



Monitoring and forecasting ice loads on a 420 kV transmission line in extreme climatic conditions

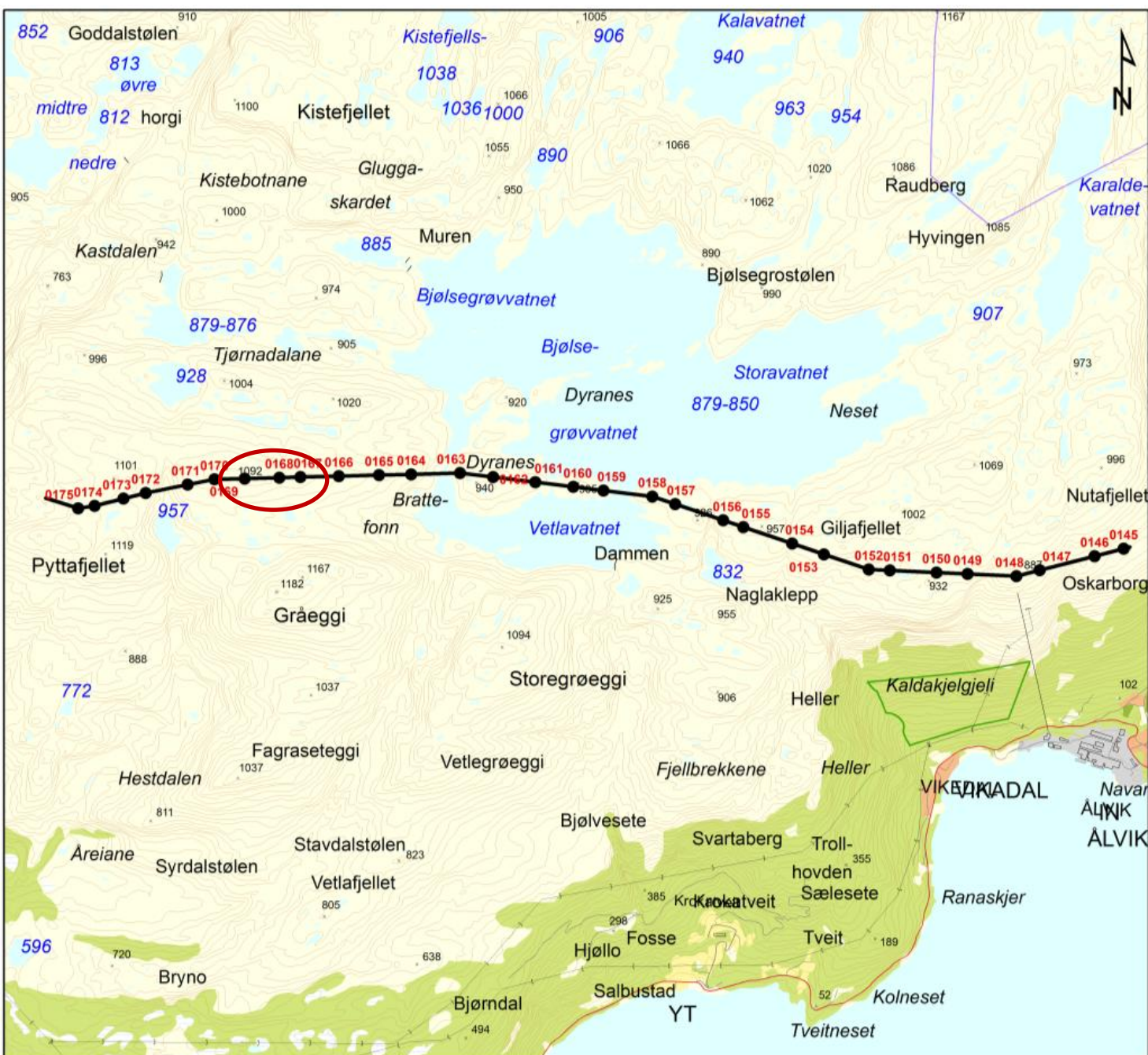
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¹Kjeller Vindteknikk AS

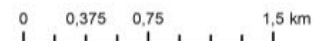
²Statnett SF



Ålvikfjellet, 420 kV Sima-Samnanger, January 2014
photo: Ole Gustav Berg, Statnett



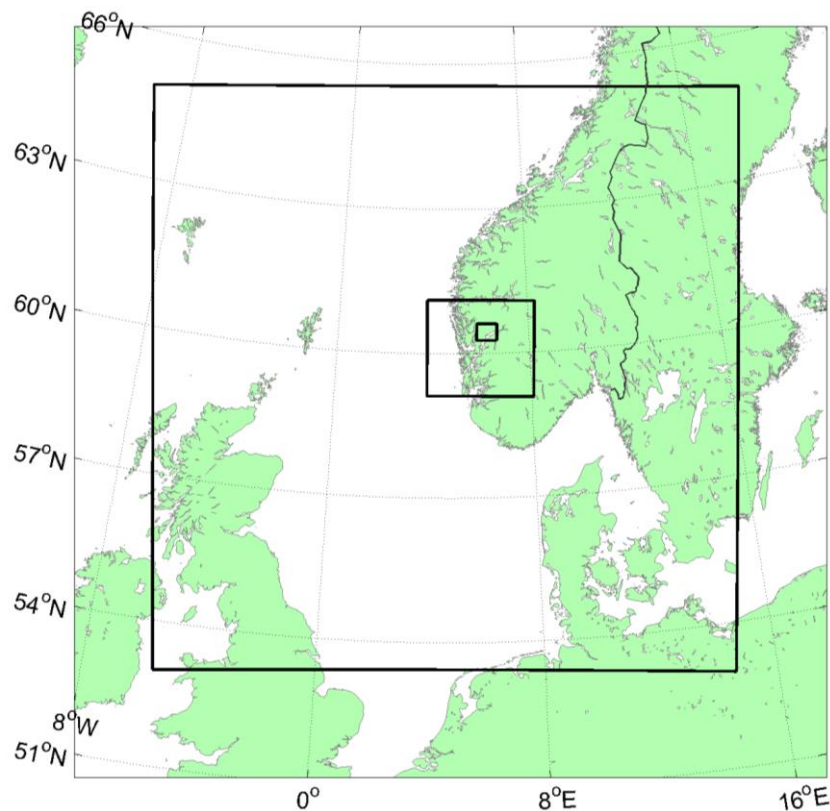
Sima-Samnanger			
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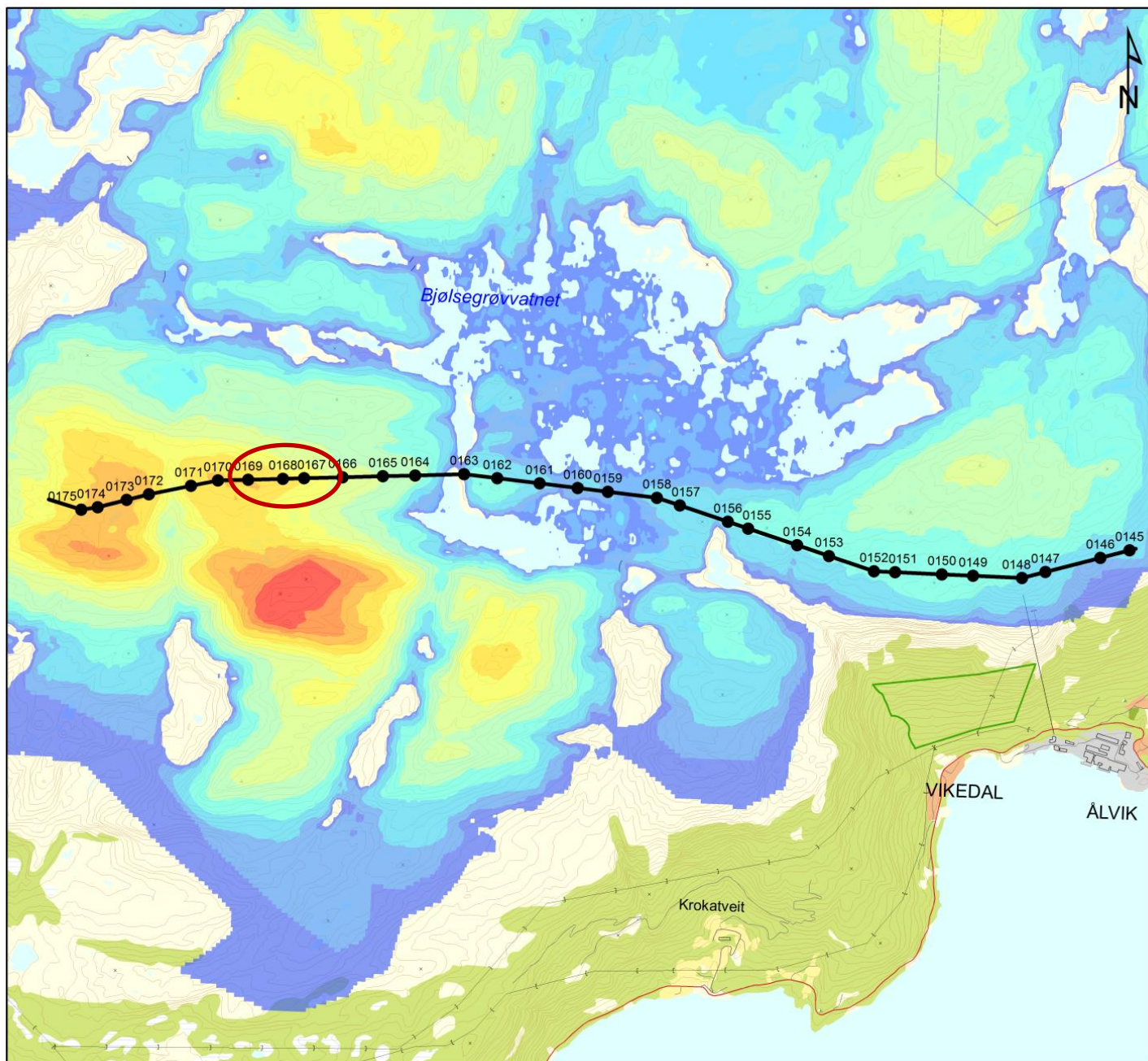
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New methods to estimate ice loads

- Meso scale model simulations:
 - Case study carried out with 500m resolution
 - Long term hindcast simulation with 6km resolution (1979-2014)
 - Weather Research and Forecasting model (WRF)



Simulated maximum ice load Dec 2013-Jan 2014



Sima-Samnanger

Figure/Drawing Title:
Islast 2013 - detalj

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0 0,375 0,75 1,5 km

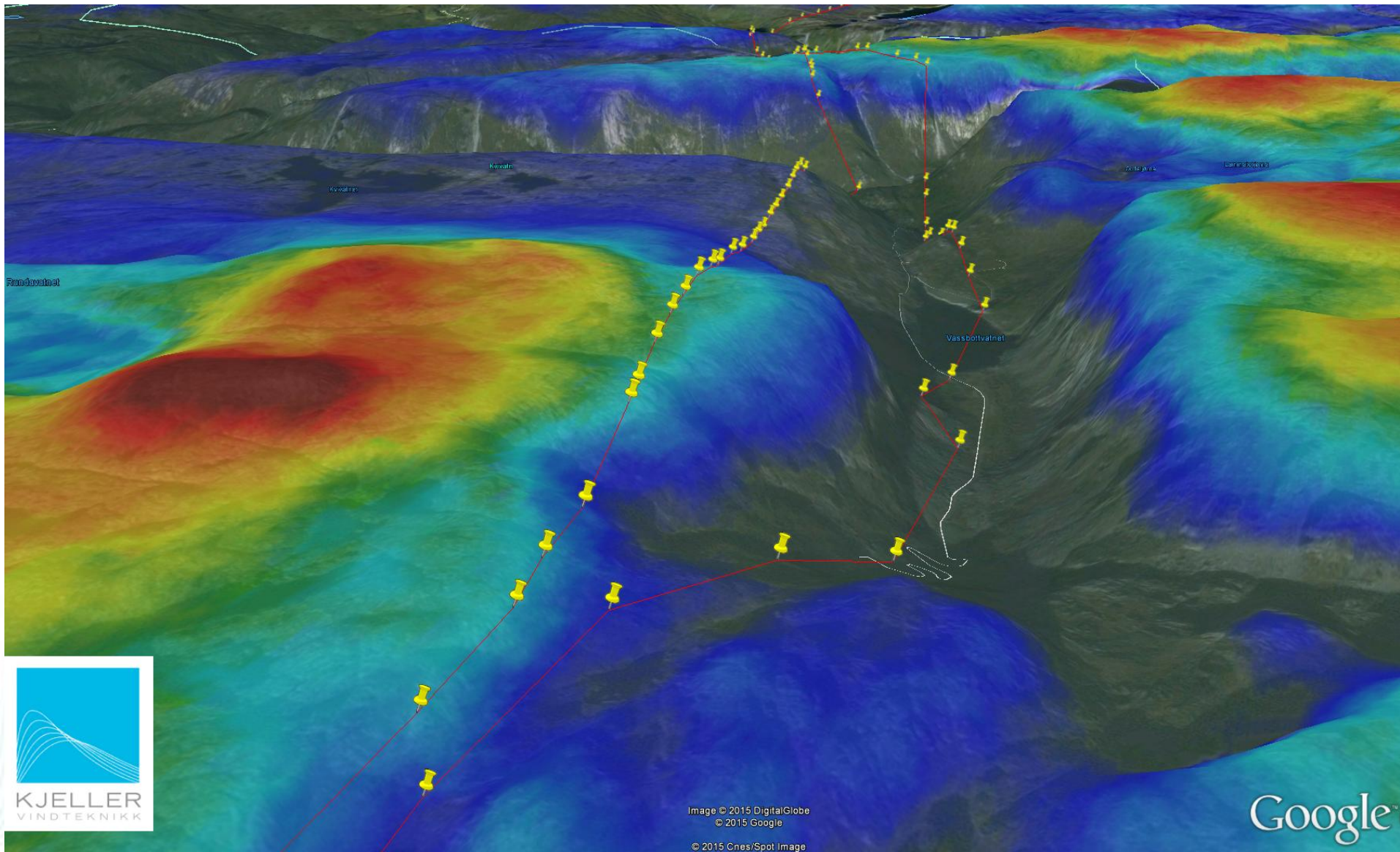
Maksimal islast [kg/m²]

0 - 0,5	20,0 - 30,0
0,5 - 1,0	30,0 - 40,0
1,0 - 2,0	40,0 - 50,0
2,0 - 5,0	50,0 - 60,0
5,0 - 10,0	60,0 - 70,0
10,0 - 20,0	> 70,0

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High resolution simulations, WRF500m



KJELLER
VINDTEKNIKK

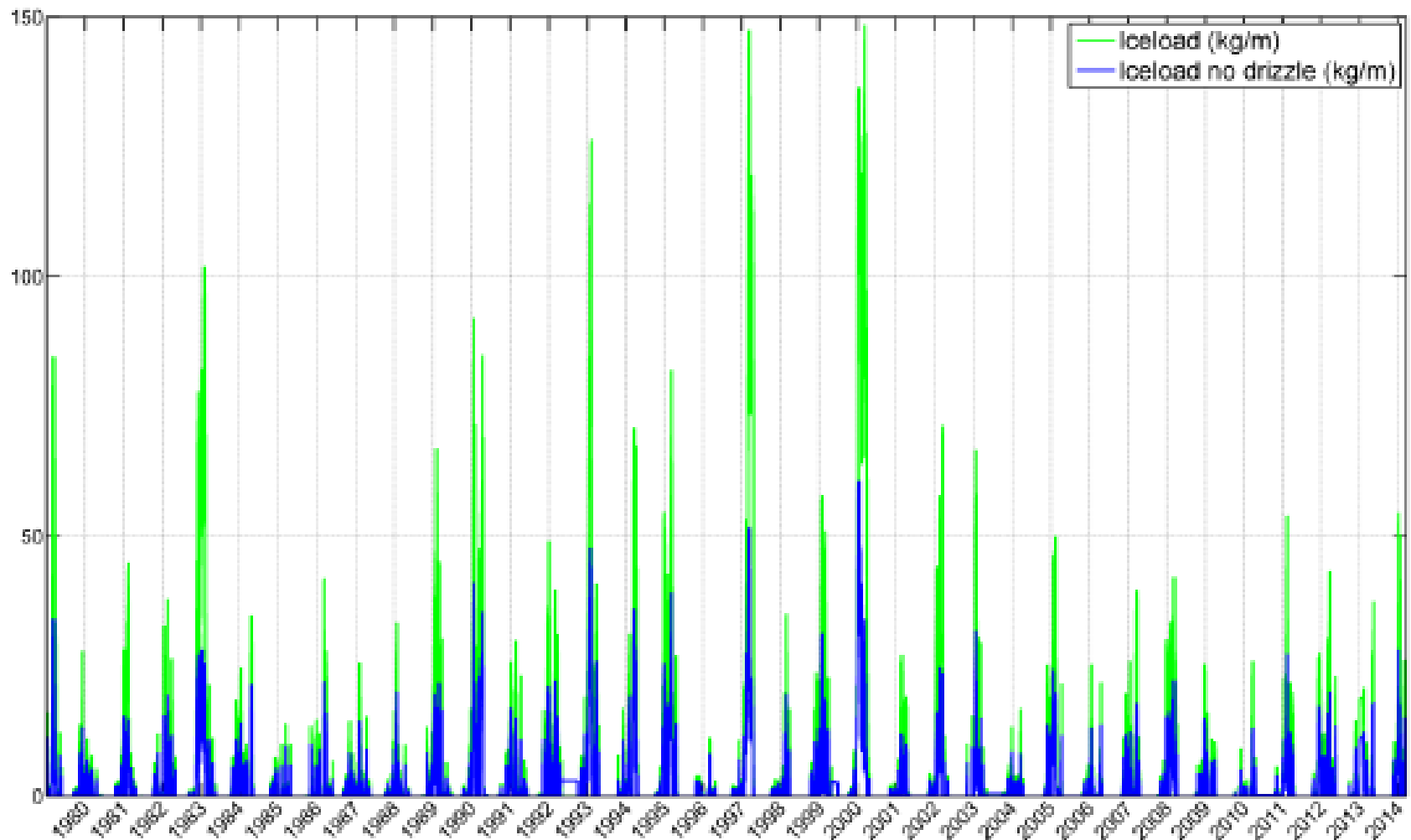
Image © 2015 DigitalGlobe
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Google

Was the collapse in 2013 an extreme event?

- Modelled ice loads 1979-2014:



Measurements, 420 kV Statnett, Hardanger

- Load tension measurements in 420 kV line
- Load tension measurements in a 80 m test span
- 2 heated webcams for monitoring
- Heated anemometer
- Temperature sensor
- Power supply (diesel)
- Real-time transmission of all data to KVT data base



Installation of test span - 2014.11.18



Installation of the test span 2014.11.18



Installation of load sensors 2014.11.18

Lastcelle N0304

Lastcelle N0305





2015.01.31



Photo: Ole Berg, Statnett

2015.01.31



Photo: Ole Berg, Statnett



Power supply - 2014.11.18

Power supply 2015.01.31



Photo: Ole Berg, Statnett

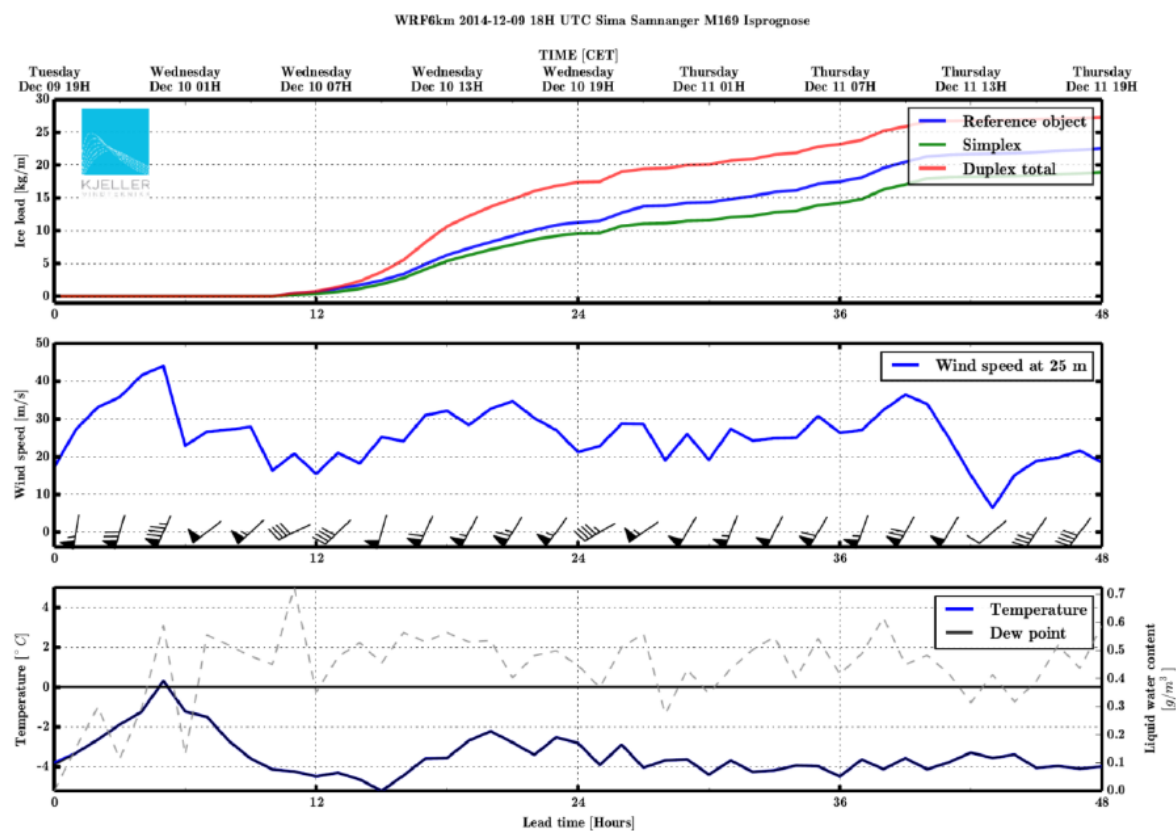


Site visit 2015.04.22



Forecasts

- 48 hour forecasts
 - Ice buildup
 - Wind speed and direction
 - Temperature, dew point
 - Liquid water content
- Forecasts delivered 4 times daily



Webcam 19.01.2015

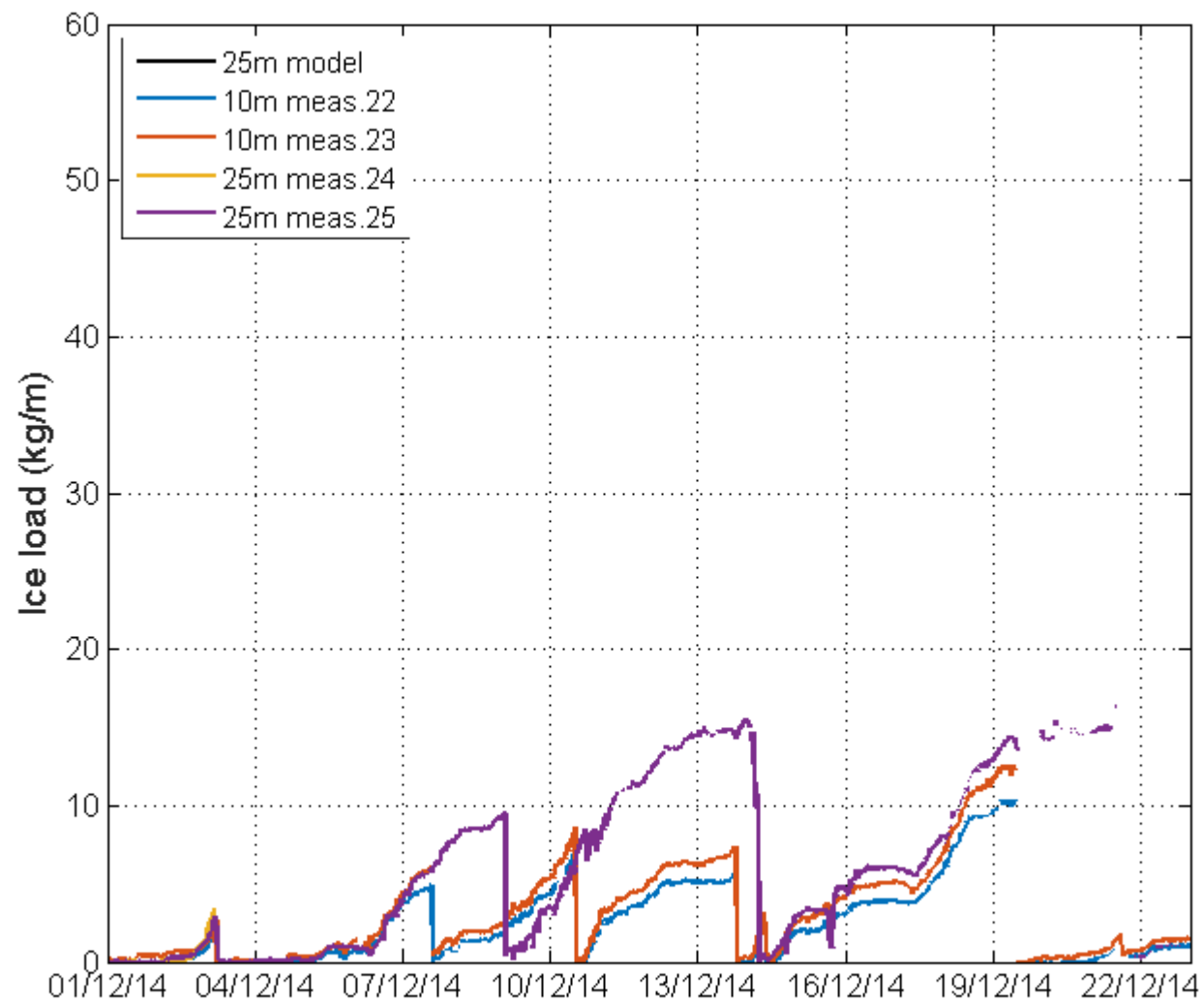


Hardanger, Feb. 2015

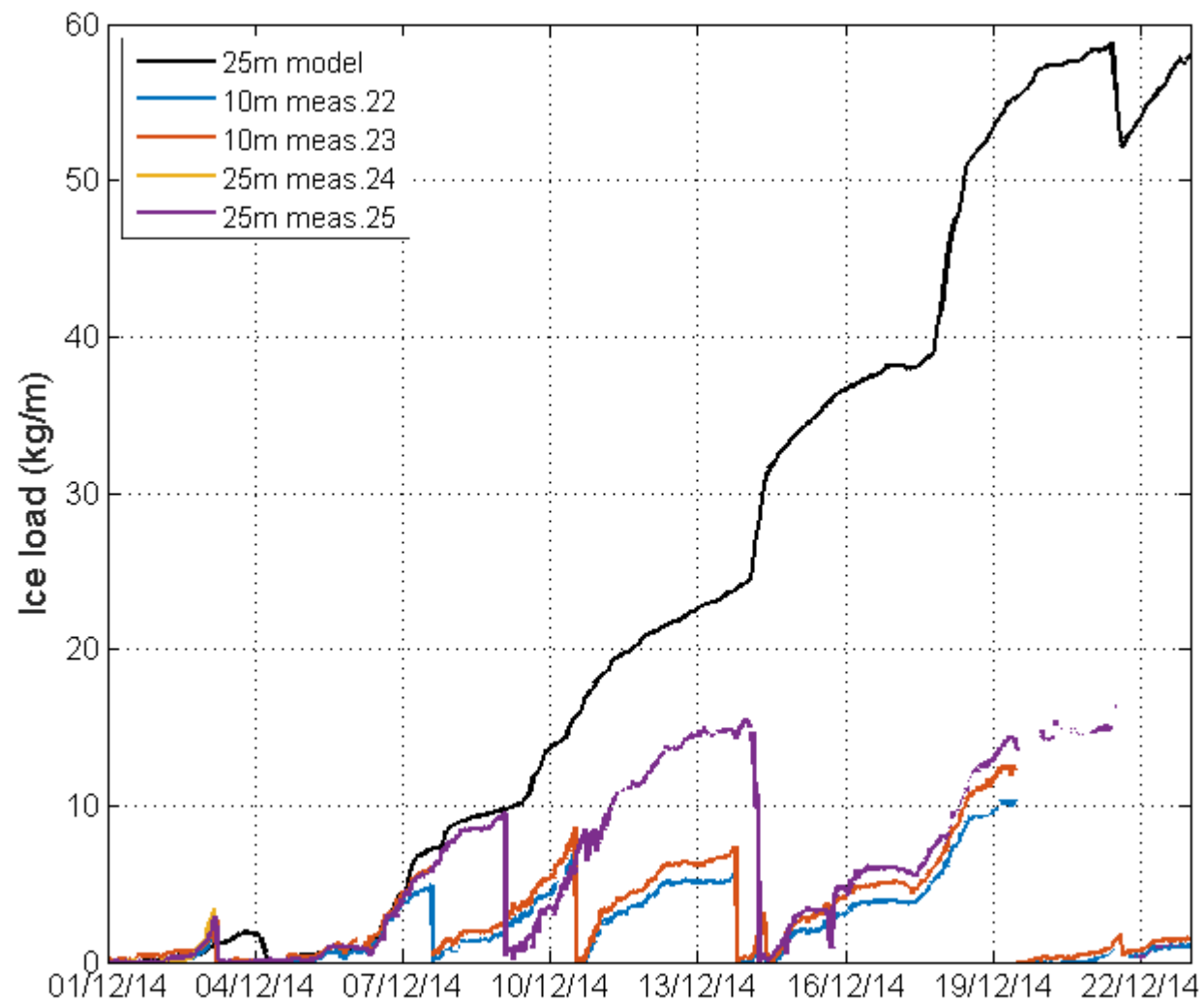


Photo: Statnett

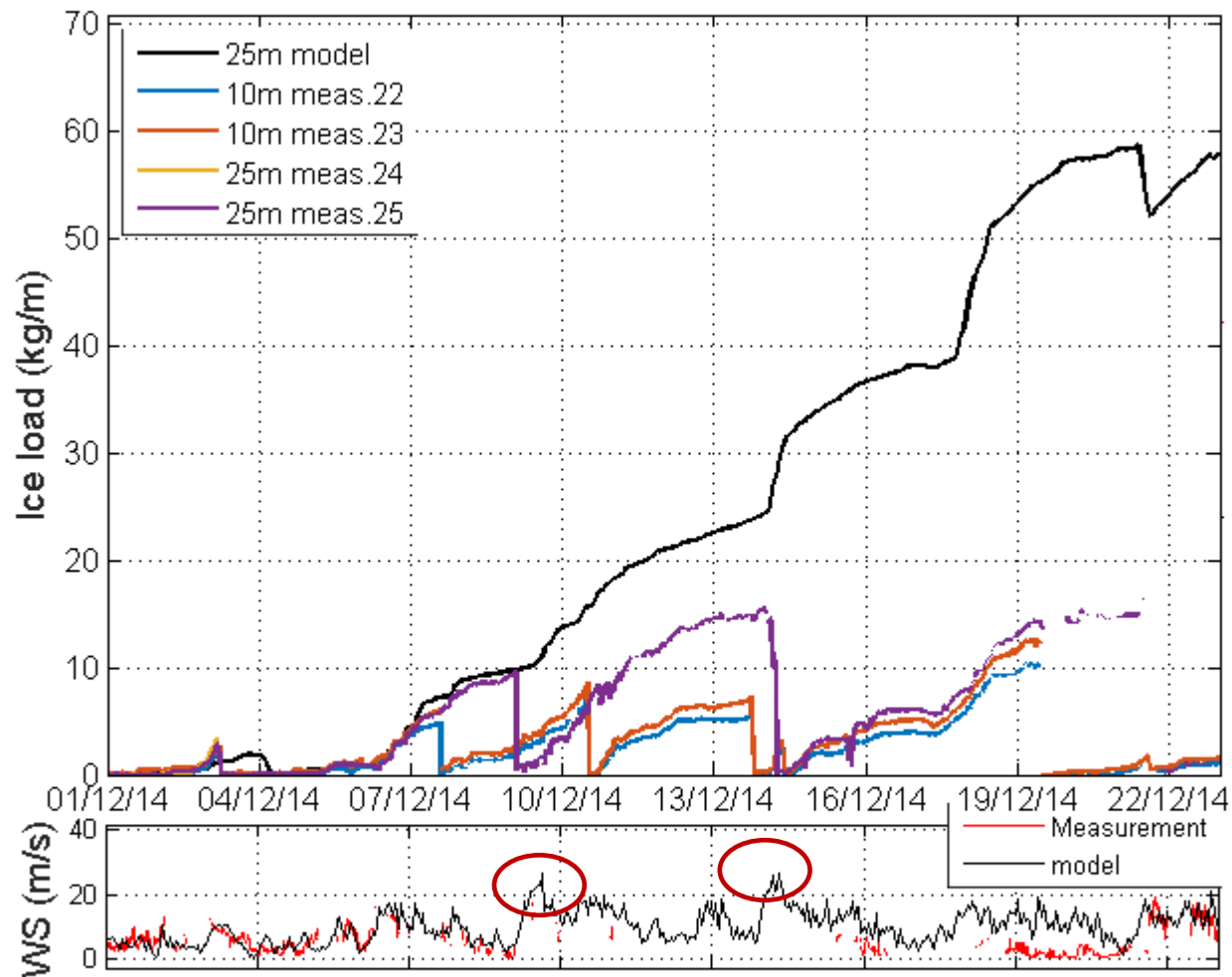
Load tension measurements



Load tension measurements

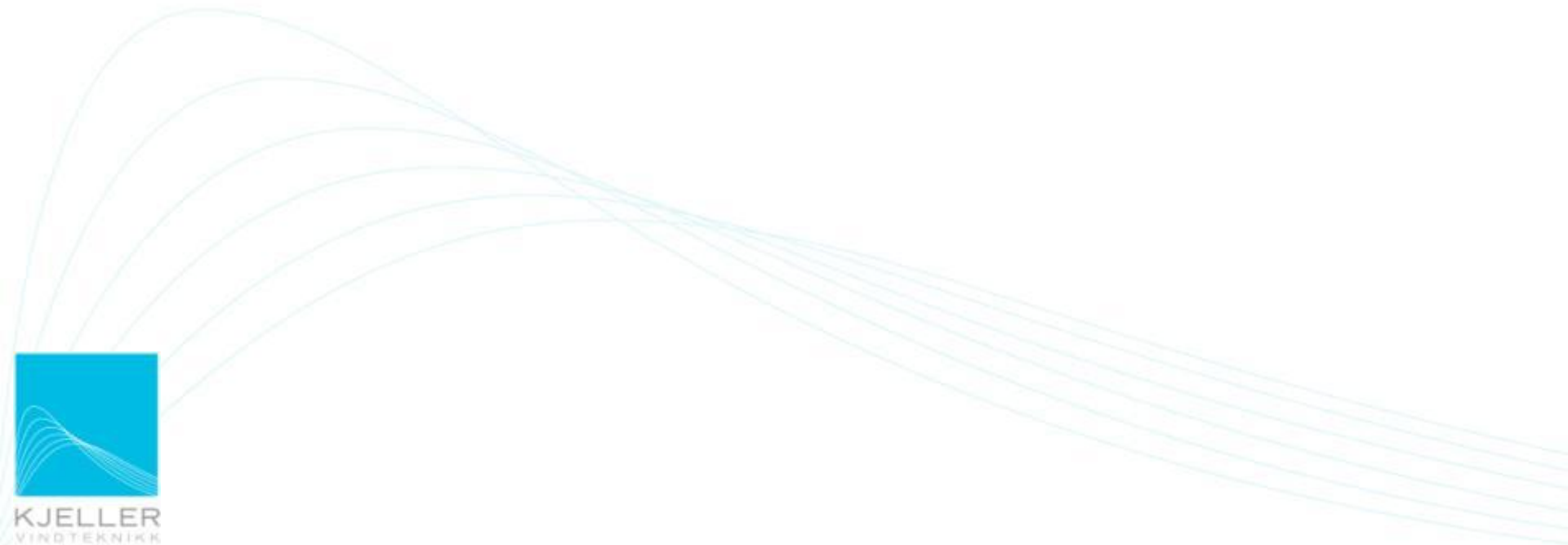


Shedding events



Summary load tension measurements

- Max ice load measured on duplex during last winter: 20kg/m
- Maximum modelled ice load during last winter: 70 kg/m
- The model has no shedding included
- Shedding events observed in relation to high wind speeds.



FRonTLINES

- R&D Project: 2015-2018
- Develop a toolbox to assess the impact from frost and rime ice on overhead transmission lines:
 - Establish a new test station
 - Laboratory experiments of ice accretion on bundle conductors
 - Develop improved models for ice accretion on bundles
 - Calculate and forecast hoar frost and related losses on power lines
- Partners:
 - Statnett
 - Kjeller Vindteknikk
 - STRI
 - VTT
 - Narvik University College
 - The Norwegian Meteorological Institute
- Financed by:
 - The Norwegian Research Council: 50%
 - Statnett : 43 %
 - KVT, STRI, VTT: 7 %



Thank you for your attention!