THE APPLICATIONS OF ICE THROW MODELLING TO RISK ASSESSMENT AND PLANNING IN COLD CLIMATES

DR GAIL HUTTON CSTAT CSCI
SENIOR STATISTICAL ANALYST, RES GROUP

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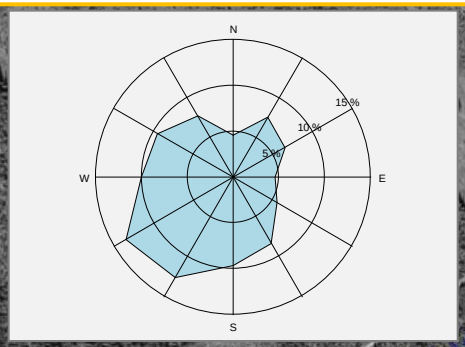
INTRODUCTION

- If ice is released when turbine blades are in motion then ice is thrown
- For purposes of risk assessment RES has been developing a physical/statistical model of ice throw trajectories
- This takes into account
  - a physical model of the trajectory of an ice fragment
  - Stochastic/statistical models of wind characteristics on-site
  - Turbine characteristics
  - Hub height
- Used to produce a risk density map
- This could have implications for
  - Public safety
  - Planning/Layout
  - Infrastructure

APPLICATIONS TO RES SITES – SO FAR

- Site 1
  - Assessment of the risk of ice strike to a public road
  - Assessment of the engineering requirements of the roof of a viewing tower located on-site close to a small turbine
- Site 2
  - Assessment of the risk of ice strike to overhead power lines
- Site 3 - Havsnäs
  - Assessment of the risk of ice strike on snowmobile tracks

SITE 1- ICE STRIKE ON A PUBLIC ROAD



Pr(Ice strikes road|Ice is thrown)
= 3.74E-4

1.5(D+H)=292.5 m
Max. throw from simulation ≈ 220 m

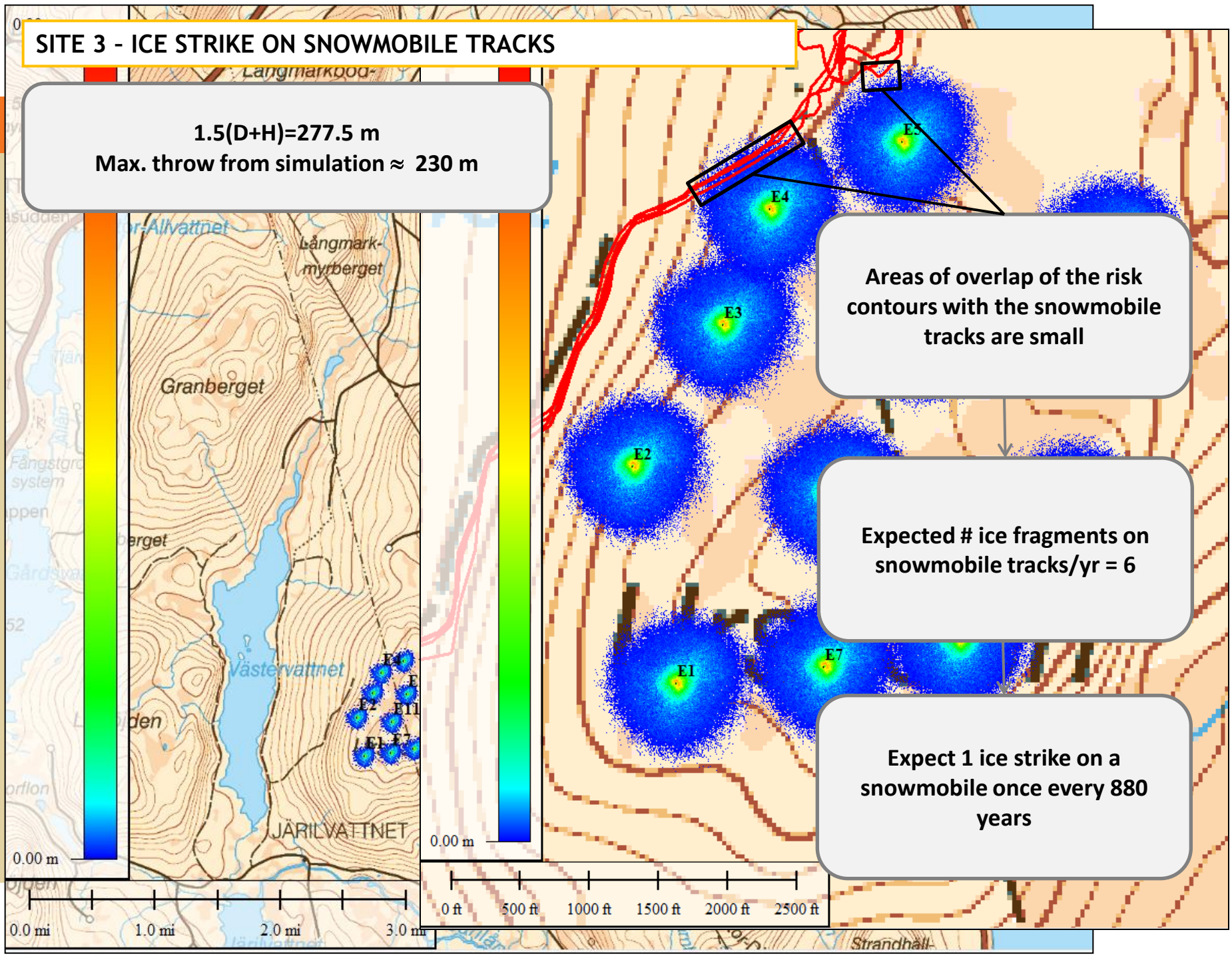
Expected strikes on road per year ≈ 2

Expected # strikes on transport/year
= 4.2E-4

1 strike on a passing vehicle per
2,400 years

SITE 3 - ICE STRIKE ON SNOWMOBILE TRACKS

1.5(D+H)=277.5 m
Max. throw from simulation ≈ 230 m



Areas of overlap of the risk contours with the snowmobile tracks are small

Expected # ice fragments on snowmobile tracks/yr = 6

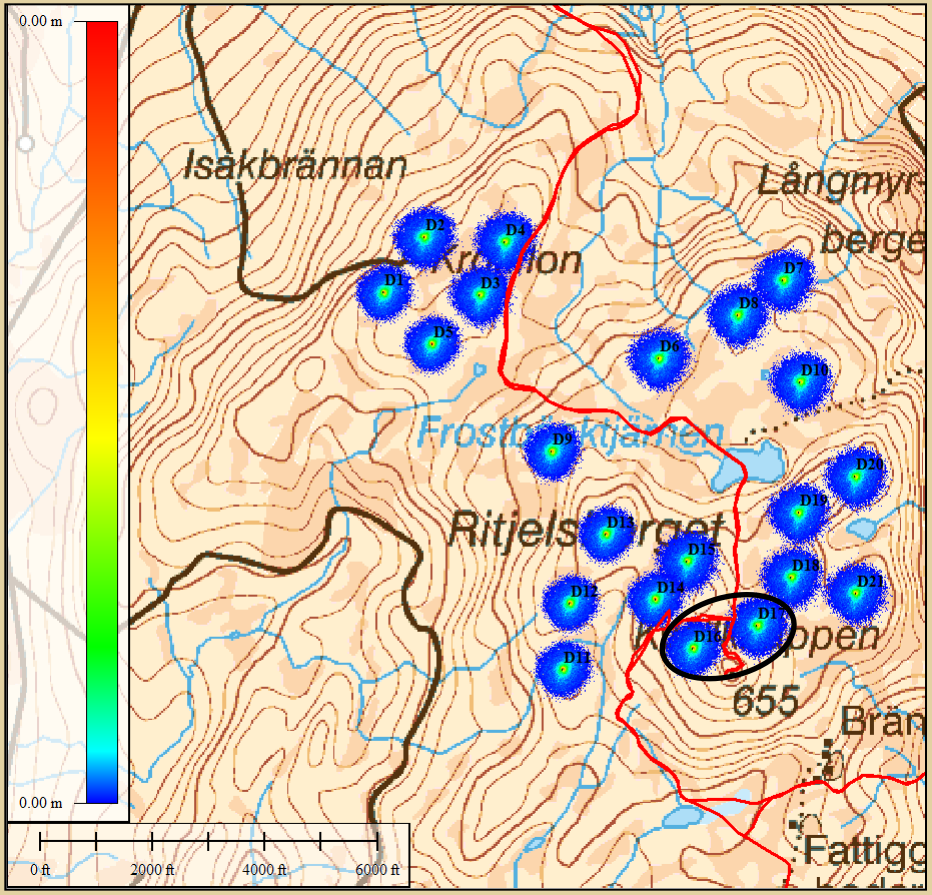
Expect 1 ice strike on a snowmobile once every 880 years

VALIDATION OF ICE THROW MODEL

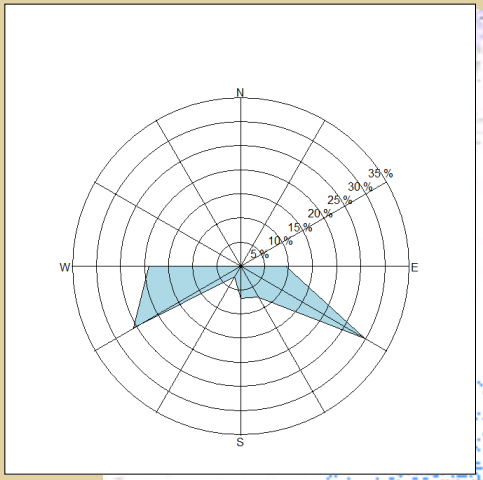
- Observations of ice throw and locations of impact made at two turbines on a Swedish site in December 2012/January 2013

  – Does the ice land in the positions predicted by the model?

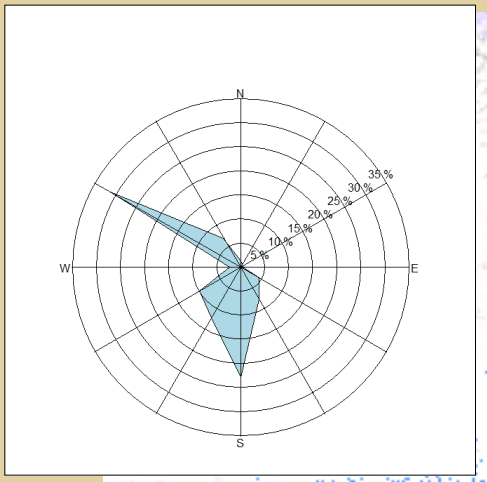
  – How does observed maximum throw distance compare to modelled throw distance?

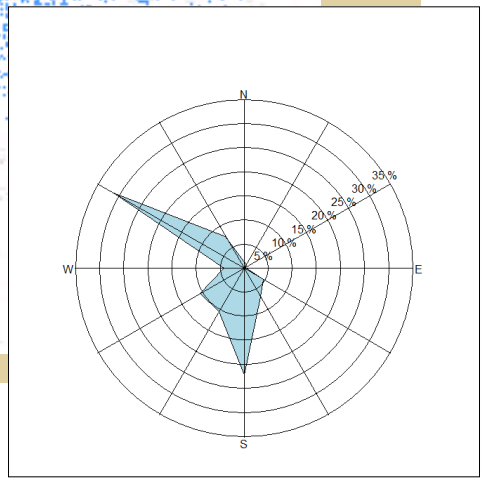


DAY 1 – 27TH DECEMBER 2012



DAY 2 – 8TH JANUARY 2013





3. Validation

CONCLUSIONS

- Development of the ice throw simulation model allows us to quantify risk
  - And address public safety/infrastructure/planning issues with more confidence
- Estimates of public safety risk are very small
- By comparison with the 1.5(D+H) rule of thumb for planning the RES ice throw model gives shorter throw distances
- Model validation by on-site observation gives promising results
  - Will continue to monitor ice throw this Winter

ACKNOWLEDGEMENTS

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ANY QUESTIONS?


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