SCIENCE FORUM 2018

CGIAR

Independent Science and Partnership Council

STELLENBOSCH, SOUTH AFRICA
10 - 12 OCTOBER, 2018

Win more, lose less:

Capturing synergies between SDGs through agricultural research

SDG interactions and agricultural research

Challenges & Opportunities

Jean-Pascal van Ypersele
Twitter: @JPvanYpersele

Université catholique de Louvain, (Belgium)
Former IPCC Vice-Chair (2008--2015)
Member of the GSDR 2019 author team

Plan

- **Where do I speak from?**
- **Climate situation and IPCC Special Report on 1.5C warming**
- **SDG interactions**
- **Maximizing synergies, minimizing trade-offs: Role of agricultural research**
- **Conclusions**

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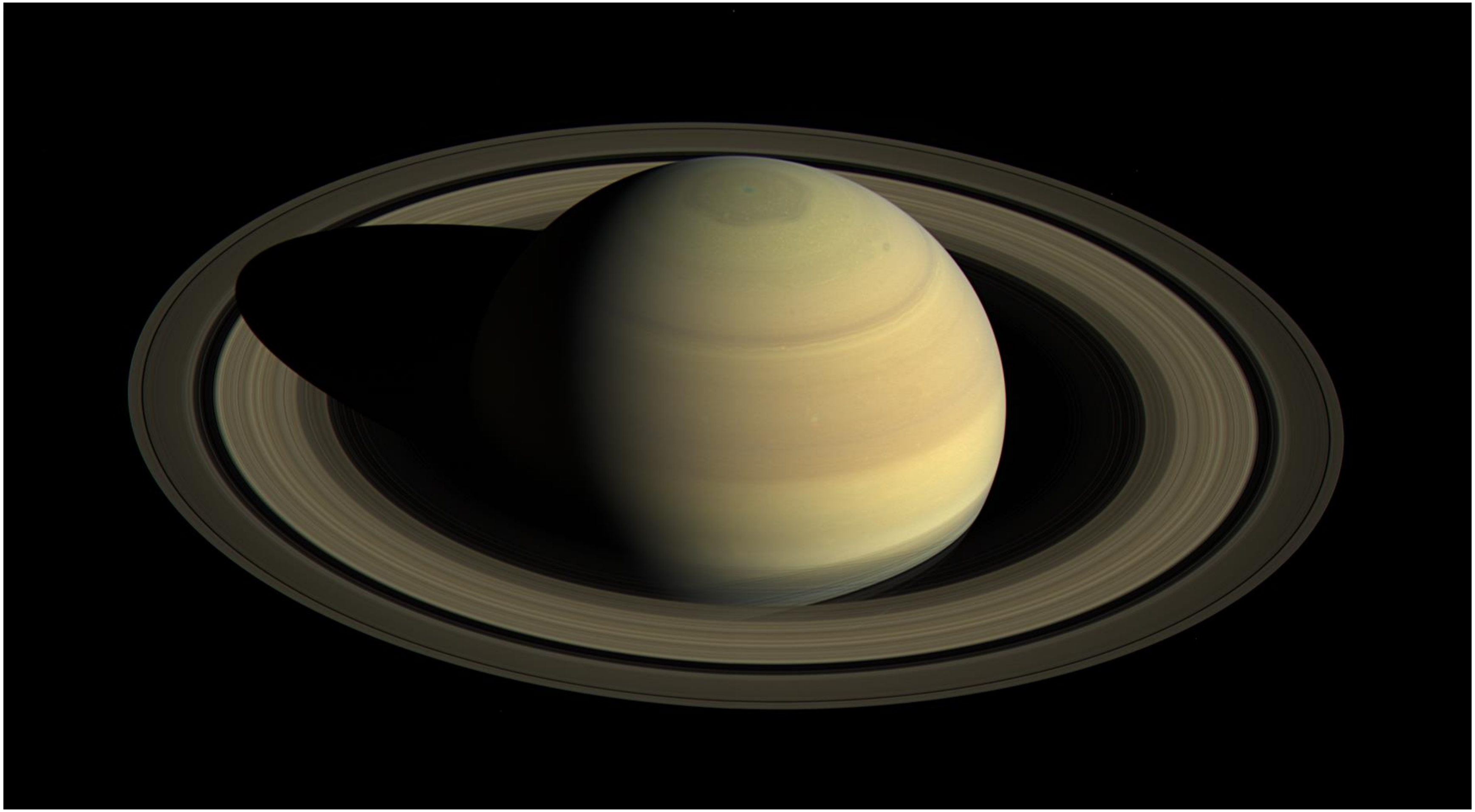
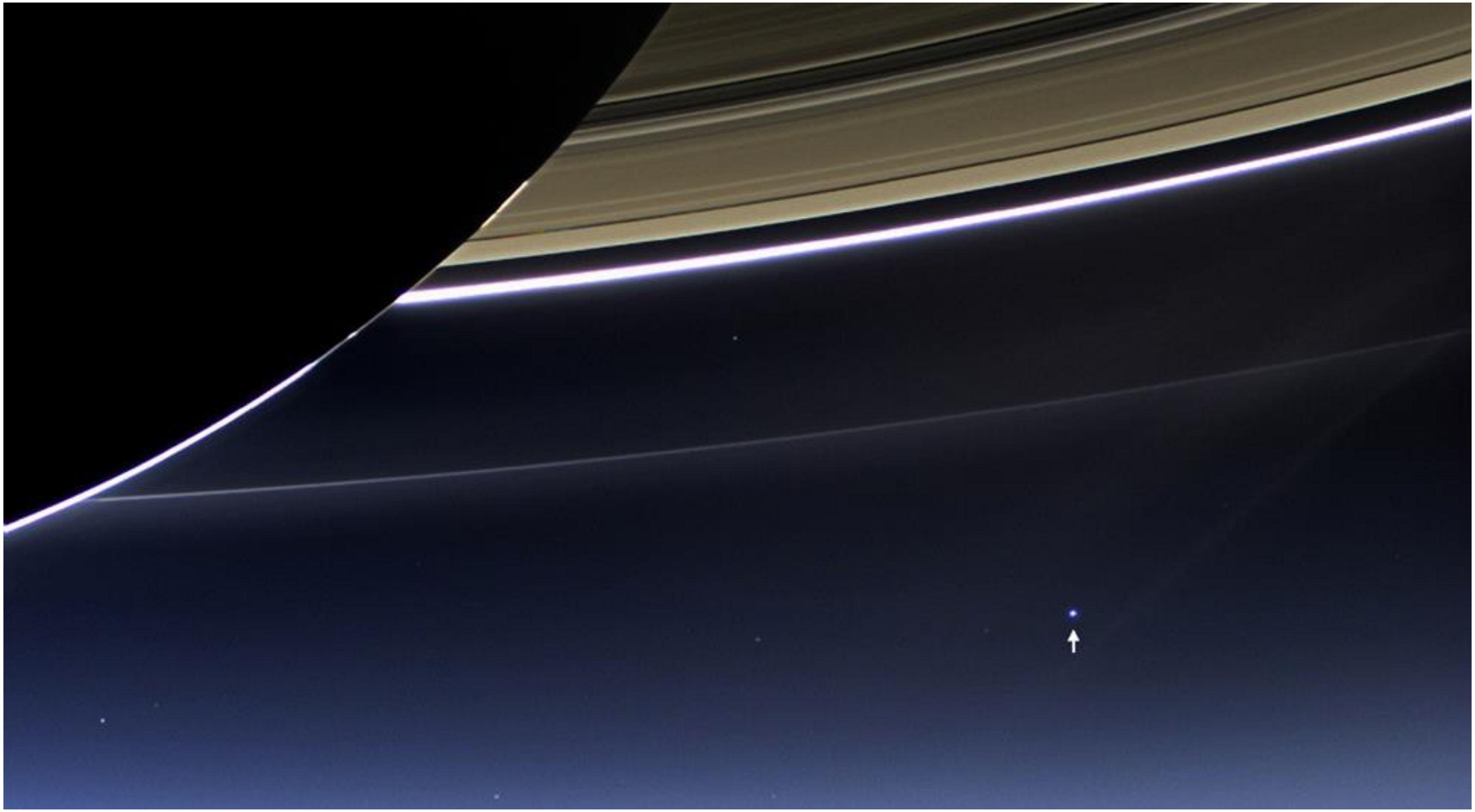
Where do I speak from?

Twitter: @JPvanYpersele

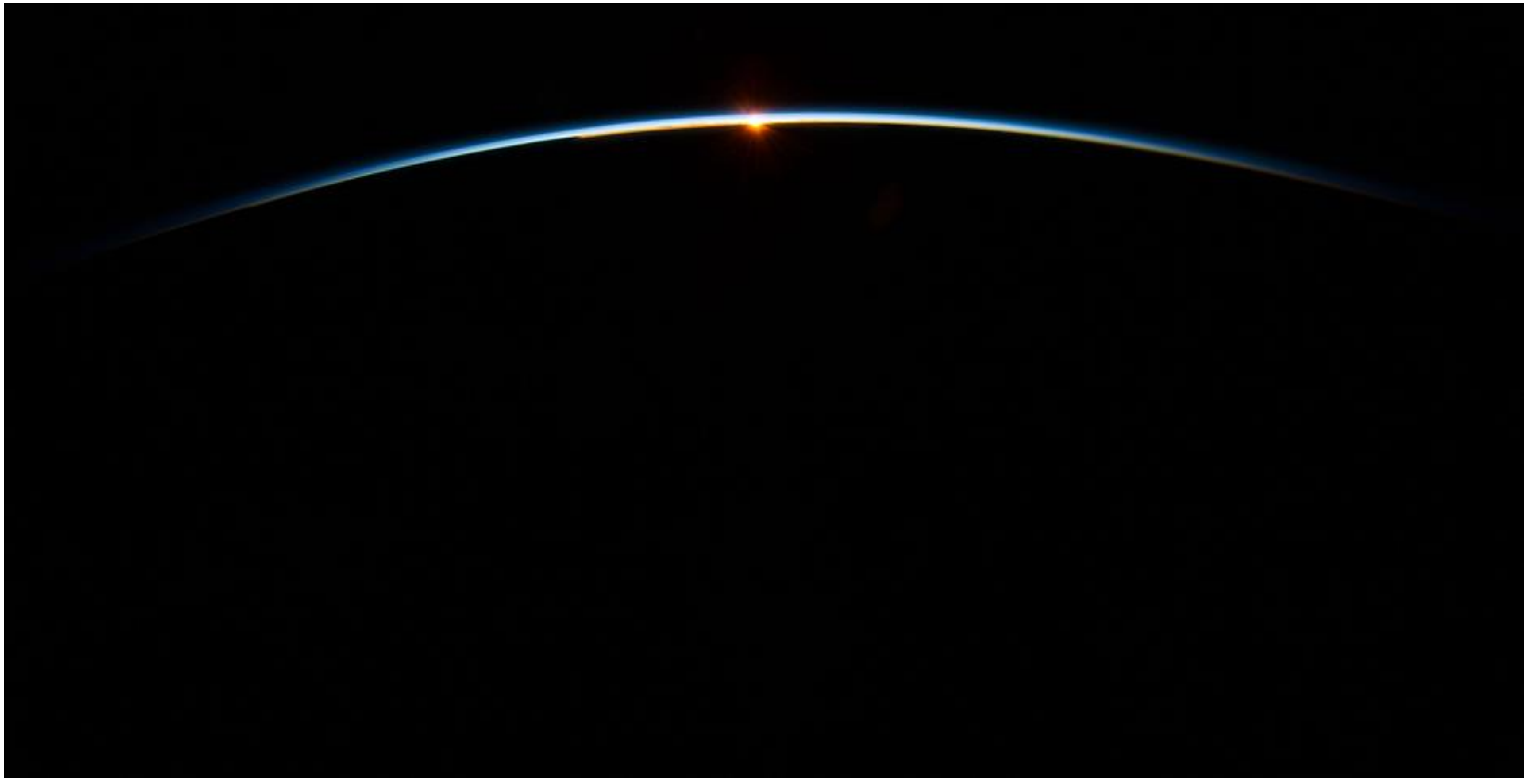
Saturn, as seen on 25-4-2016 from a 3 million km distance by the Cassini satellite launched in October 1997, 40 years after Sputnik



That small blue dot is the Earth, a seen from Cassini, orbiting Saturn, 1.44 billion km from us, on 19-7-2013



Our atmosphere is thin and fragile (as seen by ISS crew on 31 July 2013)



Jean-Pascal van Ypersele
(vanyp@climate.be)

Let us think about the future of these children from Machakos (Kenya) in a warming climate

@JPvanYpersele
April 2015

Short CV

- Physicist, MSc (1980) & Ph.D.(1986) on effect of CO_2-induced warming on climate
- Passion for « humanity-relevant » science
- Rio 1992, as Belgian Council for Sustainable Development representative, then science advisor at all UNFCCC COPs
- IPCC since 1995, Vice-Chair 2008-2015
- Co-author Global Sustainable Development Report 2019

Why the IPCC ?

Established by WMO and UNEP in 1988

to provide **policy-makers** with an **objective source of information** about

- causes of climate change,
- potential environmental and socio-economic impacts,
- possible response options (adaptation & mitigation).

WMO=World Meteorological Organization
UNEP= United Nations Environment Programme

Global Sustainable Development Report (GSDR) 2019 drafted by the Group of 15 independent scientists

Mandate agreed by UN Member States in July 2016

- The GSDR is one important component of the
  - **follow-up and review process** for the 2030 Agenda for Sustainable Development
-
- The GSDR will **inform the UN High-Level Political Forum**
  - **(HLPF)**, and shall strengthen the science-policy interface and provide a strong evidence-based instrument to support policymakers in promoting poverty eradication and sustainable development
- The report will be **available for a wide range of stakeholders**,
  - including business and civil society as well as the wide public

Scope of the report

- Guidance on the **state of global sustainable development**
  - from a scientific perspective, which will help address the implementation of the 2030 Agenda,
  - provide **lessons learned**, while focusing on challenges, address new and **emerging issues** and highlight emerging **trends and actions.**

- An **integrated approach and examine policy options**
  - with a view to sustaining the balance between the **three dimensions** of sustainable development. These policy options should be **in line with the 2030 Agenda** to inform its implementation

- Case studies with **regional** dimension, as well as **countries in special situations**

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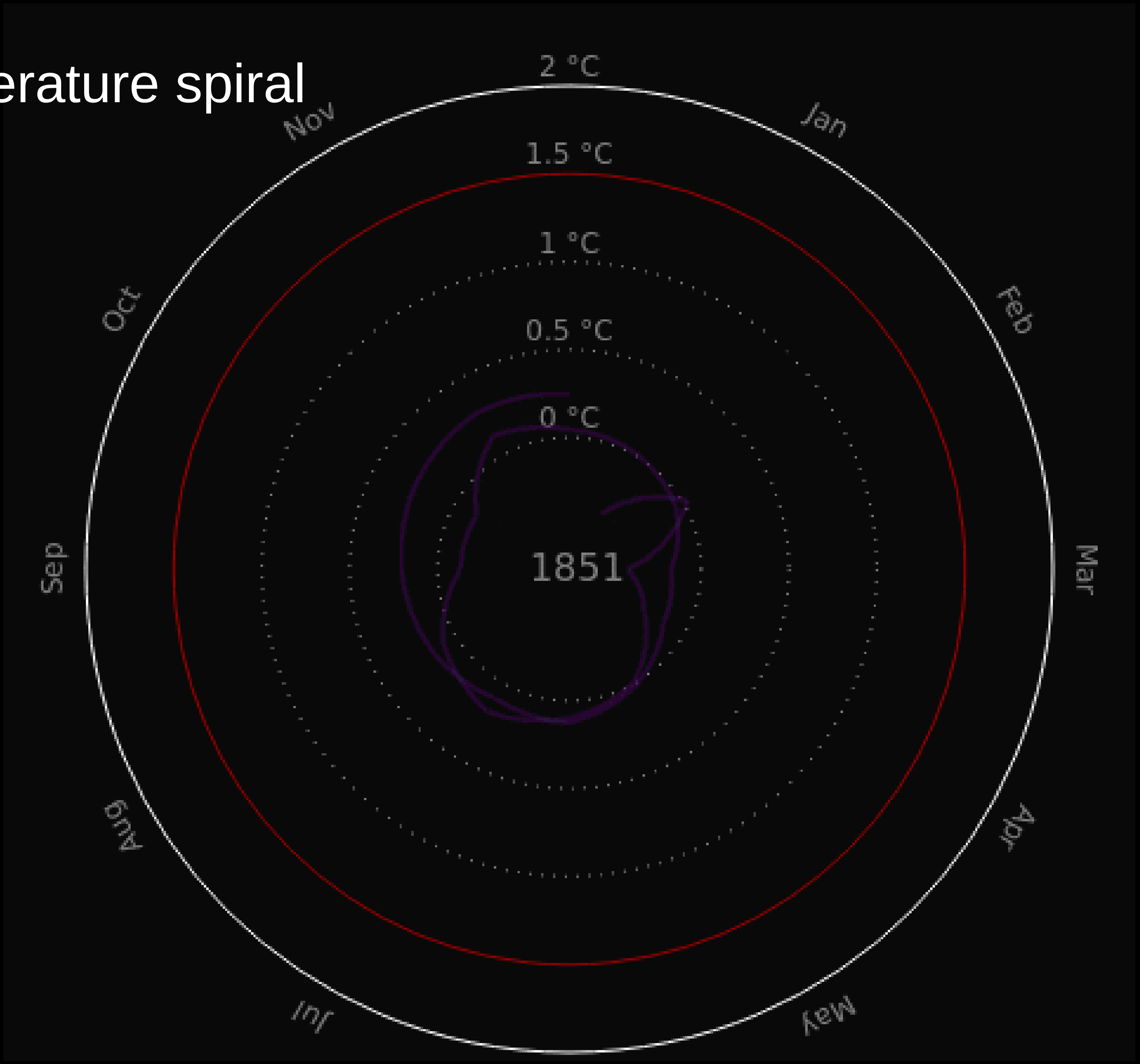
Climate situation and IPCC Special Report on 1.5C warming

Twitter: @JPvanYpersele

Temperature spiral

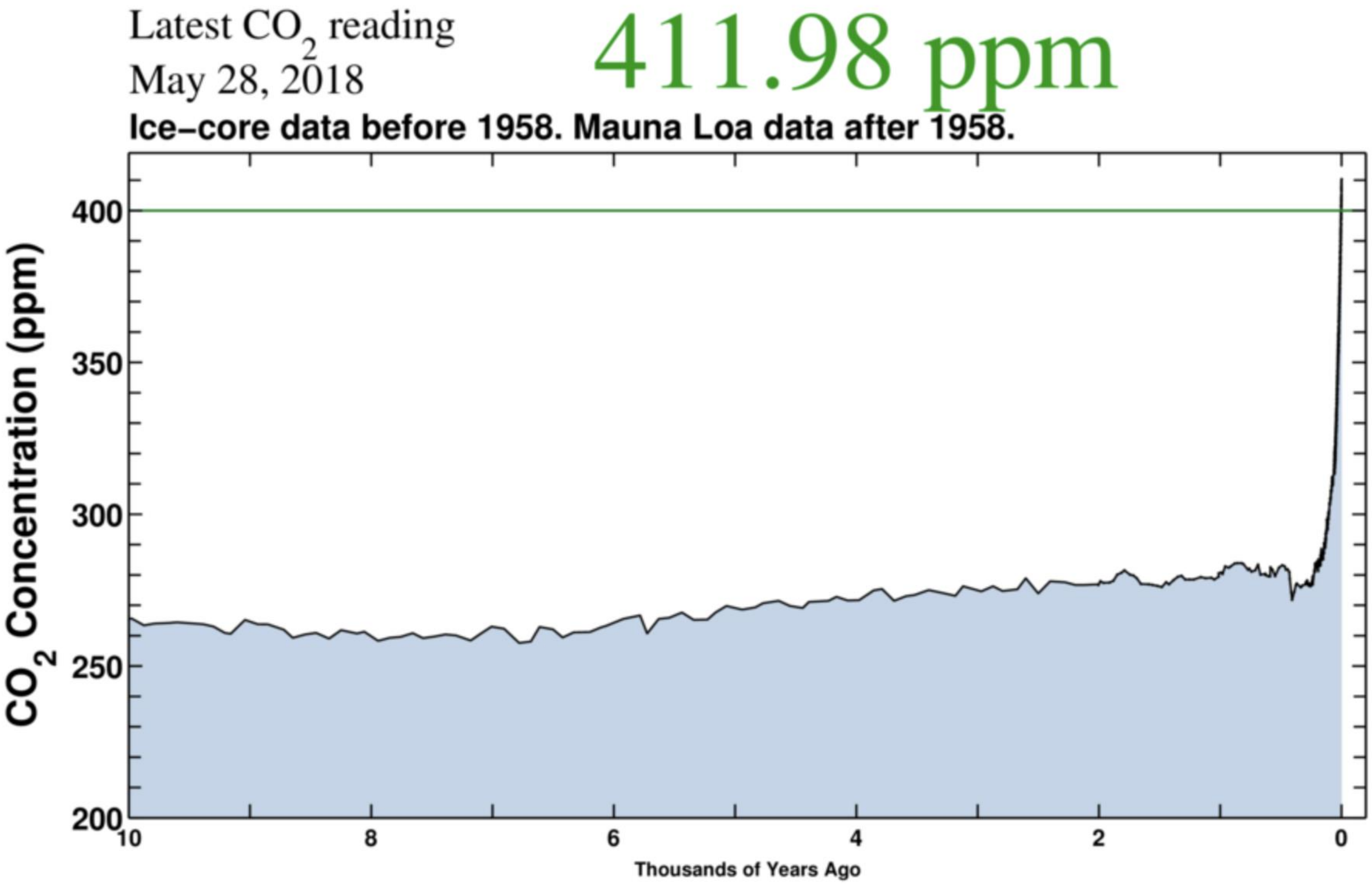


Global Mean Temperature in °C relative to 1850 – 1900
Graph: Ed Hawkins (Climate Lab Book) – Data: HadCRUT4 global temperature dataset
Available on http://openclimatedata.net/climate-spirals/temperature

Since 1950, extreme hot days and heavy precipitation have become more common

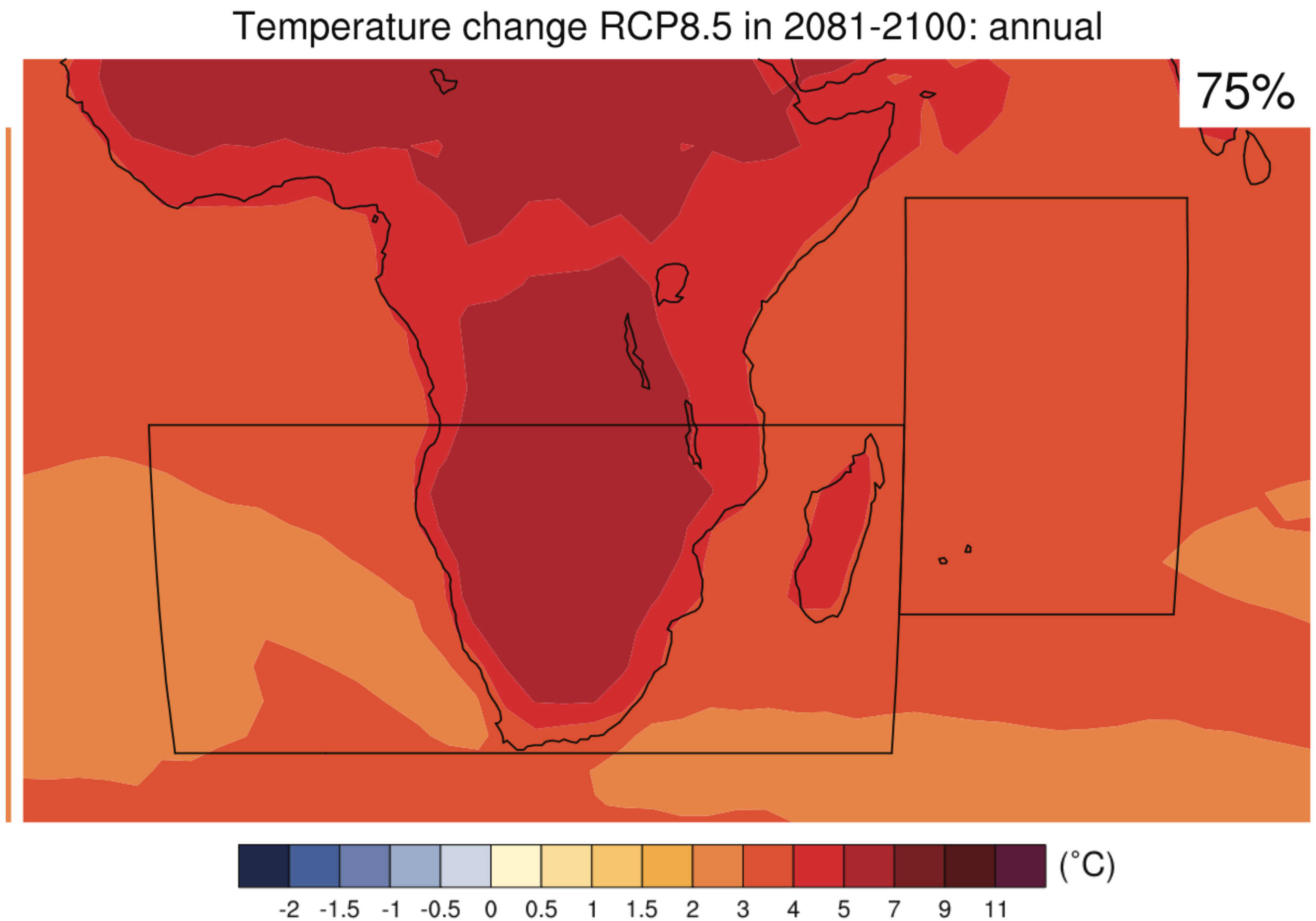
There is evidence that anthropogenic influences, including increasing atmospheric greenhouse gas concentrations, have changed these extremes

CO_2 Concentration, 28 May 2018 (Keeling curve)



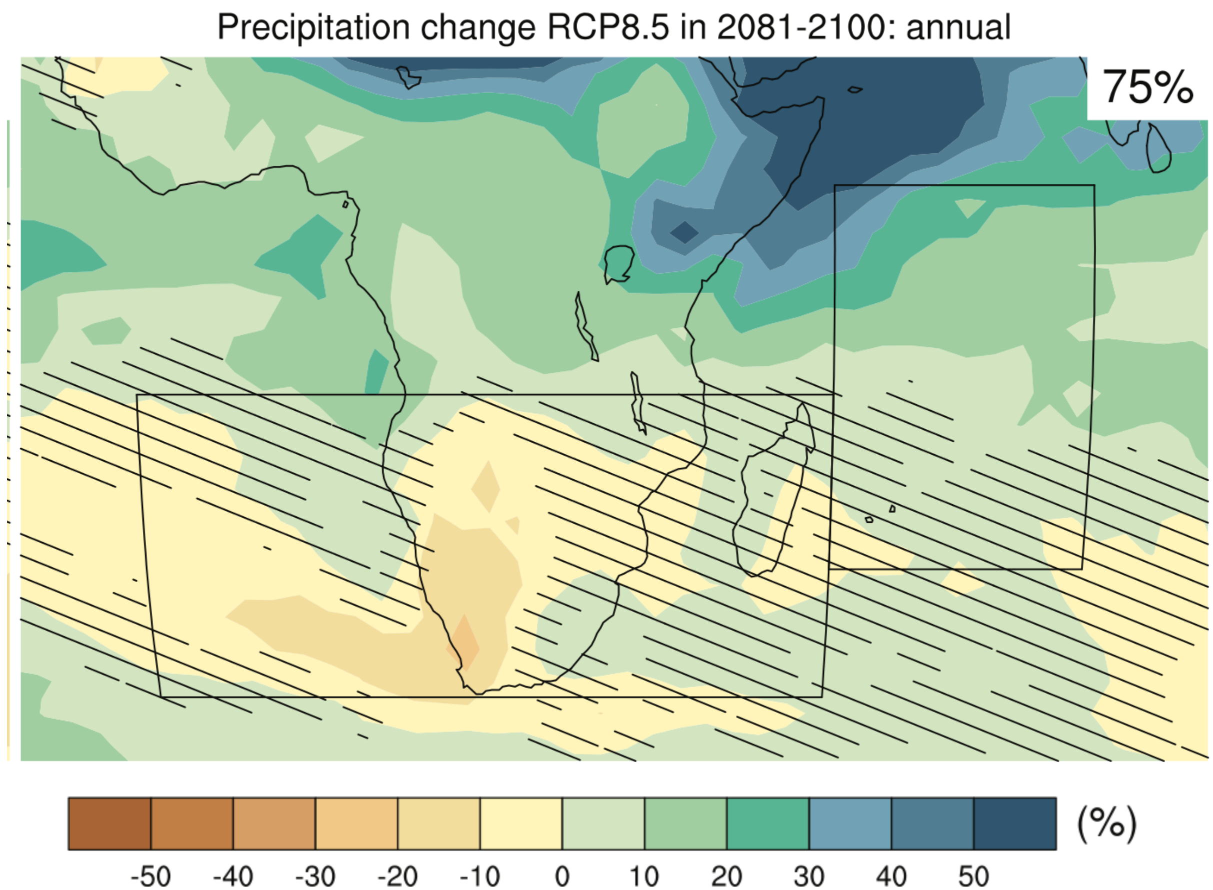
Source: scripps.ucsd.edu/programs/keelingcurve/

Map of temperature changes in 2081–2100 , with respect to 1986–2005 in the RCP8.5 scenario



IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

Map of precipitation changes in 2081–2100, with respect to 1986–2005 in the RCP8.5 scenario

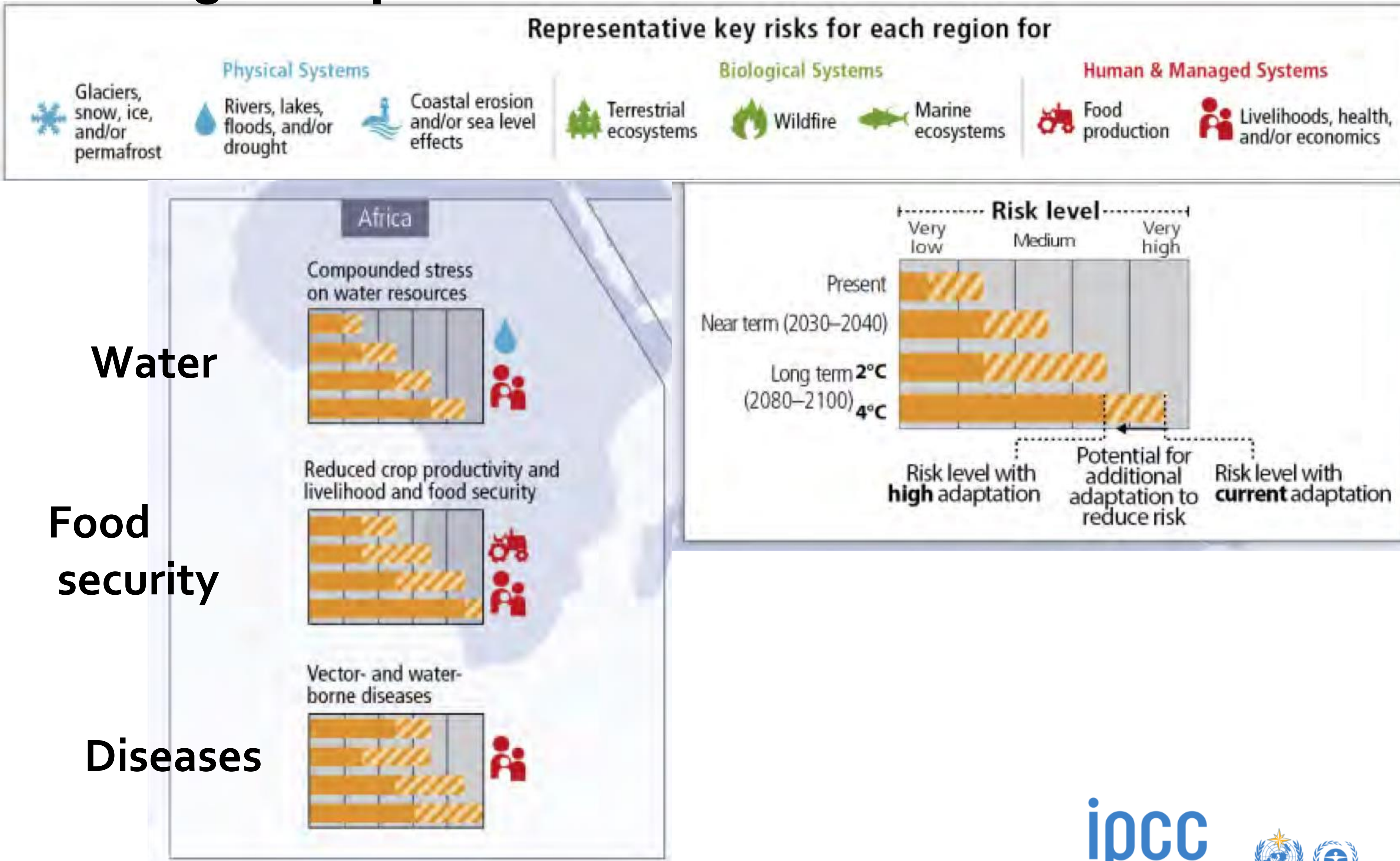


Regions where the projected change is less than one standard deviation of the natural internal variability

Regions where the projected change is large compared to natural internal variability, and where at least 90% of models agree on a sign of change

IPCC, WGI, Annex I: Atlas of Global and Regional Climate Projections Supplementary Material RCP8.5

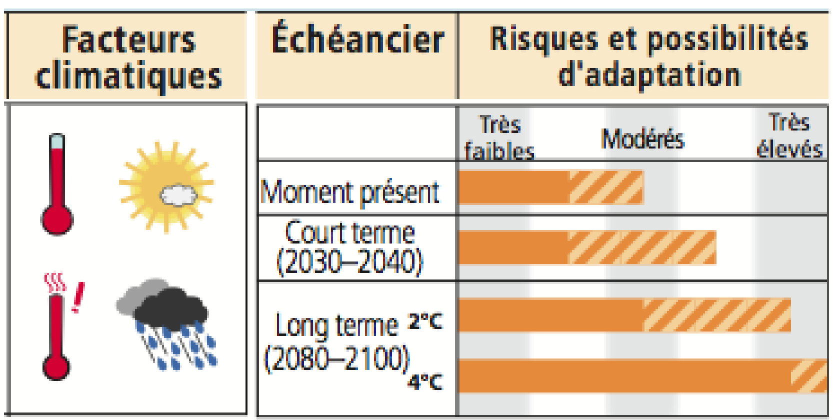
Regional key risks and risk reduction through adaptation

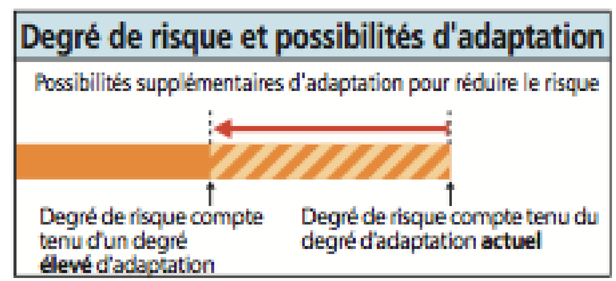


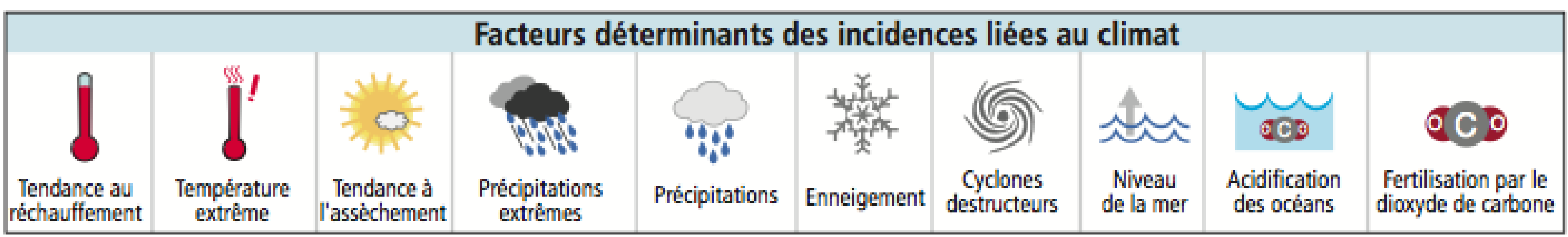
IPCC, AR5, SPM, Figure SPM.8

Major climate risk for Africa: Agriculture

Lower agricultural yields due to heat and drought – with potentially serious consequences for food safety at all levels — and damages to food system infrastructure due to pests, diseases, and floods (*high degree of confidence)*

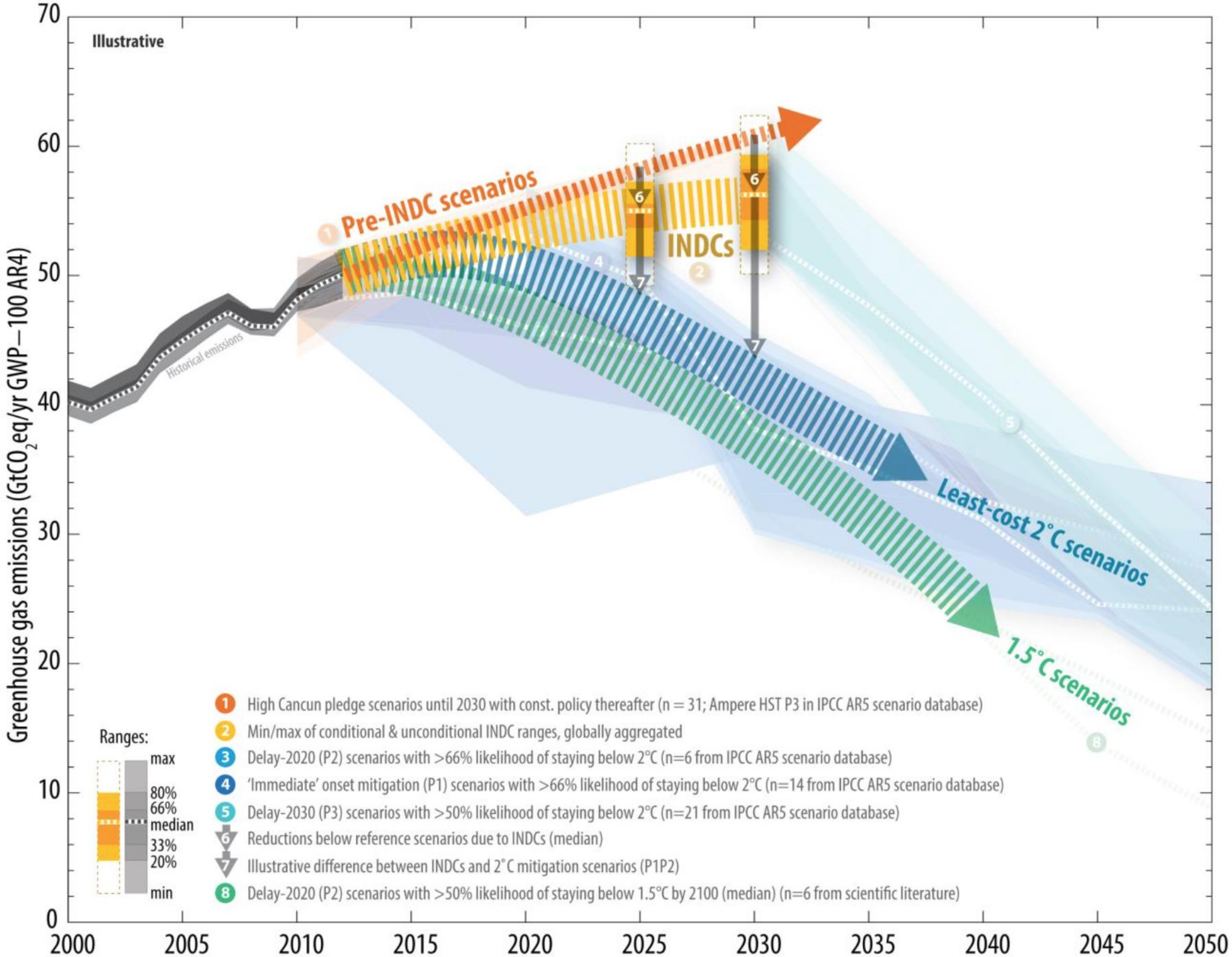






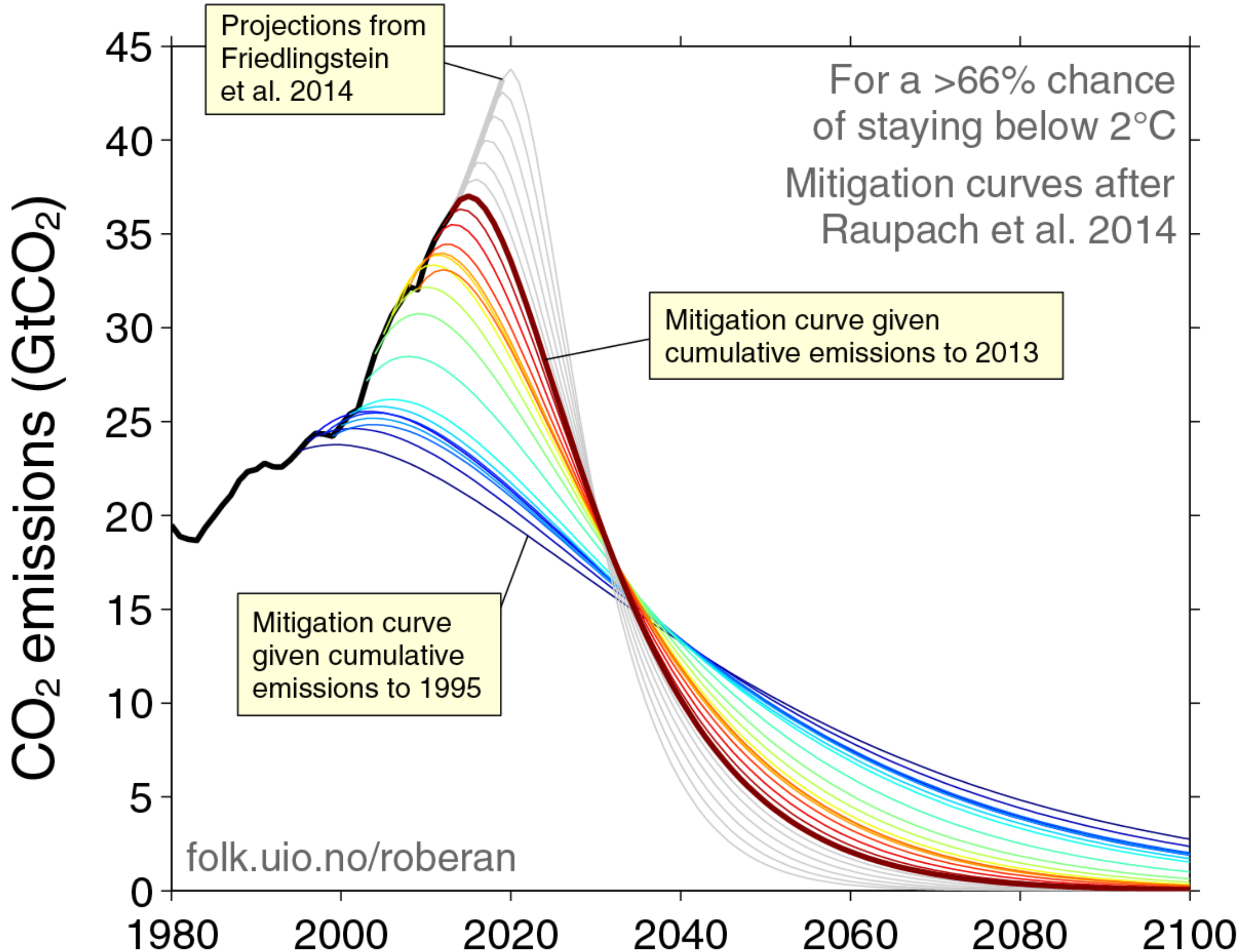
IPCC, AR5, GT II, RID, p. 21

Comparison of global emission levels in 2025 and 2030 resulting from the implementation of the intended nationally determined contributions



UNFCCC, Aggregate effect of the intended nationally determined contributions: an update
http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf

Limiting warming becomes much more difficult when the peak happens later



Source and details:

http://folk.uio.no/roberan/t/global_mitigation_curves.shtml

Risk = Hazard x Vulnerability x Exposure (Katrina flood victim, New Orleans, 2005)

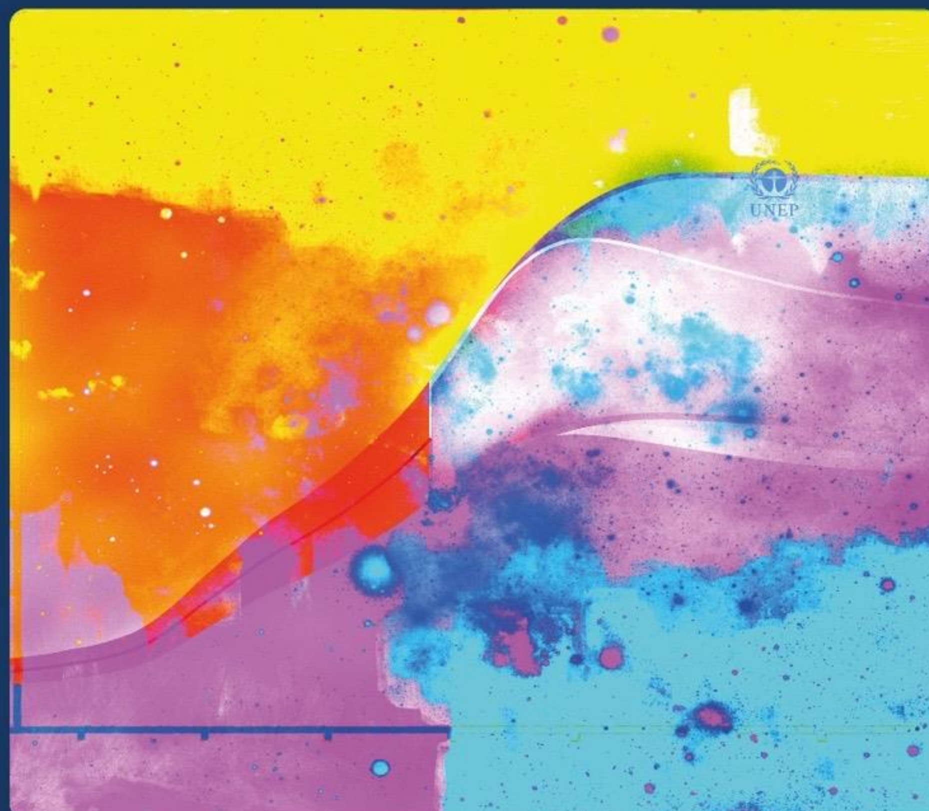
AP Photo - Lisa Krantz (http://lisakrantz.com/hurricane-katrina/zspbn1k4cn17phidupe4f9x5t1mzdr) ipcc

INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Global Warming of 1.5°C

An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.



The report in numbers

91 Authors from **40** Countries

133 Contributing authors

6000 Studies

1 113 Reviewers

42 001 Comments

Understanding Global Warming of 1.5° C

Where are we now?

Since preindustrial times, human activities have caused approximately 1.0° C of global warming.

- Already seeing consequences for people, nature and livelihoods
- At current rate, would reach 1.5° C between 2030 and 2052
- Past emissions alone do not commit the world to 1.5° C

Projected Climate Change, Potential Impacts and Associated Risks

Impacts of global warming 1.5° C

At 1.5° C compared to 2° C:

- Less extreme weather where people live, including extreme heat and rainfall
- Lower risk to fisheries & the livelihoods that depend on them
- By 2100, global mean sea level rise will be around 10 cm lower
- Up to several hundred million fewer people exposed to climate-related risk and susceptible to poverty by 2050
- Global population exposed to water shortages up to 50% less
- 10 million fewer people exposed to risk of rising seas

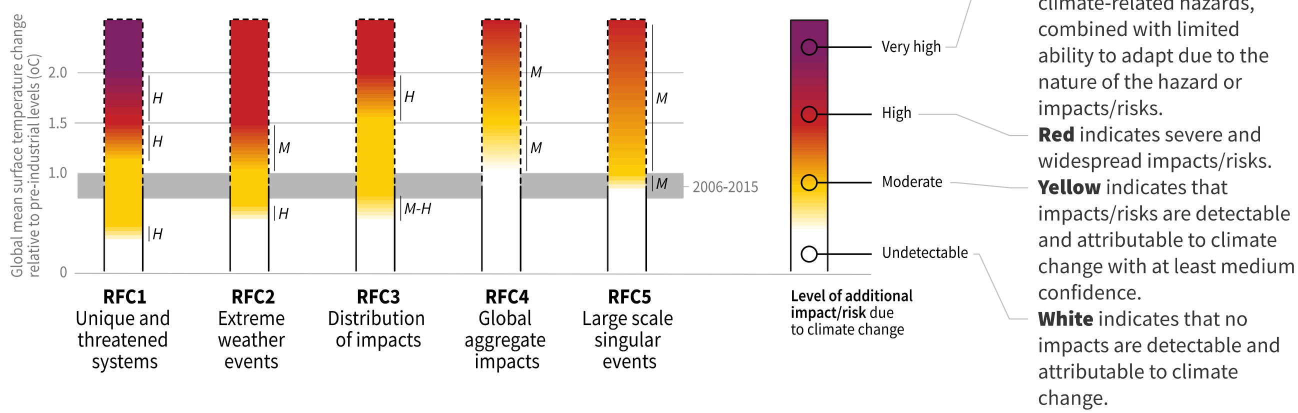
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

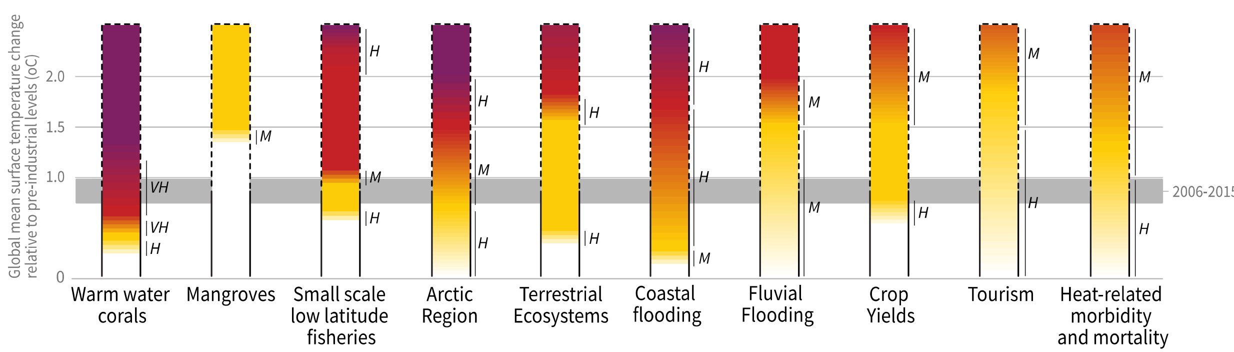
How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.

Impacts and risks associated with the Reasons for Concern (RFCs)



Impacts and risks for selected natural, managed and human systems



Confidence level for transition: *L*=Low, *M*=Medium, *H*=High and *VH*=Very high

Source: IPCC Special Report on Global Warming of 1.5°C

How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

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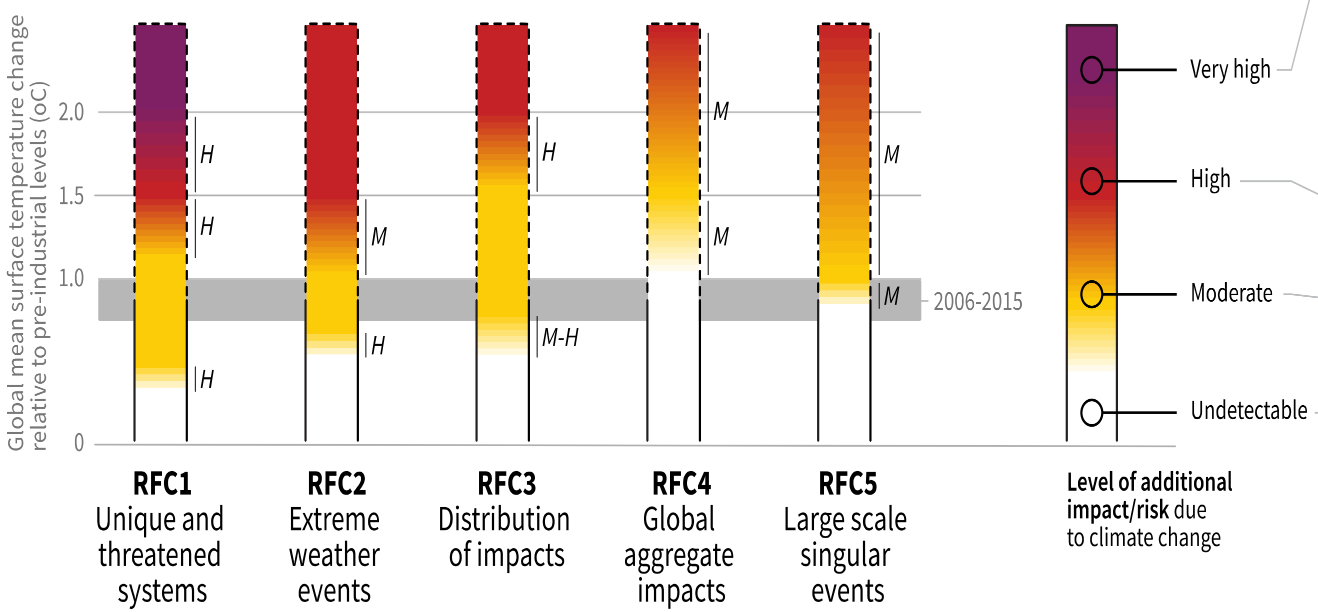


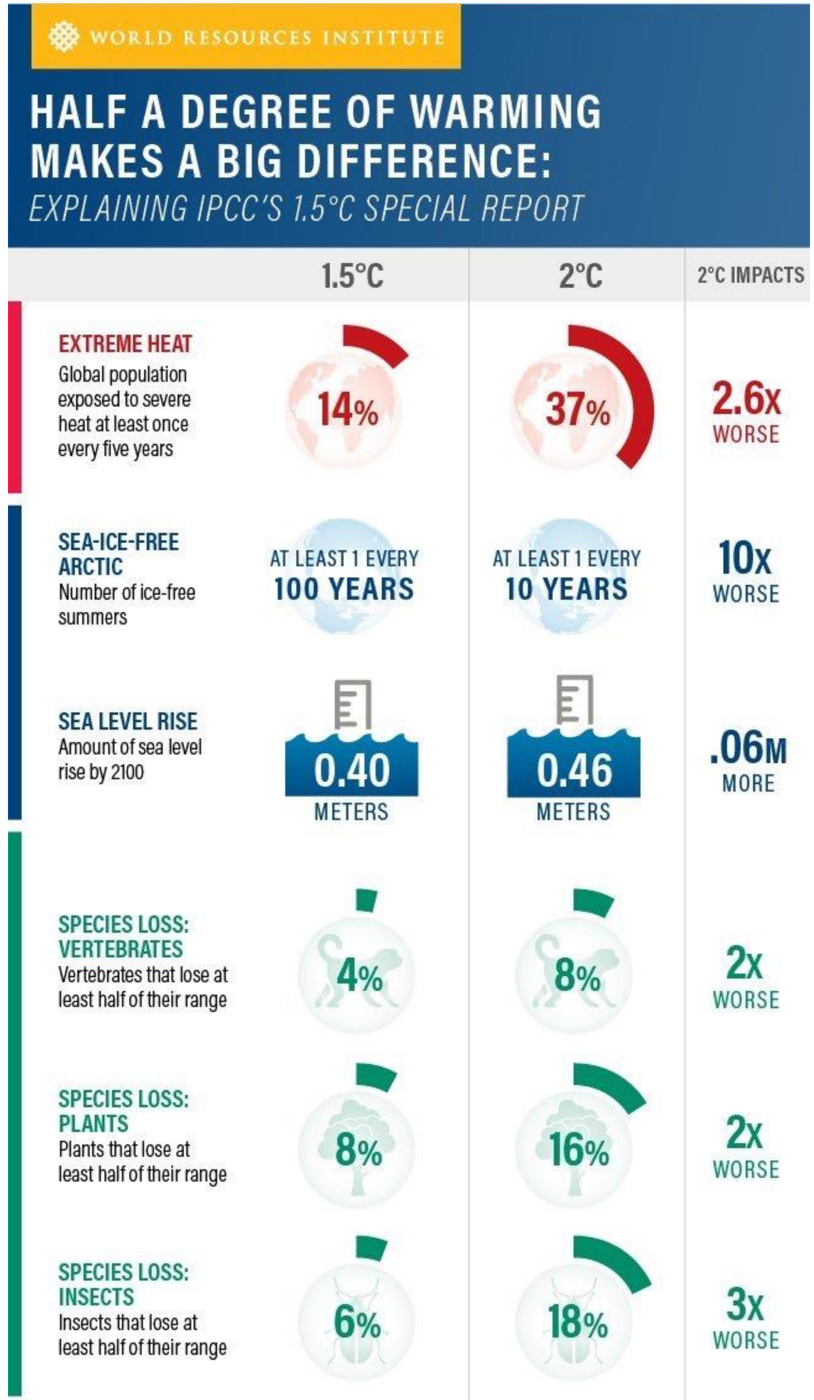
Purple indicates very high risks of severe impacts/risks and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks.

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.

Responsibility for content: WRI



Responsibility for content: WRI

Responsibility for content: WRI

IPCC SR15: Impacts on biodiversity

- B3.1 Of 105,000 species studied,

6% of insects, 8% of plants and 4% of vertebrates are projected **to lose over half** of their climatically determined geographic range for global warming of **1.5°C**,

compared with:

18% of insects, 16% of plants and 8% of vertebrates for global warming of **2°C** (medium confidence).

IPCC SR15: Increasing climate-related risks

- B5. Climate-related **risks** to health, livelihoods, **food** security, water supply, human security, and economic growth are projected to **increase with global warming of 1.5°C** and increase further with 2°C.
- B5.1 **Limiting global warming to 1.5°C**, compared with 2°C, **could reduce the number of people both exposed** to climate-related risks and susceptible to poverty **by up to several hundred million by 2050** (medium confidence).

IPCC SR15: Impacts on agriculture

- B5.3 Limiting warming to 1.5°C, compared with 2ºC, is projected to result in smaller net reductions in **yields of maize, rice, wheat,** and potentially other cereal crops, particularly in sub-Saharan Africa, Southeast Asia, and Central and South America; and in the CO2 dependent, and in the **nutritional quality of rice and wheat** (high confidence). **Reductions in projected food availability are larger at 2ºC** than at 1.5°C of global warming **in the Sahel, southern Africa, the Mediterranean, central Europe, and the Amazon** (medium confidence). **Livestock are projected to be adversely affected** with rising temperatures, depending on the extent of changes in feed quality, spread of diseases, and water resource availability (high confidence).

IPCC SR15: Compound risks

- B5.6 Exposure to multiple and compound climate-related risks increases between 1.5°C and 2°C of global warming, with **greater proportions of people both so exposed and susceptible to poverty in Africa and Asia** (high confidence). For global warming from 1.5°C to 2°C, **risks across energy, food, and water sectors could overlap spatially and temporally**, creating new and exacerbating current hazards, exposures, and vulnerabilities that could affect increasing numbers of people and regions (medium confidence)

Adaptation

- B6.2 Adaptation is expected to be **more challenging for ecosystems, food** and health systems **at 2°C** of global warming than for 1.5°C (medium confidence).
- Some **vulnerable regions**, including small islands and Least Developed Countries, are projected to experience high **multiple interrelated climate risks even at global warming of 1.5°C** (high confidence).

Emission Pathways and System Transitions Consistent with 1.5° C Global Warming

INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Greenhouse gas emissions pathways

- To limit warming to 1.5° C, CO_2 emissions fall by about 45% by 2030 (from 2010 levels)
    - Compared to 20% for 2° C
- To limit warming to 1.5° C, CO_2 emissions would need to reach 'net zero' around 2050
    - Compared to around 2075 for 2° C
- Reducing non-CO_2 emissions would have direct and immediate health benefits

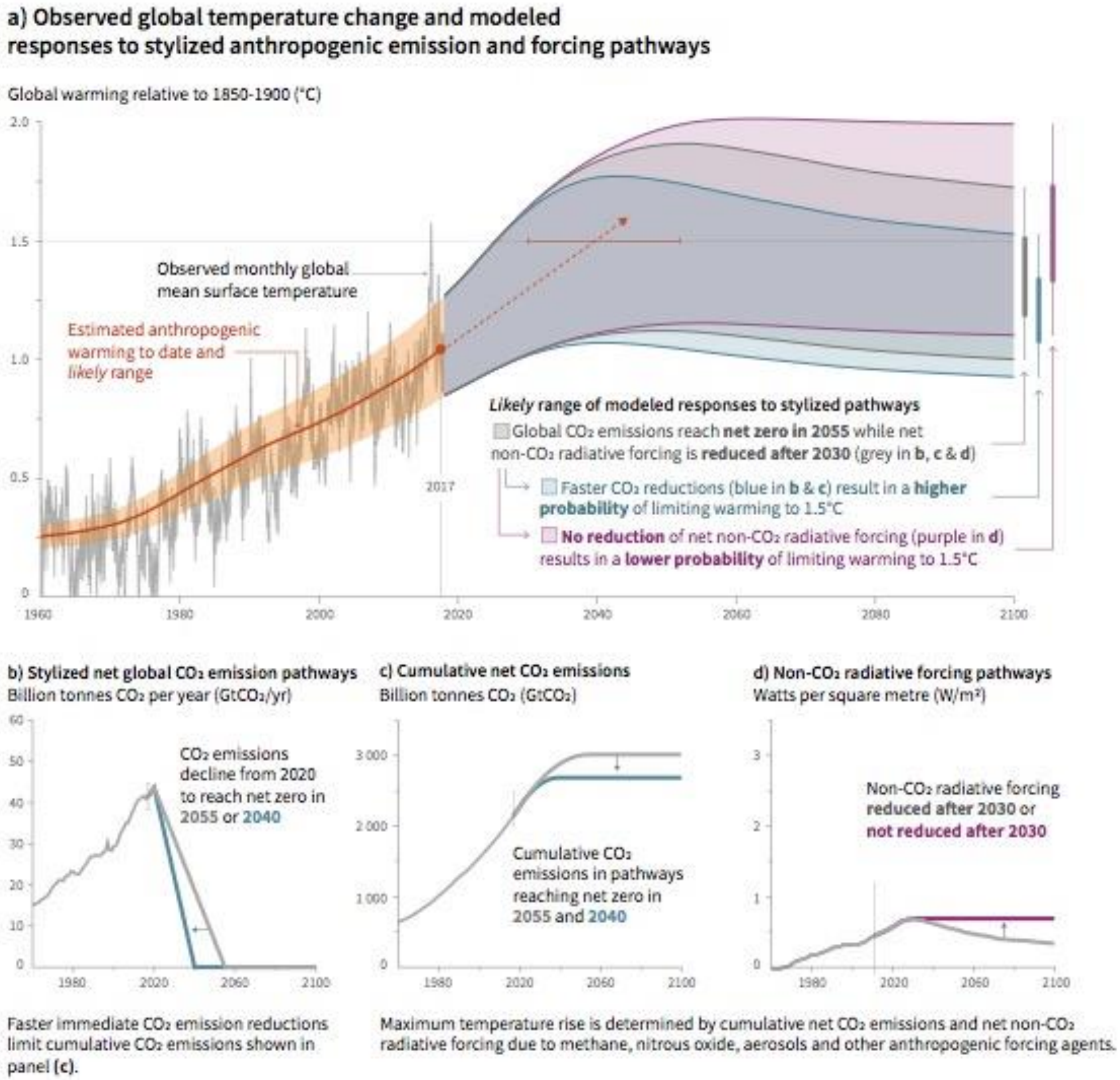
Greenhouse gas emissions pathways

- Limiting warming to 1.5°C would require changes on an unprecedented scale
    - Deep emissions cuts in all sectors
    - A range of technologies
    - Behavioural changes
    - Increase investment in low carbon options

- National pledges are not enough to limit warming to 1.5°C
- We would need to start taking carbon dioxide out of the atmosphere

- Avoiding warming of more than 1.5°C would require carbon dioxide emissions to decline substantially before 2030
- Implications for food security, ecosystems and biodiversity

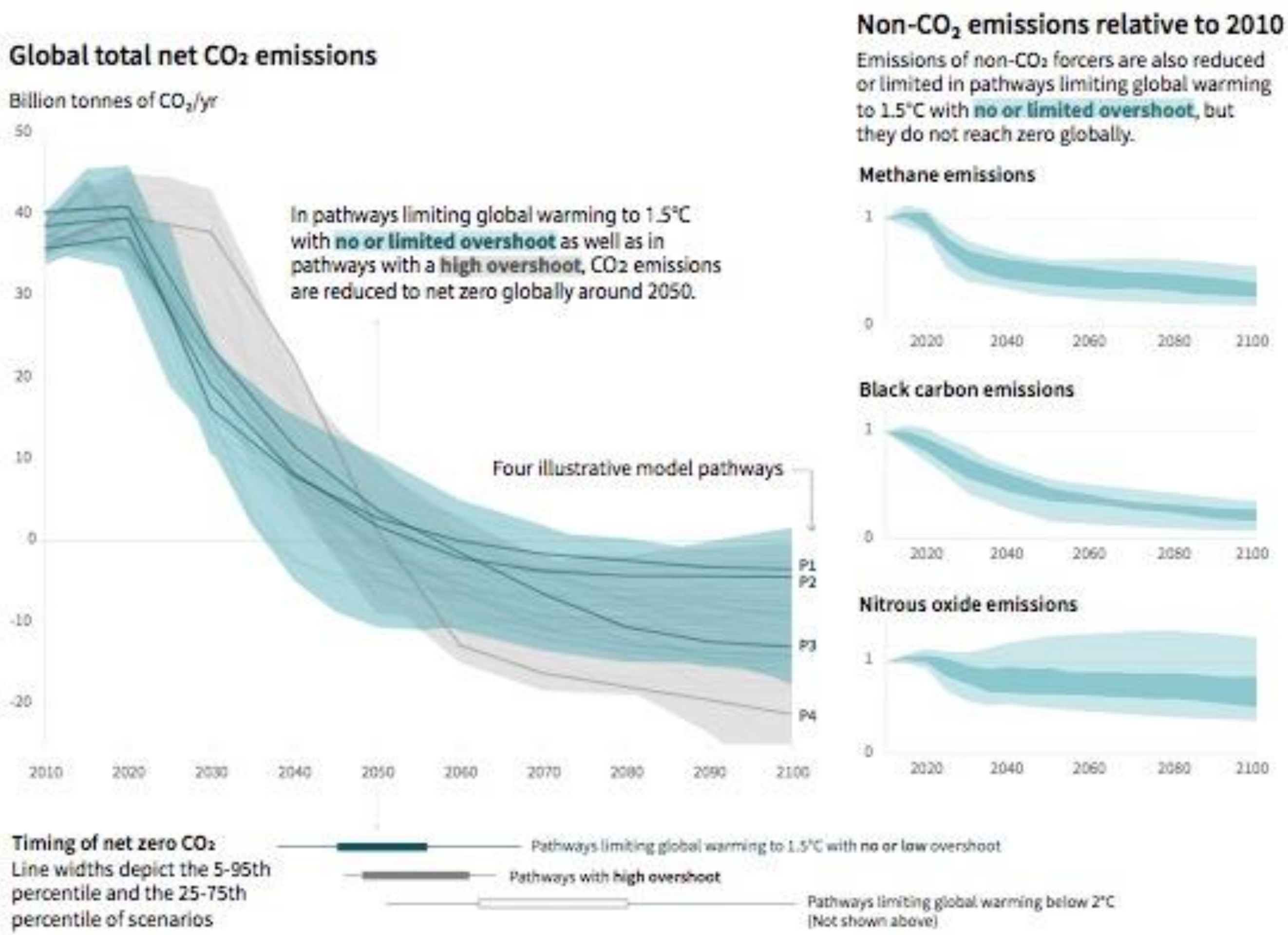
Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C



Source: IPCC Special Report on Global Warming of 1.5°C

Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO_2, and total emissions of methane, black carbon, and nitrous oxide in model pathways that limit global warming to 1.5°C with no or limited overshoot. Net emissions are defined as anthropogenic emissions reduced by anthropogenic removals. Reductions in net emissions can be achieved through different portfolios of mitigation measures illustrated in Figure SPM3B.



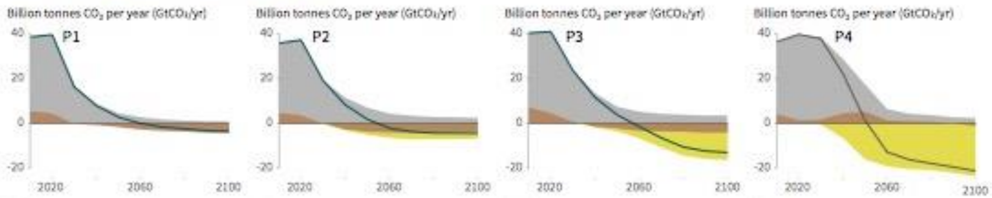
Source: IPCC Special Report on Global Warming of 1.5°C

Characteristics of four illustrative model pathways

Different mitigation strategies can achieve the net emissions reductions that would be required to follow a pathway that limit global warming to 1.5°C with no or limited overshoot. All pathways use Carbon Dioxide Removal (CDR), but the amount varies across pathways, as do the relative contributions of Bioenergy with Carbon Capture and Storage (BECCS) and removals in the Agriculture, Forestry and Other Land Use (AFOLU) sector. This has implications for the emissions and several other pathway characteristics.

Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways

Fossil fuel and industry · AFOLU · BECCS



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 down-sized energy system enables rapid decarbonisation of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Global indicators	P1	P2	P3	P4	**Interquartile range**
Pathway classification	No or low overshoot	No or low overshoot	No or low overshoot	High overshoot	No or low overshoot
CO_2 emission change in 2030 (% rel to 2010)	-58	-47	-41	4	(-59,-40)
in 2050 (% rel to 2010)	-93	-95	-91	-97	(-104,-91)
Kyoto-GHG emissions in 2030 (% rel to 2010)*	-50	-49	-35	-2	(-55,-38)
in 2050 (% rel to 2010)	-82	-89	-78	-80	(-93,-81)
*Final energy demand** in 2030 (% rel to 2010)*	-15	-5	17	39	(-12, 7)
in 2050 (% rel to 2010)	-32	2	21	44	(-11, 22)
Renewable share in electricity in 2030 (%)	60	58	48	25	(47, 65)
in 2050 (%)	77	81	63	70	(69, 87)
Primary energy from coal in 2030 (% rel to 2010)	-78	-61	-75	-59	(-78, -59)
in 2050 (% rel to 2010)	-97	-77	-73	-97	(-95, -74)
from oil in 2030 (% rel to 2010)	-37	-13	-3	86	(-34,3)
in 2050 (% rel to 2010)	-87	-50	-81	-32	(-78,-31)
from gas in 2030 (% rel to 2010)	-25	-20	33	37	(-26,21)
in 2050 (% rel to 2010)	-74	-53	21	-48	(-56,6)
from nuclear in 2030 (% rel to 2010)	59	83	98	106	(44,102)
in 2050 (% rel to 2010)	150	98	501	468	(91,190)
from biomass in 2030 (% rel to 2010)	-11	0	36	-1	(29,80)
in 2050 (% rel to 2010)	-16	49	121	418	(123,261)
from non-biomass renewables in 2030 (% rel to 2010)	430	470	315	110	(243,438)
in 2050 (% rel to 2010)	832	1327	878	1137	(575,1300)
Cumulative CCS until 2100 ($GtCO_2$)	0	348	687	1218	(550, 1017)
of which BECCS ($GtCO_2$)	0	151	414	1191	(364, 662)
Land area of bioenergy crops in 2050 (million hectare)	22	93	283	724	(151, 320)
Agricultural CH_4 emissions in 2030 (% rel to 2010)	-24	-48	1	14	(-30,-11)
in 2050 (% rel to 2010)	-33	-69	-23	2	(-46,-23)
Agricultural N_2O emissions in 2030 (% rel to 2010)	5	-26	15	3	(-21,4)
in 2050 (% rel to 2010)	6	-26	0	39	(-26,1)

NOTE: Indicators have been selected to show global trends identified by the Chapter 2 assessment. National and sectoral characteristics can differ substantially from the global trends shown above.

** Kyoto-gas emissions are based on SAR GWP-100*

*** Changes in energy demand are associated with improvements in energy efficiency and behaviour change*

Source: IPCC Special Report on Global Warming of 1.5°C

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** *Changes in energy demand are associated with improvements in energy efficiency and behaviour change*

Source: IPCC Special Report on Global Warming of 1.5°C

For 3 illustrative model pathways that limit warming with no or limited overshoot

	P1	P2	P3
CO_2 (%rel to 2010) (2030/2050)	-58 / - 93	-47 / -95	-41 / -91
Primary energy from biomass (%rel to 2010) (2030/2050)	-11 / -16	0 / +49	+36 / +121
BECCS ($GtCO_2$ total ➔2100)	0	151	414
Land for bioernergy crops in 2050 (Mha)	22	93	283
Agric. CH_4 (2030 / 2050)	-24 / -33	-48 / -69	+1 / -23
Agric. N_2O	+5 / +6	-26 / -26	+15 / 0

IPCC SR15
Fig SPM 3b

Strengthening the Global Response in the Context of Sustainable Development and Efforts to Eradicate Poverty

Climate change and people

- Close links to United Nations Sustainable Development Goals (SDGs)
- Mix of measures to adapt to climate change and reduce emissions can have benefits for SDGs
- National and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support ambitious action
- International cooperation is a critical part of limiting warming to 1.5° C

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SDG Interactions

Twitter: @JPvanYpersele

SUSTAINABLE DEVELOPMENT GOALS

Les 17 Objectifs de Développement Durable, adoptés par l'ONU en septembre 2015

If well designed, measures to prevent climate change could offer so many opportunities:

- **Co-benefits in reduced pollution, health improvement, employment, gender equality, food security, reduced poverty, energy independence…**
- **Opportunities to shift the tax burden away from labour, incentivise, and fund sustainable development**
- **Opportunities to integrate research results in a useful, policy-relevant way, accross disciplines (including social sciences)**

Example of Synergies: Combustion of fossil fuels, wood, and biomass also cause air pollution, which kills 7 million people per year (World Health Organization, 2018)

Opportunity: Addressing the causes of climate change can also improve air quality and wellbeing

Children are particularly sensitive to air pollution

Photo: Indiatoday.in, 6-12-2017

An example from SR15:

- C3.5 **Some AFOLU-related CDR** (Carbon Dioxide Removal) measures such as restoration of natural ecosystems and soil carbon sequestration **could provide co-benefits** such as improved biodiversity, soil quality, and local **food security**. If deployed at large scale, they **would require governance systems** enabling sustainable land management to conserve and protect land carbon stocks and other ecosystem functions and services (medium confidence). (Figure SPM.4) {2.3.3, 2.3.4, 2.4.2, 2.4.4, 3.6.2, 5.4.1, Cross-Chapter Boxes 3 in Chapter 1 and 7 in Chapter 3, 4.3.2, 4.3.7, 4.4.1, 4.5.2, Table 2.4}

Nilsson et al. (2016) have proposed a simple framework for rating relationships between SDG targets along a scale of interaction (also in Schmalzbauer & Visbeck (2016) :

- 3 cancelling	+ 1 enabling
- 2 counteracting	+ 2 reinforcing
- 1 constraining	+ 3 indivisible

0 consistent

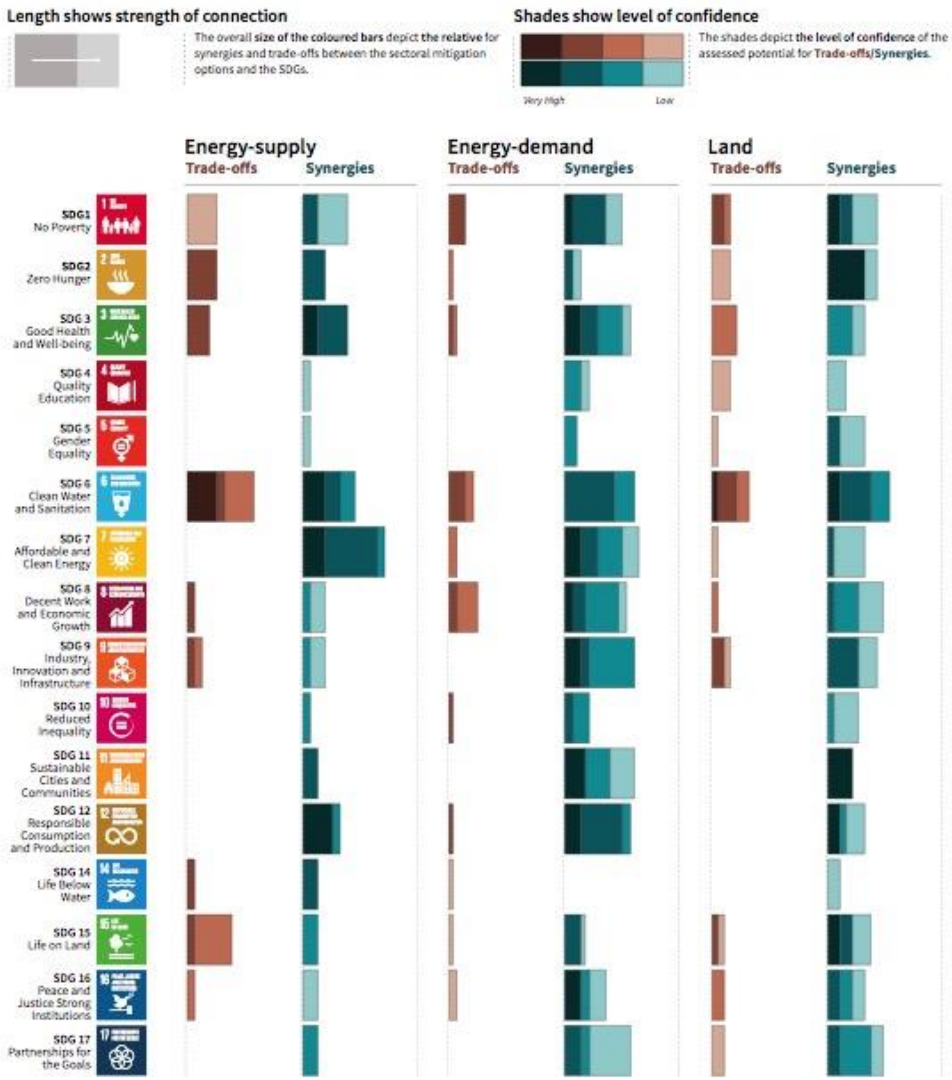
Scale to score the influence of one SDG or target on another

Schmalzbauer B., Visbeck M. (Eds.) 2016.
The contribution of science in implementing the Sustainable Development Goals.
German Committee Future Earth, Stuttgart/Kiel

Interaction	Name	Explanation	Example
+3	Indivisible	Inextricably linked to the achievement of another goal.	Ending all forms of discrimination against women and girls is indivisible from ensuring women's full and effective participation and equal opportunities for leadership.
+2	Reinforcing	Aids the achievement of another goal.	Providing access to electricity reinforces water-pumping and irrigation systems. Strengthening the capacity to adapt to climate-related hazards reduces losses caused by disasters.
+1	Enabling	Creates conditions that further another goal.	Providing electricity access in rural homes enables education, because it makes it possible to do homework at night with electric lighting.
0	Consistent	No significant positive or negative interactions.	Ensuring education for all does not interact significantly with infrastructure development or conservation of ocean ecosystems.
−1	Constraining	Limits options on another goal.	Improved water efficiency can constrain agricultural irrigation. Reducing climate change can constrain the options for energy access.
−2	Counteracting	Clashes with another goal.	Boosting consumption for growth can counteract waste reduction and climate mitigation.
−3	Cancelling	Makes it impossible to reach another goal.	Fully ensuring public transparency and democratic accountability cannot be combined with national-security goals. Full protection of natural reserves excludes public access for recreation.

Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

Mitigation options deployed in each sector can be associated with potential positive effects (synergies) or negative effects (trade-offs) with the Sustainable Development Goals (SDGs). The degree to which this potential is realized will depend on the selected portfolio of mitigation options, mitigation policy design, and local circumstances and context. Particularly in the energy-demand sector, the potential for synergies is larger than for trade-offs. The bars group individually assessed options by level of confidence and take into account the relative strength of the assessed mitigation-SDG connections.



Source: IPCC Special Report on Global Warming of 1.5°C

IPCC SR15
Fig SPM 4

IPCC SR15
Fig SPM 4

Indicative linkages between mitigation options and sustainable development using SDGs (The linkages do not show costs and benefits)

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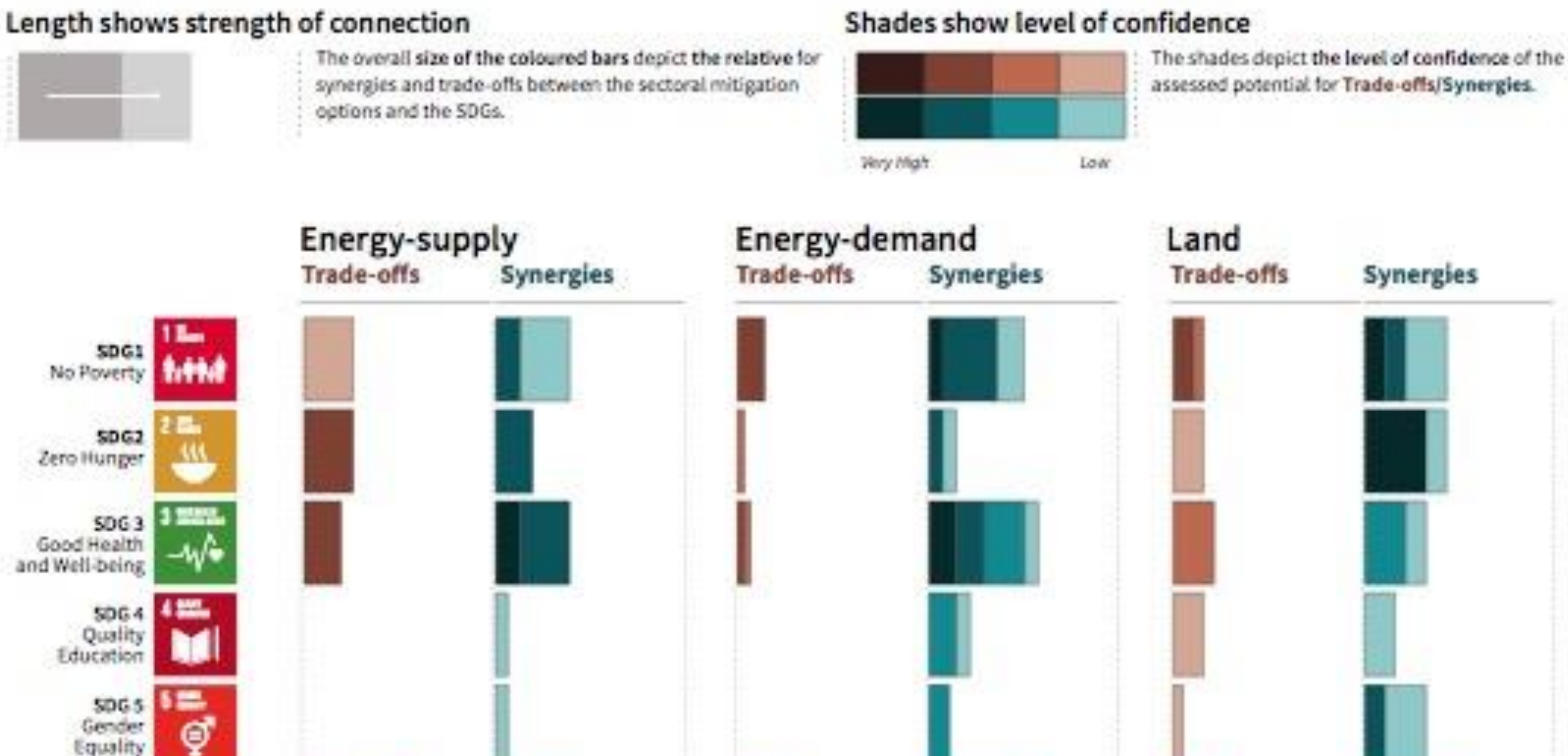

Maximizing synergies, minimizing trade-offs: Role of agricultural research

Twitter: @JPvanYpersele

Possible steps for CGIAR and this Forum

- ***Identify sticking points and trade-offs***
- ***Identify win-win opportunities and trade-offs***
- ***Understand them (interdisciplinary research, with no prejudices)***
- ***Learn from other fields and from critics***
- ***Serach how to overcome the gulf between the urgency to act and the insufficient political will***

From SR15:

- C2.5 Model pathways that limit global warming to 1.5°C with no or limited overshoot project the **conversion** of **0.5–8 million km2 of pasture** and **0–5 million km2 of non-pasture agricultural land for food and feed crops into 1–7 million km2 for energy crops** and a 1 million km2 reduction to 10 million km2 increase in forests **by 2050 relative to 2010** (medium confidence).

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Conclusions

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Conclusions (1/2)

- The challenge is huge: transform the world in a few decades so that the whole world activities are decarbonized, while poverty and hunger are eliminated

- It opens many economic opportunities, and opportunities to address in a synergistic manner other societal goals (see the 17 Sustainable Development Goals).

Joel Pett, USA Today

Conclusions (2/2)

- **(Inter- & trans-disciplinary) Science has very important role**
- **Last but not least, addressing this challenge, together, will allow us to look our children and grand children into their eyes when they will ask us how we contributed to avoiding the announced environmental collapse.**

COP23, Bonn (Fiji Presidency): Timoci, 12, speaks to Heads of State and Governments about the threats of climate change

Useful links:

- www.ipcc.ch : IPCC (reports and videos)
- www.climate.be/vanyp : my slides and other documents
- www.skepticalscience.com: excellent responses to contrarians arguments
- **On Twitter: @JPvanYpersele**

  and @IPCC_CH