# Climate Change

## Regional Exposure Assessment

# Climate Change

We understand climate change as variations in what is considered prevailing weather conditions. Climate has always changed due to diverse factors such as earth orbit inclination, volcanic activity, solar unusual activity periods, etc. Nevertheless, recent conclusions of the Intergovernmental Panel on Climate Change (IPCC) determined, that current climate has changed because of human activity, mainly because of the increase of greenhouse gases in the atmosphere (United Nations Framework Convention on Climate Change, Article 1. Definitions 1992).

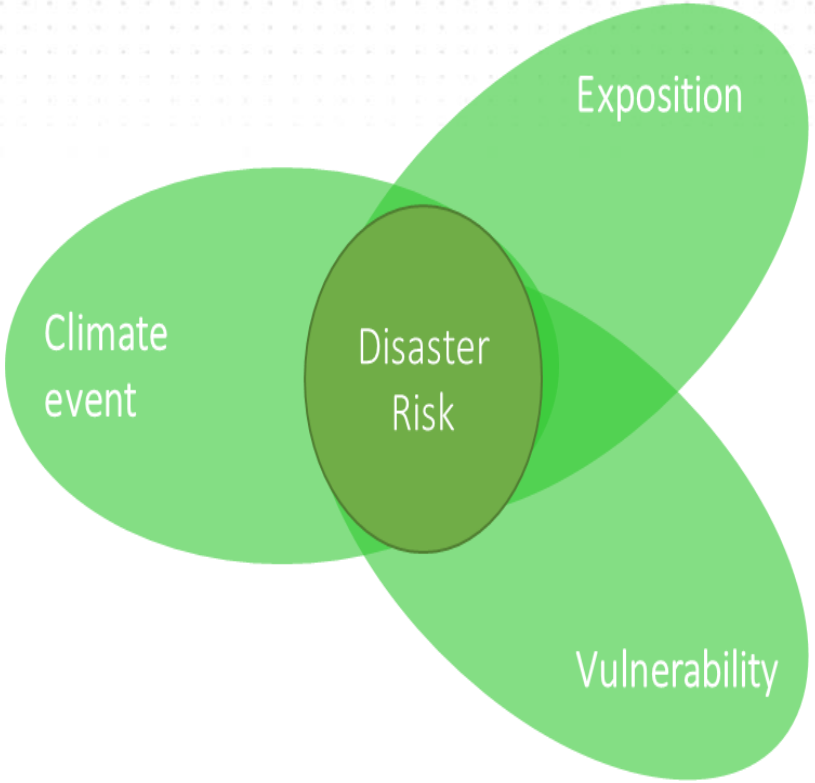
Expert scientists, by means of complex models and paleoclimate records, have estimated that we will face a series of adverse physical and social conditions over the century. Magnitude of such conditions shall be determined by the increase in the global temperature level mean. Among the major physical effects due to climate change are:

- **Catastrophic weather events**. Increase in the number of events and intensity of extreme climate phenomena, including hurricanes, tornadoes, storms, etc.
- **Change in rainfall patterns**. It will rain more in some regions, causing floods, and it will rain less in other regions, causing droughts.
- **Sea level rise**. Due to polar caps, glaciers and permafrost thawing.
- **Loss of biodiversity and change in diseases spreading gradients**. Because animals and plants have adaptation difficulties to new climate patterns, we could be facing potential massive extinction. Normal temperature and ecotone gradients for disease spreading are changing, allowing diseases to reach un-challenged territories and prosper.
- **Heat waves and extreme temperature records**. Due to the increase in average temperature, heat waves will have a greater effect on population and ecosystems. It has been forecasted that extreme temperature historic records will increase, that is, hotter and colder peak registers.

# Difference between Exposition and Vulnerability

- **Exposition.** An element that occupies the same space at the same time where a climate event occurs.
- **Vulnerability**. The degree a system may be susceptible or unable to face climate change adverse effects, including variability and extreme climate. Vulnerability is a climate change character function, magnitude and speed, and the variation a system is exposed to, its sensibility and adaptive capacity.

There is a potential risk when three factors are combined (side image): climate event, people or property exposure and people or property vulnerability. If one of these elements does not exist, there is no probability of risk.



# Methodology

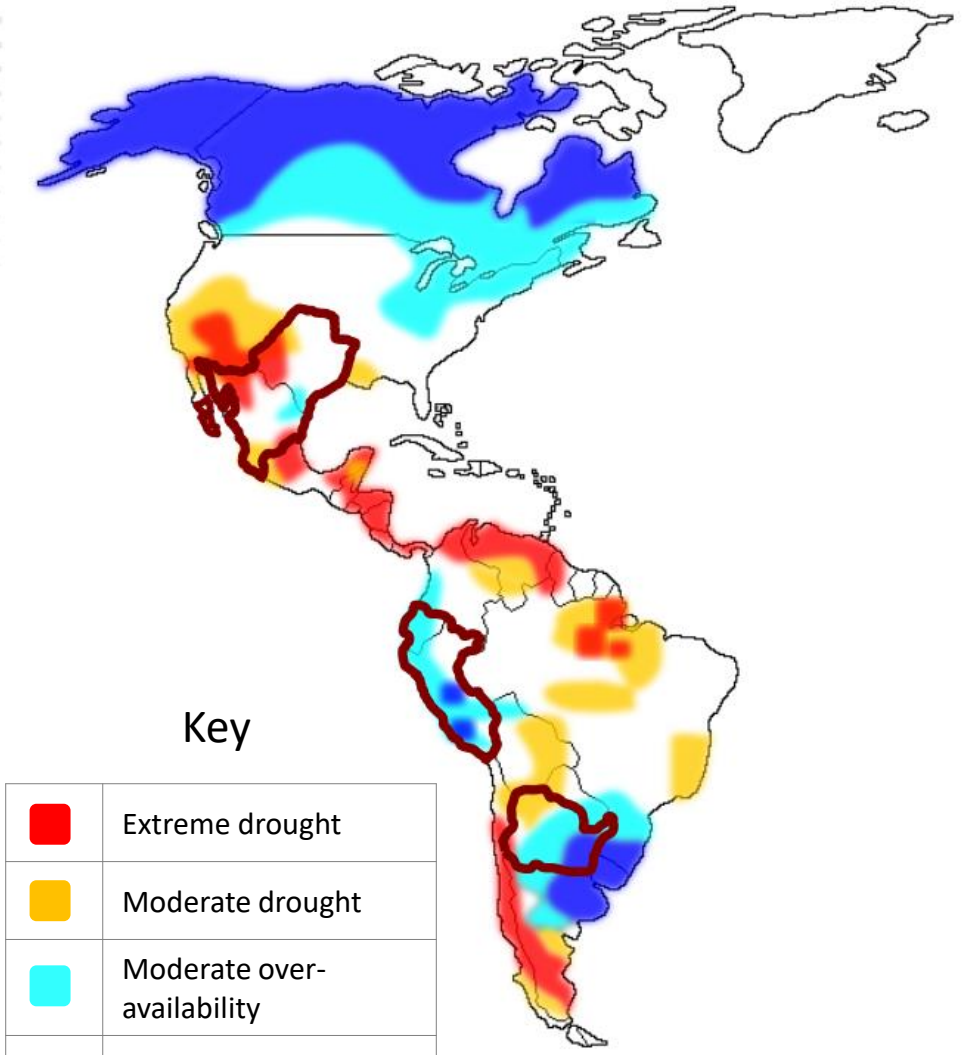
To identify exposure to diverse degrees of physical risks derived from climate change, climate change risks maps were overlapped to those of Arca Continental's operation geographies using geographic information system software. The process followed these steps:

1. Generate risks maps. In order to gather risks maps, space models of such forecasts were used. We used model based on IPCC A2 scenarios, as it is the most accepted and used. This space models were obtained from organizations such as IPCC, EPA, Semarnat, Mapelcroft and CGDev, among others, and were standardized to WGS84 (World Geodesic System 1984) using GIS software.
2. Arca continental's operation geographies were overlapped in the previously generated risks maps. The geographies were constructed using the countries states where Arca Continental has beverages operations.
3. Exposure degree to physical risks each region was determined based on its relative distance to risk zones identified in point 1. The next table shows criteria used to assign exposure degree:

| Exposure grade | Grade criteria |
|---|---|
| **Null - 0** | Geography located at more than 100km of a low risk zone |
| **Very low - 1** | Geography located within a low risk zone |
| **Low - 2** | Geography located at less than 100km of a medium risk zone |
| **Medium - 3** | Geography located within a medium risk zone |
| **High - 4** | Geography located at less than 100km of a high risk zone |
| **Very high - 5** | Geography located within a high risk zone |

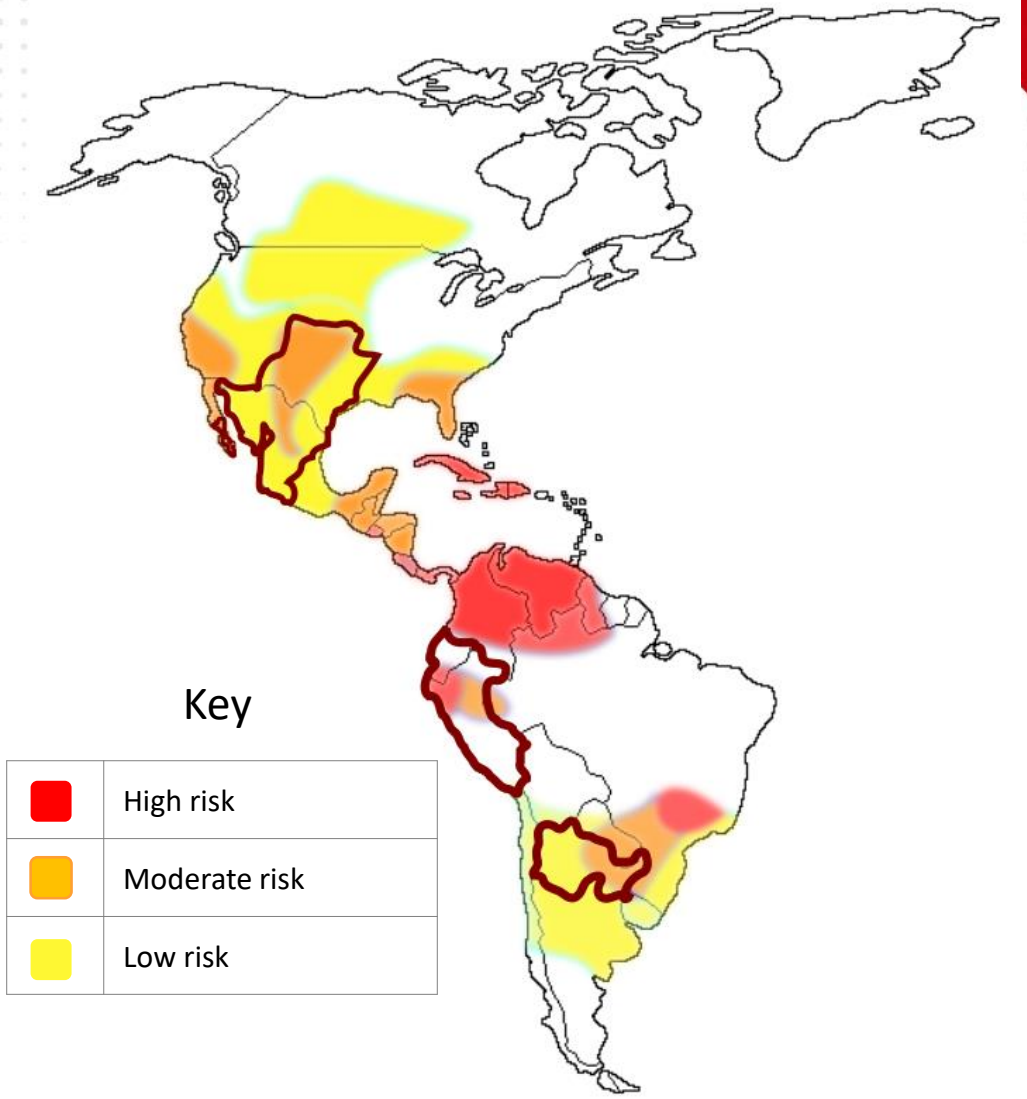
# Water Availability

- Fresh and drinking water availability will be affected by diverse factors such as temperature and population expansion; just as well for water quality (Bates, B., et al. 2008). Temperature increase has a direct impact on the amount of available water because it accelerates glaciers, ice bodies and mountain snow thawing, thus diminishing the amount of water retained for the following hot season. Therefore, available water for populations depending on ice melting and fresh water runoff decreases. Likewise, water temperature is affected by global temperature; as a result water bodies could show thermic contamination with possible consequences to society and eco-systems health.
- Secondly, the larger the population demanding a specific amount of water, the greater effect on supply sources will be, due to larger extraction; hence speeding up reserves exhaustion. Accordingly, water availability problems will become more severe as population increases over time.
- Finally, water quality depends on several events such as sea levels rise, causing salt water to filter towards underground fresh water bodies which will no longer be a supply source because of their contamination. Storms frequency and intensity may alter cycles in water bodies, causing the expected amount of nutrients, sediments and pathogens in superficial waters to change, thus its quality. Besides, it is likely that by 2050, zones with significant water availability problems will be twice as many as those having a smaller hydric stress.



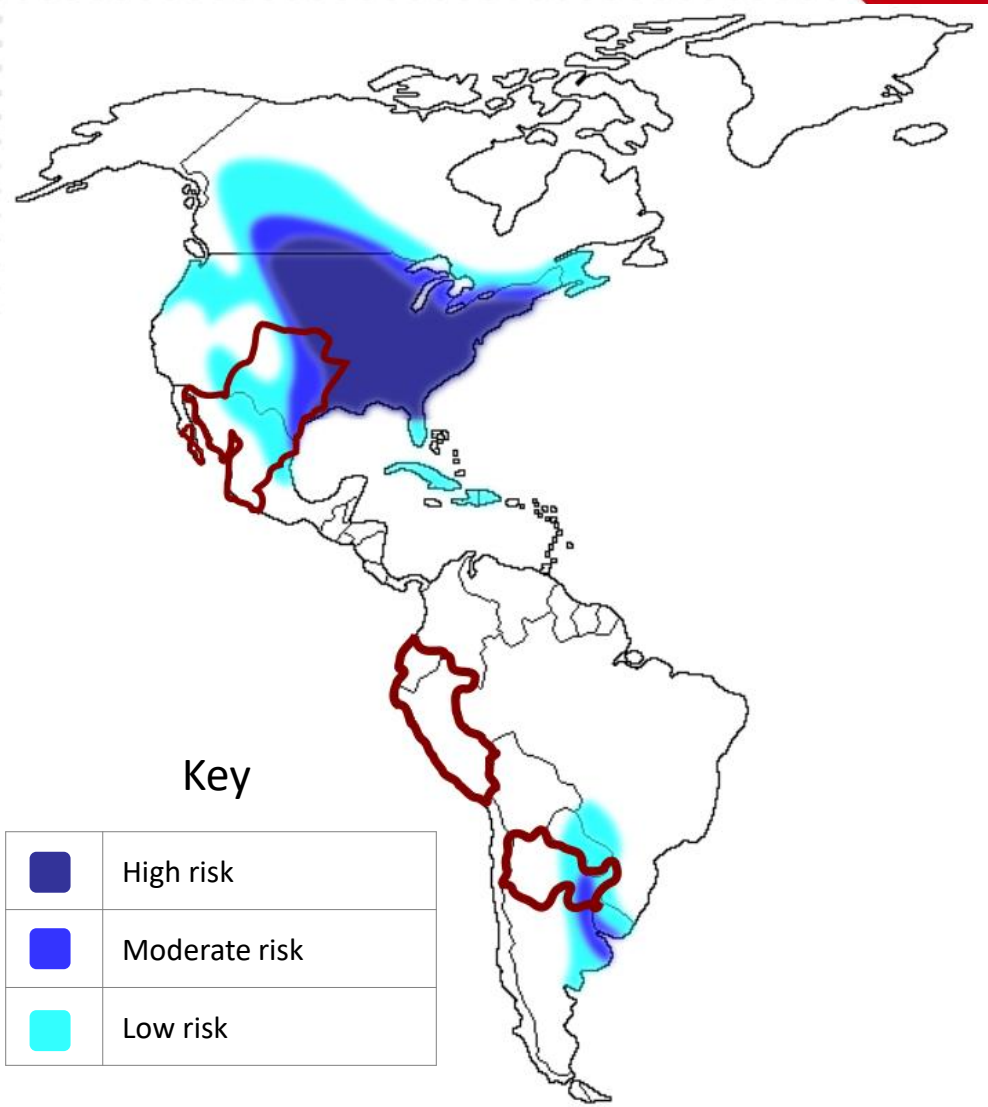
# Heat Waves and Critical Temperature Rise

- The increase of the global temperature mean is mainly because of Greenhouse gases generation and accumulation. GHG are released to the atmosphere by anthropogenic processes (industrial activities, fossil fuels burning, changes in land use, etc.), causing energy, which is reflected from our planet into space, to remain within our system; thus concentrating a larger amount of energy as heat in our atmosphere (Gitay, H., et al. 2002).
- This temperature increase in turn causes the loss of ice bodies which help regulate Earth´s temperature and reflect a significant percentage of energy received by our planet. Moreover, sea temperature also has an important increase, since water bodies absorb 80% of the heat added to our system. Therefore, temperature rise is increasingly striking, showing a 0.85 ° C rise from 1880-2012; while 11 out of the 12 recent years have been categorized as the hottest ever. In the last 25 years, the temperature increase mean is higher than in previous records (Solomon, S., et al. 2007).
- Heat waves are expected to be more frequent and intense. Likewise, it is possible to observe that the number of hot nights has increased, while the number of cold nights has diminished. Nevertheless, variation between the number of hot and cold days is not extraordinary enough to determine a tendency.
- Just as for snowfalls, operation sites major vulnerability to heat waves and critical temperature elevation will be disruption of normal operations. Work in the open should be limited; more energy will be used to cool buildings and processes; and it could become a matter of public health among vulnerable population.



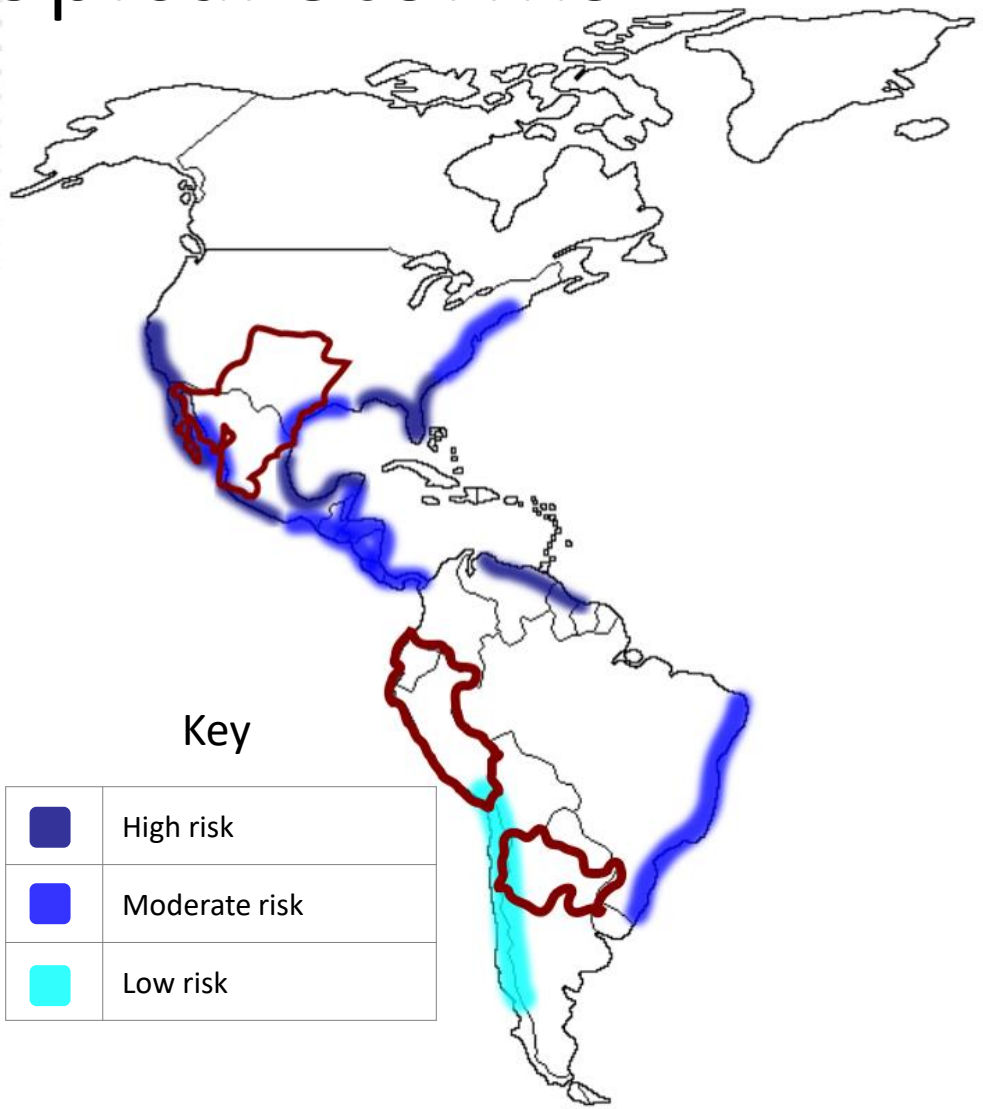
# Tornadoes and Dust Devils

- Frequent and intense tornadoes and sand storms have not been directly linked to climate change since there is not enough information (Earth System Research Laboratory Physical Sciences Division. 2011). For example, it has been recorded that tornadoes in the United Sates have doubled since 1990. Nevertheless, increase in the number of detected tornadoes may be because population grew and new regions were occupied, thus experiencing these natural events, which would not have been detected otherwise when zone was inhabited; or, because there is better equipment now to measure the intensity and frequency of tornadoes. That is, it is not possible to link the increasing number of tornadoes to climate factors, since other factors, such as population expansion and technological advances, could be the cause of change in the number of recorded tornadoes (IPCC. 2007). Even so, scientists have started to study the possibility to relate tornadoes to climate change by observing the main reasons that trigger them: climate instability and wind shears.
- On one side, climate instability appears when there is warm and humid air close to land surface, which might increase frequency with the elevation of temperature and evaporation because of climate change. While, wind shears happen when warm and humid air converges with a higher cold and dry air flow. Because both flows spin in opposite directions, there are better conditions for a tornado to be generated. That is why scientists believe it is possible that, because climate change favors the presence of factors determining the frequency of tornadoes, these could be more frequent in the future.
- Operation sites vulnerability will depend on its infrastructure degree of preparation to endure these phenomena. Surrounding community and infrastructure should also be prepared to endure such winds. Lack of preparation in these areas could raise operation sites vulnerability.



# Hurricanes, Cyclones and Tropical Storms

- Hurricanes, cyclones and tropical storms represent a great cost regarding human lives, infrastructure and economic assets. Alarmingly, it is expected that these costs will rise due to such natural events. These diverse events, such as the rising of oceans superficial water temperature, the increase of water vapor in the atmosphere, and sea level rising, are related to global warming; all these increase the intensity of natural phenomena and/or their impact (The University Corporation for Atmospheric Research. 2015).
- Sea surface temperature rise is closely related to hurricanes, cyclones or tropical storms intensity. According to an MIT investigation, their intensity has soared up 50% over the last 50 years. That is, if planet temperature is expected to rise over time, thus that of sea surface, then, hurricanes, cyclones and tropical storms intensity is also expected to increase.
- The increase of water vapor in the atmosphere represents a large amount of available energy for hurricanes, cyclones or tropical storms; this shows that it also has a close influence on intensifying these natural phenomena. Likewise, more available vapor means more rain coming together with these natural phenomena.
- Rising sea level increases impact caused by a hurricane, cyclone or tropical storm, as well as the probability of floods. It is important to point out that there is still no proof that global warming is turning these natural phenomena more frequent. As mentioned before, as yet a direct connection to this natural phenomena intensity has been observed, as well as with implicit costs.
- These meteorological events effects expand inland with torrential or persistent rains, although risk of great tidal surges and heavy winds decreases considerably; the biggest damage for inland infrastructure is frequently caused by rains.



# AC Combined Exposure

Based on the exposure criteria listed in page 4, we analyze each region level of exposure to the four climate change physical risk mentioned. The combined exposure, then, is calculated dividing the sum of all four partial exposures by the maximum grade possible. A combined exposure of 1 will means that a particular region has a very high exposure to all four physical risks.

This analysis allows us to prioritize the adaptation actions for the physical risk in each region's exposure.

| | Mexico | Ecuador | Argentina | Peru | CCSWB |
|---|---|---|---|---|---|
| Water Availability | 5 | 0 | 2 | 0 | 5 |
| Heat Waves and Critical Temperature Rise | 3 | 4 | 3 | 5 | 3 |
| Tornadoes and Dust Devils | 2 | 0 | 3 | 0 | 4 |
| Hurricanes, Cyclones and Tropical Storms | 5 | 0 | 2 | 1 | 3 |
| **Total combined exposure** | **0.75** | **0.2** | **0.5** | **0.3** | **0.75** |