

# HISTORY AND EPISTEMOLOGY OF ANTHROPOCENE SCIENCES

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**auteur-e(s) :** Kunzhang GUO (UTT), Tatiana REYES CARRILLO (UTT) Projet ET-LIOS

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# Objectifs

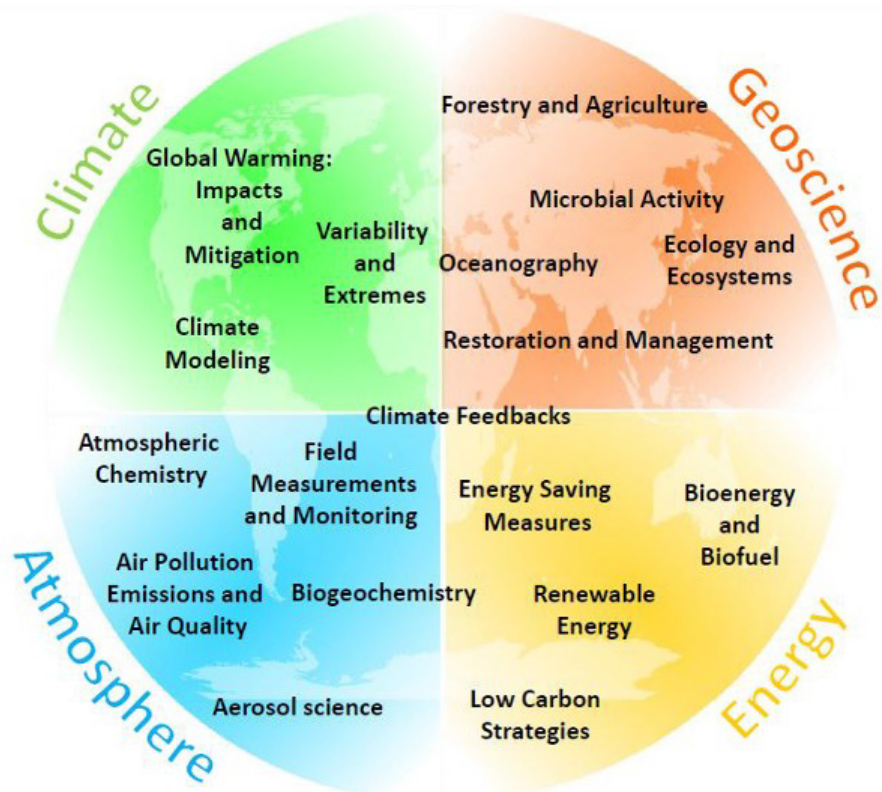
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1. To understand the process of accumulating human knowledge about the Earth system .
2. To highlight the importance of the key concepts of the Earth system being proposed and discovered in the process of accumulating knowledge .
3. To realize the importance of looking at the Earth system as a whole, from a multidisciplinary perspective, in order to achieve sustainable development for people and nature today.

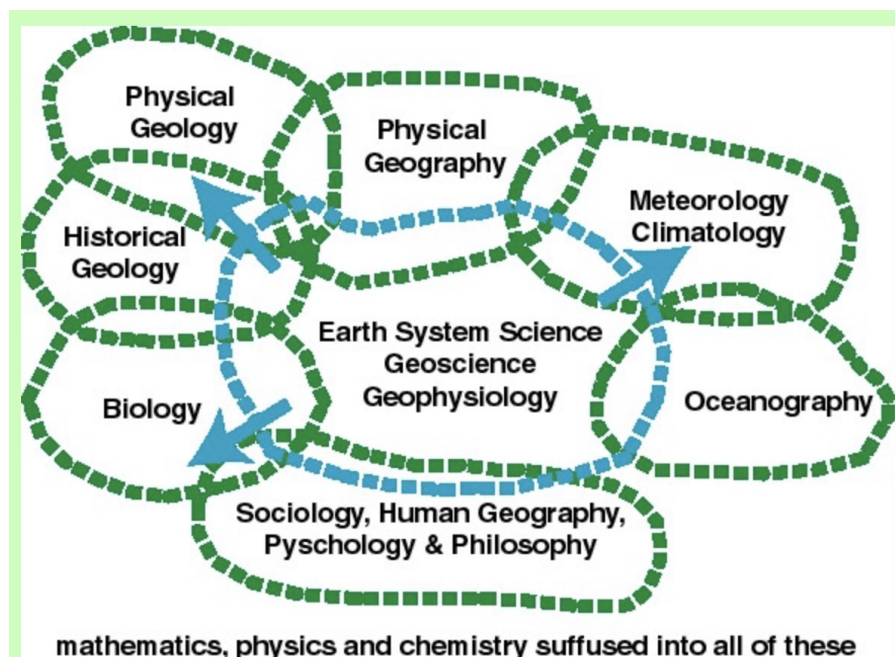
# 1. How does Earth System Sciences (ESS) Evolve ?

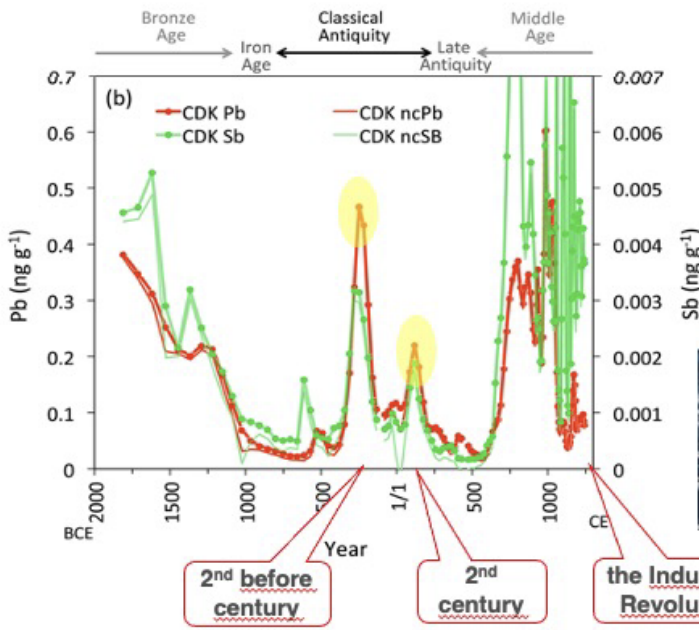
## Earth system sciences

- Earth System Science (ESS) is a rapidly emerging **transdisciplinary** endeavour aimed at understanding the structure and functioning of the Earth as a complex, adaptive system. (Will Steffen et. al. 2020)
- Transdisciplinary endeavour



<http://www.phd-ess.org/>





Romans' extensive mining and smelting of heavy metals between 350 BCE and 175 CE



French Alps



A Roman legionary supervises workers in a tin mine in Britain in around 50 AD

Lead and Antimony in Basal Ice From Col du Dome (French Alps) Dated With Radiocarbon: A Record of Pollution During Antiquity, 2019

The development of ESS is the evolution of humans understanding of global change.

### History of Earth system sciences

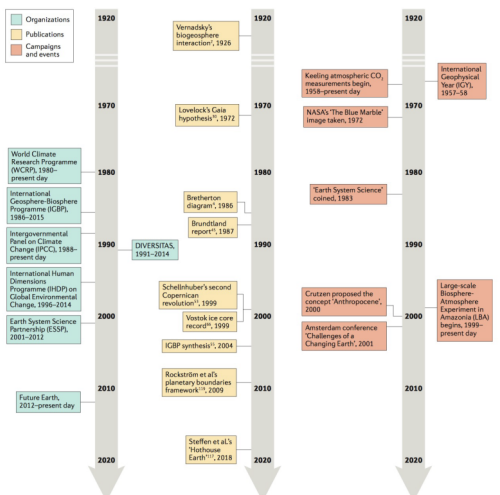
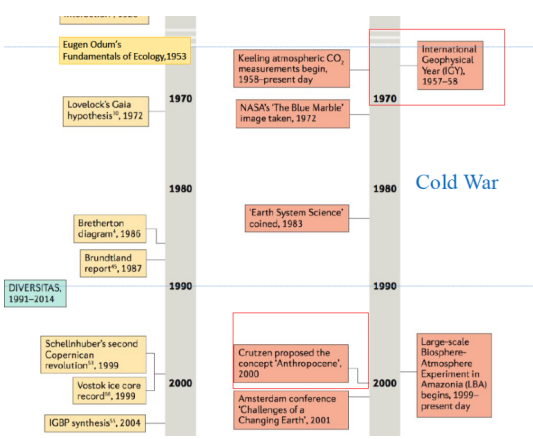


Fig. 1 | Timeline illustrating the development of Earth System Science from the mid-20th century. The figure shows the key organizations, events and concepts that have helped to define and develop Earth System Science.

- Vernadsky 'The Biosphere'



- International Geophysical year
- Eugene Odum , Father of Modern Ecology
- Gaia Hypothesis
- The Bretherton Diagram

The wisdom accumulated in this process has introduced new concepts and theories that have altered our understanding of the Earth System, particularly the disproportionate role of humanity as a driver of change.

One of the most influential concept is that of the Anthropocene.

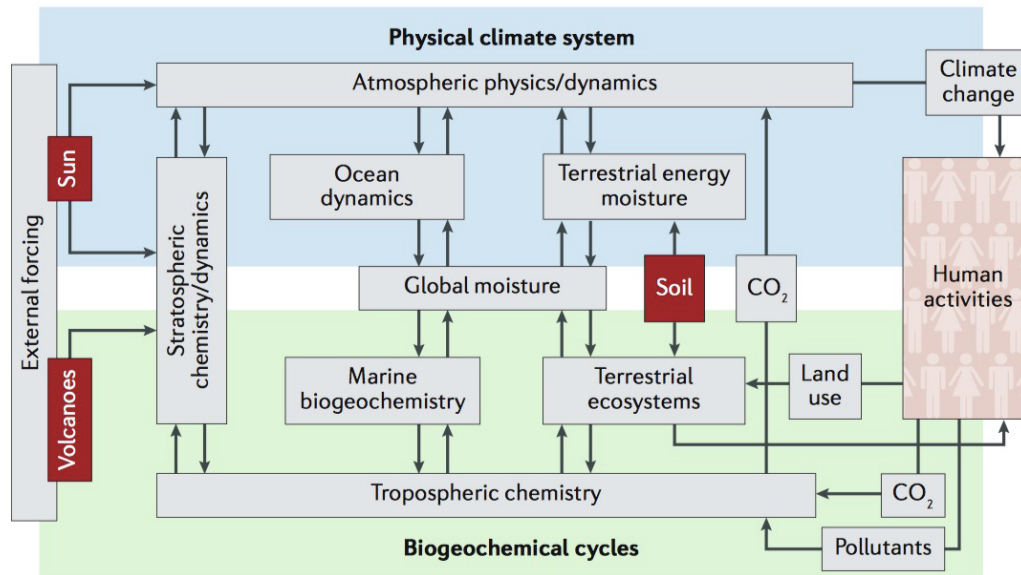


Fig. 2 | **The NASA Bretherton diagram of the Earth System.** The classical, simplified depiction of the Earth System and its interactions. The focus is on the interactions between the geosphere and the biosphere, with human forcings represented as an outside force affecting the geosphere–biosphere system. Reproduced with permission of National Academies Press from NASA (1986) Earth System Science Overview. A program for global change. Prepared by the Earth System Sciences Committee, NASA Advisory Council. 48pp. (REF.<sup>4</sup>), permission conveyed through Copyright Clearance Center, Inc.

One result from NASA ESSC is The Bretherton diagram, which epitomized the rapidly growing field of ESS through its visualization of the interacting physical, chemical and biological processes that connect components of the Earth System and through the recognition that **human activities were a significant driving force** for change in the system.

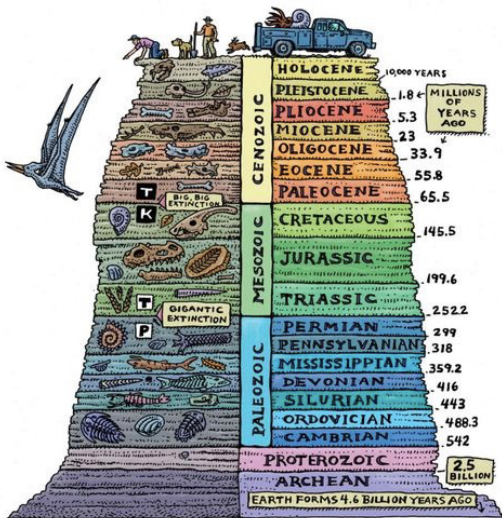
## 2. What is Anthropocene ?

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### **Définition** Anthropocene

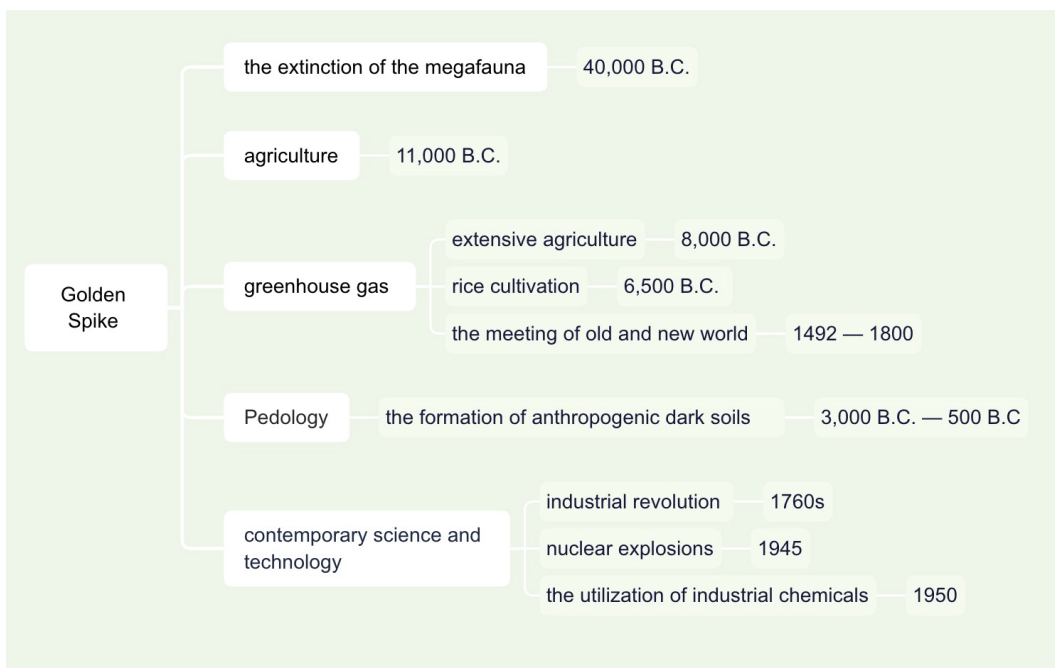
The **Anthropocene** is a concept that designates a state of the planet in which key natural systems are coupled with social systems at a global level, thus influencing Earth system as a whole, thereby turning the human species into a global geophysical force that put the future habitability of the Earth into question ( Steffen et al., 2007).

# 3. When does the Anthropocene Start ?



The **Anthropocene** is a proposed new geological epoch dating from the commencement of significant human impact on the Earth system.

- Crutzen, Nature, 2002



- Gemenne et al., 2019.12 Atlas de l'Anthropocène



# 4. What is the History of the Anthropocene ?



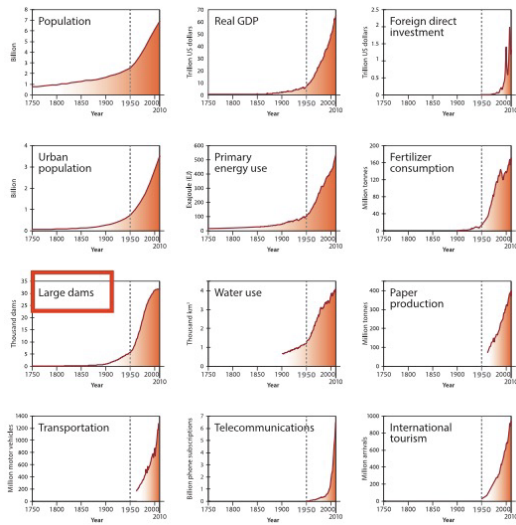
Wayne Hayes, 2014

# 5. The present situation of the Anthropocene



# 6. How do they measure the Anthropocene ?

## 6.1. Human activities



Socio-economic trends - 12 indicators

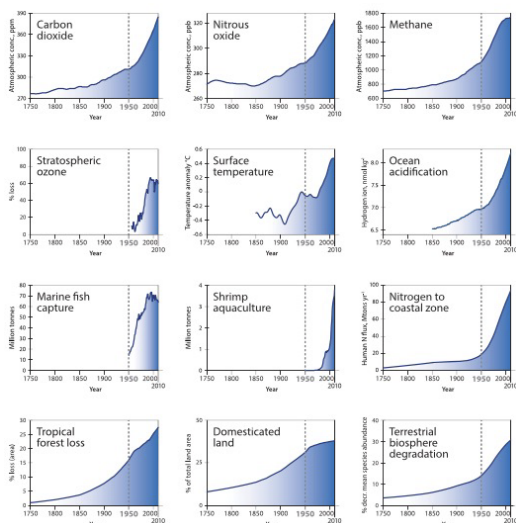
**Figure 1.** Trends from 1750 to 2010 in globally aggregated indicators for socio-economic development.

(Will Steffen et. al 2015)

The Earth System indicators, in general, continued their long-term, post-industrial rise, although a few, such as atmospheric methane concentration and stratospheric ozone loss, showed a slowing or apparent stabilisation over the past decade. The post-1950 acceleration in the Earth System indicators remains clear.

From the perspective temporality, only beyond the mid-20th century is there clear evidence for fundamental shifts in the state and functioning of the Earth System that are beyond the range of variability of the Holocene and driven by human activities.

## 6.2. Earth statement



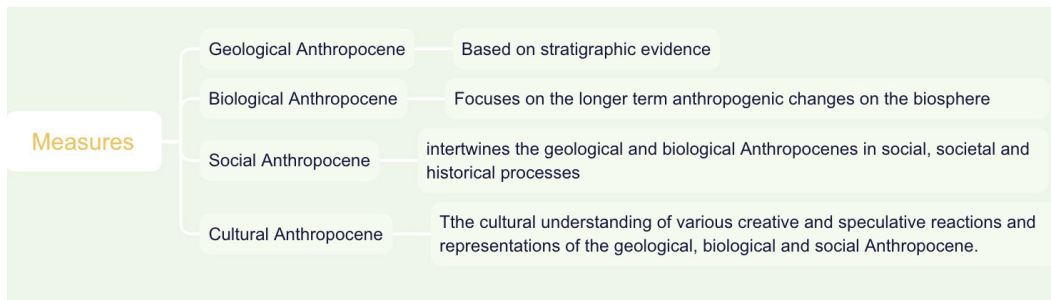
Earth system trends - 12 indicators

Generally, the dominant feature of the socioeconomic trends is that the economic activity of the human enterprise continues to grow at a rapid rate, especially after 1950s.

**Figure 3.** Trends from 1750 to 2010 in indicators for the structure and functioning of the Earth System.

## 7. How do the scholars approach to the Anthropocene ?

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**The social Anthropocene** is a socioenvironmental approach in which the evolution of human–nature relations are investigated within the context of past, present and future social structures. The perspective produces knowledge on how the changes in biosphere are connected to both world-systemic as well as national and regional social hierarchies, power and economic structures or political interests.

**Culture** : the set of values, ideas, beliefs and practices that are functioning on all areas of human life.

T Toivanen, et al., 2017

## 8. What are the measures of the Anthropocene ?

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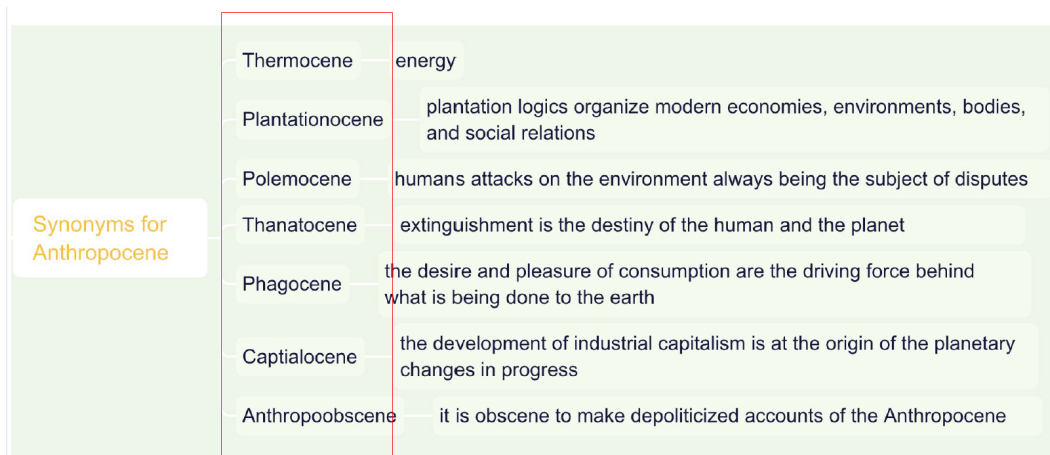
Social Anthropocene =>

- Can identify, problematize and popularize the economic, political and ideological barriers that stand in front of sustainable pathways.
- Can contribute to innovate, establish and rearrange the institutional arrangements that structure the economy, social life and environmental relations.

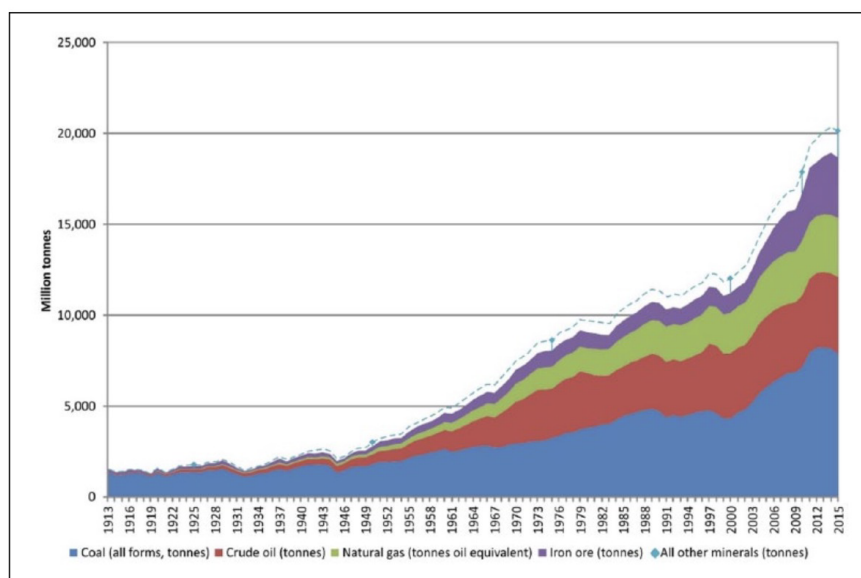
Social Anthropocene et cultural Anthropocene =>

- Create more discerning models for understanding human involvement in the Earth's processes (and the Earth's involvement in human processes);
- Point to the diverse social and cultural phenomena resistant to modelling and develop alternative methods to research such phenomena. (repressed or denied beliefs and ideological commitments, narratives of individual or collective identity or destiny, ideas about rights and responsibilities, and other forms of individual and collective thought that underlie human action)

# 9. Interpretations of the Anthropocene



Bonneuil and Fressoz, 2016 *The Shock of the Anthropocene : The Earth, History and Us.*



**Figure 1.** World production of coal, crude oil, natural gas and iron ore, with all other minerals (except for construction aggregates) interpolated between key year intervals.

(Anthony H Cooper et. al 2018 )

- By 2015, the most significant by mass of world production are coal 39%, oil 21%, and natural gas 16% ;
- Over time, the production amounts of coal, crude oil, and nature gas has been increasing.
- Where was the energy transition?

## Thermocene

- Bonneuil and Fressoz contest that the truth of the seeming energy transition in the history of energy is successive **addition** of new sources of primary. It is the confusion between relative (the use of coal decreased in relation to oil) and absolute (the consumption of coal remains continually grew), between local and global that creates this illusion.

- Energy transitions “follow neither an internal logic of technical progress, nor a logic of scarcity and substitution, nor even a logic that was simply economic, and history of energy is above all one of political, military and ideological choices that involve with strategic interests and objectives of certain social groups”.

## Plantationocene

- Estimates suggest that 75 million acres of land worldwide have been sold or leased in the past decade to foreign investors for large-scale oil palm, rubber, and other agricultural concessions.
- The plantation, as Sidney observed, was a “synthesis of field and factory,” an agro-industrial system of enterprise integral to the historic rise and growth of capitalism.



*Rubber seedlings await planting on a concession granted to Firestone*

*Tire & Rubber Company by the Liberian government in 1926. Firestone's*

*99 year lease for up to one million acres of land in Liberia paved the*

*way for the current wave of land concessions to foreign investors in*

*Liberia. Photo by Gregg Mitman.*

## Western Global Colonization Since 1500 CE



Rüdiger Glaser, 2021

## Polemocene

- It re-evaluates criticisms of anthropocentric action since the dawn of industrialisation.
- It is a history of socioecological struggles and challenges to the damages of industrialism, where people defend the forest, its rights of usage and the planet, people question machines and mass production, people are opposite to innovations. Bonneuil and Fressoz use this 'cene to emphasize a long history of political struggle motivated by social justice and "environmentalism of the poor". Despite of this resistance, they failed to prevent industrialism's expansion from the Industrial Revolution through the Cold War to today.

## Thanatocene

- It is the natural history of destruction. a teleological view that, extinguishment is the destiny of the human and the planet that is now in the stage of intense destruction, which owes to the global mobilizations of the Second World War.
- As the twentieth century progressed, wars became both deadlier and more frequent. Troops were supported, and to a certain degree replaced, by extraordinarily powerful machines, technological and logistic systems. War machines that required growing quantities of raw materials and energy had an unprecedentedly heavy impact on the environment.
- The contemporary aircraft industry is likewise a product of the Second World War, both technologically (aluminium, radar, jet engines) and institutionally. The Second World War thus prepared the technological and legal framework for mass-consumption society.

## Phagocene

This interpretation revolves around consumerism. Consumerism is a social and economic order that encourages people to acquire goods and services in ever-increasing quantities. With the advent of the Industrial Revolution, the supply of goods outstrips consumer demand, as a result of mass production led to overproduction, so manufacturers turned to planned advertising to manipulate consumer spending.

## Captialocene

- From the perspective of captialocene. The last three centuries have been characterized by an extraordinary accumulation of capital: despite destructive wars, this grew by a factor of 134 between 1700 and 2008. The dynamic of capital accumulation gave rise to a 'second nature' made up of roads, plantations, railways, mines, pipelines, wells, power stations, futures markets and container ships, financial positions and banks that structure flows of matter, energy, goods and capital on a world scale. It is this profit-oriented technostructure that swung the Earth system into the Anthropocene. The change in geological regime is the act of the 'age of capital', rather than simply the 'age of man' as the dominant narratives claim.

## Anthropoobscene

- One view from Anthro-po-obscene is that it is impotant to make depoliticized accounts of the Anthropocene. This concept could be listed on top 10 most difficult terminology in Anthropocene. It is a reflection of the reflection on the Anthropocene. The debate on the Anthro-po-obscene tries to figure out whether the interpretation of Anthropocene is associated with politics. For example, scholar Erik Swyngedouw attempts to defense that the matter of ecology is fundamentally de-politicised. And he clams that the "political" cannot and should not be grounded on the eventual truth of the Anthropocene.
- *Gemenne et al., 2019.12 Atlas de l'Anthropocène*
- *Sophie Sapp Moore 2019, 1 Plantation Legacies*