CLIMATE CHANGE PROGRAMME

Progress in the development of new scenarios to support IAV research

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Outline

1. Why new scenarios?
2. A parallel process of scenario development
3. RCPs and new climate projections
4. Storylines, SSPs and SPAs
5. Opportunities and challenges for IAV research
6. Concluding remarks

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Outline

1. **Why new scenarios?**

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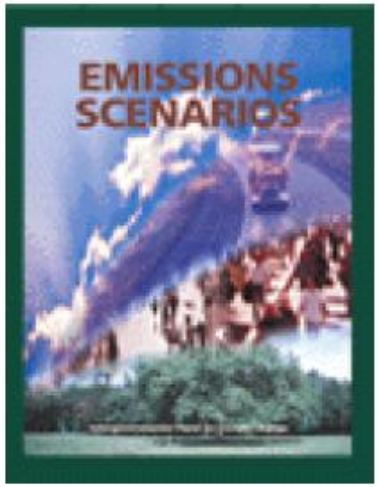
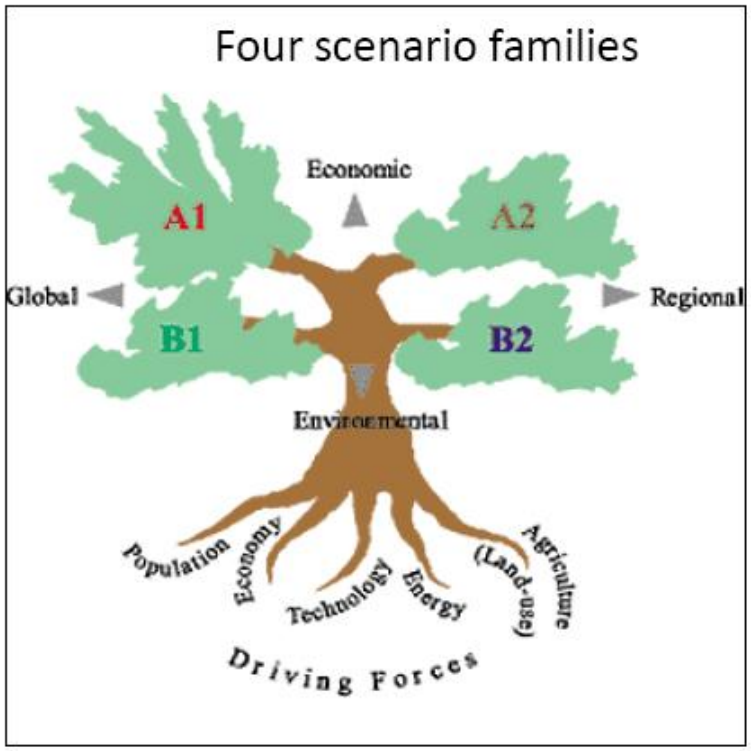
Why do we need new scenarios?



Nakicenovic et al.: Special Report on Emissions Scenarios (IPCC, 2000)



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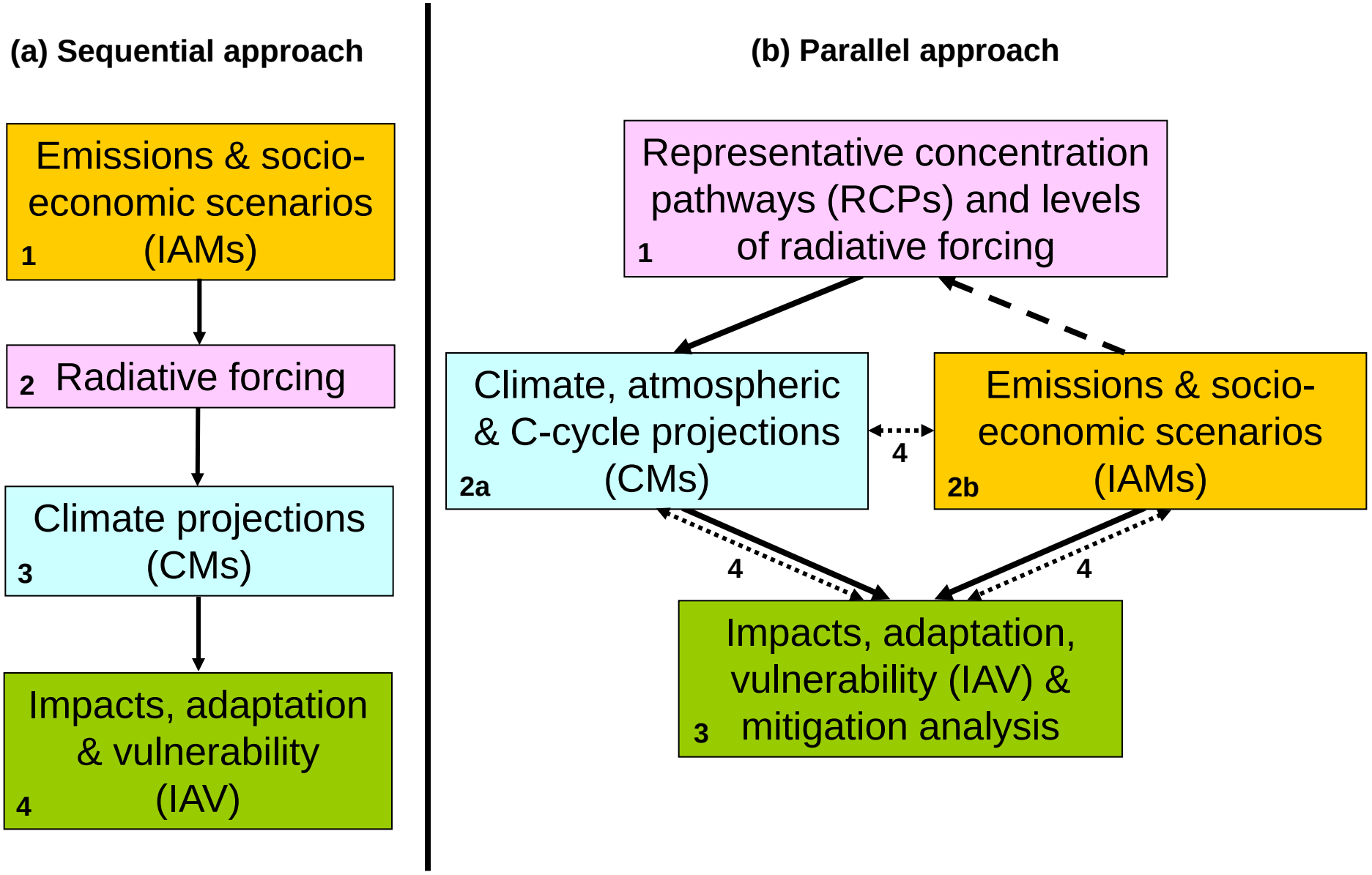
Why do we need new scenarios?

- SRES scenarios becoming outdated (base year 1990, published in 2000)
- Variables described by SRES and Post-SRES scenarios do not necessarily span relevant uncertainties in anthropogenic forcing, climate or vulnerability to climate change
- SRES scenarios do not include all relevant variables of importance in IAV analysis
- New scenarios should facilitate improved integration between IPCC WGII and WGIII
- Climate policies are specifically excluded from SRES

Outline

1. Why new scenarios?
2. **A parallel process of scenario development**


(a) Sequential approach
Emissions & socio-economic scenarios (IAMs)
1
Radiative forcing
2
Climate projections (CMs)
3
Impacts, adaptation & vulnerability (IAV)
4
(b) Parallel approach
Representative concentration pathways (RCPs) and levels of radiative forcing
1
Climate, atmospheric & C-cycle projections (CMs)
2a
Emissions & socio-economic scenarios (IAMs)
2b
4
4
4
Impacts, adaptation, vulnerability (IAV) & mitigation analysis
3

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The development of new, integrated scenarios for climate change analysis

Vol 463|11 February 2010|doi:10.1038/nature08823 nature

Moss et al. (2010)

PERSPECTIVES

The next generation of scenarios for climate change research and assessment

Richard H. Moss[1], Jae A. Edmonds[1], Kathy A. Hibbard[2], Martin R. Manning[3], Steven K. Rose[4], Detlef P. van Vuuren[5], Timothy R. Carter[6], Seita Emori[7], Mikiko Kainuma[7], Tom Kram[5], Gerald A. Meehl[2], John F. B. Mitchell[8], Nebojsa Nakicenovic[9,10], Keywan Riahi[9], Steven J. Smith[1], Ronald J. Stouffer[11], Allison M. Thomson[1], John P. Weyant[12] & Thomas J. Wilbanks[13]

Advances in the science and observation of climate change are providing a clearer understanding of the inherent variability of Earth's climate system and its likely response to human and natural influences. The implications of climate change for the

A community-led process

These are not IPCC scenarios

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Outline

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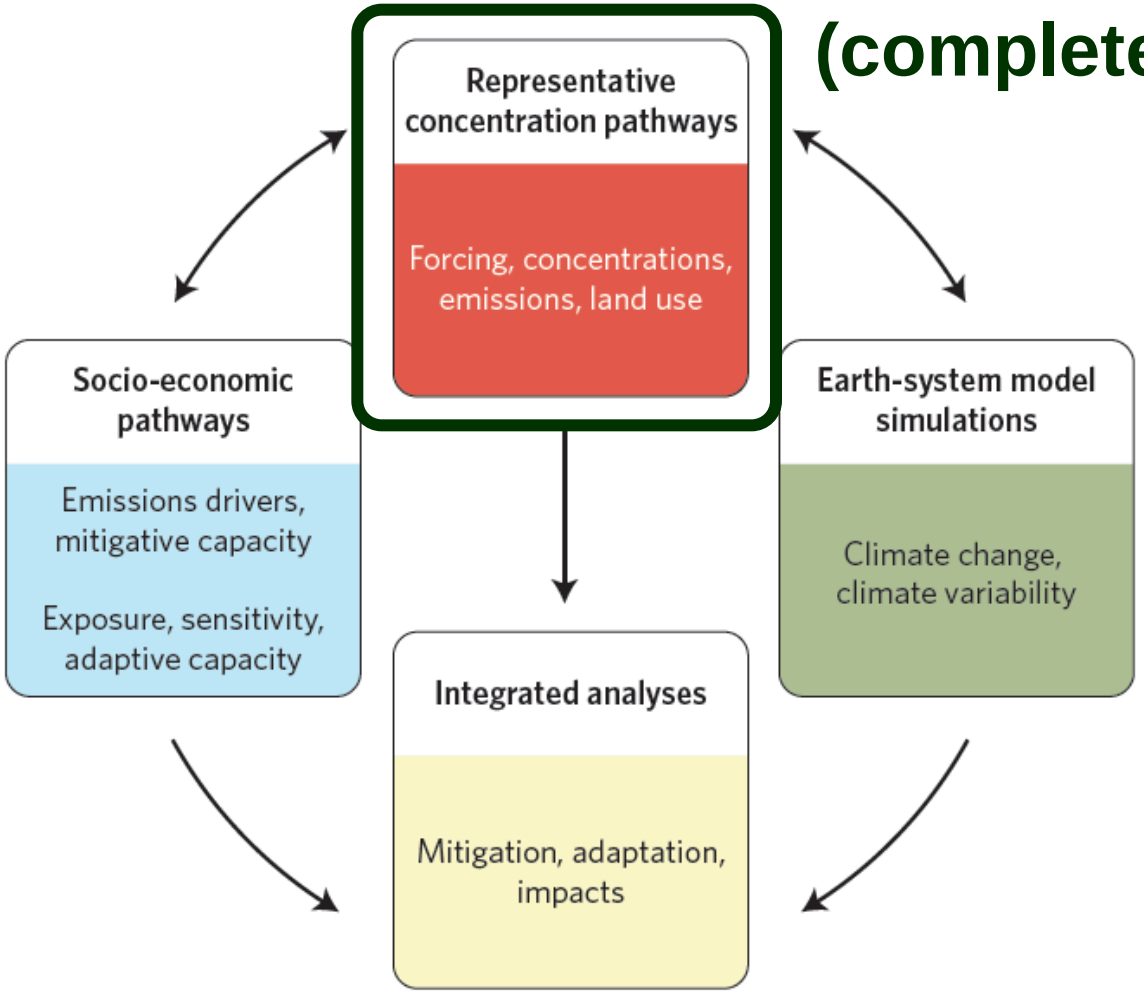
2. A parallel process of scenario development
3. **RCPs and new climate projections**

The Parallel Process

RCPs (complete)

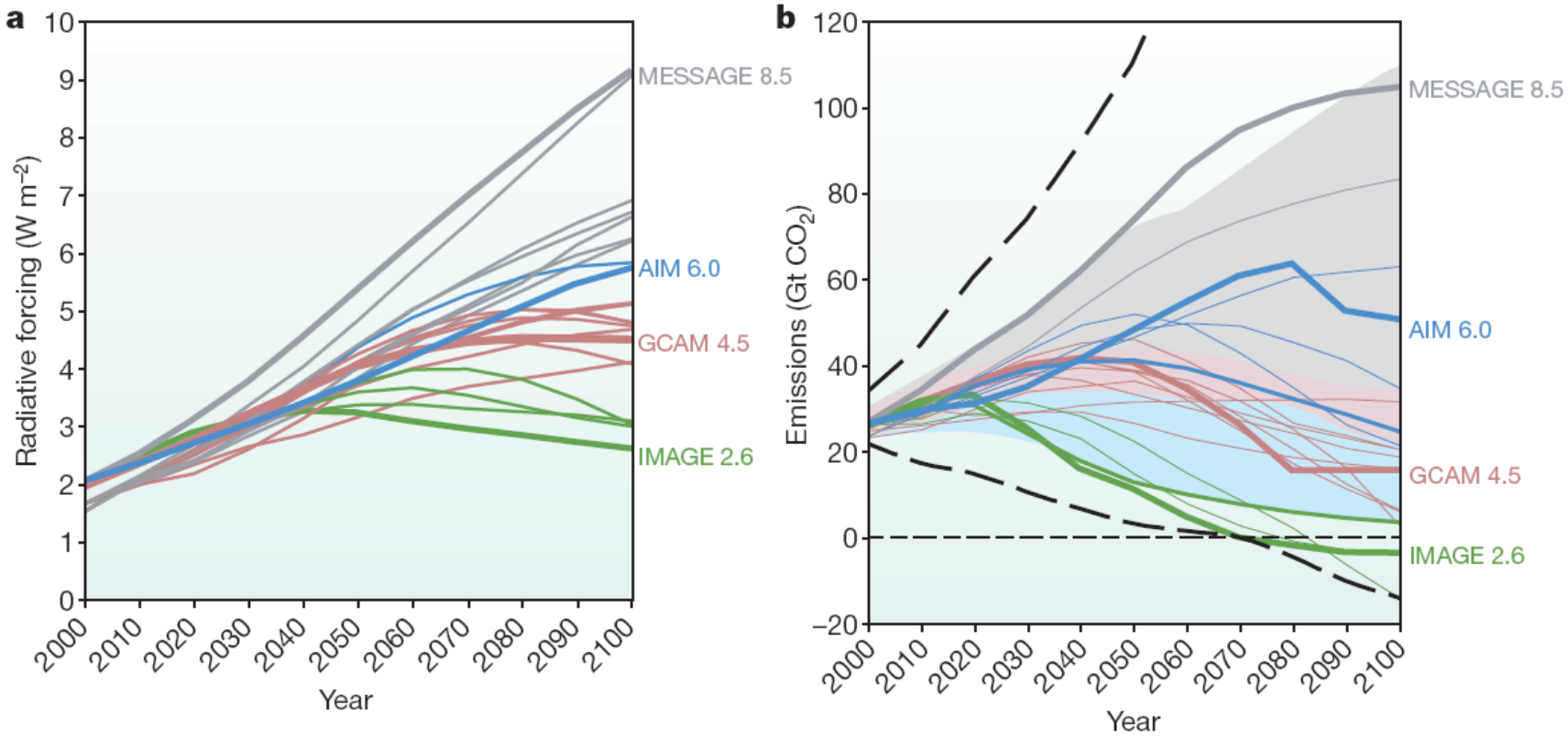


Source: O'Neill and Schweizer (2011)

Representative Concentration Pathways (RCPs)

Change in radiative forcing (relative to pre-industrial)

CO_2 emissions (energy and industry)



Source: Moss et al. 2010

Special issue of *Climatic Change* (van Vuuren et al., 2011) available online (most papers Open Access)

Database of IAM inputs/outputs for each RCP available online at IIASA website

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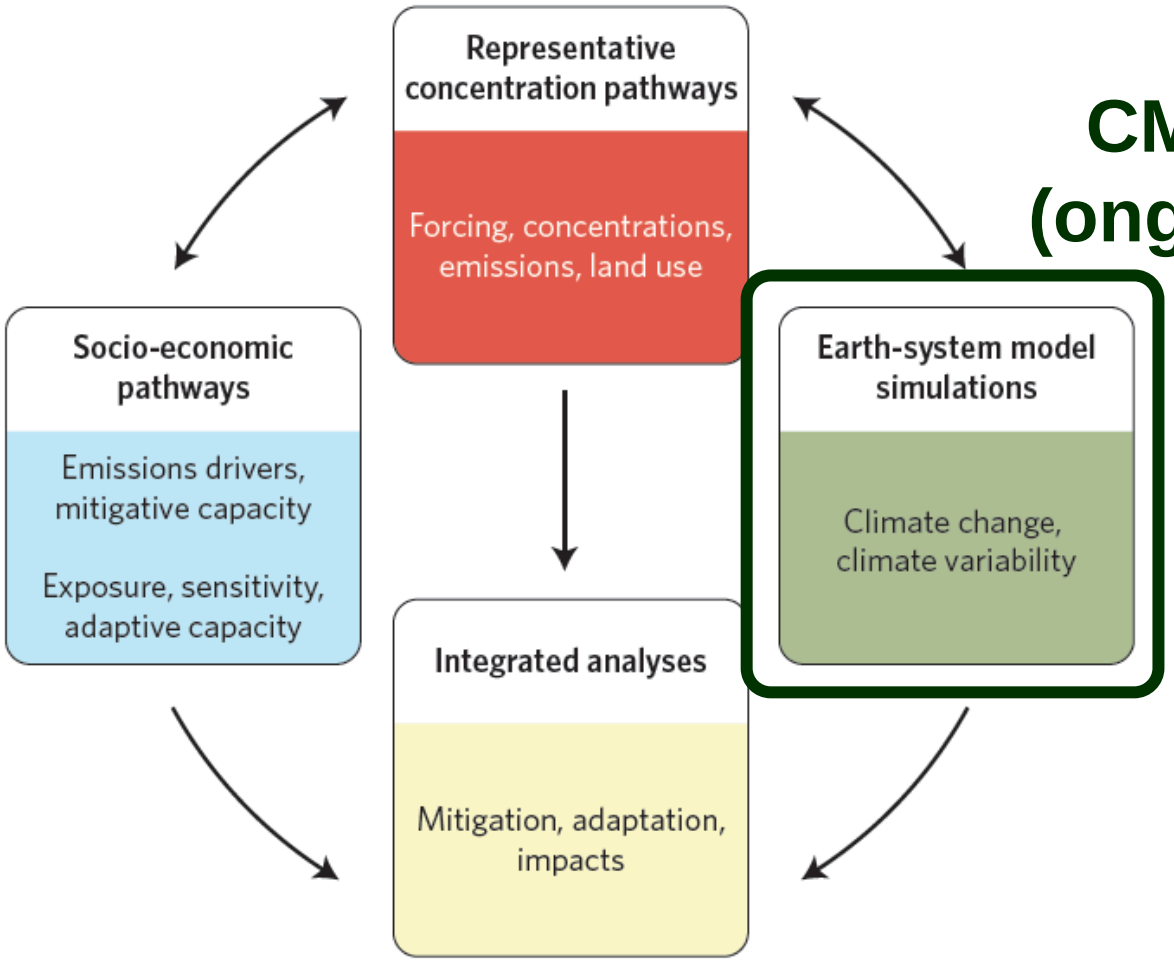
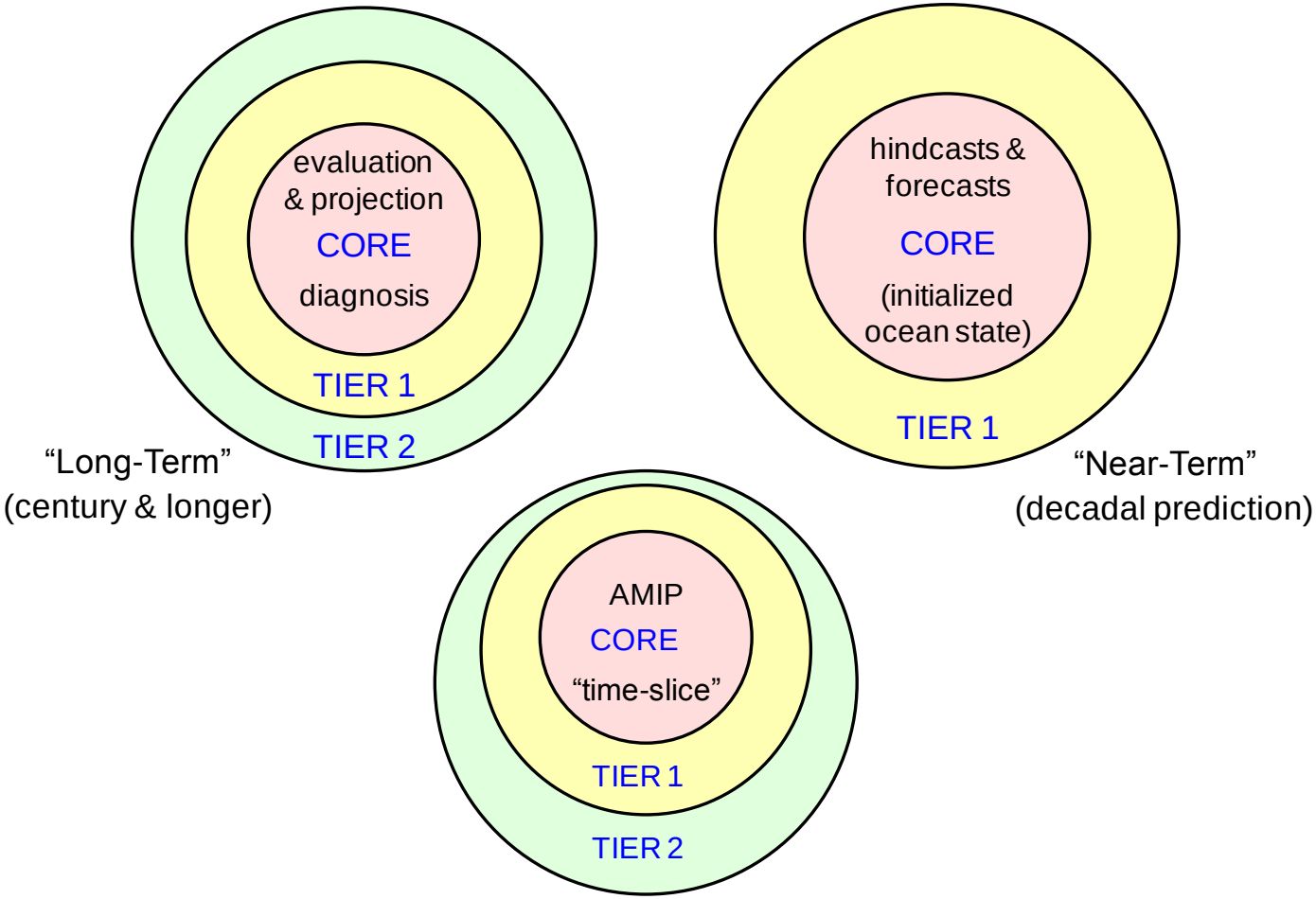
The Parallel Process



CMIP5 (ongoing)

Source: O'Neill and Schweizer (2011)

CMIP5: Three Suites of Experiments



PCMDI

http://cmip-pcmdi.llnl.gov/cmip5

Karl Taylor, 2010

Status of CMIP5 (4 November 2011)

About 23 global climate modeling groups are expected to participate in CMIP5 with 50+ models

currently about half way there

- **Data currently available from 13 groups with 23 models, 450 Tb of data**

(CMIP3 had 16 groups and 23 models, 35 Tb of data).

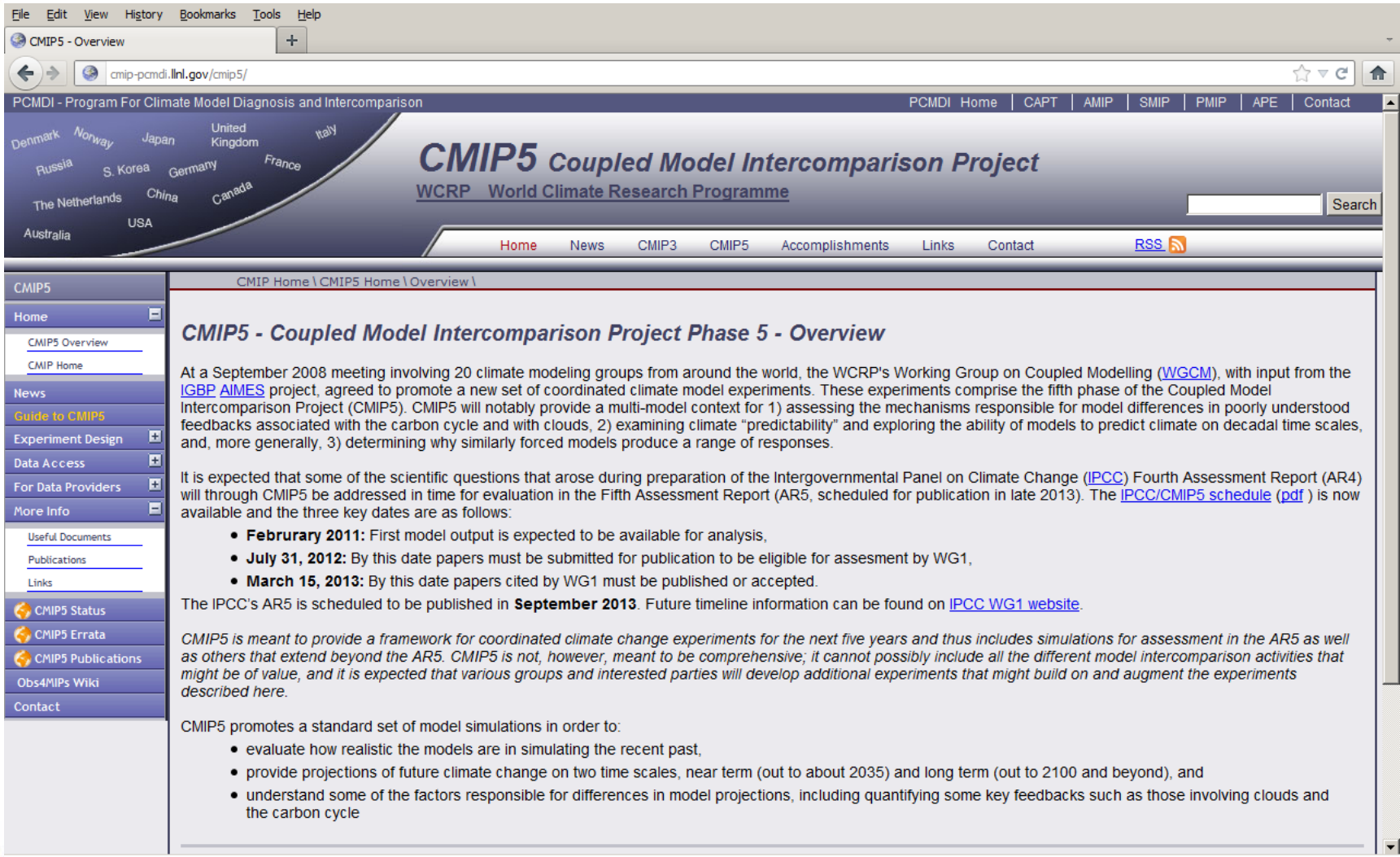
- **About 10 groups will have ESMs (6 so far)**

- **A number of groups will do the decadal prediction experiments (6 so far)**

- several groups will have high-resolution time slice AGCMs (<50 km)

Source: Meehl, Boulder Workshop, Nov 2011

CMIP5 website: http://cmip-pcmdi.llnl.gov/cmip5/



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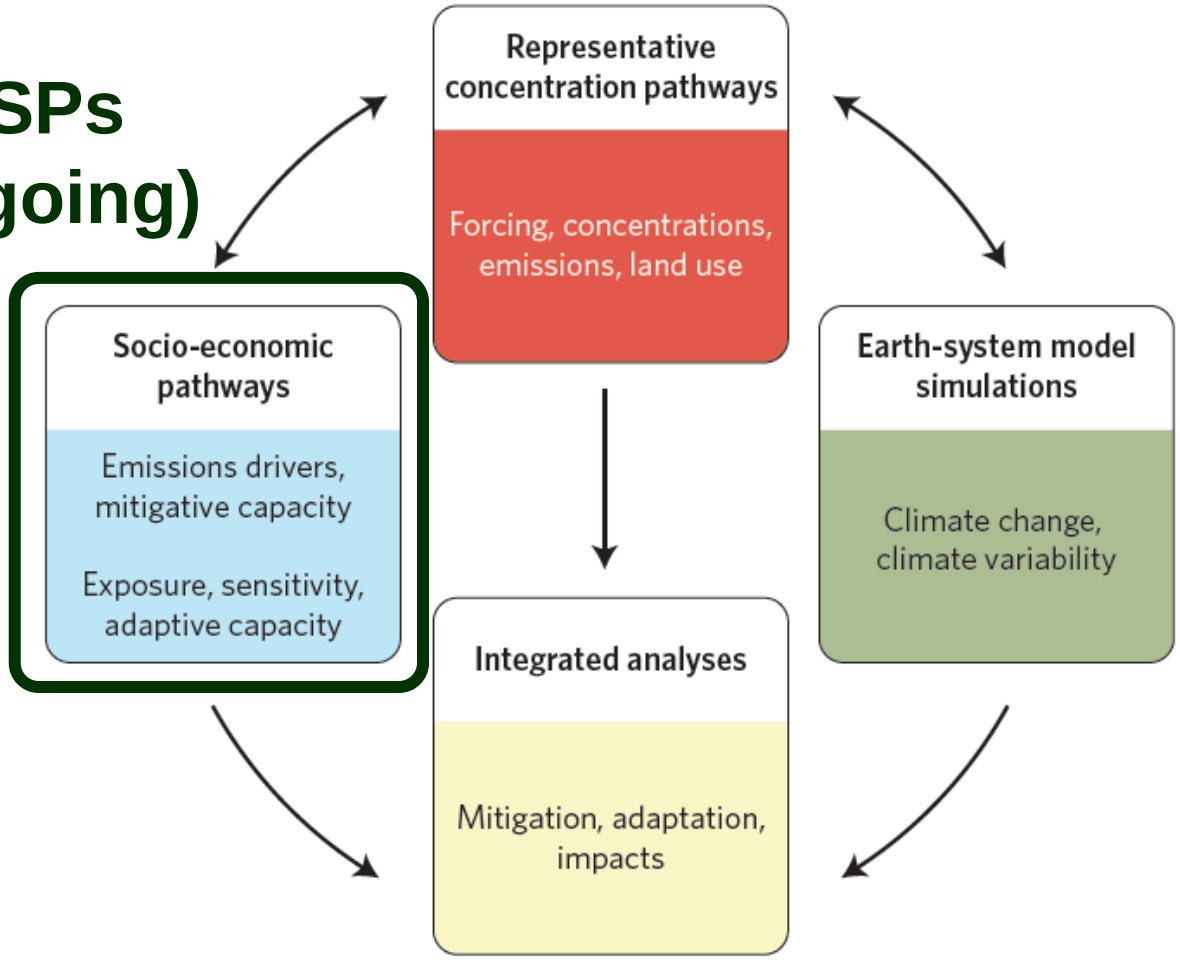
The Parallel Process

SSPs (ongoing)

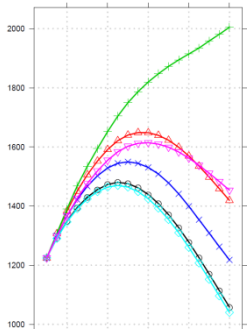


Source: O'Neill and Schweizer (2011)

What's in an SSP?

(Shared Socioeconomic Pathway)

Narrative



Quantitative elements, e.g.

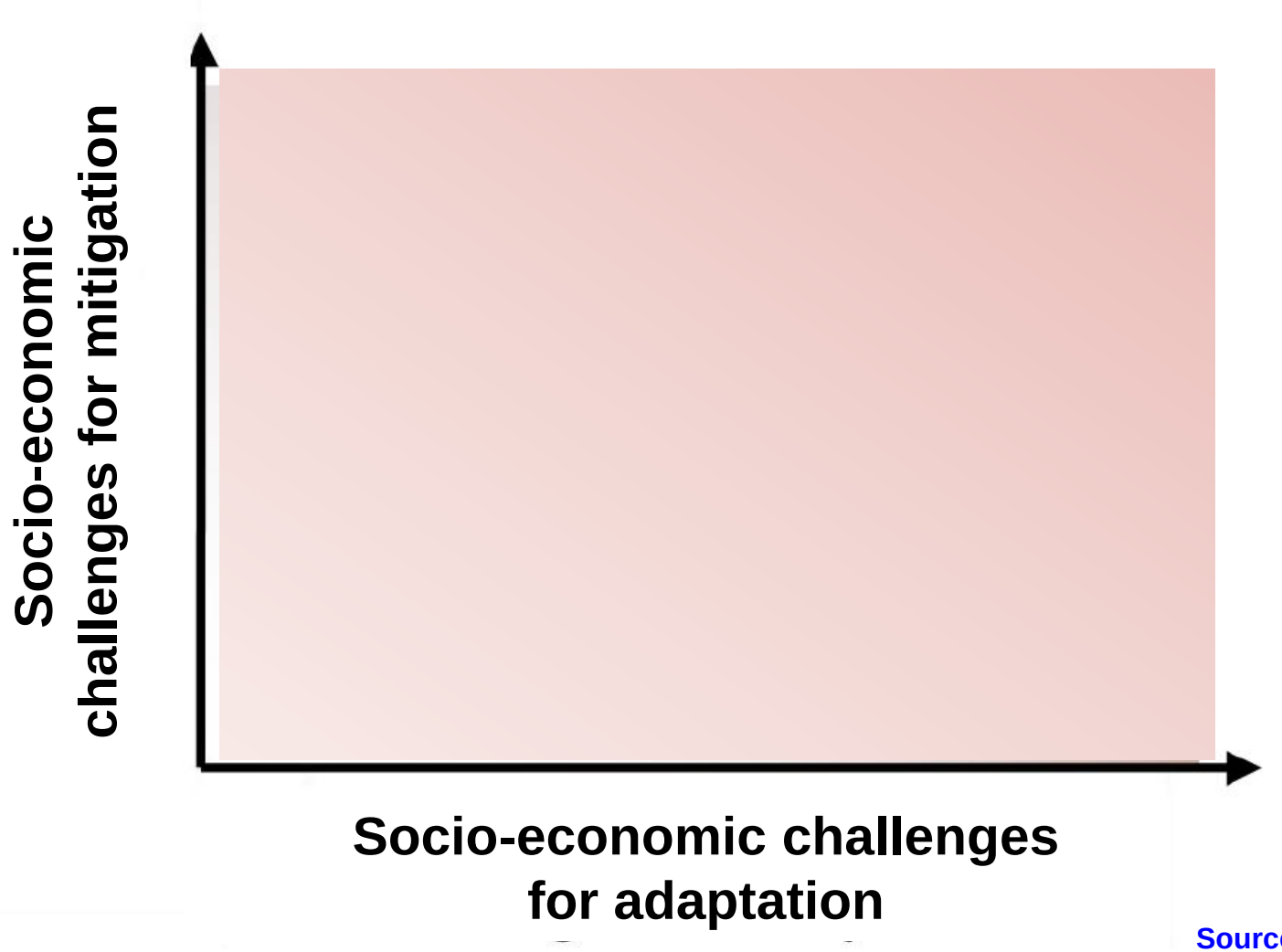
- Population
- Urbanization
- Rates of technological change
- Income
- Human Development Index
- Income distribution

Does not include:

- typical model output such as emissions, land use, climate change
- climate policy (mitigation or adaptation)
- not influenced by climate change

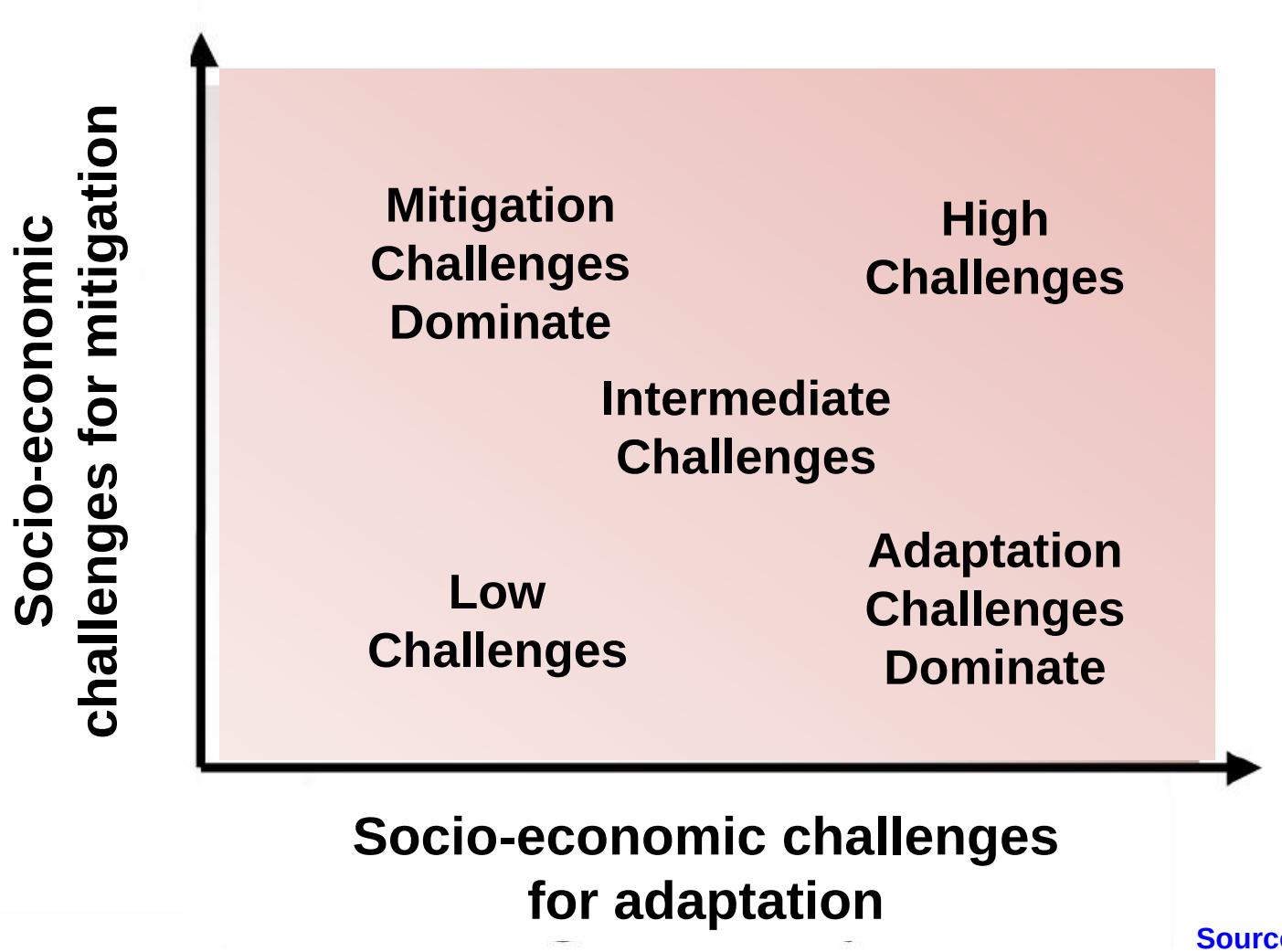
Source: O'Neill (2012)

SSP Logic



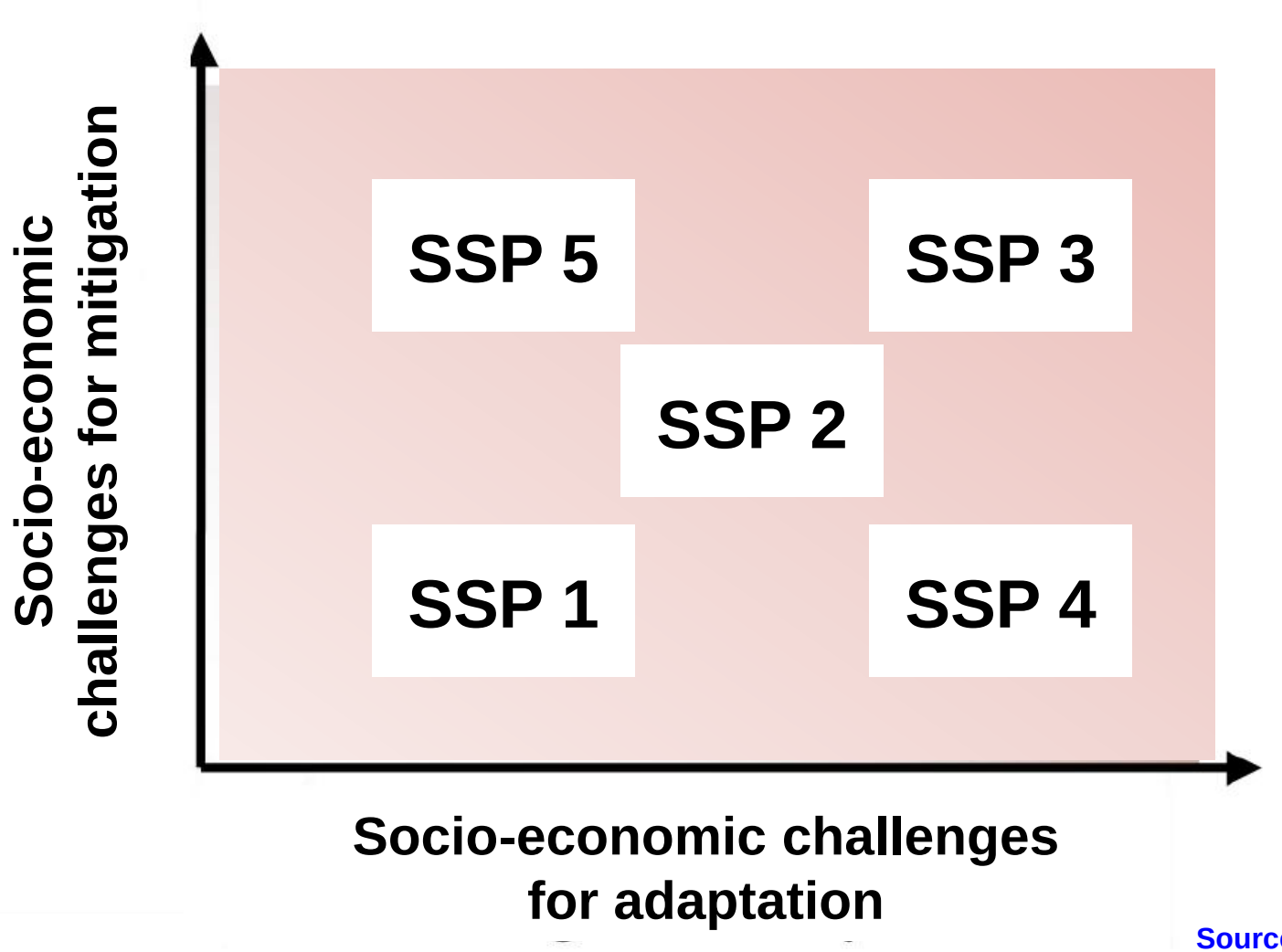
Source: O'Neill (2012)

SSP Logic



Source: O'Neill (2012)

SSP Logic



Source: O'Neill (2012)

Adaptation challenges

↓

Exposure
Sensitivity
Adaptive Capacity

↓

Average Wealth
Extreme Poverty
Governance
Water Availability
Innovation Capacity
Coastal Population
Educational Attainment
Urbanization
…
Quality of Healthcare
Availability of Insurance

Mitigation challenges

↓

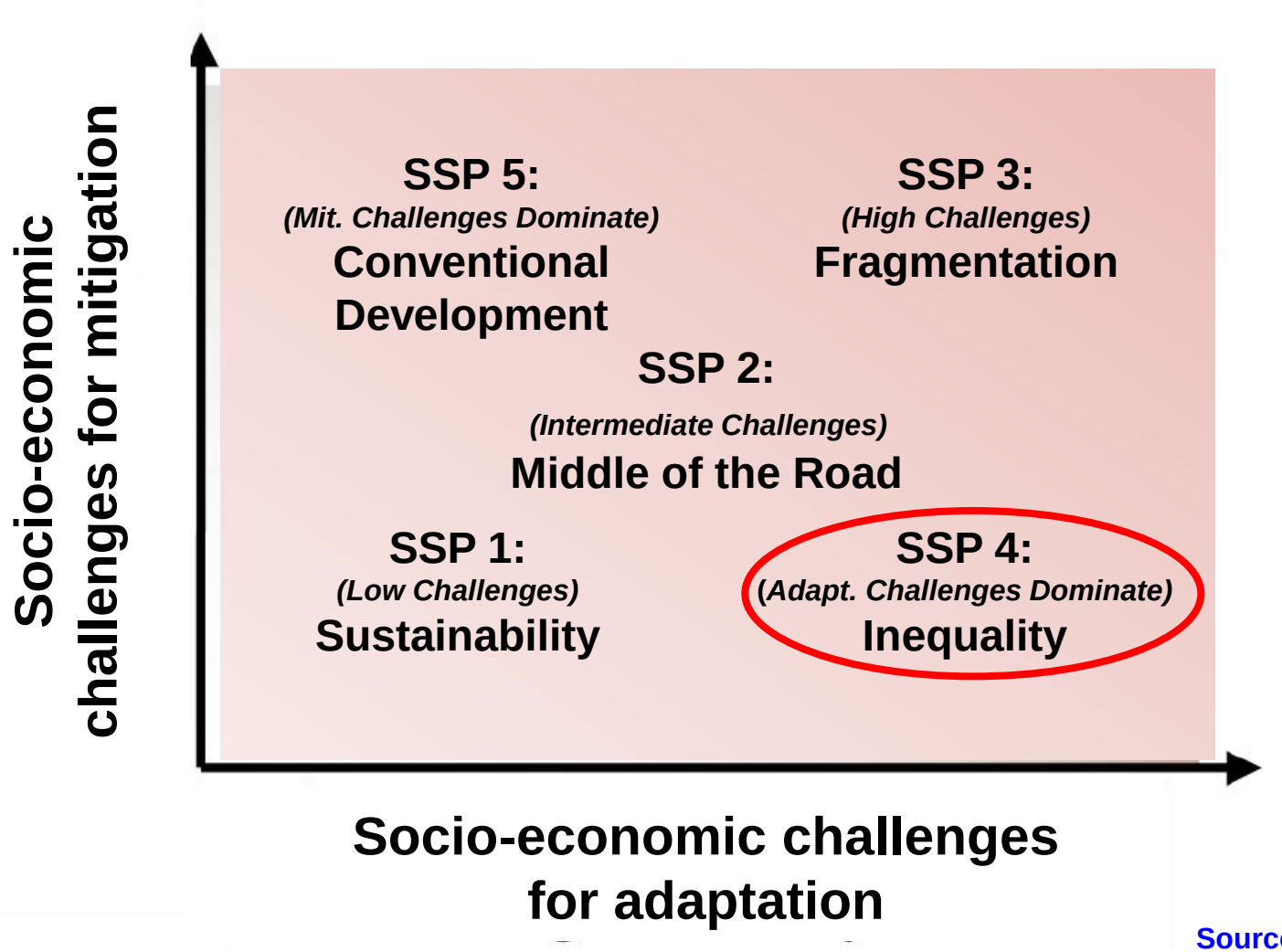
Baseline (no-policy) emissions
Mitigation capacity

↓

Population
Carbon Intensity
Agricultural Productivity
Energy Intensity
Energy-related Tech. Change
CCS availability
…
Effectiveness of Policy Institutions
Energy Tech. Transfer
Diet

Source: O'Neill (2012)

SSP Logic



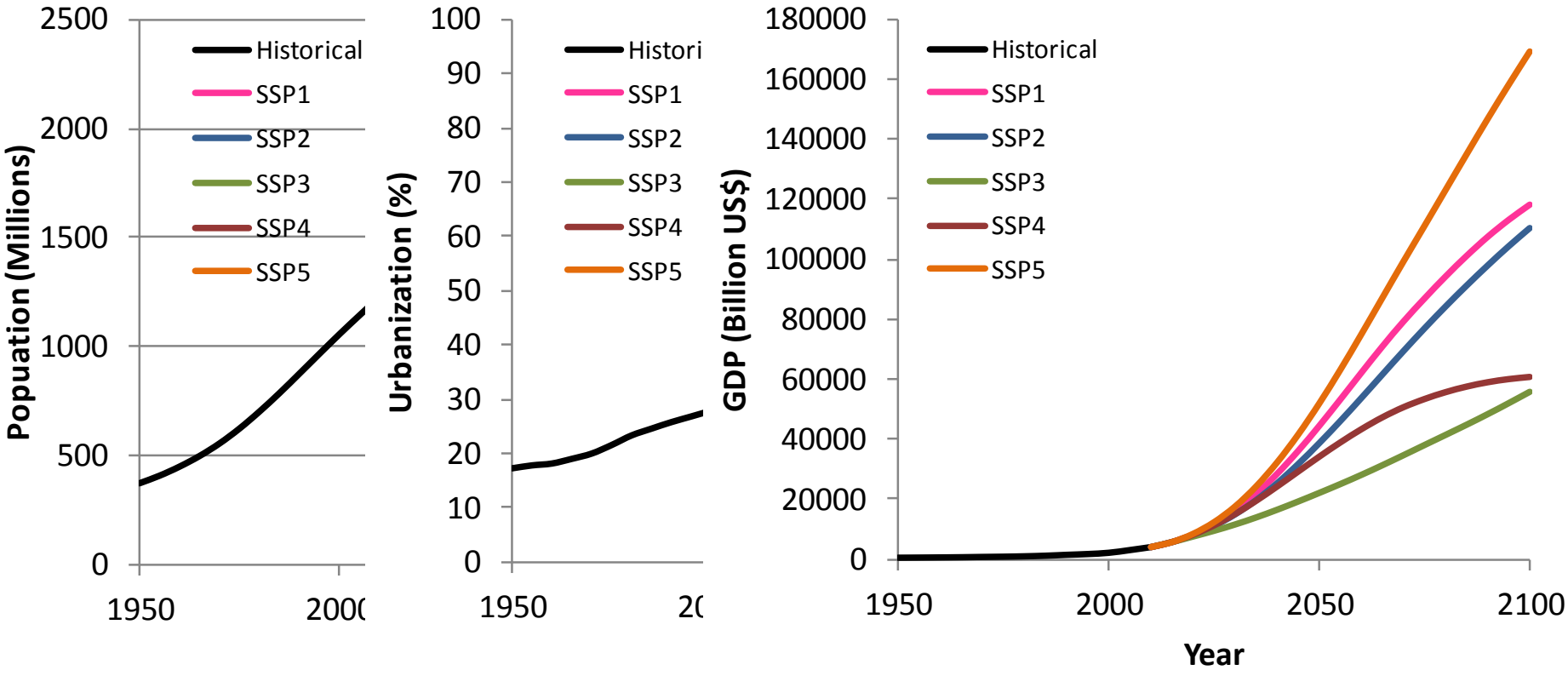
Source: O'Neill (2012)

SSP 4: Inequality

Narrative: This world is highly unequal both within and across countries. A small rich global elite is responsible for much of the emissions, while a large poor group does not emit much and is vulnerable to impacts of climate change, in industrialized as well as in developing countries. Resource scarcity considerations or the possibility of mitigation policies either drive energy efficiency and low-carbon technologies as part of energy supply *or* lead to development of mitigation capacity in case it is needed. Governance and globalization are effective for and controlled by the elite, but are ineffective for most of the population.

Source: O'Neill (2012)

SSP Element Quantifications (e.g., India)



Source: O'Neill (2012)

What's in an SPA?

(Shared Policy Assumption)

A departure from an SSP, which:

- **Assumes explicit climate policies of mitigation and/or adaptation**
- **Can be used to explore mitigation potential and cost**
- **Essential to achieve low radiative forcing found in some RCPs**

Work in progress .....

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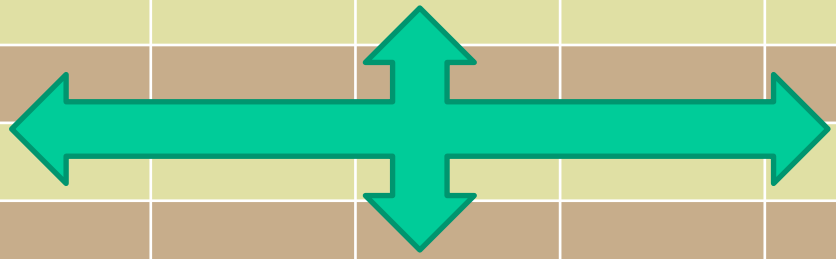
Application of new scenarios

- **Populating the future "uncertainty space"**

		SSP 1	SSP 2	SSP 3	SSP4	SSP5
	Reference	X	X	X	X	X
RCP Replication	8.5 Wm^{-2}					
	6.0 Wm^{-2}					
	4.5 Wm^{-2}					
	2.6 Wm^{-2}					



Application of new scenarios

- Populating the future "uncertainty space"
- Matching RCP climates to SSPs (no climate policy)
- Specifying climate policy scenarios (SPAs)
- Matching RCP climates to SPAs
- Interpreting global scenarios at regional and local scales
- New impact studies already underway (e.g. ISI-MIP)

Accessibility of new scenarios

1. **Quantified scenarios and narratives should be readily accessible**
2. **Base case observations should be available**
3. **Scenarios should be properly archived and documented**
4. **Guidance on scenario application and interpretation should be provided**
5. ***IPCC Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA)* can assist in this process**

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Summary

1. A community-led initiative to develop new scenarios for climate change research is well underway
2. The "parallel process" of scenario development is now published and documented (e.g. at the IPCC DDC)
3. RCPs are published in a Special Issue of *Climatic Change*
4. CMIP5 climate model projections are being finalised, evaluated (for IPCC AR5) and made available to users
5. SSP narratives have been developed, and basic socioeconomic quantifications are underway
6. The framework and logic for SSP and SPA development will be submitted for publication in late 2012
7. A joint IAV-IAM committee is overseeing work on SSPs

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Notice

Colleagues are welcome to incorporate these slides into their own presentations, assuming they are correctly acknowledged. However, the author would also appreciate being informed prior to the extensive use of this material in public meetings.

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