BAMS Meeting Summary

Planning for Compound Hazards during the COVID-19 Pandemic

The Role of Climate Information Systems

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Roundtable on Compound Hazards and COVID-19

What: An online panel with leading experts in compound hazard research, preparedness, and response, attended by over 80 online participants, met to discuss hazard response in the context of COVID-19.

When: 30 June 2021

Where: Online, convened by the World Meteorological Organization and hosted by the American Geophysical Union

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The Intergovernmental Panel on Climate Change (IPCC) defines compound events as 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 (Seneviratne et al. 2012). This definition of compound events is now embedded within the IPCC risk framework under the umbrella of a combination of multiple drivers and/or hazards that contribute to societal or environmental risks. Also embedded in this framework is the understanding that response to an imminent risk can, in its own right, serve to reduce or to increase future risk.

The COVID-19 pandemic has brought dynamics of compound hazards and risk-response feedbacks to the fore of hydrometeorological hazard preparedness and response. For example, lockdowns implemented to slow the hazard of COVID-19 transmission have the potential unintended side effect of isolating or demobilizing people in the face of an incoming compounding hydrometeorological hazard, while conventional hydrometeorological hazard responses—group evacuations, shelters, community cooling centers, etc.—potentially exacerbate disease transmission (Fig. 1). Indeed, widespread climate extremes in the summer of 2021, including major heat waves in the Northern Hemisphere, widespread flooding, and extensive forest fires, all required that emergency responders and health systems balance acute risks of disease and severe

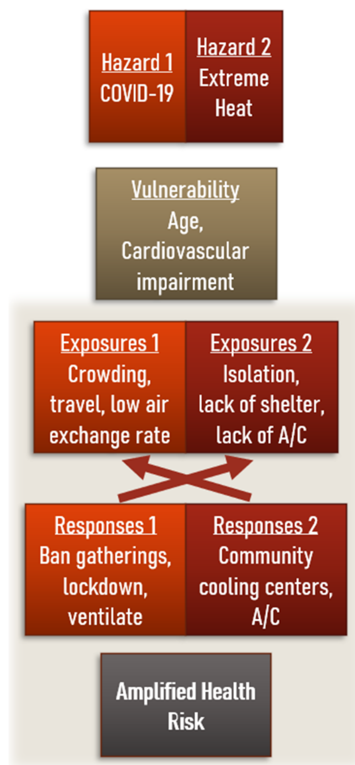

Fig. 1. A simple case of compound hazards leading to amplified health risk: COVID-19 and extreme heat are particularly damaging for older adults and individuals with cardiovascular disease. Behavior patterns that amplify COVID-19 transmission risk, however, are quite different from those that amplify heat stress risk. It follows that recommended responses to each hazard are often in conflict with exposure to the other hazard, potentially amplifying the health risk of both. Hazard–vulnerability–exposure–response–risk framing drawn from Simpson et al. (2021).

climatic hazards, and to do so in the context of economic stresses associated with both. Effective management of such hazards requires coordination across hydrometeorological services, disaster preparedness and response organizations, emergency health services, and vulnerable communities. At times it also requires that standard recommendations for responding to COVID-19 or a hydrometeorological hazard be revised, sometimes acutely, and that these revisions be communicated effectively to diverse audiences.

The WMO Task Team on COVID-19 Meteorological and Air Quality Factors convened the “Roundtable on Compound Hazards and COVID-19" to hear from global experts on hazard response in the context of COVID-19. Featured panelists were Dr. Joanne Robbins (Met Office, United Kingdom), Ms. Charlotte Norman (National Disaster Management Organization, Ghana), Dr. Liana Anderson (National Centre for Monitoring and Early Warnings of Natural Disasters, Brazil), Dr. Erich Fisher (ETH-Zurich, Switzerland), and Dr. Maarten van Aalst (Red Cross/Red Crescent Climate Centre and University of Twente, The Netherlands). Through presentations and discussion, the panel highlighted a number of key points, including the following recommendations.

Coordinate in advance of the hazard

A key challenge for understanding compound events is that decision-relevant information is held by a variety of agencies, and interdisciplinary work remains challenging due to institutional siloes, operational constraints, lack of resources to meet demand and mandate issues. *It is critical to identify mechanisms that facilitate integration and dissemination of all relevant data* in order to formulate useful narratives that can be translated for people in different sectors. In the context of epidemics, tabletop war game activities have been used to demonstrate shortcomings in existing information integration systems (Davies et al. 2020). Such exercises can be adapted to account for compound hazards, in order to motivate information coordination and exchange across all relevant institutions. Successes and failures in data integration from COVID-19 compound hazards are also instructive, and lessons from these events should be acted upon while the experiences are still fresh.

It is difficult to build compound risk information systems in real time, as hazards are unfolding. Therefore, it is critical that hydrometeorological services and their partners *invest in baseline risk analysis and impact-based forecasting that combines hazard analysis with dynamic exposure and vulnerability information*. In addition, they should look ahead at early actions needed to act on such risk information. Having these systems primed enables efficient action when compound hazards arise, and their presence can also enhance risk awareness in the public and associated accountability for decision makers. In some contexts, these baseline risk analysis systems will require fundamental development of monitoring and forecast capacities. But in other cases, integration of existing capabilities is the primary need. Data and models from realms of hydrometeorological forecasting, social vulnerability analysis, human movement during disasters, and disease transmission can be brought together for integrated risk analysis, but this capability is rarely realized for planning purposes. Such integration is not trivial. It requires concerted effort across disciplines and actors, and it must be done with methods and data appropriate to local conditions.

Learn to make use of forecasts

Anticipatory action is critical. This includes the application of *impact-based forecasts for compound hazards* that go beyond simply predicting the probability or intensity of each single hazard. Important considerations include challenges related to moving or sheltering people during COVID-19, and preparation for health system interruptions in areas where COVID-19 care is an urgent requirement. In this context, anticipatory action tools such as forecast-based financing can play an important role (e.g., Coughlan de Perez et al. 2015), and COVID-19 burdens on hazard preparedness and response need to be considered when implementing these instruments. COVID-19 challenges have amplified the demand for greater flexibility in financing and decision-making, as local actors may be in the best position to design and implement efficient preparedness and response strategies. Early action protocols need to incorporate different layers of flexibility, giving local actors more authority to act according to what makes most sense in light of a certain trigger.

Hydrometeorological service providers and users should be aware of *existing monitoring and forecast tools that can inform planning for compound hazards under COVID-19*. The U.K. Met Office Global Hazard Map (Robbins and Titley 2018) is one example of a product that can track and provide short-term (one week) forecasts of simultaneous and successive hazards across the globe and contextualize these events in relation to antecedent conditions and non-meteorological information. The tool is underpinned by ensemble forecast data to predict high-impact weather events, including forecasts of tropical cyclones, heavy rain and heatwaves. At longer lead times, subseasonal to seasonal outlooks like those provided by the WMO Global Seasonal Climate Update (Graham et al. 2011), associated Regional Climate Centers, Regional Climate Outlook Forums, and National Meteorological and Hydrological Services, and institutions like the International Research Institute and the Copernicus Climate Change Service provide probabilistic forecasts that can be indicators of some types of hydrometeorological hazards. Such forecasts contain significant uncertainty, and collaborative planning and capacity building are required to make use of the information for hazard-relevant decision-making.

Reach the most vulnerable

There is a need to *focus on protecting vulnerable population groups, and especially those groups that are hard to reach* when addressing any hydrometeorological disaster (Phibbs et al. 2016). The challenge of reaching and effectively engaging these groups is particularly acute in the case of complex compound events. In the context of less developed countries and small island developing states with increased climate adaptation challenges and overlapping risks, large proportions of the population are being left out as there is a strong tendency to help those in need but also those most easy to help. Particularly in vulnerable settings, risk information needs to be contextualized and conveyed in different ways to better capture dynamics of vulnerability. Metrics of intervention success should track the ability of the intervention to support groups that are less easy to help.

Communication is a key element of reaching diverse communities. This includes active communication efforts that *meet target audiences in their native language*, at the point and time when the information is needed (e.g., Howard et al. 2017). COVID-19 has raised awareness of how essential such efforts are, and that awareness should be applied to prioritize improved communication for all types of independent and compound hazards. In addition, the increased use of virtual platforms for disaster response trainings and educational purposes represents a complementary opportunity to in person interactions.

Both COVID-19 and climate change are topics that suffer from rampant misinformation campaigns. When COVID-19 and a hydrometeorological event made more extreme by climate change combine as a compound hazard, then, *there is great potential for misinformation that downplays the risks*. This potential needs to be considered in the design of compound hazard communications strategies.

Capitalize on alignments in hazard response

While COVID-19 can pose a significant challenge for response to hydrometeorological hazards, there are also circumstances in which *COVID-19 risk mitigation aligns with reduction of hydrometeorological, environmental, and social hazards*. For example, forest fires are social and environmental hazards that present multiple risks to health and well-being, and they can also force people to migrate from rural to urban centers and vice versa during a COVID-19 outbreak, potentially increasing the spread of COVID-19 (Aragão et al. 2020). Enhanced fire mitigation strategies and fire suppression, including efforts supported by subseasonal-to-seasonal (S2S) forecasts of relative fire risk, can reduce both types of risk. This alignment places a premium on preemptive hazard mitigation, as reducing a hydrometeorological hazard can have the health co-benefit of reducing COVID-19 transmission

Building on this alignment, there are cases where *COVID-19 safety measures have improved hazard response in general and should be mainstreamed*. This includes actions like those taken in Ghana, where hazard responders were provided with personal protective equipment for COVID-19, when these same responders had not previously received protective measures for other infectious diseases, and where free water was provided to communities to encourage handwashing.

Elevate awareness of low-probability, high-impact events

Compound hazards are rare, and those that involve a disease like COVID-19 have no recent precedent. In addition, the more complex compound events become, the more limitations there are to conventional statistical approaches to risk assessment. In this context, the use of *storyline-informed scenario planning exercises* (e.g., Shepherd et al. 2018), co-designed by stakeholders and scientists across disciplines, can be useful. Data providers, health system managers, and disaster preparedness and response experts can coordinate story-based "what if" sessions to identify key challenges and potential response strategies for combinations of hazards with no recent precedent. Such sessions can include lessons learned from analog events and from near misses.

Reaching beyond core hazard planning and response communities, *increasing risk awareness of unprecedented, compounding, and cascading climate hazards is a key area that needs to be targeted in local settings*. Recent record-breaking heat extremes, floods, and fires in the context of COVID-19 are seminal examples in this regard. Local governments and communities need to become more risk aware as this might also drive political accountability for better risk management across scales. While extremes like those experienced in 2021 may be far from recent experience, record-breaking extremes should not come as a surprise (Fischer et al. 2021), and the potential for compound hazards should be taken into account by decision makers. Ensuring broad awareness of the risks associated with rare but damaging compound events requires broad communication initiatives that are active in anticipation of hazards, and not just in response.

Further details of the roundtable can be found in the recording on the WMO COVID-19 Task Team website: https://community.wmo.int/activity-areas/health/Task-Team/activities. Outcomes of this roundtable are being integrated to the WMO COVID-19 Task Team's work plan, and will be considered in future events and guidance documents produced by the group.

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