WINTER RESILIENCE FOR ELECTRIC POWER · WORKSHOP 1

Earth-science datasets and tools for winter planning at utility scales

What's publicly available, where it lives, and how to get it

Jiali Wang, PhD — Principal Atmospheric & Earth Scientist

Argonne National Laboratory · NSF Winter Weather Resilience Project

Argonne NATIONAL LABORATORY

What I'll cover in 10 minutes

- The data problem: what winter risk assessment actually demands
- Argonne Downscaled Data Archive (ADDA) — the simulation engine behind the datasets
- National map explorers: self-serve, no modeling required
- Utility-ready products: Typical and Extreme Meteorological Year (TMY/ XMY) for load forecasting
- A worked example: future weather for a Midwest utility (ComEd)
- What's free today, how to access it, and where the gaps are for you

What winter risk assessment demands

- Long records / large ensembles
  - A 100-yr cold event = 1% chance any year → ~26% over a 30-yr asset life
  - Short records mis-estimate the tail — exactly where winter outages live
- High resolution in space and time
  - A few km, hourly/sub-hourly — to resolve cold snaps, ice, wind ramps
- Nonstationarity
  - Warming shifts the mean and the variability — yesterday's normals expire

~26%

chance of a 100-yr event over a 30-yr asset lifetime

4 km / 1 hr

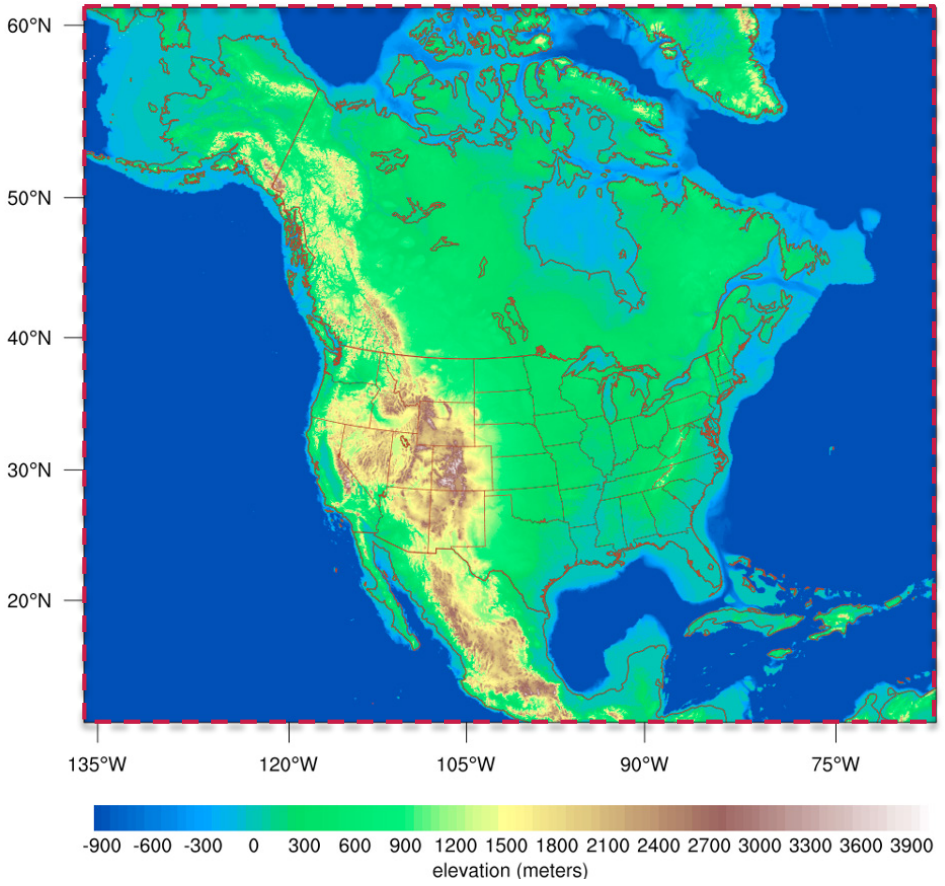
resolution needed to capture high-impact winter events

200+ yrs

of simulated weather to pin down the rare-event tail

ADDA: the engine behind the data

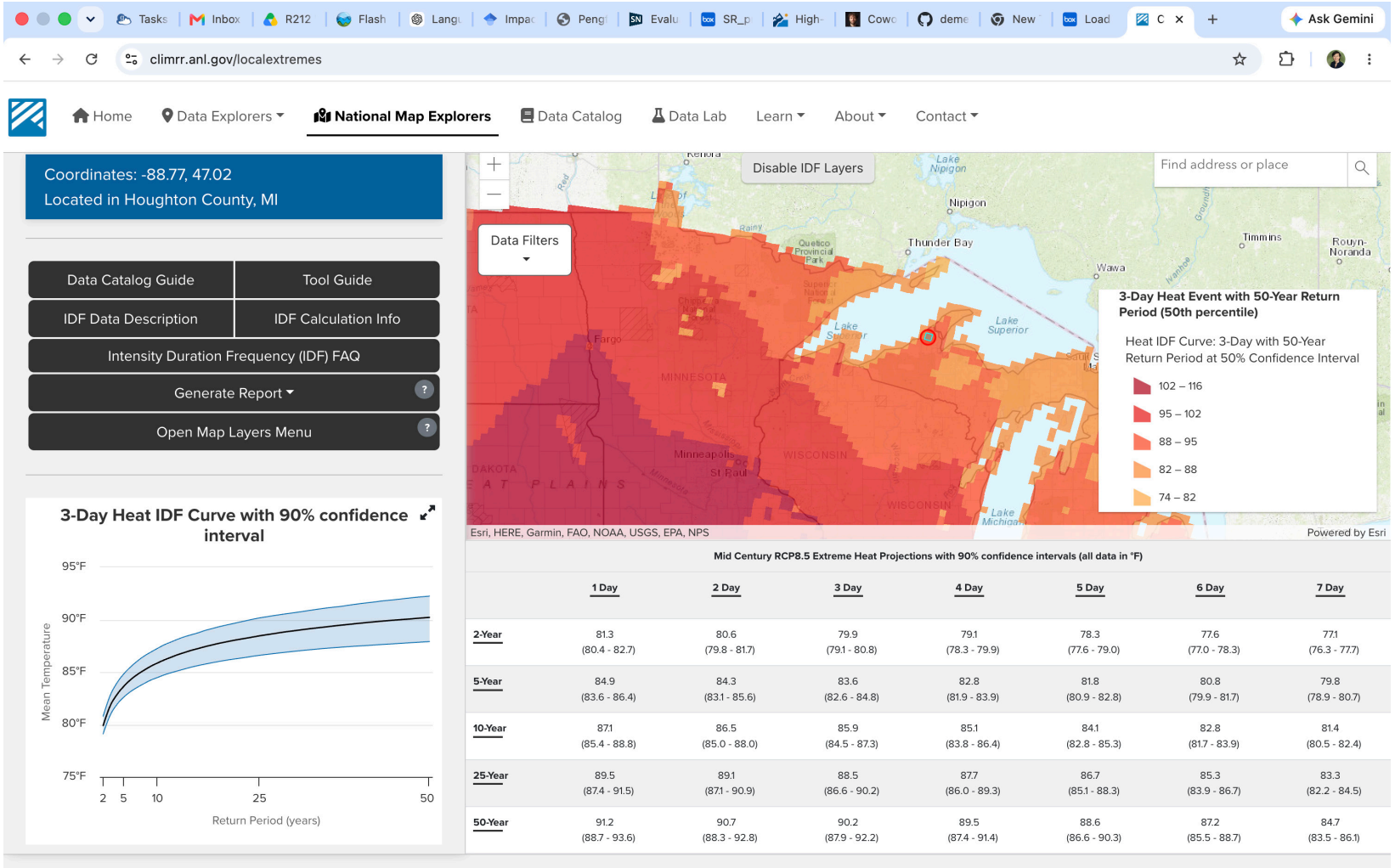
- Physics-based regional model (WRF) — one coherent system, all weather types
- 4 km and 1-hour resolution; 60+ variables; 120 simulated years
- Historical and forward-looking scenarios on the same grid
- AI downscaling to 250 m for winds — high-impact small scales
- **Variables stay physically consistent across space, time, and fields**



ADDA 4 km CONUS domain (WRF). Akinsanola et al. 2024; Peco et al. 2026.

National map explorers — no modeling required

- Point-and-click maps of extreme-event metrics — open in a browser
- Pick a location, read off return levels and projected change
- Built for planners and emergency managers, not just researchers
- A fast first look before you ever download a dataset

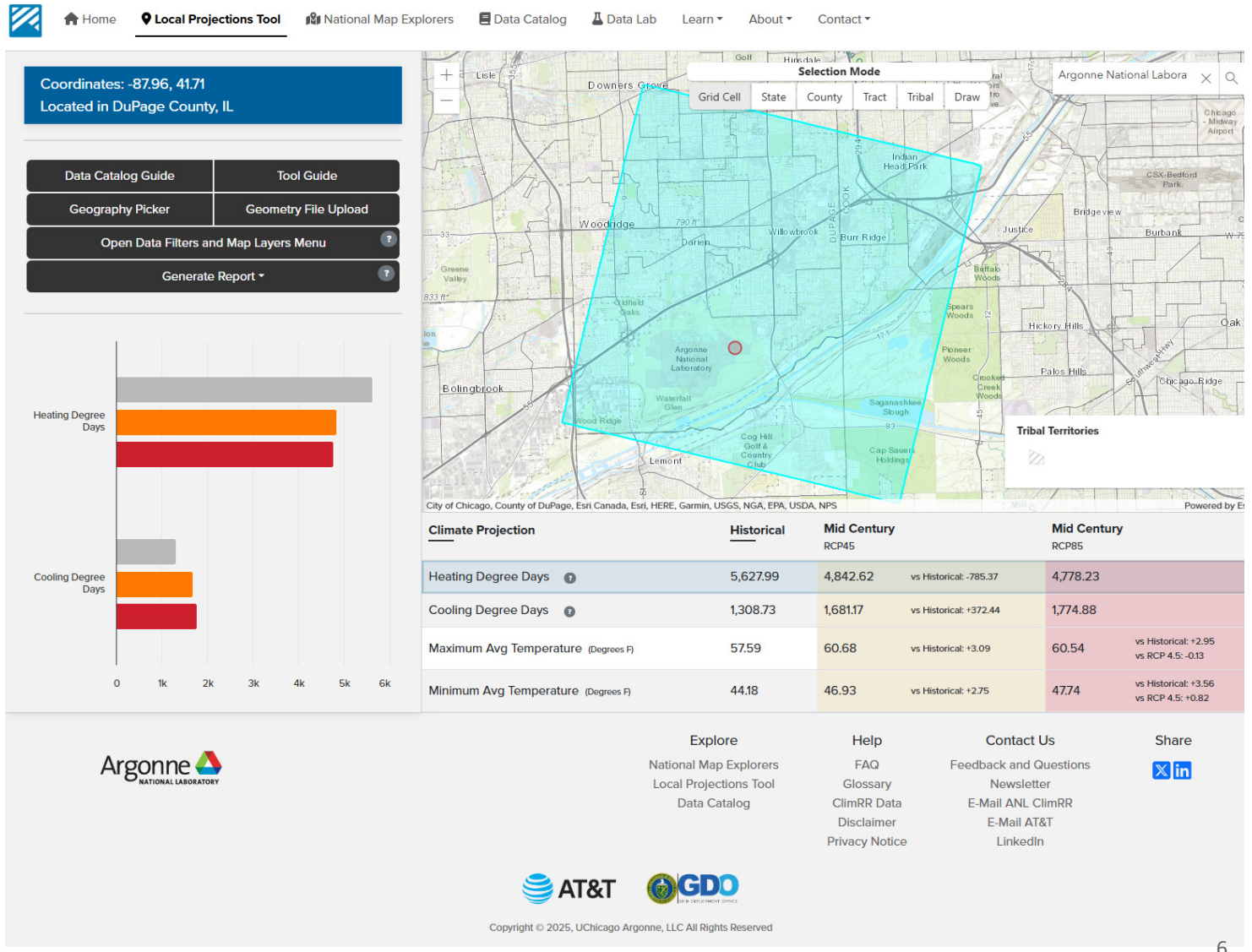


	1 Day	2 Day	3 Day	4 Day	5 Day	6 Day	7 Day
2-Year	81.3 (80.4 - 82.7)	80.6 (79.8 - 81.7)	79.9 (79.1 - 80.8)	79.1 (78.3 - 79.9)	78.3 (77.6 - 79.0)	77.6 (77.0 - 78.3)	77.1 (76.3 - 77.7)
5-Year	84.9 (83.6 - 86.4)	84.3 (83.1 - 85.6)	83.6 (82.6 - 84.8)	82.8 (81.9 - 83.9)	81.8 (80.9 - 82.8)	80.8 (79.9 - 81.7)	79.8 (78.9 - 80.7)
10-Year	87.1 (85.4 - 88.8)	86.5 (85.0 - 88.0)	85.9 (84.5 - 87.3)	85.1 (83.8 - 86.4)	84.1 (82.8 - 85.3)	82.8 (81.7 - 83.9)	81.4 (80.5 - 82.4)
25-Year	89.5 (87.4 - 91.5)	89.1 (87.1 - 90.9)	88.5 (86.6 - 90.2)	87.7 (86.0 - 89.3)	86.7 (85.1 - 88.3)	85.3 (83.9 - 86.7)	83.3 (82.2 - 84.5)
50-Year	91.2 (88.7 - 93.6)	90.7 (88.3 - 92.8)	90.2 (87.9 - 92.2)	89.5 (87.4 - 91.4)	88.6 (86.6 - 90.3)	87.2 (85.5 - 88.7)	84.7 (83.5 - 86.1)

Extreme cold will be online soon!

ClimRR portal: translated, actionable data

- Geospatial portal with model data turned into decision-ready layers
- Built with DOE-GDO and AT&T; for energy & emergency management
- Data catalog, download, and an in-browser Data Lab
- Dataset-agnostic; currently served from ADDA 12 km
- Free and public: climrr.anl.gov



ClimRR climate-risk portal · https://climrr.anl.gov

Worked example: a Midwest utility (ComEd)

Argonne + ComEd: future weather for load forecasting and grid investment in Northern Illinois

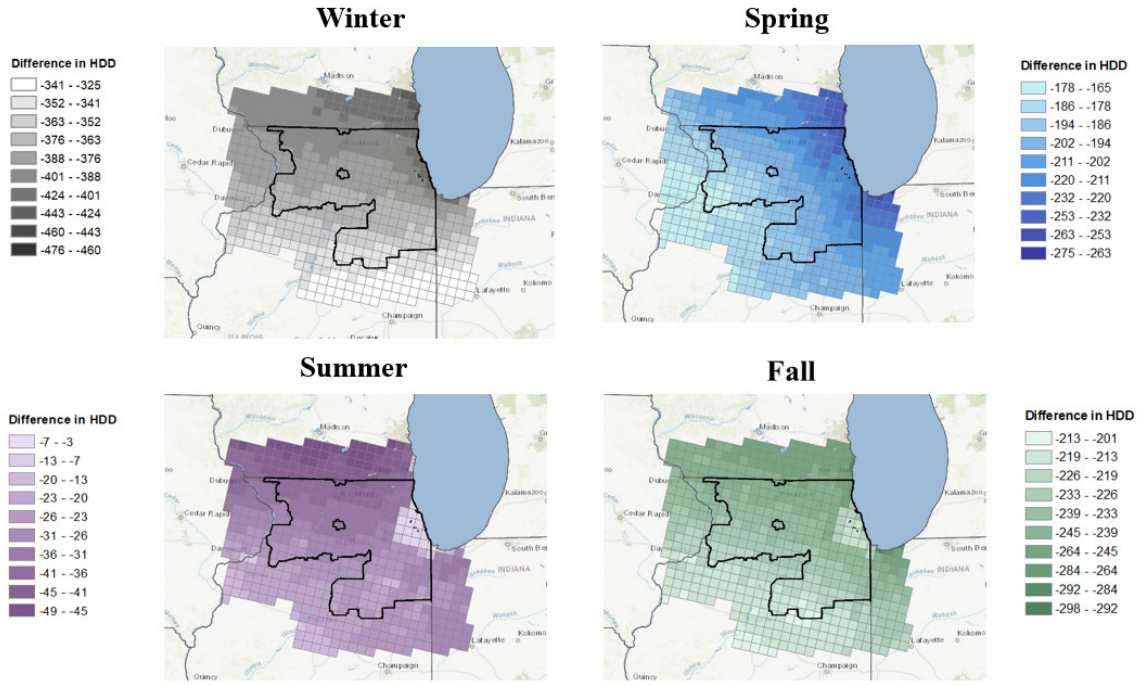
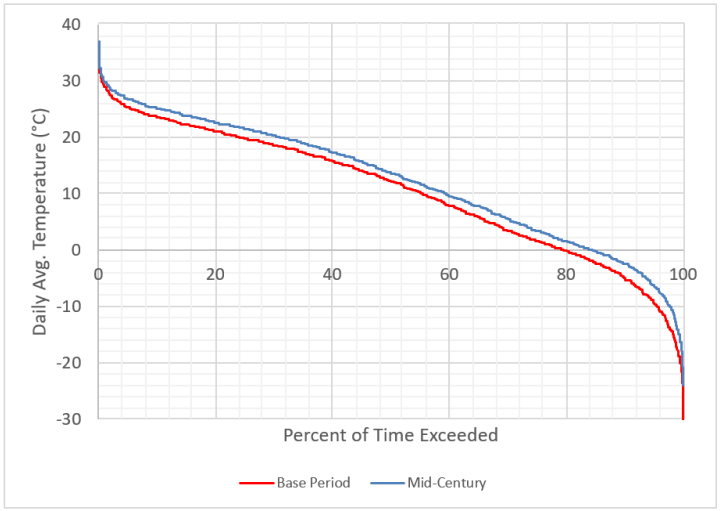


FIGURE 8 Change in the seasonal count of HDDs (varying scale) between the baseline and mid-century periods.



Daily Avg. Temp (°C)	Percent Time Exceeded		Days Exceeded Per Year	
	Base Period	Mid-Century	Base Period	Mid-Century
-30	99.98		365	
-25	99.92		365	
-20	99.51	99.82	363	364
-15	98.24	99.29	359	362
-10	95.44	97.68	348	357
-5	90.03	93.72	329	342
0	79.49	84.37	290	308
5	66.80	71.28	244	260
10	55.30	59.35	202	217
15	42.36	46.73	155	171
20	24.24	31.03	88	113
25	5.75	10.63	21	39
30	0.58	0.95	2	3
35	0.04	0.06	0.15	0.23
40				

Days/yr above temperature thresholds: baseline vs. mid-century.

Heating degree-days fall ~408 (winter avg) while cooling degree-days rise ~230 — winters milder on average, but the cold tail still sets reliability.

What's free today — and how to get it

Resource	What it gives you	How to access
Map explorers	Extreme-event metrics by location	Browser, no account
ClimRR portal	Decision-ready layers + Data Lab	climrr.anl.gov
ADDA archive	4 km hourly, 60+ variables, 300+ yrs	Request via Argonne
TMY / XMY	Planning-year files for forecasting	Via EPRI collaboration
CONUS404 / NIU	Other national downscaled sets	Public (NCAR / NIU)

Where it falls short for you?

- Resolution vs. your feeder/substation scale
- Winter specifics: ice loading, wind-on-ice, rapid cold ramps
- Hourly load drivers vs. design-day extremes
- Getting data into the tools you already use

Explore now: climrr.anl.gov