ScenarioMIP: The up and coming CMIP6 scenarios
ScenarioMIP

Members

Co-chairs: Brian O’Neill, Claudia Tebaldi, Detlef van Vuuren
SSC Members: Veronika Eyring, Pierre Friedlingstein, George Hurtt, Reto Knutti,
        Jean-Francois Lamarque, Jason Lowe, Jerry Meehl, Richard Moss,
        Ben Sanderson

Friends

Additional IAM researchers: Kate Calvin, Shinichiro Fujimori, Elmar Kriegler,
        Keywan Riahi

IAV Community: ICONICS, TGICA

LUMIP Co-chairs: Dave Lawrence, George Hurtt

AerChemMIP Co-Chairs: Jean-Francois Lamarque, William Collins, Michael Schulz

Other MIPs: C4MIP, GeoMIP
### ScenarioMIP

#### Role and Objectives

<table>
<thead>
<tr>
<th>Facilitating integrated research across climate science, IAM and IAV communities</th>
<th>Anchoring targeted experiments to answer questions about specific forcings</th>
<th>Facilitating research on uncertainty/model reliability for future projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Span wide forcing range and intermediate levels</td>
<td>• Include scenarios with forcings useful to other MIPs (land use, aerosols, high signal/noise, overshoot, etc.)</td>
<td>• Multi-model ensembles</td>
</tr>
<tr>
<td>• Continuity with CMIP5</td>
<td></td>
<td>• Emergent constraints</td>
</tr>
<tr>
<td>• Include new forcing pathways of interest</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CMIP6 and ScenarioMIP
The Past
SRES and CMIP5 RCPs

![Graph showing Anthropogenic Radiative Forcing (W m²) over time for different scenarios including SRES-B1, SRES-A1B, SRES-A2, RCP2.6, RCP4.5, RCP6.0, and RCP8.5.](image-url)
What’s new?
The new scenario framework

- Since SRES, a new set of alternative ways in which society could evolve in the future has been developed.

- **Shared Socioeconomic Pathways (SSPs)** describing these alternative futures in terms of **qualitative narratives** and **quantitative elements** (population, GDP, etc.) have been produced, together with

- corresponding **scenarios of emissions** and land-use (through IAMs), both for these futures in the absence of mitigation policies (baseline scenarios) and for the same futures but assuming several degrees of mitigation action.
Design Space

<table>
<thead>
<tr>
<th>SSP1 Sustainability</th>
<th>SSP2 Middle of the Road</th>
<th>SSP3 Regional Rivalry</th>
<th>SSP4 Inequality</th>
<th>SSP5 Fossil-fueled Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.5</td>
<td>~7</td>
<td>~3.4</td>
<td>2.6</td>
<td>~2.0</td>
</tr>
</tbody>
</table>

- **Update RCPs**
- **Fill in gaps**

**SRES A2, B1, B2**

**CMIP5 simulations (RCPs)**

- ~7
- ~2.0
ScenarioMIP
Questions for the experimental design

- Which **global average forcing pathways** (range, spacing, shape*, time horizon**)?
- Which **socioeconomic scenarios** driving forcing pathways?
- Which pathways for **specific forcers** (land use, aerosols)?
- **Emissions** driven or **concentration** driven?
- **How many** scenarios?
- **How many ensemble members**?

* Overshoot
** Extensions
### Actual Design

<table>
<thead>
<tr>
<th>2100 forcing level (W/m²)</th>
<th>SSP1 Sustainability</th>
<th>SSP2 Middle of the Road</th>
<th>SSP3 Regional Rivalry</th>
<th>SSP4 Inequality</th>
<th>SSP5 Fossil-fueled Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+LTE</td>
</tr>
<tr>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td>+LE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td></td>
<td></td>
<td></td>
<td>+OS/LTE</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td></td>
<td>+LTE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>+LTE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tier 1**

**Tier 2**

**LE**: Large ensemble

**LTE**: Long-term extension

**OS**: Overshoot

*all in Tier 2*
What drove the choice of SSPs?

- Facilitate climate research (interesting land use, and or aerosols)
- Scenarios that are most relevant to the IAM/IAV community
The Future
CMIP6 RCPs

Source: Riahi et al, 2016
## Design Summary

### Tier 1

- SSP5-8.5
- SSP3-7.0
- SSP2-4.5
- SSP1-2.6

One run per scenario
2016-2100

### Tier 2

- SSP1?-2.0?
- SSP4-6.0
- SSP4-3.7

9 more IC ensemble members for SSP3-7.0
Overshoot
Long-term extensions
LUMIP will run variants of our 2.6, 7.0 and 8.5 with complementary land use specifications.

AerChemMIP will run a variant of our 7.0 with reduced near-term climate forcers.
ScenarioMIP
Next Steps

- Paper describing goals and design in CMIP6 special issue of Geoscientific Model Development (O’Neill et al., in revision.)
- Provide future forcings to GCMs, including base-year (2016) harmonization
- Coordinate GCM simulations (~2017/2018)
- Facilitate provision of model output to the wide research community
- Analyze results
QUESTIONS?