Supplementary to the single slide presentation

EGU 2021
Session EOS3.2 - 6315

Using the IPCC for Communicating Both the Full Extent of the Global Climate Emergency and the Required Response

Peter Carter, Climate Emergency Institute

Selected images from recent IPCC reports, reproduced for communication of the global climate emergency

CLIMATE EMERGENCY INSTITUTE

Opening of COP 25, Madrid, Monday 2 December 2019 Statement by IPCC Chair Hoesung Lee

GLOBAL EMISSIONS MUST BE DECLINING FROM 2020

2019 UN COP 25 Madrid, Opening statement by IPCC Chair, Hoesung Lee

"Let me start by reminding you that our assessments show that climate stabilization implies that greenhouse gas emissions must start to peak from next year [2020]. But emissions are continuing to increase, with no sign of peaking soon.

"Our three special reports on warming of 1.5°C, climate change and land, and the ocean and cryosphere in a changing climate indicated that the impacts of current warming are much more severe than previously understood: e.g., accelerating sea level rise and ocean warming, some key ecosystems becoming much more vulnerable, and increasing risks of reaching limits to adaptation.

"Climate impacts now and in the future increasingly challenge the adaptive capacity of society and ecosystems.

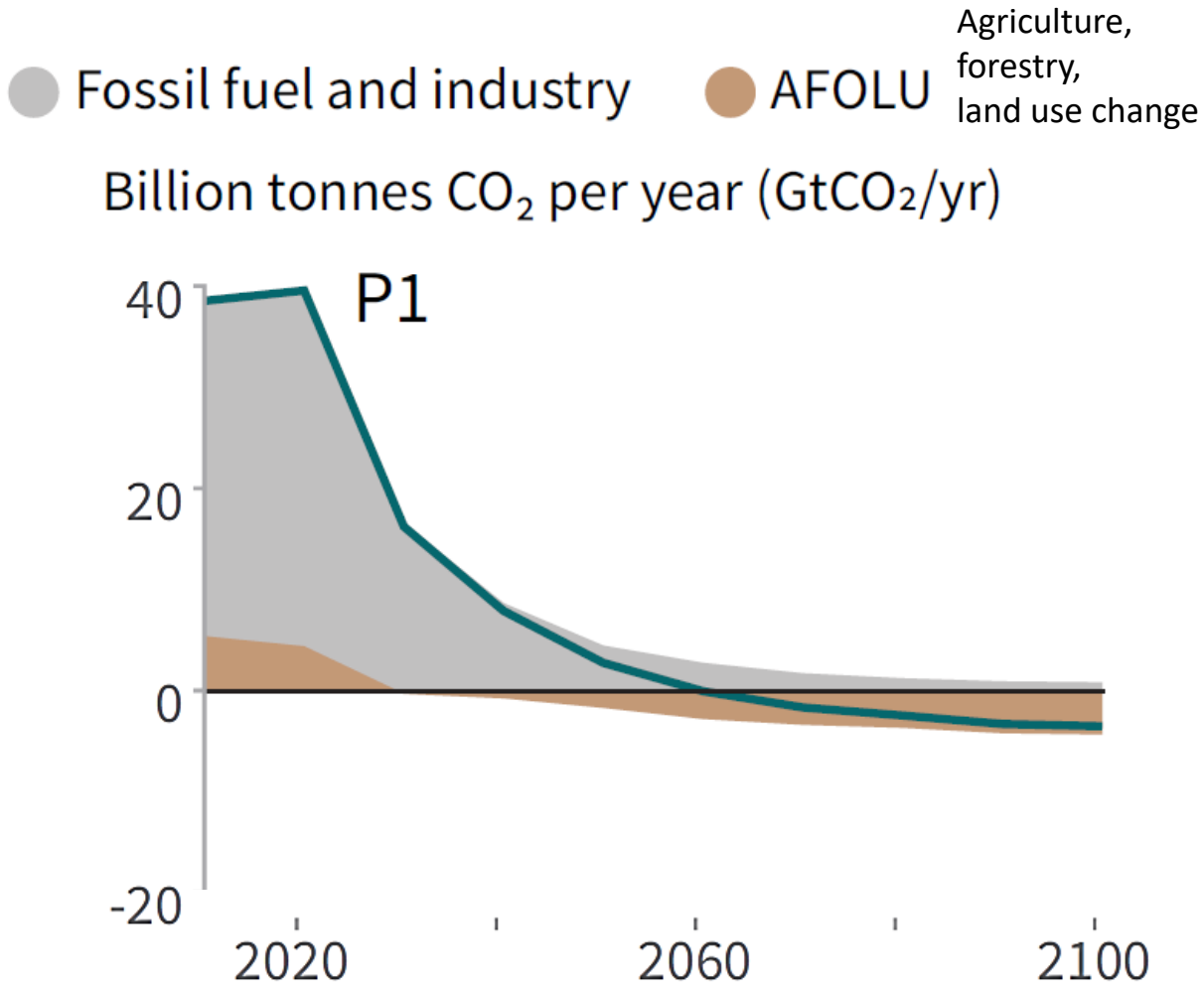
"The three special reports reconfirm the urgent need for immediate reductions in greenhouse gas emissions."

The IPCC 2018 1.5°C Special Report Best-Case Scenario

IPCC 2018 1.5°C Report shows for best-case mitigation scenario that global CO2 emissions decline rapidly from 2020, are reduced 50% by 2030, and drop to net-zero WITH VIRTUAL ZERO FOSSIL FUEL EMISSIONS by 2050.+

Breakdown of contributions to global net CO emissions

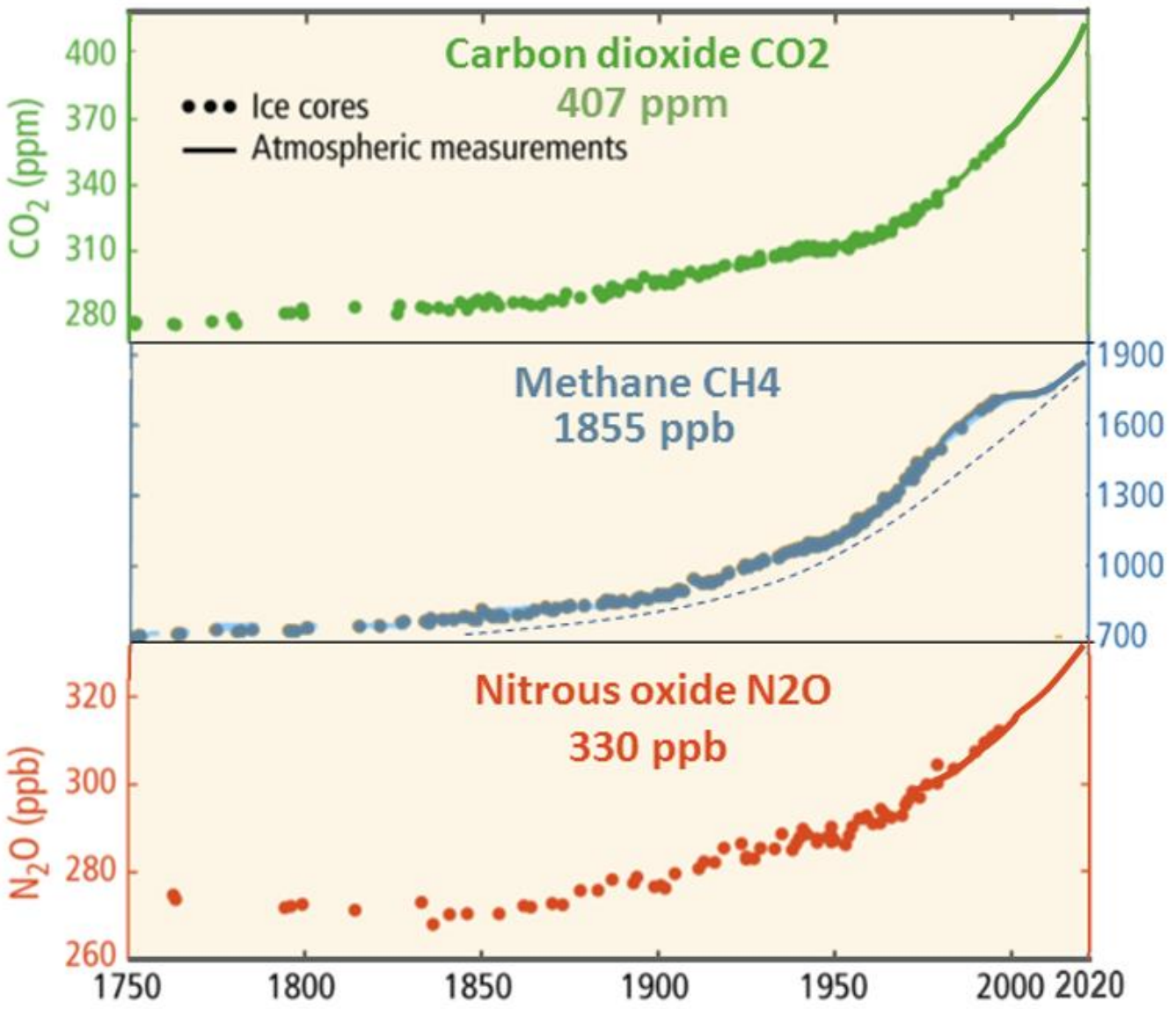
% relative to 2010	*in 2030*	*in 2050*	
CO emission change	-58%	-93%	CO2
Kyoto-GHG emissions (CO2 equivalent)	-50%	-82%	CO2 eq.
	Primary energy		
from COAL	*-8%*	*-97%*	
from OIL	*-37%*	*-87%*	
from GAS	*-25%*	*-74%*	



P1: **A scenario in which social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A downsized energy system enables rapid decarbonization of energy supply.**
Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

Figure SPM.3b

Accelerating atmospheric greenhouse gases



April 2021

416.14 ppm

1882 ppb

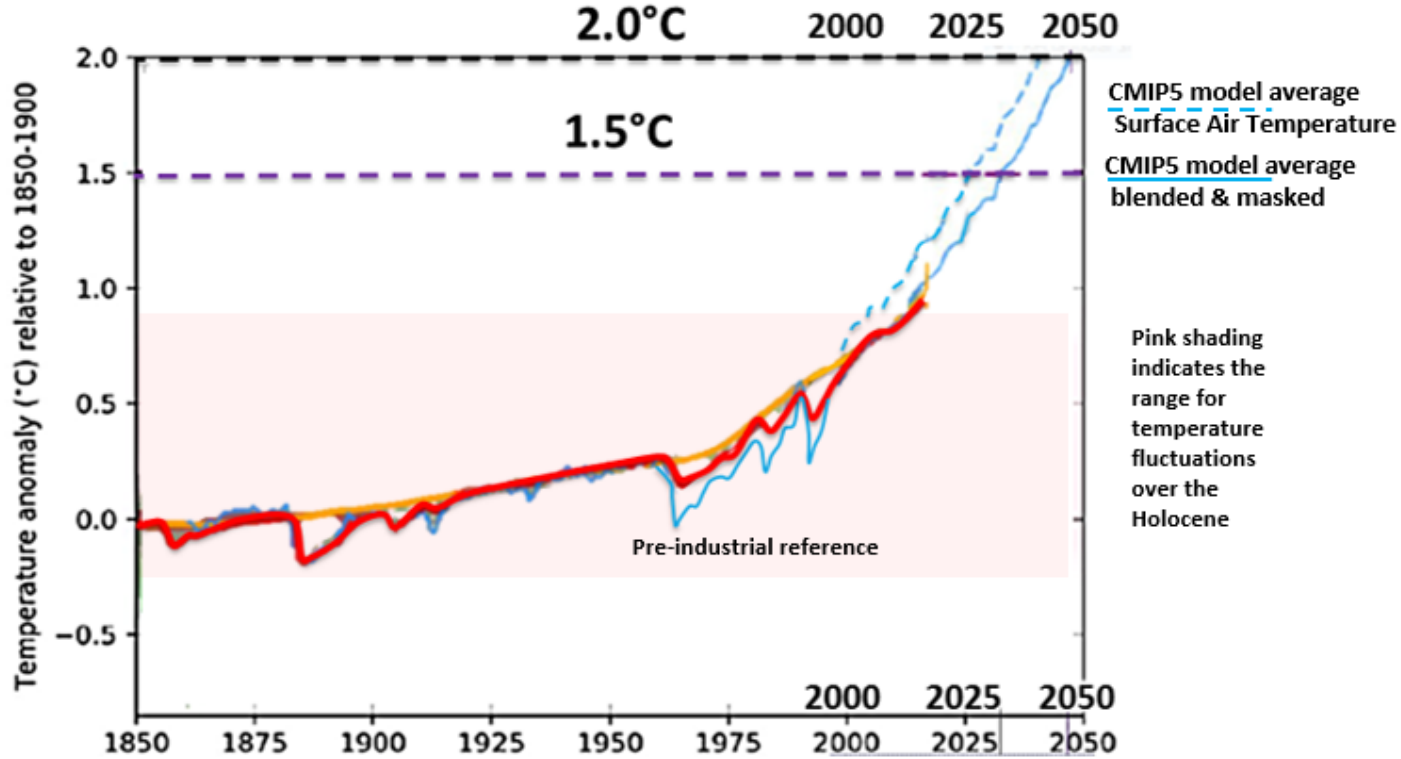
334.6 ppb

IPCC 2014 AR5, SYR, Figure 1.3

IPCC 2018 1.5°C Report's global warming projections to 2050

1.5°C by 2035 (or sooner)

2.0°C by 2045 (or sooner)



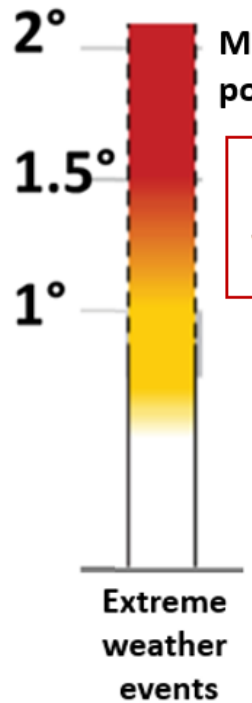
Adapted from IPCC 2018 1.5°C Report, Figure 1.2 Evolution of global mean surface temperature over the period of instrumental observations

Above 1.5°C Extreme weather disasters are severe and widespread (IPCC 2018)

From IPCC 2018 1.5°C Report

Reasons for Concern

Extreme Weather Events



Most damaging climate change impact on populations and crops - all are increasing

Red indicates severe and widespread impacts/risks.

ADDITIONAL impacts and risks

IPCC 2018 1.5°C Report

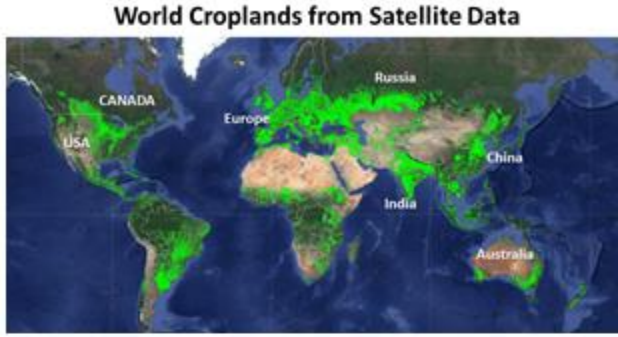
Impacts Observed from Extreme Weather Events

Impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones, and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability (*very high confidence*).

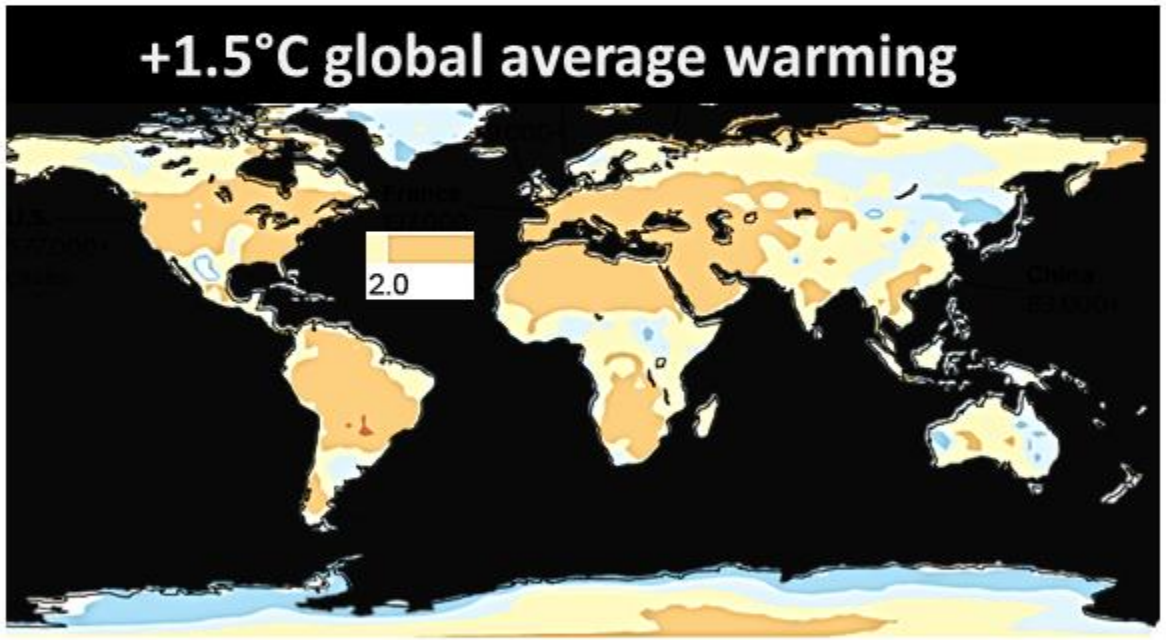
Impacts of such climate-related extremes include alteration of ecosystems, disruption of food production and water supply, damage to infrastructure and settlements, morbidity and mortality, and consequences for mental health and human well-being.

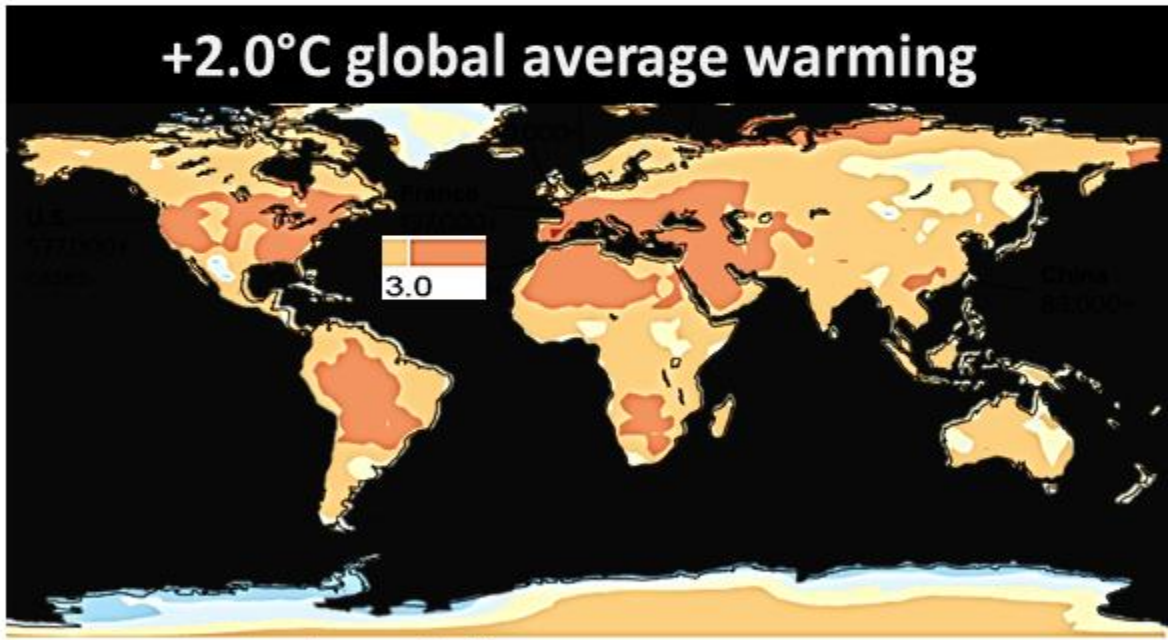
(IPCC 2014 AR5, WG2, p. 6)

Regional Extreme Heat Projected at 1.5°C and 2°C Global Average Warming

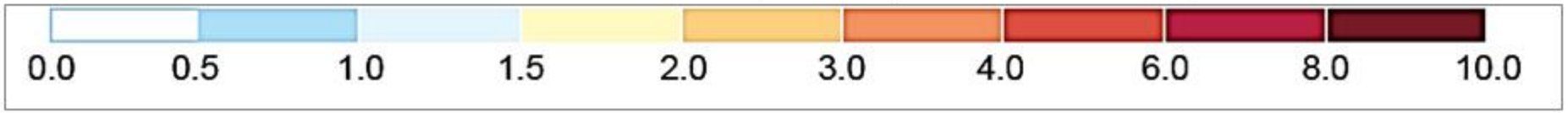


Increasing regional extreme heat
at 1.5°C and 2.0°C global average warming





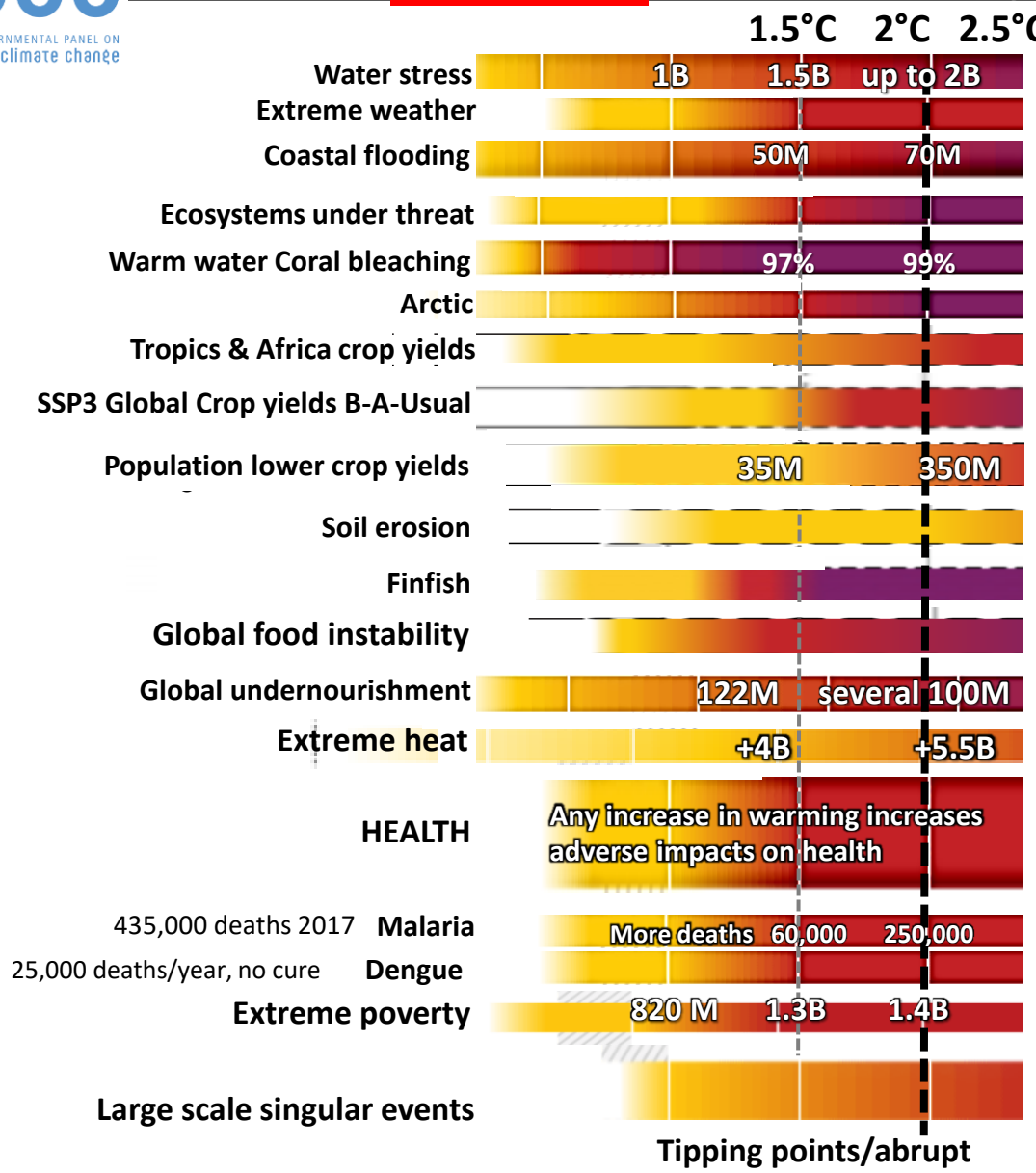
+°C (from pre-industrial)



Adapted for clarity from IPCC 2018 1.5°C Special Report, FAQ 3.1, Figure 1

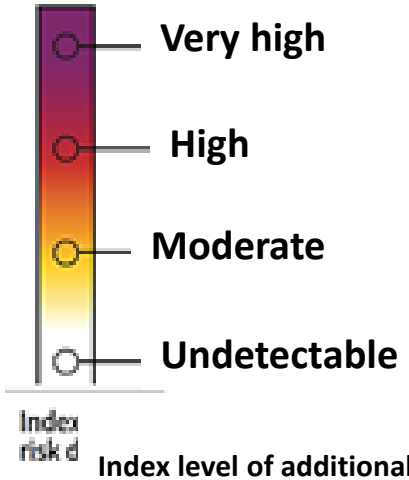
Peter Carter, Climate Emergency Institute

Sixteen IPCC *Reasons for Concern* Human & Earth Systems



(2018, 2019 & IPCC Special Reports)

RED= severe widespread impacts



Index level of additional risk/impact attributable to climate change

Increasing malnutrition, diarrheal, cardio-respiratory, infectious & vector disease, increasing impacts from heat waves floods & drought (IPCC 2007 AR4)

Arctic sea ice, Irreversible ice sheet loss, irreversible permafrost thaw, abrupt heating, Hot house Earth, AMOC shut down, India monsoon change, SW US megadrought,

Purple indicates very high risks of severe impacts and the presence of significant irreversibility or the

Red indicates severe and widespread impacts/risks.

Yellow indicates that impacts/risks are detectable and attributable to climate change with at least medium confidence.

White indicates that no impacts are detectable and attributable to climate change.

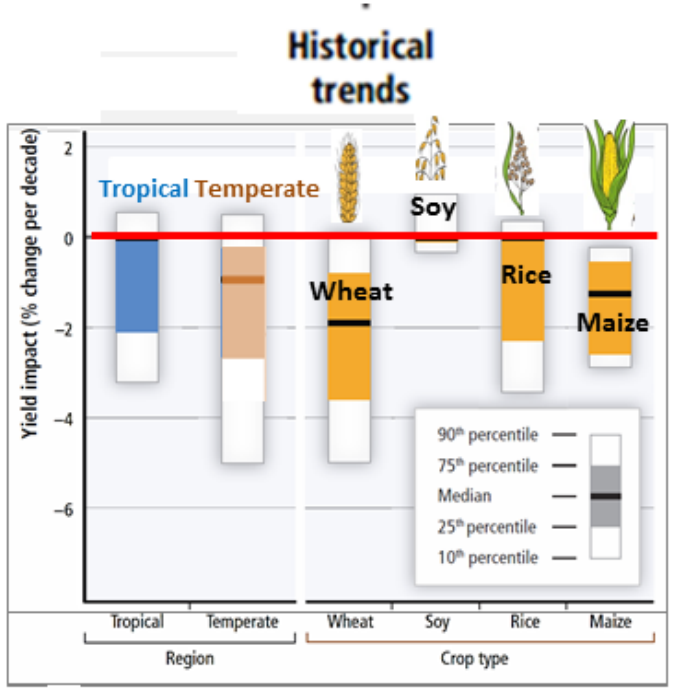
ADDITIONAL impacts and risks

(Compiled and adapted from IPCC 2018 1.5°C and 2019 Climate Change and Land Special Reports)

Crop yield effects up to 2013 and projected declines

IPCC 2014 AR5 WG2

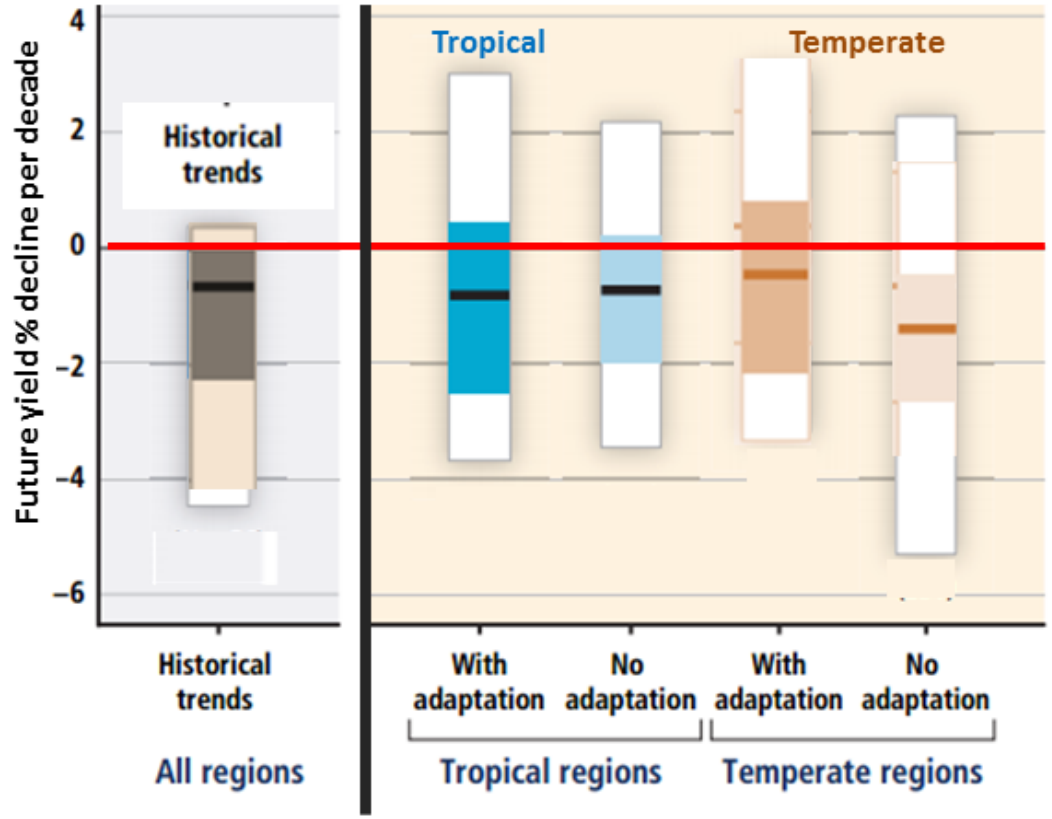
Negative yield effects up to 2013



From IPCC AR5 WG2 Figure SPM.2 | Widespread impacts in a changing world

Future yield declines

With or without adaptation

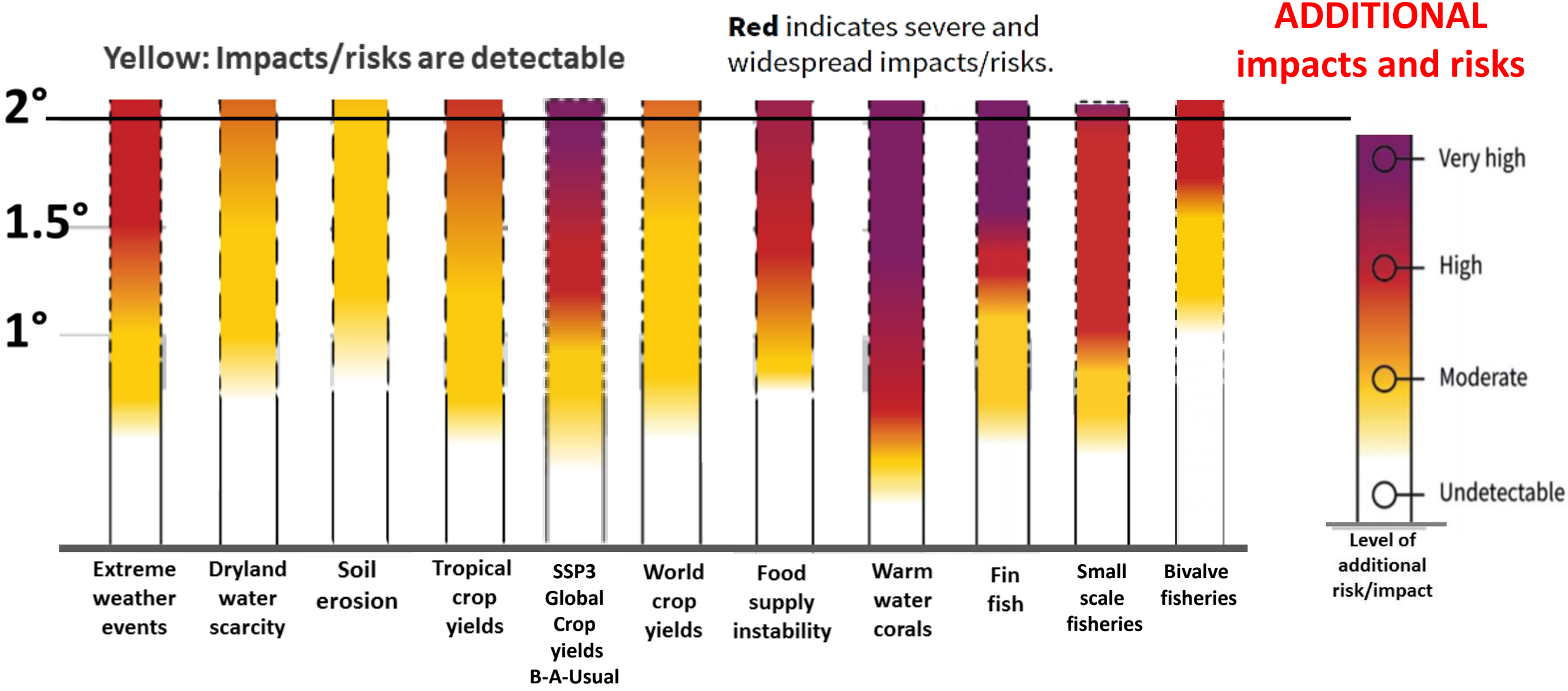


From IPCC AR5 WG2 Figure 7-7 | Summary of impact of climate and CO2 changes on crop yields, including historical and projected impacts, and for all available crops in temperate and tropical regions

11 Food Insecurity Factors

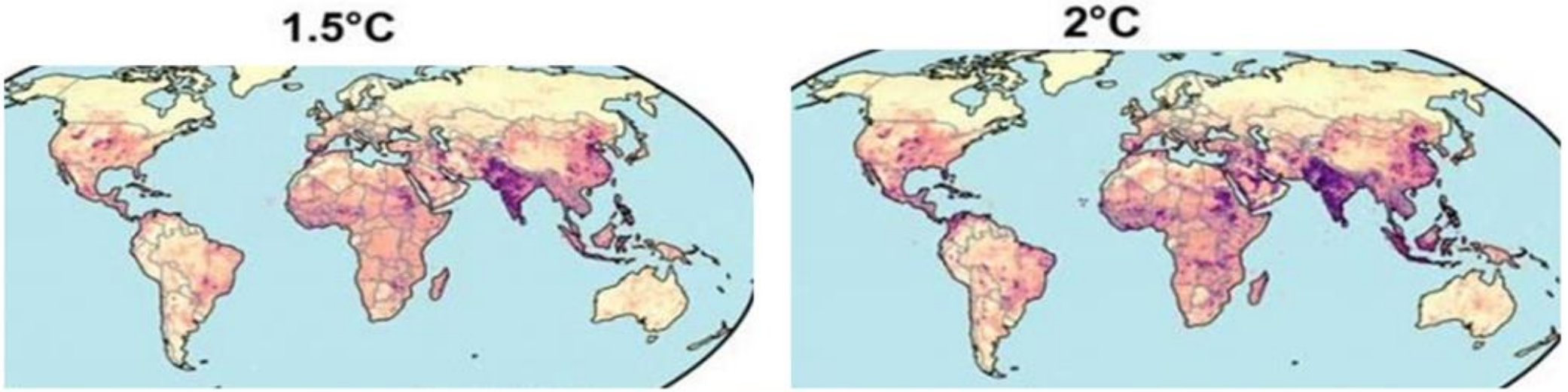
from 2018 IPCC 1.5°C & 2019 Climate Change & Land Report

ADDITIONAL impacts and risks



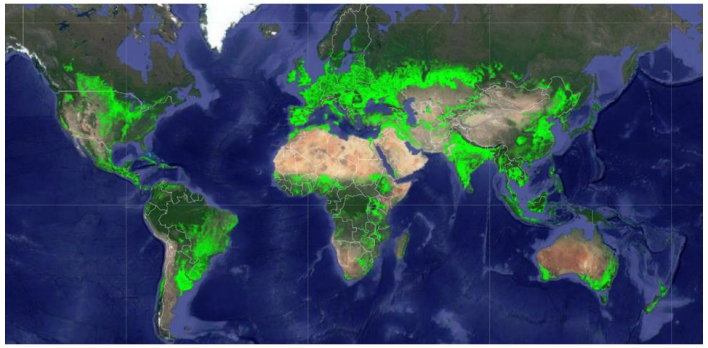
Risk of Multiple Climate Change Impacts Affecting Regions

(Like heat waves , drought and water insecurity impacting together:3)



Multi-sector risk (MSR) maps for 1.5°C and 2°C

Global croplands from combined satellite data



Working Group on Global Croplands USGS Satellite data Access 2017

IPCC 2018 1.5°C Report Figure 3.19 Multisector risk maps for 1.5°C,2°C where 2°C brings impacts not experienced at 1.5°C (1.5°C-2°C)
Score must be >4.0 to be considered multi-risk

1.5°C globally disastrous 2°C catastrophic

IPCC 2018 1.5°C Report
Table 5.1

Climate Change Impacts (per year)

IPCC 2018 1.5°C Report Table 5.1

IMPACTS	1.5°C	2.0°C
Water Scarcity (Over 1 billion people today)	496 (range to 1159) million more people exposed and vulnerable to water stress	586 (range to 1137) million more people exposed and vulnerable to water stress
Ecosystems	70-90% of coral reefs at risk from bleaching	99% of coral reefs at risk from bleaching
Coastal cities	31-69 million more people exposed to coastal flooding	32-79 million more people exposed to coastal flooding
Food systems	32-36 million more people exposed to lower yields	330-396 million more people exposed to lower yields
Undernourishment 820 million today	530-550 million more people	540-590 more people
Health	Any increase in global warming is projected to affect health negatively	
Heat waves	3546-4508 million more people exposed to heat waves	5417-6710 million more people exposed to heat waves
Vector-Borne Diseases increase with warming such as malaria, yellow fever, Lyme disease, plague, dengue, and leishmaniasis that kill 700,000/year. Lyme disease, West Nile virus and zika are others.		
Malaria (435,000 deaths 2017)	60,000 more deaths	250,000 more deaths
Dengue (25,000 deaths/year)	Increases with global warming 500 million more cases	600 million more cases
	(Global expansion and redistribution of Aedes-borne virus transmission with climate change, S. Ryan, March 2019	
Extreme Poverty	122 million more people	Several hundred million more people

Adapted from IPCC 2018 1.5°C Report Table 5.1 Peter Carter, Climate Emergency Institute

At +2°C

Water scarcity: 2 billion people

Tropical coral reefs dead (99%)

Food: 1.3 billion people undernourished

Heat waves: 6 billion more people

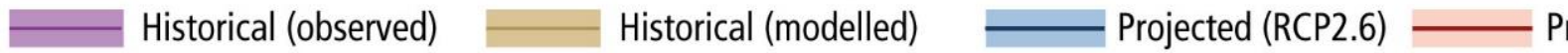
Malaria: 685,000 deaths

Extreme poverty: several hundred million more people

IPCC 2019 Report: Oceans

From IPCC 2019 Special Report on the Ocean and Cryosphere in a Changing Climate

Worst-case scenario current trajectory

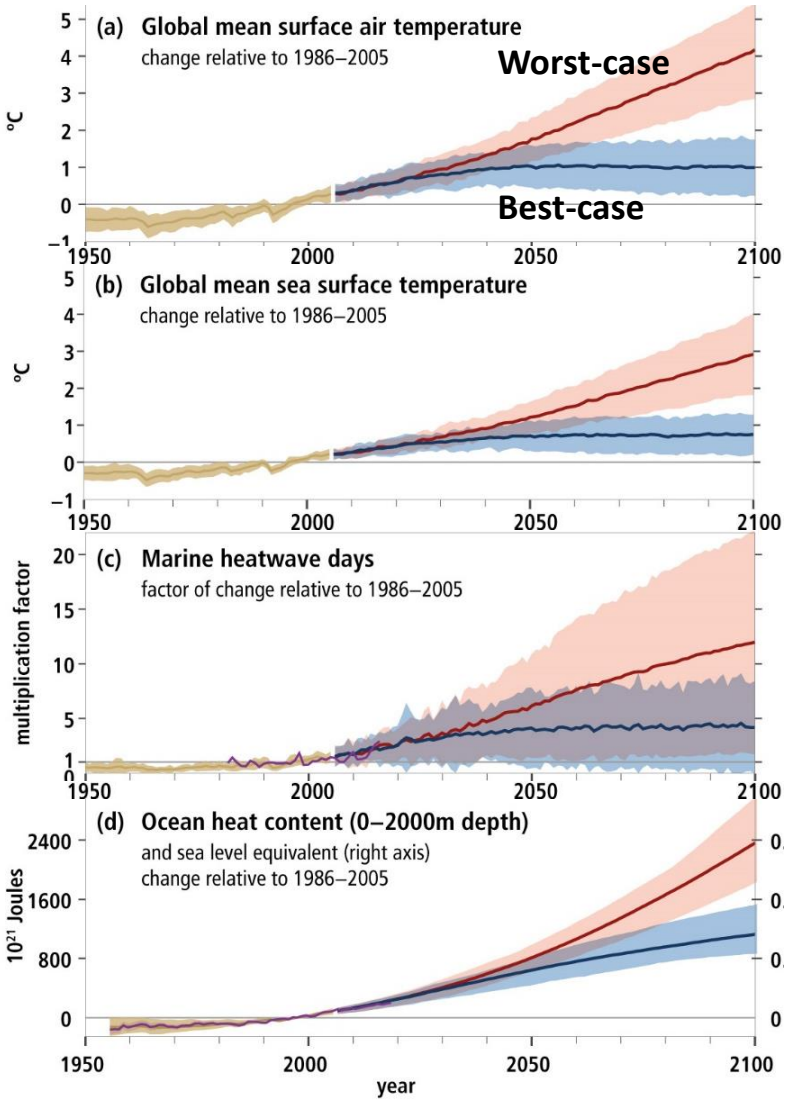


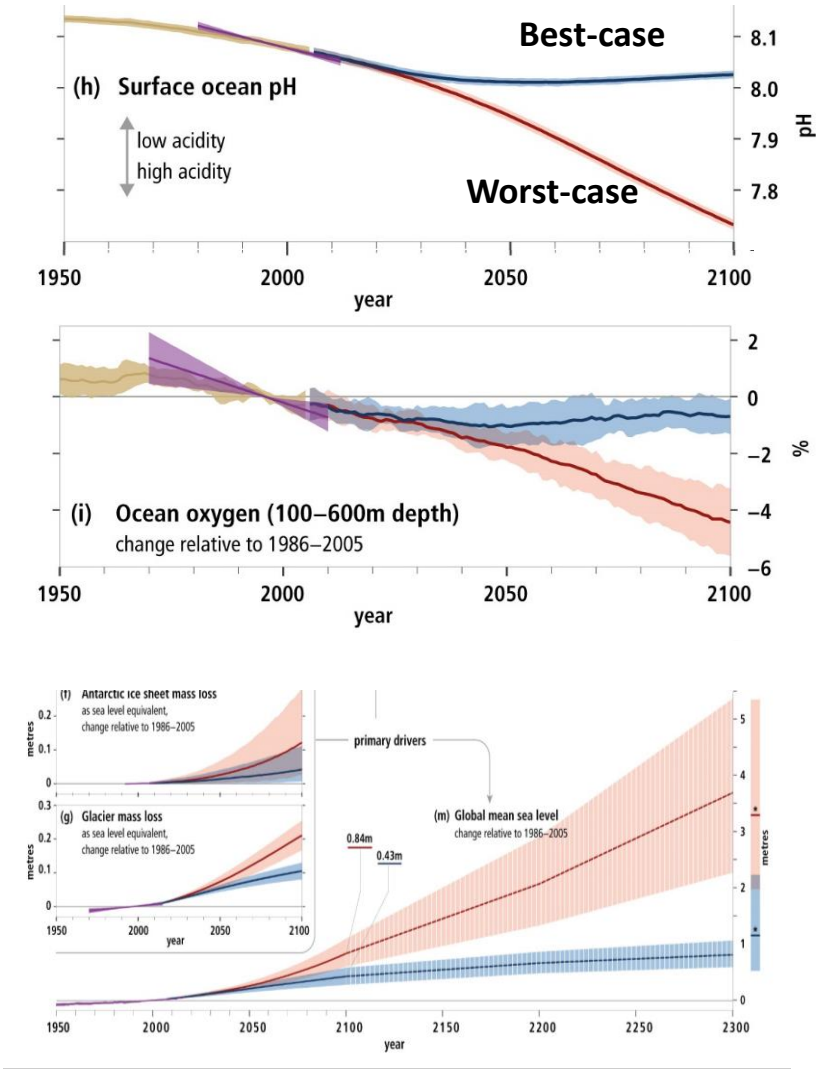
Global average land-sea surface temperature increase

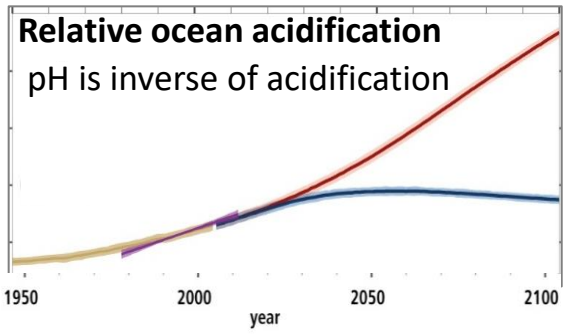
Sea surface temperature increase

Marine heatwaves (days)

Ocean heat content







Projected (RCP8.5)

Worst-case scenario current trajectory

Projected (RCP2.6)

Best-case scenario
Immediate (2020) rapid global emissions decline required for 1.5°C and 2°C limits by 2100

Figure SPM.1

IPCC 2019 Report: Cryosphere

From IPCC 2019 Special Report on the Ocean and Cryosphere in a Changing Climate

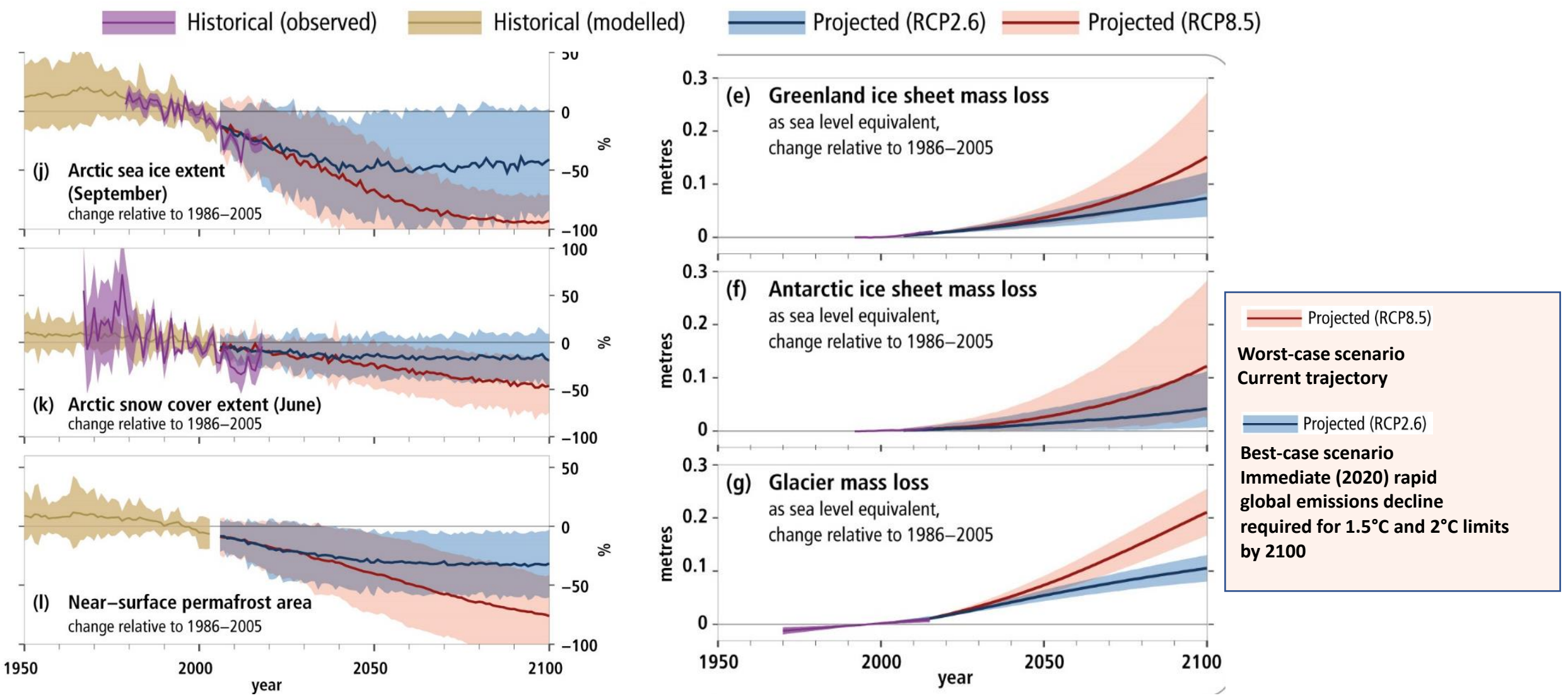


Figure SPM.1

Multiple Amplifying Feedback Runaway Risk

There are multiple very large sources of amplifying feedback

Within this century, magnitudes and rates of climate change associated with medium- to high-emission scenarios (RCP4.5, 6.0, and 8.5) [i.e. all but the best-case RCP2.6] **pose high risk of abrupt and irreversible regional-scale change in the composition, structure, and function of terrestrial and freshwater ecosystems, including wetlands.**

Examples that could lead to **substantial impact on climate** [i.e., amplifying feedback] are the boreal-tundra Arctic system and the Amazon forest. Carbon stored in the terrestrial biosphere (e.g., in peatlands, permafrost, and forests) is susceptible to loss to the atmosphere as a result of climate change, deforestation, and ecosystem degradation. Increased tree mortality and associated forest dieback is projected to occur in many regions over the 21st century, due to increased temperatures and drought. Forest dieback poses risks for carbon storage, biodiversity, ….

IPCC 2014 AR5, WG2, p. 15

THE ARCTIC HAS SWITCHED FROM CARBON SINK TO SOURCE

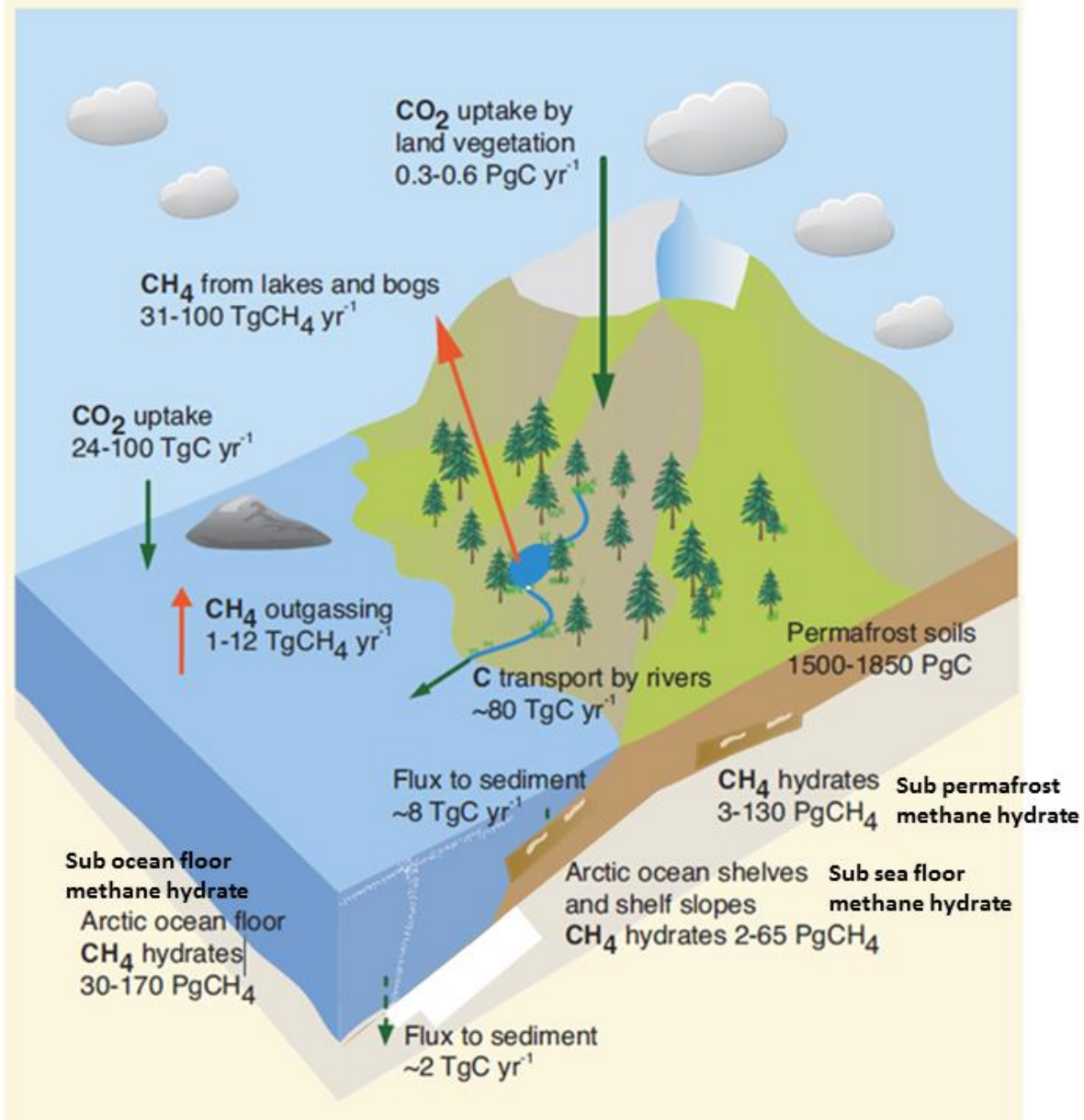
IPCC 2019 Ocean and Cryosphere Report SPM A 1.3
Permafrost temperatures have increased to record high levels. There is evidence for northern permafrost regions currently releasing additional net methane and CO2 due to thaw.

Arctic carbon

FIPCC AR5 WG1
FAQ 6.1, Figure 1 |
A simplified graph of current major carbon pools and flows in the Arctic domain, including permafrost on land, continental shelves and ocean.

(Adapted from McGuire et al., 2009; and Tarnocai et al., 2009.) TgC = 10_{12} gC, and PgC = 10_{15} gC.

(Petagram =1 billion metric tonnes)

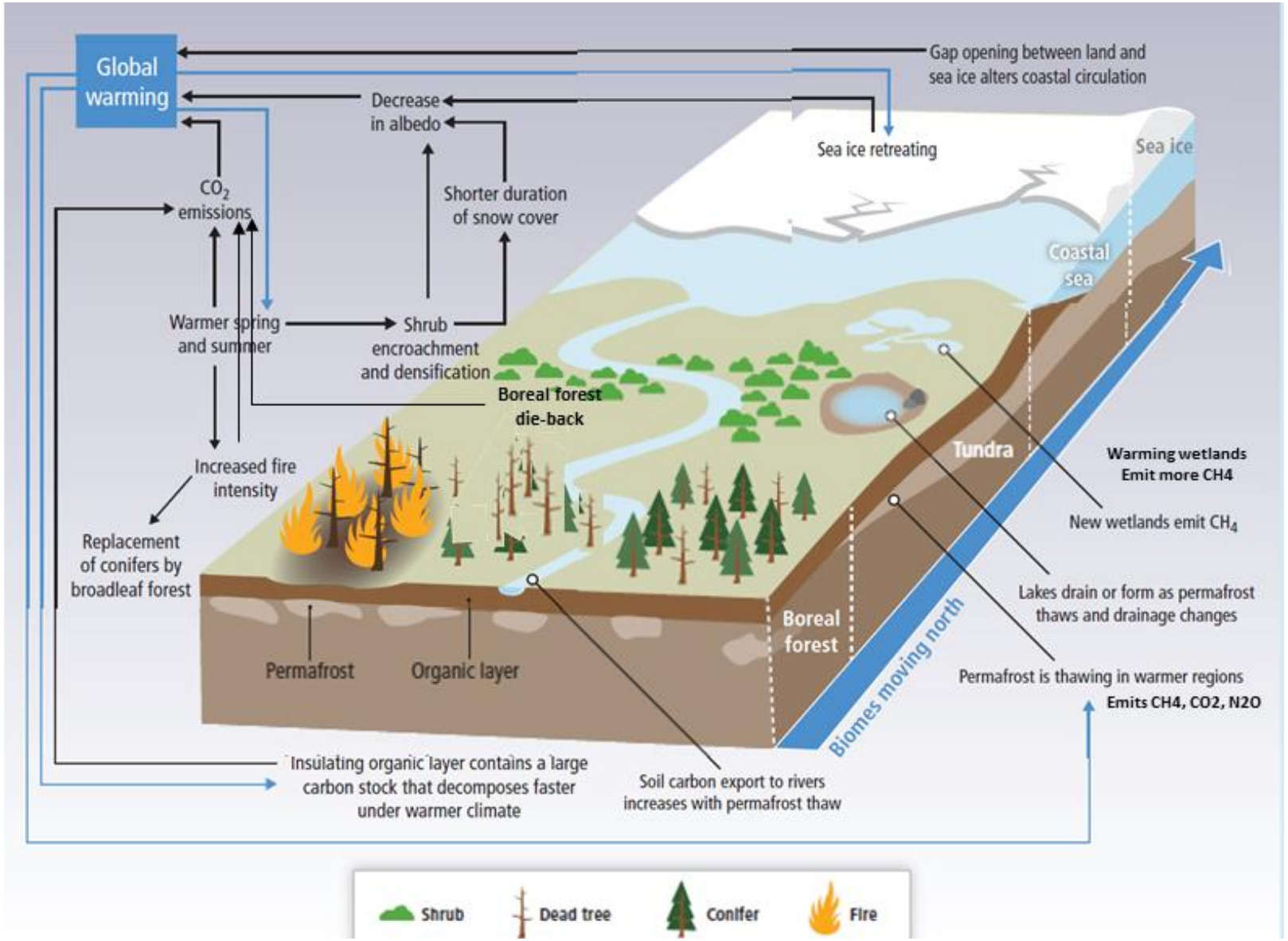


Sources of Arctic Amplifying Feedback (IPCC 2014 AR5)

Tundra–boreal biome shift

"… with net feedbacks to additional climate change."

Figure 4-10 | Tundra–boreal biome shift. Earth System Models predict a northward shift of Arctic vegetation with climate warming, as the boreal biome migrates into what is currently tundra. Observations of shrub expansion in tundra, increased tree growth at the tundra–forest transition, and tree mortality at the southern extent of the boreal forest in recent decades are consistent with model projections. Vegetation changes associated with a biome shift, which is facilitated by intensification of the fire regime, will modify surface energy budgets, and net ecosystem carbon balance, permafrost thawing, and methane emissions, with net feedbacks to additional climate change.



PERMAFROST FEEDBACK 1.4°C by 2100
"Until the year 2100, up to 250 PgC could be released as CO2, and up to 5 Pg as CH4. That corresponds to a further 100 PgC of equivalent CO2." (AR5 WG1 FAQ 6.1
[so 350PgC and about 1.4°C]

Amazon Die-back Tipping Point

Box 4-3 | ***A Possible Amazon Basin Tipping Point … potential of a large-scale, climate-driven, self-reinforcing transition of Amazon forests to a dry stable state (known as the Amazon "forest dieback"). Field studies and regional observations have provided new evidence of critical ecological thresholds and positive feedbacks between climate change and land use activities that could drive a fire-mediated, self-reinforcing dieback during the next few decades (Figure 4-8). There is now medium confidence (medium evidence, high agreement) that severe drought episodes, land use, and fire interact synergistically to drive the transition of mature Amazon forests to low-biomass, low statured fire-adapted woody vegetation.***

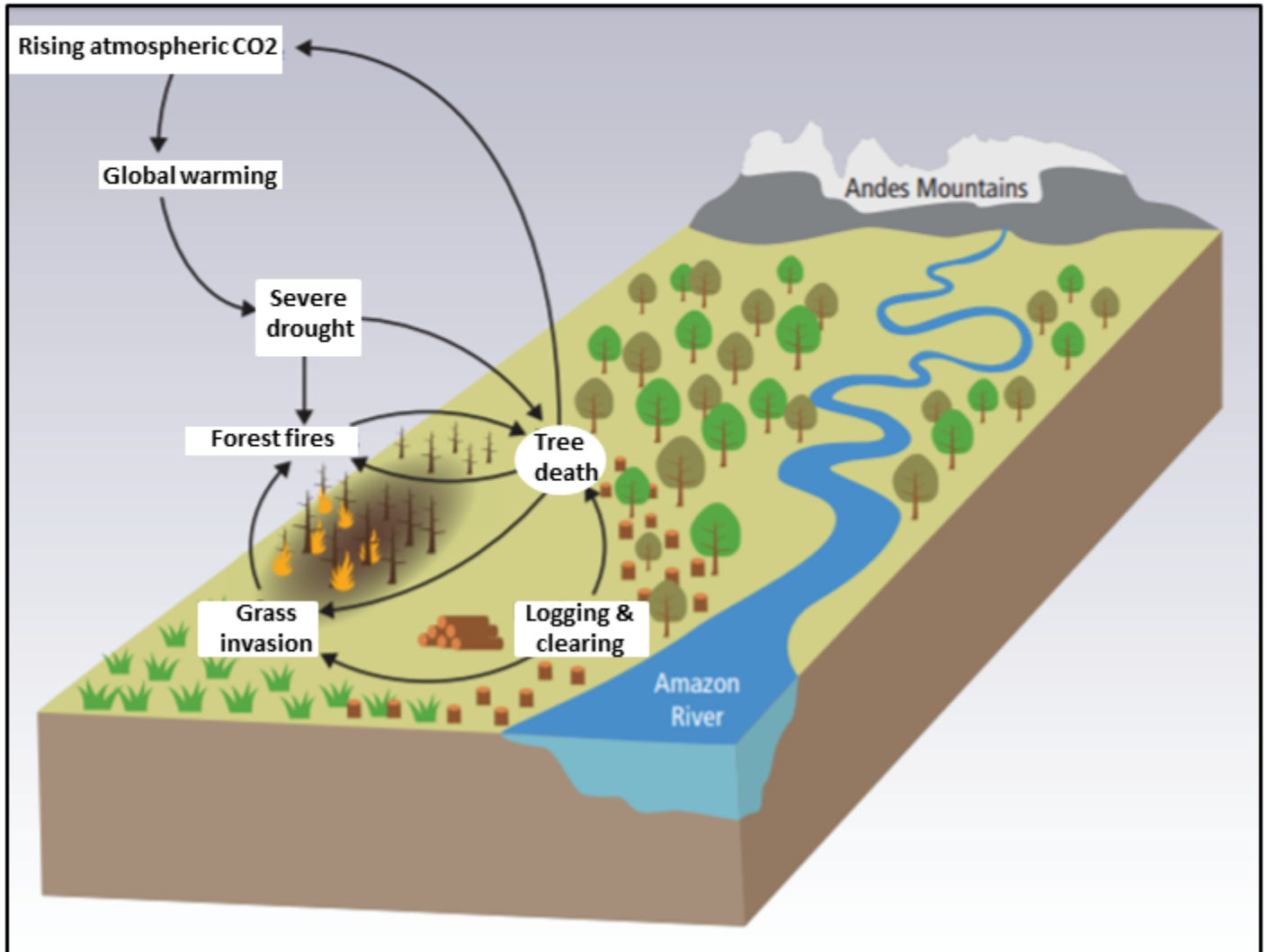


Figure 4-8 | ***The forests of the Amazon Basin are being altered through severe droughts, land use (deforestation, logging), and increased frequencies of forest fire. Some of these processes are self-reinforcing through positive feedbacks, and create the potential for a large-scale tipping point. Climate change contributes to this tipping point by increasing drought severity, reducing rainfall and raising air temperatures***

IPCC 2014 AR5, WG 2, Ch. 4, Box 4.3