Written Testimony of
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"Weathering the Storm: Improving Hurricane Resiliency through Research"
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Thank you, Chairwoman Fletcher, Ranking Member Marshall, and distinguished Members of the Committee for holding this important hearing today and for giving me the privilege of providing a private sector perspective. It is an honor to be here to address the importance of creating resiliency through scientific research and development (R&D) in a city that knows firsthand the importance of the realization of a more resilient future.

I thank this committee for its efforts to shine a national spotlight on the topic of resiliency and for facilitating a national discussion on how, as a nation, we should be creating more resilient communities. Research conducted across multiple sectors is fundamental to increasing our ability to withstand and recover from natural disasters of all kinds. This research drives innovation in academia, as represented by my esteemed colleagues testifying with me today, in government, as demonstrated by the lifesaving work of the National Hurricane Center, and in the private sector in large multinational corporations as well as at start-ups, such as One Concern.

It is my great pleasure to appear before you today in my current capacity directing the Insurance Practice at One Concern, a benevolent artificial intelligence (AI) company

based in Menlo Park, California. We are a company dedicated to saving lives and livelihoods. That mission is rooted in our founder's first-hand experience of living through both earthquake and flood disasters, and our team's personal dedication to building long-term planetary-scale resilience.

At One Concern, our mission is to work with policy makers, emergency management officials, first responders, and the private sector, to prepare communities to save lives and economic livelihoods before, during and after natural disasters, through the use of benevolent artificial intelligence, community action, and resilience. Our Executive Team and Advisors notably includes Craig Fugate, the former Administrator of FEMA from 2009 to 2017, who serves today as our Chief Emergency Management Officer, retired General David Petreaus, the former Director of the Central Intelligence Agency, retired Ambassador to Japan, John Roos, who served during the Fukushima tsunami nuclear reactor crisis, and Judith Rodin, former President of the Rockefeller Foundation and founder of their100 Resilient Cities Project.

My testimony today focuses on using research and development in artificial intelligence, machine learning, and natural hazard sciences to:

- predict disaster damage;
- aid emergency responders in the preparation, response, and recovery phases of natural disasters; and
- ultimately drive informed decisions that create resilient systems and enable financial tools to better prepare communities and the private sector for such events.

One Concern's work would not be possible without the R&D being performed by the U.S. government and at universities around the country, including the work our co-founders conducted while graduate students at Stanford University and active collaborations with leading academic institutions such as the University of Michigan and Texas A&M University. With the growing threat and impact of climate change on natural disasters, such as hurricanes, our ongoing research and development efforts, including collaboration with public and private universities, are more critical than ever for Houston, the State of Texas, our nation, and communities around the globe.

Since 1970, the number of disasters worldwide has more than quadrupled to around 400 per year (based on United Nations' disaster monitoring system). In the last 40 years natural disasters have caused more than 3.3 million deaths and $2.3 trillion in economic damages. Complicating this reality is our increasingly urban population - by 2030, 60

percent of the world's population will live in cities - a trend seen here in Houston as it has been one of the fastest growing U.S. cities in recent years.

As Members of the Committee know well, the State of Texas and the City of Houston are at significant risk from hurricanes, severe storms, and flooding. The impacts of urbanization were felt here in Houston when Hurricane Harvey hit in August 2017, causing the second costliest storm in U.S. history ($125 billion) over one of the most densely populated areas of the Gulf Coast and the fourth most populous city in the United States (2017 data). According to the federal government, Harvey's eight day tropical cyclone rainfall was the largest amount of rainwater recorded in the contential United States from one storm. More than 60 inches fell in various locations, more than 15 inches above the average annual amounts of rainfall for eastern Texas and the Texas coast. Harvey was directly responsible for at least 68 deaths in Texas, over half of which were in Harris County and the Houston metro area. In Houston proper, 204,000 homes and apartments were flooded. Almost 80,000 homes were inundated with 18 inches of water and 23,000 homes had more than five feet of floodwater. Roughly three quarters of these damaged homes were outside of the mapped floodplains.

At One Concern, we are developing technology to minimize the impact of floods like that during Hurricane Harvey, as well as earthquakes, and wildfires. Our benevolent AI platform removes the elements of human bias and insufficient data in times of crisis, providing innovative situational awareness in real-time to drive informed response. Our cloud-based platform enables decision-makers to act quickly to protect the maximum number of lives and property. Every prediction on the map in One Concern's solutions is carefully validated across hundreds of data points. In the background sit powerful, state-of-the-art complex mathematical algorithms across several fields of scientific study including structural engineering, hydrodynamic and hydrological coupled science, fluid mechanics, seismic and atmospheric sciences, and other subjects.

Machine learning and artificial intelligence sit at the core of these innovative analytics, helping to unlock new ways of understanding the manner in which complex disciplines interact. One Concern's research and development enables us to solve some of the most challenging problems in resilience to natural disasters, including devastating and life threatening flooding and storm surge caused by hurricanes.

Traditional hazard models rely on either high-resolution asset-level data not readily available at scale or low-resolution uni-dimensional data more widely available but lacking in detail. The former requires extensive pre-disaster data collection—making it computationally expensive to estimate damage during a disaster—while the latter

provides only aggregated impact estimates that are too coarse to be actionable. Given these constraints, existing hazard models provide a broad analysis with limited accuracy, resolution and actionable insights. This limited view of the modeled hazard hinders the ability of public safety and elected leaders to make targeted and timely decisions in an accurate manner for life-saving and life-safety activities such as alerts and warnings, evacuations, logistics management, and mitigation.

Houston's appropriate hesitancy to evacuate millions of people in the potential hazard zone could be a situation of the past as technologies like ours provide a granular view of an impacted area up to five days out from the flooding event. One Concern, through our R&D, has eliminated the data, modelling, and computational constraints of traditional hazard models that to date have only been able to provide a "big red (or blue) blob" of impact. We are able to create enhanced situational awareness, provide an understanding at the block level of which populations face the greatest risk and, through our continued R&D process, will allow first responders to visualize and understand the impact of mitigative actions. This level of situational intelligence could potentially change outcomes by informing targeted evacuations, engineering the flood and diverting flood water away from people and critical infrastructure.

One Concern's models gather asset-level data from various public and proprietary sources in a scalable process along with impact data from previous disasters and then implements data-driven machine learning models that require no user inputs and can output impacts at high spatial resolution. Additionally, One Concern's solutions are being developed with the capability to gather real-time hazard data such as water levels (e.g., river/stream/ocean gauges), user-reported damage reports, temperature and wind patterns from satellites, and weather conditions and forecasts to generate highly accurate localized impacts that can be updated continually as more information becomes available. Through our ongoing R&D efforts, One Concern is creating dynamic models for disaster impact analysis that combine physical sciences with machine learning techniques. As a result, One Concern's solutions create, distribute, and visualize critically valuable data during a disaster; not to merely visualize static data.

R&D in Action: Modeling Flood Events

A specific example of One Concern's unique research efforts is our platform application for active flood events. As demonstrated in Hurricane Harvey, flooding from storm surge and rainfall create a dangerous and deadly situation. A 2014 National Hurricane Center report found that during the Atlantic tropical hurricanes and storms from 1963 to 2012, 88 percent of deaths in the United States were from drowning created by storm

surge, rainfall flooding, high surf, and deaths just offshore (within 50 nautical miles of the coast).

Existing geographic information system (GIS)-based solutions show the weather forecast, location of rivers and locations of buildings on the same map; however, One Concern creates models to estimate how precipitation from the weather forecast will increase water flow in rivers, and how river flow will breach banks and inundate surrounding areas. Our R&D efferts are solving the shortcomings of existing hazard analysis and GIS-based tools by applying the combination of natural phenomena sciences and artificial intelligence to the process of impact assessments from hazards.

For example, immediately before and during a flood, our platform combines hundreds of forecast data points with real-world sensor and gauge data. It then combines that data with a coupled hydrodynamic and hydrological prediction and natural environment factors through a proprietary machine learning algorithm to estimate damage in near real time. This provides a highly accurate, high resolution understanding of the impending flood inundation, associated impacts, and a real-time situational awareness. The solution empowers leaders and stakeholders with accurate information to understand how to mitigate against, prepare for, respond to or recover from flood events

This modeling approach addresses the core complexity associated with modeling natural disasters - their dynamic nature. By definition, natural disasters are extreme events and cause permanent deformations in the physical environment. Buildings and infrastructure are weakened or partially damaged. Rivers will change course or combine, stream banks will reorganize, and debris will change water depth and direction. If the model output is based on static data, as is the case in conventional live hazard models, the model is very far from ground truth at any point in time. Using AI, One Concern’s solutions are developed to not just change their model live, but their underlying data as well. This ensures that leaders and planners are provided with accurate and reliable predictions during all phases of the disaster life cycle.

While informed decision-making during an event is paramount, the resilience of a community is typically enhanced most efficiently through proactive preparedness, planning and mitigation. Emergency managers and their partner stakeholders within the entire community invest their time and limited funding to plan, train and exercise before the next disaster. At One Concern, we are working with jurisdictions to put our R&D into action by implementing our flood risk preparedness module to allow emergency personnel to plan within the framework of highly accurate simulated disaster scenarios.

By providing realistic impact predictions, One Concern's preparedness solution will ensure that plans developed before the disaster are usable and effective.

Creating Resilience

To create true resilience, more research and development needs to be done across an entire ecosystem. One Concern is tackling this challenge. We are endeavoring to create a holistic picture of hazard risk to business and communities that identifies vulnerabilities to critical infrastructure and external dependencies, such as access to electricity and water. Analyses of how floods, fires, and earthquakes have direct structural impact to assets and indirect impact to critical dependencies, we are providing a more complete understanding of a community's baseline resilience. One Concern's R&D efforts allow a community or business to assess and mitigate risk with a more precise picture of how that action will benefit people, assets, and infrastructure. This enables a jurisdiction or a company to develop and enact mitigation plans before a disaster strikes. Local officials are better able to identify at-risk parts of the population and/or community, providing a more complete picture for disaster planning and management, enabling resilience and thus a quicker recovery when disaster strikes.

It is important that policy and infrastructure planning that is intended to improve resiliency be equitable and that it focus on mitigating overall societal risk, rather than mitigating just the greatest financial risk. One Concern's data represents the entirety of our communities, not just that of those most affluent, and is therefore well positioned to drive equitable and informed decisions around overall societal resilience.

Current systems for measuring resilience are narrowly scoped looking at a single or few factors rather than the cascading dependencies within a system that impacts how a jurisdiction or organization functions. In addition, they are not very granular, and do not permit, a side-by-side comparison of a place or a company, and are typically only calculated periodically. One Concern and our partners are developing a forward-looking, granular, objective rating for enterprises, and then governments, to estimate the impact from a variety of hazards on: businesses; critical Infrastructure and supply chains and their related dependencies; communities; and economies.

Current metrics also tend to focus on current risk rather than future potential risk, and tend to be qualitative rather than objective in their analysis. Through our ongoing R&D, One Concern considers the cascading effects of disasters within the complex networks of jurisdictions and organizations. We are creating metrics that a jurisdiction could measure how resilient their critical infrastructure and lifeline dependencies of power,

water and wastewater, communications, transportation, healthcare and food system are and how well they would fare in a natural disaster.

Effective mitigation, preparedness and response play a critical role in how a community's resilience to natural disasters such as hurricanes and associated flooding, but another key element is the access to insurance to support the community's recovery. One Concern's intent is that our innovative modeling provides a comprehensive view of a business' resilience to enable an expansion of insurance and resilience finance. Currently, there are gaps in society's ability to understand the risk to businesses from disasters beyond its physical structure. The ability for a business to operate after a disaster is not just dependent on that structure, but also its access to power, water, customers, employees and supply chain. We seek to partner with businesses and insurers to provide a transparent assessment of that risk and support the development of new business interruption insurance products that will help businesses, their communities, and the economy to recover after a disaster event.

One Concern's platform provides unprecedented situational awareness of floods, earthquakes and wildfires and actionable insights for decision-makers, allowing our partners take an integrated approach to building lasting resilience. We leverage critical research in AI, hazard science, and weather. Through our ongoing R&D, we integrate AI, machine learning, and deep learning with expertise on natural science phenomena, emergency management, and our clients' institutional knowledge. By doing so, we enable our partner jurisdictions and companies to improve the robustness of their approach and the speed at which they are able to achieve success as defined by them. Ultimately, One Concern will enable resilience that strengthens communities, protects people, places and assets, and rewards smarter infrastructure investments.

In closing, I would like to thank Chairwoman Fletcher and the Committee for inviting me here today to share One Concern's ongoing research and development efforts to create a more resilient future.

Emily Grover-Kopec

Emily Grover-Kopec serves as the Director of the Insurance Practice at One Concern and has more than 15 years of experience in catastrophe modeling and climate analytics with a primary focus on applications within the insurance industry. Prior to joining One Concern, Ms. Grover-Kopec spent 12 years at Risk Management Solutions (RMS). Most recently, she was Vice President of Modeling Solutions at RMS and focused on analytics for the flood peril in the United States. Ms. Grover-Kopec also brings experience from Columbia University's International Research Institute for Climate and Society (IRI). Her work at the IRI concentrated on monitoring climate impacts and mitigating climate risk in developing countries. Ms. Grover-Kopec holds a B.S. degree in Atmospheric, Oceanic and Space Sciences from the University of Michigan and a M.S. degree in meteorology from Penn State University.