OPINION

What did cause the April KZN floods?

What caused the floods that devastated coastal KwaZulu-Natal in April and did climate change play a part? Prof Roland Schulze dissects a disaster and looks to the future. Additional reporting by Matthew Hattingh.

SDG

It was the not-so-little girl who caused the trouble. The April KwaZulu-Natal floods that claimed 448 lives – with 88 people still missing at the time of writing – owes its origins to a complex phenomenon on the other side of the planet.

Every now and then, winds cool a vast swathe of surface sea east of South America. The Pacific catches a cold, as it were, and the world's weather sneezes. It's known as La Niña (Spanish for "the girl") and we are at present in her grip, meaning generally heavier rains and more frequent floods.

And so it happened around the second weekend of April. A cut-off low pressure system began brewing south-east of Durban. These occur when the atmosphere's usual west-east passage is disrupted, trapping a pool of low pressure in a huge eddy. Where pressure is lower air is freer to rise and the moisture it carries condenses and falls: It rains.

By Monday, 11 April, the cut-off low, code-named "Issa", had grown in intensity and from midnight through to midnight on Tuesday unleashed more than 300 mm of rain in places along the coast. That's the equivalent of 30% of the region's average yearly rainfall. Remember too, that days earlier, 50-150mm drenched the region. The ground was already sodden.

Such was the deluge that the Shongweni dam, 12 km west of

central Durban, popped two fuse gates, sending a torrent down the Umlazi River. The gates are safety mechanisms designed to save the dam wall from bursting. Just before the river passes beneath the N2 it enters a canal for the final few kilometres of its journey to the sea. Swamped, the canal spilled its waters onto the highway and flooded the coastal plain, including parts of south Durban's industrial heartland.

Similar scenes unfolded elsewhere in the eThekwini municipality. Low-lying parts of Amanzimtoti looked like a lake. To the north, holiday flats terraced into the forested dunes above Umdloti, crumbled spectacularly. In Durban's western suburbs, streams normally too insignificant to have names grew mighty overnight, tearing apart homes.

Across eThekwini, 8 584 homes were destroyed, with a further 13 536 listed as "partially destroyed". Raging waters washed away bridges, collapsed roads and let loose landslides. Some 100 electrical substations were flooded, plunging large areas of the metropolis into darkness. The floods damaged pipelines, cutting water supplies to some areas and the water treatment works in Tongaat, a 40 minute drive north of central Durban, sustained R30-million in damage, part of an estimated R25 billion in infrastructure damage across eThekwini.

Provincial Premier, Sihle Zikalala, at a briefing a month later called the floods "the worst in history". Given the devastation and death toll, Zikalala's assessment is understandable, but is it accurate? Let's first consider a few rainfall figures for 11-12 April, taking in Durban and the coastal region as well a few towns or cities in the hinterland by way of comparison:

- Margate: 311 mm
- Mt Edgecombe and Pennington: 307 mm
- Virginia Airport: 304 mm
- King Shaka Airport: 225 mm
- Port Edward: 188 mm
- Pietermaritzburg: 99 mm
- Mtunzini: 66 mm
- Greytown and Mooi River: 44 mm

Prof Jeff Smithers, of the Centre for Water Resources Research at the University of KwaZulu-Natal, estimated the one-day rainfalls recorded in coastal areas from Margate to Virginia Airport were in the order of a 1 in 50 year to a 1:100 year event. Expressed differently, there was between a 2% and 1% probability of such rainfall, or more, in any given year. A little inland, at a somewhat higher altitude, for example in Pinetown, the estimates were of these being between 1:100 and 1:200 year rainfalls. But remember, we are in a La Niña phase, when flooding is more likely. None of this is new, as detailed by BS Young's 1960 scientific paper on Floods in Natal in the Royal Meteorological Society's journal ***Weather***, as well as P Badenhorst and co-workers' Survey of the September 1987 Natal Floods, published in 1989 by the Foundation for Research and Development.

In addition, newspaper articles tell us of significant floods in the Umgeni River system, along the coast of KwaZulu-Natal and inland to the Drakensberg.
These include:

- 1856: 686 mm of rainfall was recorded in Durban from 13 to 15 April (***Natal Mercury*** of 18 and 25 April 1856), with the uMgeni breaking its banks, straightening its course and inundating the city, the Isipingo Flats becoming a lake and the sugar industry hard hit.
- 1905: From 31 May, the edge of a tropical cyclone, it is believed, brought rains and hail, spreading as far inland as

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President Cyril Ramaphosa visited the flood-stricken areas of KwaZulu-Natal on 13 April. A total of 459 people lost their lives while thousands were left homeless.

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It cost billions of Rand to repair the provincial and national road infrastructure damaged by the floods.

Dundee, but with Durban receiving 381 mm in 15 hours, Pinetown 398 mm in 15 hours and with 200 drowned in the Umhlatuzana and Umbilo rivers.

- 1917: 432 mm fell from 23-26 July, apparently with little damage, but in October, 320 mm was recorded in Durban in one day.
- 1984: In the Domoina tropical cyclone floods, the Richards Bay-Sodwana area, for example, measured 950 mm and an area of 107 000 km^2 received in excess of 370 mm, with over 80 000 people stranded. These are probably the heaviest rains experienced over much of KwaZulu-Natal since official measurements began around the 1850s.
- 1987: A cut-off low moved moist air over the southern parts of the country, commencing with general rains over the former Transkei and KwaZulu-Natal, with parts of the province receiving over 900 mm, mainly on 28 and 29 September. There were 506 known fatalities. Badenhorst estimated this to be an event with a recurrence interval of 120-150 years.

The late Zoltan Kovacs, from what is now the Department of Water and Sanitation, did a major comparative scientific assessment of the 1984 and the 1987 floods, which was published in 1988 in ***The Civil Engineer***. He concluded that heavy rain fell over considerable areas, with Domoina covering larger areas for rainfalls up to 700 mm, but with the 1987 floods covering larger areas where more than 800 mm fell.

So, if we agree the '87 floods were in fact the province's worst in recorded history, how does this compare with flooding elsewhere in the world? A popular worst-floods list puts the 1931 floods in China at the top, with a death-toll of 2.25 million. The next worst, also in China, in 1887, also caused estimated casualties in the millions. More floods in China, at different dates in the twentieth and nineteenth centuries followed and then there were floods in the Netherlands and England in the fourteenth and ninth centuries. Filling out a grisly top 10, were floods in the Holy Roman Empire. The 1987 floods came in at only 102nd place on the list, with 506 deaths.

What about climate change? Did it play a part in the April floods? Climate change is a phenomenon where the release of carbon-dioxide and other 'greenhouse gases', whether by man-made or natural processes, causes a warming of the earth's atmosphere. Evidence suggests this will increasingly have a bearing on where, when, how often and how hard rain falls. But climatic systems can be extraordinarily complicated. Researchers are using complex computer modelling and other techniques to develop a clearer picture of what's happening, but theirs remain very much a work in progress.

When it comes to drawing direct cause-and-effect links, scientists generally err on the side of circumspection. Governmental spokespeople, however, can be rather less reticent. And in the wake of the disaster, some were unequivocal on the subject of climate change. They tended to forget about the history of flooding in KwaZulu-Natal.

Inevitably, many politicians visited flood-affected areas, including the President, the ministers of Police and of Co-operative Governance, the premier and mayors. They issued many statements, some no doubt out of conviction or from ignorance of the province's flooding history, but still others, possibly for reasons of political expediency or point-scoring, jumped onto the climate change bandwagon to hide the shortcomings of their own governance.

President Cyril Ramaphosa, when inspecting the damage, said: "This disaster is part of climate change. It is telling us that climate change is serious; it is here." Desigen Naidoo, of the Institute of Security Studies, commented that the April floods were "arguably one of the most visible and deadly signs of climate change in the country to date".

However, the SA Weather Service could not with any "quantifiable precision" attribute the floods to climate change. Nor is there consensus in the scientific literature on trends in the currently observed data regarding the impacts of climate change on floods. We need to remember that climate change, real as it is, has become a buzzword and often serves as a convenient scapegoat or distraction from governmental inefficiencies.

La Niña helped give rise to Issa, which in turn was the primary source of the flooding. With the soils already saturated, there was a certain inevitability to it.

But what do we mean by the "inefficiencies" referred to above? Instead of constructing and then neglecting stormwater infrastructure we need to focus more on maintenance. Municipalities must tackle the litter, rubble and alien invasive riverine vegetation that block drainage systems and make flooding worse. An interesting research project would be to calculate the cost of proper stormwater system maintenance vs the additional cost of flood damage and loss of life because the system failed to function efficiently during, say, a 1 in 2-year, or a 1:10 or a 1:20-year flood, let alone a 1:50 or a 1:100-year flood.

But even with the best will in the world, preventing flooding can be hard to do. There are physical, economic and possibly even social limits in the construction of stormwater infrastructure. And even well designed and maintained infrastructure may prove inadequate in an extreme event.

The floods did considerable damage to the informal sector. EThekwini's growing shacklands are home to 1.2 million people, mostly poor and frequently recent migrants to the city. Their

homes seldom have solid foundations and are often built on steep slopes or in floodplains.

The municipality must continue to bring these areas into its planning. And it must enforce bylaws on where people may build. But the problem goes beyond maintenance and the better handling of informal settlements. Drains in some business districts were blocked with litter too.

When it comes to flooding, we need to appreciate that land use change is often as important, if not sometimes more important than climate change. Hard roofs and roads do nothing to slow run-off when it rains and this can be a much more significant factor in flooding than climate change, as a recent study in Pretoria found. In rural areas, over-grazing often strips the ground of its surface protection, leading to direct run-off and erosion.

What should we do? Too often, climate change research focuses on annual changes and areas on a large scale. We need more research on local issues and the individual floods they experience, including flood-prone streams; steep slopes susceptible to mudslides; local soil-types that become saturated easily; and building materials used. In the longer term we must reduce greenhouse gas emissions and close the gap between climate change policy and how it's put into practice.

In the middle term we must redesign drainage infrastructure guided by computer modelling of floods and risk assessments. Building codes and standards must be updated and aspects of town planning revised. More immediately, we must take high alerts from the SA Weather Service seriously and develop smart early warning systems. These, with efficient and well-capacitated rapid response systems, will help save lives and property, and hasten recovery.

Infrastructure must be maintained, building codes enforced, and respect encouraged for the 100-year floodline. Flood lines are shifting and the frequency of rainfalls is in flux, but change will vary from place to place. For example, for Pietermaritzburg our research shows that in next 30 years rains of 100 mm per day are projected to increase by more than 8%, rains of 150 mm/day by more than 37% and falls of 200 mm/day by over 50%, while for those same thresholds of rainfall around Durban the models show little change.

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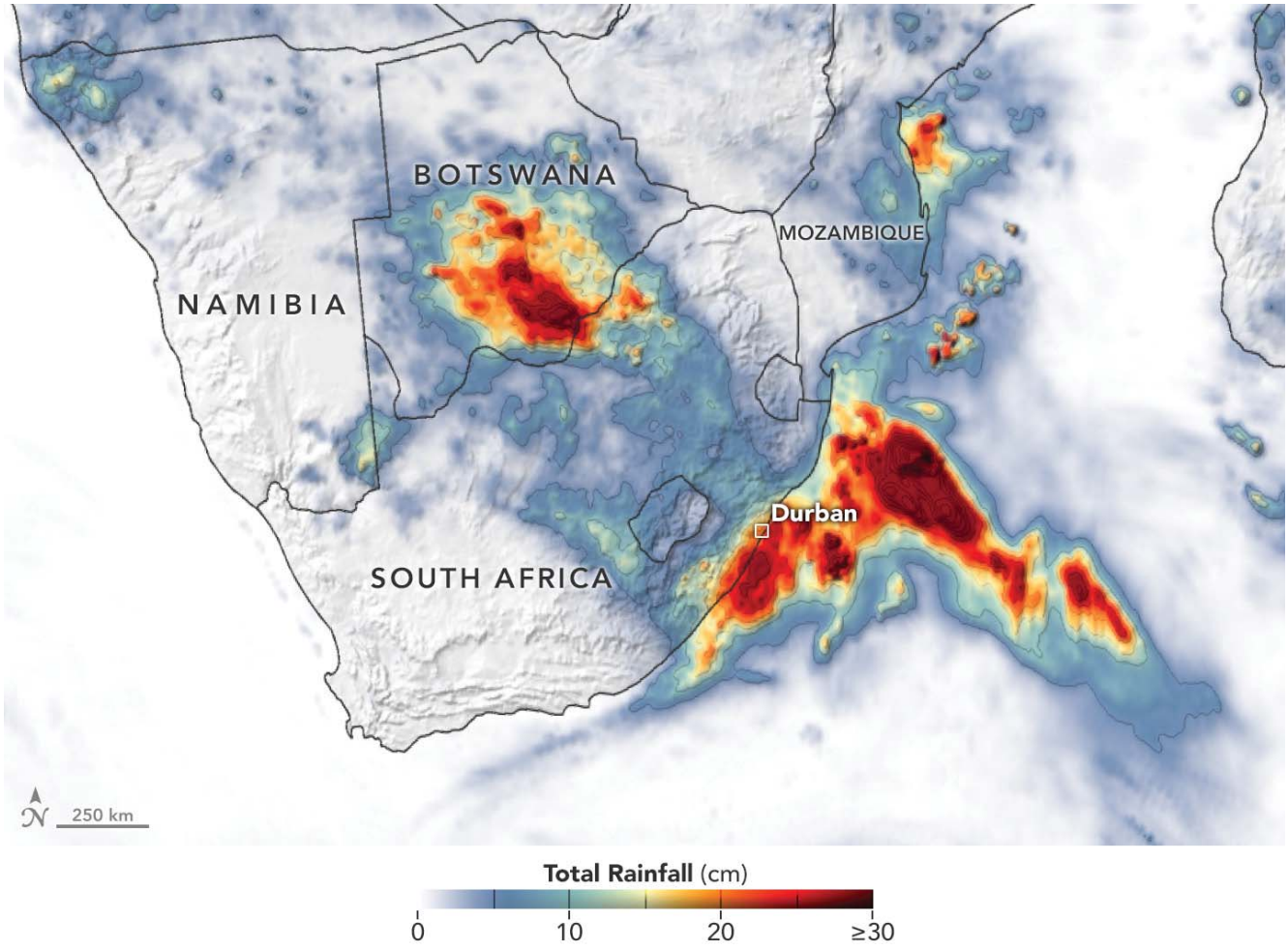

Joshua Stevens/NASA Earth Observatory

A satellite-based estimate of rainfall over a seven-day period ending on April 13, 2022, that swept over the eastern area of Southern Africa. The darkest reds reflect the highest rainfall amounts, with some places in Botswana and South Africa receiving as much as 3 000 mm or more.