Resilience for Regulators

Future Climate Modeling for Utility System Planning: Key Lessons for State Utility Regulators

December 19, 2022

NARUC Center for Partnerships & Innovation

NARUC
National Association of Regulatory Utility Commissioners

Opening Remarks & Introductions

Moderator: Hon. Tremaine Phillips

Commissioner, Michigan Public Service Commission

Panelists:

Tom Wall PhD, Program Lead, Engineering & Applied Resilience, Argonne National Laboratory

Ryan Burg PhD, Principal Business Analyst, ComEd

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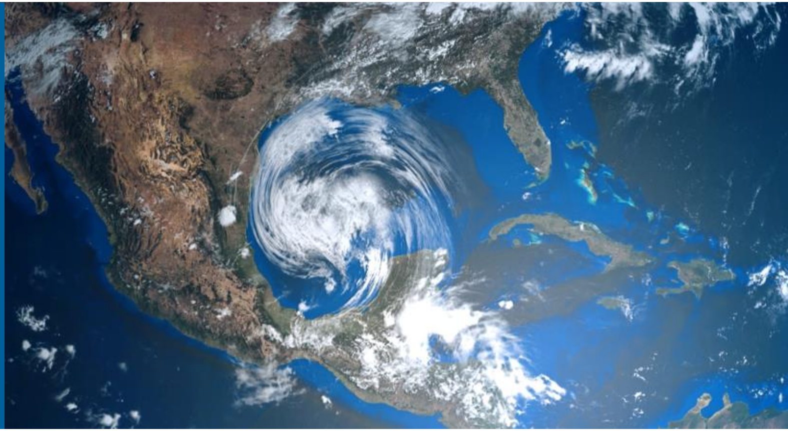
Argonne National Laboratory

BUILDING A CLIMATE RESILIENT FUTURE FOR NORTHERN ILLINOIS



TOM WALL, PH.D.

Program Lead, Engineering & Applied Resilience
Center for Climate Resilience and Decision Science

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ARGONNE'S ROLE IN CLIMATE RESILIENCE

Center for Climate Resilience and Decision Science

- The Center for Climate Resilience and Decision Science (CCRDS) conducts research and analysis to enable unmatched climate-risk informed decision-making and adaptation planning for public and private stakeholders facing a variety of climate-related challenges around the world.
- The CCRDS is comprised of a multidisciplinary scientific team that collaborates with research partners to ensure that climate risk-informed decision-making is contextualized in socio-economic, infrastructure, environmental, and fiscal realities so that mitigation actions are grounded in science and practicable for immediate implementation.

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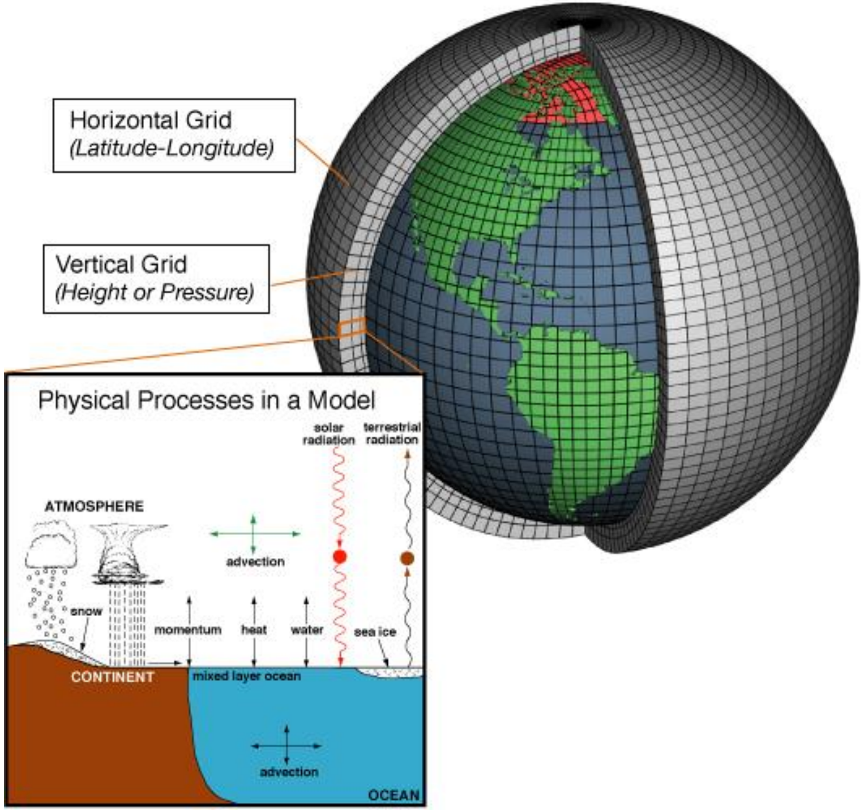
GLOBAL CLIMATE SYSTEM MODELS

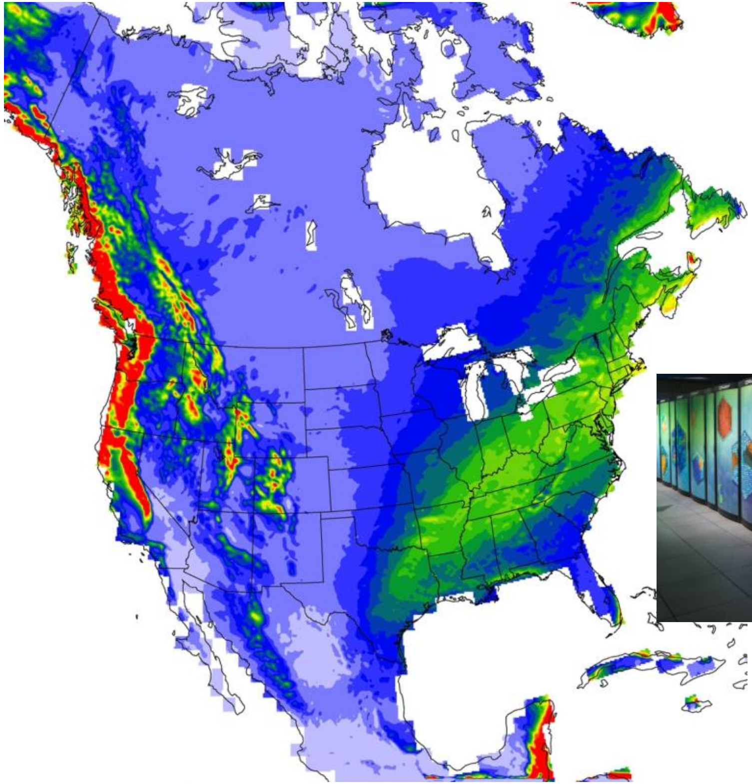
Mathematical representations of the climate system based on physical laws and understanding of processes



DYNAMICAL DOWNSCALING

ARGONNE’S DYNAMICALLY DOWNSCALED, REGIONAL CLIMATE MODELING IS A UNIQUE CLIMATE RESOURCE

- High resolution, neighborhood level (12km)
- Scientific transparency: widely published and scientifically peer reviewed modeling and outcomes
- Dynamical downscaling offers improvements over statistical downscaling
  - Physics-based, addresses non-stationarity
  - Produces 60+ unique climate variables
- RCP8.5 (upper limit) + RCP4.5 (mid-century peak)
  - Useful for infrastructure protection and disaster planning



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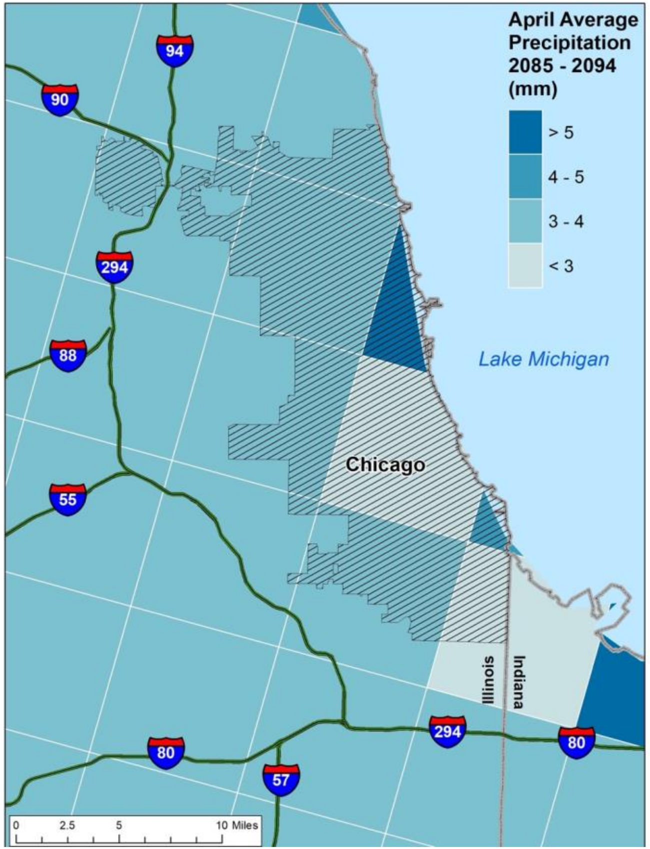

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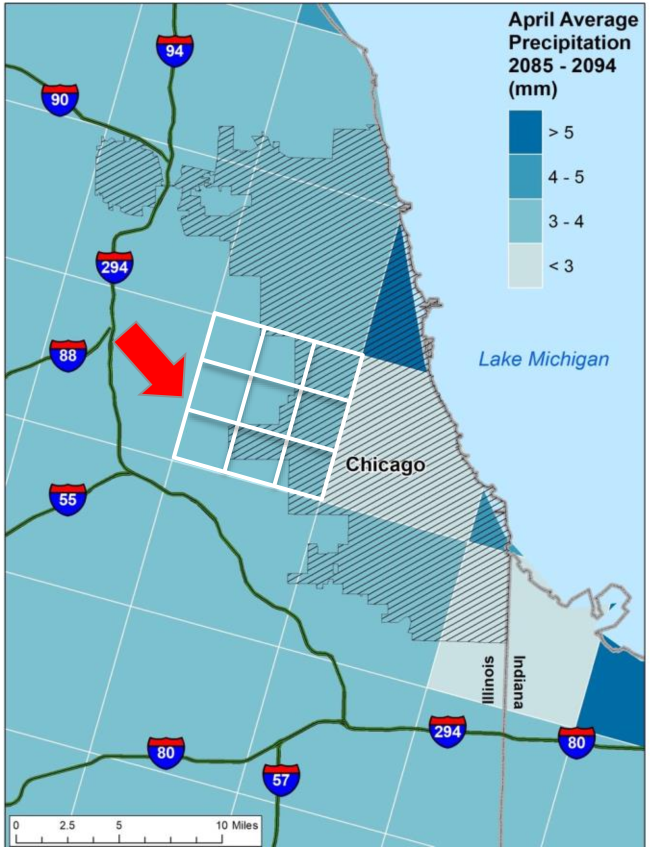
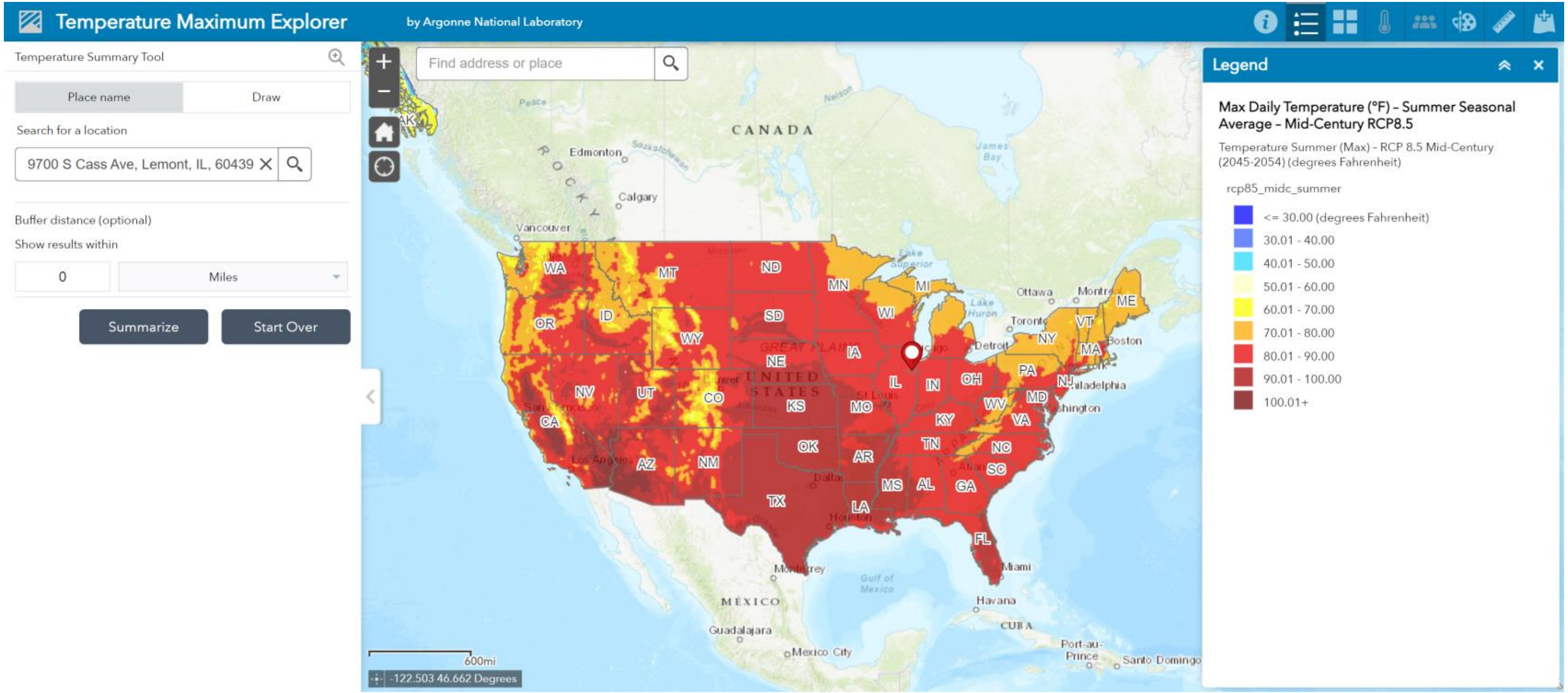


INFORMING DECISIONS

Climate Risk and Resilience Portal (ClimRR)

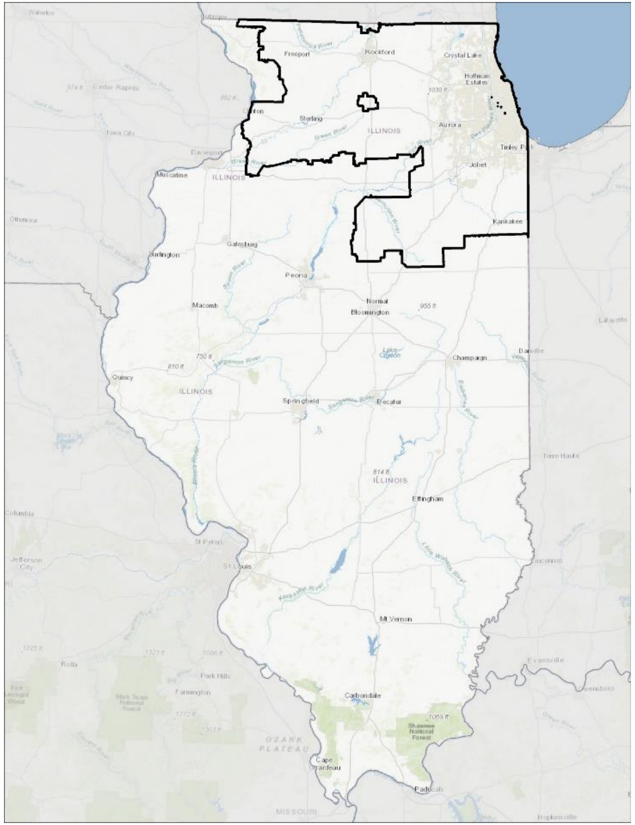


www.anl.gov/ccrds/climrr

SUMMARY OF NORTHERN ILLINOIS CLIMATE

Climate Change in Northern Illinois

- Focus on mid-century climate impacts (2045-2054)
- Emphasis on high-emission, RCP8.5 scenario
- Comparison with historical baseline (1995-2004)
- Northern Illinois mid-century climate:
  - Substantially warmer
  - More humid
  - Wind generally the same, some seasonal differences



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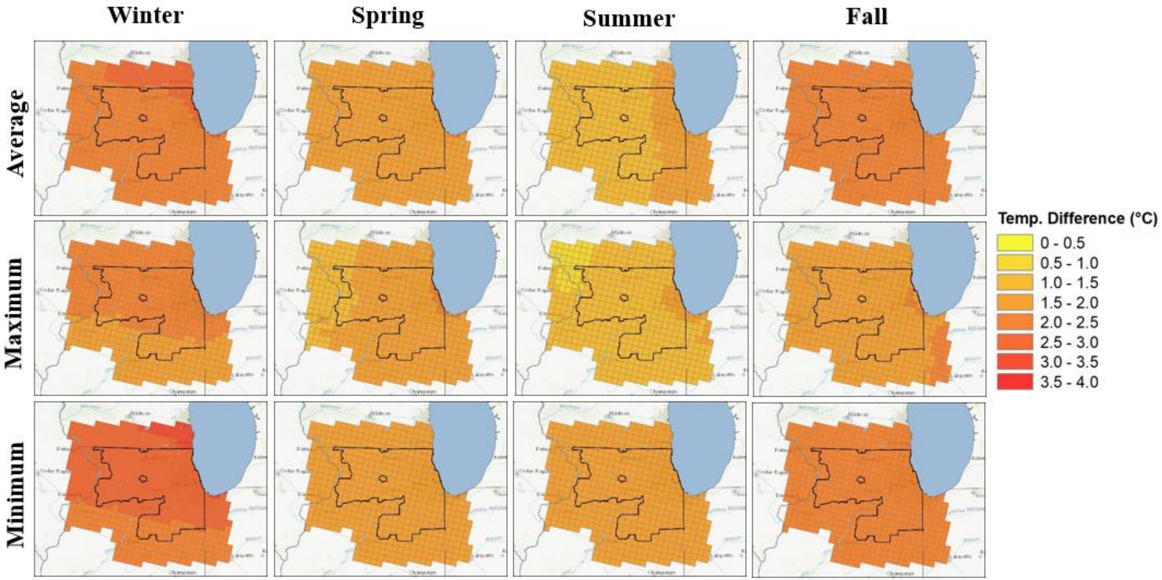
MID-CENTURY TEMPERATURES

Climate Change in Northern Illinois

- **Greater variability in seasonal temperatures, but all increase**
  - Greater increases in Winter and Fall
  - Lesser increases in Spring and Summer

- **Seasonal temperature** increases generally range between 0.5°C and 3.5°C (~0.9°F to 6.3°F)



Change in seasonal average, minimum, and maximum temperatures from baseline period to mid-century.

MID-CENTURY HUMIDITY / HEAT INDEX

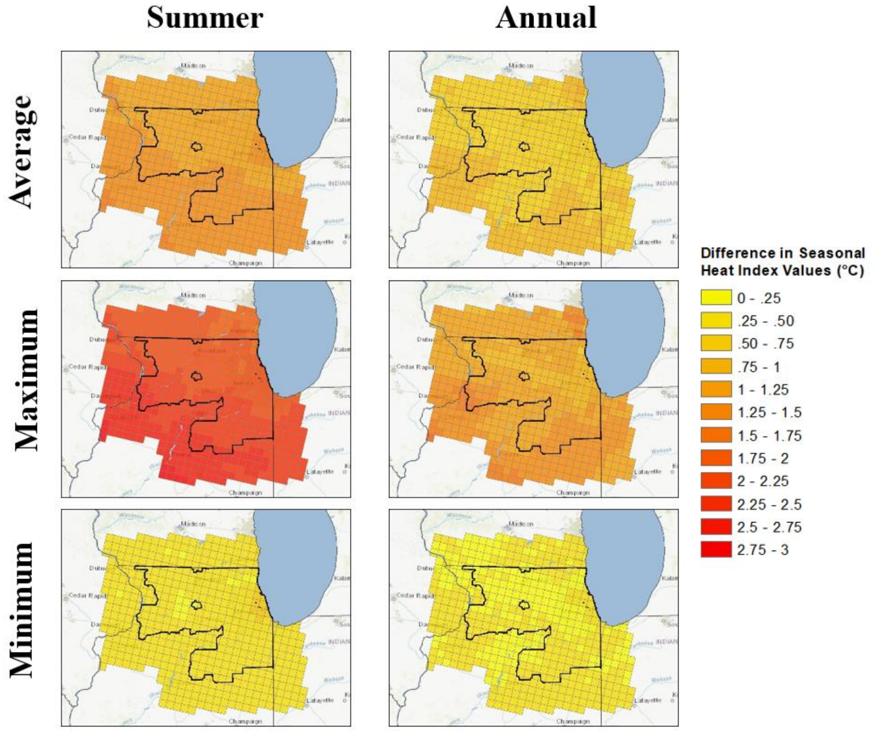
Climate Change in Northern Illinois

- Consistent increases in humidity (i.e., heat index) across entire service territory, slight trend of greater increases in southern region

- **Average Heat Index**
  - Annual increase of 0.25°C to 1°C
  - Summer increase of 0.5°C to 1.25°C

- **Maximum Heat Index**
  - Annual increase up to 1.25°C
  - Summer increase up to 1.25°C to 2.5°C

- **Minimum Heat Index**
  - Annual increase 0.25°C or stay same
  - Summer increase 0.25°C or stay same

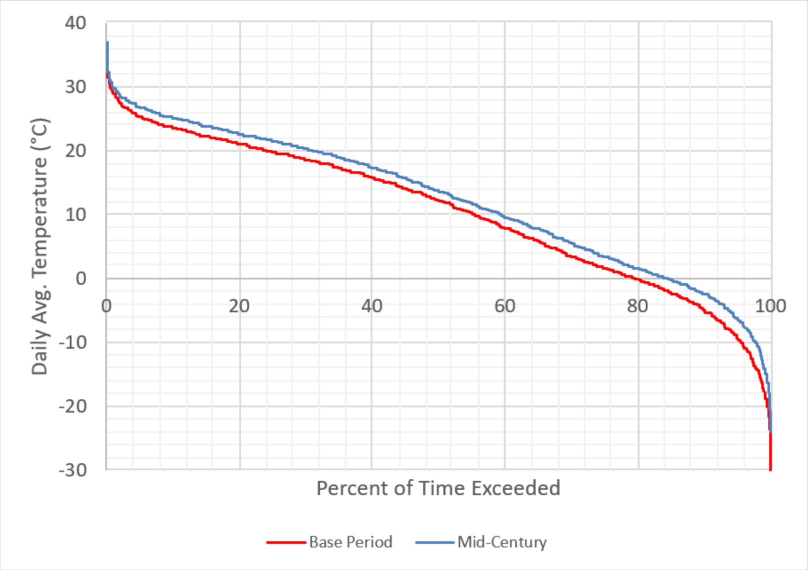


Change in the summer and annual average, maximum, and minimum heat index from the baseline to mid-century periods.

TEMPERATURES ABOVE THRESHOLD

Modeling Utility-Relevant Climate Impacts

- Consistent increase in the frequency by which **daily average** temperature thresholds are exceeded
- Baseline:
  - 30°C (86°F) exceeded 2 days/year
  - 35°C (95°F) exceeded ~1 days/decade
- Mid-century:
  - 30°C (86°F) exceeded 3 days/year
  - 35°C (95°F) exceeded ~4 days/decade



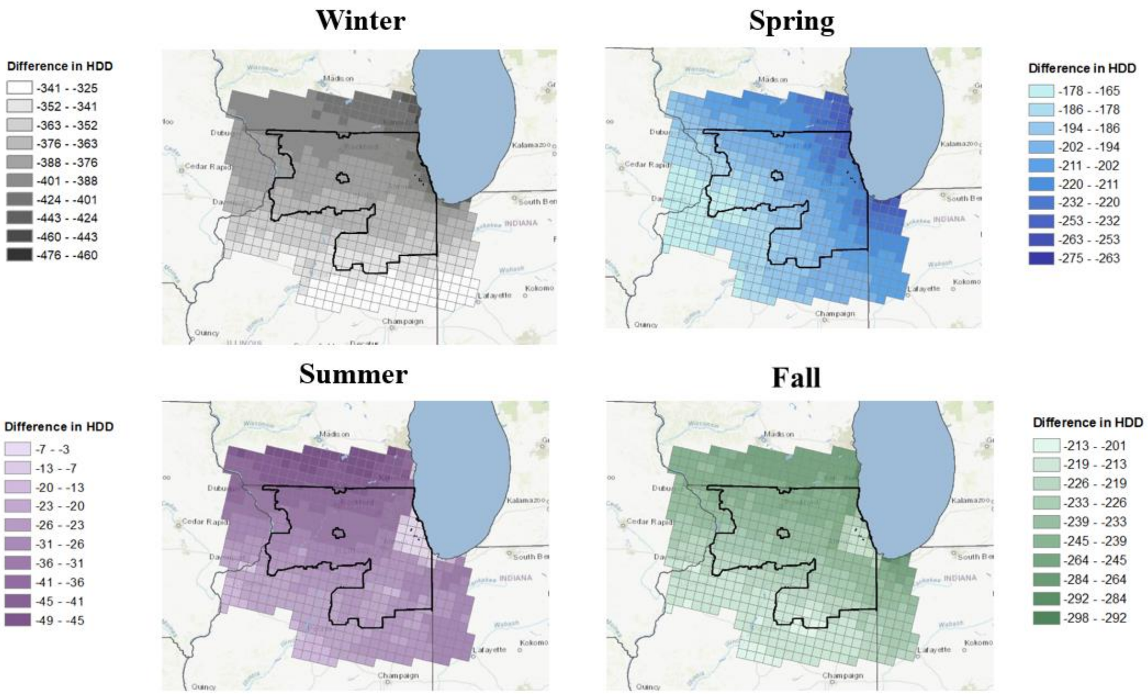
Daily Avg. Temp (°C)	Percent Time Exceeded		Days Exceeded Per Year	
	Base Period	Mid-Century	Base Period	Mid-Century
-30	99.98		365	
-25	99.92		365	
-20	99.51	99.82	363	364
-15	98.24	99.29	359	362
-10	95.44	97.68	348	357
-5	90.03	93.72	329	342
0	79.49	84.37	290	308
5	66.80	71.28	244	260
10	55.30	59.35	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				

Percentage of time (days/year) that daily average temperatures exceed a given threshold for the baseline and mid-century periods

HEATING DEGREE DAYS

Modeling Utility-Relevant Climate Impacts

- **Heating Degree Days** (HDD) calculated using 65°F base temperature
- Annual HDDs decrease between 761 to 1060 across service territory
- Greatest decreases in Fall and Winter
  - Winter: Decrease 341 to 476
  - Spring: Decrease 178 to 275
  - Summer: Decrease 3 to 49
  - Fall: Decrease 213 to 298



Change in the seasonal count of HDDs between the baseline and mid-century periods

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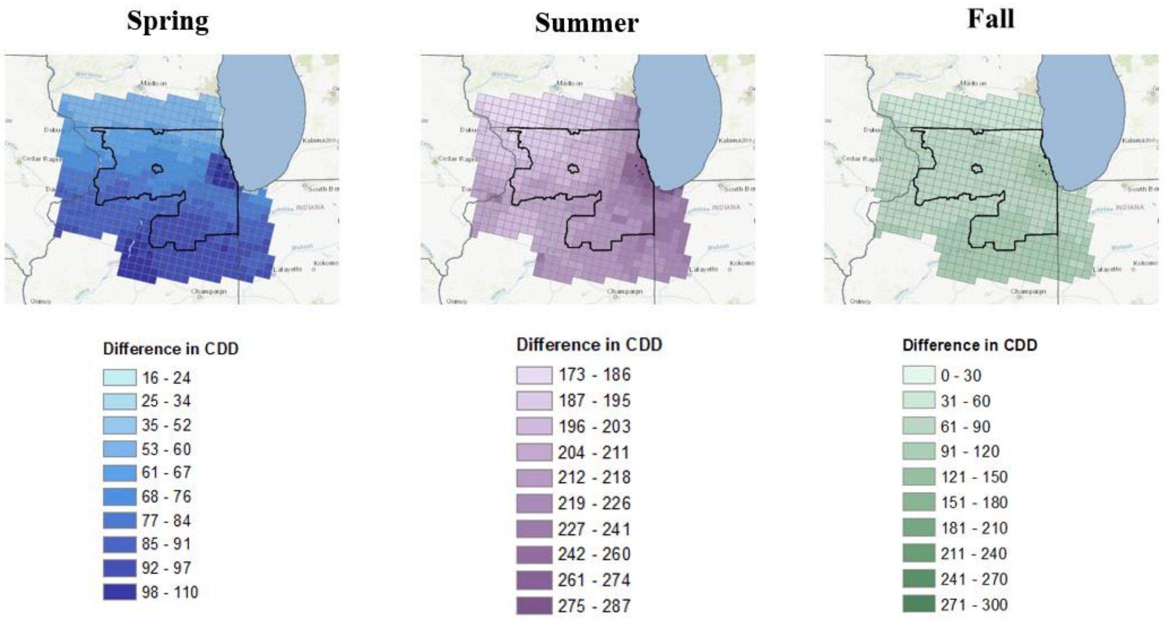
COOLING DEGREE DAYS

Modeling Utility-Relevant Climate Impacts

- **Cooling Degree Days** (CDD) calculated using 65°F base temperature
- Annual CDDs increase between 258 to 399 across service territory
- Greatest increase in Summer and also Fall (Winter not calculated)
  - Spring: Increase 16 to 110
  - Summer: Increase 173 to 287
  - Fall: Increase 0 to 120

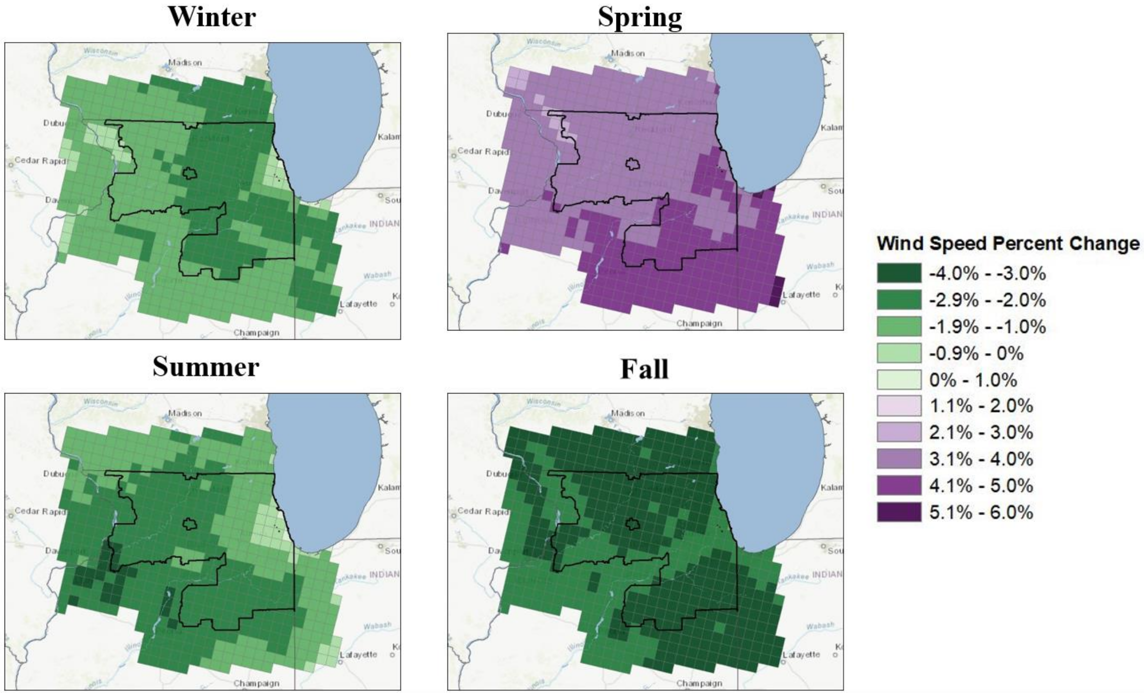


Change in the seasonal count of CDDs between the baseline and mid-century periods

MID-CENTURY WIND SPEEDS

Climate Change in Northern Illinois

- Change in annual average wind speed is negligible across service territory (-0.52%)
- Seasonal variation in maximum daily wind speed: decreases in Summer, Fall and Winter; increases in Spring.
- Across entire service territory, average wind speed changes
  - Winter: -1.51%
  - Summer: -1.90%
  - Fall: -2.96%
  - Spring: +3.95%



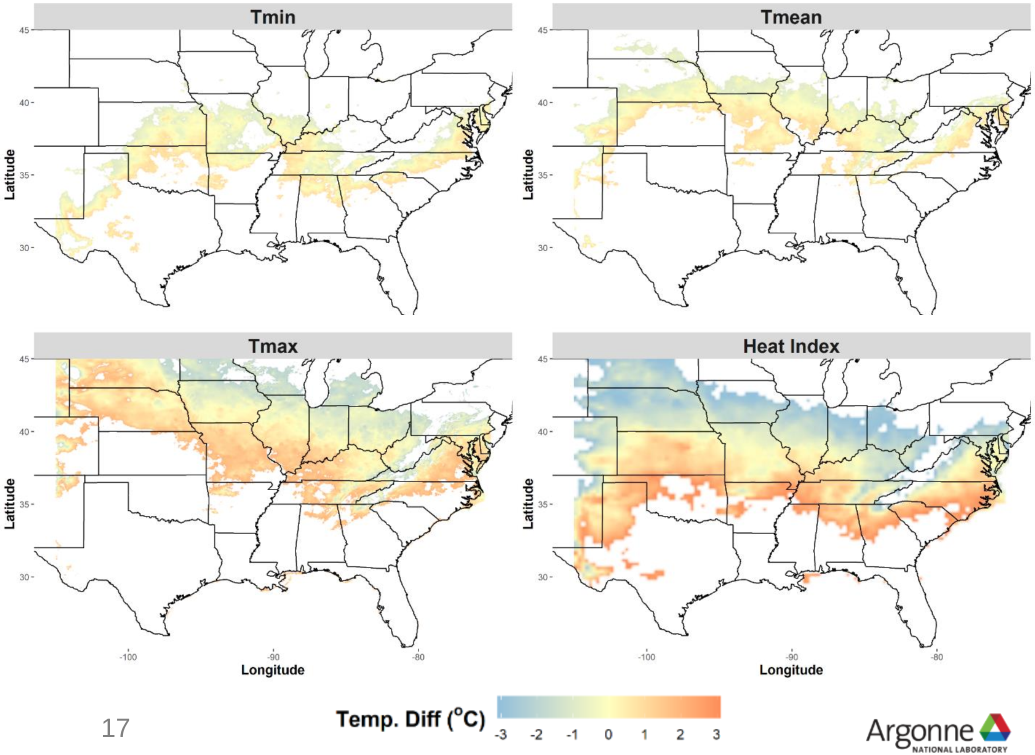
Percentage change in the seasonal averages of daily maximum wind speeds from baseline to mid-century.

REGIONAL ANALOG COMPARISON

Modeling Utility-Relevant Climate Impacts

- Climate analogs compare ComEd's **future** climate at mid-century with other regions that are **currently** experiencing similar climate today

- ComEd's future annual temperatures may feel like today's temperatures in…
  - **Min Temps**: Southern Illinois
  - **Avg Temps**: Springfield, IL
  - **Max Temps**: Champaign, IL
  - **Heat Index**: Central Missouri



QUESTIONS?

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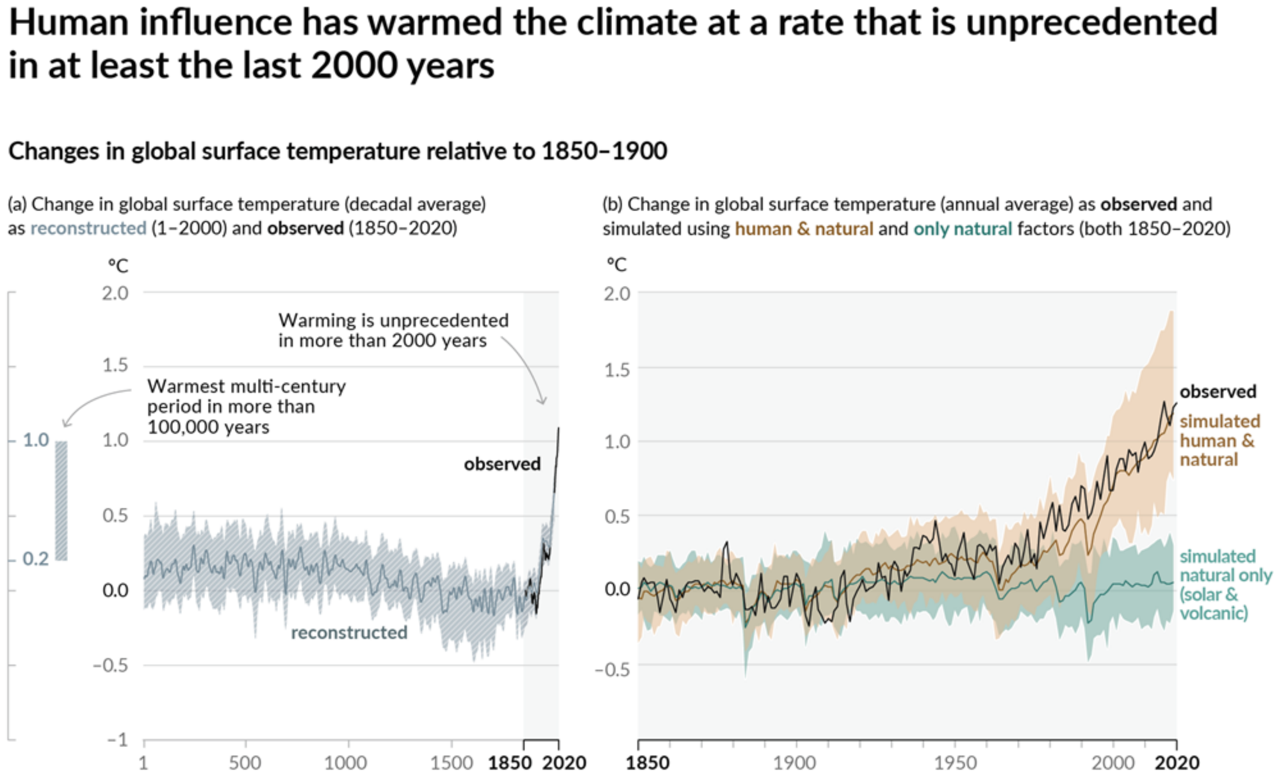
"RECENT" TRENDS IN GLOBAL TEMPERATURE



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FUTURE CLIMATE IS DRIVEN BY GHG EMISSIONS