The GCAM Shared Socioeconomic Pathways (SSPs)

KATE CALVIN

▶ 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
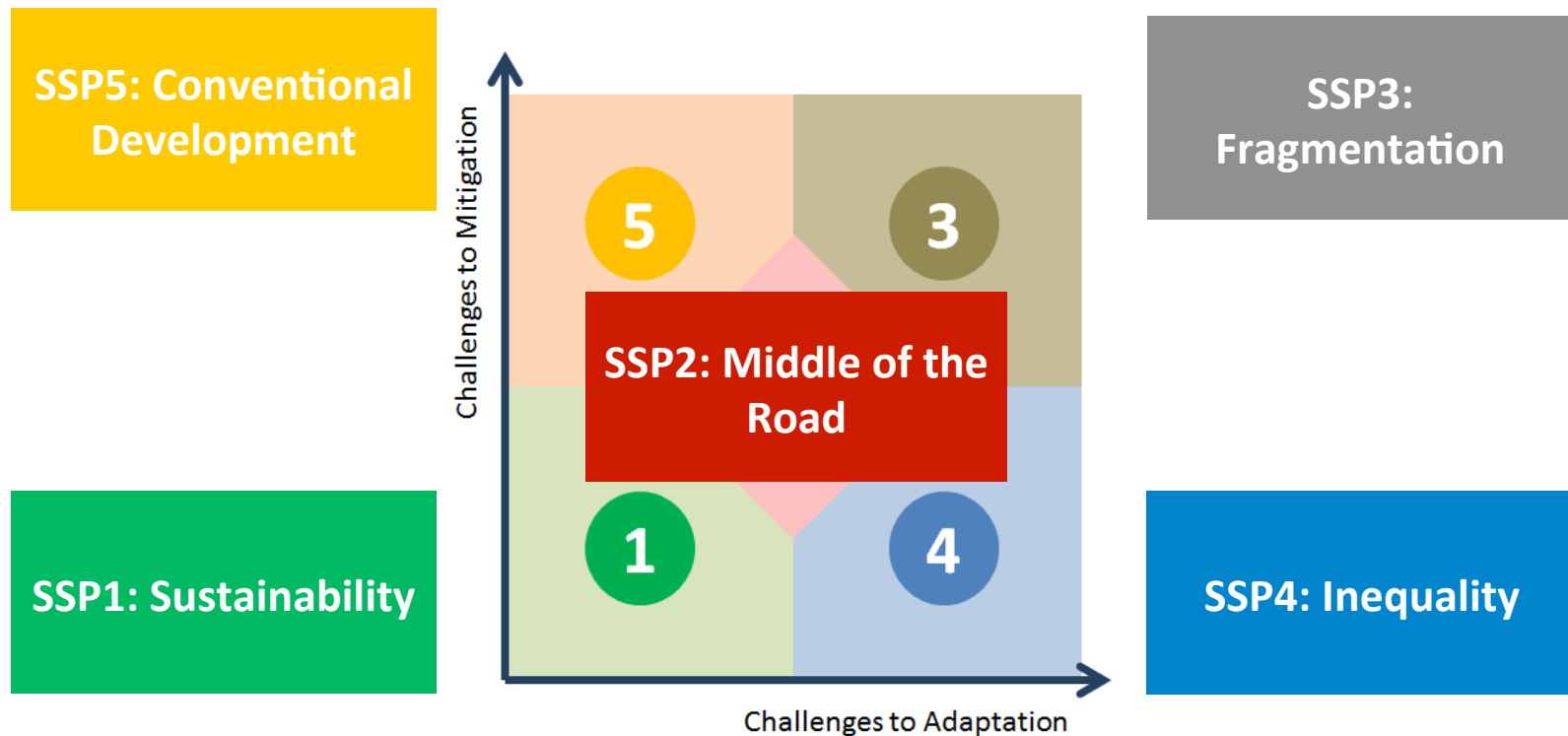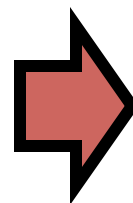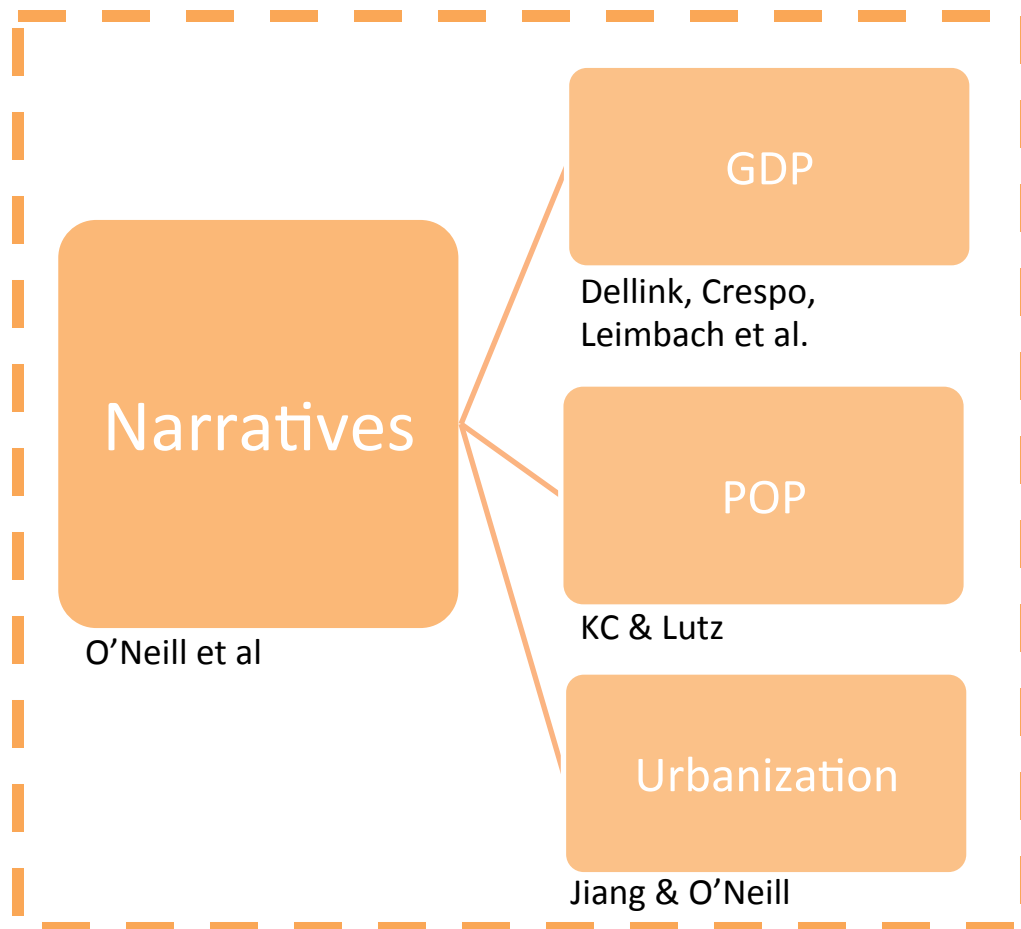- ■ **Challenges to mitigation**.

Pacific Northwest
NATIONAL LABORATORY
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IAM Models

SSPs (Basic Drivers)

Narratives

O'Neill et al

GDP

Dellink, Crespo, Leimbach et al.

POP

KC & Lutz

Urbanization

Jiang & O'Neill

Technology, Demand, Life-styles, Productivity

Energy

Land-use

GHG Emissions

Aerosol/Pollutant Emissions

AIM/CGE, GCAM, IMAGE, MESSAGE-GLOBIOM, REMIND-MAGPIE, WITCH-GLOBIOM

SSP Narratives

SSP5: Conventional Development

- Rapid economic development
- Stabilizing population
- Consumerism
- High fossil fuel dependency
- Eradication of extreme poverty and universal access to education and basic services
- Highly engineered infrastructure and ecosystems

SSP3: Fragmentation

- Rapid population growth
- Slow economic growth
- Failing to achieve MDG
- High resource intensity and fossil fuel dependency
- Low investments in technology development and education
- Unplanned settlements
- Weak int'l governance and local institutions

SSP2: Middle of the Road

- Current trends continue
- Moderate population growth
- Slowly converging incomes between industrialized and developing countries
- Delayed MDG achievement
- Reductions in resource and energy intensity at historic rates
- Environmental degradation

SSP1: Sustainability

- Good progress towards sustainable development
- Stabilizing population
- Decreasing income inequality
- Early MDG achievement
- Low resource intensity and fossil fuel dependency
- Strong int'l governance and local institutions
- Well managed urbanization
- Environmentalism

SSP4: Inequality

- Increasing inequality within and across countries
- Effective governance controlled by a small number of rich global elites
- Most of populations with limited access to higher education and basic services
- Energy tech R&D made by global energy corporations
- Low social cohesion

Fossil Resources

SSP Element	SSP 1			SSP 2			SSP 3 *Country Income Groupings*			SSP 4			SSP 5		
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
Coal															
Macro-economy	cost driver			neutral			cost reducing			cost reducing	neutral	cost driver	cost reducing		
Technology	medium			medium			high			medium			very high		
National & environmental policy	very restrictive			supportive			very supportive			supportive	supportive	restrictive	very restrictive		
Conv. Hydrocarbons															
Macro-economy	neutral			neutral			neutral			cost driver			cost reducing		
Technology	medium			medium			medium			fast			very high		
National & environmental policy	restrictive			supportive			mixed (not supported in MEA/FSU)			supportive	supportive	restrictive	very restrictive		
Non-conv. Hydrocarbons															
Macro-economy	neutral			neutral			neutral			cost driver			cost reducing		
Technology	slow			medium			medium			medium			very high		
National & environmental policy	very restrictive			supportive			very supportive			supportive	supportive	restrictive	very restrictive		
General															
Trade barriers	Free			Barriers			High Barriers			Barriers			Free		

GCAM Fossil Fuel Assumptions

	Technical Change on Extraction Cost (% per year)					Cost Adder in 2100 ($/GJ)				
	SSP1	**SSP2**	**SSP3**	**SSP4**	**SSP5**	**SSP1**	**SSP2**	**SSP3**	**SSP4**	**SSP5**
Coal	0.5%	0.5%	1%	0.5%	2%	$1.37	$0.27	$0	$0.27	$0
Gas	0.5%	0.5%	0.5%	1%	2%	$0.14	$0.14	$0.14	$0.71	$0
Conventional Oil	0.5%	0.5%	0.5%	1%	2%	$0.20	$0.20	$0.20	$0.98	$0
Unconventional Oil	0%	0.5%	0.5%	0.5%	2%	$0.21	$0.21	$0.21	$1.06	$0

Sample Config File

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<!-- BUILDINGS-->
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<!-- AGLU-->
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<Value name="aglu">../input/gcam-data-system/xml/aglu-xml/pasture_ssp34.xml</Value>

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<!-- SOLAR-->
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<!-- TRADE-->
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Policy Assumptions

	First model time period with global cooperation (i.e., harmonized global carbon price)					Land Policy				
	SSP1	SSP2	SSP3	SSP4	SSP5	SSP1	SSP2	SSP3	SSP4	SSP5
High Income	2025	2040	2040	2025	2040	Carbon Price on Land is Equal to Energy Carbon Price (i.e., UCT in Wise et al., 2009)	Carbon Price on Land is Equal to 50% of Energy Carbon Price	No Land Policy (i.e., FFICT in Wise et al., 2009)	Carbon Price on Land is Equal to Energy Carbon Price (i.e., UCT in Wise et al., 2009)	Carbon Price on Land is Equal to Energy Carbon Price (i.e., UCT in Wise et al., 2009)
Medium Income	2025	2040	2040	2025	2040	Carbon Price on Land is Equal to Energy Carbon Price (i.e., UCT in Wise et al., 2009)	Carbon Price on Land is Equal to 50% of Energy Carbon Price	No Land Policy (i.e., FFICT in Wise et al., 2009)	Carbon Price on Land is Equal to 50% of Energy Carbon Price	Carbon Price on Land is Equal to Energy Carbon Price (i.e., UCT in Wise et al., 2009)
Low Income	2025	2040	2050	2025	2040	Carbon Price on Land is Equal to Energy Carbon Price (i.e., UCT in Wise et al., 2009)	Carbon Price on Land is Equal to 50% of Energy Carbon Price	No Land Policy (i.e., FFICT in Wise et al., 2009)	No Land Policy (i.e., FFICT in Wise et al., 2009)	Carbon Price on Land is Equal to Energy Carbon Price (i.e., UCT in Wise et al., 2009)

Extra Files for Policy Cases

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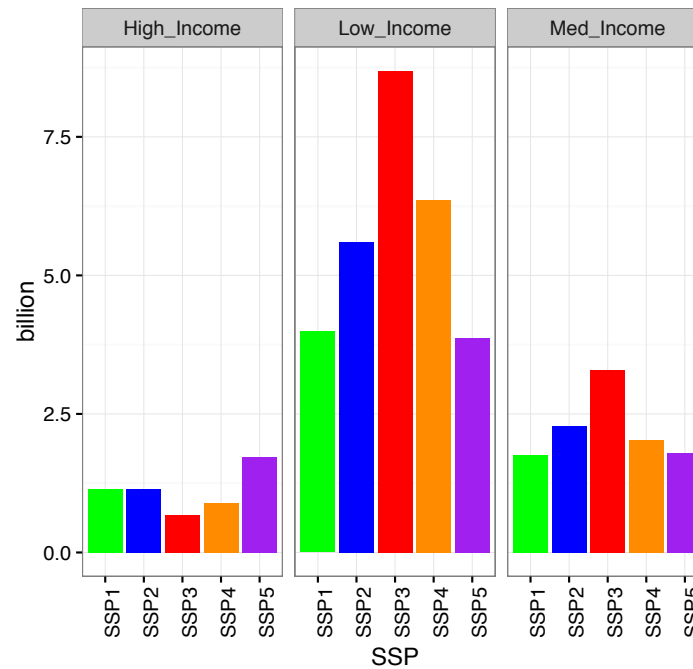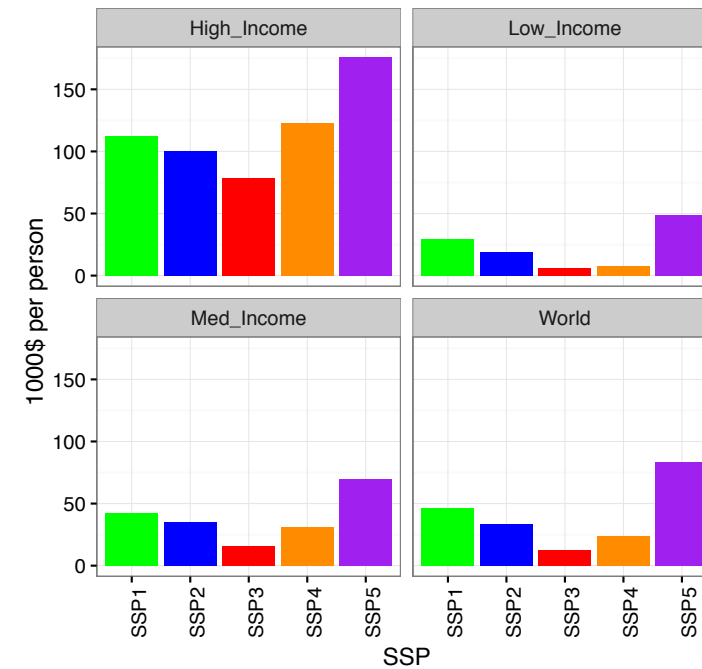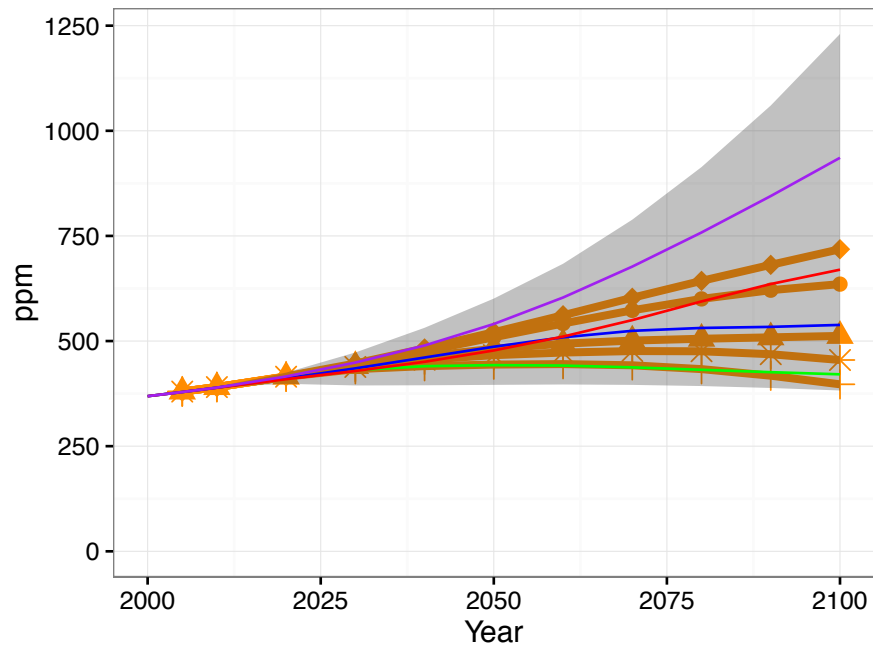
Sample Results

A. Population
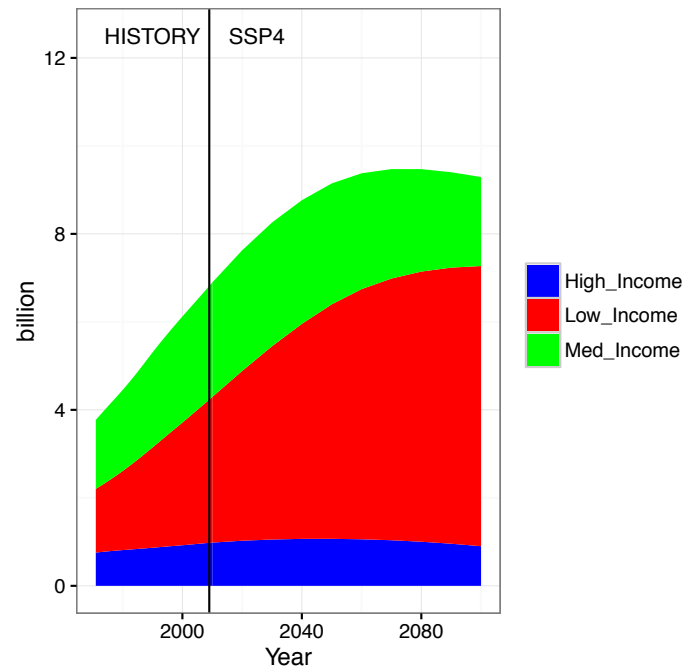
B. GDP Per Capita (MER)
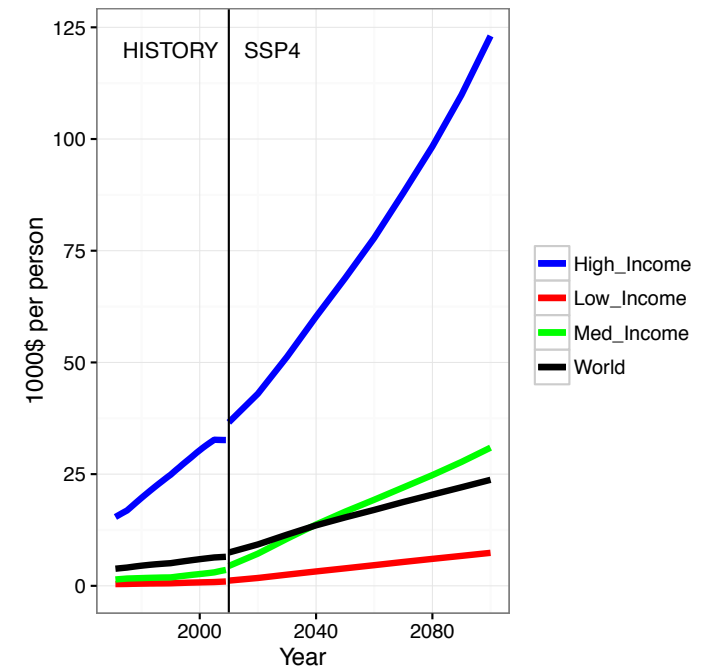
C. 2100 Population By SSP

D. 2100 GDP Per Capita (MER)

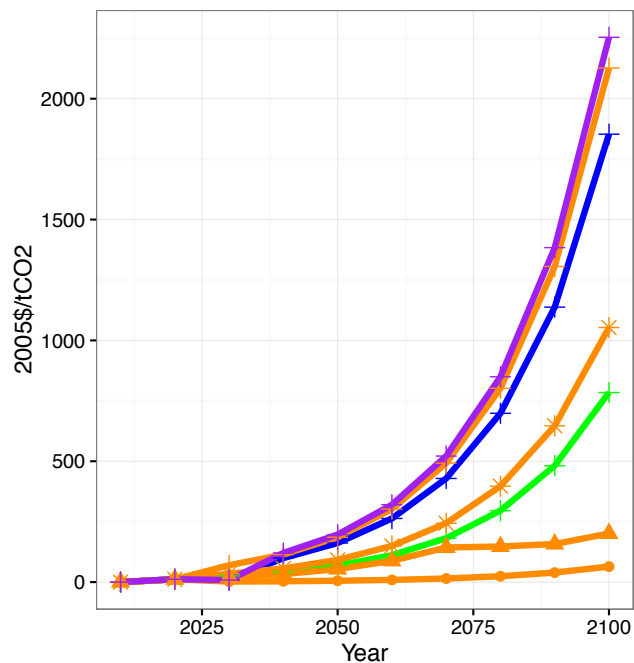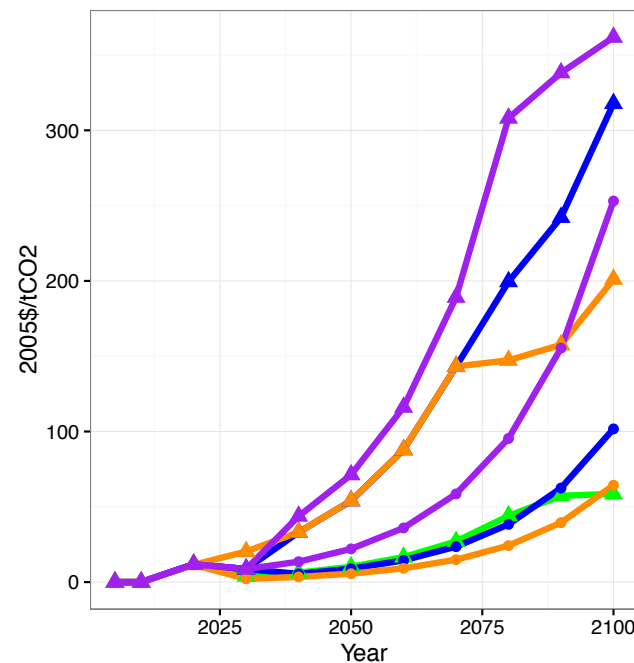A. CO₂ Concentration — B. Forcing — C. Global Mean Temperature Rise
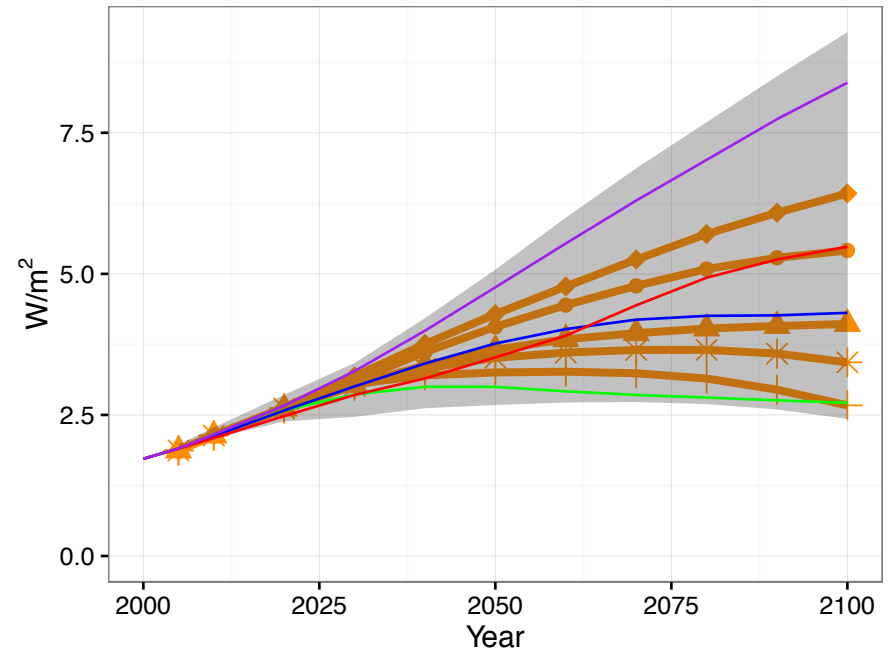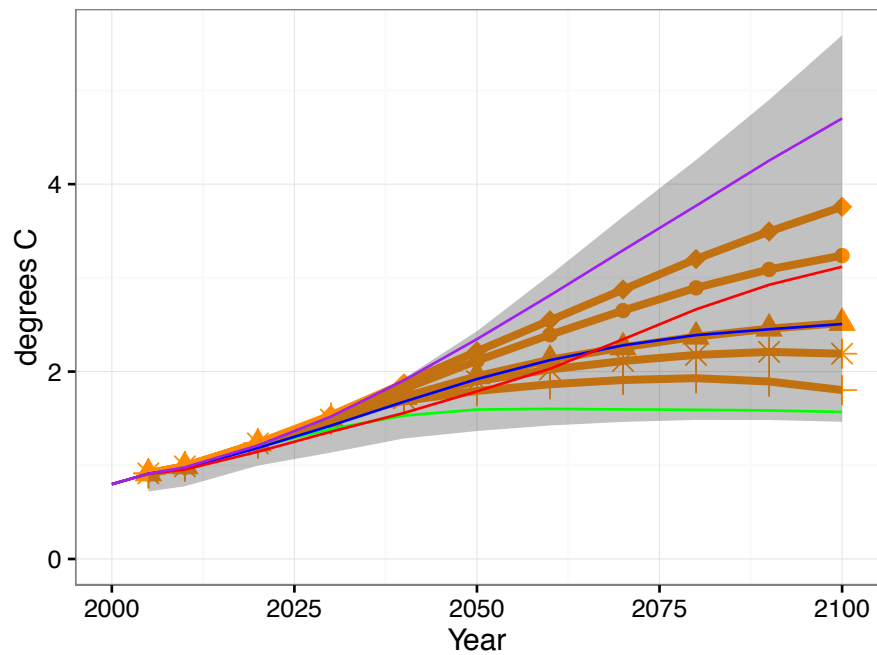
RF
+ 26
✳ 34
▲ 45
● 60
◆ Baseline
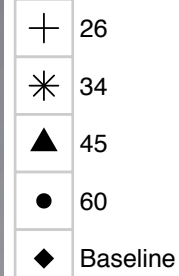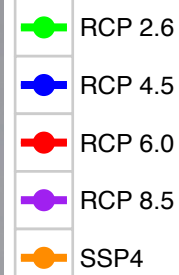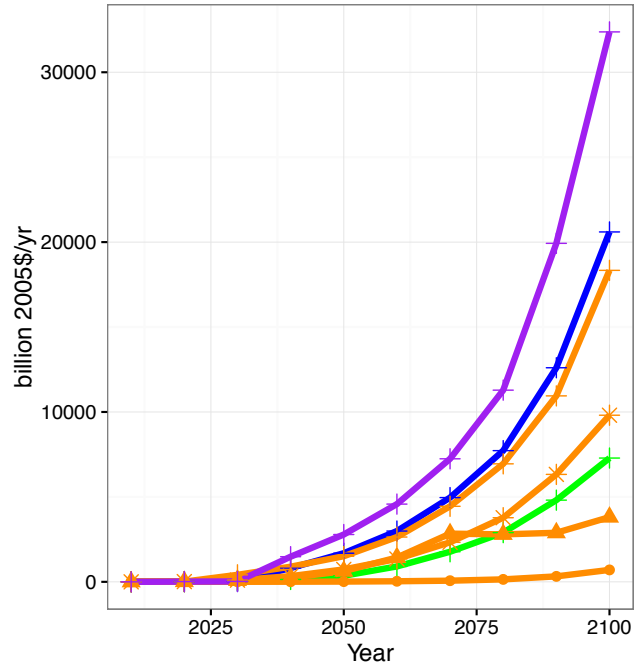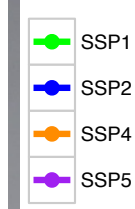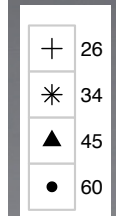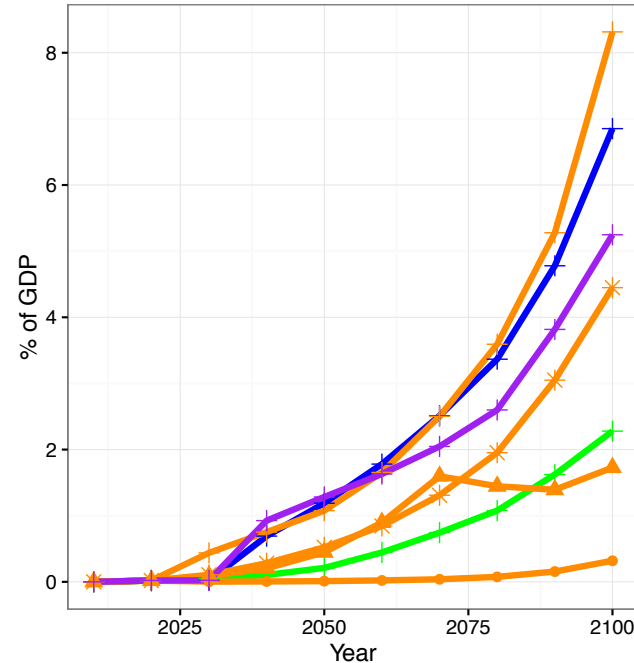
SSP
● RCP 2.6
● RCP 4.5
● RCP 6.0
● RCP 8.5
● SSP4

Documentation Paper

The SSP4: A world of deepening inequality

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Pralit Patel[a], Steve Smith[a], Stephanie Waldhoff[a], Marshall Wise[a]

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ARTICLE INFO

ABSTRACT

Five new scenarios, or Shared Socioeconomic Pathways (SSPs), have been developed, spanning a range of challenges to mitigation and challenges to adaptation. The Shared Socioeconomic Pathway 4 (SSP4), "Inequality" or "A Road Divided," is one of these scenarios, characterized by low challenges to mitigation and high challenges to adaptation. We describe, in quantitative terms, the SSP4 as implemented by the Global Change Assessment Model (GCAM), the marker model for this scenario. We use demographic and economic assumptions, in combination with technology and non-climate policy assumptions to develop a quantitative representation of energy, land-use and land-cover, and emissions consistent with the SSP4 narrative. The scenario is one with stark differences within and across regions. High-income regions prosper, continuing to increase their demand for energy and food. Electrification increases in these regions, with the increased generation being met by nuclear and renewables. Low-income regions, however, stagnate due to limited economic growth. Growth in total consumption is dominated by increases in population, not increases in per capita consumption. Due to failures in energy access policies, these regions continue to depend on traditional biofuels, leading to high pollutant emissions. Declining dependence on fossil fuels in all regions means that total radiative forcing absent the inclusion of mitigation or impacts only reaches 6.4 W m^{-2} in 2100, making this a world with relatively low challenges to mitigation. We explore the effects of mitigation effort on the SSP4 world, finding that the imposition of a carbon price has a varied effect across regions. In particular, the SSP4 mitigation scenarios are characterized by afforestation in the high-income regions and deforestation in the low-income regions. Furthermore, we find that the SSP4 is a world with low challenges to mitigation, but only to a point due to incomplete mitigation of land-related emissions.

Some Notes

▶ The GCAM SSPs will be released as part of the core in a few months.

- This release will include input and configuration files to generate reference cases for all 5 SSPs and policy cases for 4 of 5 SSPs.

- However, the results using this release will not exactly match the official SSPs because the new release will use the most updated version of GCAM. The official SSPs branched from the core in December 2014 and include only limited updates to the model since that point.

- We do plan to document the differences between the official GCAM SSPs and this release.