Intensity Duration Frequency - Frequently Asked Questions

What is a return period?

- A return period (also known as a recurrence interval) describes the frequency an event of a specified magnitude is expected to be equaled or exceeded, on average. It is a statistical measurement of the average time interval between the events, and is used to express how likely an event is to occur in any given year. For example, a 50-year event has a 2% chance of occuring in any given year.

Why does the intensity decrease as the duration increases?

- As temperature increases, intensity decreases because it is much less likely for extreme temperatures to be sustained over longer continuous periods. While temperature may peak for a single day, when temperatures are averaged over multiple consecutive days, the value is typically lower.

What does an X-day, XX-year event mean?

- An X-day, XX-year event is a temperature event with average intensity equaling or exceeding a certain temperature that lasts X days with a rarity defined by the XX-year return period. For example, a 4-day, 50-year event can be interpreted as a 4-day heat wave with a 2% chance of occurrence in a year (expected to occur once every 50 years) would have an X°F average temperature for the selected location.

What do the 5th and 95th percentile shaded bands represent?

- The temperature extremes are calculated by resampling annual maxima across three different climate models, then parametrically estimating extreme value statistics. This process is repeated 500 times to capture a range of likely temperature events. The 5th and 95th percentiles provide an uncertainty envelope for the projected temperature event representing the spread in projected extremes due to the limited sample and model variability.

How do I use the different confidence intervals?

- The confidence intervals provide context for the extent of data variability, providing a range of plausible values around the estimated median value. This can be applied based on your risk tolerance in your system or operations. When considering the range of potential sustained heat events, in a case where you have very little flexibility to accept risk into the system, it may be necessary to consider the higher intervals (95th percentile interval) to ensure the high-end range of potential heat events is accounted

for in the system or operation. In cases where the system is able to accept some increased risk, designs or plans may consider the 50th or 5th percentile. The confidence intervals provide more than a single point estimate to recognize the uncertainty in projecting outcomes beyond those in the model data.

How is this data different from the daily maximum temperature?

- IDF data is intended to display sustained events rather than a maximum for a given day. This provides an outlook for heat stress considerations in engineering thresholds and public safety concerns among other impacts.
- ClimRR's daily maximum temperature data calculates seasonal averages using the daily high temperature for each day in a season. This data offers insight into broader climatic shifts in temperature but is less useful in planning for particularly extreme heat events that can bring severe impacts to infrastructure, public health, and the built environment.

How can this data be applied in an engineering or infrastructure context?

- Sustained high heat limits cooling opportunities, pushing heat-stress limits for assets which when operating at or beyond its defined temperature thresholds can reduce lifespan or limit functional capacity. For example, in an electric infrastructure context, sustained high temperatures reduce transformer lifespans by accelerating insulation degradation. High temperatures increase energy demand, but also increase strain on the grid, forcing assets to operate in challenging conditions where they may overheat, fail, or lose efficiency. These IDF projections can be used to understand the level of potential change in sustained extreme temperatures that infrastructure may be exposed to at mid-century.

How can this data be applied in a public health planning context?

- Heat is a critical environmental and occupational health hazard. Heat stress is one of the leading causes of weather-related deaths. Sustained high heat prevents the body from cooling down, leading to higher risk of heat-related illnesses, and can exacerbate underlying illnesses. Outdoor workers and others exposed to high heat conditions must have regular breaks, water, and shade to keep cool during a heat event. Additionally, some populations are more vulnerable to heat impacts, particularly due to age and health status, requiring adequate cooling spaces to keep safe during heat events. These IDF data can be used to understand how rare heat events may shift in the future, potentially becoming more intense and more frequent.