全球氣候公義的探討與實踐

香港中文大學
The Chinese University of Hong Kong

戴沛權教授 Prof. Amos P. K. Tai
香港中文大學
地球與環境科學系副教授及副主任（教育）
大學通識教育部副主任

TGABI

DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCES

「願祢受頌讚」基督信仰的共同回應系列活動
環境公義於當代的重要性

Email: amostai@cuhk.edu.hk IG: **amospheric**
WeChat: **AMoSiTai** URL: www.cuhk.edu.hk/sci/essc/tgabi/

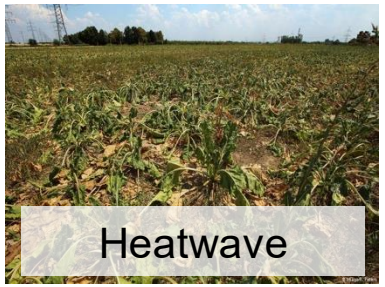
- **Associate Prof., CUHK (Earth & Environ. Sciences), since 2019**
- **Assistant Prof., CUHK (Earth System Science), 2013–2019**
- **Postdoc, MIT (Civil & Environmental Engineering), 2012–2013**
- **Ph.D., Harvard (Environmental Science & Engineering), 2007–2012**
- **B.Sc., MIT (Environmental Engineering Science), 2003–2007**

Addressing Climate Change and Environmental Pollution from Earth System Perspectives

Three main research questions:

1. How **air pollution** and **climate change** impact **crop** and **forest productivity**

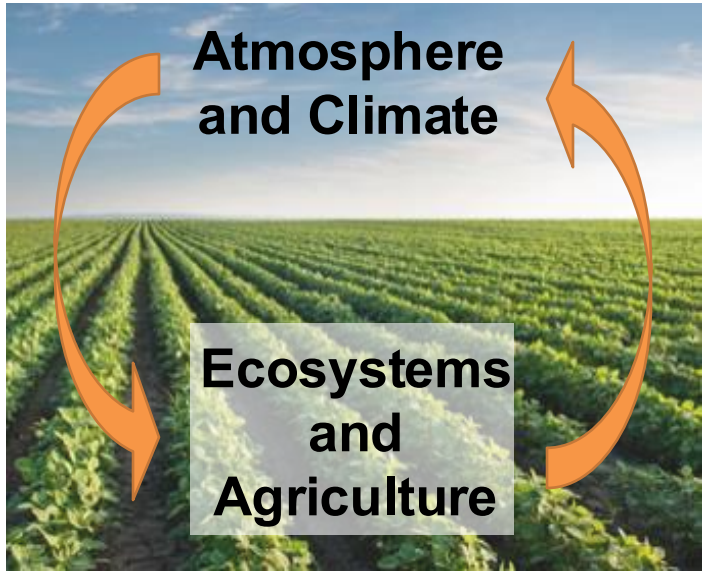

Ozone damage


Heatwave

2. How **land use** and **forest changes** and **management** affect **air quality** and **climate**

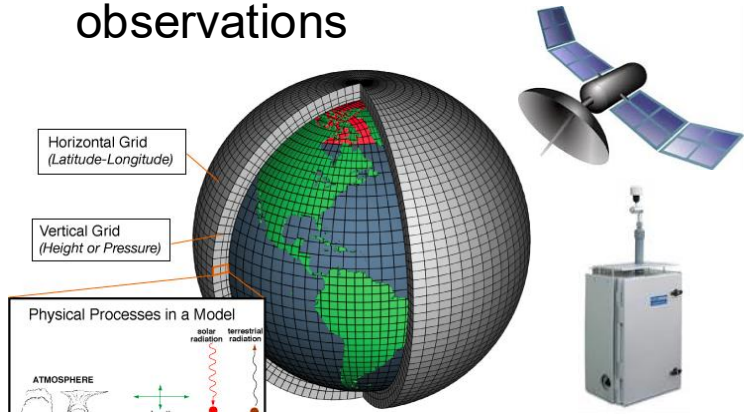

Reforestation


Wildfires



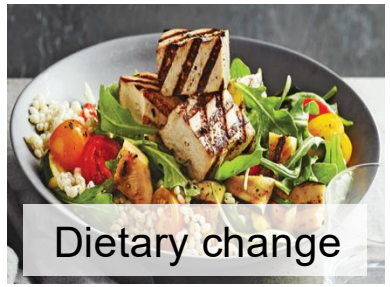
Methodologies:

- Earth system modeling
- Big-data analysis of global observations



3. How **sustainable agriculture and food systems** mitigate **air pollution** and **climate change**


Intercropping


Dietary change

Prof. Amos P. K. Tai
Dept. of Earth & Environmental Sciences, **CUHK**; IG: amospheric

Major Findings and Implications for Sustainability

nature climate change

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Threat to future global food security from climate change and ozone air pollution

13 CLIMATE ACTION

nature food

ARTICLES

https://doi.org/10.1038/s43016-021-00430-6

Check for updates

Dietary shifts can reduce premature deaths related to particulate matter pollution in China

The Guardian

Conscience, Nurtured by Truth

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Climate change, air pollution will combine to curb food supplies

Climate change, air pollution will combine to curb food supplies

2 ZERO HUNGER

即時新聞 港聞 選擇分類

中大研「間套作」耕種法 增收成減污染

(Intercropping raises yield and reduces pollution)

授戴沛權。資料圖片

■研究指香港市花洋紫荊釋放最多有機化合物。網上圖片

種樹要揀低排量 嚴規車排減臭氧

香港文匯報訊（記者 鄭伊莎）雖然植物可吸收地表臭氧濃度，有助紓緩空氣污染。不過，中大地球系統科學課程助理教授戴沛權及其團隊，根據過往文獻發現，不同種類的植物所排放的有機化合物量均有差異，如華南地區的亞熱帶常綠林品種，以及香港常見的洋紫荊、羊蹄甲等豆科類木品種，都會釋放最多有機化合物，更容易激化「臭氧殺人」污染。研究團隊認為，政府應種植排放較少有機化合物的植物，同時嚴厲規管本港的汽車排放，雙管齊下減少臭氧濃度。

戴沛權表示，研究發現華南地區以亞熱帶常綠林為主要植被，而有關植物在過往30年所排放出的有機化合物，較全中國平均值高出達80%至120%；加上在高濃度的工業及汽車排放的氮氧化物下，使華南植物透過有機排放加劇臭氧的程度，較葉面吸收臭氧而減少臭氧的程度更高，情況在中國較為罕見。

中大設華南首個「開放性臭氧園」 研究證本港臭氧濃度阻礙植物生長

社會 15:32 2020/04/08 讚好 71

香港經濟日報

(First “ozone garden” to examine ozone damage on plants)

「種啱樹」始改善空氣污染

【大公報訊】實習記者蔡美淇報道：面對各種環境議題，專家一向提倡多種植植物以增加綠化，惟香港中文大學研究指出，植物有雙重作用，除了有助城市降溫，亦可能形成更多臭氧，關鍵在於「要種啱樹」。中大理學院地球系統科學課程助理教授戴沛權發現過去30年，中國氣候於夏季提升攝氏三度，因臭氧引致呼吸病症而死亡的人數增約4400人，促請政府研究哪些植物排放較多有機化合物，並加強規管化石能源的使用量和提高使用效率。

戴沛權指出，燃燒化石燃料無疑是空氣污染及人類疾病的主兇。暖化會使植物有機排放增加，加快該化學反應，令空氣中臭氧濃度增加，「人爲污染令植物本身無害的有機化合物都變得有害！」

他補充，香港的市花洋紫荊，及常見植物如羊蹄甲和樟樹等，都屬熱帶植物，相對排放更多有機化合物，香港有至少一半的氮氧化物，是來自汽車使用的。

他建議政府加強規管化石能源的使用量和提高使用效率，尤其是汽車使用方面，減低氮氧化物排放。在進行城市綠化時，多考慮植物的品種，「種啱植物才能更有效改善空氣污染。」

(Improving air quality needs planting the right tree)

15 LIFE ON LAND

3 GOOD HEALTH AND WELL-BEING

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Pollutionwatch

Could a global farmers' assembly help cut agriculture pollution?

Ammonia from animal waste and fertilisers used to grow feed create air pollution and poorer suffer most

香港首位獲頒世界氣象組織
青年科學家研究獎

施達基金會

聯合國氣候變化大會

聯合國糧食及農業組織

香港十大傑出青年

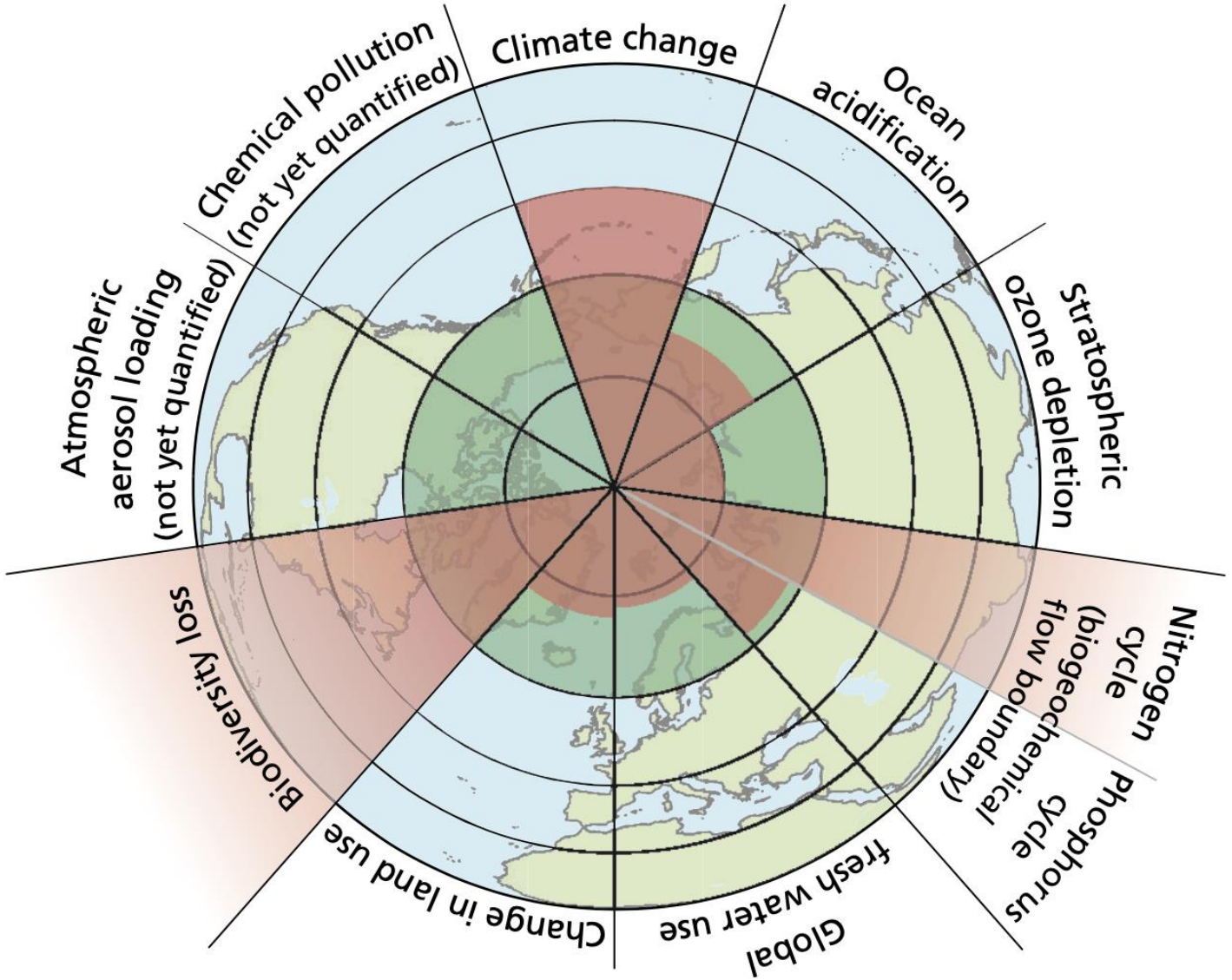
校長模範教學獎

香港青年科學院院士

香港地球之友董事

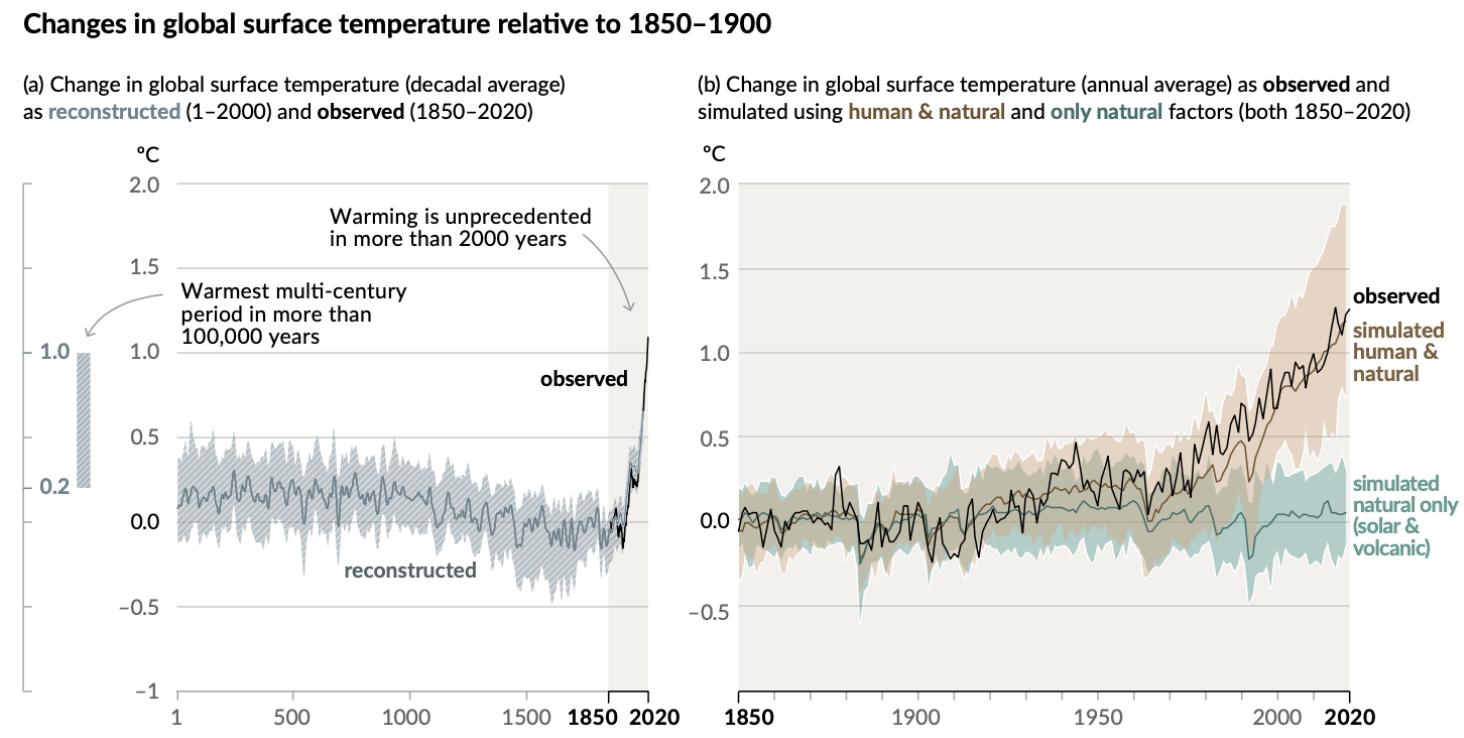
舊日的足跡

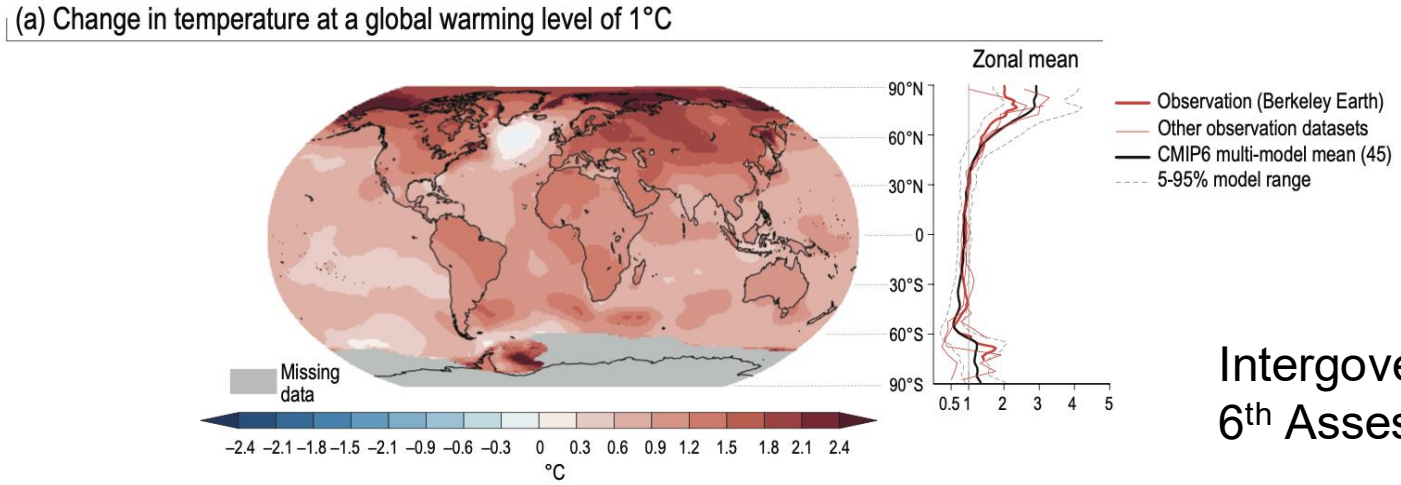
Planetary Boundaries: Safe Operating Space for Humanity



[Rockstrom et al., *Nature*, 2009]

Climate Change: Most Pressing Problem of Our Time

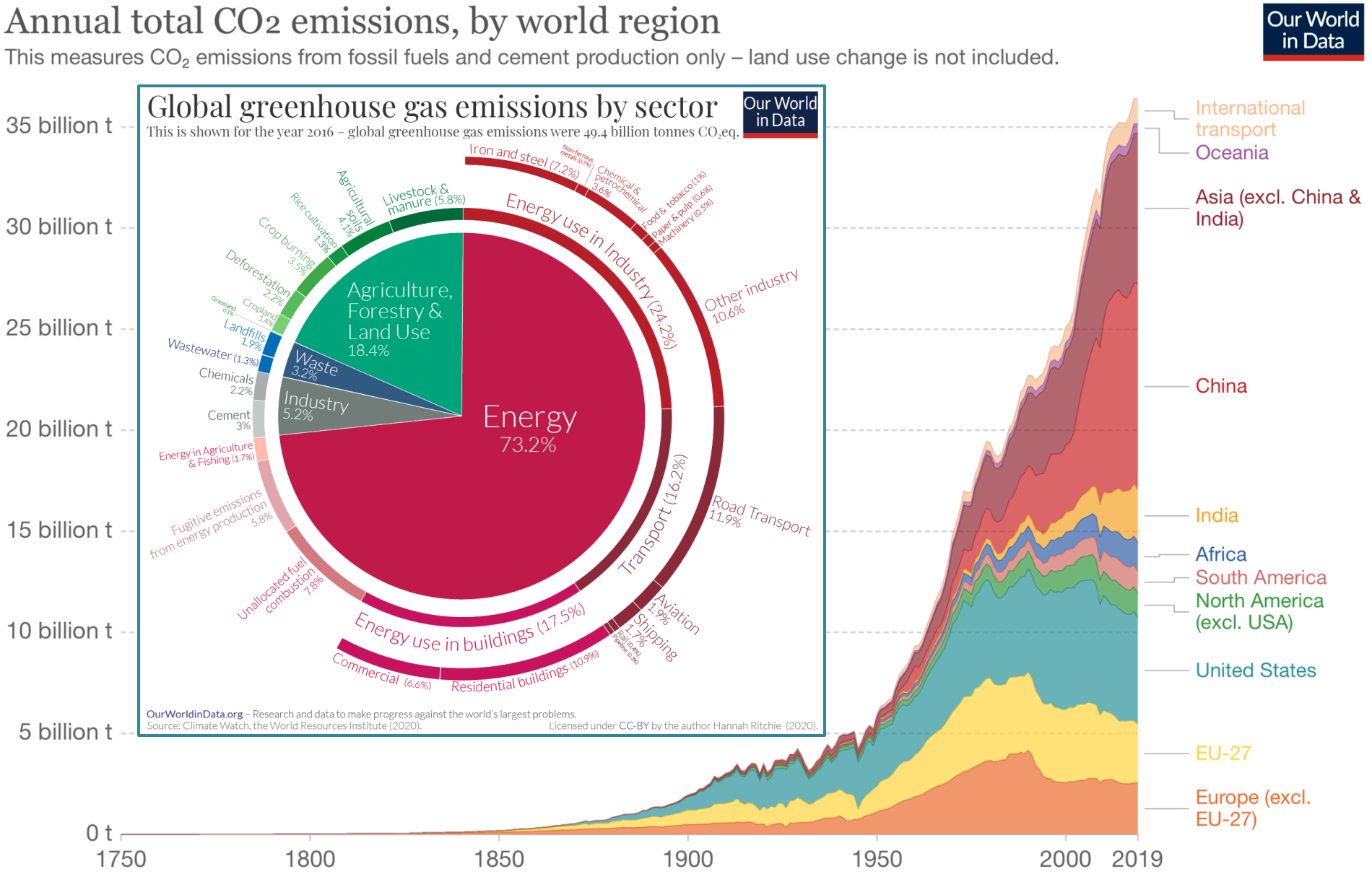




- Observed **rates** of climatic changes are **unprecedented** at least throughout human history.
- Multiple lines of observations and computer model experiments have allowed us to attribute the causes of climate change.
- Climate change is the **"crisis multiplier"** that possibly poses the greatest threat to security on most fronts of human endeavors, underlying almost all sustainability issues.

Intergovernmental Panel on Climate Change
6th Assessment Report (IPCC AR6)

Causes of Climate Change: Greenhouse Gas Emissions

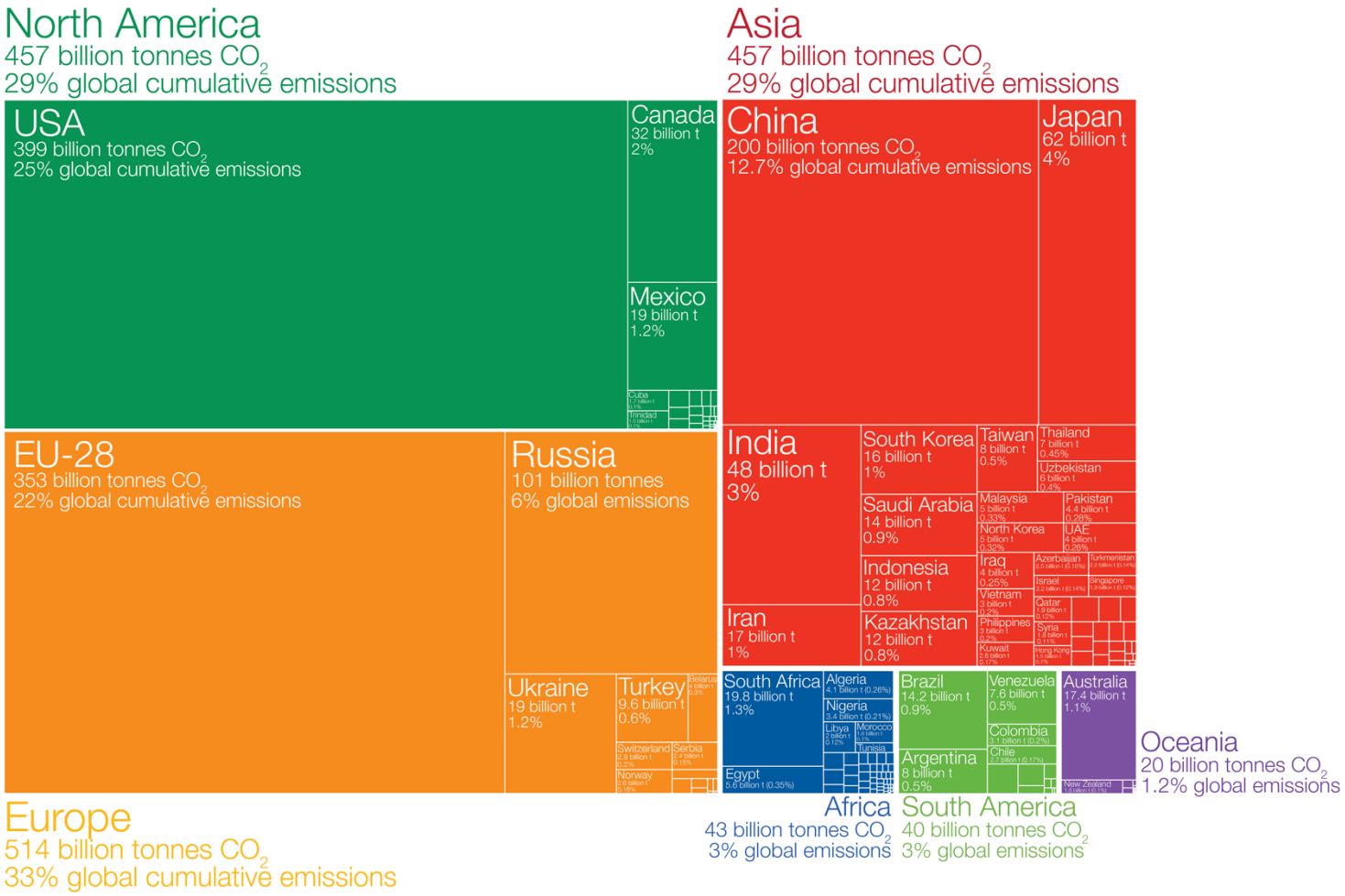


Causes of Climate Change: Greenhouse Gas Emissions

Who has contributed most to global CO_2 emissions?

Our World in Data

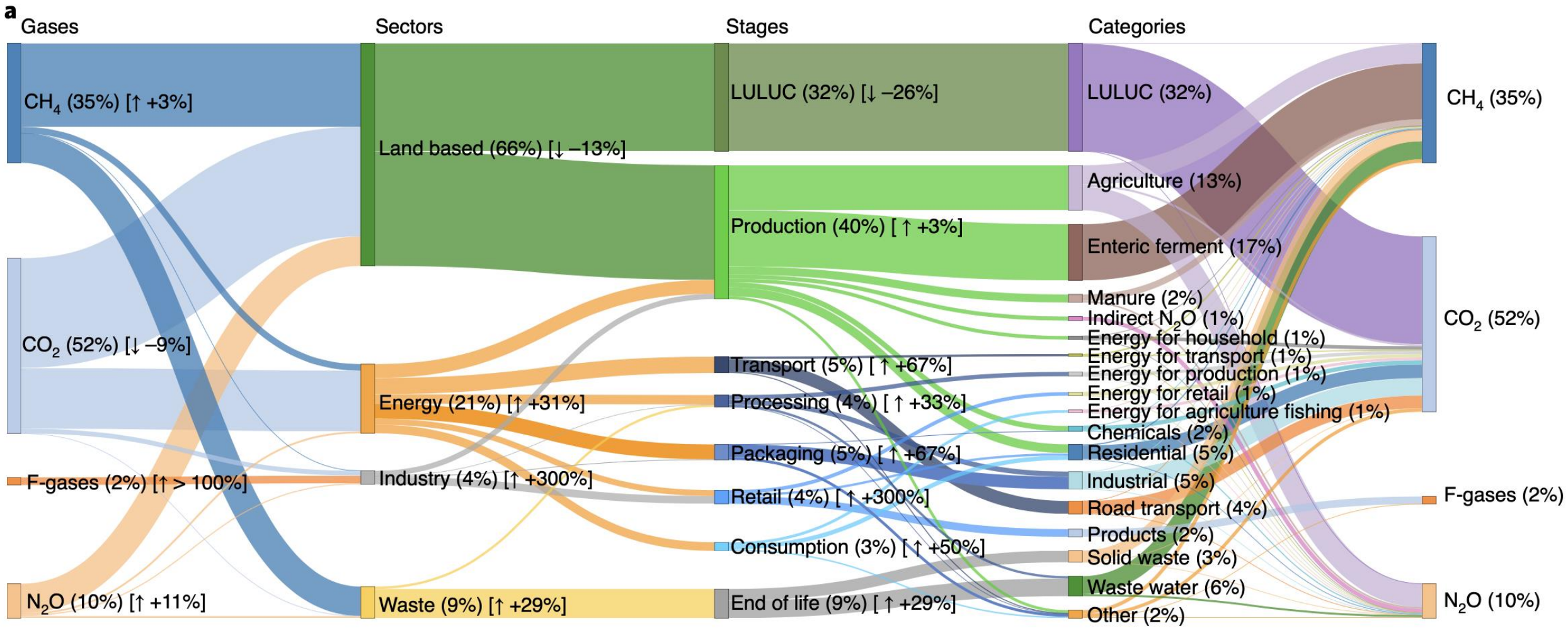
Cumulative carbon dioxide (CO_2) emissions over the period from 1751 to 2017. Figures are based on production-based emissions which measure CO_2 produced domestically from fossil fuel combustion and cement, and do not correct for emissions embedded in trade (i.e. consumption-based). Emissions from international travel are not included.



Figures for the 28 countries in the European Union have been grouped as the 'EU-28' since international targets and negotiations are typically set as a collaborative target between EU countries. Values may not sum to 100% due to rounding.

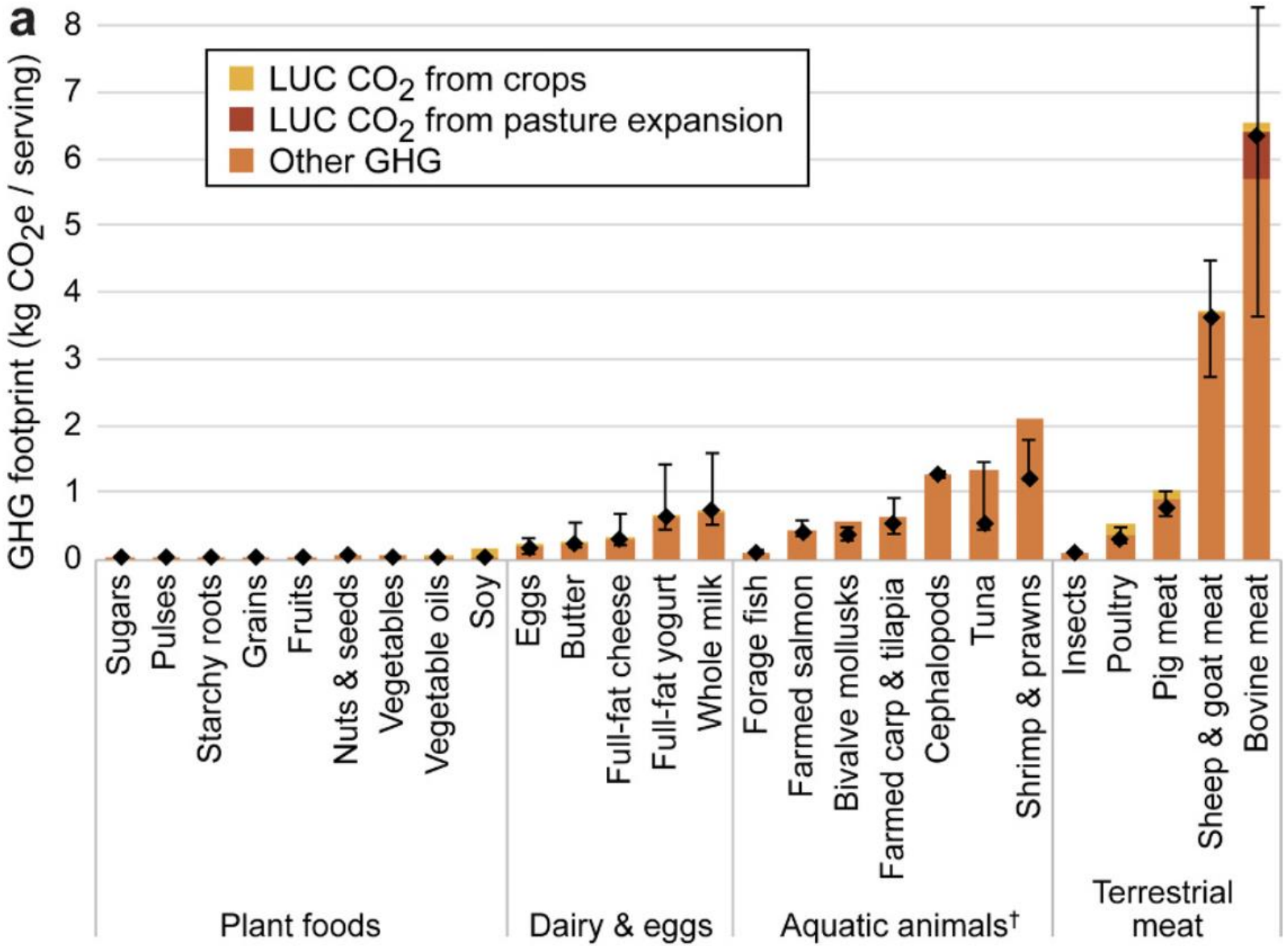
Data source: Calculated by Our World in Data based on data from the Global Carbon Project (GCP) and Carbon Dioxide Analysis Center (CDIAC).
This is a visualization from OurWorldinData.org, where you find data and research on how the world is changing.

Greenhouse Gas Emissions from Global Food Systems



[Crippa et al., 2021]

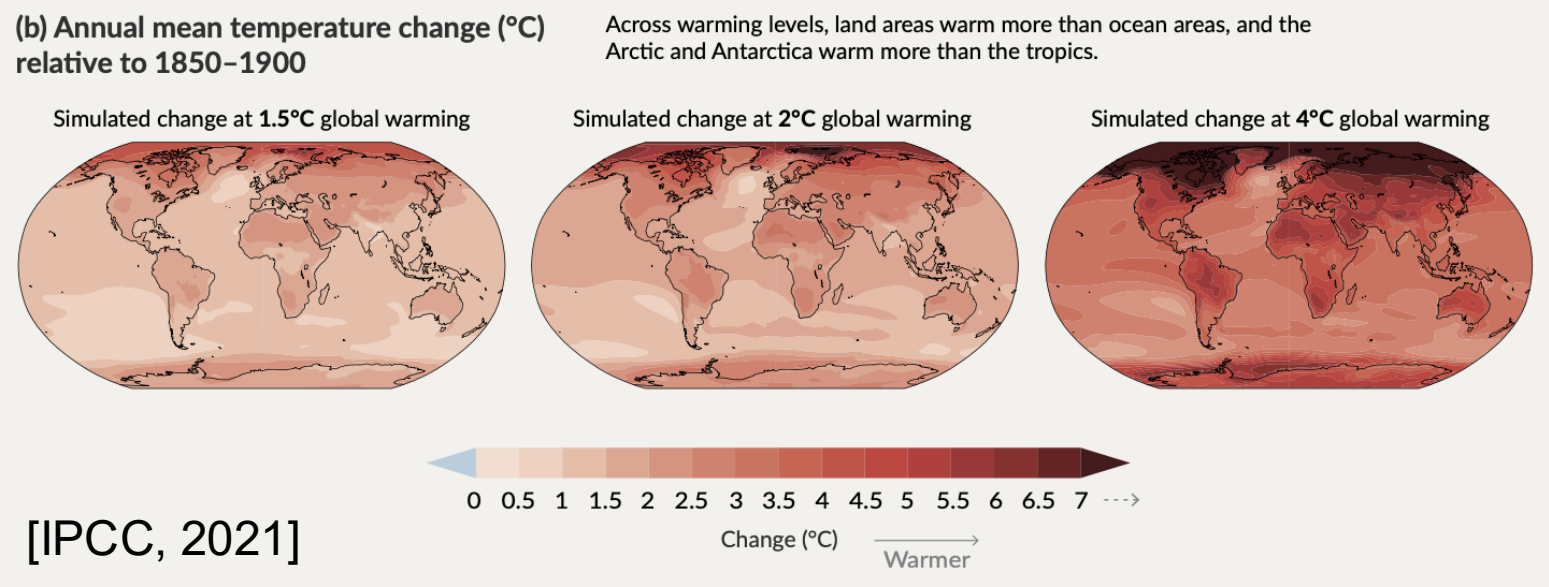
Carbon Footprints of Different Foods



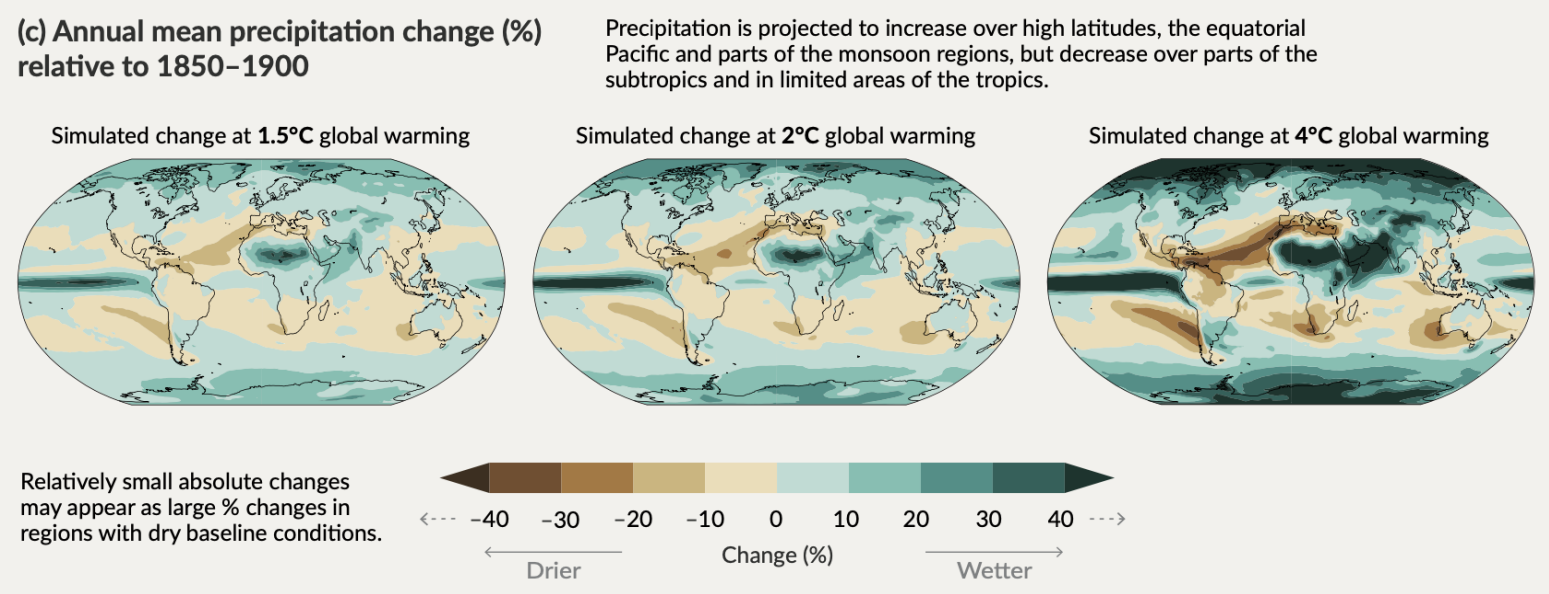
P.S. Only LULCC and production stage are considered.

[Kim et al., 2020]

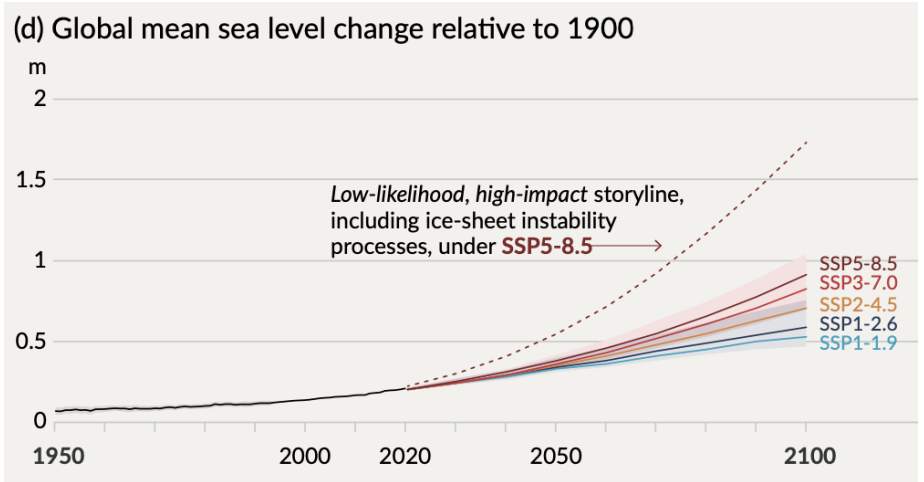
Climate Projections in IPCC 6th Assessment Report



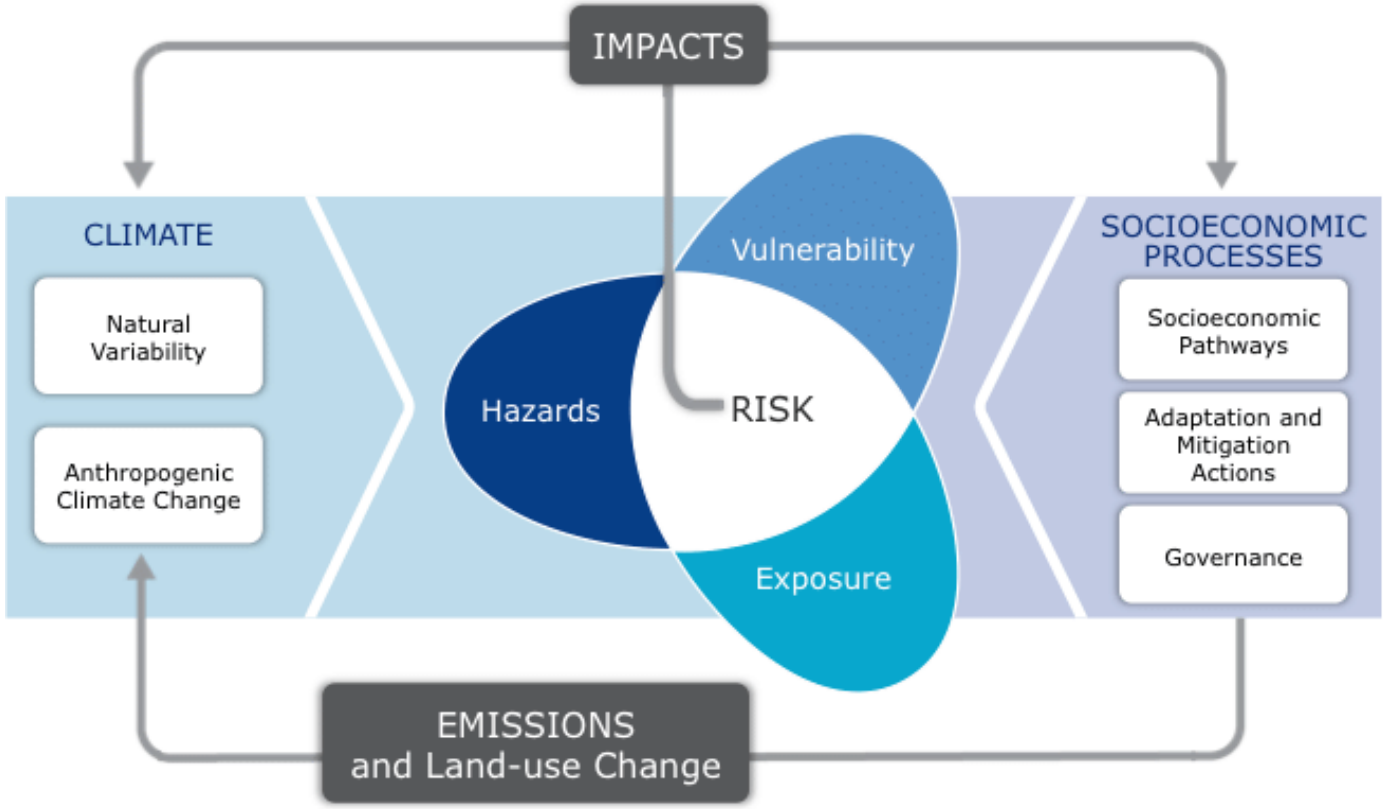
[IPCC, 2021]



- **Temperature**: Poles warm faster than tropics
- **Extreme temperature events**: More frequent and intense heatwaves, cold spells, wildfires
- **Rainfall**: Dry gets drier, wet gets wetter; more frequent and intense droughts, floods, rainstorms, etc.
- **Sea level**: Keeps rising



Impacts of and Vulnerability to Climate Change



- Extreme weather events (storms, floods, droughts, fires)
- High temperature and heat stress
- Air pollution
- Infectious disease transmission and prevalence
- Food insecurity and malnutrition
- Access to safe drinking water
- Climate migrants and refugees
- Conflicts and violence
- Economic costs
- **Not everyone is equally vulnerable to climate change**

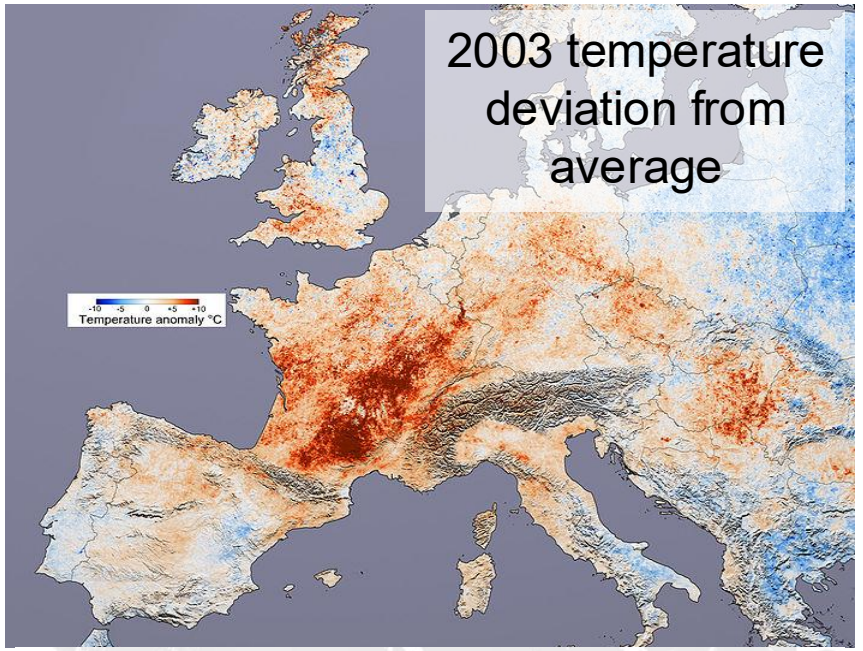
Hurricanes, Storms and Floods Can Kill

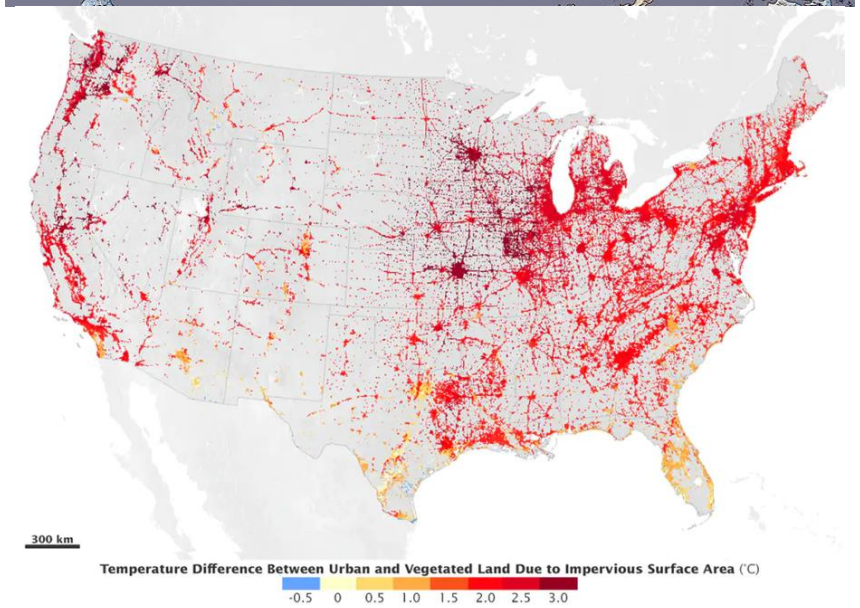
New Orleans, predominantly African American, after Hurricane Katrina

- Drowning and physical injuries from falling objects, collapsing structures, electrical shocks, fires
- Contamination of drinking water by saltwater and pathogens
- Displacement and subsequent impacts on stress and health
- Elderly are disproportionately affected (e.g., >70% of those who died after Katrina were of age 60 or above).

Heatwaves Can Kill, and Unequally

- 2003 European heatwave killed more than 15,000 in France alone.
- Hyperthermia → heat stroke → fatality
- Cities are more vulnerable due to urban heat island effects.
- Elderly are particularly sensitive to heat stress (e.g., 70% of deaths in France were of age 75 or above).
- Minorities are twice as likely to die from heatwaves as other city residents.
- Along with warming, we expect **more frequent temperature extremes** for the future.

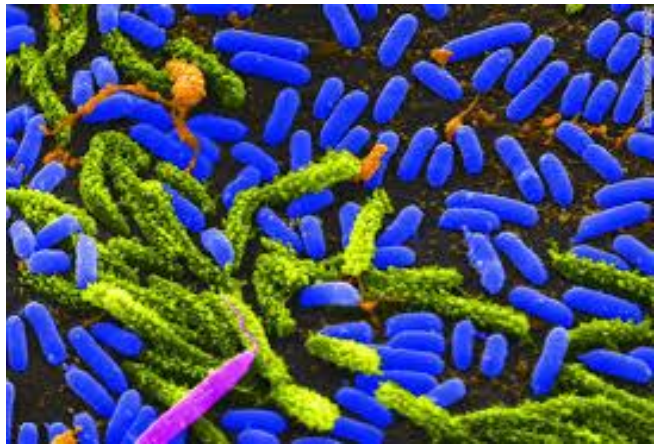




Climate Change Alters Disease Patterns

- 500 million people contract malaria each year, and >1 million die, mostly in Africa.
- Warmth and water availability promote mosquito abundance:
  - 0.5°C rise → 30–100% increase in mosquito abundance
  - More frequent rainfall → more prevalent patchy ponds → mosquito reproduction
- Shift of geographic range → introduce pathogens into novel and non-immune human populations
- Cholera outbreaks in Asia have been associated with warmer sea surface temperature and nutrient loading from agricultural runoff.

Malaria is spread by *Anopheles* mosquitoes.



Vibrio cholerae

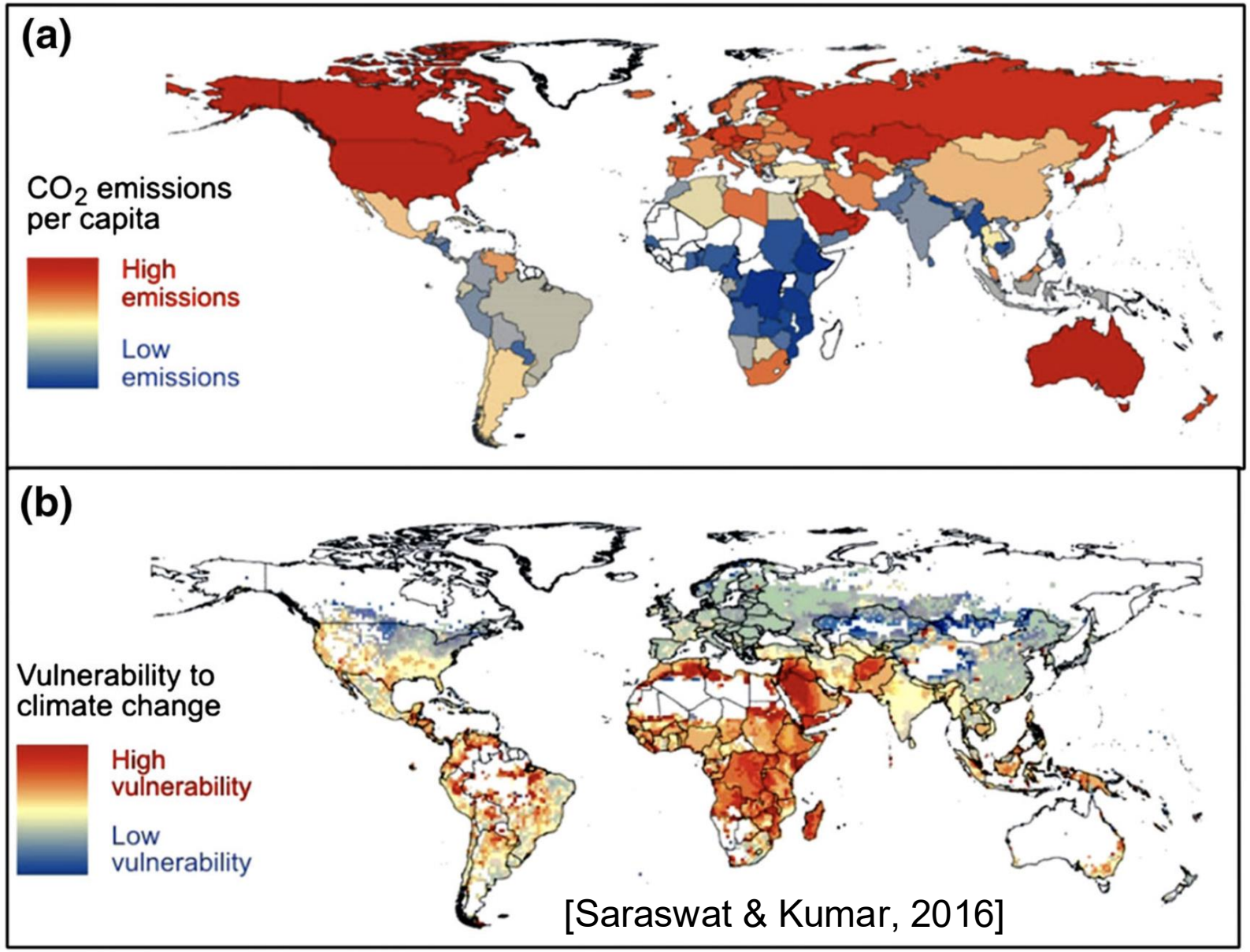
Climate Change Threatens Global Food Security

- Climate change and air pollution together can increase undernourishment rates by up to 50% by year 2050. [Tai et al., 2014, *Nature Climate Change*]
- Water scarcity accelerated by climate change also limits agriculture.
- Increasing CO_2 is also shown to reduce protein, iron and zinc content in crops; iron and zinc deficiency accounts for 63 million life-years lost annually.
- Relatively little is known about how warming may affect agricultural pests.

Food Prices in Hong Kong Have Been Affected

- Food prices have been rising more than inflation, due to climate change in addition to other economic and political factors.
- Price of imported rice has been rising by 5% per year.
- Vegetable prices have risen by more than 10% per year.
- Low-income families, especially elderly people, have been severely affected.

Climate Injustice: Uneven Distribution of Responsibility and Burden

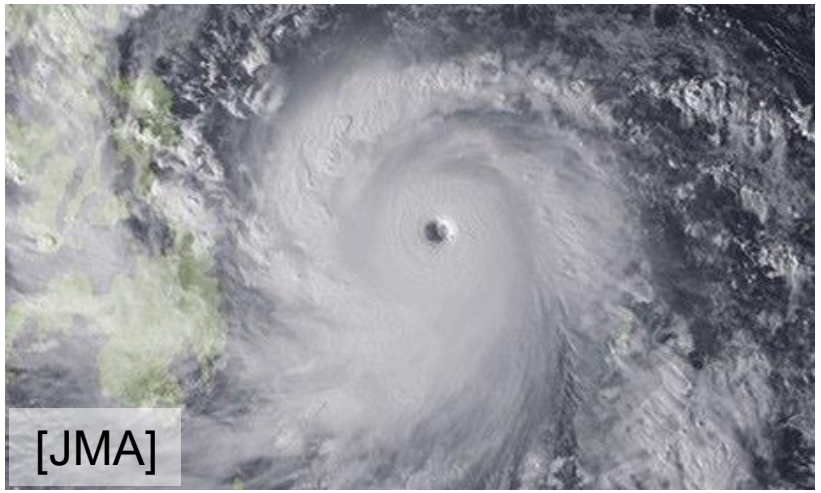


[Saraswat & Kumar, 2016]

Typhoon Haiyan and COP19 in 2013

Yeb Sano at COP19, Warsaw, Nov 2013

Typhoon Haiyan approaching Philippines, Nov 2013

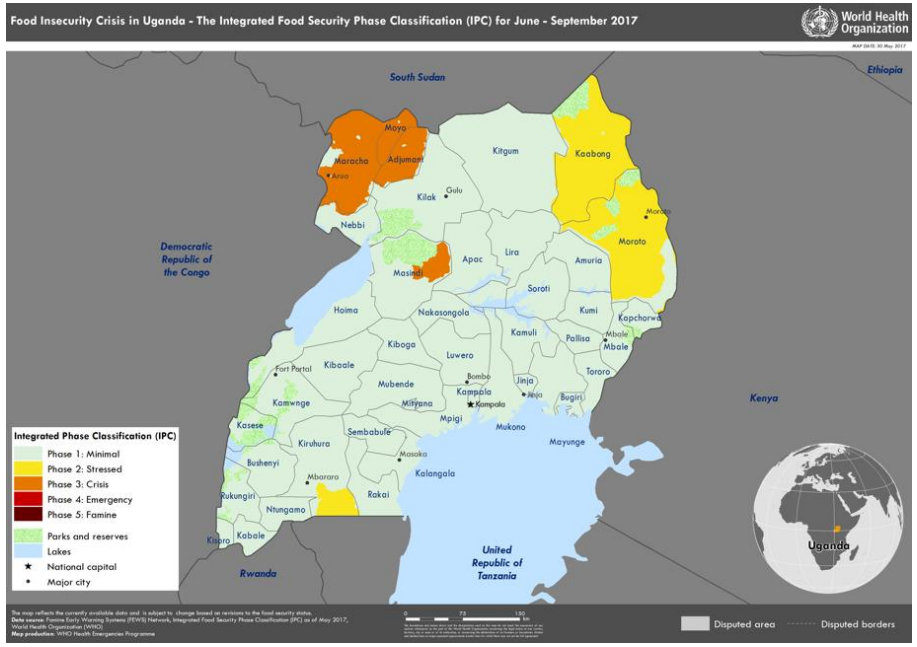


Constance Okollet from Uganda

"But these people were enjoying their life while we were suffering. I wanted to know why they were doing this to us. I wanted to know whether the people in developed countries could reduce their emissions so we could have our normal seasons back."

"In eastern Uganda, there are no seasons anymore. Agriculture is a gamble."

"We, the people at the grassroots level, are suffering the worst effects of climate change."



Anote Tong, Former President of Kiribati

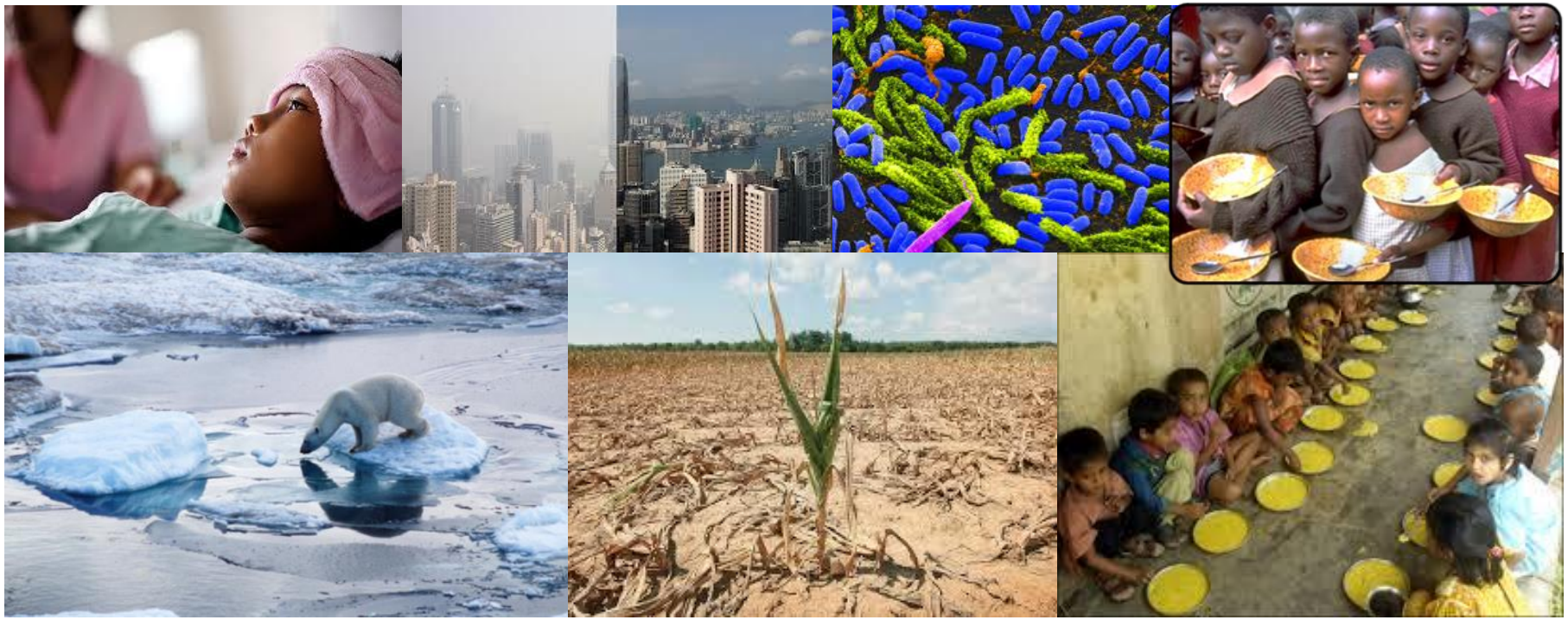
"The message was loud and clear: Whether you believe it or not, whether you are going to do anything about it or not, our fate is sealed. At some point within this century, the water will be higher than the highest point in our lands."

75 million people around the world currently live just 1 m or less above sea level.

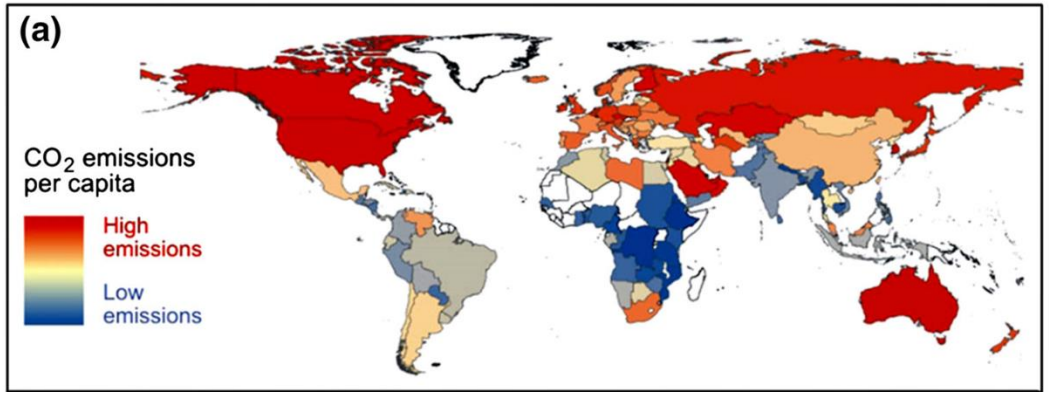
"Migration with dignity is a real strategy."

Climate Change Is an Urgent Sustainability Issue

- It affects not only the polar bears but also every one on Earth.
- It is not only a **security** (food, water, energy, conflicts) issue, but also a **justice** and **poverty** issue, multiplying most if not all sustainability issues.



Climate Justice: Multiple Facets and Perspectives



Economic, racial and gender inequality

*"You have **stolen my dreams and my childhood** with your empty words. … People are suffering. People are dying. Entire ecosystems are collapsing. We are in the beginning of a mass extinction, and all you can talk about is **money and fairy tales of eternal economic growth**. How dare you!"*

Capitalism and consumerism

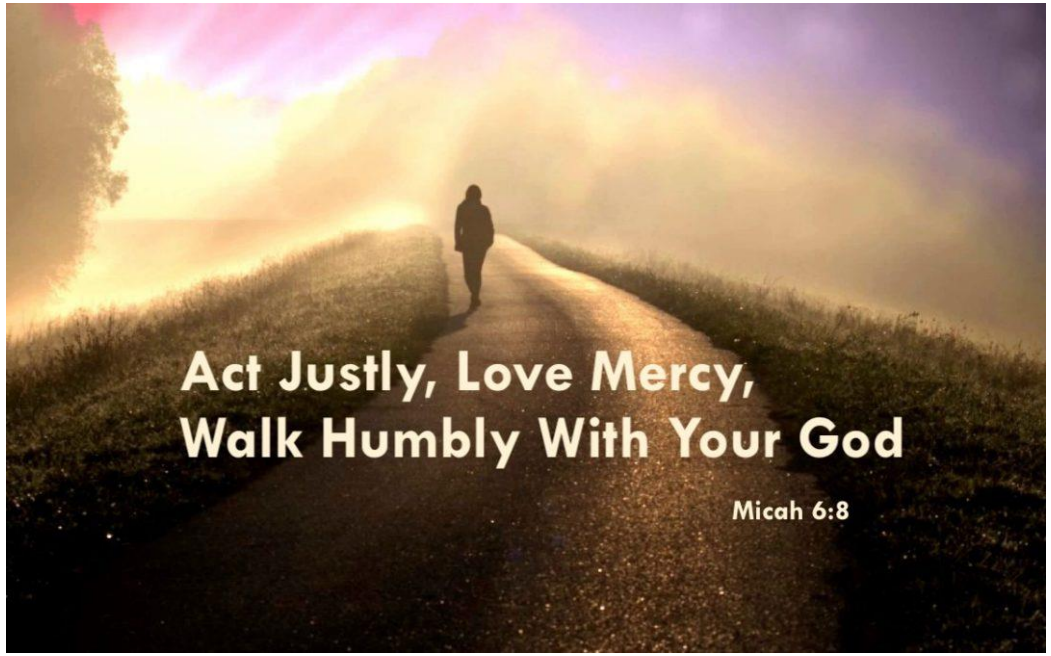
Intergenerational justice

Biblical Justice

“The people of the land have practiced extortion and committed robbery; they have oppressed the poor and needy and have extorted from the alien without justice.”
Ezekiel 22:29

“When you reap the harvest of your land, you shall not reap to the very edges of your field or gather the gleanings of your harvest; you shall leave them for the poor and for the alien: I am the Lord your God.”
Leviticus 23:22

“Thus says the Lord : Act with justice and righteousness and deliver from the hand of the oppressor anyone who has been robbed. And do no wrong or violence to the alien, the orphan, and the widow, or shed innocent blood in this place.”
Jeremiah 22:3

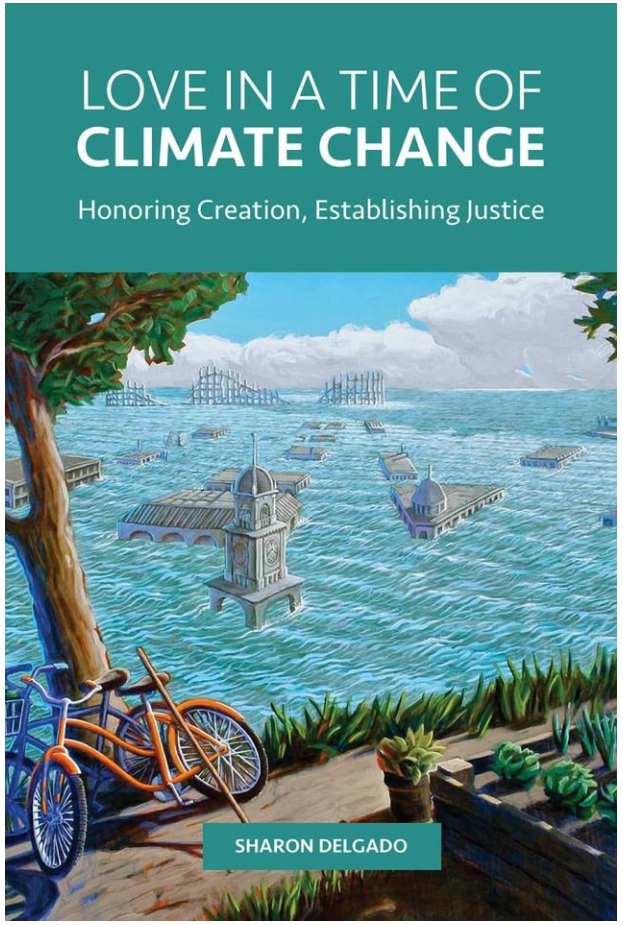


Environmental and Socioeconomic Justice in Bible

“Six years you shall sow your field, and six years you shall prune your vineyard and gather in their yield, but in the seventh year there shall be a Sabbath of complete rest for the land, a Sabbath for the Lord : you shall not sow your field or prune your vineyard. You shall not reap the aftergrowth of your harvest or gather the grapes of your unpruned vine: it shall be a year of complete rest for the land. You may eat what the land yields during its Sabbath—you, your male and female slaves, your hired and your bound laborers who live with you, for your livestock also, and for the wild animals in your land all its yield shall be for food.”
Leviticus 25:3-7

“The land shall not be sold in perpetuity, for the land is mine; with me you are but aliens and tenants. Throughout the land that you hold, you shall provide for the redemption of the land.”
Leviticus 25:23-24

On the Road to Jericho



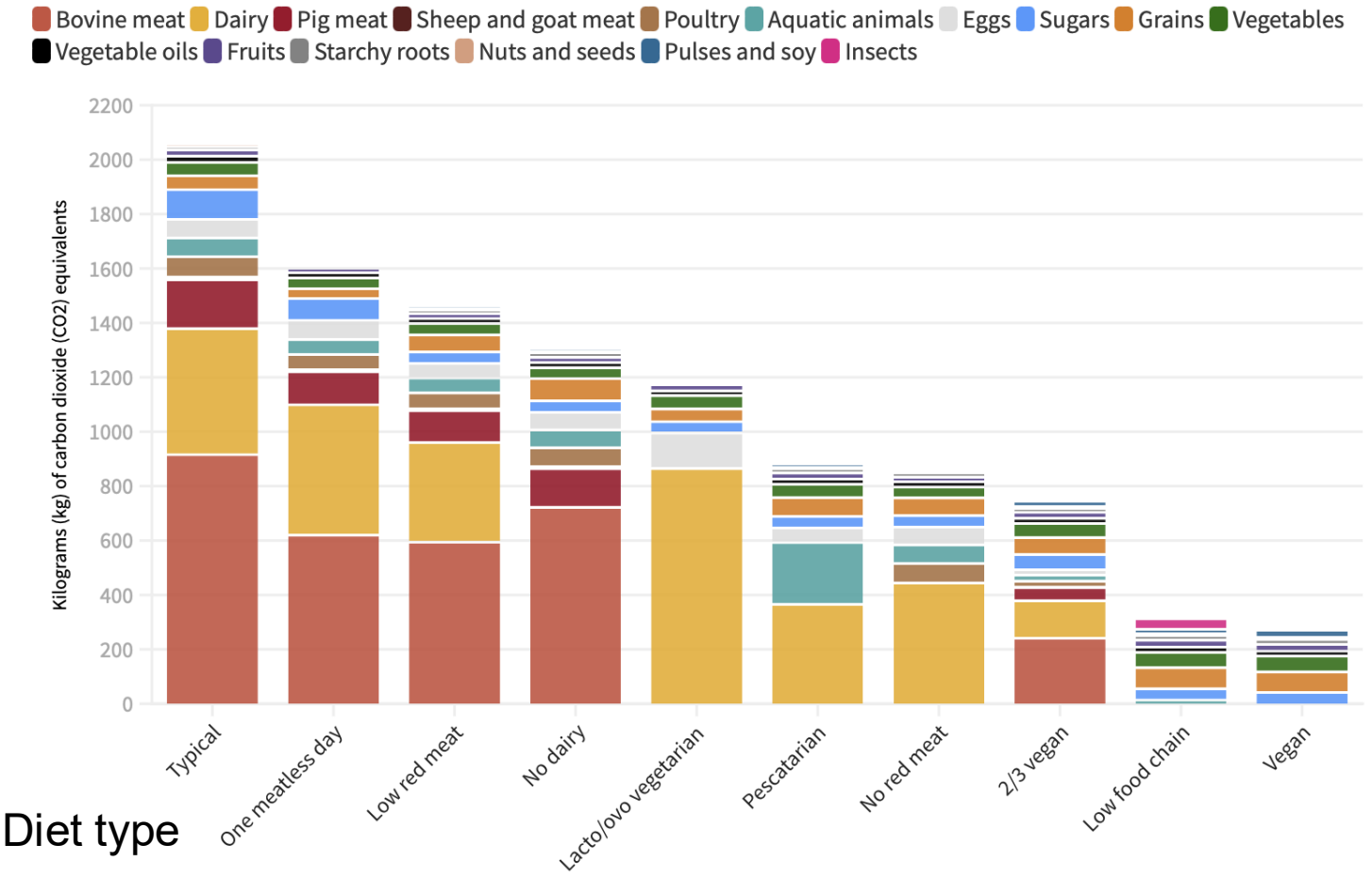
Who is our neighbor?

In the context of climate change and climate injustice:

- Who is the victim?
- Who are the robbers, priest and Levite?
- Who is the Good Samaritan?

Climate Action: Individual and Organization Level

- Reuse, reduce, recycle
- Switch off lights and electrical appliances when not in use
- Take public transportation, use energy-efficient vehicles (e.g., EV), car pool
- Reduce meat consumption, eat more plants
- Reduce food waste
- Reduce purchase of high-mileage goods
- Invest in green assets or projects



Climate Action: Political and Social Level

- Consider an environmental and sustainability career in governments, businesses and civil society
- Research problems, develop solutions: Climate change **adaptation** (to reduce vulnerability and enhance resilience) and **mitigation** (to reduce greenhouse gas concentrations and emissions)
- Actively exercise political rights, vote to change policies and institutions
- **Connect** with frontline climate activists and advocates in vulnerable communities and poor regions, and with other communities of faith; and keep **voicing out**

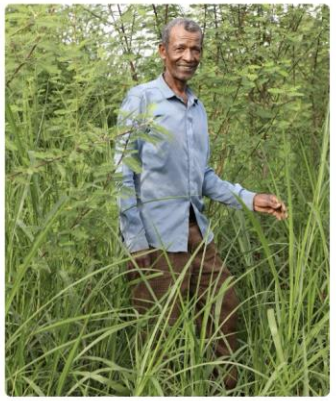
Frontline Faith-based Actions Worldwide

- Many examples across the world!!!
- Cedar Foundation of Hong Kong partnered with an NGO, Terepeza Development Association of Wolaita Kale Heywot Church in **Ethiopia**, to enable economic and gender empowerment, **conservation agriculture**, **natural resource management**, community development, and church leadership development for the rural communities in southern Ethiopia.
- It benefits tens of thousands of farmers and villagers there by helping them **adapt to climate change** in the most hard-hit areas, building **resilience** and **self-sufficiency** of vulnerable communities.









Frontline Faith-based Actions Worldwide

- World Vision has developed and implemented **Farmer Managed Natural Regeneration** (FMNR) in several **African countries**, a low-cost tree regeneration approach that offers sustainable livelihoods for communities frequently hit by droughts as a result of climate change.

FMNR made a remarkable impact in Luhundwa, Tanzania, in just three years.

Tony Rinaudo at TEDxSydney 2023

Tony Rinaudo discovered and put into practice a solution to the extreme deforestation and desertification

FMNR is a simple way to regrow trees from stumps with living roots through careful pruning and protection. Combined with other land restoration techniques, it is far more effective than planting trees.

Some Recent Good News for Climate…

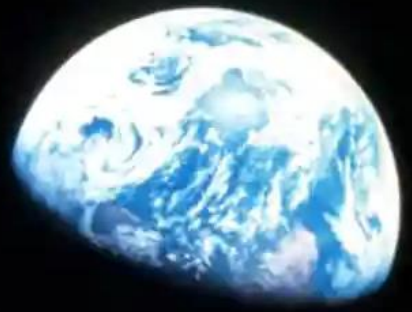
- **Renewable Energy Growth:** Renewable energy capacity grew at its fastest rate in two decades, with global capacity predicted to increase significantly by 2027 (World Economic Forum).
- **Renewable Energy Transition:** The EU saw wind and solar generate more electricity than fossil fuels in the first half of 2024 (Euronews).
- **Fully Renewable:** As global wind generation capacity increases, seven countries are now ~100% reliant on clean renewable energy (geothermal, hydroelectric, solar, wind) for their power needs: Albania, Bhutan, Ethiopia, Iceland, Nepal, Paraguay and Democratic Republic of Congo.
- **Amazon Deforestation Decline:** Amazon deforestation rates dropped significantly in 2024, marking the lowest level of destruction in nine years (Medium).
- **Legal Action:** Landmark ruling by European Court of Human Rights finds in favor of an association of 2,500 Swiss women that Swiss government's inaction to address climate change violated their fundamental human rights.
- More good news: https://ecologi.com/articles/blog/good-news-timeline

Our Hope Is in Our Lord

- We’re not alone!
- Grassroots communities, activists, businesses, and governments across the world are acting, especially to provide localized, practical solutions.
- Individual actions do amount to collective impacts.
- But most importantly, our hope is in our Risen Lord, only who can redeem all creation from our ecological sins.
- To care for creation and reduce our own impact on it is a loving response to our Lord’s grace and redemptive work, and a vocation to participate in that work.

Act Justly and Love Mercy Under Climate Change

“We came all this way to explore the Moon, and the most important thing is that we discovered the Earth” – William Anders, who took this photo now known as **“Earthrise”** from Apollo 8 spacecraft in 1968



“The Earth is what we all have in common.” – Wendell Berry, poet