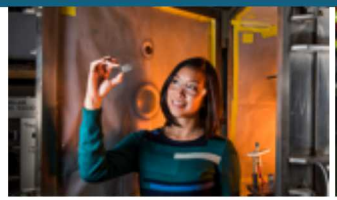
SAND2019-11194C

Sandia National Laboratories

Adverse-Weather Impact Scenarios for Power System Resilience Modeling



Andrea Staid

OpenMod Workshop, NREL

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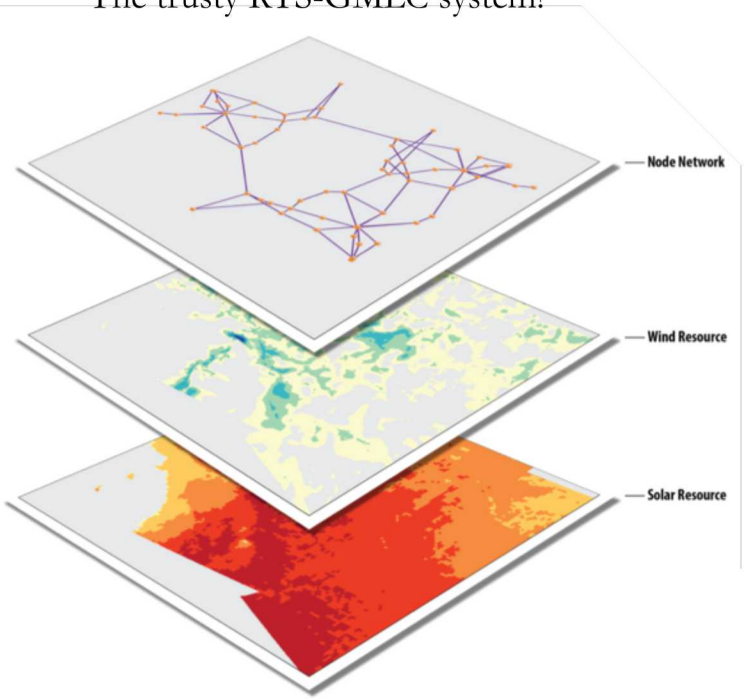
Test Systems are Essential for Reliability/Planning Studies

Reliability → **Resilience**

The trusty RTS-GMLC system!



For resilience modeling for adverse weather, we need all the same stuff as for reliability modeling, plus…

- Realistic representations of threats and impacts of interest

Impacts are usually threat-specific; need to consider behavior of:

- Generation
- Transmission
- Demands
- Recovery

As a function of:

- Weather conditions
- Resource type
- Geographical location
- Time

How Do We Model Threats?

As researchers focus more on modeling resilience, we aim to provide open-source use cases that demonstrate threats and impacts

Still lots to be done, but we have models to simulate impacts on RTS-GMLC for:

Solar eclipse

- Model area of totality and penumbra through time as the eclipse passes over the system
- PV output drops to zero at a bus during totality, decreases proportionally based on distance from center
- For fun, user has the choice of forecasting the event, or not!
- Can the system handle the surprise disappearance of PV production?

Derecho*

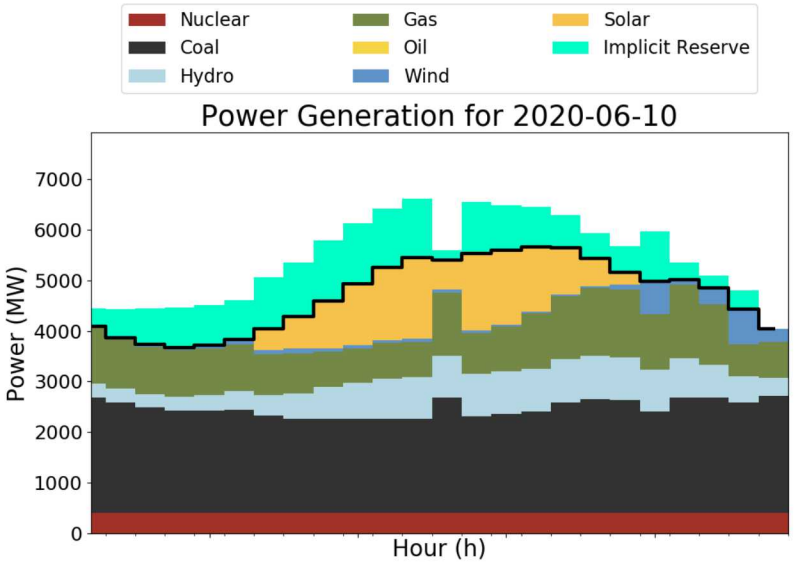
- Model fast-moving stormfront that brings high winds to each bus as it passes through
- Wind production ramps quickly up, but then hits the cut-out velocity and shuts down until the storm passes
- Damage to distribution lines and poles represented by load reductions, with restoration curves defining the load recovery
- Transmission lines can fail in high winds – we can randomly sample forced outages

Polar Vortex*

- Model temperature profiles at each bus over time
- Wind turbines have hard low-temperature cutoffs, so wind production shuts off if thresholds are reached
- Thermal generators have significantly increased forced outages rates due to freezing components, we sample failures based on fuel type and exposed temperatures
- Loads increase from baseline
- Gas supply can be disrupted

*Pretend RTS-GMLC moves to the Midwest

What Can This Look Like?

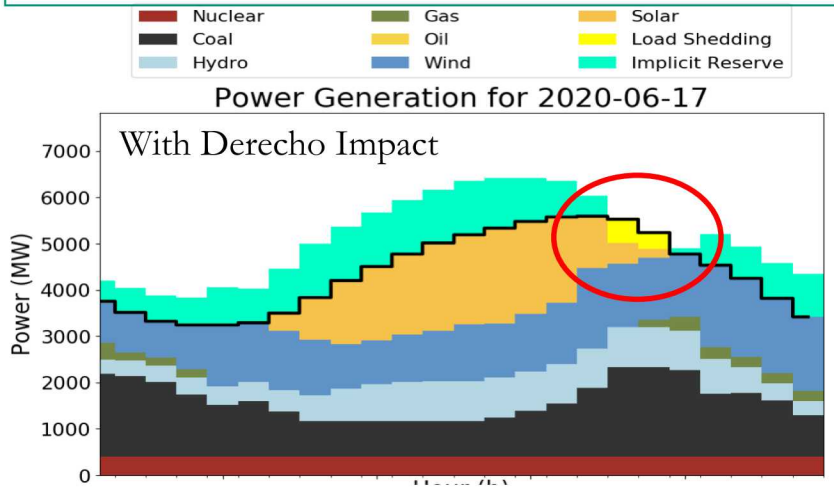


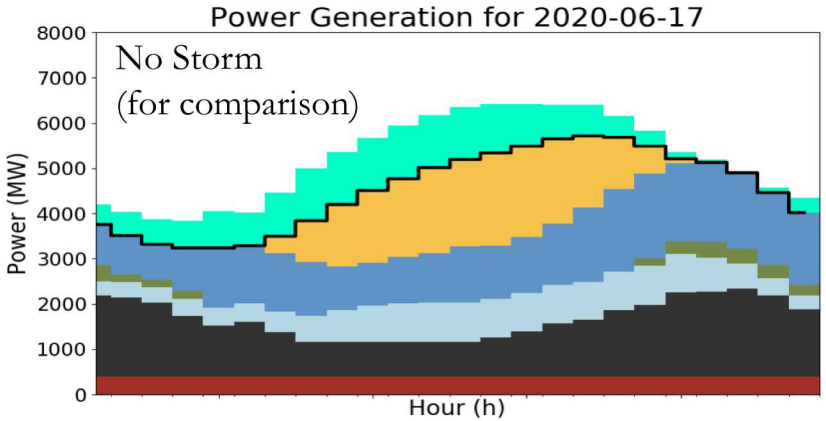
Solar eclipse

- Solar production drops off significantly in the middle of the day
- Coal and gas ramp up to compensate
- No loss of load
- Notably, this is a low-wind day, what would the impacts have looked like on another day?

Derecho

- Wind drops off as turbines reach cutout speed
- Coal ramps up to compensate, but not enough and we shed load
- System demand decreases as distribution components fail





Status and To-Do's

Status:

- Three impact scenarios, all highly parameterizable for easy experimentation with threat severity, extent of impact, at-risk components, etc.

To-Do's:

- I need to find time to clean up the code and publish it on a fork of RTS-GMLC
- As time and interest permits, I will continue to add threat/impact scenarios
  - Hurricane
  - Wildfire
  - Flood
  - Earthquake
  - Any others? What should I prioritize? I take suggestions!