Site ice classification

Case studies and recommendations

2014.02.11

Outline of today's presentation

- Introduction to Task 19
- Case study Stor-Rotliden
- Conclusions and discussion
- Future of Vattenfall's cold climate research
- Questions

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IEA's Task 19

http://arcticwind.vtt.fi

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Icing climatology – a question of definition

What else?

- Number of icing events
- Number of met. / instr. icing events
- Length of met. / instr. icing events
- Ratio instrumental and meteorological icing events
- Intensity of meteorological and instrumental icing

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Case studies

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Case studies

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Case studies – Stor-Rotliden (SRL)

Location	Stor-Rotliden, Sweden
Elevation	550 m a s l
Turbine type	40 Vestas V90 1.8 – 2.0 MW
Hub height	95 m a g l
Blade heating	No

Year	Meteorological icing [% of period (days)]	Instrumental icing [% of period (days)]	Production loss [% of production during period (average % per year)]
Dec 2012 – Apr 2013 (web camera)	**17 %** (26 days)	**40 %** (61 days)	**22 %** (7.5 %)

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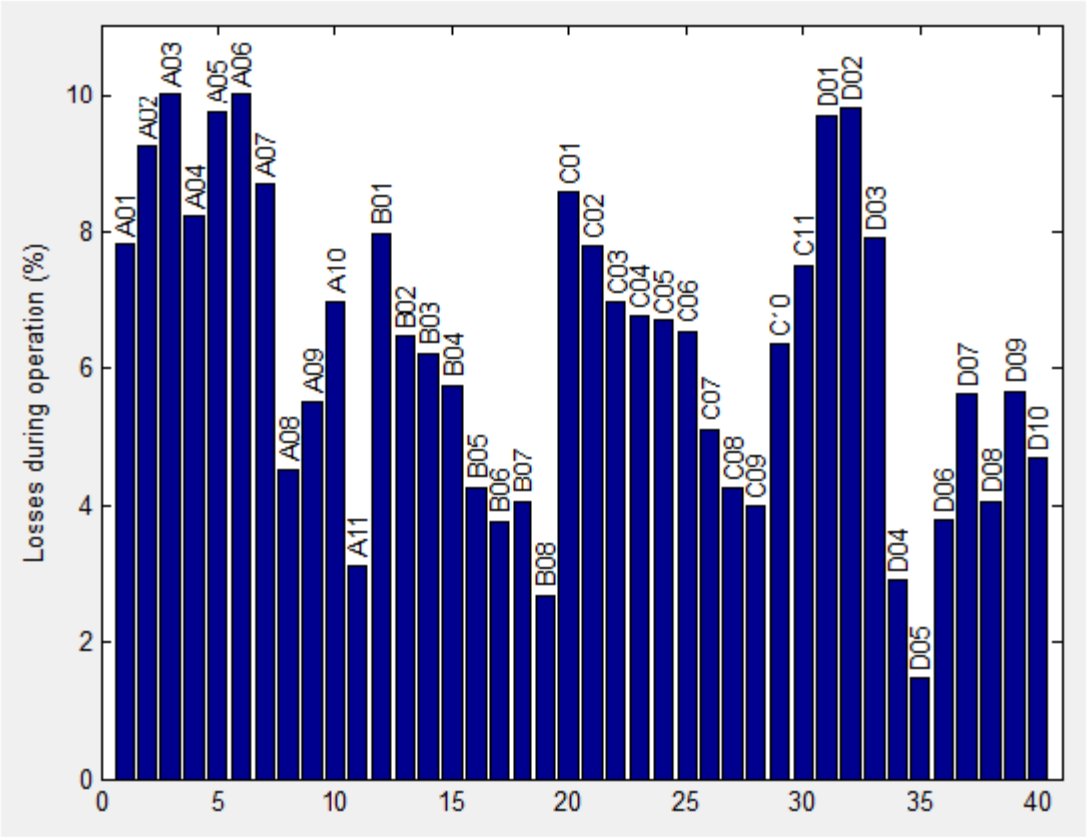
Case studies – Stor-Rotliden (SRL)



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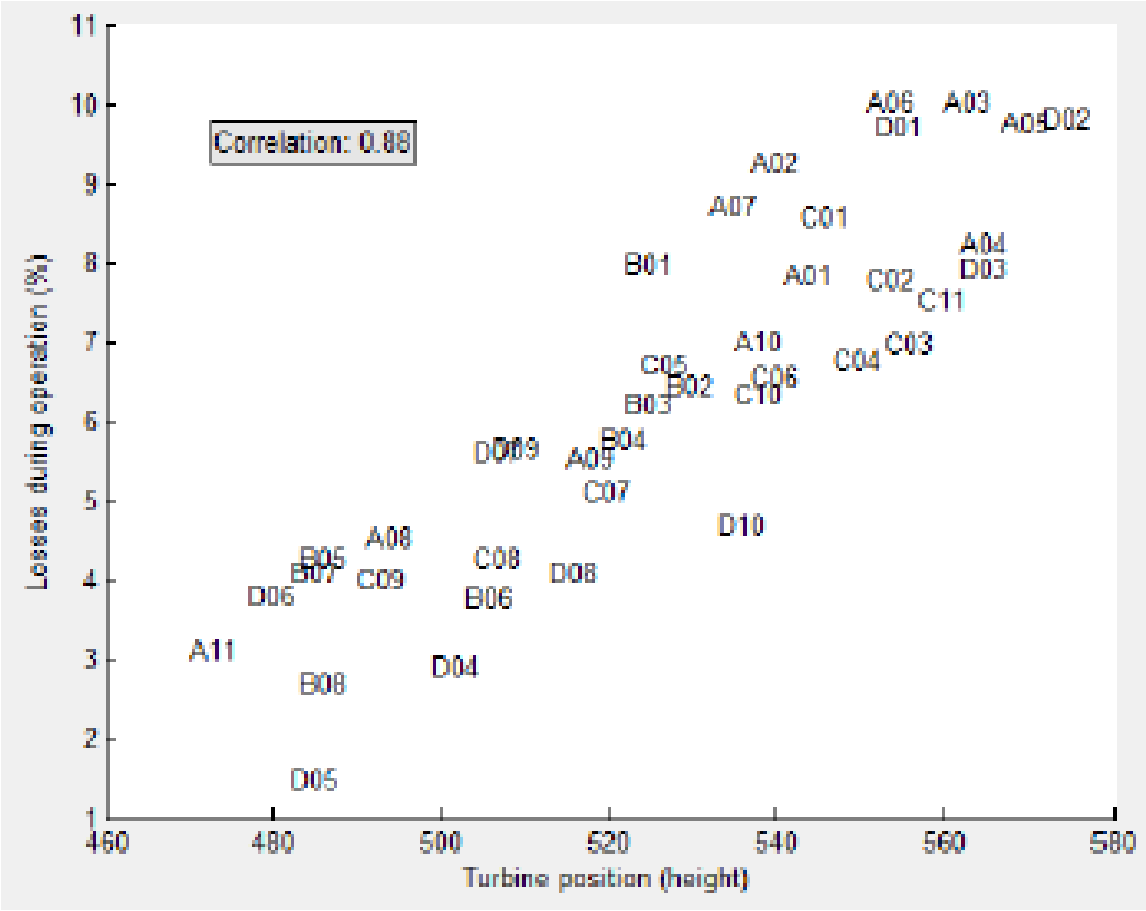
Case studies – Stor-Rotliden (SRL)



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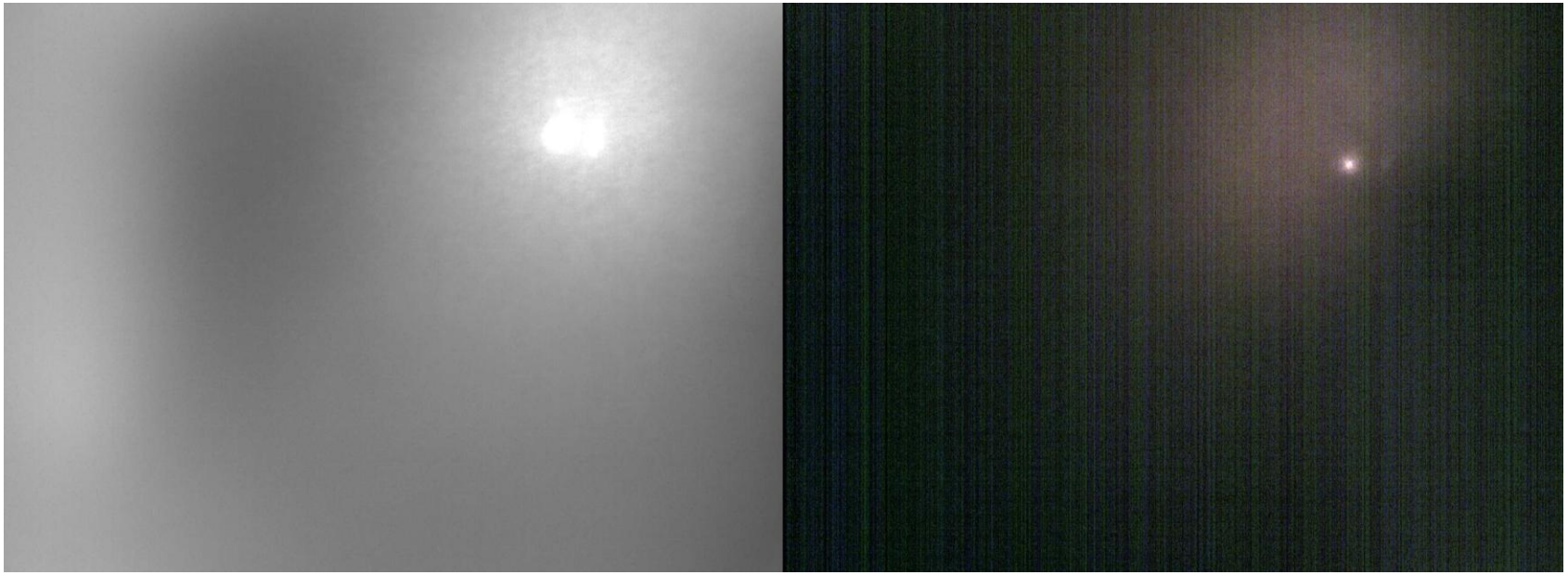
Case studies – Stor-Rotliden (SRL)

Year	Instrumental icing turbine blades [days]	Instrumental icing nacelle [days]
Nov 2012- Apr 2013	59	61

Case studies – Stor-Rotliden (SRL)

Year	Number of met. icing events	Numbers of instr. icing events
Nov 2012- Apr 2013	41	9



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Conclusions

The question is **not** ”How much icing?”!

Conclusions

- The safety and economical risks are dependent on all the presented factors
- Understanding of icing climatology is crucial for operating of wind farm and deicing system
- Don’t underestimate the value of basic research

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Market potential

Cumulative installed capacity by end of 2012 (MW)			Forecasted new capacity 2013-17 (MW)		
Low temperature	Light icing: Safety risk, some economic risk	Moderate to heavy icing: economic and safety risk	Low temperature	Light icing: Safety risk, some economic risk	Moderate to heavy icing: economic and safety risk
18 945	41 079	11 478	20 025	22 083	8 003
Total 69 000			Total 45 000 – 50 000		

Reference: Chapter 7 Cold climate turbines in *"Navigant Research, BTM World Market Update 2012"*

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Secret guest

The future of Vattenfall’s cold climate research

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Questions!

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Recommended Practices Wind Energy Projects in Cold Climate, IEA Task 19

Laakso, T., Baring-Gould, I., Durstewitz, M., Horbaty, R., Lacroix, A., Peltola, E., Ronsten, G., Tallhaug, L., Wallenius, T: *State-of-the-art Wind Energy in Cold Climate, 2011, IEA Task 19*

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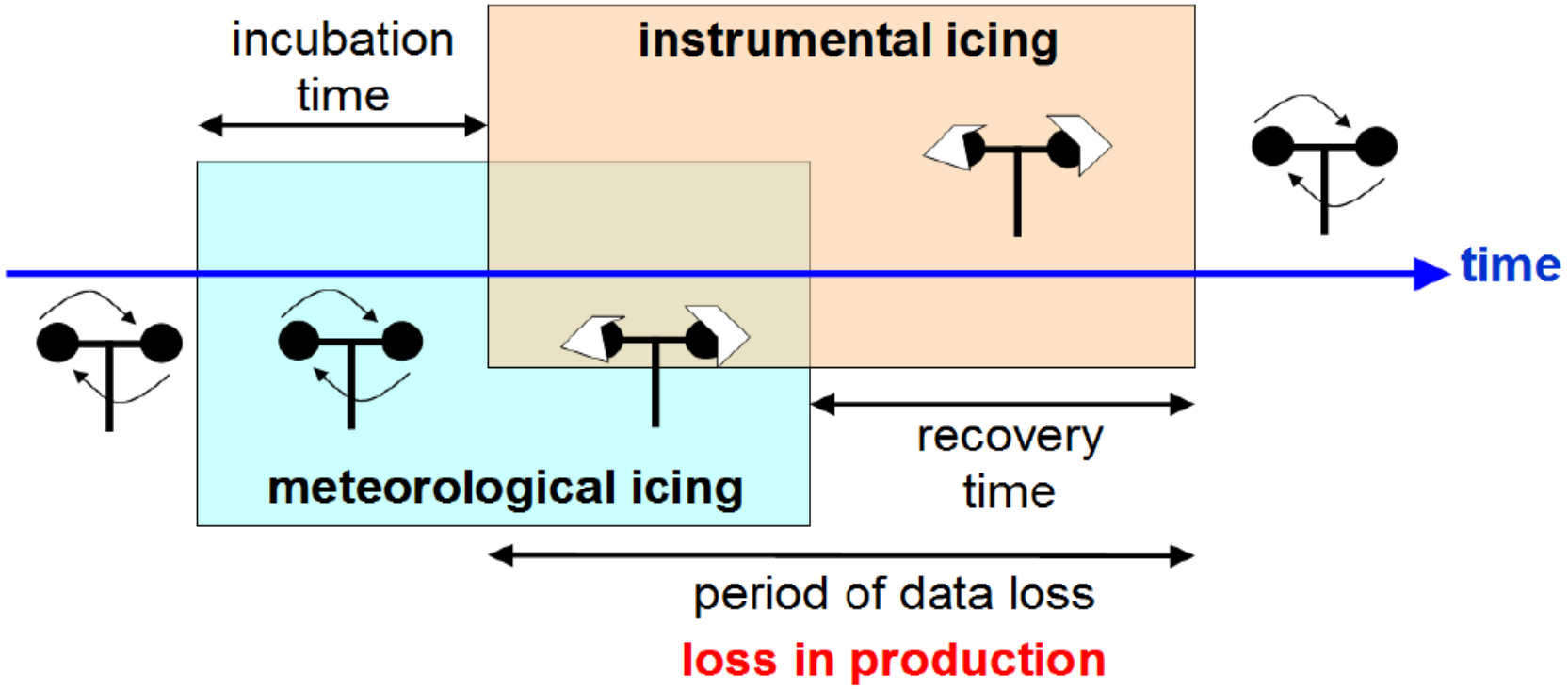
Icing climatology – a question of definition



Case studies – Rivière au Renard (RaR)

Location	Rivière-au-Renard, Quebec, Canada
Elevation	340 m a s l
Turbine type	Repower MM92 CCV 2.05 MW
Hub height	80 m a g l
Blade heating	No

Year	Meteorological icing [% of time during one year]	Instrumental icing [% of time during one year]	Production loss [% of yearly production]
2011-2012	2.2 %	4.0 %	1.5 %
2012-2013	4.7 %	10.3 %	5.0 %
Average	**3.5 %**	**7.2 %**	**3.2 %**

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Case studies – St Brais (SB)

Location	St-Brais, Switzerland
Elevation	1060 m a s l
Turbine type	Enercon E-82 2MW
Hub height	78 m a g l
Blade heating	Yes

Year	Meteorological icing [% of time during one year]	Instrumental icing [% of time during one year]	Production loss [% of yearly production]
2010	3.1 %	11.7 %	2.5 %
2011	1.8 %	5.8 %	0.5 %
2012	3.0 %	9.7 %	2.1 %
Average	**2.6%**	**9.1 %**	**1.7 %**

Case studies –Grossglockner (G)

Location	Grossglockner, Austria
Elevation	2600 m a s l
Measurement height	15 m a g l

Year	Meteorological icing [days (% of period)]	Instrumental icing [days (% of period)]	Unheated / heated anemometer (Δ > 2 m/s) [days (% of period)]	Meteorological icing events [-]
January 2011	2.1 days (6.8 %)	18.6 days (60.0 %)	22.5 days (72.6 %)	14
March 2011	1.5 days (4.8 %)	12.3 days (39.7 %)	20.5 days (66.1 %)	7

Summary case studies

Site	Ratio instrumental / meteorological
RaR	2.1
SB	3.5
G	10.4
SRL	2.4

SRL case study

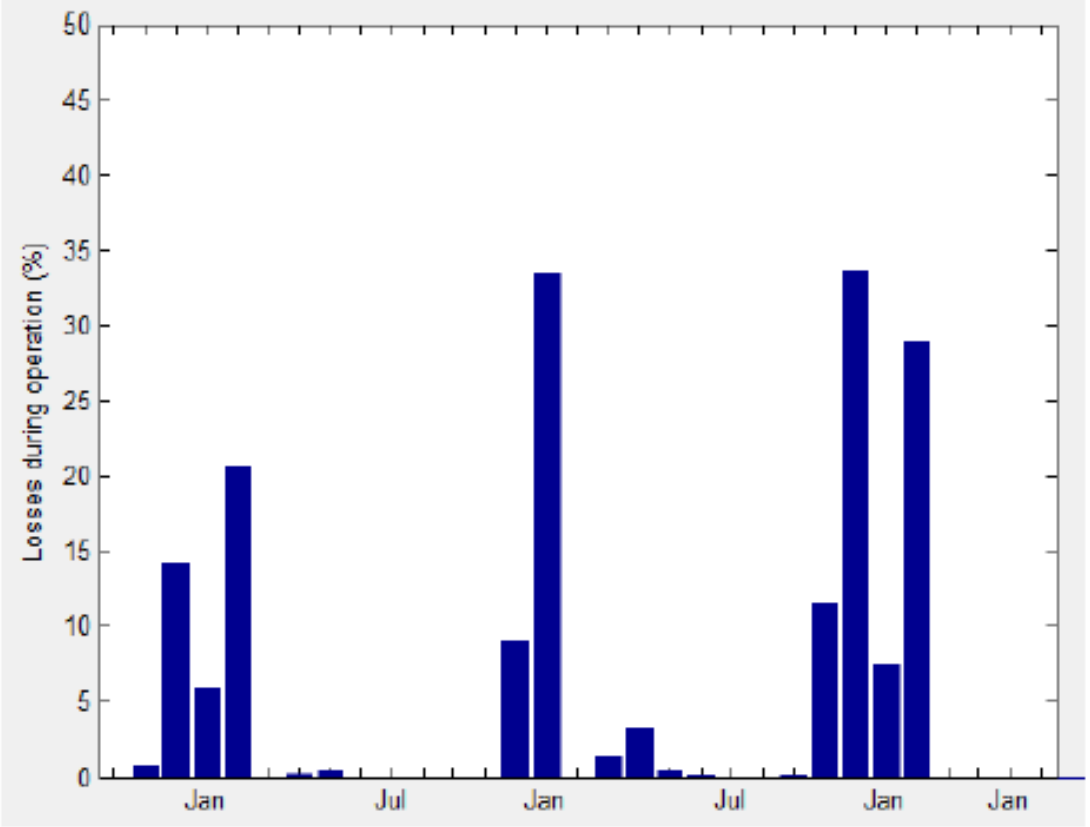

Fig. 22: Losses per month for C11

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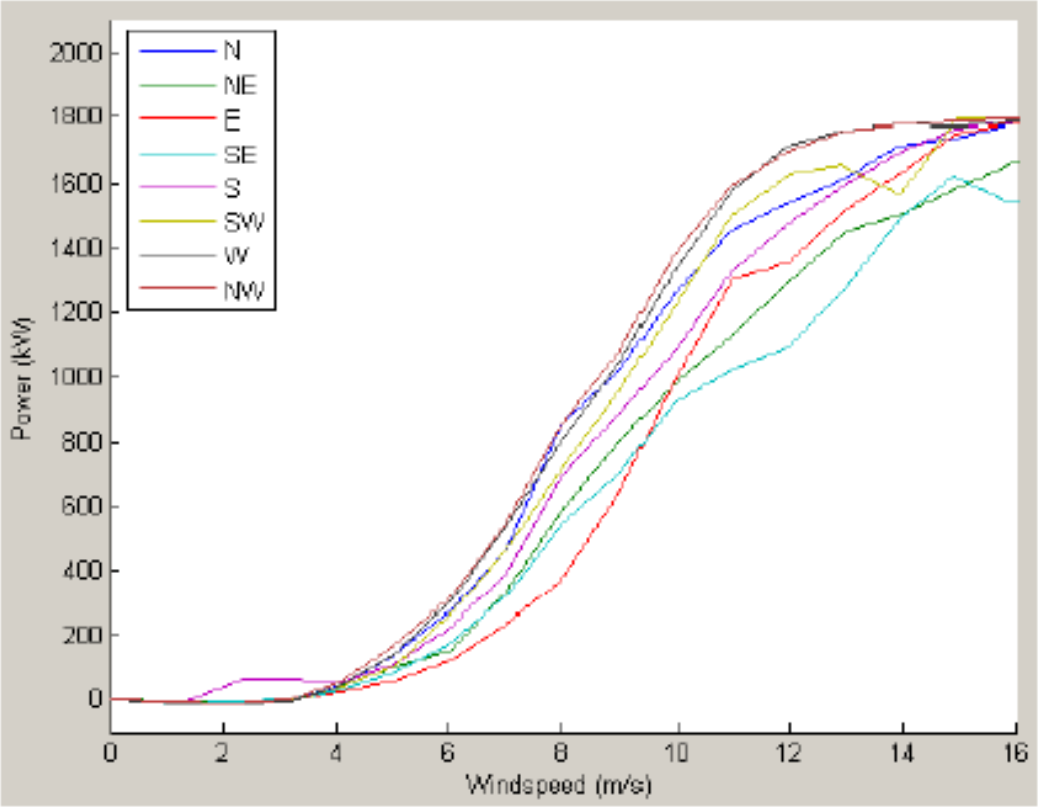
SRL case study



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