IPCC Fourth Assessment Report

Synthesis Report

Topic 5

The long-term perspective

Role of science

- Determining what constitutes "dangerous anthropogenic interference with the climate system" in relation to Article 2 of the UNFCCC involves value judgements

- Science can support informed decisions , including by providing criteria for judging which vulnerabilities might be labelled "key"

“Reasons for concern” identified in Third Assessment Report

- Risks to unique and threatened systems
- Risks of extreme weather events
- Distribution of impacts and vulnerabilities
- Aggregate impacts
- Risks of large-scale singularities

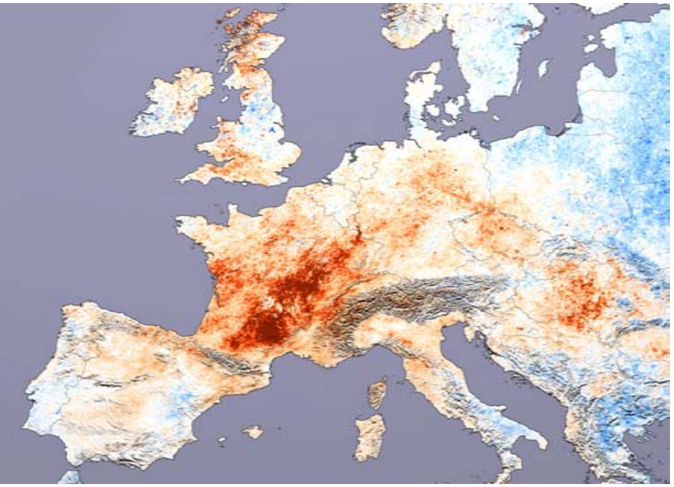
“Reasons for concern” identified in the TAR remain a viable framework to consider key vulnerabilities.

- Many risks identified with higher confidence
- Some risks larger or occur at lower increases in temperature
- Due to:
  - Better understanding of magnitude of impacts and risks
  - More precise identification of the circumstances that make systems and regions especially vulnerable
  - Growing evidence that risk of very large impacts on multiple century time scales would continue to increase

Risks to unique and threatened systems

- New and stronger evidence of observed impacts
- Confidence has increased that a 1-2^{o}C increase in global mean temperature above 1990 levels poses significant risks…, including many biodiversity hotspots
- Increases in sea surface temperature of about 1-3^{o}C are projected to result in more frequent coral bleaching events and widespread mortality, unless there is thermal adaptation or acclimatization by corals
- Increasing vulnerability of indigenous communities in the Arctic and small island communities to warming is projected

Risks of extreme weather events



- Responses to some recent extreme climate events reveal higher levels of vulnerability in both developing and developed countries

- Higher confidence in projected increases in droughts, heat-waves, and floods as well as their adverse impacts
  - Increased water stress and wild fire frequency
  - Adverse effects on food production and health
  - Increased flood risk, extreme high sea level, and damage to infrastructure

Distribution of impacts and vulnerabilities

- Sharp differences across regions
- Those in weakest economic position often most vulnerable
- Increasing evidence of greater vulnerability of specific groups such as the poor and elderly
- Increased evidence that low-latitude and less-developed areas generally face greater risk
  - Eg. dry areas and mega-deltas

Aggregate impacts

- Initial net market-based benefits from climate change are projected to peak at a lower magnitude of warming, while damages would be higher for larger magnitudes of warming.
- Net costs of impacts of increased warming are projected to increase over time
- Aggregate impacts also quantified in other metrics
  - Likely adverse effects on hundreds of millions of people through increased coastal flooding, reductions in water supplies, increased malnutrition and increased health impacts.

Risks of large-scale singularities

- Better understanding than in the TAR that the risk that additional sea level rise from both the Greenland and possibly Antarctic ice sheets may be larger than projected and could occur on century time scales
- Ice dynamical processes seen in recent observations but not fully included in ice sheet models could increase the rate of ice loss

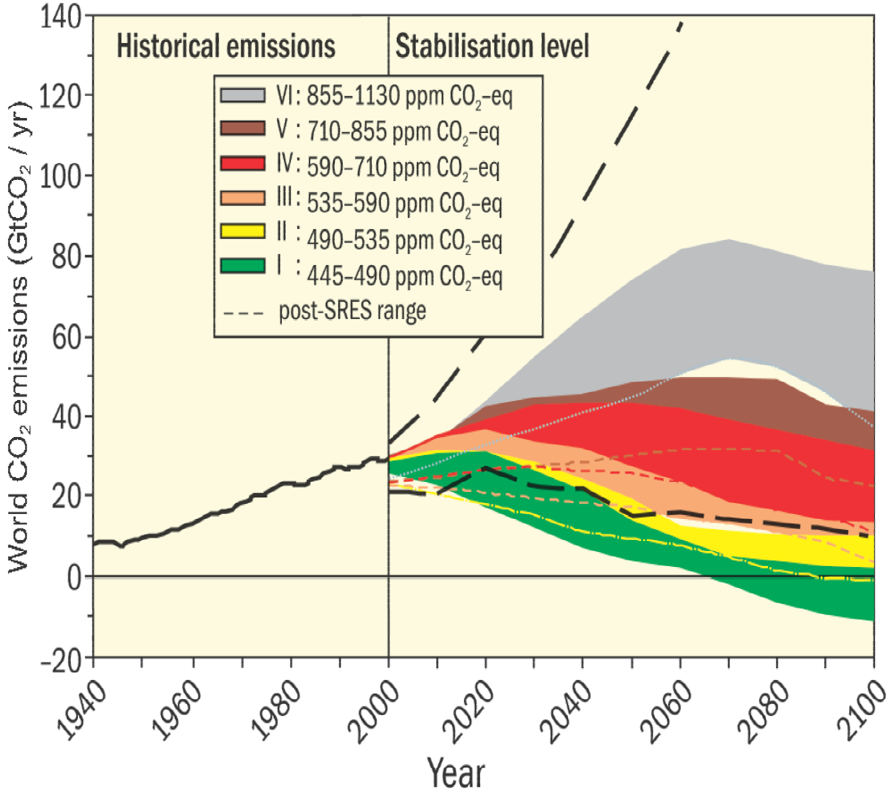
Neither adaptation nor mitigation alone can avoid all climate change impacts.

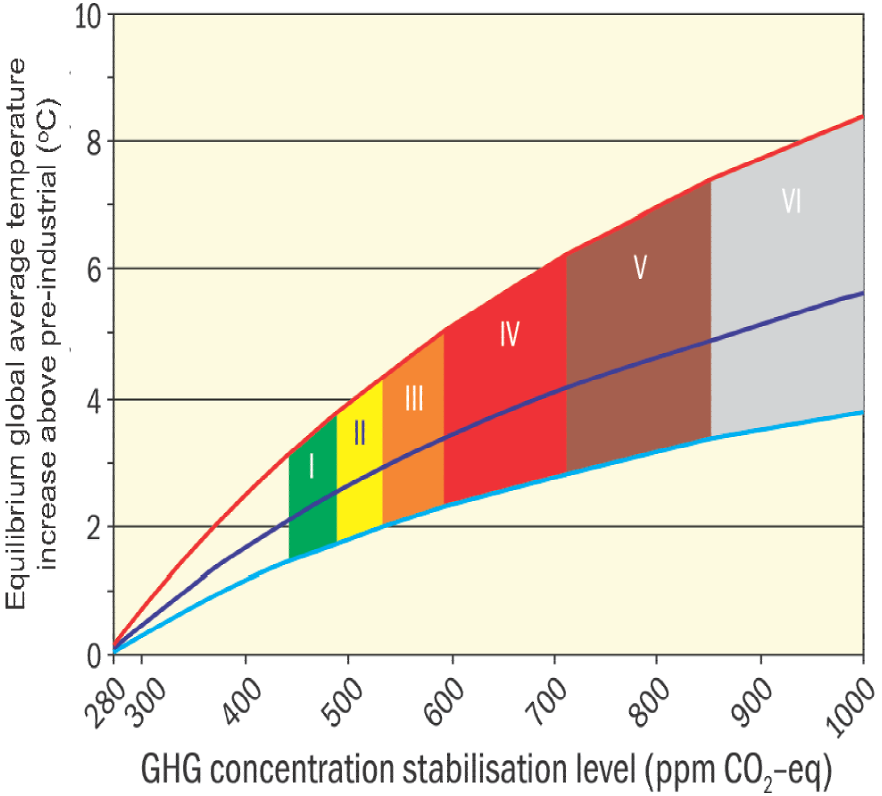
- Can complement each other and together can significantly reduce risks of climate change
- Adaptation is necessary in short and longer term to address impacts resulting from warming that would occur even for the lowest stabilisation scenarios assessed
  - There are barriers, limits and costs, but these are not fully understood
  - Unmitigated climate change would, in the long term, be likely to exceed capacity of natural, managed and human systems to adapt

Many impacts can be reduced, delayed or avoided by mitigation.

- Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilisation levels
- Early mitigation actions would avoid further locking in carbon intensive infrastructure and reduce climate change and associated adaptation needs
- Delayed emission reductions significantly constrain the opportunities to achieve lower stabilisation levels and increase the risk of more severe climate change impacts

The lower the stabilisation level the earlier emissions must go down





Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilisation levels

Category	CO_2 concentration at stabilization (2005 = 379 ppm) [b]	CO_2-equivalent concentration at stabilization including GHGs and aerosols (2005 = 375 ppm) [b]	Peaking year for CO_2 emissions [a, c]	Change in global CO_2 emissions in 2050 (% of 2000 emissions) [a, c]	Global average temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity [d], [e]	Global average sea level rise above pre-industrial at equilibrium from thermal expansion only [f]	Number of assessed scenarios
	ppm	ppm	year	percent	°C	metres	
I	350 – 400	445 – 490	2000 – 2015	-85 to -50	2.0 – 2.4	0.4 – 1.4	6
II	400 – 440	490 – 535	2000 – 2020	-60 to -30	2.4 – 2.8	0.5 – 1.7	18
III	440 – 485	535 – 590	2010 – 2030	-30 to +5	2.8 – 3.2	0.6 – 1.9	21
IV	485 – 570	590 – 710	2020 – 2060	+10 to +60	3.2 – 4.0	0.6 – 2.4	118
V	570 – 660	710 – 855	2050 – 2080	+25 to +85	4.0 – 4.9	0.8 – 2.9	9
VI	660 – 790	855 – 1130	2060 – 2090	+90 to +140	4.9 – 6.1	1.0 – 3.7	5

Sea level rise under warming is inevitable

- Thermal expansion would continue for many centuries after concentrations have stabilised
- Eventual sea level rise much larger than projected for the 21st century
- Eventual contributions from Greenland ice sheet loss could be several metres should warming in excess of 1.9-4.6°C above pre-industrial be sustained over many centuries
  - larger than from thermal expansion
  - long time scales of response to warming imply that stabilisation at or above present levels would not stabilise sea level for many centuries

High agreement and *much evidence* that all stabilisation levels assessed can be achieved

- Deployment of a portfolio of technologies that are either currently available or expected to be commercialised in coming decades
- Assuming appropriate and effective incentives are in place for development, acquisition, deployment and diffusion and addressing related barriers

The macro-economic costs of mitigation generally rise with the stringency of the stabilisation target

For specific countries and sectors, costs vary considerably from the global average

Stabilisation levels (ppm CO_2-eq)	Median GDP reduction [(a)] (%)		Range of GDP reduction [(b)] (%)		Reduction of average annual GDP growth rates (percentage points) [(c), (e)]	
	2030	2050	2030	2050	2030	2050
445 – 535 [(d)]	Not available		< 3	< 5.5	< 0.12	< 0.12
535 – 590	0.6	1.3	0.2 to 2.5	slightly negative to 4	< 0.1	< 0.1
590 – 710	0.2	0.5	-0.6 to 1.2	-1 to 2	< 0.06	< 0.05

Costs of climate change

- Impacts of climate change are *very likely* to impose net annual costs which will increase over time as global temperatures increase

- Aggregate estimates of costs mask significant differences in impacts across sectors, regions and populations and *very likely* underestimate damage costs because they cannot include many non-quantifiable impacts

Responding to climate change involves an iterative risk management process

- Includes both adaptation and mitigation, takes into account climate change damages, co-benefits, sustainability, equity, and attitudes to risk
- Limited, early results do not as yet permit an unambiguous determination of emissions pathway or stabilisation level where benefits exceed costs
- Choices about scale and timing of mitigation involve balancing economic costs of more rapid emission reductions now against the corresponding medium-term and long-term climate risks of delay

Synthesis Report can be downloaded from http://www.ipcc.ch/

Back-up slides

Article 2 of the UNFCCC

- "The ultimate objective of this Convention and any related legal instruments ….is to achieve…stabilization of greenhouse gas concentrations in the atmosphere at a level that would **prevent dangerous anthropogenic interference with the climate system**. Such a level should be achieved within a time-frame sufficient to allow **ecosystems** to adapt naturally to climate change, to ensure that **food production** is not threatened and to enable **economic development to proceed in a sustainable manner**."