POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

PBL Netherlands Environmental Assessment Agency

A framework for a new generation of socio-economic scenarios for climate change impact, adaptation, vulnerability and mitigation research

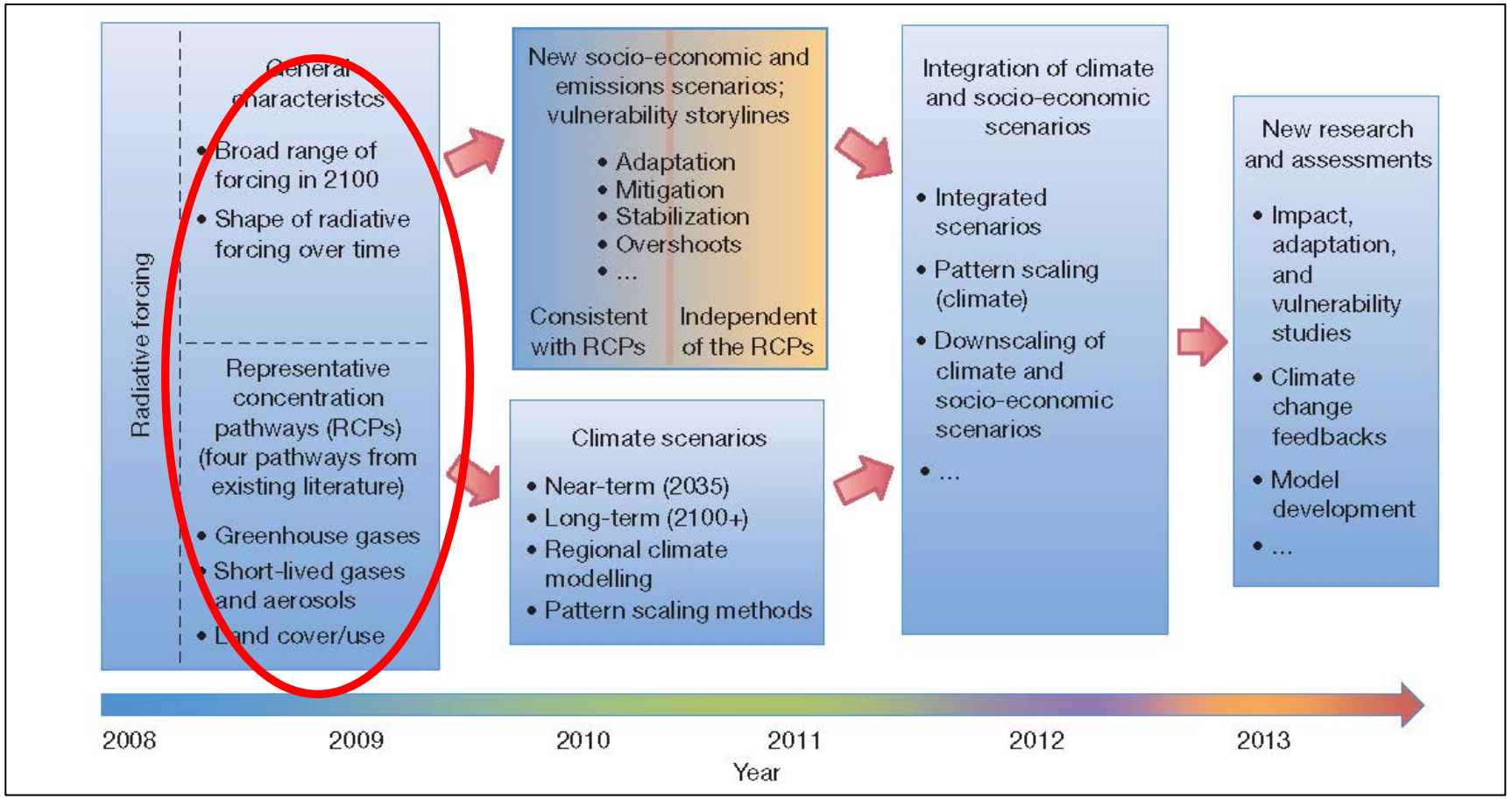
Detlef van Vuuren
Elmar Kriegler

Core Writing Team of WoSES Framework Paper:
Nigel Arnell, Tom Kram, Tim Carter, Kris Ebi, Jae Edmonds, Stephane Hallegatte, Elmar Kriegler, Ritu Mathur, Brian O'Neill, Keywan Riahi, Harald Winkler, Detlef van Vuuren, Timm Zwickel

Overview

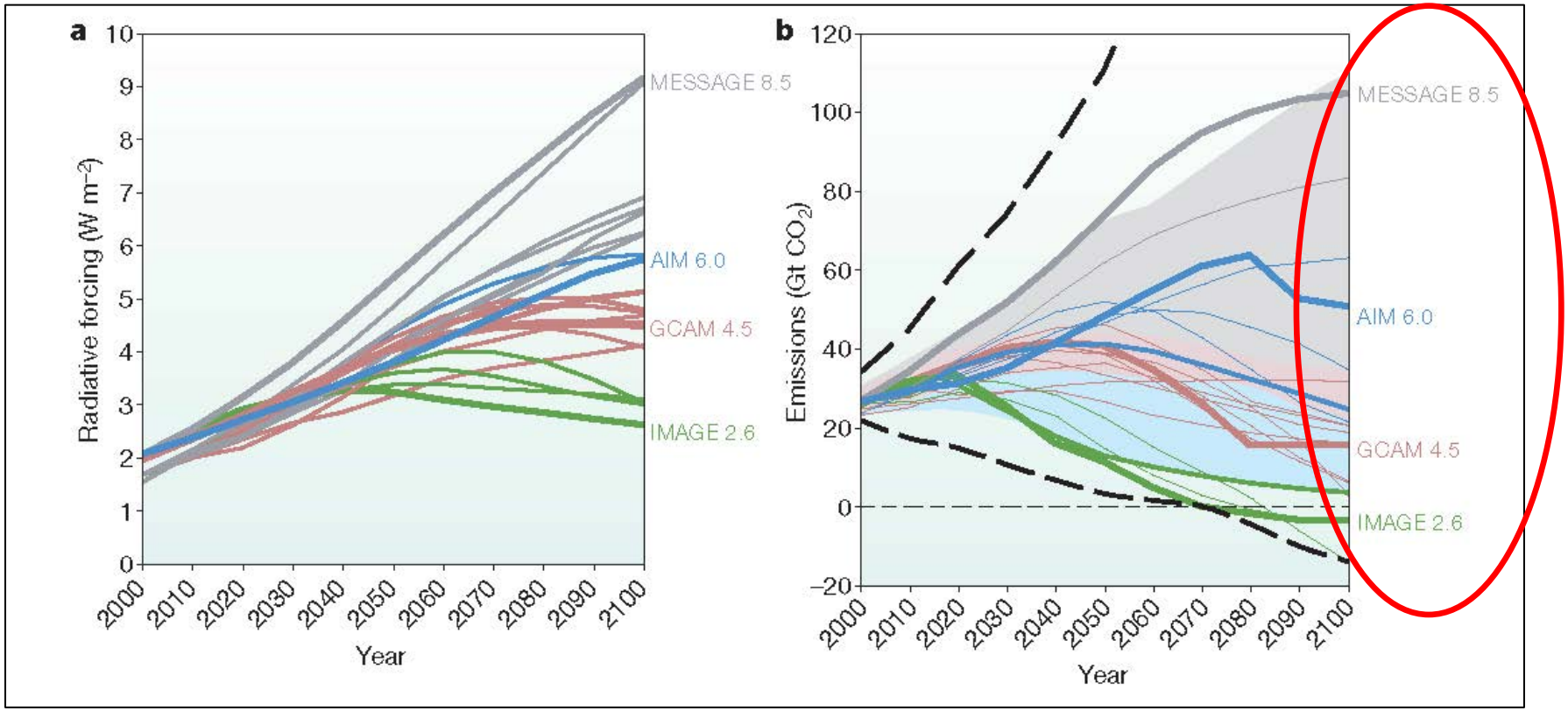
- Context: The new scenario process (Detlef)
- Outcomes of the WoSES: Scenario architecture (Detlef)
- Outcomes of the WoSES: Shared Socio-Economic Pathways (SSPs) (Elmar)
- Intended next steps (Elmar)

The new scenario process (Moss et al., 2010)



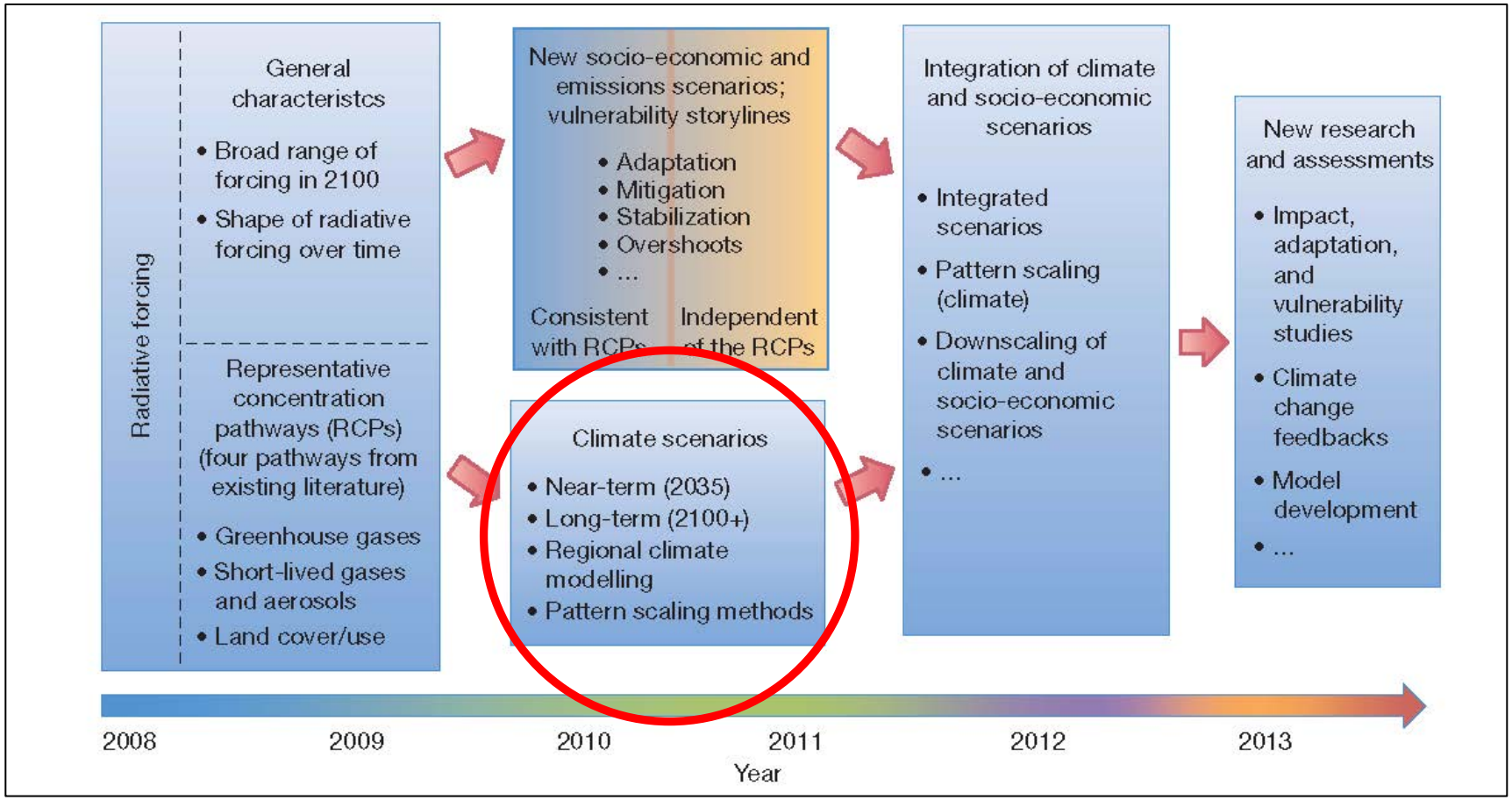
Implemented by “Scientific community”, not the IPCC

Representative Concentration Pathways (RCPs)



Moss et al. (2010)

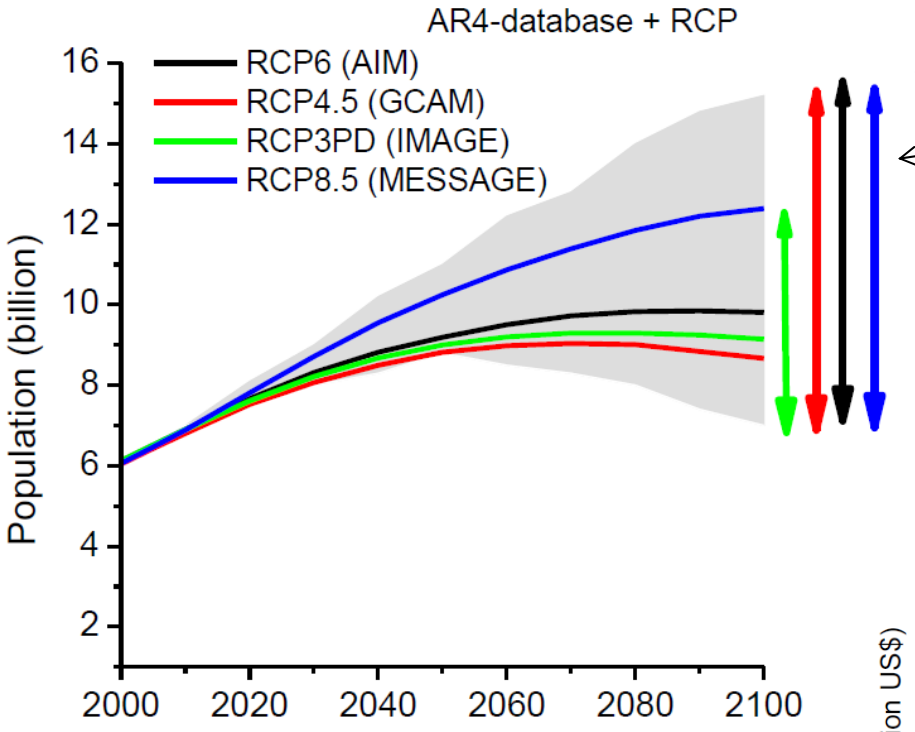
Climate scenarios



➔ CMIP5 of WGI community is in progress

Socio-economic pathways underlying RCP simulations …

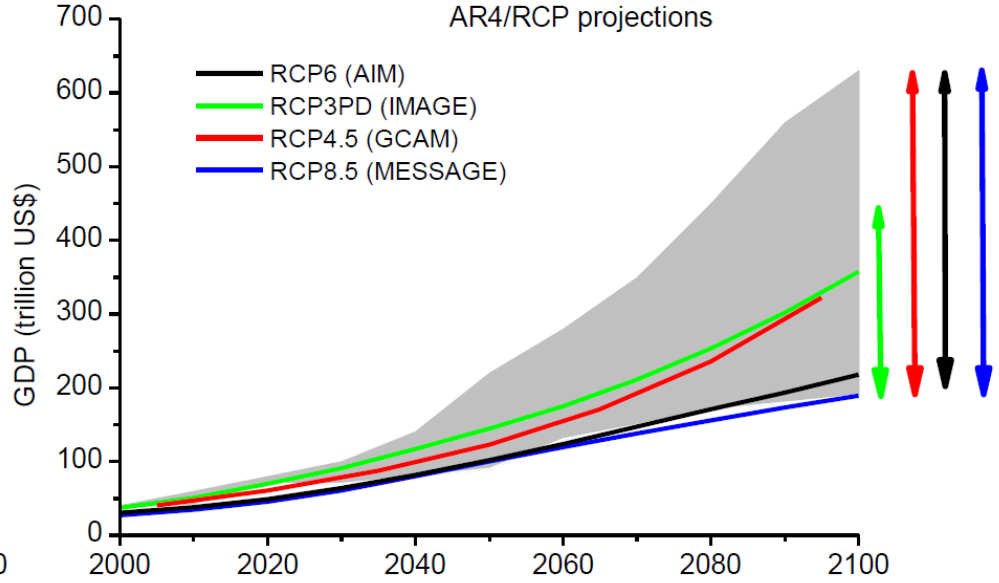
… do not provide a comprehensive set for new SE scenarios



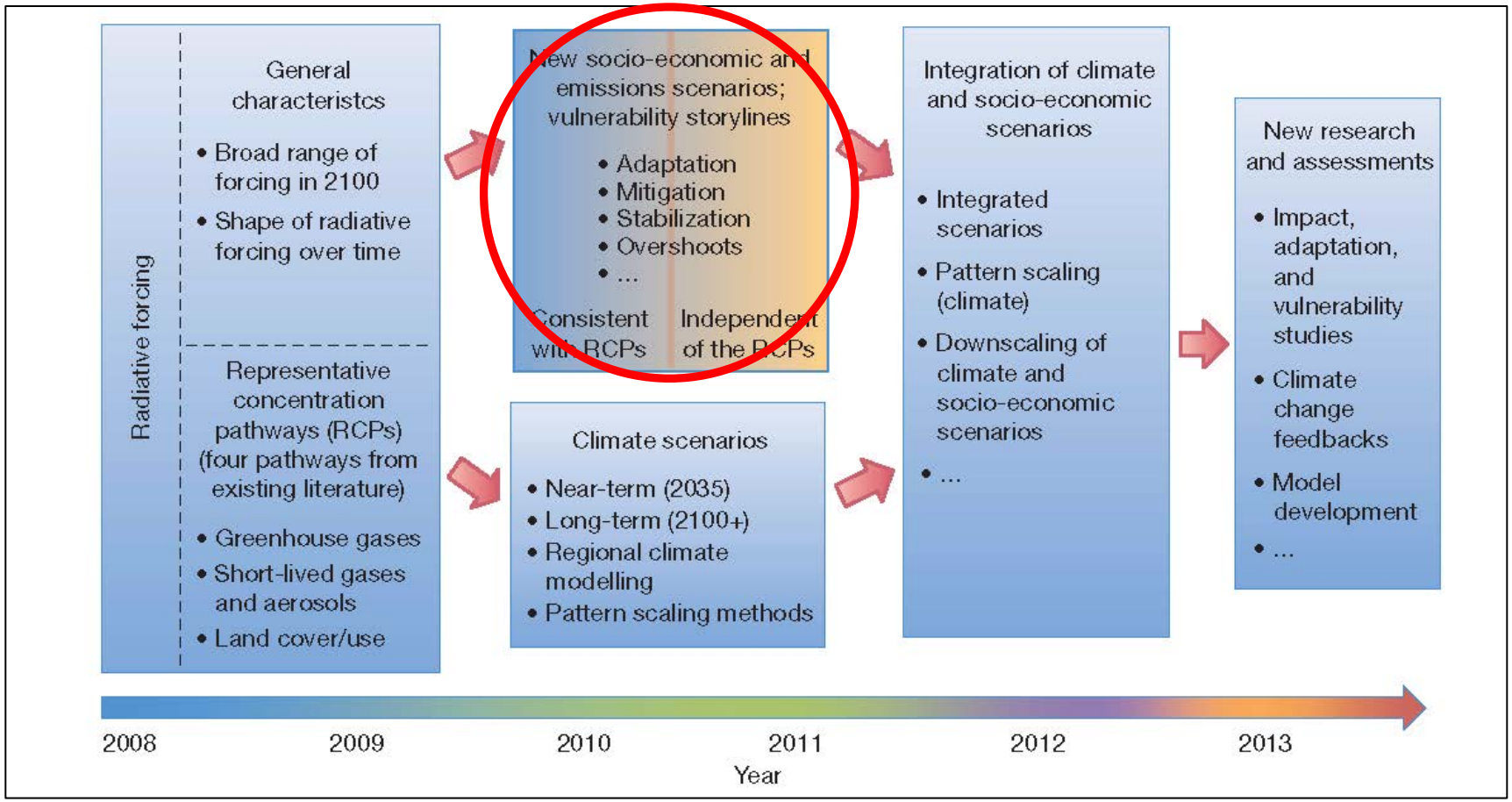
8.5 Wm^{-2}

Range of scenarios consistent with the RCP level

van Vuuren et al., 2011.



New socio-economic scenarios



➔ IPCC Workshop on Socio-Economic Scenarios, Berlin, Nov 2010

IPCC Workshop on Socio-Economic Scenarios

WoSES, 1-3. November 2010 in Berlin

(www.ipcc-wg3.de/meetings/expert-meetings-and-workshops/WoSES)

How can new SE scenarios be identified and combined with the RCPs?

- Objective and concept of the new scenario architecture
- Process to consolidate architecture and identify SE scenarios

Background material:

- Report of NAS Workshop on SE Scenarios, Washington, February 2010
- Van Vuuren et al. Artikel
- Kriegler et al. Artikel

Framework paper

Objective of the scenario architecture

Analysis of climate change and its policy implications (and the AR5 in particular) needs an integrated assessment of mitigation, adaptation and residual climate impacts

New scenario architecture should:

- Facilitate such an integrated assessment, in particular the integration of the the three IPCC working groups
- Enhance comparability of results from different research projects
- Provide a context for regional and local analysis (e.g. global boundary conditions)

Requirements for scenario set

- **Limited number**
- **Comprehensive**
- **Comparability.**
- **Structured but flexible (not over defined!)**
- **Based on concepts like vulnerability and mitigative capacity**
- **Related to RCPs**
- **Allow for multiscale application (e.g. storylines)**
- **Capture different time scales**

Use of scenarios

- Scenarios are used for different purposes :
  - Basis for climate calculations
  - Basis for impact assessment
  - Basis for mitigation analysis

What is needed?

Climate impacts depend on:

- Exposure (climate change)
- The subject at risk (f (population, income etc)
- Adaptive capacity (f (technology, income, governance etc))

Use of scenarios

- Scenarios are used for different purposes:
  - Basis for climate calculations
  - Basis for impact assessment
  - Basis for mitigation analysis

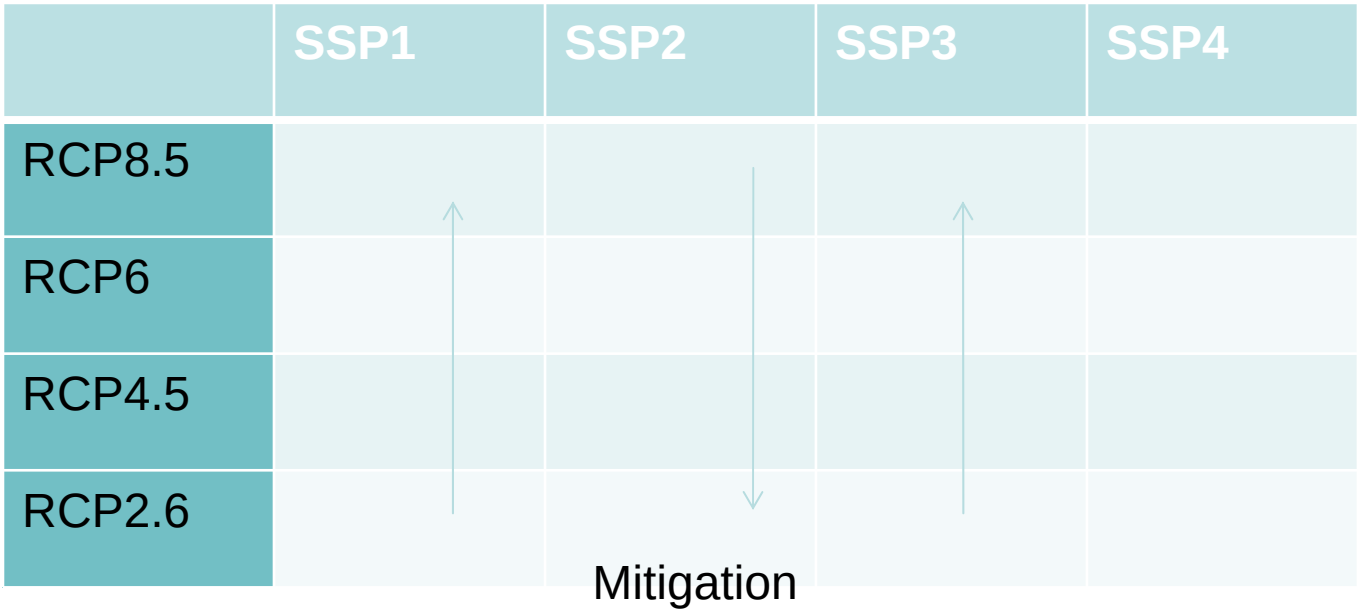
What is needed?

Mitigation depends on:

- Baseline + target
- Assumptions on technology etc.
- Assumptions on climate governance (global cooperation etc)

Concept of the scenario architecture

Matrix of socio-economic and climate / concentration pathways to be filled with results of IAM & IAV studies.



Concept of the scenario architecture

Matrix of socio-economic and climate / concentration results of I

Framework could just represent classification heuristic (IM2.6 for instance classified as Mid scenario)

Framework could also form the basis of formulating preferred quantified storylines (marker RSPs)

		SSP2	SSP3	SSP4
RCP8.5	Climate impacts		Need to adapt	
RCP6				
RCP4.5				

Mitigation

Prefered model runs (like Climate modelling community)

omic conditions determining ability to mitigate

pt

Concept of the scenario architecture

Interesting choices: how much should we define the matrix elements (trade-off consistency vs. uncertainty)

How many scenario elements?

What criteria in quantification?

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Part II – Shared Socio-economic Pathways and Climate Policy Assumptions

Elmar Kriegler and Detlef van Vuuren

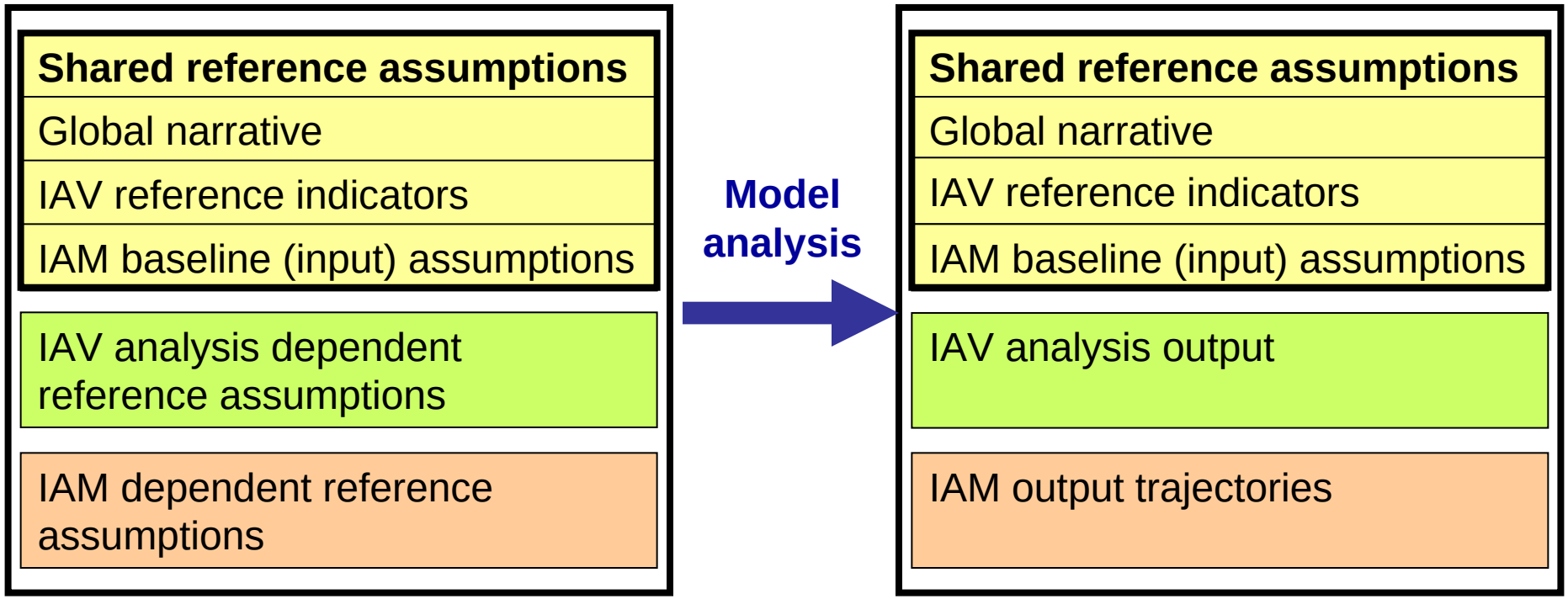
Workshop to Explore the New SSP/SMA Approach,
Changwon, 16 July 2011

Core Writing Team of the Framework Paper:
Nigel Arnell, Tom Kram, Tim Carter, Kris Ebi, Jae Edmonds, Stephane Hallegatte, Elmar Kriegler, Ritu Mathur, Brian O'Neill, Keywan Riahi, Harald Winkler, Detlef van Vuuren, Timm Zwickel

Acknowledgment: Nigel Arnell for preparing the first overview presentation of this type for the WGII 1st LA meeting in January 2011

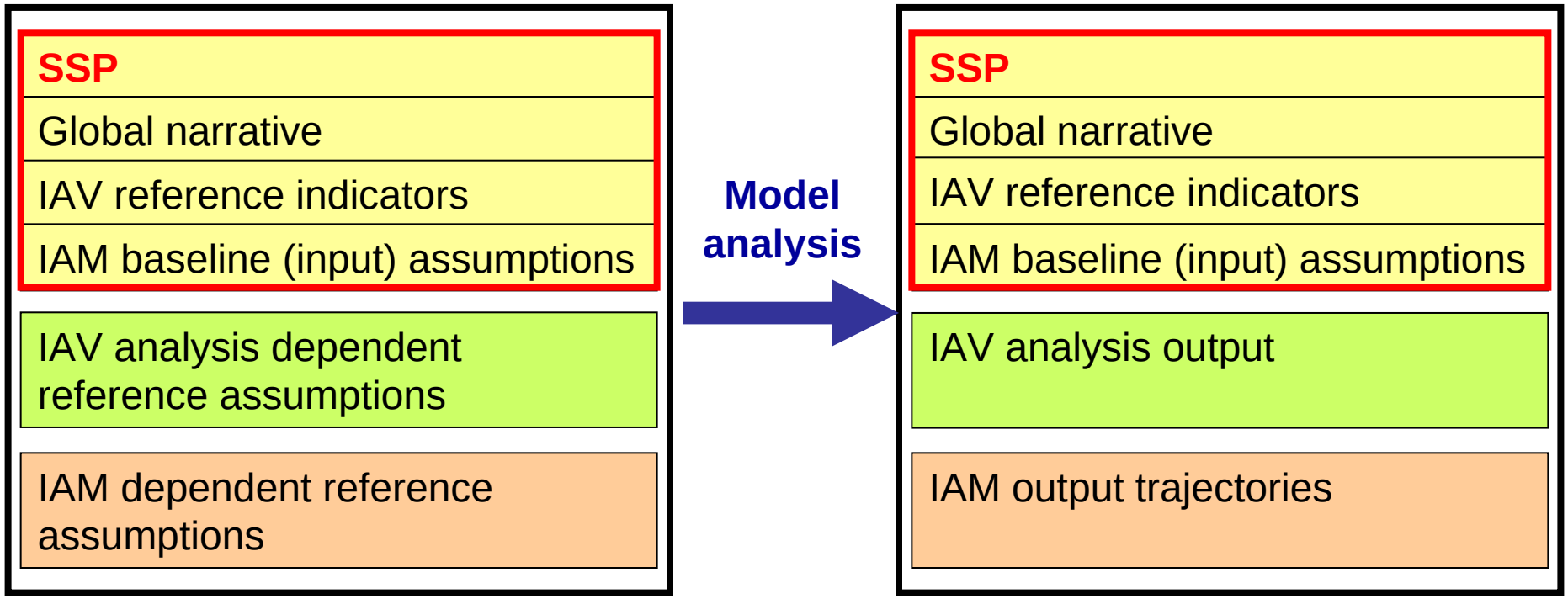
Socio-economic (reference) scenarios

Reference (or baseline) scenarios describe socio-economic development without (new) climate policy



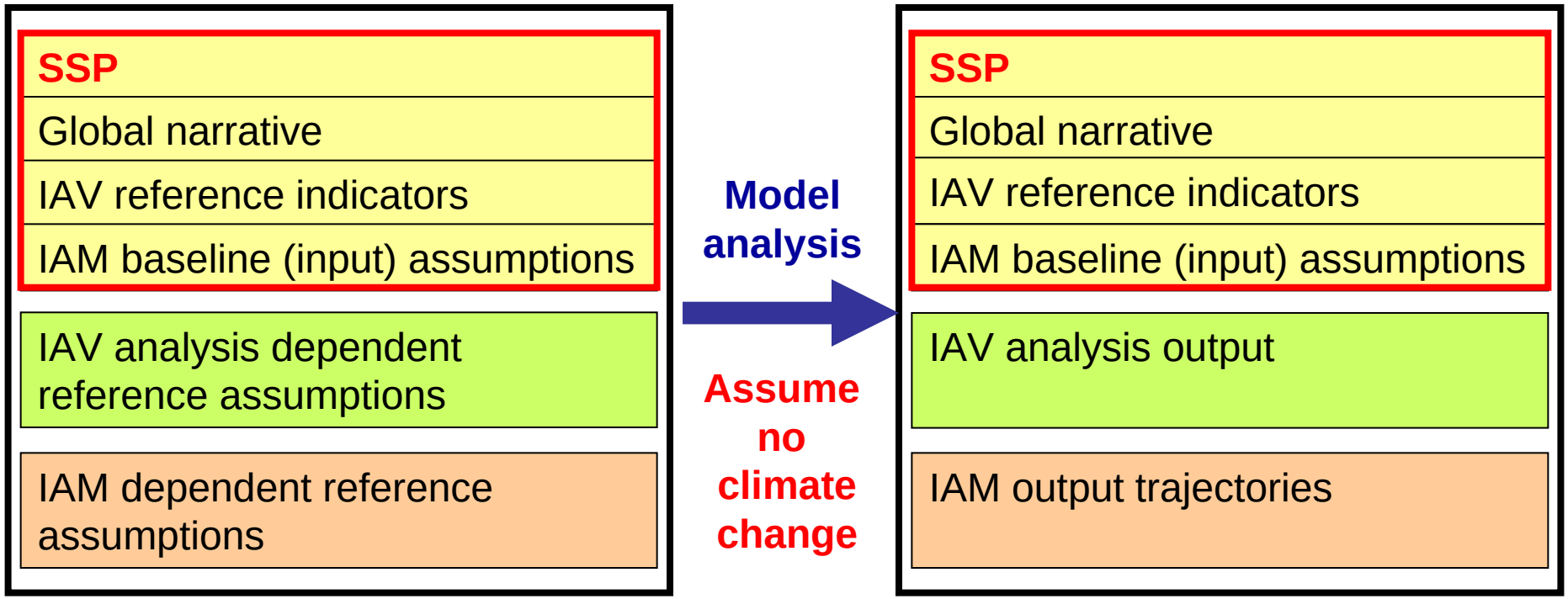
Shared socio-economic (reference) pathways (SSPs)

Component of assumptions / scenarios that is **shared by all model based scenario projections**



Shared socio-economic (reference) pathways (SSPs)

What about climate change in the reference scenario?



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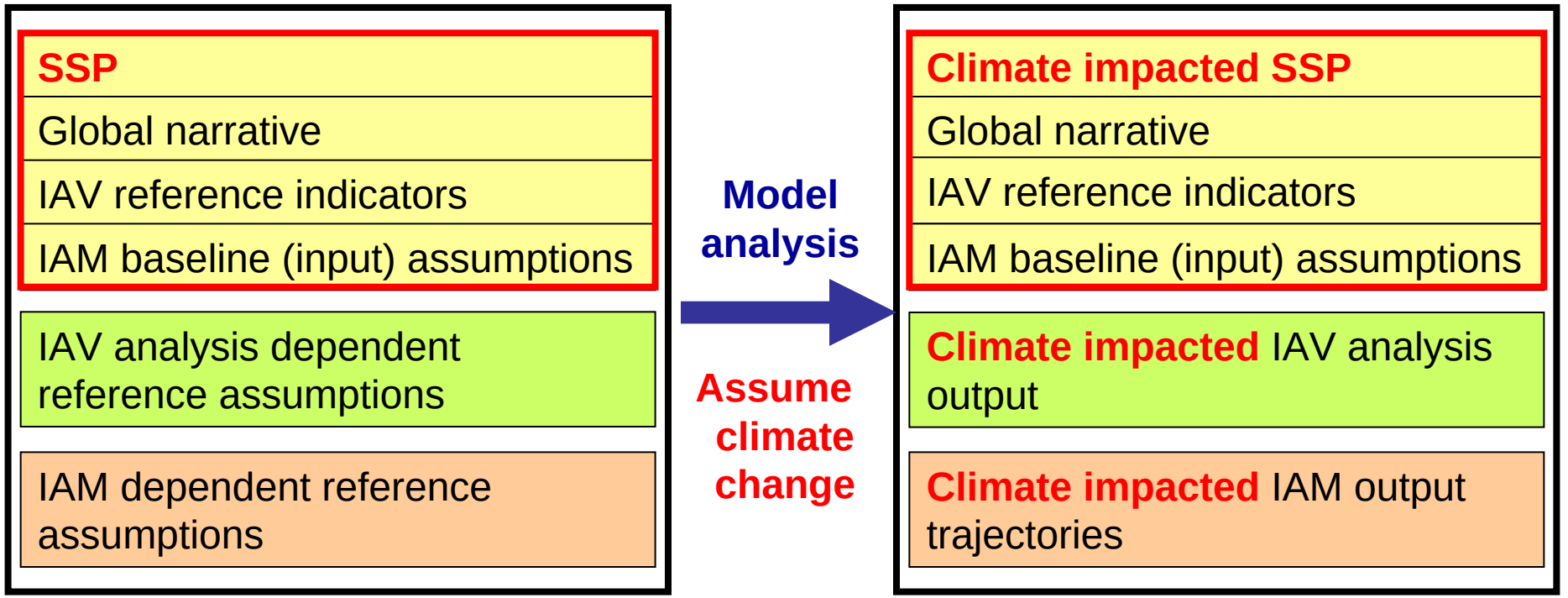
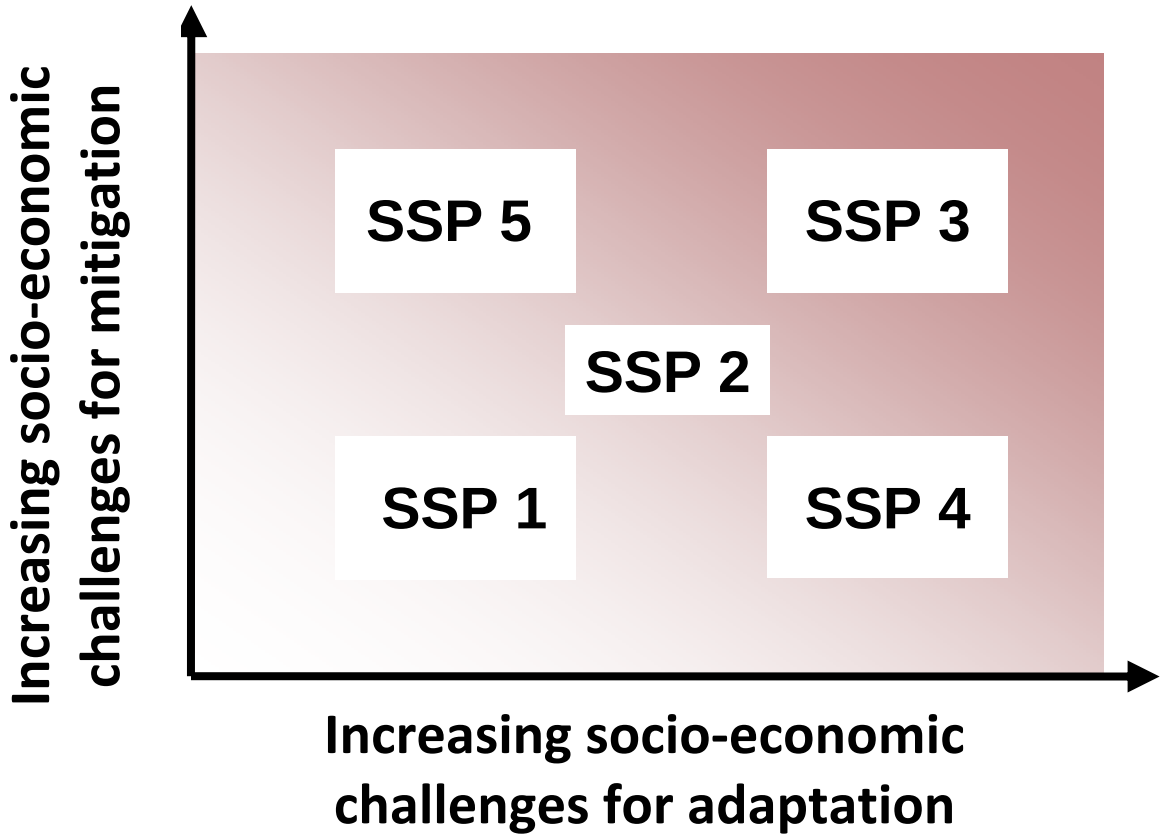


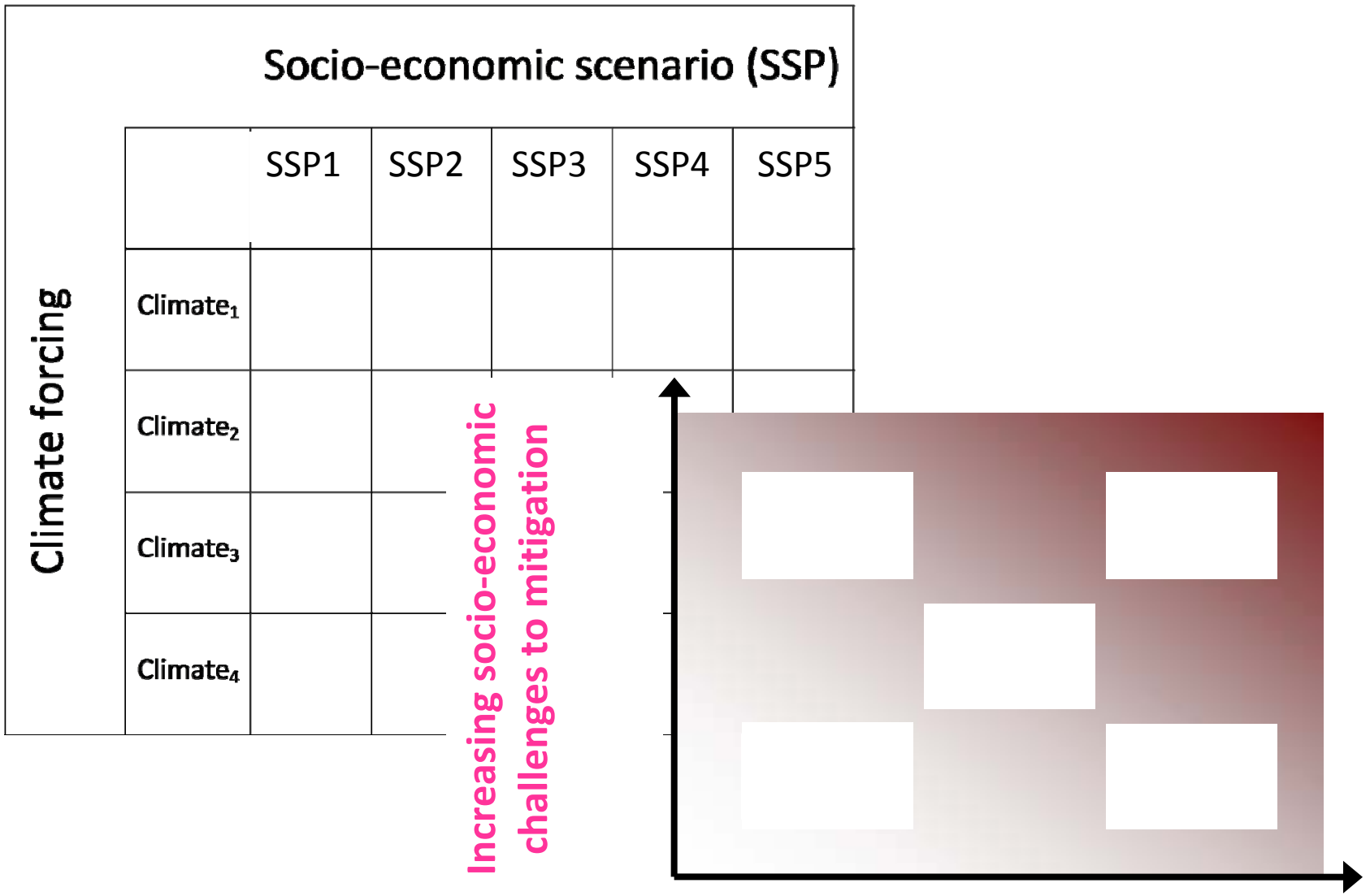
How to choose the SSPs?

- Should cover the space of socio-economic reference assumptions relevant for climate change analysis
- Socio-economic conditions relevant to mitigation
  - ➔ reference emissions
  - ➔mitigative capacity
- Socio-economic conditions relevant to adaptation
  - ➔sensitivity to climate change
  - ➔adaptive capacity

SSP „space“ relevant for climate change

Range of socio-economic challenges for mitigation & adaptation





Acknowledgment: Nigel Arnell

Illustrative examples for narratives

SSP 1 example: Development proceeds at a reasonably high pace, inequalities are lessened, technological change is rapid and directed toward environmentally friendly processes, including lower carbon energy sources and high productivity of land. (Analogue SRES B1)

SSP 3 example: Unmitigated emissions were high due to moderate economic growth, a rapidly growing population, and slow technological change in the energy sector. Investments in human capital were low, inequality was high, a regionalized world led to reduced trade flows, and institutional development was unfavorable, leaving large numbers of people vulnerable to climate.

(Analogue SRES A2)

Illustrative examples for narratives

SSP 4 example: A mixed world, with rapid technological development in low carbon energy sources in key emitting regions. However, in other regions development proceeded slowly, inequality remained high, and economies were relatively isolated, leaving these regions highly vulnerable to climate change.

SSP 5 example: Energy demand was high and most of this demand was met with carbon-based fuels (perhaps similar to the SRES A1FI scenario). Investments in alternative energy technologies were low. Nonetheless, economic development was rapid and driven by high investments in human capital. This produced a more equitable distribution of resources, stronger institutions, and slower population growth.

Potential Dimensions of SSPs

Demographics

- Population total and age structure
- Urban vs. rural populations, and urban forms

Economic Development

- Global and regional GDP, or trends in productivity
- Regional, national, and sub-national distribution of GDP, including economic catch-up by developing countries
- Sectoral structure of national economies. In particular, share of agriculture , and agricultural land productivity
- Share of population in extreme poverty
- Nature of international trade

Welfare

- Human development
- Educational attainment
- Health

Ecological factors

Resources

- Fossil fuel resources and renewable energy potentials

Potential Dimensions of SSPs

Institutions and Governance

- Existence, type and effectiveness of national/regional/global institutions in particular sectors

Technological development

- Type (e.g. slow, rapid, transformational) and direction (e.g, environmental, efficiency, productivity improving) of technological progress
- Diffusion of innovation in particular sectors, e.g. energy supply, distribution and demand, industry, transport, agriculture

Broader societal factors

- Attitudes to environment/sustainability
- Globalization of life styles (including diets)

Policies

- Non-climate policies could also be an important dimension of SSPs. These include development policies, technology policies, urban planning and transportation policies, energy security policies, and environmental policies to protect air, soil and water quality.
- It is possible that SSPs could be specified partly in terms of policy objectives, such as strong welfare-improving goals, rather than specific policies themselves.

Two levels of complexity of SSPs

“Basic” / “Thin” SSPs

“Extended” / “Thick” SSPs

Basic SSPs include less socio-economic reference assumptions than Tier-2 SSPs

For example a narrative, population and economic development trajectories, but not much on energy system and land use patterns

Two levels of complexity of SSPs

Three reasons for differentiation:

- *Practicality:* Basic SSPs can be specified "faster", increasing the probability to have a defined set available by end of 2011
- *Flexibility:* Basic SSPs allow more possibility for early "hands-on experimentation by a wide range of researchers
- *Robustness:* Basic SSPs are less affected by climate change and climate policy as the additional variables in refined SSPs

Shared climate policy assumptions (SPAs)

SSPs are complemented by **„Shared climate policy assumptions“ (SPAs)** to define socio-economic scenarios that are consistent with an RCP

Example:

SSP-1 + SPA-0 (no new climate policy) = reference (will not necessarily yield an RCP level)

SSP-1 + SPA-4.5 = RCP 4.5 forcing level

SSP-1 + SPA-2.6 = RCP3PD forcing level

What constitutes shared climate policy assumptions?

3 components:

Policy objective: RCP level or a derivative (e.g. greenhouse gas budget)

Poliy instruments & measures: e.g. CO2 and energy taxes, cap & trade, regulatory approaches

Implementation obstacles & market distortions ("2nd best"): e.g. regional and sectoral fragmentation, trade barriers, technology failure

Next steps for the scenario process

Scenario Framework Paper

Nigel Arnell, Tom Kram, Tim Carter, Kris Ebi, Jae Edmonds, Stephane Hallegatte, Elmar Kriegler, Ritu Mathur, Brian O'Neill, Ramon Pichs-Madruga, Keywan Riahi, Harald Winkler, Detlef van Vuuren, Timm Zwickel

Timeline:

- *August 2011*: Circulate draft paper to IAM and IAV communities
- Collect comments and suggestions from the communities
- Integrate comments and produce final document

  (Goal: By early November)

Next steps for the scenario process

Development and testing phase (starting now!):
Urgent need to develop SSPs and explore associated socio-economic reference and mitigation scenarios iteratively

Tentative timeline:

- Developing and testing SSPs and associated reference and mitigation scenarios
- Discuss analysis and make decisions on illustrative scenarios for use in AR5 at further scenario meetings
- Try to make illustrative scenarios available by early 2012
- Scenario process will be continuing beyond that.

Goal is to establish truly integrative socio-economic scenarios for IAV and IAM research

Thank you