

Comparison of measured and simulated icing in 28 test spans during a severe icing episode



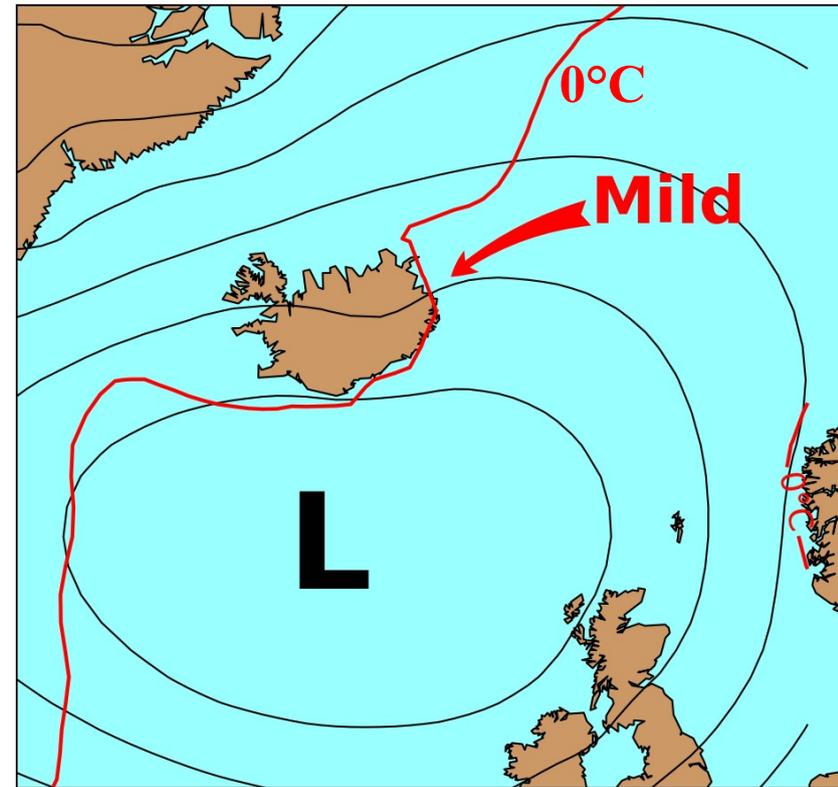
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Hálfván Ágústsson - Belgingur
Guðmundur Hannesson - EFLA
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IWAIS XIV, Uppsala, June 2015

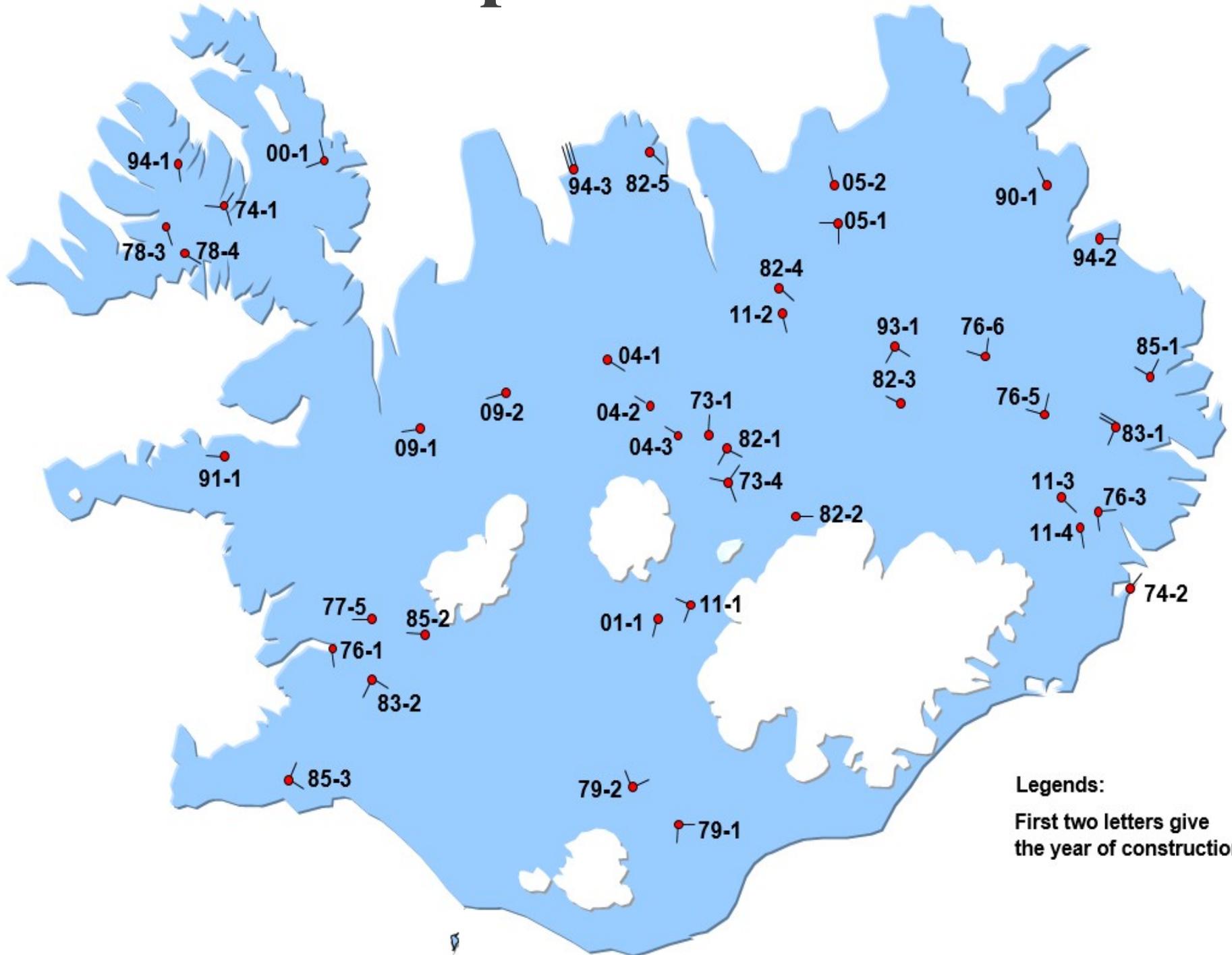


Scope of study

- Extreme in-cloud ice accretion for 99 days (23 Dec. 2013 to 2 March 2014) during an anomalous flow situation.
- Detailed and accurate measurements of ice loads in 28 test spans at 19 locations.
- Unique data and opportunity to analyze the performance of coupled ice accretion and atmospheric models.

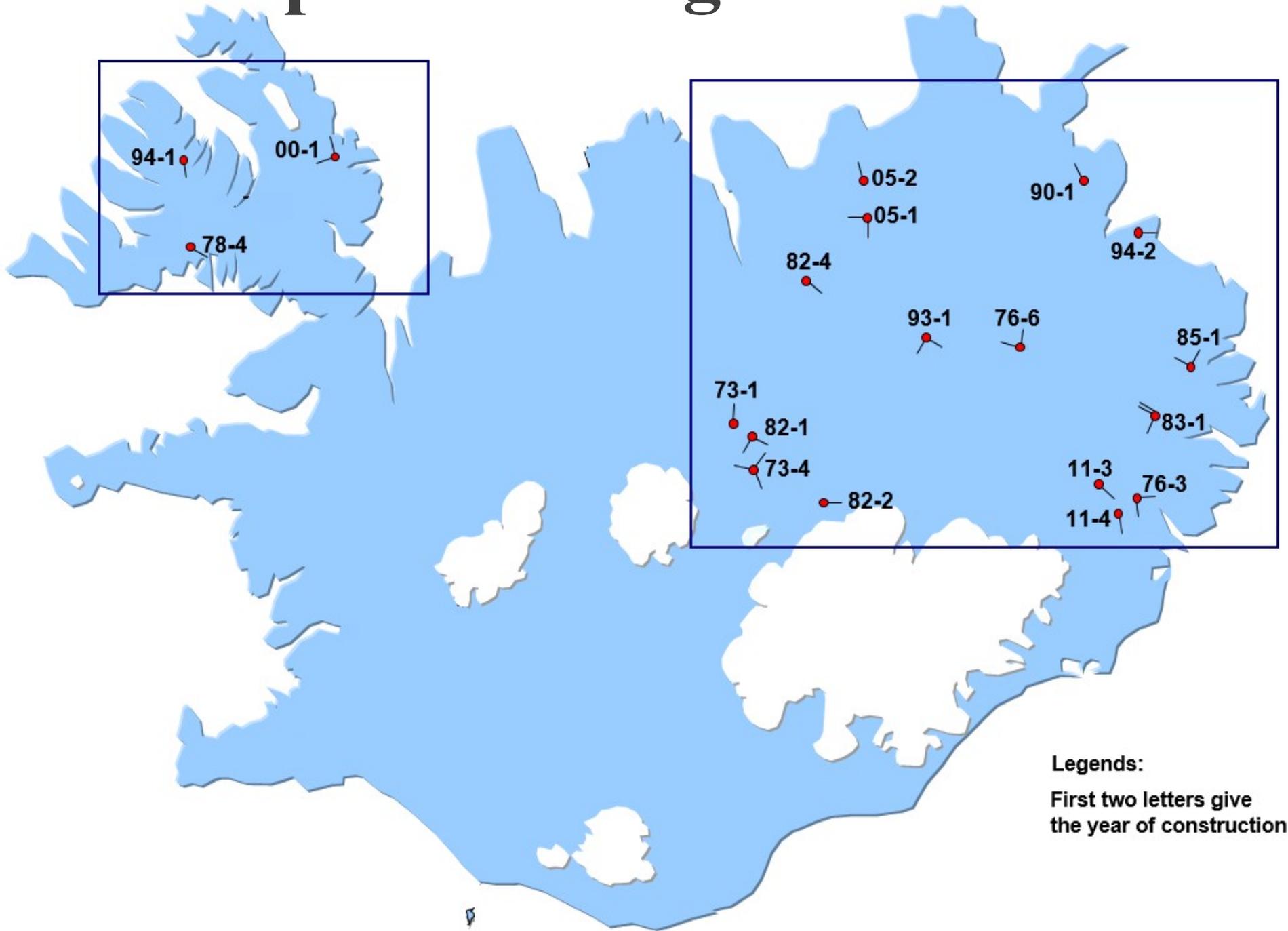


Test spans in Iceland



Legends:
First two letters give
the year of construction

Test spans and regions of interest

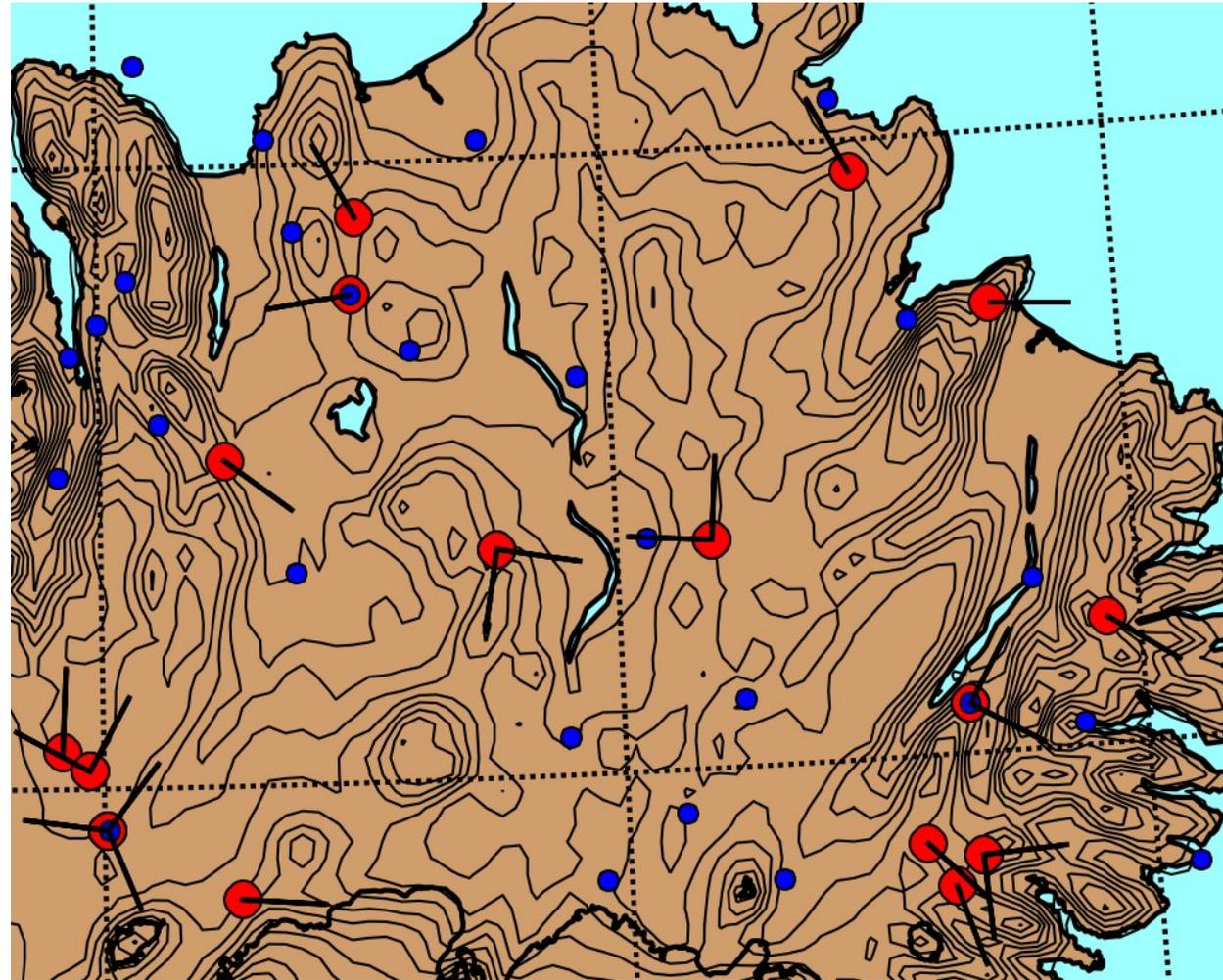
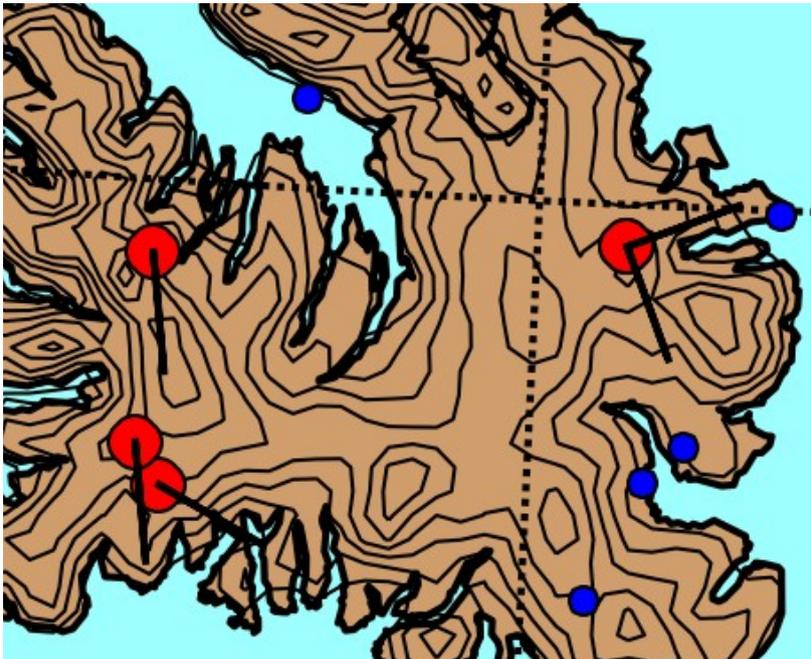


Meteorological network and orography

Weather stations
marked in blue

Test spans in red

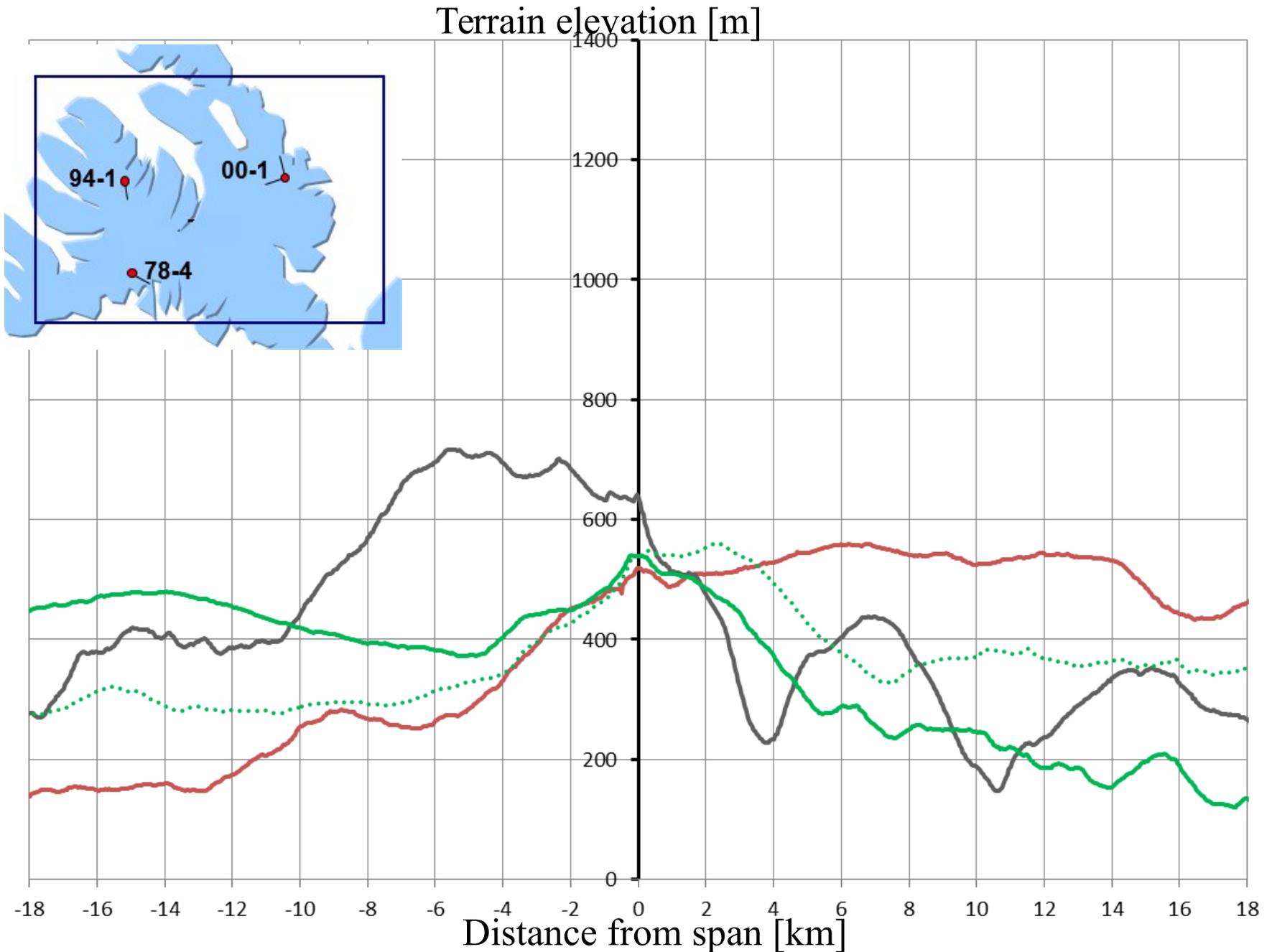
Northwest



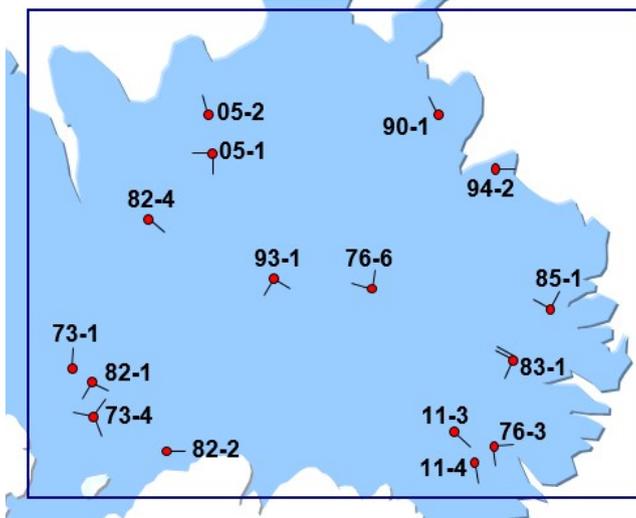
Northeast

100 metre contours

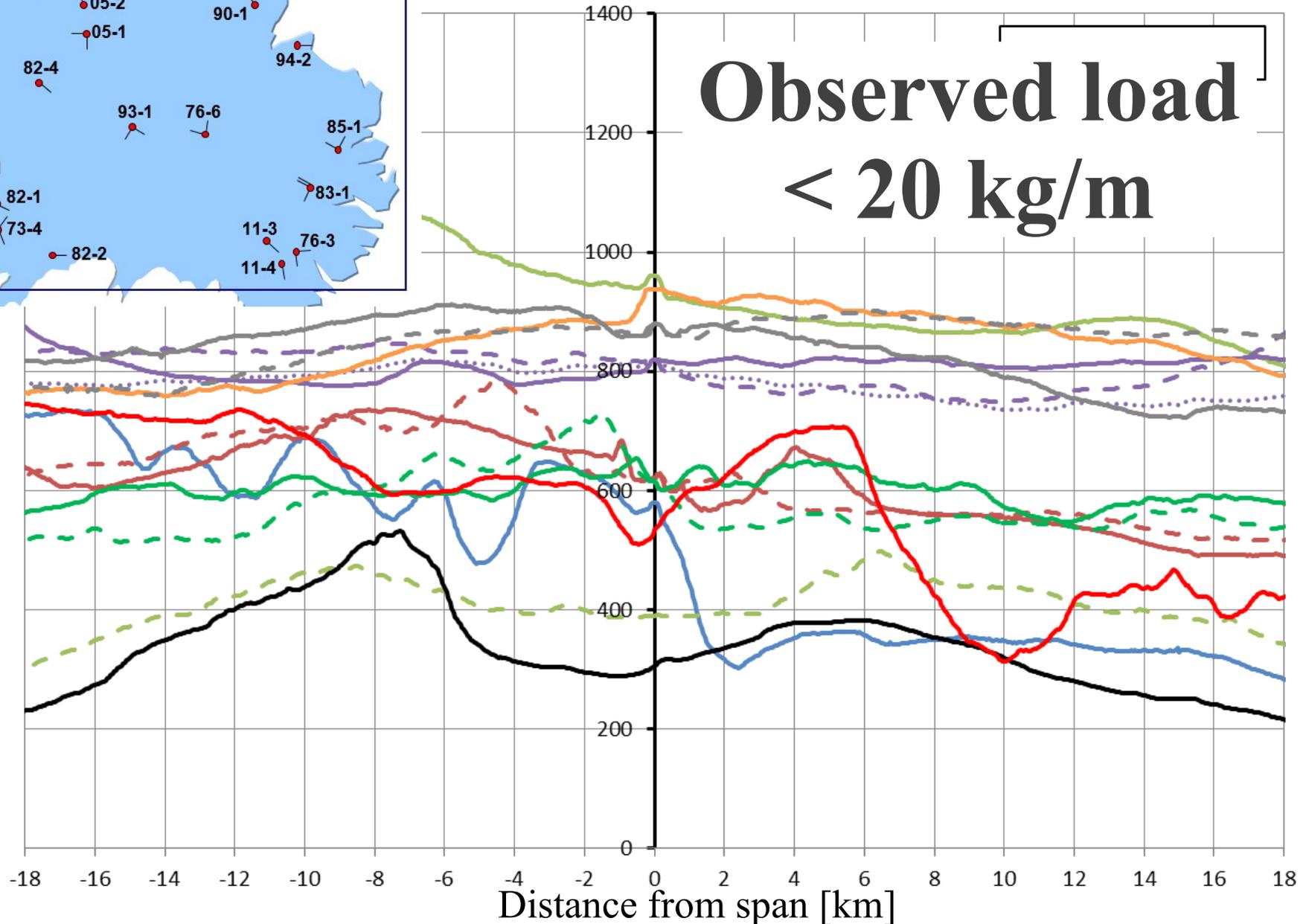
Profiles for test spans - Northwest



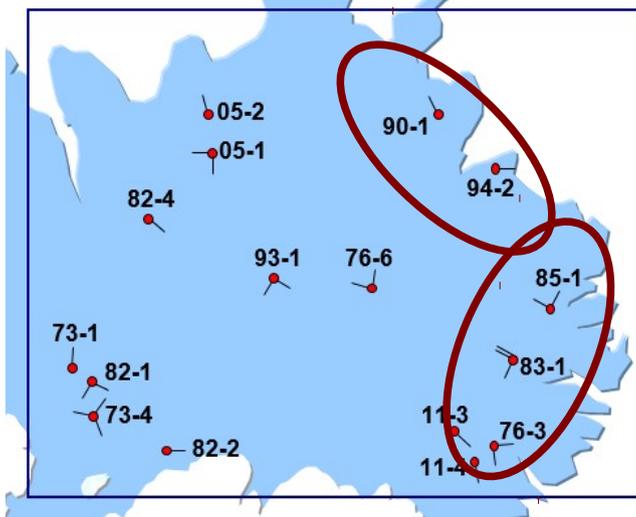
Profiles for test spans - Northeast



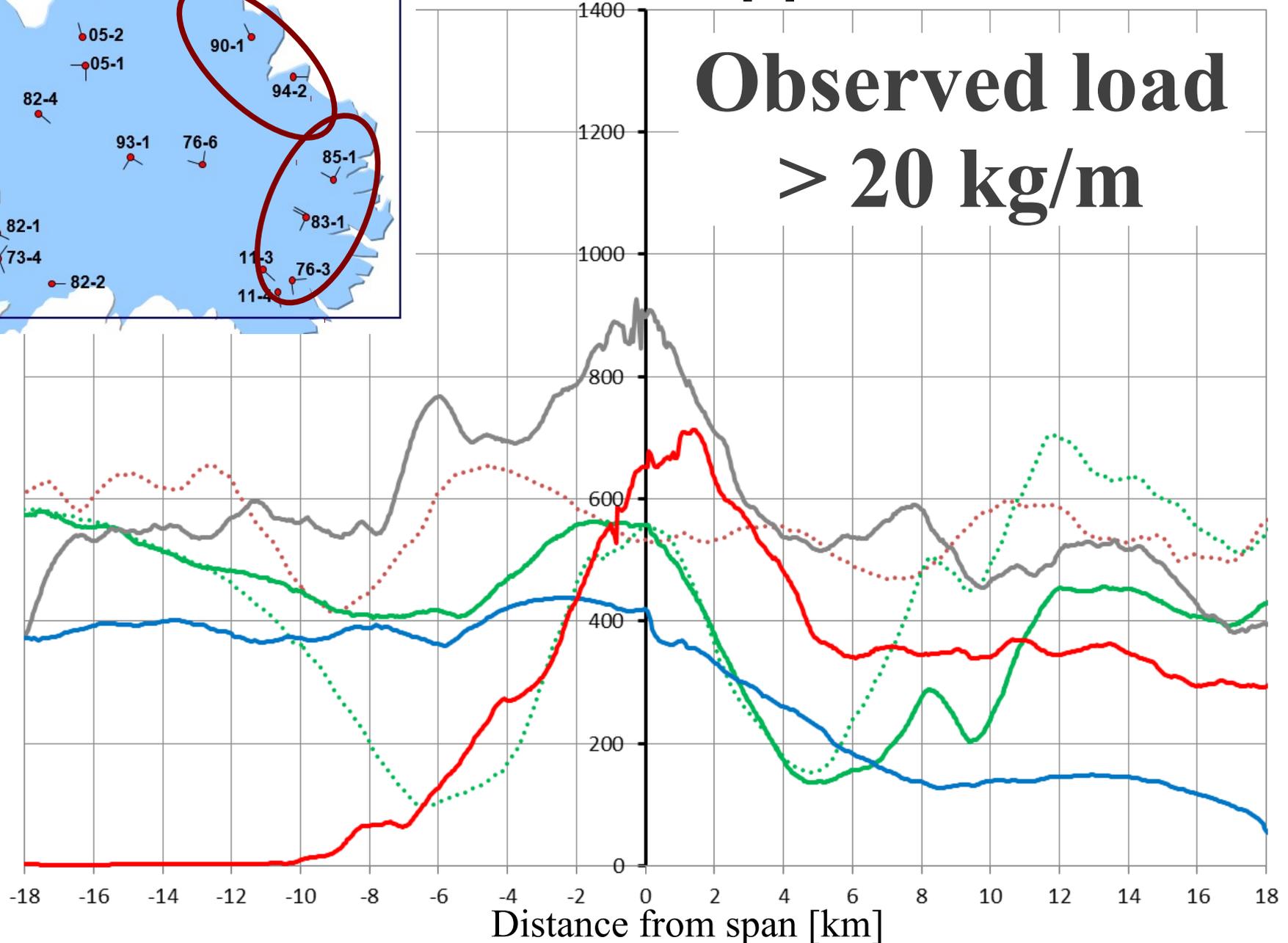
Terrain elevation [m]



Profiles for test spans - Northeast

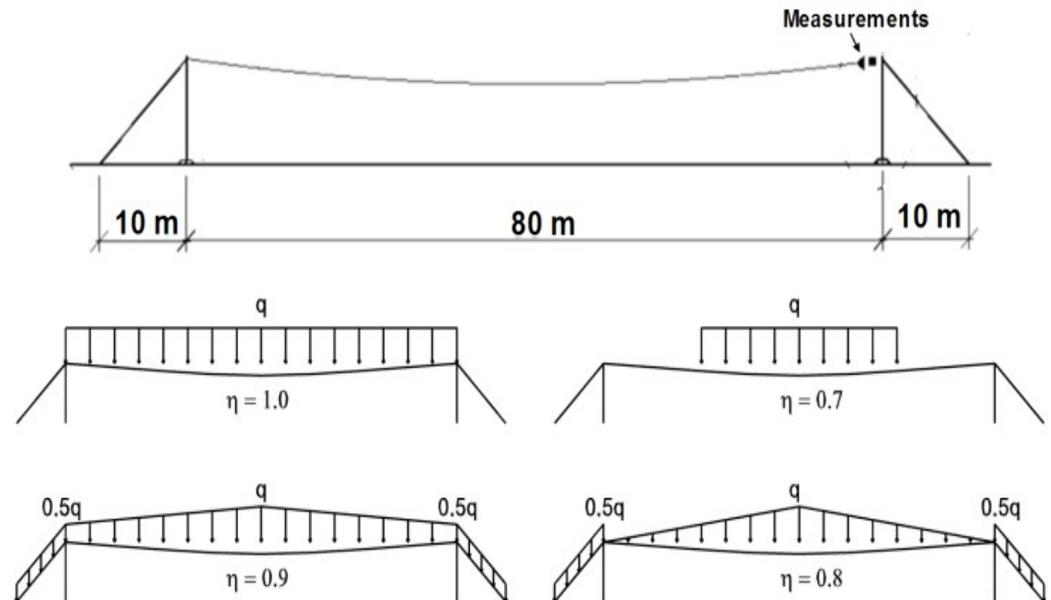
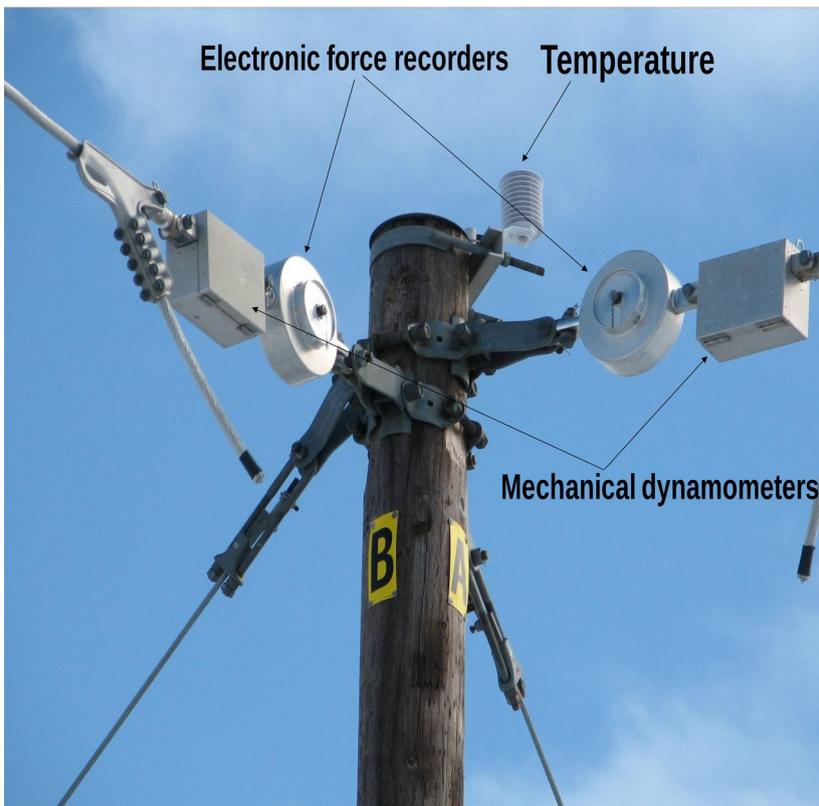


Terrain elevation [m]



Test spans - Observational uncertainty

- Ice load is calculated based on measurements of the tension load in a conductor.
- Influence of wind must be filtered from the data.
- Estimated icing depends on the load distribution.
- Calibration of load cell affects the accuracy and the max loads that can be measured.



Influence of load distribution on estimated icing





14.03.01

Atmospheric model setup

- Atmospheric data is created with the WRF-model at **1 km**.
- Initial and forcing data from the ECMWF.
- Thompson moisture physics scheme and ETA boundary layer scheme.
- Continuous simulation for 99 days, Dec. 2013 - Mar. 2014.
- Model results are interpolated upwards to correct orography elevation.



Accretion model setup

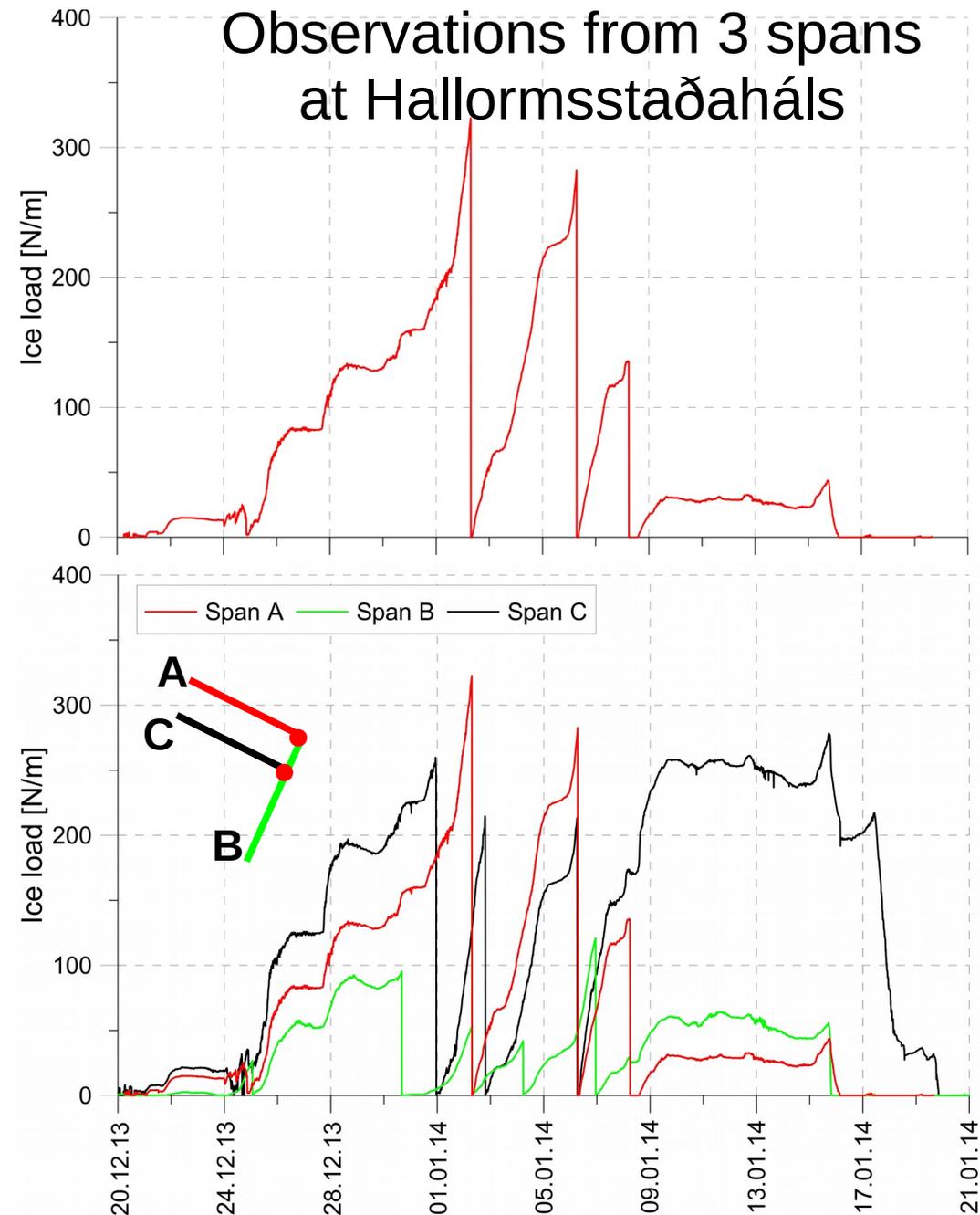
- Cylindrical icing model based on actual span direction.
- Rime (in-cloud) icing as well as freezing drizzle/rain.
- MVD based on a droplet number $N_d=50 \text{ cm}^3$.
- Ice shedding simultaneous with observations.
- Separate accounts of simulated accretion concurrent with observed icing, as well as when no accretion is observed.
- Comparison at individual spans and aggregated over spans



Broken communication transmission tower on a mountain top station.

Accretion model setup - Ice shedding

- The stochastic nature of ice shedding is hard to parameterize.
 - Melting
 - Sublimation
 - **Mechanical ice break**
- Differential ice shedding may lead to large biases in simulations.
- Accretion model is forced to shed ice simultaneously with the observations.



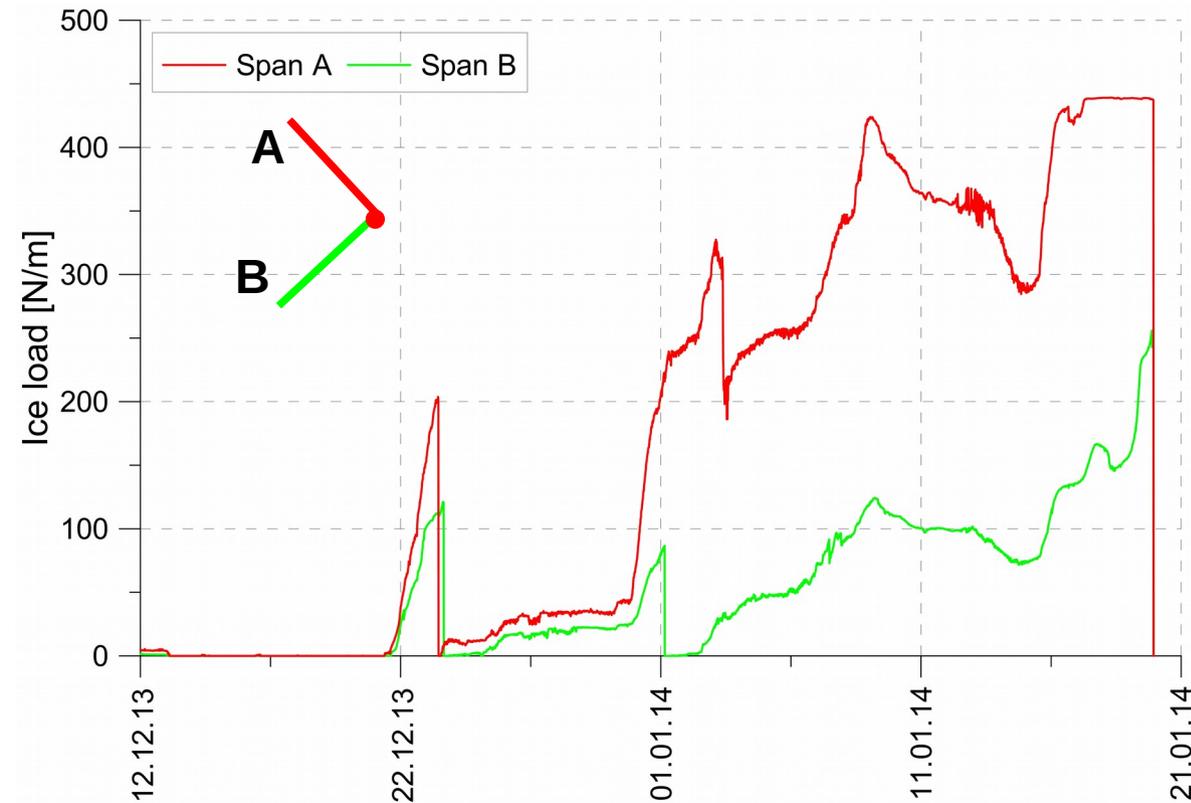
Test site 00-1

Náttmálahæðir in Northwest-Iceland

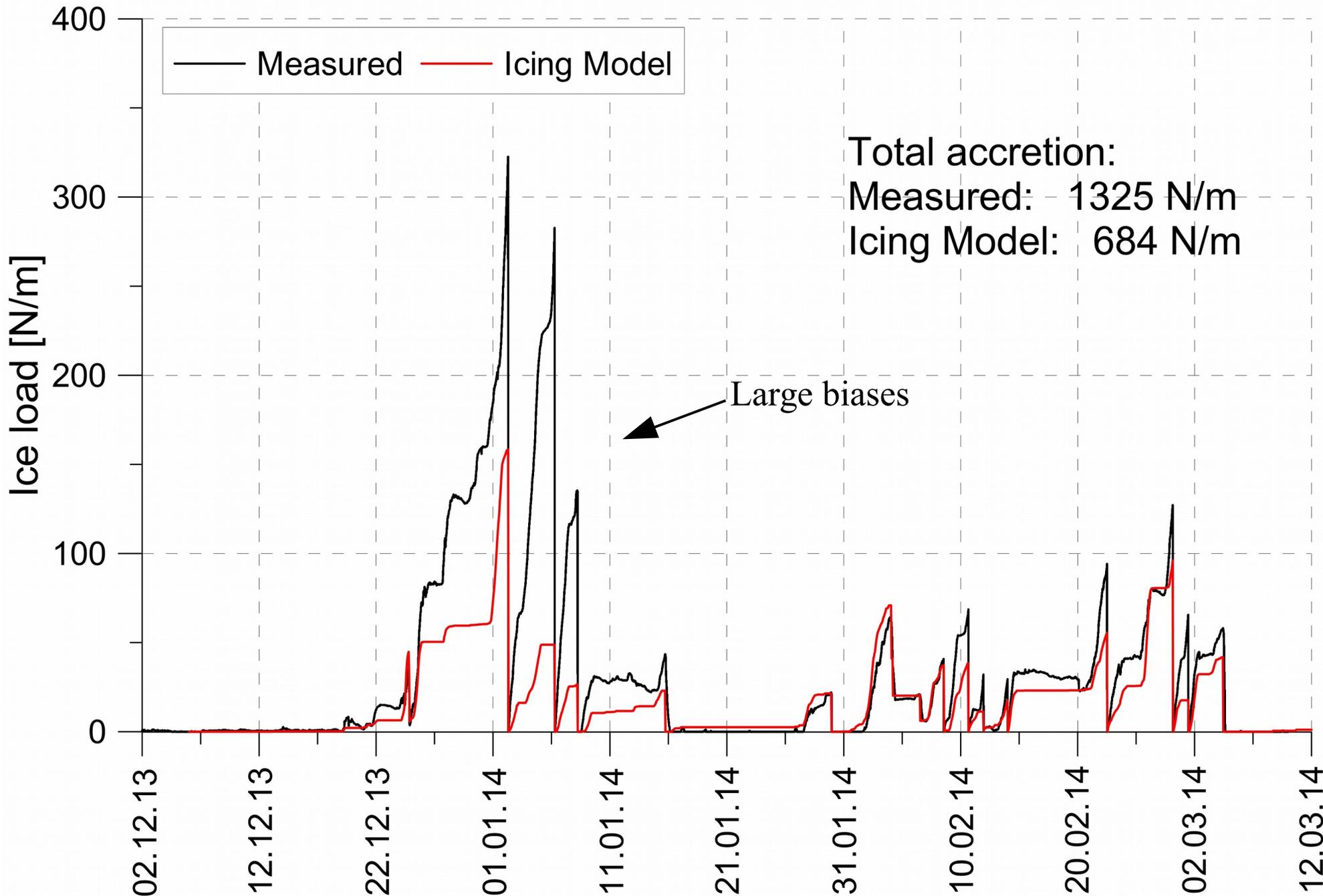
6 February 2014



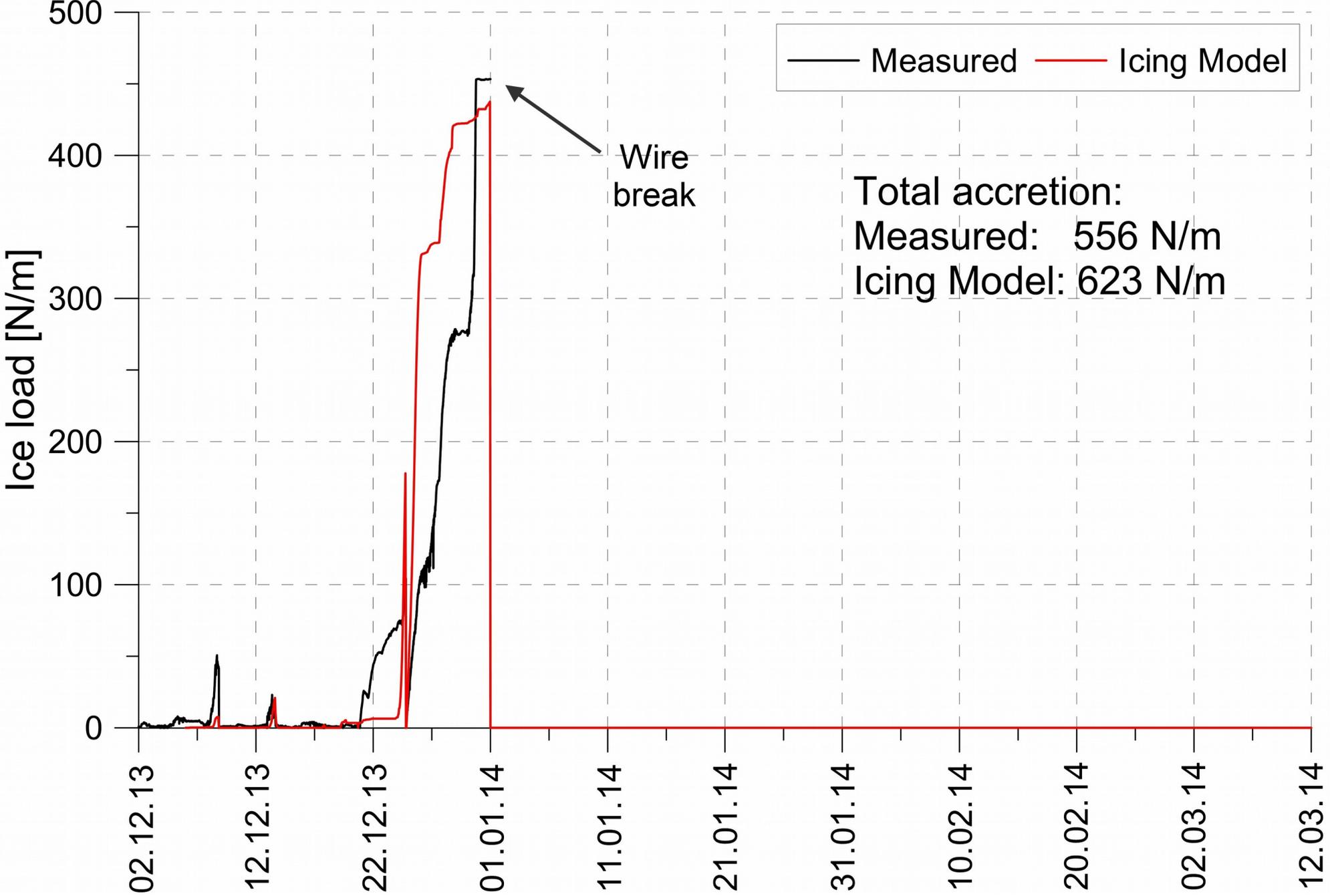
8 April 2014



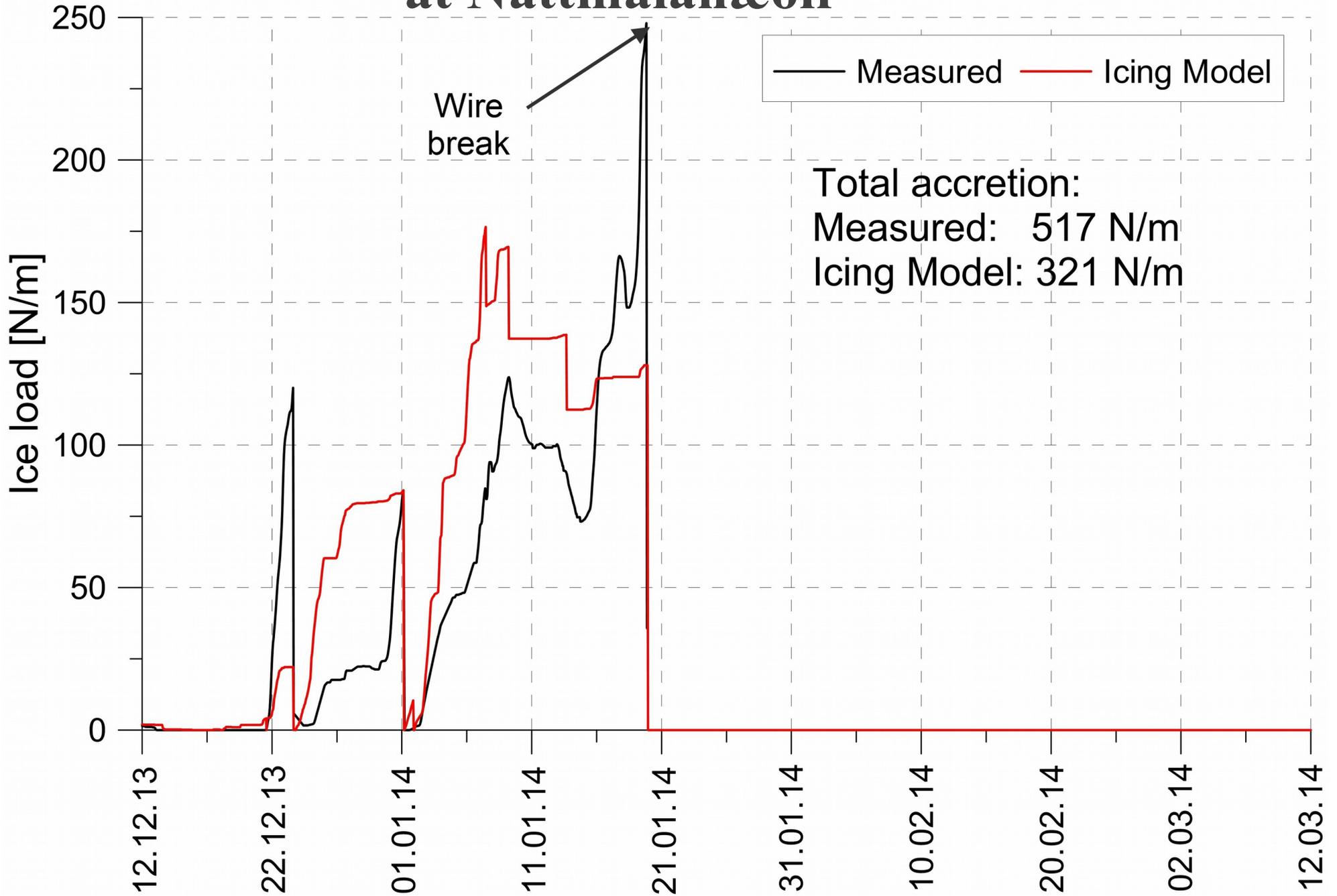
Test site 83-1-A : Measured and modelled icing in span at Hallormsstaðaháls



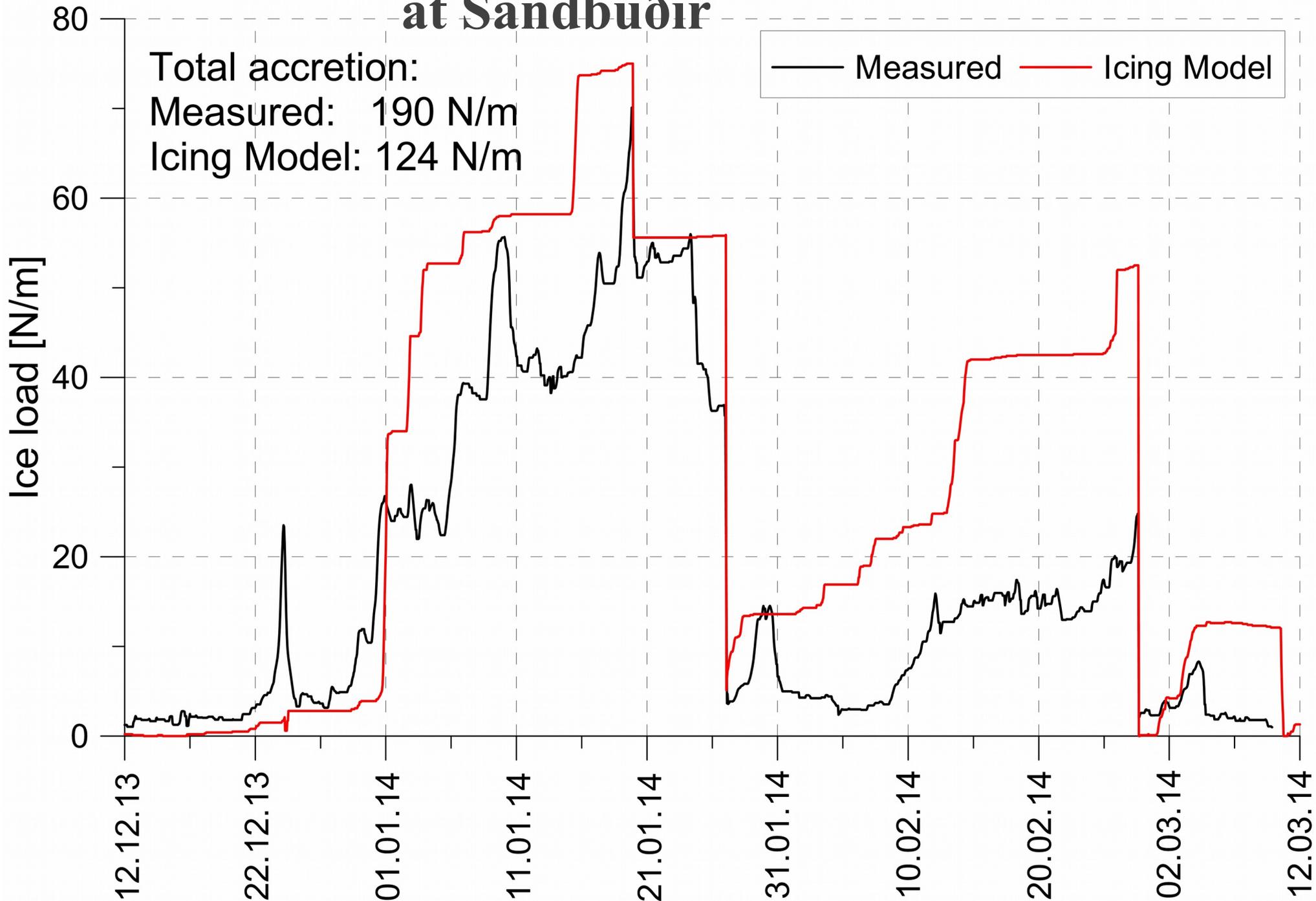
Test site 94-2-A : Measured and modelled icing in span at Ufs



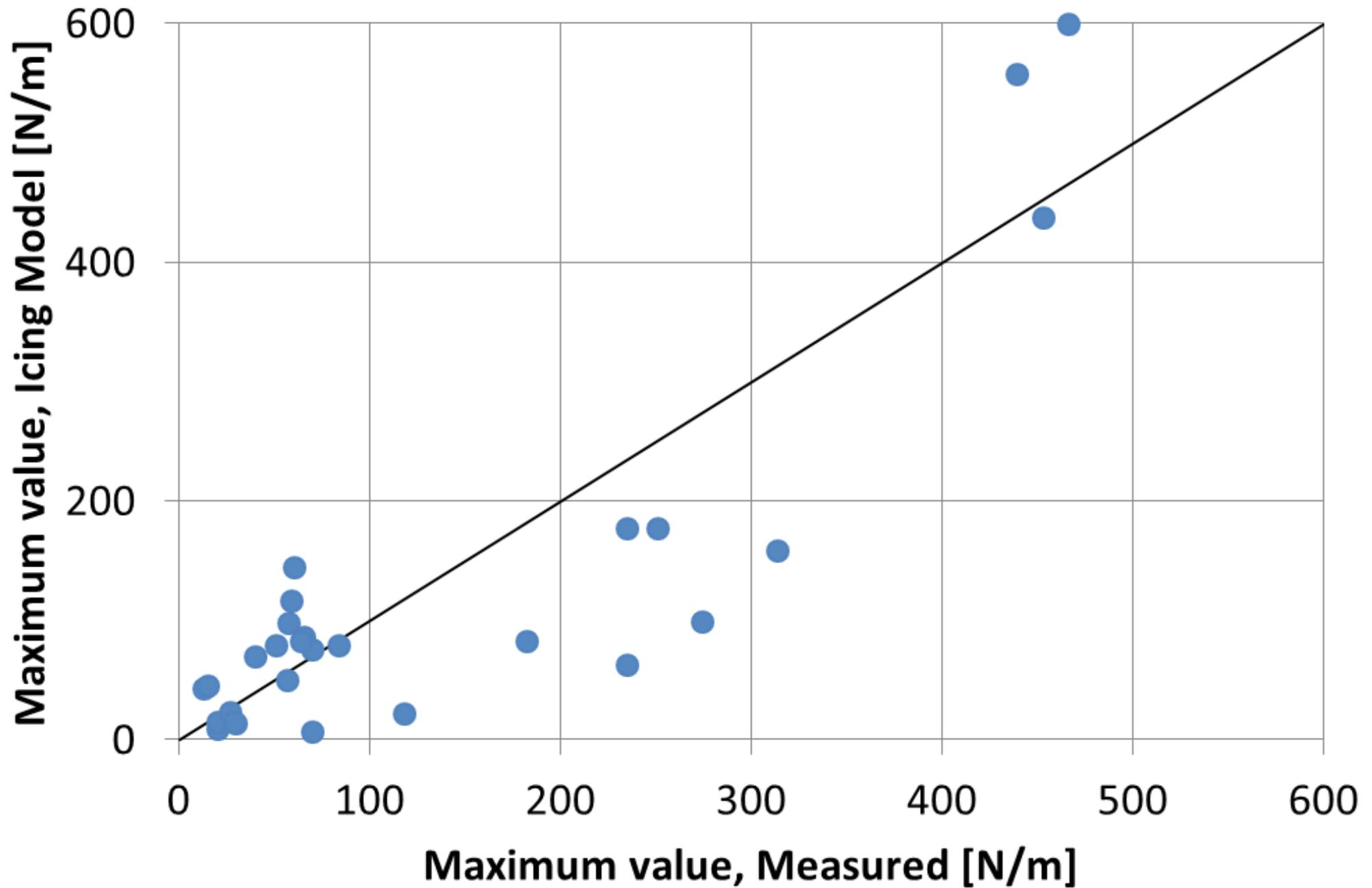
Test site 00-1-B : Measured and modelled icing in span at Náttmálahæðir



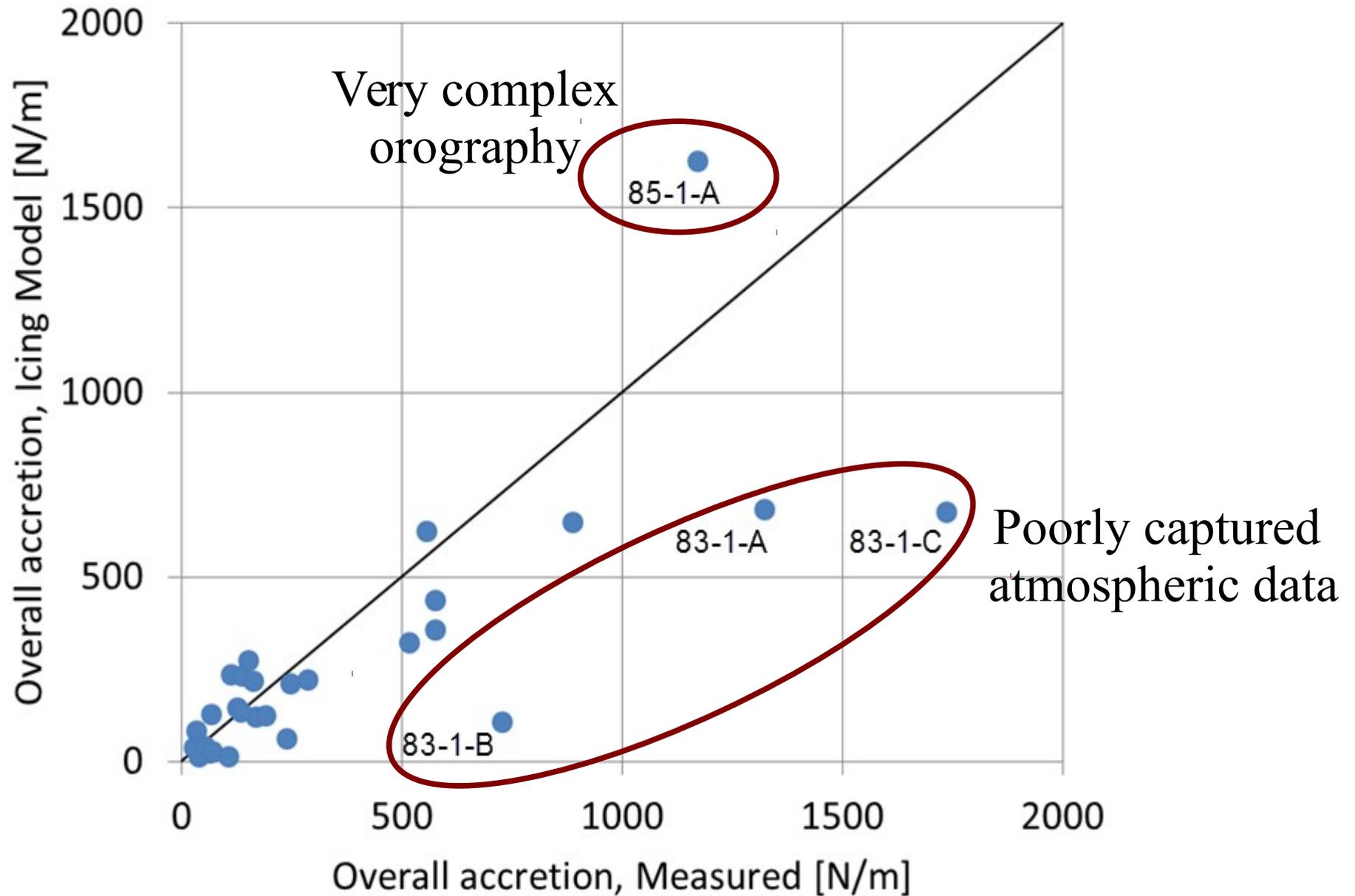
Test site 73-4-A : Measured and modelled icing in span at Sandbúðir



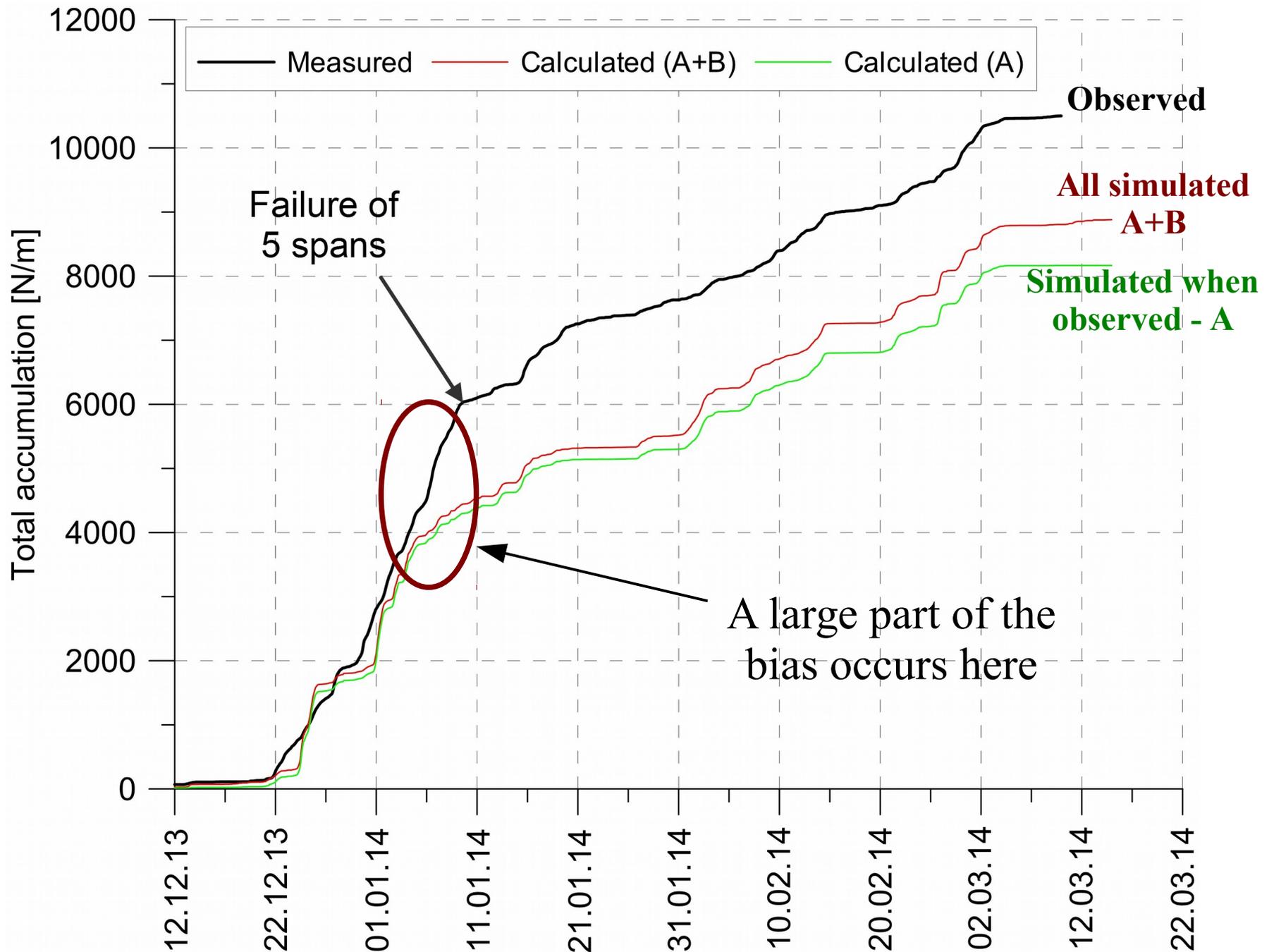
Observed and simulated maximum ice load during period



Observed and simulated total accumulation during period



Total observed and simulated accumulation at 28 spans



Concluding remarks

- Detailed and accurate observations of extreme accretion for 99 days.
 - Novel analysis of observed and simulated ice loads.
 - Forced shedding and accumulated accretion.
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- Loads on average well reproduced.
 - Timing well captured.
 - Largest errors due to:
 - complex orography,
 - atmospheric data.



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Photo: Ingvar Baldursson, 26 April 2014