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Importance of Scenarios for CCIAV

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AR5 and NCA are not even finished. And yet, its time to …

…plan scenarios for the next round of research and assessment

- Are we already behind?
- What have we learned in the first round of the new scenario process?
- What are the policy and science questions that will need to be addressed in the AR6 and other assessments?
- What research design for scenarios is appropriate for these questions?

Topics I will cover

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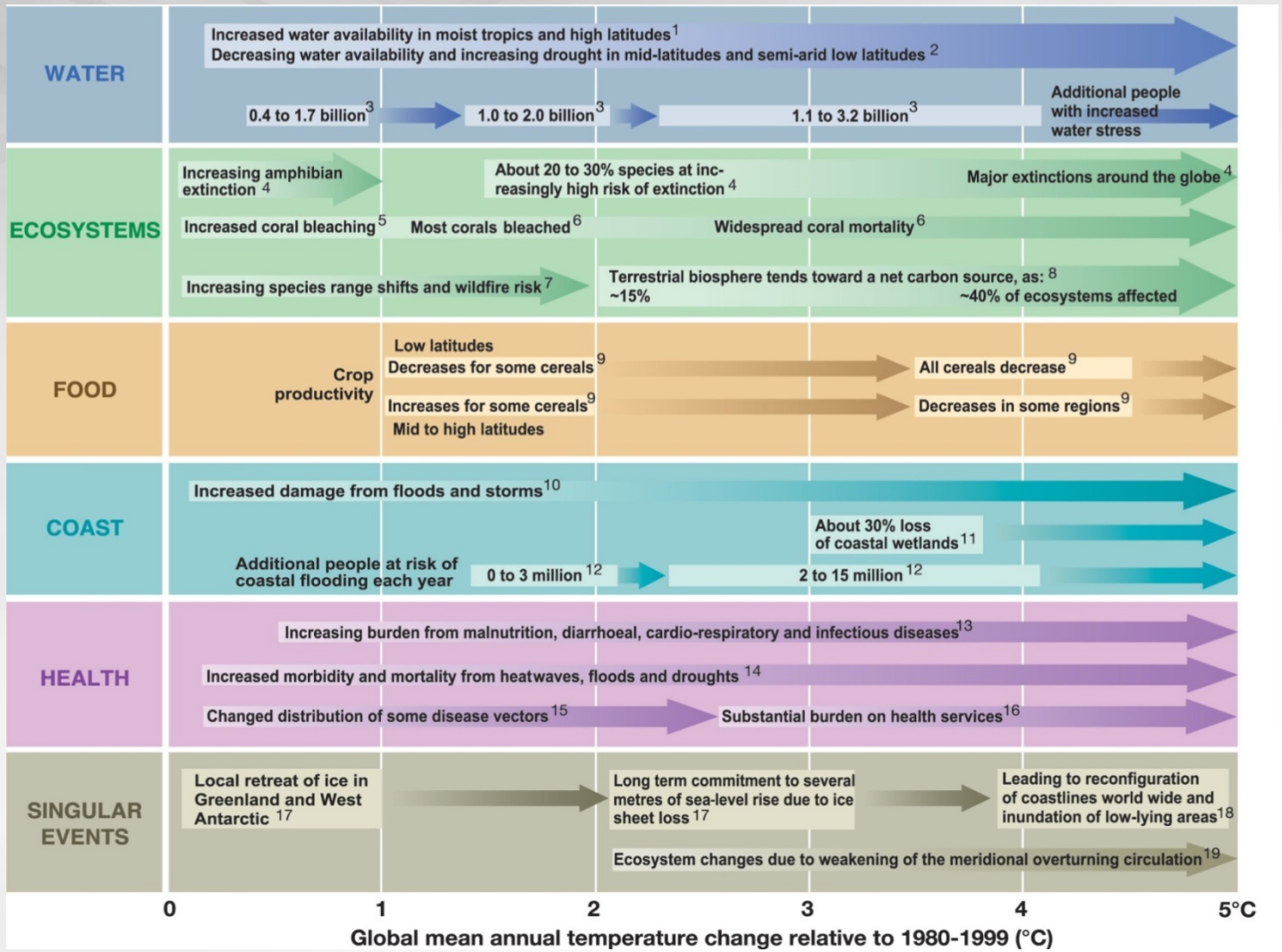
1. Drivers of scenarios development
2. How have RCPs been used?
3. Areas for improvement and potential next steps in improving scenarios for CCIAV

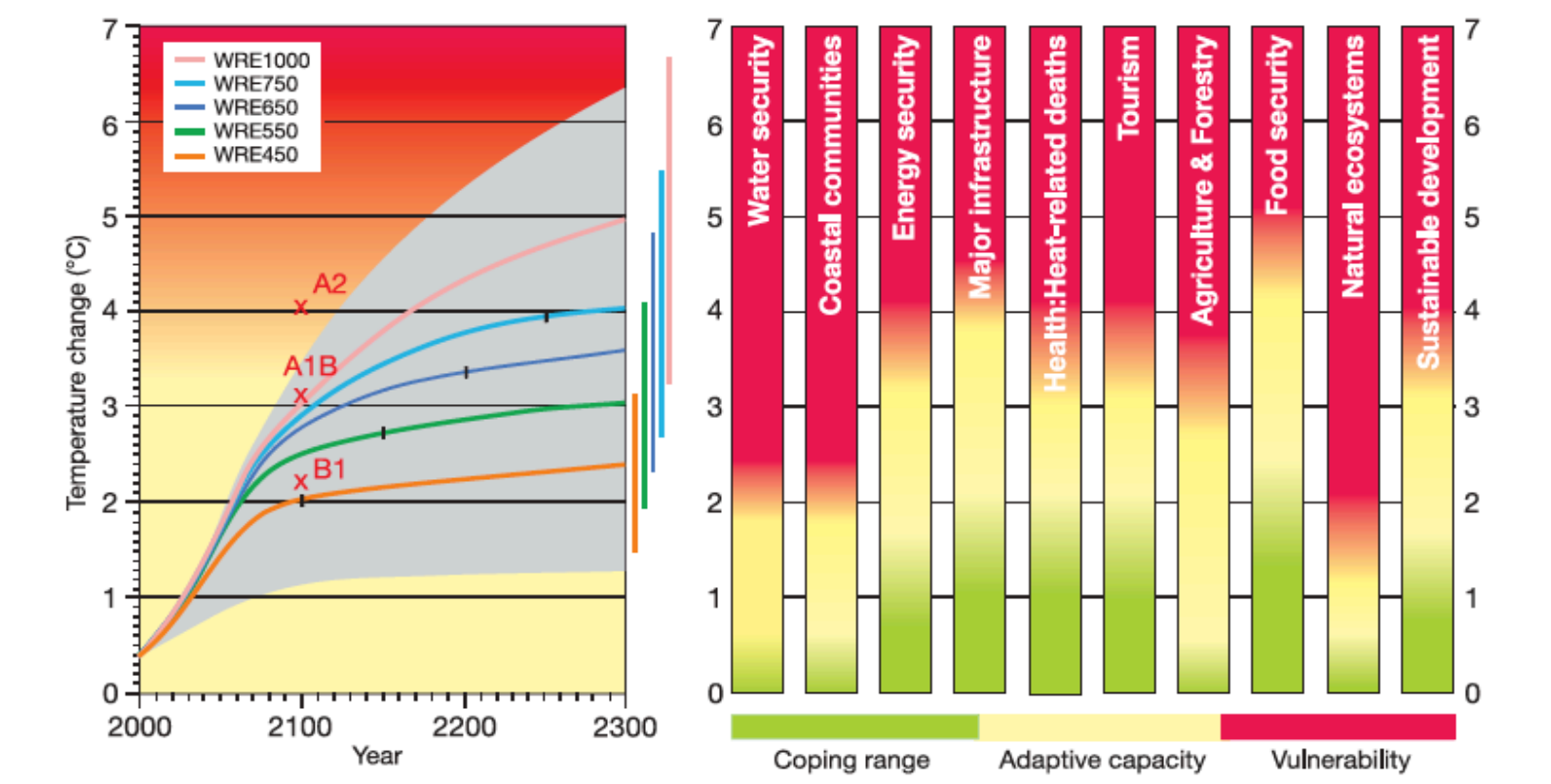
Drivers

1. Scenarios as method to coordinate synthesis



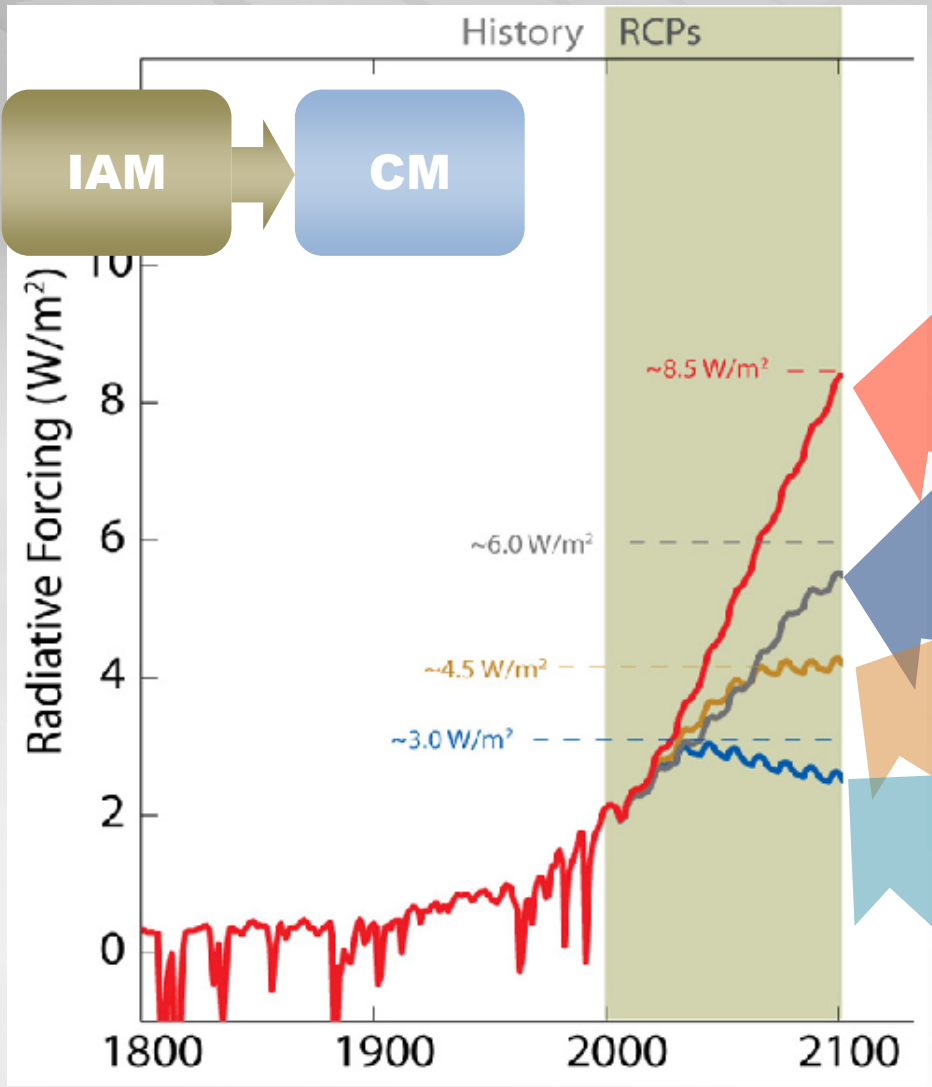
IPCC AR4, WGII, Table 20.8

Synthesis, IPCC Australia/New Zealand



Source: IPCC AR4 WG II Ch 11, Fig 11.4

2. Scenarios as inputs to ESMs: Representative Concentration Pathways (RCPs)



- The climate modeling community wanted 4 levels of radiative forcing that would span the emissions literature.
  - 8.5 Wm^{-2} (RCP 8.5, *1350ppm* CO_2-*e*)
  - 6.0 Wm^{-2} (RCP 6.0, *850ppm* CO_2-*e*)
  - 4.5 Wm^{-2} (RCP 4.5, *650ppm* CO_2-*e*)
  - 2.6 Wm^{-2} (RCP 2.6, *450ppm* CO_2-*e*)

CLIMATIC CHANGE
Volume 109, Numbers 1-2 (2011), 5-31, DOI: 10.1007/s10584-011-0148-z

Content of RCP database

- Data for climate modelers or atmospheric chemists
  http://www.iiasa.ac.at/web-apps/tnt/RcpDb/

FORCING AGENTS

GHG Emissions and Concentrations from IAMs

- Greenhouse gases: CO_2, CH_4, N_2O, CFCs, HFC's, PFC's, SF_6
- Emissions of chemically active gases: CO, NO_x, NH_4, VOCs
- Derived GHG's: tropospheric O_3
- Emissions of aerosols: SO_2, BC, OC
- **Land use and land cover [NEW]**

EXTENSIONS

- **Extension of scenarios to 2300—ECPs.**

WHAT YOU WON'T FIND

- **You will not find an integrated set of detailed socioeconomic storylines and scenarios (e.g., no common reference scenario)**

3. Scenarios as inputs to diverse CCIAV research

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	Impact	Vulnerability	Adaptation	Integrated
Scientific objectives	Impacts and risks under future climate	Processes affecting vulnerability to climate change	Processes affecting adaptation and adaptive capacity	Interactions and feedbacks between multiple drivers and impacts
Practical aims	Actions to reduce risks	Actions to reduce vulnerability	Actions to improve adaptation	Global policy options and costs
Research methods	Standard approach to CCIAV Drivers-pressure-state-impact-response (DPSIR) methods Hazard-driven risk assessment	Vulnerability indicators and profiles Past and present climate risks Livelihood analysis Agent-based methods Narrative methods Risk perception including critical thresholds Development/sustainability policy performance Relationship of adaptive capacity to sustainable development		Integrated assessment modelling Cross-sectoral interactions Integration of climate with other drivers Stakeholder discussions Linking models across types and scales Combining assessment approaches/methods
Spatial domains	Top-down Global → Local	Bottom-up Local → Regional (macro-economic approaches are top-down)		Linking scales Commonly global/regional Often grid-based
Scenario types	Exploratory scenarios of climate and other factors (e.g., SRES) Normative scenarios (e.g., stabilisation)	Socio-economic conditions Scenarios or inverse methods	Baseline adaptation Adaptation analogues from history, other locations, other activities	Exploratory scenarios: exogenous and often endogenous (including feedbacks) Normative pathways
Motivation	Research-driven	Research-/stakeholder-driven	Stakeholder-/research-driven	Research-/stakeholder-driven

Source: IPCC AR4, WG2, CH2

Content of DDC data base for CCIAV research

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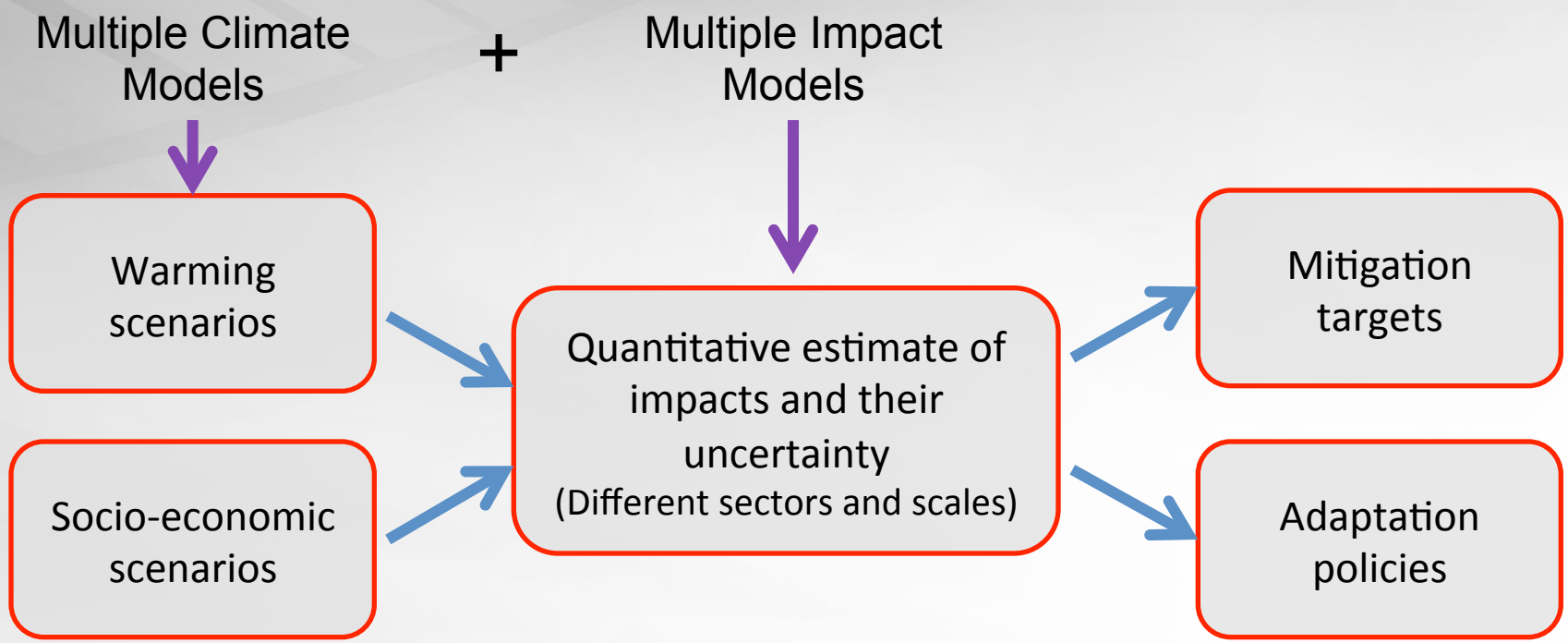
DDC_Variables for AR4

	DDC-Variable	Acronym	PCMDI-Variables	Table/ Nr
core data	2m surface air temperature	TEMP2	tas	A1a/3
	2m mean max. air temperature		tasmin	A1f/5
	2m mean min. air temperature		tasmax	A1f/6
	total precipitation		pr	A1a/2
	total incident solar radiation		Rrsds	A1a/13
	mean scalar wind speed		uas/vas	A1a/26+27
	humidity		huss	A1a/28
	mean sea level pressure		psl	A1a /1
	global mean sea level change (th. exp.)		zostoga	O1c/2
extreme Indices	frost days		fd	A4/1
	extreme temperature range		etr	A4/2
	growing season length		gsl	A4/3
	heat wave duration		hwdi	A4/4
	fraction of time (90^{th} percentile min temp)		tn90	A4/5
	rain > 10 mm/d		r10	A4/6
	consecutive dry days		cdd	A4/7
	max. 5day precipitation		r5d	A4/8
	simple daily intensity index		sdii	A4/9
	fraction of annual total prec. > 95^{th} percentile		r95t	A4/10

Plus a list of ~20 optional variables

Scenarios for CCIAV intercomparison: ISI-MIP



Common Background Scenarios | **Quantitative** Impact Models | **Policy-relevant**, **society-focused** metrics

IIASA

Source: Katja Frieler

MetroQuest Workshops

Discussing Priorities

Making Choices

Reviewing Scenarios

Discussing Implementation

Source: John Robinson

II. If we're re-examining scenarios for future research/assessment, a reasonable question is how have the RCPs been used?

Preliminary RCP citation analyses

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	Citation (web of science)	Using CMIP5 data	Using RCP data
Moss	267	45	31
Van Vuuren overview	101	25	24
van vuuren 2.6	29	3	7
Thomson 4.5	31	7	13
Masui 6.0	16	?	4
Riahi 8.5	30	12	7
Meinhausen extension	84	?	10
Hurtt Land Use	30	2	3

-> Total using RCP data: 67

Spatial scale

Global	**52**
Region	**11**
National and <	**3**

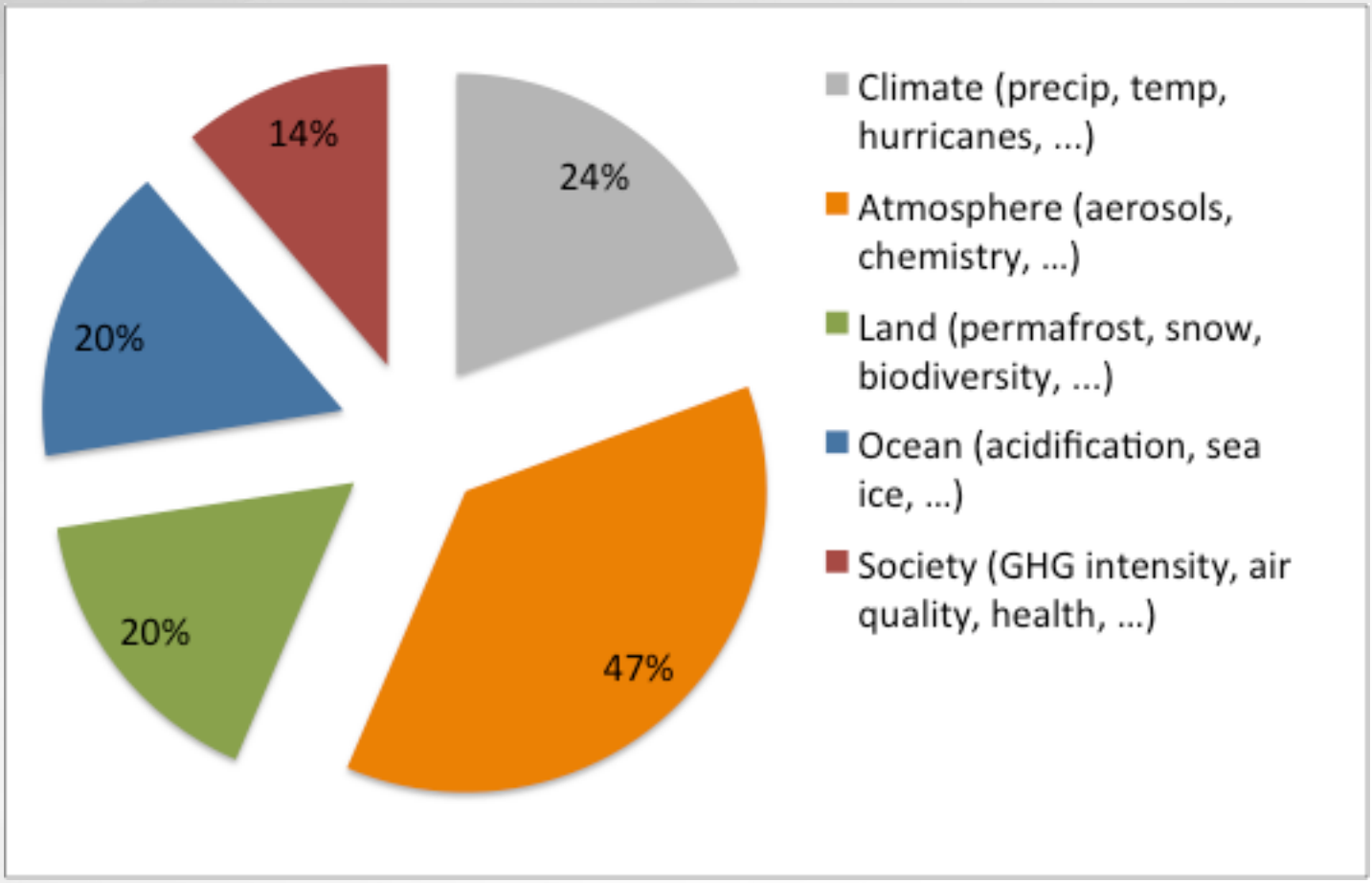
Data used

GHG and pollutant emissions	**60**
Landuse	**9**
Socio-economics	**3**

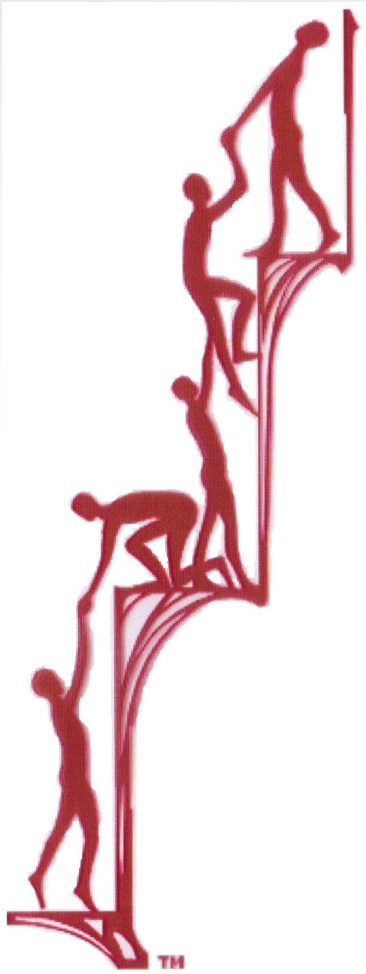
Papers also using ESM data

47

Main topic of papers using RCP data



III. Areas for improvement and potential next steps



Improving use of scenarios in assessments and decision support

- Assessment: scenarios are not widely used
  - NCA experience (careful strategy, climate “outlooks”)
  - IPCC WG II (is WG III a different story?)
- Supporting decisions: many end users can’t relate to the substance of current global scenarios
  - Survey uses and needs (e.g., higher resolution, more ‘near-term’ information)
  - Test what communicates effectively, including evaluating the “climate outlooks” and SLR scenarios
  - Experiment with scenario planning methods and evaluate experience

Some specific areas of improvement needed

- Broader range of designs (e.g., Tony's normative approach)
- Continue developing SSPs, extensions, and alternatives
- Guidance on scenario matching and integration for specific uses:
  - Socioeconomic, climate, land use, etc.
- Guidance on pattern scaling
- Better advertising of availability
- Better user support
- Advance methods for nesting scenarios – cross-scale dynamics
- Make progress on relatively likelihood of pathways (e.g., IPCC issue)
- Closer connection with users and importance of storylines, scenario planning

Snowmass scenarios workshop: Assessing recent experience and planning next scenarios for research and assessment

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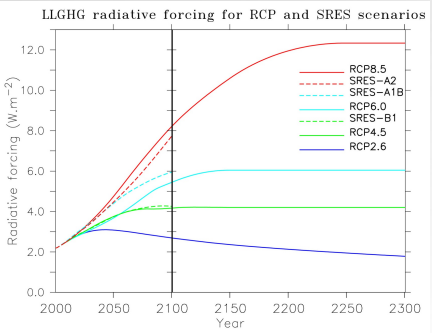
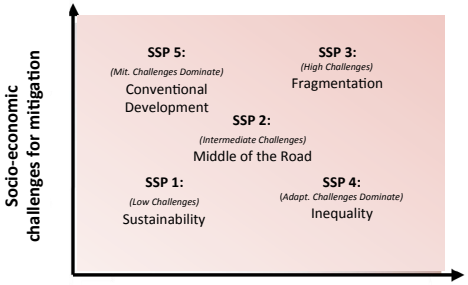
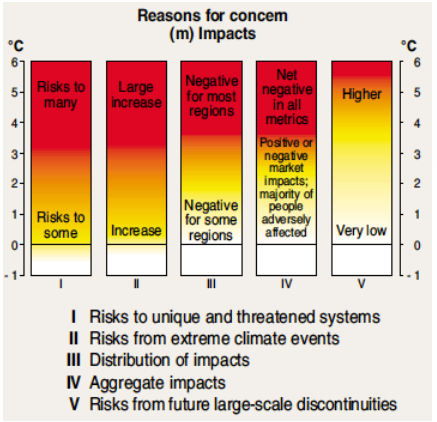
- Three issues that are expected to be important to national and international policy formulation:
  - land use
  - emissions of short-lived species, and
  - “overshoot” futures
- Needs for national or subnational assessments which require nesting and integration of different types of scenarios (e.g., climate, socioeconomic, land use, sea level) – several US cases
- Scenario recommendations for CMIP6
- Improvements to coordination across the three research communities.
- Other topics or ideas for scenarios: short presentations by participants
- Feeds into AGCI workshop on CMIP6 the week following

Conclusions

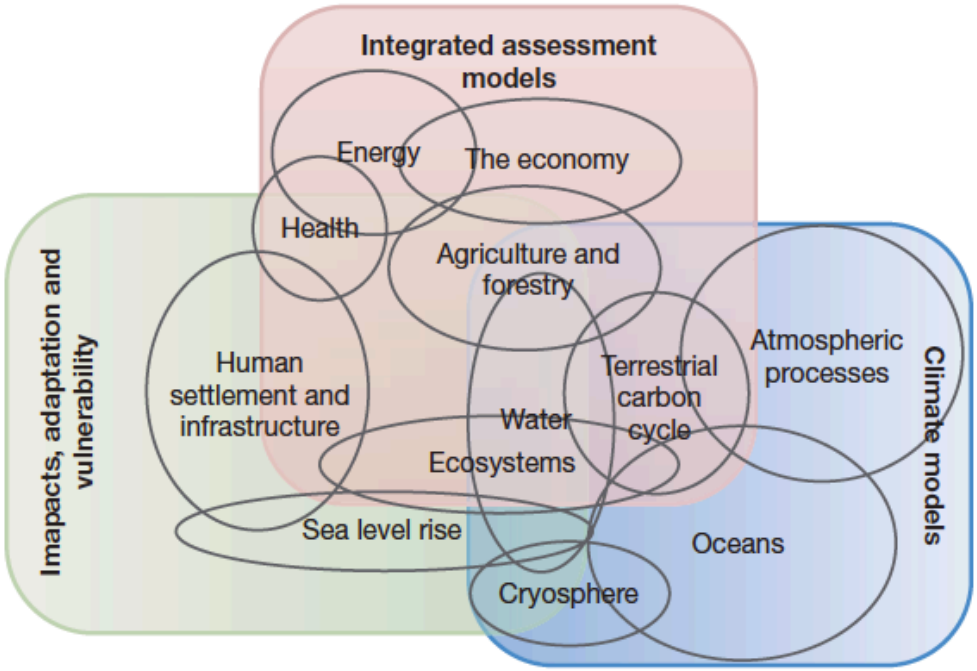
- Now is a good time to examine our use of scenarios
- Develop a plan that addresses specific questions or decision needs and goes beyond coordination of modeling
- Engage users in development of scenarios
- Improve integration of different types of scenarios
- Increase effort to disseminate and support proper use







Discussion


Integrated assessment models
Energy
The economy
Health
Agriculture and forestry
Human settlement and infrastructure
Terrestrial carbon cycle
Atmospheric processes
Water
Ecosystems
Sea level rise
Oceans
Cryosphere
Imapacts, adaptation and vulnerability
Climate models

Improve integration and data sharing

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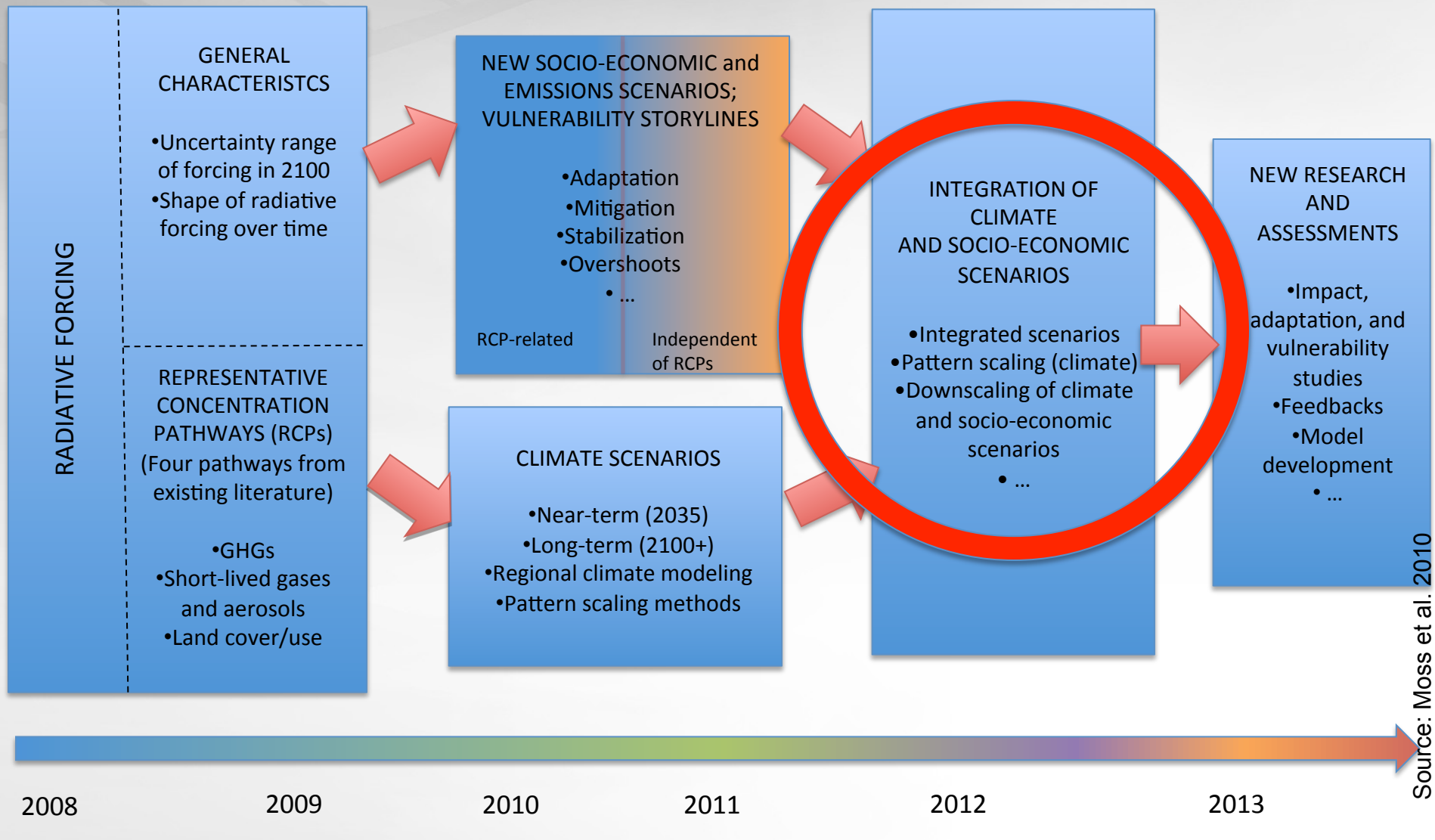

Source: Moss et al. 2010

Improve framework for linking socio-economic and climate scenarios

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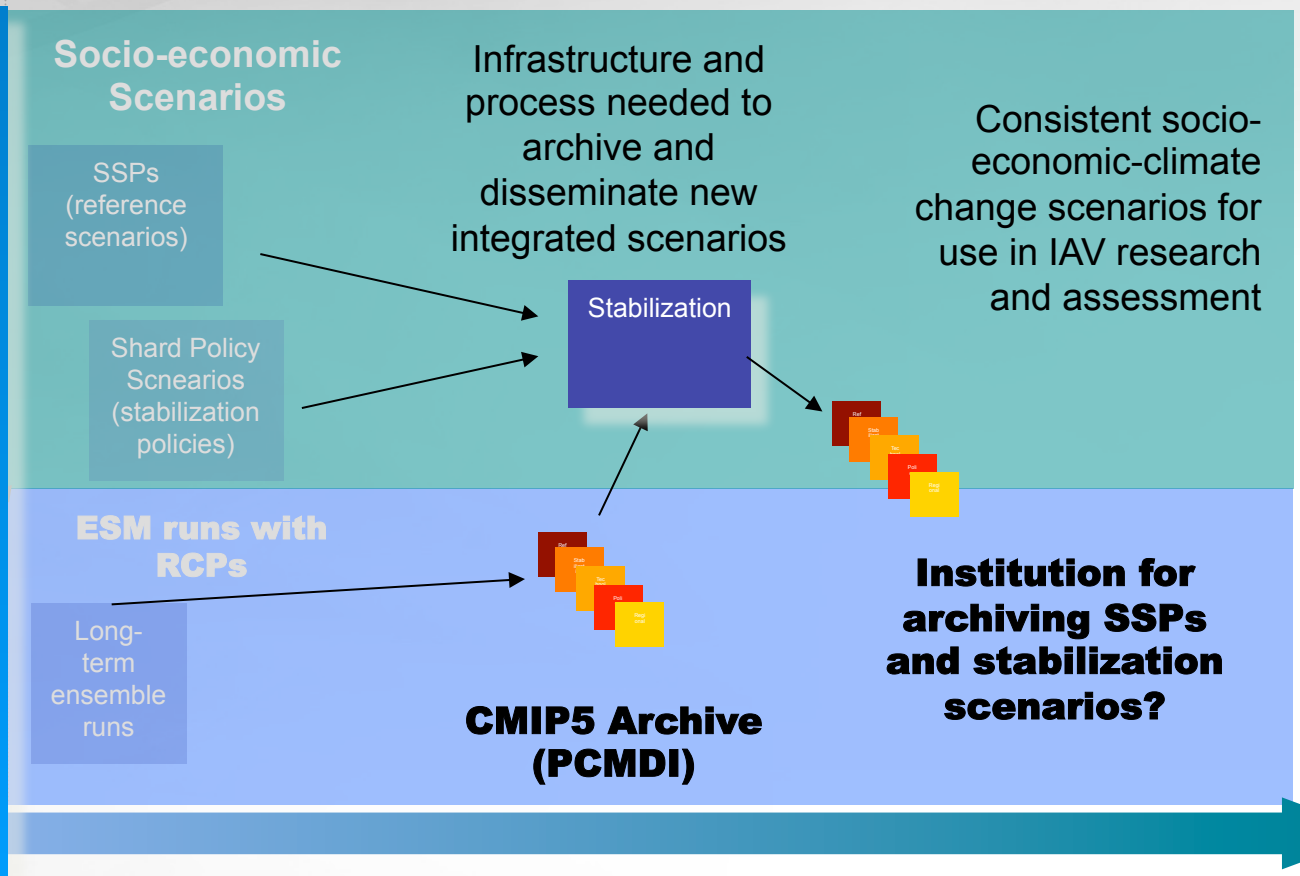
Needed for impact and regional mitigation assessments: integrated socioeconomic and climate scenarios in an accessible format from a distributed scenario archive



SPAs

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