Reconciliation of Trends in Global and Regional Economic Losses from Weather Events: 1980–2008

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Abstract: In recent years, claims have been made in venues including the authoritative reports of the Intergovernmental Panel on Climate Change (IPCC) and in testimony before the U.S. Congress that economic losses from weather events have been increasing beyond that which can be explained by societal change, based on loss data from the reinsurance industry and aggregated since 1980 at the global level. Such claims imply a contradiction with a large set of peer-reviewed studies focused on regional losses, typically over a much longer time period, which concludes that loss trends are explained entirely by societal change. To address this implied mismatch, this study disaggregates global losses from a widely utilized reinsurance data set into regional components and compares this disaggregation directly to the findings from the literature at the regional scale, most of which reach back much further in time. The study finds that global losses increased at a rate of \$3.1 billion/year (2008 USD) from 1980–2008 and losses from North American, Asian, European, and Australian storms and floods account for 97% of the increase. In particular, North American storms, of which U.S. hurricane losses compose the bulk, account for 57% of global economic losses. Longer-term loss trends in these regions can be explained entirely by socioeconomic factors in each region such as increasing wealth, population growth, and increasing development in vulnerable areas. The remaining 3% of the global increase 1980 to 2008 is the result of losses for which regionally based studies have not yet been completed. On climate timescales, societal change is sufficient to explain the increasing costs of disasters at the global level and claims to the contrary are not supported by aggregate loss data from the reinsurance industry. **DOI:** 10.1061/(ASCE)NH.1527-6996.0000141.

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Introduction

In recent years, there has existed an apparent mismatch between (1) claims that economic losses from weather-related disaster events have been increasing beyond that which can be explained by societal change, based on loss data originating in the reinsurance industry and aggregated at the global level, and (2) a large set of peer-reviewed studies focused on regional losses, which concludes that loss trends can be entirely explained by societal change. Such regional studies typically include data from much further back in time than that used in the global reinsurance data. This study reconciles the apparent disconnect by connecting the global data set with the regional analyses, finding that there is in fact no disconnect.

The most prominent and oft-repeated claims that economic losses from weather events cannot be explained solely by societal change have come from Munich Reinsurance (Munich Re), a global reinsurance company. For instance, based on its proprietary data on disaster losses, the company concluded in a press release in 2010:

"... globally, loss-related floods have more than tripled since 1980, and windstorm natural catastrophes more than doubled, with particularly heavy losses from Atlantic hurricanes. This rise cannot be explained without global warming (Munich Re 2010)."

However, the conclusion is contrary to a large body of peer-reviewed literature (e.g., that surveyed by Bouwer 2011; IPCC 2012). Yet, such claims are often repeated in influential settings. For instance, Working Group II of the Fourth Assessment Report of the IPCC included a graph showing that disaster losses from the Munich Re data set were rising in apparent lockstep with increasing global temperatures (IPCC 2007). Several years later, it was revealed that the figure had been placed into the report against IPCC guidelines by an IPCC author who expected that the figure would appear in a future peer-reviewed paper of his, but after the deadline for inclusion in the IPCC report (Pielke 2010). When that paper was eventually published in 2008 (following publication of the IPCC AR4), no such graph was actually included and it actually concluded, "We find insufficient evidence to claim a statistical relationship between global temperature increase and normalized catastrophe losses" (Miller et al. 2008).

Despite the advantage of hindsight and recognition that the IPCC erred in this instance, the notion persists that a signal of the effects of greenhouse gas emissions can be detected in increasing global disaster losses tracked in the Munich Re data set. For instance, in addition to IPCC (2007), the claim that increasing losses or loss events in the Munich Re loss data set can be casually related to greenhouse gas emissions can be found in Congressional testimony (e.g., Titley 2013), in the popular press (e.g., Sachs 2013), and in the work of influential policy-making bodies (e.g., World Bank 2013).

In addition, such claims persist despite that several research studies funded by or conducted by Munich Re have arrived at the opposite conclusion, specifically that increasing economic losses from weather events can in fact be explained entirely by

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societal changes—more people, property, and wealth in locations exposed to weather events (Barthel and Neumayer 2012; Neumayer and Barthel 2011; cf. Höppe and Pielke 2006). The 2012 IPCC Special Report on Extreme Events, which surveyed the literature on trends in disasters losses and their potential relationship with changes in climate, concurred with this conclusion (IPCC 2012).

This paper addresses the apparent mismatch between public claims and the scientific literature with the goal of reconciling explicitly the different perspectives in a quantitative manner. The paper disaggregates the Munich Re global dataset into regional components. Then, it compares the disaggregated data to the various peer-reviewed studies that have focused on those regional components of global loss. The paper then discusses the results, ultimately succeeding in reconciling the global and regional perspectives on losses. Thus, the mismatch disappears, as the various data sets are consistent with one another, supporting the conclusions found in the broader peer-reviewed literature and as summarized recently by the IPCC.

Data and Methods

This study focuses on the following weather-related disaster types:

- Storms: Hurricanes, cyclones, typhoons, hailstorms, winter storms, snowstorms, blizzards, severe storms, and tornadoes;
- Floods: Flash floods, surges, and regular floods; and
- Other: Wildfires, brush fires, forest fires, cold spells, frost, and heat waves. Droughts are not included in this analysis as there exists no systematic and longitudinal database of drought losses.

Several institutions maintain databases on disaster-caused economic losses at the global level. Munich Re maintains the NatCatSERVICE database and the Centre for Research on the Epidemiology of Disasters (CRED) maintains the Emergency Events Database (EM-DAT). The EM-DAT reports a range of disaster data of which human impact information is the main focus rather than economic loss values. As a result, this study focuses on the NatCatSERVICE database of economic losses, which in the recent era is considered of research quality as it utilizes consistent methods for calculating loss values over time, and regularly evaluates the data. Data sources include scientific, government, and nongovernmental organizations as well as insurance companies [see Höppe and Pielke (2006) for discussion of the data set, including uncertainties and limitations].

The NatCatSERVICE database reports data of research quality starting from 1980 to present and tracks individual natural disaster events occurring anywhere in the world. Munich Re graciously provided access to their data set for an analysis that was included in the doctoral dissertation of the first author and which is the basis of this paper. The authors are particularly grateful to Peter Höppe and Angelika Wirtz of Munich Re for their assistance in providing the data and willingness to answer questions as this research was conducted.

Data include the disaster type (e.g., storms, floods), the date of occurrence, countries impacted, and the associated insured and total dollar losses. The data set organizes disaster data into seven categories based on the severity of economic and humanitarian losses. This study uses NatCatSERVICE data from both *Category 5– Devastating catastrophes* and *Category 6 – Great natural catastrophes*, the categories involving the largest economic losses. Category 5 includes all disaster events that caused >$580 million (2008 USD) of damage. Category 6 includes all disaster events that caused economic losses equal to 5% of national GDP/capita of the country where the event occurred and is the economic loss threshold that Munich Re equates to the United Nations (UN) definition of a *great disaster* (thousands of fatalities, economy severely affected, extreme insured losses) (UN 1992).

NatCatSERVICE collects disaster-caused economic loss data from countries around the world, converts the losses to U.S. dollar values for the year of the disaster event using market exchange rates, and then reports the losses. This paper adjusts the economic loss data for inflation to 2008 constant-dollar values using the Office of Management and Budget's (OMB 2013) gross domestic product (GDP) implicit price deflator [cf. Neumayer and Barthel (2011) use a different method for GDP adjustment and find results consistent with those found here].

The global data set is disaggregated into the following six continental regions: Africa, Asia (including the Middle East), Australia (including Oceania), Europe, North America (including the Caribbean), and South America (including Central America) (Fig. 1). Then, for each year, all disaster events are sorted into one of three categories: Storms, Floods, or Other (Fig. 2,) which results in 18 subcategories of the global data set. Often, disaster events involve a chain reaction with a first-order disaster spawning second-order disasters (e.g., floods producing landslides). The categorization used herein is based on the first-order disaster type.

Annual regional losses are calculated by summing all losses together from disaster events of the same category occurring in the same continent in the same year. Then, losses are calculated as a percentage of GDP of that continent and year using annual GDP values from the International Monetary Fund (IMF). The IMF data provide GDP values in U.S. current-dollar values, which are then adjusted for inflation as described earlier. Several countries and their GDPs are not included in the IMF database and therefore had to be excluded from the continental GDP calculations. These include Anguilla, Aruba, Borneo Islands, Guadalupe, Guam, Macau, Marshall Islands, Martinique, Micronesia, Montserrat,

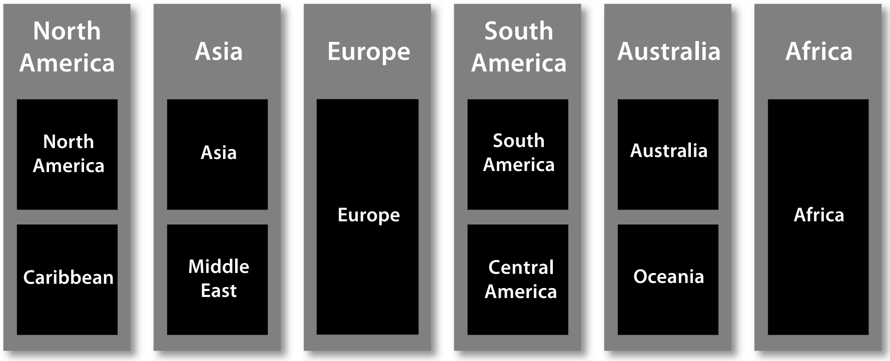

Fig. 1. Global data disaggregated into regional components

Fig. 2. Scope of disaster types

Northern Mariana Islands, Netherland Antilles, Somalia, St. Maarten, Sumatra, Virgin Islands, and Zaire (IMF 2013). Table 1 provides an example for North America in 1991.

With the disaggregated data, one is then in a position to quantify the contribution of each regional subset to the aggregate trend of the global loss data set, and to compare the disaggregated data subsets to relevant literature on loss trends for specific phenomena in the specific region. In this manner, one may compare the literature on various regions to Munich Re's global data set and identify possible gaps or inconsistencies, as well as areas of agreement.

Results

Trends in Aggregated Global Losses

Fig. 3 shows the annual global losses from the data set as a percent of annual global GDP from 1980–2008 showing a clear upwards trend (Fig. 3). For instance, the disaster events contributing to the large losses in 1998 occurred in two different continents from two different disaster types. In Asia, three separate flood events causing large losses occurred in North Korea, Bangladesh/India/Nepal, and China. In Central America (which is included with South America in this study), Hurricane Mitch caused large losses. In 2005, the major peak in losses reflects three North American storms: Hurricanes Wilma, Rita, and Katrina.

Table 1. Example: Losses as a Percentage of Continental GDP for North America in 1991

Losses	Percentage
Annual continental GDP (in 2008 $US billions)	$10,078.65
Annual *Storm* losses (in 2008 $US billions)	$5.28
Storm losses as a percent of annual continental GDP	0.05
Annual *Flood* losses (in 2008 $US billions)	$1.24
Flood losses as a percent of annual continental GDP	0.01
Annual *Other* losses (in 2008 $US billions)	$3.63
Other losses as a percent of annual continental GDP	0.04

Disaggregation of the Global Data

Fig. 4 shows the percentage of global losses attributable to each disaster category. More than half of all global losses are attributed to storms, while flood losses constitute about one-third of global losses and other losses total less than 10% of global losses.

Fig. 5 shows each of the six continents' annual total losses in inflation-adjusted dollars and shows the negligible role in this data set of economic losses from Africa, Australia, and South America. Europe's losses rank larger, but they do not match the level of losses from Asia and North America. The losses from both of the latter continents comprise the bulk of global losses throughout the time period. The absolute losses result in a similar trend to that found for disaster losses as a percent of global GDP.

Fig. 6 shows the annual percentage of global losses attributable to each continent. In certain years, a single continent's losses dominate, a result of including only those disaster events causing losses above the monetary threshold. A year when only one continent is depicted with losses means that only one continent experienced disaster events causing losses above the threshold. Similar to Fig. 5, Fig. 6 shows the negligible role of losses from Africa, Australia, and South America. Fig. 6 shows South America's losses in years that do not actually correspond to years of the continent's peak losses. Rather, South America's losses are noticeable in years when global losses are low, thus allowing the continent to contribute a

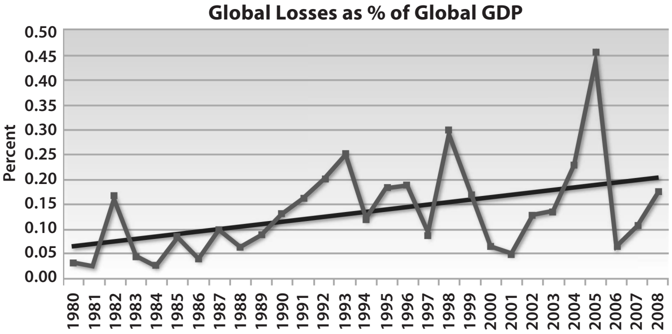

Fig. 3. Global economic losses as a percentage of global GDP

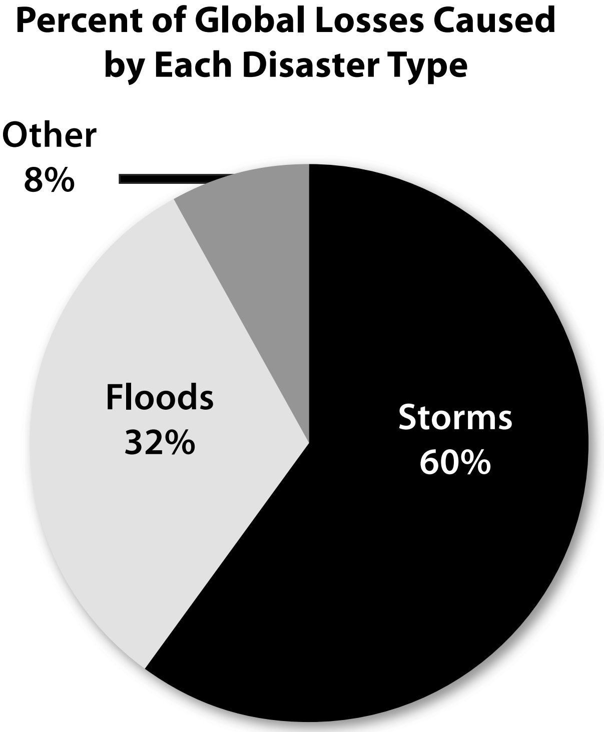

Fig. 4. Percent of global losses by disaster type

more dominant percentage of global losses. Europe's losses are not as significant as losses from Asia and North America. Similar to South America, Fig. 6 shows European losses as the largest percentage of global losses in years when global losses are relatively low, although the 6 years depicted do correspond to the years of the continent's peak losses. For the majority of the period, however, Asia and North America contribute the dominant percentages of global losses.

North America

North America has consistently experienced major storms that produce large losses, of which most of these are hurricanes in the United States (Fig. 7). Hurricane Andrew caused major losses in the Caribbean/United States in 1992. The 2005 peak reflects losses from Hurricanes Wilma, Rita, and Katrina. Hurricane Wilma affected the Bahamas, Cuba, Haiti, Jamaica, Mexico, and the United States, while Hurricanes Rita and Katrina affected the United States and can also be seen in global losses (Fig. 3).

The North American storm losses are subtracted from the aggregate global losses in order to ascertain their contribution to global losses. Fig. 8 shows that the linear rate of global losses without the contribution from North American storm losses is \$1.295 billion/year (2008 USD). Thus, North American storms (i.e., mainly U.S. hurricanes) account for almost 60% of the aggregate global trend in the data set from 1980 to 2008.

Similar to the analysis presented for North American storms, losses are individually subtracted out of each regional phenomenon from global losses to quantify their impact on the overall global trend. Table 2 summarizes the results of this approach, showing the annual average contribution of each to the global trend since 1980. Several regional sources are not included if they had insignificant economic losses reported for the time period of this study.

Table 2 summarizes the percentage of the global loss rate attributable to each regional source. Since the global rate is increasing overall, this study considers only the regional sources with increasing losses and recalculates the percentages (Fig. 9). Fig. 9 indicates that 96% of the increase in global losses can be attributed to losses from just six of the 18 regional phenomena: North American storms, Asian storms, Asian floods, European floods, European storms, and North American floods. (The addition of Australian storm and flood losses brings this total to 97% and will be discussed later.) Thus, an understanding of the factors overwhelmingly responsible for the increasing global trend in the Munich Re data requires an understanding of the dynamics driving increasing losses in these six regional phenomena. That is the subject to which the paper now turns.

Regional Attribution: Reconciling with Existing Literature

Numerous studies have focused on North American storm losses and the factors causing the large increase in losses over time. Multiple studies of U.S. hurricane losses since 1900 have concluded that economic losses are increasing due to inflation, population growth in vulnerable coastal areas, and increasing

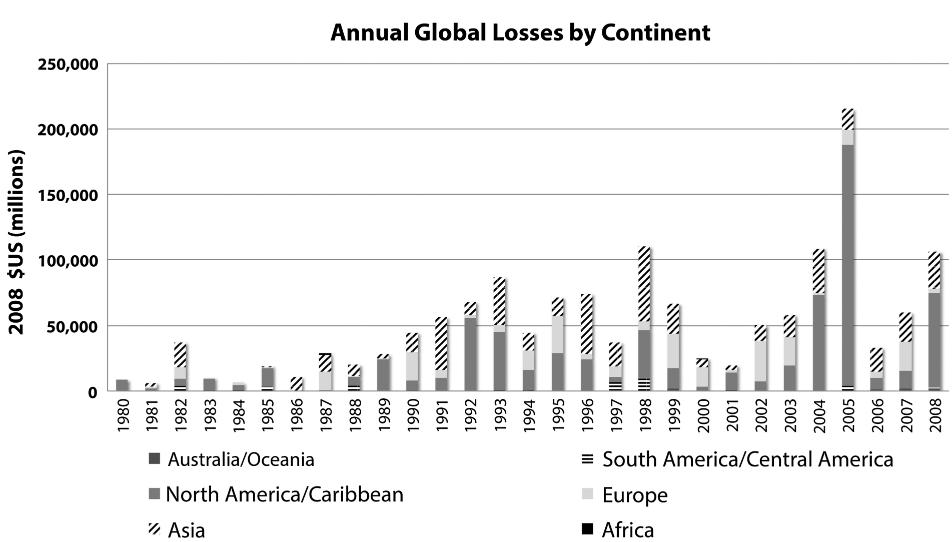

Fig. 5. Global losses by continent

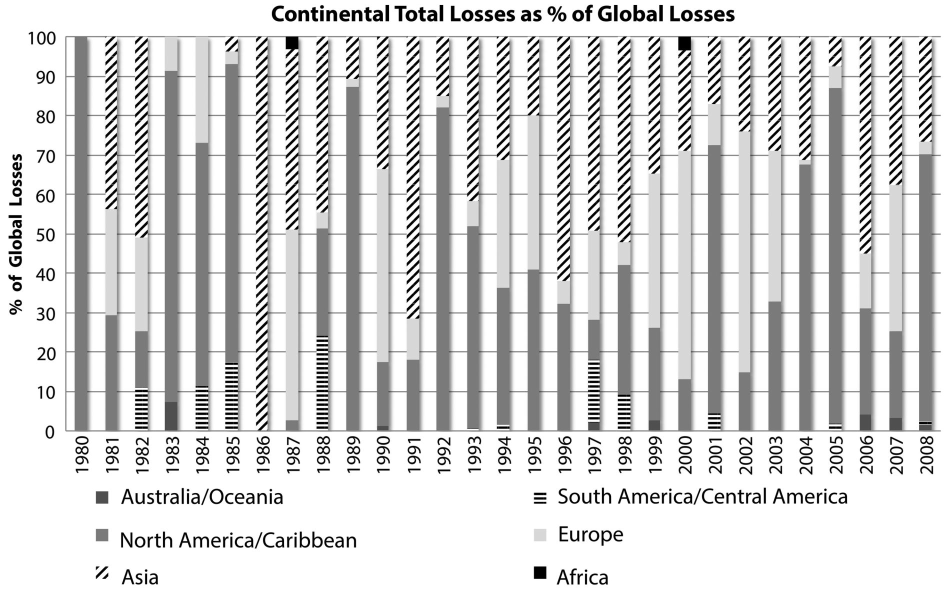

Fig. 6. Continental losses as a percentage of global losses

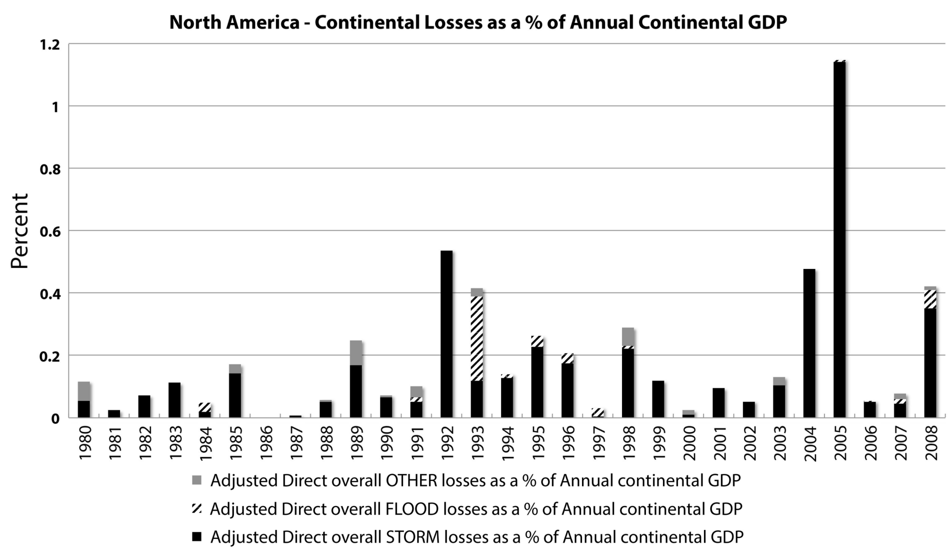

Fig. 7. Continental losses for North America

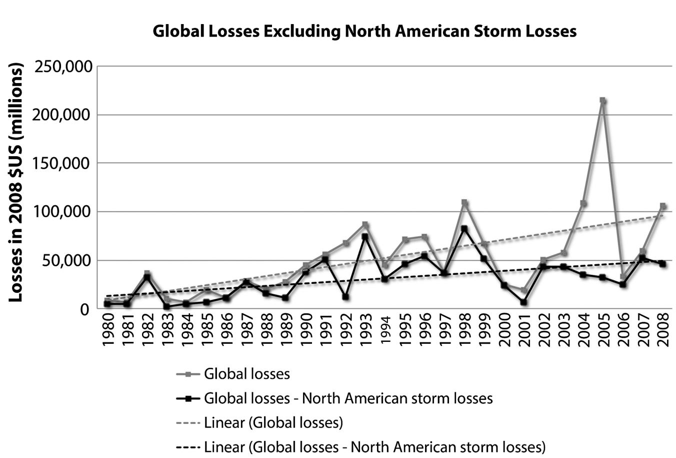

Fig. 8. Global losses excluding North American storm losses

Table 2. Contribution of Regional Phenomena to Overall Global Trend

Region/ phenomena	Annual rate of increase of global losses (2008 $US million)	Annual rate of increase of regional losses (2008 $US million)	Regional contribution to total global increase (%)
Global	3,116.6	—	—
North American storms	—	1,821.4	58
Asian storms	—	483.0	15
Asian floods	—	315.1	10
European floods	—	248.1	8
European storms	—	120.2	4
North American floods	—	79.2	3
European other	—	67.2	2
Australian storms	—	25.9	0.8
South American storms	—	14.1	0.5
Australian floods	—	7.7	0.3
North American other	—	−2.2	−0.1
South American floods	—	−13.7	−0.4
Asian other	—	−83.8	−3

Note: Values may not add to 100% due to rounding.

wealth (Choi and Fisher 2003; Nordhaus 2010; Pielke 2005; Pielke and Landsea 1998; Pielke et al. 2008; Schmidt et al. 2010). Collins and Lowe (2000) suggest additional factors including the increase in number of properties, increase in the size or quality of structures, rise in property values, increase in the number and value of assets, increase in insurance holders, increased insurance coverage, and changes in claims practices. When these studies adjust the economic loss data to reflect these factors, losses no longer show an increasing trend. Schmidt et al. (2009, 2010) attribute the majority of the increase in U.S. hurricane losses to population growth in vulnerable areas and increased wealth. They hypothesize that if anthropogenic climate change is responsible for increasing

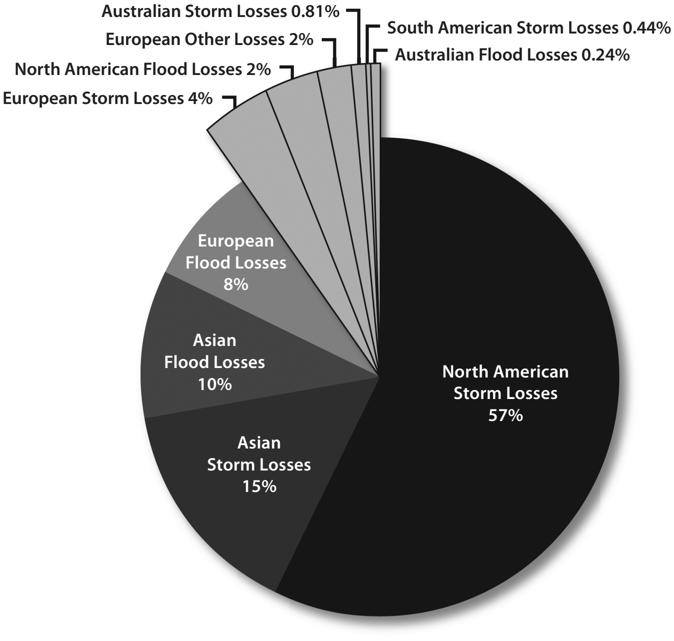

Fig. 9. Percentage of global increase attributable to regional losses

Atlantic hurricane activity since 1970, then to the extent that such a basin-wide increase contributed to an increase in landfalling storms, then it would be a factor in recent increased losses (Schmidt et al. 2009, 2010). The conditional statement finds little support in the scientific literature to date (Knutson et al. 2010; IPCC 2012), and there is strong evidence that landfall rates have not increased (Weinkle et al. 2012). Pielke et al. (2003) completed a severity study for Cuban hurricanes since 1900 where they determine that increasing economic losses are wholly attributed to inflation, population growth, and increasing wealth.

Kunkel et al. (1999) attribute the increase in U.S. storm losses since 1950 (thunderstorms and hailstorms) to inflation, population growth, increasing property at risk, increasing property value, and increasing liability coverage. Changnon (2001) attributes increasing U.S. thunderstorm losses since 1949 to inflation, shifts in insurance coverage, increased development, increased wealth, and population growth in vulnerable areas. Changnon (2009) also attributes increasing hailstorm losses in the U.S. since 1950 to increased property damage from hailstorms striking ever-growing U.S. cities, and ascribes increasing windstorm losses in the U.S. since 1952 to increasing population density in vulnerable areas and increasing wealth. Brooks and Doswell (2001) argue that damage from U.S. tornadoes since 1890 has increased due to the increasing cost of goods and accumulation of wealth. Since 1970, Van der Vink et al. (1998) observe a slower increase in tornado losses relative to other U.S. disaster losses; nonetheless, they account for the increase through population growth in vulnerable areas and increased wealth. Simmons et al. (2013) find no increase in U.S. tornado losses since 1950 in either absolute or normalized values. Thus, for North American storm losses, the literature overwhelmingly explains the increase in losses entirely by socioeconomic changes, and finds no credible evidence for human-caused climate change as a driver of increasing losses.

Several studies focus on Asian storm losses. Raghavan and Rajesh (2003) assign increased economic losses from Indian tropical cyclones since 1925 to inflation, population growth, and increasing per capita domestic product. Similarly, Zhang et al. (2009) determine that economic losses from Chinese tropical cyclones since 1983 are increasing due to inflation, growing population, and increased wealth. For Asian flood losses, a study by Miller et al. (2008) attributes a portion of increasing Asian flood losses to improved flood data since the 1980s for China and Japan. This same study further acknowledges large losses from Chinese floods since the 1980s due to increasing economic development. Chang et al. (2009) attribute increasing flood losses in Korea since 1971 to deforestation in upstream areas, population growth on floodplains, and an increased number of heavy summer precipitation events caused by reasons deemed inconclusive at present. Collectively, these studies attribute increasing Asian flood losses to a range of factors, but not anthropogenic climate change. Weinkle et al. (2012) look at trends in the landfall of tropical cyclones around the world in different basins, and find no evidence of a secular increase in storm frequency or intensity.

Barredo (2007) explains increasing European flood losses since 1950 by a number of socioeconomic factors including population growth in vulnerable areas, increasing development in vulnerable areas, increasing value of exposed assets, increasing vulnerability of development and assets, and failure of flood protection systems. Mitchell (2003) elaborates on the socioeconomic factors by discussing the rise in floodplain development particularly by export businesses located near ports and waterways; the economic impact from shutdowns of the large transportation system newly built to connect the European Union through roads, railways, and water routes all built on floodplains; "the north to south industrial relocation" of the business sector relocating from northern Europe to more appealing watershed regions of small cities in southern Europe; and European rejuvenation entailing pricier redevelopment of urban waterfront areas and suburban developments often built on floodplains. For European storms, Berz and Conrad (1993) ascribe increasing storm losses to population growth in vulnerable areas, increasing wealth, increasing insurance coverage and subsequent increase in claims, and cite environmental changes as a less significant and inconclusive factor. Barredo (2010) attributes European windstorm losses since 1970 to the increasing standard of living, per capita real wealth, and improved disaster data collection. Additional studies on European storms will improve the robustness of European severity studies, particularly if new studies focus on European winter storms, which are the most frequently occurring storm type to cause significant losses in Europe (based on the data presented in the NatCatSERVICE database).

Downton et al. (2005) assess the economic losses caused by U.S. floods since 1926 and find that losses have decreased as a proportion of U.S. GDP since the 1920s. By performing sensitivity studies with each of the socioeconomic factors, they conclude that increasing wealth is the largest cause of increasing U.S. flood losses followed by inflation and then population growth (Pielke and Downton 2000). Choi and Fisher (2003) also attribute increasing U.S. flood losses since 1951 mainly to population growth, growth in per capita real wealth, and inflation. Van der Vink et al. (1998) find U.S. flood losses are increasing since 1970 due to population growth in vulnerable areas and increasing wealth. Hirsch and Ryberg (2011) find no secular increase in U.S. floods over periods of 85 to 127 years.

Crompton and McAneney (2008) assess insured economic losses caused by Australian tropical cyclones, thunderstorms, hailstorms, and floods since 1967, and bushfires since 1925 (Crompton et al. 2010). Tropical cyclones, thunderstorms, and hailstorms fit in this study's category of *Storms*, floods correspond directly with the category *Floods*, and bushfires fit in the category of *Other*. They attribute increasing insured economic losses to changes in the number and value of dwellings over time. They conclude that these socioeconomic factors are causing losses from Australian Storms, Floods, and Other, not anthropogenic climate change.

Existing regional studies focus on losses from North American, Asian, European, and Australian storms and floods, which collectively compose 97% of the increase in global economic losses. These studies are consistent in attributing the increase in regional disaster-caused economic losses entirely to socioeconomic factors, and most of which cover a much longer time series than that reported in Munich Re's global data set.

To sum, at the regional level, analyses of normalized damage over time periods longer than but encompassing the data covered by Munich Re's data set show no evidence of an anthropogenic climate change signal in economic loss trends for phenomena that account for 97% of the documented increase in losses 1980–2008.

The secular increase thus observed in the short-term Munich Reinsurance record is thus consistent with the finding that socioeconomic change can explain the entire increase in absolute losses observed over the various time periods of data availability at the regional level. The Munich Re data set is barely long enough to make claims about climate in any case, and its focus on both impacts and extreme events would suggest that it is not nearly long enough (cf. Crompton et al. 2011). As Höppe and Pielke (2006) concluded and updated by the IPCC (2012), there is not presently sufficient evidence to indicate that greenhouse gas emissions are responsible for any quantifiable portion of the increased losses observed in economic loss data. Such attribution may yet occur in the future, but presently, those looking for a signal of human-caused climate change in extremes should continue to focus their attention on geophysical data, and not economic loss data. Of course, this work is focused on a single data set, and there are various important perspectives on disaster losses that go well beyond the analysis presented here (e.g., Benson and Clay 2004; Jha et al. 2013).

Conclusions

This study reconciles the apparent mismatch between claims that global disaster-caused losses are increasing due to anthropogenic climate change, and studies finding that regional losses are increasing due to socioeconomic factors. The study disaggregates global losses, quantifies the percentage of the global increase attributable to each regional component, and associates the disaggregation to the disaster literature in order to determine the causal factors for increasing losses.

Global economic losses in the Munich Re data set have increased since 1980, largely due to losses from three specific regions and two disaster types: North American storms and floods, Asian storms and floods, and European storms and floods. These six regional sources contribute 96% of the increase in global losses, of which 57% is attributed to losses caused by North American storms, 15% to losses from Asian storms, 10% to Asian flood losses, 8% to losses caused by European floods, 4% is attributed to losses caused by European storms, and 2% to losses from North American floods. In addition, losses from Australian storms and floods collectively contribute a further 1% to the global increase in losses. The remaining 3% of the increase in global losses that occur in regions and for phenomena where normalization studies have yet to be conducted are European *Other* losses (including losses from wildfires, cold waves, frost, and heat waves) and South American *Storm* losses. As concluded by the IPCC (2012), socioeconomic change can explain the long-term increase in global losses. Thus, the apparent disconnect between peer-reviewed research and public claims is reconciled, and there is no disconnect at all.

Even assuming anthropogenic climate change occurs as projected under a suite of models, it may be a very long time before attribution of economic losses to greenhouse gas emissions is possible. Crompton et al. (2011) conclude that an anthropogenic climate signal will not be identifiable in U.S. tropical cyclone losses for another 120–550 years with even longer timescales expected for other global weather-related natural disasters. As a result, they "urge extreme caution in attributing short term trends (i.e., over many decades and longer) in normalized U.S. tropical cyclone losses to anthropogenic climate change. The same conclusion applies to global weather-related natural disaster losses in the near future" (Crompton et al. 2011). *Climate change* is defined by the IPCC (2007) as a change observed over a time period of 30–50 years or longer; therefore, Munich Re's database spanning only several decades makes the identification of an anthropogenic climate change signal in disaster economic losses highly unlikely and perhaps a mathematical impossibility, given present expectations for the magnitude and pace of changes in extremes.

The analysis presented here is also consistent with the IPCC Special Report on Extremes (IPCC 2012), which concluded that "long-term trends in economic disaster losses adjusted for wealth and population increases have not been attributed to climate change, but a role for climate change has not been excluded."

Bouder et al. (2007) similarly suggest that research is unlikely to identify a climate signal in disaster losses in the near future:

because of issues related to data quality, the low frequency of extreme event impacts, limited length of the time series, and various societal factors present in the disaster loss record, it is still not possible to determine the portion of the increase in damages that might be attributed to climate change brought about by greenhouse gas emissions. This conclusion is likely to remain unchanged in the near future (Bouder et al. 2007, p. 753).

The conclusions of this study reinforce the current consensus found in academic literature [e.g., as summarized by IPCC (2012), Bouwer (2011), and extended in this paper] and offer a corrective to frequent claims found in the media, in political debate. and among multilateral institutions about trends in disaster losses.

The bottom line here is that a signal of greenhouse gas emissions cannot be found in the aggregate loss data from Munich Re. Those making claims to the contrary should take note.

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