UConnOPM

OUTAGE PREDICTION MODEL

November 14th, 2023

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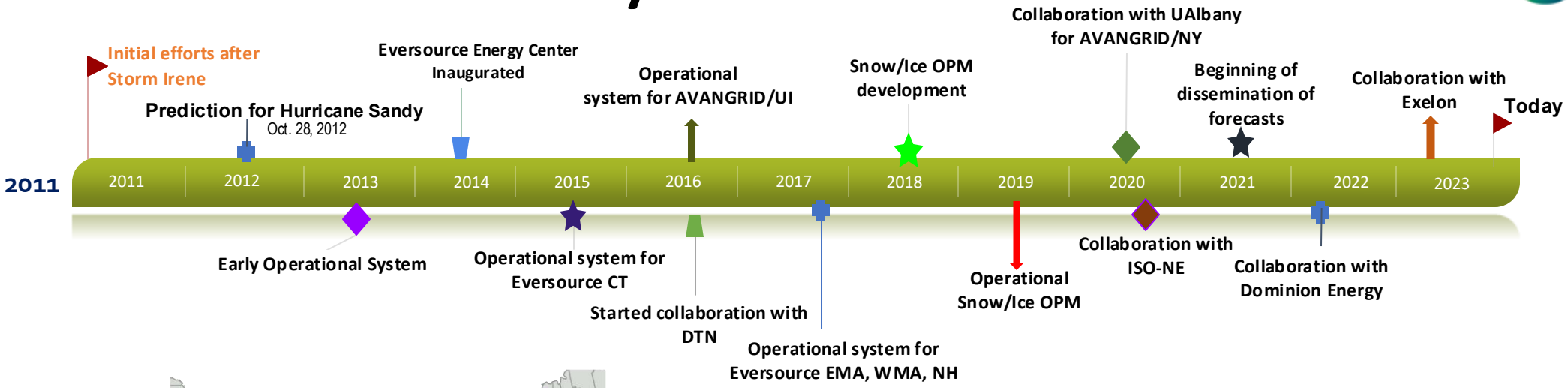
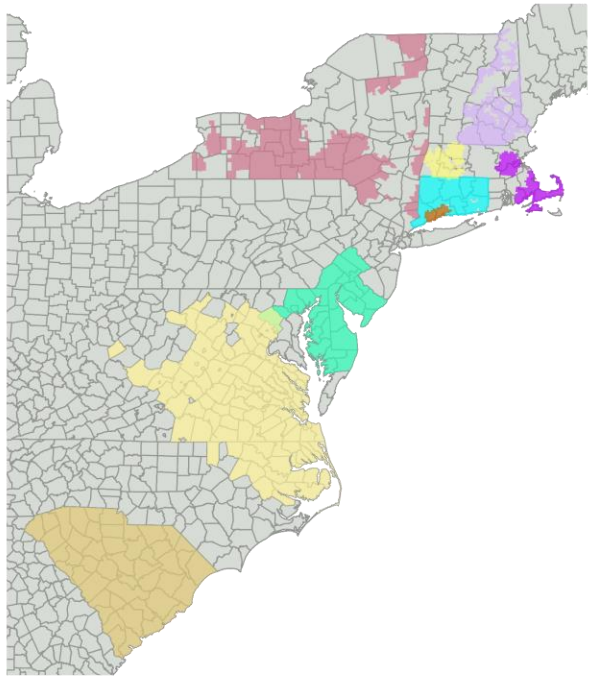
University of Connecticut

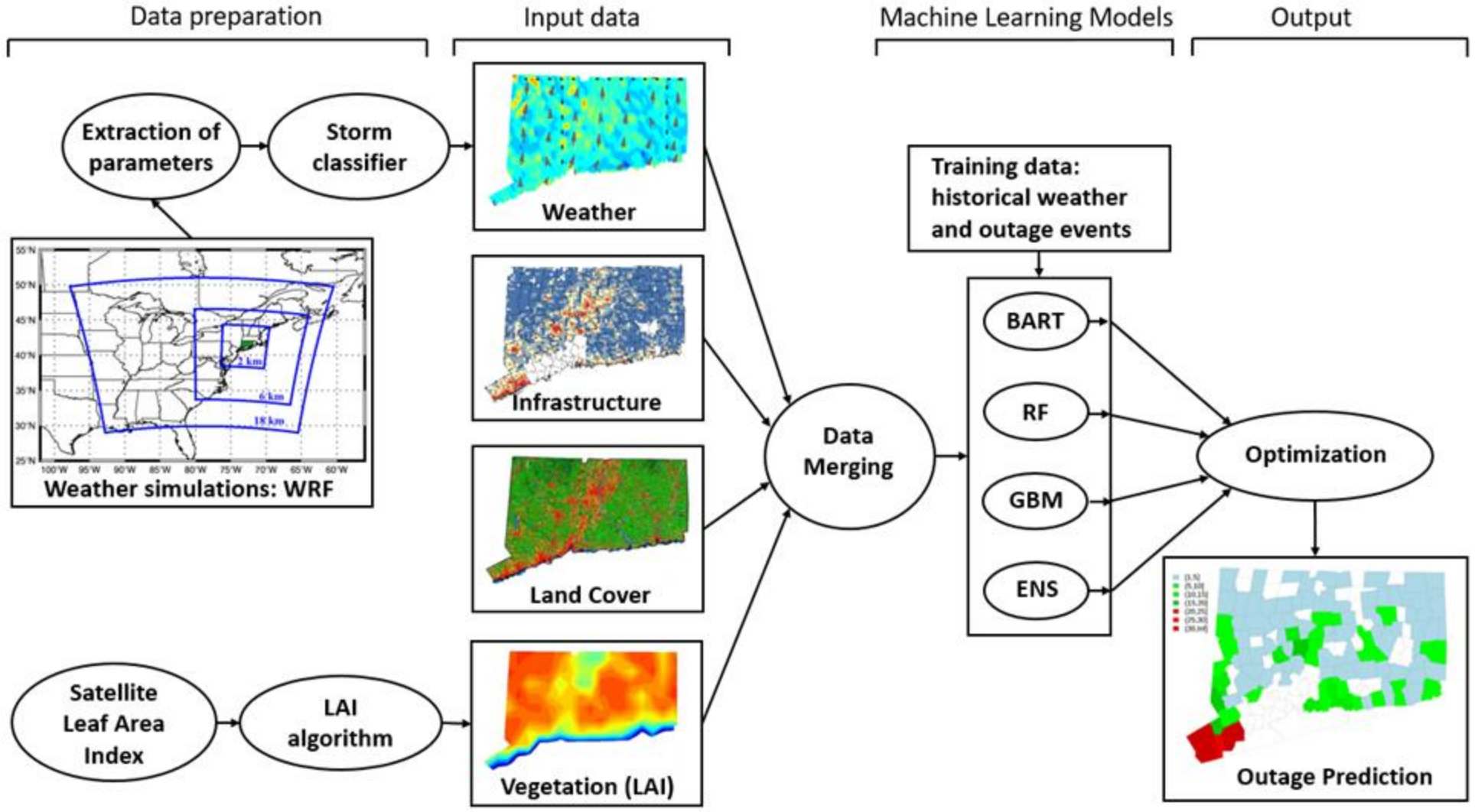
The UConn OPM history





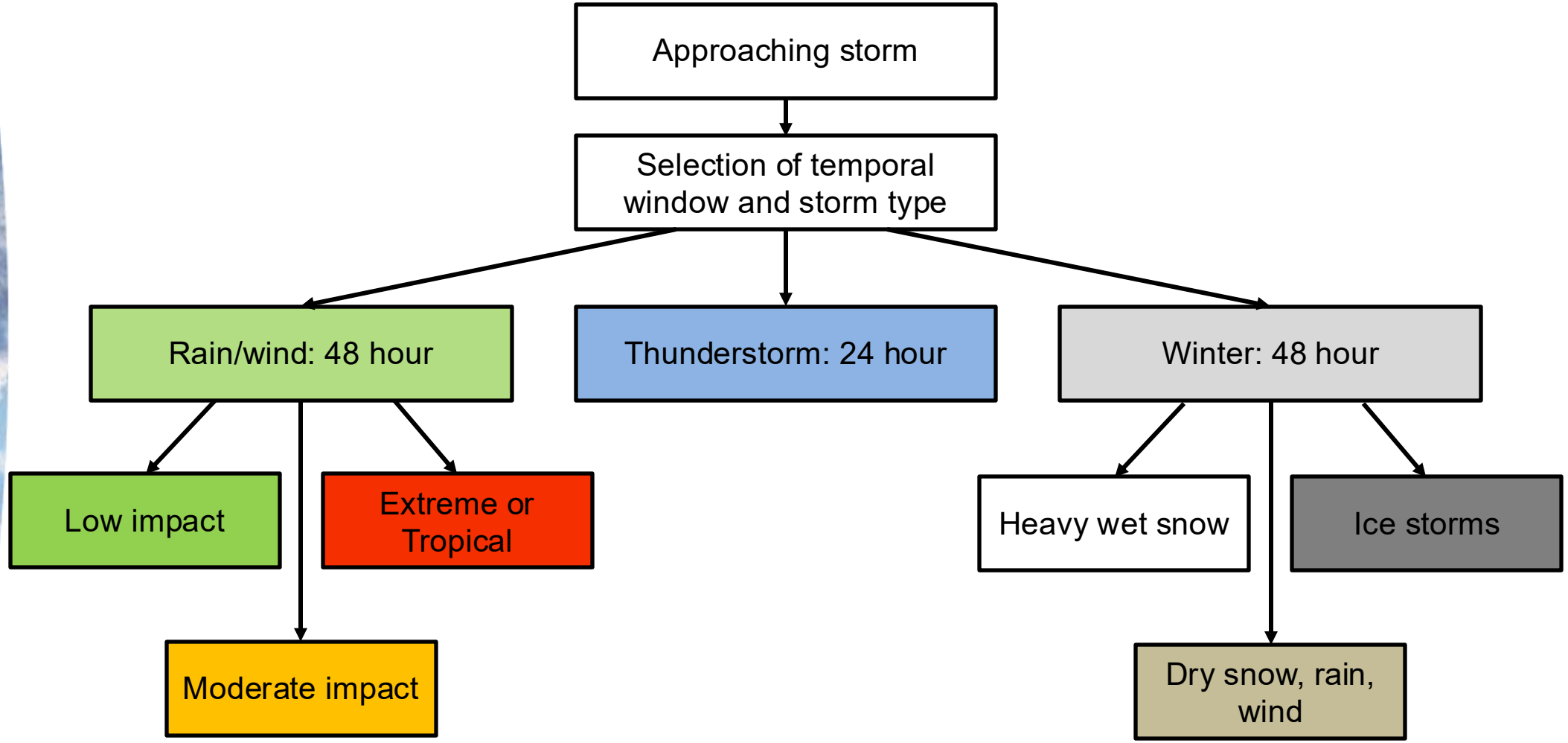
March 2nd, 2018 nor'easter in Massachusetts.

The OPM architecture:



Adapted from: Cerrai et al., 2019a

The OPM operational system:



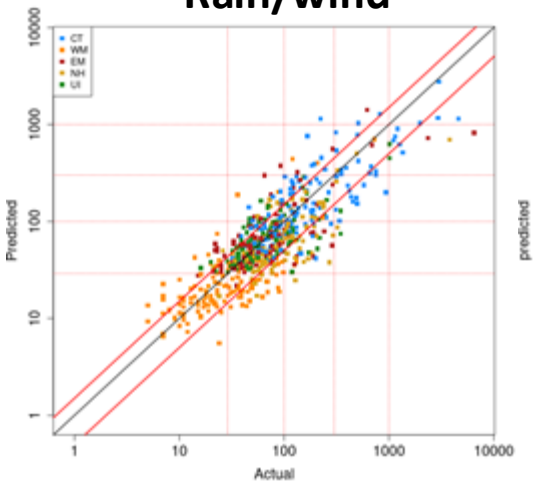
The OPM: historical storms validation

		Model			
		Rain-Wind	Thunderstorms	Winter	Extreme
Storms in Model Calibration	CT	151	125	55	44
	WMA	155	132	67	35
	EMA	103	55	32	13
	NH	115	71	73	15
	Total	524	383	227	107
Performance	Median error	38%	38%	67%	33%

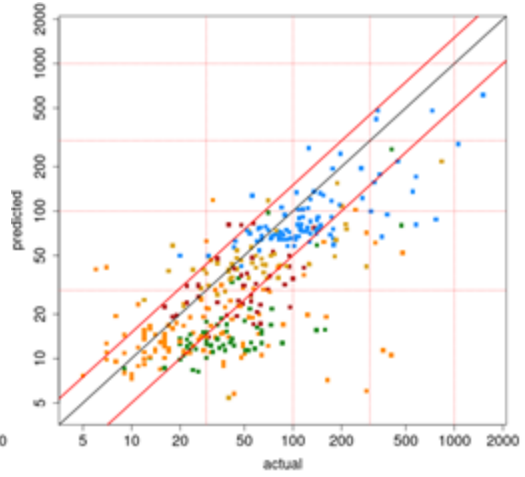
OPM system by the numbers:

- 4 Eversource territories
- 4 models for each territory
- 1241 historical storms simulated for calibration
- Typical error of ~40%

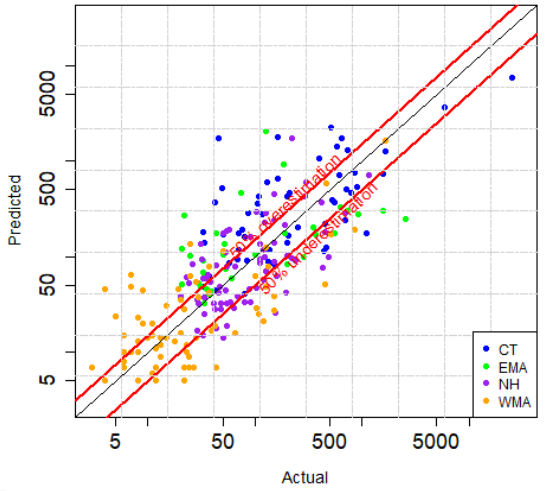
Rain/wind



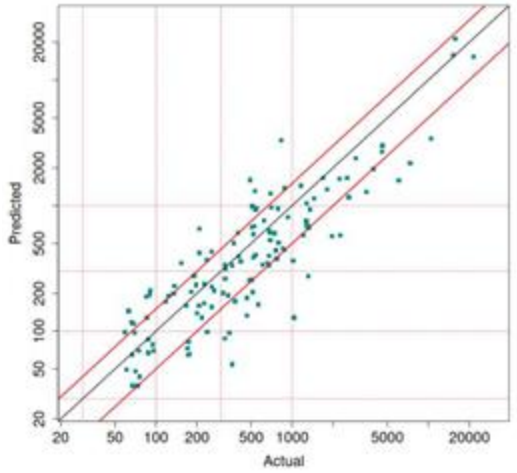
Thunderstorms



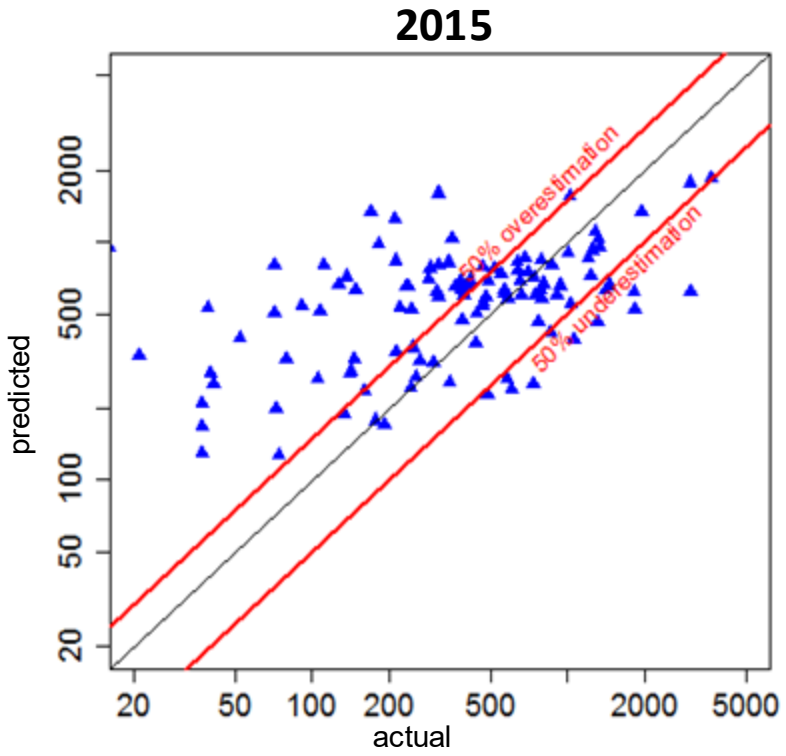
Winter Storms



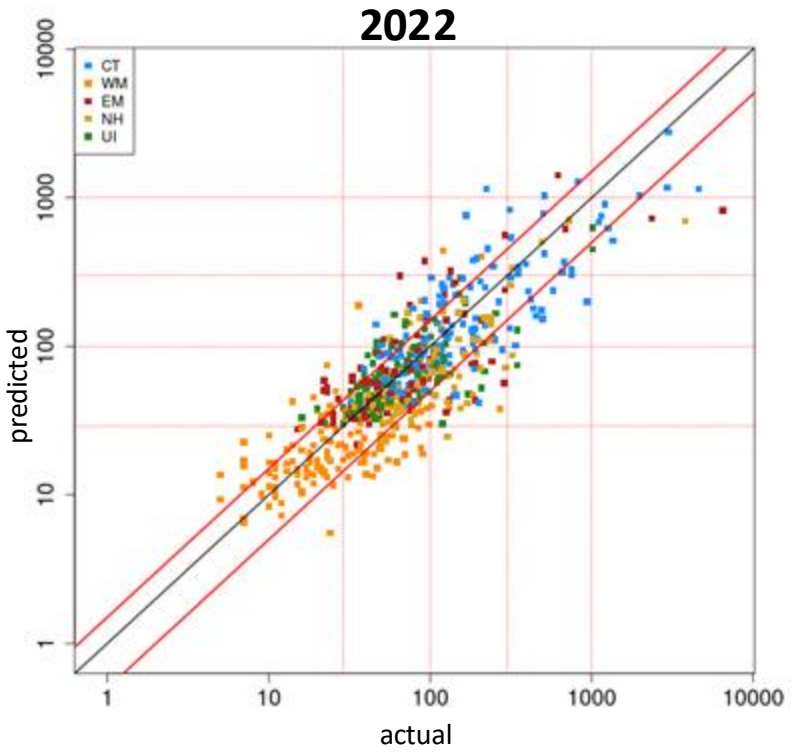
Severe Events



Rain/wind OPM improvements: 2015 vs 2022



7 years of research



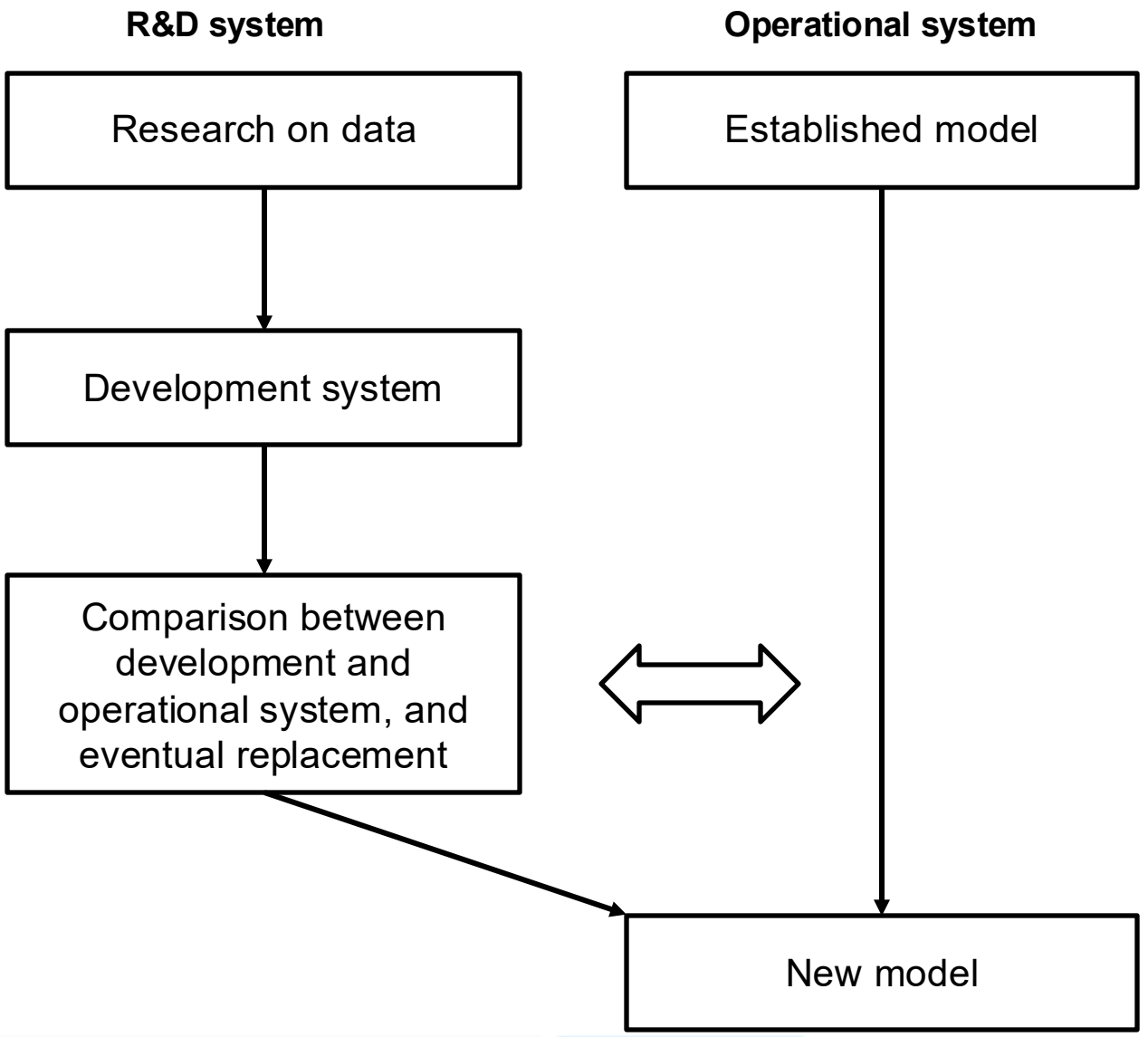
	Mean error	Correlation
OPM in 2015	**330%**	**0.22**
OPM in 2022	**38%**	**0.75**

From research to operations:

1st stage: 3-6 months

2nd stage: 3 months to 1 year

3rd stage: 1 month



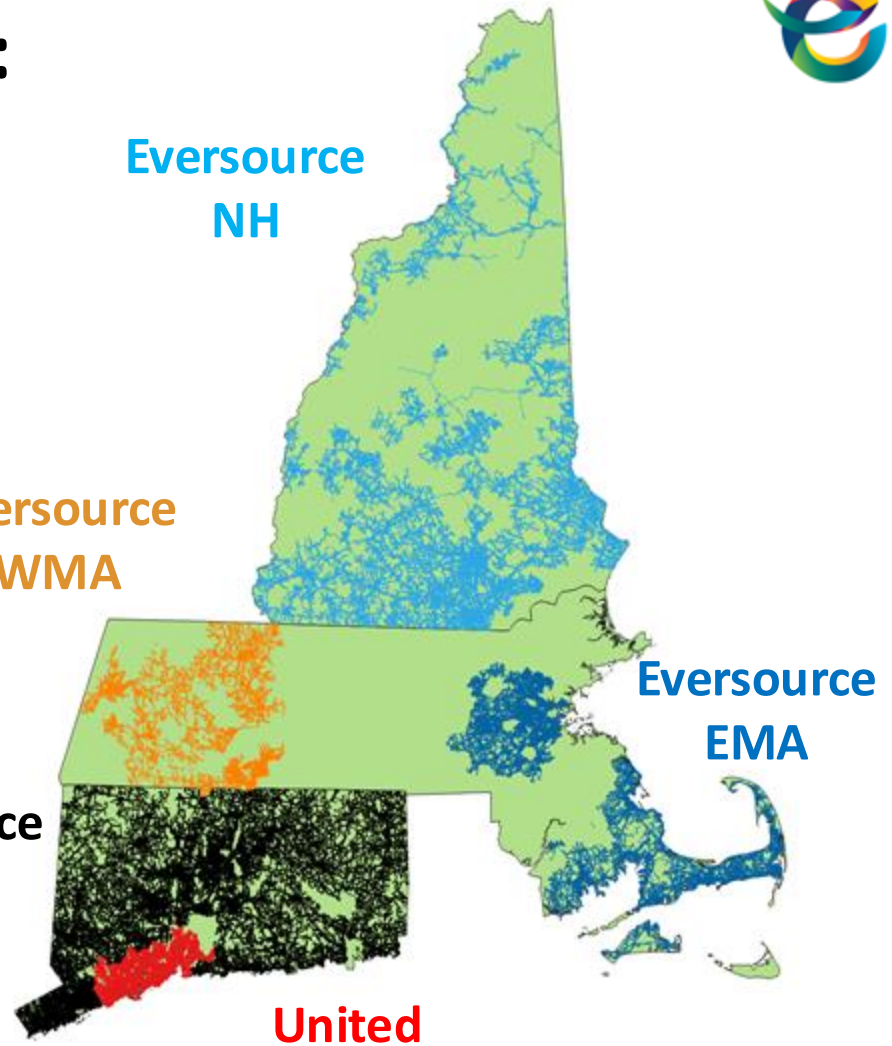
Current operations for Eversource:

Year	Number of forecasted storms	Models* operational for all territories
2017	64	RW
2018	74	RW,T
2019	68	RW, T, SI
2020	66	RW, T, SI
2021	52	RW, T, SI, EX
2022	57	RW, T, SI, EX
2023	60 (YTD)	RW, T, SI, EX

* RW: Rain/wind; T: Thunderstorm, SI: Snow/ice, EX: Extreme

OPM operations by the numbers:

- Over 400+ storms forecasted since 2017
- 10 students (7 in outage modeling group, 3 in weather modeling group)
- 4 faculty, 1 postdoc
- Coordination with Eversource spokespersons, NWS, and TVs before major storms



The OPM territories

Sample OPM Forecast for Eversource

Summary Table

Territory	Model	Max Gusts (mph)	Snow (in)	Snow density	TS prediction	Recommended TS
CT	NAM-WRF 3.8	35-45	5-12”	Medium-high along coast	346-458	230-450
WMA	NAM-WRF 3.8	30-40	8-12”	Medium-low	21-47	20-40
EMA	NAM-WRF 3.8	30-40	1-5”	High in Cape Cod	46-160	50-100
NH	NAM-WRF 3.8	30-40	3-6”	Medium	26-58	25-50

Probability Table

Trouble spots	0-30	30-70	70-150	150-300	300-500	500-750	750-1500	1500-5000	>5000
CT	0%	10%	20%	30%	30%	10%	0%	0%	0%
WMA	50%	50%	0%	0%	0%	0%	0%	0%	0%
EMA	0%	40%	40%	20%	0%	0%	0%	0%	0%
NH	10%	70%	20%	0%	0%	0%	0%	0%	0%

Sample High Impact OPM Forecast for Eversource

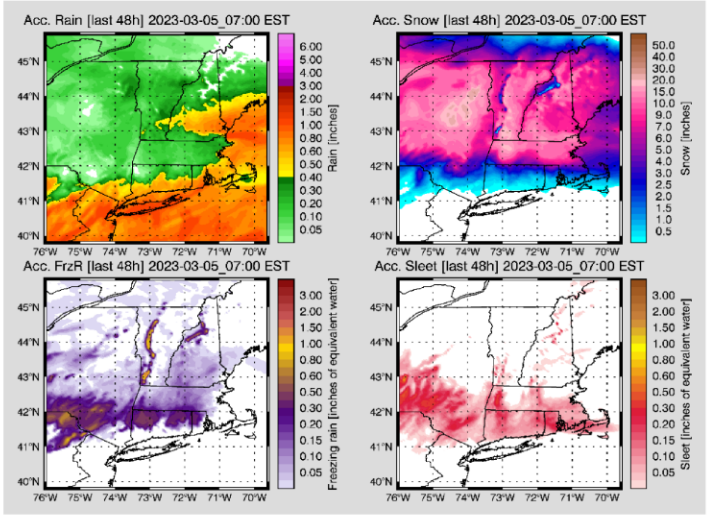
UConnOPM OUTAGE PREDICTION MODEL

OPM Weather and Trouble Spot Prediction: March 4th, 2023 snowstorm

Forecast confidence: MEDIUM

There are minor updates in the expected number of trouble spots with respect to the forecast sent earlier on Friday:

- A slight decrease of the expected number of trouble spots in CT, and a slight increase in NH.
- The area at highest risk of outages is expected to be Southeastern NH.

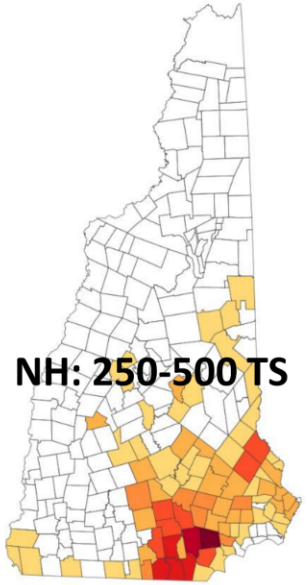


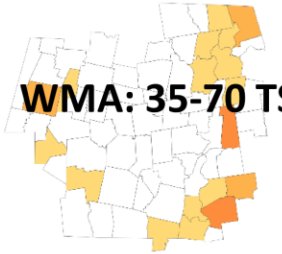
Summary Table

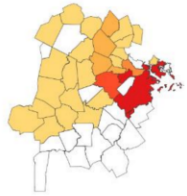
Territory	Max Gusts (mph)	Snow (in)	Snow density	TS prediction	Recommended TS
CT	40-55	1-6”	Medium	314-461	200-400
WMA	35-50	3-12”	Medium	44-88	35-70
EMA	45-60	1-6”	Medium-high	203-490	150-300
NH	40-45	6-12”	Medium-high in SE NH	347-663	250-500

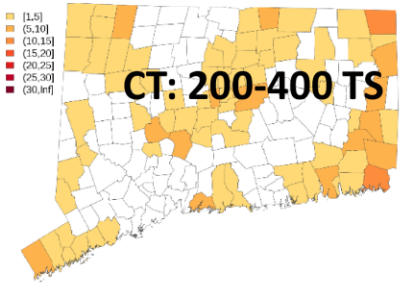
Probability table

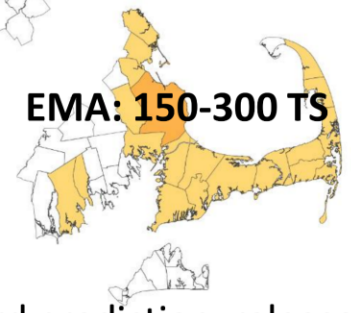
Trouble spots	0-30	30-70	70-150	150-300	300-500	500-750	750-1500	1500-5000	>5000
CT	0%	0%	15%	35%	35%	15%	0%	0%	0%
WMA	30%	50%	20%	0%	0%	0%	0%	0%	0%
EMA	0%	10%	25%	30%	25%	10%	0%	0%	0%
NH	0%	0%	15%	25%	40%	15%	5%	0%	0%











Third prediction, released on:
March 04th, 12:30 a.m. EST

Future Research Directions for the OPM

- Finalize development of new operational OPM models for Eversource based on GFS
- Continued research into improving the individual OPM models
  - Improved understanding of wet snow during winter storms
  - Improving WRF wind gust values
- Development of an outage restoration model to complement OPM forecasts

Contact Us!

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