Adaptability and the risk mindset

Hydsoc SA AGM
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What might you infer for the following:

Example 1) Next in sequence:

HHHHHTHHTTHTTTTHHHTTHTHTTTT?

63542513642253662111136452?

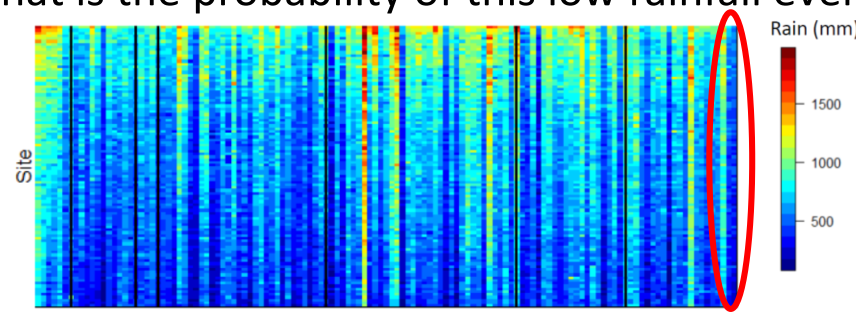
Example 2) Probability:

What is the chance that two people here share the same birthday?

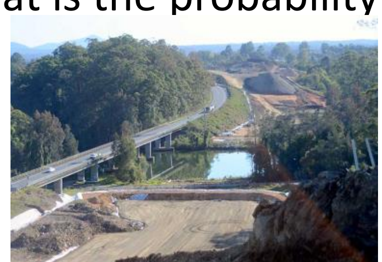
What is the chance that the 2020 Olympics will not occur?

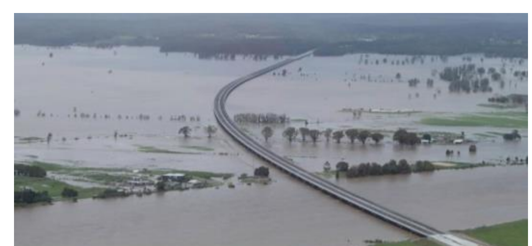
What is the probability of this happening?

What is the probability of this low rainfall event?



What is the probability of road-closure for this highway before/after upgrade?

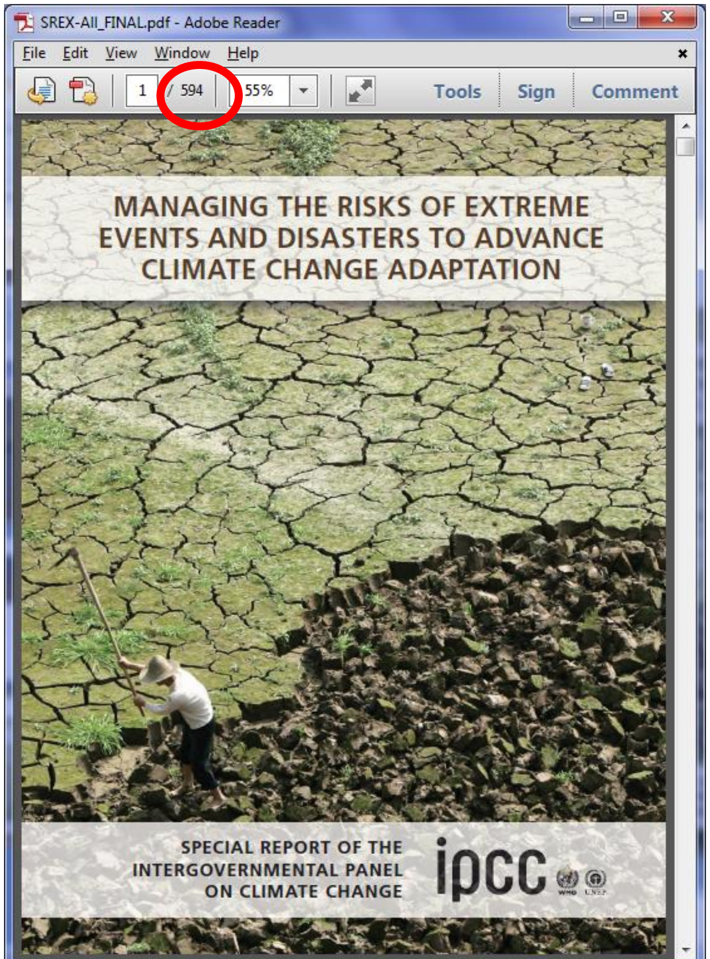




Reductionism is central to the scientific process, but our practice of it has gaps.

'Complicated phenomena, in which several causes concurring, opposing, or quite independent of each other, operate at once, so as to produce a compound effect, may be simplified by subducting the effect of all the known causes, as well as the nature of the case permits, either by deductive reasoning or by appeal to experience, and thus leaving, as it were, a *residual phenomenon* to be explained. It is by this process, in fact, that science, in its present advanced state, is chiefly promoted.'

JOHN F. W. HERSCHEL (1830). *A Preliminary Discourse on the Study of Natural Philosophy*



threshold perspective (e.g., a 40°C threshold for midday temperature in the mid-latitudes).

In the scientific literature, several aspects are considered in the definition and analysis of climate extremes (Box 3-1).

3.1.3. Compound (Multiple) Events

In climate science, compound events can be (1) two or more extreme events occurring simultaneously or successively, (2) combinations of extreme events with underlying conditions that amplify the impact of the events, or (3) combinations of events that are not themselves extremes but lead to an extreme event or impact when combined. The contributing events can be of similar (clustered multiple events) or different type(s). There are several varieties of clustered multiple events, such as tropical cyclones generated a few days apart with the same path and/or intensities, which may occur if there is a tendency for persistence in atmospheric circulation and genesis conditions. Examples of compound events resulting from events of different types are varied – for instance, high sea level coinciding with tropical cyclone landfall (Section 3.4.4), or cold and dry conditions (e.g., the Mongolian Dzud, see Case Study 9.2.4), or the impact of hot events and droughts on wildfire (Case Study 9.2.2), or a combined risk of flooding from sea level surges and precipitation-induced high river discharge (Svensson and Jones, 2002; Van den Brink et al., 2005). Compound events can even result from 'contrasting extremes', for example, the projected occurrence of both droughts and heavy precipitation events in future climate in some regions (Table 3-3).

Impacts on the physical environment (Section 3.5) are often the result of compound events. For instance, floods will more likely occur over saturated soils (Section 3.5.2), which means that both soil moisture status and precipitation intensity play a role. The wet soil may itself be the result of a number of above-average but not necessarily extreme precipitation events, or of enhanced snow melt associated with temperature anomalies in a given season. Similarly, droughts are the result of pre-existing soil moisture deficits and of the accumulation of precipitation deficits and/or evapotranspiration excesses (Box 3-3), not all (or none) of which are necessarily extreme for a particular drought event when considered in isolation. Also, impacts on human systems or ecosystems (Chapter 4) can be the results of compound events, for example, in the case of health-related impacts associated with combined temperature and humidity conditions (Box 3-1).

Although compound events can involve causally unrelated events, the following causes may lead to a correlation between the occurrence of extremes (or their impacts):

1) A common external forcing factor for changing the probability of the two events (e.g., regional warming, change in frequency or intensity of El Niño events)
2) Mutual reinforcement of one event by the other and vice versa due to system feedbacks (Section 3.1.4)
3) Conditional dependence of the occurrence or impact of one event on the occurrence of another event (e.g., extreme soil moisture levels and precipitation conditions for floods, droughts, see above).

Changes in one or more of these factors would be required for a changing climate to induce changes in the occurrence of compound events. Unfortunately, investigation of possible changes in these factors has received little attention. Also, much of the analysis of changes of extremes has, up to now, focused on individual extremes of a single variable. However, recent literature in climate research is starting to consider compound events and explore appropriate methods for their analysis (e.g., Coles, 2001; Beirlant et al., 2004; Benestad and Haugen, 2007; Renard and Lang, 2007; Schölzel and Friederichs, 2008; Beniston, 2009b; Tebaldi and Sanso, 2009; Durante and Salvadori, 2010).

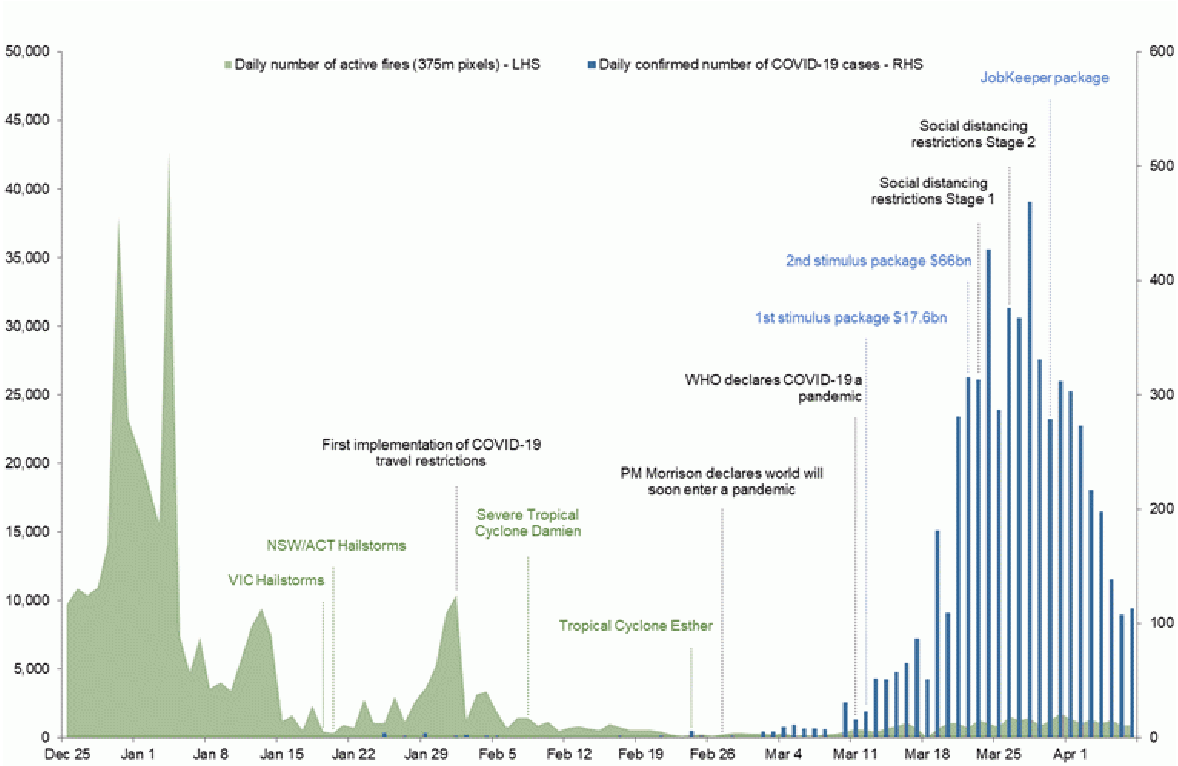
3.1.4. Feedbacks

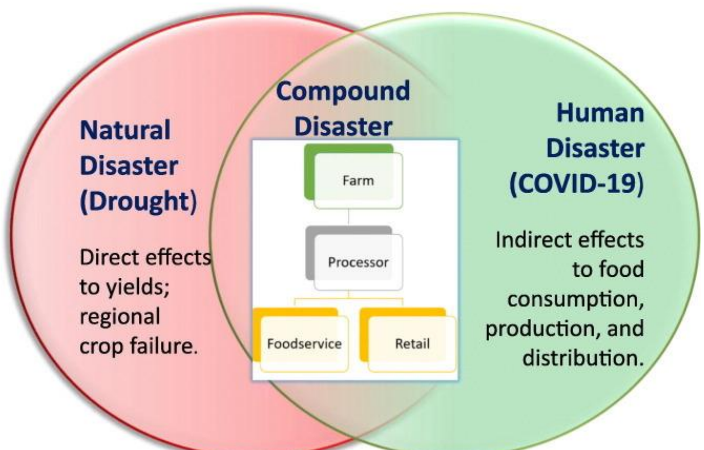
A special case of compound events is related to the presence of feedbacks within the climate system, that is, mutual interaction between several climate processes, which can either lead to a damping (negative feedback) or enhancement (positive feedback) of the initial response to a given forcing (see also 'climate feedback' in the Glossary). Feedbacks can play an important role in the development of extreme events, and in some cases two (or more) climate extremes can mutually strengthen one another. One example of positive feedback between two extremes is the possible mutual enhancement of droughts and heat waves in transitional regions between dry and wet climates. This feedback has been identified as having an influence on projected changes in temperature variability and heat wave occurrence in Central and Eastern Europe and the Mediterranean (Seneviratne et al., 2006a; Diffenbaugh et al., 2007), and possibly also in Britain, Eastern North America, the Amazon, and East Asia (Brabson et al., 2005; Clark et al., 2006). Further results also suggest that it is a relevant factor for past heat waves and temperature extremes in Europe and the United States (Durre et al., 2000; Fischer et al., 2007a,b; Hirschi et al., 2011). Two main mechanisms that have been suggested to underlie this feedback are: (1) enhanced soil drying during heat waves due to increased evapotranspiration (as a consequence of higher vapor pressure deficit and higher incoming radiation); and (2) higher relative heating of the air from sensible heat flux when soil moisture deficit starts limiting evapotranspiration/latent heat flux (e.g., Seneviratne et al., 2010). Additionally, there may also be indirect and/or non-local effects of dryness on heat waves through, for example, changes in circulation patterns or dry air advection (e.g., Fischer et al., 2007a; Vautard et al., 2007; Haarsma et al., 2009). However, the strength of these feedbacks is still uncertain in current climate models (e.g., Clark et al., 2010), in particular if additional feedbacks with precipitation (e.g., Koster et al., 2004b; Seneviratne et al., 2010) and with land use and land cover state and changes (e.g., Lobell et al., 2008; Pitman et al., 2009; Teuling et al., 2010) are considered. Also, feedbacks between trends in snow cover and changes in temperature extremes have been highlighted as being relevant for projections (e.g., Kharin et al., 2007; Orlowsky and Seneviratne, 2011). Feedbacks with soil moisture

Leonard et al. (2014) A compound event framework for understanding extreme impacts

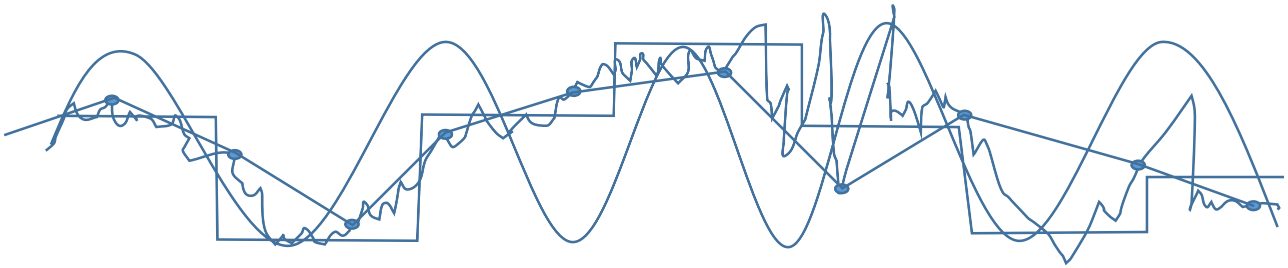
Droughts, fires, cyclones, hailstorms and a pandemic – the March quarter 2020

(https://www.abs.gov.au/articles/droughts-fires-cyclones-hailstorms-and-pandemic-march-quarter-2020)

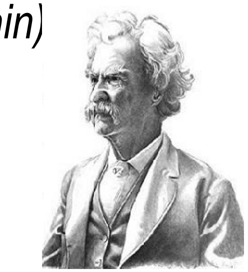


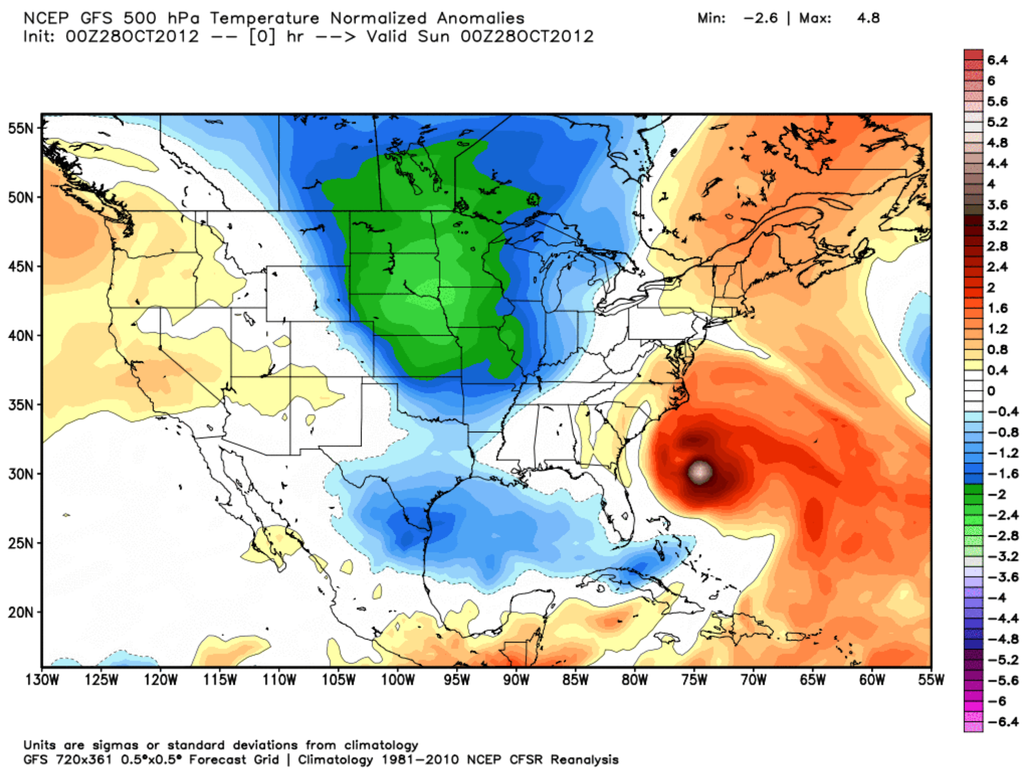


The systems we seek to understand are more complex than what we imagine



Truth is stranger than fiction, but it is because fiction is obliged to stick to possibilities, truth isn't (Mark Twain)

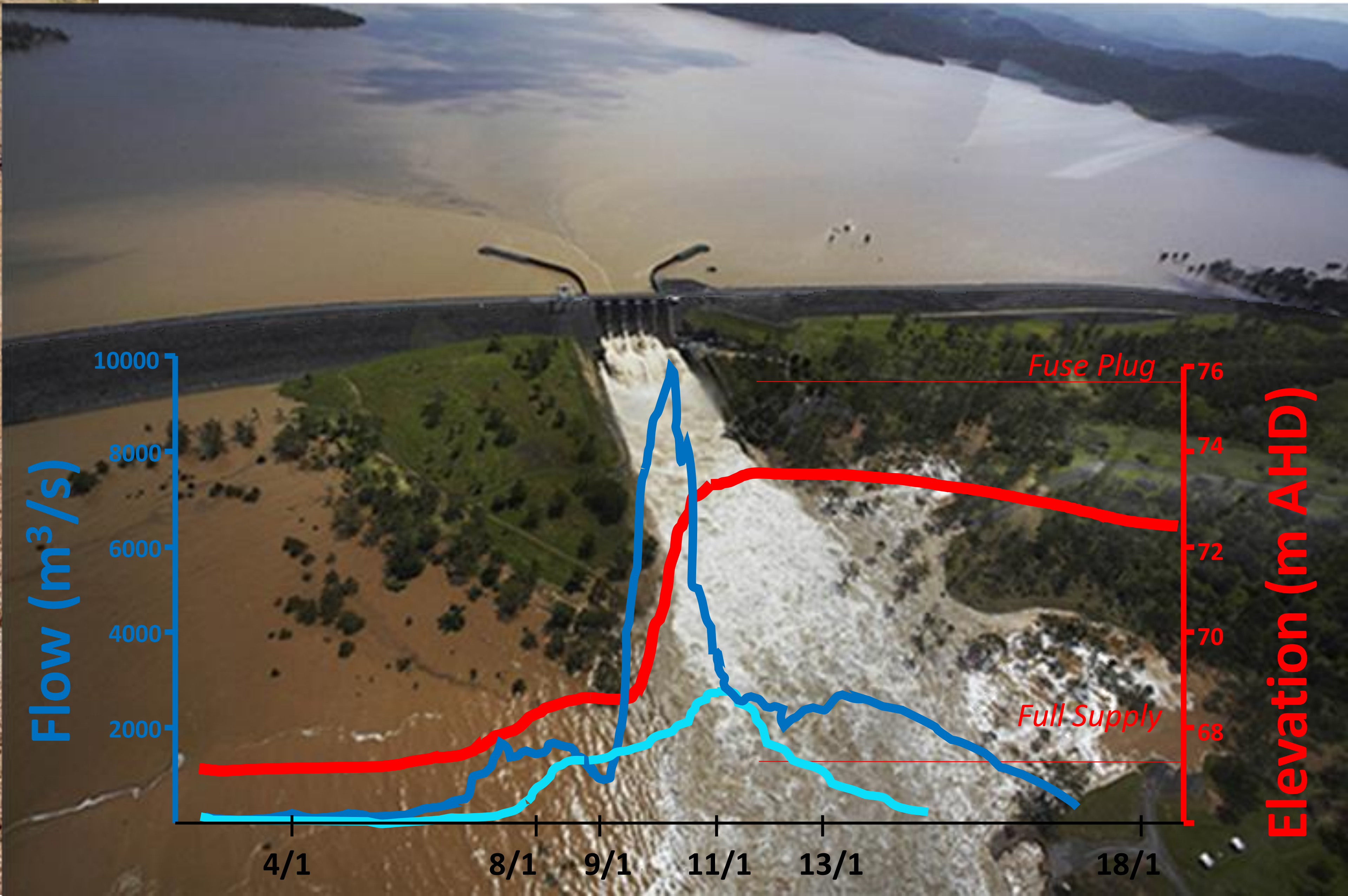




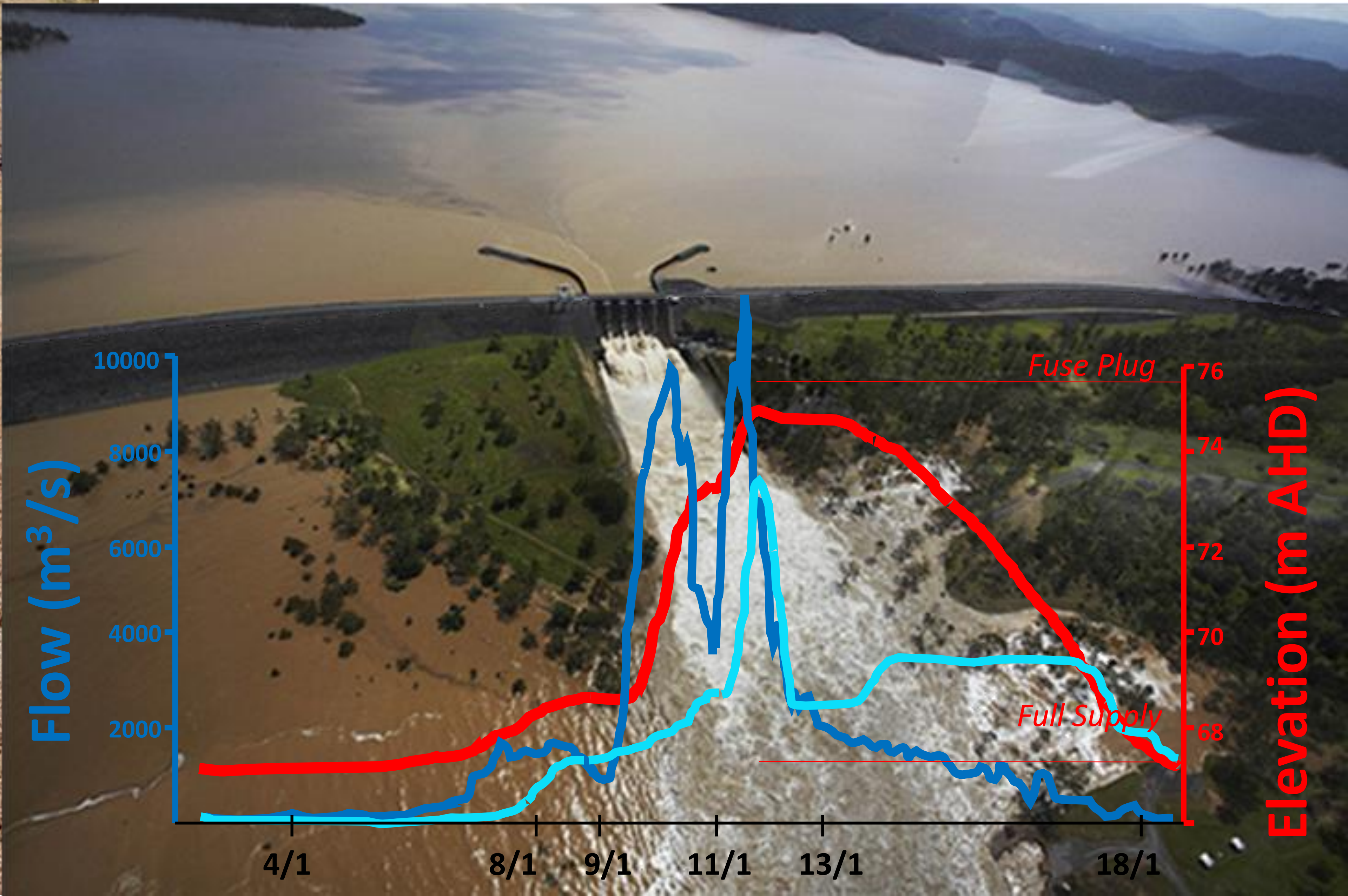
2012 Frankenstorm (Hurricane Sandy)

2009 Black Saturday

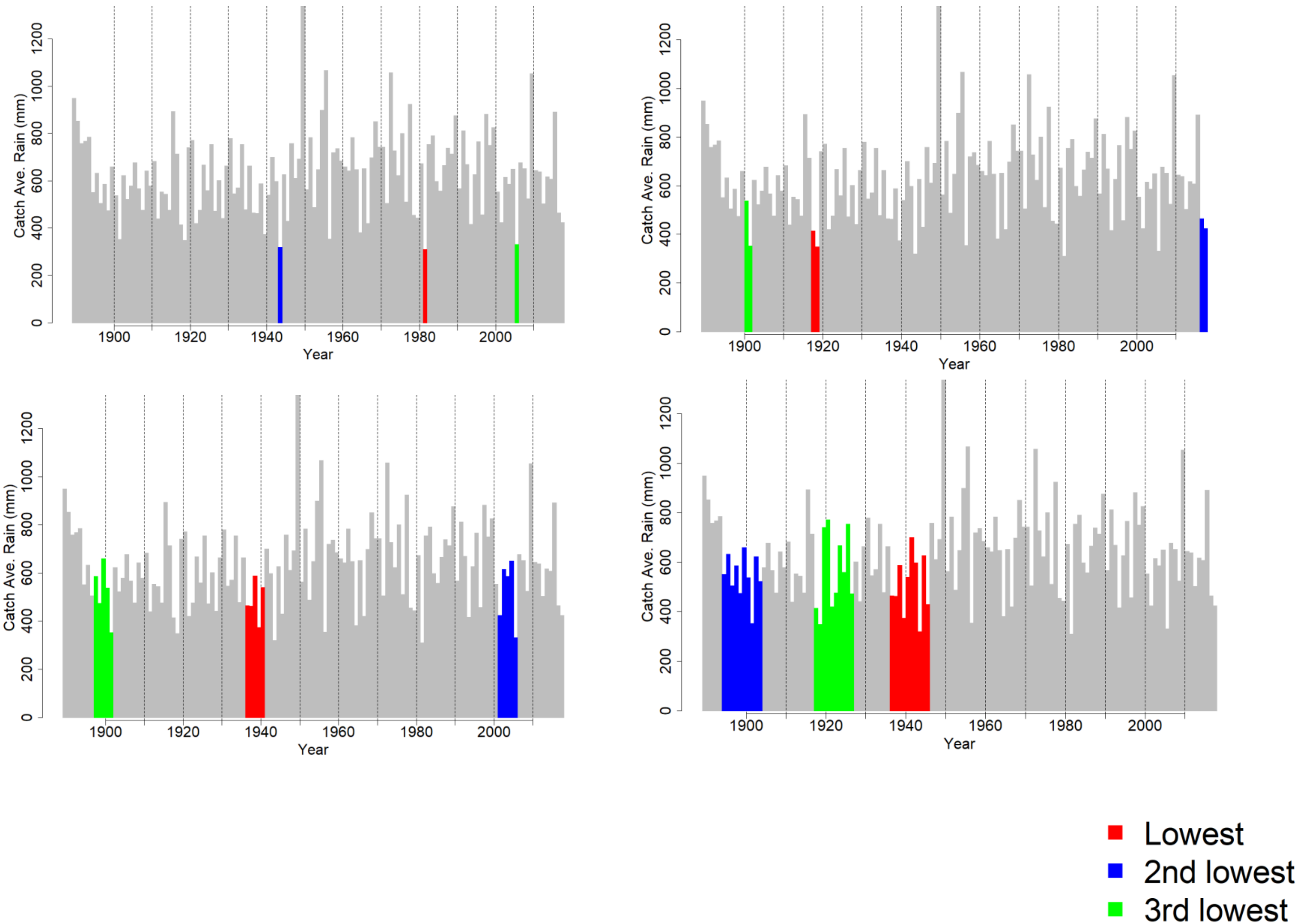
2011 Brisbane Flood



2011 Brisbane Flood



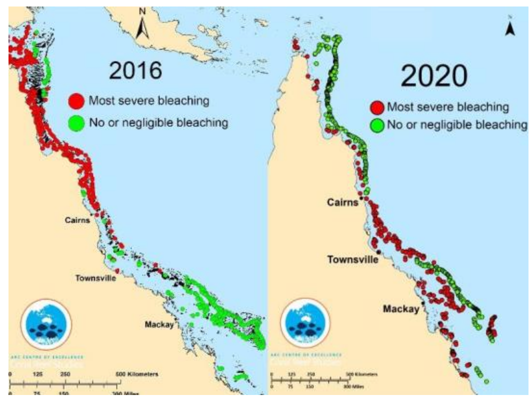
2017-2020 Drought



Some things that happened in 2020

Heatwave in Antarctica

A third coral bleaching event in 5 years



Coal mine approved in drinking reservoir catchment

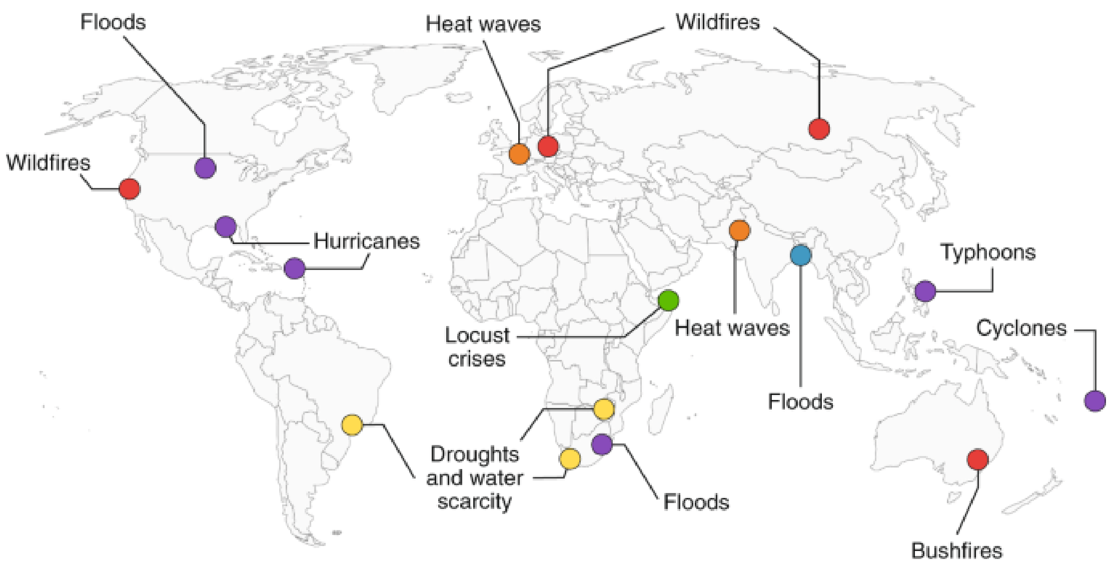
https://theconversation.com/5-big-environment-stories-you-probably-missed-while-youve-been-watching-coronavirus-135364

Water and climate are central to achieving global goals on sustainable development, climate change and disaster risk reduction

Disaster response is an inadequate framework, and there is still far too little emphasis on pre-disaster preparedness.

Risk frameworks should seek to include a wider variety of scenarios in planning, drawing from a rich history of precedents and plausible interactions of multiple hazards and elements of the impact system.

Both climate change adaptation and pandemic preparedness should be framed as part of countries' legal obligation to realize the right to health through their laws, policies and budgets.



3 billion people lacked access to basic handwashing facilities

https://medium.com/@r.nadin/if-we-were-not-ready-for-a-predictable-pandemic-what-else-arent-we-ready-for-e28812e16e84

https://www.nature.com/articles/s41558-020-0804-2 Compound climate Risks in the COVID-19 pandemic

… and don’t underestimate human ability to adapt when circumstances necessitate

What cost would you estimate for putting all university teaching programs online?

What timeline would be required to convert all university teaching programs to run online?

What is the likelihood that all this could happen within the next week at effectively zero cost?