



Comparison of Wind Turbine Wake models used in Commercial Software to Optimise the Wind Farm Layout

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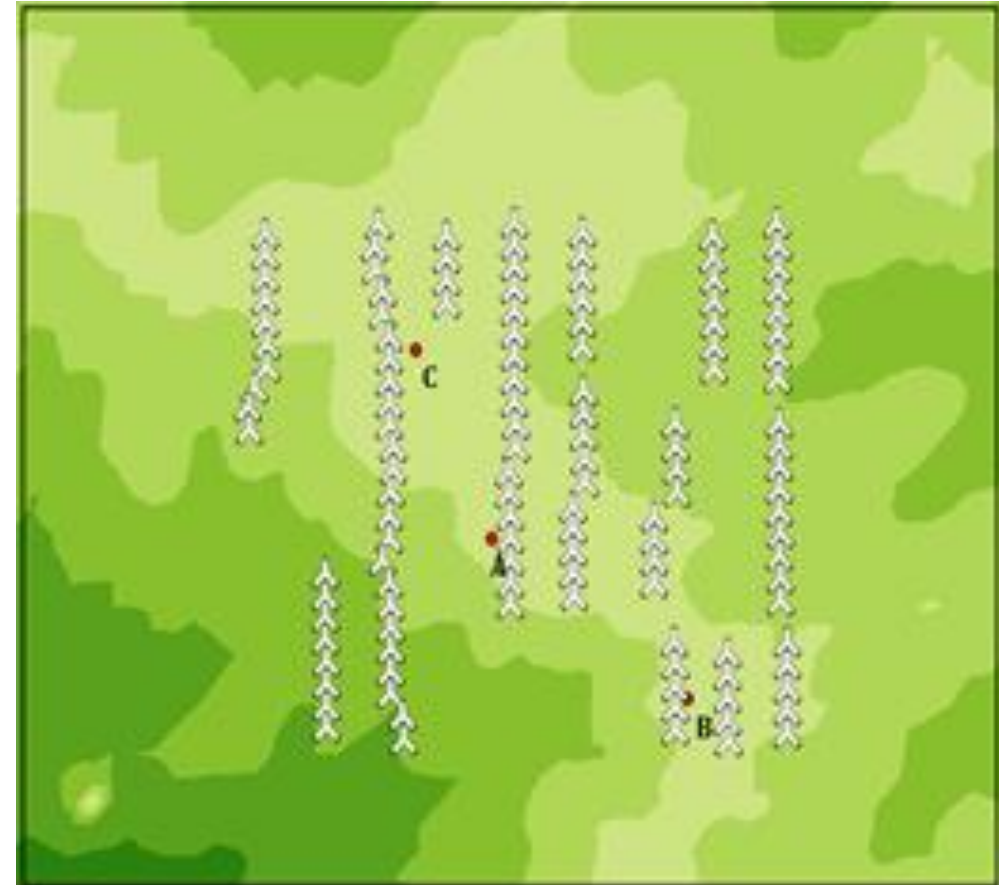
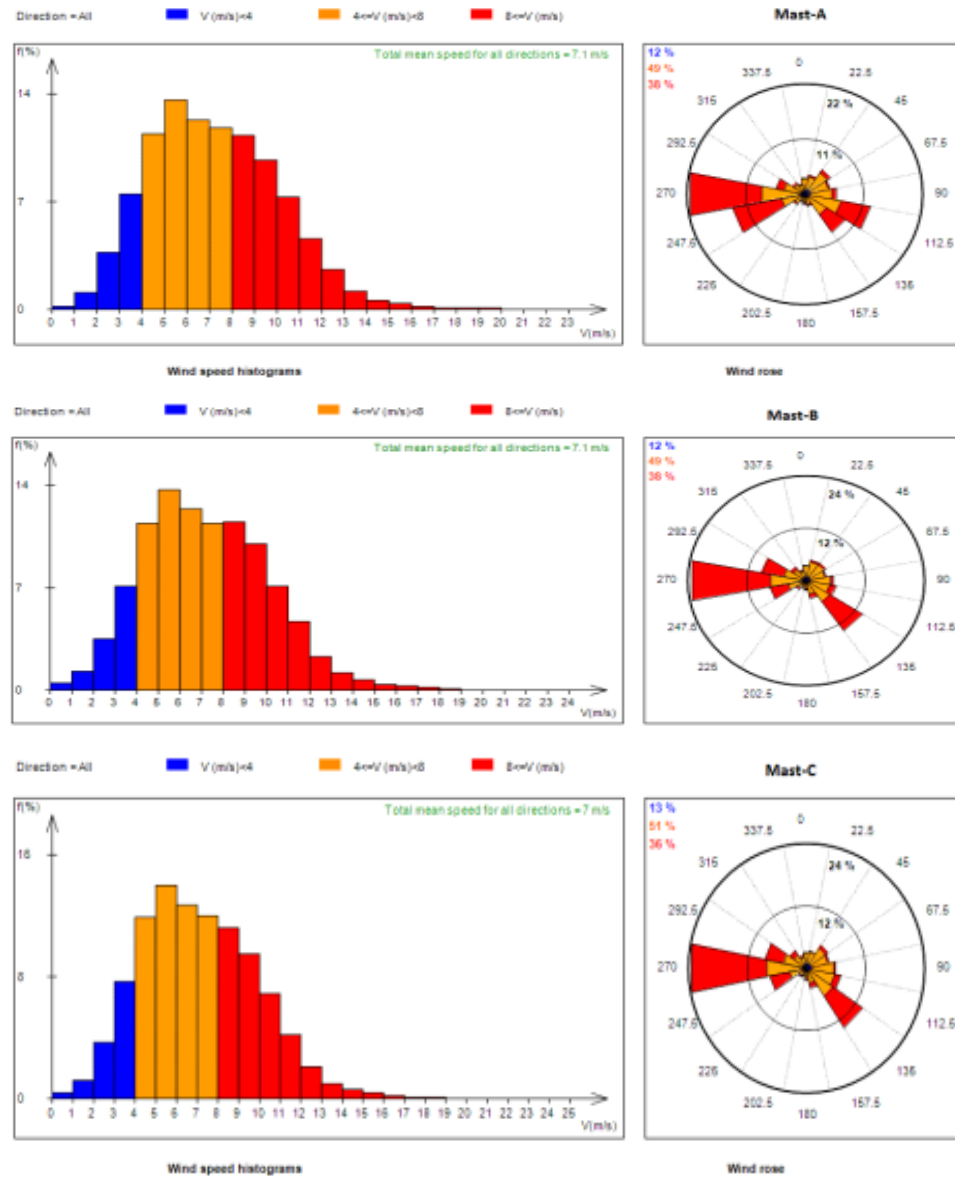
Introduction

- Wake Effect
- Impacts of Wake Effect

Wake Models Used in Commercial Software

Wake Models/Software	WAsP	WindPro	WindSim	MeteoDyn
Jensen or Park	√	√	√	
Larsen		√	√	
Ainslie (EVM)		√		
Modified Park				√
Ishihara			√	
Fast EVM				√

Wind Farm Layout and Wind Characteristics

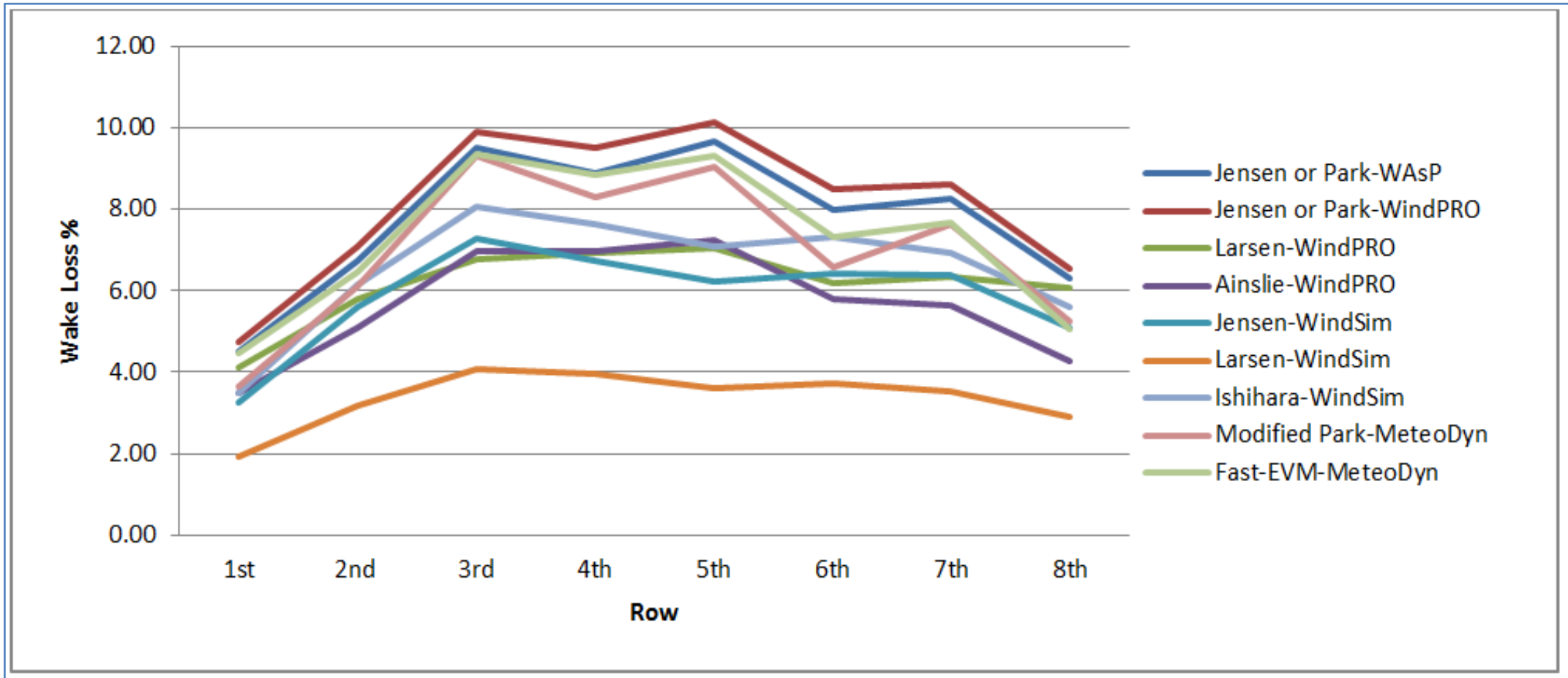


Wind Mast	K	A (m/s)	Mean (m/s)	TI
Mast A	2.56	7.95	7.05	0.11
Mast B	2.53	7.97	7.07	0.12
Mast C	2.53	7.81	6.93	0.12

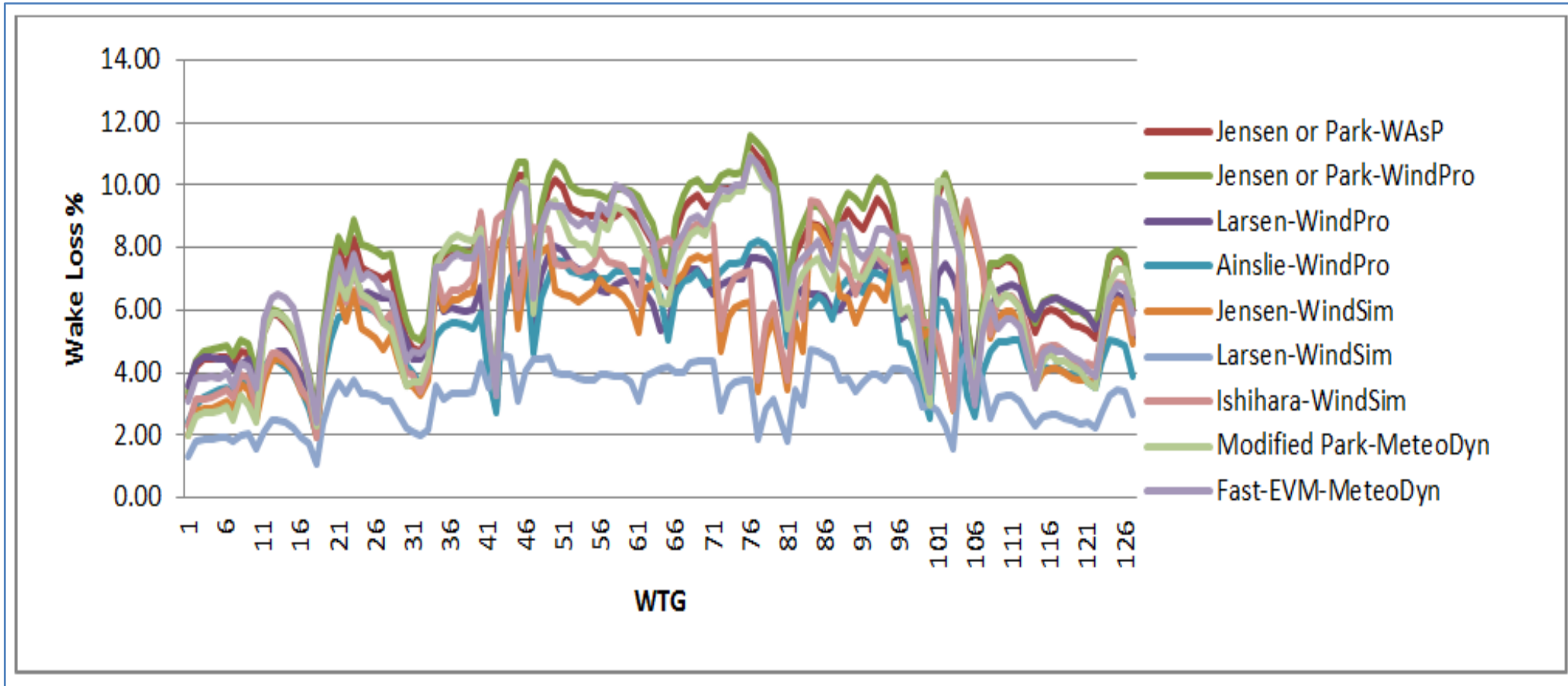
Results

Wake Models	1st Row	2nd Row	3rd Row	4th Row	5th Row	6th Row	7th Row	8th Row	Average	Rank
Jensen or Park-WAsP	4.51	6.73	9.5	8.9	9.66	7.99	8.28	6.32	7.74	2
Jensen or Park-WindPRO	4.74	7.09	9.91	9.51	10.12	8.51	8.61	6.56	8.13	1
Larsen-WindPRO	4.13	5.81	6.78	6.92	7.04	6.19	6.36	6.06	6.16	6
Ainslie-WindPRO	3.48	5.11	6.98	6.96	7.23	5.79	5.65	4.28	5.68	8
Jensen-WindSim	3.24	5.62	7.3	6.75	6.25	6.43	6.37	5.1	5.88	7
Larsen-WindSim	1.93	3.18	4.07	3.95	3.6	3.72	3.53	2.91	3.36	9
Ishihara-WindSim	3.49	6.16	8.05	7.66	7.09	7.31	6.93	5.61	6.54	5
Modified Park-MeteoDyn	3.66	6.12	9.3	8.3	9.03	6.59	7.62	5.26	6.98	4
Fast-EVM-MeteoDyn	4.47	6.45	9.35	8.86	9.32	7.31	7.67	5.06	7.31	3

Variation of Wake Losses in Rows

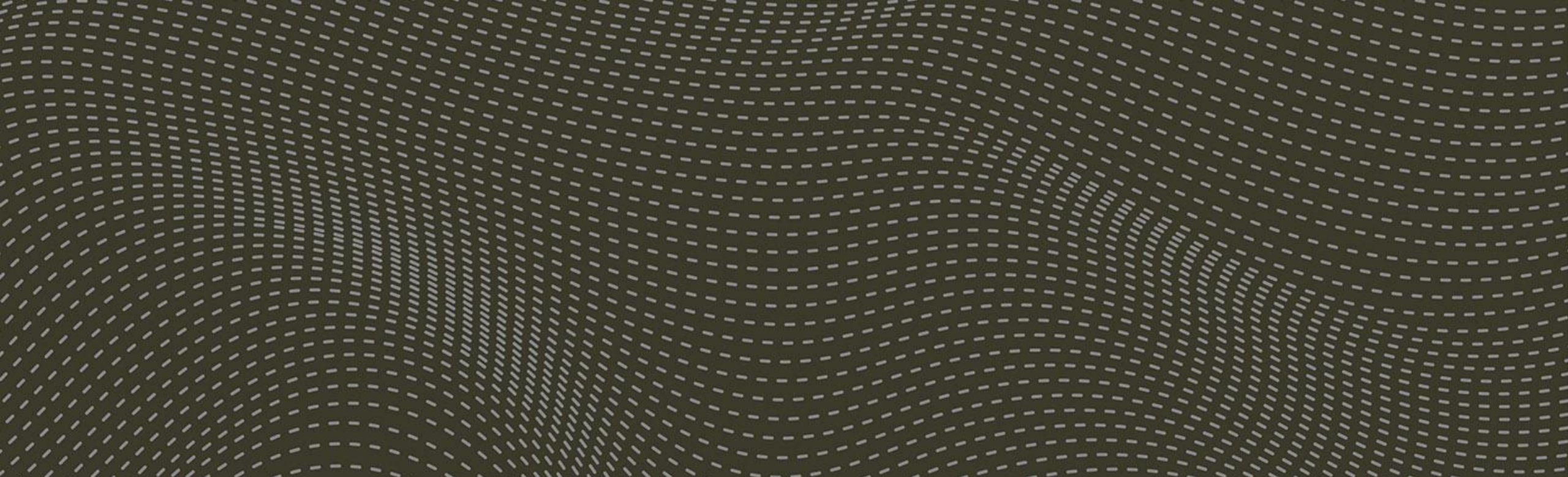


Wake Pattern of Different Models in a Studied Wind Farm



Conclusion

- We have analyzed six different wake models that are used in various wind farm software. Among these six models, Jensen is found to be capturing more wakes followed by Fast EVM.
- After conducting analysis we found that middle rows (3rd, 4th and 5th) had got more energy losses in the wind farm, and the same can be reduced by keeping more distance between turbines in these rows and between rows.
- However accuracy of the modeled wake can be determined only by a validation with real time data from the wind farm site and it is yet to be done.



Thanks

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