Integrated assessment modeling for informing policy & decision-making:

Where do we go from here?

Domestic Panel:

Thoughts from *the Adaptation Summit, National Assessment Planning, America's Climate Choices, the World Development Report 2010, and 20 years in DC…*

Energy Modeling Forum
CCI/IA
July 27, 2010

Rosina Bierbaum
Natural Resources and Environment
University of Michigan

Lots of guidance on improving climate change information

National Climate Adaptation Summit

Timing is ripe:

Adaptation planning

Assessment planning

National Climate Services

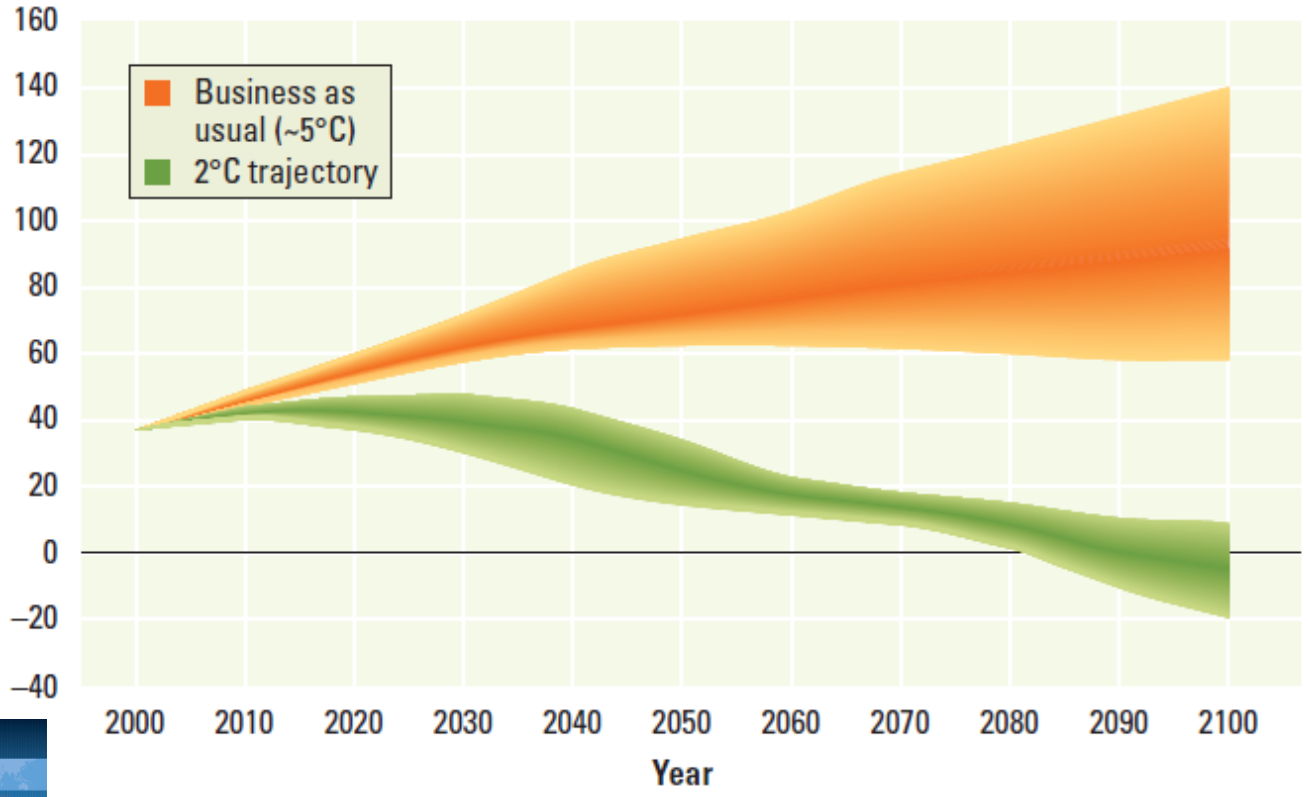
New 10-year research plan

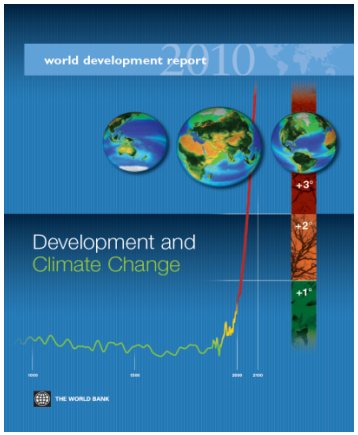
New leadership

Climate legislation is nigh….

IAMs help us understand BAU versus a path towards 2˚C …

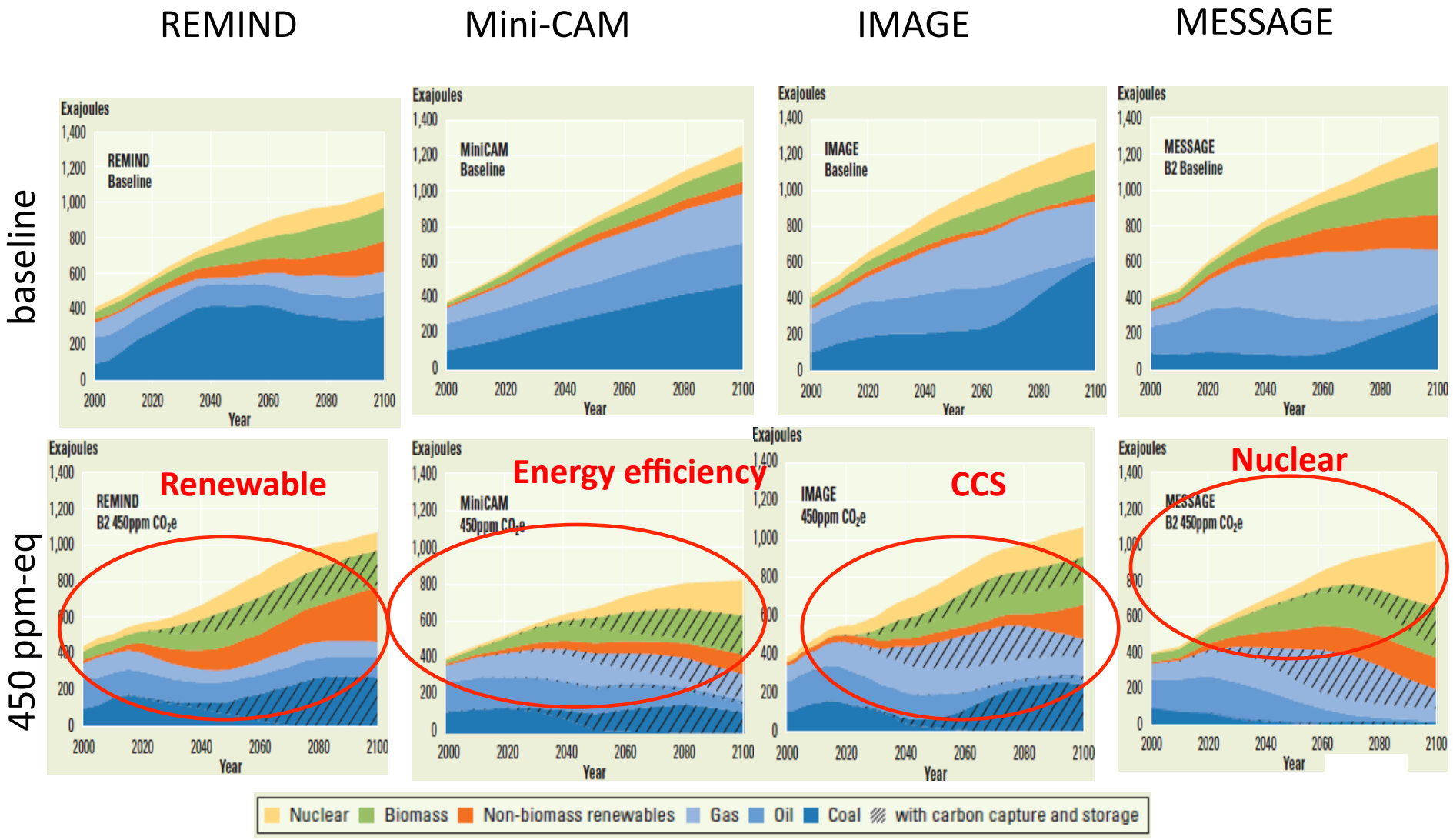
Projected annual total global emissions (billion tons of CO_2 equivalent)





IAMs make it clear energy systems must be radically transformed

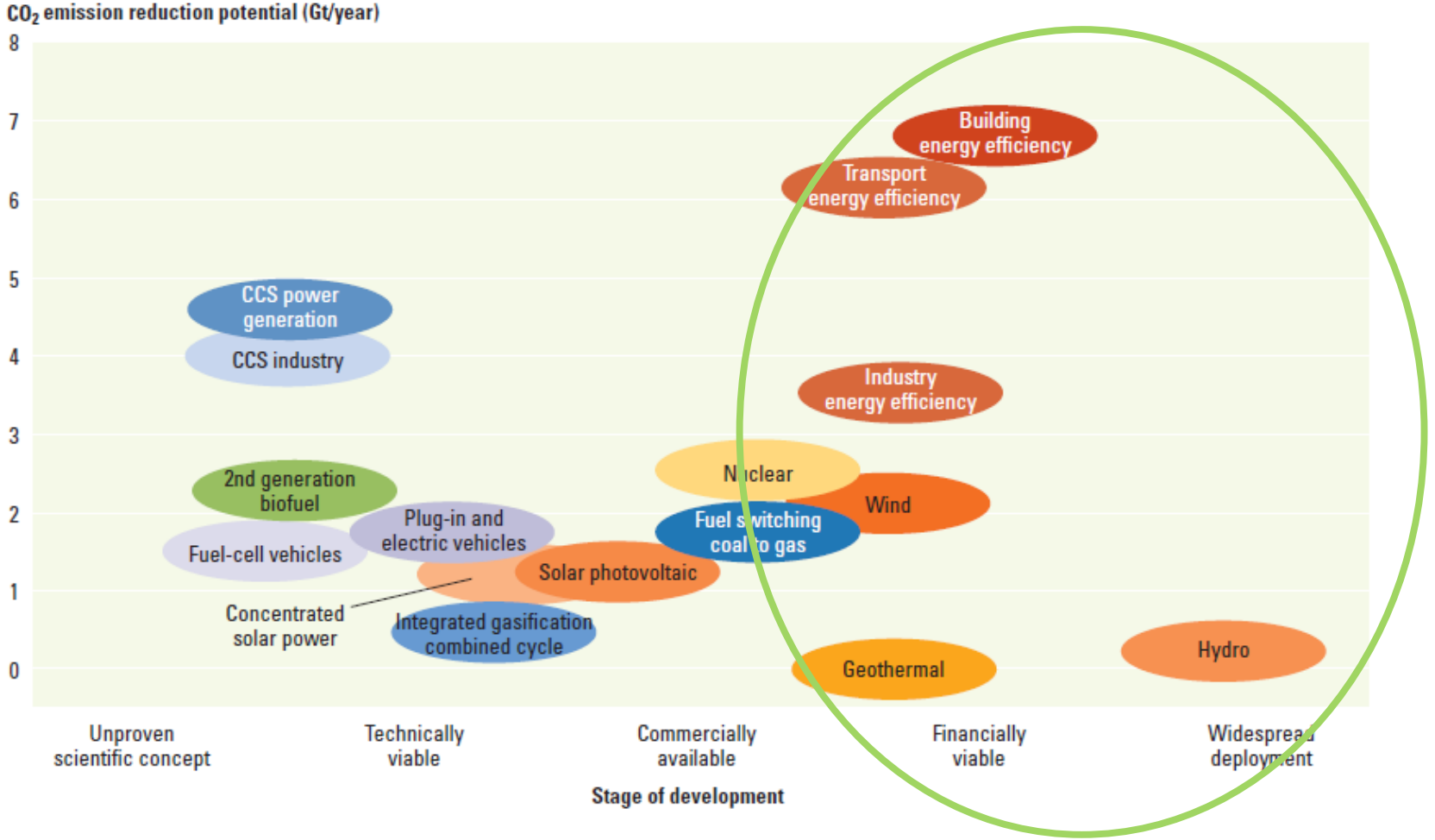
…but not how innovation can be spurred



Increase the pace of innovation / penetration

BUT HOW? What tools for very rapid penetration?

- Many climate change technologies are already financial viable



Source: World Bank (2009) World Development Report 2010

But what about innovation/massive change in:

- Transportation
  - Internal combustion forever?
- Infrastructure
  - Energy/water n… to withstand new extre…
- Urba…
  - …ople in cities by 2050?
- Land … planning
  - For people, biodiversity, ecosystem services…?

Nationally and Regionally!!!!

What about ways to buy time against DAI?

- Black Carbon
  - 1-2 decades?
- REDD
  - 1-2 decades?
- HFCs
  - 1 decade?
- Tropospheric ozone
  - 1 decade?

AND, what would make this happen????

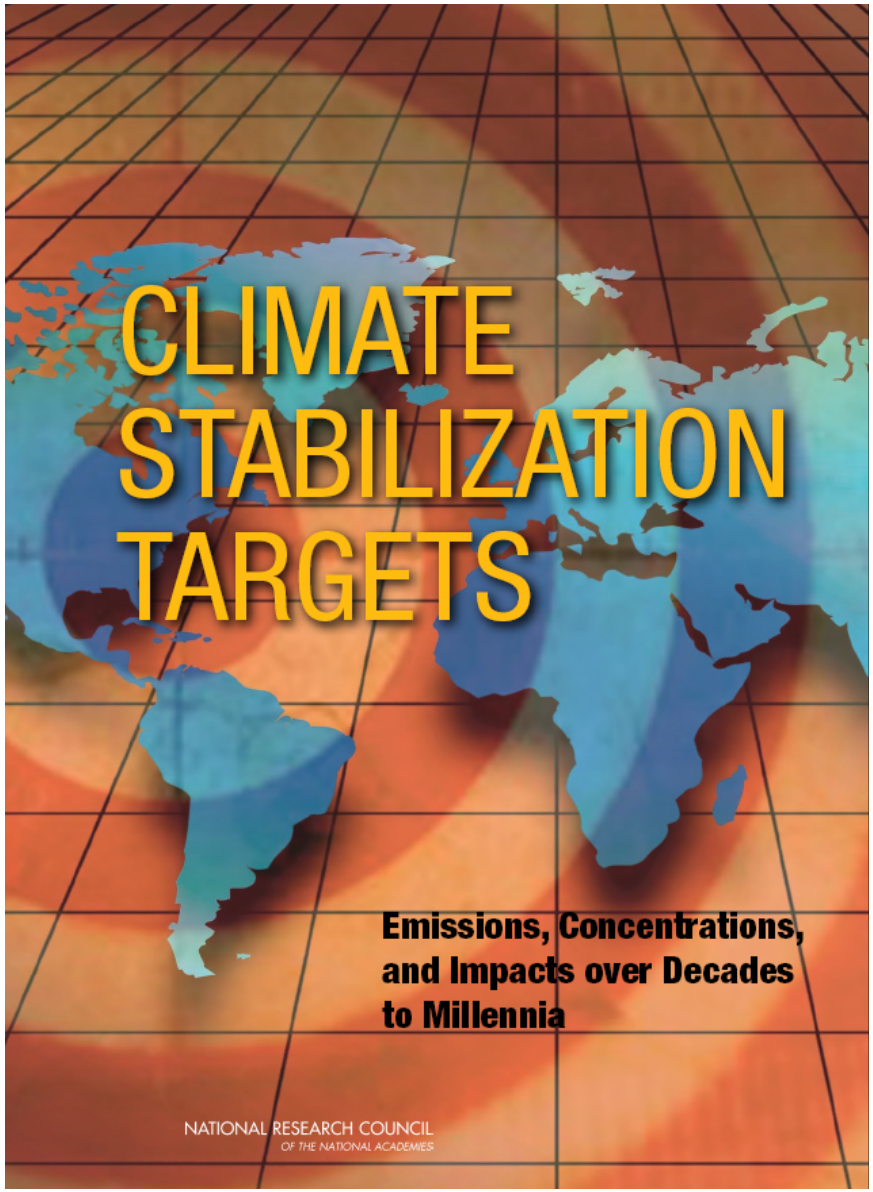
IAMS help us realize we need both Mitigation and Adaptation in sectors

Sector	Mitigation	Adaptation	Examples
Transport	√		Electric vehicles
Industry	√		Energy efficiency
Energy supply	√		Renewable energy
Waste management	√		Recovering/reducing methane from waste
Building	√	√	Storm-resistant buildings, energy efficiency
Agriculture	√	√	Drought resistant crops
Forestry	√	√	Processing and use of forest products
Human health		√	Health monitoring and surveillance systems
Coastal adaptation		√	Geographical planning systems for coastal zones
Water		√	Non-water based sanitation

But what about help in understanding:

- Devils in the details of ecosystem
  - Multiple stresses which can lead … ought/ pest/tree dieoff; phytopla…
- Mitigation and A…
  - E.g., co… and water; biofuels
- Co…
  …, ecosystem services, food supplies, etc.
- …ent planning and management
  - …otecting people, biodiversity, ecosystem services…?
- Equity
  - Climate change could be the biggest environmental justice issue ever—"a fair deal or no deal"

Nationally and Regionally!!!!



Climate Stabilization Targets:

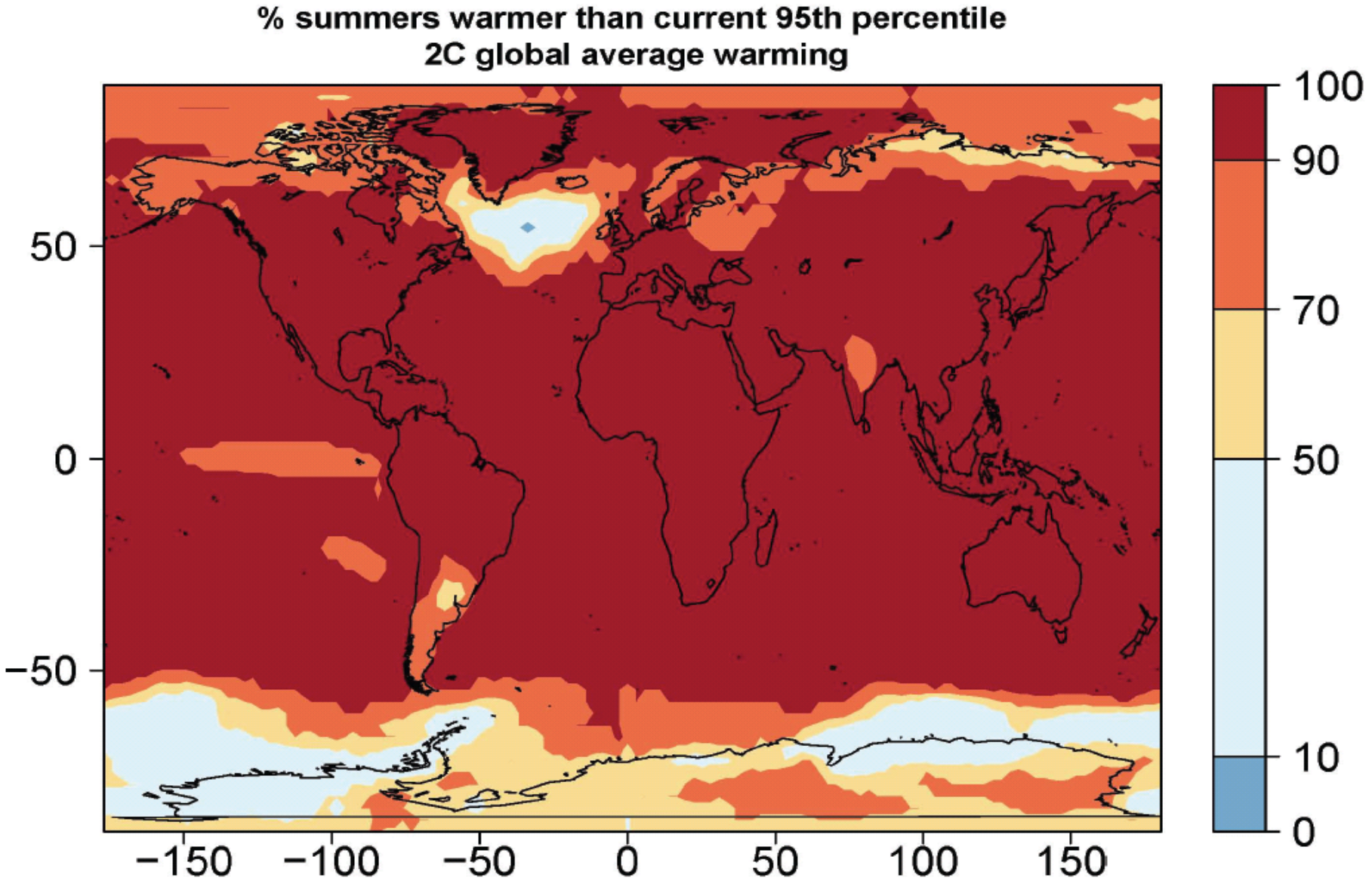
Emissions, Concentrations, and Impacts over Decades to Millennia

Report from The National Academies

Board on Atmospheric Sciences and Climate

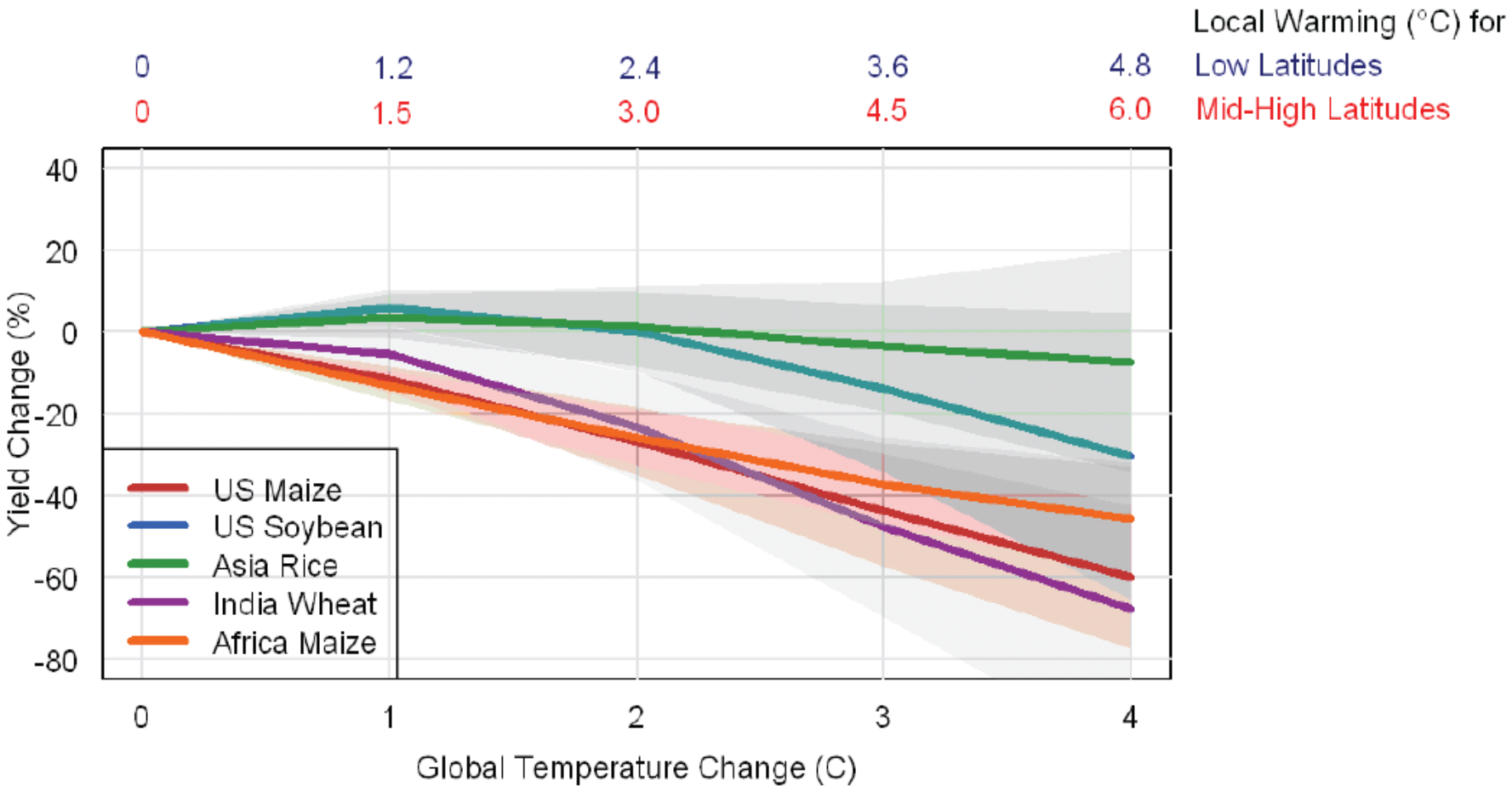
National Research Council, 2010, Climate Stabilization Targets:
Emissions, Concentrations, and Impacts over Decades to Millennia

Summer heating in a warming world



National Academies, Stabilization Targets, 2010

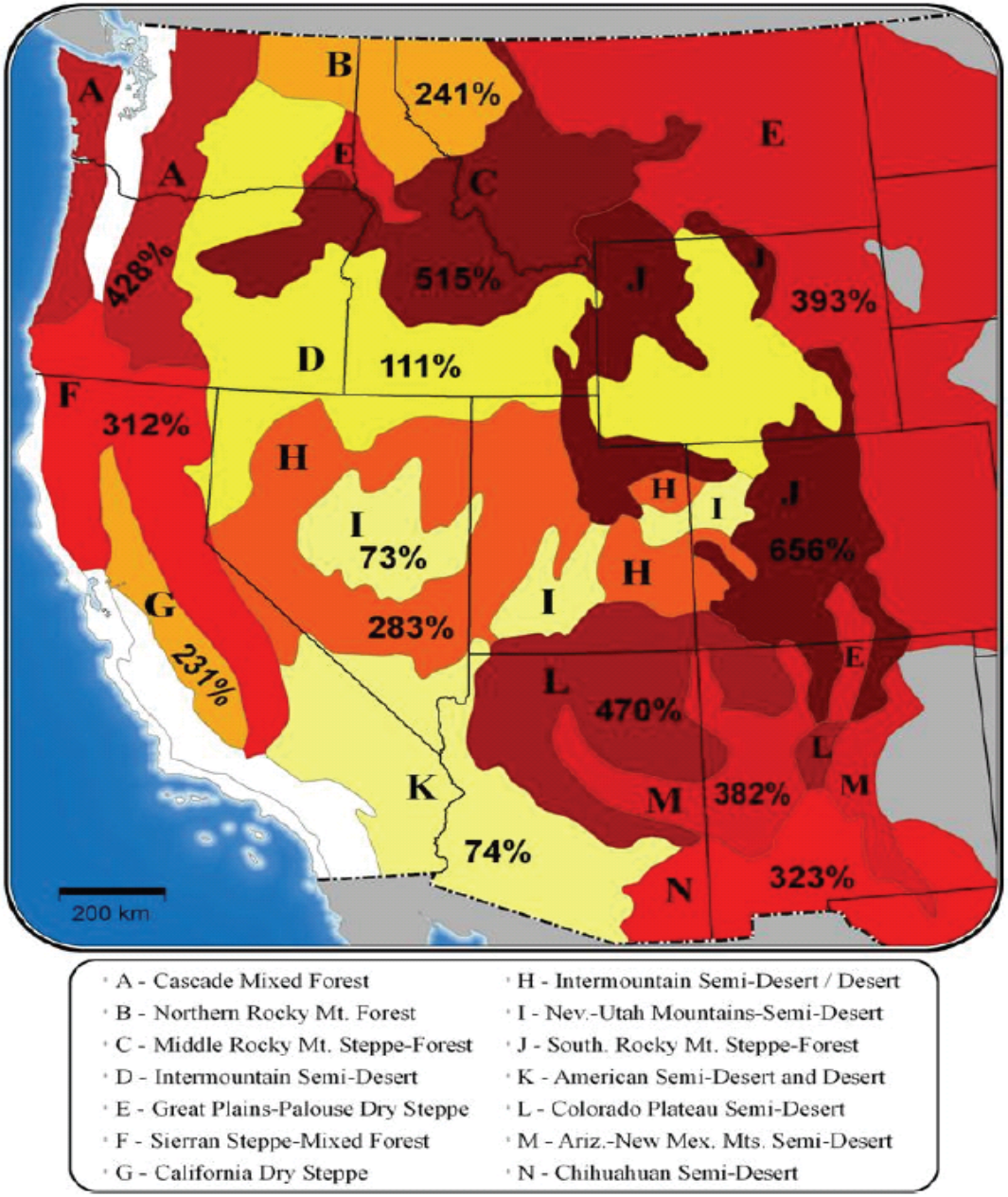
Crop yields vs global and local T increase



National Academies, Stabilization Targets, 2010

US Western wildfires in a warming world

Percentage increases in median annual area burned for a 1°C increase in global average temperature



National Academies, Stabilization Targets, 2010

SOME CLIMATE CHANGES AND IMPACTS OF NEXT FEW DECADES AND CENTURIES

FOR 1–4°C WARMING

RAIN

- 5–10% less rainfall per degree in Mediterranean, SW North America, southern Africa dry seasons
- 5–10% more rainfall per degree in Alaska and other high latitude NH areas
- 3–10% more heavy rain per degree in most land areas

RIVERS

- 5–10% less streamflow per degree in some river basins, including the Arkansas and Rio Grande

FOOD

- 5–15% reduced yield of US corn, African corn, and Indian wheat p

SEA ICE

- 15% and 25% reductions in

FOR 1–2°C WARMING

FIRE

- 200–400% increase in area burned per degree in parts of western US

FOR 3°C

COASTS

- Loss of about 250,000 square k
- Many millions more people at

EXTREMES

- About 9 out of 10 summer sea
  1 summer out of 20 in the last
  nearly all land areas

FOR 4°C

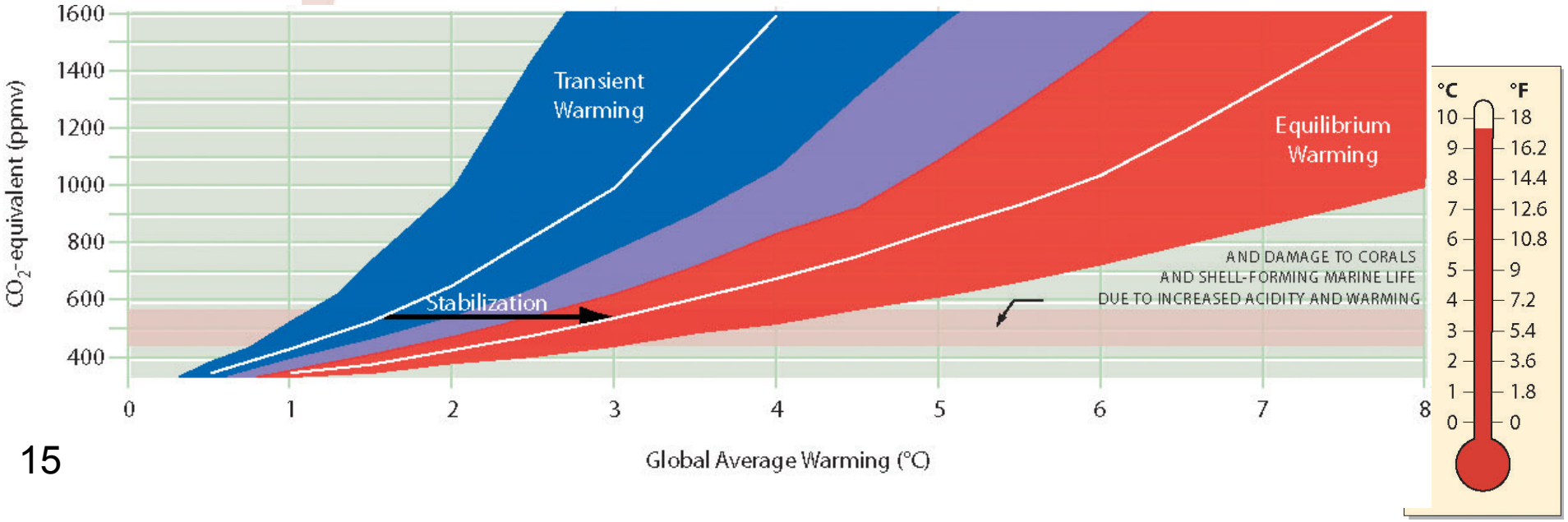
EXTREMES

- About 9 out of10 summers warmer than the warmest ever experienced during the last decades of the 20th century over nearly all land areas

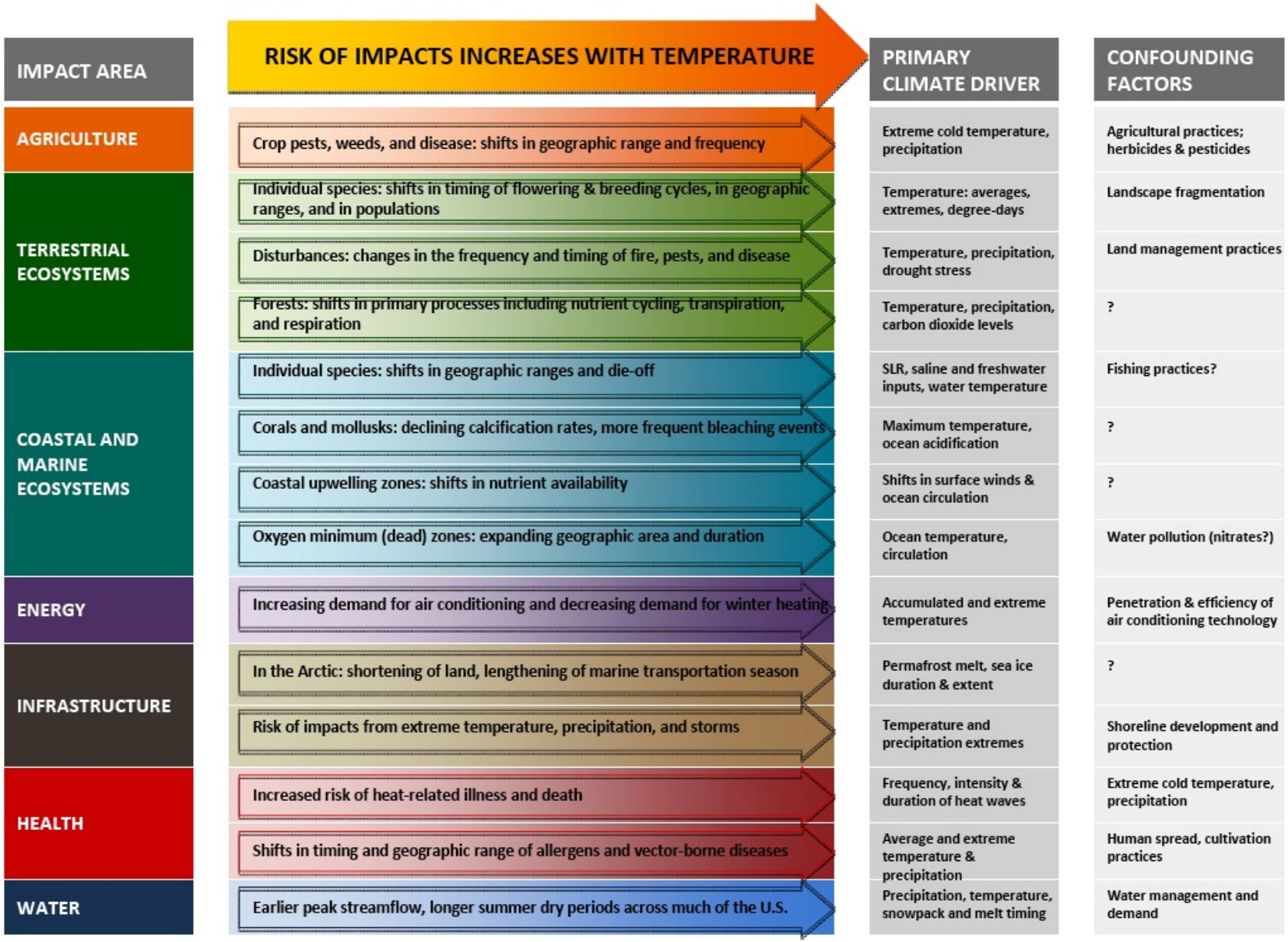
FOR 5°C

FOOD

- Yield losses in most regions and potential doubling of global grain prices



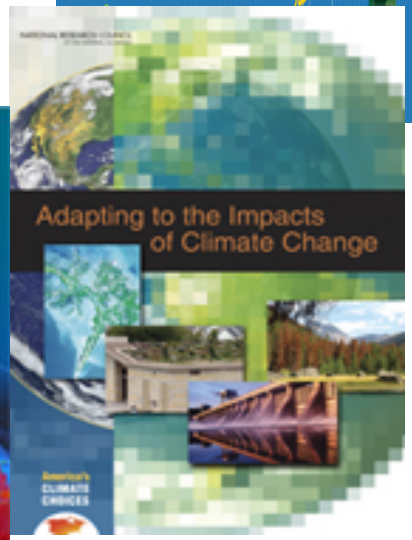
And there are also unquantified risks….

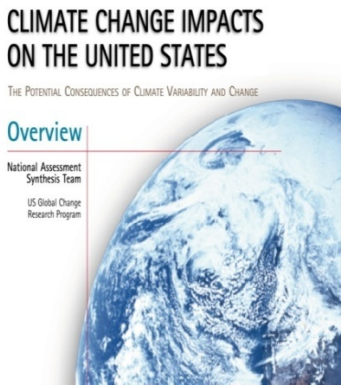


IMPACT AREA	RISK OF IMPACTS INCREASES WITH TEMPERATURE	PRIMARY CLIMATE DRIVER	CONFOUNDING FACTORS
AGRICULTURE	Crop pests, weeds, and disease: shifts in geographic range and frequency	Extreme cold temperature, precipitation	Agricultural practices; herbicides & pesticides
TERRESTRIAL ECOSYSTEMS	Individual species: shifts in timing of flowering & breeding cycles, in geographic ranges, and in populations	Temperature: averages, extremes, degree-days	Landscape fragmentation
	Disturbances: changes in the frequency and timing of fire, pests, and disease	Temperature, precipitation, drought stress	Land management practices
	Forests: shifts in primary processes including nutrient cycling, transpiration, and respiration	Temperature, precipitation, carbon dioxide levels	?
COASTAL AND MARINE ECOSYSTEMS	Individual species: shifts in geographic ranges and die-off	SLR, saline and freshwater inputs, water temperature	Fishing practices?
	Corals and mollusks: declining calcification rates, more frequent bleaching events	Maximum temperature, ocean acidification	?
	Coastal upwelling zones: shifts in nutrient availability	Shifts in surface winds & ocean circulation	?
	Oxygen minimum (dead) zones: expanding geographic area and duration	Ocean temperature, circulation	Water pollution (nitrates?)
ENERGY	Increasing demand for air conditioning and decreasing demand for winter heating	Accumulated and extreme temperatures	Penetration & efficiency of air conditioning technology
INFRASTRUCTURE	In the Arctic: shortening of land, lengthening of marine transportation season	Permafrost melt, sea ice duration & extent	?
	Risk of impacts from extreme temperature, precipitation, and storms	Temperature and precipitation extremes	Shoreline development and protection
HEALTH	Increased risk of heat-related illness and death	Frequency, intensity & duration of heat waves	Extreme cold temperature, precipitation
	Shifts in timing and geographic range of allergens and vector-borne diseases	Average and extreme temperature & precipitation	Human spread, cultivation practices
WATER	Earlier peak streamflow, longer summer dry periods across much of the U.S.	Precipitation, temperature, snowpack and melt timing	Water management and demand

So, we must Adapt, adaptively:
how can we help make *robust* rather than optimal decisions

- Infrastructure to withstand new “extremes”
- Seed varieties that perform well in droughts/floods/heat; seed banks
- Prioritize lands to preserve and manage multiple threats
- Emergency response plans, early-warning alert systems
- Develop social safety nets / insurance
- Information systems / share best practices
- Weather & climate monitoring and services
- Regional assessments



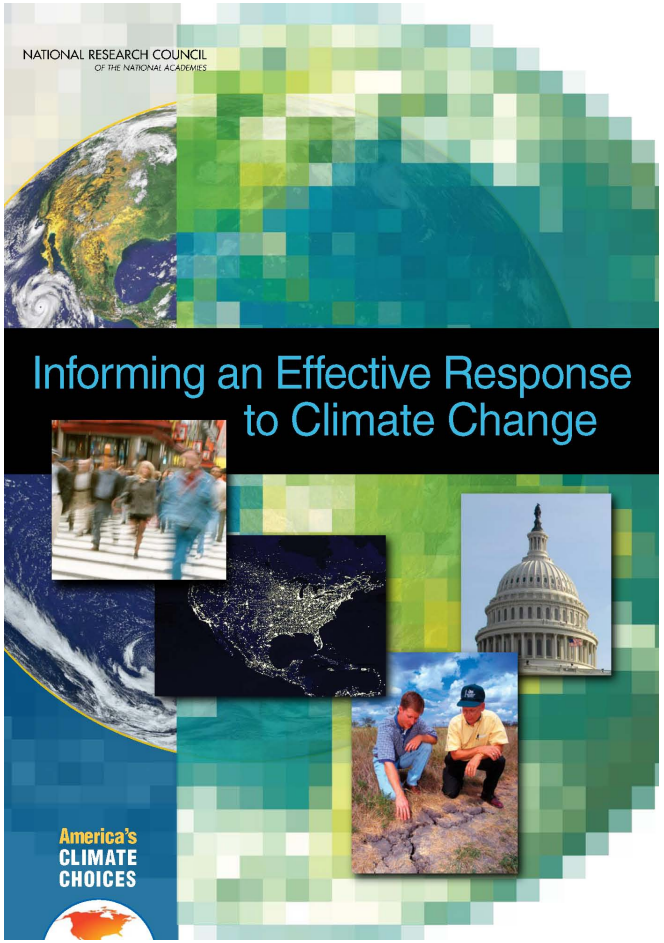


National Climate Adaptation Summit

Some conclusions…..

- One size doesn't fit all but all scales need similar information
- Providing access to data/models/outputs is not the same as providing "usable" data --need an interface and 2-way communication
- Need help in analyzing the costs of adaptation and the costs of NOT adapting (and additionality)
- Need a clearing house of 'best practices' and toolkits that exist
- Need data layers that help identify hotspots—such as the intersection of urban heat island effects, CSOs, foreclosure areas
- Assessment should focus on progress in mitigation and adaptation efforts --not just on state of systems

America's CLIMATE CHOICES
AT THE NATIONAL ACADEMIES



Informing an Effective Response to Climate Change

My interpretation of the message:

Need to help decisionmaking at all levels NOW --- Can't just talk to ourselves!

http://americasclimatechoices.org

Who is making decisions about climate change in the US?

	National	Regional	Local	International
Government	Federal agencies, Executive, Congress, Judiciary	Tribal &State governments, regional offices of Federal agencies, interstate networks (e.g., RGGI)	City, county and other local government	Intergovernmental organizations (e.g., World Bank, UNFCCC, ICLEI)
Private Sector	Corporate HQs, national business networks	Regional corporate offices, companies and business associations	Local businesses and associations	Multinational corporations, international business networks (e.g., WBCSD)
Non-profit organizations	Environmental and other NGOs	Regional offices of NGOs, regional organizations	Local NGOs	Internat'l environmental, humanitarian organizations
Citizens	citizen & consumer networks	Voters, citizen networks	Individuals as voters, consumers,	International citizens networks

Federal

Example decisions
Whether to participate in international agreements and bilateral/ multilateral assistance programs relating to climate change
Whether to regulate GHG emissions; if so, what policy mechanisms (e.g., cap & trade, carbon taxes, stds, etc.) to use, how mechanisms are designed, & what agencies/institutions will administer them.
How to adapt to climate change on federal lands and jurisdictions
Funding priorities for RDD&D & observing
How best to educate & communicate the public

State, tribal and local government

Example decisions
How to control GHG emissions, esp. from utilities, transport & buildings, whether to join regional trading initiatives, & how to encourage citizens to reduce their emissions
How to incorporate climate change into land-use planning, infrastructure projects, disaster planning
How to amend the building code to reduce GHGs & to address the impacts of climate change, including increased potential for flooding, droughts, high winds, heat waves, and disruption of utility services
Potential information campaigns and educational guidelines

Private sector

Example decisions
How to reduce GHG emissions from operations & supply chains, & whether to participate in regional & global carbon markets & offsets
How to develop good information for consumers about carbon in products and other sustainable practices
Whether and how to insure climate risks
How and what to communicate about climate change (especially from media and cultural sector)

As we advance the IAM field and work together, keep in mind….

- Available info is not necessarily “usable” info
- Must understand composite of multiple stresses
- Users and providers are equal participants
- Need a clearing house of ‘best practices’; toolkits
- Link across scales and across sectors
- Focus on interactions between mitigation and adaptation
- Identify what research is ‘most important to do’ and in particular, what you need to know to cope with climate change
- Help create a research and policy strategy with priorities so we get the answers we need in a timely fashion

What needs to be resolved…

- What metrics should we have for success?
- What ways can we measure outcomes and impacts?
- How best to network our networks and develop case studies/best practices?
- How to integrate from the top-down and bottom-up?
- How much “process” and how many “products” – and at what intervals?

Where do we go from here?

“There is no room to be wrong….”

Nested Assessment Concept

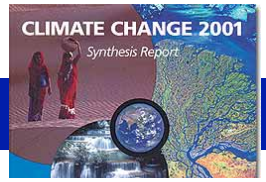
- Although it would be ideal *to address climate change impacts and responses for each sector at local, regional, and national scales*, it is *unlikely that sufficient resources will be available* to accomplish this.

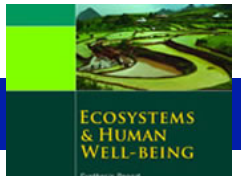
- One option is to *develop a broad conceptual framework* or matrix that *links local, sector-specific information to the larger-scale climate changes*.

- Using a nested matrix approach, *those areas or sectors that are highly vulnerable could be selected for a more focused integrated assessment* that includes the demographic and institutional context as well as physical parameters.

Recommendation: CCSP should *consider implementing this nested matrix concept* in developing subsequent assessments

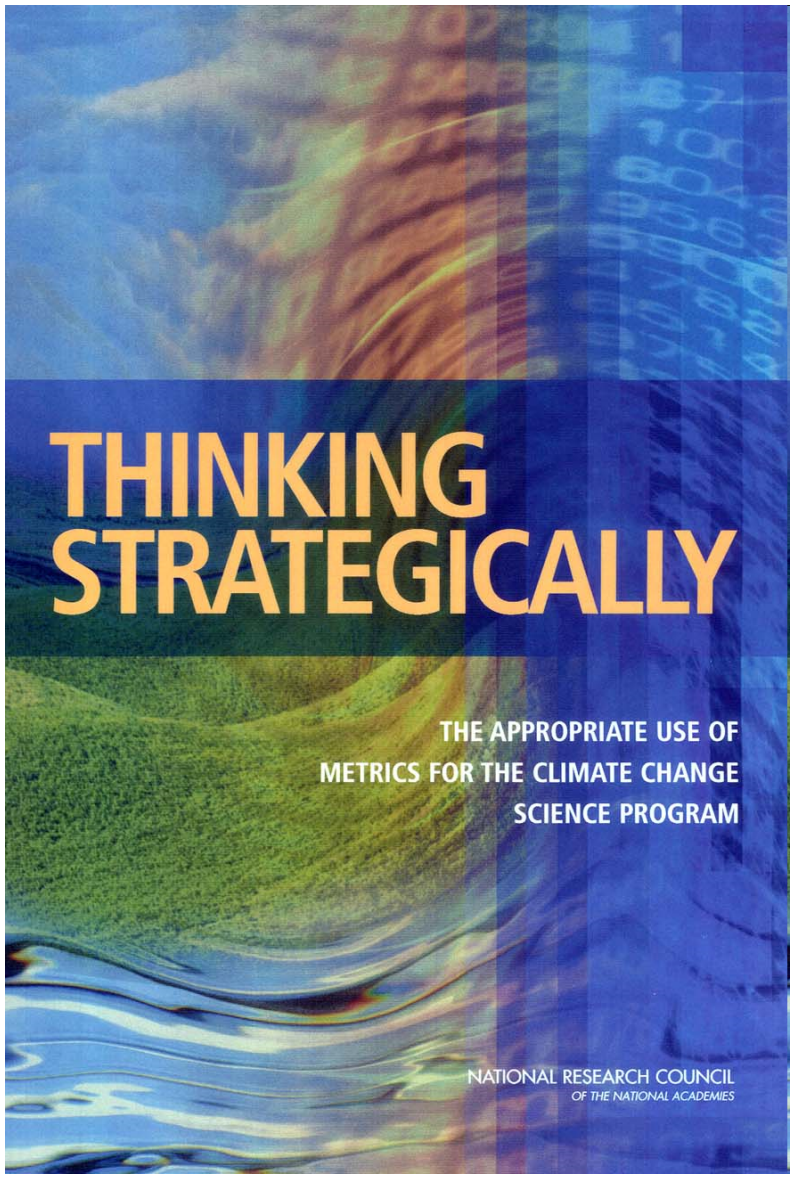
Analysis of Global Change Assessments: Lessons Learned, 2007





"Impact" metrics that can be applied

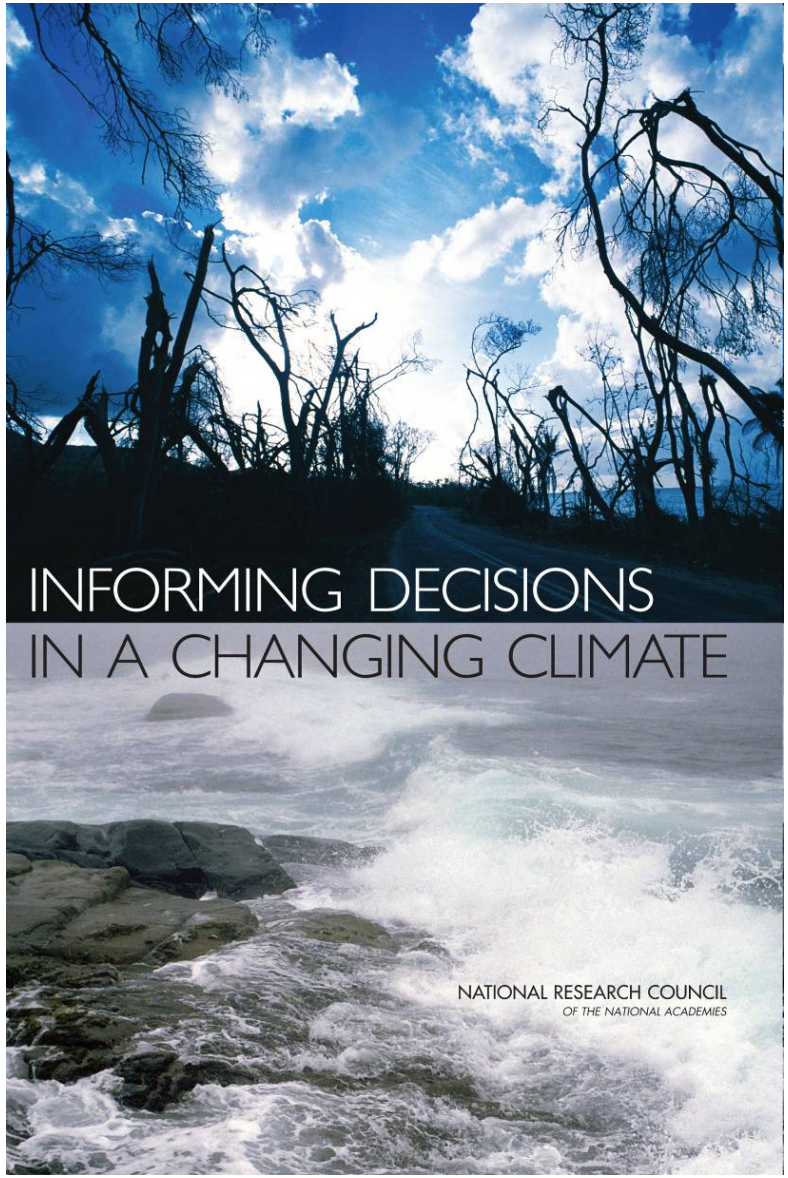
- The results of the program have informed policy and improved decision making.
- The program has benefited society in terms of enhancing economic vitality, promoting environmental stewardship, protecting life and property, and reducing vulnerability to the impacts of climate change.
- Public understanding of climate issues has increased.



Five key foci for decision support research: *

Understanding…

- climate change vulnerabilities.. for regions, populations, and sectors
- the potential for mitigation…and consequences of mitigation options
- adaptation contexts and capacities, including consequences of adaptive responses
- how mitigation and adaptation interact
- taking advantage of emerging opportunities associated with climate variability and change



**Informing Decisions in a Changing Climate" (NRC, 2009)*

Research needs related to multiple stresses, extreme events, nonlinearities… (NRC, 2007 and others)

Better drought & flood planning; improve tools for municipalities & methods for testing

Enhance monitoring/surveillance systems, early warning systems, evacuation routes & response mechanisms for extreme events

Use of historical records and “What If?” scenarios to evaluate ‘break points’

Models that can provide quantitative predictions of multiple environmental stresses

Prediction of threshold effects such as climate/pest interactions; megadrought ecosystem thresholds, cascading effects.