



Bookkeepers of catastrophes: The overlooked role of reinsurers in climate change debates

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ABSTRACT

Global warming had long been discussed as an abstract matter of physics and chemistry. Only in the 1990s did the more tangible costs caused by natural catastrophes come into focus. The key corporate actors to advance this damage and risk perspective on climate change and corroborate it with data – reinsurance companies – have largely been overlooked in the literature. Drawing on expert interviews, hitherto confidential archival sources and text analysis, this paper traces how the two largest reinsurers have made sense of climate change and become important voices in creating awareness of man-made climate change. It underscores their unique role as both producers and translators of climate change knowledge and highlights the thorny and even subjective nature of interpreting climate-related data. This sheds new light on the history of climate change knowledge and raises important questions about the role of business actors.

1. Introduction

The socio-political implications of climate change are manifold, involving a wide range of actors, interests and sentiments (Hulme, 2009). Arguably the epitome of a wicked problem (Lazarus, 2008), climate change gives rise to complex political and scientific debates, which are said to be shaped by epistemic communities (Haas, 2015) and knowledge politics (Grundmann, 2007). One might think of this political landscape as some actors producing scientific knowledge and other actors turning that knowledge into political arguments and policy propositions – and through two-way feedback processes they ‘co-produce’ our idea of climate (change) (Allan, 2017). Whereas the knowledge-translating actors acknowledged in the literature range from political parties and governments to interest groups and transnational organizations, the knowledge-producing actors are for the most part thought to be scientists researching climate-related issues. In this paper we focus on a group of actors that has crucially contributed to both producing and translating climate change knowledge, namely reinsurers, but that has been largely overlooked by the literature.

Reinsurers are the insurers of insurance companies who step in when damages become too large to bear by individual insurers. As such, they were among the first corporate actors to be directly impacted by climate change and thus forced to make sense of it in intellectual and business

terms. Their business model is inherently global, their data collection on natural catastrophes unparalleled and their expertise in geophysics and meteorology longstanding. Due to this unique role, reinsurers have been instrumental, as we contend, in linking the question of climate change to real-life damages and losses rather than the more abstract matters of physics and chemistry that constitute meteorology.

Historically the link between climate change and natural catastrophes has been debated contentiously across the political spectrum. These days, in contrast, headlines about the damages caused by climate change have become a regular feature of public discourse. Natural catastrophes that destroy public infrastructure, private wealth and human lives in unprecedented magnitude are commonly attributed to global warming. Pointing to this link between climate change and the damages it causes, has become a core tenet of calls to curb CO₂ emissions and contain global warming. We contend that the central role played by reinsurers in introducing the damage and risk perspective on climate change as knowledge producers and disseminating their findings as translators of climate change knowledge makes it imperative for social scientists to appreciate this actor more thoroughly. It is this unique position at the nexus of producing and translating climate change knowledge that makes reinsurers particularly instructive case studies. Our findings show that despite evermore suggestive data these actors still had to rely on their gut feeling when drawing conclusions regarding the link between

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natural disasters and climate change. This sheds new light on the thorny and sometimes subjective nature of interpreting climate-related data.

The early research activities of fossil fuel interests and their ‘doubt-seeding’ public campaigns beginning in the 1970s are increasingly well studied (Supran and Oreskes, 2017; Supran et al., 2023). In contrast, the role of ‘awareness-creating’ early movers from the corporate world, reinsurers, has drawn scant attention. Note that these early corporate movers did not just differ in their public messaging vis-à-vis climate change (doubt-seeding versus awareness-creating), but also the substance of their research activities. Whereas fossil fuel interests like ExxonMobil engaged in in-house meteorological projections of global warming, reinsurers focused on the damages and losses caused by natural catastrophes and merely juxtaposed their findings with meteorological projections made by others. It is due to this pragmatic damage and loss perspective that reinsurers, as our analysis shows, at times grew frustrated with the predictions about anthropogenic climate change by bodies such as the Intergovernmental Panel on Climate Change (IPCC) in the 1990s, which reinsurers deemed as too timid and convoluted in light of the clear trends they saw in their own data.

While the social sciences discovered climate change as a field of study rather late,¹ recent years have seen an explosion of research interest in the topic. This trend notwithstanding, the role of insurers and reinsurers in the context of climate change has drawn limited attention. This is surprising for various reasons. Environmentalist groups (albeit not without expressing frustration) have long pointed to the crucial role of (re)insurers in potentially fighting climate change (Haufler, 2009). And reporting on natural catastrophes almost invariably quotes estimates by (re)insurers about the losses and damages involved. Still, while social scientists of different stripes have begun to consider the impact of climate and extreme weather events through this loss and damage perspective (e.g. James et al., 2014, Calliari, 2018, der Geest and Warner, 2015, Jarzabkowski et al., 2015, Mechler et al., 2019, Elliott, 2018, McNamara and Jackson, 2019, Vanhala and Hestbaek, 2016), the key actor in advancing this perspective and corroborating it with the requisite data, has largely been bracketed. To be sure, a few contributions in political science (Haufler, 2009), history (Haueter, forthcoming, Larsson and Lönnborg, 2021) and sociology (Collier et al., 2021; Lehtonen, 2016) have related (re)insurance to climate change. These works largely rely on public statements like press releases by these actors. As such, this research has yet to engage with the internal sensemaking of (re)insurers vis-à-vis climate change and their wider role as knowledge actors in the requisite debates.

Against this backdrop, the paper seeks to answer the modest but fundamental question: How have reinsurers contributed to making sense of climate change over time?² The analysis is divided into two parts.

¹ This applies to different degrees to different disciplines, with, for example, economics being an ‘early mover,’ whereas political science (Javeline, 2014) and sociology (Dunlap and Brulle, 2015) only later turned their attention to the issue of climate change.

² Note that the paper is not about the business model and the material interests of (re)insurers, but primarily about their sensemaking of climate change and their role in climate change debates. (Re)insurers are business actors that can be expected to be driven by profit motives, including in the context of global warming (e.g. Johnson, 2015). Analyzing how they adjusted their business models to this changed environment lies beyond the scope of this paper.

First, we trace the historical evolution of how (re)insurers made sense of climate change, beginning in the 1970s, applying process tracing techniques.³ We focus on Munich Re and Swiss Re, which have been and continue to be the two largest reinsurance companies in the world (Pearson, 1995). More importantly for the purposes of this paper, they were the first ones to allocate substantial in-house resources to researching meteorological phenomena and collecting data on natural catastrophes. We conducted interviews with current and former employees of the geoscience units of these companies (for more information, see Appendix). To address the limitations of interviews (including potential biases and memory lapses among the oftentimes retired veterans of the industry), we carried out a comprehensive documentary research, including business reports from the 1970s to today, publications about natural catastrophes and climate change, hitherto confidential transcripts of board meetings, unpublished memos and internal correspondence. Second, we analyze how reinsurers publicly advanced this perspective on climate change through political advocacy, media appearances and publications. In addition to collecting anecdotal evidence illustrating these activities, we quantify reinsurers’ political involvement, media presence and scientific impact using text analysis. This triangulation of sources and methods allows for a fine-grained analysis of reinsurers’ internal sensemaking that brought about their damage perspective on climate change as well as an overview of its external dissemination.

2. Reinsurers, natural catastrophes and climate change

2.1. Reinsurers as producers of climate change knowledge: The damage perspective

For insurance companies, making sense of climate change – a term that only became more commonly used in the second half of the 1980s – is inherently linked to damages stemming from natural hazards. There are three main types of natural hazards, distinguished by their origins: extraterrestrial (meteorites, solar storms), geophysical or terrestrial (earthquakes, volcanic eruptions, tsunamis) and atmospheric (storms, floods, hail, lightning, avalanches, landslides) (Höppe, 2008). While sometimes referred to as unpredictable “acts of god” (Jarzabkowski et al., 2015), (re)insurers’ business model makes it imperative to gauge the occurrence and magnitude of natural catastrophes as precisely as possible. As such, they “present problems for the insurance industry both in the calculation of premiums and the assumption of liability. In order to calculate premiums, the insurer must be able to estimate both the expected claims frequency and the average claims expenditure” (Ficker, 1983). While the very largest insurers have begun to allocate resources to study these matters, they mostly rely on reinsurers to pass on geoscientific research to them as one of their services (Berz, 1983, 4). Given their role as underwriters in cases of large damages and their truly global business model, reinsurers also have a stronger material interest to

³ Process tracing has become the method of choice to disentangle complex phenomena through within-case analysis. It emphasizes the importance of periodization not only to reduce the complexity of historical processes, but because “[p]eriods are bounded by important events, changes, or turning points that can be conceptualized as markers of variation in a potentially important explanatory variable” (Lieberman, 2001, 1017). Creating “detailed narratives” (George and Bennett, 2005, 210) of political phenomena is a fundamentally descriptive exercise constituting the foundation of the process tracing method (Collier, 2011, 823). However, process tracing aims to move beyond descriptive ordering or correlations by opening up the black box obscuring causation and “establish the ways in which the actor’s beliefs influenced his receptivity to and assessment of incoming information about the situation, his definitions of the situation, his identification and evaluation of options, as well as, finally, his choice of a course of action” (George, 1979, 113). By triangulating documentary sources and expert interviews, our analysis identifies turning points in reinsurers’ sensemaking of climate change and the underlying lines of reasoning.

engage in this type of research than insurers, for they are the ones who bear the risk of large natural catastrophes (interview Rauch).

This paper contends that reinsurers have played a unique role both in terms of producing and translating knowledge about man-made global warming. This section focuses on the ‘production’ of such knowledge. It identifies major turning points in the emergence of the damage perspective on climate change and traces how reinsurers over time grew more confident in linking the increasing number of outliers in their damage data to the issue to anthropogenic climate change.

2.1.1. Collecting and making sense of the data (or the question of the “gut feeling”)

Probably the earliest statement by reinsurers linking damage occurrences to climate change stems from Swiss Re General Manager Erwin Hürlimann, who wrote in 1929: “In view of the persistently unfavorable course of the hail business, we wonder whether the deeper causes are not to be sought in certain climatic changes, which make the present tariff rates based on an earlier experience appear inadequate” (SwissRe, 2021, 36). It was not until the early 1970s, however, following a noticeably increased frequency of winter storms in the 1950s and 1960s (interview Berz), that reinsurers grew more interested in understanding natural hazards (Conrad, 1976; MunichRe, 1973).⁴ Especially the damages caused by cyclone Tracy in the Australian coastal city of Darwin in 1974 alerted (re)insurers, as it caused damages in the hundreds of millions of US Dollars in a town with a population of less than fifty thousand (interview Berz).

In the past, the scientific expertise by reinsurers had largely been restricted to physicists and engineers (interview Loster). Sensitized toward the risks posed by natural hazards, Munich Re and Swiss Re began to allocate resources to in-house research arms dedicated to the geosciences in the 1970s. Munich Re’s board member Klaus Conrad at the time explained to the company’s supervisory board the need to hire more scientists: “The reinsurer was forced to hire people, who because of their education are able to somewhat predict something that statistically insufficiently corroborated, to make sense of it and price it. (...) The crucial point is that scientists in their field of expertise make predictions about developments in risks that didn’t use to exist in that form” (Conrad, 1976).

In 1974 Munich Re founded a geo risk research unit focusing on “natural science questions.” The unit was headed by a meteorologist, who teamed up with a seismologist, a mathematician and another natural scientist. The unit’s main goals were to develop accumulation of risk zones for earthquakes in cooperation with Swiss Re, to study climate predictions and to create a global database on natural catastrophes (MunichRe, 1974). Collecting data from, inter alia, news agencies and national insurance organizations, resulted in the world’s largest database on the occurrence of and damage caused by natural catastrophes, documenting tens of thousands of cases (interview Berz, interview Höpfe, Faust et al., 2006).

These data collection efforts led to an ever more detailed picture of a trend toward more frequent and more damaging weather-related natural catastrophes (e.g. Berz, 1979; MunichRe, 1982). The main socio-economic drivers of the increase in exposure to natural catastrophes were clear: “the increase in the world’s population and in insurance density, the concentration of people and insured property in conurbations, the improved standard of living, the settlement in and industrialization of particularly exposed areas and the introduction of less resistant building methods and more hazardous technologies” (MunichRe, 1982, see also Berz, 1983, Berz, 1984, SwissRe, 1985).

Attributing trends in damages stemming from natural catastrophes to climatic changes, however, was by no means a foregone conclusion. The first head of Munich Re’s geo-risk unit, Gerhard Berz, for example notes

that during his university studies, lecturers still assumed that, if the climate was to change at all, it was headed toward the next ice age (interview Berz, see also SwissRe, 1994, 24). Still, as early as 1973, a Munich Re publication on flood inundation points to the potential risk posed by climate change for damages (MunichRe, 1973, 7):

Investigations into the overall trend of claims are indispensable, and here climatic variations become most significant. Such investigations involve a study of thermodynamic processes such as, for example, the rising temperature of the earth’s atmosphere (as a result of which glaciers and the polar caps recede, surfaces of lakes are reduced and ocean temperatures rise); changes in the earth’s atmosphere due to the large-scale increase in areas irrigated and cultivated and increases in humidity resulting therefrom; and lastly the pollution of the earth’s atmosphere, e.g. rise of the CO2 content of the air causing a change in the absorption of solar energy. We wish to enlarge this complex of problems in greater detail, especially as – as far as we know – its conceivable impact on the long-range risk trend has hardly been examined.

Following these early recognitions of the potential existence of (anthropogenic) climate change and its consequences for insurance damages,⁵ the 1970s and 1980s were marked by intense research efforts to answer the question whether emerging trends in natural hazards could have their causal origins in climatic dynamics. In this context, Swiss Re displays an at times curious back and forth. In its first mentioning of climate change in 1979, Swiss Re strikes a markedly progressive tone, underscoring “the limits of growth” and “the environmental crisis.” While the possibility of climate change is discussed at some length, the main focus lies on aspects like water quality and air pollution. Climate change as a consequence of the greenhouse effect is presented as a scenario that “cannot be ruled out anymore.” Scientists have yet to reach a consensus on what drives climate change, but there is a shared understanding that the problem ought to be taken seriously (SwissRe, 1979).

In 1985, Swiss Re’s Herbert Tiedemann (1985) gave a presentation in front of the firm’s board of directors, entitled “Meteorological Influences – Outlier or permanent change?”, contending:

There is no scientific model that can explain widespread and long-term climate changes or fluctuations. Our knowledge about the interplay of factors determining the weather is insufficient.

Interpreting the increase in average temperatures since 1973 as an indication of a climate trend is pure conjecture.

The theory that an increase in atmospheric CO2 leads to an increase in temperatures [...] has to be discarded, for it cannot explain reality without contradictions.

Tiedemann acknowledges that climate warming could be problematic with regards to damage exposure, but highlights that other man-made influences on the environment (like deforestation or river straightening) are “much more important and already noticeable.” In the same year, Tiedemann expanded on these views in a comprehensive Swiss Re publication entitled “Environmental Changes and Catastrophe Risks,” which continues to contain contradictory statements, conceivably testifying to the thorny challenge of making sense of this issue (SwissRe, 1985).

Doubts about the underlying causalities notwithstanding, reinsurers grew increasingly concerned with the damages caused by natural catastrophes that appeared to be linked to changing weather patterns. In 1985, senior executives from various international insurers and reinsurers, including Commercial Union Assurance, Allianz, Munich Re and Swiss Re, formed a “weather/earthquake study group” to review

⁴ These storms included the Dutch North Sea flood of 1953, the Great Flood of Hamburg in 1962 and the Lower Saxony Storm of 1972.

⁵ Note that out of the three main categories of natural hazards (extraterrestrial, geophysical and atmospheric), only atmospheric hazards can be meaningfully affected by human behavior (Höpfe, 2011).

this issue.⁶ The group's report summarizes their position as follows (Study-group, 1986):

Although there is no common agreement between Climatologists on whether the world is experiencing a permanent change in weather patterns, it is the opinion of the Group that these perils, because of their potential widespread nature, may eventually prove even more disastrous than the more commonly recognized effects of earthquake and volcanic eruption. [...] There are reasons to believe that the climate is changing, which may alter the incidence of catastrophic floods, windstorm or hail, by a factor of about 10. Similarly, historical earthquake records suggest phases of low and high seismicity, the latter increasing exposure by several hundred percent. Furthermore, such changes have a strong influence on the probability of occurrence of several catastrophes within a few years.

We observe an increasing awareness of both the magnitude of damages and the likelihood that these might be linked to (anthropogenic) climate change. Whereas reinsurers' damage data clearly displayed too many outliers to stick to previous assumptions, meteorological scholarship had yet to provide clear answers to the 'climate question.' The current head of Munich Re's geo-risk unit, Ernst Rauch, who joined the company in 1988, describes this period from the perspective of reinsurers as follows (interview Rauch):

We saw these changes in the damage patterns, but we couldn't link these clearly or with a high likelihood to climate change. The sensemaking, if you will, of these damage patterns was a very early engagement with the science on this. Science, already back then, beginning in the 1970s, increasingly dealt with climate issues. The combination of changes in damage patterns with engagement and collaboration with scientists led to this gut feeling that potentially at least a part of these changes in damage patterns had something to do with climate change. We couldn't prove this truly analytically, in a scientific sense; we still can't by the way, even though we get that question once a week, to quantify climate change and put a price tag on it, but we can't do that with our data, for there's an array of drivers in the context of these change. But the crucial point was, in the 1970s we couldn't purely explain the changes in damages with socioeconomic data.

Note that it is part of a reinsurer's day-to-day business to contextualize complex quantitative models with qualitative judgement calls when pricing, for example, catastrophe deals (Jarzabkowski et al., 2015, 79).⁷ In that sense they might be uniquely positioned as knowledge producers to walk the tightrope of carefully interpreting data while also daring to draw conclusions that cannot yet be definitively proven by the data.

2.1.2. Turning point: Trusting the gut feeling

While reinsurers were confident that the increase in exposure to damages stemming from natural catastrophes could not be solely explained with socioeconomic factors such as an increased population anymore, they were careful not to communicate their hunch about the link to climate change too assuredly. This caution subsided markedly in the late 1980s. In light of heavy losses due to natural catastrophes in the previous years,⁸ Swiss Re began to warn against the catastrophic consequences of anthropogenic climate change (SwissRe, 1988, 1989). For Munich Re we can precisely trace how the internal sensemaking of climate change made its way from the research unit to corporate leaders. On June 19th 1989, Munich Re's board of directors asks their chief geoscientist to write a memo summarizing the state of the art regarding research on climate change. The memo presented to the board in

November of the same year leaves little doubt as to whether climate change is a fact and man-made (Berz, 1989):

1988 was the warmest year ever recorded in the 130 years or so since worldwide meteorological monitoring first began. The mean global temperatures of five other years in this decade: also exceeded all previous readings. This, in my opinion, is strong evidence of a significant warming of the earth's atmosphere, i.e. that the man-made greenhouse effect is finally upon us.

The rise in temperature has been observed above all in the tropics while there has been little change in the polar regions. This is contrary to the predictions of nearly all better known computer climate models, which had forecast that the temperature increase in the polar regions would be up to five times as high as the global average. For this reason the other predictions made on the basis of these models may also be regarded with a degree of skepticism especially as far as the regional effects they specify are concerned. Most of them are based on the assumption that the level of carbon dioxide in the atmosphere will double within the next 50 to 60 years or so if the hitherto very steady increase continues.

The combined effect of other greenhouse gases such as methane, nitrous oxides, and chlorofluorocarbons (CFCs) is just as strong, but their build-up has been quicker so far and long-term forecasts are more difficult. Even on the basis of what I feel is an optimistic assumption that the increase will remain constant in the coming decades, i.e. that it will not accelerate as in the past, the mean global temperature will rise by about 0.3 degrees per decade, that is by some 1.8 degrees by the middle of the next century; if the greenhouse gases continue to build up at an accelerating rate, however, the result will be a boost in temperature of over 5 degrees. This would produce the highest mean temperature since the beginning of the ice age about 2.5 million years ago.

The memo also clearly links the damage dimension of natural catastrophes to climate change:

In the changing climate that is to be expected, both natural disasters and the gradual change in environmental conditions will put a substantial burden on the insurance industry. On the one hand, the annual fluctuations in the results will grow as a consequence of the ever-increasing size and frequency of natural disasters, and on the other hand, the long-term trend in the results will point downwards if premiums continue to be calculated on the basis of past loss experience and thus lag behind current and future developments. In regions where the risk of windstorm and storm surge is high, the demand for cover will already become much greater in the next 10 to 20 years, but the limit of insurability may be reached on account of antiselection and excessive loss frequency. A correspondingly negative loss experience could result in a shortage of capacity.

On November 18th 1989 Munich Re's board decides to send out this memo to a "wider circle" of affiliated (re)insurers and political decision-makers, but not yet to the public. Here is the cover letter by CEO Jannott accompanying the memo that was sent out in February of 1990 (MunichRe, 1990):

Dear __,

The ever clearer climatic changes on the earth are attracting more and more attention and anxiety. They have become a subject that dominates discussion all over the world.

The situation concerns each of us personally. But in addition our sector of the economy is affected quite considerably by the consequences of the change in the climate.

Our geoscientists have summarized the way things stand – as they see it – in the essay enclosed and added some comments on the consequences for the insurance industry. We imagine that this paper could be of interest to you, too, and therefore we are pleased to send you the copy enclosed.

The letter prompted about thirty (documented) replies that constitute a fairly comprehensive survey of what (re)insurers thought about the issue of climate change in the early 1990s. Largely in agreement with

⁶ Swiss Re was represented by Herbert Tiedemann in that study group.

⁷ We thank an anonymous reviewer for drawing our attention to this.

⁸ "The last three years, with the October storms in France and England in 1987, Hurricane Gilbert in 1988 and Hugo in 1989, each brought us a 'once in a century-even'" (Conrad, 1990).

the statements made in the memo, a few replies also contain skepticism.

In early 1990, a series of devastating storms prompted another memo by Berz (1990):

The series of winter gales can, from a strictly scientific point of view, not be taken as conclusive evidence for the anthropogenic greenhouse effect, but rather as a further indication thereof.

[...]

We will maintain or contact with leading climatologists, so that we are sure to always have current information on the latest findings and ideas on this series of winter gales and global climatic change.

This marks the first documented case of a reinsurer (carefully and probabilistically) linking a concrete natural catastrophe to man-made climate change. CEO Jannott also sent out this memo to a wider circle, underscoring that the storms could potentially be attributed to climate change:

A few weeks ago I sent you a paper by our scientists concerning the present state of climate research. In the meantime Europe has been hit by an exceptional series of storms, which according to current estimates caused economic damage of over DM 20 billion. In all likelihood this will result in a record claims burden for the insurance industry.

More than ever we are confronted with the question of whether this is already “proof” of a significant change in our climate. At present, however, science is not able to provide a definite answer.

In this connection I am sure you will be interested in the enclosed brief support by our experts on the course and causes of the series of storms in the winter just ended.

The original letter draft prepared by Berz followed the passage ending on “At present, however, science is not able to provide a definite answer” with the following sentence that CEO Jannott struck through: “In any case, however, we should understand this accumulation of heaviest natural catastrophes as a warning that the living conditions on this planet will worsen dramatically, if we do not immediately take drastic measures to ‘rescue’ nature.” This editorial intervention does not mean, however, that CEO Jannott did not want to ring the alarm about climate change. During his presentation at the *Club des Principaux Assureurs* on October 5th 1990 he said (Jannott, 1990):

End of October, experts from all over the world will meet for the Second World Conference on Climate. The statistical proof that, what is expected by experts to happen, will also actually happen, is, I was informed, not possible within the next ten years. On the other hand, to the laymen, the indications for this seem overwhelming: The six hottest years world-wide in this century all happened in the eighties. We had three warmest winters in a row since at least 700 years. The ozone hole grows. The Oceans are warming up. Glaciers are melting. The sea level is increasing.

Leaving some of their caution behind, reinsurers began to make the case that a link between trends in natural catastrophes and climate change is at least very likely. Munich Re’s board decided that beginning in the summer of 1990 they should make a concerted effort to counter the widely held opinion that the climate changes and natural catastrophe events still move within “the statistical corridor,” for “this conviction is no longer acceptable” (MunichRe, 1989). During a board meeting on January 17th 1990, CEO Jannott furthermore encourages efforts to raise awareness of the issue of climate change in political associations representing (re)insurers. It had become clear that extrapolating from the past, the way they had learned it, is no longer useful in the context of predicting atmospheric natural hazards (Conrad, 1990).⁹ Three intertwined dynamics made reinsurers change their public stance on the issue

⁹ Contrary to seismic risk analysis, where the return period of earthquakes can reasonably well be calculated based on past occurrences (see e.g. Gerathwohl, 1972), the prediction of atmospheric natural risks such as floods is markedly exacerbated if the climate is not constant anymore.

and warn against climate change: (1) particularly disastrous damage years accumulated, (2) corporate leaders became increasingly concerned and interested in their researchers’ judgments (3) and scientific advances made anthropogenic global warming at least more plausible. Situated at the intersection of the pragmatic damage data perspective of the insurance industry on the one hand and the careful natural scientific perspective on the other, reinsurers saw themselves forced to rely on their gut feeling. Munich Re’s board member Conrad (1990) at the time described it as follows:

Let me now return to the windstorm risk [...]. This is a manifestation of the risk of change we reinsurers encounter time and again. But is it true that there is also a change in the phenomena of nature which give rise to the insured losses in the first place? Is the risk of random fluctuation as such subject to the risk of change? How must we extrapolate our data into the future beyond the year 1993? Were the years of 1987 to 1993 a freak accumulation of storm calamities? One thing is certain: the developments I have presented to you have given rise to increases in premiums for covering the windstorm catastrophe risk. Increases which take into account recent loss experience and a perceived trend for the future. But which increase would be technically correct?

This is where we are abandoned by science. Scientists maintain it will take them until the end of this century, before they can give us statistically reliable data about the (man-made) change in climate, but that is precisely what we would need for exact extrapolations. This means that – with due consideration of the latest scientific findings – we must do what the property insurer, unlike the life insurer with his exact calculations, has always done, anyway: We must rely on our “feeling” and intuition as well as the balance of supply and demand (or, in other words, the “market forces”). There are many things I might say about an insurer’s “feeling” and intuition. It will never develop in an ivory tower and not always in an Underwriting Box; but rather in close touch with the ever changing underlying realities. Given Munich Re’s large network of offices abroad we are of course in a particularly good position, able to keep a very close eye on local changes in the composition of portfolios, purchaser behavior and risk conditions.

[...]

What we are doing to mother nature is such a dangerous experiment that we as citizens and businessmen should make every effort to at least slow down the rate of this change.

The current head of Munich Re’s geo-risk unit, Ernst Rauch, characterizes these differences between the scientific and the reinsurance perspective (interview Rauch):

Science is at times very careful. I can give you an example. If you read the IPCC reports, formulations like ‘more likely than not,’ ‘medium confidence’ and so forth, if we were to use it exactly like that, we would be more surprised by some of the disruptive damage trends than we actually are. [...] We have to see it differently because if we compare the science to our data we see that things fundamentally match, but also that in reality things are more volatile than one can theoretically deduce from a statistical likelihood function, so to speak.

Among reinsurers a growing frustration vis-à-vis scientists and especially the IPCC took hold throughout the 1990s and the first half of the 2000s (Faust et al., 2006; Höpfe and Grimm, 2008; SwissRe, 1994, 1998). While reinsurers increasingly described anthropogenic climate change as a fact, a fact that they felt to be true based on their data, the IPCC remained cautious. The following two quotes shall serve to illustrate this growing frustration.

The second IPCC report, however, continues to maintain that there is no proof of any connection between global warming and an increase in the frequency or intensity of extreme atmospheric events. Nevertheless, the analysis of statistical series and computer models have produced numerous new indications that there has been or will be a distinct change

in the occurrence probability of extreme values as far as a number of meteorological parameters are concerned (Berz, 1999, 286). [T]he third IPCC report (2001) still saw no clear proof of the correlation between global warming and the increased frequency and intensity of extreme atmospheric events. Many studies and simulations, however, have provided a good deal of evidence that the probabilities of various meteorological parameters reaching extreme values have already changed or will change significantly (Hoeppel and Berz, 2005, 2).

When the IPCC came out more strongly in their stance on the root causes of climate change in their fourth report, reinsurers, unsurprisingly, felt vindicated (MunichRe, 2006a, 43):

The fourth report of the IPCC [...] published in February 2007 corroborated the findings of earlier climate change analyses and prognoses and confirmed our own estimates, which are essentially based on worldwide loss data. In view of continued global warming, we anticipate a long-term increase in severe, weather-related natural catastrophes. [...] Climate change is a fact. All we can do now is to limit global warming; it can no longer be stopped or reversed in the present century. We expressly welcome calls by the EU Commission to reduce greenhouse gas emissions in order to limit the overall increase in temperature to 2 °C. To that end, a follow-up agreement to the Kyoto Protocol, with consistent reduction targets, is indispensable.

Taken together, this survey of how the two biggest reinsurers have made sense of climate change highlights how much time, data collection and internal deliberations it took to reach the point where they firmly considered and communicated it to be man-made (for an overview, see Table 1). What makes this particularly interesting is that despite this seemingly cautious and slow approach, reinsurers can still be considered early movers in this regard.

2.2. Reinsurers as translators of climate change knowledge: Advancing the damage perspective

Upon tracing the internal sensemaking of climate change, we now turn to the question of how reinsurers have advanced their damage perspective in public and what impact this might have had on climate change debates. Beginning in the early 1990s, Munich Re and Swiss Re started citing their own data and broader scientific advances to warn their clients, politicians and the public at large against the ramifications of man-made climate change.¹⁰ This public outreach took the form of a flurry of scientific and non-scientific publications, increased media engagement, political consulting of national parliaments (e.g. repeated US Senate hearings) and international bodies such as the UN, as well as founding political climate initiatives of their own. At the heart of these efforts was the dissemination of their data on damages stemming from natural catastrophes, as currently still collected in Swiss Re Sigma's database of catastrophes and losses and Munich Re's NatCatService. Until very recently both databases were also accessible to a wider research audience.¹¹ Fig. 1 exhibits an early example of the by then typical graph. It shows the parallel growth of total insured and insured losses as assessed by insurance and reinsurance companies, including an economic growth comparison in the upper panel, and the growing number of catastrophes of different categories in the lower panel. The temporal juxtaposition of increasing disaster frequency and increasing losses, both insured and uninsured, was a visual aid to link climate change to palpable losses. This type of figure, which is updated annually by Munich Re, captures (re)insurers' core contribution to climate knowledge.

¹⁰ Note that this engagement has met with criticism from environmentalist groups (Haufler, 2009).

¹¹ Both services confirmed by July 2024 that the data were not available for purposes of academic research anymore.

Table 1
Main phases of reinsurers' sensemaking of climate change.

1970s	1980s	1988–1990	1991–2007
- Increased interest in understanding natural hazards due to higher frequency of winter storms	- Concerns regarding damages stemming from natural catastrophes continue to grow	- Turning point upon heavy losses due to natural catastrophes (hurricane Andrew) and growing concerns among management	- Widespread communication efforts that increasingly present anthropogenic climate change as a fact
- Resources allocated to study climate predictions and gather data on natural catastrophes	- Confidence that damage patterns cannot solely be attributed to socio-economic factors	- Link between trends in natural catastrophes and climate change is presented as at least very likely and widely communicated	- Growing frustration with cautious climatologists in light of trends in damages data
- Manmade climate change is not ruled out anymore, but focus is on socio-economic drivers of increased damages due to natural catastrophes	- Emerging 'gut feeling' about link between anthropogenic climate change and damage patterns but reticent public communication	- First incident of a reinsurer linking a concrete natural catastrophe to man-made climate change	- Sense of vindication when in 2007 IPCC changed wording on expected impact of climate change on weather-related catastrophes

By the 1990s, climate change as a topic had moved from the in-house geo-risk units into the management board and from there as well into the annual business reports which, from 1999 onwards, continuously address climate topics. This is shown in Fig. 2 through the absolute mentions of German-English climate-change dictionary terms¹² in the digitized business reports of the biggest three reinsurance companies. The Figure also shows that Swiss and Munich Re with their larger in-house geo-risk perspective were more likely to make climate change a topic even in annual (business) reports than their competitor without substantial in-house expertise, Hannover Re, in the earlier years, followed by a catch-up process. The mentions reached a first peak in the aftermath of the hurricanes in the North Atlantic in 2004 and 2005, whose unparalleled losses fueled a broad discussion about the association between climate change and tropical cyclones (Johnson, 2011, 33). This also led Munich Re's geo-risk researchers to author a publication on hurricanes, which called for completely re-thinking modelling natural hazards in light of "never-ending loss records" (MunichRe, 2006b). Only in recent years was this level of business report mentions reached again.

Alongside this increased outreach, the geo risk units of Munich Re and Swiss Re grew to around 30 employees, respectively (interview Rauch, Hoffman, 2006).¹³ Interestingly, it was really only the issue of climate change that made reinsurers more vocal participants of public discourse, as the example of Swiss Re illustrates (Hoffman, 2006):

Swiss Re has historically operated as a quiet company in a low public profile industry. That said, there is a strong sense of pride within Swiss Re about its roles as a 'knowledge company' and an 'enabler' with a very long-term perspective. [...] The irony is that the company has historically

¹² "Klimakrise", "Umweltkrise*", "Klimakatastrophe*", "Klimaveränderung*", "Umweltkatastrophe*", "Erderwärmung", "Klimawandel", "Treibhaus*", "climate mitigation", "climate adaptation", "global warming", "greenhouse effect", "greenhouse gas*", "climate crisis*", "climate catas*", "environmental catas*", "environmental crisis*", "ozone", "climate change".

¹³ Whereas the biggest direct insurer, Allianz, initiated the "Climate Core Group" in 2005, most direct insurers do not have in-house climate-specific expertise. US (re)insurers for the longest time did not invest in any such research, neither individually nor at the industry level (Haufler, 2009).

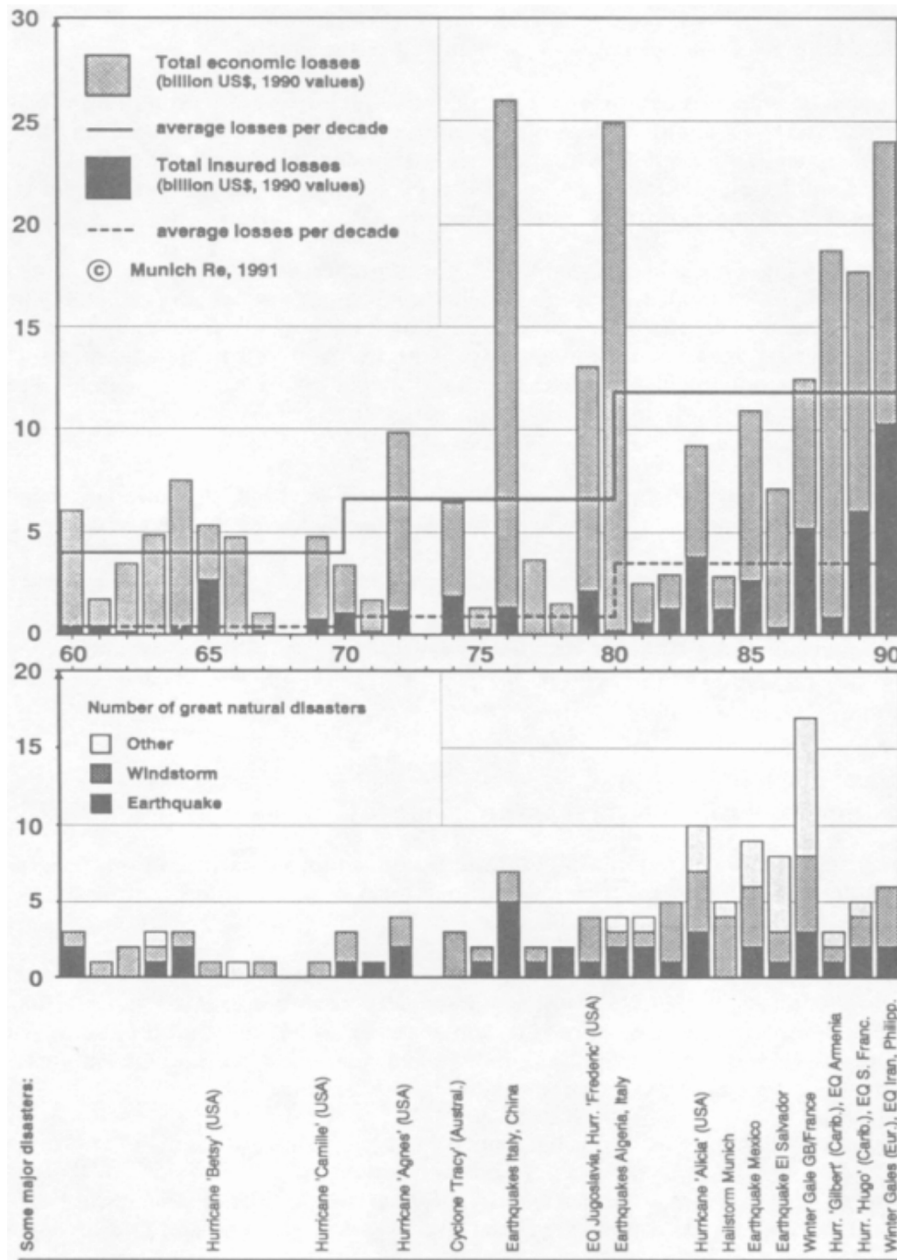


Fig. 1. Munich Re's account of natural catastrophes, insured and uninsured losses.). Source: (Berz, 1992)

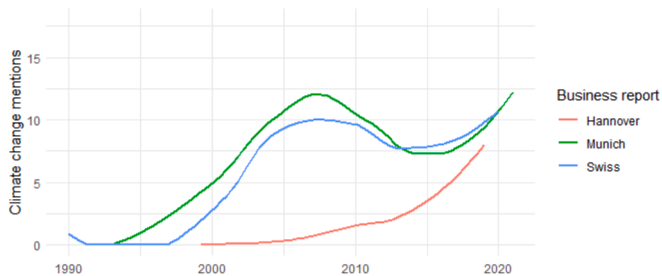


Fig. 2. Climate change mentions in business reports. Note: Sourced from corporate websites post-2000, corporate archives pre-2000; loess-function applied to smoothen year-to-year counts.

sought to remain quiet and not draw attention to itself or its positions. [...] The company's approach to global warming ended this anonymity.

Anecdotal evidence suggests that reinsurers' damage perspective has had considerable ideational power. Their perspective provided a novel way of looking at climate change that was data-driven and that did not come from scientists or activists, but from corporate actors. Hartmut Graßler, former director of the Max Planck Institute for Meteorology and longtime participant in global climate change debates, remembers (interview Graßler):

There was serious competition among the two big reinsurers [Swiss Re and Munich Re] over who had the more reliable data about damage statistics. And that was perceived much more favorably by politicians than our natural-scientific statements, because this was about money and that's where it hurts. It is obviously very different when a little fish such as myself from some Max-Planck Institute says something about how

strongly the concentration of certain greenhouse gasses has increased and that that's man-made with a high likelihood. That doesn't move people the same way, as an international reinsurance corporation pointing to the billions of US-Dollars that have to be forked up for insured damages after every hurricane.

The conjecture is clear: Messages from corporate actors with a data-driven perspective on climate change that is presented in terms of damage costs rather than scientific complexities, are more easily digestible and thus effective in moving policymakers and potentially the public. Experiences by professor of meteorology and former Chief Climate and Geo Scientist at Munich Re, Peter Hölpe, confirm this notion. Not without bitterness about the relatively lacking trust in scientists, he remembers (interview Hölpe):

The voices of these two large companies [Swiss Re and Munich Re] were received much more openly by politicians than when scientists communicated their findings. I noticed that very clearly when I started at Munich Re. I was used to giving presentations, including to the public, and there were always these doubts whether scientists might be exaggerating because they seek more funds for their research – and the worse a picture you paint, the easier it is to get funding. Afterwards, when I acted on behalf of Munich Re with the concrete data that I could produce and show, that's when I realized that people believe me much more than when I presented as a scientist. That was surprising for I would have assumed that a representative of a corporation would be seen much more skeptically than somebody who does research at a university and is essentially above economic constraints.

While the substantial impact of reinsurers as knowledge actors in climate change debates is hard to gauge beyond such anecdotal evidence, we can map their media presence over time. Given their early engagement with climate change-related issues, their involvement should at least in the early years be more pronounced than that of other corporate actors. To see this, we compared the media presence in newspaper climate change debates of big reinsurers, insurers, fossil fuel companies and banks. We searched all Nexis English-language news media across all geographies for occurrences of climate-change terms starting in 1980.¹⁴ We first set the absolute count of news articles published on climate-change and each of the corporate players relative to all climate-articles published on Nexis to standardize for both Nexis coverage growth and the growing frequency of mentioning climate change generally (left-hand panel of Fig. 3). We smoothed the time series using a loess-function. Additionally, we also searched for the total number of all English news articles in Nexis for each of the corporate players and divided the climate change articles by the total number of articles of every company to control for the fact that (American) English-language news tend to report much more on American institutions and on non-B2B institutions (right-hand panel of Fig. 3). The left-hand side is about how much financial institutions have been jointly mentioned with climate change, the right-hand side sets this into relation to the general media presence of these institutions.

The descriptive analysis corroborates reinsurers' strong media presence in comparison to other financial players in the early years. Fig. 3 shows that in the depiction of news articles mentioning both climate-change and financial institutions of different stripes, the two big reinsurers are in the lead throughout the 1990s and early 2000s. Only the big American oil companies Exxon and Chevron are considerably more present in the English-speaking media in absolute terms. Only

¹⁴ The Boolean search terms are: ("climate change" OR "global warming" OR "greenhouse effect" OR "greenhouse gas" OR "carbon emissions") AND the name of the two largest reinsurers (Munich/Swiss Re), of two largest American banks (Goldman Sachs, Bank of America), two large American oil companies (Chevron, Exxon), and two largest European insurers (Axa insur*, Allianz insur*), accessed on June, 13th 2023.

afterwards are they overtaken by the American banks and, about a decade later, by the two big direct insurers. Throughout the period and with a slight increase, 5–10 % of all news articles mentioning the two big reinsurers do also mention climate change (when compared to 0.6 % in the case of the two big banks). The two big reinsurers did thus not only become a public player in climate change debates in absolute terms (also due to the fact that they operate in a less mediatized business-to-business market and are continental European companies), but climate change itself was more and more linked to insurers' public presence in relative terms.

Aside from the absolute and relative numbers of media presence on climate change, it is important to note that the public communication of reinsurers also differed qualitatively when compared to the fossil fuel industry, which has been documented to deal in doubts and highlight uncertainty regarding climate change until the early 2010s (Supran and Oreskes, 2017; Supran et al., 2023). Public communication by reinsurers, in contrast, was much more in line with their internal sense-making, where an initial uncertainty soon made way for creating climate change awareness.

Reinsurers did not only carry this knowledge into the media space, where they became the standard reference for reporting on losses and catastrophes, but also into the scientific community through publications by their researchers. Swiss Re and Munich Re host research departments that collaborate with other researchers, often university-based, resulting in publications in scientific journals. A search without time window for authors with an affiliation or even publication venue of one of these reinsurance companies produced 252 search results in the Web of Knowledge Database, which is the historically leading database of peer-reviewed scientific (article) publications (accessed June, 13th 2023). A total of 181 of these studies mention the terms "climate change" OR "global warming" OR "greenhouse" OR "carbon emission*" in either title, abstract, keywords or general topic.¹⁵ Fig. 4 displays an increasing trend over time. The citation stars in this list have three-figure citation counts (up to 697). The citations are mainly in the fields of earthquakes, evapotranspiration, option pricing and climate change adaptation. Overall, this speaks to substantial scientific in-house expertise and legitimacy of the biggest reinsurers.

This scientific legitimacy is also evidenced by the very early and prominent presence of reinsurance scientists in the reports of the IPCC, which contrasts with the hostile relationship the fossil-fuel industry had with the IPCC (Westervelt, 2022). As a closer look at the different assessment reports (ARs) of the IPCC shows, the authors from reinsurers' geo-risk departments appear across the different assessment reports and working groups. The earlier Assessment Reports (AR2 in 1995, AR3 in 2001 and AR4 in 2007) gave the topic more attention, primarily in Working Groups G II and III. Later reports (AR5 in 2014 and AR6 in 2021) use fewer related sources and give relatively less attention to reinsurance, although having one reviewer from Swiss Re. The special report "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation" (2012) relies heavily on data provided by reinsurers.

Next to direct authorship, reinsurance scientists are also frequently referenced: In total there is one citation from Gerhard Berz in AR1 (1990), but the second report already mentions 9 publications from Swiss and Munich Re, with AR3 (2001) having 15 different reinsurance references, AR4 containing 6 references and the 2021 report still three. Almost every report also cites figures from the direct insurance

¹⁵ (TI= ("climate change" OR "global warming" OR "greenhouse" OR "carbon emission*") OR AB = ("climate change" OR "global warming" OR "greenhouse" OR "carbon emission*") OR TS = ("climate change" OR "global warming" OR "greenhouse" OR "carbon emission*")) AND.

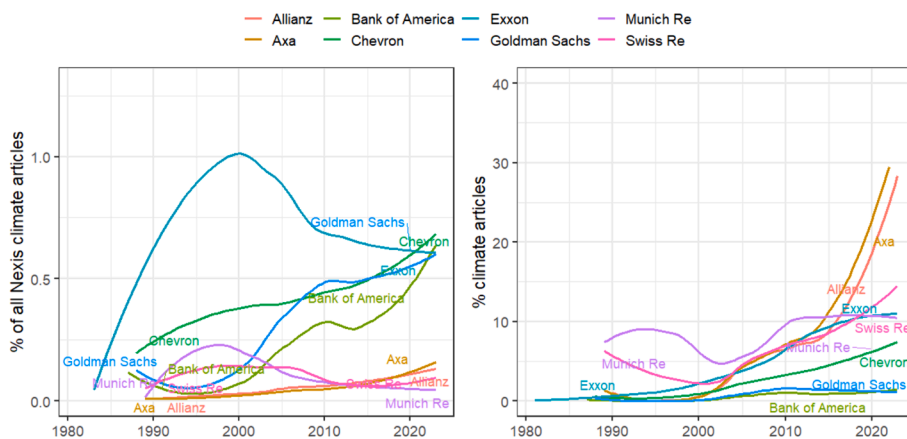


Fig. 3. Absolute and relative count of climate-articles containing mentions of corporate actors. Note: Source Nexis, the left-hand panel shows the loess-curve for the percentage of each institution's climate articles by all Nexis climate articles, the right-hand panel show the percentage of each institution's climate articles by all articles mentioning the institution's name.

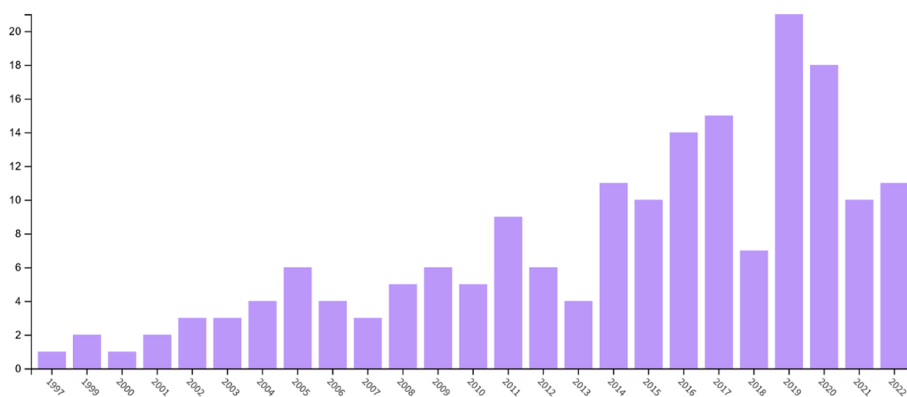


Fig. 4. Number of articles published by reinsurance researchers. Note: Source Web of Knowledge Database; the time series shows the absolute number of articles published by reinsurance researchers every year.

industry.¹⁶ Whereas reinsurers are predominantly cited with their research units, direct insurers are largely referred to in relation to their financial products and potential reactions to climate events. Reinsurers, in turn, are mostly quoted regarding the increases in insured and uninsured losses due to weather and climate related causes.

Finally, the damage perspective was eventually taken up by the insurance sector at large, including direct insurers and their associations, though not without resistances and delays. Being less exposed to systematic excess risks than reinsurers, but more exposed to premium competition from customers, direct insurers were not first movers on climate change topics and it took time and epistemic entrepreneurialism by reinsurers to put the topic on the agenda. As Gerhard Berz from Munich Re recalls:

From the beginning of the 1980s onwards, we also repeatedly communicated this message to our customers, the primary insurers: Climate change will cost us more, we have to prepare for it. Of course there was resistance, yes, I'm thinking now of Australia, among other places, where I also appeared at insurance events, where a pretty cold wind blew against me. The Australians are of course very dependent on coal and simply

didn't want to hear it, but at the same time there were also leading scientists in Australia who confirmed that a continent like Australia is particularly exposed to climate change. In America, it took much longer, I would say until well into the 1990s, for the primary insurers, i.e. our customers, to really buy into this. Of course, they have always said, yes, yes, you're setting yourselves up for disaster in order to increase premiums accordingly, to get us to buy even more reinsurance. Some of them did, but it took a long time in various countries for the insurance markets to realise that this was a threat to them.

In the 1990s then, a few direct insurers – Allianz through its connection with Munich Re and committed individuals at Scottish General and Storebrand (Haueter, forthcoming) – started to voice loss-related concerns. While US insurers remained generally more hesitant, by the 2000s, industry associations such as the Association of British Insurers and the German Insurance Association (GdV) did not only affirm higher losses, but also linked it to climate-change induced catastrophes (Dlugolecki, 2004; GdV, 2008). In the 2000s, climate change started to be perceived as top global risk in the industry (Petherick, 2011). While the finding of ever bigger catastrophic losses was gradually taken as a new fact in the industry, there has been disagreement as to whether it is reducible to a combination of rising and geographically concentrating assets or not and whether it can be attributed to anthropogenic causes (Johnson, 2011).

The spill-over of early warnings by reinsurers into the broader industry eventually also occurred through their institutionalization in the joint insurance statement launched in 1995 within the United Nations

¹⁶ (e.g. from the Association of British Insurers (ABI), Insurance Council of Australia, Insurance Council of New Zealand in AR4 or the Allianz Group, Insurance Australia Group, EIOPA, Geneva Association (especially the Geneva Papers), Caribbean Catastrophic Risk Insurance Facility, German Insurance Association, Munich Climate Insurance Initiative, Insurance Council of New Zealand, Insurance Institute for Business and Home Safety in AR5).

Environmental Program's (UNEP) Financial Initiative, where (European) reinsurers like Swiss Re and Gerling Global Re and insurers were frontrunners, resulting also in a joint publication with Greenpeace's main climate campaigner (Leggett, 1993). Echoing prior statement by banks, the publication subscribed to long-term sustainability goals regarding insurance business and investments. Displaying the cumulative membership shares by industry since its beginning, Fig. 5 shows how reinsurers and insurance companies had a strong early momentum of joining the program in the 1990s, with other financial industries following suit since the 2000s.

In 1996 the first international conference/workshop of the UNEP Insurance Initiative took place under the slogan "Implementing Environmental Commitment by the Insurance Sector" (UNEP, 1996). Subsequent to this event, the first position paper by the industry, "Insurance and Climate Change" was drafted by the UNEP III. Addressing governments, the paper called for immediate and substantial greenhouse gas reductions and political initiatives to establish changes in sectors that contribute intensely to emissions, such as the oil industry. "Large reinsurers were therefore among the early adopters of environmental, social, and governance (ESG) concerns" (Haueter, 2021) and also joined the later initiative on responsible financial investment. The road from public sustainability statements to a full implementation of ESG criteria in underwriting, assets and liability side of the balance sheet, however, still took a decade, where the largest direct insurers the driving force compared to reinsurers (interview Bresch).¹⁷ For example, while Munich Re reports that its own operations have been carbon neutral since 2015, the current pledge is to be at net zero carbon emissions in investment and underwriting by 2050 (MunichRe, 2023).

3. Conclusion

This paper has provided the first in-depth analysis of the role of reinsurers in climate change debates. Detailing their data collection efforts and internal deliberations, we are afforded a window into how reinsurers struggled to make sense of climate change over time as knowledge-producing actors. This evolution can be divided into three phases: First, in the 1970s and early 1980s, reinsurers cautiously entertained the idea that man-made climate change might be linked to increasingly frequent and severe natural catastrophes. Second, beginning in the mid-1980s, as heavy losses were mounting and 'outliers' in damage statistics became too regular an occurrence, reinsurers grew increasingly convinced that damages caused by natural catastrophes are linked to changing weather patterns. Third, in the late 1980s and early 1990s, top management began to pick up their in-house scientists' 'gut feeling' on the link between anthropogenic climate change and the damage dimension of natural catastrophes, warning against the catastrophic consequences of global warming.

In the following, reinsurers widely disseminated their findings through scientific and industry publications, media appearances and involvement in political processes. In doing so, they provided an (initially) unique perspective on climate change that focuses on losses and damages rather than physics and chemistry. In part due to this statistics-driven view, reinsurers asserted that evermore frequent and damaging natural catastrophes are likely a consequence of man-made climate change at an earlier stage than, for example, the IPCC, making them important translators of climate change knowledge. The quantitative text analyses in this paper corroborate this early mover status and suggest that it is justified when reinsurers refer to themselves as "one of the first alerters of potential climate change effects" (Hoeppel et al., 2012), at least in the corporate world.

These findings shed new light on the history of climate change

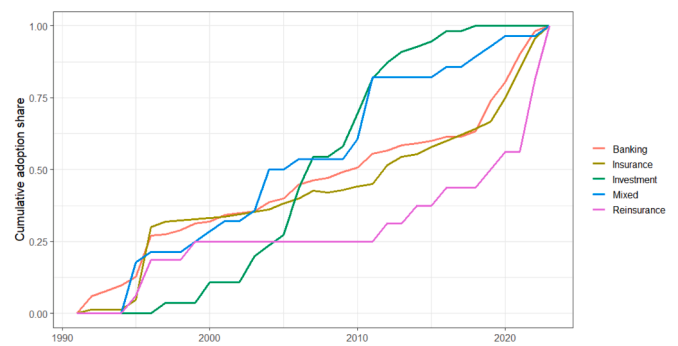


Fig. 5. Cumulative adoption share of members in UNEP's financial initiative programs. Note: Current and web-archived versions of: <https://www.uneppi.org/members/>. The graph shows the timing of members joining the initiative, not the adoption share of all firms in the industry.

debates and the evolution of climate change knowledge. Given the predominant view of private business actors as either 'greenwashing' or 'doubt-seeding,' the active role of reinsurers as early epistemic entrepreneurs causing climate change awareness may come as a surprise. At a time where insurances against natural catastrophes becomes a new dividing line between the rich and the poor (Howell and Elliott, 2018) and providing any insurance coverage at all becomes increasingly difficult (Charpentier et al., 2022), future research would do well to delve into the business interests of the (re)insurance industry in the context of climate change.

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CRedit authorship contribution statement

Nils Röper: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Sebastian Kohl:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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¹⁷ At the time of writing and hence not further considered in our historical material, the major (re)insurance members left the Net-Zero Alliance over antitrust litigation concerns in the US.

Appendix

To validate the findings from documentary research and enhance the reconstruction of actors' motives and beliefs we draw on expert interviews. Given the explorative nature of our interest in insurers' sensemaking of climate change, a semi-structured interview technique is most promising (Tansey, 2009, 771). We have conducted six in-depth interviews with subjects selected based on case knowledge (purposive sampling) and recommendations (snowball sampling). The purposive sampling was based on our documentary research, as we contacted current and former employees of the geoscience units of Munich Re and Swiss Re who had authored publications dealing with climate change. The interviews were conducted online as semi-structured interviews of about 90 min on average and were fully transcribed in agreement with the interviewees. All interviews were conducted in German, translations are ours.

List of interviews

Date	Interviewee	Function
Dec 15th, 2022	Gerhard Berz	Chief Climate and Geo Scientist at Munich Re from 1974 to 2004
Jan 26th, 2023	Thomas Loster	GeoRisks Research from 1988 to 2004, Munich Re
Mar 3th, 2023	Hartmut Graßl	Former director of the Max Planck Institute for Meteorology, former member of the German Advisory Council on Global Change, board member of the Munich Re Foundation
Mar 6th, 2023	Ernst Rauch	Current Chief Climate and Geo Scientist at Munich Re
Mar 9th, 2023	Peter Höppe	Former professor of meteorology and Chief Climate and Geo Scientist at Munich Re from 2004 to 2017
Jun 8th, 2023	David Bresch	Former head of Atmospheric Perils (2001–2008), global head of sustainability (2008–2015) and head of business development (2015–16) at Swiss Re

References

- Allan, B.B., 2017. Producing the climate: states, scientists, and the constitution of global governance objects. *Int. Organ.* 71 (1), 131–162.
- Berz, G., 1984. Research and statistics on natural disasters in insurance and reinsurance companies. *Geneva Papers on Risk and Insurance*:135–157.
- Berz, G., 1990. The Series of Winter Gales 1990: Chronology and Causes. Memo, Munich.
- Berz, G., 1999. Catastrophes and climate change: concerns and possible countermeasures of the insurance industry. *Mitig. Adapt. Strat. Glob. Chang.* 4, 283–293.
- Berz, Gerhard, 1979. Earthquake, Typhoon and Flood. Scientific and Underwriting Aspects Including Accumulation Control. Presentation held at Fire Prevention Seminar Taipei September 12, 1979.
- Berz, Gerhard, 1983. The International Implications of Disaster Insurance: Research on Natural Disasters in Insurance and Reinsurance Companies. In: Presentation held at Insurance and Natural Disaster Management Townsville, 20th - 22nd July, 1983.
- Berz, Gerhard, 1989. Aktueller Stand zum Thema „Klimaänderung“. Memo June 19th 1989.
- Berz, Gerhard. 1992. "Greenhouse Effects on Natural Catastrophes and Insurance." *The Geneva Papers on Risk and Insurance. Issues and Practice* 17 (64):386-392.
- Calliari, E., 2018. Loss and damage: a critical discourse analysis of Parties' positions in climate change negotiations. *J. Risk Res.* 21 (6), 725–747.
- Charpentier, A., Barry, L., James, M.R., 2022. Insurance against natural catastrophes: balancing actuarial fairness and social solidarity. *The Geneva Papers on Risk and Insurance-Issues and Practice* 47 (1), 50–78.
- Collier, S.J., Elliott, R., Lehtonen, T.-K., 2021. Climate change and insurance. *Econ. Soc.* 50 (2), 158–172.
- Collier, David, 2011. Understanding process tracing. *PS: Polit. Sci. Polit.*, 44(4), 823–830.
- Conrad, Klaus, 1976. Naturwissenschaften im Instrumentarium des Rückversicherers. Presentation to the supervisory board of Munich Re July 8, 1976.
- Conrad, Klaus, 1990. Das Risiko einer Klimaveränderung aus der Sicht der MR. Presentation to Munich Re's supervisory board July 11, 1990.
- der Geest Kees, V., Warner, Koko, 2015. Loss and damage from climate change: emerging perspectives. *Int. J. Glob. Warm.* 8 (2), 133–140.
- Dlugolecki, A., 2004. A changing climate for insurance: A summary report for chief executives and policymakers. Association of British Insurers, London.
- Dunlap, Riley E, and Robert J Brulle. 2015. Climate change and society: Sociological perspectives: Oxford University Press.
- Elliott, R., 2018. The sociology of climate change as a sociology of loss. *Eur. J. Sociol./archives Européennes De Sociologie* 59 (3), 301–337.
- Faust, E., Höppe, P., Wirtz, A., Schmidt, S., 2006. Trends in natural catastrophes–potential role of climate change. *Understanding and Attributing Trends and Projections, Climate Change and Disaster Losses Workshop.*
- Ficker, Rudolf. 1983. "Catastrophe Coverages and Their Impact on Reinsurance - Natural Vs. Created Peril Coverage." Presentation held at the 4th Plenary Session of the XIX. International Insurance Seminar Singapore 29.6.1983.
- GdV. 2008. Auswirkungen des Klimawandels auf die Schadenssituation in der deutschen Versicherungswirtschaft.
- George, A.L. (Ed.), 1979. Case Studies and Theory Development: The Method of Structured, Focused Comparison. In *Diplomacy: New Approaches in History, Theory and Policy*. The Free Press, New York.
- George, A.L., Bennett, A., 2005. Case Studies and Theory Development in the Social Sciences. MIT Press, Cambridge, MA.
- Gerathewohl, K., 1972. Das Erdbeben-Kumulproblem der Münchener Rück. Presentation to the Supervisory Board, Munich 13 (07), 1972.
- Grundmann, R., 2007. Climate change and knowledge politics. *Environ. Polit.* 16 (3), 414–432.
- Haas, P., 2015. *Epistemic Communities, Constructivism and International Environmental Politics*. Routledge, London.
- Haueter, Niels Viggo. 2021. "The Impact of Reinsurance." Oxford Research Encyclopedia.
- Haueter, Niels Viggo. forthcoming. "Climate Change and the Insurance Industry – The Long Road to the UNEP 1995 Insurance Statement." In *Climate Change and Business History*, edited by Teresa da Silva and Robert Fredona.
- Haufler, Virginia, 2009. Insurance and Reinsurance in a changing climate. In: Selin, H., VanDeveer, S.D. (Eds.), *Changing Climates in North American Politics: Institutions, Policymaking, and Multilevel Governance*. The MIT Press, Cambridge, pp. 241–262.
- Hoeppe, Peter, and Gerhard Berz. 2005. "Risks of climate change-the perspective of the (re-) insurance industry." IEEE Power Engineering Society General Meeting, 2005.
- Hoeppe, Peter, Ernst Rauch, Detlef Stolten, and Bernd Emonts. 2012. "Economic Risk and Potential of Climate Change." 18th World Hydrogen Energy Conference 2010-WHEC 2010: Speeches and plenary talks/ed.: Detlef Stolten; Bernd Emonts....
- Hoffman, AJ. 2006. "Getting ahead of the curve: corporate strategies that address climate change. Prepared for the Pew Center on global climate change." October, available at: www.pewclimate.org/docUploads/PEW_CorpStrategies.pdf (accessed 4 April 2009).
- Höppe, P., 2008. Naturgefahren und Klimawandel: die Rolle der Versicherungswirtschaft. *Vierteljahrshefte Zur Wirtschaftsforschung* 77 (4), 110–115.
- Höppe, Peter, Tobias Grimm, 2008. "Rising natural catastrophe losses–what is the role of climate change?" *Economics and Management of Climate Change: Risks, Mitigation and Adaptation*, 13–22.
- Höppe, Peter. 2011. "Was kosten Naturkatastrophen die Wirtschaft." *Fachtagung der Hanns-Seidel-Stiftung, München April 7th:2011.*
- Howell, J., Elliott, J.R., 2018. Damages done: the longitudinal impacts of natural hazards on wealth inequality in the United States. *Soc. Probl.* 66 (3), 448–467.
- Hulme, M., 2009. *Why we disagree about climate change: Understanding controversy, inaction and opportunity*. Cambridge University Press.
- James, R., Otto, F., Parker, H., Boyd, E., Cornforth, R., Mitchell, D., Allen, M., 2014. Characterizing loss and damage from climate change. *Nat. Clim. Chang.* 4 (11), 938–939.
- Jannott, Horst, 1990. The Consequences of the January/February 1990 Storms - Climatic Changes and Their Impact. Meeting at the Club des Principaux Assureurs October 5th, 1990.

- Jarzabkowski, P., Bednarek, R., Spee, P., 2015. Making a Market for Acts of God: The Practice of Risk-trading in the Global Reinsurance Industry. Oxford University Press, Oxford.
- Javeline, D., 2014. The most important topic political scientists are not studying: adapting to climate change. *Perspect. Polit.* 12 (2), 420–434.
- Johnson, L., 2015. Catastrophic fixes: Cyclical devaluation and accumulation through climate change impacts. *Environ Plan A* 47 (12), 2503–2521.
- Johnson, Leigh, 2011. "Insuring Climate Change? Science, Fear, and Value in Reinsurance Markets." Ph.D. Thesis, Dissertation, University of California.
- Larsson, Anders Olof, Mikael Lönnborg, 2021. Swedish life reinsurance and risk management. In: *Highlights on Reinsurance History*, edited by André Straus and Leonardo Caruana de las Cagigas. Frankfurt: Peter Lang.
- Lazarus, R.J., 2008. Super wicked problems and climate change: Restraining the present to liberate the future. *Cornell L. Rev.* 94, 1153.
- Leggett, J.K., 1993. Climate Change and the Insurance Industry: Solidarity Among the Risk Community, 2nd ed. Greenpeace.
- Lehtonen, T.-K., 2016. Objectifying climate change: weather-related catastrophes as risks and opportunities for reinsurance. *Polit. Theory* 45 (1), 32–51.
- Lieberman, E.S., 2001. Causal inference in historical institutional analysis: a specification of periodization strategies. *Comp. Pol. Stud.* 34 (9), 1011–1035.
- McNamara, K.E., Jackson, G., 2019. Loss and damage: A review of the literature and directions for future research. *Wiley Interdiscip. Rev. Clim. Chang.* 10 (2), e564.
- Mechler, R., Bouwer, L.M., Schinko, T., Surminski, S., Linnerooth-Bayer, JoAnne, 2019. Loss and damage from climate change: Concepts, methods and policy options. Springer Nature.
- MunichRe, 1982. Schadenregulierung bei Naturkatastrophen. München.
- MunichRe, 2006b. Hurricanes – More intense, more frequent, more expensive: Insurance in a time of changing risks. Munich Re, Munich.
- MunichRe, 1973. Die Bedeutung der Umweltverschmutzung für die Versicherung.
- MunichRe, 1974. Internal report on activities by geo risk unit. May 31, 1974.
- MunichRe, 2006. Natural Catastrophes 2006: Analyses, Assessments, Positions. Munich.
- MunichRe, 2023. "Munich Re discontinues NZIA membership." <https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2023/media-release-2023-03-31.html>.
- MunichRe, 1989. "Klimaänderungen, weiteres Vorgehen." Internal transcript of Grundsatzgespräch Munich, 17./18.11.1989.
- MunichRe, 1990. "Verteilung des Papiers „Klimaveränderungen“ durch Herrn Dr. Jannott." Munich, 15.02.1990.
- Pearson, R., 1995. The development of reinsurance markets in Europe during the nineteenth century. *J. Eur. Econ. History* 24 (3), 557–572.
- Petherick, A., 2011. Calculated risks. *Nat. Clim. Chang.* 1 (4), 188–189.
- Study-group, 1986. "Weather/Earthquake Study Group."
- Supran, G., Oreskes, N., 2017. Assessing ExxonMobil's climate change communications (1977–2014). *Environ. Res. Lett.* 12 (8), 084019.
- Supran, G., Rahmstorf, S., Oreskes, N., 2023. Assessing ExxonMobil's global warming projections. *Science* 379 (6628), eabk0063.
- SwissRe, 1985. Umweltveränderung und Katastrophenrisiken. Zürich.
- SwissRe, 1994. Risiko Klima. Zürich.
- SwissRe, 1979. Oekologie und Umweltschutz. Zurich.
- SwissRe, 1988. Berge, Wasser, Katastrophen. Zurich.
- SwissRe, 1989. Umweltschutz-Lebensschutz. Zurich.
- SwissRe, 1998. Klimaforschung räumt die Ungewissheit nicht aus. Das Risiko Klima bewältigen. Zurich.
- SwissRe, 2021. Swiss Re's Track Record on Climate Change Knowledge. In *Swiss Re Business Report 2021*, 36–37. Zurich.
- Tansey, O., 2009. Process Tracing and Elite Interviewing: A Case for Non-probability Sampling. *Methoden Der Vergleichenden Politik-Und. Sozialwissenschaft*:481–496.
- Tiedemann, Herbert, 1985. "Meteorologische Einwirkungen - Ausnahme oder dauernde Änderung." SRCA 002831.
- UNEP, 1996. "United Nations Environment Programme: Financial Services Initiative Newsletter." <http://web.archive.org/web/2001011211900/http://www.unep.ch/etu/finserv/finserv/newslet1.htm> 1st Edition.
- Vanhala, L., Hestbaek, C., 2016. Framing climate change loss and damage in UNFCCC negotiations. *Glob. Environ. Polit.* 16 (4), 111–129.
- Westervelt, A., 2022. IPCC: We can tackle climate change if big oil gets out of the way. *The Guardian* 5.