Scenarios for future CMIP

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Working Group on Coupled Modeling – 25
Topics

SSP-RCP scenario framework use
  CMIP6 model participation
  Use of scenario framework in research and assessment

Emerging scenario research needs
  Scenarios Forum (including CMIP, IPCC sessions)
  AIMES workshop on human-earth system coupling
  Integrated Assessment Modeling Consortium meetings

Goals for CMIP/ScenarioMIP process
CMIP6 Scenario MIP ESM runs

Scenario ESMs

Tier 1 45-50
SSP1-1.9 16
Overshoot 17
Tier 2 10
Lg. Ens. 9

Data courtesy of Neil Swart, Environment Canada.
Wide use in integrated analysis
More than half of studies on impacts
Climate and impact studies use more high-end scenarios on balance
Mitigation analyses use more low-end scenarios on balance

SSP-RCP scenario use in the literature

Carole Green, 2022
IPCC AR6 experience

WG1: Strong use in many chapters, Tier 1 + SSP1-1.9
   Possibly over-emphasis on SSP5-8.5 and RCP8.5, but constrained by literature especially at regional level

WG2: No systematic use for synthesis, but significant contribution to assessed literature

WG3: Systematic use as “illustrative pathways”, mainly SSP2

SYR: ?

AR7: Workshop coming up in April 2023 for AR6 stock-taking and look forward to AR7
Emerging research needs

Updated CMIP6 scenarios?
  Population/GDP updates occurring now, (presumably) IAMs to follow
  Encourage/request Tier 2 scenario simulations

Re-assess high/low end scenario plausibility, policy relevance
Re-assess high/low end scenario plausibility

Tebaldi et al., 2021, ESD.

Implausible emissions (coal use)? Implausible lack of impacts?

Implausible rate of emissions reduction? Use of negative emissions?
Emerging research needs

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Re-assess high/low end scenario plausibility

Temperature overshoot scenarios
  Particularly lower magnitude than SSP5-3.4-OS
Temperature overshoot scenarios

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Emissions-driven scenarios for deep decarbonization
   Earth system plausibility of large-scale CDR
   Carbon cycle feedbacks, land use effects
Emissions-driven scenarios for deep decarbonization

1.5 C emissions pathways: 5-20 GtCO2/yr negative emissions by 2100!
Emerging research needs

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Reference scenarios with impacts
  Implications for ScenarioMIP simulations?

ESM runs for calibration of emulators
  Simple climate models, emulation of global mean temperature
  Spatial climate outcomes for impact assessment
  Substantial progress in emulation since AR6 cycle, several approaches
Example of emulation advances: STITCHES (Tebaldi et al. 2022)

Start with ESM simulations
Define target GSAT path to be emulated (eg from IAM)
Divide all simulations into X-year segments
For each target segment, take ESM segment that has similar GSAT, ΔGSAT
“Stitch” ESM segments together
If ESM has saved it, STITCHES can emulate it! (with caveats…)
Goals for ScenarioMIP process in CMIP7

Reconstitute MIP membership to reflect wider participation by different research communities
   Possibly semi-formal connection to large scale impact modeling
Proceed as MIP without also having a Task Team on same topic
Start process early
   Allow for development of tools to automate IAM->ESM process
Re-evaluate potential role of emulation in ScenarioMIP design
Pursue coordinated approach across MIPs
   Strategic Ensemble Design TT, LUMIP, C4MIP, AerChemMIP, RCMIP, GeoMIP, …
   Repeat the cross-MIP AGCI meeting from early AR6?
Develop short-/longer-term plans, to meet needs for AR7 and beyond
Thank you