

Where next for global environmental research? The answer is Future Earth

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It is likely that you live in a crowded European city. You want fresh air when you cross the road, you want to see that everyone everywhere has quality of life, you want to know that plants and animals are safe from extinction through local habitat destruction and globally from climate change. This world that we want needs a different type of scientific research to what has gone before. It needs research that can help solve environmental problems as well as better analyse and understand them. Future Earth has been created for scientists across all disciplines to work together with societies' experts to find solutions to the most pressing challenges facing people and the planet. Here we describe this new global organisation called Future Earth and what it wants to achieve in Europe and how.

A new beginning for the global environment

2015 in the future could be considered the date that politicians, economists, lawyers and technologists see as the visionary year when progress on global sustainability really began. 2015 is the year that humans began to heal the planet.

First, in 2015, in September in New York, the United Nations General Assembly agreed the Global Sustainable Development Goals, more frequently called the SDGs or Global Goals. Almost 200 countries signed-up to them after the UN's largest ever consultation to ensure engagement, participation and agreement. The Global Goals are 17 goals to be achieved by 2030 with 169 targets for the benefit of people, planet and prosperity. All countries will assess their progress against the targets. They attempt to balance the three pillars of sustainable development - Economy, Society and Environment - by ending poverty, combatting climate change, and fighting inequality and injustice. No single powerful international organisation is working on the three pillars together, without which significant progress towards sustainability would be unachievable.

The Global Goals build on the 15 Millennium Development Goals (MDGs) that were adopted in 2000 until 2015. Great progress has been made on the MDGs with progress on reducing hunger, disease, inequality, and access to water and sanitation. The MDGs show the strength of a unified agenda of progress based on goals and targets. The

SDGs go much further, addressing the causes of poverty: that benefits rich and poor and the planet alike.

Second, in 2015, in December in Paris, the UN agreed The Accord de Paris, after 21 years of negotiating. 175 countries have now signed-up to limit their carbon dioxide pollution into the atmosphere from the burning of coal, oil and gas that power all our economies. The Paris Accord is where global politics finally agreed with the data and the recommendations of climate scientists. It is without doubt that the five international assessments led by the Intergovernmental Panel on Climate Change (IPCC) were fundamental to this landmark political outcome. The most recent IPCC Assessment concluded in 2013 that human influence on the warming of the climate system is clear.

In the years before and even during the two weeks of Paris negotiations, scientists and the environmental movement were focused on stressing the importance of an agreement, ideally with a target of a global average warming of not beyond 2°C by 2100. The politicians went further than anyone expected and agreed less than 2°C and ideally only 1.5°C.

New global environmental governance

The process behind the Paris Agreement is new and it is powerful. In time for Paris, each country's governments voluntarily declared their emissions targets that they want to achieve, called their Intended Nationally Determined Contribution (INDC). This too was a new bottom-up consultative and participatory approach to climate gover-



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Ouverture par Mme Anne Lagauderie de la quatrième réunion plénière de la Plateforme intergouvernementale sur la biodiversité et les services écosystémiques (IPBES), dont elle est la secrétaire générale, Kuala Lumpur (Malaisie), février 2016.

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nance that worked for reaching an agreement. It is very different from the top-down wrangling over emissions cuts that went before when none of the major emitting countries wanted to volunteer their perceived economic disadvantage of being the first to cut their emissions.

Current commitments with INDCs are headed for a global average temperature of around 3°C this century, a long way above well below 2°C and 1.5°C. Each nation will revisit its INDC targets every 5 years with the idea of strengthening its national contribution as the route to transforming societies to zero carbon energy systems becomes clearer. 3°C still carries the likelihood of significant climate impacts, so researching consequences and preparedness for high-end climate change remains essential.

France’s leadership on the Paris Agreement means that it is now well respected the world over for its environmental diplomacy. The Paris Agreement was under the Presidency of Laurent Fabius, rebranding France’s reputation. For example, the French Ambassador to Bangladesh Mme Sophie Aubert, spoke in April at a climate change workshop in Bangladesh, a low-lying and poor nation where preparedness for sea-level rise, water shortages or floods and storms is more essential to Bangladeshi scien-

tists and citizens than a zero carbon energy system.

There are some signs that it might be possible to decouple economic growth from emissions, although it is far too early to tell. After years of global cumulative increase, carbon dioxide emissions have stalled in the past two years. This is mostly due to a slowdown of coal burning in China in line with its economy. Also, over half of new energy needs in China in 2014 were met from renewables and non-fossil fuels, energy collected from hydropower, wind turbines, solar power, and nuclear energy. On the other hand, behind this recent global flattening of the line on the emissions graph is growth in most Asian developing economies, the Middle East, and a slight decrease in Europe and some industrial countries.

Into The Anthropocene Epoch

The consultative approach to agreeing the UN’s Sustainable Development Goals and the bottom-up INDCs that paved the foundations for the Paris Accord are a transformation to participatory methods of successful global governance. A similar transformation is happening in environmental change research, with a new global initiative called Future Earth.

Who Governs Global Future Earth?

The Governing Council of Future Earth consists of the International Council for Science, the International Social Science Council, the Belmont Forum of funding agencies, the UN educational, scientific and cultural organisation (UNESCO), UN environmental programme (UNEP), UN University (UNU), World Meteorological Organisation (WMO), Sustainable Development Solutions Network (SDSN) and the Science and Technology in Society forum (STS).

Environmental change research has been astoundingly successful in a few decades at better understanding the natural environment, identifying problems, monitoring problems, and assessing the consequences. For example, our well recorded loss of biodiversity includes the pollinators that reproduce our crops for us; we need fresh water and clean air to safeguard our health; we need unpolluted and fertile soils to grow our crops; we need healthy and productive oceans, and of course a relatively stable climate.

International recognition of the value of these 'free' life-support services that ecosystems provide us with means that a new UN assessment has started, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). Global fisheries, for example, is a \$100 billion annual economy, employs 700 million people, and more than 3 billion people get more than 30% of their diet from the sea. Restoring the environment and the natural services that it provides us with is interlinked with ending poverty, injustice and inequality and combating climate change. The environment is not 'other' – it is at the heart of progress with the other two pillars of sustainable development, economy and society.

The Anthropocene is our proposed new geological epoch because mankind is now the dominant force influencing the global environment. It is only now in this new epoch that environmental science understands enough about environmental problems to turn its focus to the solutions. No-one in science, policy or technology knows yet how to solve global environmental problems, including climate change. While problems are solved at the small scale of a river or a lake or a forest, a community or a coastline, global problems are less tractable, complex, and interlinked with economy and society. The cost of the loss of global fisheries, for example, is shared across many millions of people and thousands of communities, invisible from any balance sheet and therefore undetectable but has huge impact on national economies, livelihoods and well-being. While workable solutions are not yet clear, what is well understood is that the method of science and research has to radically change to meet the challenge of the Anthropocene. Changing the method of science towards seeking and contributing to environmental solutions is the purpose of Future Earth.

Future Earth evolves from the Anthropocene

Third in 2015 was the formal start of Future Earth, a new global, regional and local organisation to support and promote global environmental research, whose vision is for people to thrive in a sustainable and equitable world. It is born of the recognition that science needs to better contribute to solving the problems of the Anthropocene in addition to better understanding them. Future Earth is recognition by its funders that society requires a new type of science that bridges across traditionally separate academic disciplines, including health, engineering, and humanities (social, natural and physical) to produce a new type of useful knowledge in partnership with society, not separate from society.

Future Earth in France

Paris hosts one of the five global secretariat hubs of Future Earth located at Université Pierre et Marie Curie (UPMC). It is funded by a consortium of the Ministère de l'Enseignement supérieur et de la Recherche, Centre national de la recherche scientifique, Alliance nationale de recherche pour l'environnement and Agence nationale de la recherche. The French hub's focus is on synthesis and foresight of research knowledge and co-leads the starting-up and coordinating three areas of Future Earth's thematic research activities, called Future Earth Knowledge Action Networks. The French team's focus is on the nexus of food, water, and energy, oceans, and natural assets. Further focus is on advancing transdisciplinary knowhow and promoting skills of Early Career Researchers. At the country level, the French National Committee for Global Change Research oversees Future Earth's research in France. Its Chair is Wolfgang Cramer of CNRS at Institut Méditerranéen de Biodiversité et d'Ecologie marine et continentale (IMBE).

To engage across disciplines, Future Earth is working with society using a technique called coproduction of knowledge where it asks society what it wants to know, discusses how research can help, incorporates all available expertise into the research. It then works alongside these societal partners and engages widely through tested and effective as well as innovative science communication, for example the Future Earth New Media Lab.

Future Earth is building on the unique foundation of the researchers within four Global Environmental Change Programmes that for 30 years was coordinating environmental research worldwide. These four programmes all delivered excellent science that better assessed and understood the problems, but the issues of the Anthropocene need a coming together of separate disciplines as well as better engagement with policy, business, economic and societal

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Interview with Thorsten Kiefer the Director of the Paris Hub of Future Earth

You call Future Earth a platform. What is the difference between a platform and a network?

We call Future Earth a platform because we want to cultivate a new level of openness and inclusiveness and participation than a predetermined 'programme' would otherwise suggest. Within our new platform of Future Earth, a diverse range of international transdisciplinary interaction is developing. Our Knowledge-Action Networks are a globally interactive participatory theme. They connect existing research organisations across different disciplines with each other and with society and experts outside of academia for the purpose of collaborating on complex sustainability issues.

How will Future Earth handle scientific controversies such as have happened on climate, on health or on biodiversity impacts?

There are many experts that Future Earth can mobilise, for example for the Synthesis and Foresight that we co-lead from the office in Paris. Controversies of contested knowledge, for example impacts on biodiversity, could make it into the research priorities of Future Earth as essential questions where global evidence is needed. Fabricated controversies in the media such as on climate change can be addressed from a communications perspective, scientifically backed up by our pool of global experts from across many disciplines.

What other organisations do you work with in France?

Future Earth is timely because lots of organisations are integrating traditionally different disciplines into their work to make better and more useful research, and we look forward to working with such organisations in France. We network them with other organisations in other regions for greater international partnerships and for learning and sharing for greater research outcomes.

Do you have the capacity to use all existing research, or do you base yourself more at the interface between IPCC and IPBES, for example?

IPCC and IPBES are currently among our most obvious stakeholders, but in our Knowledge Actions Networks and globally connecting research we aim far beyond, in particular through engaging with wider society and expertise that is outside of traditional academia. Future Earth facilitates high quality research that is equally useful.

Future Earth refers a lot to the Global Goals. The human goals of the Millennium Development Goals that went before have seen significant progress or been met. Environmental goals on the contrary have mostly regressed. Is it going to be the same with the SDGs?

The purpose of Future Earth is to help deliver knowledge to achieve politically agreed or societally wanted transformations to sustainability. It is impossible to make significant progress on sustainability without bridging across all three of the pillars, economy, society, and environment, together.

expertise. Future Earth is both refreshing and making a step-change in the design, the doing, and the communication of global change research. Joined-up thinking is required to solve complex social-environmental problems, and that thinking is not the sole domain of the sciences. Like the bottom-up and consultative process that led to the agreements of the global goals in New York and the climate change targets in Paris, a similar reorganisation of process is required that delivers on what went before.

Future Earth is currently in consultation with the environmental and sustainability sciences research community about its new research themes, called Future Earth Knowledge Action Networks, for joining academic disciplines with societal experts on the themes of environment and society. The Knowledge Action Networks focus on the nexus of water, energy and food; healthy oceans; transformations to sustainable societies; protecting natural assets; implementing the global goals; sustainable cities; and safeguarding human health. Essential for all of these themes is searching for sustainable finance and economics. Most of these Knowledge Action Networks are not

new themes of research, what is different is that Future Earth research will be done differently, through coproduction and partnership to solve environmental problems at the level of global, regional and local organisation, as well as it will monitor and deepen understanding of how the environment works.

As an example, the top-level questions for the Ocean Knowledge Action Network are science and solutions-oriented. How do human activities, combined with natural variability, affect the health of oceans, coasts, and their ecosystem and economic services? How can negative effects on ocean health be avoided? How can ocean health and ecosystem services be preserved or restored for the benefit of people? Each Knowledge Action Network has a set of questions that combine the concepts of science-based sustainability and fair stewardship for livelihoods and well-being, better understanding interactions across ecosystems and society, and developing effective management and governance. In all cases, this is researchers working alongside expertise from wider society.

Seeking global environmental solutions

A further innovation of Future Earth is the way that it is organised so that it engages with policy and societies everywhere and that this learning is connected together. Like any traditional large organisation it has a Headquarters, but this one is distributed, across Montreal, Stockholm, Paris, Tokyo, and Boulder and Fort Collins in Colorado. To further devolve global research that also engages with essential local priorities, Future Earth has regional offices in Uruguay, Rwanda, Cyprus, Japan and the UK, with much sharing of practical expertise between regions. New Centres in important regions are also planned, such as India. And at the very local level, Future Earth has in-country national committees and networks. All of these structures are autonomous but collaborating internationally and providing momentum so that the intellectual total is more than the sum of its parts. Future Earth is global, regional, and local.

We close with a recent assessment of what scientific knowledge already exists in support of the UN's new Sustainable Development Goals. An analysis of journals 2009-2013 shows that there were 334,000 academic peer reviewed publications on the topic of sustainability. This is only 3% of the world's academic output during this time, though the growth rate of sustainability publications is high at 7.5% per year. Academic publications are not a good indicator of societal impact as most journals are unread and uncited except by their authors, but these results do show how much more science knowledge is emerging and is needed to transition towards global sustainability.

Future Earth is merging the expertise and know-how of the Global Environment Change Programme that better understood environmental problems with this emerging field of sustainability science, for research that will be done in partnership with society. Future Earth's transdisciplinary and coproduced research over the next 15 years will greatly strengthen the sciences' contribution to the solutions needed to deliver the Sustainable Development Goals and the Paris Accord on climate change.

Further sources of information

The UN Sustainable Development Goals: www.global-goals.org

The UN Framework Convention on Climate Change: <http://unfccc.int/>

Intergovernmental Platform on Biodiversity and Ecosystem Services IPBES: www.ipbes.net

Intergovernmental Panel on Climate Change IPCC www.ipcc.ch

Future Earth began in 2015: www.futureearth.org/knowledge-action-networks

French National Committee for Global Change Research <http://cnfcg.ipsl.fr/>

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