

Identifying Extreme Events with the Risk Screening Tool (RiSc)



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September 2026

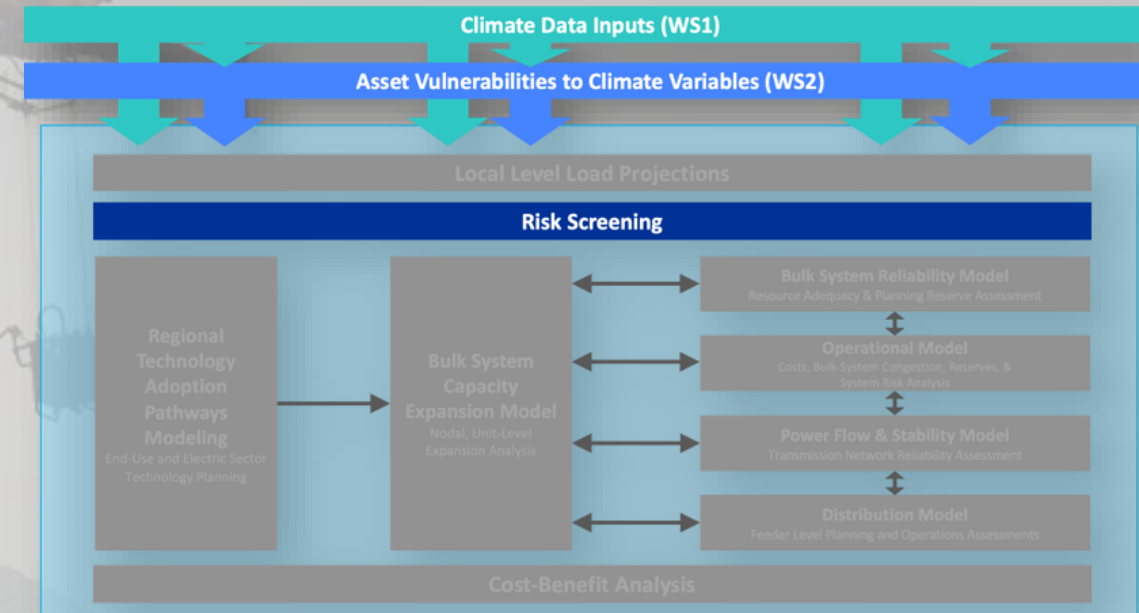
Climate Risk Screening (RiSc) Tool

How do we identify extremes while considering impacts of climate?

- Climate data is a large state-space
- Need an efficient platform to evaluate climate data and asset vulnerability together to find periods of highest system risk

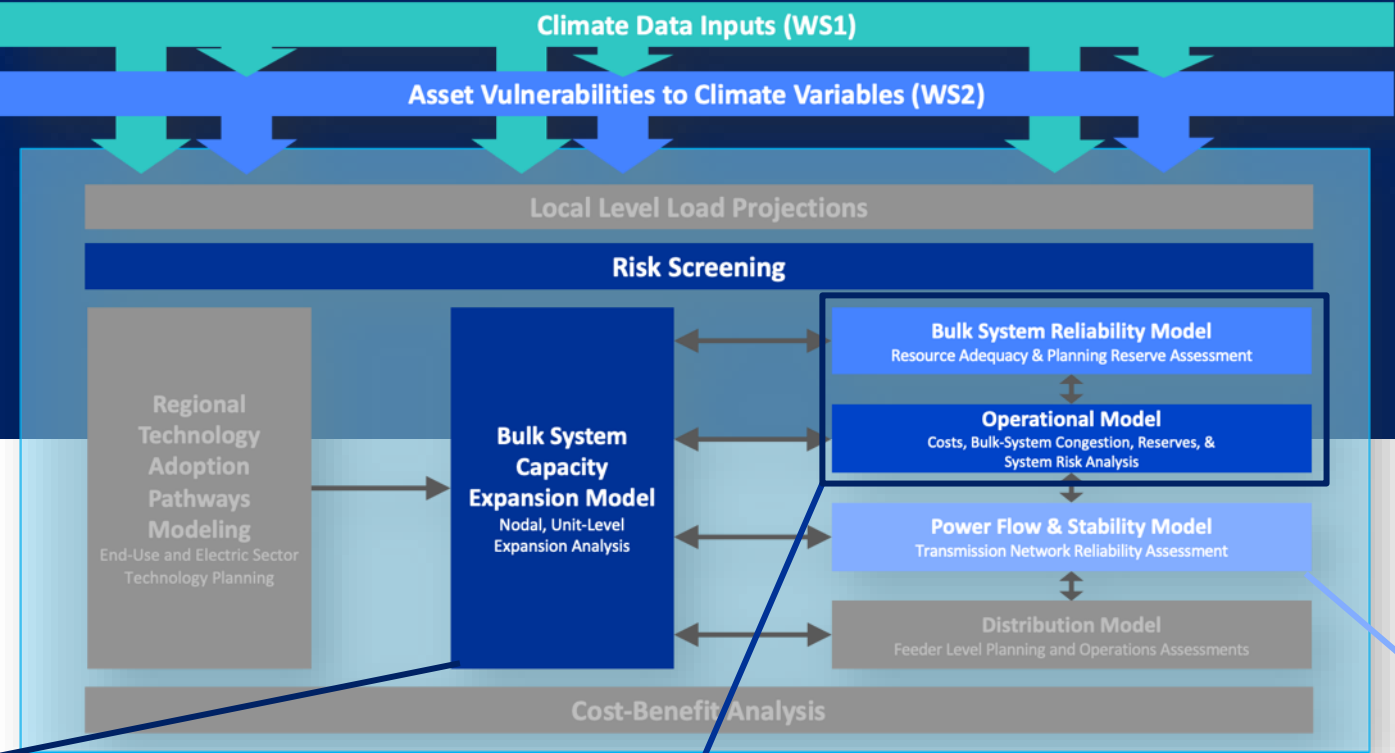
Risk Screening (RiSc) Tool

- Developed by the T&OP team as part of EPRI's Resource Adequacy Initiative and Climate READi
- Fast, approximate method for identifying time periods and events of potential high risk of energy shortfalls
- Aids Understanding the nature of system risks (e.g., weather drivers, structural vulnerabilities)
- Tool available publicly at <https://github.com/epri-dev/Risk-Screening-Tool/>



RiSc identifies the set of extreme events (1) used to plan the system and (2) additional events required to test the effectiveness of the plans

Results from RiSc can feed into multiple bulk-system processes



The set of events that the capacity expansion assessment uses to optimize generation and transmission build-outs

The time windows for assessment during the resource adequacy assessments and production cost analyses

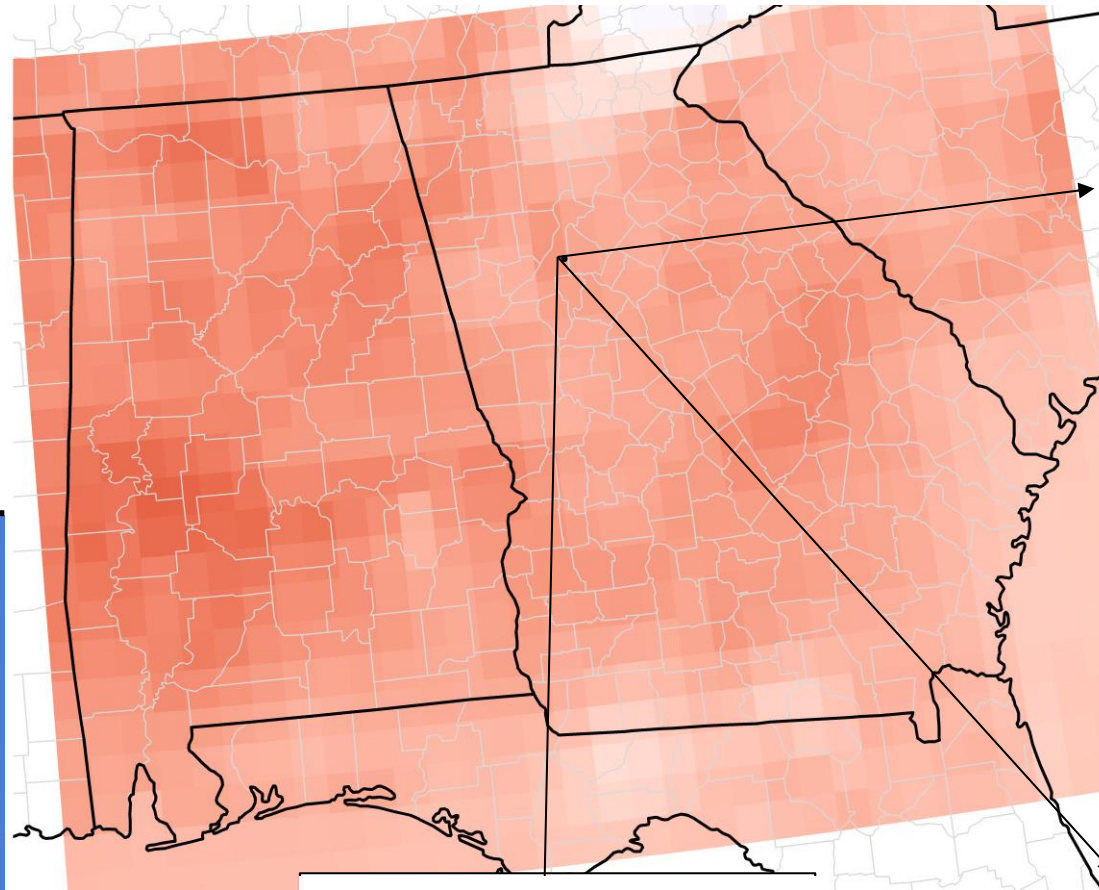
The hours of high generation availability risk across the system for transmission planning snapshot scenario selection

Input: Climate & Weather Data

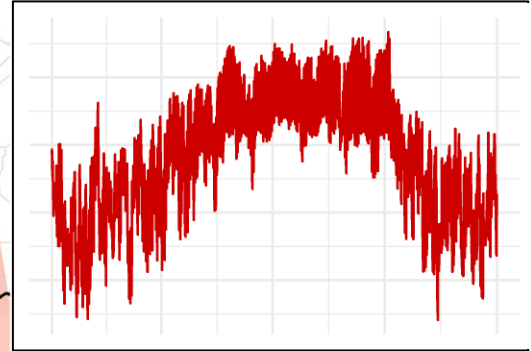
Climate and Weather

RiSc needs location-specific historical (and optionally projected) hourly values of weather variables.

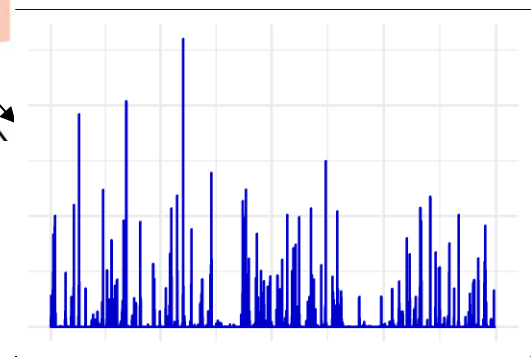
Risc needs data for air temp, precipitation, wind speed, solar irradiance, among others



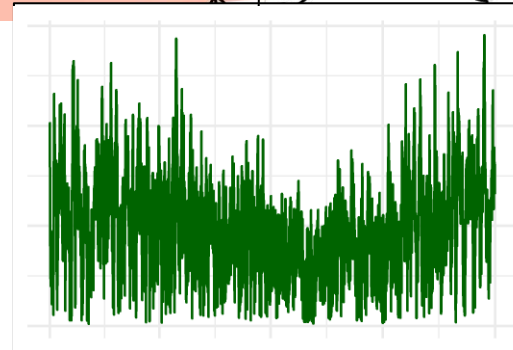
Air temperature



Precipitation



Wind speed



Input: Asset Vulnerabilities



RiSc needs a list of asset vulnerability functions that map derating factors to values of weather variables (e.g., temperature, solar irradiance, windspeed).

This example uses the vulnerability functions derived during the Climate READI Texas case study.

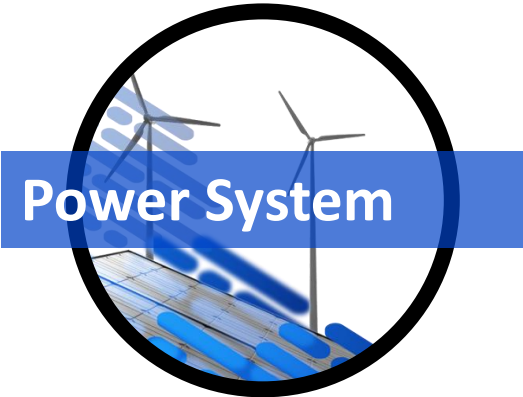
But they can be customized.

Resource Type	Weather Variable (1)	Threshold(1)	Weather Variable (2)	Threshold(2)	Derating	Event
 Wind Onshore	 Temperature	<32F	 Precipitation	>0	90%	Blade icing
	 Wind Speed	>25m/s			100%	Cut-off wind speed
 Nuclear	 Temperature	>110F			70%	Extreme heat

Vulnerabilities currently represented in RiSc

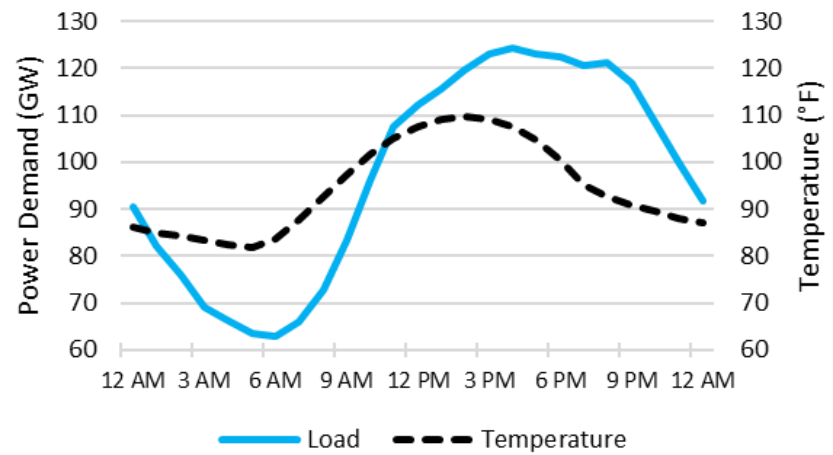
Description	Climate Variables	Technologies Impacted
Icing	Air Temp., Precip.	Solar PV, Wind
Temperature derating (both hot and cold)	Air Temp.	Solar PV, Wind, Gas GT, Gas CC, Coal/Gas Steam, Nuclear
Extreme Wind	Wind Speed	Solar PV, Wind, Gas GT, Gas CC, Coal/Gas Steam, Nuclear
Snow	Air temp., snowfall	Solar PV
Low Solar irradiance	Solar irradiance	Solar PV
Low wind speed	Wind speed	Wind
Flood	Precip.	Solar PV, Nuclear, Gas GT, Gas CC, Coal/Gas Steam

Input: Power System Data (Generator Fleet and Load)

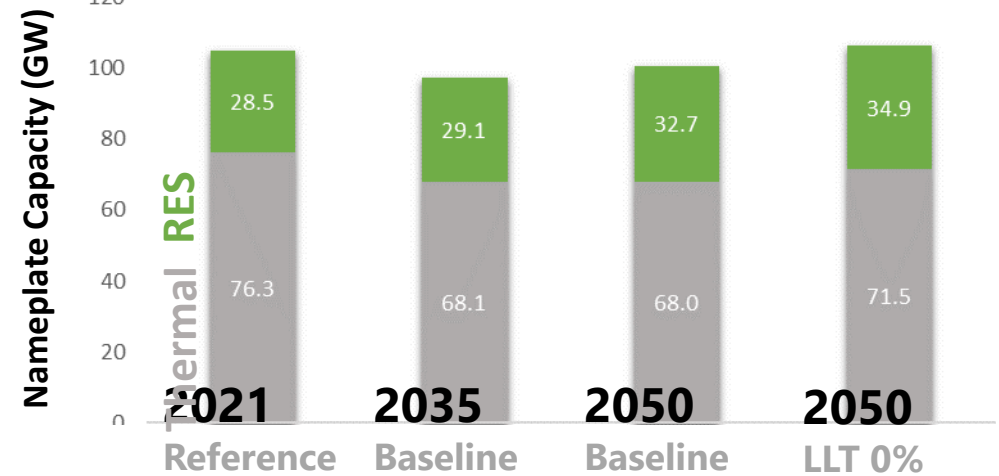


RiSc can use either current/historical configuration of the system or projections of the power system simulated by capacity expansion models

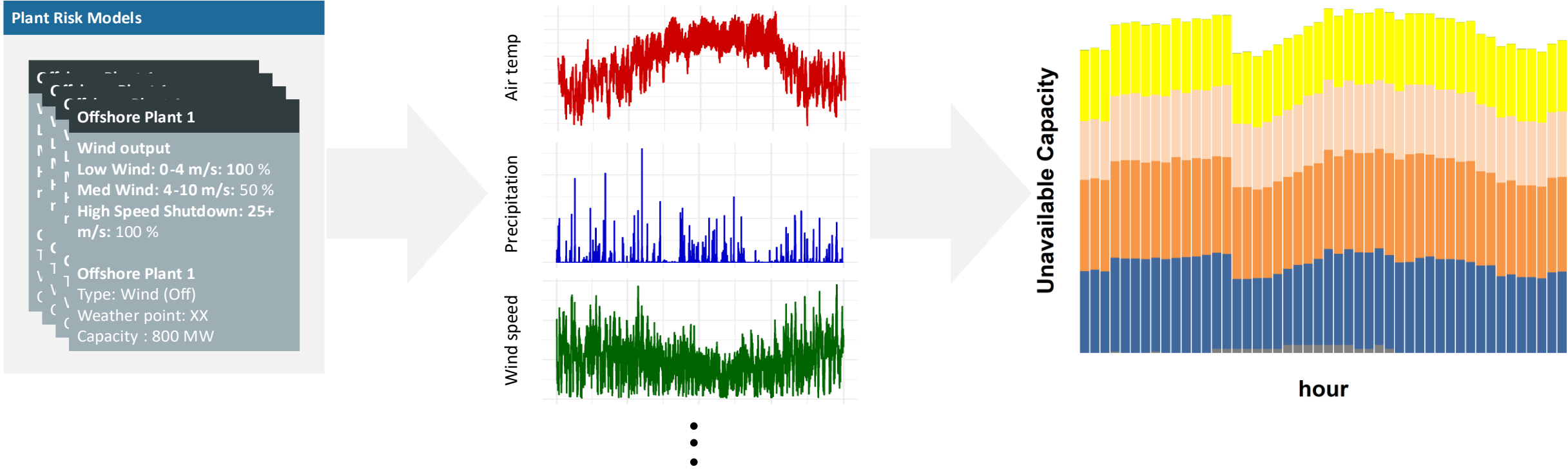
Note: RiSc does not represent the transmission network



Capacity Expansion Plans for Texas



RiSc process: Apply asset vulnerabilities to weather data set

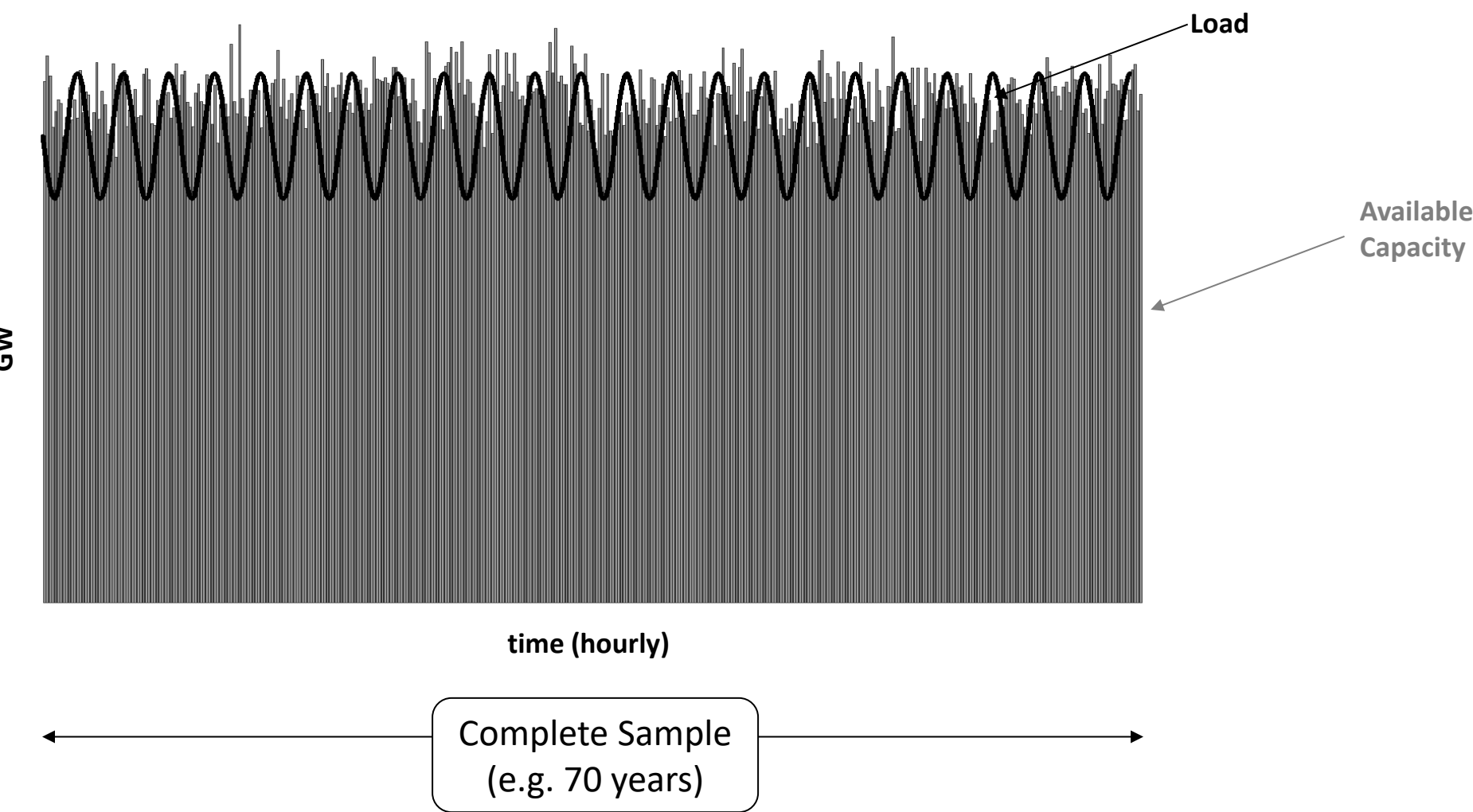


For each asset, assign their vulnerability functions and location

Apply location-specific weather data to each generation and compute deratings for every hour

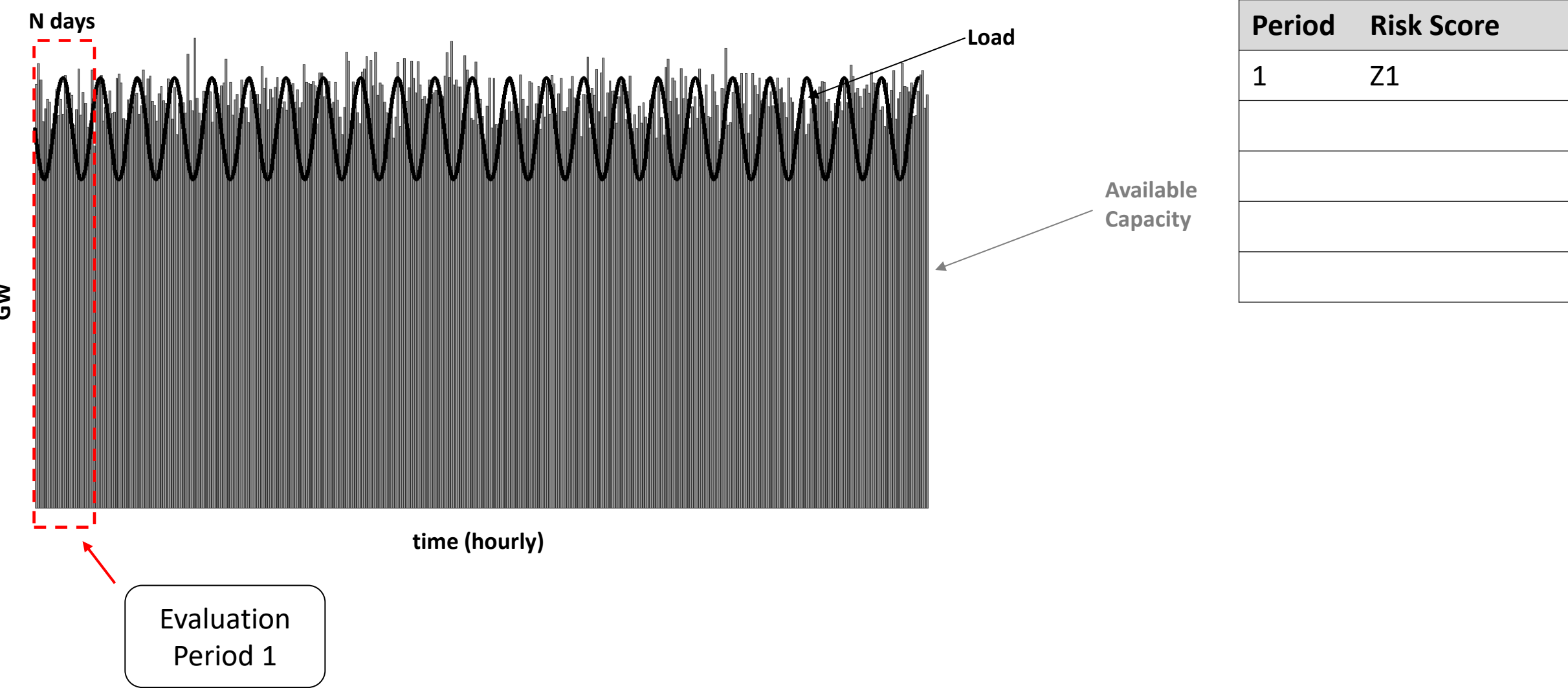
For each hour, aggregate capacity deratings across all generators to compute a time-series of system-level capacity deratings

RiSc screens the total sample of weather data and finds periods of high stress to the system



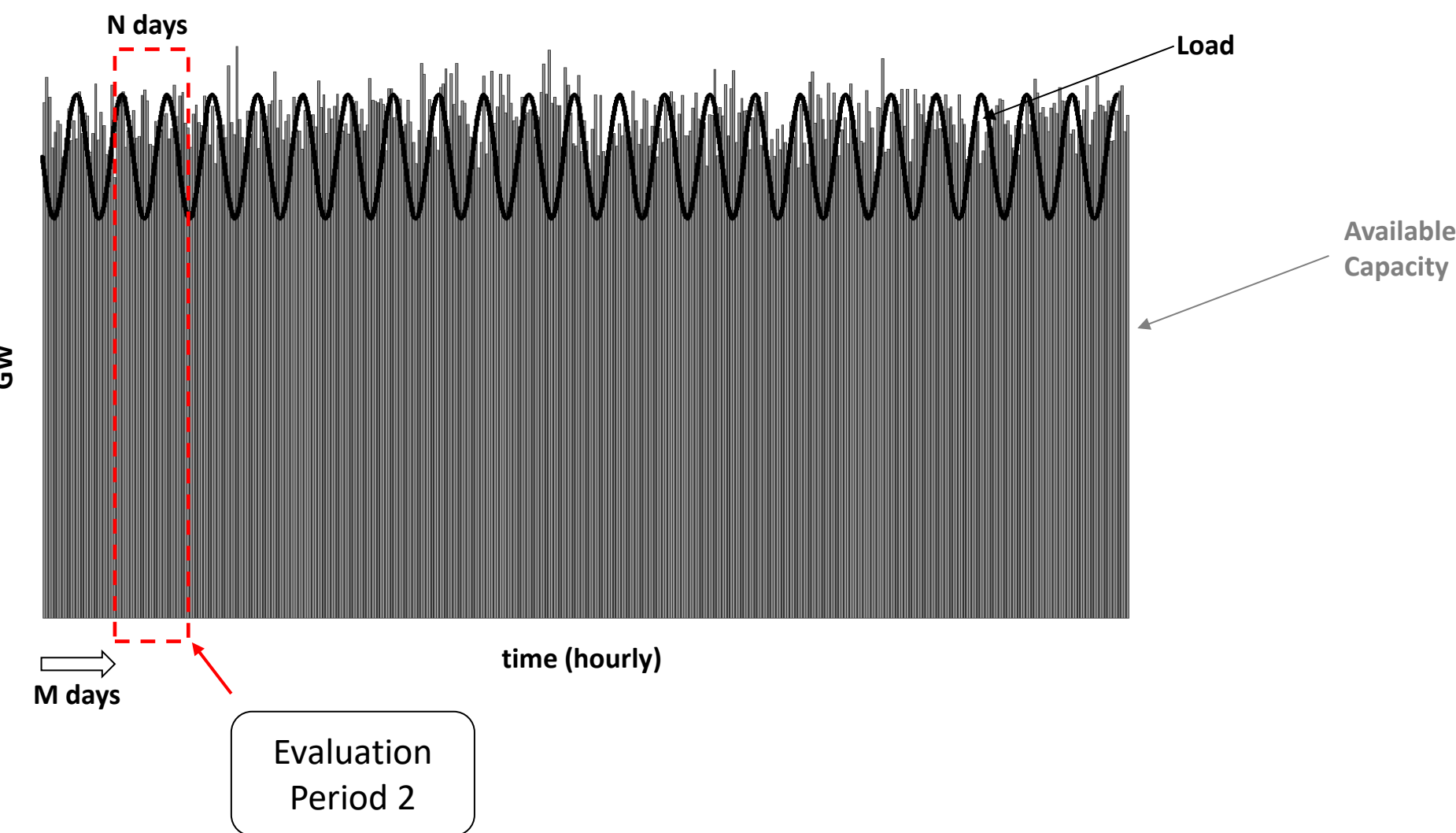
**Illustrative example*

RiSc screens the total sample of weather data and finds periods of high stress to the system



**Illustrative example*

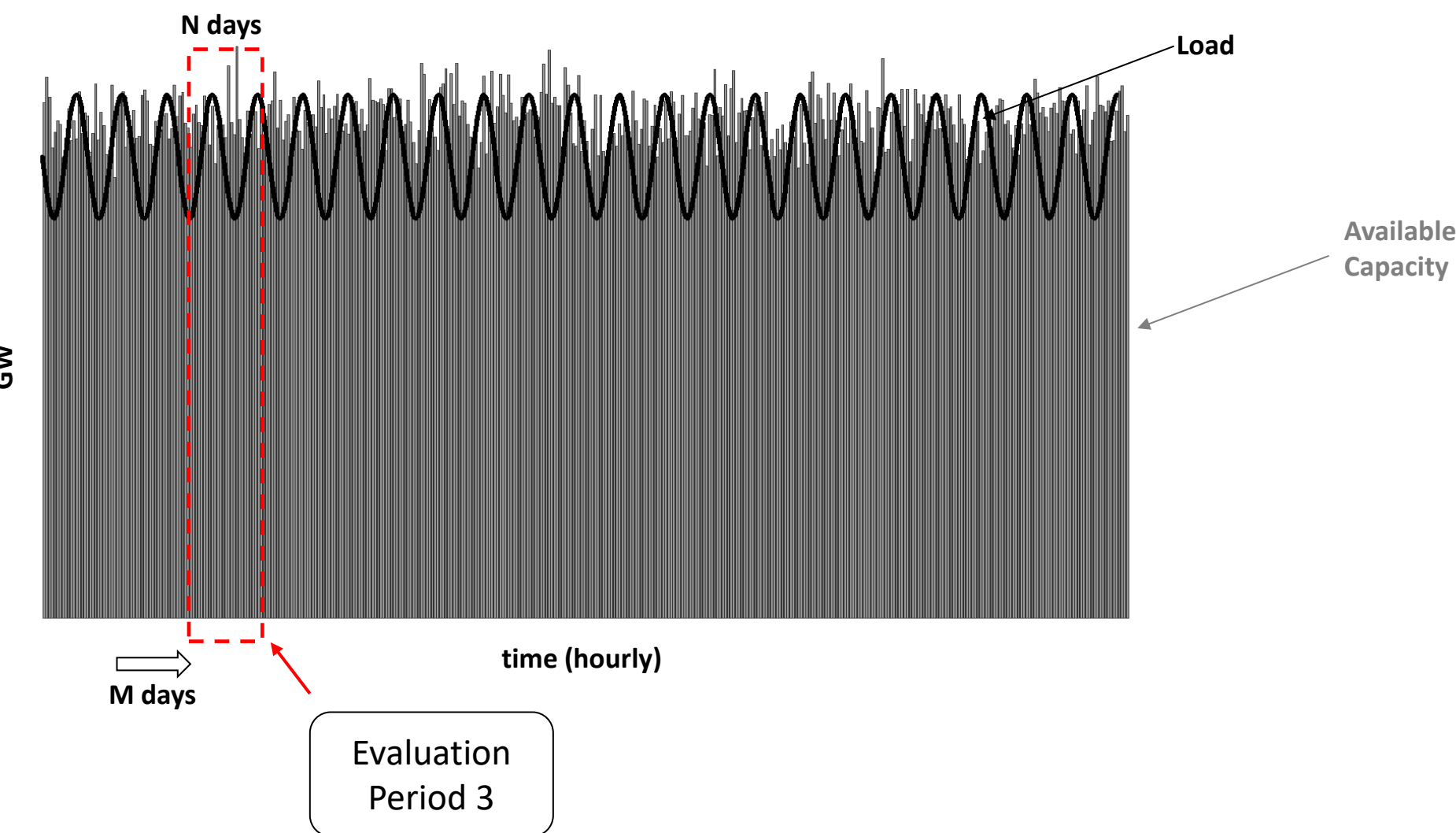
RiSc screens the total sample of weather data and finds periods of high stress to the system



Period	Risk Score
1	Z1
2	Z2

**Illustrative example*

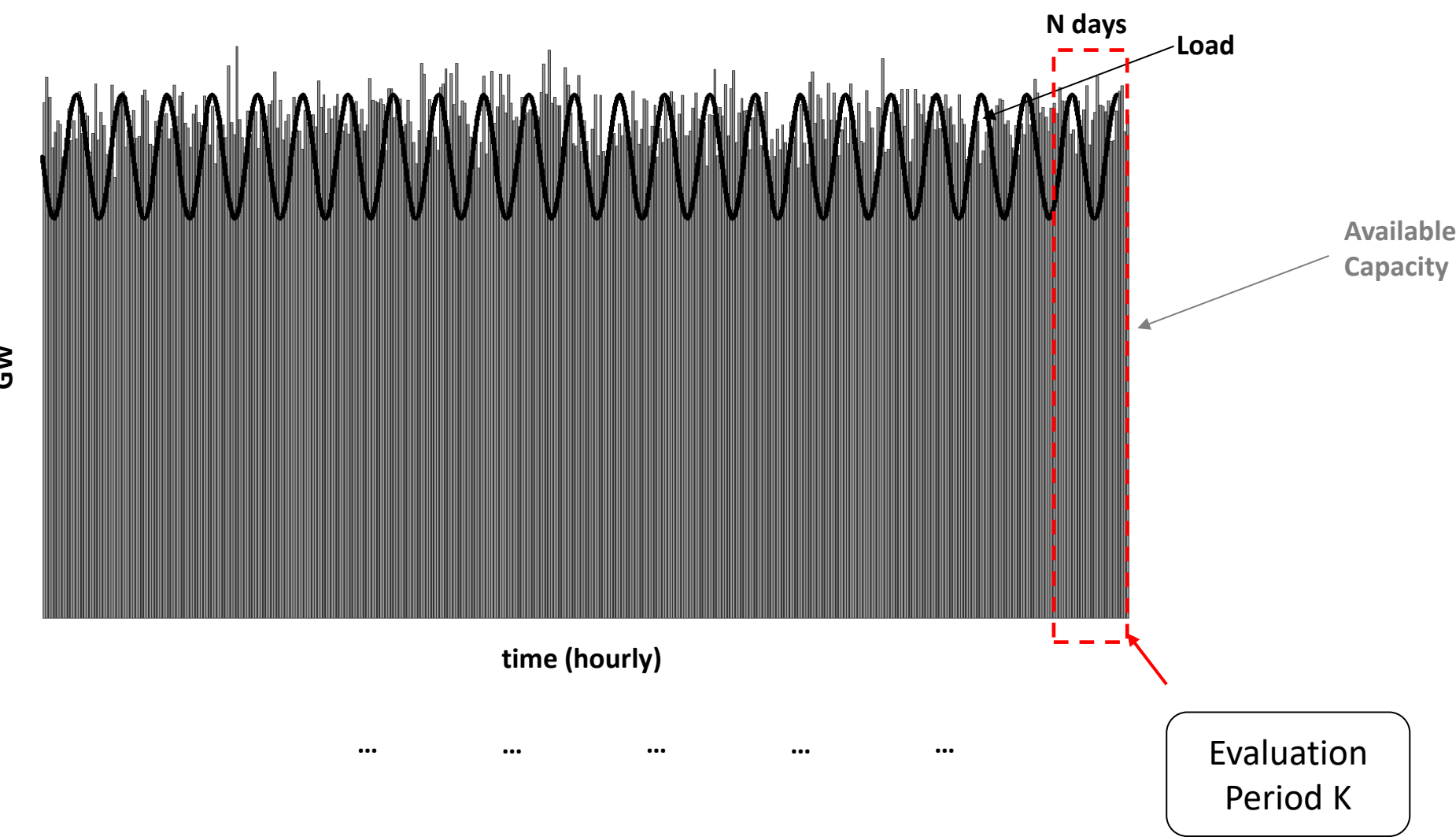
RiSc screens the total sample of weather data and finds periods of high stress to the system



Period	Risk Score
1	Z1
2	Z2
3	Z3

**Illustrative example*

RiSc screens the total sample of weather data and finds periods of high stress to the system



Period	Risk Score
1	Z1
2	Z2
3	Z3
...	...
K	Zk

Finally, rank all periods evaluated according to their **“Risk Scores”**

**Illustrative example*

Sample Output: Identification of extreme events based on max impact (Texas Case Study)

2050 Risk Screening Results		
Top 4 Extreme Events		
Baseline		
Rank by Max Risk	Top Extreme Events	Estimated Load Shedding Risk [GW]
1	Dec 1989	7.5
2	Dec 1983	7.2
3	Aug 2000	6.9
4	Aug 2011	4.9

List of top temperature extremes recorded in Houston, Texas history from 1951–2023

Rank	Temperature	Date
1	9 °F	December 23, 1989
2	13 °F	December 25, 1983
3	14 °F	February 2, 1951
4	15 °F	February 16, 2021

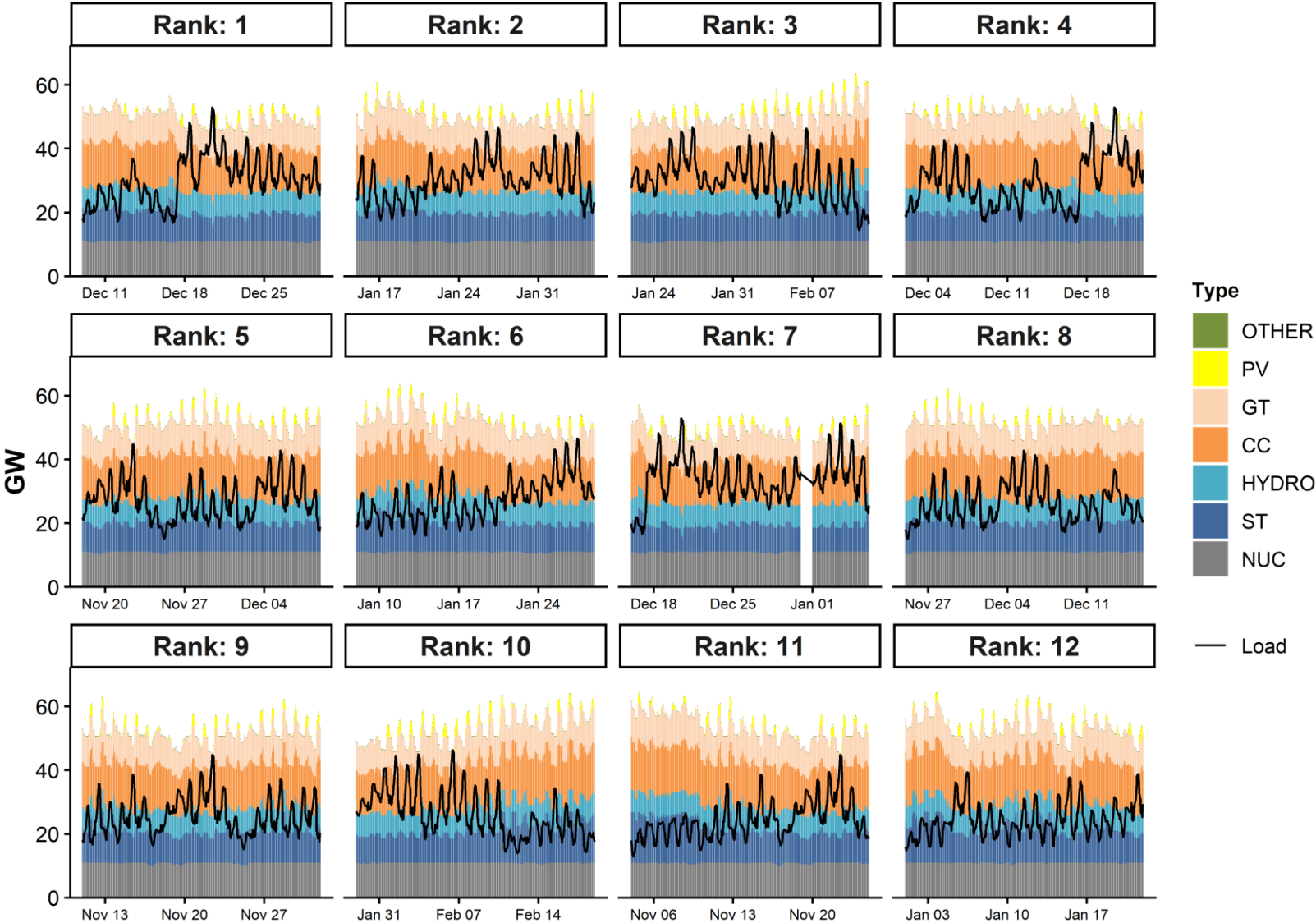
Source: NOAA

Rank	Temperature	Date
1	108 °F	September 4, 2000
2	106 °F	August 27, 2011
3	106 °F	August 13, 1962
4	105 °F	June 29, 2013

Source: NOAA

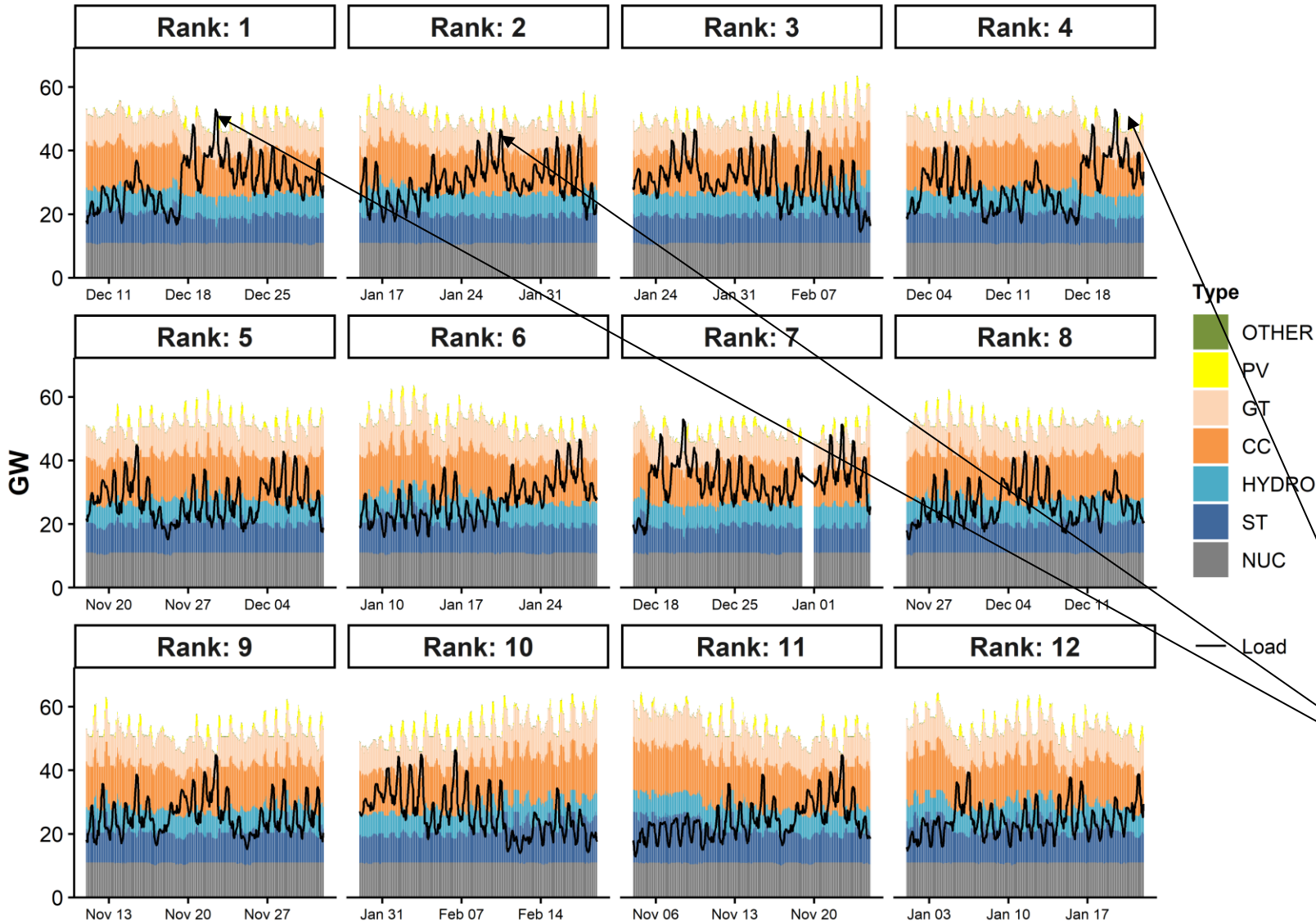
Winter
Summer

Sample Output: Periods with highest risk (Southeast)



- Each panel shows a 21-day event between assuming weather conditions from 2000-2020 evaluated by RiSc
 - Columns represent hourly available capacity of all generation sources
 - Line represents simulated hourly load
- Events are ranked from the ones with highest risk to ones with least risk
 - Only the 12th highest ranked events are showed here

Sample Output: Periods with highest risk (Southeast)



- Each panel shows a 21-day event between assuming weather conditions from 2000-2020 evaluated by RiSc
 - Columns represent hourly available capacity of all generation sources
 - Line represents simulated hourly load
- Events are ranked from the ones with highest risk to ones with least risk
 - Only the 12th highest ranked events are showed here
- Highest ranked events show periods where estimated system load could be higher than available capacity in the system

Some ongoing EPRI projects using RiSc

▪ Risc Users Group Supplemental

- Support a community of users to fast-track the development and application of the tool
- PM: Justin Sharp

▪ Gulf Coast TEP

- Funded by DOE
- Collaboration with Argonne National Laboratory
- Develop a new framework that enhances existing transmission planning processes
- EPRI PIs: Caroline Draxl and Eknath Vittal

▪ *Darkdoldrums* Supplemental

- Four members (SRP, GRE, MH, Southern)
- Explore periods of renewable drought across different regions in North America
- PM: Caroline Draxl

▪ CLIMRR Data Collaboration

- Funded by DOE
- Collaboration with Argonne National Laboratory
- Create industry relevant weather datasets for the CLIMRR portal
- EPRI PI: Delavane Diaz

Public GitHub Repository

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 epri-dev / Risk-Screening-Tool Public

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 Code  Issues  Pull requests 2  Actions  Projects  Security and quality  Insights

 main ▾  3 Branches  1 Tag

 Go to file  Code ▾

 EPRI-SQA Merge pull request #1 from jcmartin/main  

4c28003 · 8 months ago

 16 Commits

 db	add initial db	last year
 db_scripts	Delete db_scripts/clean-2024.sql	last year
 demo	initial push	2 years ago
 logs	initial push	2 years ago
 settings	initial push	2 years ago
 .gitattributes	remove old entry	2 years ago

About

No description, website, or topics provided.

 Readme  BSD-3-Clause license  Activity  Custom properties  13 stars  5 watching  3 forks

Report repository

<https://github.com/epri-dev/Risk-Screening-Tool/>