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Climate change and natural disasters:

Scientific evidence of a possible relation between recent natural disasters and climate change

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KEY POINTS

- There is convincing evidence that changes in the earth's climate are taking place that can not be explained without taking into account human influence, through the emission of greenhouse gases (GHGs).
- Trends in average conditions are much easier to identify than changes in extremes, largely because the latter are inherently episodic and rare.
- Our theoretical understanding of the physical processes behind the influence of climate change on various extreme weather events indicates that more extreme events would in general be an expected outcome.
- The degree to which we can identify historical changes in extreme events, and link them to climate change, varies depending on the event and the location:
  - Heat waves in Europe have become much more likely; the extreme temperatures of the summer of 2003 are estimated to have been 75% due to human influence. Increased temperatures worsen drought conditions.
  - Precipitation events are getting more severe due to climate change. Harder rainfall and shifts in rainfall patterns mean both increased likelihood of flash flooding and drought. There may not be a change in large scale flooding.
  - Storminess in Europe may not have increased over the past century; hurricane intensity has increased by 70% in the last 50 years. Evidence for the influence of climate change is difficult to identify in the context of major natural cycles, but observed changes are consistent with modelled effects of GHG emissions.
- Modelling indicates that in future, continued increases in greenhouse gas concentrations will drive more climate change and more extreme weather events:
  - Heat waves of the kind experienced in 2003 could occur in Europe every other year by the end of the century.
  - Precipitation changes will yield more flooding, particularly flash flooding, but also drought (which is also furthered by increasing temperatures).
  - More intense windstorms would be consistent with modelling, though no clear predictions can be made. Rising hurricane intensity could lead to a 30% rise in the most intense storms by 2100.
- Given the increasing severity of extreme events, further and improved adaptation measures are needed. After a slow start to action on the issue, adaptation appears to be rising on the European agenda. It is important to note that:
  - Natural disasters result when extreme events strike vulnerable areas: reducing vulnerability can reduce the impact of extreme events.
  - Measures of three types are all important in decreasing the likelihood of damage: administrative/legal, engineering, and personal behaviour.
- Community civil protection efforts include the EU Flood Action Programme and the new Floods Directive. Improvements were proposed in April of 2005.
- The Solidarity Fund has provided €1billion in disaster relief since 2002. A proposed change would broaden its scope to include more than just natural disasters. The focus of the fund and intended use of aid may need more review.

POLICY BRIEF FOR THE EP ENVIRONMENT COMMITTEE

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1 INTRODUCTION: EXTREME WEATHER DISASTERS

As the devastating impact of recent natural disasters such as hurricane Katrina indicates, mankind is vulnerable to extreme weather events even in wealthy nations. Clearly such extreme events have always been part of life; however, with the likelihood of anthropogenic global climate change[1] being a phenomenon already underway, there is the prospect that 'acts of God' may in fact be getting a little help.

Whether this is indeed so is a subject of intense research. There are several aspects to the issue:

1. Establishing that there is climate change, and if there is a human contribution to it;
2. Determining how such change might be affecting extreme events and how this will evolve in the future;
3. Fashioning appropriate strategies to prevent and react to disasters.

Each of these is a discussion unto itself:

(1) There is incontrovertible evidence for natural cycles and variation in the global climate system, but also very strong evidence that certain changes currently taking place are exceedingly unusual and do not fit into natural patterns. In particular, the current global average temperature is likely higher now than in at least the last 2000 years (Jones and Mann, 2004). The broad consensus is that the observed changes would be highly unlikely without human influence (e.g. IPCC, 2001). The significance of this human influence for the discussion here is complex: on the one hand, if there were climate change but no human influence, we may not be able to avert the change through our actions, but would still be wise to adapt to it. However, having established that there is anthropogenic influence, we can both attempt to avert climate disasters and adapt to them. Further, knowing that we are in some measure responsible elevates the moral imperative to act.

(2) Given observed changes in average climate indicators like global average surface temperature, there must still be a link established to changes in specific extreme events like hurricanes and floods. This is highly complex, both in terms of understanding the physical processes at work, and because extremes are by nature rare, with or without climate change, and make data difficult to gather and compare.

[1] 'Climate change' and the more common term 'global warming' are often used interchangeably, thought the former is broader than the latter: the globe is on average heating up, which has more impacts than just warmer temperatures – there are a range of resulting changes in the climate, some of which are explored in this paper. 'Anthropogenic' refers to the fact that greenhouse gas emissions due to human activity have an influence on the climate, and that any viewed changes are not just due to natural variability.

(3) Response strategies for climate change and extreme events, then, have a two-fold challenge:

a) Determining how best to react when there is uncertainty about likely future climate change, what is influencing it, and how it is related to or enhancing extreme events
b) Determining priorities both between attempting to mitigate anthropogenic climate change versus preparing for changes, and between disaster preparedness and relief options

Given that even barring climate change many societies are clearly unprepared to cope with natural disasters, it is far from evident that our response will be any more adequate if global warming simply makes the problem worse. Fortunately, Europe has far more resources than most parts of the world and may be able to fashion a substantial response strategy. However, preparing for the unprecedented and unpredictable is a highly difficult undertaking.

The following two sections describe the types of natural disasters linked to extreme weather, and describe recent events in Europe that highlight the importance of the issue. After this short introduction the paper will turn to the question of the scientific link between disasters and climate change.

1.1 Types of climate-related natural disasters

Climate change is predicted to have a range of serious consequences, some of which will have impact over the longer term, like spread of disease and sea level rise, while some have immediately obvious impacts, such as intense rain and flooding. While recognising the importance of the other predicted consequences of climate change, this report focuses on this second category: the 'extreme weather events' responsible for natural disasters. They include:

- Extreme temperature highs – heat waves
- Storms, including windstorms, hurricanes, etc.
- High levels of precipitation, and associated flooding
- Lack of precipitation, and associated drought

Note that there are also important impacts from 'secondary' effects of climatic events – e.g. avalanches, rock falls, landslides due to flooding, and forest fires in areas of drought. While significant, as these events are not climatic as such, they are not covered here.

Potential changes in climate-related extreme weather of interest here can be broken into three other categories: in the first case there are more frequent or severe simple extremes (like higher temperatures), secondly, changes in complex extremes (like windstorms), which rely on a confluence of forces to come about, and third the possibility of major disastrous climate events such as the cessation of the thermohaline circulation – which, though they would fundamentally change regional climates, are unlikely[2]. This paper therefore focuses on the first two categories.

[2] The thermohaline circulation is the 'ocean conveyor belt' that distributes large volumes of warm and cold water around the globe, where Europe is the beneficiary of warm currents from the Southern

1.2 Recent natural disasters in Europe

Several headline events have piqued concern about extreme weather disasters in recent years. Record-setting storms, flooding, drought and a heat wave have all had far-reaching consequences (EEA, 2004; Jha, 2005):

- The **windstorms** at the end of 1999 were among the most dramatic in European history. Anatol, Lothar and Martin, affected Scandinavia, France, Germany and neighbouring countries. These storms killed almost 150 people and caused massive losses (€6.7 billion in insured losses from Lothar and Martin, €500 million in economic losses from Anatol). In France the storms threw an amount of timber equal to three times the annual harvest.
- The major **flood** event of the last few years, and the most economically destructive disaster in Europe’s history, occurred in 2002. Floods took place along the Danube and Elbe rivers, affecting much of Central Europe; there was also significant flooding in the UK and France. 600,000 people were affected and 80 killed in 11 countries. Economic losses were at least €15 billion.
- Much of Southern Europe has been in the grip of severe **drought** for at least a year, the worst ever recorded. In the summer of 2005, 97% of Portugal experienced severe drought conditions, France considered closing nuclear power plants, and across the European Union cereal production fell by at least 28 million tonnes - around 10% of the total.
- The **heat wave** in the summer of 2003 caused massive loss of life – the deaths of at least 22,146 people have been attributed to the heat (table 1.2).

Table 1.2: Excess deaths from Europe's 2003 heat wave (WHO 2004):

France	14,802
Spain[3]	59
Italy	3,134
Portugal	2,106
England and Wales	2,045
Totals	*22,146*

While these events are the prime examples of their types in Europe, it should be borne in mind that other areas of the world fare far worse. With a total of 6,700 flood-related deaths between 1993 and 2002 Europe is far outstripped by the devastating total in Asia: nearly 1.4 million people. 6,655 deaths attributed to European windstorms in that period are similarly dwarfed by 18,000 in the Americas and 275,000 in Asia. Given the massive scale of such global catastrophes, it is clearly in our interest to see if anthropogenic climate change is contributing to the damage, and to limit it if so.

Atlantic. More about potential changes can be found in Stocker et al., 2001; Bryden et al., 2005; and Quadfasel, 2005

[3] 6,000 deaths were widely attributed to the heat wave in Spain, but were not verified by the WHO

2 THE SCIENTIFIC EVIDENCE ON LINKS BETWEEN EXTREME WEATHER DISASTERS AND CLIMATE CHANGE

With a number of extreme weather events hitting headlines in recent years, establishing the link to climate change has become a pressing, and political, concern. But climate change and its impacts are scientific questions of great complexity, so simple answers are not to be expected. Understanding what science can establish is ever more important – especially if political decisions are to be based on it.

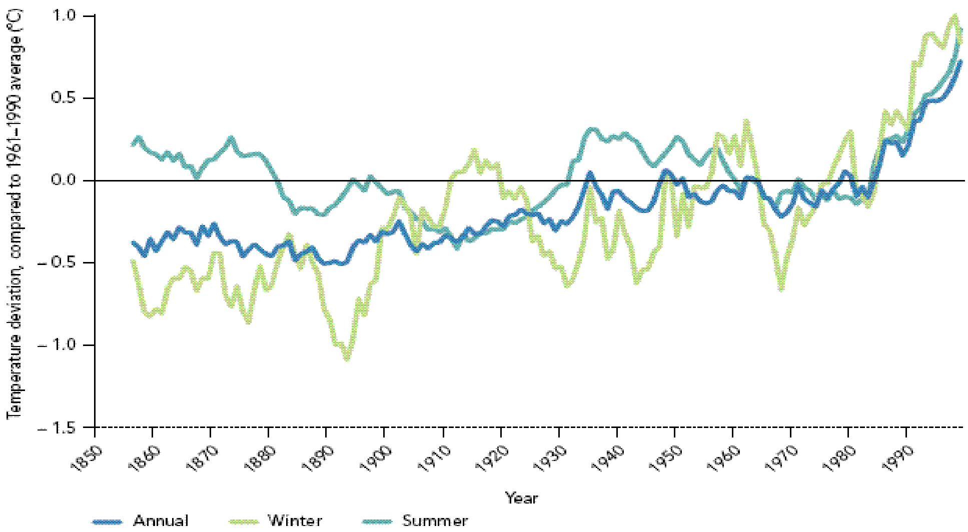
This chapter addresses the difficulties inherent in linking climate change to extremes (section 2.1); the evidence of current climate change influence on heat waves (2.2), on precipitation and flooding (2.3), and on storms and hurricanes (2.4); finally, there is a look forward to changes in extreme events expected for the future (2.4).

2.1 Linking climate change to changes in averages is easier than to extremes

Global warming measured by instrumental readings in the past 150 years is quite well established. Further, reconstructions using proxy data show that the world is now warmer than it has been for almost two millennia (figure 2.1) (Jones and Mann, 2004). In line with this trend, initial data analysis indicates 2005 may be the second warmest on record, and the warmest on record in the northern hemisphere (WMO, 2005).

Warming is clearly in evidence in Europe – winter, summer and total annual temperatures are all rising, with an average 0.95 ºC rise since 1900 (figure 2.2). The rate of warming is rising, and is now 0.17 °C ± 0.05 °C per decade. Evidence of rising average temperatures thus seems quite solid (EEA, 2004).

Figure 2.2: mean winter, summer and annual temperatures in Europe since 1855 (EEA, 2004)



Establishing the link between trends in average conditions and extreme weather is quite another matter, and immensely complicated. There are three main lines of evidence: the first is **empirical**, through comparison of current data about disasters with the historical record. The second is **theoretical**, including through simulation in global and regional climate models (GCMs and RCMs). A third means is not direct, but by proxy – examining data on **damage** from extreme events, including the frequently cited rise in insurance claims. Each line of evidence is complicated:

- Empirical data changes in quality and availability over time – unlike temperature, the pressure inside hurricanes is not something for which we have an adequate centuries-long record, for example. Further, extreme events are by their nature more variable and less frequent, making it difficult to establish patterns.

- Theoretical models also have limitations. While climate models are increasingly refined, they are simplifications of an incredibly complex system and are generally not suited to examining either a specific phenomenon or a specific geographical location.

- Indirect proxies such as measurement of impacts are complex: non-climate aspects of the data are themselves variable (i.e. the amount of insured property keeps changing), linked to variable climatic phenomena (i.e. there is an element of chance in the location of a damaging event, and infrequent repetition to allow comparison), simply compounding the difficulty of using them as evidence.

Despite these difficulties, various lines of evidence are being assembled to create a picture of the influence of climate change on extreme weather. As will be explored below, in some cases, like heat waves and intense rainfall, the **influence is already clear**; in others, like hurricanes, the **evidence is just emerging**; in some other cases there are as yet **no clear indications**. However, in all cases **the trend toward the future is worrying**: modelling indicates that unless serious action is taken, global warming will reach levels at which several types of extreme events are much more likely.

What one cannot say, and may never be able to, is that any one event can be ascribed directly to climate change. While climate change may make a specific event more likely, there is always the chance that it might have happened under unchanged circumstances, given natural variation. Any scientific evidence for the link between natural disasters and climate change will thus have to refer to statistically significant trends, and not to specific incidents.

2.2 Heat waves: 2003 has changed our view of likely extremes

As was made all too clear from the summer of 2003, heat waves can be deadly[4]. Among the effects of global warming on extreme events, increasing high temperatures extremes are among the easiest to identify.

2.2.1 Both cold and warm extremes are warming

Meta analysis combining world regions indicates that cold and warm extreme temperatures are rising globally, possibly with greater warming at the cold end (Alexander et al., 2005). In Europe, daily high temperatures are rising more in

[4] Excessive heat is rarely a cause of death in and of itself. Rather, loss of water and salt in sweat can cause coronary and cerebral thrombosis, and people with failing hearts may find them unable to cope with the increased blood flow needed (Keatinge, 2005).

summer than in winter (Moberg and Jones, 2005), and warm extreme temperatures are rising twice as fast as cold extremes are warming (Klein Tank and Können, 2003). A Spanish study looking at the longer time scale 1894-2003 found the rise in warm days is particularly pronounced since 1973 (Brunet et al., 2005).

2.2.2 Extremes are affected by both rising means and rising variability

The European heat wave in the summer of 2003 was so extreme, it forced a review of the relationship between rising mean temperatures and rising extremes. Data from Switzerland (Schär, 2004) indicate that the mean temperature from 1941-2000 was 0.8 degrees higher than in the period 1864-1923. The higher mean would obviously yield more peak high temperatures; however, temperatures in the summer of 2003 were over 5 standard deviations above even the higher mean of the last 50 years: such an event is statistically very unlikely unless in addition to higher means (figure 2.3), the variation in temperatures has increased (figure 2.4). As a result there is a far wider tail of the probability distribution on the warm side – there is a higher likelihood of drastic extremes such as the summer of 2003 than we had previously thought.

Figure 2.3: a warming shift in the average Temperature (IPCC, 2001)

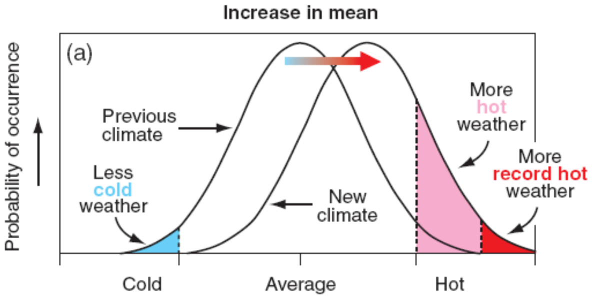
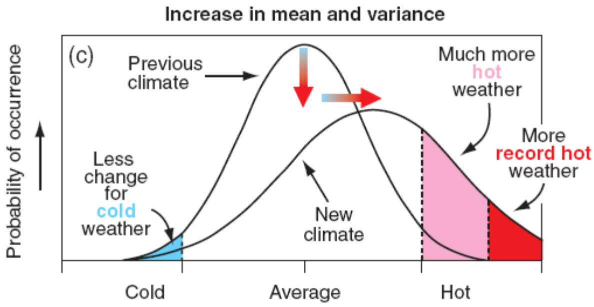


Figure 2.4: a warmer mean and more variability: higher extremes (IPCC, 2001)



> *Culling the sick and beating the cold: not reasons to be sanguine*
>
> It is sometimes argued that the sick and elderly who die in excess numbers during heat waves were frail and would most likely have died in a relatively short period thereafter anyway. Data from Spain during 2003, however, indicate that summer deaths were indeed additional (Simón, et al. 2004). Further, the line of argument is on slippery ethical ground. As deaths were entirely among older people, particularly those over 85 (Simón, et al. 2004, EEA, 2004), one could argue that the heat wave could not have curtailed the lifespan of this group by very long. But this is cold comfort to them and their families. The argument, while of potential interest to epidemiologists, is of little merit as a guide to societal choices on how to cope with global warming.
>
> A more interesting discussion is to notice that with warmer winter weather, fewer will die of the cold, which is on average more deadly than hot weather; further, deadly heat in some northern countries is tolerated in southern countries (Keatinge, et al., 2000). Given the importance of temperature rises as a basis of concern about global warming, this argument is potentially of great importance, though not often discussed. The main problem with these findings is that a summer like that of 2003 is simply far warmer than those in the data from comparative studies to date. With more temperature rises in the hot than in the cold extremes in future, and weather like that of 2003 to be expected more often, heatwaves will be far more deadly, and adaptation more demanding that simply teaching Finns to take mid-day siestas.

2.2.3 Statistical studies indicate a high likelihood of human influence on heat waves

The magnitude of the rise in mean temperatures and the existence of severe extremes like the summer of 2003 are simply inconsistent with natural cycles, and the most plausible explanation is climate change (IPCC, 2001; Schär, 2004). These changes in turn are consistent with the modelled influence of anthropogenic greenhouse gases, enhancing confidence that the phenomenon is indeed largely attributable to human influence.

Brown, et al. (2005) conclude that the increased risk of a severe heat wave like that of 2003 is 75% due to human influence. Stott, et al. (2004) estimate it is very likely that human influence has already at least doubled the risk of the 2003 heat wave occurring.

2.3 Rainfall is heavier while drought is more pervasive, but flooding patterns are hard to establish

Proving the link between climate change and precipitation levels, and the resulting flooding or contribution (with rising heat) to drought, is more difficult than for heat waves (Wijngaard et al., 2003; Deque, 2003). Precipitation and flooding are periodic phenomena, making patterns in extreme events harder to observe and model. Drought, on the other hand, is very obvious to recognise, but only recent global analysis is able to discern climate change trends from natural variability.

2.3.1 Precipitation is getting more intense in Europe

Increases in temperatures and in ambient water vapour point toward the theoretical likelihood of an increased intensity of rainfall in short periods of time, which in some regions may then lead to longer dry periods. Recent measurements bear this out (McGregor, et al., 2005), and a cross-Europe dataset of the period 1946-1999 shows increasing consistency between climate modelling and observed precipitation changes since 1975 (Klein Tank, et al., 2002).

While the average amount of precipitation is rising, the incidence of heavy rainfall is increasing yet faster; there is a trend toward more high-intensity rainfall events in Europe since 1950 (Klein Tank and Können, 2003). Precipitation intensity has been reported increasing in the UK (Osborn, et al., 2000) and the Alpine region (Frei and Schär, 2001), particularly in winter. Even places where the mean amount of annual rainfall is declining, like most of the Mediterranean, are seeing a rise in intense rainfall events (Alpert et al., 2002). These precipitation trends are consistent with trends in other regions of the world, particularly outside the tropics (Alexander et al., 2005).

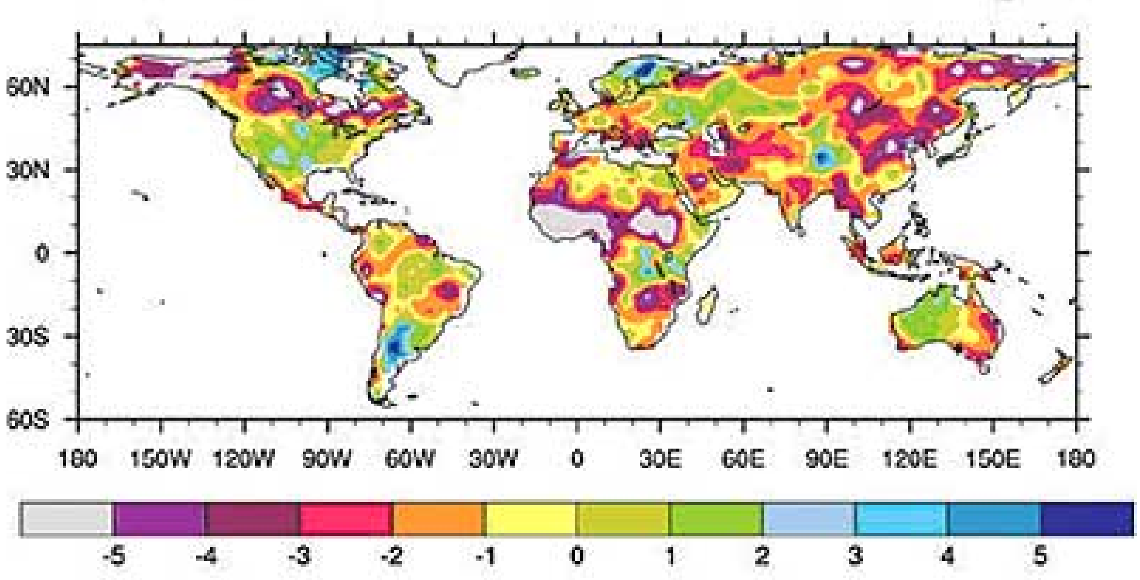
2.3.2 Major flooding may not be more frequent, but data is insufficient

At the global level flooding trends are difficult to establish – there may be an increase in high-volume floods in high-latitude regions during the 20^{th} century (Milly et al., 2002), but not for smaller events, and there is no consensus from various global and regional studies (Robson, 2002). Flooding is the most common disaster in Europe, with 238 recorded events between 1975 and 2001 (EEA, 2004). However, observations from the Elbe and Oder rivers do not show a clear increase in the flood occurrence rate (Mudelsee et al., 2003). That a trend is not established may simply be due to the difficulty of seeing trends in the small data set of infrequent major events (Frei, 2003).

2.3.3 Drought has increased considerably since the 1970s

Droughts are cyclical and severe events can be expected every 10 years, with very severe events recurring on average every 40 years (Saunders, 2005). The North Atlantic Oscillation is strongly influential, which when in its negative phase, as it is now, causes dryer winter weather and hence less recharging of rivers and reservoirs, exacerbating summer droughts (Saunders, 2005). Nevertheless, a recent study (Dai et al., 2004) found that the land area of the world affected by severe drought has doubled since the early 1970s. The area affected includes much of Europe (figure 2.5). Half of this trend is estimated to be due to changes in precipitation, and half due to warmer weather.

Figure 2.5: trends in the Palmer Drought Severity Index from 1948 to 2002, with grey, reds and yellows indicating drying, which includes much of Europe, Asia, Africa and Canada (NCAR, 2005).



2.4 Windstorms and hurricanes: a complex but emerging picture

While trends for temperature and precipitation are somewhat more clear, the picture for the intensity of windstorms is just emerging, and results seem to vary in different regions of the world.

2.4.1 It is difficult to establish that windstorms in Europe are more frequent or intense

Although recent strong storms like Lothar and Martin may have been dramatic, they are not necessarily out of the ordinary. Storms of such a scale are expected about once in ten years on average, while storms causing €1 billion in damage occur every two or three years (EEA, 2004).

There is no discernable trend in windstorm frequency or severity at European scale, with an

‘Natural’ variability

There is no clear pattern in storm changes in Europe to be ascribed to climate change, and the evidence of influence on hurricanes is just now emerging out of the context of large natural variation. But these results have to be taken in context: while it is often difficult to discern a pattern in extreme activity that is distinct from the influence of natural cyclical changes like those of the El Niño, if the El Niño itself is being influence by climate change, then quite a bit of analysis that essentially ascribes observed changes in climate to a natural cycle would have to be re-evaluated. This is understandably an area of intense scientific study (IPCC, 2001).

emphasis on ‘discernable,’ given that there is enough variability across time and geographic location to make a signal difficult to detect even if it is there. Storm intensity was at its peak in the 1880s in North-western Europe, and has been falling from a secondary peak in the early 1990s (Alexandersson, et al., 2000). Over the Baltic Sea there seems to have been a more discernible rise in wind speeds over the last 50 years, which does correspond largely with a positive phase of the North Atlantic Oscillation (NAO), but which may also be influenced by climate change (Pryor et al., 2003).

2.4.2 Hurricanes may be getting far more intense

One area where significant progress has recently been made is in identifying the impact of climate change on hurricanes. Although they are not the most destructive global disasters in terms of loss of life, they are high profile and very expensive, and are the subject of much research. Recent active hurricane seasons were capped by 2005, which broke records for the most named tropical storms in a season (26), of which a record-breaking number became hurricanes (14), seven of which were ‘major’ (category 3 or more), of which a record-breaking three storms reached category 5 status. Four hurricanes (another record) made landfall in the United States, and one (Wilma) briefly reached the most intense level ever recorded (WMO, 2005).

Insurance claims as an indicator of worsening weather

Assertions about the evidence for hurricanes’ increasing destructive potential have been countered by those that claim that if there were such a dramatic rise in storm power, it should have been reflected in the damage seen in affected areas on land. While damage and insurance claims have indeed risen dramatically, this is associated with the existence of more expensive, and more insured levels of vulnerable assets (Pielke, 2005a, 2005b**).**

The counterargument (Emanuel, 2005; Mills, 2005) is that such an increase has not been seen because of the tiny statistical set at hand – after all, there are very few hurricanes in any one year, only a small number of these make landfall, and this landfall is only the end of its lifetime – thus a fraction of a percent of total hurricane power ever causes damage to populated areas. Over long time series, such as the coming 50 years, the increased damage should become clear, not to mention worsened by yet further global warming. The insurance industry is not taking any chances (characteristically) and devoting significant effort to understanding the implications (e.g. Swiss Re, 2005; Climate Group, 2005).

The remarkable 2005 hurricane season, coming on the back of an active 2004 season, has fuelled the debate around the possibility that global warming is contributing to the increased frequency and intensity of hurricanes. Recent research indicates that the increased frequency of storms is still probably due to natural cyclical variation (Trenberth, 2005, WMO, 2005). However, measurement shows a noticeable rise in sea surface temperatures (these were the highest on record in the North Atlantic in 2005), which are a main determinant of the strength of storms, as well as total column water vapour and the convective available potential energy (WHO, 2005; Trenberth, 2005). This suggests that when a storm develops, it is likely to have more intense wind and produce more rainfall than without global warming (Trenberth, 2005)

Recent work (Emanuel, 2005a and 2005b) is the first to match historical data with a large increase in the total power dissipation (PD) over hurricanes over the 30 past years. PD is a measure of the total measure of the energy released by a hurricane over its complete track. The PD of all hurricanes has risen 70% in the past 30 years, with a 15% rise in maximum wind speed and a 60% rise in duration. Webster et al.. (2005)

find that even though total numbers of cyclones have decreased in most places, there are more category 4 and 5 storms, with the greatest increase being in the Pacific and Indian Oceans.

2.5 Scientific uncertainties may soon be resolved the hard way: much more obvious damage

As noted above, some trends in severe weather seem better identified than others. However, the main barriers to our understanding are in the first place statistics – picking the signal from the noise of natural variation – and in the second place the limited time period (relatively speaking) in which warming has been taking place. Modelling that takes into account further greenhouse gas emissions and hence global warming indicates that, unfortunately, the signal will become much clearer in future

2.5.1 Serious heat waves will become common

By the end of this century, heat waves, defined as three successive days over 30°C, may become three to ten times more likely (Beniston, 2004). Given continued warming, by the end of the century heat waves that could previously be expected every 100 years could be ten times more likely (Schär, 2004). In that sense, 2003 is an indicator of the challenge ahead of us, as it is likely to be more typical in the future (Beniston, 2004). 2003's summer weather could even occur every other year (Luterbacher et al., 2004).

2.5.2 Heavy rain, flooding and drought will worsen

Models indicate more winter precipitation in Europe during the course of this century, except for the far south. It is likely that high rainfall winters will become 2-5 times more likely than now (Palmer and Rälsänen, 2002). Meanwhile, summer precipitation will decrease over most of Europe, except for the far north. However, for heavy rain events, there will probably be heavier summertime events despite the drop in total amounts (Christensen and Christensen, 2003).

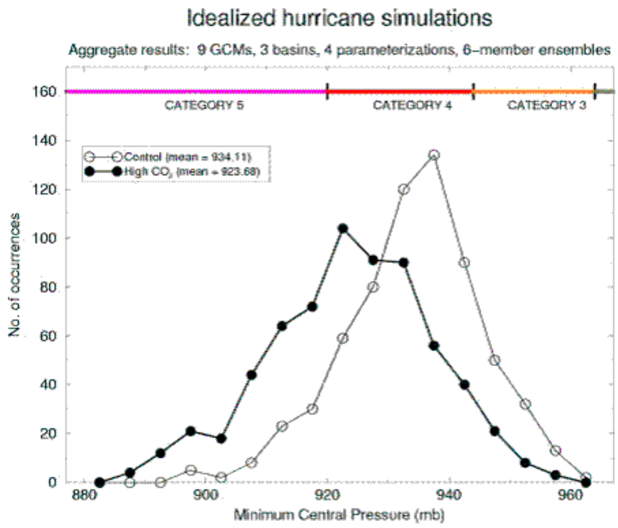
More extreme rainfall means more likelihood of floods, particularly flash floods. This is also true in winter, as more precipitation will fall as rain than snow and there is more risk of immediate runoff (EEA, 2004). In places like the Mediterranean where there is less rain, but more intense precipitation events, the result can be a crippling combination of drought, then heavy rainfall and destructive flash flooding. Together with forest fires and soil degradation in can lead to desertification. (EEA, 2003)

Paired with the increases in heat, which causes surface drying, the reduction in total summer precipitation means more droughts can be expected (Parry 2000, Klein Tank et al., 2002).

2.5.3 Future storm trends are worrying

The situation regarding projections of future storminess is far less clear than that for temperature and precipitation. Although there are a growing number of studies addressing changes in storm activity as a result of climate change there is little consensus yet (IPCC 2001). What we do know is that more water vapour in the air should provide more energy to storms and intensify low-pressure systems (Frei et al., 1998), while higher sea surface temperatures, which should rise as global temperatures rise with climate change, are a major factor in the intensity of storms (Emmanuel, 2005a and 2005b).

Figure 2.5: The projected increase in more severe hurricanes due to global warming (Knutsen, 2005). The bold line is calculated per a scenario where there is an 80-year build-up of atmospheric CO_2 at 1%/yr compounded



Increasing storm intensity could have serious consequences. A simulation of hurricane intensity in a scenario with double current atmospheric CO_2 concentrations shows a tripling of the number of category 5 storms (figure 2.8).

3 EUROPEAN RESPONSE TO CLIMATE CHANGE DISASTER RISKS

With or without climate change, physical damage from extreme weather is increasing in Europe as populations encroach on at-risk areas and economic growth raises the value of assets (EEA, 2005). With climate change having made certain extreme weather events more likely, and the high likelihood that it will be even worse in the future, it is prudent fashion an adequate response.

3.1 Adaptation is rising in the European agenda

Despite, or perhaps because of, Europe's leading international role in emissions reductions efforts, adaptation to climate change has received far less attention. As the Kyoto Protocol was being discussed and its very existence hung the balance, it was viewed as sending the wrong political signal to examine adaptation in depth – as though it were tantamount to being resigned to failing to limit climate change. This is despite recognition that a certain amount of change is inevitable, and early adaptation effort is prudent (table 3.1). Adaptation has also largely been thought of as a developing country issue.

With the entry into force of the Kyoto Protocol there now seems to be more willingness to examine adaptation and disaster preparedness in Europe. Inclusion of adaptation as one of the focus topics in the second phase of the European Climate Change Programme is a good indication of this rising interest[5].

Table 3.1 Reasons to adapt to climate change now (IPCC, 2001)

1. Climate change cannot be totally avoided
2. Anticipatory and precautionary adaptation is more effective and less costly than forced, last-minute, emergency adaptation or retrofitting
3. Climate change may be more rapid and more pronounced than current estimates suggest. Unexpected events are possible
4. Immediate benefits can be gained from better adaptation to climate variability and extreme atmospheric events
5. Immediate benefits also can be gained by removing maladaptive policies and practices

According to the IPCC (2001), extreme conditions are the key challenge climate change presents for vulnerability and adaptation, rather than changes in average conditions. Also important is the speed with which conditions change. Both factors are often lost in the climate change discussion of global averages and long time scales. In Europe, there is generally sufficient capacity to adapt to changes in average conditions - but discontinuous change or extreme events can be a challenge, particularly to vulnerable communities, which are found even in wealthy countries.

Points 4 and 5 in table 3.1 regarding the immediate benefits are important to note – if extreme events are enhanced by climate change but still mainly part of a natural variation, then any adaptation on the basis of the increased risk due to climate change is going to be helpful for events that would have happened anyway. Preparing for a 1

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[5] See http://europa.eu.int/comm/environment/climat/eccp.htm

in 100 year event means one is ready for a 1 in 10 year event – thus, although climate change makes things worse, it may raise the profile of adaptation enough, and set the level of ambition higher, to help avoid damage from far more than the extremes.

3.2 Vulnerability to disasters

A season with three windstorms more than average which all happen to occur in remote locations may be far less damaging than a season with one windstorm in a populated location. There is thus an element of chance in the impact of an increase in extreme weather. Further, some areas are also more vulnerable to damage, such as delicate coastal ecosystems or urbanisations in flood plains. **An extreme event becomes a disaster when vulnerable areas are affected**.

Vulnerability can described by location and by issue:

- Any populated area exposed to a potential threat will by definition mean a higher potential for greater numbers of people being affected; moving population into areas likely to be affected is thus inviting trouble.
- Coastal zones, which are both exposed to storms and which harbour delicate ecosystems like wetlands
- Flood plains/riversides, which are both exposed to flooding and often attractive for population and agriculture
- Special, or already marginal habitats: alpine, arid, arctic, rainforest, etc., which depend on particular conditions for their unique character
- Agriculture, fisheries and forestry are economic activities tied to nature and hence can be devastated by natural disasters
- Water resources are fundamental to human health and economic activity – the interruption or pollution or drinking water, the lack of rainfall or irrigation for crops can put vulnerable populations in danger both in acute circumstances and over the long term

While more extreme events will over the course of time mean more potential disasters, **it is possible to reduce the vulnerability** of populations, areas and activities. This means that disasters are potentially avoidable, even given worsening climatic conditions. Some relevant measures to do so are discussed in the next section.

3.3 Measures to reduce damage from extreme events

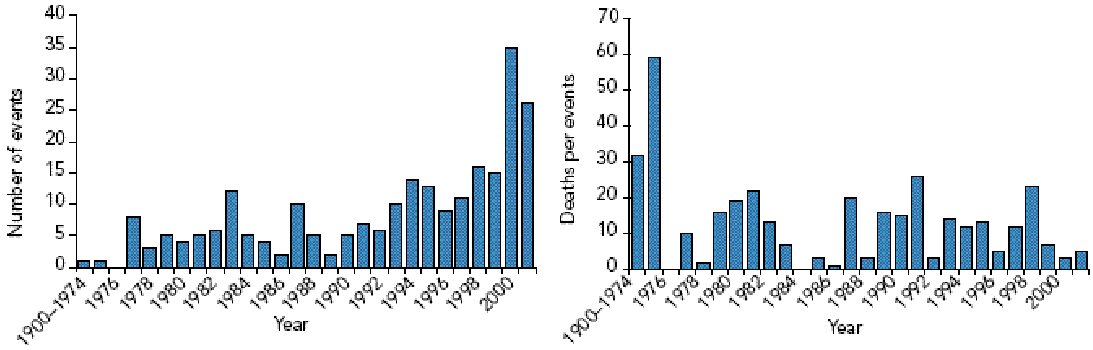
Effort to reduce damage has to be made at several levels – while it may seem obvious that the best way to prepare for a heavy coastal storm surge is to build a seawall, it could well be that restricting building permits is cheaper and more effective. Adaptive measures can thus be targeted to improving administrative preparedness, engineering or personal behaviour (table 3.2).

Table 3.2: examples of multilevel adaptive measures for some health outcomes of climate change (IPCC, 2001)

Adaptive measure	Heat-related illness	Health and extreme weather events
Administrative/legal	• Implement weather watch/warming systems • Plant trees in urban areas • Implement education campaigns	• Create disaster preparedness programmes • Employ land-use planning to reduce flash floods • Ban precarious residential placements
Engineering	• Insulate buildings • Install highly reflective materials for roads	• Construct strong seawalls • Fortify sanitation systems
Personal behaviour	• Maintain hydration • Schedule work breaks during peak daytime temperatures	• Heed weather advisories

Significant improvement in disaster preparedness and relief has already been made in Europe – for example, although floods have become significantly more common in the past century, they result in far fewer deaths, primarily due to improved warning and rescue systems (EEA, 2004).

Figure 3.3: the increasing number of flood events in Europe over time (left), contrasted to the falling number of deaths per event (right). (EEA, 2004)



Following the deadly European heat wave of 2003, the affected countries made a series of changes in their emergency response strategies, and passed regulatory measures designed to avoid a repeat of the tragedy.

The Spanish government, as did others in Europe, launched a plan[6] to avert a serious death toll in future heat waves[7]:

- An alert system that activates when temperatures exceed the 95th centile of maximum temperatures over the last 25 years.
- Awareness campaigns addressed to high risk groups, the general population and healthcare and social services professionals.

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[6] Plan de acciones preventivas contra los efectos del exceso de temperaturas sobre la salud (Prevention plan against adverse effects on health of high temperatures)

[7] Quoted from Simon et al., 2005.

- A voluntary register of people at high risk who could benefit from support services delivered by the Red Cross and other social organisations.
- Development of conduct protocols during heat waves for healthcare and social services professionals.
- A daily mortality surveillance system.

Adjusting UK land-use to account for flooding

The UK has experienced a series of intense flooding episodes in recent years, and there is concern that climate change will make conditions worse in the future. Current estimates are that by 2080 peak river flows in Britain could be 20 per cent higher, and in the Thames estuary region, sea levels could be 90 centimetres higher. According to Environment Agency of England and Wales, a quarter of a million people in London and along the Thames Estuary live on the currently mapped floodplain.

The Environment Agency is currently preparing a long-term flood management plan for the whole of the Thames Estuary in line with the UK government's sustainable communities strategy. Instead of using the traditional approach to reducing flood risk, which has been single-use, hard, river edge defences, they are planning sustainable flood management solutions, such as the creation of areas of flood-compatible land use adjacent to rivers. Riverside parkland, open spaces, walkways or wildlife habitats can act as occasional flood storage, provide an attractive setting for development and be of great benefit to birds and animals.

Source: Environment Agency, 2005

Adaptation makes a real impact. For example, despite a rise of at least 1°C in southeast England and North Carolina, USA, heat-related mortality has not risen in southeast England and has virtually disappeared in North Carolina. In the latter case, research indicates that the rise in air conditioning is the likely reason (from 57% of the population to 72% between 1978 and 1997) (Keatinge, 2005). Of course air conditioning can be expensive to those people most at risk – the elderly poor, for example. Fortunately, there are also simpler measures that can be of great assistance:

- Eating regular meals and drinking enough water;
- An open window and a fan;
- Light and loose fitting clothing;
- Avoidance of unnecessary exertion;
- Sprinkling water on clothing.

While simple, these measures are only effective if carried out in time to prepare for temperature peaks – nursing homes will need to see sufficient personnel are available and act quickly enough; those incapacitated people living at home will need help from family, neighbours or extension services. Simple advice on news broadcasts warning of hot weather can make a real difference (Keatinge, 2005).

4 MANAGEMENT AND COORDINATION OF EUROPEAN CIVIL PROTECTION

The examples of potential adaptation measures just noted require society to work together at several levels – government funding and coordination, civil society service delivery, and personal responsibility. At the European level a range of policy actions have taken place and are planned for the future which are designed to improve the ability to prepare for and react to disasters. The following sections describe the major initiatives.

4.1 The EU Flood Action Programme

There were many actions on civil protection taken in the wake of the 2002 floods. One included an effort by the European Commission that has led to the proposal for an EU Flood Action Programme in three parts: enhancing research and information, targeting EU funding tools on flooding, and a legal instrument – a Floods Directive. This initiative is based on a Communication on preventing damage from flooding (COM (2004) 472).

The Communication identifies a number of actions being undertaken in Europe, including:

- *Research:* there has been a range of projects since the 1980s (www.eu-medin.org/floods-rtd-projects.php). The €10m research project FLOODsite (www.floodsite.net) contributes to integrated flood risk analysis and management. The Joint Research Centre is contributing to forecasting, mapping, and scenario modelling.
- *Structural funds:* in particular the European Regional Development Fund and the Cohesion fund can be used for preventive infrastructure investments and related research and technological development. INTERREG contributes one third of the €419m budget of the IRMA project has been promoting cross-border cooperation on combating floods. SCALDIT is another INTERREG project, with cooperation of France, Belgium and the Netherlands.
- *The EU solidarity Fund:* (OJ L 311 of 14.11.2002) was motivated by the 2002 floods. It is an instrument dedicated to rapid financial assistance following a major disaster (defined as having damage over €3 billion or 0.6% of national GDP. It is only an emergency fund, not one designed to assist in preparation or fund long term reconstruction, nor does it cover uninsured losses (see section 4.3, below).
- *Agricultural policy:* land cover can influence flood impacts; the CAP reform of 2003 should promote soil protection and maintenance of permanent pastures, which should improve the capacity of soils for water retention. An additional €1.2 billion for rural development under the CAP in 2007 can be used to restore agricultural and forestry production damaged by disasters.
- *The Water Framework Directive:* Water directors from the 25 Member States and the Commission coordinate an implementation strategy; following the 2002 floods, they approved a manual of best practice in June 2003.
- *Monitoring:* to improve disaster preparedness of national civil protection authorities the Commissions has developed monitoring instruments which assist in the forecasting and monitoring of floods. Research projects also produce risk

maps that can be of assistance to national authorities. These include the work under the projects GMES, INSPIRE and GALILEO.

Many actions have been undertaken at Member State level, and through coordination among groups of Member States:

- Austria, Finland, Spain, Ireland and the Netherlands have defined in law the statutory rights to a level of flood protection based on the number of people potentially affected, and the economic and cultural values at risk of damage.
- In the UK, a holistic flood management approach is under development; flood defence improvements and a warning system receive around £500million per year. Hungary has developed a sustainable flood management and regional development programme for the Tisza valley.
- Many Member States are creating flood risk maps, generally used to raise awareness and for spatial planning.
- As rivers affect many countries, there are efforts to coordinate protection measures along major rivers such as the Rhine, Oder, Meuse, Danube, Saar, Mosel and Elbe. In the Rhine Action Plan on Flood Defence investment in flood protection from 1998 to 2020 will reach €12.3billion

The Communication states that there are five priority areas for a Floods Directive:

– **Prevention:** preventing damage caused by floods by avoiding construction of houses and industries in present and future flood-prone areas; by adapting future developments to the risk of flooding; and by promoting appropriate land-use, agricultural and forestry practices;
– **Protection:** taking measures, both structural and non-structural, to reduce the likelihood of floods and/or the impact of floods in a specific location;
– **Preparedness**: informing the population about flood risks and what to do in the event of a flood;
– **Emergency response**: developing emergency response plans in the case of a flood;
– **Recovery and lessons learned**: returning to normal conditions as soon as possible and mitigating both the social and economic impacts on the affected population.

The Floods Directive will create obligations for Member States to ‘manage risks of floods to people, property and environment by concerted, coordinated action at river basin level and in coastal zones in order to reduce the risks of floods to people, property and environment. It would be developed step-by-step and focus on particular regional circumstances in order to ensure that local and regional circumstances are taken into account in:

- the analysis of present and future flood risk through flood mapping;
- information on flood risk and its effects which should be made available to citizens, involved parties and relevant authorities;
- the elaboration and implementation of flood risk management plans’.

A public consultation on the plan was completed in September of 2005[8]; between 67 and 96% responded positively to the main points of the Commission's proposal.

4.2 Community Civil protection measures

Community measures in the area of Civil Protection are designed to improve Europe's protection of people, the environment, property and cultural heritage in the event of major disasters, which include natural, technological and radiological disasters. This covers everything from floods to oil spills to terrorist attacks[9].

4.2.1 Objectives of Community Civil Protection measures

The objectives of Community Civil Protection measures cover aspects of both preparation and reaction:

Prevention and preparedness: supporting and supplementing efforts at national, regional and local level; establishing a framework for effective and rapid cooperation between national civil protection services when mutual assistance is needed; supplemented by training programmes.

Information: to the public, and among competent authorities in Member States

Intervention: to facilitate rapid mobilisation of intervention teams, experts and other resources during the first days after a disaster.

Post disaster analysis and recovery: to share lessons learnt from interventions, and to grant financial assistance via the Solidarity Fund

There are two general tools to accomplish the objectives:

The Community Action Programme: with a budget of €2 million, it supports major projects, workshops and training courses in the field of prevention, preparedness and response to natural and man-made disasters both at land and at sea.

The Community Civil Protection Mechanism: which includes the Monitoring and Information Centre (MIC) inside the Commission, following disasters and providing information, training programmes, exercises and expert exchanges; a lessons learned programme from the interventions; a Common Emergency Communication and Information System (CECIS) and a Contacts Directory.

In addition there are specific tools for specific types of disasters, including the Community framework on marine pollution and SEVESO, for chemicals

4.2.2 Proposal to improve Civil Protection measures

In April of 2005 the Commission published a Communication 'Improving the Community Civil Protection Mechanism' (COM (2005)137). It responded to the Council and Parliament's requests to explore further measures than those taken in the Mechanism to date. In particular, the possibility of developing an EU rapid response

[8] http://www.eu.int/comm/environment/water/flood_risk/pdf/evaluation_consultation.pdf

[9] Source for this section: Commission Communication 'Improving the Community Civil Protection Mechanism': COM (2005)137

capacity to deal with major disasters. This reacted largely to the Indian Ocean Tsunami and the desire to develop the capability project disaster relief quickly at a global scale. A number of improvements are suggested, affecting preparedness, needs assessments and enhanced coordination. Rapid-response capability and links with the military are highlighted.

4.2.3 An evaluation of Community Civil Protection efforts

An evaluation of Community efforts on civil protection was published in July of 2005 (TEEC, 2005). It found that although the instruments have been put in place, 'the resulting actions are not yet considered to have fulfilled their objectives in full due to several weaknesses in post-action delivery.' Further, there is 'still some way to go in integrating civil protection objectives and marine pollution objectives into other Member States policies and actions. ' However, while objectives may not have been integrated at the policy level, in terms of action on the ground, there have been a number of positive changes in implementation. There have been improvements in the form of strengthened networking, better understanding between countries and the identification of information exchange deficits.' The most prominent feature of the added value offered through the Community is the additional financial contribution; however, improved international exchanges and strengthened capacities are also noted.

4.3 The EU solidarity fund

One element of Community civil protection measures is the EU Solidarity Fund (EUSF). The EUSF was constituted in November 2002 following the major floods of that year[10]. It is designed to provide rapid financial support following a major natural, technological and environmental disaster within the EU or an accession country.

4.3.1 The current fund has distributed just over €1 billion

The EUSF is to be used for cleanup, emergency services, reconstruction of basic infrastructure and protection of cultural heritage. A government can apply for assistance form the fund if the criteria are met: the estimated cost of the direct damage must be over €3 billion or 0.6% of the gross domestic product of the country, whichever is lower. A neighbouring country that is affected by the same disaster can also receive aid, even if the amount of damage does not reach the threshold.

The funding approved to date under the Solidarity Fund totals just over €1 billion, issued in 19 cases, some of which were to different countries for the same disaster (summary in table 4.1, full list in annex I). 14 applications were rejected.

With an application deadline of 10 weeks after the disaster and a delay period of sometimes six months before approval, the funding cannot be thought of as providing funding for immediate relief. Further, the scale of funding in relation to the damage must be borne in mind: it is generally from 1 – 5% of the value of the damage, reflecting the focus of the fund on providing critical assistance, not compensating for (uninsured) losses.

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[10] Council Regulation (EC) No 2012/2002 of 11 November 2002

Table 4.1: Statistical overview of EUSF (European Commission, 2005c)

Total n° of applications received since 2002	**35**	
of which major disasters	14	40 % of applications
regional disasters	19	54 %
neighbouring country	2	6 %
Applications accepted	**19**	46 % of applications
Applications rejected	**14**	40 %
Applications withdrawn	**1**	3 %
Decision pending	**1**	11 %

4.3.2 Critique of the Solidarity Fund

After Bulgaria applied to the Solidarity Fund for relief following two episodes of flooding in 2005, their request came under criticism. WWF (2005) argued that the Bulgarian government was planning to repair dykes and dams that it blamed for causing the flooding when they failed. However, WWF found that the engineering approach to flood control favoured in the region is itself a risk factor in the severity of flooding when it occurs. They thought that a preferable option would be to enhance natural retention zones, giving rivers more space by connecting them to natural floodplains.

The whole length of the Danube and its tributaries suffer from the same problem, with nearly 80% of the floodplains being cut off from the river due to development over the past 150 years. According to work by the International Commission for the Protection of the Danube River (ICPDR), these physical changes mean that 90% of the Danube River does not meet EU environmental standards. The ICPDR's Action Programme on Sustainable Flood Protection encourages the use of natural flood protection measures as a more effective way of directing river reconstruction efforts.

There are several eligibility criteria (see table 4.2) to receive Solidarity Fund support, and it is intended to be used for specific types of uses – reconstruction, emergency services, etc. However, there are no explicit criteria for judging the comparative benefit of different approaches to using the funding, despite the fact that significant effort has gone into designing alternative means of avoiding the impact of natural disasters. Reconstruction of dams that failed once already may not be the best use of funding, for example. Certainly it is not in the interests of the Community to provide support for measures that will not be sustainable.

4.3.3 The proposed new Solidarity Fund

The European Commission has proposed an extension of the Solidarity fund, with several alterations[11]. Most significant is the adjustment in focus from almost entirely 'natural' disasters to include industrial and technological disasters (a major oil spill, for example), public health emergencies (such as an outbreak of bird flu), and acts of terrorism.

[11] COM(2005) 108: Proposal for a Regulation of the European Parliament and Council establishing the European Union Solidarity Fund

In addition, the scale of the disaster needed for eligibility has been lowered to from €3 billion to €1 billion, or 0.5% of GDP, whichever is lower. Further, rather than relying entirely on estimated damages as the determining factor for eligibility, there will be room for political decisions about the importance or potential importance of the disaster – such as a terrorist act or emerging public health threat. This expanded scope will still be covered by the same amount of funding – €1billion per year.

The Fund was created following the disastrous 2002 floods, and is now proposed to have its scope expanded following terrorist attacks in Madrid and London, and under the shadow of bird flu extending its range into Europe. Clearly all of these threats are dangerous, but there would seem to be the possibility that by bundling them into one fund, without increased funding available, the reaction to each threat is potentially diluted. They may in some way compete with each other for attention and claim to the available funding.

A full comparison of the terms of the old and new solidarity funds is provided in Annex II.

5 CONCLUSIONS

While climate science is immensely complex and uncertainties inevitable, there is convincing evidence that changes in the earth's climate are taking place that can not be explained without taking into account **human influence** through the emission of greenhouse gases (GHGs).

Although identifying trends in extreme events is difficult, largely because they are inherently episodic and rare, our theoretical understanding of the physical processes behind the influence of climate change on various extreme weather events indicates that **more extreme events** would in general be an expected outcome.

When examining the empirical evidence, in some cases we have high confidence that **climate change has already had an impact** on some disasters; in others, there is growing certainty, and in others the link is not yet clear – however, there are few if any cases in which no influence of some kind is expected to be found given enough data.

Modelling of scenarios where there are further elevated atmospheric greenhouse gas concentrations shows **more climate change and more extreme weather events in the future**: worsening heat waves, increased flooding and drought, and more intense storms. Importantly, results are not uniform globally, and more region-specific clarity is needed.

More potential for disasters does not necessarily mean more disasters – the key link is how we **reduce our vulnerability and prepare to cope with impacts**. Given the increasing severity of extreme events, further and improved adaptation measures are needed. After a slow start to action on the issue, Europe appears to be putting adaptation higher on the agenda.

The Solidarity Fund and the new Floods Directive are two aspects of enhanced **Community civil protection** efforts. However, climate change is just one of several other very important demands on European disaster preparedness and relief funding. The key will be to ensure that money is apportioned and spent wisely. To that end, there **should be new guidance** on the application of Community funding to ensure the most effective civil protection and adaptation measures are being carried out, as well as a an **assessment** of what the appropriate levels of effort and funding would be to meet the current and expected future challenge of extreme weather events.

6 RECOMMENDATIONS FOR THE EUROPEAN PARLIAMENT

1. ***Let it rain:* Provoke debate, raise awareness**

   The EP could raise the level of discussion on extreme events linked to climate change. From the point of view of engaging policy makers and the public this will have the effect of relating a relatively distant concept – climate change – to the devastating impacts people are well aware of. This could be a promising method of raising awareness about climate change in general.

   While recent EU policy addresses the increased risks associated with flooding, the EP could prompt discussion on policy action to prevent or mitigate the impacts of other extreme events such as droughts and heat waves. The potential to integrate measures in sectoral policies (e.g. water, agriculture, industry, energy, tourism) should be investigated.

2. ***Number-crunching:* Support data gathering and dissemination of conclusions**

   While raising awareness, one must bear in mind the current tenuousness of the some of the scientific linkages, and avoid making overly broad statements. Until more scientific certainty is available, it is important to point out the risks and the responsibility to prevent their realisation. The precautionary principle should be referred to here, which, although its legal status is not uncontested, forms an important pillar of EU environmental policy. While there is no absolute scientific certainty, risks are severe enough to justify action. It would be very helpful in this regard to support better data gathering and scientific inquiry into extremes, as well as dissemination of conclusions.

3. ***Prevent wet feet*: Adapt prevention measures**

   The changing probability of extreme events means we need to rethink our coping strategies – for example, flood defences designed for 1 in 100 year events may face such events every 10 years in future. Hence, simply constructing along the old lines of thinking, or, following a disaster, simply to reconstruct existing flood defences, might be a losing strategy over the long run. Support for adaptation may be enhanced by pointing out benefits that would be gained from adaptive measures even without a climate-related increase of natural disasters (no-regret and win-win strategies).

4. ***Smart money:* Contemplate funding criteria, modes & needs**

   More contemplation needs to go into the alternative uses of public funding; criteria for structural and cohesion funding in relation to natural hazards are currently being reviewed by DE Regio – close attention should be paid to this work. Also, the goals and criteria of the new Solidarity Fund should be closely followed: there is the potential of it being stretched too thin to have an effective impact. To spend funding in the most effective way possible, a thorough evaluation of plans is necessary. Finally, given the scale of the adaptation challenge, there should be a review of Europe's funding needs and preparedness for a future in which extreme events, particularly flash floods, drought and heat waves, are more likely.

5. ***The helping hand:* Support the most vulnerable outside the EU**

While Europe faces a serious adaptation challenge, the situation is worse in many other less wealthy regions, and in areas more vulnerable to climate change. Greater focus on adaptation within the EU should go paired with greater support for efforts outside of the EU. The EU can begin on its own borders: the population of the 17 countries bordering Europe are generally less wealthy than the EU-25 and more dependent on agriculture, which makes them yet more vulnerable to climate change. It is in Europe's interest to extend greater adaptation support to its neighbours. The first reason is simply humanitarian, but the second is self-serving: disasters on Europe's borders may cause economic and social unrest, with range of potential repercussions for the EU, including increased illegal immigration pressure. The European Neighbourhood Policy, to take one example of relevant policy, does not mention adaptation, and should be reviewed.

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8 ANNEX 1: OUTCOMES OF EU SOLIDARITY FUND APPLICATIONS SINCE 2002 (EUROPEAN COMMISSION, 2005C)

Year	Country		Nature of the disaster	Damage	Category	Aid granted
2002	1	AT	Flooding	2,900	Major	134
	2	CZ	Flooding	2,300	Major	129
	3	FR	Flooding (Le Gard)	835	Regional	21
	4	DE	Flooding	9,100	Major	444
Total aid 2002						**728**
2003	1	ES	Oil spill (Prestige)	436	Regional	8.626
	2	IT	Earthquake (Molise/Apulia)	1,558	Regional	30.826
	3	IT	Volcanic eruption (Etna)	894	Regional	16.798
	4	IT	Flooding (North Italy)	1,900	(major)	Rejection
	5	GR	Adverse winter weather	Not clear	(major)	Rejection
	6	PT	Forest fires	1,228	Major	48.539
	7	FR	Forest fires (Southern France)	531	(regional)	Rejection
	8	ES	Forest fires (Portuguese border)	53	Bordering	1.331
	9	MT	Flooding	30	Major	0.961
	10	IT	Flooding (Friuli Venezia-Giulia)	525	Regional	Rejection
Total aid 2003						**107.081**
2004	1	FR	Flooding (Rhone delta)	785	Regional	19.625
	2	ES	Flooding (Malaga)	73	(regional)	Rejection
	3-9	ES	Forest fires (7 applications)	(480)	(regional)	all 7 rejection
	10	SK	Flooding	29	(regional)	Rejection
	11	SI	Earthquake	13	(regional)	withdrawn
Total aid 2004						**19.625**
2005	1	SK	Storm (Tatras)	202,733	major	5.67 m€
	2	IT	Flooding (Sardinia)	223	(regional)	Rejection
	3	EE	Storm	47.868	Major	1.29m€
	4	LV	Storm	192.590	Major	9.49m€
	5	SE	Storm	2297.313	Major	81,73 m€
	6	LT	Storm	15.156	Neighbouring	0.37m€
	7	EL	Evros flooding	(134.967)	(regional)	Pending
	8	RO	Spring flooding	(488.730)	(major)	49 m€
	9	BG	Spring flooding	(75)	(regional)	20.35 (Jan 2006)
	10	BG	Summer flooding	(234)	(major)	W/ no.9
	11	RO	Summer flooding			W/ no.8
Total aid 2005 (+ one in 2006)						**147.55**
Grand total of aid granted since 2002						**1022.606m€**

9 ANNEX II: COMPARISON OF THE CURRENT TO THE PROPOSED SOLIDARITY FUND (INFOBASE, 2005)

	Current Solidarity Fund	New Proposal
Entry into force	November 2002	January 2007
Geographical scope	Member States and candidate countries after formal opening of accession negotiations	no change
Application deadline	10 weeks after first damage	no change
Applicant	national government only	no change
Thematic scope	'mainly' major natural disasters (health threats and terrorism excluded)	major disasters resulting from (i) natural disasters; (ii) industrial and technological disasters; (iii) public health emergencies; (iv) acts of terrorism
Eligibility criteria	(1) total direct damage above threshold; (2) neighbouring country; (3) exceptional mobilisation for extraordinary regional disasters	(1) total direct damage above threshold; (2) neighbouring country; (3) political criterion (no regional disasters)
Threshold (to be met per applicant state)	In relation to above: (1) total direct damage above €3 bn or 0.6% of GNI, whichever is the lower; (2) no threshold if major disaster in neighbouring country recognised; (3) major part of population affected, lasting repercussions on living conditions and economic stability of affected region	In relation to above: (1) total direct damage above €1 bn or 0.5% of GNI, whichever is the lower; (2) no threshold if major disaster in neighbouring country recognised; (3) political decision of the Commission: for cases where damage is inappropriate criterion (health threats, terrorism)
Eligible operations	Emergency operations (i) to restore to working order basic infrastructures; (ii) to secure protective infrastructure; (iii) pay for emergency services and provisional housing, (iv) for protection of cultural heritage; (v) cleaning up No compensation of private damage	As now, plus (i) medical, psychological and social assistance to the direct victims of acts of terrorism and their families; (ii) protection of the population against imminent health threats, including the replacement of vaccine, drugs, medical products and medical equipment used up during an emergency
Implementation period	1 year following payment of grant	18 months from first damage
Budgetary procedure	Full budgetary procedure involving EP and Council following a Commission proposal for an amending budget in each case	no change
Advance payments	not possible	upon request of applicant state: 5% of the estimated cost of eligible operations, maximum € 5 million to be made available rapidly through internal budget transfer
Payment of grant	100% up front upon conclusion of the implementation agreement with beneficiary state, no co-financing obligation	no change
Implementation	Under full responsibility of beneficiary state; Minimum requirements on monitoring and reporting; Final report 6 months after end of grant	no change
Technical assistance	not available	up to € 2 million/year for external expertise
Annual amount	€1 billion (not 'budgetised')	no change