Interdisciplinary Workshop on Climate and Biodiversity

Summary by Eulalie Saïsset, Eve Rebouillet, Mathias Abondance and Matthieu Hombrouck

9:00-10:30 Climate

Hélène Ollivier

Is carbon pricing bad for competitiveness? The EU ETS

In theory, carbon pricing creates extra costs for firms, which have to update their production process, purchase allowances and monitor their emissions. However, some firms may benefit from higher prices and carbon pricing can push investment into good technologies. Hélène Olivier uses the European Union Emission Trading System (EU ETS) to investigate the consequences of carbon pricing. Her analysis compares regulated and control firms before and after the introduction of a carbon pricing with the difference in differences method, to avoid spillover effects.

Her work's data come from a French manufacturing panel, between 1996 and 2016 (the EU ETS system began in 2005). There are around one thousand regulated plants, among 500 firms. The carbon pricing only concerns the most polluting plants. At most, it impacts 50% of the plants in each sector. It is therefore possible to create control groups, based on the non-regulated plants. On average, regulated plants represent between 20 and 30% of a sector's carbon emissions.

Two effects are found. First, there is indeed a positive effect on sales. Second, spillover effects exist between firms. Some non-regulated companies increase their sales to the detriment of their regulated competitors. Furthermore, pollution is displaced between plants when a firm manages both regulated and non-regulated firms. Part of the production is transferred to smaller plants, which limits the environmental consequences of the policy. Nevertheless, the main finding is that there is no evidence that the EU ETS system leads to loss of competitiveness; on the contrary, sales increased.

Simon Caney

Living Justly within Ecological Limits

What kind of world can we offer to future generations? We should give them at least what we have, and sometimes even more. That being said, there are numerous available policies to reach this goal, from carbon taxes and renewable energies to degrowth and geoengineering. We should choose among them according to some values, because many imply ethical questions. For instance, electric vehicles require cobalt, which is extracted in terrible conditions; a fuel tax can create poverty. Simon Caney argues in favour of a list of five values: responsibility, equality, democracy, liberty and non-anthropocentric values.

First, we commonly agree that polluters should be held responsible for their actions. A just transition is therefore a one in which everyone contributes according to its emissions. It means for example that polluters should finance clean energy. However, agents do not have a fair share of resources and opportunities. A poor person that can only develop through use of fossil fuels and a rich one that can use other energies but doesn't do not share the same

responsibility. We need to take into account resources and opportunities, which leads to the equality principle.

We should not hold the poor person responsible for its emissions. As a consequence, the ecological transition should impose a burden on the advantaged people, not the disadvantaged. If a climate policy fuels unemployment, then investments in green jobs have to be made; different ways to extract minerals must be found. A just transition should reduce inequalities, not exacerbate them. Moreover, it is also unfair to hold people responsible for emissions they cannot avoid because they are caused by social choices: organization of cities, access to public transportation… To hold people responsible, they have to be part of the decision process, so there is a need for democracy.

Finally, since there are different ways to live within ecological limits, societies should be able to choose the ways they use to transition. It is also possible to integrate non-anthropocentric values. Because environmental destruction has impacts on other living beings, their interests should be taken into account.

Jean-Pascal van Ypersele

Science of climate change: The latest IPCC assessment

There is a consensus among scientists about the reality of climate change and its human origin, especially the use of fossil fuels, cements, and deforestation. Greenhouse gases reduce the insulation properties of the atmosphere. We need to stop their emission as soon as possible. Without human activities, there is a stable carbon cycle. Photosynthesis absorbs 120 Gigatons of carbon each year and vegetation releases the same amount through respiration. With biological and chemical processes, oceans also absorb and release 70 GtC. Now, because of deforestation and fossil fuels, the carbon concentration is rising in the atmosphere. During the nineties, on average 8 Giga tons of carbon were released each year because of human activities. Half of them was stocked by oceans and vegetation.

Broecker (1975) already predicted temperature evolutions. The IPC was established in 1988 to provide policymakers with an objective source of information about causes of climate change, environmental and socio-economic impacts and possible response options. The first report established that humans increase the atmospheric concentration of greenhouse gases. Without change, temperature could increase between 2 and 5 degrees by 2100, and sea level rise by 60 cm. Episodes of high temperature will be more frequent and some species will go extinct. Against science, one billion of dollars was spent each year in the US to sow doubt about climate change, between 2003 and 2010.

The fifth report confirmed the others. It is unequivocal that human influence has warmed the atmosphere, ocean, and land. Climate change is already affecting many places. It increases the probability of extreme events. Extreme heat and heavy rainfalls are more frequent and intense; oceans are acidifying and losing oxygen. At the same time, oceans and land carbon sinks are projected to be less effective at slowing the accumulation of CO2 in the atmosphere. Many changes are irreversible for centuries to millennials, such as changes in ice sheets and sea levels. Changes in several climatic impact-drivers would be more widespread at 2 degrees compared to 1.5 global warming. In addition, low-likelihood outcomes, such as ice sheet collapse or ocean circulation changes, cannot be ruled out.

11:00-12:30 Biodiversity

Katheline Schubert

The value of biodiversity as an insurance device

Biodiversity is difficult to handle from an economic point of view. There has been a lot of applied works trying to quantify the value of biodiversity but there is still poor theoretical framework about biodiversity in economics.

Biodiversity provides a wide range of ecosystem services, usually described in 3 types: provisioning, regulating, and cultural services. Projections by the FAO expect agriculture production to increase by 70% between 2005 and 2050. This would imply an increase in the area of land dedicated to agriculture, but this *land-use change* has an impact on biodiversity and is one of the major causes of biodiversity destruction according to the IPBES.

In her presentation, Katheline Schubert focuses on one of the components of the overall value of biodiversity: its insurance service. Noack et al (2019) showed with data that the negative impact of weather events on crop income declines when natural biodiversity increases: this suggests that keeping a good level of biodiversity is an insurance against bad outcomes in agriculture.

Ecosystem services have an economic non-market value, since they are not or hardly (and so very costly) replaceable artificially. To estimate the value of ecosystem services, economists compute the amount of money we would pay the damages their disappearance would cause.

Making a simple model of land-use change where biodiversity acts as an insurance against agricultural productivity fluctuations, Katheline Schubert showed us how we can compute the optimum share of land devoted to farming and to biodiversity conservation, as well as the share of land that will be effectively implemented. This optimum estimation then allows to estimate the insurance value of biodiversity defined as the welfare gain of switching from a situation where there is no biodiversity to a situation where biodiversity is either at its optimum value or that chosen by the farmers.

Tatiana Visak

Considering non-human along with human welfare: some ethical challenges

Ethics fundamentally deal with how we ought to act all things considered, with environmental, economic, social, all perspectives taken into account.

Welfare is an important value that can give us an orientation to answer this complex and important question. When we ask how we ought to act, it makes sense to consider the impact of our various options on the value of lives. In other words, a guiding question may be: To what extent do our actions make lives better or worse for individuals whose lives will be affected?

The answer to this question depends on the correct answer to each of a lot of distinct but interconnected questions, such as the set of eight questions Tatiana Visak suggested. It is important to discuss them and play around with different combinations of answers, which

lead to many different solutions about how we ought to act. An increasing number of ethicists recently noticed that some combinations of answers lead to counter-intuitive conclusions. Tatiana Visak gave two examples:

1) Let's accepts egalitarianism, that is, the normative principle that we should strive for the same amount of welfare for all welfare subjects. Consider that welfare consists in having certain goods in one's life (the more the better), and that goods are things such as intellectual knowledge, morality and spirituality. Then, welfare subjects from different species have a different capacity for welfare as a they do not have the same goods in their lives (for example, dogs and mice do not have all these human goods). Assume welfare subjects have an equal moral status. It follows that perfectly happy mice and dogs are worse off than only mightily happy humans, and that we should engage efforts to increase the welfare of happy mice and dogs in order to equalize welfare.

2) If welfare subjects from different species have the same capacity for welfare, and if we assume that insects are welfare subjects, then it follows that climate change is something to promote because it benefits insects and insects are by far more numerous than the rest of the welfare subjects.

Tatiana Visak concluded that since the practical decisions currently being taken massively affect the welfare of human and non-human welfare subjects, we need to join forces and scrutinize the answers to each of these 8 questions to shed more light on how we ought to act.

Irène Hu

Man Overboard! Industrial Fishing as Driver of Migration Out of Africa

The continent of Africa is experiencing the highest rate of overfishing and high levels of illegal, unreported and unregulated fishing, revealing a regulation failure in the exclusive economic zone.

From an economic point of view, fish stocks are common pool resources where artisanal and industrial fishing are in competition. Industrial fishing vessels are more capital intensive and less labor intensive, and the reverse is true for artisanal canoes.

Combining geocoded datasets on industrial fishing with macro data of 37 African countries, Irène Hu et al. are bringing empirical evidence that industrial fishing impacts migration rates and that migration is in fact an adaptation strategy to this marine resource decline.

Fishing conditions are proxied with SST (as fish live in a certain temperature range) and chlorophyll (a proxy of phytoplankton, which is at the base of the food chain). Out migration is proxied at the macro level (i.e. international flows) with OECD and Eurostat bilateral migration data (such as foreign population flows and asylum applicant forms), and at the micro level (i.e. intra- and inter-country flows) with micro surveys on the evolution of households sites and compositions when facing more industrial pressure. Machine learning on a recently released geolocalized dataset of positions from Automatic Identification System, which aims to avoid collisions, enables to track boats and estimate whether or not a vessel is fishing.

Irène Hu shows a significative and negative effect of industrial fishing on the household size between 0 and 50 km from the shoreline, and positive effect between 50 and 100km, as if coastal people were moving inland. She finds that industrial fishing increases migration at a macro level from African coastal countries to OECD countries, as well as at a micro level from coast to cities. The latter may be triggering the macro migration by pulling pressure on cities.

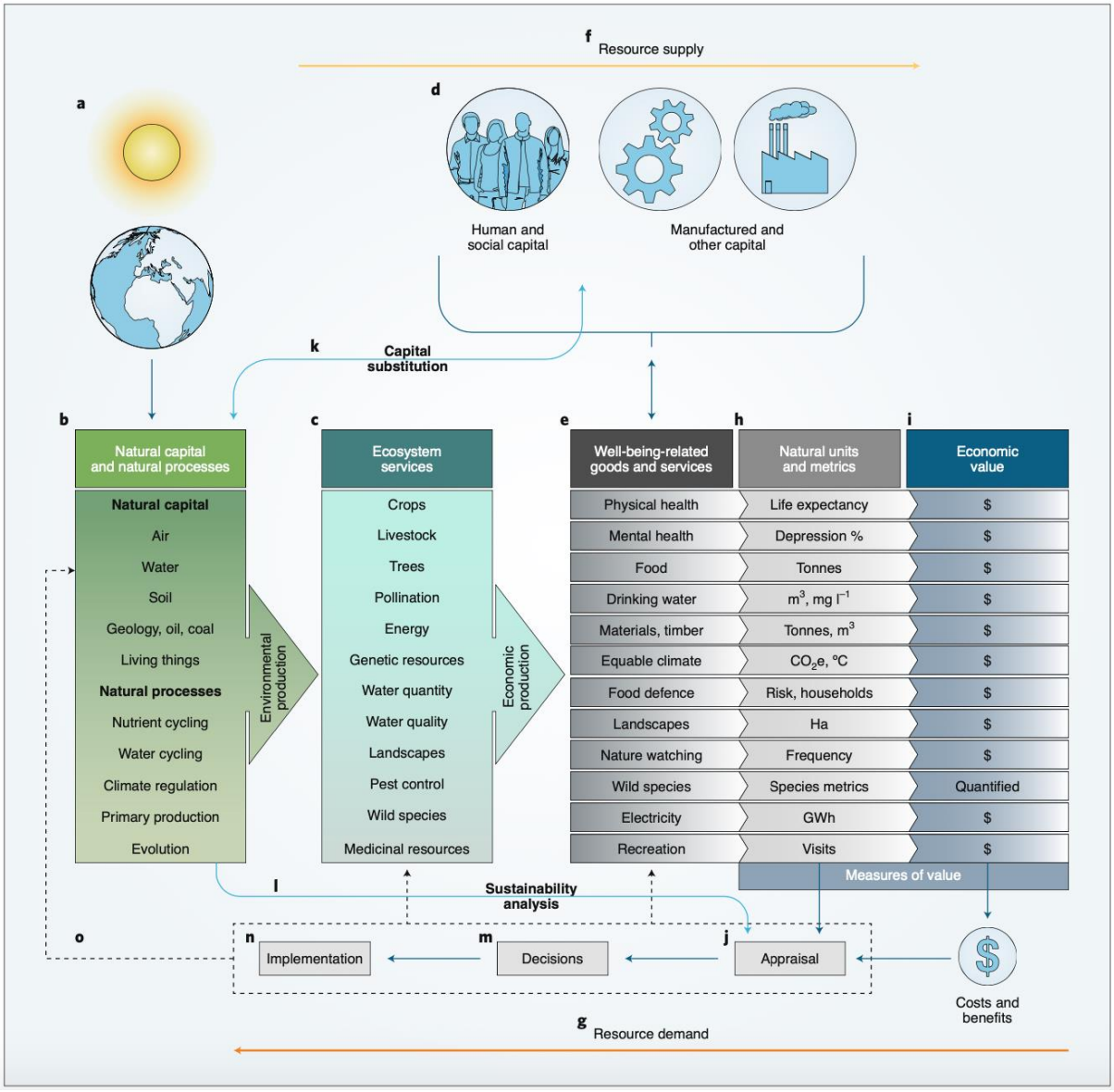
14:00-15:30 Biodiversity

Ian Bateman

Bringing climate, biodiversity and other ecosystem services into economic decision making

Climate change and biodiversity degradation are resulting from complex socio-economic systems, and they cannot be solved by simplistic solutions as planting trees. Ian Bateman has worked on the so-called “Natural capital approach” in order to answer the need for a single framework in this field, since this notion is widely used and often refers to different understanding of this approach.

The main idea of the Natural Capital approach is to take into account the ecosystem services' importance in the economic decision making.



Source: Fig. 1 | Natural Capital Framework *(Bateman and Mace, 2020)*

To explain this approach, he used this figure from his paper: “The framework (Fig. 1) represents the relationships between natural capital, ecosystem services, the economy and human well-being. This figure is necessarily a simplification of the many interactions, feedbacks and non-linearities of the whole system, focusing upon links between the environment and economy. The application of the framework has three components: (1) efficiency, assessing the flow of benefits and costs arising from alternative decisions; (2) sustainability, the effects of those alternative decisions upon natural capital stocks; and (3) equity, assessing the distributional aspects of implementing alternative decisions” (Bateman and Mace, 2020).

Thanks to this framework, he has shown that the benefit-to-cost ratio for some large-scale investments in the United Kingdom was probably overestimated or underestimated, having for consequence inefficiency of the public policies and the market.

More about his work:

- Bateman, I. J., & Mace, G. M. (2020). The natural capital framework for sustainably efficient and equitable decision making. Nature Sustainability, 3(10), 776-783

Mark Budolfson

Quantifying animal welfare, and integrating with existing ecosystem models

Mark Budolsfon claims that the standard well-being approach is missing a crucial point: welfare does not only concern humans. Ignoring the non-anthropocentric value of animal welfare in decision analysis models could lead to mistaken policies, because for example humans might not be willing to pay to prevent horrific welfare losses to animals. However, the quantifying part of animal welfare to include in existing ecosystem models is complex and requires a specific theory and method. Indeed, it requires us to put human and non-human welfare on the same scale. Mark Budolfson proposes a formalization translating the welfare into years of life, adjusting for several parameters:

$$W^{TU} \approx \sum_{is} n_{is}^{\psi} f_{is} \delta_{is}$$

With individual i, species s, n_{is}an empirical proxy of the comparative well-being-capacity for different species (for example the number of neurons), f_{is}a life quality adjustment term, $\delta_{is}$the life duration.

In words, this formalization enables us to put the welfare of different species on the same scale assuming that the proxy used is relevant for the inter-species welfare comparison. By using averages over large categories of animals (mammals, fish, insects…), Mark Budolfson and his co-author have easily made estimations of well-being capacity of the different categories compared to humans.

Even if the specification is very sensitive to the scaling parameter $\psi$of the comparative well-being capacity, and the inclusion of insect welfare in the model, this exercise enables to formalize that animal well-being could significantly influence our policies depending on our philosophical answers to the animal welfare importance. Mark Budoflson has shown an application of the model on Climate change policies showing that the conclusion of a standard model such as the DICE model (Nordhaus) could be different in terms of optimal policy intervention.

More about his work:

- Budolfson, M., & Spears, D. (2019). Public policy, consequentialism, the environment, and nonhuman animals. In The Oxford Handbook of Consequentialism.

Jocelyne Porcher

Domestic biodiversity, human work, animal work

Biodiversity almost always refers to the wildlife species but we should not forget the domestic biodiversity, in other words the farm animals on which we have an almost complete control.

For example, she denounces the transformation of dairy farming areas due to industrialization in monoculture. According to some authors, there would be no concern if these animals would disappear because the industrial fertilizers can replace them in the production of human food today. In the middle of the 19th century, there were dozens of breeds of pig, poultry or cow. Today and since 1950, breeding is based much more on productivity leading to extremely strong genetic tightening and a strong loss in domestic biodiversity.

Jocelyne Porcher has given details on her systemic vision: the industries have succeeded to instrumentalize the "animal well-being" notion in order to make their practices more acceptable to citizens. According to her, we should instead ask for better working conditions (of animals as for humans) by encouraging artisanal and little farms, which are systematically more respectful of animals. She also came back on the French agricultural plan for 2030, which aims to develop the genetic, robotic and digital dimensions. According to her, these 3 dimensions are the symbol that the actual policy is in the continuity of the industrial breeding from the mid-20th century. Moreover, the development of vegan diets or of "cultured meat" (meat in laboratory) are wrong answers and are part of the numerical capitalism development which would end up in a complete separation between domestic animals and humans.

More about her work:

- Jocelyne Porcher. Animal work. In Kalof L. (ed). The Oxford Handbook of Animal Studies, page np. Oxford University Press, 2017. doi: 10.1093/oxfordhb/9780199927142.013.8. URL: https://hal.archives-ouvertes.fr/hal-01608244 Chapitre 16.

16:00-17:30 Climate

Frances Moore

Use and non-use value of nature and the social cost of carbon

The disruption of ecosystems by climate change will be direct, long-lasting and widespread throughout the world. This has implications for human welfare, which derives value from nature in different ways. There are two types of benefits to be distinguished: use value, when natural systems are needed for economic activities (e.g. recreation, pollination, water quality) and non-use value, which is derived from the very existence of ecosystems and species without consumption (for what their current or future existence provides). The value of these ecosystems has so far been little taken into account in the welfare costs of climate change, especially if one aims to reflect the non-substitutability of species.

Starting from the DICE model (Dynamic Integrated Model of Climate and the Economy) proposed by Nordhaus, a number of elements can be introduced to include the wealth that natural capital represents. In particular, it is interesting to take into account the fact that production depends on natural capital, that this capital is damaged by climate change, and that in addition to consumption, other non-market ecosystem services contribute to welfare. We then obtain a *Green DICE* model which predicts that the value of the optimal carbon tax

will be much higher than the value forecast by the classical model ($160 in 2020 compared to $28 for the classical model) for largely different emission trajectories. This shows the vulnerability of natural capital to climate change and the importance of these results for policy recommendations.

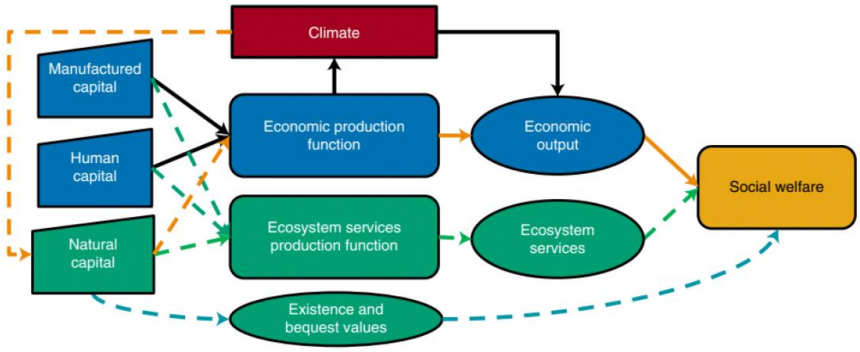


Fig. 1 | GreenDICE diagram for modelling the welfare effects of climate change impacts on natural capital. Schematic of the GreenDICE structure showing the instrumental (green and orange arrows) and intrinsic (blue arrows) pathways through which natural capital affects welfare. Dashed links represent additions to the standard DICE model. Solid black lines show relationships already present in DICE.

More about her work:

- Bastien-Olvera, B.A., Moore, F.C. Use and non-use value of nature and the social cost of carbon. *Nat Sustain 4*, 101–108 (2021). https://doi.org/10.1038/s41893-020-00615-0

Kian Mintz-Woo

Biodiversity losses and damages

Conventional estimates of the damage to biodiversity caused by climate change seek to determine the harm in terms of ecosystem services, the ability to develop medicines or agricultural productivity for example. They are based on different value models ranging from anthropocentrism, to ecocentrism - ecosystems are morally considerable, through sentientism - having preferences is needed to be morally considered, or biocentrism - being the subject of a life is needed to be morally considered. But this remains largely unsatisfactory as these choices are subject to unresolved debate.

In contrast, the Loss & Damages framework proposed by the IPCC in the 5th Assessment report focuses on what can be done in terms of adaptation, reflecting on compensations for what will suffer irreversible damage. This involves distinguishing between the different limits to adaptation, be they hard - physical or technological limits for example, or soft - linked to economic or social constraints.

Although it is not possible to completely determine which losses will be completely irreversible, this approach provides a framework for action that focuses on what can be done while asking the question of responsibility and of the trade-offs to come.

More about his work:

- Mechler, R., Calliari, E., Bouwer, L. M., Schinko, T., Surminski, S., Linnerooth-Bayer, J., Aerts, J., et al. (2019). Science for Loss and Damage. Findings and Propositions. In R. Mechler, L. M. Bouwer, T. Schinko, S. Surminski, & J. Linnerooth-Bayer (Ed.), Loss and Damage from Climate Change: Concepts, Methods and Policy Options (pp. 3-37) . Cham, Springer.

Robert Socolow

Can wilderness values survive renewable energy?

Wilderness values have long been a major concern in environmental debates. The priority then was to preserve landscapes from industrialization and intrusion generated by human activities. In particular, many measures were taken to protect natural habitats, wildlife areas and national parks or even unspoiled territories.

But this is no longer the central concern of environmentalists: other issues have taken over the public debate, including environmental justice and geoengineering. This implies taking into account new indicators, some of which are non-anthropocentric. To include, for example, the preservation of biodiversity beyond the well-being of human beings alone seems to be an interesting approach.

Furthermore, strategies for adaptation to climate change will necessarily involve a transition to renewable energies in the years to come. This may also bring new disruptions and risks if not done carefully, especially as these solutions are land intensive. However, these developments offer some grounds for optimism if they are well executed.

More about his work:

- Robert H. Socolow (2020) Contending with climate change: The next 25 years, Bulletin of the Atomic Scientists, 76:6, 294-301, DOI: 10.1080/00963402.2020.1846410
- Socolow, R. H. (2020). Witnessing for the Middle to Depolarize the Climate Change Conversation. Dædalus, 149(4), 46-66.