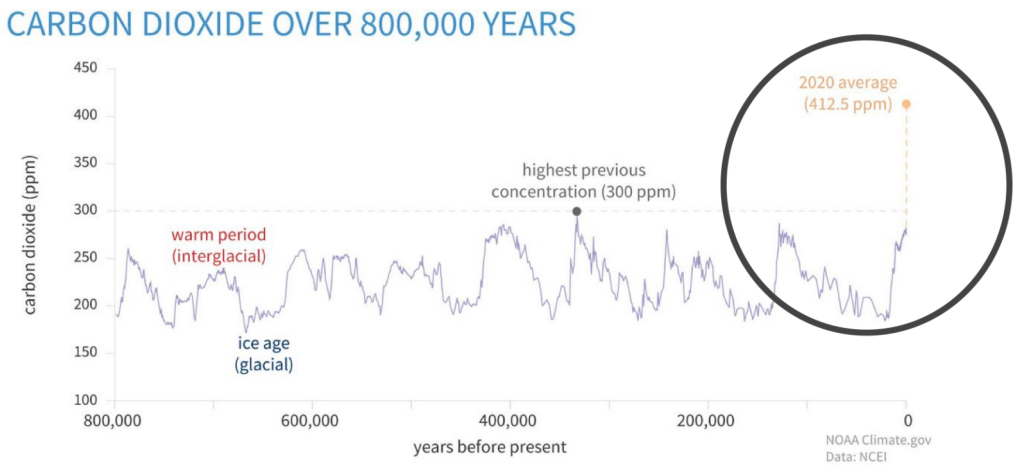
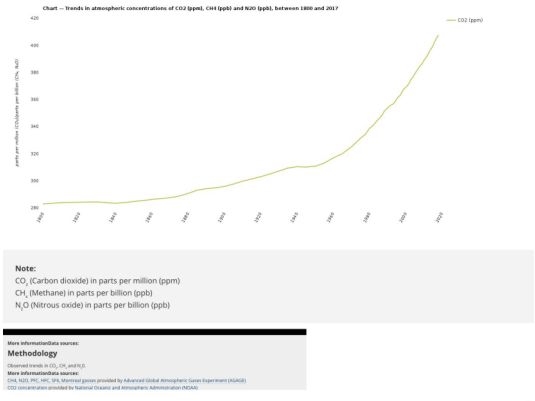
Anthropogenic activities and carbon cycle

1. Disruption of the carbon cycle-causes

1.1. Observation of disruption of the carbon cycle



Atmospheric carbon dioxide concentrations (CO2) in parts per million (ppm) for the past 800,000 years. On the geologic time scale, the increase to today's levels (orange dashed line) looks virtually instantaneous. Graph by NOAA Climate.gov based on data from Lüthi et al., 2008, via the NOAA NCEI Paleoclimatology Program.



"Recent increases in global averaged temperature over the last decade already appear to be outside the normal variability of temperature changes for the last thousand years. A number of different analyses strongly suggest that this temperature increase is resulting from the increasing atmospheric concentrations of greenhouse gases, thus lending credence to the concerns about much larger changes in climate being predicted for the coming decades." (Wuebbles, 2001)

1.2. Source of the disruption

« Human-related emissions from fossil fuel use have been estimated as far back as 1751. Before 1863, emissions did not exceed 0.1 GtC/year. However, by 1995 they had reached 6.5 GtC/year, giving an average emission growth rate slightly greater than 3% per year over the last two and a half centuries. Recent growth rates have been significantly lower, at 1.8% per year between 1970 and 1995. Emissions were initially dominated by coal. Since 1985, liquids have been the main source of emissions despite their lower carbon intensity. The regional pattern of emissions has also changed. Once dominated by Europe and North America, developing nations are providing an increasing share of emissions. »

« Physical processes and feedbacks caused by land-use change, that may have an impact on the climate, include changes in albedo and surface roughness, and the exchange between land and atmosphere of water vapour and greenhouse gases [see section 4, chapter 7]. [...] Land-use change may also affect the climate system through biological processes and feedbacks involving the terrestrial vegetation, which may lead to changes in the sources and sinks of carbon in its various forms [see chapter 3)]. » (IPCC, 2001)

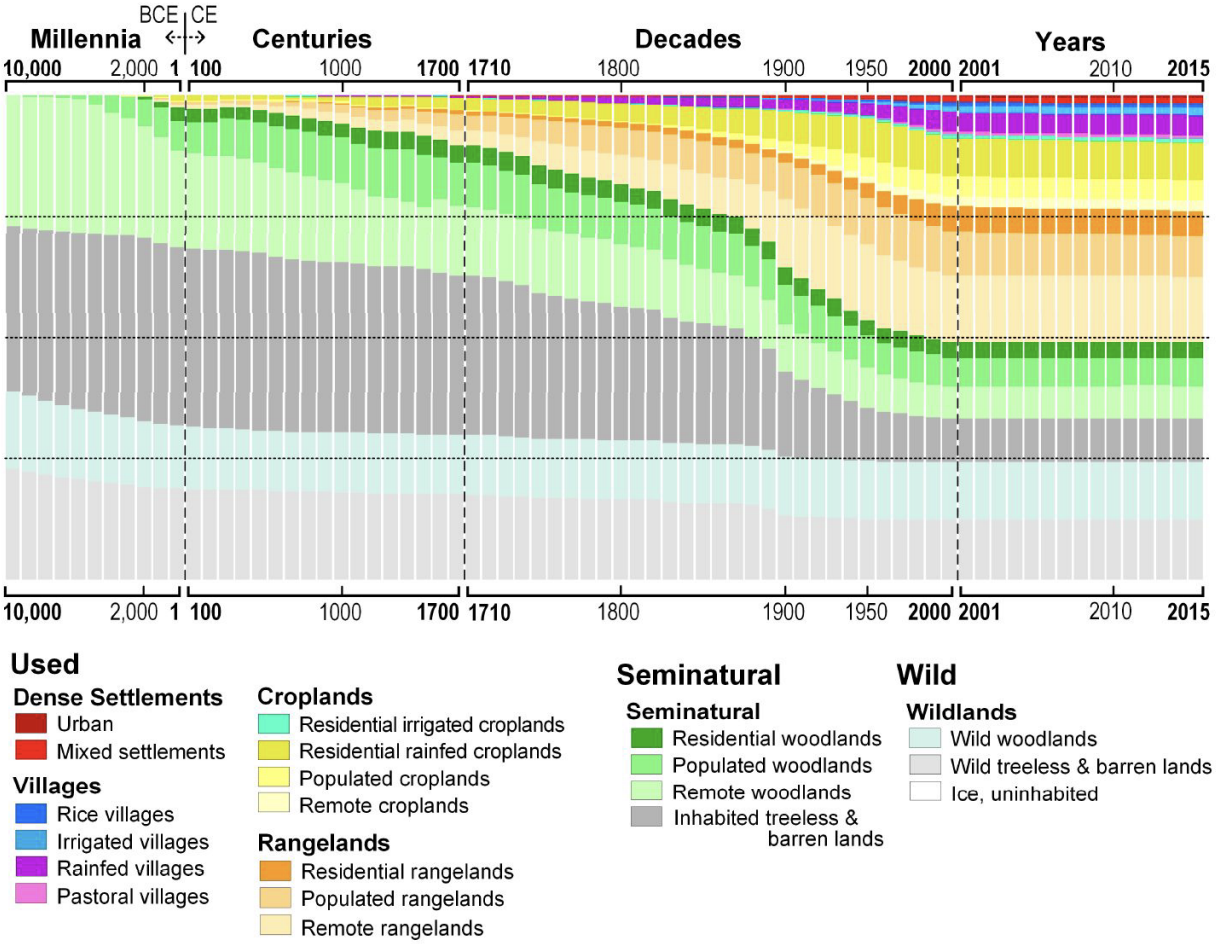


Figure 3. Changes in anthrome areas from 10,000 BCE to 2015 CE for all time intervals in the Anthromes 12K dataset. Relative global areas are indicated using stacked bars, which add up to the total global land area, not including Ice, uninhabited, which showed no significant changes over time.

1.3. Media

https://pod.utt.fr/video/4142-carboncycle-video8mov/

2. Disruption of the carbon cycle-environmental issues

2.1. Consequences on the Earth System

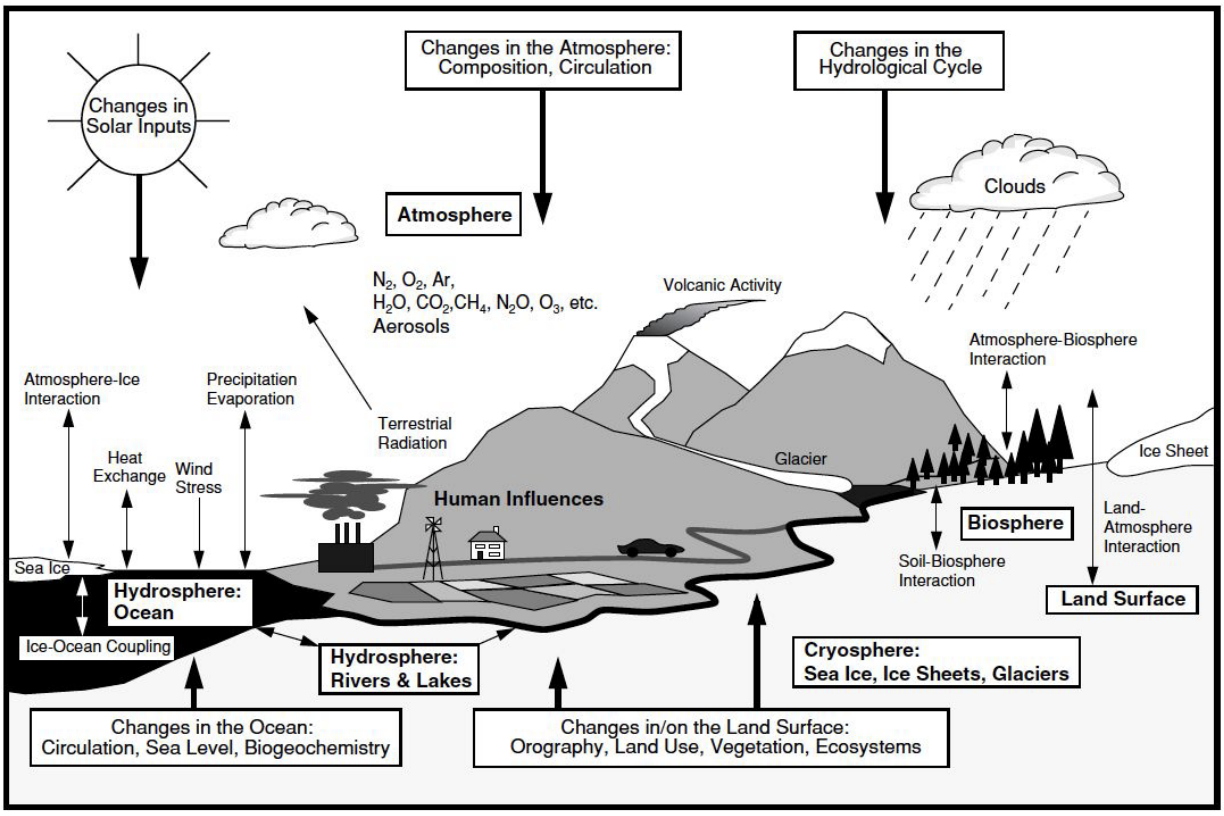


Figure 1.1: Schematic view of the components of the global climate system (bold), their processes and interactions (thin arrows) and some aspects that may change (bold arrows).

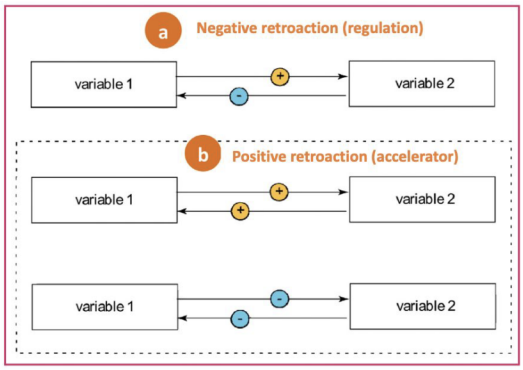


Figure: Schematic representation of negative (a: regulating effect on the system) and positive (b: runaway effect on the system) feedback loops.

An arrow with a "+" indicates a positive correlation between the two variables, and an arrow with a "-" indicates a negative correlation.

2.2. Feedback loops

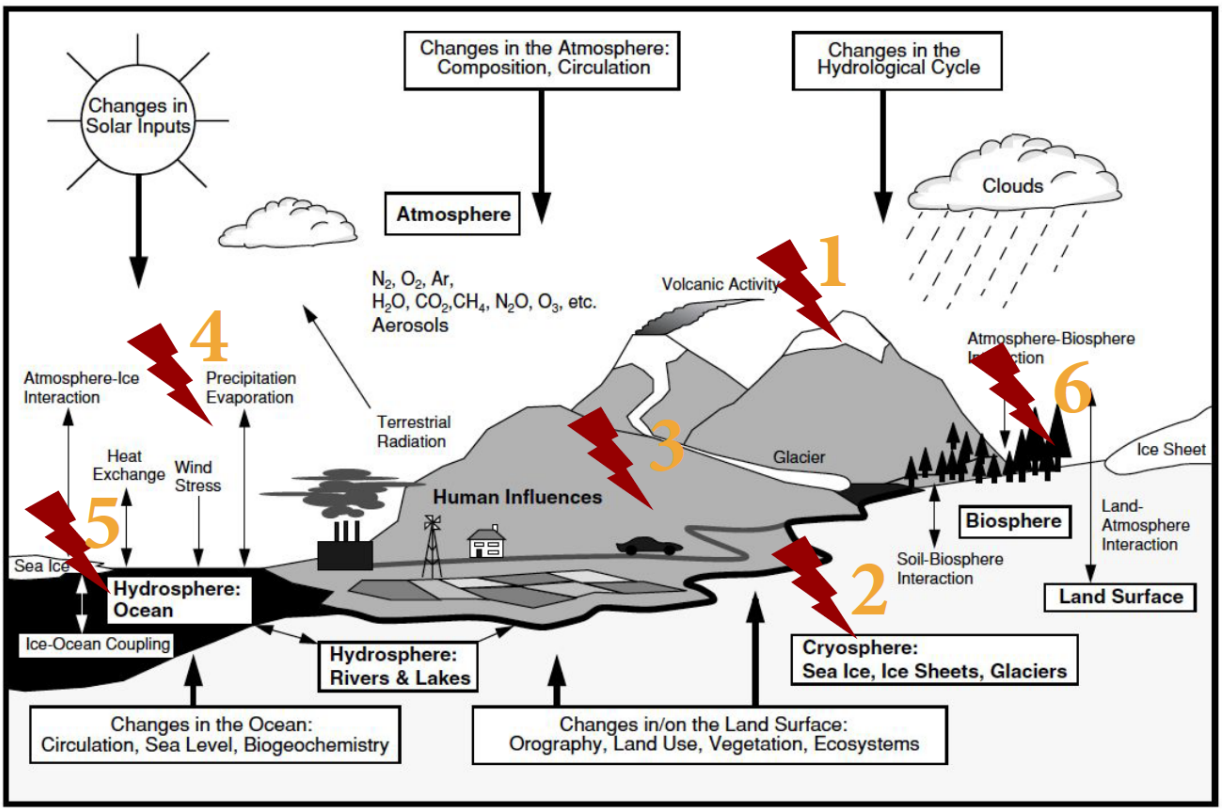
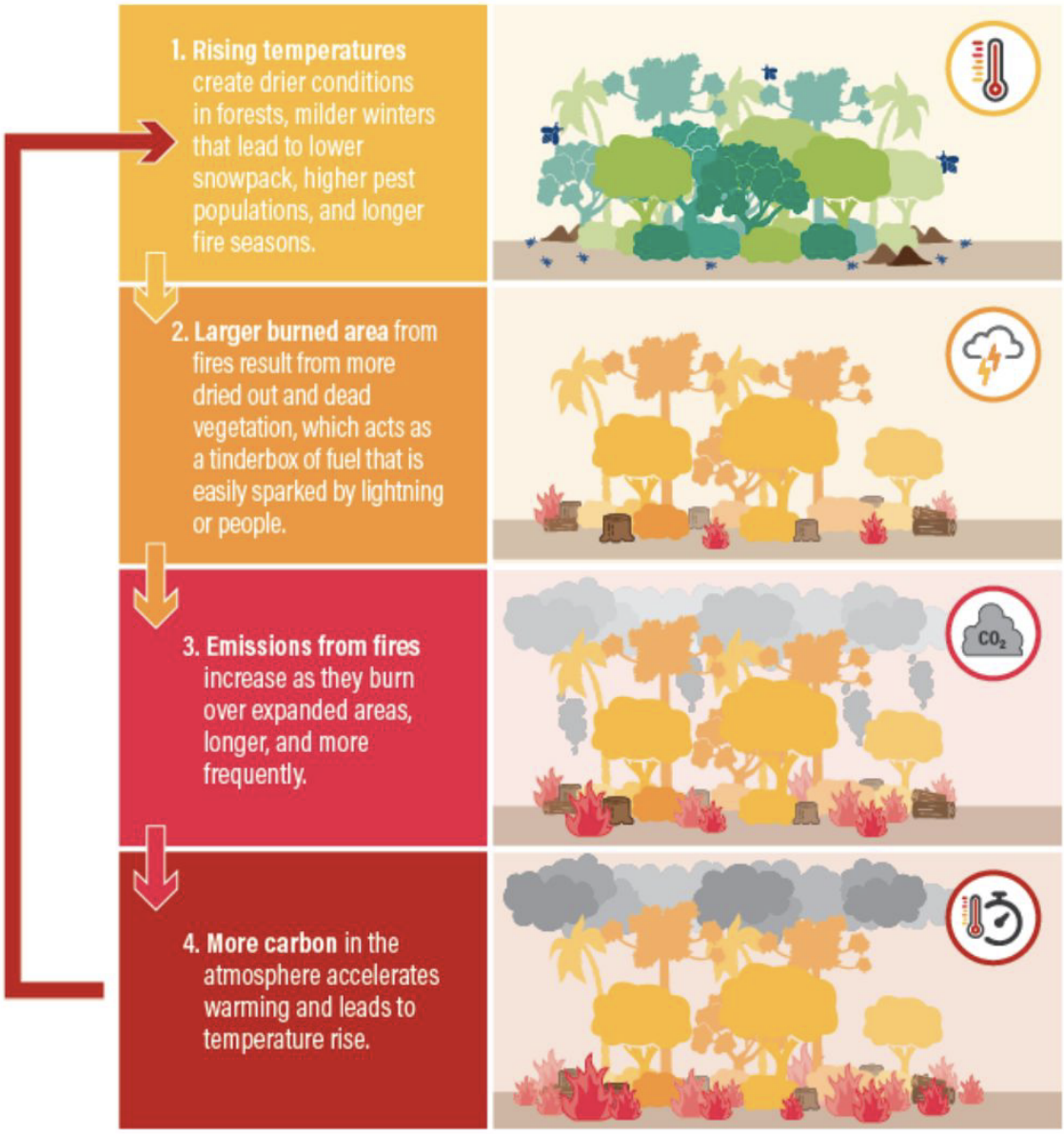


Figure 1.1: Schematic view of the components of the global climate system (bold), their processes and interactions (thin arrows) and some aspects that may change (bold arrows).

Feedback loop 1

Feedback loop 2

Feedback loop 6



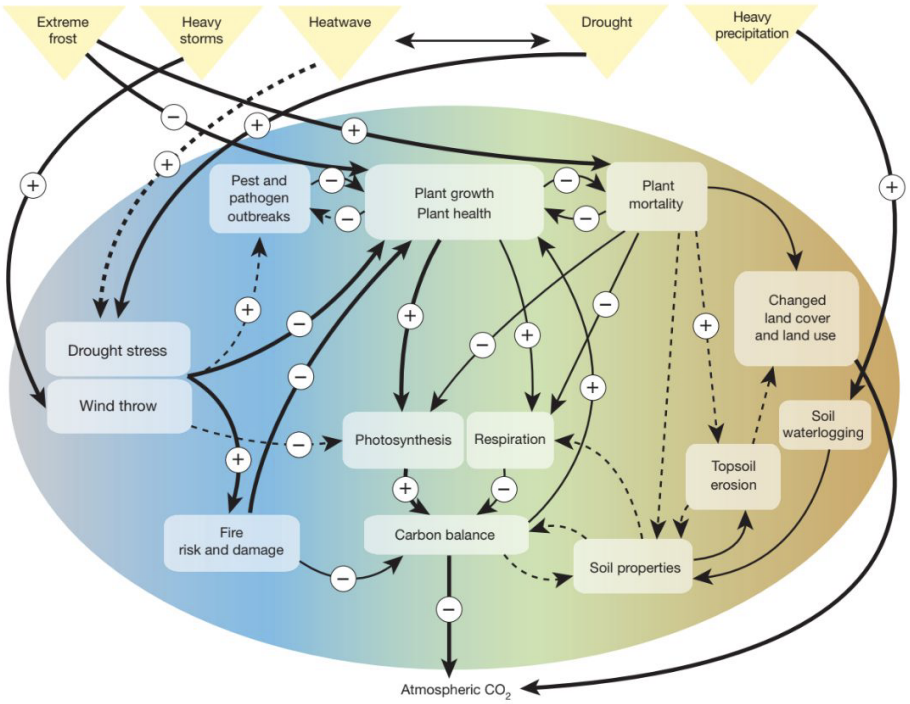
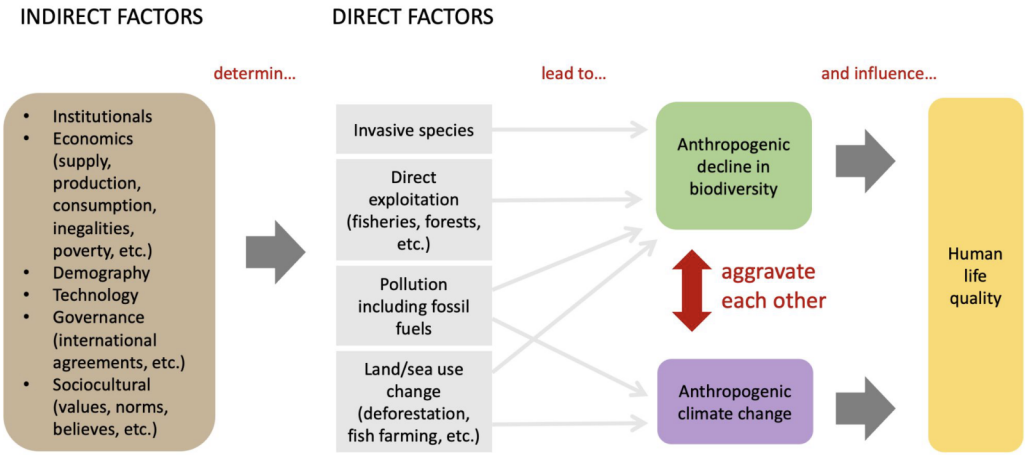


Figure 1 | Processes and feedbacks triggered by extreme climate events. The extreme events considered are droughts and heatwaves, heavy storms, heavy precipitation and extreme frost. Solid arrows show direct impacts; dashed arrows show indirect impacts. The relative importance of the impact relationship is shown by arrow width (broader arrows are more important).

Feedback loop 6 : focus biodiversity

- Climate change = main cause of biodiversity loss
- Preserving biodiversity = mitigating climate change
- /!\ technological solutions to mitigate climate change can have negative impacts on biodiversity
- Same causes: our socio-economic way of life



Anthropocene Atlas, Gemenne

Interesting source : https://ipbes.net/sites/default/files/2021-06/20210609_workshop_report_embargo_3pm_CEST_10_june_0.pdf

2.3. Media

https://pod.utt.fr/video/4143-carboncycle-video9mov/

3. Disruption of the carbon cycle-social issues

3.1. Social impacts

- Migrations
- Wars

El-Hinnawi (1985): *« those people who have been forced to leave their traditional habitat, temporarily or permanently, because of a marked environmental disruption (natural and/or triggered by people) that jeopardize their existence and/or seriously affects the quality of their life »*.

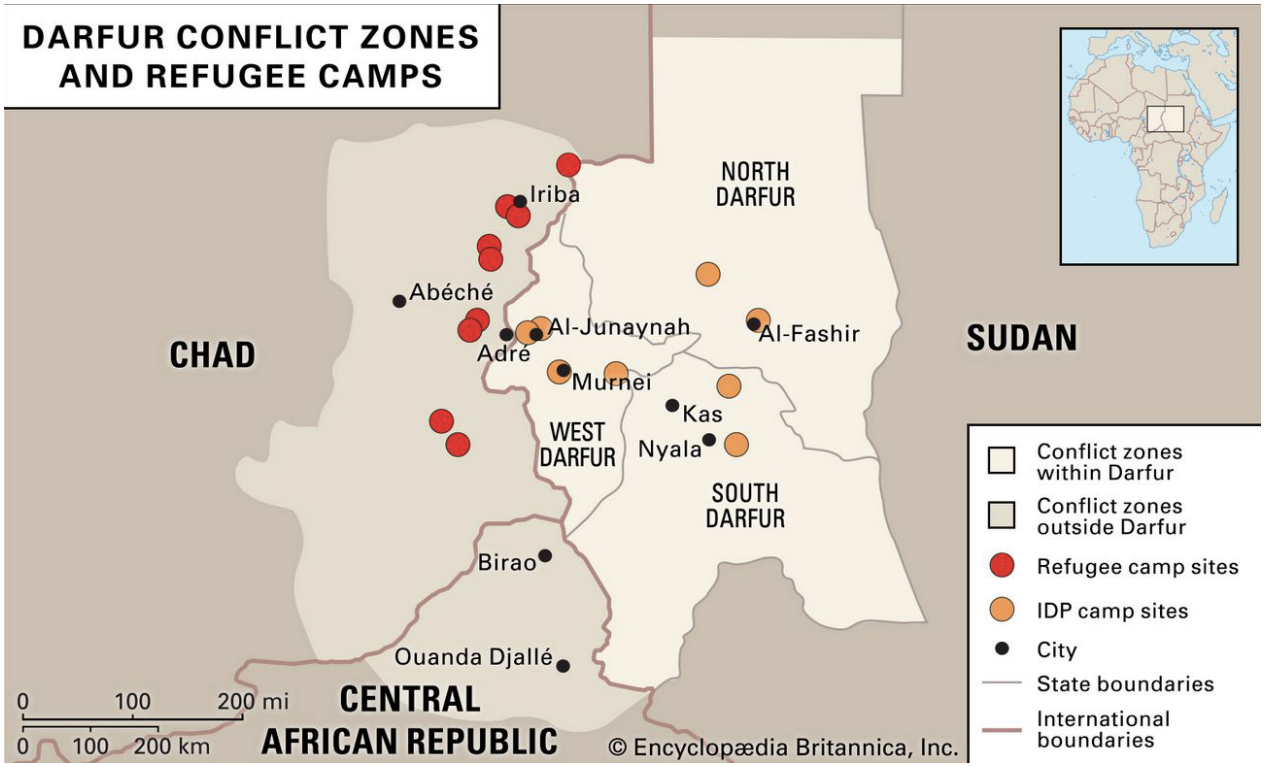
Table 4: Typology of Potential Migrations

Direct Climate Changes	Indirect Climate Changes	Type of Movement	Time Span
Gradual climate change	Chronic disasters such as drought, degradation	Seasonal labour migration. Temporary circulation	Seasonal
Gradual climate change	Chronic disasters-drought/ degradation	Contract labour migration	Yearly
Sudden or gradual climate change	Natural disasters/ severe drought/ Famine/Floods	Forced/distress migration	Temporary
Sudden or gradual climate change	Extreme Temperatures/ Sea Level Rise	Permanent migration	Lifetime

(Partially adapted from Kothari, 2002:20)

Climate Refugees ***Définition***

- 1951 Refugee Convention: refugee = from political persecution (UN)
- “Climate Change Displaced People” : people whose habitat is threatened or is already at risk of being extinguished due to climatic change (Hodgkinson et al., 2009)
- “Climate refugees” or “forced climate migrants”



Britannica, The Editors of Encyclopaedia. "Darfur". Encyclopedia Britannica, Invalid Date, https://www.britannica.com/place/Darfur. Accessed 15 September 2021.

The complex ethnic distinctions in Darfur are perhaps less important than the contrast between agriculturalists and pastoralists. The relationship between the two is governed by competition for land and water resources, which can be affected by short- and long-term climate change (whether random, cyclical or greenhouse-induced), both in terms of absolute availability and geographical extent of the resources.

Jeffrey Mazo (2009) Chapter Three : Darfur : The First Modern Climate-ChangeConflict, The Adelphi Papers, 49:409, 73-86, DOI: 10.1080/19445571003755538

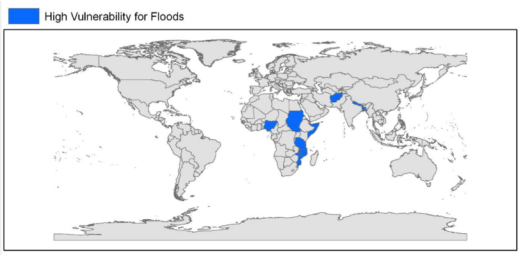
Armed Conflicts *Définition*

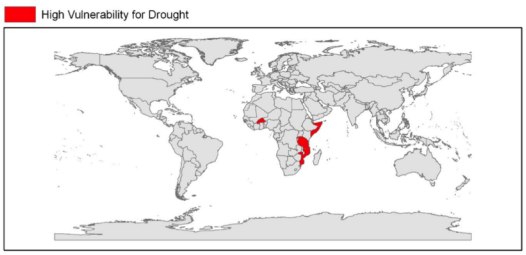
3 elements (Sakaguchi, 2017):

1. There are correlation between climate change and violence but no robust conclusion.
2. There are weak empirical support to the link between climate change and violence
3. Methodologies used in the different students have an impact on results

« Migration is generally considered to be the intermediate stage which links environmental degradation and disasters to conflict (Homer Dixon, 1991 and 1994) »

(Assessing the Impact of Climate Change on Migration and Conflict, Raleigh)





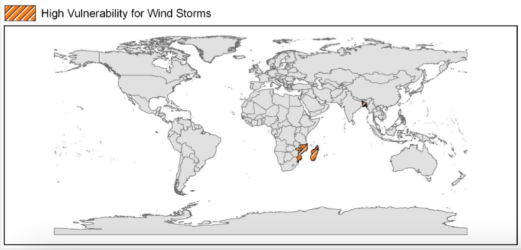


Table 3: Areas Highly Vulnerable to Disasters in Near Future

Droughts	Floods	Wind Storms
Burkina Faso	Afghanistan	Bangladesh
Mozambique	Bangladesh	Madagascar
Rwanda	Malawi	Mozambique
Somalia	Mozambique	
Tanzania	Nepal	
	Nigeria	
	Somalia	
	Sudan	
	Tanzania	

3.2. Media

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4. Conclusion

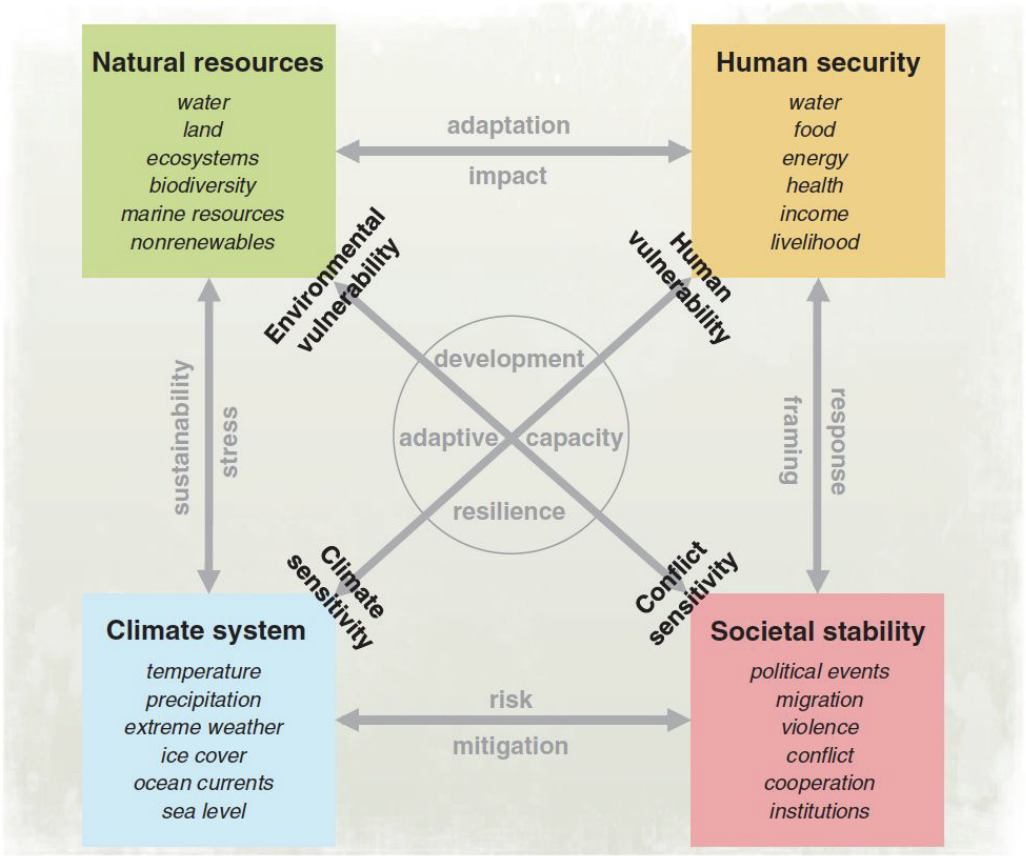

Fig. 1. Analytical framework of linkages between the climate system, natural resources, human security, and societal stability [based on (*28*)].

Scheffran, 2012 based on Scheffran, 2009