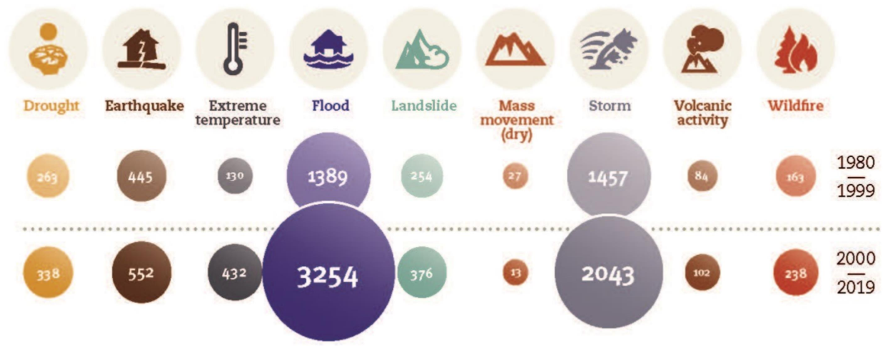
The number of disasters has increased five-fold over the last 50 years according to the World Meteorological Organization (WMO, 2021) and by all accounts is expected to continue to increase. According to EM-DAT (CRED / UCLouvain), one of the foremost international databases of disasters linked to natural hazards worldwide, there were 7,348 disasters in the 20-year period from 2000 and 2019, significantly higher than the 4,212 disasters that occurred in the previous 20-year period (1980-1999) (Figure 1). The disasters in the last twenty years have claimed approximately 1.23 million lives, an average of 60,000 per annum. Over 4 billion people were affected; many on more than one occasion. Additionally, the disasters reported during that time led to economic losses worldwide of approximately US$ 2.97 trillion, an increase from US$ 1.63 trillion (1980 and 1999). The purpose of this paper is to examine and compare the impact of these natural disasters in various countries on their economies and the world.

Figure 1: Total disaster events by type between 1980 and 1999 / 2000 and 2019



Source: CRED / UCLouvain (2020)

Since the launch of EM-DAT with the initial support of the World Health Organisation (WHO) and the Belgian Government in 1988, CRED / UCLouvain have collected data on the occurrence and effects of over 24,000 mass disasters in the world from 1900 to the present day. For the purpose of this paper, geo-referenced EM-DAT data is retrieved for 1081 natural disasters that occurred between 2000 and 2022 across 8 countries spanning Africa, Europe, North America, Oceania, South Asia and South East Asia. The disasters are organised into 16 different disaster types following definitions of the IRDR Peril Classification and hazard Glossary, including droughts, floods, storms and wildfires. This data is used to obtain the average impact of a typical disaster event (over the period 2000-2022) on the number of houses destroyed, land / forest area destroyed, total damage, injuries and deaths, and potential sectoral impacts (e.g., shutdown of the electricity sector/ grid) for each of the 16 disaster types and by locations (country). Some summary data of the natural disasters is provided in Figure 2 below.

These average impacts are then translated using additional data collected from country statistical offices into impacts on land, forests, capital stocks, dwellings, labour, and selected sectors that are incorporated as shocks into a global supply chain model. For instance, the average number of houses destroyed in Australia due to a typical forest fire between 2000 and 2022 is combined with the housing stock data to obtain shocks to capital used by the dwellings sector, while the average value of economic loses (excluding dwellings) were assumed to relate to the destruction of capital used by other sectors.[1] Similarly, data on deaths and injuries are used to estimate changes in the labour supply and the loss of land or forests is linked to the supply of land for agriculture or forestry in the model.[2] We also use empirical estimates of business closures for disasters developed by Burkhardt (2021), to take account of business closures and the availability of affected workers. For sectors that were affected by a disaster event, industry output was assumed to decline by at least the estimated loss of production due to the business closure (Walmsley, Rose, et al., 2023).

FIGURE 2: AVERAGE IMPACTS BY DISASTER SUBTYPE FOR AUSTRALIA (2000-2022)

Disaster Subtype	No. events	Duration (Avg no. of days)	Total Deaths (Avg)	No. Injured (Avg)	No. Affected (Avg)	No. Homeless (Avg)	Affected Sectors (No. events)	Destroyed Houses (Avg no.)	Destroyed Forest (Avg ha)	Destroyed Farm (Avg ha)	Economic losses ('000 US$, Avg)
Drought	3	211	-	-	-	-	Animals (1)	-	-	-	$2,153,895
Drought - Other	-	-	-	-	-	-		-	-	-	$ -
Cold wave	-	-	-	-	-	-		-	-	-	$ -
Heat wave	3	16	243	2,000	-	-		-	-	-	$ -
Severe winter conditions	-	-	-	-	-	-		-	-	-	$ -
Coastal flood	1	6	-	-	670	-		-	-	-	$ 19,894
Flash flood	6	4	6	-	1,210	-	Animals (1), Electricity (1), Transportation (2)	-	-	-	$ 649,177
Riverine flood	24	15	6	1	11,479	-	Animals (4), Electricity (2), Industry (3), Transportation (1)	45	-	-	$ 922,989
Flood - Other	11	6	4	21	8,123	-	Electricity (1)	-	-	-	$ 585,878
Convective storm	16	4	4	12	9,861	30	Electricity (9), Transportation (1)	20	-	-	$ 974,820
Extra-tropical storm	-	-	-	-	-	-		-	-	-	$ -
Tropical cyclone	17	8	3	30	5,278	3,285	Animals (2), Communication (1), Electricity (7), Industry (2), Transportation (1)	-	-	-	$ 903,247
Storm - Other	10	2	1	27	393	9	Electricity (3), Transportation (1)	-	-	-	$ 30,890
Forest fire	5	33	5	85	1,350	163	Animals (3), Electricity (1), Water (1)	275	498,500	170,000	$ 149,228
Land fire (Brush, Bush, Pasture)	16	22	28	138	2,272	1,039	Animals (4), Electricity (3), Transportation (2), Water (1)	453	200,000	2,000	$ 395,368
Wildfire - Other	2	3	-	2	27	114	Animals (1), Electricity (1)	-	-	-	$ 22,109

SOURCE: CALCULATION BASED ON EM-DAT DATA (CRED / UCLOUVAIN)

The global supply chain model developed by Walmsley and Minor (2016) using GTAP v10 data and adapted to include 18 agro-ecological zones (AEZs) and unemployment (Walmsley and Strutt, 2011) is used for this analysis. We assume a very short-run closure in which there is unemployment and capital is sluggish across sectors. The impacts of these disasters in Australia and Germany on their GDP are shown below in Figure 3. The results show that Australia is impacted by a larger variety of disasters than Germany, although the losses for Germany in dollar terms are larger – this is most likely due to Germany being a larger economy and having a more concentrated population. Droughts are by far the greatest source of loss in Australia, most likely due to their longevity (average length 211 days compared to next highest 33 days for forest fires, see Figure 2). In Germany, floods have the largest impact.

FIGURE 3: REAL GDP IMPACTS BY DISASTER SUBTYPE

	Australia		Germany	
Disaster Subtype	**GDP impact (%)**	**GDP impact ($US 2021 Mill.)**	**GDP impact (%)**	**GDP impact ($US 2021 Mill.)**
Drought	-0.04	-50,852	-	-
Drought – Other	-	-	-	-
Cold wave	-	-	-	-
Heat wave	0.00	-0	-	-
Severe winter conditions	-	-	-	-
Coastal flood	-0.00	-470	-	-

[1] That is, we shock the GTAP variable qfe after swapping it with tf. Capital is assumed to be sluggish.
[2] Again, we use qfe.

Flash flood	-0.01	-15,325	-0.000	0
Riverine flood	-0.02	-21,924	-0.033	-119,399
Flood – Other	-0.01	-13,830	-0.127	-465,158
Convective storm	-0.02	-23,060	-0.009	-31,514
Extra-tropical storm	-	-	-0.013	-47,060
Tropical cyclone	-0.02	-21,354	-	-
Storm – Other	-0.00	-729	-0.001	-4,384
Forest fire	-0.01	-9,554	-	-
Land fire -Brush, Bush, Pasture)	-0.01	-11,976	-	-
Wildfire – Other	-0.00	-522	-	-

Author's calculations

Limitations and Further Research

The extent to which disasters are more likely to impact a specific area of the affected country and specific sectors is reflected in the extent to which the data show that houses, agricultural land, forests are impacted. More specific information on the differences between disasters is needed to improve our analysis. One example where differences between disasters could be improved is in the distinction between forest and land fire. While we have incorporated the AEZ data into the database we do not yet use it to shock forest and agricultural land. Instead we use information on the impact of disasters on forest and agricultural land to implement shocks to land used by the forest sector and land used by all other (agricultural) sectors. We plan to shock the AEZ pertaining to forests specifically, rather than land used by the forest sector, then the impact of the loss of forests on other sectors (e.g., livestock) could be improved.

Finally, while we use the average impacts of the disasters, further examination of the variances in these data could also be used to examine the impact of extreme disasters.

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