

New planetary dashboard shows 'Great Acceleration' in human activity since 1950

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Clouds over Australia are shown. Credit: NASA

Human activity, predominantly the global economic system, is now the prime driver of change in the Earth System (the sum of our planet's interacting physical, chemical, biological and human processes), according to a set of 24 global indicators, or "planetary dashboard", published in the journal *Anthropocene Review* (on January, 19 2015).

The research charts the "Great Acceleration" in [human activity](#) from the start of the [industrial revolution](#) in 1750 to 2010, and the subsequent

changes in the Earth System - greenhouse gas levels, ocean acidification, deforestation and biodiversity deterioration.

"It is difficult to overestimate the scale and speed of change. In a single lifetime humanity has become a planetary-scale geological force," says lead author Professor Will Steffen, who led the joint project between the International Geosphere-Biosphere Programme (IGBP) and the Stockholm Resilience Centre.

Twelve indicators depict human activity, for example, economic growth (GDP), population, foreign direct investment, energy consumption, telecommunications, transportation and water use. Twelve indicators show changes in major environmental components of the Earth System, for example, the carbon cycle, nitrogen cycle and biodiversity. This new "planetary dashboard" highlights how the trajectories of Earth and human development are now tightly bound. The findings will be presented at the World Economic Forum in Davos, Switzerland, 21-24 January.

"When we first aggregated these datasets, we expected to see major changes but what surprised us was the timing. Almost all graphs show the same pattern. The most dramatic shifts have occurred since 1950. We can say that around 1950 was the start of the Great Acceleration," said Professor Steffen, a researcher at the Australian National University and the Stockholm Resilience Centre.

"After 1950 you can see that major Earth System changes became directly linked to changes largely related to the global economic system. This is a new phenomenon and indicates that humanity has a new responsibility at a global level for the planet," he added.

Co-author IGBP Deputy Director, Dr Wendy Broadgate said, "The Great Acceleration indicators allow us to distinguish the signal from the noise.

Earth is in a quantifiably different state than before. Several significant Earth System processes are now driven by human consumption and production."

Another co-author, Dr Lisa Deutsch, Senior Lecturer at the Stockholm Resilience Centre notes that: "Of all the socio-economic trends only construction of new large dams seems to show any sign of the bending of the curves - or a slowing of the Great Acceleration. Only one Earth System trend indicates a curve that may be the result of intentional human intervention - the success story of ozone depletion. The levelling off of marine fisheries capture since the 1980s is unfortunately not due to marine stewardship, but to overfishing."

The findings provide strong evidence that in recent decades key components of the Earth System have moved beyond the natural variability exhibited in the last 12,000 years, a period geologists call the Holocene. The Holocene, Latin for "entirely recent", began at the end of the last ice age and provided the stability for agriculture to develop, leading eventually to townships and cities to flourish.



The trajectory of the Anthropocene. Credit: SRC/IGBP/F Pharand Deschenes

The Great Acceleration trends support the proposal that Earth has entered a new geological epoch, the Anthropocene, coined by researchers Paul Crutzen and Eugene Stoermer in 2000. Since then, the onset of the Anthropocene has been keenly contested by geologists, Earth System scientists and others, even though the term has not yet been formalised by the International Commission on Stratigraphy. Some say the dawn of agriculture 10,000 years ago - the Neolithic Age - is a likely candidate. Others say the industrial revolution, around the late 1700s.

The new paper argues that, "Of all the candidates for a start date for the Anthropocene, the beginning of the Great Acceleration is by far the most convincing from an Earth System science perspective. It is only beyond the mid-20th century that there is 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 and not by natural variability."

Furthermore, choosing the beginning of the Great Acceleration leads to a possible specific start date: when the first atomic bomb was detonated in the New Mexico desert on Monday 16 July 1945.

"Radioactive isotopes from this detonation were emitted to the atmosphere and spread worldwide entering the sedimentary record to provide a unique signal of the start of the Great Acceleration, a signal that is unequivocally attributable to human activities," the paper reports.

The research explores the underlying drivers of the Great Acceleration: predominantly globalisation.

The bulk of economic activity, and so too, for now, the lion's share of consumption, remain largely within the OECD countries, which in 2010 accounted for about 74% of global GDP but only 18% of the global population. This points to the profound scale of global inequality, which distorts the distribution of the benefits of the Great Acceleration and confounds international efforts, for example climate agreements, to deal with its impacts on the Earth System. However, the paper shows that recently, global production, traditionally based within OECD countries, has shifted towards BRICS nations—Brazil, Russia, India, China and South Africa. Moreover, the mushrooming middle classes in BRICS nations are driving greater consumption here too.

About one half of the global population now lives in urban areas and about third of the [global population](#) has completed the transition from agrarian to industrial societies. This shift is evident in several indicators. Most of the post-2000 rise in fertilizer consumption, paper production and motor vehicles has occurred in the non-OECD world.

Coinciding with the publication of the Great Acceleration indicators, researchers also led by Professor Steffen have published a new assessment of the concept of "planetary boundaries" in the journal *Science*. The international team of 18 scientists identified two core planetary boundaries: climate change and "biosphere integrity". Altering either could "drive the Earth System into a new state." The planetary boundaries concept, first published in 2009, identifies nine global priorities relating to human-induced changes to the environment. The new research confirms many of the boundaries and provides updated analysis and quantification for several of them including phosphorus and nitrogen cycles, land use and biodiversity.

The original 24 indicators were published in the first IGBP synthesis in 2004, when Professor Steffen was IGBP Executive Director. The term 'Great Acceleration' was not used until 2005 at the Dahlem Conference on the history of the human-environment relationship, which brought together many IGBP scientists. This new research is part of IGBP's final synthesis, which will be completed in 2015.

The International Commission on Stratigraphy has set up a working group to analyse the validity of the Anthropocene claim. Professor Steffen is a member of this working group, which is due to report its conclusions in 2016.

More information: The trajectory of the Anthropocene: The Great Acceleration (*Anthropocene Review*) 15 January 2015.

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