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CLIMATE CHANGE IN THE MEDIA

REPORTING RISK AND UNCERTAINTY

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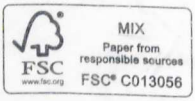

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Executive Summary

Politicians, scientists, and policy makers are increasingly using the concept and language of risk in a context of uncertainty to frame what is probably the greatest challenge this century, human-induced climate change. As much of the debate about climate change concerns the future, it inevitably involves degrees of uncertainty about the timing, pace, and severity of possible impacts, as well as the options for managing and avoiding them.

But uncertainty can be an obstacle to decision making. And scientific uncertainty is often misunderstood, particularly by the general public, and misinterpreted as ignorance. Many people fail to recognise the distinction between 'school science', which is a source of solid facts and reliable understanding, and 'research science' where uncertainty is engrained and is often the impetus for further investigation.

One of the arguments in favour of using the language of risk is that it shifts public debate away from the idea that decisions should be delayed until conclusive proof or absolute certainty is obtained (a criterion that may never be satisfied), towards timely action informed by an analysis of the comparative costs and risks of different choices and options (including doing nothing).

Another is that risk is an essential part of everyday experience, including the worlds of insurance, health, and investment. Many people have to deal with it daily and manage it in different ways: most people in the developed world take out house insurance against the low probability, very high impact event of a fire. Patients are increasingly familiar with the concept of the risks and benefits of different health treatments (though they rely on trusted intermediaries to help them to navigate the risk). And some of the risk assessments people make are on the same timescale as possible climate impacts – for example, taking out a pension policy into which they pay for 40 years.

Meena Menon, The Hindu

'We are guided by the IPCC concepts. If we are writing a piece on the IPCC we would quote its text. That is the newspaper's policy. It is important for us to be accurate. The IPCC are not bad, except for the blunder on the retreat of Himalayan glaciers. They did not respond properly to that when the mistake was identified. It gave the Western press a chance to attack Pachauri [the director of the IPCC].'

Andy Revkin, New York Times

'The IPCC concepts are helpful for policy makers so that they have some grounding in what the climate science means in real terms.'

Guro Tarjem, NRK radio, Norway

'I don't think I'd use terms like "likely", "very likely" or "high confidence" in my reporting. Serious journalists will make note of these terms and try to get familiar with them. However, journalists will never grasp them intuitively like a scientist does. Instead of using "very likely", it is better to say that "there is a 90% chance and this is very serious".'

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Reporting the Future

In this chapter, we look more closely at what we know about the way the media report uncertainty and risk surrounding climate change. There is now a vast body of literature on the media and climate change in general, not just in the USA, UK, and Australia, but also a growing amount on other countries.[1] There is also a large amount of work on the media's portrayals of risk or uncertainty around a variety of topics, including health reporting (see Ashe, 2013). However, much less has been published on media representations of risk and uncertainty around climate science. We review some of the studies that have been done, and then look in more detail at the difficulties for journalists of reporting numbers in general, and probabilities in particular. We discuss the example from the UK of how television's portrayal of ranges of probabilities in weather forecasting might help the public understanding of risk. This is followed by a brief discussion of how more use of visual aids and 'info-graphics' could aid journalists and scientists in presenting risk and uncertainty.

How the media report risk and uncertainty

Many academics and climate scientists take a dim view of the media's portrayal of uncertainty in climate science. Not untypical are comments made by a leading Australian climate professor, Will Steffen, from the Australian National University in Canberra, who has acted as an advisor to different governments. As he expresses it, 'When the science on climate change is so clear, why is it still portrayed as *uncertain* in the media? There's a big divergence between what is known with a high degree of certainty and what is reported' (cited in Lloyd, 2010). He has called it his 'biggest frustration' that a rational discourse is not taking place in his

country's media, and urged journalists to focus on the areas where there is less scientific consensus (such as the speed of sea level rise). Professor Steffen was doubtless frustrated by the amount of space given by parts of the Australian media to climate sceptics. This is a common sentiment amongst mainstream climate scientists in other countries too, and particularly the UK and the USA. But before looking at such allegations of 'false balance', we turn briefly to look at media portrayals of risk and uncertainty in other sectors.

A useful overview of the literature can be found in the RISJ 2013 publication 'How the media report risk and uncertainty around science', which includes sections on the drivers of media coverage, and the challenges for scientists and journalists (Ashe, 2013). The broad context is that, in general, news stories about science are often inherently specialist, containing ideas and language that are unfamiliar to most of the lay public and general reporters. Risk and uncertainty in particular are difficult concepts. To name but four difficulties, as we saw in Chapters 2 and 3, there is a wide variety of definitions across academic disciplines; risk and uncertainty can mean different things to the public and experts; risk can involve numbers; and it is hard to untangle where there are more and less amounts of uncertainty around scientific issues.

Another problem is that many 'risk' stories like climate change, nuclear proliferation, population growth or the spread of diseases are slow-burn, creeping issues that do not easily fit the value of newsworthiness, or what some academics call 'first order journalistic norms' like personalisation, dramatisation, and novelty (Boykoff and Boykoff, 2007). As the BBC's environment analyst Roger Harrabin says, (the appearance of) novelty, drama, conflict and personality are the main drivers of news coverage, even about some science issues.[2] He has carried out research on health reporting, suggesting a mismatch between the media's excessive interest in some relatively low risk health areas compared to high risk areas: unusual health hazards such as the SARS virus or vCJD attracted far more press interest than long-term public health concerns such as smoking, alcohol, and obesity (Harrabin et al, 2003). Professor Nick Pidgeon says that conflict, human interest, and personalities are indeed elements likely to attract journalists to risk stories, but adds others like questions of blame, alleged secrets, and cover-ups, and when high numbers of people are exposed to a risk.[3]

It is perhaps not surprising then that some academics have highlighted the shortcomings of the media in reporting risk and uncertainty. Others

have sprung to the media's defence (see for example Kitzinger, 1999), and some put the blame more on the shortcomings of science press releases (Riesch and Spiegelhalter, 2011). But when journalists are criticised, it is usually for one of the following:

- *Not making it clear where mainstream certainty and uncertainty on scientific issues lie*: a classic example of not reporting the mainstream scientific consensus robustly was the UK media's treatment of the possible link between the MMR vaccine and autism (see Boyce, 2007).
- *Highlighting worst case scenarios rather than a range of risks*: journalists are often not good at including caveats or qualifiers about ranges of outcomes. In his article examining the media reporting of the *E. coli* food poisoning in Europe in mid-2011, Peter Sandman recommended to public officials dealing with health risks that 'because journalists will tend to drop your maybes and on-the-other-hands and quote the most confident-sounding things you say, [...] "explaining" uncertainty isn't enough. You need to "proclaim" uncertainty' (Sandman and Lanard, 2011).
- *Not distinguishing between numerators and denominators (so-called 'denominator neglect')*: a journalist's job is clearly to cover rare and exceptional events, but the danger comes when they do not make clear how rare these events actually are.[4] In the risk context, 'denominator neglect' can be a focus on the few times when someone at risk actually suffers (the numerator), rather than the many times when those at risk go on unscathed (the denominator). An example of denominator neglect would be the *Daily Express* headline mentioned in Chapter 1, 'daily fry-up boosts cancer risk by 20%'. The failure to mention that it was a 20 per cent increase on a very small number would have left the reader confused about the gravity of the risk (but its inclusion would probably have ruined the story).
- *Not distinguishing between 'absolute' and 'relative' risk*: an important aspect of the L'Aquila case in Italy in October 2012 was whether the public should have been better informed, via scientists and the media, of both the absolute and relative risk of a major earthquake happening when assessing whether to take precautions. In general, in reporting low probability, high impact events like earthquakes, many experts argue that it needs to be explained to the public that the relative risk (i.e. the risk compared to an earlier calculation of risk) could have significantly increased, but the absolute risk

could still remain very small.[5] A headline proclaiming 'Chances of earthquake doubled' (relative risk) could produce panic, whilst a headline 'Minimal chance of earthquake' (very low absolute risk) could produce complacency.

In the specific area of reporting uncertainty in climate science, much of the literature has focused on one aspect of this, which is the amount of space given to sceptical voices. The allegation against journalists is one of 'false balance' or 'balance as bias'. Professor Steffen's comments above have been echoed by a long list of other scientists such as Professor Steve Jones in the UK (in his 2011 report on the BBC) and Professor Schneider in the USA.[6] The essence of their critique is that the media give more space to the different types of climate sceptic than the science would justify, suggesting that there is more controversy than actually exists amongst scientists. They stand accused of not providing enough context, often by failing to mention that many of the sceptics' views are marginal within the climate science community, or by accepting the views of a non-scientist on the science.

There is now a voluminous body of work on this area,[7] so it is enough to say here that it is a more complex picture than many critics of the media would maintain. There are huge variations in the volume, manifestations, and drivers of the media's treatment of sceptics, depending on a wide range of variables including the type of media (print, broadcast or online), the type of newspaper (right- or left-leaning, tabloid or broadsheet), the type of article (news versus opinion), the period in question, and the media landscapes in different countries, as well as societal factors such as the presence of sceptical lobby groups or politicians.

What is pretty much established is how media-generated controversy or misrepresentation of the degree or type of uncertainties around climate science can be an important factor in influencing public perceptions. As we saw in Chapter 3, in 2012 two studies were published in the UK about public understanding of the uncertainties around climate science, and the role that the media play in portraying them. One of the main findings of the Shuckburgh research was that 'there is seen to be a lack of consensus in scientific opinion, partly because this is frequently the way climate science is presented in the media. Many focus group participants thought that scientists are often in disagreement with each other or change their mind over time' (Shuckburgh, Robison and Pidgeon, 2012: 19).

The study carried out by the Glasgow Media Group, which also worked extensively with focus groups in the UK, similarly pinpoints

the media's role in the 'construction of uncertainty' in the mind of the public. The study's very first conclusion states that 'there is widespread public confusion over climate change which reflects the journalistic construction of the subject as one of uncertainty. Most people have only a vague understanding of the science, and believe it is inconsistent anyway' (Glasgow Media Group, 2012: 2). This study also highlighted the way politicians are often the most quoted source on climate change (a finding corroborated by other studies). As they are one of the least trusted groups in the UK, this has led to more disengagement from the topic. 'There is a widespread culture of cynicism and distrust, which has led to feelings of powerlessness generally', argues the report.

Media coverage can send the message to readers and viewers that the science is uncertain without ever mentioning the word 'uncertainty' in stories. Of particular relevance to this study is research by two Americans who designed an experiment with readers involving three different newspaper story treatments – controversy, context, and control (neither context nor controversy). They found that greater contextualisation within climate science stories helped to soften the controversy stirred up through uncertainty (Corbett and Durfee, 2004). In other words, the inclusion of an assessment where the majority of scientists' views lie in what is known or uncertain can mitigate the effect of a controversy highlighted in the media and prompted by uncertainty. The lack of contextualisation, and in particular the presence of 'duelling experts' without a sense of where the consensus lies, can hinder public understanding.

There have not been many studies which look specifically at the media's more general portrayal of uncertainty or risk around climate science, or which carry out detailed content analysis of just how the media reports them. Of those that have done it, in one of the earliest studies, US academic Stephen Zehr looked at the representation of scientific uncertainty around climate change in the US print media from 1986 to 1995. He concluded that uncertainty was represented in several forms, and that uncertainty 'was used to help construct an exclusionary boundary between the public and climate change scientists', thereby contributing to deferential citizens and diffused public involvement through acceptance of the need for more research (Zehr, 2000: 85).

Other studies have shown the different ways uncertainty has been portrayed in different media within the same country, or between the media in different countries. Bob Ward from the Grantham Research Institute in London has argued that the various media outlets in the UK

have adopted distinct approaches, in part driven by ideological differences, in reporting the link between climate changes and weather-related natural disasters, and the uncertainties involved (Ward, 2008). The Swedish academic Ulrika Olausson showed from a study of articles in three Swedish newspapers in 2004–5 that the media – at least in Sweden – were reluctant to display any kind of scientific uncertainty that would undermine the demand for collective action (Olausson, 2009).

Media researchers have spent more effort on analysing the different 'framing' by the media of the climate change narrative. There is a vast literature on framing theory, and the way the media frame particular stories (see for example Entman, 1993; Nisbet and Mooney, 2007). In essence, framing a story means selecting some aspects of a perceived reality and making them more salient than others in a text. In other words, frames tend to privilege some aspects of a complex problem rather than others. This can have the effect of providing a perspective from which a reader or viewer can interpret a problem by stressing some aspects of it or by ignoring or downplaying other aspects, and can deeply influence how persuasive consumers find that information. Frames can be triggered by words (sometimes called linguistic repertoire or discourse), but also by non-verbal or visual prompts, particularly in broadcast media, such as tone of voice, gestures, imagery, music, and who the messengers are (Moser, 2010: 39). All sorts of influences come to bear on how a journalist frames a story, including editorial practice, news criteria, the power of the messenger, or the journalist's conscious or unconscious ideology.

Much work has gone into assessing the dominant or strong frame of climate change stories, and different authors have selected a wide variety of different frames to assess them.[8] Many of their studies show that a variant of the disaster frame is often dominant or frequently present in the headline or the body of the text. These disaster frames share an emphasis on general or specific adverse consequences or impacts from climate change such as more intense hurricanes, species death, ice melting, or sea level flooding, and effects on humans such as population displacements, food shortages or health problems. Sometimes, but not always, this disaster frame is accompanied by the language of catastrophe, which some researchers code separately as a different frame such as 'alarmism', 'catastrophe' or 'fear'.

For example, a study by the British climate scientist Professor Mike Hulme found that in virtually all the UK print media, easily the most

common tone of the reporting of the IPCC's 2007 WG-1 and WG-2 Fourth Assessment reports was alarmist, dominated by the language of catastrophe, fear, disaster, and death (Hulme, 2009b: 124). Over 75 per cent of the articles fell into this category. He also concluded that the reporting of WG-1, which was about the climate system, included 'embellished interpretations' of the impacts (not included in the WG-1), which were 'reported by recycling previously published accounts and reports, or through creative imagination'. It can be argued in defence of journalists that the WG-1 report tended to lack context, so a temperature rise, for example, had to be translated into possible impacts in order to have more salience with readers.[9]

In similar fashion, two researchers at the Tyndall Centre at the University of East Anglia looked at 150 articles in the UK quality press from 1997 to 2007, and examined which of five discourses (optimism, rationalism, ethical or self-righteous mitigation, 'disaster strikes' or potential catastrophe, and opportunity) were the most common (Doulton and Brown, 2009). An example of the 'disaster strikes' discourse was 'They're going under: two islands have disappeared beneath the Pacific Ocean – sunk by global warming'; of the potential catastrophe discourse, 'Ten years to prevent catastrophe'; and of the opportunity discourse, 'simple renewable energy technology can be used both to adapt to the threat of climate change and also lift people out of a subsistence existence'. They found that 'potential catastrophe' was by far the most common discourse, accounting for a third of the 150 articles, whilst 'disaster strikes' was also relatively common, with around 20 articles.

In sharp contrast, 'optimism' and 'opportunity' corresponded to only five articles each. The authors were particularly interested in the link between development and climate change, so they were looking for frames which stressed the opportunities arising from the benefits for the developing world to be had from switching to clean energy, and in kick-starting a move towards sustainability. This research supports those who argue that, in general, the media tend to focus more on dramatic representations of climate science (scary, doom-laden scenarios using the language of fear and disaster) than the language of opportunity and solutions. For example, the IPCC's 2007 WG-3 report on mitigation, which included policy options, received significantly less coverage in the UK print media (although this may have been due to competing stories, and its launch in Bangkok compared to Paris for the WG-1 and Brussels for WG-2) (Hulme, 2009b: 123).

Such a prioritisation of frames is seen as very significant by communication analysts. In general alarmist or fear-based messages are more likely to induce apathy or paralysis through powerlessness or disbelief than motivation and engagement – particularly if not accompanied by an action strategy to reduce the perceived risk (Moser and Dilling, 2007: 64–80; O'Neill and Nicholson-Cole, 2009). For example, Professor Mike Hulme says shrill voices crying doom can paralyse instead of inspire. As he has expressed it, 'I have found myself increasingly chastised by climate change campaigners when my public statements and lectures on climate change have not satisfied their thirst for environmental drama. I believe climate change is real, must be faced and action taken. But the discourse of catastrophe is in danger of tipping society onto a negative, depressive and reactionary trajectory' (as quoted in Revkin 2007).

Max Boykoff's study of news articles on climate change in the four main daily tabloid newspapers in the UK (the *Sun*, *Mirror*, *Express*, and *Mail*) from 2000 to 2006 also found that 'headlines with tones of fear, misery and doom were most prevalent' (Boykoff, 2008). Through a combination of content analysis and interviews with journalists, Boykoff concluded that the articles were 'predominantly framed through weather events, charismatic 'mega-fauna' (like polar bears) and the movements of political actors and rhetoric, while few stories focused on climate justice and risk'. By the 'climate justice and risk' frame, he did not mean the narrow sense of risk we have been using in earlier chapters, but a discussion of the ethics surrounding the different vulnerabilities of low-income and better-off sectors of society, and their different abilities to cope with climate change impacts.

The examples above have been taken from the UK and from print media. However, a study in 2012 of three popular US news websites run by broadcast companies (Fox News, MSNBC, and CNN) from 2007 to 2009 showed that 'environmental catastrophe' and 'scientific/technical uncertainty' were two of the top four most common frames in the headlines (along with 'strategy/conflict' and 'public accountability/governance') out of the 12 present (Boenker, 2012). Likewise, a 2006 study of eight Norwegian newspapers found that the main focus in the reporting was that of an imminent climate catastrophe; uncertainties also were given attention, mostly by climate scientists who were quoted relatively often (Ryghaug, 2006).

So, in summary, there is strong evidence from other studies that the media frequently use the disaster and/or uncertainty frames in their

climate change stories. The opportunity frame is seldom present, although more specific studies of media coverage of the wide range of reports stressing the green economy or other opportunities from low-carbon development might yield different results. There is also a gap in the literature examining the media's framing of climate change as 'explicit risk', which, in the narrow definition expanded in the next chapter, can include the use of numbers to assign probabilities to the likelihood of adverse outcomes and to calculate their possible consequences.

Strength in numbers

It is a common complaint from media observers that many journalists are not very good with numbers and probabilities, or that they worry too much that their readers or audiences will not understand them. The former head of the Institute of Fiscal Studies in the UK and now warden of Nuffield College at Oxford University, Andrew Dilnot, has given a number of RISJ seminars pointing out how journalists frequently misinterpret or misrepresent numbers, including not understanding means and medians, or writing misleading headlines. In similar fashion, the *Financial Times* journalist and presenter of the BBC radio programme *More or Less*, Tim Harford, argues that journalists like to pepper their stories with numbers because they look like facts, but in fact 'the principle of the good use of statistics is no different to the principles of good journalism: ask if the numbers are true, ask what do they really mean, and ask what's the bigger story or wider context?'[10]

The former director general of the BBC Mark Thompson told an Oxford audience in 2012 that it would be a major advance if more BBC journalists could understand risk and statistics to improve their reporting.[11] One obstacle is that few British journalists have a background in science or maths. The 2013 report by the National Council for the Training of Journalists (NCTJ) in the UK showed that only 5 per cent of the 1,000-plus journalists surveyed had undergraduate degrees in science, compared to 23 per cent in literature, 16 per cent in social studies (including politics and economics) and 12 per cent in history (NCTJ, 2013: 31). The number with a maths degree is likely to be even fewer than science as it was one of several subjects featured in the 10 per cent classified as 'other'. What is more, few journalists get numeracy training at their workplace.

This is a particular problem when the number of specialist journalists, including environment reporters, is declining in the Western media and there are more general reporters dipping into previously specialist areas. Secondly, more and more journalism involves numbers from 'big data' to economics, opinion surveys, crime statistics, ageing populations, and health and environmental risks, to name but a few. In the USA, the *New York Times* blogger and data processor Nate Silver received a huge amount of publicity for correctly predicting the outcome of the 2012 elections in all 50 states. As the science writer Frank Swift argued in a *Guardian* article calling for more science education for journalists, 'the triumph of Nate Silver's data-driven election forecasts bruised the egos of American journalists who'd clung to conventional tools like political pundits and vox-pops, but the implication is clear: embrace the world of data or face irrelevance'.[12]

A strong case can be made that journalists need to be better not just at understanding data, but at understanding and presenting the numbers around risk and uncertainty. Considerable effort has been directed at the better reporting of health risk, with a number of organisations and academics in the UK and USA providing advice and guidelines (see for example LaFountain, 2004; Science Media Centre, 2012). There is some evidence that at least in the UK there have been improvements. The NHS Choices site, which monitors media coverage of health issues, reckons that in 2012, with the exception of the tabloid *Daily Express*, fewer 'wonder cures' were hitting the headlines and peer-reviewed medical reports were covered more responsibly. But, 'journalists still cannot be trusted with the evidence, especially when it is a matter of probability and subtle distinction between absolute and relative risk.'[13]

Health reporters may be better at reporting risk as they are under more scrutiny – their coverage can have a direct and immediate impact on readers' lives. But covering probabilities and risk is a hugely important challenge for climate change reporting too. For example, Hurricane Sandy in October 2012 prompted a lot of media discussion in the USA as to whether, or to what extent, it could be linked to human-made global warming. Scientists differed as to whether the media did a good job, and some were very critical of headlines like Bloomberg Businessweek (1 November 2012) which put on its front page in large letters, 'It's Global Warming, stupid'. But one of the most telling observations came from Professor Tom Knutson, a meteorology expert with the US Geophysical Fluid Dynamics Laboratory, who said,

> *A trap reporters can fall into is chasing after answers to a poorly worded straw man question: Did climate change cause this event? Instead the science will generally only be able to look at questions of attribution in a probabilistic sense: Has climate change altered the odds of events like this one occurring? (Pidcock, 2012b)*

So better reporting involves better portrayal of probabilities. If it is true that journalists find probabilities difficult, then, at least in the UK, they are hardly alone. There is a lot of evidence that the general public also find them hard to grasp. For example, many people believe intuitively that after nine throws of heads, the odds of tails are increased on the tenth throw of a coin.[14] And when a 2012 survey by the Royal Statistical Society's 'getstats' campaign asked MPs to give the probability of getting two heads when tossing a coin twice, more than half failed to get the answer correct (25 per cent or one in four). However, the politicians fared better than the general public. In a similar survey conducted in 2010, just a third of the 1,028 respondents answered correctly.[15]

It is notoriously difficult to communicate probabilities to lay audiences. However, some risk experts have put forward a convincing case that much more could be done, at least in the UK, to familiarise journalists, policy makers, and the general public with probabilities by changing the media's presentation, particularly on television, of short-term and seasonal weather forecasting. In the USA, TV forecasts giving probabilities of precipitation (rain, sleet, and snow) have been provided by the National Weather Service since the 1960s. It is also true of Canada. Weather forecasts on television in these countries are usually accompanied by information giving such probabilities and indicators of ranges (such as how strong the UV content of sun will be).

In the UK, the tradition has been to give what are known as 'deterministic' rather than 'probabilistic' forecasts. A 'deterministic' forecast is a single 'best bet' prediction of what is most likely to happen like 'sunny intervals', 'occasional showers' or 'overcast'; a 'probabilistic' forecast can be providing odds for a range of temperature forecasts, or just one number attached to the probability of precipitation like 'a 30 per cent chance of rain falling in London'. Deterministic forecasts are also the norm on television in the four other countries included in this study, Australia, France, India, and Norway, although, as in the UK, official meteorological websites often include probabilistic forecasts.

One of the advantages of probabilistic forecasts is that the Met Office in the UK, which is the main body giving predictions about the weather, could have avoided the ridicule heaped upon it in the tabloid press after its press office predicted 'a barbecue summer' for 2009 (which turned out to be a washout). Another example is the famous case in October 1987 when a BBC weather presenter, Michael Fish, told viewers that a woman had rung him to say that she was worried about reports of a hurricane coming. He added with a wry smile that 'if you're watching, don't worry, there isn't!' That evening, the worst storm to hit south-east England since 1703 caused record damage and killed 18 people.

Climate scientists now use thousands of daily observations from across the world to design computer models that replicate the climate system, and to make weather forecasts over short and longer periods. They run slightly different versions of the models, and start from different initial weather conditions, to determine the most and least likely weather outcomes, which are called ensemble forecasts. They are never entirely accurate, and the longer the period of forecast ahead, the less accurate they are. Tiny uncertainties at the start of the modelling, which can come from weather observations which are not completely accurate or which do not completely cover the atmosphere, can produce different results. This is what actually happened in October 1987 as a tiny uncertainty over the position of a low pressure system over the Atlantic made an enormous impact of whether it was amplified or not. Professor Tim Palmer of Oxford University has gone back and run the models which in fact show that 30 per cent of them were showing hurricane force winds coming to south-east England.

Professor Palmer is one of many scientists strongly advocating the use of probabilistic forecasts on television, in part because it shows the public that uncertainty does not mean scientists do not know anything. On the contrary he says, uncertainty can often be quantified in helpful ways as a basis for making decisions. Giving ranges of probabilities and reliability or confidence levels are essential. So for example he says 'a good journalist would have asked the Met Office in the case of the 2009 summer forecast: what is the level of probability of a barbecue summer; and how many times have you been right in the past when you have made such a prediction?'[16] Another advantage is that a probabilistic forecast is more likely to include the chances of a low probability, high impact event like a hurricane which may have only a 10 per cent chance of happening but could cause an enormous amount of damage.

Some believe that the main reason why the UK media do not present probabilistic forecasting is the view amongst many editors that the British people cannot understand probabilities.[17] This may be the case but, even if everybody were to be more numerate, it remains an enormous challenge for climate scientists, weather forecasters, and journalists to find the best way – out of all the options – of communicating the risks, uncertainties, and probabilities. There are several pitfalls, some of which are likely to be given voice in parts of the media. One is that presenting more, or too much, information to the public can be confusing. Another is that giving probabilities could attract the accusation that the forecasters don't really know, or that they are merely trying to deflect blame if they get it wrong. An article in the *Daily Mail* in November 2011 responded to the Met Office's new way of presenting forecasts online with the headline 'New Met Office forecast system likely to mean 80% chance of confusion' (Cohen, 2011).

The Met Office ran an online weather game in 2011–12 together with researchers from the Universities of Cambridge and Bristol, which was one of the largest projects of its kind ever carried out.[18] It involved helping an ice-cream vendor named Brad to make decisions over when to sell his products over a four-week period depending on an assessment of the weather uncertainties. Different presentations of uncertainty involving graphics and written probabilities were given. To cut a long story short, the top line result from most of the several thousand taking part in the game was that understanding the probabilities would not be an obstacle to making good risk-based decisions. As Liz Stephens from Bristol University says, 'while educational attainment and age showed some influence, in general the users were not that confused by the uncertainties involved. As long as the probability was provided, the exact method of presentation did not greatly affect this understanding'.[19]

Ken Mylne, the ensemble forecasting manager at the Met Office, says that the move to probabilistic forecasting is 'more likely to be a marathon than a sprint', but the key is public familiarity. 'We need to start getting probabilistic forecasting out there more. Then it will be so much easier for people to understand things like seasonal and long-range forecasts' (Pidcock, 2012a). Clearly there is a role for television, but also for other visual representations on different media platforms of complex numerical information covering risk and uncertainty.[20]

There are now a wide variety of ways for the media to present risk information visually from 'cones of uncertainty' depicting different

possible hurricane paths, to risk ladders, icon arrays, probability contours for wind gusts, or tree maps.[21] Crucially, the same risk information can be presented in a combination of formats online to take account of the varied ways different people absorb this type of information or need to use it. There is already a rich collection of academic and more popular articles exploring the visualisation of uncertainty and risk, and the benefits or downsides of different approaches (see for example Spiegelhalter et al, 2011; Stephens et al, 2012). Examples have been examined from the world of sport, weather, climate, health, economics, and politics, but there is still a lot to understand about how different types of visualisation are processed and understood by lay audiences.

There are also a lot more opportunities for mainstream media and online sites to present complex climate science information visually. The technological advances in recent years have massively increased the possibilities for much better visual presentations on newspaper and other media websites, let alone on tablets and other platforms. Richard Black, the BBC website's former environment correspondent, gives the example of the way the BBC website portrayed some of the data from the 2007 IPCC reports. He says one rather clunky chart was 'the funkiest thing we did with the IPCC report, but now it looks way out of touch.'[22] Sarah Clarke, the environment and science correspondent for the ABC in Australia, says that in a January 2013 story examining sea level rise, she presented the risks associated with climate change in the most visual way possible, using maps and areas of high population to spell out the different levels of flooding over time.[23] She thinks 'viewers are better able to comprehend the conclusions if it's translated to "impact" and "risks" and visually demonstrated how it would affect their environment. Graphic representation and pictures are the key to assisting the understanding of climate change science.'[24]

Other journalists and media critics interviewed for this study highlighted other examples of where, in their view, info-graphics clearly help understanding of risks and uncertainty, although many stressed too that the data can be manipulated or falsely presented to serve an agenda. Andy Revkin is a fan of the 'Burning Embers' graphic depicting climate risks, which was actually left out of the 2007 IPCC report.[25] Alister Doyle points to the 'greenhouse gamble' developed by the Massachusetts Institute of Technology which is designed to convey uncertainty in climate change prediction: you spin roulette wheels and end up with anywhere from 3 to 7+ degrees of warming depending on the choice of policies to curb GHG

emissions.[26] And *CJR*'s Curtis Brainard is an admirer of the UCS' graphic describing the strength of scientific evidence, from low to high, linking climate change to changes to different extreme weather events, and of the IPCC's chart describing the confidence levels, which he says should be included in more stories about climate change and uncertainty.[27]

Finally, it is interesting to note that some newspapers in the West which are keenly trying to re-invent themselves and find a new business model in the face of declining revenues, are making info-graphics in print, online, and tablet a key element of their re-launch. Juan Señor is a former RISJ fellow and partner of Innovation, a company which is one of the market leaders in advising newspaper owners how to find new formats, content, and ways of working. He says that the technological advances around info-graphics make it an ideal way to present complicated information and also to show a story rather than tell it: 'Innovative, interesting and clear info-graphics have to be a necessary part of the mix of the future offer on different platforms. The presentation of climate risks is perfect for info-graphics'.[28]