

# Progress in the development of new scenarios to support IAV research

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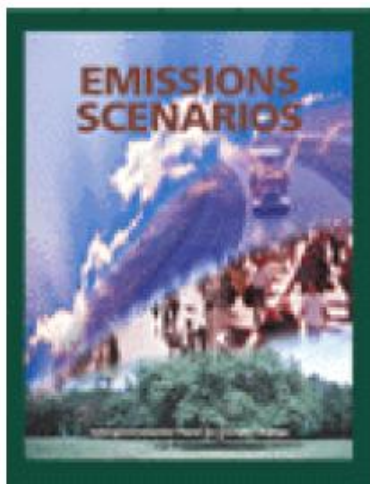
# Outline

- 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**

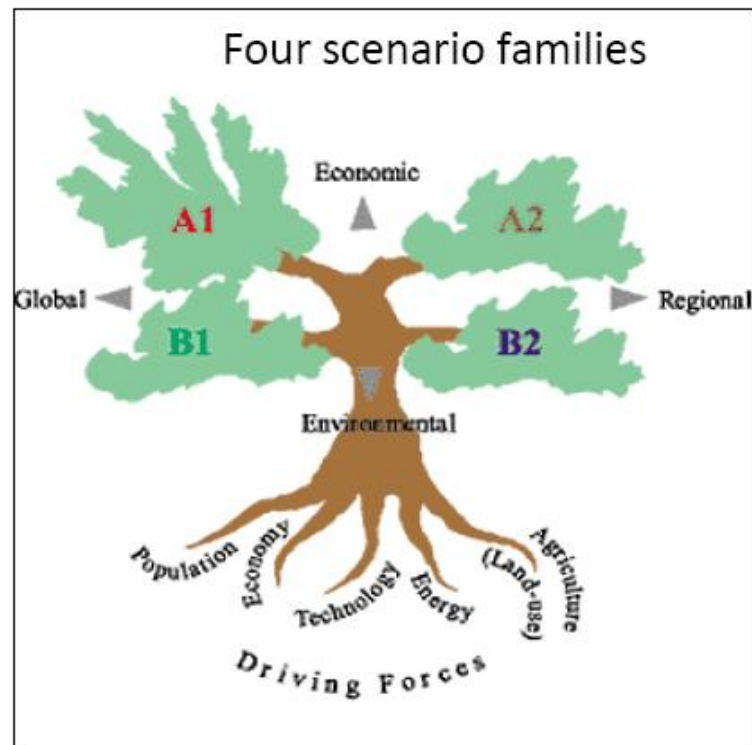
# Outline

## 1. Why new scenarios?

# Why do we need new scenarios?



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



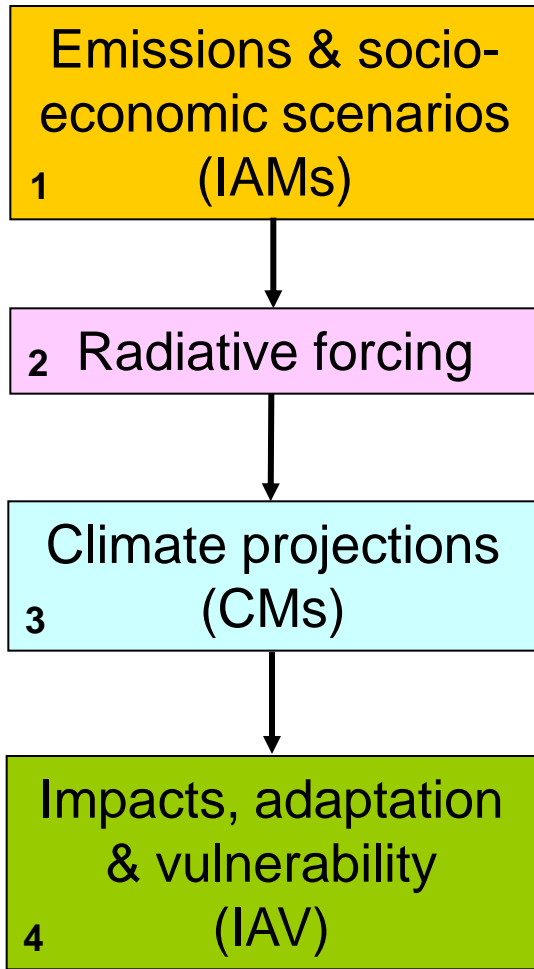
# Why do we need new scenarios?

- SRES scenarios becoming outdated (base year 1990, published in 2000)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

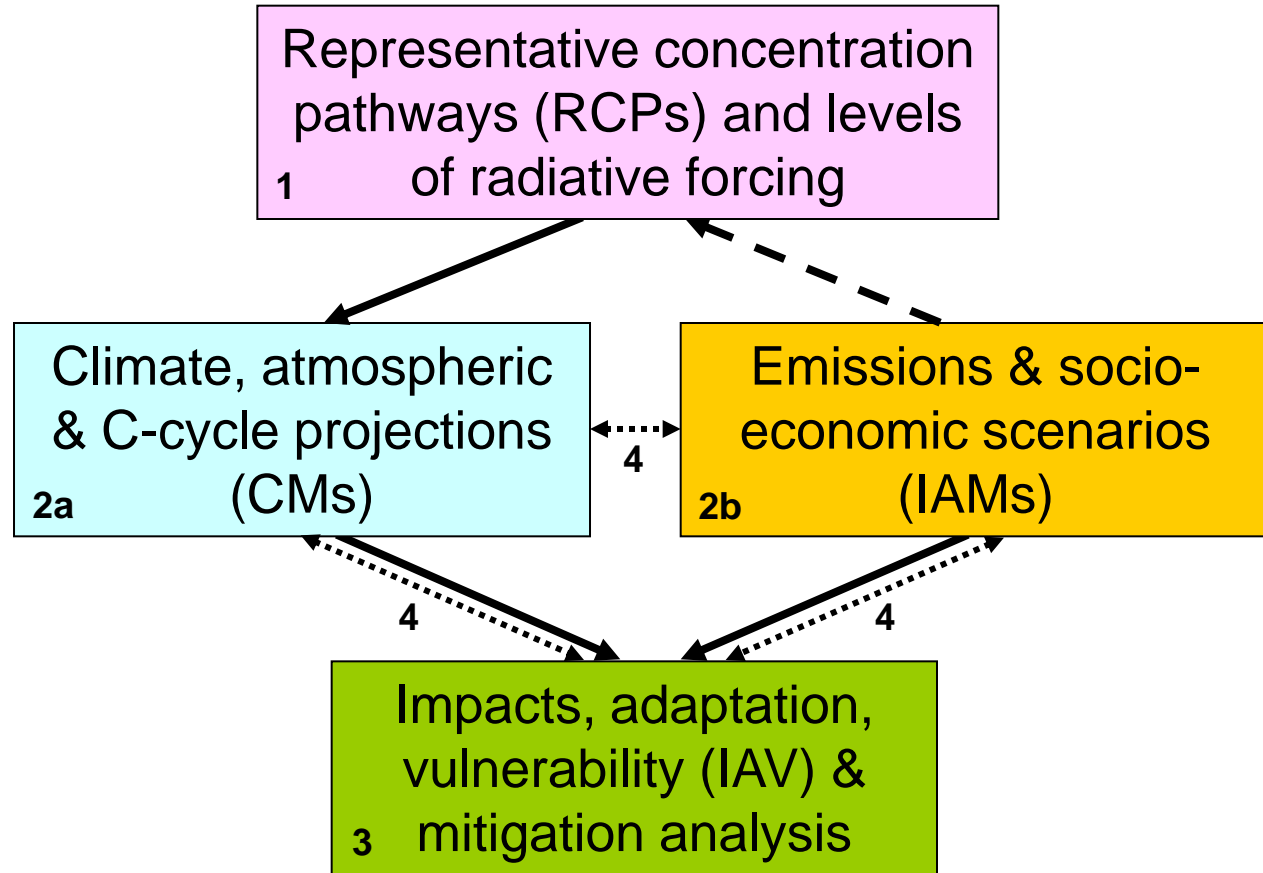
# Outline

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

**(a) Sequential approach**



**(b) Parallel approach**



# 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

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## The next generation of scenarios for climate change research and assessment

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

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

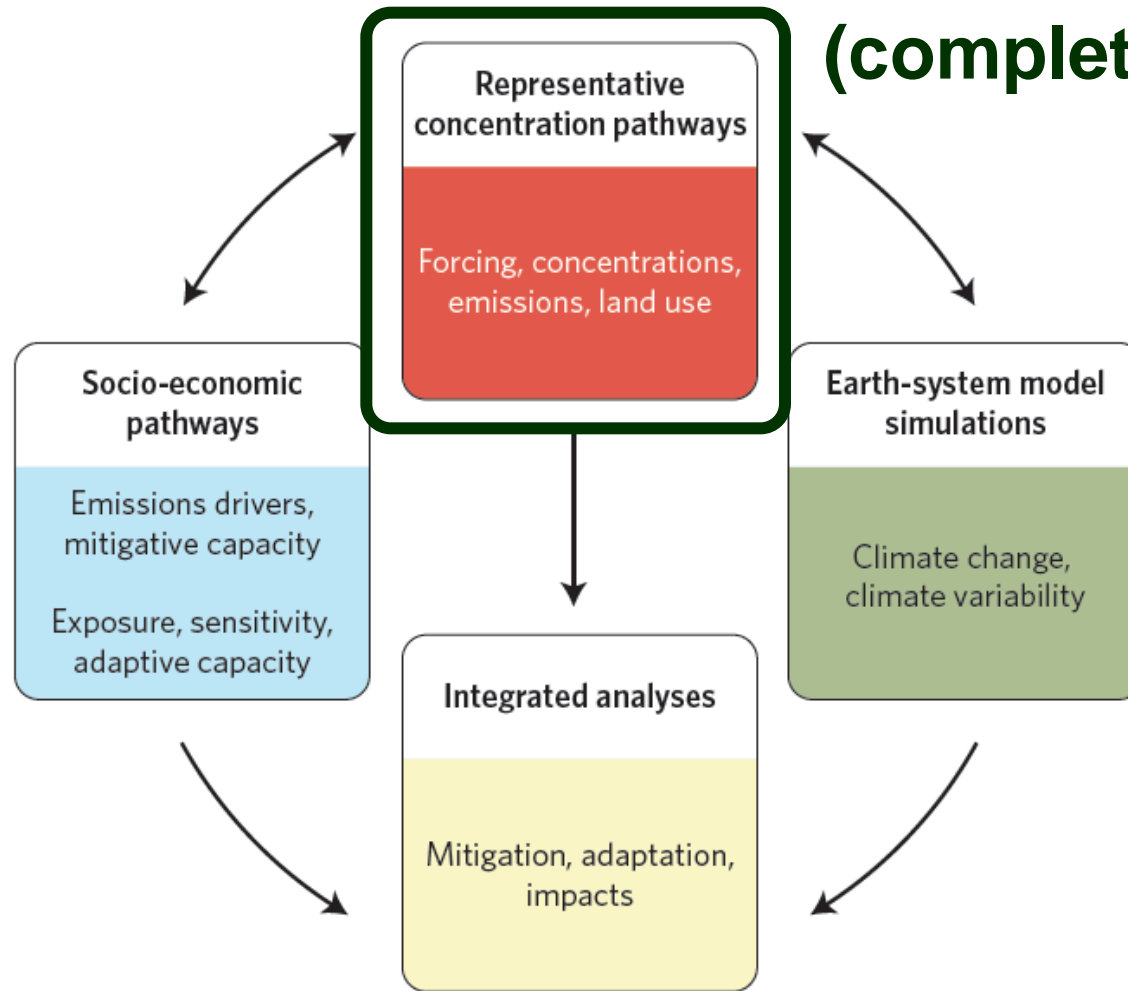


# Outline

1. Why new scenarios?
2. A parallel process of scenario development
3. **RCPs and new climate projections**

# The Parallel Process

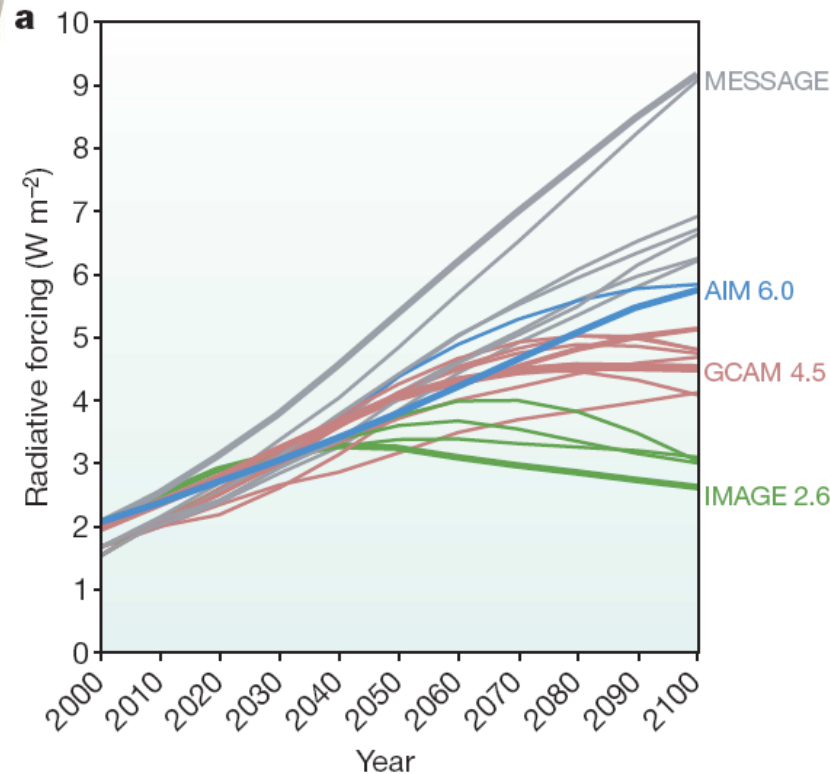
## RCPs (complete)



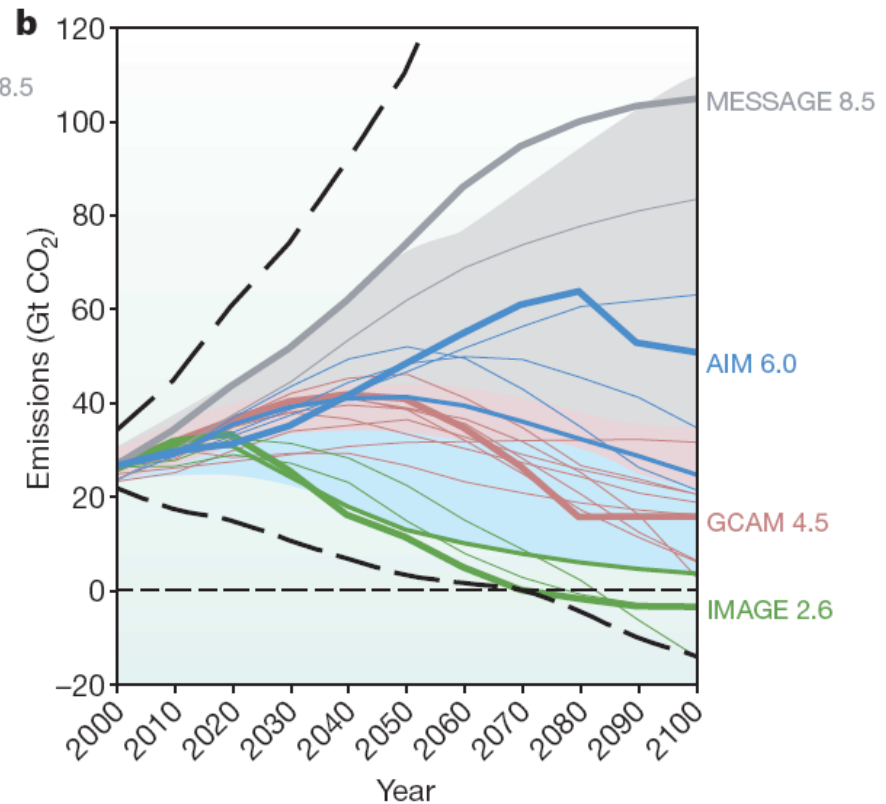
Source: O'Neill and Schweizer (2011)

# Representative Concentration Pathways (RCPs)

**Change in radiative forcing  
(relative to pre-industrial)**



**CO<sub>2</sub> emissions  
(energy and industry)**

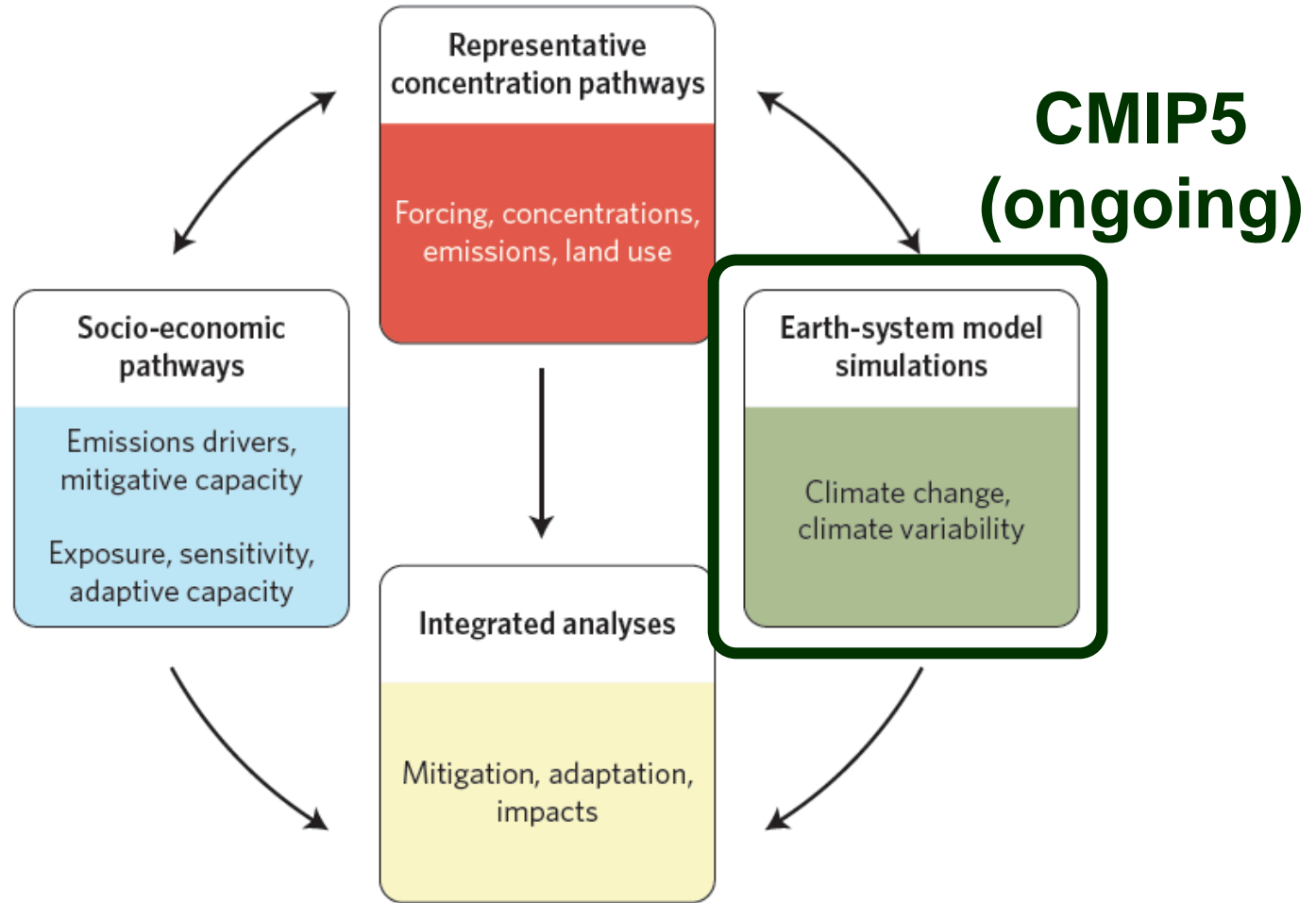


Source: Moss et al. 2010

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

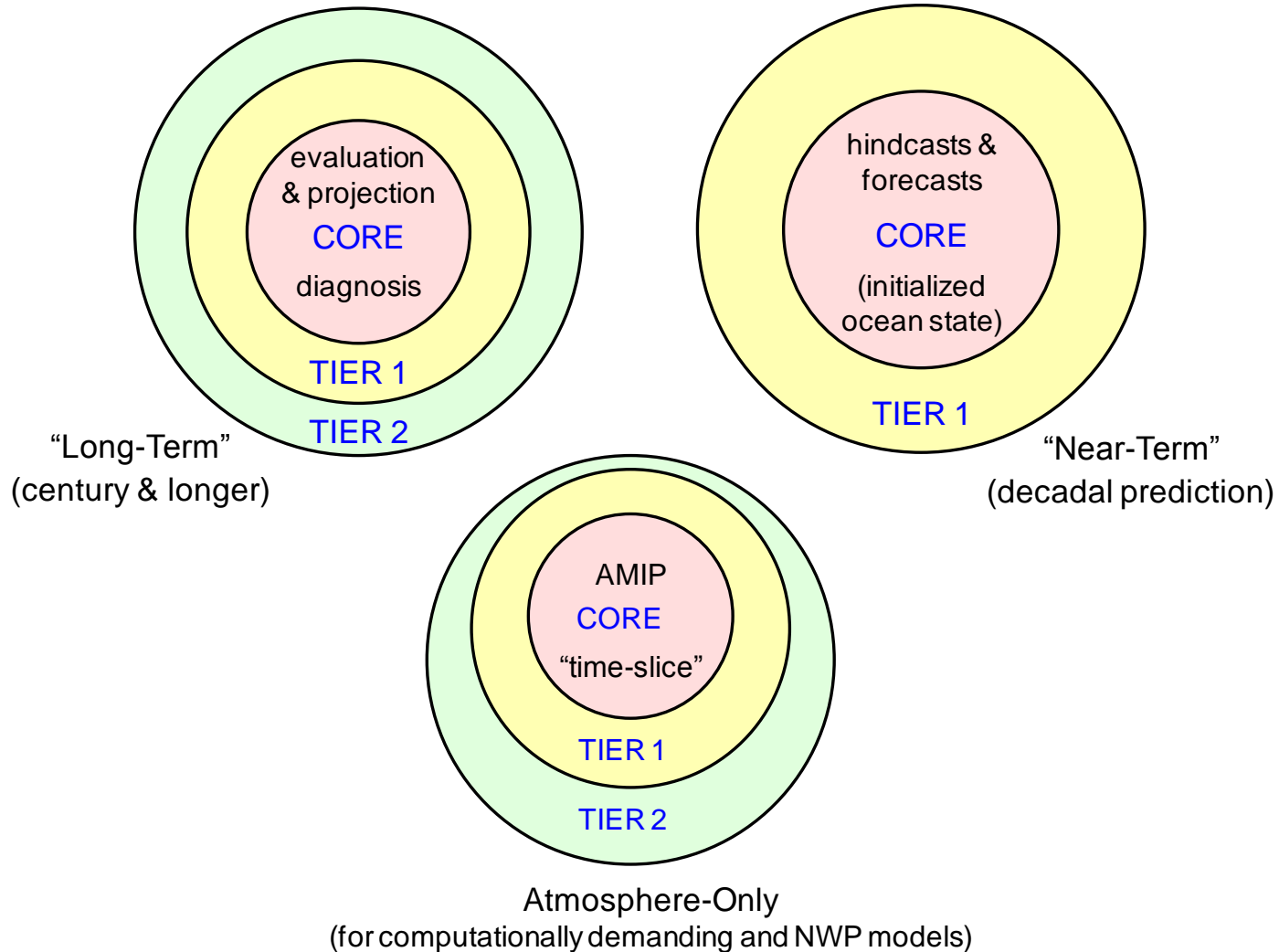
Database of IAM inputs/outputs for each RCP available online at IIASA website

# The Parallel Process



Source: O'Neill and Schweizer (2011)

# CMIP5: Three Suites of Experiments



<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)



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

The screenshot shows a web browser window displaying the CMIP5 website. The browser's address bar shows the URL <http://cmip-pcmdi.llnl.gov/cmip5/>. The website header includes the PCMDI logo with a world map and the text "CMIP5 Coupled Model Intercomparison Project" and "WCRP World Climate Research Programme". Navigation links include Home, News, CMIP3, CMIP5, Accomplishments, Links, and Contact. A search bar is also present.

The main content area is titled "CMIP5 - Coupled Model Intercomparison Project Phase 5 - Overview". It contains the following text:

At a September 2008 meeting involving 20 climate modeling groups from around the world, the WCRP's Working Group on Coupled Modelling ([WGCM](#)), with input from the [IGBP AIMES](#) project, agreed to promote a new set of coordinated climate model experiments. These experiments comprise the fifth phase of the Coupled Model Intercomparison Project (CMIP5). CMIP5 will notably provide a multi-model context for 1) assessing the mechanisms responsible for model differences in poorly understood feedbacks associated with the carbon cycle and with clouds, 2) examining climate "predictability" and exploring the ability of models to predict climate on decadal time scales, and, more generally, 3) determining why similarly forced models produce a range of responses.

It is expected that some of the scientific questions that arose during preparation of the Intergovernmental Panel on Climate Change ([IPCC](#)) Fourth Assessment Report (AR4) will through CMIP5 be addressed in time for evaluation in the Fifth Assessment Report (AR5, scheduled for publication in late 2013). The [IPCC/CMIP5 schedule \(pdf\)](#) is now available and the three key dates are as follows:

- **February 2011:** First model output is expected to be available for analysis,
- **July 31, 2012:** By this date papers must be submitted for publication to be eligible for assessment by WG1,
- **March 15, 2013:** By this date papers cited by WG1 must be published or accepted.

The IPCC's AR5 is scheduled to be published in **September 2013**. Future timeline information can be found on [IPCC WG1 website](#).

CMIP5 is meant to provide a framework for coordinated climate change experiments for the next five years and thus includes simulations for assessment in the AR5 as well as others that extend beyond the AR5. CMIP5 is not, however, meant to be comprehensive; it cannot possibly include all the different model intercomparison activities that might be of value, and it is expected that various groups and interested parties will develop additional experiments that might build on and augment the experiments described here.

CMIP5 promotes a standard set of model simulations in order to:

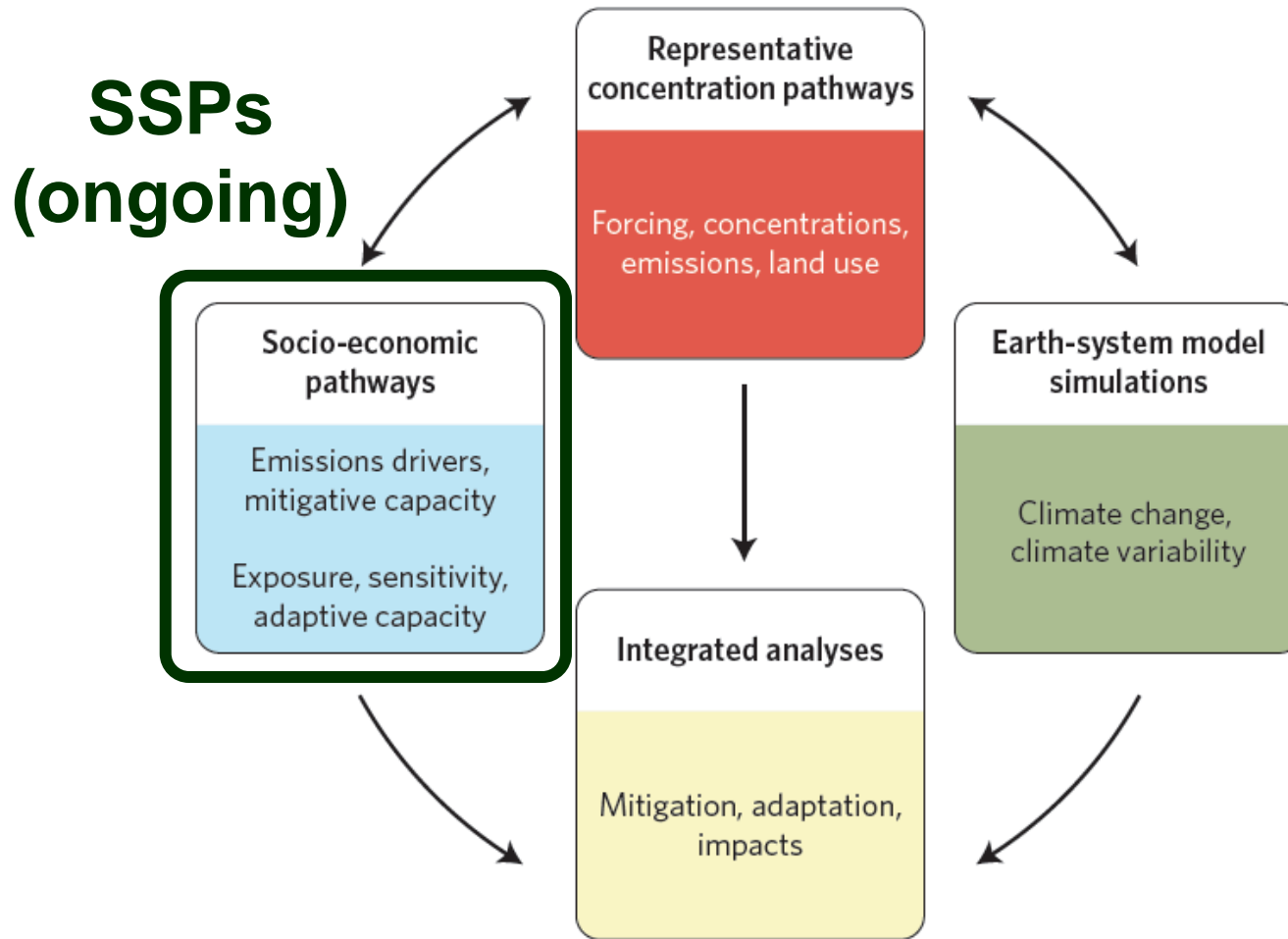
- evaluate how realistic the models are in simulating the recent past,
- provide projections of future climate change on two time scales, near term (out to about 2035) and long term (out to 2100 and beyond), and
- understand some of the factors responsible for differences in model projections, including quantifying some key feedbacks such as those involving clouds and the carbon cycle

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4. **Storylines, SSPs and SPAs**



# The Parallel Process



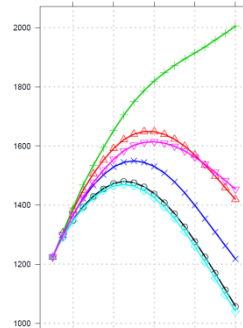
Source: O'Neill and Schweizer (2011)

# 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

**Socio-economic challenges for mitigation**



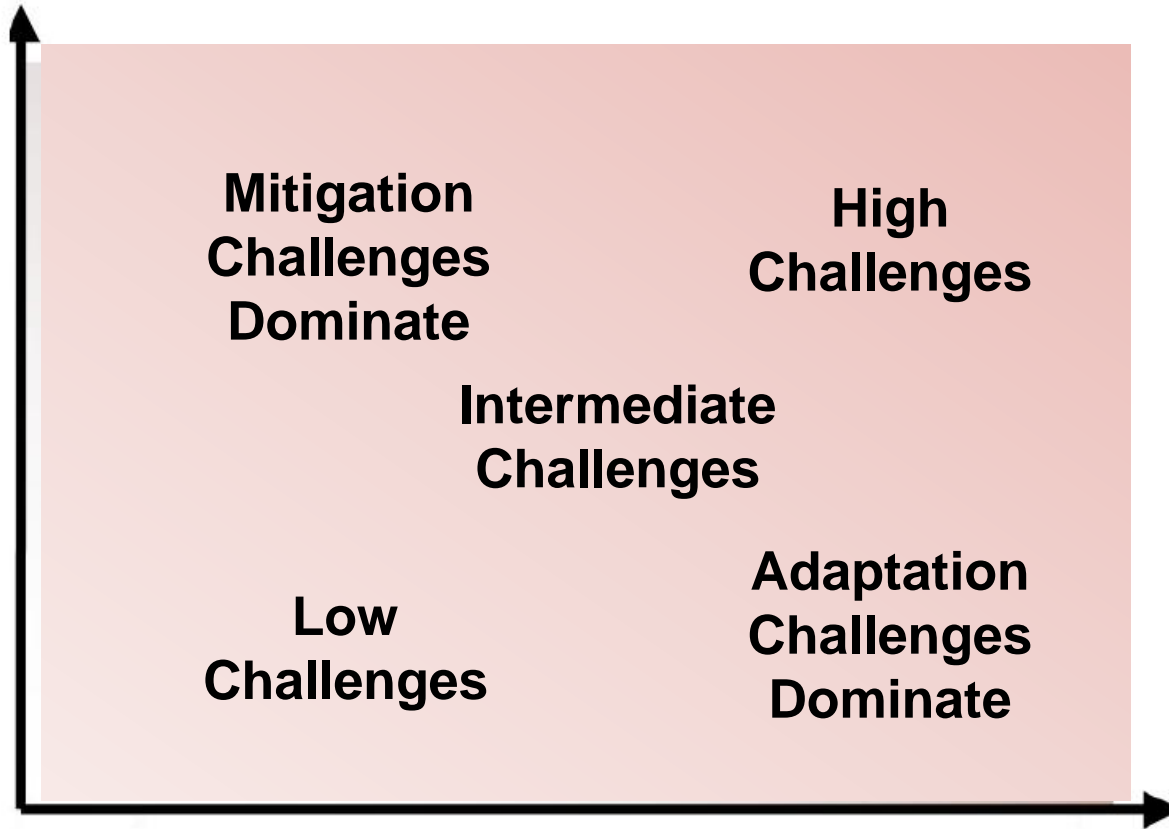
**Socio-economic challenges for adaptation**

Source: O'Neill (2012)



# SSP Logic

**Socio-economic challenges for mitigation**



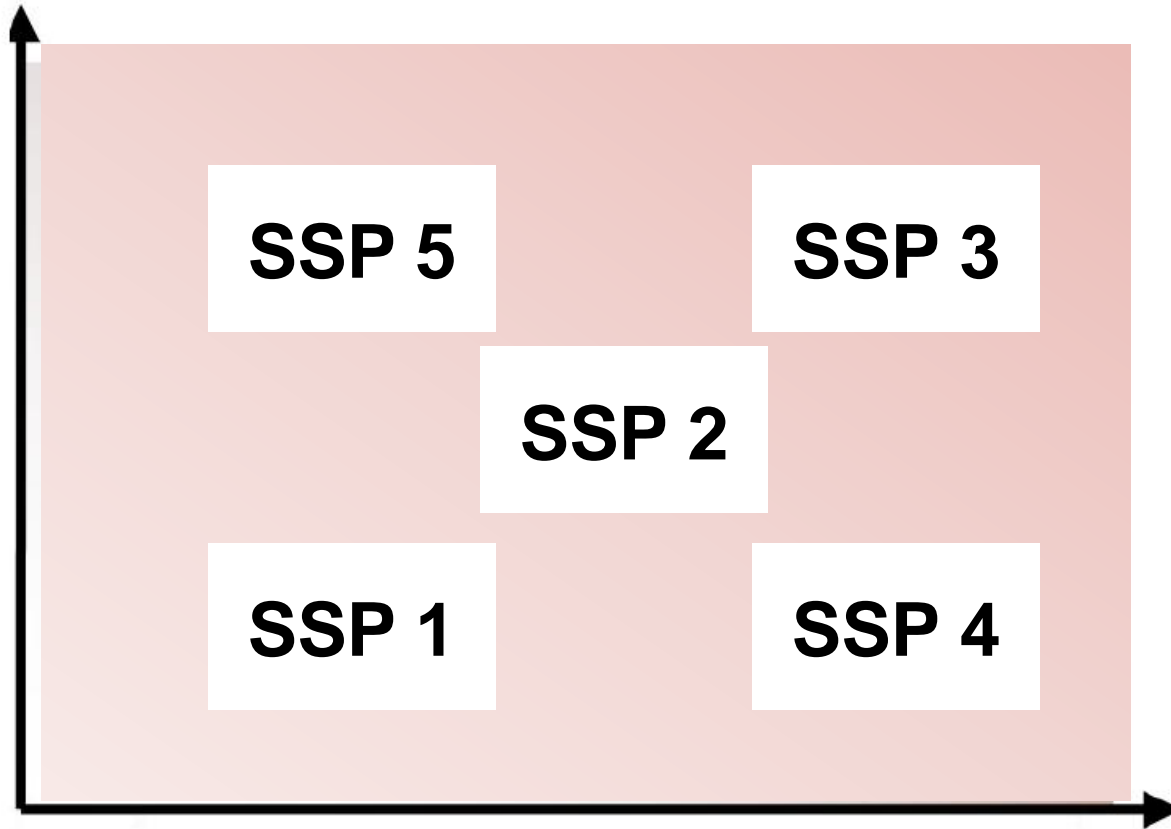
**Socio-economic challenges for adaptation**

Source: O'Neill (2012)



# SSP Logic

Socio-economic challenges for mitigation

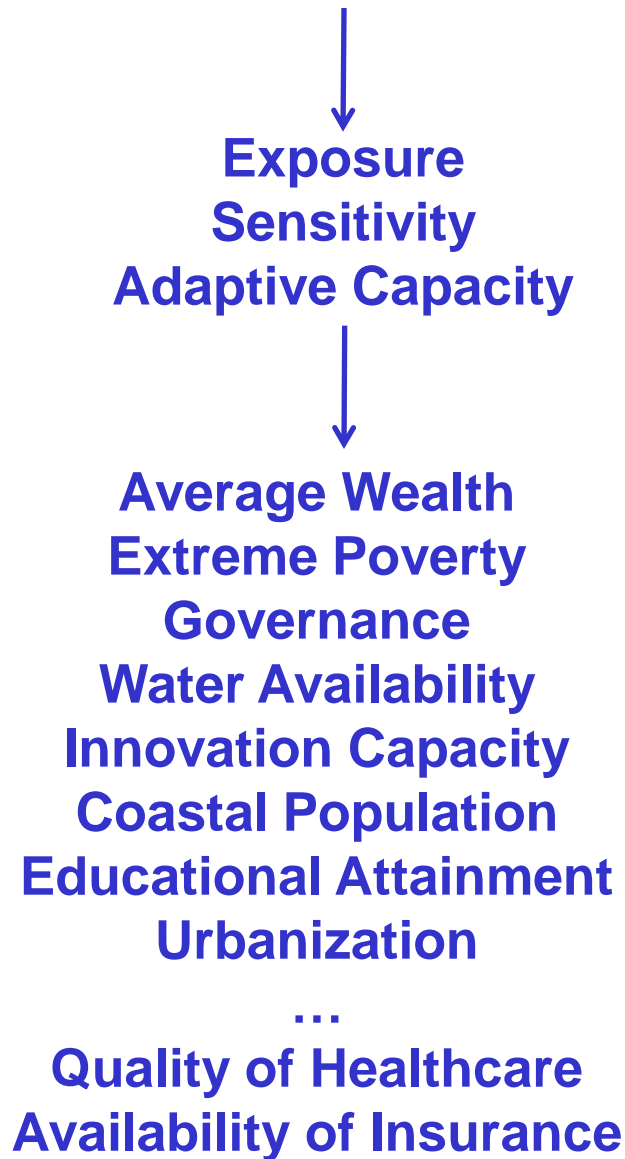


Socio-economic challenges for adaptation

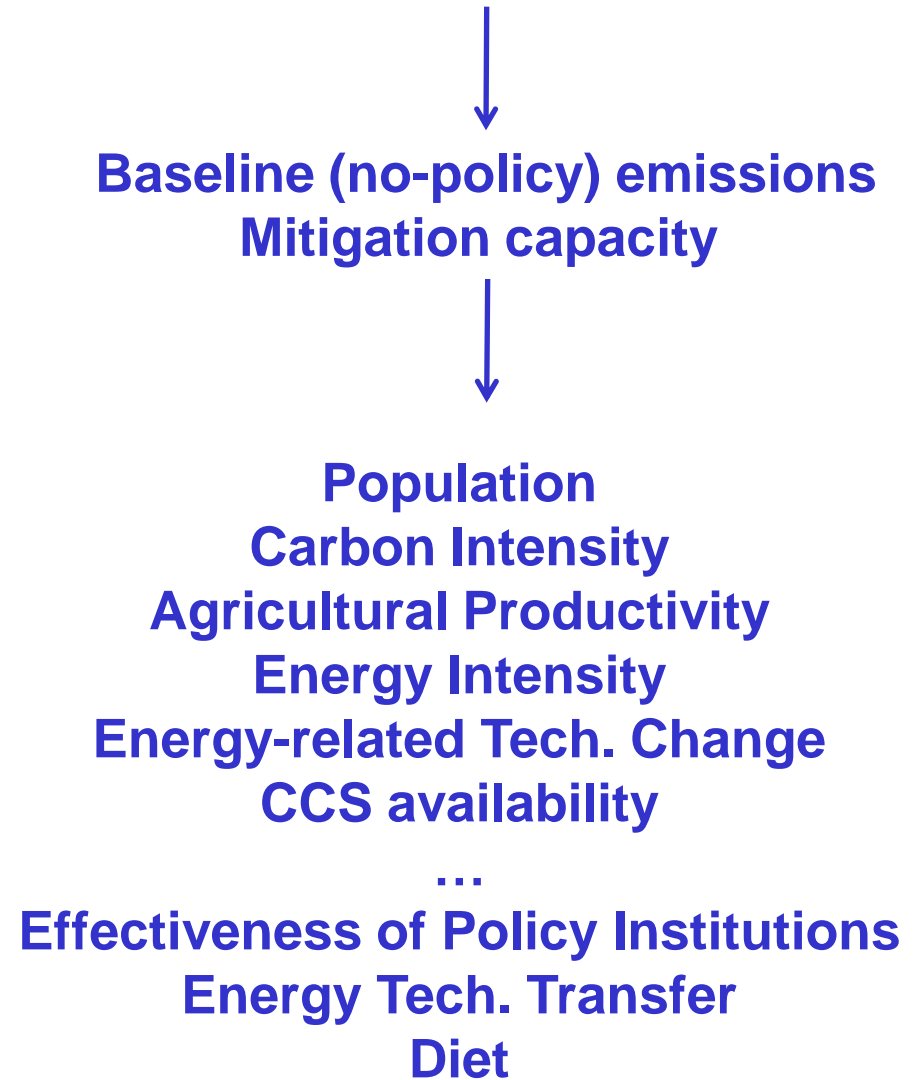
Source: O'Neill (2012)



## Adaptation challenges



## Mitigation challenges

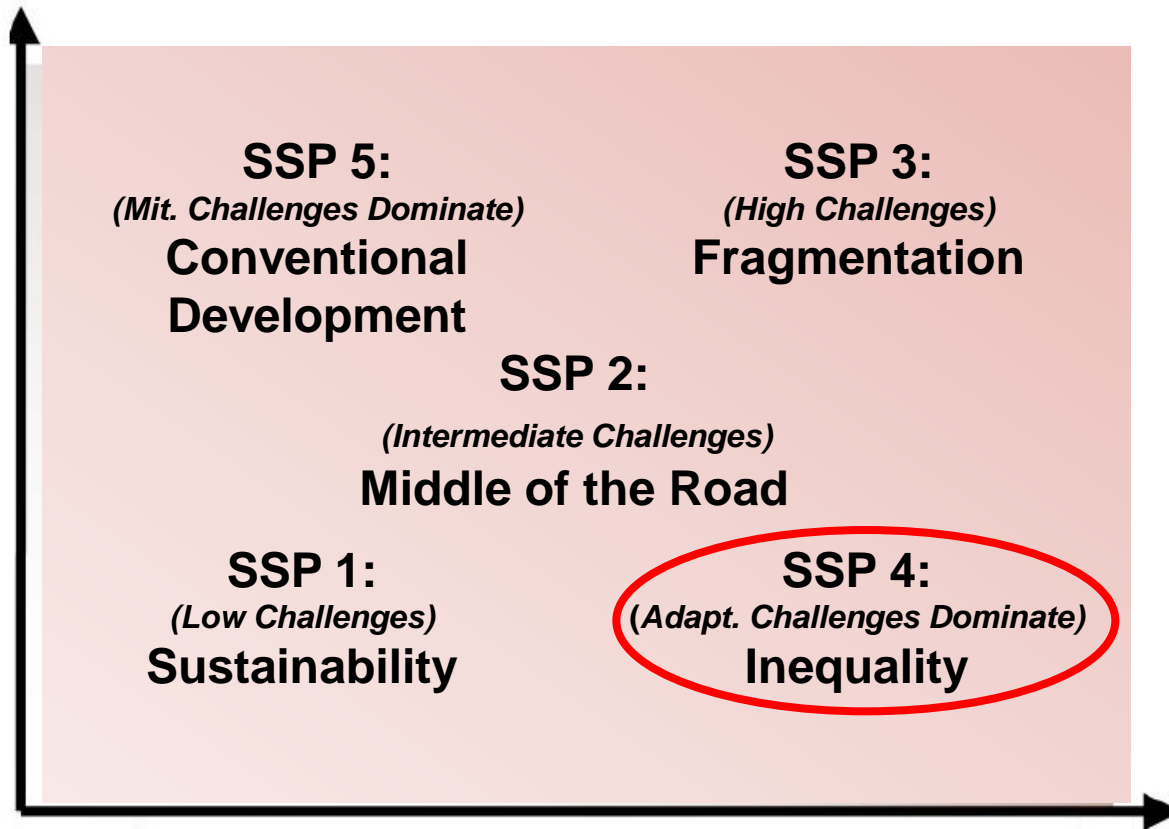


Source: O'Neill (2012)



# SSP Logic

Socio-economic challenges for mitigation



Socio-economic challenges for adaptation

Source: O'Neill (2012)



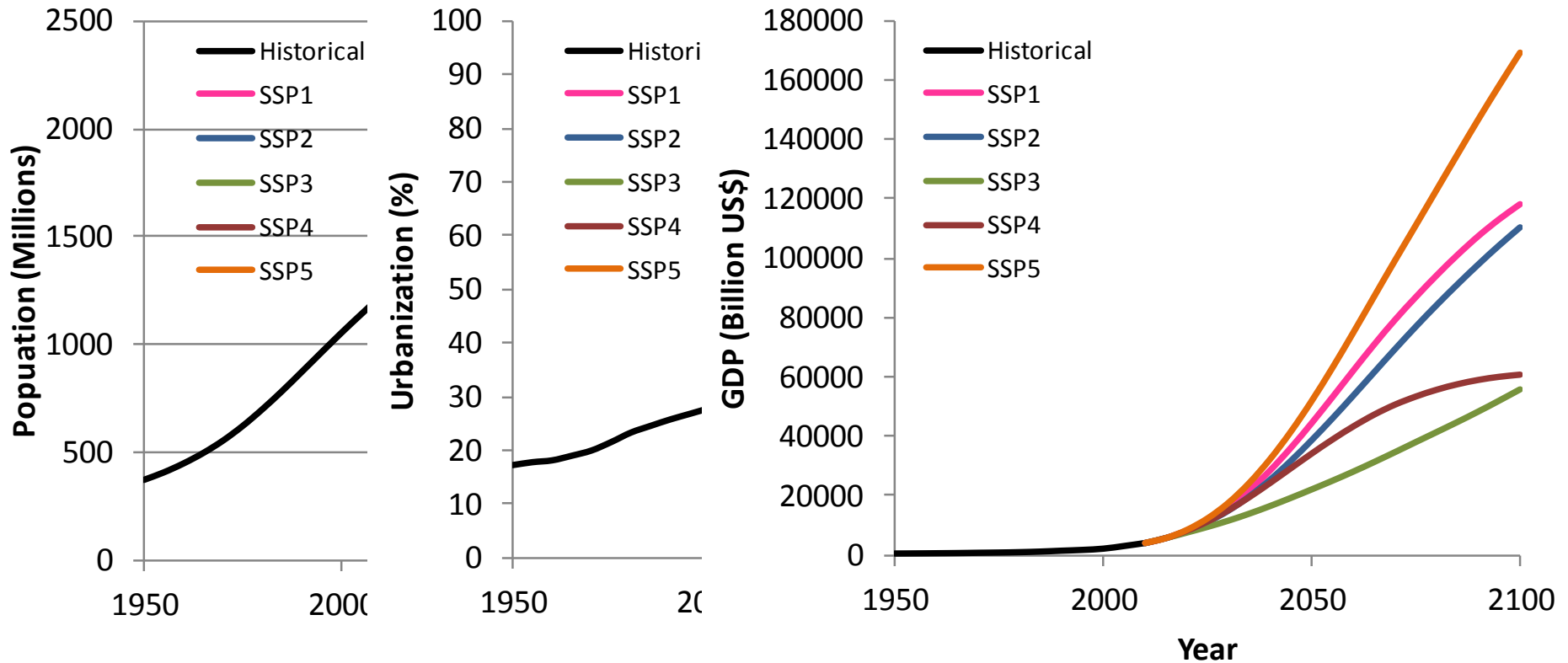
# SSP 4: Inequality

**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 .....**

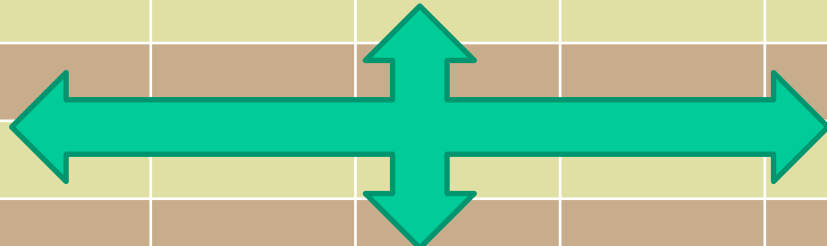
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# Application of new scenarios

- Populating the future "uncertainty space"

		SSP 1	SSP 2	SSP 3	SSP4	SSP5
	Reference	X	X	X	X	X
Replication RCP	8.5 Wm <sup>-2</sup>					
	6.0 Wm <sup>-2</sup>					
	4.5 Wm <sup>-2</sup>					
	2.6 Wm <sup>-2</sup>					



# 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



## 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.**