How to communicate the uncertainties in climate change research outcomes?

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Preface

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Last but not least I would like to thank my roommates for their (sometimes) brilliant ideas and input.

Summary

Uncertainty is not confined to science; it is a fact of every day life as well. We wonder about what the weather will be like tomorrow, or what the next elections will bring. But these uncertainties rarely seem to bother us, while we have become accustomed to these types of uncertainties.
Scientific uncertainty is another matter, especially in areas of science that are controversial such as climate change. Scientists have developed a scientific vocabulary to detail the uncertainties that are enclosed in their research outcomes. Because of this scientific jargon and the long communication trajectory; from the scientist through the media to the public, misconceptions about these uncertainties can arise.
This study aimed to investigate where on the path of communication to the general public, of scientific research results of climate change studies, these misconceptions can arise and what could be improved on the part of the scientists and the journalists involved. The end result was a two-hour classroom lecture for future science communicators.

This study was performed on the basis of two cases.
The first case; the Hockey Stick Affair, a scientific and media debate around the hockey stick graph, which shows the temperature in the northern hemisphere has not been as high in a thousand years as it is today. This graph made by Mann, Bradley and Hughes in 1998, became an icon for IPCC reports and was attacked by critics such as McIntyre and McKitrick. In the scientific controversy and in the media debate nuances surrounding the hockey stick graph seem to have faded over time, but in the last year both scientists and journalists have brought back some of these nuances. The main reason misconceptions arose in this particular case was because of the fact that journalists did not paint a total picture; they did not hear both parties involved in the debate. This caused the public to think the whole Kyoto Treaty was based solely on research studies of Mann and his colleagues. And when doubt was cast on the verity of this graph, the public was made to believe that ratifying the Kyoto Treaty was a big mistake.

The second case is called Snow on Greenland, this case was chosen because of the effort to reduce uncertainties surrounding its field. Scientists from the Centre for Isotope Research (CIO) of the University of Groningen have set out to Greenland and made a layer of special labelled snow. Over the next few years they will monitor this layer of snow in order to measure the mixing process.
Snow contains water and water contains a mixture of different water molecules (isotopes) regular water and heavy water. During colder periods precipitation contains more heavy water than during summer time. Because of these properties, the composition of snow contains information on the climate. Eventually snow turns into ice, but during this process of compressing the molecules mix.
Scientists have been looking at ice core data for years. When making their calculations they have been compensation for this mixing process.
The CIO team is attempting to find out how accurate these compensations have been so far.
The communication trajectory of this particular study did not impose any difficulties. All basic principles of the research where communicated correctly in the newspapers and magazines, as were the uncertainties involved. This because of good communication on the part of the scientist concerned with giving the interviews and the journalists involved. Both requested a check back before the articles were printed.

During this research study the difference in two types of journalists became visible. The way in which specialised scientific journalist communicate differs from the way regular reporters write their articles. This will probably have to do with the time available to spend on each item and the journalist's background.

This research has come up with suggestions on how to improve the communication trajectory of climate change research results.
Some of these improvements could be made by the scientists, especially when their research has societal relevance; in that case they have a responsibility towards the media. They could ask for a check back before the story gets printed, they could use metaphors, use less jargon and provide easier access, start a web log for instance.
Both scientist and journalist could find out during the interview whether they are speaking the same language and the basic principles are understood correctly. It is the job of the scientific journalist to communicate the nuances surrounding scientific research results in a correct way towards the public. Therefore they could also ask for a check back themselves. Journalists should look beyond their own nose, while not everything is as straightforward as it seems, especially not when it is printed in a non-peer reviewed journal.
Last but not least, the public's perception of the reliability of the article is improved when reading a newspaper article that contains more context, therefore journalist should provide more of it.

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1. Introduction

This notion that science is something that belongs in a separate compartment of its own, apart from everyday life, is one that I should like to challenge. We live in a scientific age; yet we assume that knowledge is the prerogative of only a small number of human beings……This is not true. The materials of science are the materials of life itself. Science is the reality of living; it is the what, the how, and the why in everything in our experience. Rachel Carson in 1952

According to Rachel Carson, science is a part of every day life. It has it strengths and weaknesses, its successes and failures, its doubts and uncertainties.
Science is as much an uncertainty generator as it is a certainty producer. This, because scientists continue to ask questions and probe for gaps in their own work field, thereby identifying new uncertainties that need to be explored. [Friedman et al, 1999]

When scientists are trying to understand how human cloning can be established, their investigations are surrounded by uncertainties at every stage of the research.
But this uncertainty has not been weakening science. Uncertainty is actually a stimulus that propels science forward. For example, the uncertainty of how genetic traits were replicated, eventually led to the discovery of the double helix configuration. [Pollack, 2003]

Scientific uncertainty begins when we make measurements. What do we use to make a measurement? How well can this particular tool carry out this measurement? If we repeat the measurements, how closely will the separate measurements agree with each other?
When these measurements are translated in the results, another stage of uncertainty becomes apparent.
Scientists have developed a certain scientific vocabulary to detail the uncertainties that are enclosed in their research outcomes. Examples of this particular vocabulary are statistical methodologies, through which the uncertainties are translated into numbers, and modelling. Most scientists are familiar with this way of processing data and take it for granted. When publishing an article in a scientific journal or magazine, this needs no further explanation, since the readers of these journals are all scientists.
When the outcome of research needs to be presented to the public, journalists play an important role in the communication between the scientist and the public. Considering the fact that most citizens obtain their knowledge on science from the media it is important that the message given by the scientist is being translated correctly to the public. This is also the case when it comes to the issue of climate change. Bell found that the media were the sole source of information on climate change for New Zealanders and Wilson reported that the media were the primary information source in the USA. [Bell, 1994], [Wilson, 2000]

In climate change research, for example, models are being used to display and visualize certain scenarios, this in order to make an attempt to predict a potential future. Different models are used to paint a picture that covers most possible scenarios. Scientists usually want to cover many if not all possibilities.
When these outcomes are being presented to the public a lot of confusion can be created. Stamm, Clark and Eblacas report that mass media appears to make a positive contribution to understanding, as well as, perpetuation some popular misconceptions. [Stamm et al, 2000]

One typical example is the Netwerk broadcast on the Hockey stick-graph. Netwerk is a popular news programme, in which certain news items are discussed more in depth. This particular broadcast was used to “discuss” the findings by Stephen McIntyre en Ross McKitrick. These two scientists rebutted the “hockey-stick graph” by M. Mann, R. Bradley en M. Hughes [Mann et al, 1999]. This hockey-stick graph shows that the Earth’s temperature in the northern hemisphere was slightly cooling from the year 1000 until 1900, but in 1900 the temperature started to rise quite dramatically. The shape of the graph vaguely resembles the shape of a hockey-stick, hence the name. This graph is also used in the Intergovernmental Panel of Climate Change (IPCC) Third Assessment Report of 2001. This report discusses the science of climate change.
McIntyre and McKitrick, no climate change experts themselves, went over the data used by Mann, Bradley and Hughes. They claimed that the rise in temperature displayed in the hockey-stick graph, was created by a statistical trick. Their article was published in a scientific magazine and picked up by the media. In the Netwerk broadcast only one side of the story was explained, namely the McIntyre and McKitrick-side. This broadcast caused people to think that the whole Kyoto Protocol was based on thin air.
The hockey-stick has been functioning as a logo for climate change in the media ever since, while the study done by Mann et al is not the only scientific research the Kyoto Protocol is based on.

1.1 Problem definition

In general scientific research results show a certain degree of uncertainty. When it comes to forecasting a potential future, especially when it concerns climate change, science can never be a 100% certain in its estimations. The communication trajectory of scientific news leads from the source; either the scientists or the person putting out the press release, through, either a scientific journalist or regular journalist to the public. It is also possible for a journalist to start this process, by asking a scientist for information or clarification about their research.
The communication trajectory contains many interactions between different parties. Scientists use a lot of scientific vocabulary in communicating their research results. The combination of these facts can lead to a lack of understanding of certain issues or result in a complete misunderstanding on the part of the public. This miscommunication can cause a lot of problems for policy makers, who have to base their policies on these research results. Moreover, if the public feels it can not trust these results because of the fact that the uncertainties have not been explained or defined well enough, it could hamper the implementation of changes, especially when it concerns behavioural changes.

1.2 Research Aim

This research aims to produce a MSc. level classroom lecture providing guidelines to future science communicators on how to communicate scientific uncertainties. The lecture could make a contribution to solving the problem of miscommunication in the future.
In order to achieve this goal, the communication of research results from the source through the media to the public needs to be scrutinized and analyzed. This research should give insight in possible bottlenecks and point out whether there is a way to improve this path of communication, in order to achieve a better understanding by the public of the uncertainties that are characteristic of this particular branch of science.

1.3 Research Questions

1.3.1 Main question:

How to communicate the uncertainties in climate change research outcomes on the separate tracks of the communication trajectory from the source through journalists to the general public?

1.3.2 Sub questions:

1. How do scientists describe uncertainty in their research results on climate change issues?
2. How do journalists and other intermediaries deal with this uncertainty?
3. How does the public handle this uncertainty?
4. Are there any applicable theories on uncertainties and the communication thereof?
5. What could be alleviated by good communication on the part of the scientists?
6. What could be alleviated by good communication on the part of the journalists and other intermediaries?

2. Methods

2.1 Literature Study

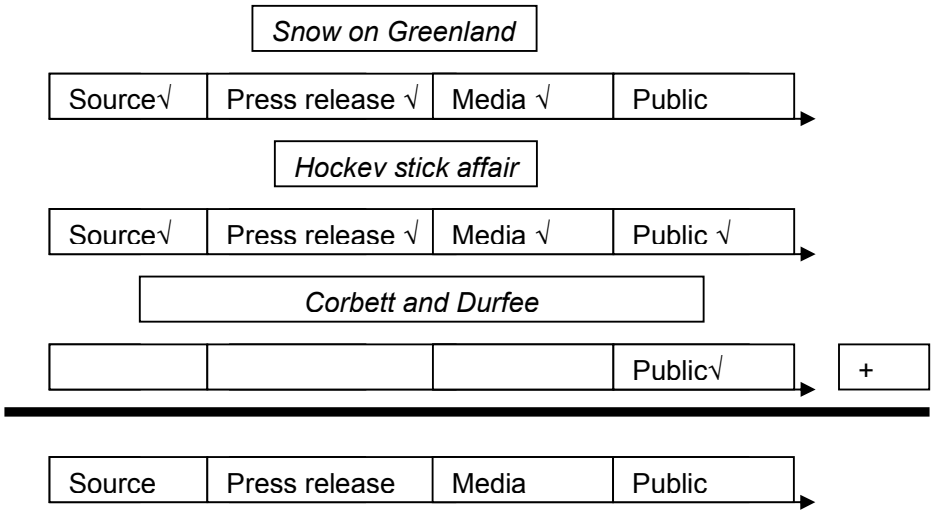
For this research three types of literature study are necessary. First of all theories about uncertainties need to be described. Secondly theories on the communication of uncertainties need to be identified and thirdly, more information on the main cases needs to be gathered.
To give an answer to the research questions two main cases were used as an example and to clarify theories and statements.
For these particular cases a few criteria were defined:

- Case needs to concern the subject of climate change
- Case needs to have been published in the media
- Background information on the case needs to be traced back to real scientific papers and newspaper articles

Based on these considerations two main cases were used as a framework for answering the study questions, looking at the facts and interpretations given by the scientists, journalists and other intermediaries:

1. Parts of the trajectory of communication on the "Hockey stick affair" mentioned in the introduction. [Mann et al, 1998]
2. Parts of the trajectory of communication of the news of producing snow on Greenland, for which the primary press release was given out by Meijer (August 19, 2005). A group of scientists from the CIO (Centrum voor IsotopenOnderzoek) department of the R*u*G, are been making their own snow on Greenland in order to study the mixing of different layers of snow. This will benefit insight in past atmospheric CO_2 concentrations.

Most parts of the trajectories of all the cases will be looked at. When combining these trajectories it might be possible to come up with a general way of communicating research results. (See simplified graph below)



For the last part of the trajectory (media to public) a study by J.B. Corbett and J.L. Durfee will be used. (Corbett and Durfee, 2004)

This study explains that readers' assessments of the certainty of scientific findings in news stories depend on certain characteristics of the text.

Furthermore, research material was gathered for a third case. This case is on the news of the acidification of the oceans. This case will only be used to demonstrate the search methods. All collected information is documented and might be used for further research.

2.2 Literature search methods:

The search engines Web of Science, Science Direct, Picarta, Google Scholar and Scopus have been searched for relevant articles.
After having found several relevant articles, the references were used to find more (snowball method).
For the literature search the following key words have been used:
Communication
Uncertainty
Climate change
Climate
Science
Communic?
Uncertain?
Scien?
and combinations of these words.
The data has been collected between September and October 2005.

The LexisNexis news portal (www.lexisnexis.nl) and the NDC online newsportal (www.ndc-informatieservice.nl) have been used in order to find newspaper articles for the cases. Articles were also obtained from newspaper magazines and the University newspaper, the UK.

2.2.1 Case1 - The Hockey Stick Affair

For the newspaper search the following keywords have been used:
Hockeystick (hockey stick)
Klimaat (climate)
Klimaatverandering (climate change)
Mann
McKitrick
McIntyre

2.2.2 Case 2 - Snow on Greenland

For the newspaper search, the following keywords have been used:
Sneeuw (snow)
Groenland (Greenland)
Harro Meijer

2.2.3 Case 3 – Acidification of oceans

On 28/11/05 a newspaper search was carried out via the lexisnexis.nl portal.
Firstly British newspapers were searched by using the following key words:

1. acidification & oceans
2. acidification & ocean
3. acidification
4. carbonic acid

5. seawater & acid
6. Hopkins & ocean
7. Langdon & ocean
8. Atkinson & ocean
9. Orr & ocean
10. Raven & ocean

Secondly, American newspapers were searched by using the same key words.
Dutch newspapers were the last to be searched; the following key words were used:

1. verzuring & oceanen (acidification & oceans)
2. verzuring & oceaan (acidification & ocean
3. verzuring (acidification)
4. verzuring & zeewater (acidification & saltwater)
5. zuur & zeewater (acid & saltwater)
6. koolzuur & zeewater (carbonic acid & saltwater)
7. CO_2 & zeewater (CO_2 & saltwater)
8. CO_2 & oceanen (CO_2 & oceans)
9. koolzuur & koraal (carbonic acid & coral)
10. CO_2 & koraal (CO_2 & coral)
11. klimaat & oceanen (climate & oceans)
12. klimaat & oceaan (climate & ocean)
13. Langdon
14. Atkinson
15. Orr
16. Raven
17. Hopkins

2.3 Interviews

2.3.1 Case 1-The Hockey Stick Affair

In order to find out how journalist deal with uncertainties in their newspaper articles and in order to find out how they feel uncertainty should be handled by journalists in general and by scientists, interviews by phone have been carried out with:

- Marcel Crok, a member of the editorial staff of *Natuurwetenschap &Techniek*, a popular Dutch scientific journal
- Martijn van Calmthout, a member of the editorial staff of *De Volkskrant*
- Karel Knip, a member of the editorial staff of *Het NRC Handelsblad*
- René Fransen, a member of the editorial staff of *De UK*, the university newspaper of the R*u*G

All four journalists are specialised in scientific subjects and have written pieces on climate change and in particular about the Hockey Stick Affair.
A summary of these interviews can be found in the Appendix.
There has also been some email contact with Michael Mann.

2.3.2 Case 2 – Snow on Greenland

In order to uncover the perspective of a scientist in this case, prof. dr. Harro Meijer was interviewed. He is one of the scientists who participated in this research project.
René Fransen was also interviewed on this subject, while he has written an article in the UK about it.
A summary of these interviews can be found in the Appendix.

2.4 Course Aims

At the end of the two hour lecture, students will have to be able to reiterate:

- What is meant by scientific uncertainty
- Which part(s) the scientist can play in the communication of this uncertainty towards the journalist
- Which part(s) the journalist can play in the communication towards the public
- In which ways the uncertainties can be dealt with in (newspaper) articles
- Which aspects these different ways of communication depend on
- To what extent the principle of a “both sides of the story”-approach can be clarifying or the opposite
- In what ways a scientific conflict can be dealt with in the media, in order to clarify the conflict to the public
- What kind of consequences giving one’s own opinion in your article can have on the public

2.5 Methods (Assignments)

- Asking the students about their own feeling of uncertainty considering the hockey stick case, on several occasions during the lectures
- Asking the students to read articles/information and point out where nuances are omitted or present
- Asking the students to choose between two or more newspaper articles on the same topic, their choice based on the credibility of the article, or the clarity
- Asking the students to give examples of scientific uncertainties in every day life
- Asking the students to come up with metaphors that could be used in a newspaper article, to explain Case 2 (Snow on Greenland)
- Asking the students to fill in a questionnaire before and after the lectures. This questionnaire contains the questions mentioned in the course aims section of this paper

3. Results

3.1 Scientific uncertainty

The first step in the literature search led to an evaluation of scientific uncertainty.
There are a few ways to describe, or subdivide scientific uncertainties.
The RIVM paper *Coping rationally with risks* specifies three levels of scientific uncertainty. [Hollander and Hanemaaijer, 2003]
First of all there is *inaccuracy*, statistical uncertainty, and this concerns uncertainty surrounding the data, often expressed in error bars. This often means there is a lack of data and saying something valid about the results is difficult, while you are comparing apples and pears. To decrease this statistical uncertainty, more data needs to be obtained.
The second level of scientific uncertainty is *unreliability,* for example as displayed in models. Models are a simplified concept of the way things work. In models relations between different aspects are incorporated. Models that try to give an idea about the future climate change do not only incorporate the measured rise in temperatures, but also the increase in CO_2 emissions, the solar radiation and volcanic eruptions. But there are still question marks being placed next to the causality of certain relations.
To minimise this uncertainty, “what if”-scenarios are analysed. An every day example is the weather forecast, in which the chance of precipitation is given in percentages and the minimum and maximum temperatures are stated. Nowadays, during hurricane season, the expected path of the storm is being displayed by a cone shaped picture, while the uncertainty of its path increases over time.
The third category of scientific uncertainty is *ignorance*. This category deals with the bigger picture. You have no idea how the system works, there are just a few pieces of the puzzle available. Sometimes it is a matter of lack of knowledge and one can not say anything about probabilities. This means the precaution principle applies.
Funtowicz and Ravets, call this division of uncertainties, technical, methodological and epistemological uncertainties. [Funtowic and Ravets, 1990]

3.2 Communication of uncertainties

The second step in the literature search led to an inventory of theories on the communication of scientific uncertainty, some specifically in the case of climate change.
As mentioned in the introduction, mass media plays an important role in the communication of scientific research results to the public. Not only does it attribute to the public understanding of scientific research, it can also create misconceptions. [Stamm, Clark and Eblacas, 2000]
In order to reduce the chance of misconceptions, Bell suggests that scientists should find out during the interview whether the journalist understands the principal aspects of his research. Another thing scientists could ask for is a partial check back. In order for the scientist to make sure certain quotes or important details are printed correctly. [Bell, 1994]

Because of the fact that climate change is such a difficult field of science, it raises many issues for communicating its findings and results to the broader community. Attempting to communicate to non-specialists through this complex of issues, inevitably leads to the use of simplifications and to a reduction in detail. That makes it harder to maintain a clear sense of the underlying levels of confidence. [Manning, 2003]

There are quite a number of other researchers that mention the problem that arises from the use of specialized jargon by scientists in the field of climate change.
Pat and Schrag suggest that a potential misunderstanding is introduced, not because of over simplification of the concepts, or omission of details and caveats, but simply because of an asymmetry between the way language was used and than interpreted. [Pat and Schrag, 2003]
Wilson agrees to this, his research stresses that journalists believe, scientists should use less technical jargon in their research outcomes and in their communication towards journalists. [Wilson, 2000]
Wilson also mentions the fact that the source of information plays an important part in the communication process. He believes that reporters need to be talking directly to the scientist in stead of to spin-doctors who interpret their work for their own purposes. [Wilson, 2000]

Heijmans, Pleijter and Wester have investigated how Dutch newspapers inform the public about scientific research. They also looked at ways in which newspaper reports handle research related topics such as background information, methods and ranges of uncertainty. They discovered that Dutch newspapers show to pay a relatively high attention to scientific research, but little information is given on background information and methodological aspects of the research projects. The relevance of the findings is hardly discussed. [Heijmans et al., 2003]
The differences in viewpoint between specialized scientific journalists and journalists that do not work as a specialized scientific reporter, was also investigated. The latter consider scientific research results as regular news that is being judged on news value. This means that it needs to match the reader's interest. Therefore the emphasis is not on the quality of the research, but on certain interesting details of the research that appear in the results. These journalists feel that they do not have enough time to verify the quality of the research and purely point out the interesting research outcomes to their readers. This issue of available time is one Wilson underlines as well. Journalists always have a deadline to reach.
Specialized scientific reporters on the other hand, find it important to verify the quality of the research and look at the relevance of the research results. Furthermore, these journalists have access to a vast network of scientists and researchers that they can consult. Therefore, obtaining more background information can be less time consuming. [Heijmans et al., 2003]

3.3 Case 1- The Hockey Stick Affair

3.3.1 Introduction

Recently a graph depicting past global temperatures received a lot of media attention. The graph, in the shape of a hockey stick, showed global temperatures in the late 20th century to be unprecedented (the blade of the hockey stick). The graph, made by a scientist called Mann and his colleagues, became an icon for IPCC reports and was attacked by critics such as McIntyre and McKitrick. In the scientific controversy and media debates, nuances surrounding the hockey stick graph seem to have faded over time.

When researching past climates one can look at actual measurements made with thermometers and other measuring devices to map the temperatures of the last 150 years. But it is still very difficult to calculate an average world temperature.
For data on previous centuries climatologists have to rely on the thickness of tree rings, growth rings in coral, isotope ratio's in ice in the poles and other indicators. These derivative indicators for previous climate are also known as "proxies". There is

no data available that enables you to reconstruct a period of 1000 years from one source, therefore all these different proxies have to be used together to be able to cover such a huge time span. These proxy data come from various places on earth, from different climates, different species and are of different quality. Climatologists have the immense job of editing all these different data in order for it to be suitable to be compared and to be put in a timeline.
Climatologists look for patterns within this data that could possibly say something about previous temperatures. It is obvious that these research outcomes are surrounded by a lot of uncertainty, because of all the different sources of data that are used and all the editing that is done.

3.3.2 The history of the Hockey Stick

Michael Mann is such a climatologist and he is specialised in the research of tree rings and other natural indicators of past climate. He and two colleagues, Raymond Bradley and Malcolm Hughes, published an article on a global reconstruction of annual surface temperature patterns over the past six centuries in Nature in 1998 [Mann et al. 1998]. This reconstruction was based on "*a multi-proxy network of widely distributed high-quality annual-resolution proxy climate indicators individually collected and formerly analysed by many paleoclimate researchers*" [Mann et al. 1998]. With this multi-proxy network, a collection of tree ring data from for instance Mexico and Canada is meant as well as ice core, ice melt and coral records that had already been used and analysed by other climatologists.
Mann, Bradley and Hughes used these global temperature reconstructions and analysed the spatiotemporal patterns of climate change over the past 500 years. They also made an estimation of the relationship between global temperature changes, variations in volcanic aerosols, solar irradiance and greenhouse-gas concentrations during the same period. Their results suggest that "*Each of these factors has contributed to the climate variability of the past 400 years, with greenhouse gases emerging as the dominant forcing during the twentieth century."* And that *"Northern Hemisphere mean annual temperatures for three years in the nineties of the twentieth century, are warmer than any other year since (at least) AD 1400"*. [Mann et al, 1998]
The article shows the following graph. See figure 1. Notice the uncertainty displayed in the error bars.

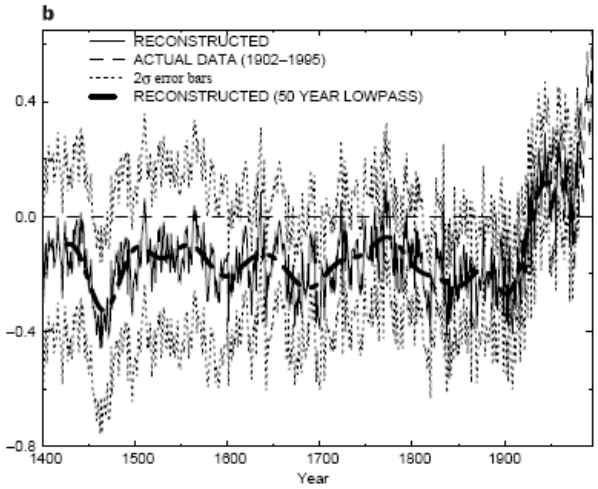


Figure 1. Mean temperature change in ˚C in the Northern Hemisphere over the last 600 years. [Mann et al. 1998]

This article does not draw far-reaching conclusions; the authors see their research as a step in the history of temperature reconstruction. The scientists use words like “estimating” and “suggests” and uncertainties are indicated in their graphs, therefore a certain nuance is displayed. The article does not contain words like anthropogenic or man-made. Mann et al see their publication as a step in the right direction for temperature reconstruction.

In 1999 the same group of scientists published another article, this time they focused on the northern hemisphere temperatures and covering the past millennium. In this particular article the same methodology as described in their previous article is applied to a sparser proxy data network that was available for years prior to AD 1400. They made an attempt to extend the Northern Hemisphere temperatures as far back as possible. They also re-evaluated their earlier estimates of uncertainties in the first series. [Mann et al, 1999]
The conclusion of the article reads as follows: “*Although Northern Hemisphere reconstructions prior to about AD 1400 expand uncertainties, several important conclusions are possible, not withstanding certain caveats. While warmth early in the millennium approaches mean 20th century levels, the late 20th century still appears anomalous: the 1990’s are likely the warmest decade and 1998 the warmest year, in at least a millennium. More widespread high-resolution data which can resolve millennial-scale variability are needed before more confident conclusions can be reached with regard to the spatial and temporal details of climate change in the past millennium and beyond*.” [Mann et al, 1999]
The article mentioned above contains the graph that posed for the eventual “Hockey Stick” graph and is depicted in figure 2. Error bars are again indicated. The steep rise in temperature in the 20th century is meant to be the blade of the stick and slow decrease from the year 1000 until approximately 1990 is supposed to be the shaft.

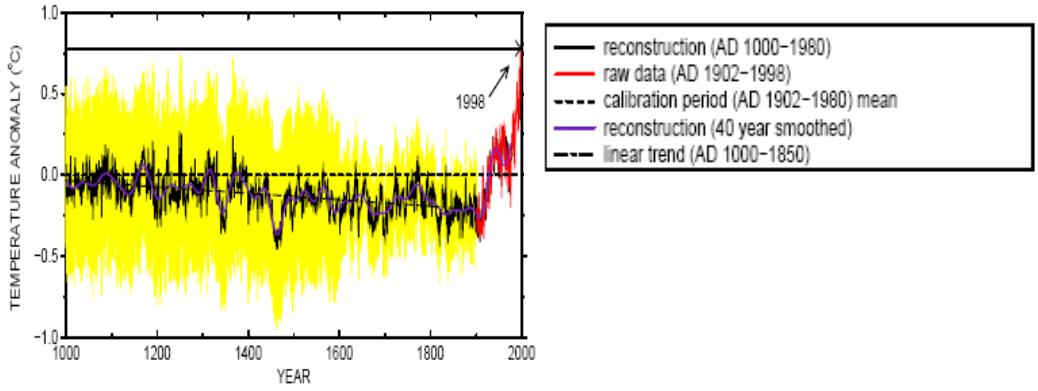


Figure 2. The Hockey stick graph from 1999 with uncertainties in yellow [Mann et al, 1999]

Mann and his colleagues are once more very cautious in making too strong conclusions.

In 2001 the Intergovernmental Panel on Climate Change (IPCC) produced their Third Assessment Report (TAR), which focuses on the science of climate change. In this report the graph made by Mann et al is used to portray the temperatures in the Northern Hemisphere over the last millennium, with an enormous increase over the last century.
The graph made by Mann et al. has been used three times in the report, twice in the chapter on climate change, one of which in combination with three other climate reconstructions. See figure 3 and 4.

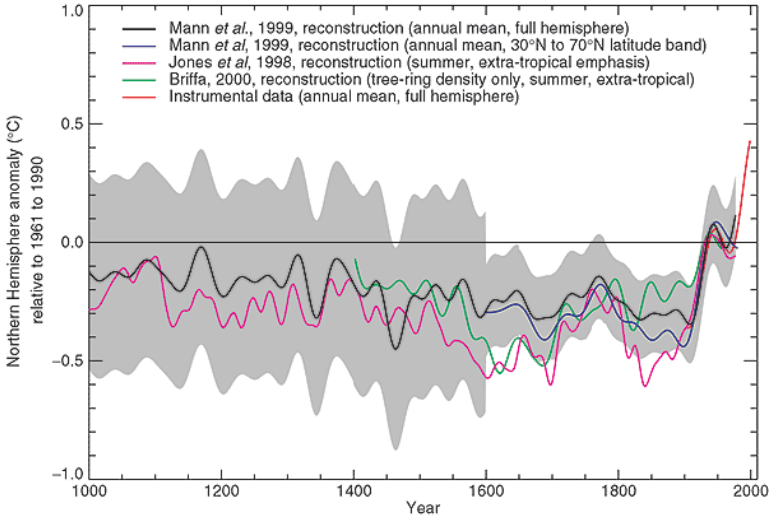


Figure 3. A reconstruction of the temperatures of the past millennium of four different studies, with shaded area as error limits. The zero line denotes the 1961 to 1990 reference period mean temperature. [Climate Change 2001: Working Group I: The Scientific Basis, chapter 2, page 69]

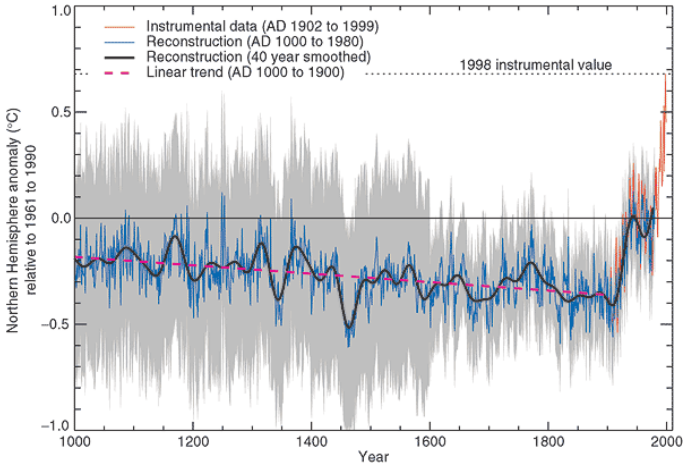


Figure 4: Millennial Northern Hemisphere (NH) temperature reconstruction (blue) and instrumental data (red) from AD 1000 to 1999, adapted from Mann et al. (1999). Smoother version of NH series (black), linear trend from AD 1000 to 1850 (purple-dashed) and two standard error limits (grey shaded) are shown. [Climate Change 2001: Working Group I: The Scientific Basis, chapter 2, page 69]

Chapter 2 from the IPCC Scientific Basis consists of a 45 page explanation of the scientific foundations of the theorem that the earth is warming. It covers a variety of topics like paleoclimate research but also oceanography, rainfall, El Niño, La Niña and ice sheet coverage.

The page the two graphs are depicted on, not only mentions research done by Mann et al, but also by six other groups of scientists (including the three mentioned in the Figure 3).

Further more; the accompanying text is as follows[1]:" *The uncertainties (the shaded region in Figure 3) expand considerably in earlier centuries because of the sparse network of proxy data. Taking into account these substantial uncertainties, Mann et al. (1999) concluded that the 1990s were likely to have been the warmest decade,*

[1] Words underlined by the author of this research report

and 1998 the warmest year, of the past millennium for at least the Northern Hemisphere. Jones et al. (1998) came to a similar conclusion from largely independent data and an entirely independent methodology. Crowley and Lowery (2000) reached the similar conclusion that medieval temperatures were no warmer than mid-20th century temperatures. Borehole data (Pollack et al., 1998) independently support this conclusion for the past 500 years although, as discussed earlier, detailed interpretations comparison with long-term trends from such of such data are perilous owing to loss of temporal resolution back in time."
The IPCC concludes the chapter by saying:" *We conclude that the variations and trends of the examined indicators consistently and very strongly support an increasing global surface temperature over at least the last century, although substantial shorter-term global and regional deviations from this warming trend are very likely to have occurred.*"
It is obvious uncertainties/nuances are still underlined in the explanation of the graph.

The third time you come across a more simplified version of the graph, on a more prominent spot; in the summary for policymakers. See figure 5.

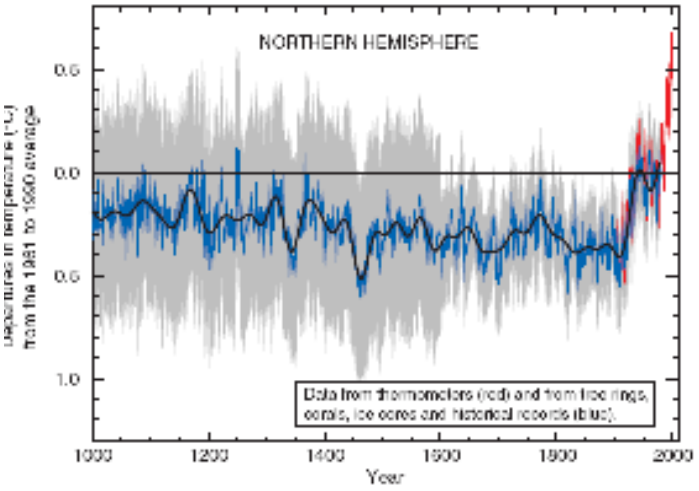


Figure 5. Reconstruction of temperatures of past millennium, this time only data from Mann et al 1999 is used. [IPCC, 2001 Climate Change 2001: Working Group I: The Scientific Basis: Summary for policy makers]

The summary for policymakers still mentions uncertainties:" *The 95% confidence range in the annual data is represented by the grey region. These uncertainties increase in more distant times and are always much larger than in the instrumental record due to the use of relatively sparse proxy data.*" [IPCC, 2001 Climate Change 2001: Working Group I: The Scientific Basis: Summary for policy makers]
But when it comes to making conclusions it is more definite: "*Nevertheless the rate and duration of warming of the 20th century has been much greater than in any of the previous nine centuries. Similarly, it is likely that the 1990s have been the warmest decade and 1998 the warmest year of the millennium*. "[IPCC, 2001 Climate Change 2001: Working Group I: The Scientific Basis: Summary for policy makers]
But still the IPCC uses the word "likely" and explains the uncertainties.

Figure 5 is the graph that has been named "Mann's Hockey Stick". Over the past few years it has not only turned into an icon for policy makers and environmentalist who believed in the climate change theorem, but also for sceptic people and opponents of this same theorem. Provided that they would succeed in attacking the credibility of

this IPCC-icon, they could also cast doubt on the IPCC as an institution and on the Kyoto protocol itself.
And that has been happening ever since the IPCC TAR has been published. Mann' s research has been scrutinised, not only because of the fact that he made the hockey stick graph, but also because he was one of the authors of the second chapter of the Scientific Basis of the TAR. Add to that the fact that reconstructing climate by way of proxies is a very difficult job and you have found a perfect target.

It needs to be stressed that Mann was indeed one of the ten lead authors of the IPCC TAR Climate Change chapter, but there were over a hundred contributing authors, among which there were numerous other scientist whose research was used. There are also two review editors mentioned in the technical support list. This knowledge combined with the fact that uncertainties were indeed displayed adds to the belief that nuances were still present when the TAR was published and that they must have disappeared somewhere along the line during the media debate.

In 2003 the first scientific attack on the "Hockey Stick" was made. Two Canadian authors, McIntyre and McKitrick, claimed that the data set of proxies of past climate, used in the Mann et al 1998 article, contains a whole list of errors, among which "*unjustifiable extrapolation of data, obsolete data, and incorrect calculation*."[McIntyre and McKitrick, 2003]. This attack is solely based on statistics.
The article published in Energy & Environment, a British social scientific journal, contains the following correction of the hockey stick graph. See below in figure 6.

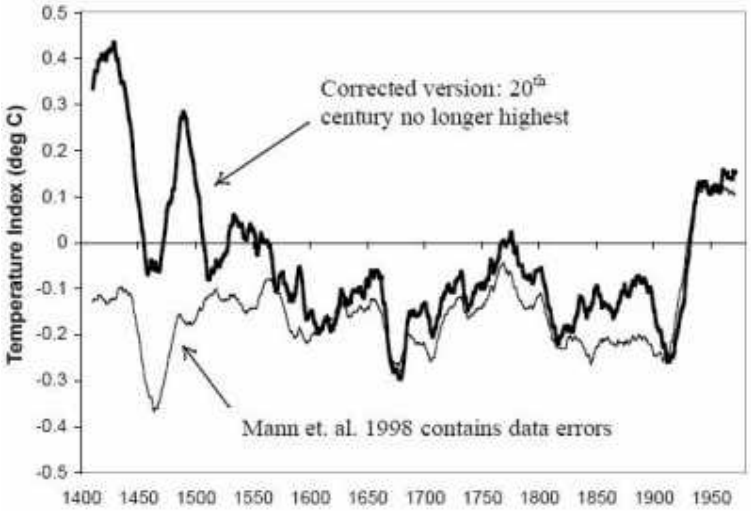


Figure 6. The thin line showing the famous Hockey stick by Mann et al and the thick line showing the "corrected" version by McIntyre an McKitrick [McIntyre and McKitrick, 2003]

These two scientists are claiming that the 1990s was likely not the warmest decade and 1998 was not the warmest year of the millennium. With these words they are lashing out to the IPCC and their credibility.
A few remarks need to be made when looking at this critique. First of all, McIntyre and McKitrick are no paleoclimatologists, therefore they are not specialized in reconstructing past climates. McKitrick claims expertise based on his specialization in environmental economics and policy analysis and McIntyre based on his B.Sc in mathematics and 30 years of experience in the mining industry.
Secondly, when looking at figure 6, no error bars or any other type of uncertainty is indicated.
And thirdly, Energy & Environment is not a peer-reviewed scientific journal.

Even though this was a hot topic politically wise, there is hardly any evidence to be found in the media.
One remarkable event took place though. In 2004 Mann et al placed a corrigendum of their previous article Mann et al 1998 in Nature. [Mann et al, 2004] This corrigendum gives a list of errors in proxy data sets and shows a few minor corrections. It also displays a list of information that was not taken up in their supplementary information, according to McIntyre and McKitrick. Nevertheless, their conclusion remains the same.

Both parties in the debate on the validity of the "Hockey Stick", decided to make their debate more available to outsiders. Both Steven McIntyre and Michael Mann started web logs on the internet, in which they argue and underpin their research outcomes and in which other people can leave questions or remarks. On both blogs a bit of blackening each others names takes place, but several other scientists in the field of paleoclimate leave their remarks on the internet. Mann's blog, www.realclimate.org has grown to be a source of overall environmental scientific news.
www.climateaudit.org, the initiative of McIntyre, still focuses mainly on the statistical debate.
Almost daily new additions are added on both sites.

But 2005, the year that the Kyoto Treaty became effective, turned out to become the year of the hockey stick, at least in Holland it has.

In 2005 McIntyre and McKitrick made another effort in tackling the credibility of the hockey stick. In January of 2005 Energy and Environment published their second article. [McIntyre and McKitrick, 2005a]
McIntyre and McKitrick present similar accusations as in their earlier article in 2003. But this time they emphasize the political implications of the hockey stick graph made by Mann, Bradley and Hughes. They make the following remark: "*Finally, we comment on several policy issues arising from this controversy: the lack of consistent requirements for disclosure of data and methods in paleoclimate journals, and the need to recognize the limitations of journal peer review as a quality control standard when scientific studies are used for public policy.*" [McIntyre and McKitrick, 2005a]
A very interesting remark, while energy and environment is not even a peer reviewed journal. This paper displays no error bars in the graphs, or any other way of showing uncertainties. There is no mention of uncertainties in the text either.
In February 2005 Geophysical Research Letters publishes a short article by the same two authors. In brief they accuse Mann et al of having made a statistical model which "*nearly always*" produces hockey stick like graphs, no matter what data you use. [McIntyre and McKitrick, 2005b]
Again there is hardly a word to be found about possible uncertainties in their work.

Marcel Crok a member of the editorial staff of the Natuurwetenschap & Techniek, a popular Dutch scientific magazine, decided to write a piece on the debate between Mann et al and McKitrick and McIntyre. On the 26th of January the press release advertising his upcoming article on the magazine's website, opens with the words: "*Proof behind Kyoto is not correct*".
In his article he has made an effort in trying to explain the statistical background of the dispute between Mann et al and the Canadians. He explained how the proxies work and what kinds of statistics are being used. He claimed in his article that the "Hockey Stick" graph is a statistical fairy tale. He had asked a statistics expert for a view on the case and had had thorough contact with the McIntyre and McKitrick-side. He had also asked Mann for his point of view, but Michael Mann's answers were only published on the magazine's website and not taken up in the article.

The article suggests that thorough research has been done and the claims made by McKitrick and McIntyre must be true.
The literal translation of his article Crok sent to the National Post in Canada, who printed a slightly summarised version of it on the 27th of January. On the 29th of that same month, the magazine, Natuurwetenschap & Techniek, was out in stores.
On the 14th of February the Wall street journal did a piece on the dispute about the Hockey stick graph.
As a reaction to this newspaper article a popular Dutch television programme, called Netwerk, did a broadcast on the item as well, showing an interview with Steven McIntyre and suggesting that the Kyoto is based on thin air.
Fons de Poel, the presenter of this issue, says things like:" *The fundaments of the Kyoto Treaty are wrong*", "*The Canadians have tackled the entire climate treaty*". He also has a short interview with Steven McIntyre, who was asked to state very briefly what he felt were the mayor issues in the whole hockey stick affair. He named four: He was very surprised nobody has ever tried to replicate the study done by Mann et al, he discovered a major defect in this particular study, the fact that this defect had such important repercussions and the fact that this discovery had brought up such an antagonism.
Nobody from the other side of the camp was asked to reply.
Uncertainties or nuances are very hard to find in this broadcast. It is a very one sided overview and very blunt statements are made. For a layman on this topic it looks like the whole IPCC TAR was based on one study only, namely the one done by Mann, Bradley and Hughes and that the Kyoto protocol was entirely based on this rapport. Therefore, because two Canadian scientists claim the results of this study were wrongly attained, countries that have ratified the Kyoto Protocol have made a big mistake and will waste all their tax payers' money on meaningless new policies.

From this moment on the general public was regularly confronted in the media about the debate on whether the current temperature rise is a novelty, or whether the temperatures have previously been this high. In other words, whether we, as mankind are definitely responsible for the global warming. And if we are, what do we need to do about it?

But the story continues. Since the Netwerk broadcast, there have been several other scientists who have been interfering in the Hockey stick dispute. There have been a few that have also looked into the critique given by McIntyre and McKitrick.
Hans von Storch, for instance, a German mathematician/physicist, and his team, propose the glitch, as they call McIntyre and McKitrick's accusations, is correct and the variations in past temperatures should have been higher by at least a factor 2. But they also mention that this does not matter for the overall conclusion. [Von Storch et al, 2004]
Peter Huybers, a geophysical scientist at the oceanographic institute in Woods Hole, examined to what extent McIntyre and McKitrick were right, when they accused Mann, Bradley and Hughes' reconstruction methods of automatically producing hockey stick like graphs. He concludes that the method indeed tends to produce ascending lines, but that this tendency was exaggerated by McIntyre and McKitrick. [Huybers, 2005]
Eugene Wahl and Caspar Ammann, two American environmental scientists claim their examination of the proxy data set used for the Mann et al. reconstruction and the reconstruction itself, suggests a slight modification for the early 15th century, but this modification is in the order of 0,05 ˚C. This does not alter the primary conclusion of Mann et al, namely that both the 20th century upward trend and high late 20th century hemispheric surface temperatures are anomalous over the last 600 years. [Wahl and Ammann, 2005]

It looks like a certain nuance has been brought back into the hockey stick story on the part of the scientists.
The media has also picked up on this. Martijn van Calmthout, a member of the editorial staff of a well known Dutch newspaper, The Volkskrant, has written a story named “The hockey Stick strikes back” in which he explains the whole debate and shows Mann was not solely responsible for writing the IPCC TAR and underlines the fact that there have been several other studies that under scribe the findings by Mann Bradley and Hughes. He also mentions the fact that the hockey stick is not the definite proof the Earths surface temperature is higher, but that scientists have been suspecting this for ages because of climate models that are being used in research. [Van Calmthout, 2005]

3.3.3 Scientists and uncertainty

In the field of paleoclimatology, scientists have to deal with a huge degree of uncertainty, not only because their data consists of a large range of different sources, but also because their research outcomes need to be translated in order to be able to say something sensible about future climate.
Scientists communicate the uncertainty that is appertaining to their research, through error bars or shaded areas in the graphs displaying their results.
They also underline the uncertainties by their language, using words like “suggesting”, “likely” and “probable”.
In this particular case scientists from both sides of the debate have started a web log in order to increase the communication. This makes the scientists more approachable and their information more/easier accessible.
Another side of the story is that scientists also strive for media attention. They aim to achieve this through press releases. If these press releases succeed in triggering the attention of the journalists, they might print the story in their newspaper.
It is very common for scientists to be granted funds for further research on the basis of their reputation. Therefore press releases are written in order to get media attention and often contain catchy, but blunt statements.

3.3.4 Journalists and other intermediaries and uncertainty

One of the major principles in journalism is the fact that you should always hear both/all parties involved, but this should only be used when the story discusses a reconstruction of a certain event. In the case of the “Hockey Stick”, it concerns a scientific debate. When only showing both sides of the story, the readers can only establish the fact that the two parties disagree. In the case of Mann et al versus McIntyre and McKitrick, the point of controversy is the question whether Mann et al did the analysis of tree rings properly or not. When writing a newspaper article about this subject, the journalist also needs to provide context. [Van Calmthout, 2005]
But what appears to be the overall opinion of all journalists interviewed in this case, is that they find it the duty of the scientific journalist to do thorough research. Journalists, and especially scientific journalists, need to be taught to see beyond their own nose, to not be satisfied to easily, to find out what the source of information really is and always keep in the back of their heads that things are not as straightforward as the seem. [Crok, Van Calmthout, Fransen, Knip, 2005]
A good start is to find out which scientific journal has printed the research, bearing in mind the fact that Nature and Science do not publish the absolute truth, but do make a selection, to provide a scientific discussion of a certain standard. [Knip, 2005]
These journals are peer-reviewed, which means that a panel of scientists looks at the research and judges whether the study is set up in the right way, whether the described execution is correct and whether the results justify the conclusions.

It is the job of the journalist to communicate the nuances in a correct way to the public. [Fransen, 2005]
Obviously, it depends on the background of the journalist, to what extent they can be expected to go into detail.
It also depends on the type of magazine or newspaper they write for and on their readers. [Van Calmthout, 2005]
Depending on which section of the newspaper the story is meant for, i.e. the scientific supplement or the hot news page, the type of language used should be adapted.
When it comes to uncertainties, language used and readability are also very important. How often do you have to underline the amount of uncertainty by using the words, likely, nearly, it could well be that, etc?
Journalists always have a deadline to reach, therefore Karel Knip calls journalism the art of the incomplete (kunst van het onvoltooide). [Knip, 2005]

3.4 Case 2 - Snow on Greenland

3.4.1 Introduction

This case has been chosen because it concerns a scientific research programme that makes an effort to reduce the uncertainties surrounding its field.

The ice sheet of Greenland, which can be as thick as 3 kilometres, serves as an archive of snow, dating back to about 150.000 years. Because the composition of isotopes in precipitation depends on the temperature, the ice, which is formed by compressed snow, contains valuable climate history.
Precipitation always contains a mixture of normal water (H_2O) and “heavy water” (D_2O), in the latter water molecule two of the hydrogen atoms have been replaced by heavier deuterium atoms, hence the name. This heavy water evaporates and condensates slightly different than regular water. Because of these properties, precipitation during winter time contains less heavy water than during summer time. The concentration of heavy water in precipitation is approximately 0,015% and differences between winter and summer periods make a few percent of that amount. These are only small differences, but they are measurable by specialized isotope laboratories, like the Centrum voor IsotopenOnderzoek (CIO) at the University of Groningen.
These measurements are carried out on samples collected by drilling out a column of ice and looking at the different layers of snow. This can be accurately done to about 15.000 years back, after which the snow has been compressed to much to be able distinguish separate years. But longer warm or cold periods, like ice ages are still visible.
One problem that arises during the interpretation of these measurements is the diffusion problem. You could say that this complicates reading the thermometer.
Fresh snow is being compressed because of the fact that every year new snow settles down on top of it. Eventually this layer of snow turns into ice, but during the first few decades this snow is compressed to “firn”, a layer of icy snow. Because of the fact that small air spaces still exist in this firn, it is possible for the different layers of snow to diffuse. Because of this diffusion the differences between summer and winter time decrease. During the calculations scientists have been compensating for this diffusion, but the compensations are based on estimates, not on solid data. They still do not know how fast this diffusion takes place.
Therefore scientist Harro Meijer, professor at the University of Groningen and some of his colleagues, initiated a research project of putting some fresh snow on Greenland and following that particular layer of snow for several years in order to be

able to find the exact speed of diffusion. In April 2005 the Dutch Institute for Scientific Research (NWO) granted his proposal to go to Greenland and carry out his research. In the summer of 2005, the team of researchers set of with 1000 litres of water which contained a higher concentration of D_2O than natural rain water, and a snow making machine and flew over a 100 km into the Greenland ice sheet. On the ice sheet they put down a 2 cm layer of their isotope labelled snow on a field of 6 by 6 meters. They added a blue colour to the water in order to be able to see it on the white snow and they had also raised the concentration of heavy water in order to be able to trace their layer of snow and its diffusion over the next few years.
In about four years time they will be able to give some insight as to whether their compensation methods have been accurate so far.

3.4.2 Scientists and uncertainty

Because the CIO is part of the RuG, the press releases go through the news agency of the university. Therefore the scientists have great influence on what gets printed in the press release. The scientists of the CIO always see to it that the full story gets presented in the press releases.
Prof Meijer suggests using metaphors in press releases in order to explain uncertainties *Isotope thermometer is not very exact* (See press release Snow on Greenland in Appendix). This could help the readers to get a better picture of the uncertainties involved.
He also believes that because of the societal relevance of their research, scientists that are involved with this kind of research have the responsibility to guard the media coverage. After having been interviewed, he always requests to read the article before it gets printed, to make sure no mistakes have been made and the journalist communicates the essence of the story in a correct way.
Scientists should be well prepared when presenting their research, they should take into account that it will take some time to answer questions and do interviews.

Imposing an embargo can be of use when the presented research has real news value. This is not the case with the “Snow on Greenland” research, because this particular story concerns ongoing research.

3.4.3 Journalists and other intermediaries and uncertainty

After talking to Rene Fransen, a few points became clear. First of all he prefers to be provided with all the information in the press release. If he has to do some digging to find out what the methods are behind the research, he puts the press release aside and does not use it for his newspaper. Simply because it is time consuming.
He feels it is the job of the scientific journalist to make a selection of all the provided news and choose which items he would like to print in his newspaper. But it is also the job of the journalist to translate these news stories in such a way the general public/ his readers can understand.
After having written a piece on a certain topic, he hands his article back to the scientist involved, for a brief check. Making sure to point out it concerns a content check here, hoping the scientist will not change the whole set up. This feedback system takes time, but prevents untruths to be printed.
When looking at the media coverage on snow on Greenland, the information provided in the newspaper articles and in the article in the Quest, a popular magazine in the Netherlands is correct. The short stories merely talk about obtaining more information on past climates, which is, in brief, the essence of the story. The bigger pieces elaborate a bit more: Put new snow down in order to be able to measure the mixing process to evaluate calculation methods.

What stands out though is the amount of metaphors that have been used: "*Snowfall of the past 150.000 years is hidden on Greenland like annual rings in a tree*" [Schlimbach, 2005] and "*Layers of snow mix in, like ink on paper"* [Dorre, 2005].

3.5 Public and uncertainty in general

3.5.1 Introduction

To be able to fill in the part of the audience (general public) response to journalistic discourse of global warming issues and in particular the media displays of its uncertainty, the research project done by Corbett and Durfee is used. Both scientists are affiliated with the Department of Communication at the University of Utah in the United States of America.

3.5.2 Research study

The two scientists, named above, designed an exploratory study to test readers on actual effects of textual variations in news stories that have long been discussed in the media.
The experimental design enabled the researchers to manipulate two key factors identified in past research as affecting individuals' assessment of scientific uncertainty, the inclusion of context and controversy [Dunwoody, 1999], [Van Dommelen, 2000] and [Zehr, 2000].The experiment not only allowed them to run these singular tests, but also test the effect of both controversy and context on scientific uncertainty as well as the effect of neither of both textual variations.
They formulated the following hypothesis:

1. The readers of newspaper stories that include context will be more certain of scientific claims (contained in the story) than those who read the article with controversy only.
2. The readers of newspaper stories with both context and controversy will have more certainty than readers of stories with only controversy and less certainty than readers of stories with only context. [Corbett and Durfee, 2004]

In other words; in this case the degree of certainty about global warming, felt by the readers when reading the newspaper article, should decline according to this diagram:

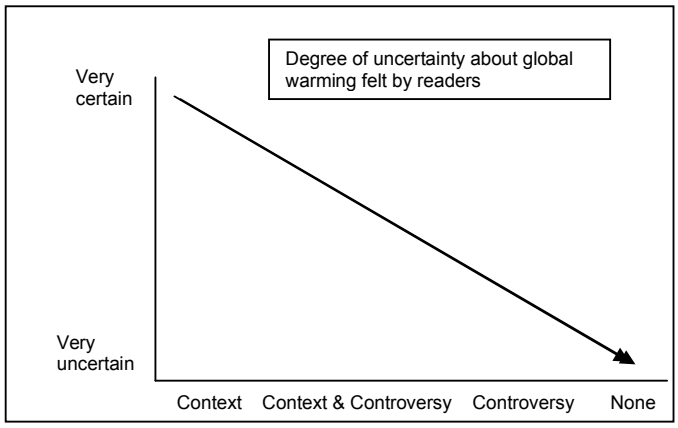


Fig 7. Degree of uncertainty according to [Corbett and Durfee, 2004]

It is reasonable to assume that people, who identify themselves as having a stronger pro-environmental ideology, will have a stronger certainty about global warming prior

to the test compared to people that do not. However it is also expected that when these individuals are asked to rate the certainty portrayed within a particular news story about this issue, they will also be affected by the textual treatments and will rate uncertainty accordingly. Therefore a third hypothesis was formulated:

3. The stronger the individuals' environmental ideology, the stronger their prior certainty about the existence of global warming. [Corbett and Durfee, 2004]

Four different news stories were drawn up. These treatment stories were developed from actual scientific studies: a scientific journal published a study by scientists who discovered that a certain part of the Antarctic ice sheet was actually thickening. Because this particular study suggests uncertainty about global warming, since thickening ice sheets suggests the opposite of global warming, it was used for this study. It also provided the opportunity to test whether the addition of context would lessen this uncertainty, while there is a lot of available data on the subject.
Controversy was realised by adding a paragraph that presented scientists who disagreed with the findings presented in the journal.
Context was realised by the addition of a paragraph that included other accurate scientific findings in the same area of research.
All of the treatment stories were designed to resemble a newspaper article in layout and text format. Each story had approximately the same amount of text, because the context and controversy treatments included an additional paragraph, the story lengths of the two shorter stories was equalised by adding some simple facts related to ice sheets, like size and formation. [Corbett and Durfee, 2004]

Two undergraduate communication classes at the University of Utah in the USA were asked to participate in this research. On March 13 and 14 in the year 2002, 209 students were presented with a consent form together with one of the four test articles and a short survey. The students were asked to sign the consent from, read the article and answer the 19 questions.
The students, who were presented the text with no manipulations to the text, were regarded as the control group.

3.5.3 The results

Looking at the first hypothesis, the results showed that providing context to a news story makes people feel the most certain about the claims made in the article. Adding controversy, on the other hand produced less certainty.
Readers of the control treatment, lacking both controversy and context, were the least certain about global warming.
Hypothesis 2 predicted that readers of newspaper stories with both controversy and context would perceive global warming as more certain than those who read controversy alone and less certain than context alone. This hypothesis was not entirely proven, while only the controversy & context treatment differed significantly from the control treatment. See figure 8.
The test of the third hypothesis found a significant, positive correlation between environmental ideology and prior certainty about global warming [Corbett and Durfee, 2004].
Concluding; the degree of reliability felt by the readers of the newspaper article increased by adding more context to the story.

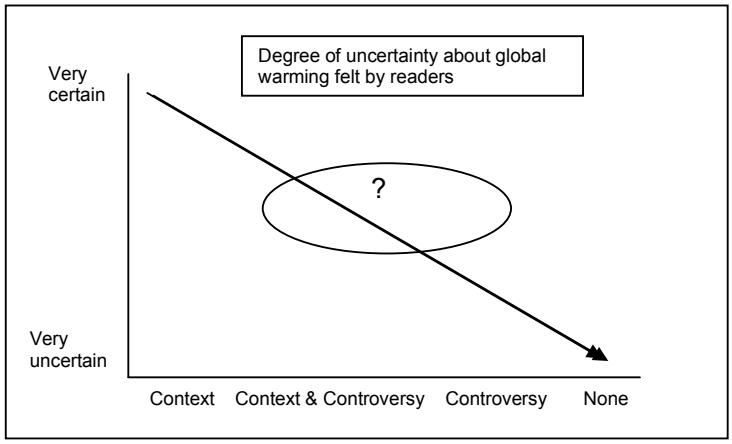


Fig 8. Results of research [Corbett and Durfee, 2004]

3.6 The MSc. level classroom lecture

This research project aimed to produce a classroom lecture providing guidelines on how to communicate scientific uncertainties.
The lecture (2 x 45 minutes) was given on the 7th of February 2006 to 7 students of the science communication master programme.
The PowerPoint presentation that was used as support during the lecture is taken up in Chapter 7, as is a timeline/schedule of the two hour lecture.
Before and after the lecture a questionnaire was filled out in order to be able to verify whether all course aims were met. The same questions were asked on both questionnaires. The answers were compared and judged which answer was better, and therefore whether the students' knowledge on the subject had improved.

The results of the questionnaire are shown in Table 1, below.

Question	**# improvement**	**# no improvement**
Explain what is meant by scientific uncertainty	4	3
Give examples of ways communication of uncertainty can be dealt with in newspaper articles	5	2 (1 worse answer)
Which part(s) can scientist play in communication trajectory?	5	2
Which parts(s) can journalists play in communication trajectory	5	2
To what extend can the "Both sides of the story" approach be clarifying or the opposite?	3	4
What can be the consequence of giving ones own opinion in a newspaper article?	7	0
In what ways can a scientific debate be dealt with in the media in order to clarify the conflict for the public	5	2

Table 1. Results of questionnaire

4. Discussion

This research project has focussed on finding out where bottle necks appear in the communication trajectory of scientific uncertainty and how these could possibly be overcome. This has led to a thesis in which I, as the researcher, have always tried to stay objective and state the facts as they are. Throughout the whole process I have tried not choose sides and I have aimed at getting a complete (as possible) picture.
Therefore, it would be good to explain my own experiences during this research project, while I have experienced first hand what journalists and the general public have to endure while getting informed by the media on complex scientific research results. Especially during the research on the Hockey Stick story I was pulled into a different camp almost after reading every new piece, whether that was a newspaper article or scientific paper.

My own experiences started with the Netwerk broadcast, which was the direct cause of this research project. The broadcast showed a one sided story, merely stating the findings of McIntyre and McKitrick (thus not showing the controversy, since only one party in the debate got the floor). The context given in the broadcast was that of the recently ratified Kyoto-protocol, which was framed as being an unnecessary loss of money. Because the current affairs programme makes itself out to be a programme with a certain standard of journalism, you are quite willing to believe their statements and you sympathise with the editor's point of view.
Reading newspaper articles written by Martijn van Calmthout, it becomes clear that he has spent some time doing his research and you can clearly see he is specialised in climate change subjects. His articles give both context and controversy, while a lot of background information is given and both camps are presented, this way the controversy is being put in perspective. Just like Corbett and Durfee stated, the presence of more context made me feel less uncertain about Van Calmthouts statements. These articles read as objective articles with a scientific background, not imposing the point of view of the editor.
Marcel Crok's article, on the other hand, does make it very apparent which side of the camp he is on. He truly believes his research proves McKitrick and McIntyre are correct in their findings. The article gives you the feeling a lot of research has been done and the results are scientifically founded. This perception of scientific foundation made me feel very certain about his statements, even though the article was one sided.
In the end, after getting the bigger picture myself, I discovered his article to be one sided and not well researched at all. This subject was probably too complex, even after spending quite some time researching it.
All these different stories made me switch sides all the time, until I looked at the scientific articles that were on the basis of this media debate.
After having scrutinised these research papers and having looked at the present and omitted nuances I came to the conclusion that I believed Mann and his colleagues. They have been very prudent with their statements and have always explained and pointed out the uncertainties surrounding their research. McKitrick and McIntyre, on the other hand, were not as cautious, they were quite blunt when they accused Mann, Bradley and Hughes of having made numeral mistakes. In their own results they show no uncertainties or nuances.

To me, the presences of context and controversy have contributed towards a feeling of certainty, according to the conclusions of Corbett and Durfee. But the presence of nuances or uncertainties has also been an important factor in my pursuit of the reality about the Hockey Stick.

I feel that through experience (such as I had myself) one will learn best what is at stake in communicating uncertainties. Therefore, I have tried to convey these experiences to the students during my lecture, by confronting them with the various sources one after the other.

5. Conclusions

This study aimed to locate bottle necks and find suggestions on how to communicate the uncertainties in climate change research outcomes on the separate tracks of the communication trajectory from the source through journalists to the general public. This research study became a quest for facts and nuances surrounding the Hockey Stick Affair and the Snow on Greenland story, in order to fulfill this goal.
The conclusions and recommendations mentioned below have been the basis for a two hour interactive lecture for future science communicators. The course aims were largely met and the lecture was successful.

5.1 The Hockey Stick Affair

When looking at the Hockey Stick story, it becomes apparent that nuances have disappeared over time. The process can be compared with a funnel. The IPCC bases it's TAR on several (paleo-) climate studies, as does the Kyoto Treaty. A few years later the media makes you believe the entire TAR and Kyoto Treaty are based on one study only, the Mann, Bradley and Hughes study. When this particular study is believed not to be true, the whole Kyoto Treaty is based on thin air. Fortunately nearing the end of the same year, both science and the media have brought back some of these nuances and have corrected some of the misconceptions that were present. See below (fig 9.).

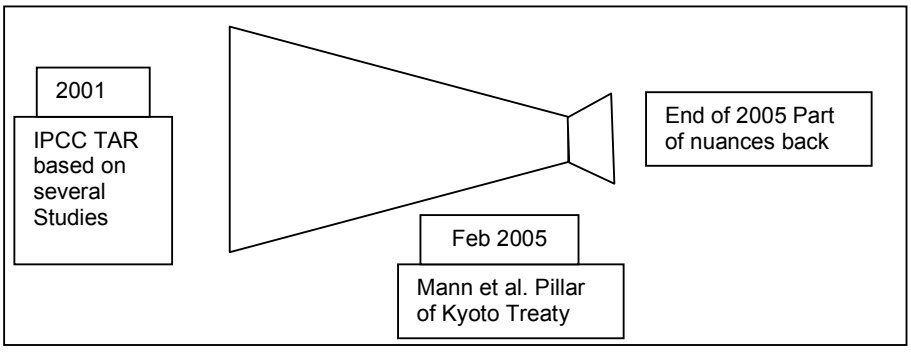


Fig 9. The funnel-like disappearing of nuances in the Hockey Stick story.

5.1.1 Uncertainties in scientific articles

In the scientific articles on which the Hockey Stick was based, uncertainties were displayed as error bars or shaded areas in graphs. Uncertainties were also mentioned in the text explaining these graphs or underlined by using words such as "likely". This was only the case in the articles published by Mann, Bradley and Hughes, and later on by scientists that brought back some of the nuances of the story, like Huyberts and Wahl.
McKitrick and McIntyre, on the other hand did not define uncertainties surrounding their results. No nuances what so ever were present in their scientific reports. Therefor one can say that they have contributed to some of the misconceptions around the Hockey Stick story.

5.1.2 Uncertainties in the media

The main reason misconceptions were possible to arise, is the fact that in the media both sides of the debate were not always heard or even asked to give their point of view. This resulted in a very one-sided story and made the general public in The Netherlands believe that Michael Mann was not telling the truth and that the Dutch had been very foolish to have ratified the Kyoto Treaty.

5.2 Snow on Greenland

The Snow on Greenland story on the other hand was being presented and communicated to the public correctly. Obviously the contents of this particular research study can hardly be compared to the Mann, Bradley and Hughes study. But comparing the way this study has been communicated by the scientist towards the media and by the media towards the public, it is very clear the Snow in Greenland story was more successful. The reasons for this success were the fact that metaphors were used by the scientist and both scientists and journalist had used the principle of check back.

5.3 Journalists

This research project can also confirm the notion that there are indeed two types of journalists, as mentioned by Heijmans, Pleijter and Wester; the specialised scientific journalists and the regular reporters. This difference was clearly visible when comparing articles written by the interviewed journalists and the newspaper articles printed in the Dutch papers, concerning the Snow on Greenland story. The latter were all very short, did not give context or controversy, but because of good communication by the scientist, and the use of metaphors, the scientific facts were all printed correctly.

Most of the stories written by the specialised journalists contained both context and controversy, namely pointing out the difference in opinion of the Mann side and the McIntyre side. This contributed to a feeling of certainty about the stated facts, just like Corbett and Durfee pointed out.

Most likely this difference in style of writing is caused by the different amount of time spend on the articles and their background.

Regular reporters generally only have a small amount of time to prepare small news articles, since they have to produce articles on a daily basis and the today's news has to be in the paper by tomorrow. Regular reporters do not necessary have a matching background.

Special scientific journalists, on the other hand often have a share in the scientific edition of the paper, which is most often only printed once a week. Therefor they are not as short on time as the regular reporters. Scientific reporters generally have a background in science are more familiar with the subject at hand.

However, even though Marcel Crok had spent much time on the subject and his background was related to the subject at hand, he is criticised.

6 Recommendations

Several research studies have established that the media plays an important role in the communication of science towards the public. In order to improve the communication trajectory, from the scientists through the media to the public, this research study has come up with a few suggestions.

6.1 Improvements in communication by scientists

There are a few points of action scientists could keep in mind when presenting their research outcomes to the public.

In case their research has societal relevance, the scientists have a responsibility towards the media.

Scientists could find out during their interviews whether the journalist who is doing the interview really understands the basic principles of his research, just by asking a few questions himself.

After having given the interview, the scientist could request a partial check back; he could read the article of the journalist and check the content on mistakes. Bearing in mind not to get overexcited and start correcting grammar and style.

If it is possible or applicable the scientists could use a metaphor to explain their research. Preferably a metaphor the journalist can relate to; chances are, the journalist will copy this straight into his or her article.

These are all ways by which scientists can have some control over what is being printed in the newspapers or magazines. They should, however, bear in mind, this takes time and effort.

Another very import factor in the communication of scientific research results to a journalist is the use of scientific jargon. The use of branch specific jargon can easily lead to misunderstanding because their words can easily be mistranslated, especially when stories are not being checked by the scientists before being printed.

An easy, but again time consuming, way to bridge the gap between public and scientist, can be to start a web log. This allows everybody who is interested in that particular study to contact the scientist and ask questions. The scientist is free to answer relevant questions whenever he feels like it. When misconceptions arise they are easy to detect and therefore easier to correct.

But most of all, scientists should be open about their research results, especially when it concerns the uncertainties – no matter how desperate the traditional journalist will be for absolute answers.

6.2 Improvements in communication by journalists and other intermediaries

The key to the problem of possible miscommunication does not only lie with the scientists, it is still the job of a journalist to communicate stories in the correct way to the public. This is a responsibility they have towards their readers. Even though they never seem to have enough time to prepare a story, it is still their responsibility to paint a total picture and in case of a scientific debate, show all sides of the story.

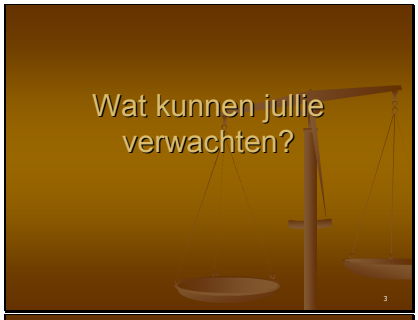
Something that is applicable to scientists as well as journalists is the fact that they both want to be sure that the facts given by the scientists are interpreted in the correct way by the journalist, because they may not always be speaking the same language. Journalists can verify during the interview whether basic facts are interpreted correctly. This is not only the responsibility of the scientists; journalists can also offer or even request the scientists to check their article before it gets printed.

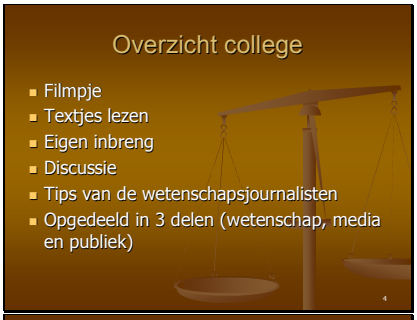
Journalists should consider their sources of information. Press releases can be very catchy and blunt in their statements, while the actual facts of the research are not given. Journalists should always look beyond their own nose.
Peer reviewed journals are always more trustworthy than the ones that do not employ the system of peer review before printing. However, one should keep in mind, that even *Science* and *Nature* do not tell the absolute truth, but ensure scientific debate of a certain standard.
Dutch research has proven that scientific newspaper articles often lack context, while American research has pointed out that the amount of context given is something that clarifies and increases the sense of certainty.
To reach a better understanding of the public, the media could ensure giving more context, especially when it concerns difficult issues.

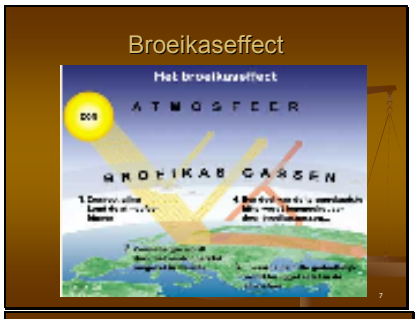
> Or as Henry Pollack says*: "The key in public communication of science in general and global warming in particular, is not to deny the uncertainty, or the controversies that arise from it, but to place the finding in the proper and objective context of the scientific process"*

7. Derived Classroom materials

7.1 PowerPoint Presentation







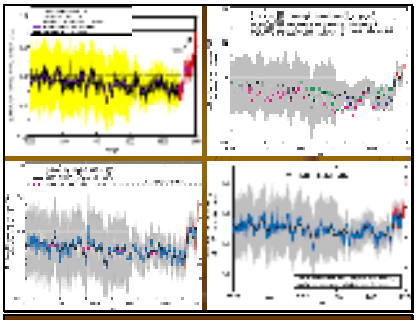
Wetenschap

11

Proxies

- Afgeleide aanwijzingen voor vroeger klimaat
  - isotopenverhoudingen ijskernen
  - groeiringen in coraal
  - Diktes van boomringen
- Patronen herkennen
- Met elkaar vergelijken
- Grote onzekerheden

9



Wetenswaardigheden

- Mann een v/d 10 lead authors
- Meer dan 100 andere auteurs
- Energy & Environment niet peer reviewed

13

Wetenschappelijke artikelen

- Waar kom je nuances tegen?
- Waar verdwijnen ze?

12

IPCC

- Intergovernmental Panel on Climate Change
- Opgericht in 1988
- Onder vleugel van VN

10

- Hoe denken jullie nu over de hockeystick?

16

Links

IPCC1 IPCC 2 IPCC SumPM M&M 03 M&M 05 MBH 98 MBH 99 Corrigendum

14

- Waar zou je op letten bij het schrijven van je eigen artikel?

17

Weblogs

www.Realclimate.org

www.climateaudit.org

19

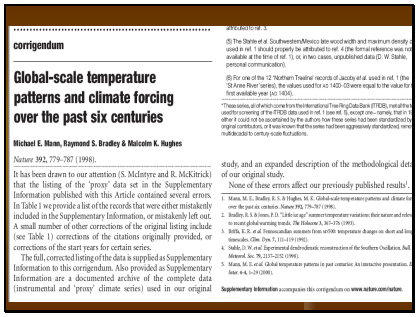
PAUZE

21

Bij het lezen van de textjes

- Let weer op aanwezigheid/ontbreken van van nuances

23



corrigendum

Global-scale temperature patterns and climate forcing over the past six centuries

Michael E. Mann, Raymond S. Bradley & Malcolm K. Hughes

Nature **392**, 779–787 (1998).

It has been drawn to our attention (S. McIntyre and R. McKitrick) that the listing of the 'proxy' data set in the Supplementary Information published with this Article contained several errors. In Table 1 we provide a list of the records that were either mistakenly included in the Supplementary Information, or mistakenly left out. A small number of other corrections of the original listing include (see Table 1) corrections of the citations originally provided, or corrections of the start years for certain series.

The full, corrected listing of the data is supplied as Supplementary Information to this corrigendum. Also provided as Supplementary Information are a documented archive of the complete data (instrumental and 'proxy' climate series) used in our original study, and an expanded description of the methodological deta of our original study.

None of these errors affect our previously published results[1].

1. Mann, M. E., Bradley, R. S. & Hughes, M. K. Global-scale temperature patterns and climate for over the past six centuries. *Nature* **392**, 779–787 (1998).
2. Bradley, R. S. & Jones, P. D. "Little ice age" summer temperature variations: their nature and rele to recent global warming trends. *The Holocene* **3**, 367–376 (1993).
3. Briffa, K. R. et al. Fennoscandian summers from ad 500: temperature changes on short and lon timescales. *Clim. Dyn.* **7**, 111–119 (1992).
4. Stahle, D. W. et al. Improvement of tree-ring dendroclimatic reconstruction of the Southern Oscillation. *Bull. Meteorol. Soc.* **79**, 2137–2152 (1998).
5. Mann, M. E. et al. Global-temperature patterns in past centuries: An interactive presentation. *E Inter.* **4-4**, 1–29 (2000).

Supplementary Information accompanies this corrigendum on **www.nature.com/nature**.

"De milieu problemen in onze contreien zijn opgelost"

[Simon Rozendaal,2004]

20

Media

22

- Wie geloof je op basis van cv?

24

BOE!!!!!

[Van Calmthout, 2005]

26

- Wat is jullie mening over de hockeystick nu?

25

Tropische stormen

Wetenschappelijke onzekerheid in het dagelijks leven

27

Publiek

30

Verwachting ipv voorspelling!

	DO	VR	ZA	ZO	MA
Min. / Max.	-2 / 1	-6 / -1	-6 / 1	-4 / 3	-2 / 3
	40%	80%	80%	70%	40%
	30% 1 mm	10% 0 mm	10% 0 mm	10% 0 mm	20% 0 mm
Wind in Bft	NO 4	O 3	NO 3	NO 3	NO 3

28

Publieks opinie

- Context
- Controverse
- Beide

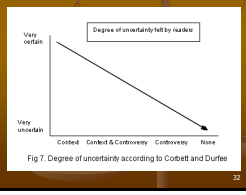


Fig 7. Degree of uncertainty according to Corbett and Durfee

[Corbett and Durfee, 2003]

32

Bij lezen textjes

- Let op gevoel van zekerheid
- Textuele verschillen

31

- "Lagen sneeuw mengen als een inktvlek op papier" [Het Parool, 2005]
- "Isotopen thermometer" [Persbericht Harro, 2005]

34

Taken wetenschapper

- Achterkomen of journalist essentie begrijpt
- Metaforen gebruiken
- Makkelijker bereikbaar zijn

36

Case 2

- Bedenk metaforen

33

Ten slotte

35

Dingen waar je tegen aan loopt als journalist

- Deadlines
- Tijdgebrek

" De kunst van het onvoltooide"
(Karel Knip, 2005)

37

"Je moet erachter komen of kritiek zuiver wetenschappelijk is of meer een vorm van geleerd jennen"

[Van Calmthout, 2005]

39

Taken journalist

- Verder kijken dan je neus lang is
- Peer reviewed of niet
- Science Nature niet absolute waarheid
- Checken door wetenschapper
- Context gebruiken
- Hoor en wederhoor waar gepast

38

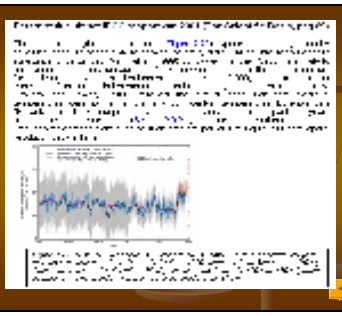
Karel Knip:

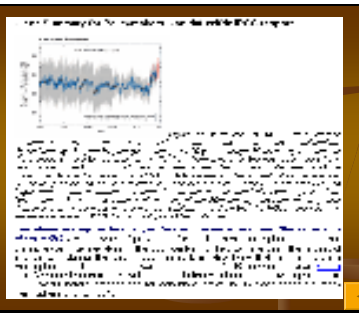
"Het meest zou ik geholpen zijn met een helderder verstand en een beter geheugen"

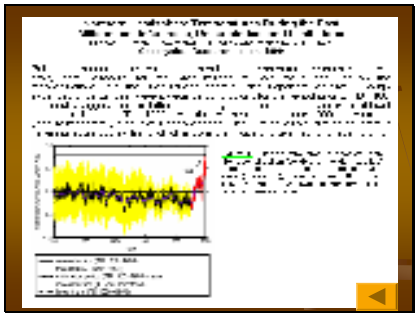
40

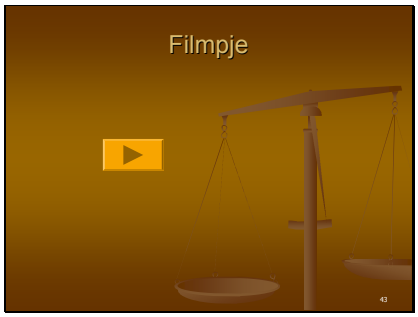
- vragenlijstje

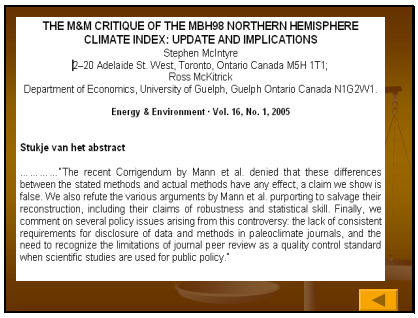
42











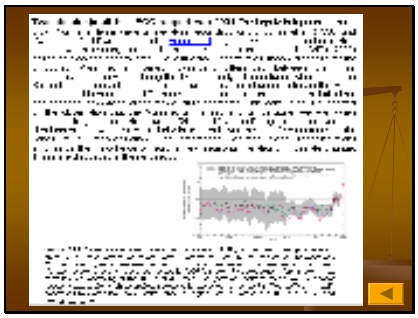
THE M&M CRITIQUE OF THE MBH98 NORTHERN HEMISPHERE CLIMATE INDEX: UPDATE AND IMPLICATIONS

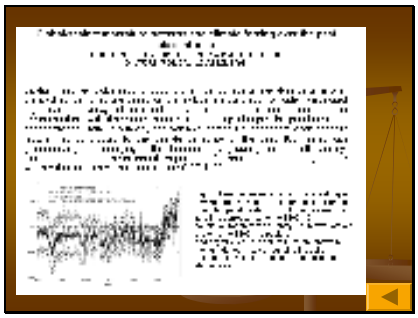
Stephen McIntyre
2–20 Adelaide St. West, Toronto, Ontario Canada M5H 1T1;
Ross McKitrick
Department of Economics, University of Guelph, Guelph Ontario Canada N1G2W1.

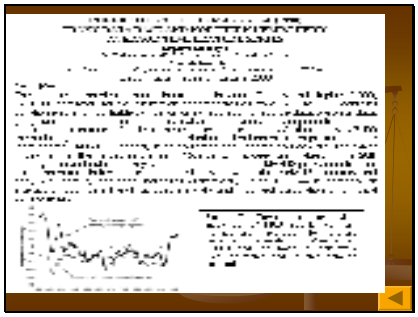
Energy & Environment · Vol. 16, No. 1, 2005

Stukje van het abstract

……."The recent Corrigendum by Mann et al. denied that these differences between the stated methods and actual methods have any effect, a claim we show is false. We also refute the various arguments by Mann et al. purporting to salvage their reconstruction, including their claims of robustness and statistical skill. Finally, we comment on several policy issues arising from this controversy: the lack of consistent requirements for disclosure of data and methods in paleoclimate journals, and the need to recognize the limitations of journal peer review as a quality control standard when scientific studies are used for public policy."







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NATURE |VOL 430 | 1 JULY 2004 |

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minuten	onderwerp	vragen	extra
0-2	introductie mezelf & college		slides
2-8	vragenlijstje	invullen	
8-18	filmpje netwerk	http://www.netwerk.tv/index.jsp?p=items&r=deze_week&a=157508	
18-28		Wat vonden jullie daarvan?	
		Zijn jullie ervan overtuigd dat verdrag van Kyoto onzin is?	
		uitleg broeikaseffect, kyoto, IPCC en proxies	
28-38	uitdelen summ Mann98 incl HS	Let bij het lezen op nuances en onzekerheden	
	summ Mann 99 incl HS		
	IPCC stukjes incl grafiek		
	summ M&M 03&05 incl HS		
	corrigendum		
38-51		Begrijpen jullie de textjes?	slides met links naar textjes
		Waar komen jullie nuances tegen?	
		Waar verdwijnen ze?	slides met alle 4 de grafieken
		Zoek de verschillen in grafieken	slides met extra info
		Hoe denken jullie nu over het broeikas effect?	laten zien dat onzekerheid minder
		waar zou je op letten bij het schrijven van een artikel?	wordt (grijze gebied) naarmate tijd
		even laten zien dat additional data in te zien zijn bij nature	
		Voor pauze even weblogs laten zien,	
PAUZE			

minuten	onderwerp	vragen	extra
0-15	1e pagina artikel Crok	let op de aanwezigheid/ontbreken van nuances	
	persbericht Crok	Waar zien jullie nuances?	
	bios M& M&Mann	wie geloven jullie op basis van cv?	
		Nu jullie wat meer achterrond info/context hebben	
		wat denken jullie nu?	
15-20	Herrie om Hockeystick	vertellen artikel Calmthout	quote Calmthout
	brief Crok	duidelijk maken media debat	
20-22		Kennen jullie hedendaagse voorbeelden van onzekerheid?	slides weerbericht orkaan
22-32	textjes durfee	2 groepjes ieder 1 stukje, daarna buurmans stukje lezen	zelf, groepje, classicaal
	context, controle, controverse		
32-40		let op verschillen, textueel, maar ook voor je gevoel	
		welk stuk geeft je meer een gevoel van zekerheid?	
		wat zijn de verschillen?	
40-42	Stukje Harro quest		
42-47		bedenk metaforen	
47-52		slides met puntjes	
		quotes	
52-57		vragenlijstje	
57-62		filmpje Pier Vellinga http://www.novatv.nl/index.cfm?fuseaction=videoaudio.details&reportage_id=2598	

8. Appendix

8.1 Overview Hockey Stick Affair

1983 The United Nations appointed an international commission to propose strategies for "sustainable development" - ways to improve human well-being in the short term without threatening the local and global environment in the long term: The Brundtland Commission

1987 "Our Common Future", widely known as The Brundtland Report was published. This landmark report helped trigger a wide range of actions, including the UN "Earth Summits" in 1992 and 2002, the International Climate Change Convention and worldwide "Agenda 21" programmes.

1988 Recognizing the problem of potential global climate change, the World Meteorological Organization and the United Nations Environment Programme established the Intergovernmental Panel on Climate Change (IPCC).

1992 Agenda 21, the Rio Declaration on Environment and Development, and the Statement of principles for the Sustainable Management of Forests were adopted by more than 178 Governments at the United Nations Conference on Environment and Development held in Rio de Janeiro. Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment.

1997 The Kyoto Protocol (to the United Nations Framework Convention on Climate Change) is an international treaty on climate change Countries that ratify this protocol commit to reduce their emissions of carbon dioxide and five other greenhouse gases by 5% over the period from 2008 until 2012 compared to 1990, or engage in emissions trading if they maintain or increase emissions of these gases.

1998 Michael Mann, Raymond Bradley and Malcom Hughes published their article on a global reconstruction of annual surface temperature patterns over the past six centuries in Nature [Mann et al. 1998]. Using these global temperature reconstructions they make an estimation of the relationship between temperature changes, variations in volcanic aerosols, solar irradiation and greenhouse-gas emissions during the same period.
This article presents the famous “hockey stick” for the first time. The graph shows the temperatures in the Northern Hemisphere over the last 600 years, with an enormous increase over the last century. It is rather difficult to picture the shape of a hockey stick, but long end of the stick is supposed to be the temperature of past times and the short end is supposed to represent the last few years, during which the increase in temperature occurred. (See fig 1.)

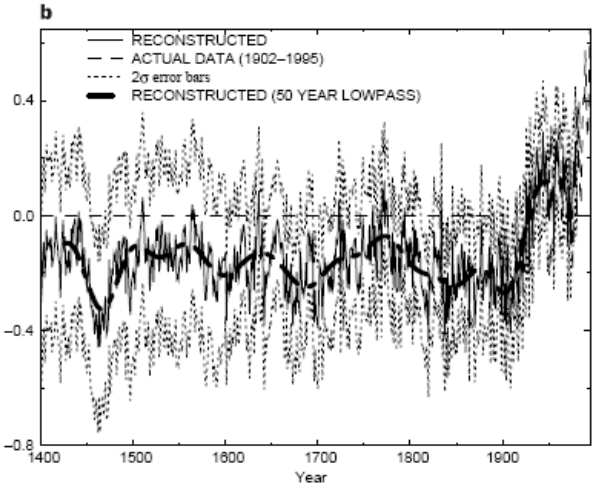

Fig 1. The “hockey stick” graph, showing the change in mean temperature in the Northern Hemisphere over the last 600 years.

But no attention, at least no negative attention is paid to the findings of this article in the scientific world. (See appendix Times cited Mann et al.)

1999 Geophysical Research Letters publishes Mann et al’s new article: “Northern Hemisphere Temperatures during the past millennium: inferences, uncertainties and limitations”. [Mann et al, 1999] The time scale of the temperature reconstruction in this article goes back to the year 1000 AD. Even though uncertainties prevent decisive conclusions for the period prior to 1400 AD, their results suggest that the last part of the 20th century is irregular in the context of at least the past millennium. The 1990s was the warmest decade and 1998 the warmest year, at moderately high confidence. The 20th century warming counters a millennial-scale cooling trend which is consistent with long term astronomical forcing.
Another “hockey stick” graph is used to display their findings. (See fig 2.) This one resembles the shape of a hockey stick a bit more.

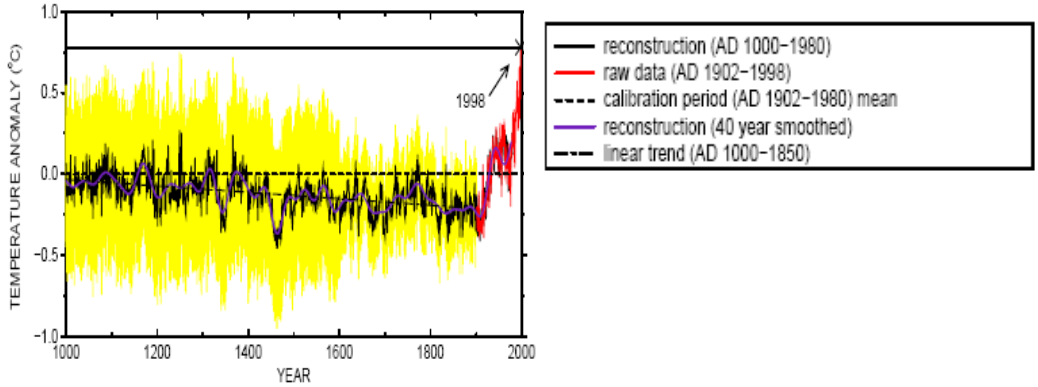

Fig 2. The Hockey stick graph from 1999 with uncertainties in yellow [Mann et al, 1999]

2001 The Intergovernmental Panel on Climate Change (IPCC) produced their Third Assessment Report (TAR), which focuses on the science of climate change. It covers the physical climate system, the factors that drive climate change, analyses of past climate and projections of future climate change, and

detection and attribution of human influences on recent climate. In this report the graph made by Mann et al is used to portray the temperatures in the Northern Hemisphere over the last centuries, with an enormous increase over the last century. The graph has been used twice in the reports, once in the chapter on climate change, the scientific foundations of the theorem that the earth is warming, in combination with three other climate reconstructions. And a second time, a more simplified version on a more prominent spot, in the summary for policymakers.
From this moment on sceptic people and opponents of the climate change theorem, saw this graph as an IPCC-icon and tried to bring it down.

2002 The Earth Summit of Johannesburg was held, during which countries discussed topics like improving people's lives and conserving our natural resources in a world that is growing in population, with ever-increasing demands for food, water, shelter, sanitation, energy, health services and economic security.

2003 Stephen McIntyre and Ross McKitrick published their article “Corrections to the Mann et al. (1998) Proxy data base and northern hemispheric average temperature series” in Energy and Environment. [McIntyre & McKitrick, 2003]. McIntyre and McKitrick find that the data set of proxies of past climate used in Mann et al. 1998 for the estimation of temperatures from 1400 to 1980 contains collation errors, unjustifiable truncation or extrapolation of source data, obsolete data, geographical location errors, incorrect calculation of principal components and other quality control defects. They describe these errors and defects and make a new Northern Hemisphere average temperature index for the period of 1400-1980, using corrected and updated source data.
The major conclusion by McIntyre and McKitrick is that the values in the early 15th century exceed any values in the 20th century. The particular "hockey stick" shape derived in the Mann et al. 1998 construction – a temperature index that decreases slightly between the early 15th century and early 20th century and then increases dramatically up to 1980 — is primarily an artefact of poor data handling, obsolete data and incorrect calculation of principal components.
This is also the first time the name “Hockey Stick” appears.

2003 Considering the fact that both McKitrick and McIntyre are Canadian and they both have an appointment at a Canadian university, Canadian newspapers do write about their opposition on Mann et al. The first article in the National Post [National Post, 2003] in which both researchers and the word climate are mentioned, dates back to October 2003. But in the world of science there is no trace of a lot of following by other scientists.

2004 Mann, Bradley and Hughes have written a Corrigendum in Nature on their previous article, as a response to the McKitrick and McIntyre critique. They provide a list with corrections and a list with data that was mistakenly used or left out. But they also mention that none of these errors affect their previously published results. [Mann et al. 2004]
At the end of this year a German climatologist, named Von Storch publishes a critique on the Mann et al 1998 work in Science. [Von Storch 2004] He claims that by using a model simulation he can prove that the amplitude of variation between warm and colder periods, shown by Mann et al. is wrong. It should be larger, meaning it could have been warmer in the 12th century and colder in the 17th century.

2005 This is the year of the Hockey Stick, at least in Holland it is. Somewhere along the line, the graph on temperature rise in the northern hemisphere made by Mann et al, had been named “the Hockey Stick”, because of its shape.

McKitrick and McIntyre finally get their new article “Hockey sticks, principal components, and spurious significance” published by Geophysical Research Letters in January [McKitrick and McIntyre 2005]. In brief this article accuses Mann et al of having made a statistical model which produces hockey stick like graphs, no matter what data you use.

Marcel Crok a member of the editorial staff of the Natuurwetenschap & Techniek, a popular Dutch scientific magazine, decided to write a piece on the debate between Mann et al and McKitrick and McIntyre. On the 26th of January he advertised his coming article on the magazine’s website with the opening words: ”Proof behind Kyoto is not correct”. He claimed that the hockey stick graph is a statistical fairy tale. He had asked a statistics expert for a view on the case and had had thorough contact with the McIntyre and McKitrick-side, he had also asked Mann for his point of view. The article suggest that thorough research has been done and the claims made by McKitrick and McIntyre must be true.

The translated version of his article he sent to the National Post in Canada, who printed it on the 28th. On the 29th the magazine was out in stores. On the 14th of February the Wall street journal did a piece on the dispute about the Hockey stick graph. As a reaction on this newspaper article a popular Dutch television programme called Netwerk did a broadcast on the item as well, showing an interview with Steven McIntyre and suggesting that the Kyoto is based on this air. All of this in the same week the Kyoto protocol came into effect.

From this moment on the general public was regularly confronted in the media about the debate on whether the current temperature rise is a novelty or has whether the temperatures have previously been this high. In other words, whether we, as mankind are definitely responsible for the global warming. And if we are, what do we need to do about it?

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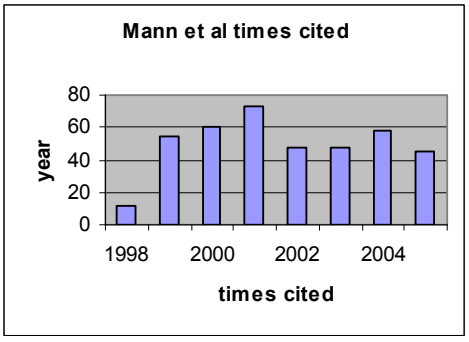

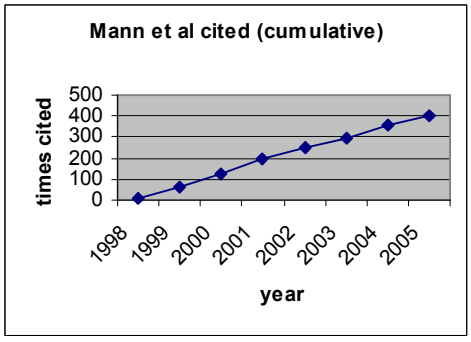

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8.7 Interviews

8.7.1 Marcel Crok

Redacteur Natuurwetenschap en Techniek 3/11/05
Afgestudeerd als (fysisch) chemicus (leiden, 1995) en na een stage bij het Chemisch Weekblad (tegenwoordig heet dat C2W) wetenschapsjournalist geworden; eerst vijf jaar freelance; daarna twee jaar bij De Ingenieur en inmiddels bijna drie jaar bij Natuurwetenschap & Techniek

Komt u wel eens in aanraking met wetenschappelijke onzekerheid zoals in klimaatveranderingvraagstukken?
Ja in mijn werk voor Natuurwetenschap &Techniek

Hoe legt u de onzekerheid uit die altijd een grote rol speelt in klimaatveranderingvraagstukken? (sociaal/economisch/wetenschappelijk?)
Vooral Wetenschappelijk, maar ik had nooit verwacht dat ik in zo'n beerput terecht zou komen. Speelt ook politiek en sociale onzekerheid bij mee.

Op welke manier: 2 kanten van het verhaal (voor- en tegenstanders?) of anders?
Hoor en wederhoor is in principe altijd het uitgangspunt

Denkt u dat het voor de lezers duidelijker is op die manier?
Er is altijd sprake van discussie in de media, als je lezers twee kanten van het verhaal geeft, kunnen ze zelf oordelen. Maar zo'n discussie is voor de lezer niet altijd duidelijk.

Denkt u dat het geven van een bredere context verduidelijkend werkt voor de lezer?
Ja, natuurlijk

Hoe ver denkt u te moeten gaan in het uitleggen van statistiek bij onderzoeksuitkomsten, om zo een duidelijker plaatje te schetsen van de wetschappelijke onzekerheid?
In dit geval juist wel heel ver. Want bij de Hockeystick gaat het juist alleen om statistiek. Daarom hebben we ook specialisten benaderd, maar de meeste mensen laten het gewoon weg, omdat het veel te moeilijk is.

Hoe zou volgens u de communicatie over wetenschappelijke onzekerheid beter kunnen?
Bij Hockeystick-affaire=> Als de wetenschappers al moeite hebben met het tackelen van de wetenschappelijke onzekerheid, dan is het voor journalisten nog veel lastiger.

Wat zou u graag willen dat wetenschappers anders/beter zouden doen?
Wetenschappers zouden een opener houding moeten hebben. Vaak is het zo dat ze een bepaalde hypothese hebben, waar ze dan bewijs voor zoeken om het te bewijzen. Maar als er dan bewijs wordt gezocht om het tegenovergestelde te beweren, kunnen ze de kritiek niet aan.

Bij de presentatie van uitkomsten?
Persberichten worden altijd catchy geschreven, anders worden ze niet opgepikt door media. Het is de taak van de journalist om op hun hoede te blijven en kritisch te blijven kijken naar gepresenteerde stukken

Is het reëel dit te verwachten? Zijn er goede voorbeelden hiervan, of super slechte?
Nou ja zou wel zo moeten zijn. Het verhaal dat afgelopen week in de Spits stond is super slecht voorbeeld. (het bericht dat treinen 30% efficiënter zouden kunnen rijden als buffertijden zouden worden weggelaten, maar na enig onderzoek bleek dit maar op een traject te zijn bekeken en was er geen rekening gehouden met andere aansluitingen….)

8.7.2 Martijn van Calmthout

Redacteur van de Volkskrant
Achtergrond: Experimentele Natuurkunde gestudeerd.

Als u een artikel schrijft, denkend aan een artikel over klimaat verandering, hanteert u het principe hoor en wederhoor?
In principe doe je dat wel, maar het hangt een beetje af van wat voor soort verhaal het is, de lengte, allerlei afwegingen waar je rekening mee houdt.

Denkt u dat dit principe verduidelijkend werkt voor de lezer om twee kanten van het verhaal te belichten?
Nou nee, dat is natuurlijk een interessante kwestie; als je hoor en wederhoor toe past, laat je in feite de conclusie over aan de lezer en de vraag is wat moet de lezer daar dan mee. Hij kan dan als hij zuiver redeneert alleen maar vaststellen dat de deskundigen het niet eens zijn bij wijze van spreke, of niet eens op punten, maar hoofdlijnen wel. Daarmee is de mededeling van het verhaal, zeker bij klimaatverandering, voor de lezer niet helder.
Hoor en wederhoor zijn nuttig als het gaat om reconstructies. Als het gaat om meer wetenschappelijke discussies, zoals de hockeystick, dan heb je een andere kwestie, namelijk een debat, waarbij de ene partij een stelling inneemt en de andere partij daar naar kijkt en zijn commentaar op levert.
Daar wordt de vraag wat is hoor en wederhoor natuurlijk al veel ingewikkelder. Want de Hockeystick draait in principe om de vraag of Mann et al hun boomringenanalyze goed gedaan hebben of niet. Zij zullen zelf zeggen van wel. Er zijn mensen die het daar niet mee eens zijn. Vraag een is dan, hoe ga je daar een verhaal over schrijven. (Hij vertelt hoe zij -de Volkskrant- dat hebben gedaan tot nog toe) We hebben al heel lang klimaatsveranderingen in de krant. Verhalen zijn in lijn met de mededelingen die vanuit de wetenschap over dat onderwerp naar buiten komen. Wij schrijven over wetenschappelijk

onderzoek, dus als wetenschappers zeggen wij hebben dit onderzoek gedaan, dan kun je daar natuurlijk een bericht over schrijven. Klimaatverandering natuurlijk meer dan bericht waard. Dus daar schrijven we van publicatie naar publicatie over, maar er zijn ook algemenere stukken.
Meeste klimaatonderzoekers zijn het toch wel eens dat er zoiets bestaat als klimaatsverandering, dus dat hoeven we niet elke keer aan de orde te stellen. Anderzijds is er een tegenbeweging die wijst op de onzekerheden. Ten eerste, hoe kun je het hier en nu meten? Ten tweede, is het op historische tijdschalen te verklaren/raar is wat we nu zien?. Want reconstructies zijn natuurlijk onzekerder dan datgene wat je nu kunt meten. Derde, dat als je accepteert dat menselijk handelen invloed heeft, wat moet je dan gaan doen? En dat is nog ingewikkelder, want dan krijg je politieke en economische kwesties. Wat wij in de krant proberen te laten zien, is niet voordurend het gejoel over dat dingen onzeker zijn, maar het is verre van verboden om dat op te nemen.

Probeert u daarin in ook uw eigen mening naar voren te brengen? Of wat u denkt dat waar is?
Nee, want ik ben een journalist en geen onderzoeker, dus in die zin kan ik moeilijker volhouden dat sommige dingen waar zijn dan bijvoorbeeld een onderzoeker van het KNMI.
Kijk als Johan Cruijf een doelpunt maakt dan schrijft de Sportredactie; “JC maakt doelpunt” Als Mann een publicatie heeft waarin staat dat de huidige opwarming exceptioneel is in vergelijking met alles wat er de afgelopen eeuwen het geval is geweest, dan schrijf ik dat als journalist op. Natuurlijk waar nodig met kanttekeningen. Maar op het moment dat een publicatie naar buiten komt heb je ook niet veel meer dan alleen die mededeling dat pietje zus en zo denkt te kunnen beweren.
Dus dat is stap 1 in het schrijven over dit soort onderwerpen. Mensen zeggen iets en dat schrijf je op, dat is de taak van de journalistiek.
Nou vraag je of ik een mening heb, nou die heb ik wel, maar die mening is niet zo heel relevant, behalve dat je als journalist probeert serieus te werk te gaan. Je zoekt dus uit of dit zomaar iets wat iemand roept, of dat dit gebaseerd op een uitgebreide studie. Dit doe je niet door aan het eind van ieder stuk te schrijven dat je het niet helemaal zeker weet, maar door vakgenoten te polsen over of het plausibel is. Dit niet zo zeer om het principe hoor en wederhoor toe te passen, maar gaat meer om, om uit te vinden of het een incidenteel geluid is wat iemand zegt, of dat het past in het beeld van vakgenoten?Je probeert dus context te vinden.

Er zijn ook journalisten die aan de hand van hun eigen research een bepaalde kant op gaan en zo dus eigenlijk een beetje de mening van de lezer proberen te bepalen. Wat is uw kijk daarop?
Jazeker in Nederland is de hele hockeystick toestand, nogal heftig geworden na het verhaal van M. Crok in de Natuurwetenschap en Techniek. Ik kende het verhaal van M&M, maar vind dat de manier waarop het gepresenteerd werd door Crok, extreem partijdig er werd gewoon hard gezegd dat Kyoto op drijfzand berust etc.
In termen van het deugt niet-schrijven, dat is een opinieachtige benadering, ik was daar nogal verbaasd over. Op zich was het geen nieuw nieuws, McKitrick& McIntyre (M&M) hadden al eerder kritiek geleverd. Maar dit speelde dus ten tijde van ratificatie van Kyoto en publicatie van M&M in Geophysycal Research Letters. In mijn ogen was dit stuk een poging om de opinie stevig te beïnvloeden.
Dat vond ik eigenlijk te ver gaan. Ik heb daar ook bespreking van gemaakt in krant, waarin ik ook opmerkte dat ik niet begreep dat je op die manier als populair wetschappelijk blad wilde opereren.
Laatste tijd weer nieuwe publicaties van Mann et al die weerlegging lijken te zijn van M&M. Er was dus ook inhoudelijk reden om een verhaal te schrijven over de repliek van Mann, dus vandaar verhaal in Volkskrant van 29/10/05. Hun conclusie is dat commentaren geen stand houden van M&M.
Ikzelf denk dat het debat nooit op zal houden, want klinkt wel als wetenschappelijk debat, maar zijn meer dingen aan de hand. Broeikas is een politieke kwestie. In die zin denk ik dat het niet uit maakt, wat je als wetenschapper terug zegt op kritieken uit sceptische hoek, omdat het niet gaat om wie er gelijk heeft, maar om te blijven aanvoeren dat de mensen die zeggen dat klimaat verandering gaande is, het niet zeker weten. Vanuit de sceptische hoek, die volgens mij ook ondersteund wordt vanuit de industriële hoek, energie en dergelijke, wordt er voortdurend in gespeeld op onzekerheid. Een vorm van onrust stoken die wat je ook terug zegt altijd zal blijven bestaan. Dit maakt discussie wel moeilijker, omdat je nooit weet of kritiek zuiver wetenschappelijk is of meer vorm van geleerd jennen.

De journalist moet dus nagaan wat het geval is?
Ja en dat is heel moeilijk ik wil best sceptici aan het woord laten maar ze moeten wel iets te melden hebben, het moet wel serieus zijn. In dat soort situaties moet je hoor en wederhoor toepassen.

Het hangt er natuurlijk ook vanaf hoeveel tijd u kunt besteden aan een artikel?
Jazeker, in mijn geval is dat vrij veel omdat wij vooral achtergrond verhalen maken. Maar in dagelijks nieuws heb je geen tijd om alles tot in de puntjes uit te werken voordat het de krant in gaat.

Bij Nature en Science hanteren ze een embargo, vindt u dat handig?
Als je het wilt hebben over de tijd te hebben om gebalanceerd verslag te doen, dan is dat natuurlijk zeker goed. Niet alleen daarom, maar ook omdat het vaak gaat over hele ingewikkelde abstracte dingen. En zo’n verhaal schrijf je natuurlijk niet in tien minuten. Wel als er iemand geliquideerd wordt op de Dam, natuurlijk.

Zou dat ook een optie zijn voor het uitbrengen van persberichten?
Nou de meeste bladen hanteren het en dat is heel goed, maar of het haalbaar is om het bij alle persberichten te doen is de vraag. Hoe meer tijd je hebt, hoe langer je er naar kunt kijken, hoe evenwichtiger je kunt schrijven. Het zou natuurlijk heel handig zijn, meer tijd dus ook mooier en duidelijker schrijven. –(noemde voorbeeld over statistiek)

Nog even over statistiek, want dat speelt bij het hele hockeystick verhaal een grote rol. Er wordt vaak overheen gepraat, het woord boomringen komt af en toe voor, maar daar blijft vaak bij, denkt u dat het uitleggen van de statistische onderzoeksmethoden helpt bij het begrijpen van het verhaal?
Nou Crok liet in zijn stuk zien dat hij van mening was dat elke lezer moet weten wat er met die gegevens gebeurt, om te laten zien hoe zeer we bedrogen worden, zeg maar. Ik heb daar nogal mijn twijfels bij. Ik denk niet dat een modale lezer daar echt iets mee opschiet. Ik zou dat dus in de krant niet zo snel doen, tenzij er over een helder punt een hele discussie losbarst, dan kun je dat misschien proberen.

Dus het hangt af van het blad waar je voor schrijft en de lezer?
Ja, en wat ik zelf het merkwaardigst vond aan Natuurwetenschap & Techniek was, dat door zo diep in te gaan op statistiek de suggestie werd gewekt/versterkt, dat dit dan toch wel het definitieve antwoord moest zijn op de verzinsels van Mann et al. Het werd met zo veel wetenschappelijk air gebracht dat voor iemand die daar niet zo in zit het bijna evident was dat dit wel hele serieuze dan wel hele zwaarwegende kritiek was terwijl iemand die er wat verder vanaf staat toch wel twijfels bij zou kunnen hebben. Dus daar werd eigenlijk de wetenschappelijkheid als onderhuids argument meegegeven aan de lezer.

Crok zelf ook overtuigd van de kritiek van M&M
Absoluut, nou dat mag van mij, alleen gebruikt hij die quasi wetenschappelijke manier van presenteren als soort van " als het zo goed is uitgezocht is dan zou het wel niet waar zijn." Er zo gedetailleerd over schrijven dat je de suggestie wekt, dat er heel goed over na is gedacht en onderzocht.
De lezer schiet daar dus in zekere zin helemaal niks mee op.

Nog even over het communicatietraject, denkt u dat er iets moet veranderen aan de manier waarop journalisten bijvoorbeeld de informatie krijgen toegereikt? Persberichten worden vaak heel catchy geschreven....
Ik moet zeggen dat het wel lastig is als journalist, want je kunt heel gemakkelijk gaan voor de platte mededelingen en niet verder kijken dan je neus lang is. Omdat er heel veel aangereikt wordt. Heel veel met name Amerikaanse, maar tegenwoordig ook Europese bronnen, hebben tamelijk goed begrepen hoe je PR bedrijft. En daarin kom je niet met "het zou kunnen zijn dat...." maar met "het is zo dat.." Die onzekerheid op dat niveau staat dus zeker niet in de kop van wat je allemaal aangeboden krijgt. Dus het is aan wetenschapsjournalisten om je te realiseren dat sommige bronnen harder schreeuwen dan ze waar kunnen maken, om überhaupt in beeld te komen. Mensen moeten aandacht trekken en dat doe je niet met zwaar genuanceerde verhalen, dat doe je met stevige statements, die je in de derde alinea van nuanceringen voorziet. Soms gebeurt dat ook helemaal niet.
Wat ik zelf lastiger vind daaraan is dat de serieuze bladen, de Nature en Sciences van deze wereld, daar ook aan doen. Die kiezen ook sappige statements uit om mee in de publiciteit te geraken. Maar veel mensen hebben de neiging om zo'n blad serieuzer te nemen dan bijvoorbeeld een persbericht van een Amerikaanse universiteit. Maar in feite worden voor de manier waarop het materiaal wordt aangeboden, dezelfde pr-trucs gebruikt als bij grote bedrijven die iets willen verkopen.
Je moet je, als wetenschapsjournalist, dus voortdurend bewust zijn, dat dingen ingewikkelder zijn dan ze lijken. En wat dat betreft ook minder rechtlijnig waar zijn dan dat ze lijken. Is volgens mij het belangrijkste kenmerk van een wetenschapsjournalist.

Vindt u dat hieraan iets veranderd moet worden?
Nou nee, ze zoeken aandacht en die krijgen ze op deze manier ook. Ik denk dat je journalisten vooral moet gaan trainen in zich toch voortdurend afvragen wat er nou gezegd wordt en hoe hard de onderzoekers hun geschreeuw waar kunnen maken. Dat moet je mensen aanleren.

Dus het is meer de taak van de journalist?
Ja absoluut, ik begrijp namelijk heel goed waarom bronnen niet genuanceerd willen zijn. En ik beschouw het als een taak van de krant om en na te gaan in hoeverre beweringen hard zijn. En ik denk dat we als krant die nuance moeten proberen over te brengen op de lezer. Dus nuance, onzekerheid, zijn dingen die bij bijna elk onderwerp wel bijna aan de orde moeten zijn.

Uiteindelijke boodschap: het is de taak van de wetenschapsjournalist om verder te kijken dan neus lang is.
Hier moeten we toekomstige journalisten beter op voorbereiden.

8.7.3 Karel Knip

Redacteur NRC Handelsblad 14/11/05
Achtergrond K.Knip: studeerde chemische technologie (TH Delft, afgebroken en opgegeven) en biologie (Universiteit van Amsterdam, niet afgemaakt). Vanaf 1982 was Knip als medewerker verbonden aan de redactie economie van NRC Handelsblad. In 1988 kwam hij er in vaste dienst, verbonden aan de redacties economie en wetenschap. Hij heeft onder meer energie, milieu, wapentechnologie en 'alledaagse wetenschap' in zijn portefeuille.

Bij het schrijven van uw artikelen, laat u dan uw mening doorschemeren?
Niet altijd, bij de grote stukken vaak wel. Ik probeer ook duidelijk te maken wanneer er dan een oordeel van mij doorheen klinkt. T is niet altijd noodzakelijk hoor, soms is de conclusie op logische gronden wel te trekken.

Gebruikt u het principe hoor en wederhoor?
Hoor en wederhoor kun je niet eindeloos mee door blijven gaan, ik beschouw een artikel, een mededeling van iemand als het horen en dan kan ik het wederhoor toepassen in de vorm van andere artikelen of iemand op bellen, maar ik ga dan niet weer opnieuw de eerste op bellen. Ik probeer wel zo eerlijk mogelijk de feiten tegenover elkaar te plaatsen, maar ik zou niet zeggen dat het hetzelfde hoor/wederhoor karakter heeft als bij het binnenlands nieuws van NRC. Ik heb hier te maken met een helder wetenschappelijk verhaal, een oordeel.

Hoe ver denkt u te moeten gaan met het uitleggen van de statistiek bij de onderzoeksuitkomsten?
Nou in hoeverre dat doenlijk is. Zeker in klimaatonderzoek is de statistiek een specialisme op zich geworden, dus dat is bijna niet meer te doen om het uit te leggen. Ik heb een handboek achter de hand om mij zelf uit de nood te helpen van tijd tot tijd. De ins en outs van klimaatstatistiek zijn niet meer goed over te brengen. Het uitgangsmateriaal, bij de Hockeystick is dat dus de jaarringen van bomen, dat kun je toch vaak wel uitleggen.

Hoe denkt u dat de communicatie van wetenschappelijke onzekerheid beter zou kunnen? Zou dat vanuit de wetenschapper anders gecommuniceerd moeten worden, of zouden journalisten iets moeten veranderen aan hun werkwijze?
Wat wij toch voornamelijk als richtlijn hebben, zijn publicaties in gezaghebbende wetenschappelijke tijdschriften, zoals Science en Nature. Verder kan ik terug vallen op de dikke pillen die om de 5 jaar worden uitgereikt door de IPCC. Maar in beide gevallen is de essentie, dat er een uitputtende peer-review heeft plaatsgevonden. Dus wetenschappers hebben onderzoek/artikelen beoordeeld op hun waarde en hun geldigheid, dat is voor ons als wetenschapsjournalist een uitgangspunt. Als een artikel eenmaal gepubliceerd wordt, wil het niet zeggen dat het de absolute waarheid is, maar is het wel de moeite waard. Of dat proces nog verbeterd kan worden, ik denk het bijna niet.

Maar er zijn journalisten die van mening zijn dat er bij publicaties van Mann er al toch iets is misgegaan bij dit uitputtende peer-review.....
Daar zijn de meningen over verdeeld. Maar het proces in principe is goed.

Wat voor artikelen schrijft u doorgaans?
Grote en kleine. Maar dat wil niet zeggen dat ik aan de kleinere artikelen heel weinig tijd besteedt.
Ik zoek er altijd andere informatie bij. Alles gaat ook zo heen en weer in de kranten he?! Waterdamp speelt wel een rol, een week later geen rol.....het is toch altijd even oude stukken erbij halen.

Daar krijgt u voldoende tijd voor?
Jazeker, maar we hebben tegenwoordig ook twee doordeweekse wetenschapsbijlages en die worden veel sneller in elkaar gezet. Daar selecteren we ook wat minder zwaarwichtige stukken voor. Dit moet zo snel gebeuren dat je er niet zo veel studie bij kunt plegen.

Wat vindt u van het embargo dat Nature en Science hanteren?
Ik zit nu al zo'n 15 jaar in het vak van klimaatonderzoek, dus ik weet wel ongeveer wat de gang van zaken is. Bij andere onderwerpen kun je enigszins overvallen worden door een bepaald bericht en dan opereer je ook anders, veel behoedzamer. Vaak laat je het ook maar voor wat het is. Je brengt dan dus gewoon het nieuws over zonder commentaar en heel veel achtergrond. Onderwerpen als materiaal kunde, nieuws dat zo helemaal vreemd is voor je dat je het in de krant zet zonder enige nadere toelichting.

Maar wat vindt u van dit embargo, is het een idee om het ook bij andere tijdschriften en persberichten toe te passen?
Er is veel debat over, ik vind het wel een aardig systeem, dat je er wel even over na kunt denken voordat het echt losbarst in de media. Anderen zijn er fel op tegen, die zeggen op het moment dat het er is moet je er maar mee aan de gang.

Andere tijdschriften hanteren het ook. Ja ik ben er nog niet helemaal over uit. Maar ik vind het wel prettig werken.

Kunt u mij misschien een voorbeeld geven van een artikel of ander soort communicatie middel waarin het communicatie proces niet goed is verlopen?
Nou ik denk dat dat heel geregeld voor komt. Als het verhaal uit Nature of Science komt dan is het heel betrouwbaar, het hoeft niet per se de uiterste waarheid te zijn, maar toch zeer belangrijk. Zoals ik net al zei.
Maar het lukt wetenschappers vaak om hun onderzoek via congressen in de belangstelling te krijgen. Op zo'n congres vindt natuurlijk geen peer-review plaats. Het instituut waar de wetenschapper voor werkt heeft er hoogstens even naar gekeken, maar meestal is dat niet eens het geval. Deze lezingen komen dan ook via Internet tot de media en dat zijn vaak zeer uitgesproken meningen die niet de toetsing hebben ondergaan zoals die bij Nature en Science. Je ziet dan heel vaak dat dat toch de kranten in gaat.
Vooral Amerikanen hebben vaak veel congressen en dan gaat daar zo'n mannetje heen van een nieuws bureau en die zet dat allemaal op internet. Persbureaus kijken daar dan naar. En die halen daar dan dingen uit. Dan krijg je dus geweldige missers over bijvoorbeeld effecten van of gevaren van medicijnen, noem maar op, dat zie ik bijna wekelijks gebeuren.

Daar zou dus veel kritischer naar gekeken moeten worden?
Ja het is een waarschuwing, je moet eerst kijken waar het nieuws vandaan komt. Het is voor ons heel simpel: Is het Peer-reviewed of niet? En dan wel door gezaghebbende groep wetenschappers.
Die uitspraken op congressen die neem je met een korreltje zout.

8.7.4 Prof. Dr. Harro Meijer

Scientist at CIO, Groningen 1/12/05

Wat viel je op bij interviews?
Hing af van niveau interviewer, meeste kwamen af op mooi verhaal.
Geen kwaliteitskranten aanwezig.
Enorm verschil in welke krant/media het artikel/interview kwam.

Vond je de interviews prettig?
Ja

Essentie opgenomen in berichten?
Ja, meestal wel, maar heb dan ook gevraagd om stuk na te kijken voor publicatie

Stelden ze de goede vragen?
Ja over het algemeen wel.

Had je het idee dat ze meer wilden weten of klakkeloos jouw verhaal overnamen?
Mensen met betere achtergrond wilden wel meer weten, rest gewoon mooi verhaal.

Vind je het de taak van de wetenschapper dat hun onderzoek juist ik krant komt?
Wij (klimaatonderzoekers) hebben toch wel die taak ja, want ons onderzoek heeft veel maatschappelijk belang. Komt dicht bij de mensen, dus moeten ook goed op de hoogte gehouden worden.
Maar dat heb je zelf in de hand. Je kunt dus vragen om na te lezen en je praatje goed voor te bereiden.
Of je persbericht de deur uit doet heb je ook zelf in de hand, moet je wel tijd voor hebben om die interviews te geven.

Wat vind je van het embargo dat Nature en Science hanteren?
Ja is wel handig, maar alleen als iets echt nieuwswaarde heeft, dan heb je als wetenschapper meer tijd om je praatje voor te bereiden en journalisten hebben meer tijd om dieper op de zaak in te gaan.
Maarja niet alles heeft nieuwswaarde, sneeuw op Groenland ook niet, maakt niet uit of dat van de zomer of nu in de krant staat, want het is ongoing research.

Moet er kritischer gekeken worden naar persberichten door journalisten?
Ja, voornamelijk bij onderwerpen als kanker onderzoek. Heeft ook maatschappelijk belang, maar in persberichten staat vaak niet hoe men precies aan de resultaten is gekomen.
Bij het CIO wordt er voor zorggedragen dat altijd het hele verhaal verteld wordt.

8.7.5 René Fransen

12/12/05
Achtergrond: Biologie gestudeerd in Utrecht, 7 jaar als wetenschapper in UMCU, daarna als wetenschapsjournalist voor UK, Groningen

Komt u wel eens in aanraking met wetenschappelijke onzekerheid zoals in klimaatsverandering vraagstukken?
Ja

Hoe legt u de onzekerheid uit die altijd een grote rol speelt in klimaatsverandering vraagstukken? Wetenschappelijk/ Sociaal/economisch?
Het probleem met klimaatsverandering vraagstukken is dat het zo'n groot tijdsspan beslaat. Eerst moeten we erachter komen of het daadwerkelijk door ons is veroorzaakt, wetenschappelijke onzekerheid, maar dan als er maatregelen bedacht moeten worden, dan wordt het natuurlijk politiek. Niemand wil de geschiedenis in gaan als degene die het verbod op autorijden invoerde....

Op welke manier probeert u uw verhaal te vertellen? : 2 kanten van het verhaal (hoor/wederhoor) of anders?
Dat hangt er van af, als er heel duidelijk sprake is van een aanval op iemand/iemands onderzoek ofzo, dan moet je de ander ook aan het woord laten, maar je moet wel heel duidelijk wegen. Je moet wel van te voren weten hoe waardevol zo'n commentaar is.

Denkt u dat het voor de lezers duidelijker is op die manier?
Dat hangt er vanaf, ze moeten wel een mening kunnen vormen.

Denkt u dat het geven van een bredere context verduidelijkend werkt voor de lezer?
Je moet je lezer nooit overschatten. Vaak is het handig om een klein opstapje te gebruiken. Een kleine inleiding. Dus ja dat denk ik wel.

Hoe ver denkt u te moeten gaan in het uitleggen van statistiek bij onderzoeks uitkomsten, om zo een duidelijker plaatje te schetsen van de wet.sch. onzekerheid?
Statistiek is in de meeste gevallen veel te moeilijk om op in te gaan. Zelfs wetenschappers weten vaak niet de ins en outs.
Maar het hangt natuurlijk van het stuk af. Marcel Crok ging er wel heel diep op in, omdat het de essentie van zijn verhaal was.

Hoe zou volgens u de communicatie over wetenschappelijke onzekerheid beter kunnen?
Alle informatie geven aan journalisten.

Wat zou u graag willen dat wetenschappers anders/beter zouden doen?
Ik wil hierbij de wetenschap een laatste waarschuwing geven: Geef alle informatie in het persbericht, anders schuif ik het terzijde. Vaak staat er in het persbericht maar de helft van de informatie. Alleen de uitkomsten van een onderzoek zijn genoemd, ik kan vaak niet alle methoden terug vinden en dan moet ik gaan graven, bellen of op Internet kijken. Als dat het geval is dan gebruik ik dat persbericht niet.

Bij de presentatie van uitkomsten?
Ja completer persbericht dus.

Bij de communicatie naar journalisten toe?
Nee je moet gewoon als journalist wat wantrouwend zijn.

Is het reëel te verwachten dat persberichten completer worden? Zijn er goede voorbeelden hiervan, of superslechte?
Zou heel reëel moeten zijn, maar er zijn ook andere krachten die op wetenschappers werken. Bijvoorbeeld populariteit, als wetenschappers vaak publiceren, of als ze vaak in de krant komen te staan met hun onderzoek, dan is het mogelijk dat ze sneller onderzoeksgelden toegewezen krijgen, alleen al door hun naamsbekendheid.
Dus doen ze er alles aan om mooie persberichten te schrijven, die vaak niet volledig zijn. Dat kost de journalist gewoon te veel tijd.
Zoveel slechte voorbeelden. Laatst nog was er een medicijn gevonden dat de kans op een hartaanval bij mannen onder de 40 halveerde. Nou dat is toch heel wat denk je dan. Maar dan ga je wat verder kijken en dan blijkt dat er niet zoveel mannen zijn van onder de 40 die een hartaanval krijgen. En je zou dan dus alle mannen van die leeftijd een pil moeten geven, om het gewenste effect te krijgen… Dus als je het in de context plaatst dan is het al niet zo heel schokkend meer.

Zou het bijvoorbeeld een optie zijn om een embargo in te stellen na het uitbrengen van persberichten? Net als bij Nature en Science.
Ja het geeft je wel meer tijd om je in te lezen, maar aan de andere kant schuift het je deadline gewoon op, nu heb ik mijn stukje op woensdag al klaar ipv op vrijdag.
Maakt dus niet zo heel veel uit.

Even over stukje Sneeuw op Groenland…

Hoe kwam je op het idee om hier een stukje over te schrijven? Nav persbericht?
Ja, uitgegeven door RuG

Had je je van te voren ingelezen in onderwerp?
Nee, alleen het persbericht gelezen.

Vind jij het de taak van de journalist om verder te kijken dan z'n neus lang is, of moet de wetenschapper ervoor zorg dragen dat zijn onderzoek juist in de media uiteengezet wordt?
Het is de taak van de wetenschapsjournalist om te selecteren welk nieuws hij wil vertellen. En ook zijn taak, om het op zo'n manier te vertalen dat zijn publiek het kan begrijpen.
Ik geef mijn tekst altijd even terug aan de wetenschapper om door te lezen, want er kunnen altijd kleine foutjes insluipen. Dan hoop ik dat de wetenschapper alleen inhoudelijk nakijkt en niet aan mijn tekst gaat schaven. Dat is wel onhandig voor journalisten, maar het voorkomt onwaarheden.

8.8 Press Release Mann et al. 1998

UMass Scientists Lead Team Reconstructing Global Temperature Over Past Six Centuries
Study is most definitive to date on global warming

AMHERST, Mass. - Climatologists at the University of Massachusetts have reconstructed the global temperature over the past 600 years, determining that three recent years, 1997, 1995, and 1990, were the warmest years since at least AD 1400. The study, which was conducted by Michael Mann and Raymond Bradley of the geosciences department, along with University of Arizona colleague Malcolm Hughes, is detailed in the April 23 issue of the journal *Nature.*

The researchers were able to estimate temperatures over more than half the surface of the globe, pinpointing average yearly temperatures in the northern hemisphere to within a fraction of a degree, going back to AD 1400. The study places in a new context long-standing controversy over the relative roles of human and natural changes in the climate of past centuries, according to Mann. Scientists were particularly interested in natural "forcings," that is, factors that can affect the climate significantly, but which are not part of the climate system itself. Based on statistical comparisons of reconstructed northern hemisphere temperatures, the best estimates indicate that natural changes in the brightness of the sun and volcanic emissions both played an important role in governing climate variations over the period studied.

However, over the past few decades, greenhouse gases produced by human activities appear to have had an increasing influence on temperatures. "The anomalous warmth of several recent years appears likely to be related to human influences on climate," said Mann.

The study bears out concerns voiced by scientists in recent years regarding global warming, Bradley said. It is known that industrialization during the past century has increased levels of carbon dioxide in the Earth's atmosphere by more than 25 percent over its pre-industrial level. Several so-called greenhouse gases have the potential to heat the atmosphere, Mann said, "but the one we're most concerned about is carbon dioxide, because carbon dioxide is the primary greenhouse gas resulting from industrialization." These greenhouse gases form a sort of blanket around the Earth, trapping in heat that would otherwise be radiated back to space, Mann explained. This causes the Earth's atmosphere to heat up.

If the amount of carbon dioxide in the atmosphere were to continue to increase at its current rate, it could rise to double its pre-industrial level during the next century, leading to a magnification of the already observed warming, according to Mann. For example, melting ice caps could raise sea levels, threatening coastal regions with more frequent flooding. The

planet as a whole might expect to see frequent extreme weather events, Mann said. "Heat waves and droughts could become more common, and more intense," he said.

Climatologists are also concerned about the degrees of uncertainty surrounding increased or accelerated global warming, Mann said. "We have a sense of what might happen to the planet as a whole, but the fact is, we don't really know what the regional impacts might be."

Weather instruments were introduced only in the mid-1800s, so to go back 600 years, scientists reconstructed the climate records by relying on the small number of very long historical records, along with annually recorded "proxies" – natural archives that actually chronicle climate variations, said Bradley. Among these archives are: the density and width of tree rings, samples of centuries-old layered ice, and corals, which incorporate chemicals into their skeletons depending on water temperature and salinity, both of which are affected by climate.

The researchers relied on proxies from more than 100 sites across the globe, ranging from Arctic regions, to South American mountaintops, to locations throughout North America and Europe. In certain cases they used historical temperature estimates, which had previously been translated into an estimate of seasonal climate conditions. These were based on diary accounts of events such as crop yields, dates of first frosts, wine harvests, and famines. Several documents were lengthy weather station records which relied on conventional, though cruder, versions of meteorological instruments, such as early thermometers. These were used to supplement the network of proxy climate records. Advanced statistical techniques were used to translate the proxy information into surface temperature patterns, so that past centuries could be compared with the 20th century.

Researchers found certain individual years particularly intriguing. For example, historical documents from 1791 suggested conditions consistent with a strong El Nino event that year; the proxy-reconstructed temperature pattern bore out these suspicions. The weather was much cooler than usual over most of the globe in 1816 following the eruption of the Indonesian volcano, Tambora, the year before. Warming observed in certain regions, however, was consistent with changes in atmospheric circulation also expected to result from a strong volcanic eruption.

8.9 Press release Snow on Greenland

'Sneeuw naar de gletsjer dragen'

RUG maakt sneeuw op de Groenlandse ijskap

Wetenschappers van de RUG bereiden zich deze zomer voor op de winterse variant van het spreekwoordelijke 'water naar de zee dragen': Op de Groenlandse gletsjers zullen ze in augustus met een sneeuwkanon zelfgemaakte sneeuw verspreiden. Daartoe gaan ze eerst oefenen in een vrieshuis in de Eemshaven. Het doel van het onderzoek is het bestuderen van de menging van oude en verse sneeuw. Dit is nodig voor een beter inzicht in ons 'klimaat archief'.

De Groenlandse ijskap is een geweldige massa ijs, met een dikte tot 3 km. Hij vormt (evenals die van Antarctica) als het ware een 'archief' van de sneeuw die in de afgelopen tienduizenden jaren gevallen is. De samenstelling van sneeuw, of andere neerslag, geeft informatie over het klimaat op aarde. Water bestaat namelijk uit een mengsel van watermoleculen die in gewicht en opbouw van elkaar kunnen verschillen (isotopen).De mate waarin bepaalde zwaardere varianten voorkomen is afhankelijk van de heersende temperatuur.

Kosten noch moeite

Kosten noch moeite zijn de afgelopen jaren gespaard om dit archief te 'lezen'. Daartoe wordt een verticale kolom ijs uit de kap geboord en vervolgens geanalyseerd op de isotopen-samenstelling. Dat laatste gebeurt in een aantal gespecialiseerde laboratoria in de wereld, waar het Centrum voor Isotopen Onderzoek (CIO) van de Rijksuniversiteit er één van is.

Helaas is deze natuurlijke 'isotopenthermometer' niet erg exact. Een groot verstorend effect is dat de vers gevallen sneeuw zich altijd een beetje vermengt met de sneeuw van het jaar ervoor. Deze 'isotopendiffusie' wordt groter naarmate de sneeuw er langer ligt, en duurt voort totdat de sneeuw door de grote druk zodanig samengeperst is dat het massief ijs is geworden.

Sneeuwkanon

Kennis van de isotopendiffusie is noodzakelijk om de isotopenthermometer hierop te kunnen corrigeren. Omdat de porositeit van de sneeuwlagen een belangrijke factor bleek, is de afgelopen jaren in een aantal laboratoriumexperimenten geprobeerd de invloed van de porositeit te doorgronden. Dit gebeurde

echter steeds met kunstmatig verkregen ‘sneeuw’ (ijsschaafsel). Echte experimenten in Groenland ontbreken tot op heden.
Onderzoekers van het CIO krijgen nu, dankzij financiële steun van NWO, de gelegenheid om met een klein sneeuwkanon en 1000 liter water met een kunstmatig verhoogde isotopensamenstelling te vliegen naar een punt bovenop de ijskap van Groenland. Daar brengen zij een laagje van twee centimeter ‘gelabelde’ sneeuw aan en bestuderen vervolgens het ‘live’ verloop van de isotopendiffusie. Om de bediening van het sneeuwkanon onder de knie te krijgen gaan de Groningers de komende weken eerst oefenen in een vrieshuis, en indien nodig ook buiten, bij het researchstation Jungfraujoch, hoog in de Alpen.
Noot voor de pers
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