INSTITUT DE FRANCE
Académie des sciences

Les traductions des
Comptes Rendus
Géoscience
Sciences de la Planète

Anticipating the evolution of territories

Full text translated by Romain Dziegielinski
Translation posted online: 2023-11-08
https://doi.org/10.5802/crgeos.32-en

Abstract: In the middle of the last century, the emergence of a new risk, the climate risk, was a sudden and largely unexpected phenomenon that has significantly changed our vision of environmental issues. Of course, the link between humans and nature is strong and ancient: a country like France has very few landscapes that have not been shaped by generations of builders, foresters or farmers. But climate change linked to greenhouse gas emissions has brought about a radically new problem, whose novelty results from its very nature. The risk of climate change was revealed by equations or very indirect observations, before it was even really observable. But the speed of its progression, with greenhouse gas emissions in the atmosphere which have so far never stopped increasing and accelerating their growth, has made a huge difference. Moreover, this evolution has developed in a context where it has been intimately intertwined with other rapidly changing issues: energy, environmental, social, political and demographic. However, despite the variety of warning signals put forward by the scientific community, despite the now widely shared recognition of the existence of strong climate challenges, the dynamics with which these changes have developed, very often remain underestimated and even misunderstood. Climate risk is still very often associated with a certain form of immobility, marked by the repetition of discourse that gives the impression that the stakes have changed little over the last few decades. This incomplete awareness is one of the most important brakes on the development of effective environmental policies, because it erases an essential dimension of current climate issues: we are facing a problem that is very advanced in its development and everything is no longer possible today. The future world will necessarily be marked by the need to arbitrate between partially contradictory issues.

Keywords: Climate change, Vulnerable Territories, Greenhouse gas emissions, Acclimaterra, International strategies, Multidisciplinarity, Anticipation

Original article:
Hervé Le Treut, "Anticiper l'évolution des territoires". *Comptes Rendus Géoscience*, vol. 352, issue 4-5 (2020), p. 329-337. https://doi.org/10.5802/crgeos.32

1. Introduction

In the middle of the last century, the emergence of a new risk, the climate risk, was a sudden and largely unexpected phenomenon that has significantly changed our vision of environmental issues. Of course, the link between humans and nature is strong and ancient: a country like France has very few landscapes that have not been shaped by generations of builders, foresters or farmers. But climate change linked to greenhouse gas emissions has brought about a radically new problem, whose novelty results from its very nature. The risk of climate change was revealed by equations or very indirect observations, before it was even really observable. But the speed of its progression, with greenhouse gas emissions in the atmosphere which have so far never stopped increasing and accelerating their growth, has made a huge difference. Moreover, this evolution has developed in a context where it has been intimately intertwined with other rapidly changing issues: energy, environmental, social, political and demographic.

However, despite the variety of warning signals put forward by the scientific community, despite the now widely shared recognition of the existence of strong climate challenges, the dynamics with which these changes have developed, very often remain underestimated and even misunderstood. Climate risk is still very often associated with a certain form of immobility, marked by the repetition of discourse that gives the impression that the stakes have changed little over the last few decades.

This incomplete awareness is one of the most important brakes on the development of effective environmental policies, because it erases an essential dimension of current climate issues: we are facing a problem that is very advanced in its development and everything is no longer possible today. The future world will necessarily be marked by the need to arbitrate between partially contradictory issues.

The following text is structured in two slightly different parts, which will converge in the conclusion. They are:

- Giving some benchmarks to better assess the speed of climate change, and the complexity of the decision-making it leads to.
- Showing that places that are often referred to as "territories", and are therefore, in the sense often given to this term, places of life and work, already bear the mark of these environmental changes, with all the complexities and contradictions that intersect there. And these territories therefore undoubtedly also bear part of the future solutions, because they are places that are both close to the citizens and confronted with the need for often difficult decision-making and arbitrations, which condition the implementation of environmental policies.

1.1. *Climate change: a very short story*

We often hear the idea that the climate issue has been around for a long time and that it is only due to the negligence of governments that it is being addressed slowly and belatedly. Whatever else one might think of world governments, this description is wrong.

Indeed, this climatic awareness is very often traced back to the work of the Swedish Nobel Prize-winning chemist Svante Arrhenius in 1903, who had calculated as early as 1896 that a doubling of atmospheric CO_2 could increase the temperature of the planet by 4 to 5 degrees Celsius. This was an assessment consistent with recent calculations, even though it was probably a bit lucky. But this was a very different approach from what could be called an alert today: the doubling of CO_2 was expected by Arrhenius in about 3,000 years, and it was seen as a positive development, protecting a humanity with increasing demographics from the effects of a possible glaciation.

An article by professors Roger Revelle and Hans Suess (from the University of California), published in 1957, is also very often cited, and rightly so, as the true starting point for scientific warning on CO_2 emissions. It showed that the ocean would not absorb all the CO_2 injected into the atmosphere through the use of fossil fuels. At that time, it was about 1 billion tonnes of carbon each year, which is already a lot, but about 10 times less than now. This article showed that this oceanic limit would imply an increase in CO_2 in the atmosphere

— and the creation in 1957 of an observatory on the slopes of the highest volcano in Hawaii, the Mauna Loa, was primarily intended to verify that this excess CO_2 was measurable. It was therefore in the 1960s that the first evidence emerged that atmospheric CO_2 levels were actually increasing.

The difficulties in understanding the role of greenhouse gases do not end there. The memory we kept of the 1970s, a time when a scientific diagnosis that would remain undisputed afterwards gradually formed, is often affected by a persistent myth that at that time the scientific community was unanimous in predicting global climate cooling. A survey of all peer-reviewed articles published between 1965 and 1979 was conducted in 2008 to relay and deepen an analysis carried out by the IPCC in 2007 [Le Treut et al. 2007]. A North American researcher, Thomas Peterson (NOAA / National Climatic Data Center), and his colleagues [Peterson et al. 2008] found that 44 of these articles presented arguments in favour of future warming, 20 were "neutral" (did not decide on the mechanisms likely to prevail in the future) and 7 presented the elements likely to cause cooling. The number of articles published had increased steadily throughout the period analysed, increasingly oriented towards warming. These figures actually describe a scientific community that, in the late 1970s, was still in the midst of debate, but was moving more and more towards a consensus on the risk of future warming, as CO_2 emissions began to dominate other climatic factors, such as the role of aerosols.

The most significant quantification, both of the possible nature and the consequences of global warming, came in 1979, in the form of the collective report presented to the American Academy of Sciences by the highly respected Jule Charney, Professor at UC-Los Angeles, and later at Princeton and MIT [National Research Council 1979]. Both numerical models available suggested that the warming associated with a doubling of atmospheric CO_2 would be in the range of 1.5°C to 4.5°C. This last figure was particularly worrying, since it corresponds to the temperature amplitude that separates the glacial and interglacial ages during the Quaternary period, for nearly a million years.

These results were not immediately accepted either. The use of models to anticipate future climate change has constantly posed conceptual problems that are difficult to grasp outside the field of specialists. It is, in fact, about creating a new planet, a digital planet, which functions in a manner similar enough to the real planet to serve as a reference. It is based primarily on physical laws that govern the different forms of energy, the different water reservoirs, the movements of the air or the ocean, the effects of the Earth's rotation, around the sun or on itself — universal laws, which will remain unchanged in the event of an increase in greenhouse gases, but will lead to different results. This definition of climate models is very similar to the one found in meteorology, but it is very different from the practices of other scientific disciplines, particularly those dealing with the living world and lacking a basis for similar fundamental laws. This is an important point: the notion of risk is necessarily defined differently from one scientific community to another ([Balaji 2020], this volume, which also mentions the beginnings of climate modelling).

However, despite these difficulties, the initial work presented in the Charney report, which essentially took into account the role of the atmosphere, drew an extremely rapid response from the scientific community, as well as from policy makers: creation in 1980 of the World Climate Research Programme, under the dual supervision of the International Science Council and the World Meteorological Organization, creation of the IPCC (Intergovernmental Panel on Climate Change) in 1988, creation of the Rio Earth Summit in 1992, leading to the definition of the "United Nations Framework Convention on Climate Change" (sometimes noted as UNFCCC later). It was structured around three principles: the precautionary principle, the principle of common but differentiated responsibilities, and the principle of the right to development.

To measure the speed of this collective response, it is interesting to compare the results of the 1992 Rio Summit, which was strongly devoted to climate change, with those of the 1972 Stockholm Summit. The Stockholm Summit was extremely rich in reflections on topics such as economic and social development, the fight against poverty, the evolution of demography, the preservation of resources, etc. The conclusions of this summit revolved around 26 principles, none of which used the word "climate". The climate issue has therefore been added in a very short time to older issues, and this by relying on a culture and tools that are primarily those of the physical or chemical sciences.

1.2. *Climate change: very different cultural visions*

The entry into force of the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 marked the beginning of a series of actions that have still not succeeded in reducing the growth rate of greenhouse gas emissions. This text is not about repeating the history of these 26 years. They have had successes (especially, but not only, the Paris Agreement!) and there are similarities between the various failures: these are the disagreements between states. Here we shall confine ourselves to a few simple remarks on the consequences of these failures. The goal is to recall that the succession of these failures modifies the problem at hand. It is impossible today to say whether the climate problem could have been solved in the 1970s as an energy problem. But it is, on the other hand, certain that today (perhaps as in the past) it can only be solved as an energy, physical, geochemical, ecological, social, and political problem.

This does not remove the reason that has made the "climate-energy" relationship the driving force behind the many reflections that have dominated the political and media landscape so far: around 80% of the energy produced today is linked to the use of fossil fuels, which themselves account for more than half of greenhouse gases. If we want to control global warming, we must find a long-term replacement of fossil fuels with other forms of energy. But the conditions for doing so are now very different. The main greenhouse gases — long-lived gases — have, as the name suggests, a very long atmospheric residence time, often characterised by a "half-life", which is difficult to estimate in the form of a simple figure, but greater than 100 years for CO_2 or nitrous oxide, and around 12 years for methane. All these gases therefore remain for a long time in the atmosphere where they mix and accumulate. This has two major and often misunderstood consequences. First, the greenhouse gases that circulate above our heads come from all the countries of the world, in a proportion that roughly matches their emissions. We are therefore first and foremost exposed, in our territories, to gases emitted in the United States or China — and our emissions in turn affect these same countries. Moreover, we are also faced with a largely irreversible situation: the longer we wait to act, the more cumulative emissions will increase the level of warming at which it will eventually be possible to stabilise the global climate.

This leads to a second series of reflections. We are not in control of the climate issues: they depend on an international context that is not regulated by any world government, and also on a situation that has already been heavily affected by decades of greenhouse gas emissions. Of course, the importance that each of us, everywhere on the planet, must attach to reducing our greenhouse gas emissions remains — it is even reinforced by this observation. But it does mean that we may have to arbitrate on difficult decisions. The United Nations Framework Convention on Climate Change (UNFCCC) has put on an equal footing the development of emerging countries and the reduction of climate danger. But what happens if there are contradictions in pursuing these two issues? What status should be given to maintaining biodiversity? Or to the risk of serious and prolonged pollution of our environment? Should the world's population be allowed to grow, or should we try to manage it? What place should be given to other fundamental values: those of democracy and human rights? There is therefore a broad set of priorities which are becoming increasingly difficult to arbitrate, as the cumulation of our greenhouse gas emissions gradually narrows the range of what is still physically possible, because they fall within fields of science and systems of values which are very different from one another.

The IPCC report assessing the conditions for holding warming below 1.5 degree (compared to the pre-industrial era) is from this point of view a fundamental document that illustrates these difficulties in a very concrete way (see Masson-Delmotte [2020] in this volume). It stems from a request made by the UNFCCC under the Paris Agreement, calling for an assessment of the scenarios that are still possible to meet with this 1.5 degree warming limit. This is a very ambitious goal, given that decades of greenhouse gas emissions have already brought us to 1 degree of warming. These possible scenarios also respond to an unquestionably legitimate concern: to address the reality of short-term environmental threats, affecting a wide variety of vulnerable areas around the globe. They have been studied with remarkable care by a multidisciplinary panel of experts from the three IPCC groups.

But what does the word "possible" mean in this context? The possibles scenarios that are proposed for the consideration of policy makers are based primarily on the idea of a sober development that will perhaps lead

to a consensus. But to achieve carbon neutrality within a timeframe consistent with holding warming below 1.5 degree, they also need to rely on a much wider range of methods and solutions: for example, on nuclear energy, on renewable energies that can take various forms (e.g. the massive production of agrofuels) or a ability to create carbon sinks, the feasibility of which has not yet been proven (see for example Czernichowski-Lauriol (2020), this volume). The feasibility and/or dangerousness of these methods are still the subject of technical or ethical debate. But, in any case, the stakes are enormous. Carbon neutrality should be achieved by 2050, according to the IPCC report: 28 years, to achieve a complete replacement of fossil fuels on a global scale. It is a revolution that has probably had no equivalent in the history of the world. It is only conceivable in a world of solidarity and without conflict. This world is the only one that the IPCC can envision within the very strictly defined framework that makes its mission so valuable. But how can such constrained thinking be used to establish priority choices, which may also correspond to different societal choices?

In any case, we must be vigilant because these scenarios can also lead to the search for dangerous solutions. In the name of an absolute climate imperative, which would not be contradicted by any other constraint or value, it may be tempting to resort to exceptional solutions, which are known to be possible but certainly dangerous: for example, an artificial cooling of the planet caused by the spreading of sulphates in the stratosphere to reflect the incident solar radiation and thus reduce its intensity on the planet.

Important thresholds have been exceeded, everything is no longer possible and the necessary trade-offs are difficult to put in place. On a global scale, the transitions called for by the Paris Agreement are unlikely to occur on schedule and with the desired results, if only because the promises made by the States on which they are based are far from sufficient and far from being kept. We will not escape the need to define more clearly the values that motivate our choices.

2. The territories: places of awareness

The increasingly visible manifestations of climate change imply reconsidering the way in which territories can adapt to it, in France as elsewhere. The protection of these territories must take into account the risk of at least partial failure of climate policies, at international, European or national level. This need corresponds to a concern that first developed in highly vulnerable countries or regions: islands threatened with flooding, agricultural regions subject to long-lasting droughts, for example in the intertropical zone... We will deal with it here from a somewhat particular angle, relying on a work carried out in Aquitaine, then in Nouvelle-Aquitaine, to measure a little more precisely what the contribution of a regional approach can be in relation to national policies. This is a mission that was given to us by the Aquitaine region in 2011. It was extended in 2016 as part of Nouvelle-Aquitaine, by forming a more structured think tank of about twenty experts who took the name of AcclimaTerra [Le Treut 2018].

What the Aquitaine region asked for when they contacted us was very specific, very clear. The aim was to develop a territorial vision of the climate problem, which could be used in a concrete way, emphasising the risks and damage that the region could suffer in the future, with the anticipation of new situations. It was a way of taking the opposing view to the famous injunction to "Think globally, act locally", with a much stronger focus on "Think locally".

Curiously, at the regional level, there were few or no examples of similar work. However, it was only a simple approach of reversing the view on the regional reality. The global and planetary organisation of the climate system, the associated development of numerical models working on the same global scale, have very often led to the assessment of climate risk in a "top-down" mode: by defining the possible future(s) on a global scale, then by "regionalising" them on a smaller scale. A commonly used approach has been to set distant goals (for example, not to exceed 1.5 or 2°C of average global average warming by 2100), and to set up a form of *retro-planning* towards the present time, which makes it possible to define what needs to be decided today so as not to drift towards undesirable futures a century later. However, this approach has proved to be very insufficient to address in detail the management of a necessarily complex territory facing climate change: it is difficult to aggregate in such an approach the multidisciplinary nature of the risks involved.

One of the key words that guided the work was vulnerability. It refers to all the elements of fragility of a territory, in various fields. The way to operate was conceptually simple, but more complex to implement. Collectively, the aim was to make an inventory of all the existing works bearing information on climate change in (New) Aquitaine and organise them in such a way as to highlight the links between different issues: the coastline, water management, air and soil quality, urban areas, agriculture, forests, mountains. Two books have been published to accompany this work: one in 2013 [Le Treut 2013], concerning Aquitaine, and the other in 2018 applying to Nouvelle-Aquitaine [Le Treut 2018]. This transition from Aquitaine to a much larger territory gave a different scope to the project: its organisation was clarified, and gave it a new name: "AcclimaTerra".

Perhaps the biggest surprise that accompanied our work was the breadth and depth of information available in the Aquitaine or Nouvelle-Aquitaine region. In total, nearly 400 researchers contributed to the two volumes that were published, most of them being researchers working in the region. Over the years, the development of this work took a somewhat specific form which was to go and meet the actors of Nouvelle-Aquitaine. Initially, twenty cities or so were targeted: AcclimaTerra spent three days there each time, for contacts with elected representatives, entrepreneurs, associations, the general public and schools. This series of operations aimed to present the work of AcclimaTerra, but also to listen to the people we met, it was then repeated in about twenty other cities. It was accompanied by more targeted operations, assistance in setting up territorial climate-air-energy plans (PCAET), repeated mediation actions in a wide range of areas — with, for example, an "Acclimacampus" project at the University of Bordeaux. In general, these activities also demonstrated the importance of the territorial dimension and showed that understanding of environmental issues was greatly enhanced by the attachment of each person to his or her region.

Another awareness was that of the systemic dimension of the regional reality. Of course, the region is not autonomous: its climate development depends on large-scale factors. The already significant warming in the Nouvelle-Aquitaine region (about 1.5°C compared to the pre-industrial era) is characteristic of a large part of Europe. But it is accompanied by more local phenomena: the increase in the number of agricultural droughts, for example. Water resources are undoubtedly one of the most sensitive elements of regional management, and were extensively discussed in the AcclimaTerra report. They depend on a wide variety of processes. It cannot be mentioned without referring to the snow cover in the mountains, the hydroelectric resources, the cooling of nuclear power plants, the muddy plug of the Gironde estuary, the agricultural sectors, the forest, the vineyards, etc. Moreover, this complexity can only be managed in respect of an ecological, human and economic context. And this broad context in turn defines a regional climate system whose complexity is arguably equal to that of the global climate system. The regional domain, which is that of the French territorial division, draws its importance from this dual quality: being close to the citizens, but being able to address the difficult and often contradictory issues between which it is and will be necessary to arbitrate.

A key word in the AcclimaTerra project has therefore also been multidisciplinarity. The aim was to address the regional climate problem in its systemic dimension in the broadest possible way, by relying on a gradual accretion of a wide range of competences. The ambition of the work was to organise this work in such a way as to highlight the links between problems and scientific disciplines that are often inseparable but require very different expertise: climate aspects, the short and long history of territories, the coastline, water management, air or soil quality, urban areas, agriculture, forests, mountains, wetlands, biodiversity, health, the role of law and governance, local energies, social aspects... The initial group gradually organised itself to rise at the level of these issues. First, in the form of an office that continues to manage the numerous requests from actors in the region. Then, thanks to the role of the scientific council which was a major forum for discussion and reflection, where the "writing groups" of the reports and the mediation activities were built. However, it is not a stabilised construction. It remains fragile, with a status that has changed. AcclimaTerra was initially a group of experts from the region; it has become an association, which the region continues to support, in particular through the work of one or two project managers.

The website "Acclimaterra.fr" wanted to thank all the people who participated in this work. It is impossible to reproduce it here but we can at least mention the participants in the successive offices (Francis Grousset, Antoine Kremer, Denis Salles and Eric Villenave, then Nathalie Caill-Milly, Daniel Compagnon, Alain Dupuy,

and Benoît Sautour) and the project managers (Emilie Bourdens, Yohana Cabaret, Camille Jonchères, Clémence Marcher), stressing the role of all, as well as that of the region and its services.

3. Conclusion: from diagnosis to action?

AcclimaTerra's work has been above all documentary and information sharing. It raises a recurring question: what is the usefulness of the work done? Does it lead to concrete results?

Part of the answer liest in the list of themes covered in the two reports, cited above, and in all forms of mediation that have accompanied them. Each of these themes has been studied in depth by a group of ten or more researchers, always focusing on the same issue, that of future climate change and how to anticipate it. The work carried out is therefore necessarily a source of suggestions and even recommendations, whether direct or indirect. We were able to see that AcclimaTerra's words was generally received with interest, in places of public expression, as well as with elected representatives and professionals. It is therefore a work that has an interest and an impact in itself.

But it is important, very important, to understand what pitfalls may prevent scientific diagnosis from contributing to decision-making — a situation that has emerged frequently in our analyses. In a democratic framework, it is up to the elected representatives to make this decision, it is voted on (in this case in the regional assemblies) and the compatibility as well as the mutual understanding of reflections are essential. It is a question (and there is nothing new about this) of minimising the space between the field of experts and that of elected representatives, to allow them to work in a framework that respects their own missions, their operating rules and their ethics. However, in a regional context, this approach easily takes on a more concrete and operational dimension, due to the proximity between the various actors.

Nouvelle-Aquitaine has had a rather particular initiative in this regard, because it targets very strongly the partnership with the academic world. It created "NeoTerra", a project led by the region, which is based on AcclimaTerra and a parallel group concerning biodiversity (Ecobiose). NeoTerra provides scientists and policy-makers with a framework to exchange, and thus to consider partnerships that can better study the systemic nature of future changes.

The regional dimension plays a role here which has ultimately been very little studied. However, it is necessary because the current climate change is too advanced for us not to take into account, in its study, the inevitable multiplication of solutions and initiatives that may conflict with each other. The shared vision of climate change adaptation and mitigation is very limiting from this point of view. It has become necessary today to reconcile two issues that do not conflict, but which may not come together spontaneously: to participate without weakness in the reduction of greenhouse gas emissions, and to protect territories from growing and largely irremediable risks that models now know how to frame very well, as shown, for example, by the results published by the IPCC in 2001, which have very correctly anticipated the evolution of temperatures between 2000 and 2020 (see [Masson-Delmotte 2020]).

This reconciliation is possible: in a world where significant factors in greenhouse gas emissions are linked to transport, housing and agriculture, it is necessary to take advantage of what the territories already are: places where the problems posed are called urban planning, changes in agricultural sectors, transport infrastructure, defence of natural areas and vulnerable areas, development of local energy sectors, air, water and soil quality, support for the organisation of fishing, etc. More than an adaptation (the word sounds somewhat passive) it is an active change, a major change in terms of awareness, but also in terms of scientific and socio-economic development that becomes necessary.

It also calls for an evolution of research. The systemic aspect of regional changes remain poorly defined. For example, given the already observed increase in agricultural droughts in Aquitaine, who is in a position to precisely define their future impact on flora and fauna, depending on the seasons? There is a lot of information on each of these topics but it is not widely used. This also applies to research methods that are still somewhat forgotten, such as the satellite tool, which is still largely absent from regional studies. The need to understand what causes these lack of interest is particularly important, because the funding needed for

preventive protection and regional development can only be mobilised if there is a capacity to objectively justify what can be done in terms of carbon and financial balances.

Of course, these approaches should in no way be seen as a form of identity withdrawal. This science, which must be shared between scientific disciplines, each of which having their own history, must also be shared between very different territories but facing similar or sometimes even opposing issues.

References

AcclimaTerra, Le Treut H. (dir) (2018). *Anticiper les changements climatiques en Nouvelle-Aquitaine. Pour agir dans les territoires.* Éditions Région Nouvelle-Aquitaine.

Balaji, V. (2020). Science des données versus science physique: la technologie des données nous conduit-elle vers une nouvelle synthèse ? *C. R. Géosci.*, 352(4-5):297–308.

Czernichowski-Lauriol, I. (2020). Captage et Stockage du CO_2 : le puits de carbone géologique. *C. R. Géosci.*, 352(4-5):383–399.

Le Treut, H. (2013). *Les impacts du changement climatique en Aquitaine : un état des lieux scientifique.* Presses universitaires de Bordeaux, Pessac. LGPA-Editions, (Dynamiques environnementales, HS, 2013).

Le Treut, H., Somerville, R., Cubasch, U., Ding, Y., Mauritzen, C., Mokssit, A., Peterson, T., and Prather, M. (2007). Historical overview of climate change. In Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor, M., and Miller, H. L., editors, *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and New York, NY, USA.

Masson-Delmotte, V. (2020). Réchauffement climatique : état des connaissances scientifiques, enjeux, risques et options d'action. *C. R. Géosci.*, 352(4-5):251–277.

National Research Council (1979). *Carbon Dioxide and Climate: A Scientific Assessment.* The National Academies Press, Washington, DC.

Peterson, T. C., Connolley, W. M., and Fleck, J. (2008). The myth of the 1970s global cooling scientific consensus. *Bull. Am. Meteorol. Soc.*, 89:1325–1337.

Revelle, R. and Suess, H. (1957). Carbon dioxide exchange between atmosphere and ocean and the question of an increase of atmospheric CO_2 during the past decades. *Tellus*, 9:18–27.