

## Operational Evaluation of a Mesoscale Weather and Outage Prediction Service for Electric Utility Operations

**Goals**

- Predict the combination of weather conditions that can disrupt the electrical distribution network of overhead lines at the level of the substation area and the characteristics of those disruptions
- Enable sufficient precision and lead time for proactive allocation and deployment of resources to minimize time to repair
- Migrate from monitoring a storm to the ability to stage resources at the right place and time prior to the event to minimize the impact
- Implement as a service (IBM "Deep Thunder" or "DT") tailored for ConEd's requirements and evaluate its quality
- Quantify forecast uncertainty caused by various data sources and different modeling structures

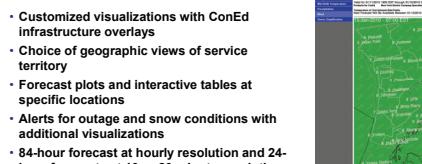
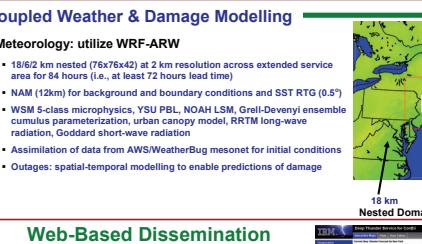
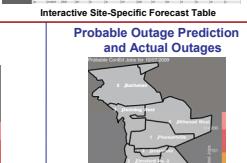
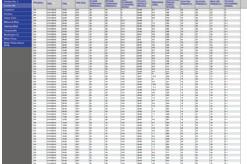
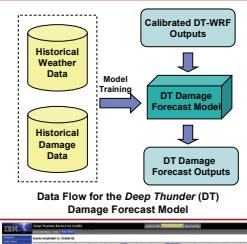
**Initial Steps**

- Meteorological analysis
  - Characterize key historical events that impact utility operations
  - Use AWS/WeatherBug observing stations, anecdotal reports and public data to evaluate past forecasts and events
  - Employ results to tune and improve modeling
- Impact analysis
  - Characterize those key historical events from the utility's perspective
  - Use historical damage data, outage reports, etc. to evaluate past events
- Uncertainty quantification
  - Multiple sources (not just meteorological) need to be addressed

**Coupled Weather & Damage Modelling**

**Meteorology:** utilize WRF-ARW

DATE	T0SP	T0MP	T0P2	T0Y1	T0Y2	T0Y3	T0Y4	T0Y5	T0Y6	T0Y7	T0Y8	T0Y9	T0Y10	T0Y11	T0Y12	T0Y13	T0Y14	T0Y15	T0Y16	T0Y17	T0Y18	T0Y19	T0Y20	T0Y21	T0Y22	T0Y23	T0Y24	T0Y25	T0Y26	T0Y27	T0Y28	T0Y29	T0Y30	T0Y31	T0Y32	T0Y33	T0Y34	T0Y35	T0Y36	T0Y37	T0Y38	T0Y39	T0Y40	T0Y41	T0Y42	T0Y43	T0Y44	T0Y45	T0Y46	T0Y47	T0Y48	T0Y49	T0Y50	T0Y51	T0Y52	T0Y53	T0Y54	T0Y55	T0Y56	T0Y57	T0Y58	T0Y59	T0Y60	T0Y61	T0Y62	T0Y63	T0Y64	T0Y65	T0Y66	T0Y67	T0Y68	T0Y69	T0Y70	T0Y71	T0Y72	T0Y73	T0Y74	T0Y75	T0Y76	T0Y77	T0Y78	T0Y79	T0Y80	T0Y81	T0Y82	T0Y83	T0Y84	T0Y85	T0Y86	T0Y87	T0Y88	T0Y89	T0Y90	T0Y91	T0Y92	T0Y93	T0Y94	T0Y95	T0Y96	T0Y97	T0Y98	T0Y99	T0Y100	T0Y101	T0Y102	T0Y103	T0Y104	T0Y105	T0Y106	T0Y107	T0Y108	T0Y109	T0Y110	T0Y111	T0Y112	T0Y113	T0Y114	T0Y115	T0Y116	T0Y117	T0Y118	T0Y119	T0Y120	T0Y121	T0Y122	T0Y123	T0Y124	T0Y125	T0Y126	T0Y127	T0Y128	T0Y129	T0Y130	T0Y131	T0Y132	T0Y133	T0Y134	T0Y135	T0Y136	T0Y137	T0Y138	T0Y139	T0Y140	T0Y141	T0Y142	T0Y143	T0Y144	T0Y145	T0Y146	T0Y147	T0Y148	T0Y149	T0Y150	T0Y151	T0Y152	T0Y153	T0Y154	T0Y155	T0Y156	T0Y157	T0Y158	T0Y159	T0Y160	T0Y161	T0Y162	T0Y163	T0Y164	T0Y165	T0Y166	T0Y167	T0Y168	T0Y169	T0Y170	T0Y171	T0Y172	T0Y173	T0Y174	T0Y175	T0Y176	T0Y177	T0Y178	T0Y179	T0Y180	T0Y181	T0Y182	T0Y183	T0Y184	T0Y185	T0Y186	T0Y187	T0Y188	T0Y189	T0Y190	T0Y191	T0Y192	T0Y193	T0Y194	T0Y195	T0Y196	T0Y197	T0Y198	T0Y199	T0Y200	T0Y201	T0Y202	T0Y203	T0Y204	T0Y205	T0Y206	T0Y207	T0Y208	T0Y209	T0Y210	T0Y211	T0Y212	T0Y213	T0Y214	T0Y215	T0Y216	T0Y217	T0Y218	T0Y219	T0Y220	T0Y221	T0Y222	T0Y223	T0Y224	T0Y225	T0Y226	T0Y227	T0Y228	T0Y229	T0Y230	T0Y231	T0Y232	T0Y233	T0Y234	T0Y235	T0Y236	T0Y237	T0Y238	T0Y239	T0Y240	T0Y241	T0Y242	T0Y243	T0Y244	T0Y245	T0Y246	T0Y247	T0Y248	T0Y249	T0Y250	T0Y251	T0Y252	T0Y253	T0Y254	T0Y255	T0Y256	T0Y257	T0Y258	T0Y259	T0Y260	T0Y261	T0Y262	T0Y263	T0Y264	T0Y265	T0Y266	T0Y267	T0Y268	T0Y269	T0Y270	T0Y271	T0Y272	T0Y273	T0Y274	T0Y275	T0Y276	T0Y277	T0Y278	T0Y279	T0Y280	T0Y281	T0Y282	T0Y283	T0Y284	T0Y285	T0Y286	T0Y287	T0Y288	T0Y289	T0Y290	T0Y291	T0Y292	T0Y293	T0Y294	T0Y295	T0Y296	T0Y297	T0Y298	T0Y299	T0Y300	T0Y301	T0Y302	T0Y303	T0Y304	T0Y305	T0Y306	T0Y307	T0Y308	T0Y309	T0Y310	T0Y311	T0Y312	T0Y313	T0Y314	T0Y315	T0Y316	T0Y317	T0Y318	T0Y319	T0Y320	T0Y321	T0Y322	T0Y323	T0Y324	T0Y325	T0Y326	T0Y327	T0Y328	T0Y329	T0Y330	T0Y331	T0Y332	T0Y333	T0Y334	T0Y335	T0Y336	T0Y337	T0Y338	T0Y339	T0Y340	T0Y341	T0Y342	T0Y343	T0Y344	T0Y345	T0Y346	T0Y347	T0Y348	T0Y349	T0Y350	T0Y351	T0Y352	T0Y353	T0Y354	T0Y355	T0Y356	T0Y357	T0Y358	T0Y359	T0Y360	T0Y361	T0Y362	T0Y363	T0Y364	T0Y365	T0Y366	T0Y367	T0Y368	T0Y369	T0Y370	T0Y371	T0Y372	T0Y373	T0Y374	T0Y375	T0Y376	T0Y377	T0Y378	T0Y379	T0Y380	T0Y381	T0Y382	T0Y383	T0Y384	T0Y385	T0Y386	T0Y387	T0Y388	T0Y389	T0Y390	T0Y391	T0Y392	T0Y393	T0Y394	T0Y395	T0Y396	T0Y397	T0Y398	T0Y399	T0Y400	T0Y401	T0Y402	T0Y403	T0Y404	T0Y405	T0Y406	T0Y407	T0Y408	T0Y409	T0Y410	T0Y411	T0Y412	T0Y413	T0Y414	T0Y415	T0Y416	T0Y417	T0Y418	T0Y419	T0Y420	T0Y421	T0Y422	T0Y423	T0Y424	T0Y425	T0Y426	T0Y427	T0Y428	T0Y429	T0Y430	T0Y431	T0Y432	T0Y433	T0Y434	T0Y435	T0Y436	T0Y437	T0Y438	T0Y439	T0Y440	T0Y441	T0Y442	T0Y443	T0Y444	T0Y445	T0Y446	T0Y447	T0Y448	T0Y449	T0Y450	T0Y451	T0Y452	T0Y453	T0Y454	T0Y455	T0Y456	T0Y457	T0Y458	T0Y459	T0Y460	T0Y461	T0Y462	T0Y463	T0Y464	T0Y465	T0Y466	T0Y467	T0Y468	T0Y469	T0Y470	T0Y471	T0Y472	T0Y473	T0Y474	T0Y475	T0Y476	T0Y477	T0Y478	T0Y479	T0Y480	T0Y481	T0Y482	T0Y483	T0Y484	T0Y485	T0Y486	T0Y487	T0Y488	T0Y489	T0Y490	T0Y491	T0Y492	T0Y493	T0Y494	T0Y495	T0Y496	T0Y497	T0Y498	T0Y499	T0Y500	T0Y501	T0Y502	T0Y503	T0Y504	T0Y505	T0Y506	T0Y507	T0Y508	T0Y509	T0Y510	T0Y511	T0Y512	T0Y513	T0Y514	T0Y515	T0Y516	T0Y517	T0Y518	T0Y519	T0Y520	T0Y521	T0Y522	T0Y523	T0Y524	T0Y525	T0Y526	T0Y527	T0Y528	T0Y529	T0Y530	T0Y531	T0Y532	T0Y533	T0Y534	T0Y535	T0Y536	T0Y537	T0Y538	T0Y539	T0Y540	T0Y541	T0Y542	T0Y543	T0Y544	T0Y545	T0Y546	T0Y547	T0Y548	T0Y549	T0Y550	T0Y551	T0Y552	T0Y553	T0Y554	T0Y555	T0Y556	T0Y557	T0Y558	T0Y559	T0Y560	T0Y561	T0Y562	T0Y563	T0Y564	T0Y565	T0Y566	T0Y567	T0Y568	T0Y569	T0Y570	T0Y571	T0Y572	T0Y573	T0Y574	T0Y575	T0Y576	T0Y577	T0Y578	T0Y579	T0Y580	T0Y581	T0Y582	T0Y583	T0Y584	T0Y585	T0Y586	T0Y587	T0Y588	T0Y589	T0Y590	T0Y591	T0Y592	T0Y593	T0Y594	T0Y595	T0Y596	T0Y597	T0Y598	T0Y599	T0Y600	T0Y601	T0Y602	T0Y603	T0Y604	T0Y605	T0Y606	T0Y607	T0Y608	T0Y609	T0Y610	T0Y611	T0Y612	T0Y613	T0Y614	T0Y615	T0Y616	T0Y617	T0Y618	T0Y619	T0Y620	T0Y621	T0Y622	T0Y623	T0Y624	T0Y625	T0Y626	T0Y627	T0Y628	T0Y629	T0Y630	T0Y631	T0Y632	T0Y633	T0Y634	T0Y635	T0Y636	T0Y637	T0Y638	T0Y639	T0Y640	T0Y641	T0Y642	T0Y643	T0Y644	T0Y645	T0Y646	T0Y647	T0Y648	T0Y649	T0Y650	T0Y651	T0Y652	T0Y653	T0Y654	T0Y655	T0Y656	T0Y657	T0Y658	T0Y659	T0Y660	T0Y661	T0Y662	T0Y663	T0Y664	T0Y665	T0Y666	T0Y667	T0Y668	T0Y669	T0Y670	T0Y671	T0Y672	T0Y673	T0Y674	T0Y675	T0Y676	T0Y677	T0Y678	T0Y679	T0Y680	T0Y681	T0Y682	T0Y683	T0Y684	T0Y685	T0Y686	T0Y687	T0Y688	T0Y689	T0Y690	T0Y691	T0Y692	T0Y693	T0Y694	T0Y695	T0Y696	T0Y697	T0Y698	T0Y699	T0Y700	T0Y701	T0Y702	T0Y703	T0Y704	T0Y705	T0Y706	T0Y707	T0Y708	T0Y709	T0Y710	T0Y711	T0Y712	T0Y713	T0Y714	T0Y715	T0Y716	T0Y717	T0Y718	T0Y719	T0Y720	T0Y721	T0Y722	T0Y723	T0Y724	T0Y725	T0Y726	T0Y727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See Related Presentations (Poster 521 Probability and Statistics; J11.3 Energy; J6.1 Socio-Economic)