Integrated Scenarios for AR5? A Proposal for a New Set of Community Scenarios

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Tsukuba International Congress Center, Tsukuba, Japan – 12-14 December 2006

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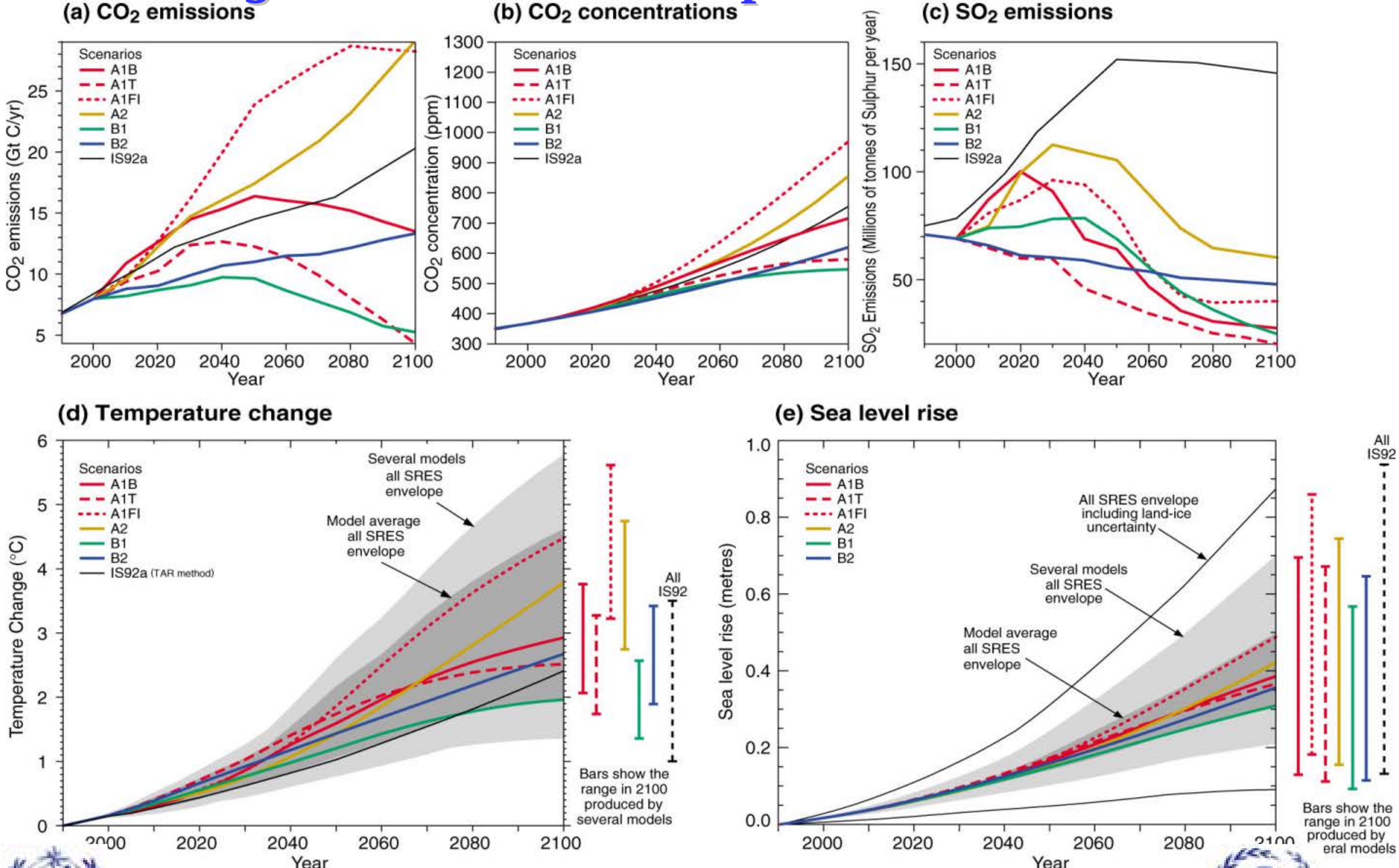
Acknowledgements:
Peter Cox, Jerry Meehl, Kathy Hibbard, Ron Stouffer, Richard Moss, Keywan Riahi

Previous IPCC Scenarios and Future Outlook

1990 1992 1995 1996 2000 2001 2004 2014 >2007

- 1990 — Four SA90 scenarios
- 1992 — Six IS92 scenarios
- 1995 — Evaluation Scenarios
- 1996 — Panel decision new scenarios
- 2000 — Special Report Emission Scenarios (SRES)
- 2001 — TAR mitigation scenarios
- 2004 — AR4 assessment of stabilization scenarios
- 2014 >2007 — AR5 Completion? Based on ???????

The Composition of the Atmosphere is Projected to Change Causing an Increase in Temperature and Sea Level



WMO

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

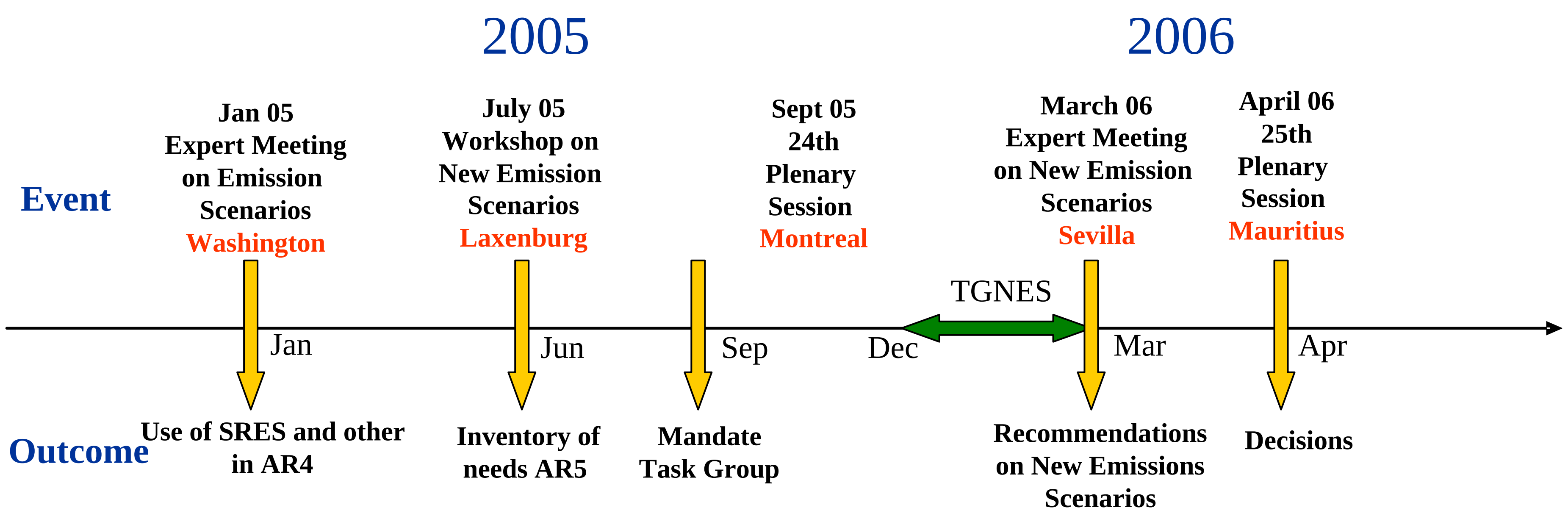
UNEP

AR4 Illustrative Scenarios*

Reference 8	Stabilization <5W/m2	Stabilization ~4.5W/m2	Stabilization <3W/m2	Stabilization >3W/m2
AIM		AIM 4.5		
IPAC		IPAC 4.5		
MiniCam		MiniCam 4.5		
MIT		MIT Mitigation		
MESSAGE 1		MESSAGE 4.6		
MESSAGE 2		MESSAGE 4.6	MESSAGE 3.2	
IMAGE 1	IMAGE 5.3	IMAGE 4.5	IMAGE 3.7	
IMAGE 2				IMAGE 2.9

* Assessed by WGIII for WGI

IPCC scenario events and outcomes



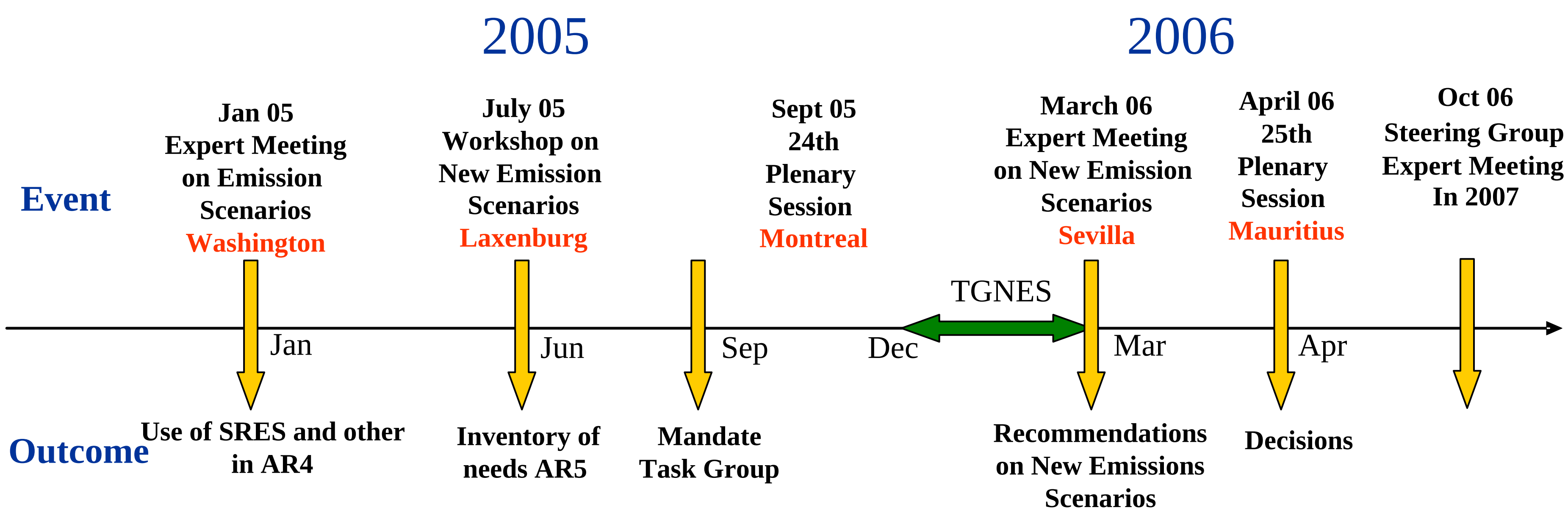
SOURCE; AFTER BERT METZ, 2006

What is meant by ‘facilitation’ or ‘coordination’

- **Facilitation**: supporting development of new ...narios by,for instance, helping identify user ...quirements, identifying ‘benchmark’ ...xpert meetings, help to get fundin...
- **Coordination:** inv... ...new scenarios by, for instance, e... assumptions by modeling groups on ... and key drivers behind scenarios .
- *(NB Co-ordination is not: commissioning, or directing scenario development)*

“Catalyze”

IPCC scenario events and outcomes



SOURCE; AFTER BERT METZ, 2006

Chair proposal on actions of IPCC

New Task Group on scenarios:

- **Specify organisation of scenario development; what level of involvement, by whom**
- **Organise expert meetings in 2007: specify 'wish list' and 'interagency meeting'**
- **Technical Paper with 'benchmark' emission trajectories based on AR4 in second half 2007**
- **Scoping note for Special Report Integrated Scenarios (SRIS) for IPCC-26**

- Assuming the IPCC AR5 publication date is early 2013, modeling groups are making decisions this year (2006) on what form their next generation models will take (to be used for climate change projections).

- The IPCC Task Group on New Emission Scenarios (TGNES) and other groups (CCSP) have been discussing new emission scenarios (e.g. “mitigation/adaptation”, or more generically “stabilization”). These scenarios will come to bear on climate change projections performed for assessment in the IPCC AR5 with the new emerging earth system models.

- Thus there has been a confluence of activities in model development and scenario development that must be communicated and coordinated across various groups and scientific communities this year.

Source: Jerry Meehl, 2006

Classification of Stabilization Scenarios

Category	Additional Radiative forcing	CO2 Concentration	CO2 - eq. Concentration	Global mean temperature increase above pre-industrial levels	No. of scenarios
	W/m2	ppm	ppm	Celsius	
A1	2.5 – 3.0	350 – 398	444 – 487	2.0 – 2.4	6
A2	3.0 – 3.5	398 – 442	487 – 535	2.4 – 2.8	18
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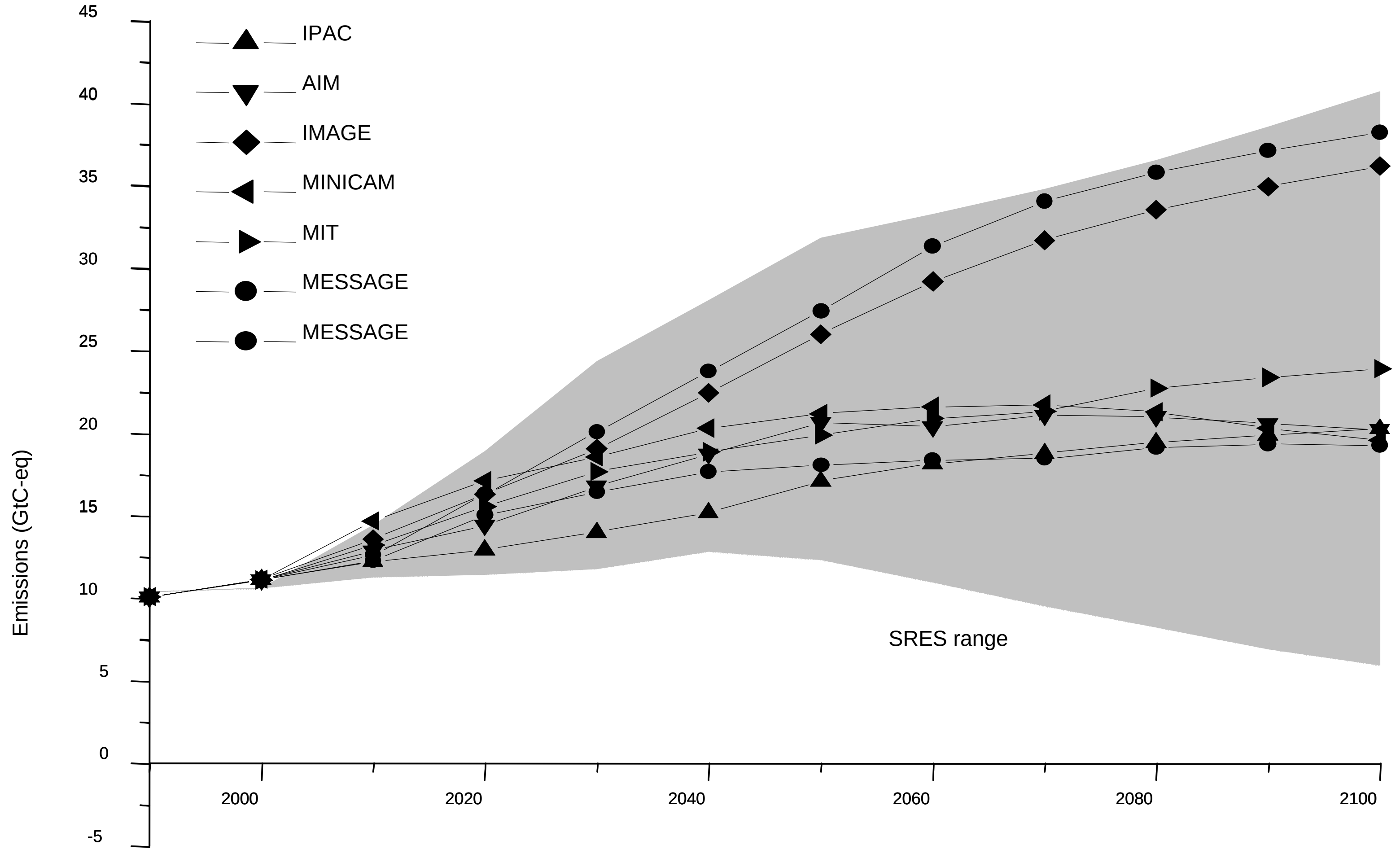
Total					177

Selected AR4 Scenarios



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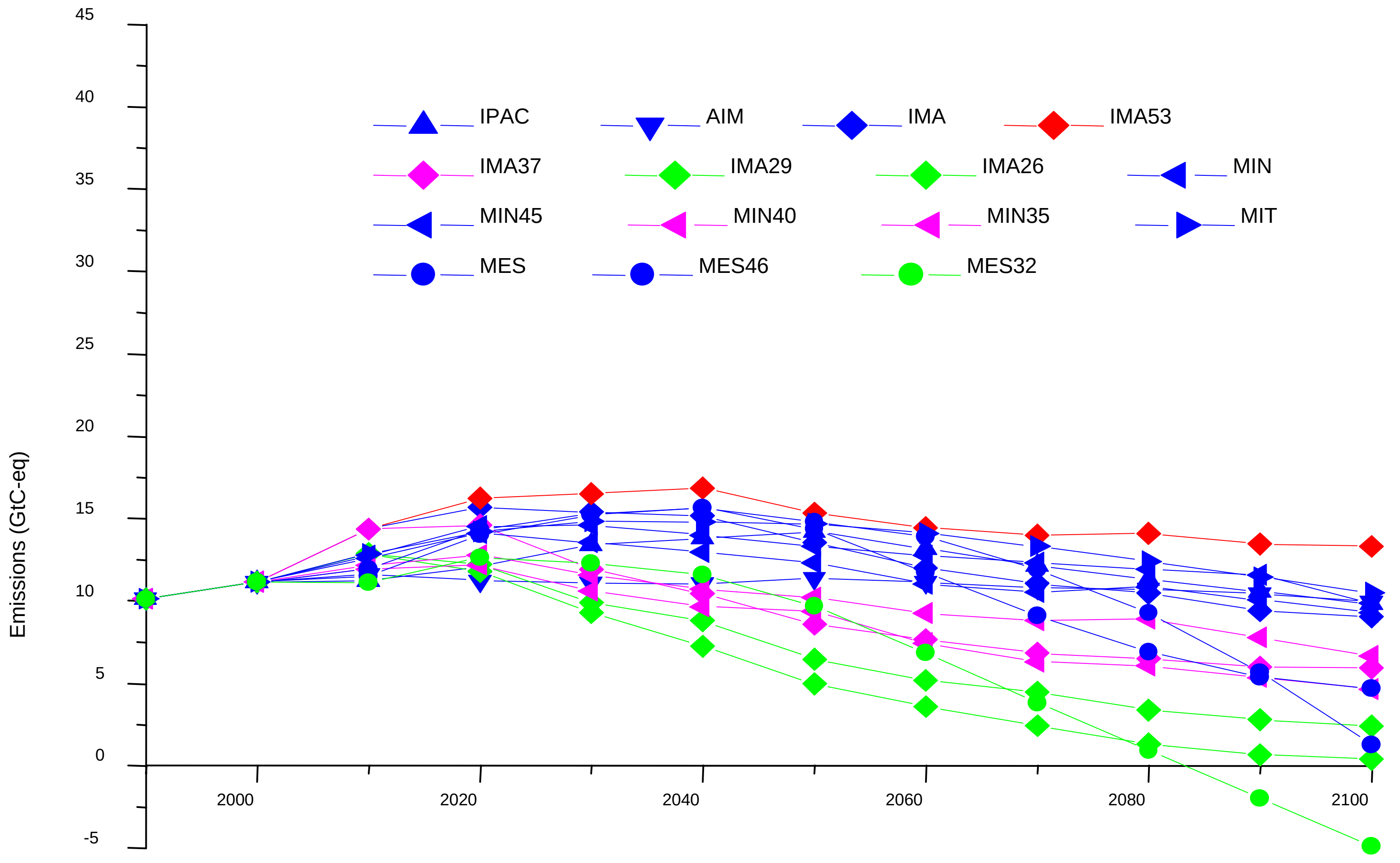
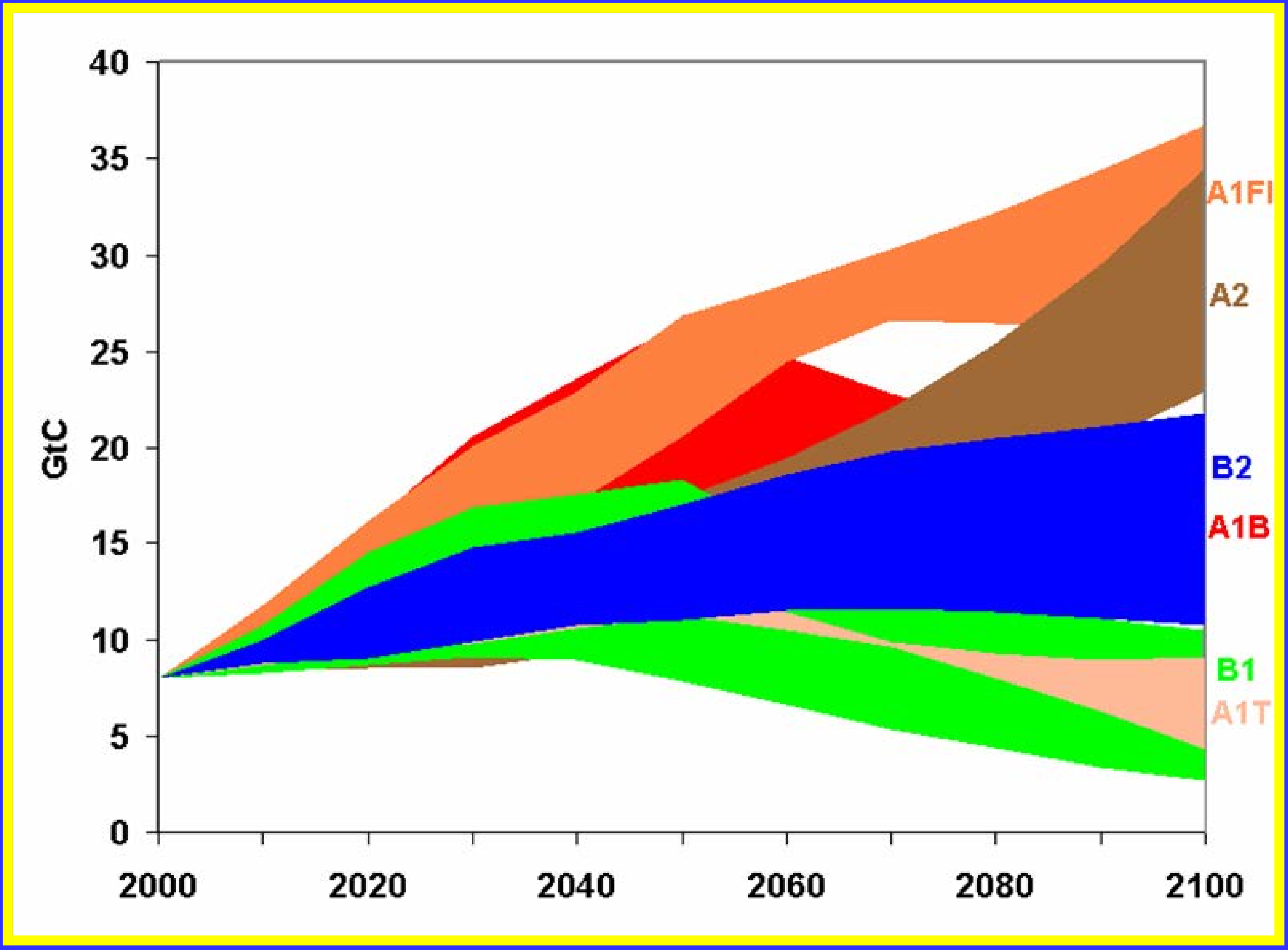


Global Carbon Dioxide Emissions



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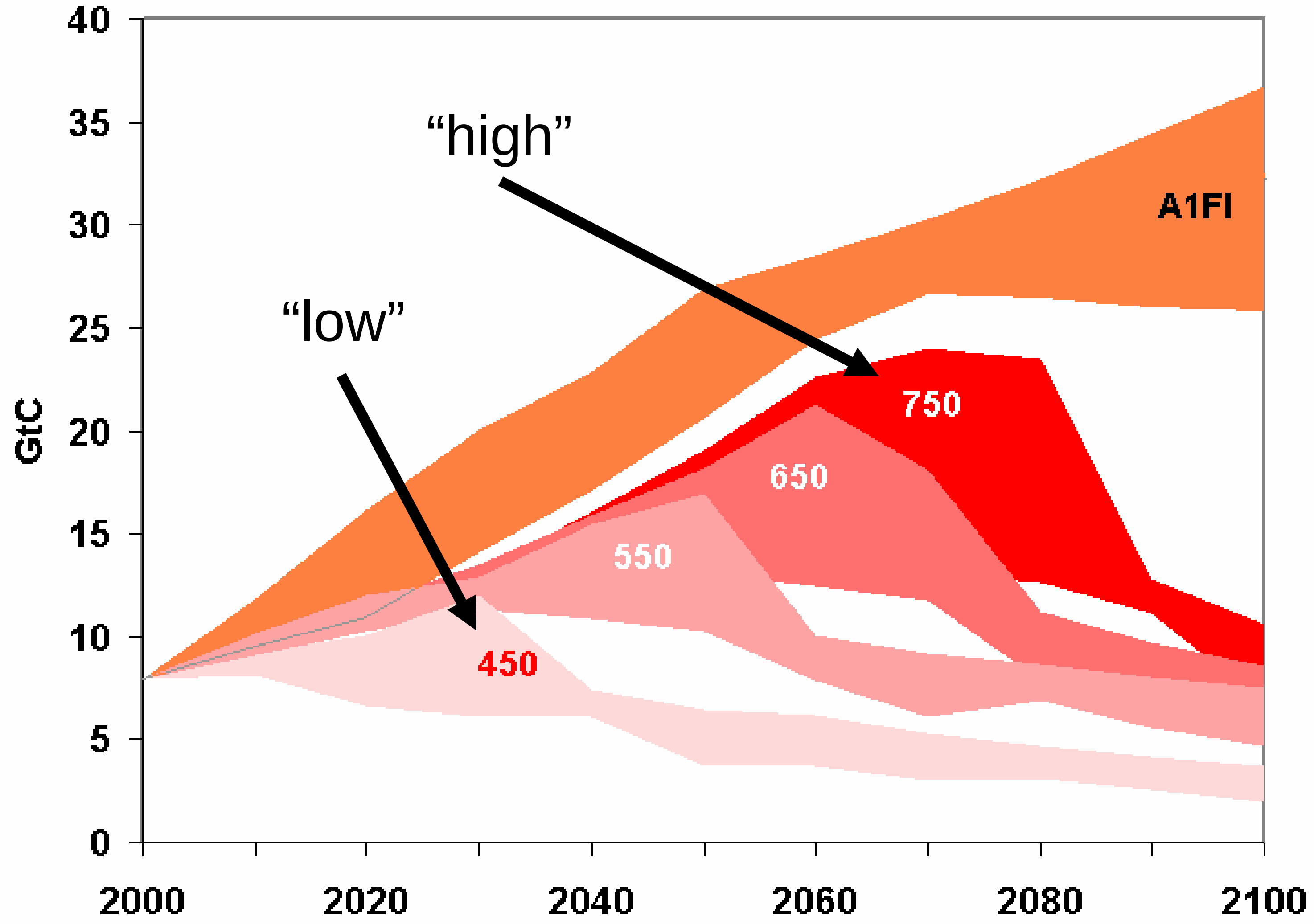

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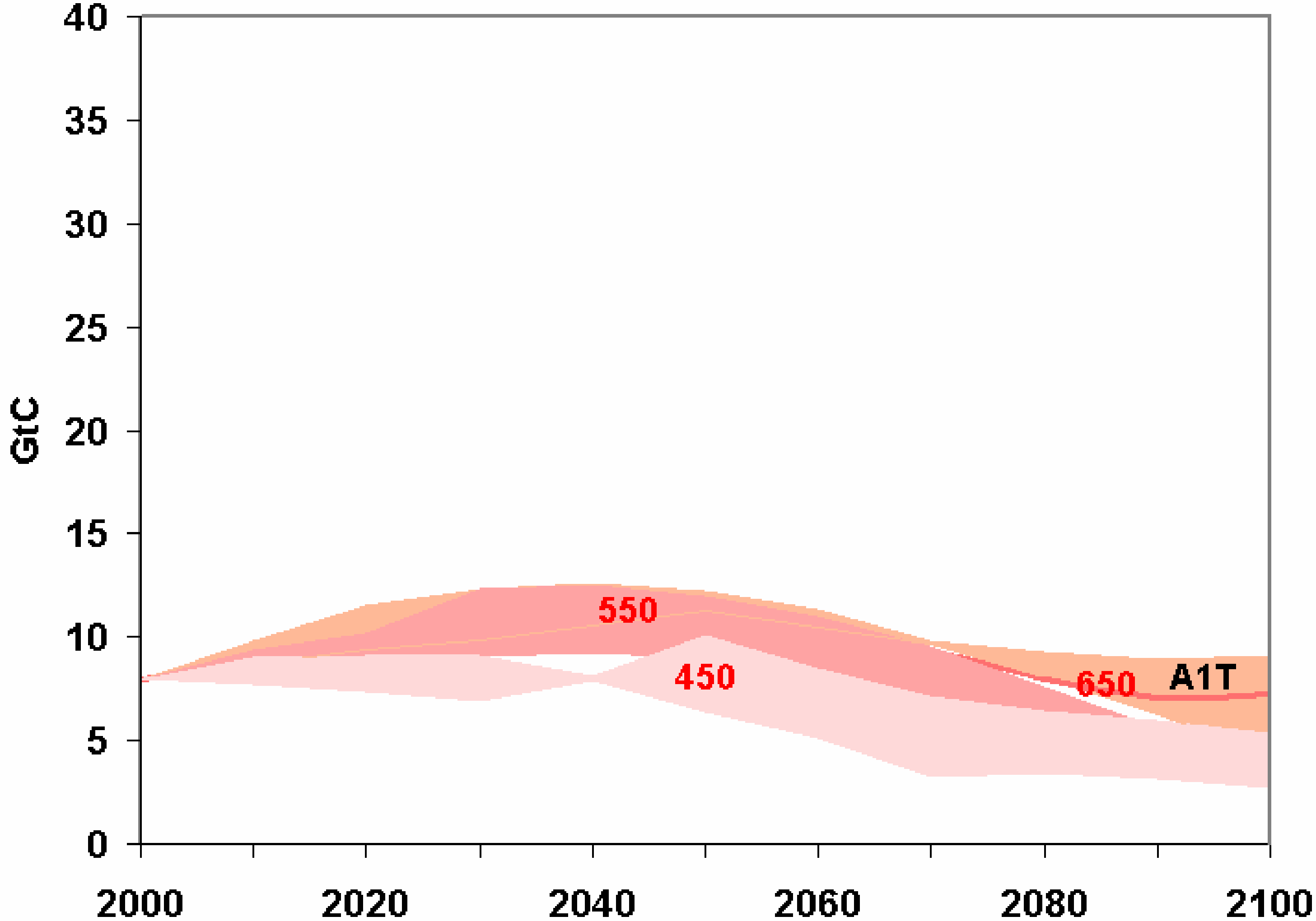
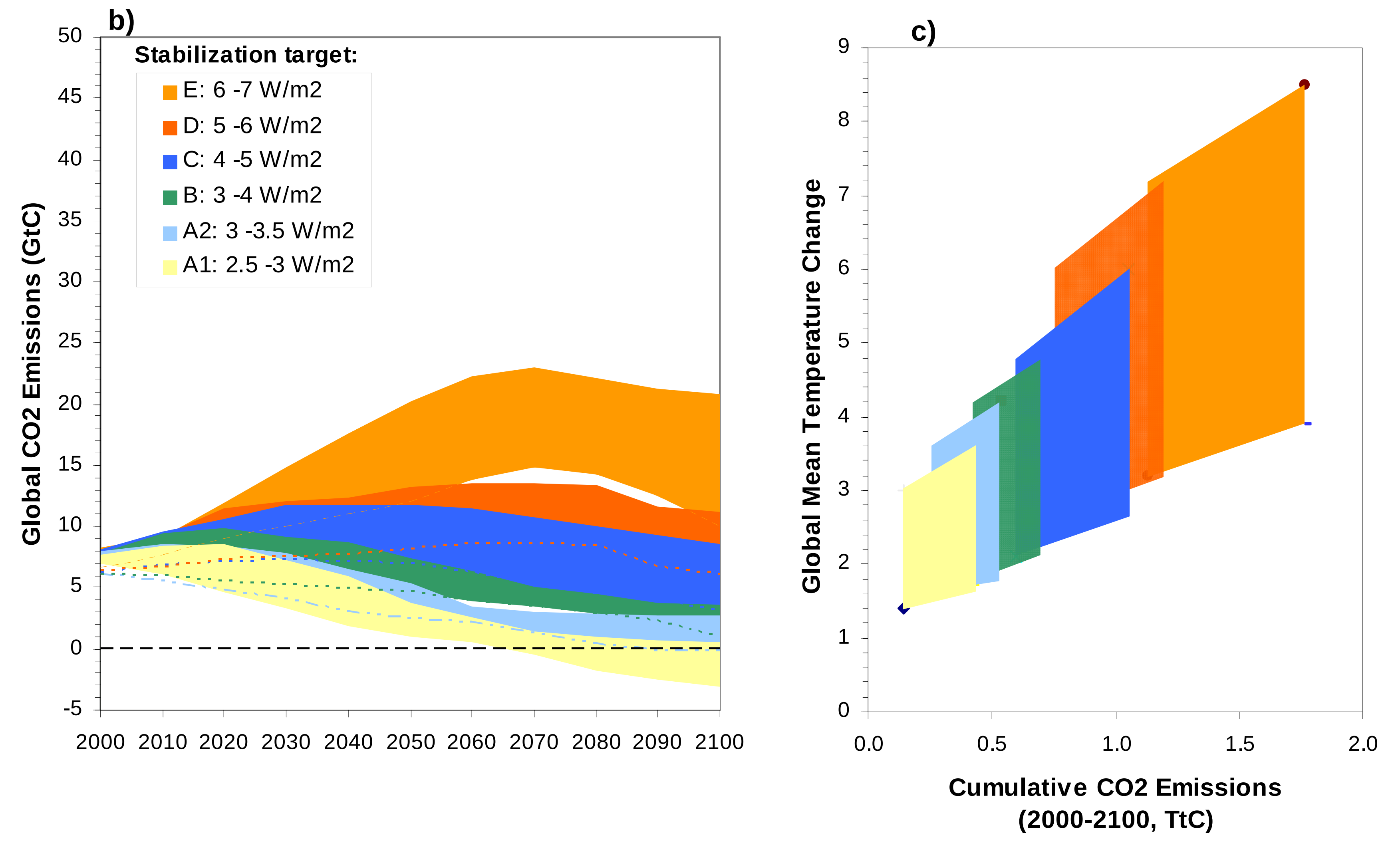
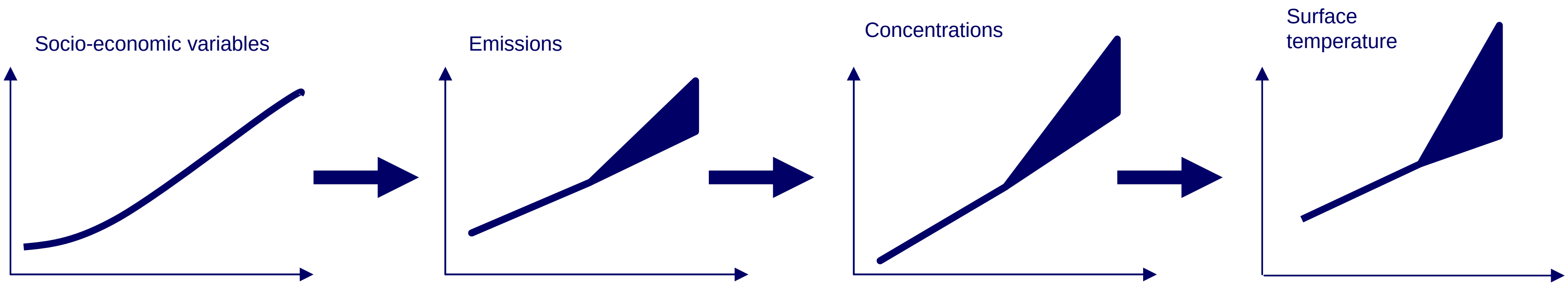


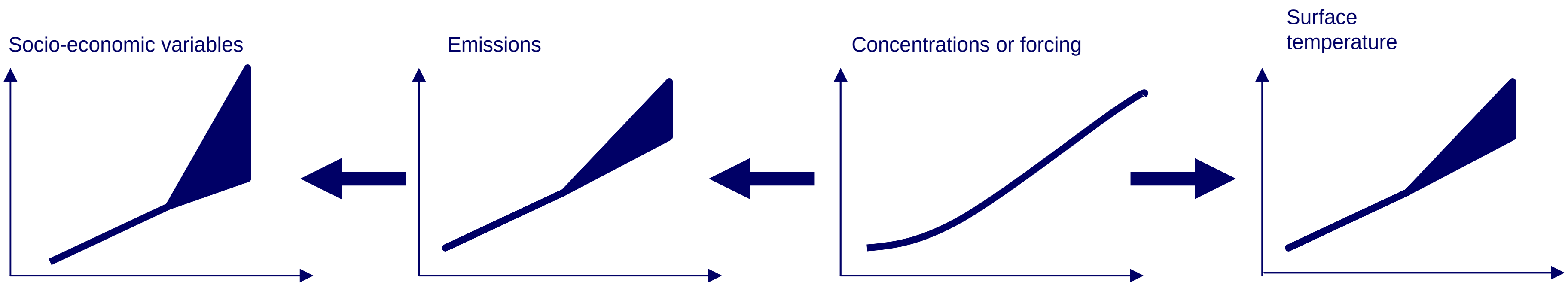
Stabilization scenarios AR4



Forward approach: start with socio-economic variables



Reverse approach: start with stabilization scenario concentrations



For coordinated climate change projection experiments to be run by the international climate modeling community for assessment in the IPCC AR5, two classes of climate change experiments are proposed, each focused on defined scientific questions:

1. **Near-Term (2005-2030)**
2. **Longer term (to 2100 and beyond)**

Source: Jerry Meehl, 2006

Near-Term Experimental Design (2005-2030)

A prime goal of projections for the next 25 years is to provide better guidance on the likelihood of changes in regional extremes

- To produce such regional scale predictions will require finer-resolution models (about ½ degree to 1 degree horizontal resolution, and increased vertical resolution and domain) with inclusion of:
    - simple atmospheric chemistry
    - aerosols
    - dynamic vegetation
    - (no carbon cycle on this timescale)

- Both improved process representation and higher resolution are important, and compromises will be required to make the simulations computationally feasible.
- Such simulations will also require accurate ocean data for coupled initialization; this is currently problematic due to the lack of salinity data. Improved initialization datasets such as soil moisture and sea ice may also be required.

Source: Jerry Meehl, 2006

Near-Term Experimental Design (2005-2030) continued…

- Since there is little quantitative difference across scenarios for GHG concentrations on the short term, a single mid-range scenario would be run.

- Additionally, a number of scenarios for pollutants (aerosols and short-lived gases) could be provided (by WG3) for low, medium and high emission projections as perturbations around the standard scenario.

- To provide statistically significant regional assessments will require ensemble simulations of at least 10 members for each scenario

- To incorporate past climate forcings, for model evaluation, and for the coupled assimilation/initialization process, simulations should start some time during the latter half of the 20^{th} century.

Source: Jerry Meehl, 2006

Long-Term Experimental Design (2100 and Beyond)

WHAT ARE CARBON CYCLE FEEDBACKS ON CLIMATE SYSTEM?

- Long-term runs provide an opportunity to contribute to a policy perspective on avoiding consequences of climate change (e.g. mitigation/stabilization)
- Lower resolution AOGCM and/or ESM (roughly 2^{o}) w/pre-industrial spinup including 20th century experiments with natural and anthropogenic forcings (at least 10 ensemble members).
- WG3 to provide CO2 concentration stabilization benchmark scenarios: (1) high case ~700 ppm, (2) low case ~400 ppm, and possibly (3) midrange ~550 ppm. At least one ensemble per scenario; models to include terrestrial and ocean carbon cycle, dynamic vegetation as available, chemistry and aerosols prescribed to 2100, stabilized after 2100 to 2300; WG3 would derive policy options to attain permissable emissions
- To address this problem, two experiments will be required with an additional optional experiment

Source: Jerry Meehl, 2006

Long-Term Experimental Design (continued)

Experiment 1: Carbon cycle responds to increasing CO2 concentrations and temperature changes

- An AOGCM or ESM-type model w/time series of specified GHG concentrations provided by WG3

- Carbon cycle model produces a time-series of CO_2 fluxes that are saved

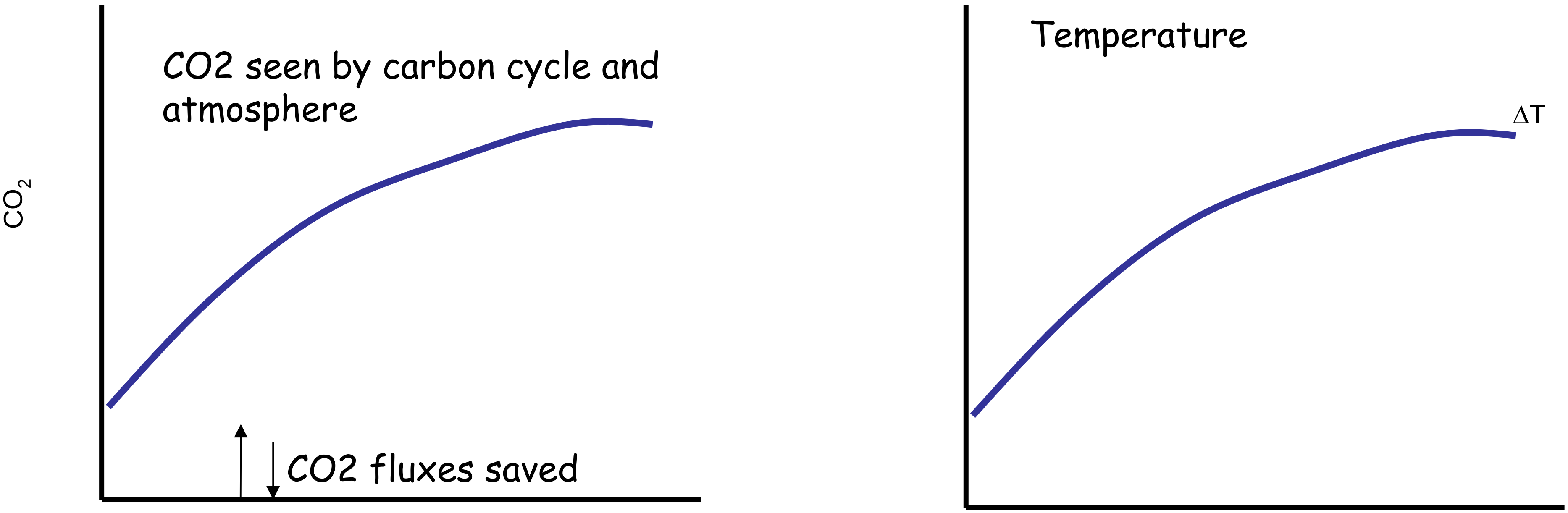
  Note: CO_2 fluxes do not enter the atmosphere to change climate system response to specified concentration time series.

- The CO_2 fluxes from this experiment (e.g., land/ocean CO_2) are used to derive emissions that are returned to WG3 to derive mitigation policies to achieve the desired emissions

(emissions = rate of change of concentrations + CO2 flux).

Source: Jerry Meehl, 2006

Experiment #1:
Carbon Cycle sees increasing CO2 Concentrations and ΔT;
Land/Ocean CO2 fluxes saved to derive emissions for WG3



Land/Ocean CO_2 fluxes are NOT interactive with atmosphere

Source: Jerry Meehl, 2006

Experiment 2: Carbon cycle responds only to increasing CO2 concentrations

- Atmospheric CO_2 is fixed for radiation code in the model only, therefore, temperature will remain about the same (but includes internal climate variability).

- Time-evolving CO2 concentrations from Experiment 1 are input to the carbon cycle, and land-ocean CO2 fluxes are saved

- The derived emissions between Experiments 1 and 2 can be compared to infer the magnitude of carbon cycle feedback

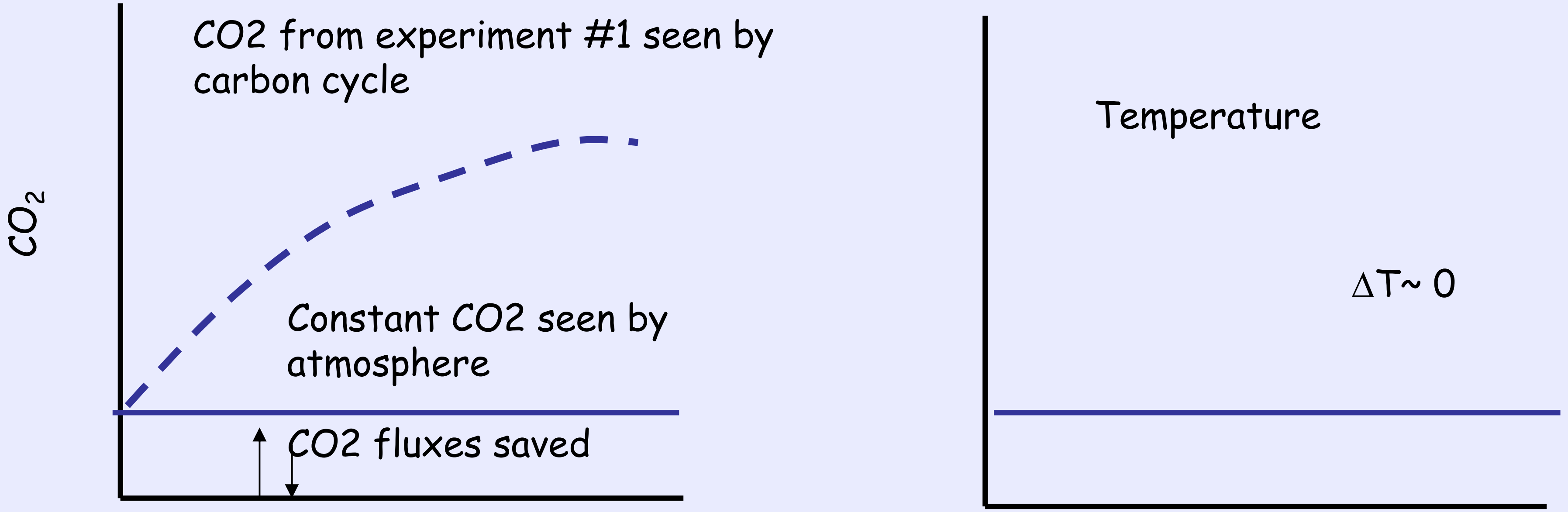
- The derived emissions will be noisy and WG3 will need to fit, or smooth the time series emissions pathways.

Source: Jerry Meehl, 2006

Experiment #2:

Carbon Cycle sees CO_2 Concentrations from Experiment #1; atmospheric CO_2 and T are constant;

Land/Ocean CO_2 fluxes saved to derive emissions for WG3



Land/Ocean CO_2 fluxes are NOT interactive with atmosphere

Source: Jerry Meehl, 2006

Experiment 3 (optional): Magnitude of carbon cycle feedback in terms of temperature

- Determine the magnitude of the carbon cycle AND climate feedback in terms of temperature change

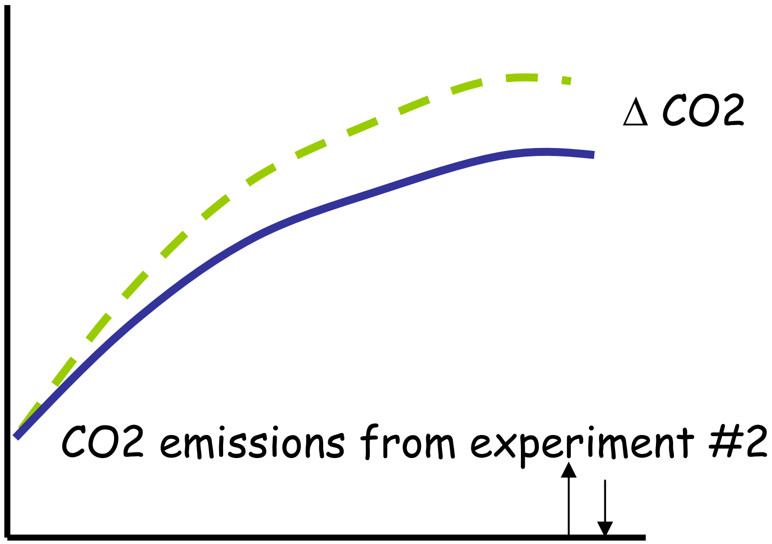
- Diagnosed emissions in the absence of climate effects on the carbon cycle (from Experiment 2), will be used to drive the ESM (coupled carbon cycle-climate model) in Experiment 1.

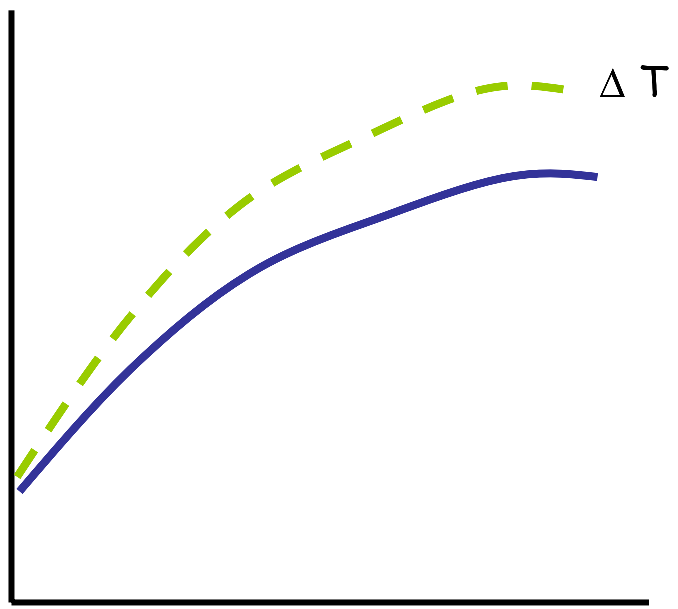
- In this experiment, CO_2 will evolve distinctly from the original prescribed CO_2 scenario (of Experiment 1).

- The temperature difference between experiments 1 and 3 defines the magnitude of the carbon cycle feedback on temperature

Source: Jerry Meehl, 2006

Experiment #3 (optional): Derived emissions in the absence of climate change from Exp. #2 are used to drive carbon cycle-climate model from Experiment #1





Source: Jerry Meehl, 2006

Short-Term Experimental Design:
(2005-2030), single scenario, one experiment

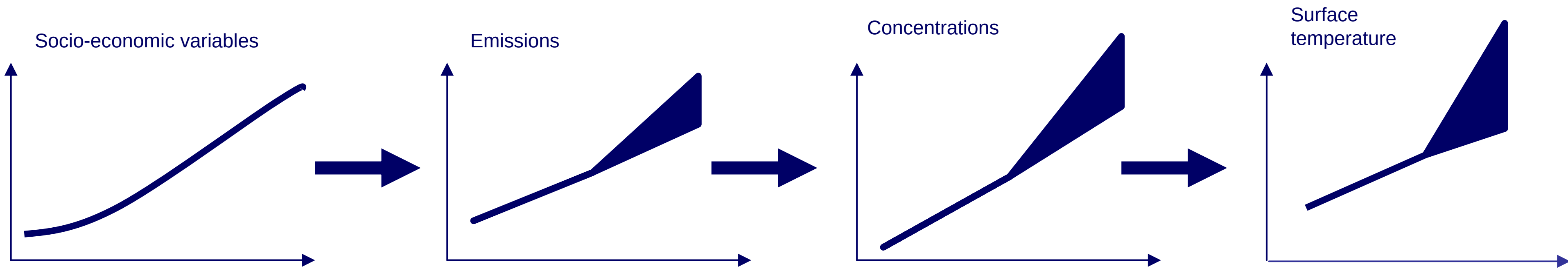
Experiment	Inputs	CO_2 Affects:	Model Features	Output
Short-Term Experiment: ***Air-quality and regional analyses of extremes***	Single GHG scenario, possible variation of pollutants	Climate →	High resolution AOGCM/ESM (0.5 to 1°) no carbon cycle, simple chemistry and aerosols, possibly dynamic vegetation Coupled initialization ~1950-2005 →	Regional projections: extreme climate events, air quality

Long-Term Experimental Design:
(1870-2100 and beyond), two stabilization scenarios (low and high), three experiments

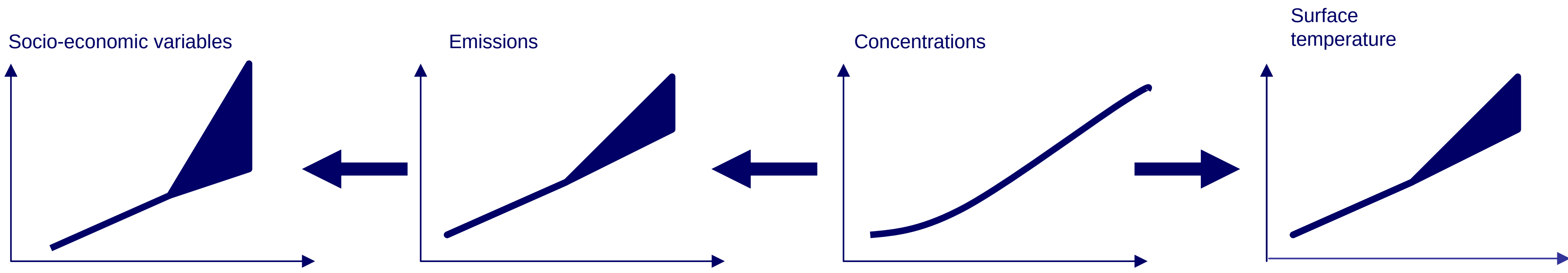
Experiment	Inputs	CO_2 Affects:	Model Features	Output
Long-Term Experiment 1: ***Quasi-inverse estimates of emissions***	Prescribed Atmospheric CO_2 Concentrations	Climate, Land/Ocean Carbon Fluxes →	Medium resolution AOGCM or ESM (~2°) w/carbon cycle, dynamic veg; Prescribed aerosols; Pre-industrial spinup →	Climate changes; Deduced land/ocean C fluxes
Long-Term Experiment 2: ***Carbon cycle feedbacks***	CO_2 concentrations: (a) Fixed at pre-industrial for climate system (b) From experiment 1 for carbon cycle	(a) Climate system (b) Carbon cycle →	Medium resolution AOGCM or ESM w/carbon cycle, dynamic veg; Prescribed aerosols; Pre-industrial spinup →	No climate change; land/ocean CO_2 fluxes are saved
Long-Term Experiment 3 (optional): ***Fully coupled models***	Derived CO_2 emissions from Experiment 2 w/fully coupled carbon cycle	Climate, Land/Ocean Carbon Fluxes →	Medium resolution ESM w/carbon cycle, dynamic veg; Prescribed aerosols; Pre-industrial spinup →	Climate & Biogeochemical Feedbacks to Climate and Carbon Cycle

Source: Jerry Meehl, 2006

Forward approach: start with socio-economic variables



Reverse approach: start with stabilization scenario concentrations

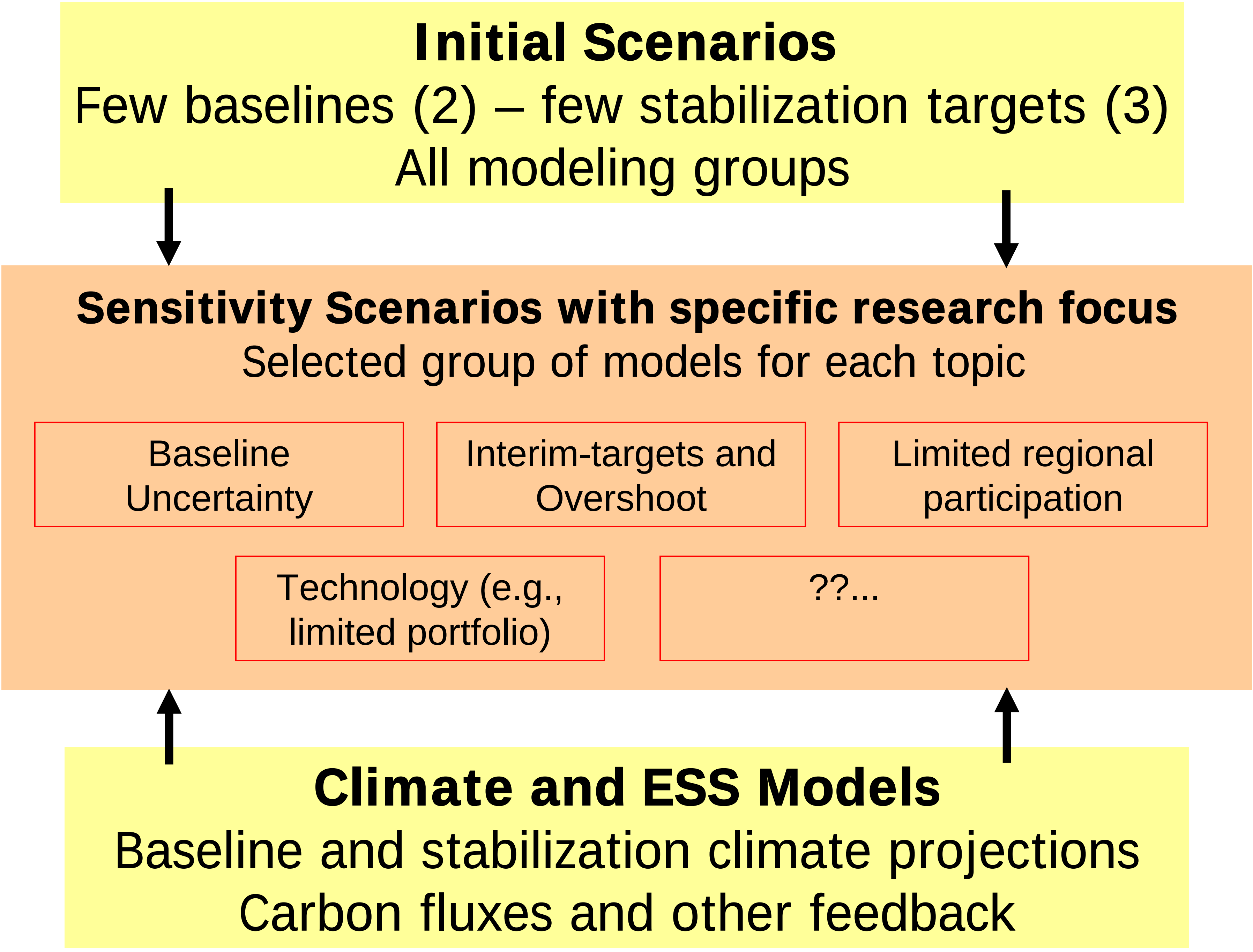


Source: Jerry Meehl, 2006

International Consortium

Facilitate the coordination of scenario development efforts

International Institute for Applied Systems Analysis (IIASA)	Energy Modeling Forum (EMF) Stanford University	National Institute for Environmental Studies (NIES)
- Asbjorn Aaheim CICERO University of Oslo *- Keigo Akimoto* Research Institute of Innovative Technology for the Earth (RITE) *- Eduardo Calvo* WG III Bureau IPCC *- Patrick Criqui* Institut d'Economie et de Politique de l'Energie, IEPE-CNRS *- Francisco de la Chesnaye* US Environmental Protection Agency *- Jae Edmonds* Pacific Northwest National Laboratory *- Allen Fawcett* US Environmental Protection Agency *- Brian Fischer* CRA International *- Donald Hanson* Argonne National Laboratory *- Jean-Charles Hourcade* CIRED/CNRS/EHESS *- María E. Ibarrarán* Universidad de las Américas, Puebla *- Kejun Jiang* Energy Research Institute	*- Mikiko Kainuma* National Institute for Environment Studies (NIES) *- Claudia Kemfert* DIW Berlin *- Atsushi Kurosawa* The Institute of Applied Energy *- Emilio Lèbre La Rovere* Programa de Planejamento Energético - PPE/COPPE/UFRJ *- Bruce McCarl* Texas A&M University *- Nebojsa Nakicenovic* International Institute for Applied Systems Analysis (IIASA) *- Hom Pant* Australian Bureau of Agricultural and Resource Economics (ABARE) *- Keywan Riahi* International Institute for Applied Systems Analysis (IIASA) *- Richard Richels* Electric Power Research Institute (EPRI) *- Thomas Rutherford* Economist	*- Ronald Sands* Joint Global Change Research Institute *- Priyadarshi Shukla* Indian Institute of Management *- Steve Smith* Pacific Northwest National Laboratory *- Richard Tol* University of Hamburg, Institute for Environmental Studies (IVM), Economic and Social Research Institute (ESRI) *- Jose Eddy Torres* Energy-Environment-Economy Modeling and Analysis Group Universidad de Los Andes / Universidad Nacional de Colombia *- Detlef van Vuuren* The Netherlands Environmental Assessment Agency (MNP) *- Marc Vielle* CEA-LERNA *- Virginia Vilariño* Business Council for Sustainable Development – Argentina *- John Weyant* Energy Modeling Forum (EMF), Stanford University


Initial Scenarios
Few baselines (2) – few stabilization targets (3)
All modeling groups
Sensitivity Scenarios with specific research focus
Selected group of models for each topic
Baseline Uncertainty
Interim-targets and Overshoot
Limited regional participation
Technology (e.g., limited portfolio)
??...
Climate and ESS Models
Baseline and stabilization climate projections
Carbon fluxes and other feedback

Possible Approach

- Transparent and open process (Web-interface for sharing results across modeling groups and with outside user communities)
- Funding needed (EU, US, Japan, particularly for developing country participation)
- Initial set of baselines and stabilization scenarios needed
- New set of scenarios to be developed with climate and carbon cycle feedback

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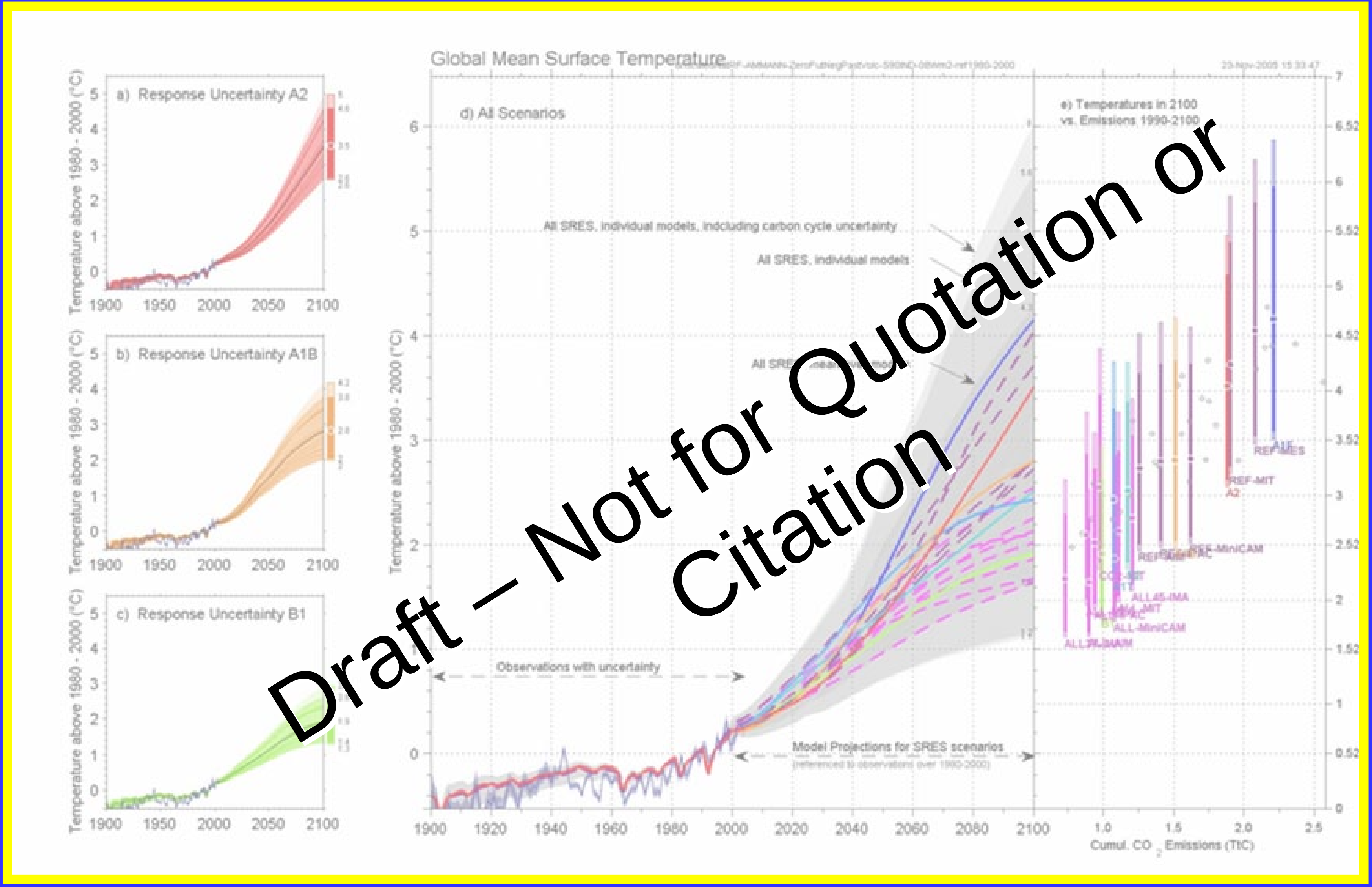
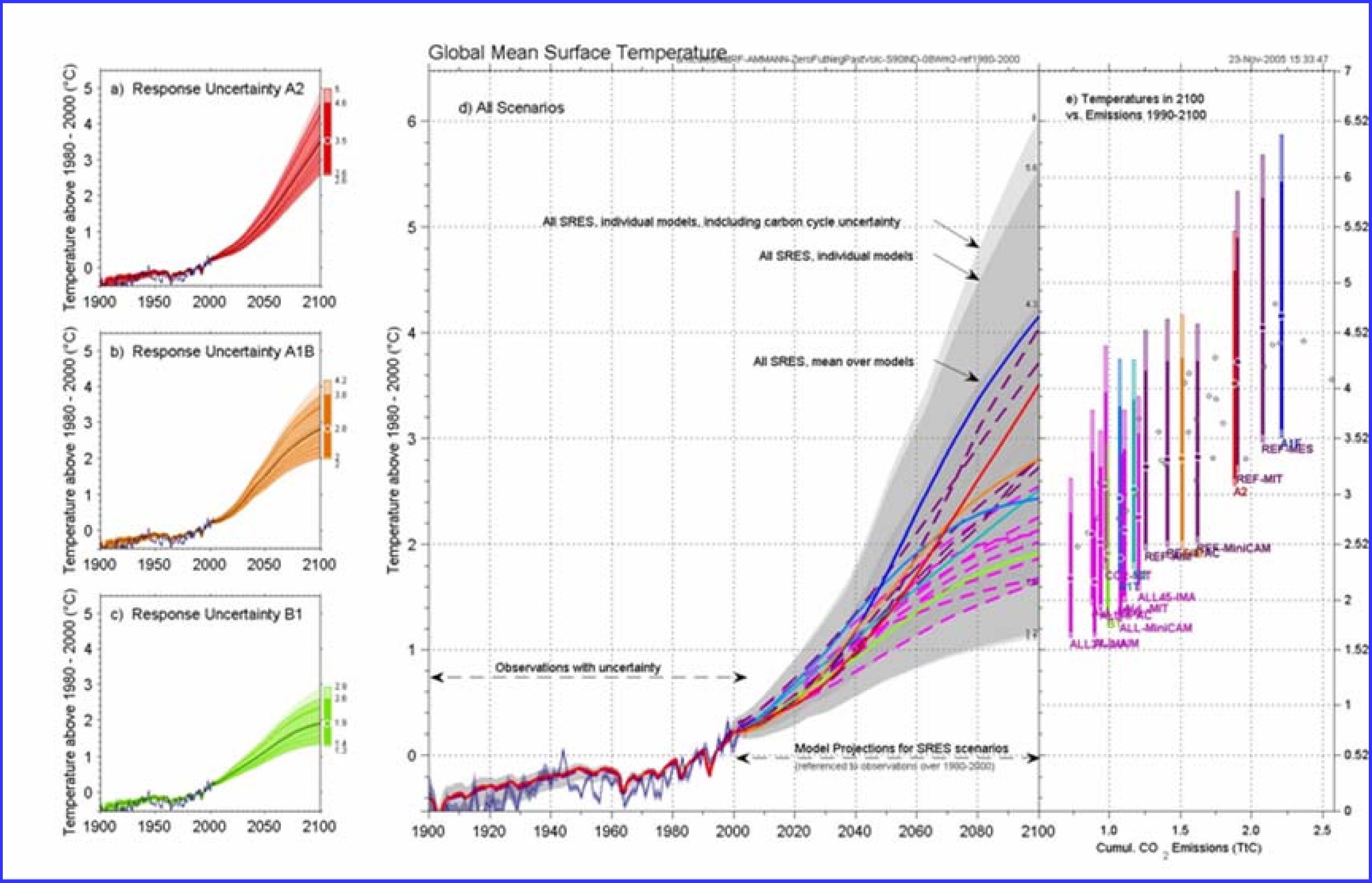
Global Mean Temperature Change

AR4 Illustrative Scenarios and Full Range



Global Mean Temperature Change

AR4 Illustrative Scenarios and Full Range



Emissions pathways for alternative ranges of CO2 and CO2-eq. stabilization targets.

All stabilization scenarios in the scenario database

Scenario Category	CO2-only concentrations by 2100	CO2-equivalent concentrations by 2100	Year when global emissions peak	Year when global emissions fall below 2000 levels	Change in global emissions in 2050 relative to 2000 levels	Change in global emissions in 2100 relative to 2000 levels
	ppmv	ppmv	year	year	%	%
The 90th precentile range of the stabilisation scenarios in the literature						
A	< 420	<510	2000 - 2040	2000 - 2060	-86 to +18	-161 to -67
B	420 - 490	510-590	2000 - 2050	2000 - 2060	-41 to +33	-91 to -38
C	490 - 570	590-710	2010 - 2080	2010 - dnr	-3 to +73	-85 to +47
D	570 - 660	710-860	2030 - 2100	2060 - dnr	+27 to +116	-24 to +81
E	> 660	>860	2040 - 2090	2100 - dnr	+67 to + 143	-5 to +186

Next steps:

- Based on Aspen workshop report, a white paper will be developed from AIMES/WGCM at joint meeting September 27, 2006 in Victoria, and will be circulated to AIMES/WGCM/SPARC/IGAC/TGNES communities , and forwarded as input to the ESSP meeting in November, 2006

- An Aspen meeting report or short article based on white paper will be submitted to EOS Transactions

- Recommendation to IPCC late 2006, early 2007.

Characteristics of IPCC Scenarios

	SA90	IS92	SRES	TAR	AR4*
Scenarios	4 (1f)	6	40 6i+4n	80 4s+4n	20 2n+2new
Models	2	1	6	9	6
Population	1	3	3	3	2 (+)
GDP	1(2)	6	$6:20+4_{ppp}$	6 (+)	5 (+)
GHGs	4+2	6+4	6+4	CO_2	6+4
Intervention	2	0	0	80	12 ~6,4.5,3W/m^2

* Assessed by WGIII

Baseline Emissions Scenarios

- SRES scenarios are widely used for the assessment of climate change and impacts (WG1&WG2)
- WG3 conclusions comparing new baseline emissions scenario literature with SRES (Ch 3):
  - No significant change in ranges (uncertainty) of future emissions and underlying driving forces compared to SRES
  - Main difference concerns downward correction of demographic projections (not yet implemented in the majority of new emissions scenarios)
  - The majority of the new emissions scenarios employ MER-based GDP assumptions. A few studies in the literature reporting PPP, indicate that the impact on emissions is small (problems: lack of comprehensive PPP data)

Stabilization and Mitigation Scenarios

- Major difference to TAR: studies suggest that it is technically feasible to stabilize GHG concentrations at levels significantly lower than TAR (450 CO_2-eq.)
- Most of the low scenarios imply a temporal overshoot of the target
- Potential challenge for consistency – climate outcomes of these low stabilization scenarios are not analyzed in WGI (TS and SPM)
- New multigas literature indicates that for a specific stabilization target, emissions might peak later in time compared to TAR

TGNES Recommendations

The three IPCC WG should use a common base:

- The assessments of impacts, adaptation and vulnerability should be consistent with views on the evolution of climate change, which in turn should be consistent with views on emissions trajectories.
- The assessment of emissions should be consistent with views of socio-economic drivers and land-use change and take account of feedbacks from climate change and response policies (e.g. stabilization)
- Finally, impacts, adaptation and vulnerability are in their turn dependent on those socio-economic drivers and land-use change.

TGNES Recommendations

Three options for the role of IPCC in the development of scenarios:

- B1A: Development left to the scientific community (may or may not self-organise, eg EMF)
- B1B: IPCC involved in facilitating (catalyzing) the establishment of a coordinating mechanism for development of new scenarios
- B2: IPCC provides coordination of scenario development

Chair proposal on actions of IPCC

New Task Group on scenarios:

- **Specify organisation of scenario development; what level of involvement, by whom**
- **Organise expert meetings in 2007: specify 'wish list' and 'interagency meeting'**
- **Technical Paper with 'benchmark' emission trajectories based on AR4 in second half 2007**
- **Scoping note for Special Report Integrated Scenarios (SRIS) for IPCC-26**

Scenario Development

- New scenarios for AR5 – emerging plans of the climate modeling community
- How to organize the development of new integrated assessment scenarios for AR5
- A possible joint response to the request by IPCC Chair on new scenarios

Scenario Development

- Start with stabilization scenarios in the literature - chose a high, median and low
- Agree on a process for developing common baselines and stabilization cases
- Assess implications of different stabilization paths and profiles on

Classification of Stabilization Scenarios

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Scenari o Categor y	CO_{2-} only concentrations by 2100	CO_2 – equivalent concentrations by 2100	Year when global emissions peak	Year when global emissions fall below 2000 levels	Change in global emissions in 2050 relative to 2000 levels	Change in global emissions in 2100 relative to 2000 levels
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The 70th percentile range of the stabilisation scenarios in the literature						
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A2	398 – 442	487 – 535	2000 – 2020	2000 – 2040	-62 to -31	-89 to -55
B	442 – 484	535 – 587	2010 – 2030	2020 – 2060	-29 to +5	-81 to -46
C	484 – 571	587 – 708	2020 – 2060	2050 – dnr	+9 to +58	-54 to +47
D	571 – 657	708 – 853	2050 – 2080	2090 – dnr	+27 to +84	-10 to +75
E	657 – 789	853 – 1129	2060 – 2090	dnr – dnr	+91 to +142	+49 to +180

• Assuming the IPCC AR5 publication date is 2014, modeling groups are making decisions this year (2006) on what form their next generation models will take (to be used in IA and for climate change projections).

• The IPCC TGNES and other groups have been discussing new emission scenarios (e.g. "mitigation/adaptation", or more generically "stabilization"). These scenarios will come to bear on climate change projections performed for assessment in the IPCC AR5 with the new emerging earth system models.

• Thus there has been a confluence of activities in model development and scenario development that must be communicated and coordinated across various groups and scientific communities this year.

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Near-Term Experimental Design (2005-2030)

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Near-Term Experimental Design (2005-2030) continued…

- Since there is little quantitative difference across scenarios for GHG concentrations on the short term, a single mid-range scenario would be run.

- Additionally, a number of scenarios for pollutants (aerosols and short-lived gases) could be provided (by IA models) for low, medium and high emission projections as perturbations around the standard scenario.

- To provide statistically significant regional assessments will require ensemble simulations of at least 10 members for each scenario
- To incorporate past climate forcings, for model evaluation, and for the coupled assimilation/initialization process, simulations should start some time during the latter half of the 20th century.

Long-Term Experimental Design (2100 and Beyond)

WHAT ARE CARBON CYCLE FEEDBACKS ON CLIMATE SYSTEM?

- Long-term runs provide an opportunity to contribute to a policy perspective on avoiding consequences of climate change (e.g. mitigation/stabilization)
- Lower resolution AOGCM and/or ESM (roughly 2°) w/pre-industrial spinup including 20th century experiments with natural and anthropogenic forcings (at least 10 ensemble members).
- IA models to provide CO2 concentration stabilization benchmark scenarios: (1) high case 6W/m2 ~700 ppm, (2) low case 3W/m2 ~400 ppm, and possibly (3) midrange 4.5W/m2 ~550 ppm. At least one ensemble per scenario; models to include terrestrial and ocean carbon cycle, dynamic vegetation as available, chemistry and aerosols prescribed to 2100, stabilized after 2100 to 2300; IA models would derive policy options to attain permissible emissions
- To address this problem, two experiments will be required with an additional optional experiment

Long-Term Experimental Design (continued)

Experiment 1: Carbon cycle responds to increasing CO2 concentrations and temperature changes

- An AOGCM or ESM-type model w/time series of specified GHG concentrations provided by IA models

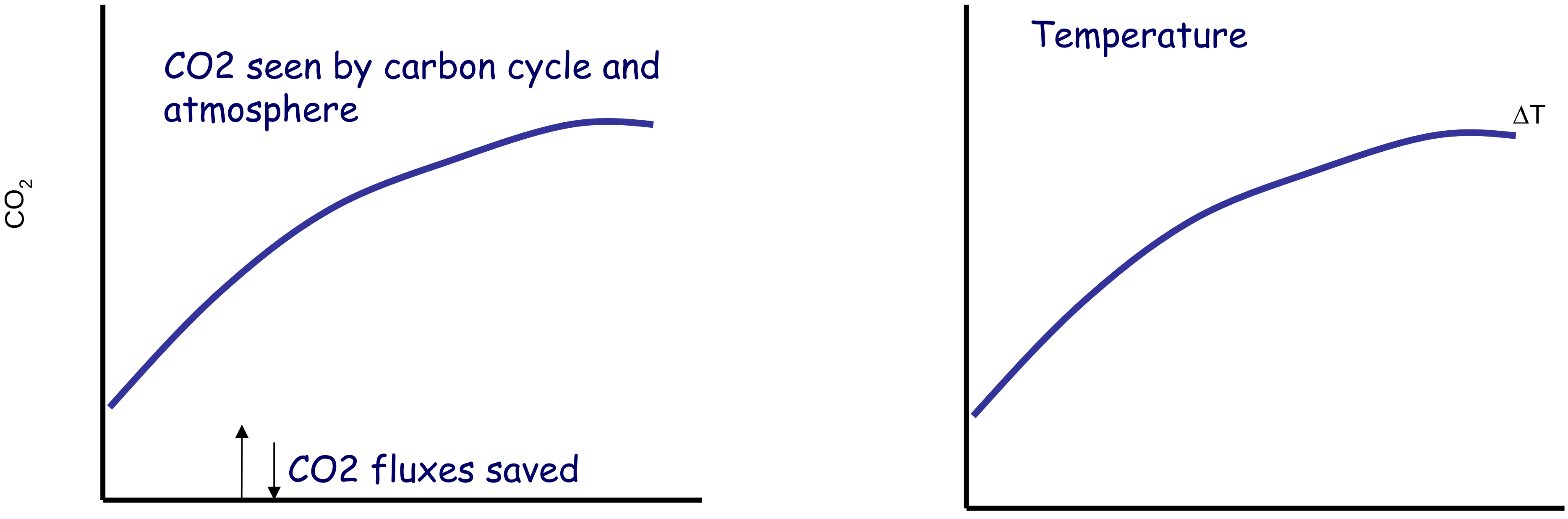
- Carbon cycle model produces a time-series of CO_2 fluxes that are saved

  Note: CO_2 fluxes do not enter the atmosphere to change climate system response to specified concentration time series.

- The CO_2 fluxes from this experiment (e.g., land/ocean CO_2) are used to derive emissions that are returned to IA models to derive mitigation policies to achieve the desired emissions

(emissions = rate of change of concentrations + CO2 flux).

Experiment #1:
Carbon Cycle sees increasing CO2 Concentrations and ΔT;
Land/Ocean CO2 fluxes saved to derive emissions for WG3



Land/Ocean CO_2 fluxes are NOT interactive with atmosphere

Experiment 2: Carbon cycle responds only to increasing CO2 concentrations

- Atmospheric CO_2 is fixed for radiation code in the model only, therefore, temperature will remain about the same (but includes internal climate variability).

- Time-evolving CO2 concentrations from Experiment 1 are input to the carbon cycle, and land-ocean CO2 fluxes are saved

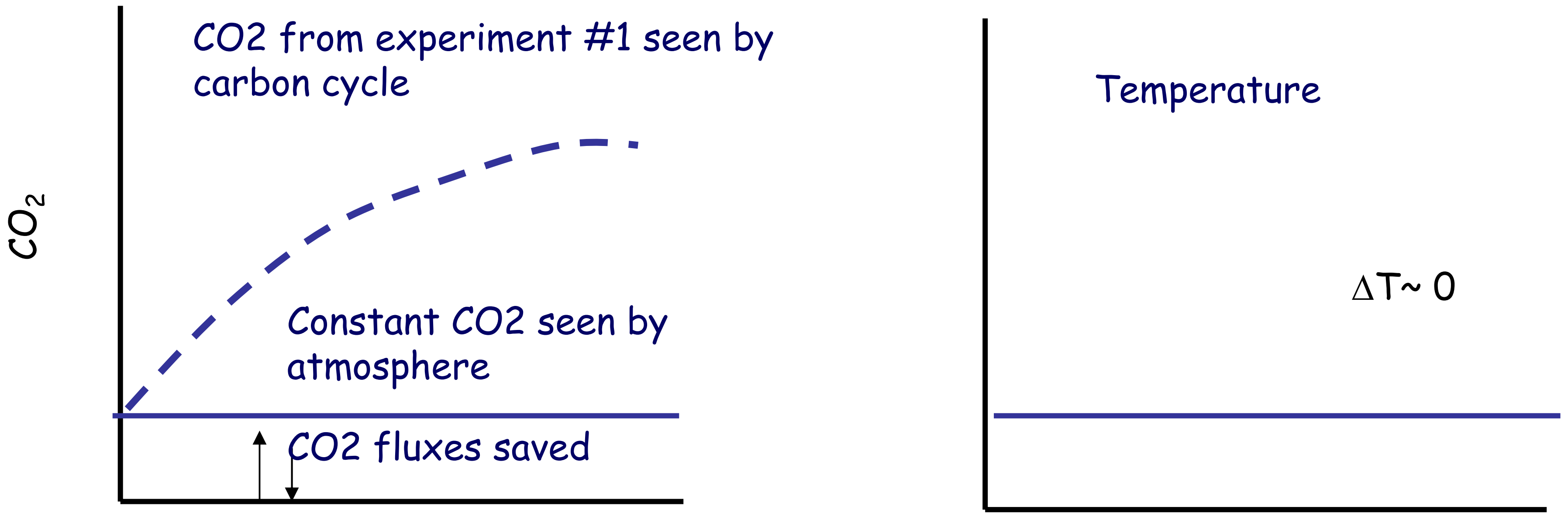
- The derived emissions between Experiments 1 and 2 can be compared to infer the magnitude of carbon cycle feedback

- The derived emissions will be noisy and IA models will need to fit, or smooth the time series emissions pathways.

Experiment #2:

Carbon Cycle sees CO_2 Concentrations from Experiment #1; atmospheric CO_2 and T are constant;

Land/Ocean CO_2 fluxes saved to derive emissions for WG3



Land/Ocean CO_2 fluxes are NOT interactive with atmosphere

Experiment 3 (optional): Magnitude of carbon cycle feedback in terms of temperature

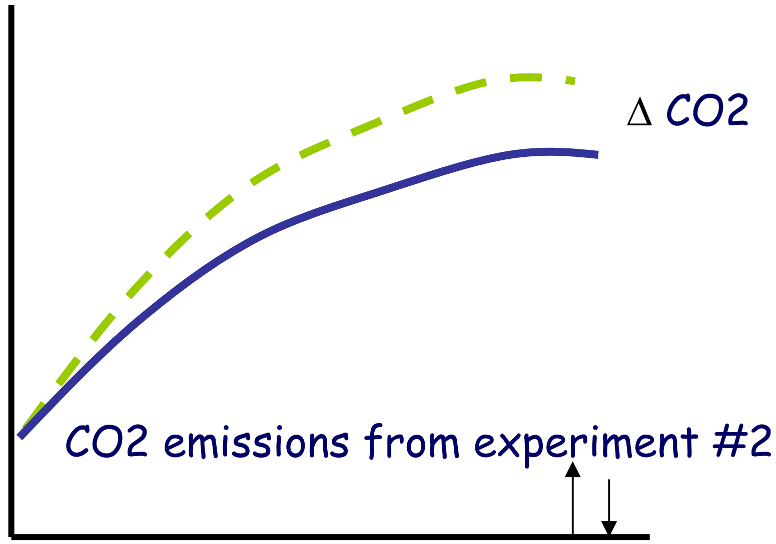
- Determine the magnitude of the carbon cycle AND climate feedback in terms of temperature change

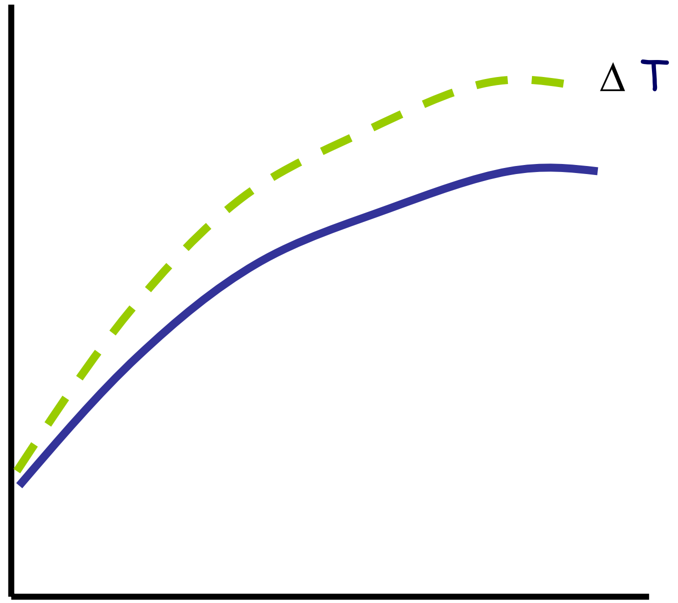
- Diagnosed emissions in the absence of climate effects on the carbon cycle (from Experiment 2), will be used to drive the ESM (coupled carbon cycle-climate model) in Experiment 1.

- In this experiment, CO_2 will evolve distinctly from the original prescribed CO_2 scenario (of Experiment 1).

- The temperature difference between experiments 1 and 3 defines the magnitude of the carbon cycle feedback on temperature

Experiment #3 (optional): Derived emissions in the absence of climate change from Exp. #2 are used to drive carbon cycle-climate model from Experiment #1





AR4 Stabilization Scenarios

Category	Radiative forcing	CO_2 concentration	CO_2 - eq. concentration	Equilibrium temperature		No. of scenarios
	W/m2	ppmv	ppmv	Min	Max	
A	< 3.25	< 420	<510	0.6	3.9	16
B	3.25 - 4	420 - 490	510-590	1.7	4.8	9
C	4 - 5	490 - 570	590-710	2.1	6.1	83
D	5 - 6	570 - 660	710-860	2.7	7.3	6
E	> 6	> 660	<860	3.2		3
Total						117

Recommendations:

- An integrated effort that produces past/current/future emissions of aerosols and ozone precursors would ensure the use of consistent and documented data relevant to climate/carbon cycle/aerosol/chemistry communities .
- To asses regional effects in short-term predictions will also require gridded emission data for aerosols and short-lived gases. A coordinated effort will be needed to produce these datasets (AC&C is considering this).
- For the long-term runs, WG2 and WG3 IPCC reports need to be lagged about 2 years behind a WG1 report. It would be desirable if all 3 Working Groups are using as close to current generation model projections as possible. An alternative would be for the modeling groups to make new cc projection simulations asap (ca 2009-2010 timeframe) and delay the next full assessment by ca 2 years (to 2015).

Recommendations (continued):

- There is a need for a PCMDI-equivalent (data collection, archival, and distribution), for the WG2 and WG3 communities, or an expanded role for the IPCC DDC, and a WGCM-type community organizing mechanism for WG2 and WG3.

- WG2 and WG3 need to have input to selection of archived fields for analysis in the new integrations for AR5, in particular, a list of fields related to the carbon cycle.