Compound Pandemic and Hurricane Hazard Index (CPHI) Overview

Jennifer Dargin; jenniferdsara@tamu.edu, Sara Garcia; sariaktx@tamu.edu, Bora Oztekin; bora@tamu.edu, Ali Mostafavi; mostafavi@tamu.edu

UrbanResilience.AI Lab, Texas A&M University

Practices such as social distancing and sheltering-in-place have changed the operation of our day-to-day lives while business and other facility closures have limited the accessibility to certain services. In light of recent events, from a cyclone hitting the coasts of India and Bangladesh in late May, and the dam failures causing catastrophic flooding in a Michigan city, concerns about how the pandemic situation will affect the response to such natural hazards are being raised. Are we prepared to handle additional threats, such as flooding and hurricanes, as the world continues to cope with the spread of COVID-19? Now more than ever, robust hazard mitigation planning is needed to help cities prepare for the compound impact of multiple hazards. An important aspect of this process is identifying and planning safe evacuation zones and shelters that also take into account the risks of the spread of infectious diseases and viruses, such as COVID-19.

The UrbanResilience.AI team developed the Compound Pandemic and Hurricane Hazard Index (CPHI) as an indicator of county-level compounded vulnerability and risk to COVID-19 exposure and spread, hurricane impact, and flooding. Socioeconomic factors are also considered as a factor for determining a community's accessibility to facilities and services necessary for preparative and protective actions during a disaster event. The CPHI is comprised of data collected from the Pandemic Vulnerability Index, the Social Connectedness Index, Social Vulnerability Index, and the Natural Hazards Index, at the county level for Gulf Coast and East Coast states, which are prone to hurricane events. The final index was developed by summing the normalized values of these indexes by county and taking their weighted average. The final index score is a percentile rank of each county, where increasing rank corresponds to a higher risk to a compound hazard event.

The CPHI is displayed visually as a choropleth map, where the color gradient from dark purple to yellow corresponds to increasing risk to a compound hazard event (i.e. dark purple and red areas have low compound hazard risk, yellow and orange areas have high risk). Users can click on each county to view its CHI score in addition to the individual score of its 6 hazard risk components: (1) Pandemic Risk, (2) Natural Hazard Risk, (3) Socioeconomic Status, (4) Household Composition and Disability, (5) Minority Status, (6) Housing type and transportation. Table 1 includes a description of each component, the rationale for its inclusion, and a link to the public data source.

Table 1: Compound Pandemic and Hurricane Hazard

Compound Hazard Risk Component	Indicator	Source	Description
(1) Pandemic Risk	Pandemic Vulnerability Index (PVI)	NIEHS, North Carolina State University and Texas A&M University	Pandemic Vulnerability Index - A normalized value to depict the risk of each county when it comes to having cases of COVID – 19. The data is updated on a weekly basis. The PVI values used reflect conditions and cases averaged between 03/15/2020 and 06/01/2020.
	Facebook Social Connectedness Index (SCI)	FB Data for Good	The SCI measures the strength of connectedness between two geographic areas as represented by Facebook friendship ties. These connections can reveal important insights about economic opportunities, social mobility, trade, and more. They also aid in the tracking of how groups of people move between counties in normal times, as well as in times of disasters.
(2) Natural Hazard Risk	Hurricane Hazard Index	National Center for Disaster Preparedness, Earth Institute, Columbia University	The Hurricane Risk is based on historic data on Hurricane tracks collected from National Oceanic and Atmospheric Administration between 1851-2004. The final score is based on the category number that describes that event and weighted by intensity. Values describing each hurricane event were aggregated by United States County, normalized by total county area. The Flood Hazard is based on data collected by United States Federal Emergency Management Administration's National Flood Hazard Layer. Flood areas were aggregated by county and are expressed as a fraction of the total county land area. Flood hazards were classified based upon percentage of land that is susceptible to flooding. National Flood Hazard Layer only covers populated areas; areas not included in National Flood Hazard Layer were given low flood risk.
	Flood Hazard Index	National Center for Disaster Preparedness, Earth Institute, Columbia University	

(3) Socioeconomic Status	% Below Poverty	ATSDR's Geospatial Research, Analysis & Services Program (GRASP)	Components 3 – 6 correspond to the SVI's 4 Themes. The SVI was developed "to help public health officials and emergency response planners identify and map the communities that will most likely need support before, during, and after a hazardous event. The degree to which a community exhibits certain social conditions, including high poverty, low percentage of vehicle access, or crowded households, may affect that community's ability to prevent human suffering and financial loss in the event of disaster. These factors describe a community's social vulnerability" (ATSDR)
	% Unemployed		
	% Income Index		
	% No High School Diploma I		
(4) Household Composition and Disability	% Aged 65+		
	% Aged 5+ with Disability		
	% Single Parent Household		
(5) Minority Status	% Minority		
	% Speaks English "Less than Well"		
(6) Housing type & Transportation	% Multi-Unit Structures		
	% Mobile Homes		
	% Crowding		
	% No Vehicles		
	% Group Quarters		