

FLOOD WARNING

A year ago, storms devastated parts of the UK, causing £2bn of damage and permanently changing communities. As the risk of flooding increases, Oliver Ralph talks to victims and experts about how prepared we are for extreme weather. Portraits by *Luke & Nik*. Main image by *Jonathan Knowles*

85m

Number of people affected by floods globally each year

MAPPING FOUR FLOODS

■ Storm surges coming off the coast
■ All other types of flood



Frozen ground increased surface run-off after a harsh winter, with snowmelt making the flooding worse



High tides and a storm combined to devastating effect, killing hundreds in the resulting storm surge



The wettest autumn in at least 200 years led to massive flooding, causing damage estimated at £1bn at the time



A series of storms

5.5m

Properties at risk of flooding in England and Wales

It is a warm autumn day, and the blue ribbons tied halfway up the trees of Warwick Road in Carlisle flutter gently in the breeze. They are a subtle reminder of the flooding that hit the area last December, each one positioned at the height the water reached.

They are hardly necessary — unobtrusive reminders are everywhere. Almost a year on from the floods, skips still line the sides of the road, overflowing with debris. They jostle for space with the builders' vans and Portalos as concrete floors, damp-proofing courses and new kitchens and carpets are installed. Most of the houses are still in the throes of renovation.

John Kelsall takes me into his daughter's home on a side street. There are no builders' vans here yet. The floorboards are up and the walls have been stripped bare. The downstairs of the house is a shell. He points to a smudgy white line in the middle of the living-room window. "That," he says, "is where the water got to." The family, expecting their first child at the time, moved out when the water moved in and they still don't know when — or indeed if — they will return.

Desmond, Eva and Frank, the three storms that hit the north of England and Scotland last December, prompted floods that caused widespread devastation. An estimated 16,000 homes were affected, with the total cost of damages put at about £2bn, according to PwC. Only £1.3bn of that was covered by insurance.

"FLOOD FREQUENCY IS CHANGING. IF NO MITIGATION MEASURES ARE TAKEN, BY 2050 WE EXPECT UP TO 100 PER CENT HIGHER LOSSES ACROSS EUROPE. THE MAIN CAUSE OF HIGHER LOSSES IS NOT CLIMATE CHANGE BUT URBANISATION."

Maurizio Savina
Flood risk expert at RMS

For most of the UK's population, the rising waters in northern England and Scotland were just another item on the news; a few fleeting



Cars submerged by water in Carlisle after storm Desmond caused flooding last December © Getty

images before the focus moved elsewhere. For some, the worst consequence was that a McVitie's factory in Cumbria closed for four months, depriving fans of their Carr's water biscuits. But for many residents of Carlisle, Leeds, York, Hawick and the rest, this was a life-changing event.

Floods affect 85 million people around the world each year, and cause about 6,000 deaths. Already this year, there have been serious floods in continental Europe, the US, Myanmar and Somalia. In the UK, the Environment Agency says that 5.5 million properties in England and Wales, or one in six of the total, are at risk.

The urgency of the flood threat is increasing with the impact of climate change and the accompanying rise in the risk of extreme weather and heavy rainfall. The Intergovernmental Panel on Climate Change (IPCC) predicted in 2012 that the frequency of precipitation and increases in global sea levels would contribute to rising coastal high-water levels in Europe.

British winters have been particularly damp lately. In Carlisle, visitors to the Joiners Arms are greeted with two plaques commemorating floods. The first is from 2005, the second from 2015 when the pub suffered its second "once in 100-year" event in the space of a decade.

The UK's wettest winter was in 2013-14.

The second-wettest was in 2015-16. In a recent exercise for the government, the Met Office modelled a scenario in which rainfall increased by 20 to 30 per cent over the worst excesses seen last year.

But it is not just about the rain. Flood experts say that we are making it worse for ourselves by building on flood plains, moving more people into towns and cities and getting rid of vegetation that would otherwise absorb water. The Committee on Climate Change, a body that analyses government climate-change policy, ranks flooding as its number one risk for the UK over the next five years.

Dieter Helm, an economics professor at Oxford University who specialises in infrastructure, says the political approach is woefully inadequate. "The typical government response is get your welly boots on, get out there, be seen to be in the flood and concerned, announce a review, declare that we're never going to let this happen again, have a review, apply some sticking plaster and wait for the next time to get your welly boots out."

Flood planning, he says, is a short-term affair dictated by government spending priorities. And Helm believes that the incentives are all wrong — the Environment Agency aims to protect those properties at most risk but that strategy does not

dissuade people from living in risky areas. Helm also despairs over the excessive use of physical walls designed to protect properties from flooding. It is far better, he argues, to manage water across entire river catchment areas. "We're talking about bringing together agricultural policy, land use policy, house building and house planning, forestry and all the various components of a river system."

Earlier this month, a report from a parliamentary select committee said that current flood risk-management structures were "fragmented, inefficient and ineffective", and called for the creation of a national floods commissioner for England. Theresa May said this week that 1,200 soldiers would be put on standby this winter to help deal with flood-related emergencies.

John Curtin, who is in charge of flood management at the Environment Agency, denies there is just a short-term response. "We have a long-term scenario in which we look at a 50-year horizon," he says. "We look at climate change as well as how rapidly defences will deteriorate." He adds that there is nothing wrong with revisiting plans every so often. "Any time you go through a major flood event, it is good practice to review and refine what you do."

This year the government is due to spend £735m on building new flood defences and maintaining old ones. That is a fifth more than the 10-year average. However, flood-defence spending is forecast to fall to £437m by 2020 (although that will be topped up with money raised from an increase in insurance tax).

The Cumbrians are not impressed. "There's an awful lot of talk and an awful lot of listening but not an awful lot of clear planning," says John Kelsall. He and his family are girding themselves for the possibility of more floods. "The rivers are very high at the moment. It's ready to go if we have another storm."

How prepared is the UK if another storm hits this winter? Would a repeat of last year's rain lead to a repeat of the damage caused? We interviewed six people closely involved in the issue, from climate change scientists to insurers and flood victims, to find out how real the risks are and what we should be doing to get ready.

WATER LEVELS

1864
About 240 people were killed in the Great Sheffield Flood after the Dale Dyke Dam broke as its reservoir was being filled for the first time. One body was washed 18 miles downstream.



1928
The last time central London was hit by major flooding. The Houses of Parliament, Tate Gallery and Tower of London were all swamped. Fourteen died in basement dwellings; thousands were left homeless.



1953
North Sea floods killed 326 people in the UK and left around 24,000 homes damaged. According to the BBC, a "storm surge and an unusually high tide raised sea levels to 1.5m-2m above their predicted levels".

1982
York floods, with the city centre submerged and soldiers deployed on rescue missions. York is particularly vulnerable because it was set up at a fording point of the river Ouse.



2000
The UK's wettest autumn on record. Peak flows on five major rivers — the Thames, Trent, Severn, Wharfe and Dee — were at their highest for 60 years, and the river Ouse in Yorkshire reached its highest level since the 1600s.

2007
Several days of torrential rain following the wettest summer since rainfall records began in 1766 caused the worst flooding in England in 60 years, with 13 people killed and more than 130,000 homes and businesses swamped.

2015
Lancashire and West Yorkshire were particularly badly hit, with Leeds city centre flooded.

"WE HAVE OVER 200,000 POSSIBLE FLOODS IN THE UK MODELS. WE LEARN FROM WHAT WE OBSERVE, THEN CREATE MODELS AND MAPS BASED ON WHAT MAY HAPPEN. NEW TECHNOLOGY AND BETTER COMPUTING POWER ALLOW US TO BE MORE COMPREHENSIVE. WE USED TO MODEL TO ONLY 1KM RESOLUTION. NOW WE CAN GO DOWN TO 5M, AND DIFFERENTIATE THE RISK BUILDING BY BUILDING."

Maurizio Savina
Flood risk expert at RMS

£2bn

Cost of damage caused by 2015 floods



The mapping specialist, Maurizio Savina

The November 1994 floods in northern Italy killed at least 30 people, made about 4,500 families homeless and left a big impression on Maurizio Savina. Still a teenager at the time, he watched as the nearby town of Casale Monferrato was inundated.

The floods left Savina with a lifelong interest in water and the way it flows. After studying engineering in Turin, the US and Switzerland, Savina now spends his

time mapping and modelling the movement of water. The company he works for, RMS, advises governments and insurers across the world on flood risk — where they will hit, with what force and with what consequences. As floods grow in both size and severity, there is plenty of call for his services.

Savina's job, he says, is about both "forecasting" the medium-term future and "nowcasting" what will happen in the next few hours. Although "nowcasting" is mostly used for windstorms at the moment, predicting when and where they will make landfall, the technique is being developed for floods.

"Flood frequency is changing," he says. "If no mitigation measures are taken, by 2050 we expect up to 100 per cent higher losses across Europe." The main cause of higher losses, he says, is not climate change but urbanisation. "People are getting closer to water. Since 1990, the number of people living in flood-prone areas has grown by 20 per cent.

"Bringing people closer to water means that more people are getting flooded, and some people are getting flooded more often. Urban catchment areas are growing, and the water is flowing into drainage systems that were not built for that level of use."

Modelling the impact on individual properties is an increasingly complex, multistage process. The days of simple flood maps based solely on past experience are long gone. Now RMS uses data about the water-flow rate in rivers, rainfall, predicted future events, and resilience and resistance measures. Data are gathered at all levels, from satellites and drones to on-the-ground observations, all with the aim of assessing both the vulnerability of individual properties and their value.

"We have over 200,000 possible floods in the UK models," he says. "We learn from what we observe, then create models and maps based on what may happen. New technology and better computing power allow us to be more comprehensive. We used to model to only 1km resolution. Now we can go down to 5m, and differentiate the risk building by building."



The watchdog, Lord Krebs

My trip to visit John Krebs in Oxford is delayed by, of all things, a flood alleviation scheme. The Hinksey project, which is designed to raise a 400m stretch of rail track at a cost of £175m, disrupted services to and from the city over the summer.

Krebs has a professional interest in the scheme. His job, as part of the Committee on Climate Change set up by the government in 2008, is to assess how well the country is prepared for whatever the climate throws at us next. The CCC's latest risk-assessment report considered the hazards faced by the UK over the next five years. Flooding was first on the list, beating high temperatures, water shortages and risks to food supply.

Krebs says that 860,000 households, or 18 million people in the UK, are facing significant flood risk and the situation could get worse. "Under some scenarios, that could have doubled by the middle of this century, even with current levels of action to reduce the risk. There is a real necessity to start acting now," he says.

Global warming is one of the causes but not the only one. "We've made things worse for ourselves in a number of different ways," he says. "We are continuing to build apace in flood-risk areas. We're building 4,500 homes per

year in areas of significant flood risk." There are also problems in rural areas. "The [problem is that] the way we're using the land is encouraging water to drain quickly off hills into river valleys rather than to stay where it falls. This, therefore, contributes to the flooding of towns and cities." The draining of sponge-like upland peat bogs for agricultural land is one example of this.

The government's response, says Krebs, leaves something to be desired. "On a scale of one to 10, it's probably five-ish. Last year we said we thought it was time for the government to take a new strategic look at the approach to flood risk. The government's response was to say, 'We don't think it's appropriate at this time.' They felt there was enough going on already."

Whitehall, he says, needs to take a wider view of the problem. "The priority should be to view flood-risk management as a water-catchment problem rather than a hard-defences problem. At the moment it is mainly seen as, 'Can we throw more money at it and bigger defences?'"

A wider approach might involve radical action. One of Krebs' ideas is to pay farmers to allow their land to be flooded. That might divert water that would otherwise flow into towns and cities. Flooded farmland, he points out, is cheaper to fix than flooded towns.



The climate scientist, Friederike Otto

Otto is harnessing people power. The Oxford university academic and her team are asking how much, if at all, man-made climate change is contributing to the sort of extreme rainfall that creates floods. To do that, she has recruited tens of thousands of volunteers and persuaded them to lend her their computers.

The weather is certainly changing. Otto has analysed changes in weather patterns in particular areas and seasons. "Extreme rainfall is becoming more likely, especially in winter," she says.

"We've looked at the south of England, where there has been a 40 per cent increase in extreme winter rainfall. It is similar in the north of England and south of Scotland." But the pattern is not repeated across the year — there has been no change in extreme rainfall in the summer, and in the spring extreme rainfall has decreased.

How much of this can be blamed on man-made climate change? In theory, it is an easy link to make. A warmer atmosphere can hold more water, so rain is more likely. And global warming can also affect weather systems. For Otto and her team, though, the challenge is to work out statistically whether the trends are linked.

For that, she uses a programme called climate-prediction.net. To test how temperature changes affect weather systems, Otto needs to run thousands of models testing the impact of small changes in temperature on specific regions. Even powerful supercomputers can only generate a handful of these sorts of simulations, so, instead, she uses spare computer capacity donated by volunteers to run all the different models.

The results can determine whether, for example, a particular change in temperature can lead to a one in 1,000-year possibility of a certain type of severe weather becoming a one in 100-year possibility.

Otto and her team tested their theories on the storms that swept Scotland and the north of England last winter. Using a variety of different models to test what might have caused storm Desmond, the climate-prediction.net team found that climate change did make that type of weather event more likely.

"While we know that the temperature has changed, we don't know what the impact is today," she says. "We're providing the methodological tools to do that."



The insurer, Brendan McCafferty

When it comes to flooding, there are few thornier issues than how to make insurance affordable for people who are likely to be flooded. The person tasked with finding an elegant solution is Brendan McCafferty. An insurance industry veteran with stints at Aviva, RSA and Willis under his belt, McCafferty is now chief executive of Flood Re, a body that began operating in April. Its sole aim is to enable those at risk to find reasonably priced cover.

"There were undoubtedly thousands, if not tens of thousands, of people that had been flooded in the past three to five years that were very unlikely to be able to afford flood insurance," he says. "A typical person who had suffered a flood in the past would be asked to pay premiums of several thousand pounds and their excesses were likely to be tens of thousands of pounds."

The solution is simple in theory but complex in practice. Flood Re is a mechanism that subsidises home insurance for people in flood-prone areas. It is funded by a £180m annual levy on the insurance industry that, in turn, is often passed on in the shape of higher premiums to everyone who buys home insurance. Set up as a joint initiative between the government and the insurance industry, Flood Re is accountable to parliament. But the government does not provide financial support and would not put in money if Flood Re were to run out of funds.

McCafferty, who is moving to Axa next year to run its UK general insurance business, insists his organisation will be able to pay out even in extreme scenarios. "We have a sum of £2.1bn [of claims] that Flood Re can meet every year," he says. "That reflects what we would pay back to the industry in a catastrophic weather event. We're really, really confident that the £2.1bn is comfortably in excess of what we need for a one in 200-year event."

Flood Re is only supposed to last until 2039. After that, the theory goes, flood insurance should be affordable for all without the need for a subsidy. "Our job," he says, "becomes one of looking at what needs to happen to create that outcome. We'll bring our data, our picture of where the risks are and where the real actual claims are. That might mean insurers taking action, it might mean government, it might mean householders. We will be looking at what we can do to incentivise and encourage and reward the right response."

"There's an awful lot more work to be done," he adds. "Our need to reflect that risk in the way that we manage our lives is something we're still at the beginning of grappling with."