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Hiding the good news on hurricanes and floods

BY MARCEL CROK

Whenever an extreme weather event causes death and destruction, climate change becomes the culprit. The simple message always is "the climate is getting more extreme". But is that the case? The IPCC must answer such questions in a scientific and impartial way. Here we investigate whether the IPCC in their AR6 report succeeded in that task. The short answer is "no". Although deep inside the WG1 report the IPCC acknowledges some rather good news about extremes – i.e., that hurricanes and floods have not gotten worse – that good news is not communicated clearly to the policy makers and the media. In the WG2 report things got worse, and the IPCC even contradicts some of its own WG1 claims. The IPCC needs to do a much better job.

Ever since hurricane Katrina hit New Orleans in 2005 and caused tremendous damage and deaths, climate change has been linked to extreme weather events. So, whenever a flood, drought, heatwave or hurricane occurs, scientists and the media quickly blame anthropogenic climate change for being the cause of it. Nowadays, there is even a sub discipline, called event attribution, that deals with the question whether a specific extreme event, like the terrible floods in Pakistan in 2022, have been caused by our emissions of CO_2. That is a dangerous question from a political and legal perspective, since countries that suffer loss and damage from an extreme event can consider claiming compensation from developed countries. Their idea is that rich countries have emitted most manmade CO_2 and are therefore to blame for the loss in more vulnerable developing nations. A huge fund for so-called "Loss and Damage" is now being negotiated at the yearly COP-meetings.[1]

So, given the importance of extreme events for the people who endured them, as well as for political, legal, and economic reasons, it is quite important for the IPCC to get the science about this 'right'. In this chapter we analyse what the IPCC has written about trends in extreme events. We compare what is written in the main WG1 and WG2 reports and how this is reflected in the *Summary for Policy Makers* (SPM).

Pielke Jr.'s Assessment

Only days after the WG1 report was published in August 2021, the well-known US scientist Roger Pielke Jr summarised its finding with respect to extreme weather events in a long post on his personal website.[2] Pielke is very familiar with the literature about extreme events but was not involved in this (or any) IPCC report. He produced a table that is very revealing about what the IPCC had to say about all kinds of extreme weather, see table 1.

The IPCC uses 'detection' and 'attribution' as a framework to analyse trends in climate. Detection means that on climatic time scales a statistically significant change in some parameter has been 'detected'. The next step is to identify a 'cause' for that change, which in practice often means 'greenhouse gases', as these are the climate forcings assumed to dominate the total forcings by the IPCC.

1 https://unfccc.int/news/cop27-reaches-breakthrough-agreement-on-new-loss-and-damage-fund-for-vulnerable-countries
2 https://rogerpielkejr.substack.com/p/how-to-understand-the-new-ipcc-report-1e3

Table 1: Summary by Roger Pielke Jr of the AR6 WG1 report detection and attribution findings for different extreme weather phenomena.

	DETECTION	ATTRIBUTION
heat waves	yes	yes
heavy precipitation	yes	yes
flooding	no	no
meteorological drought	no	no
hydrological drought	no	no
ecological drought	yes	yes
agricultural drought	yes	yes
tropical cyclones	no	no
winter storms	no	no
thunderstorms	no	no
tornadoes	no	no
hail	no	no
lightning	no	no
extreme winds	no	no
fire weather	yes	yes

As shown in figure 1, according to the IPCC, greenhouse gases have contributed most to an increase in radiative forcing since 1750. Changes in the sun have contributed close to nothing (for a different perspective about that see our chapter 6). The IPCC then attributes the detected trend to these anthropogenic forcings.

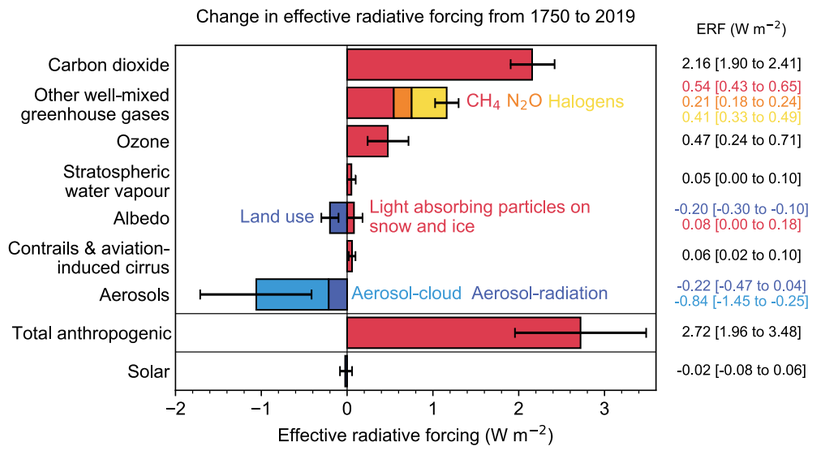

Figure 1: Reproduction of figure 7.6 from the WG1 report showing the change in radiative forcing since 1750.[3]

So, it's no surprise to see that, in the table provided by Pielke, the detected trends are also attributed by the IPCC to greenhouse forcing. However, what is most remarkable, and goes against most of the media coverage of extreme weather, is that for most extreme weather phenomena, no trend is detected. This is true for flooding, drought (meteorological or hydrological), tropical cyclones (in the Atlantic called hurricanes), winter storms, thunderstorms, tornadoes, hail, lightning, or extreme winds (so, storms of any type).

3 https://www.ipcc.ch/report/ar6/wg1/figures/chapter-7/figure-7-6

Damage Trends

Globally, most damage by far (around 90%) from extreme weather is due to floods and tropical cyclones. So, Pielke's table, based on the WG1 report, is truly good news. The most damaging extremes, hurricanes, floods and (weather-related) droughts have not changed on climatic time scales. The earth has warmed by slightly more than one degree Celsius, the CO_2 concentration has gone up, but the most dramatic extreme weather events have not (yet) changed.

The IPCC did not provide a handy table like Pielke did in his blog post. They provided written evidence of the lack of trends, in chapter 11 of the WG1 report. We are not going to discuss all of them, but here are some examples from the chapter.

They claim an attributable trend in extreme precipitation but not in flooding. Here are the relevant sections (our bold):

> The **frequency and intensity of heavy precipitation events have increased** over a majority of land regions with good observational coverage since 1950 (high confidence, Box TS.6, Table TS.2). Human influence is likely the main driver of this change (Table TS.2). [TS page 84]
> However, **heavier rainfall does not always lead to greater flooding**. This is because flooding also depends upon the type of river basin, the surface landscape, the extent and duration of the rainfall, and how wet the ground is before the rainfall event (FAQ 8.2, Figure 1). [Page 1155]
> There is low confidence about peak flow trends over past decades on the global scale [Page 1568]
> In summary there is **low confidence in the human influence on the changes in high river flows on the global scale**. [Page 1569]

Citing these sentences Pielke commented on twitter: "So don't claim floods are increasing; Don't say they are "climate driven"."[4]

Tropical cyclones

Next, we look at hurricanes (or tropical cyclones, TC):

> There is low confidence in most reported long-term (multi-decadal to centennial) trends in TC frequency- or intensity-based metrics due to changes in the technology used to collect the best-track data. [Page 1585]

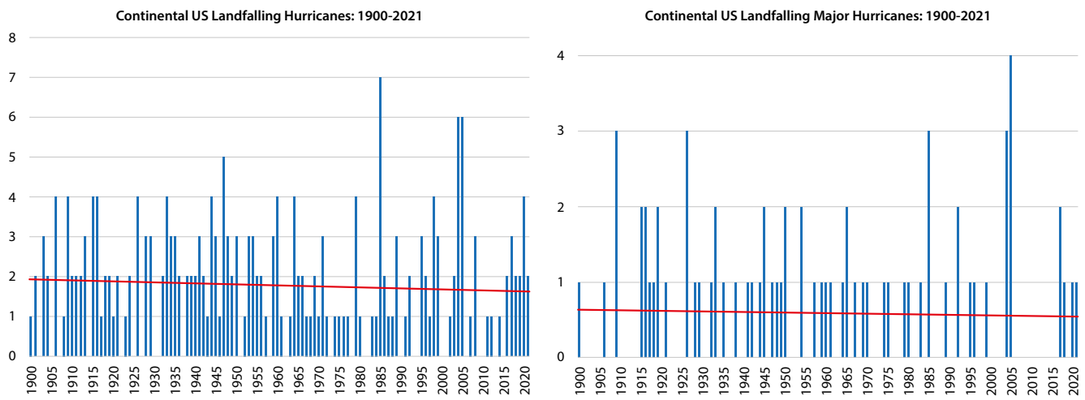

Figure 2: Number of US landfalling hurricanes and major hurricanes between 1900 and 2021. Updated graph from Klotzbach (2018)[5]

4 https://twitter.com/RogerPielkeJr/status/1424735415576104965

5 Klotzbach, Philip J., et al. "Continental US hurricane landfall frequency and associated damage: Observations and future risks." *Bulletin of the American Meteorological Society* 99.7 (2018): 1359-1376.

Pielke commented on the denigrating remark by the IPCC about the best-track data:

> The denigration of the TC "best track" dataset is bizarre. The dataset is the highest quality available on tropical cyclones around the world and widely used in research. It'd be a shame if the IPCC process were to have been used to promote certain work by denigrating the widely recognized best available data.

The IPCC decided not to show a graph in this section of the report, but here is a very relevant one, showing landfalling (major) hurricanes in the US. It shows that if anything there is a small decreasing trend. These graphs have been published in a peer reviewed paper by Phil Klotzbach in 2018 and are shown here in an updated version. The paper is not mentioned in the WG1 report.

This lack of trend in US landfalling hurricanes is important information, because they alone make up 60% of the global historical damage due to extreme weather events.[6]

Strangely, the IPCC decided to say nothing about trends in *global* tropical cyclone (TC) landfalls, although this 2012 paper, "Historical Global Tropical Cyclone Landfalls", by Weinkle et al. seems highly relevant.[7] That paper was co-authored by Roger Pielke Jr and Ryan Maue and concluded: "The analysis does not indicate significant long-period global or individual basin trends in the frequency or intensity of landfalling TCs of minor or major hurricane strength."

That paper showed this graph:

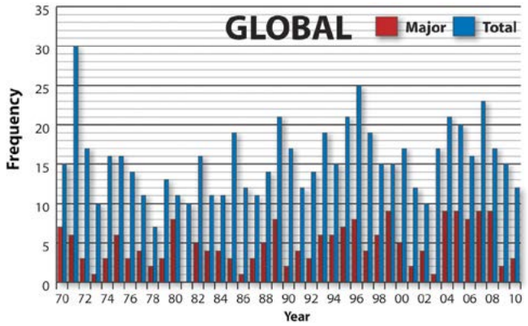

Figure 3: reproduction of figure 2 from Weinkle et al. (2012) showing global total and major hurricane landfalls.

Ryan Maue frequently updates this dataset on his website.[8] Here is the latest one:

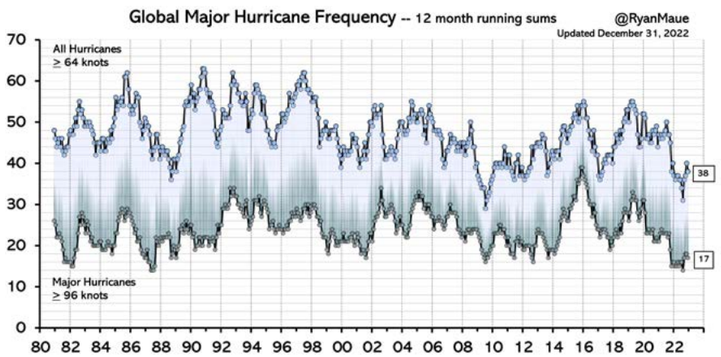

Figure 4: global hurricane frequency. On top all hurricanes, at the bottom major hurricanes. Source: Ryan Maue

6 Mohleji, S., & Pielke Jr, R. (2014). Reconciliation of trends in global and regional economic losses from weather events: 1980–2008. *Natural Hazards Review*, *15*(4), 04014009.

7 Weinkle, J., Maue, R., & Pielke, R. P., Jr (2012). Historical global tropical cyclone landfalls. Journal of Climate, 25(13), 4729–4735. https://doi. org/10.1175/jcli-d-11-00719.1

8 https://climatlas.com/tropical/

Clearly neither all nor major hurricanes show an up or down trend. There is large variability from year to year and from decade to decade. The calendar year with most hurricanes was 59 in 1992 and the least was 38 in 2009. The number of major hurricanes peaked in 2015 with 38 and the least occurred in 1981 with 15.

Now with these graphs the picture is quite clear that nothing unusual is going on with tropical cyclones.

Nevertheless, the IPCC manages to conclude this in their report (our bold):

> In summary, there is mounting evidence that **a variety of TC characteristics have changed over various time periods**. It is likely that the global proportion of Category 3–5 tropical cyclone instances and the frequency of rapid intensification events have increased globally over the past 40 years. [Page 1587]

That paragraph is confusing to say the least, especially without showing the graphs included herein. Pielke commented on twitter that using the latest forty years can also be misleading, as the 1970s and early 1980s were periods with relatively low tropical cyclone activity.

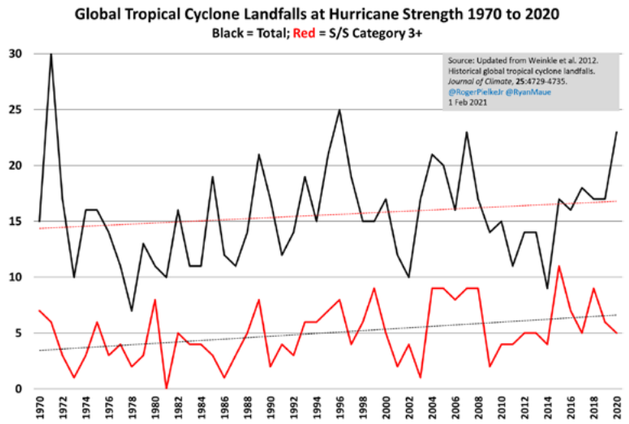

Figure 5: global tropical cyclone landfalls since 1970. Based on Weinkle et al. 2012. Source: Pielke Jr[9]

In figure 5 we see a trend up and it is tempting to think it is due to anthropogenic climate change. A truly global picture is missing before 1970, but there is good data for the North Atlantic and the Western Pacific, and those two areas account for about 70% of the global landfalls. The data for these two basins goes back to 1945:

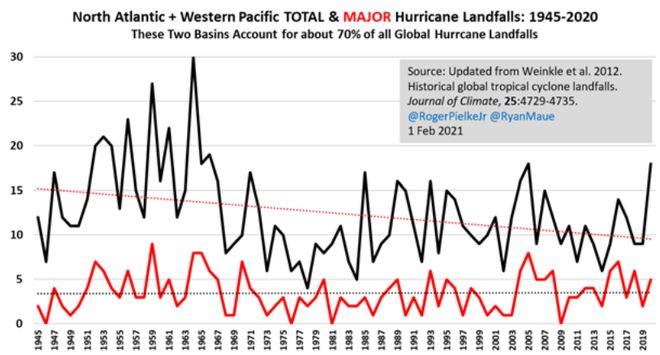

Figure 6: tropical cyclone landfalls in the North Atlantic and Western Pacific since 1945. Source: Pielke Jr

9 https://rogerpielkejr.substack.com/p/a-remarkable-decline-in-landfalling

Suddenly the upward trend that we saw from the 1970s is changed to a downward trend for all hurricanes and no trend for major hurricanes. It clearly shows one should be careful drawing conclusions from shorter periods of time.

Drought

Next is drought. In AR6 the IPCC changed its definitions of drought (AR5 just talked about drought) and now distinguishes meteorological and hydrological drought (no trends) from ecological and agricultural droughts (trend detected).[10] Agricultural and ecological drought is related with abnormal soil moisture deficit (combination of precipitation deficit and excess evapotranspiration), meteorological drought with precipitation deficits and hydrological drought with streamflow deficit.

Here are some of the key conclusions:

On hydrological drought:

> There is still limited evidence and thus low confidence in assessing these trends at the scale of single regions, with few exceptions [Page 1578]

On meteorological drought:

> The regional evidence on attribution for single AR6 regions generally shows low confidence for a human contribution to observed trends in meteorological droughts at regional scale [Page 1579]

On agricultural and ecological drought:

> In summary, human influence has contributed to increases in agricultural and ecological droughts in the dry season in some regions due to increases in evapotranspiration (medium confidence).

So, based on the AR6 WG1 report you cannot simply state that drought in general is increasing.

Extreme hot days and heatwaves

AR6 is most confident about trends in hot days and heatwaves (our bold):

> In summary, it is virtually certain that there has been an increase in the number of warm days and nights and a decrease in the number of cold days and nights on the global scale since 1950. Both the coldest extremes and hottest extremes display increasing temperatures. It is very likely that these changes have also occurred at the regional scale in Europe, Australasia, Asia, and North America. It is **virtually certain that there has been increases in the intensity and duration of heatwaves** and in the number of heatwave days at the global scale.

It is noteworthy though that they use 1950 as a reference year. It is well-known that at least in the US, the 1930s were the hottest. Here is a graph for the US:

10 Here is a footnote from the Technical Summary explaining the differences: "Agricultural and ecological drought (depending on the affected biome): a period with abnormal soil moisture deficit, which results from combined shortage of precipitation and excess evapotranspiration, and during the growing season impinges on crop production or ecosystem function in general (see Annex VII: Glossary). Observed changes in meteorological droughts (precipitation deficits) and hydrological droughts (streamflow deficits) are distinct from those in agricultural and ecological droughts and are addressed in the underlying AR6 material (Chapter 11)."

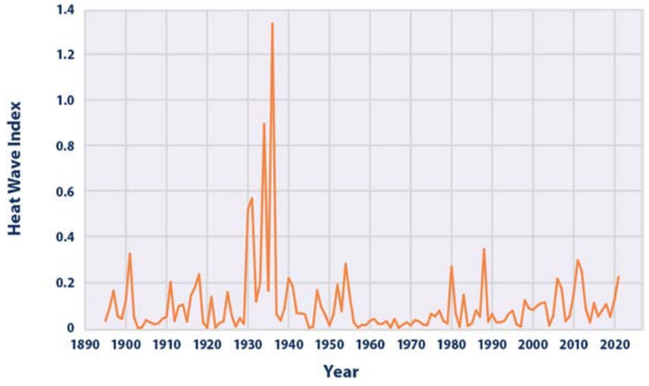

Figure 7: This figure shows the annual values of the U.S. Heat Wave Index from 1895 to 2021. These data cover the contiguous 48 states. An index value of 0.2 (for example) could mean that 20 percent of the country experienced one heat wave, 10 percent of the country experienced two heat waves, or some other combination of frequency and area resulted in this value. Source: EPA[11]

AR6 WG1 Summary for Policy Makers

So, even if we take IPCC at face value and accept that some extremes (heatwaves, extreme precipitation, ecological and agricultural drought are increasing in frequency), the more impactful extremes (in terms of damage and deaths) such as flooding and tropical cyclones are not. This is good news. We are now going to see how the *Summary for Policy Makers*, arguably the most important part of the report, reflects these findings.

First let's look at tropical cyclones, as these, especially those landfalling in the US, dominate global disaster damages.

> Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. **Evidence of observed changes** in extremes such as heatwaves, heavy precipitation, droughts, and **tropical cyclones**, and, **in particular, their attribution to human influence, has strengthened since AR5**. [AR6, SPM, A.3; Page 8]

Now this statement is highly misleading if not simply wrong. IPCC is simply hiding the fact that the frequency and intensity of tropical cyclones have not increased. It even claims the opposite, an observed 'change' in tropical cyclones, that can be attributed to human influence (i.e., the emission of greenhouse gases).

Point A.3.4 of the SPM goes into more detail (our bold):

> It is likely that the **global proportion of major** (Category 3–5) tropical cyclone **occurrence** has increased over the last four decades, and it is very likely that the latitude where tropical cyclones in the western North Pacific reach their peak intensity has shifted northward; these changes cannot be explained by internal variability alone (medium confidence). **There is low confidence in long-term (multi-decadal to centennial) trends in the frequency of all-category tropical cyclones**. Event attribution studies and physical understanding indicate that human-induced climate change increases heavy precipitation associated with tropical cyclones (high confidence), but data limitations inhibit clear detection of past trends on the global scale.

In three very detailed blog posts[12] Roger Pielke Jr showed how in different drafts IPCC changed the word "intensities" first in "instances" and then in "occurrence". The last change is not only flawed but happened outside the official review process. As Pielke observed: "This is not how assessments are supposed to work." Pielke also wrote that "a high-level participant in the IPCC

11 https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves#%20

12 https://rogerpielkejr.substack.com/p/a-tip-from-an-ipcc-insider; https://rogerpielkejr.substack.com/p/misinformation-in-the-ipcc; https://rogerpielkejr.substack.com/p/trends-in-the-proportion-of-major

(purposely vague to protect their identity) has confirmed to me that the major error on tropical cyclones that I recently identified was (a) indeed a major snafu and (b) a result of claims being inserted into the IPCC outside its review process." So, let's see if the IPCC will correct this error.

Ryan Maue published data on another metric, the so-called ACE, Accumulated Cyclone Energy. It is a measure of the total energy involved in tropical cyclones. If the proportion of major hurricanes increase, one would also expect an increase in the ACE. Here is the graph:

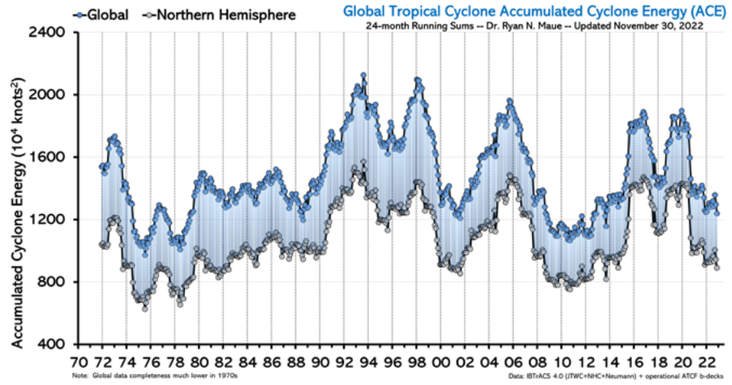

Figure 8: Last 50-years+ of Global and Northern Hemisphere Accumulated Cyclone Energy: 24 month running sums. Note that the year indicated represents the value of ACE through the previous 24-months for the Northern Hemisphere (bottom line/gray boxes) and the entire global (top line/blue boxes). The area in between represents the Southern Hemisphere total ACE. Source: Ryan Maue[13]

Again, we see large year-to-year and decade-to-decade variability but no clear trend. In summary, the IPCC is hiding good news about tropical cyclones.

Floods

There is a statement about compound flooding in the SPM but not about the lack of trends in flooding in general. Remember, this is what the full report said: "In summary there is **low confidence in the human influence on the changes in high river flows on the global scale**." [Page 1569]

A statement like this is not highlighted in the SPM. It does mention this though (our bold):

> Human influence has likely increased the chance of compound extreme events[14] since the 1950s. This includes increases in the frequency of concurrent heatwaves and droughts on the global scale (high confidence), fire weather in some regions of all inhabited continents (medium confidence), and **compound flooding** in some locations (medium confidence).

We can therefore conclude that the two most important extreme events (from the perspective of damage) are not fairly covered in the SPM.

Now let's see if and how the IPCC treats heatwaves. They write:

> It is virtually certain that hot extremes (including heatwaves) have become more frequent and more intense across most land regions since the 1950s, while cold extremes (including cold waves) have become less frequent and less severe, with high confidence that human-induced climate change is the main driver of these changes. Some recent hot extremes observed over the past decade would have been extremely unlikely to occur without human influence on the climate system. [A.3.1]

13 https://climatlas.com/tropical/

14 Compound extreme events are the combination of multiple drivers and/or hazards that contribute to societal or environmental risk (Glossary). Examples are concurrent heatwaves and droughts, compound flooding (e.g., a storm surge in combination with extreme rainfall and/or river flow), compound fire weather conditions (i.e., a combination of hot, dry and windy conditions), or concurrent extremes at different locations.

On droughts:

> Human-induced climate change has contributed to increases in **agricultural and ecological droughts** in some regions due to increased land evapotranspiration (medium confidence). [A.3.2]

They mention an increase in agricultural and ecological drought, but not the lack of a trend in hydrological and meteorological droughts.

WG1 Report

In general the WG1 report did a reasonably good job in describing trends in extreme weather events. However, the IPCC seems to be extremely focused on bad news and ignores good news. It tries hard to make the connection between climate change and more extreme weather. Deep inside the report it acknowledges (though grudgingly) that most extremes have not changed, such as flooding, drought (meteorological or hydrological), tropical cyclones, winter storms, thunderstorms, tornadoes, hail, lightning or extreme winds. So, there is a lot of good news available in the report, but one really has to look for it. The good news is not highlighted in the summary of the chapter, let alone in the *Summary for Policy Makers*. And did you ever hear an IPCC contributing scientist publicly acknowledge that there is no trend in tropical cyclones and flooding?

WG2 report

The WG2 report was published nine months after the WG1 report. So, the authors of the WG2 report knew what was inside the WG1 report. WG2 covers the impacts of climate change so logically trends in extremes are also important in that part of the report. Let's focus on some of the most important extreme weather events, tropical cyclones, flooding and drought.

First, here is what WG2 has to say about tropical cyclones (our bold):

> Adverse impacts from **tropical cyclones, with related losses and damages, have increased due to sea level rise and the increase in heavy precipitation** (medium confidence). [SPM, page 9]

And

> Some extreme weather events are increasing in frequency and (or) severity as a result of climate change (Seneviratne et al., 2021) (high confidence). These include extreme rainfall events (Roxy et al., 2017; Myhre et al., 2019; Tabari, 2020); extreme and prolonged heat leading to catastrophic fires (Bowman et al., 2017; Krikken et al., 2019; van Oldenborgh et al., 2020); and **more frequent and stronger cyclones/hurricanes** and resulting extreme rainfall (Griego et al., 2020). These extreme events, coupled with high vulnerability and exposure in many parts of the world, turn into disasters and affect millions of people every year. [Page 588]

This is opposite of what the WG1 report said, namely "[t]here is low confidence in most reported long-term (multi-decadal to centennial) trends in TC frequency- or intensity-based metrics".

Instead of simply citing WG1 the WG2 claim of more frequent and intense hurricanes/cyclones goes to the paper Griego et al. (2020)[15], which has no analysis of hurricane/cyclone frequency or intensity.

WG2 is also claiming that floods are getting worse (our bold):

> Extreme weather events **causing highly impactful floods and droughts have become more likely and (or) more severe due to anthropogenic climate change** (high confidence). {4.2.4, 4.2.5, Cross-Chapter Box DISASTER in Chapter 4} [executive summary chapter 4, page 555]

15 Griego, A.L., A.B. Flores, T.W. Collins and S.E. Grineski, 2020: Social vulnerability, disaster assistance, and recovery: a population-based study of Hurricane Harvey in Greater Houston, Texas. Int. J. Disaster Risk Reduct., 51, 101766, doi:10.1016/j.ijdrr.2020.101766.

Remember what WG1 said, "there is low confidence about human influence on the changes in high river flows on the global scale." [page 1569]

Here is something about drought (our bold):

> **Anthropogenic climate change has contributed to the increased likelihood and severity of the impact of droughts (especially agricultural and hydrological droughts)** in many regions (high confidence). [executive summary chapter 4, page 555]

The WG1 report said human influence on agricultural and ecological drought but no trends in hydrological and meteorological drought. So again, there is a conflict between WG1 and WG2.

Conclusions

If and to what extent extreme weather is changing is a very important question. This question has dominated political debates around climate change. It is therefore extremely important that the IPCC, which is, or should be, politically neutral, gets the science about this right. Here we have shown that in general the WG1 report did a reasonably fair job, except for the *Summary for Policy Makers*. However, the chapter about extremes (chapter 11) had a lot of good news to offer (no trends in hurricanes and flooding), but the IPCC failed to emphasize these results, both in the summary of the chapter and in the *Summary for Policy Makers*.

Policy makers therefore cannot be blamed for being unaware of the good news about recent changes in extreme weather, in particular, that the most impactful events (like hurricanes, floods, and hydrological and meteorological droughts) have not increased. We also show that global disaster losses normalised for GDP have not increased and that climate-related deaths have decreased in other chapters. These facts paint a far less bleak picture of climate change than the doom and gloom seen in the latest IPCC reports.

In WG2 things really get worse, the IPCC even contradicts many its own claims from the WG1 report. In 2010 several errors were discovered in the 2007 AR4 report. Those errors ultimately led to an investigation by the InterAcademy Councel (IAC).[16] The IAC recommended many changes to improve the IPCC process. The bias and errors we have laid bare in this chapter and the chapters about disaster losses and climate-related deaths show that rather than improving, the IPCC, and especially the WG2 report, have deteriorated. It is more focused on advocacy than on a comprehensive, neutral science assessment.

16 Climate Change Assessments, Review of the Processes & Procedures of the IPCC (interacademies.org)