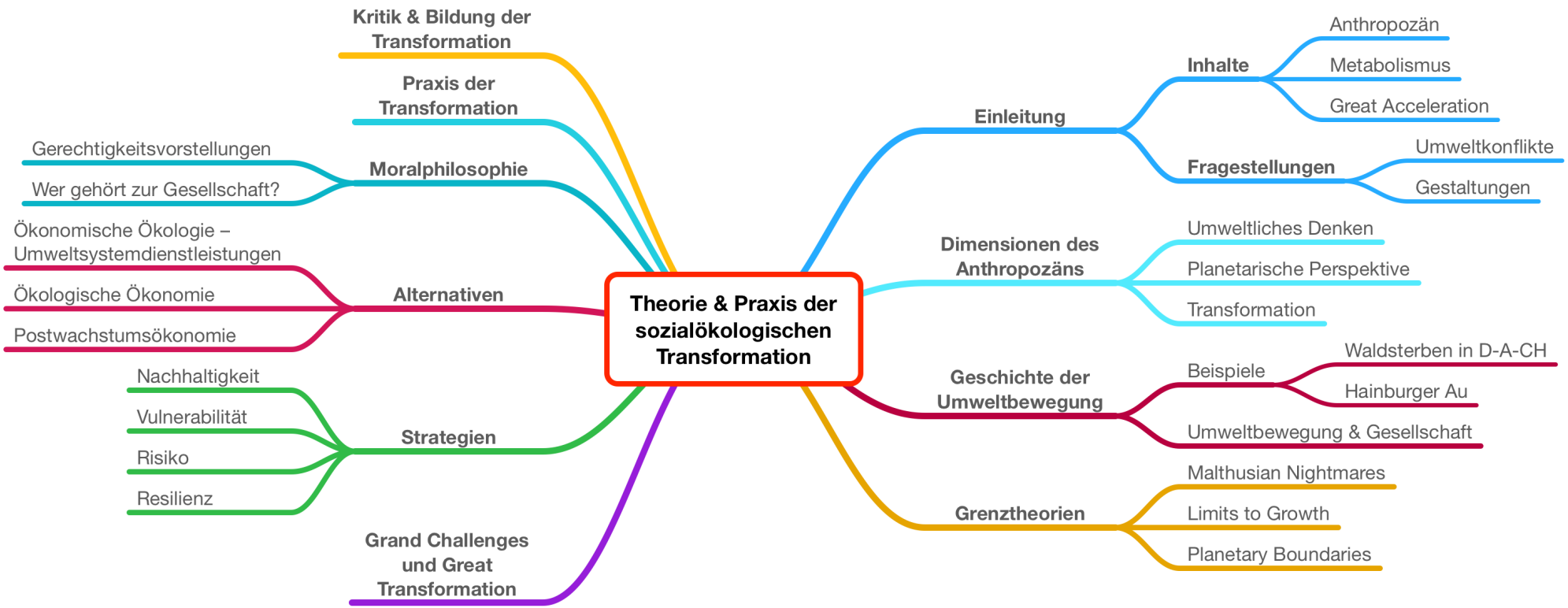
Theorie & Praxis der sozialökologischen Transformation

Prof. Dr. habil. Pascal Goeke
pascal.goeke@ph-linz.at

Seminarinhalte



Aufgaben – Details bei Moodle

- Lektüre (OneDrive-Link mit ph-linz.at)
- Asynchrone Sitzungsaufgaben
- Präsentation eines Transformationsbeispiels, höchstens 10 Minuten
- Fachliche Klärung, ca. 50.000 Zeichen bis zum 31.7.

Referate

Datum	Name	Name	Name
15.3.2023	Lena Panhuber	Florian Nestler	Niclas Schaupp: E-Fuels
19.4.2023	Martin Seufer-Wasserthal		
10.5.2023	Nicole Staudinger	Cora Rothkirch	Valentin Thalguter
24.5.2023	Lena Dirnberger	Patricia Salzwimmer	
14.6.2023	Katrin Haselberger		Harald Fichtner

Leider vergaß ich die Folien beim Schließen zu speichern und ich konnte nicht vollständig rekonstruieren, wer wann dran ist. Ich bitte um Nachsicht und entsprechende Nachmeldungen.

Das Anthropozän

Annäherungen

1. Das Anthropozän – Definitionen und Grundlagen
2. Eine kleine Erfolgsgeschichte der einfachen Vokabel
3. Erfolgsbedingungen und Elemente
   a. Umweltliches Denken
   b. Planetarische Perspektive
   c. Transformationsimperativ
4. Fazit: Von einer sachlichen Beobachtungs-kategorie zu einer kategorischen Weltbeobach-tungsformel

Anthropozän – Schöpfungsmoment (2000)

- International Geosphere-Biosphere Program, Annual Conference 2000
- Paul J. Crutzen (1933-2021), Atmosphären-chemiker, Nobelpreisträger für Chemie (1995)

„the chairman mentioned the Holocene again and again as our current geological epoch. After hearing that term many times, **I lost my temper, interrupted the speaker, and remarked that we are no longer in the Holocene. I said that we were already in the "Anthropocene."** My remark had a major impact on the audience. First there was a silence, then people started to discuss this. In the coffee break, somebody approached me and said I should patent the term. After my talk I looked to see whether the term Anthropocene had been used before. Indeed it had, by a limnologist of the University of Michigan, Eugene F. Stoermer." (Crutzen 2013)

http://www.igbp.net/

Crutzen, Paul J. und Christian Schwägerl (2013): **›A Huge Variety of Possibilities‹: Interview with Nobel Laureate Paul Crutzen on his Life, his Career in Research, and his Views on the Anthropocene Idea.** In: Environment & Society Portal, (www.environmentandsociety.org/exhibitions/anthropocene/huge-variety-possibilities-interview-nobel-laureate-paul-crutzen-his-life (12.10.2015)).

Bitte lesen Sie die beiden Texte

- Crutzen, Paul J. (2002). Geology of Mankind. *Nature, 415*, 23. doi:10.1038/415023a

- Crutzen, Paul J., & Stoermer, Eugene F. (2000). The ›Anthropocene‹. *Global Change Newsletter, 41*, 17-18.

Anthropozän – Verkündung (2000)

The "Anthropocene"

by Paul J. Crutzen and Eugene F. Stoermer

The name Holocene ("Recent Whole") for the post-glacial geological epoch of the past ten to twelve thousand years seems to have been proposed for the first time by Sir Charles Lyell in 1833, and adopted by the International Geological Congress in Bologna in 1885 (1). During the Holocene mankind's activities gradually grew into a significant geological, morphological force, as recognised early on by a number of scientists. Thus, G.P. Marsh already in 1864 published a book with the title "Man and Nature", more recently reprinted as "The Earth as Modified by Human Action" (2). Stoppani in 1873 rated mankind's activities as a "new telluric force which in power and universality may be compared to the greater forces of earth" [quoted from Clark (3)]. Stoppani already spoke of the anthropozoic era. Mankind has now inhabited or visited almost all places on Earth; he has even set foot on the moon.

The great Russian geologist V.I. Vernadsky (4) in 1926 recognized the increasing power of mankind as part of the biosphere with the following excerpt "... the direction in which the processes of evolution must proceed, namely towards increasing consciousness and thought, and forms having greater and greater influence on their surroundings". He, the French Jesuit P. Teilhard de Chardin and E. Le Roy in 1924 coined the term "noösphere", the world of thought, to mark the growing role played by mankind's brainpower and technological talents in shaping its own future and environment.

The expansion of mankind, both in numbers and per capita exploitation of Earth's resources has been astounding (5). To give a few examples: During the past 3 centuries human population increased tenfold to 6000 million, accompanied e.g. by a growth in cattle population to 1400 million (6) (about one cow per average size family). Urbanisation has even increased tenfold in the past century. In a few generations mankind is exhausting the fossil fuels that were generated over several hundred million years. The release of SO_2, globally about 160 Tg/year to the atmosphere by coal and oil burning, is at least two times larger than the sum of all natural emissions, occurring mainly as marine dimethyl-sulfide from the oceans (7); from Vitousek et al. (8) we learn that 30-50% of the land surface has been transformed by human action; more nitrogen is now fixed synthetically and applied as fertilizers in agriculture than fixed naturally in all terrestrial ecosystems; the escape into the atmosphere of NO from fossil fuel and biomass combustion likewise is larger than the natural inputs, giving rise to photochemical ozone ("smog") formation in extensive regions of the world; more than half of all accessible fresh water is used by mankind; human activity has increased the species extinction rate by thousand to ten thousand fold in the tropical rain forests (9) and several climatically important "greenhouse" gases have substantially increased in the atmosphere: CO_2 by more than 30% and CH_4 by even more than 100%. Furthermore, mankind releases many toxic substances in the environment and even some, the chlorofluorocarbon gases, which are not toxic at all, but which nevertheless have led to the Antarctic "ozone hole" and which would have destroyed much of the ozone layer if no international regulatory measures to end their production had been taken. Coastal wetlands are also affected by humans, having resulted in the loss of 50% of the world's mangroves. Finally, mechanized human predation ("fisheries") removes more than 25% of the primary production of the oceans in the upwelling regions and 35% in the temperate continental shelf regions (10). Anthropogen
well illustrated by the
communities that leave
sediments. The effects
clude modification of
cycle in large freshwater
cur in systems remote
sources (11-13).

Considering these
major and still growing
man activities on earth
and at all, including
seems to us more than
emphasize the central
in geology and ecology
use the term "anthropoc
rent geological epoch.
current human activiti
over long periods. Acco
by Berger and Loutre (14
anthropogenic emission
may depart significantly from natural
behaviour over the next 50,000 years.

To assign a more specific date to the onset of the "anthropocene" seems somewhat arbitrary, but we propose the latter part of the 18th century, although we are aware that alternative proposals can be made (some may even want to include the entire holocene). However, we choose this date because, during the past two centuries, the global effects of human activities have become clearly noticeable. This is the period when data retrieved from glacial ice cores show the beginning of a growth in the atmospheric concentrations of several "greenhouse gases", in particular CO_2 and CH_4 (7). Such a starting date also coincides with James Watt´s invention of the steam

„more than appropriate to emphasize the central role of mankind in geology and ecology by proposing to use the term ‚anthropocene' for the current geological epoch" (Crutzen/Stoermer 2000: 17).

Crutzen, Paul J. und Eugene F. Stoermer (2000): **The ›Anthropocene‹.** In: *Global Change Newsletter* 41, S. 17-18.

Anthropozän – Verbreitung (2002)

concepts

Geology of mankind

Paul J. Crutzen

For the past three centuries, the effects of humans on the global environment have escalated. Because of these anthropogenic emissions of carbon dioxide, global climate may depart significantly from natural behaviour for many millennia to come. It seems appropriate to assign the term 'Anthropocene' to the present, in many ways human-dominated, geological epoch, supplementing the Holocene — the warm period of the past 10–12 millennia. The Anthropocene could be said to have started in the latter part of the eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane. This date also happens to coincide with James Watt's design of the steam engine in 1784.

Mankind's growing influence on the environment was recognized as long ago as 1873, when the Italian geologist Antonio Stoppani spoke about a "new telluric force which in power and universality may be compared to the greater forces of earth," referring to the "anthropozoic era". And in 1926, V. I. Vernadsky acknowledged the increasing impact of mankind: "The direction in which the processes of evolution must proceed, namely towards increasing consciousness and thought, and forms having greater and greater influence on their surroundings." Teilhard de Chardin and Vernadsky used the term 'noösphere' — the 'world of thought' — to mark the growing role of human brain-power in shaping its own future and environment.

The rapid expansion of mankind in numbers and per capita exploitation of Earth's resources has continued apace. During the past three centuries, the human population has increased tenfold to more than 6 billion and is expected to reach 10 billion in this century. The methane-producing cattle population has risen to 1.4 billion. About 30–50% of the planet's land surface is exploited by humans. Tropical rainforests disappear at a fast pace, releasing carbon dioxide and strongly increasing species extinction. Dam building and river diversion have become commonplace. More than half of all accessible fresh water is used by mankind. Fisheries remove more than 25% of the primary production in upwelling ocean regions and 35% in the temperate continental shelf. Energy use has grown 16-fold during the twentieth century, causing 160 million tonnes of atmospheric sulphur dioxide emissions per year, more than twice the sum of its natural emissions. More nitrogen fertilizer is applied in agriculture than is fixed naturally in all terrestrial ecosystems; nitric oxide production by the burning of fossil fuel and biomass also overrides natural emissions. Fossil-fuel burning and agriculture have caused substantial increases in the concentrations of 'greenhouse' gases — carbon dioxide by 30% and methane by more than 100% — reaching their highest levels over the past 400 millennia, with more to follow.

So far, these effects have largely been caused by only 25% of the world population. The consequences are, among others, acid precipitation, photochemical 'smog' and climate warming. Hence, according to the latest estimates by the Intergovernmental Panel on Climate Change (IPCC), the Earth will warm by 1.4–5.8 °C during this century.

Many toxic substances are released into the environment, even some that are not toxic at all but nevertheless have severely damaging effects, for example the chlorofluorocarbons that caused the Antarctic 'ozone hole' (and which are now regulated). Things could have become much worse: the ozone-destroying properties of the halogens have been studied

The Anthropocene

The Anthropocene could be said to have started in the late eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane.

If it had turned out t
chemically like brom
would by then have
round phenomenon,
of the Antarctic sprin
by wisdom, this catas
not develop.

Unless there is a gl
meteorite impact, a
demic — mankind
environmental force f
daunting task lies ah
engineers to guide soc
mentally sustainable
the era of the Anth
require appropriate h
scales, and may well ir
accepted, large-scale
jects, for instance to
this stage, however,
treading on *terra incog*

*Paul J. Crutzen is at the Ma
Chemistry, PO Box 3060, I
Germany, and the Scripps
Oceanography, University
San Diego, 9500 Gillman I
California 92093-7452, US*

FURTHER READING

Marsh, G. P. *Man and Nature
Earth as Modified by Human*
Cambridge, Massachusetts,
Crutzen, P. J. & Stoermer, E.
(Royal Swedish Academy of
Stockholm, 2000).
Clark, W. C. & Munn, R. E. (e
Development of the Biosphe
(Cambridge Univ. Press, Cam
Vernadski, V. I. *The Biosphe*
annotated version from the
(Springer, New York, 1998).
Turner, B. L. *et al. The Earth
Action* (Cambridge Univ. Pre
McNeill, J. R. *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (W. W. Norton, New York, 2000).
Houghton, J. T. *et al.* (eds) *Climate Change 2001: The Scientific Basis* (Cambridge Univ. Press, Cambridge, 2001).
Berger, A. & Loutre, M.-F. *C. R. Acad. Sci. Paris* 323 (IIA), 1–16 (1996).
Schellnhuber, H. J. *Nature* 402, C19–C23 (1999).

„For the past three centuries, the effects of humans on the global have escalated. Because of these anthropogenic emissions of carbon dioxide, global climate may depart significantly from natural behaviour for many millennia to come. It seems appropriate to assign the term ‘Anthropocene’ to the present, in many ways human-dominated, geological epoch, supplementing the Holocene — the warm period of the past 10–12 millennia.“ (Crutzen 2002: 23)

Crutzen, Paul J. (2002): **Geology of Mankind.** In: *Nature* 415, S. 23.

Anthropozän – Begründung (2007)

Article **Will Steffen, Paul J. Crutzen and John R. McNeill**

The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?

We explore the development of the Anthropocene, the current epoch in which humans and our societies have become a global geophysical force. The Anthropocene began around 1800 with the onset of industrialization, the central feature of which was the enormous expansion in the use of fossil fuels. We use atmospheric carbon dioxide concentration as a single, simple indicator to track the progressi
trial value of
had risen to
human enterp
sion, the Grea
es for Earth
concentration
1950, with ab
trial era occu
Acceleration i
next few dec
evolution of t

discernible at the global scale? How has this imprint evolved through time?

– How does the magnitude and rate of human impact compare with the natural variability of the Earth's environment? Are human effects similar to or greater than the great forces of nature in terms of their influence on Earth System functioning?

What are the socioeconomic, cultural, political, and techno

Box 1. Global Change and the Earth System

The term *Earth System* refers to the suite of interacting physical, chemical and biological global-scale cycles and energy fluxes that provide the life-support system for life at the surface of the planet (1). This definition of the Earth System goes well beyond the notion that the geophysical processes encompassing the Earth's two great fluids—the ocean and the atmosphere—generate the planetary life-support system on their own. In our definition

Box 2. The Anthropocene

Holocene ("Recent Whole") is the name given to the postglacial geological epoch of the past ten to twelve thousand years as agreed upon by the International Geological Congress in Bologna in 1885 (3). During the Holocene, accelerating in the industrial period, humankind's activities became a growing geological and morphological force, as recognised early by a number of scientists. Thus, in 1864, Marsh published a book with the title "Man and Nature," more recently reprinted as "The Earth

Steffen, Will; Paul J. Crutzen und John R. McNeill (2007): **The Anthropocene: Are humans now overwhelming the great forces of Nature?** In: *AMBIO: A Journal of the Human Environment* 36(8), S. 614-621

Anthropozän und die Erdsystemwissenschaften

„The Earth System is defined as the integrated biophysical and socioeconomic processes and interactions (cycles) among the atmosphere, hydrosphere, cryosphere, biosphere, geosphere, and anthroposphere (human enterprise) in both spatial – from local to global – and temporal scales, which determine the environmental state of the planet within its current position in the universe. Thus, humans and their activities are fully part of the Earth System, interacting with other components.“ (Rockström et al. 2009, 32)

Rockström, Johan et al. (2009): **Planetary boundaries: Exploring the Safe Operating Space for Humanity.** In: *Ecology and Society* 14(2), S. 32.

Anthropozän – Realdefinition

Der Begriff Anthropozän bezeichnet die jüngste Epoche der Erdgeschichte. Das wesentliche Merkmal dieser Epoche im engeren Sinn ist, dass die menschliche Gesellschaft zum bedeutsamsten erdsystemischen Faktor geworden ist. Daher wird man die Existenz der Menschheit auch dann noch erkennen können, wenn die Menschheit selbst ausgestorben ist und nicht mehr Zeugnis ihrer eigenen Existenz wird ablegen können.

Anthropozän als Formel

Traditionell

$$\frac{dE}{dt} = \int (A, G, I)$$

dE = development of the Earthsystem

dt = development time

A = astronomical forces (z.B. Meteoriten & Sauriersterben)

G = geophysical forces (z.B. Atmosphärische Veränderungen)

I = internal dynamics (z.B. Cyanobakterien vor 2,5 Milliarden Jahren und das Gift Sauerstoff, Große Sauerstoffkatastrophe)

Anthropozän

$$\frac{dE}{dt} = \int_{(A,\, G,\, I \,\to 0)} (H)$$

H = human society

Gaffney, Owen und Will Steffen (2017): **The Anthropocene equation.** In: *The Anthropocene Review* 4(1), S. 53-61.

Erdgeschichte in 24 Stunden

tatsächlich bis heute verstrichene Zeit [Mio. Jahre]	erdgeschichtliches Ereignis (Entstehung der/von…)	heruntergerechnet auf einen Tag	
		verbleibende Zeit bis Tagesende	Uhrzeit
0,01 (Holozän)	Ackerbau und Viehzucht	0,2 s	23:59:59,8
0,19 (spätes Pleistozän)	*Homo sapiens*	3,6 s	23:59:56,4
2 (frühes Pleistozän)	*Homo habilis*	38 s	23:59:22
7 (spätes Miozän)	„Vormenschen“	2 min 15 s	23:57:45
20 (frühes Miozän)	Menschenaffen	6 min	23:54
40 (Eozän)	Affen	12 min	23:48
60 (Paläozän)	Primaten	18 min	23:42
200 (früher Jura)	Säuger	1 h 5 min	22:55
315 (spätes Karbon)	Amnioten	1 h 40 min	22:20
360 (spätes Devon)	Landwirbeltiere	1 h 55 min	22:05
425 (Silur)	Knochenfische	2 h 15 min	21:45
470 (Ordovizium)	Wirbeltiere	2 h 30 min	21:30
600 (Ediacarium)	Bilateria	3 h 10 min	20:50
1500 (Mesoproterozoikum)	Eukaryoten	7 h	17:00
2400 (Neoarchaikum)	Photosynthese	13 h	11:00
3800 (Eoarchaikum)	Einzeller	20 h	04:00
4570 (Hadaikum)	Erde	24 h	00:00

https://de.wikipedia.org/wiki/Geologische_Zeitskala#Vergleich_Erdzeitalter_%E2%80%93_Ein_Tag (10.10.2021)

Datierung

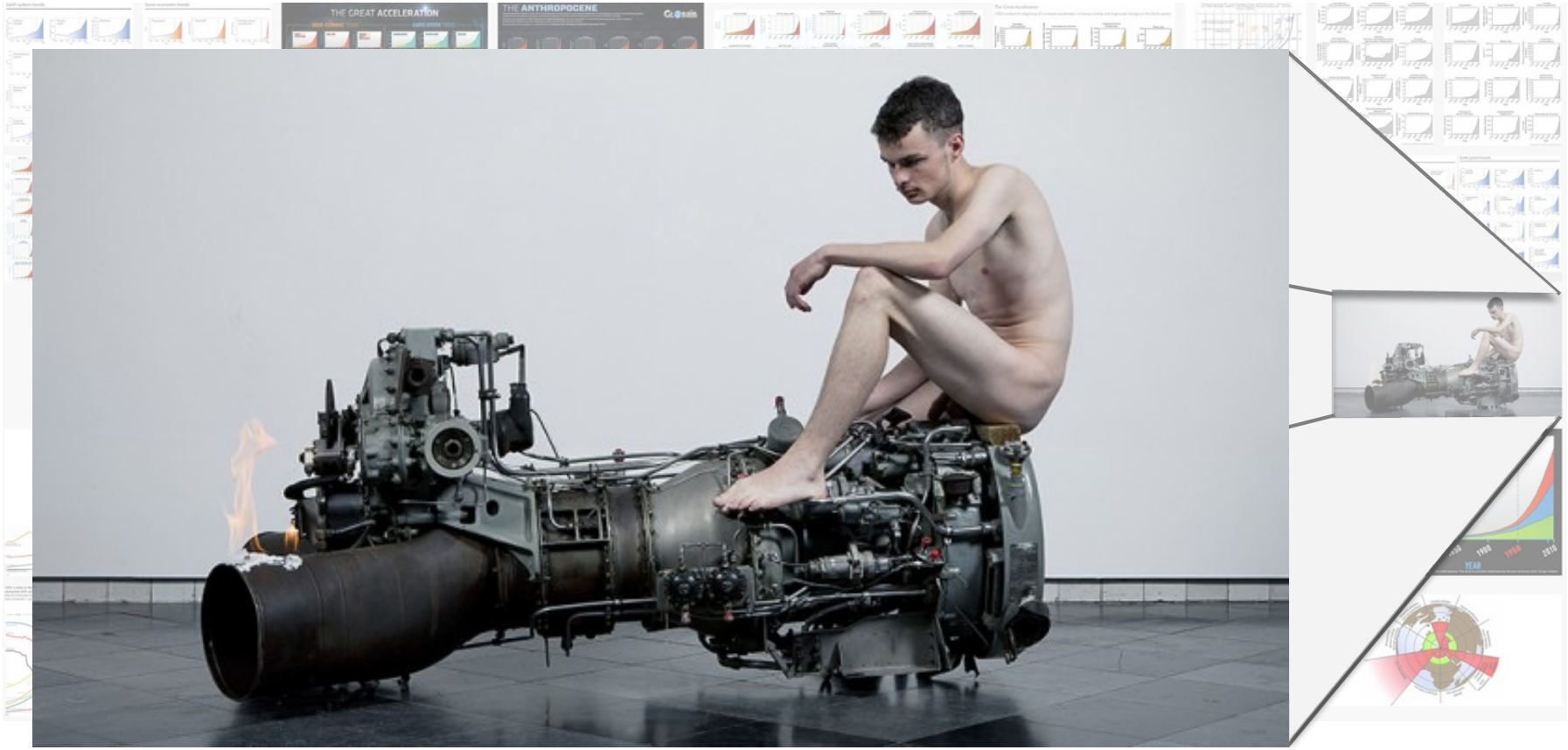
Table 1 | Potential start dates for a formal Anthropocene Epoch

Event	Date	Geographical extent	Primary stratigraphic marker	Potential GSSP date*	Potential auxiliary stratotypes
Megafauna extinction	50,000–10,000 yr BP	Near-global	Fossil megafauna	None, diachronous over ~40,000 yr	Charcoal in lacustrine deposits
Origin of farming	~11,000 yr BP	Southwest Asia, becoming global	Fossil pollen or phytoliths	None, diachronous over ~5,000 yr	Fossil crop pollen, phytoliths, charcoal
Extensive farming	~8,000 yr BP to present	Eurasian event, global impact	CO_2 inflection in glacier ice	None, inflection too diffuse	Fossil crop pollen, phytoliths, charcoal, ceramic minerals
Rice production	6,500 yr BP to present	Southeast Asian event, global impact	CH_4 inflection in glacier ice	5,020 yr BP CH_4 minima	Stone axes, fossil domesticated ruminant remains
Anthropogenic soils	~3,000–500 yr BP	Local event, local impact, but widespread	Dark high organic matter soil	None, diachronous, not well preserved	Fossil crop pollen
New–Old World collision	1492–1800	Eurasian–Americas event, global impact	Low point of CO_2 in glacier ice	1610 CO_2 minima	Fossil pollen, phytoliths, charcoal, CH_4, speleothem $\delta^{18}O$, tephra†
Industrial Revolution	1760 to present	Northwest Europe event, local impact, becoming global	Fly ash from coal burning	~1900 (ref. 94); diachronous over ~200 yr	^{14}N:^{15}N ratio and diatom composition in lake sediments
Nuclear weapon detonation	1945 to present	Local events, global impact	Radionuclides (^{14}C) in tree-rings	1964 ^{14}C peak§	^{240}Pu: ^{239}Pu ratio, compounds from cement, plastic, lead and other metals
Persistent industrial chemicals	~1950 to present	Local events, global impact	For example, SF_6 peak in glacier ice	Peaks often very recent so difficult to accurately date§	Compounds from cement, plastic, lead and other metals

For compliance with a Global Stratotype Section and Point (GSSP) definition, a clearly dated global marker is required, backed by correlated auxiliary markers that collectively indicate global and other widespread and long-term changes to the Earth system. BP, before present, where present is defined as calendar date 1950.
* Requires a specific date for a GSSP primary marker. †From Huaynaputina eruption in 1600 (refs 78, 79).
§ Peak, rather than earliest date of detection selected, because earliest dates reflect available detection technology, are more likely influenced by natural background geochemical levels[101], and will be more affected by the future decay of the signal, than peak values.

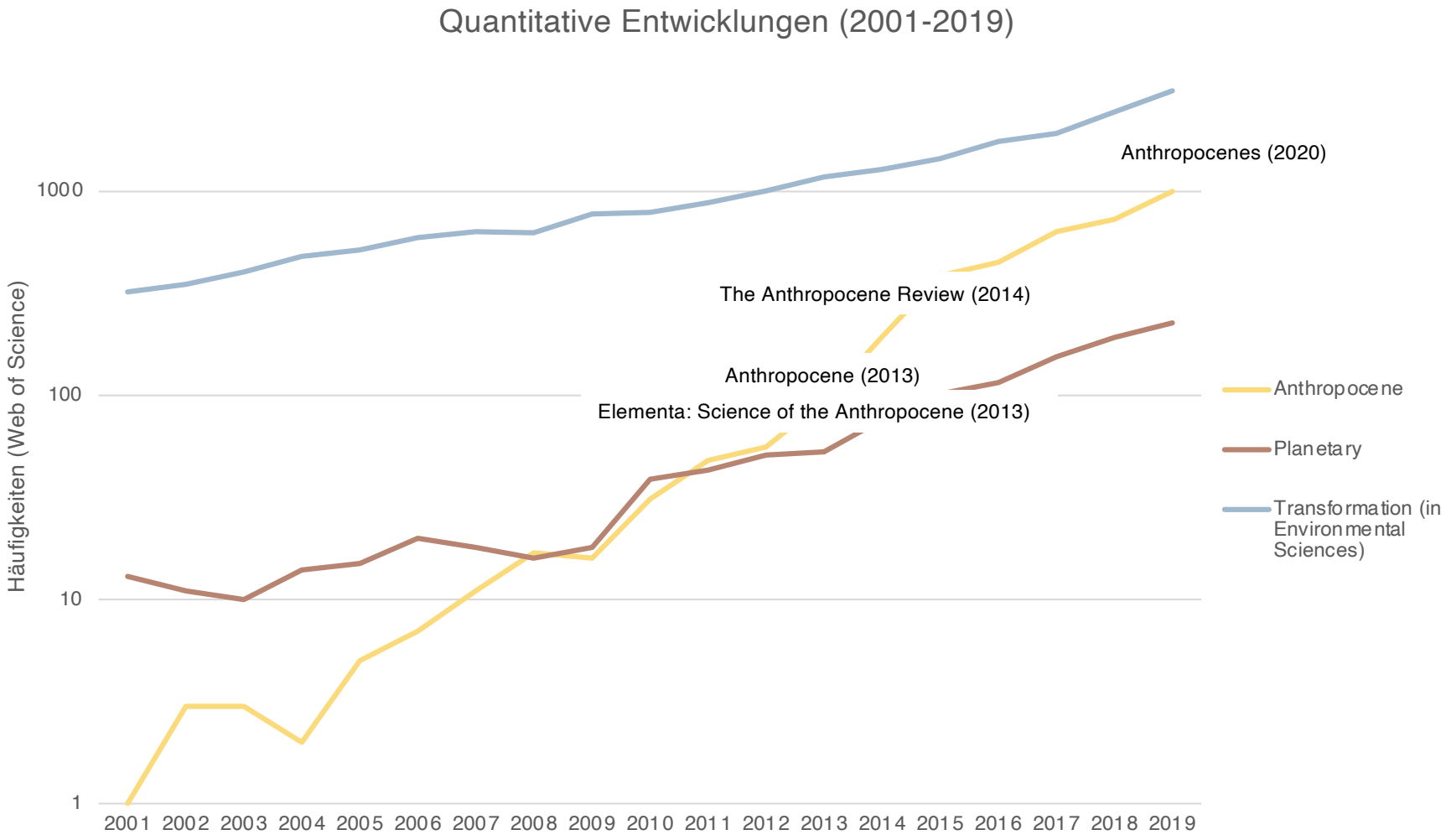
Lewis, Simon L. und Mark A. Maslin (2015): **Defining the Anthropocene.** In: *Nature* 519, S. 171-180. S. 175

Technik



Roger Hiorns – Untitled, 2011. Courtesy of Corvi-Mora, London, Luhring
https://anti-utopias.com/newswire/taipei-biennial-2014-the-great-acceleration/

Erfolg einer Vokabel



Web of Science, Nennungen im Titel oder Abstract

Anthropozän – Resonanzen (Auswahl)

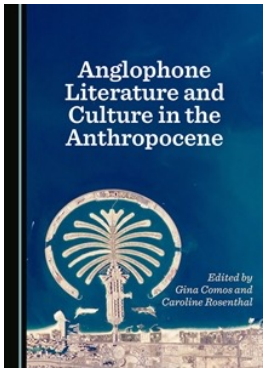
Kunst & Kultur

Ethik & Religion

Anthropozän

Disziplinen

Lebens-gestaltung



Stunning Facts

Plastik, Gebäude, Maschinen

Künstlich hergestellte Produkte haben wohl erstmals mehr Masse als alle Lebewesen

Es ist ein welthistorischer Moment: Die vom Menschen hergestellten Dinge könnten in diesem Jahr erstmals mehr wiegen als die gesamte Biomasse der Erde. Forscher sprechen von »schockierenden Zahlen«.

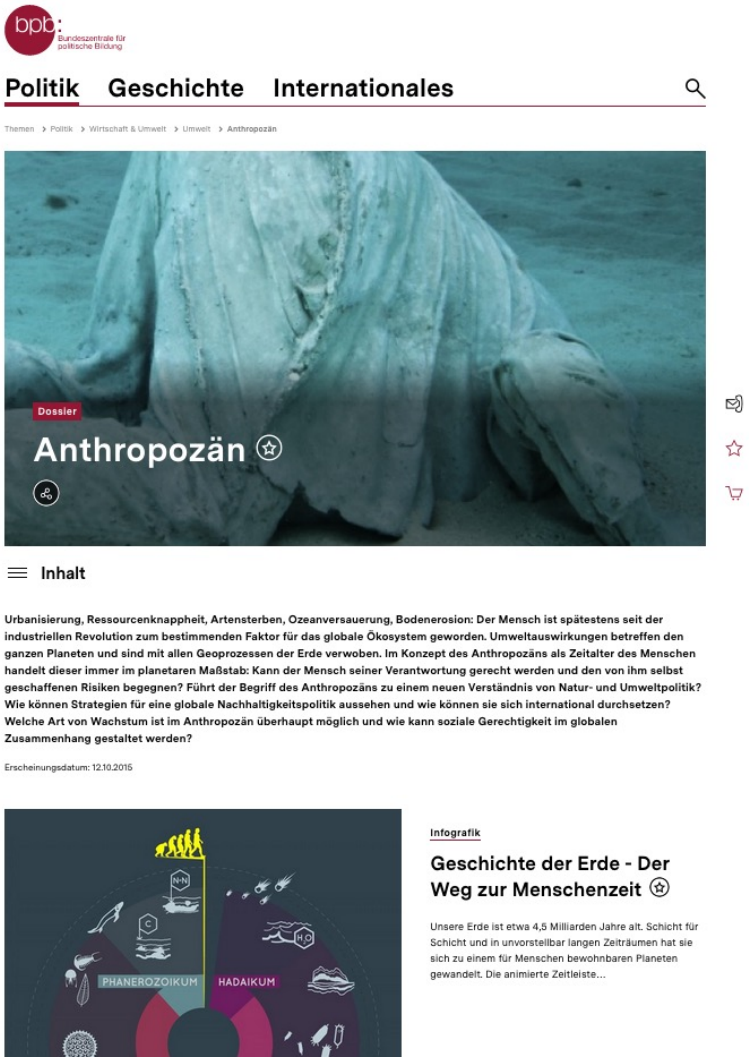
Der Spiegel (2020): **Künstlich hergestellte Produkte haben wohl erstmals mehr Masse als alle Lebewesen**. 9.12.2020 (https://www.spiegel.de/wissenschaft/mensch/anthropozaen-kuenstlich-hergestellte-produkte-ueberwiegen-erstmals-die-masse-aller-lebewesen-weltweit-a-9f577654-7140-4199-a20f-39fcb30e78fa (9.7.2021)

Omnipräsenz

Tagesschau (2020): **Der Schrott im Orbit soll weg.** 10.12.2020 (https://www.tagesschau.de/ausland/europa/esa-weltraum-schrott-auftrag-101.html (8.6.2021))

Dimensionen des Anthropozäns

bpb: Bundeszentrale für politische Bildung



https://www.bpb.de/gesellschaft/umwelt/anthropozaen/