

A photograph of a person holding a bright red umbrella, wading through a very deep, fast-moving flood. The water is murky brown and splashing. The person is wearing a green shirt and dark pants. In the background, there are some black vertical posts sticking out of the water. The overall scene conveys the severity of flooding.

# THIS IS CLIMATE CHANGE IN EUROPE



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#### **Climate Action Network Europe**

is Europe's largest coalition working on climate and energy issues. With over 120 member organisations in more than 25 European countries, CAN Europe works to prevent dangerous climate change and promote sustainable climate and energy policy in Europe.



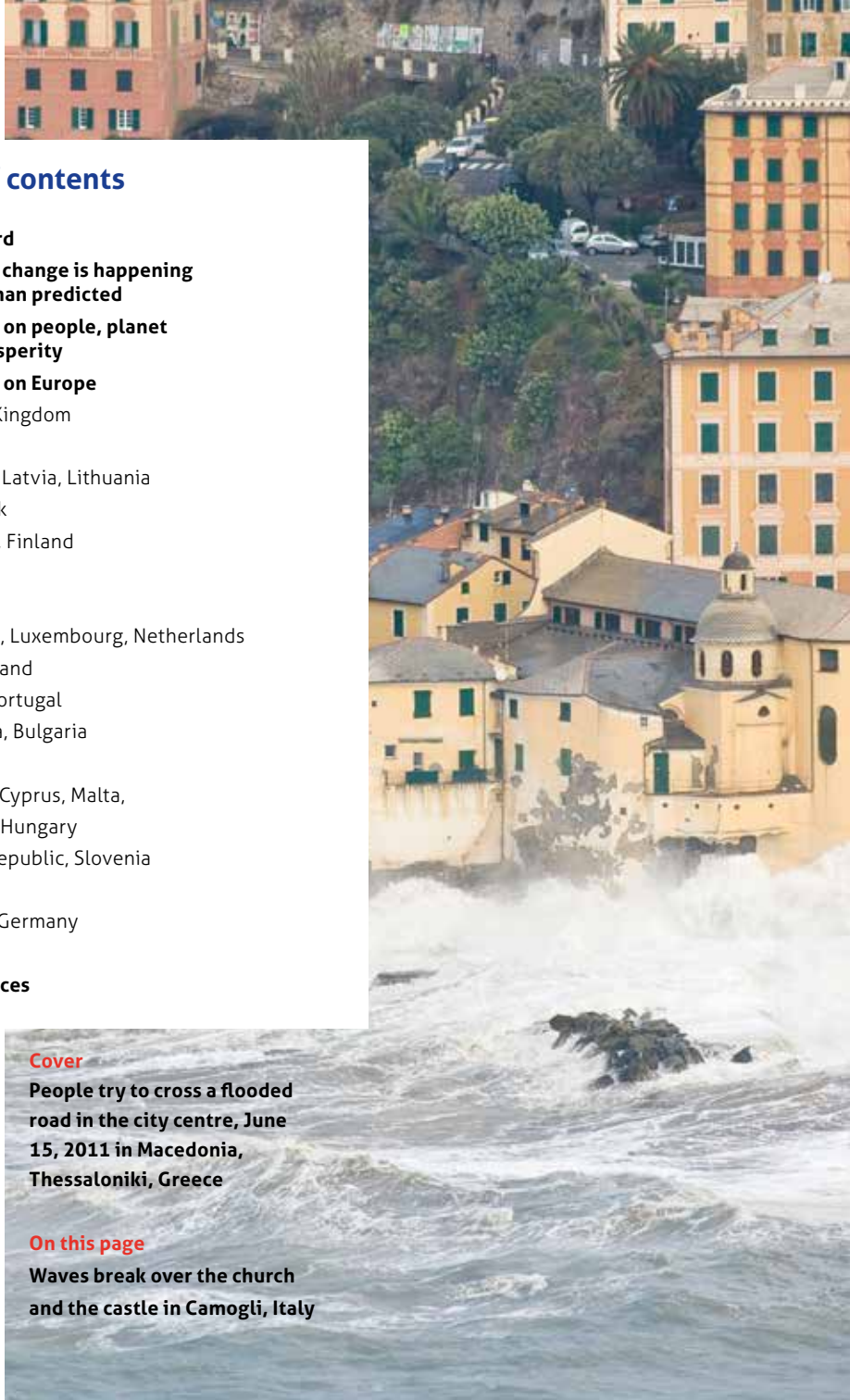
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#### **Cover**

**People try to cross a flooded road in the city centre, June 15, 2011 in Macedonia, Thessaloniki, Greece**

#### **On this page**

**Waves break over the church and the castle in Camogli, Italy**





## Foreword

Europe and the rest of the developed world can no longer ignore the impacts of climate change. Extreme weather events are no longer restricted to far off, exotic places. They are also happening on the doorsteps of the richest, most powerful countries, here in Europe, in our communities, affecting our daily lives.

The publication of the first part of the Intergovernmental Panel on Climate Change's Fifth Assessment report in September 2013 offered a stark reminder of the risks of a warming world: all regions will face negative impacts on people's lives and health, on our planet and on our prosperity.

Not only are rich countries largely responsible for warming our planet, they are also exposed to its effects. Our societies and our populations are increasingly vulnerable. The forest fires in Greece and Portugal, the record heat waves and the massive floods in central Europe in recent years are just some examples of the significant loss and damage that climate change is bringing to European societies and to our economies.

Lately, almost every season, European countries face new records of meteorological extremes – the hottest, the driest, the wettest, the coldest, the windiest. The scale and speed at which our planet is heating up can no longer be ignored. The impact this has on an already resource-constrained world is evident.

The 2-4°C degrees warmer world, which will come about if current emissions trends continue, will make our infrastructure increasingly vulnerable to ever more intense weather events. Such a warmed world will bring devastating impacts to our societies' basic support systems such as food production, water resources and ecosystems. Human health will suffer as a result.

In much of the developing world, the situation is already critical. Intense weather events hit hardest and cause the most damage to the poorest populations of the world. Their problems are and will increasingly be our problems in our interconnected world.

Negative impacts of climate change can no longer be avoided. We are already too late for that. But by acting now, we still have the opportunity, to avoid the worst consequences of runaway climate change. The next 5 to 10 years are critical in changing the polluting patterns on which our economies currently depend.

With this publication, Climate Action Network Europe seeks to highlight how global warming, currently 0.85°C, is already impacting Europe. Our message is clear. Climate change is causing damage to our societies, our environment and to our current and future prosperity. This damage is only going to get worse, unless we take action at the global level but also at the European level.

Today is an exceptional moment in time when the impacts of climate change have become visible in all parts of the world, including in Europe. When denial is no longer an option and real action on climate change can begin. Europe can do much more to take effective action on climate change. Europe can lead by example and adopt more ambitious greenhouse gas emissions reduction targets for 2020.

Climate change is affecting our daily lives and will increasingly affect our life choices. Let's make the choice to act while we still can.

November 2013

Wendel Trio, Director of Climate Action Network Europe

Summer 2012 was marked by weather extremes in Europe. The United Kingdom experienced its wettest summer since 1912, which led to widespread flooding. Spain, in contrast, suffered drought and wildfires after the second lowest summer rainfall for 60 years, with major socioeconomic consequences from the decline in agricultural and hydroelectric power production.

# CLIMATE CHANGE IS HAPPENING FASTER THAN PREDICTED

Fire disaster on August 21,  
2006 Chalkidiki, Greece

“Unless we take action on climate change,  
FUTURE GENERATIONS will be ROASTED,  
TOASTED, FRIED and GRILLED.”

Christine Lagarde, Managing Director, International Monetary Fund

Climate change is happening faster than predicted, and impacts look to be worse than predicted. The Intergovernmental Panel on Climate Change (IPCC) published the climate science volume of its 5th Assessment Report in September 2013 and confirmed with extreme certainty that climate change is happening, is caused by human activity and requires urgent action.

Sea levels are rising, precipitation patterns are changing, sea ice is declining and oceans are acidifying - all with grave consequences for our communities, environments and economies. The IPCC concluded that our planet's surface is now 0.85°C warmer than in 1880 and that if current emission trends are not reversed, the world's climate will warm by up to 5°C by 2100.

The outlook for a warmer planet has compelled many experts to assess the associated risks. NATO, for example, is examining the range of security threats resulting from climate change. These vary from water and food shortages, to large scale migration and threat of armed conflicts. The International Energy Agency, which helps countries in securing energy supplies, has in recent years increasingly warned of the threat of investing in polluting infrastructures.

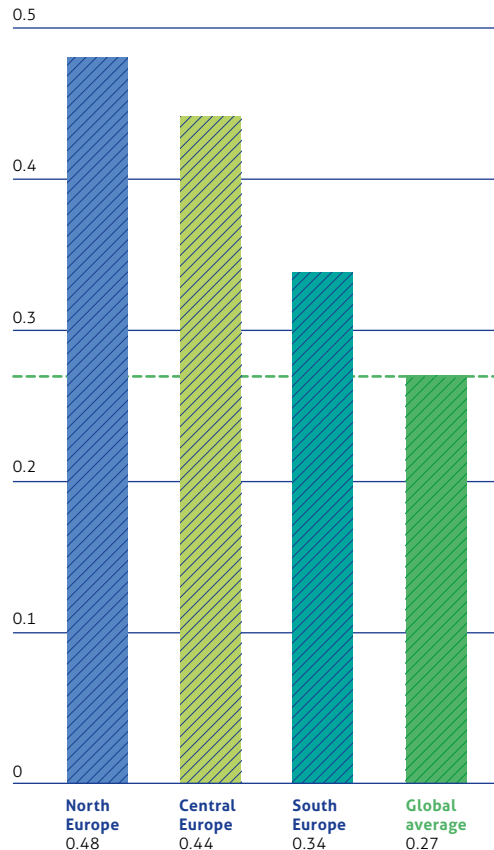
Concerns over the economic impacts of climate change have led historically conservative institutions, such as the World Bank, to become outspoken on the dangers of climate change. The World Bank's *Turn Down the Heat* report concludes that if the world warms by 2°C, a warming which may be reached in 20 to 30 years, there will be widespread food shortages, unprecedented heatwaves and more intense cyclones.

The report's strongest warning is that given current greenhouse gas emission trends, the world is on a path to a 4°C warmer world by the end of this century. The picture of the devastating impacts on agriculture, water resources, ecosystems, and human health that a 4°C rise will bring is devastating. Adaptation to such levels of warming will simply not be possible.

"A 4°C world is likely to be one in which communities, cities and countries would experience severe **DISRUPTIONS**, damage, and **DISLOCATION**, with many of these risks spread unequally. It is likely that the poor will suffer most and the global community could become more **FRACTURED**, and more **UNEQUAL** than today. The projected 4°C warming simply must not be allowed to occur."

World Bank report Turn Down the Heat: Why a 4°C warmer world must be avoided

Europe is warming faster than the global average



Rate of warming between 1979 and 2010 (°C per decade)

Data from page 46 - Chapter 14 of the IPCC's Fifth Assessment Report (°C)



# IMPACTS ON PEOPLE PLANET AND PROSPERITY

Drought landscape  
of the Bardenas,  
Navarra, Spain



## Impact of climate change on people

### Crop failures lead to price hikes

Longer and more widespread periods of drought ending in Biblical downpours are likely to hamper food production in the coming years. Growth of global agricultural production is forecast to slow to 1.5 per cent a year on average over the coming decade, compared with 2 per cent growth between 2003 and 2012, reports the Organisation for Economic Cooperation and Development (OECD). This slowdown would raise world food prices by 15-40 per cent. In Europe the price of food has noticeably shot up in recent years.

#### Climate impacts on coffee, tea, chocolate, fruit and vegetables

Carbon pollution is increasing temperatures in areas where common vegetables are grown. A warmer climate is damaging for many low-temperature vegetables such as broccoli, lettuce, and peppers and could lead to less availability. What's more, higher temperatures and changing rainfall patterns are bad for leafy greens, increasing the risk of salmonella and e-coli.

Tropical fruit supplies are hit more and more often by extreme weather. Climate change increases the risk of hurricanes and typhoons that impact fruit grown in tropical regions. The Philippines, the world's third largest banana exporter, lost one third of its crop in 2012 due to Typhoon Bopha. Chocolate, coffee and tea prices will increase as supplies dwindle. Much of Ghana and Cote d'Ivoire, which together produce half the world's cocoa, are expected to be too hot for cocoa plants by the middle of the century. Increasing temperatures in almost every coffee producing region of the world has already led to declines in coffee bean yields and price increases. The same is true for tea yields.

### Pest infested crops on the increase

For farmers worldwide, pests are already a serious problem. They are responsible for the loss of between 10 and 16 per cent of all crops during production. Infestations in food stores also result in further losses after harvest. Given the right amount of warmth and moisture, these pests thrive and grow. Changes to the climate are allowing pests to become established in previously unsuitable regions. The Colorado potato beetle is moving northwards through Europe into Finland and Norway where the cold winters would normally knock back the beetle.

### Global food chain disrupted

In today's global market place, what happens in one part of the world has significant knock-on effects across the entire planet. The extreme drought and wildfires that dramatically hit harvests across Russia in 2010 led the government to place a ban on wheat exports. This caused a significant rise in prices on international commodity markets, in turn having a knock-on effect in higher prices for consumer goods.

Flooding due to climate variability has become a significant problem for rice farming, especially in the lowlands of South and Southeast Asia. Flooding already affects about 10 to 15 million hectares of rice fields in South and Southeast Asia, causing an estimated \$1 billion (€0.75 billion) in yield losses per year. These losses could increase considerably given sea level rise as well as an increase in the frequency and intensity of flooding caused by extreme weather events.

The latest IPPC report confirms that food insecurity due to greater climatic variability is set to increase. During the 2003 European heatwave, crop yields in Italy saw a record drop of 36 per cent for maize grown in the Po valley. In France, the maize harvest declined by 30 per cent and the fruit harvest by 25 per cent compared to 2002.

The (uninsured) economic losses for the agriculture sector in the European Union that year were estimated at €13 billion, with the largest losses in France (€4 billion). Adaptation will be essential if Europe is to retain food production, given the risks of climate change to all agricultural producing countries.

## Water, water, everywhere, but not a drop to drink

Water shortages and floods, today a common feature of the European climate, illustrate the risks posed by too little or too much water. The OECD reports that by 2050 more than 40 per cent of the world's population will live under severe water stress and nearly 20 per cent could be exposed to floods. The economic value of assets at risk from floods is expected to be about US\$45 trillion (€35 trillion) by 2050 according to their recent report *Water Security for Better Lives*.

Water risks exacerbated by climate change are jeopardizing populations and cities, economic growth, energy security and food security. Climate change impacts will also increase transport costs, leading to delays and disruption. The world over, sea level rise, coupled with storm surges, will continue to increase the risk of major coastal impacts, including flooding of airports, ports and harbours, roads, rail lines, tunnels, and bridges, creating severe challenges for populations and policy makers alike.

“Our **PLANET** is changing in ways that will have profound impacts on all of **HUMANKIND**.”

US President Barack Obama, June 25, 2013



Catastrophic and damaging  
flood of Elbe river in Germany,  
houses and streets underwater



“I got it **WRONG** on climate change – it’s far, far **WORSE**.”

Economist Lord Nicholas Stern, Author of the 2006 report  
Economics of Climate Change, World Economic Forum,  
Davos, January 2013

## Human health significantly impacted

The human body is fairly adaptable, but once the outside air gets hotter than 35°C, people start experiencing heat stress. At this temperature we begin to have difficulty maintaining normal body temperature, putting strain on the heart. Babies, older people and those with heart conditions are most at risk. Some 70,000 people died across Europe alone because of the 2003 heatwave.

The latest IPCC report makes a very strong link between heatwaves and climate change. The IPCC concludes that in Europe, climate change will affect human health in many different ways. Given the increased likelihood and severity of heatwaves, there will be more heat-related deaths. The risk of death and injury will increase from windstorms, flash floods and coastal flooding especially for vulnerable people such as the elderly, disabled people, children, and those on low incomes. Many communities could become isolated from medical help as “superstorms” wipe out local roads and infrastructure.

Flooding could also lead to contamination of healthy water supplies and increase the spread of diarrhoea and respiratory illnesses. In cities, heat-amplified levels of smog could exacerbate respiratory disorders. Climate change-induced increases in concentrations of pollens and spores could ensure that many more suffer the miseries of asthma and hay fever, according to the World Health Organisation.

## Uncertainty, instability and mass migration

According to the chief of US Pacific forces, climate change is now seen as the biggest long-term security threat in the Asia-Pacific region, a direct result of mass migration.

With climate instability comes loss of livelihoods and mass migration. The UK National Security Strategy of the UK Cabinet Office concludes, “*Climate change is potentially the greatest challenge to global stability and security.*”

Syria has experienced a five-year severe drought, which displaced 1.5 million people as farmers and herders lost their livelihoods, flooded into the cities and fuelled social instability. According to experts, desertification is happening to about two-thirds of the world’s grasslands, accelerating climate change and causing traditional grazing societies to descend into social chaos.

## Impact of climate change on the planet

### Melting glaciers

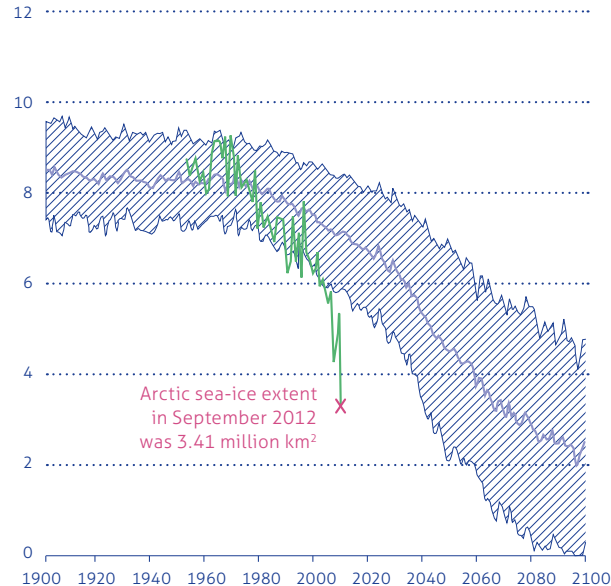
Glaciers and ice cover are disappearing at an alarming rate. The Polar Science Centre recently recorded a 75 per cent decrease in the summer sea ice volume in the Arctic. Record low sea ice cover was observed in 2007, 2011 and 2012 at around half the size of its normal minimum levels in the 1980s, states the European Environment Agency (EEA). From the Arctic to Peru, from Switzerland to the equatorial glaciers of Man Jaya in Indonesia, massive ice fields, monstrous glaciers, and sea ice are disappearing, fast.

When temperatures rise and ice melts, more water flows to the seas from glaciers and ice caps, and ocean water warms and expands in volume. This combination of effects has played the major role in raising average global sea level by almost 20 cm in the past hundred years, according to the IPCC.

#### Observed and projected Arctic sea-ice

- IPCC projections of sea-ice extent
- Actual observations of sea-ice extent

Extent (million km<sup>2</sup>)



September sea-ice extent for 1979 to 2013 shows a decline of 13.7% per decade

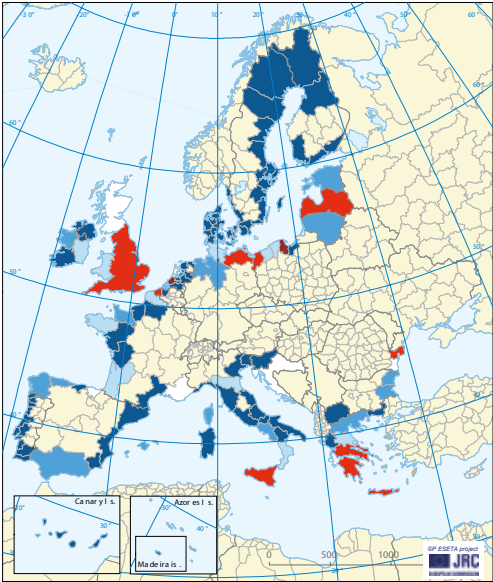
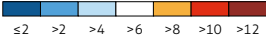
“Most Europeans live in **CITIES**, which can be extremely **VULNERABLE** to extreme weather events exacerbated by climate change.”

Jacqueline McGlade, former EEA Executive Director

Rising sea levels means more flooding in European coastal areas



People flooded (thousands/year) in coastal areas across Europe  
Baseline 1961–1990



IPCC SRES A2 scenario, 2080s (ECHAM4), without adaptation



Rising sea levels

The latest IPCC report concludes that between 1901 and 2010, global sea levels rose by 19 cm, an average of 1.7 mm per year. Looking at the last few decades, it is clear that sea level rise is speeding up. Between 1993 and 2010, sea levels rose by 3.2 mm per year, almost twice the long-term average.

With greenhouse gas emissions set to continue rising, the IPCC predicts more and faster sea level rises by the end of the 21<sup>st</sup>

century, somewhere between 26 and 82 cm. Exactly how much will depend on how and we choose to act on climate change. A sea level rise of this scale would have major consequences for global communities in coastal areas.

Essential ecosystem services threatened

Ecosystems and species provide important goods and services for human society,



including water, food, cultural and other values. Key ecosystem services such as natural hazard regulation, water purification and waste management, pollination and pest control are under threat from climate change. These are the natural processes upon which we depend to support life on earth. With global warming, stresses on ecosystems have the potential to trigger large-scale ecosystem collapse.

In a scenario of 2.5°C warming, severe ecosystem change, based on absolute and relative changes in carbon and water fluxes and stores, cannot be ruled out. Considerable change is projected for cold and tropical climates at 3°C of warming. At more than 4°C warming, biomes in temperate zones will be substantially affected. Biomes are large geographical areas of distinctive plant and animal groups adapted to that particular environment and climate. Major biomes include deserts, forests, grasslands, tundra, and several aquatic environments, each comprised of multi-ecosystems. Even with warming limited to less than 2°C, small biome shifts are already projected in temperate and tropical regions.

Such profound changes would impact not only the human and animal communities that rely directly on the ecosystems, but would also create costs to society as a whole. There would be extensive loss of biodiversity and diminished land cover. There would also be significant loss of ecosystem services such as fisheries and forestry, upon which populations depend.

## Habitats and species at risk

Most plants and animals live in areas with very specific climatic conditions. If the warming trend continues at its current rate, experts predict that up to one-quarter of all plants and animals alive today could become extinct within 100 years. It is not only the endangered species that will suffer under climate change. Common plants and animals are threatened too.

As habitats are destroyed, species will need to adapt to survive and many of the species alive today will not be able to adapt quickly enough. The implications for such massive species loss on access to food, medicines, remedies and other everyday goods we now take for granted cannot be estimated.

## Impact of climate change on prosperity

### Climate change costs the earth

The Stern Review on the Economics of Climate Change in 2006 changed the climate conversation among policy makers. The report assessed the effects of global warming on the world economy and concluded that the benefits of strong, early action on climate change will always far outweigh the costs of not acting.

The report stated that climate change might wipe 5-20 per cent off global GDP by the beginning of the next century. Yet, it would take just 1 per cent of GDP to lessen the most damaging effects of climate change, if we act now. The Stern Review concluded that climate change is the greatest and widest-ranging market failure the world has ever seen.

Since the publication of the report, the author Lord Stern has continued to argue that by assuming standard growth models and failing to take account of risks such as permafrost melt and the cost of mass migration, many economists are grossly underestimating the future costs of climate change. In a paper published in 2013 in the Journal of Economic Literature, Lord Stern calls for economists to develop a new kind of modelling that focuses more on the potential impacts of climate change on people's lives, including large-scale migration and conflict.

Dr Jim Yong Kim, President of the World Bank told business leaders gathered in Davos earlier this year, *"Tackling climate change will not break the bank, but the longer we dither, the more expensive it will become."* As climate change plays a larger role in extreme weather, taxpayers will need to spend more and more each year to clean up after each and every disaster.

## Floods and clean-up costs

The European Environment Agency says increased flooding is likely to be one of the most serious effects from climate change in Europe over coming decades. Annual costs due to coastal floods are expected to reach €25bn, with Belgium, Denmark, the Netherlands, Portugal and the UK being the most hit. Belgium, Ireland, Italy, the Netherlands and the UK will bear the brunt of costs from river floods, estimated at €98bn by 2080. About one-fifth of European cities with over 100,000 inhabitants are very vulnerable to river floods.

**The recent Global Risks report by the World Economic Forum identified food shortages, water crises and rising greenhouse gas emissions as three of the top global risks in terms of likelihood and impact that the world faces, alongside chronic fiscal imbalances and severe income disparity.**

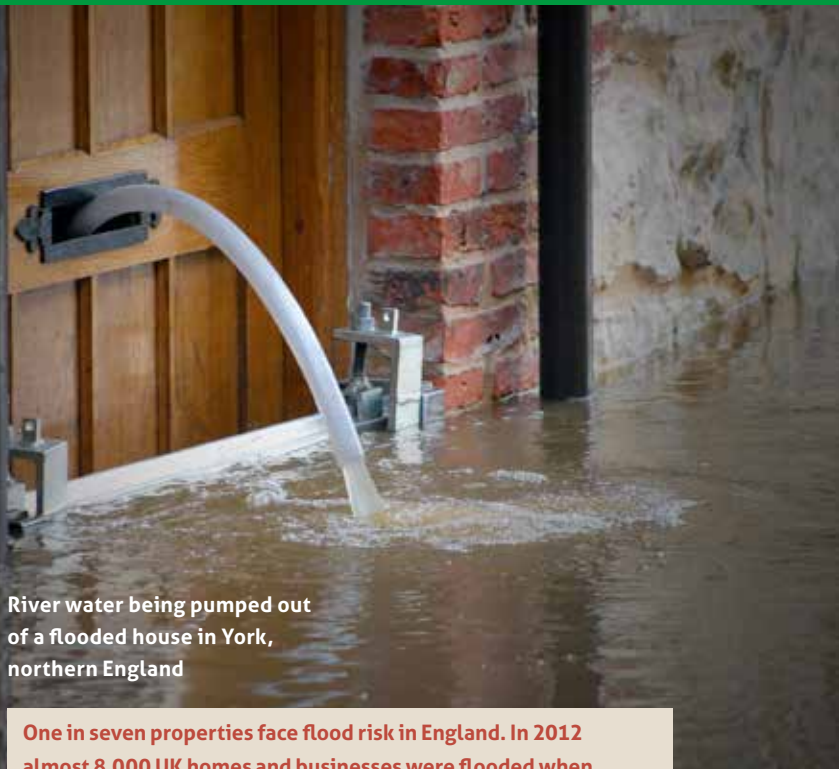
**For the first time in history the world has experienced three consecutive years where annual economic losses from disasters exceeded €75 billion. A new record of €103 billion was set in 2012, with Hurricane Sandy alone costing an estimated €19 billion in insured losses. Drought cost the US €15 billion in economic losses, while earthquakes left Italy nearly €12 billion worse off. Economic damage in Germany from flooding is estimated to have cost €12 billion in 2013.**

**Floods across Central Europe in 2002 had already caused losses of €12 billion. The US National Academy of Sciences reported the cost of climate change to date for key economic sectors in Europe – agriculture, human health, coastal flooding, river flooding and tourism – at €20 billion to €65 billion.**

# IMPACTS ON EUROPE

Canoeist paddles  
past flooded pub.  
River Ouse, York,  
North Yorkshire, UK





River water being pumped out of a flooded house in York, northern England

One in seven properties face flood risk in England. In 2012 almost 8,000 UK homes and businesses were flooded when 137 cm of rain fell, just 6.6 mm short of the annual rainfall record set in 2000. Total insurance losses through flooding reached €1.5 billion. Back in summer 2007, in the northern city of Hull, after 10cm of rain fell in just 24 hours, 600 streets, nearly 9,000 homes and 91 of the city's 99 schools were flooded, and 1,300 businesses were affected. The cost of claims from flooding in June and July 2007 exceeded a massive € 4.1 billion in England alone. The UK Institute of Civil Engineers estimates that home insurance firms are set to lose € 4.7 billion a year by 2035 on repairing floodwater damage. Flood defense costs are expected to rise by 60 per cent to €239 million by 2030.

## United Kingdom

2012 was the wettest year on record for England and the second wettest for the UK as a whole. There were floods one in every five days in the UK, yet one in four days were in drought. By the 2020s, there could be a significant shortfall between water supply and demand.

The British Agriculture Bureau estimates that flooding in the UK caused €1.5 billion in damages to the farming sector in 2012.

The UK is going to get warmer with parts of southern England forecast to warm by 7°C by 2050 according to a study by the London School of Economics and University of Leeds. UK infrastructure is simply not adapted to a Mediterranean climate. Roads can melt and underground systems overheat. Black tarmac on a new road in the centre of Cambridge melted in July 2012, while Hampshire county council deployed a fleet of gritters to dust the roads to stop surfaces melting. South West Trains suffered delays as metal tracks expanded, and the London Underground Victoria line recorded temperatures of almost 40°C

Climate change poses as grave a threat to the UK's security and economic resilience as terrorism and cyber-attacks, according to UK Foreign Secretary's climate envoy, Rear Admiral Neil Morisetti. *"The areas of greatest global stress and greatest impacts of climate*

*change are broadly coincidental. Just because it is happening 2,000 miles away does not mean it is not going to affect the UK in a globalised world, whether it is because food prices go up, or because increased instability in an area – perhaps around the Middle East or elsewhere – causes instability in fuel prices,”* Morisetti said. *“In fact it is already doing so,”* he added, noting that Honda’s UK car plants had been forced to switch to a three-day week after extreme floods in Thailand cut the supply chain.

“A **WASH-OUT** summer further compounded by a sodden autumn and winter has **HAMMERED** production. Climate change scientists have long predicted that agriculture will face major **CHALLENGES** from global warming. However 2012 starkly demonstrated the cost that **EXTREME** weather events can wreak on farmers and the food supply chain.”

Peter Kendall, president of the British National Farmers Union.

## Ireland

*“There were fire alarms going off all over the city — again caused by the thunder and lightning,”* said a spokesman for the fire brigade in front of Letterkenny General Hospital, Ireland, July 2013. The Irish Times reported that water up to a metre deep gushed through the doors of the hospital’s accident and emergency unit.

Ireland is expected to get warmer, wetter and windier. Predicted negative impacts in the short term include more intense storms and rainfall events, increased likelihood of flooding in rivers and on the coast, where almost all Ireland’s cities and large towns are situated, and water shortages in summer in the east.



**Flooded roads in East Kilbride, southwestern Scotland**

## Baltic States

### Estonia, Latvia and Lithuania

Heatwaves and flashfloods have become typical weather events in the Baltic States now too.

The flashfloods and storms in May 2013 in Latvia were the most powerful and destructive in 20 years. The worst destruction occurred in Ogre, Plyavinyas, and in the areas around the city of Daugavpils. In August 2013, the Lithuania Tribune reported a record temperature of 37°C.

Old wooden pier by Baltic sea

In Estonia, climate change will have the most significant effect on agriculture, forestry and coastal resources. The total biomass of forests is estimated to decrease by 21 to 35 per cent. Sea level rise is also estimated to cause considerable economic losses, especially in storm surge zones.

In Latvia, the invasion of new species of flora and fauna is now occurring considerably faster than in the past. Many more foreign species have been documented in recent years than during previous decades of the 20th century.

In the Baltic States, concern about climate change is such that the governments of Estonia, Latvia and Lithuania have joined with other partners to agree a joint strategy known as Baltadapt to help the region adapt to climate change.

They fear that climate change will increasingly cause biodiversity loss across the region. There is particular concern for the sea, where overfishing has already left marine ecosystems extremely vulnerable to climate change.

Climate change is also already upsetting the migration patterns of birds in Lithuania. Confused by the unseasonably mild winters in recent years, many birds decide not to leave for warmer climes, bringing an unwelcome and dangerous shock for them when the cold does arrive.



## Nordic countries

### Denmark

Low-lying coastal areas in northwestern Europe are at high risk from flooding and the risks are expected to increase as sea levels rise and storm surges become stronger and more frequent. North Sea countries including Denmark are particularly vulnerable.

Recent surveys reveal that half of Danes are worried about their homes flooding. One in four homeowners have had water damage to their basements or attics in previous years, while 40 per cent of apartment residents have been affected by water in their homes. Like any city located by the sea, Copenhagen will face particular danger as sea levels rise and “superstorms” hit coastal areas with greater frequency.

City planners in Copenhagen are already taking steps to ensure its resilience as far ahead as 2100.

*“We’ve looked at how climate change will affect Copenhagen in the long-term future”,* says Lykke Leonardsen. “For Copenhagen, the most serious effect of climate change will be increased precipitation, so we’ve developed a plan that addresses how to catch all the rainwater in the city.” Leonardsen, a city planner, belongs to the 10-person team working solely on long-term climate change adaptation, planning ahead to the year 2100. Leonardsen’s team envisions lowering the level of a local lake, thereby freeing space around its shores. This space will then be turned into a park, with playgrounds and running paths. When a superstorm hits, the lake and its surrounding park will be used for water storage.

King Hans wooden suspension bridge in the flooded meadows near Skjern, Denmark



## Sweden

The European Environment Agency predicts temperatures in northern Sweden and Finland will rise faster than in other European countries, possibly by as much as 2.5°C to 2050, and 6°C by the end of the century. Densely populated areas, including Stockholm, have already seen a shift from a cold-temperate to a warm-temperate climate, which reduces the frequency of winters bringing heavy snowfalls. The winter of 2007 - 2008 was the warmest of all winters since 1858 - 1859 in southeastern Sweden.

If global warming exceeds 2°C, the direct climate effects on forest growth and distribution may transform vast areas of Sweden's boreal forest into open woodland or grassland. This change would have massive effects on the Swedish economy. Swedish forestry companies have already borne the economic impact of powerful storms. The 2011 storm brought down vast tracts of forest in Sweden as well as Norway and Finland with significant losses to forest owners.

## Finland


Finland is the most forested country in Europe. Forests cover approximately three quarters of the country's total area. Export revenue from forestry products make up almost a quarter of Finland's total export revenue. This is ten times more than the world average.

Changing climatic conditions are making the trees in Finland more susceptible to damage. Certain species are declining, and damage from both winds and pests are having a serious economic impact. Storm damage may become more common, especially in late autumn and early spring. Trees felled by violent winds cause considerable economic losses. What's more, forest fires are projected to increase in southern Finland.

Pests and non-native species may become more common with global warming in all European countries. In the forests of Finland, organisms that cause damage to trees may increase considerably as the climate becomes warmer and more humid and as the growing season becomes longer. At the same time, the increasingly mild winters help pests and their eggs to survive the winter. Even a small change in temperature can lead to a rapid increase in insect populations.

Most of the pests found in Finland produce only one generation of offspring per summer. But the changing climate could lead to more than one generation being born during each summer, creating insect invasions. The increasingly dry and warm summers may allow the pine wood nematode, for example, to spread to Finland. Pine wood nematodes are pests that can cause significant damage where pine trees have not had a chance to develop immunity to the species.



A large, fallen tree trunk lies horizontally across the frame, its bark heavily damaged and peeling, revealing a bright orange-brown interior. The tree is surrounded by dense green foliage and other trees in the background. The scene is a forest, likely in Sweden, showing the aftermath of the Gudrun storm in 2005.

The Gudrun storm in 2005  
felled 75 million cubic metres  
of forest in Sweden





## Norway

In Norway, over the last century, extreme rainfall and snowmelt has increased, creating damage from overflowing rivers and streams. Heavy floods affected the Gudbrandsdalen region in 2011 and 2013. Storms isolated thousands across the country in 2011 when railways were badly damaged. Insurance companies paid twice as much for damages in the last ten years compared to the 1980s.

The Norwegian fish-farming industry suffers from higher water temperatures in the summer. Entire fish farms now have to be towed further north. Even more worrying is that fish parasites thrive in warmer temperatures and are threatening the quality of production.

The annual mean temperature in Longyearbyen, the world's northernmost permanent human settlement, has increased by 0.9°C per decade since the mid-1960s. Permafrost is reduced, causing foundations for houses to shift.

Briksdal glacier melting  
fast in Norway

## France

France is the leading tourist destination in the world and tourism is the leading sector of the country's economy, bringing in over €30 million a year and generating almost one million jobs. But boiling summers, severe flooding and melting glaciers could soon put an end to that.

The Alps, and in particular the Pyrenees that divide France and Spain, could see significant snow loss, curtailing the ski season, shutting some resorts altogether and increasing the likelihood of avalanches.

*"When I first came here there was snow on those trees halfway down the mountain. Today the whole idea seems ridiculous. My clients used to ask me if I saw evidence of climate change in the mountains but today they don't even bother to ask because there's so much evidence."*

British mountain guide, Andy Perkins, first came to Chamonix more than 30 years ago.

Food and drink are significant contributors to the French economy and tourism. But climate change is affecting the 'terroir', the delicate balance of weather, soil and other factors that are central to the production of some of its choicest delicacies. French winemakers are keenly feeling the effects of growing competition from other countries as higher temperatures in recent years have produced grapes with lower acidity and higher sugar content. Adaptation may be possible, but producing new wine from new varieties is a complicated and risky business.

France had a rude awakening to climate change impacts in 2003, when over 14,000 people died during the heatwave. Since then, flashfloods and tropical-like storms have become a current feature of the French climate. In July 2013 such a storm destroyed significant parts of the Burgundy vineyards. *"It is awful to see these vines ripped by hail and several years of wine growers' work destroyed by the weather in one afternoon,"* said Xavier de Volontat, head of France's independent wine makers organisation.

**1,900 people died in Paris  
in the extreme heat of  
summer 2003**



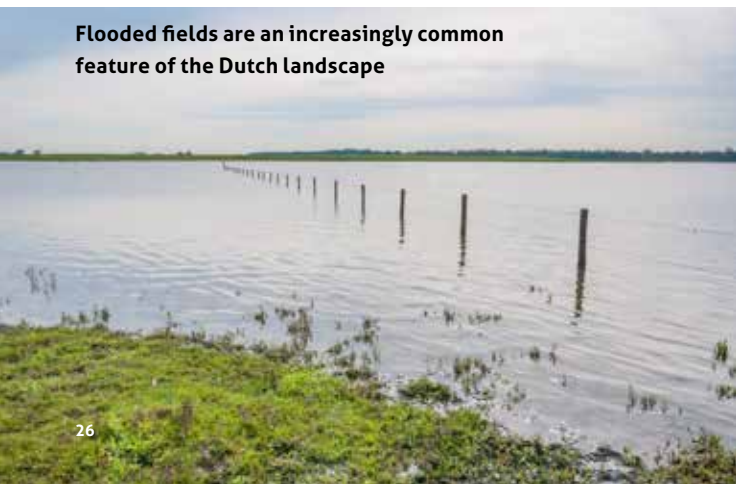
## Benelux

### Belgium

The Belgian climate is getting warmer and drier in the summer and wetter in the winter. According to the EU climate adaptation report, temperatures in the winter months are forecast to rise by up to almost 5°C, while temperatures in the summer may shoot up by more than 6°C by the end of the century. An increase in winter rain of up to 20 per cent and a decrease in summer rainfall is also forecast.

Almost 85 per cent of the Belgian coast is low-lying and therefore one of the most vulnerable coastlines in Europe. These areas are likely to experience increasing erosion, storm damage and flooding. Adaptation measures that Belgium is planning are the creation of artificial islands and reefs, active breakwaters and super-dykes. Where dykes need to be built, a 60 cm rise in sea level is taken into account.

**Flooded fields are an increasingly common feature of the Dutch landscape**



### The Netherlands

The Netherlands, of all the countries in Northern Europe, is most susceptible to sea level rise and river flooding. Fifty-five per cent of its territory is below sea level, 60 per cent of the country's population lives in these areas and 65 per cent of its GNP is produced here.

The country is already dependent on a series of dikes and other man-made defences, as well as natural dunes, to keep people safe from the North Sea and the country's major rivers. Climate change will increase the odds of a breach that could lead to a flooding disaster. The Dutch government is working hard and spending billions of euros to try to ensure this never happens.

### Luxembourg

Two main threats to Luxembourg from climate change are floods and forest instability. Since the 1990s average temperatures have increased sharply resulting in longer frost-free periods during the winter months and the country as a whole has witnessed more frequent flooding. These trends are forecast to continue with negative consequences on public health, agriculture and forests.

According to the OECD, Luxembourg is suffering from deteriorating water quality due to the more intense rainfalls, which causes erosion and rapid infiltration towards groundwater. Such changes in the water cycle could increase public health risks related to water quality and water scarcity.



## Switzerland

The climate has changed in Switzerland too. The measured rise in temperatures during the 20th century of 1.4°C is almost twice as high as the global average. In the future Switzerland can expect increases in extreme rainfall, floods and landslides. Due to warmer winters, more winter precipitation will fall as rain instead of snow, leading to immediate run-off and increased risk of flooding.

The glaciers in the Alpine region have melted considerably in the last 150 years. In the hot summer of 2003 alone, some glaciers lost 5-10 per cent of their ice volume. It is expected that this glacial melting will continue through the 21<sup>st</sup> century. According to the Worldwatch Institute, about three quarters of the current glacier surface could disappear by 2050. Already the average snow line has increased in altitude considerably since 1960. Predicted future warming would result in a further raising of the snow line by around 300 metres. This would have serious consequences for low-lying winter sport destinations in Switzerland.

As a result of climate change, more frequent, more intensive and longer-lasting heat waves and an increase in summer droughts are expected in Switzerland as well. The rise in temperature in the Alps leads to a melting of the permanently frozen sub-soil (permafrost). With that, the risk of rock-falls increases. What's more, infrastructure that has been built on permafrost, such as cable car stations, are increasingly destabilised by melting permafrost.



In one summer in 2003 Swiss glaciers lost 5 to 10 per cent of their ice volume

## Spain

Drought is already transforming fertile land into desert in parts of Spain. Nearly one-third of the country faces a significant risk of desertification and six per cent of Spain's soil has already eroded irreversibly. Mediterranean droughts will start earlier in the year and last longer. Such droughts are a combination of a lack of rain and disappearing glaciers. The Pyrenees have lost almost 90 per cent of their glacier ice over the past century. Climate change means they will disappear completely within a few decades. This will have a severe impact on summer water supplies and have potentially dramatic effects on agriculture.

If there is not enough water inland, the opposite is true at the coast. Sea levels around Spain are rising by 3mm each year, which may force Spain's popular beaches to shrink by an average of 15 metres by 2050. This will be catastrophic for the people who live there. It may also have serious consequences for the tourism industry and those whose economic survival relies on foreign visitors.

The acidification of the oceans is already bringing increasing numbers of jellyfish to the Spanish coastline, along with its devastating impacts on the marine ecosystem and its food chain. Holidaymakers may snub Mediterranean resorts, as the threat of water shortages, forest fires, and algae blooms become the norm rather than the exception. Wildlife is also under threat. Blazing forests are increasingly common in the heat of summer. Higher sea temperatures may trigger diseases fatal to the Mediterranean dolphin populations.

## Portugal

Perhaps not surprisingly, the climate change impacts predicted for Spain apply also for Portugal. Already facing extreme economic hardship, like many of the southern European countries, Portugal is also likely to experience more frequent and prolonged droughts.

Extreme heat will become more frequent such as experienced on the uncomfortable night of 1 August 2003 which was the hottest in centuries, with night temperatures above 30°C. Portugal experienced extensive forest fires during the 2003 heatwave when temperatures reached as high as 48°C and an area the size of Luxembourg went up in flames.



In Portugal an area the size of Luxembourg was lost to the flames in the heatwaves of 2003



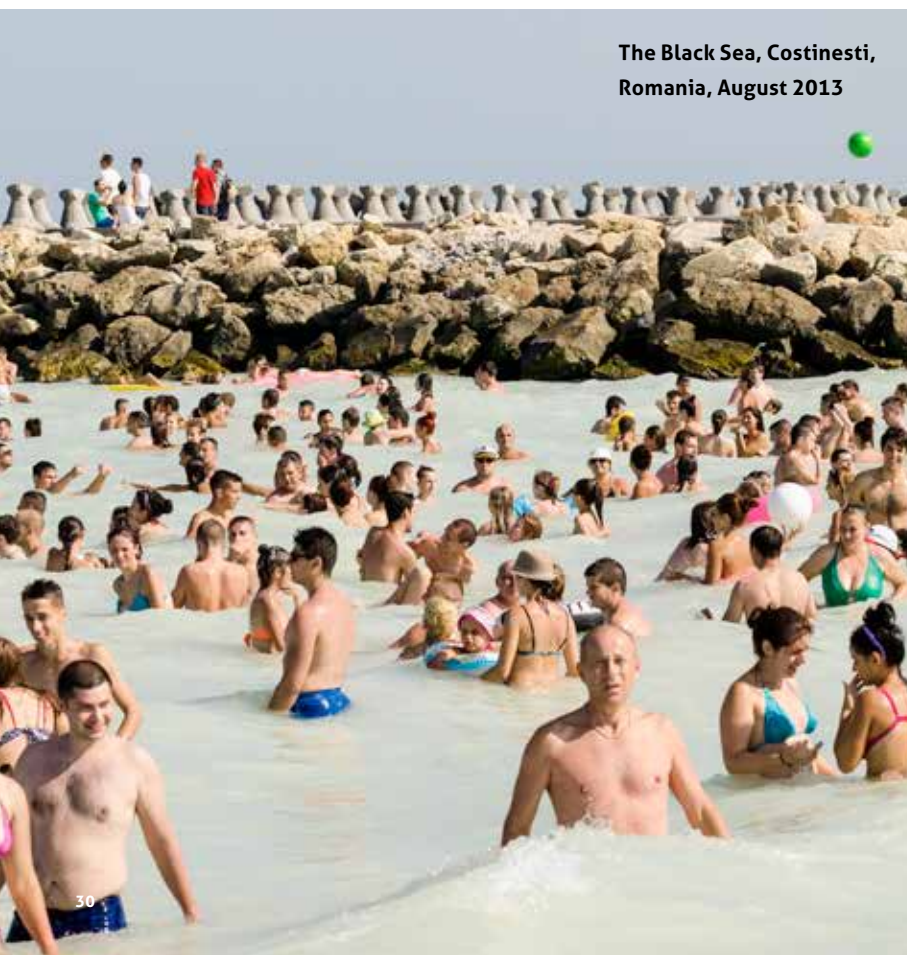
## Romania & Bulgaria

Heatwaves are becoming the norm as Romania and Bulgaria struggle to cope each summer with temperatures soaring out of control. In July 2013, Bucharest was put on orange alert as people passed out on the streets of the capital because of the extreme heat and emergency services were swamped with calls from people unable to cope.

The situation was even worse in 2007 when parts of the country were put on red alert as the mercury shot up to an oven-like 46°C. The government banned outdoor work, including construction, in the hottest hours.

Bulgaria has experienced similar baking weather with the thermometer regularly hitting 40°C, forcing dozens of mostly elderly people to be admitted to hospital with heart ailments and breathing difficulties. Police have to ban heavy trucks from main roads, warning that high temperatures have softened the asphalt.

**The Black Sea, Costinesti,  
Romania, August 2013**





## Italy

In the Spring of 2013 in Sicily, a massive 5cm of rain poured down in just half an hour, shocking holidaymakers and residents alike. Such tropical-style downpours are becoming a common feature of Europe's extreme weather patterns.

Winter sports in the Italian Alps are threatened by climate change as the duration of snow cover is expected to decrease by several weeks. Glaciers are forecast to melt or significantly reduce in size. These changes will cause the formation of large lakes, which will have the potential to provoke serious flooding.

At the same time, droughts are creating havoc for crops. Italian farmers suffered close to €1 billion in crop damage from drought in 2012, with losses in corn, wine grapes and sugar beet. Corn losses ranged from 30 per cent to complete destruction for non-irrigated fields, while the damage in soybeans and sugar beets was around 50 per cent.

The drought also caused considerable losses in the quality and quantity of fodder, sunflowers, tomatoes, summer fruits, grapes and olives. For a country whose economic prosperity is closely linked to its popular food products, these losses were particularly devastating.



In November 2012, 70 per cent of the historic city of Venice was under water as sea levels reached 1.5m – the sixth highest water level since 1872

## Greece

Extremely high summer temperatures are projected to become the norm in Greece given current emission trends. In Greece, as in Spain, the frequency of heat waves in the 1990s was about three times higher than in previous decades. The coolest summers at the end of the century may be warmer than the hottest ones in the recent past. The hottest summer on record in Athens in 2007 would be among the five coolest ones by the end of the century.

This is a terrifying forecast. In recent years, Greece has already seen swathes of its forest and agricultural land ravaged by fires. In 2007, massive wildfires swept through woodland and villages, mainly in southern Greece, killing more than 70 people. In 2009, suburbs outside Athens were evacuated as forest fires raged out of control. Scores of homes were gutted and the blazes caused “biblical damage” to an estimated 120,000 hectares of virgin fir and prime forest. In 2013, houses in the town of Marathon - the site of the historic 490 BC battle between Athenians and Persians - were destroyed by wildfires.

An increase in dry spells will also add to the burden of climate change on Greece, where dozens of drought stricken islands are forced to import greater amounts of water every year. The outlook for agricultural production is catastrophic, which is a terrible forecast for a country whose economic stability is far from healthy.

In a quirk of fate worthy of a Greek myth, heavy snowfall, strong torrential rains, sub-zero temperatures and gale-force winds battered parts of Greece, in spring 2011, disrupting land and sea transport.

## Cyprus & Malta

Climate change is causing less rain, more droughts and increasing temperatures in Cyprus. Rainfall has decreased by 17 per cent and temperature increased by 1°C since the beginning of the 20th century.

Extreme droughts and rainfalls have caused problems in the agricultural sector with increasing vulnerability to desertification. There has also been a sharp increase in the number of wildfires during the summer months. Cyprus like other Mediterranean islands is getting more and more scorched in the summer heat, putting its businesses and people at risk.

As another small island, Malta faces a number of daunting challenges that will be brought on by rising sea levels, coastal flooding, escalating temperatures, drought and coastal erosion. These include the erosion of beaches that will reduce the tourism value of these areas and affect other local resources such as fishing.



Car ruins after fire disaster in August 2006 in Chalkidiki peninsula, northern Greece

## Croatia

Extreme weather events such as droughts and hail have resulted in average losses of €176 million per year from 2000-2007, equivalent to 0.6 per cent of national GDP, generated by the agriculture, forestry and fisheries sector. Future corn production will likely be affected by climate change resulting in losses of €6-16 million in 2050 and € 31-43 million in 2100.

Climate change is expected to result in sharp falls in river levels – a major challenge for a country where hydroelectric power production accounts for up to half of the national electricity production. It could cost costs of tens of millions of euros to replace generating capacity if river flow is reduced.

More than 10 million tourists flock to Croatia each year, but many of the country's picture postcard destinations, especially on the Adriatic coast, are at threat from climate change. Submerged beaches and furnace-like heatwaves could become the only features to welcome future tourists.

## Hungary

Heatwaves are also a major problem in Hungary. Data for Budapest suggests that a rise in the average daily temperature of 5°C would increase mortality rates by ten per cent, incidents of cardiovascular diseases by 12 per cent, and emergency ambulance calls by 15 per cent.

Already in the summer of 2013, Budapest recorded 37.2°C on 19 June, following a record 34.8°C on the same day in 2012. In 2007, a heatwave killed an estimated 500 people in Hungary. In a one-week period in July 2007, firefighters were called out 3,000 times in Hungary to quell blazes.

Health risks from extreme precipitation, related to floods and water contamination, are also a concern. In 2006, after heavy precipitation, contaminated piped drinking water caused an epidemic of more than 3,000 cases of gastroenteritis in Miskolc, Hungary's fourth largest city.



## Czech Republic

*"At 03:00, the police started driving past with their sirens on, asking everyone to leave their homes," Jakub Szanto, homeowner of a first floor flat in the Prague district of Modrany, reported to the BBC. "I emptied the contents of the fridge into a huge box, woke the kids up, told them we were going to play a game called 'Evacuation' and we left for grandma's."*

In June 2013, the Czech government declared a nationwide state of emergency, Prague's metro system was shut down and most schools in the capital were closed because of the dramatic flooding. Prague's central sewage-treatment plant was also shut down to prevent damage from high water levels, sewage seeped into the river, which was still flooding parts of the city.

This occurred a mere decade after the last devastating floods swept through the city, closing parts of its metro system for months, flooding the historic centre, killing hundreds of zoo animals and causing billions in damage.

**In 2012, severe drought cost Slovenia €128 million in agricultural losses**

## Slovenia

According to the OECD, Slovenia saw an increase in its average temperature by approximately 0.4°C each decade from 1971-2010. Summer temperatures are expected to increase by up to 8°C by the end of the century. Such heat is accompanied with less rain. Lack of rain has already caused hugely problematic summer droughts, with riverbeds drying up. The summer of 2013 brought temperature highs all across the country, including a record 40.8°C in Ljubljana.

In 2012, severe drought cost Slovenia €128 million in agricultural losses. Farms in the eastern Pomurje region, the country's breadbasket, were estimated to have incurred crop losses of €21 million as thousands of hectares of cornfields were decimated. In 2013, damage from drought was labelled a natural disaster as it exceeded 0.3 per cent of budget revenue. Harvests of corn, potatoes, pumpkins, vineyards and orchards were all devastated.

On the other hand, heavy downpours have sparked some of the most severe landslides ever witnessed. Heavy and abundant rain covered the western, northwestern and northern parts of Slovenia in September 2007, creating severe flooding. Again in 2010, severe flooding caused widespread damage to central Slovenia, including Ljubljana, with 140 municipalities affected. In 2012, flooding in northern Slovenia put the city of Dravograd under water. In 2013, northeastern Slovenia found itself inundated. In the summer of 2008, hailstones the size of eggs fell in northeast Slovenia (Ptuj, Maribor, Prekmurje) during a severe storm, at an estimated cost of €300 million in Ptuj alone.





## Slovakia

Droughts, decreased rainfall and a significant increase in torrential downfalls are a growing trend in Slovakia, making floods and drought more common. A large number of slopes in Slovakia's Velka Tatra mountains already carry a high risk of avalanche, partly due to devastating wind storms in 2004 that felled many hectares of forest. This risk is predicted to grow.

By the end of the century, Slovakia and other countries in central Europe will experience the same number of hot days as are currently experienced in southern Europe, with annual average temperature rises of 4 to 4.5°C.

**Flooding in Central Europe** Many of Europe's major rivers, the Danube, the Elbe, the Rhine and the Vistula – to name but four – flow through this region. They have always flooded, but recent years have seen record after record broken as torrential downpours have left the rivers swollen and angry.

In June 2013, record flooding hit major rivers in Austria, the Czech Republic, Germany, Poland, Slovakia and Hungary. In a two-day period, parts of Austria received the amount of rain that normally falls in two-and-half months.

The Danube River in Passau, Germany was the highest it had been since 1501 and the Saale River in Halle, Germany hit the highest in its 400-year period of record. Tens of thousands of people were forced to flee their homes and at least a dozen people died.

**The flooded Tyrsovo Embankment of the Danube in June 2013 in Bratislava, Slovakia**



Spring 2013 will be remembered for widespread severe flooding in Europe. In Passau, in southern Germany, at the confluence of the Danube, Inn and Ilz rivers, floodwaters reached 12.9 metres, beating the previous record of 12.2 metres from 1501. These summer floods came after an extremely cold winter, and were followed by extreme summer heat, with record temperatures.

## Austria

The June 2013 flooding of the Danube affected Austria dramatically with close to 20,000 volunteer fire fighters working in the flood-affected zone, along with 1,000 soldiers from the Austrian army, bringing hundreds of people to safety. Over a two-day period, parts of Austria received the amount of rain that normally falls in two-and-a-half months.

Other climate change impacts on Austria include reduced snow cover, which will have a negative impact on Austria's winter tourism and economy, and excessively hot summers. Austria set a new national high of 40.5°C in Bad Deutsch-Altenburg, a town near the Slovakian border, in the summer of 2013. This was the first time the country broke the 40 °C mark, since daily records began in 1858.

## Germany

*"My existence has been destroyed overnight - destroyed."* Shopkeeper, Passau, Southern Germany, after the river Danube rose to levels not seen for 500 years in June 2013. *"We're dealing with a national catastrophe."* Gerda Hasselfeldt, a Christian Socialist Union MP.

The German Farming Bureau estimated the agricultural damage for the 2013 floods at more than €300m, including waterlogged fields, lost crops and flooded farm buildings. It said at least 150,000 hectares had been flooded. In the same year, the road and rail network in Germany sustained more than €100 million worth of damage from climate change.

Yet summer rains have become less frequent and some regions are already suffering droughts. Water scarcity threatens agriculture and makes forest fires more likely. In Brandenburg, Germany's driest region, groundwater has already dropped significantly and the worst predictions are that levels may halve by 2050 compared to today's levels.



Floods in the streets of Steyr, Austria



## Poland

The June 2013 storms almost paralysed the city of Warsaw with around 3cm of rain in a three-hour period. Firefighters had to free people from eight trapped cars. Four underground stations on the city's subway were flooded, leaving train services suspended for almost two hours.

Forestry, energy, agriculture, transport and construction are among the sectors in Poland most vulnerable to climate change. Droughts and floods could limit access to the water needed for cooling power plants, as well as damaging food and energy crops and limiting the efficiency of hydropower.

Experts predict that adaptation will cost the Polish economy about €15bn between 2014 and 2020. But if adaptation does not take place, the cost to the economy could be €20bn over the same period due to extreme weather events such as flooding.

The human cost of extreme weather is also high. Forty-one children were taken to a hospital in July 2013, after suffering from dehydration waiting in a broken-down bus in the village of Gostynie in central Poland.



**Firemen protecting against high water in June 2013 in Kalety, Poland**



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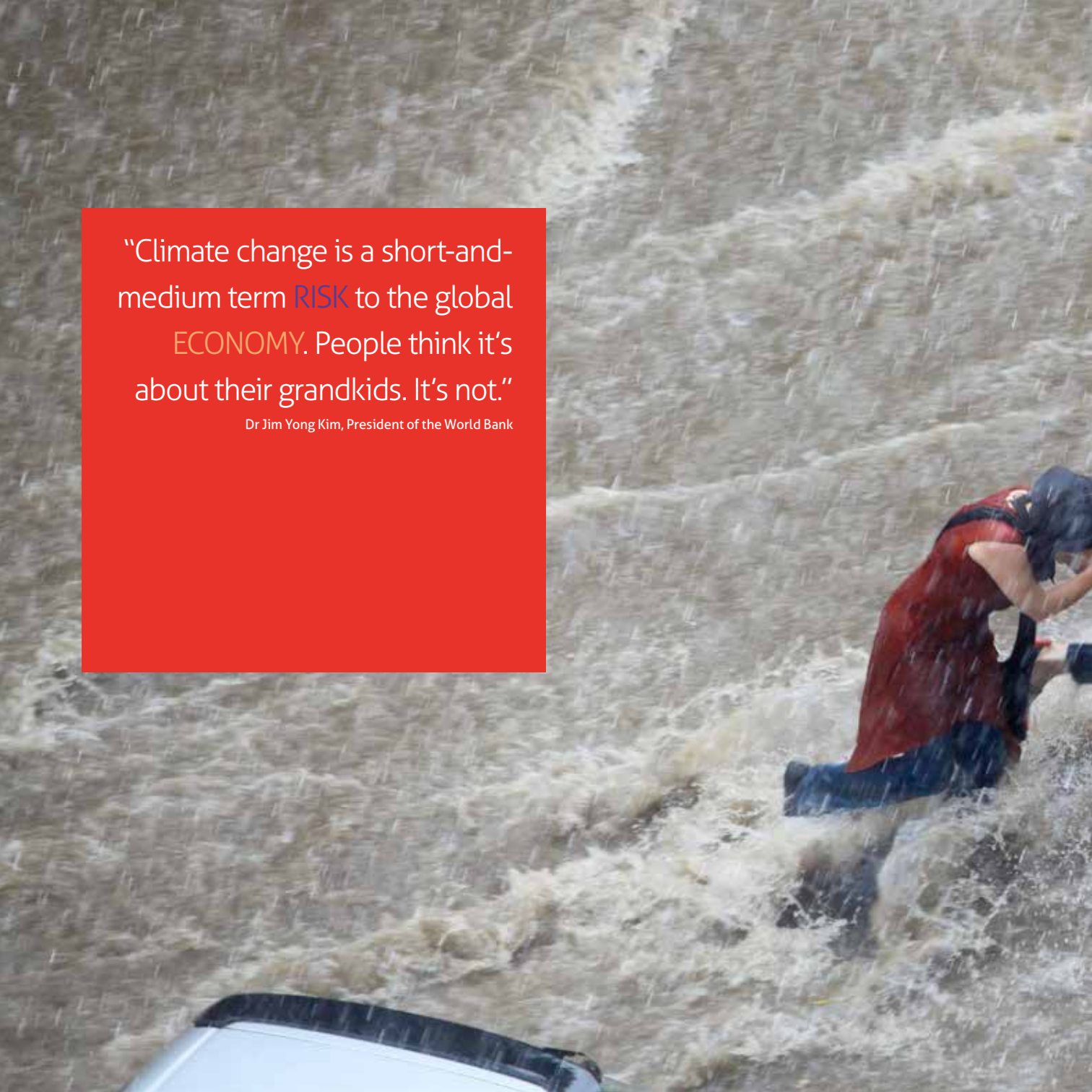
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A photograph of a person wading through deep floodwaters. The person is wearing a red sleeveless shirt and dark pants, and is carrying a blue bag. They are standing next to a white car, which is partially submerged in the water. The water is murky and turbulent, with large splashes. The background is a blurred view of the floodwaters.

“Climate change is a short-and-medium term **RISK** to the global **ECONOMY**. People think it’s about their grandkids. It’s not.”

Dr Jim Yong Kim, President of the World Bank