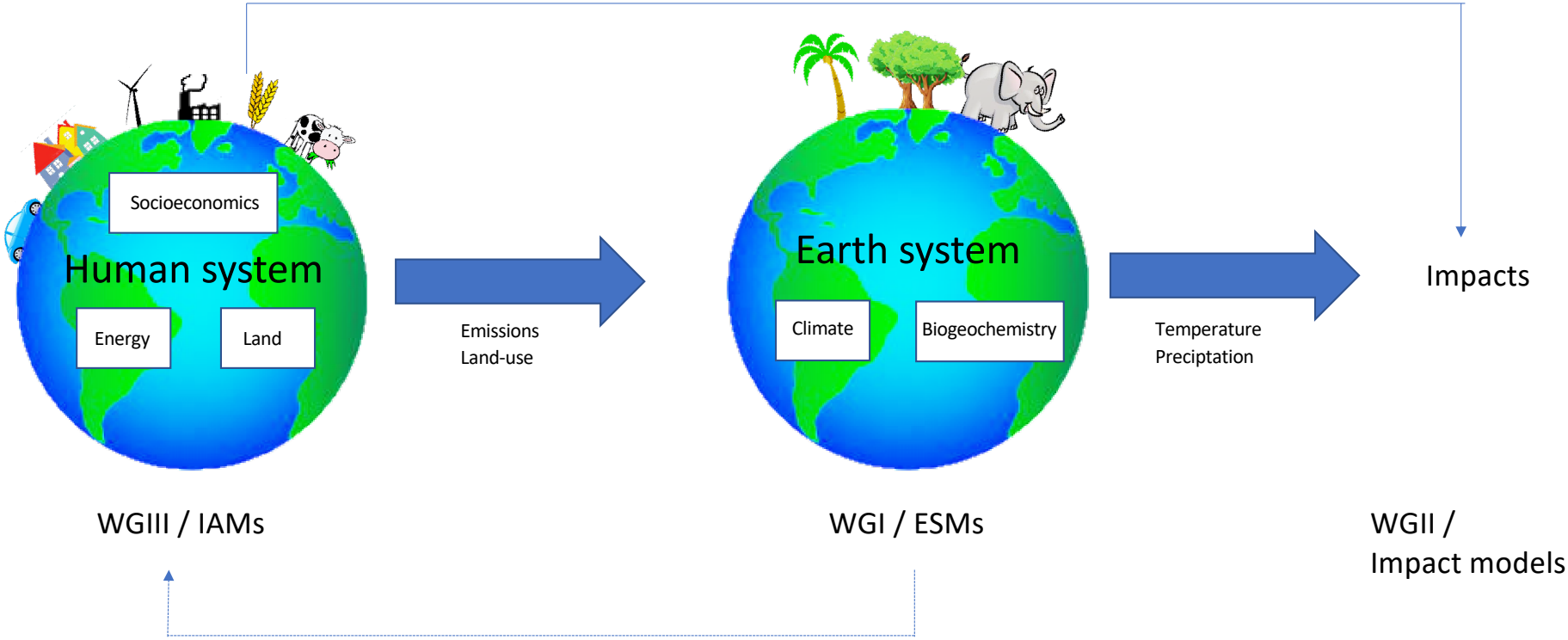
What is MESH?

- Working group within AIMES focused on Modeling Earth and Human System Interactions
- Co-chairs:
  - Kate Calvin
  - Brian O'Neill
  - Julia Pongratz
  - Ben Sanderson
  - Detlef van Vuuren

Recent MESH activities

- MESH co-organized an AGCI session in July of 2021
- Three sessions:
  - Human-Earth System Feedbacks:
    - Defining critical human-earth system feedbacks and modeling needs
    - Advances/Improving human-earth system feedbacks around land use
  - Uncertainty:
    - Model projection uncertainty due to human-earth system interactions
  - Scenario and model development:
    - Role of Human-earth system interactions in scenario and model development
    - Representation of land use in scenario and model development
    - Disruptions, shocks, and extreme events in scenario and model development

Human-Earth System Feedbacks



1. Impacts on agriculture
2. Cooling / heating demand
3. Impacts on energy supply
4. Labour productivity
5. Water availability
6. Extreme events
7. Air pollution

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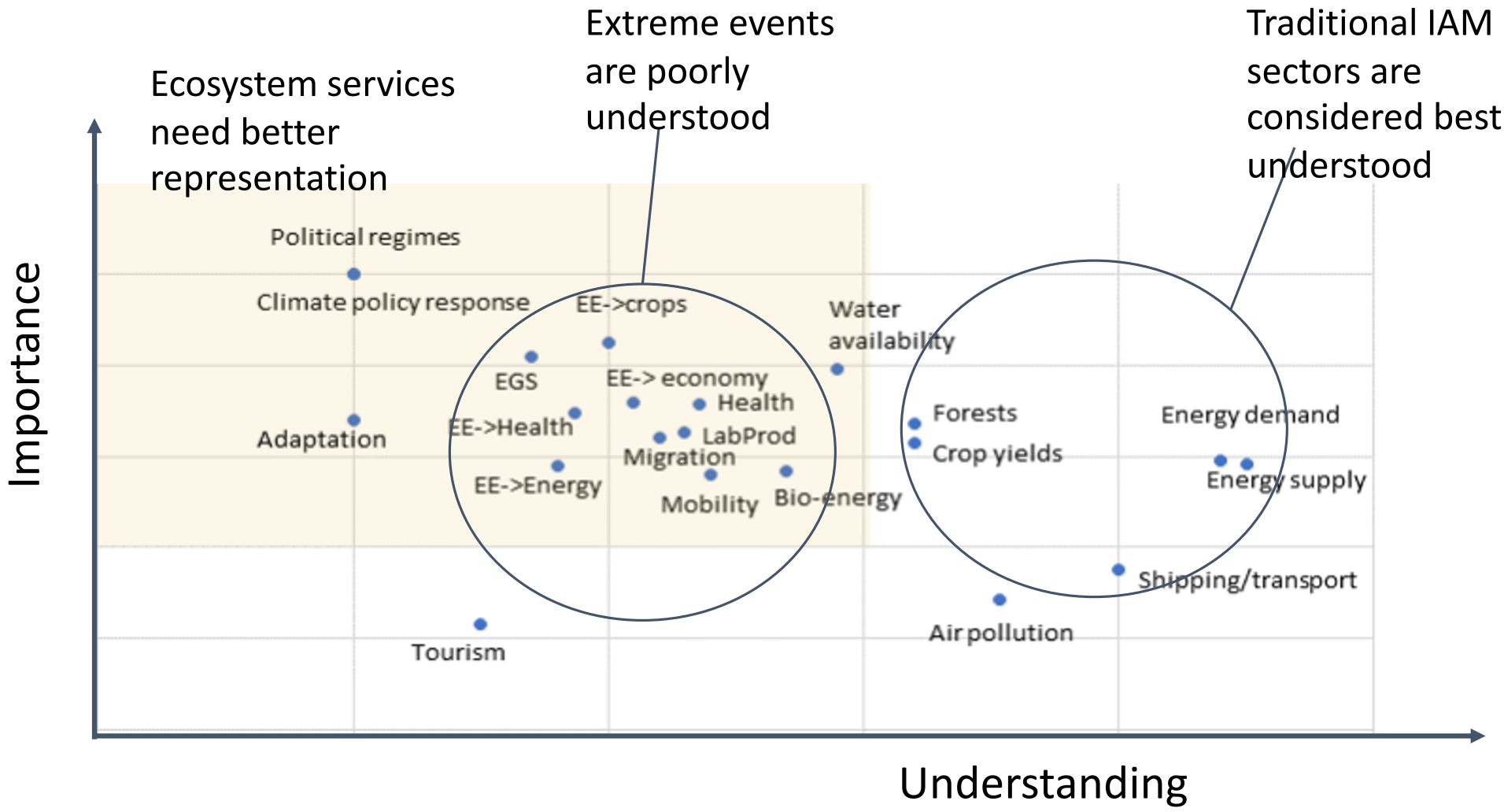
Are there feedbacks that could alter the original scenario in such a major way that the linear system breaks down?


Ecosystem services need better representation
Extreme events are poorly understood
Traditional IAM sectors are considered best understood
Importance
Understanding
Political regimes
Climate policy response
Adaptation
EGS
EE->crops
EE-> economy
Health
EE->Health
LabProd
Migration
EE->Energy
Mobility
Bio-energy
Water availability
Forests
Crop yields
Energy demand
Energy supply
Shipping/transport
Air pollution
Tourism

Uncertainty

P(emissions|ambition)

P(climate|emissions)

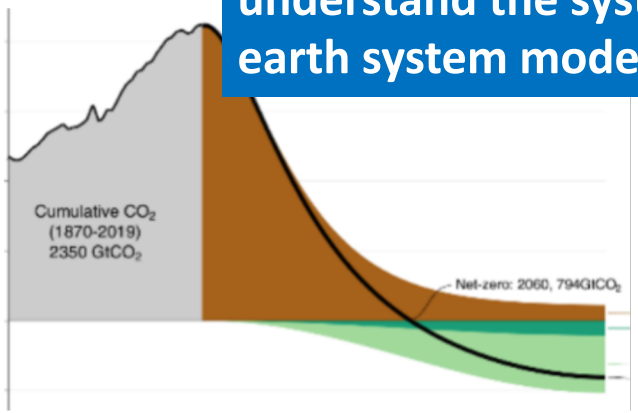
P(impact|climate)

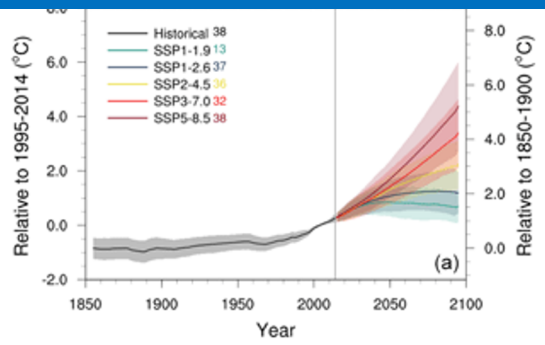
Ambition (1.5C/GDP)

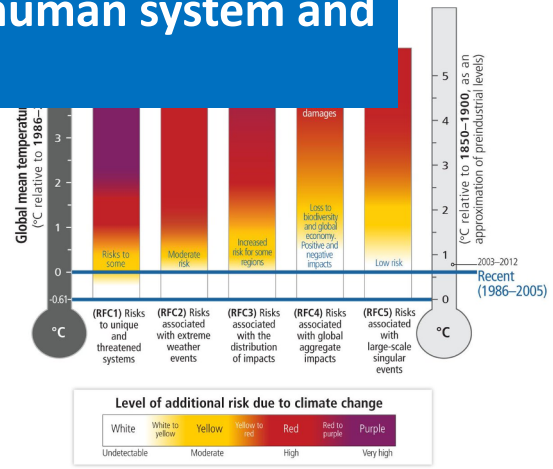
Emissions (or concs) RCP

Climate (1.5C)

Are different methods to describe uncertainty preventing us to fully understand the system? Are our current methods to link human system and earth system models leading to limited understanding?







Some ideas that emerged from the uncertainty session

- Models:
  - Need for model diversity
  - Balancing model complexity
  - Missing feedbacks from impacts to socio-economic models in the CMIP6 simulation chain
  - Significant uncertainty in human system modeling
  - Linguistic uncertainty – what is a model? What is feasible? What is a grassland?
- Scenarios:
  - Concentration-driven vs. Emissions driven runs
  - Expanding scenarios (e.g., capturing transitions between SSPs, CDR, SRM)
  - Need HR, PPE and LE experiments
  - How do we develop scenarios relevant to question of the day vs. develop scenarios that are robust to changing nature of science?
- Communication of scenarios and models

Scenario and model development

- Does our current scenario design allow us to represent human-Earth system feedbacks?
- What improvements or changes to the scenario design are needed to represent land use feedbacks consistently?
- How do we represent shocks, extreme events, and disruptions in our models and scenarios?

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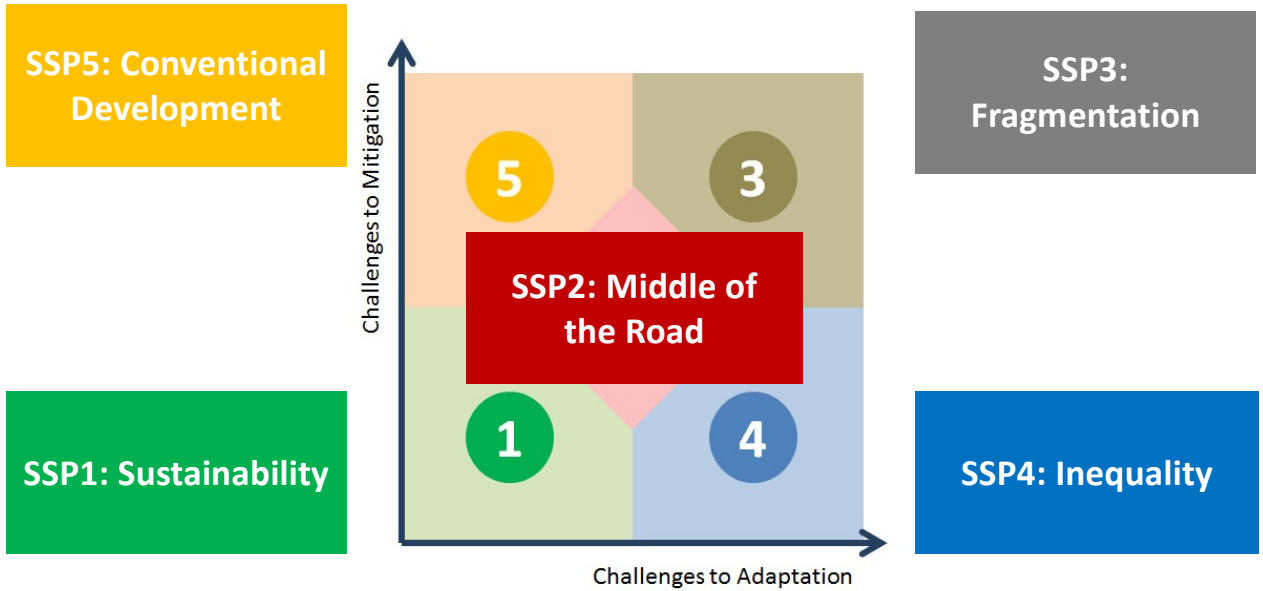
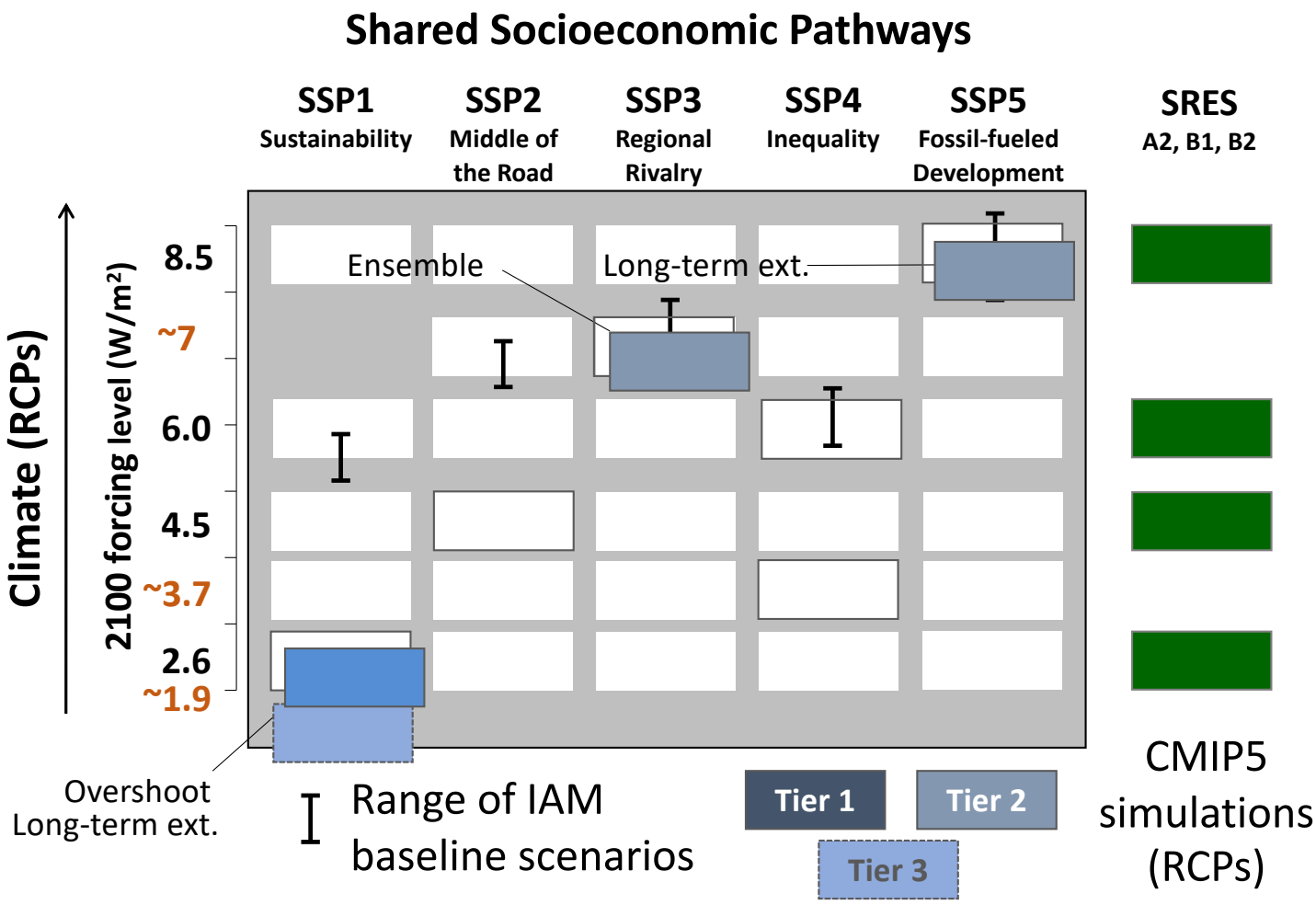
Current Scenario Design

- Five Shared Socio-economic Pathways were designed to explore a range of future societal circumstances that exhibit a wide range of
  - Challenges to adaptation, and
  - Challenges to mitigation.



ScenarioMIP Design: Specific Scenarios



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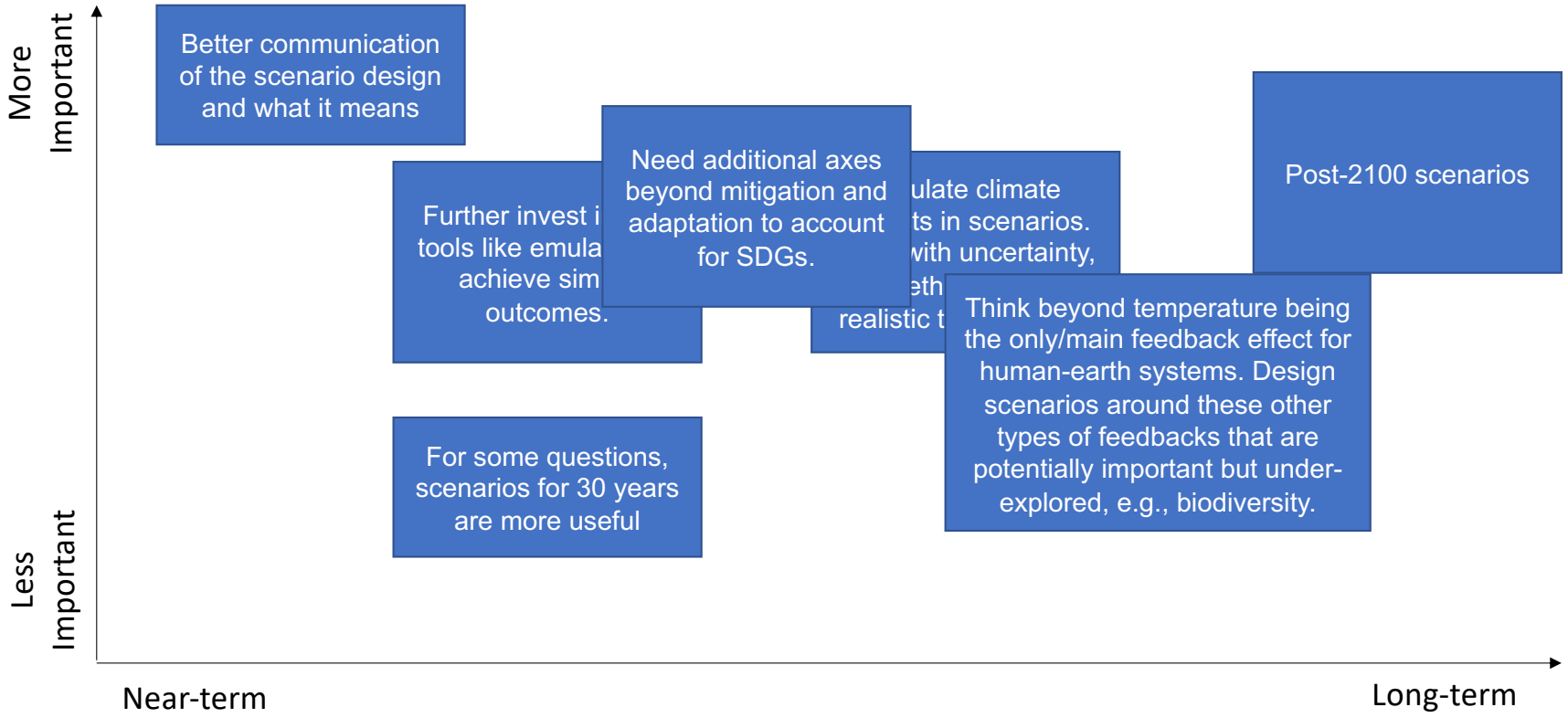

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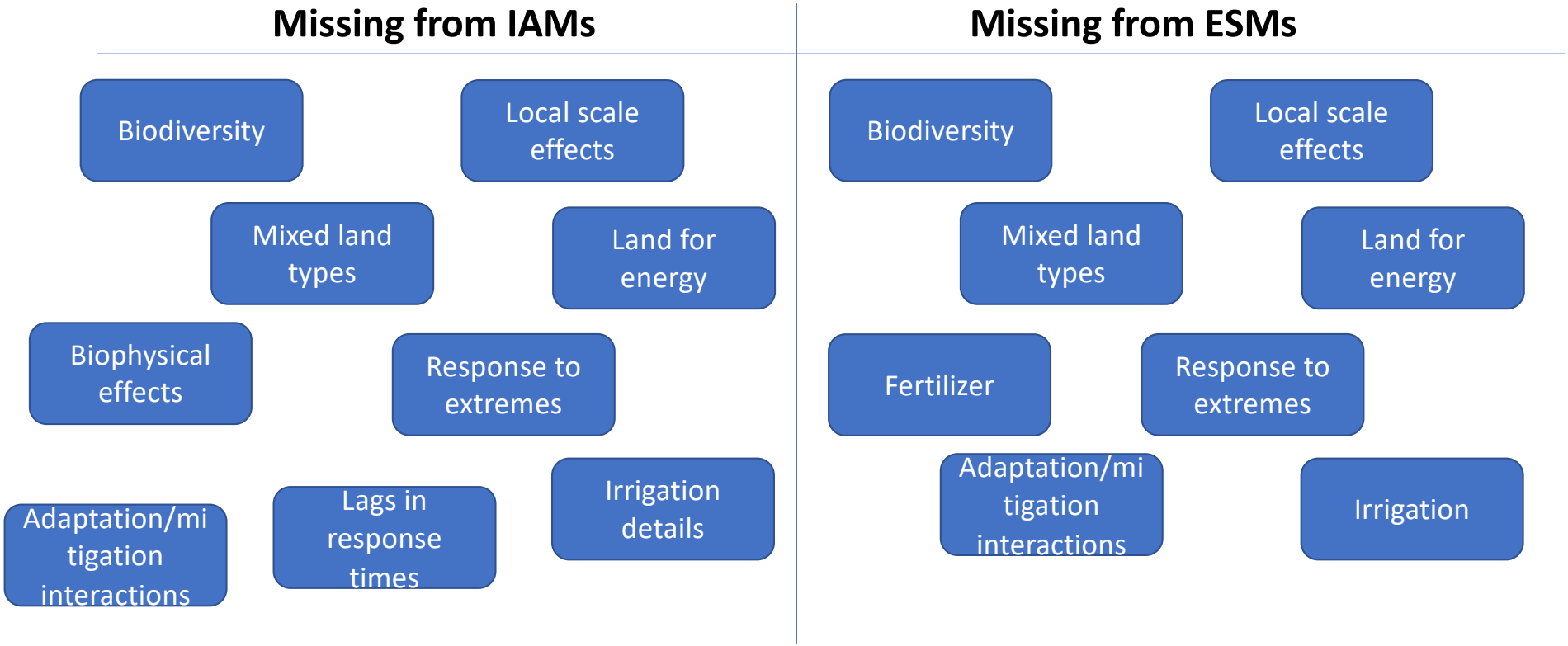
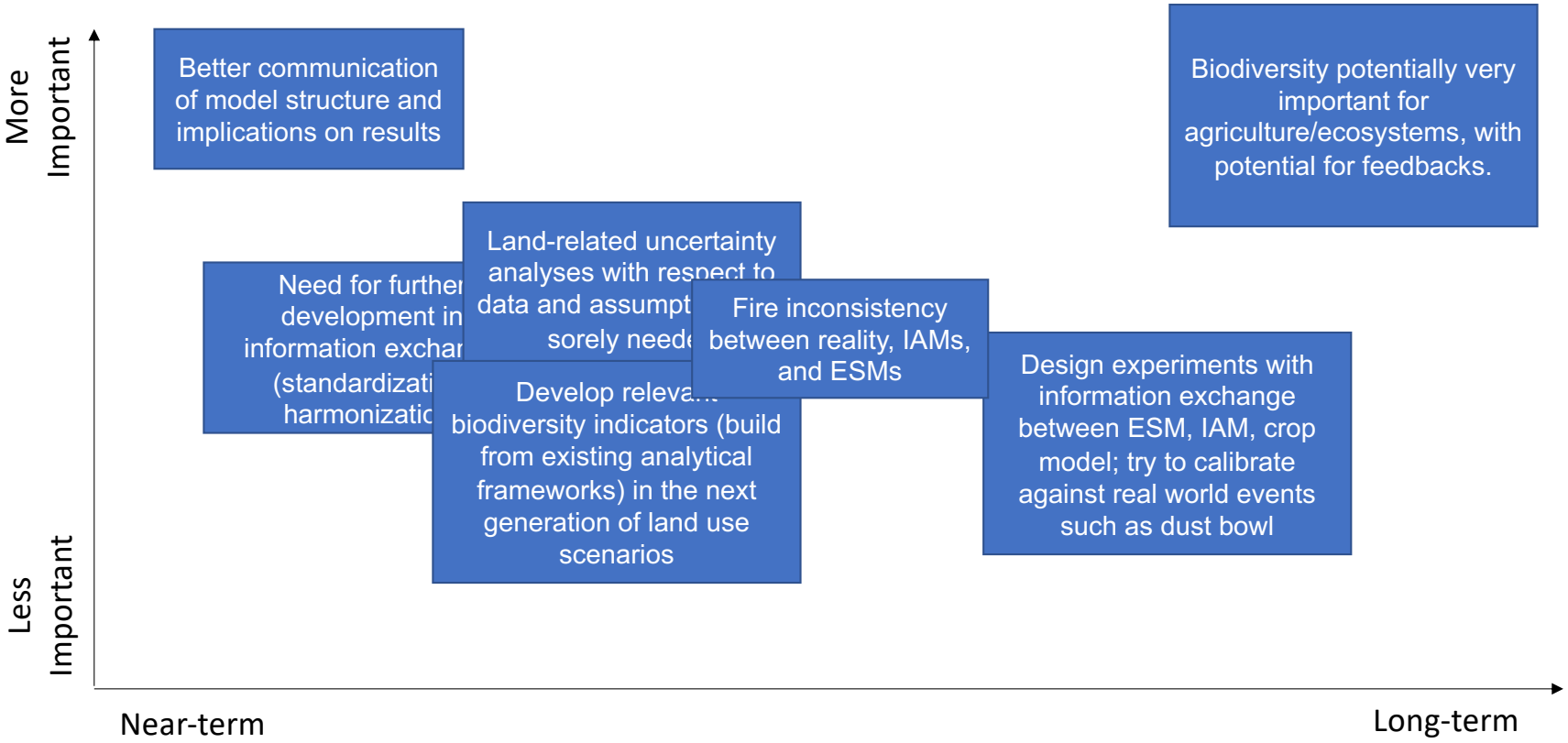
Missing elements in the current treatment of land use



Inconsistencies in the current treatment of land use

- Differences in scale
- Differences in land types and in the definition of land types
- Differences in baseline
- Difference assumptions about productivity and changes in productivity
- LULCC inconsistencies

What improvements or changes to the scenario design are needed to represent land use feedbacks consistently?



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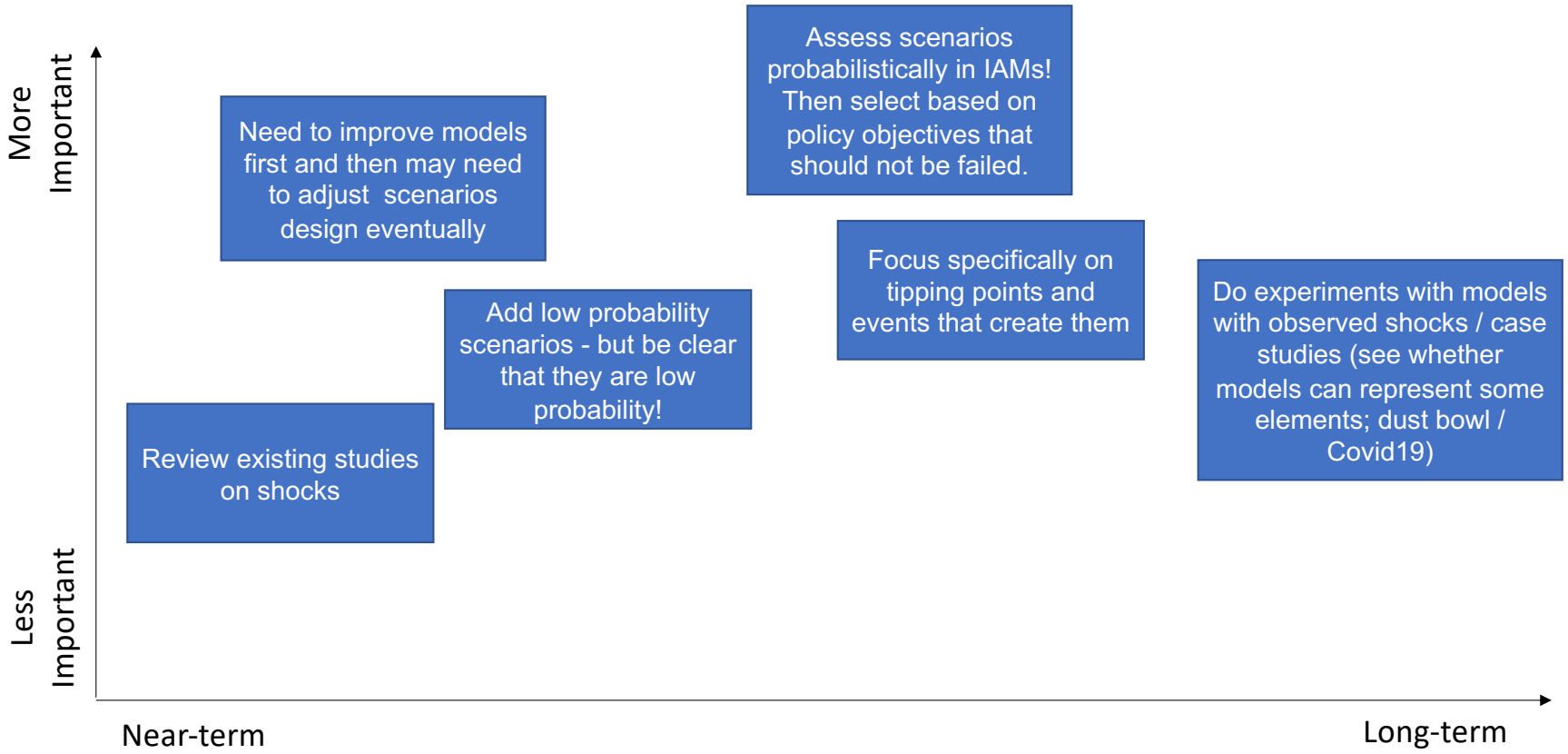

Thank you!