ZX Lidars

Measuring the Wind in Cold Climates – a real-world Summary of Lidar Performance

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Why are Lidars used in cold climates?

- Hub heights are getting steadily taller
- Masts are costly, power hungry and unreliable in cold weather conditions
- Health and safety risks are high with any tall structure, especially one covered in ice

But…

- Can Lidar really be relied upon in these conditions?

Site Locations

- 3 real-world development sites
- All within Nordland, Norway
- In-land in complex terrain
- Co-located 44m masts at each location

Typical Conditions

- Temperatures down to – 20 °C
- Deep snow (enough to bury a Lidar!)
- High wind speeds (gusts at above 40 m/s were recorded)
- Low visibility severely restricts access by air

- In these conditions campaign planning is everything

Challenges

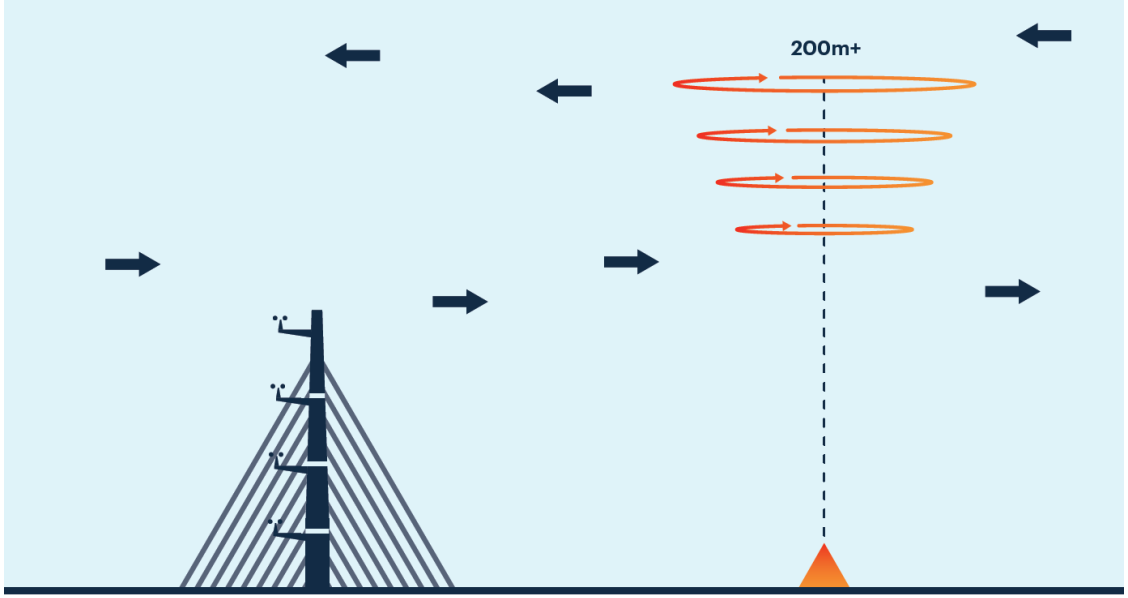
- Access
- Power
- Communications
- Suitability of the Lidar design, can it survive reliably?
- Snow drifting

Continuous Wave Advantage

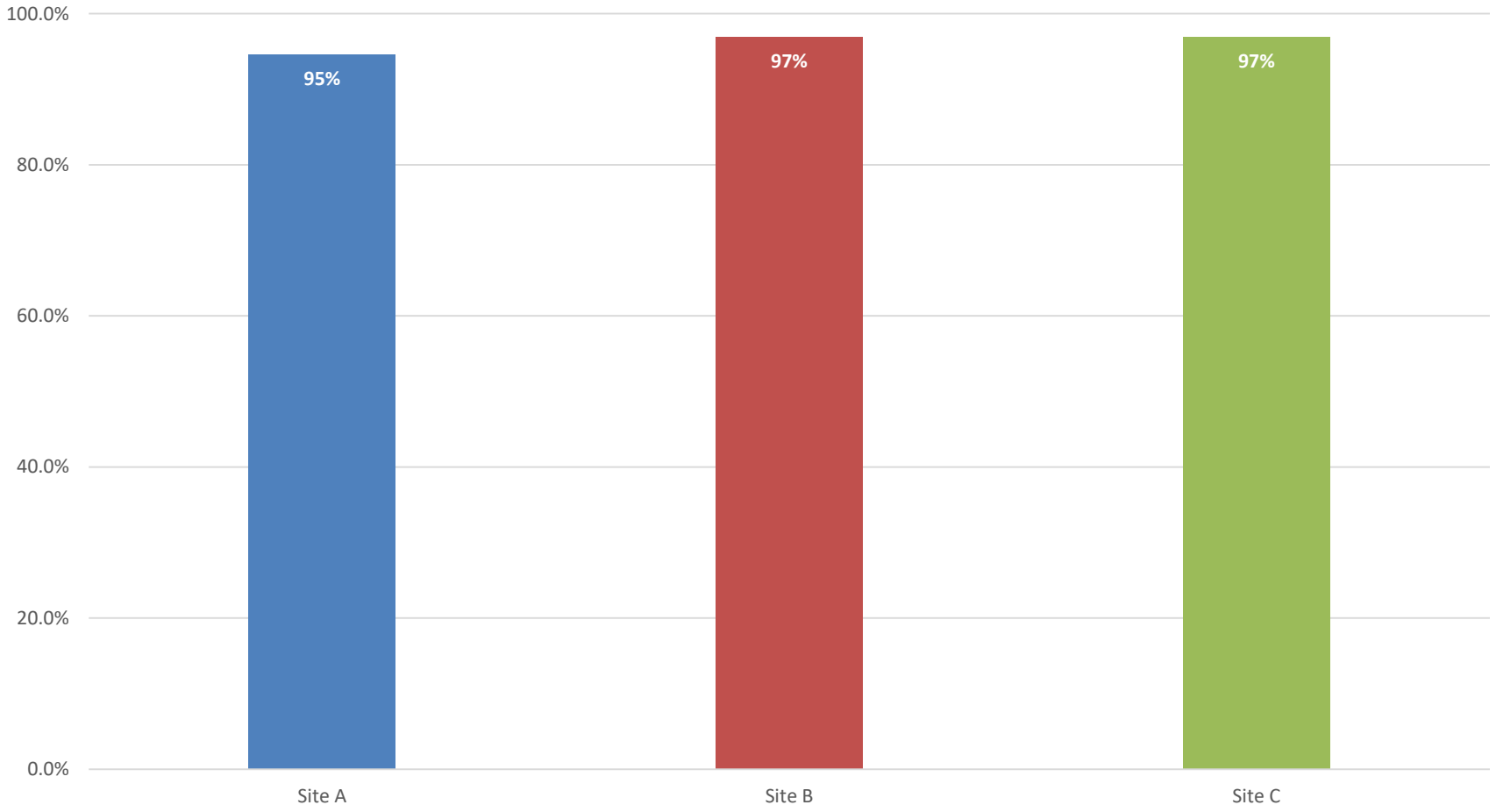
- Extremely high-fidelity, high-sensitivity laser design
- CW lidars can use significantly more powerful lasers than pulsed, and they concentrate the energy at each measurement height. This in turn leads to two further significant advantages:
  - Constant and very high sensitivity at all measurement heights (even in clear air operation)
  - The ability to measure at lower heights or ranges, down to 10 m.

Development Methodology

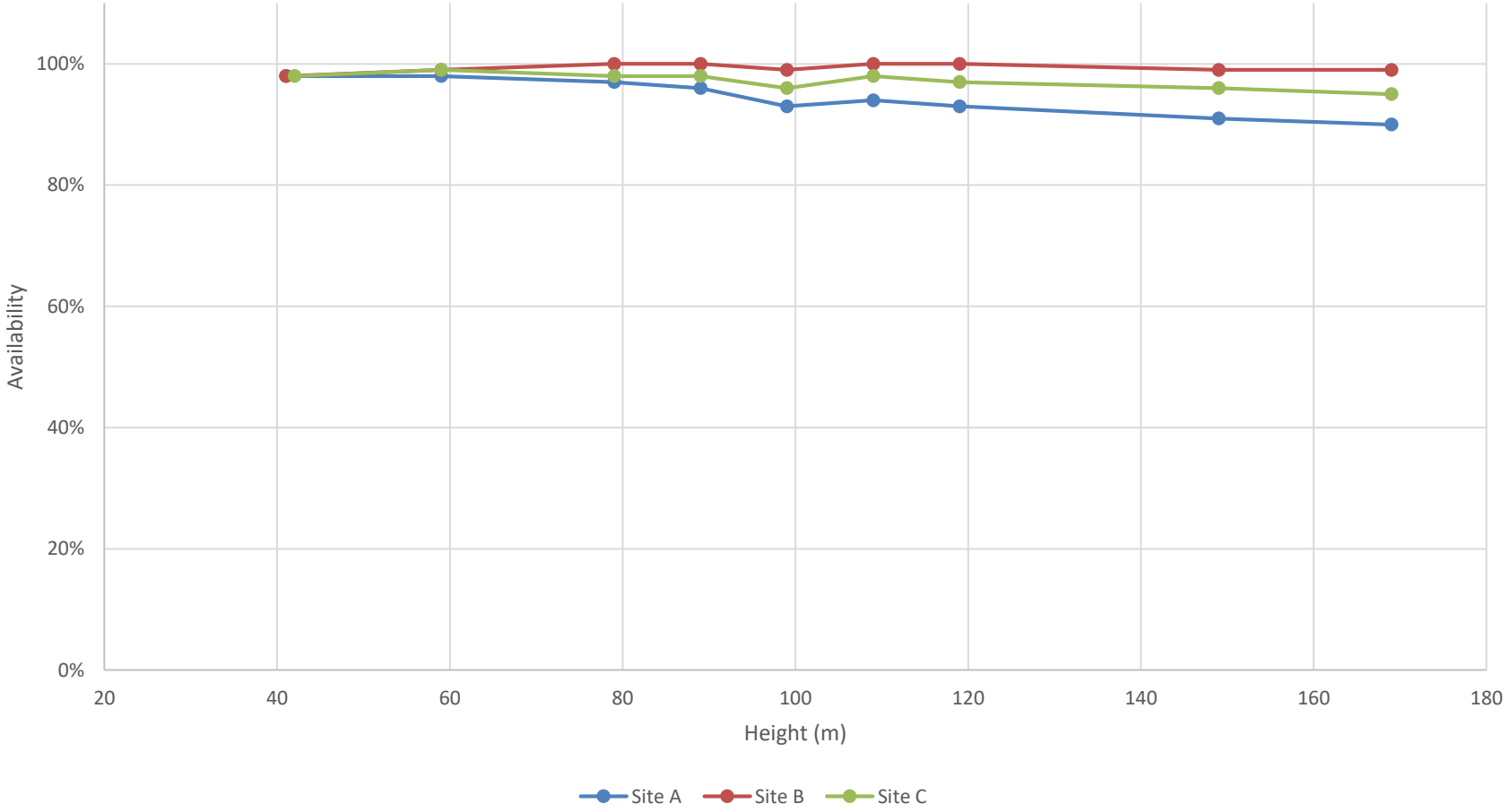
- Short (44m) masts plus Lidar
- Lidar co-located to build up shear profile
- Then moved around the site to reduce uncertainty
- Balances risk and cost using the benefits of both devices
- Provides an additional filtering device for mast data



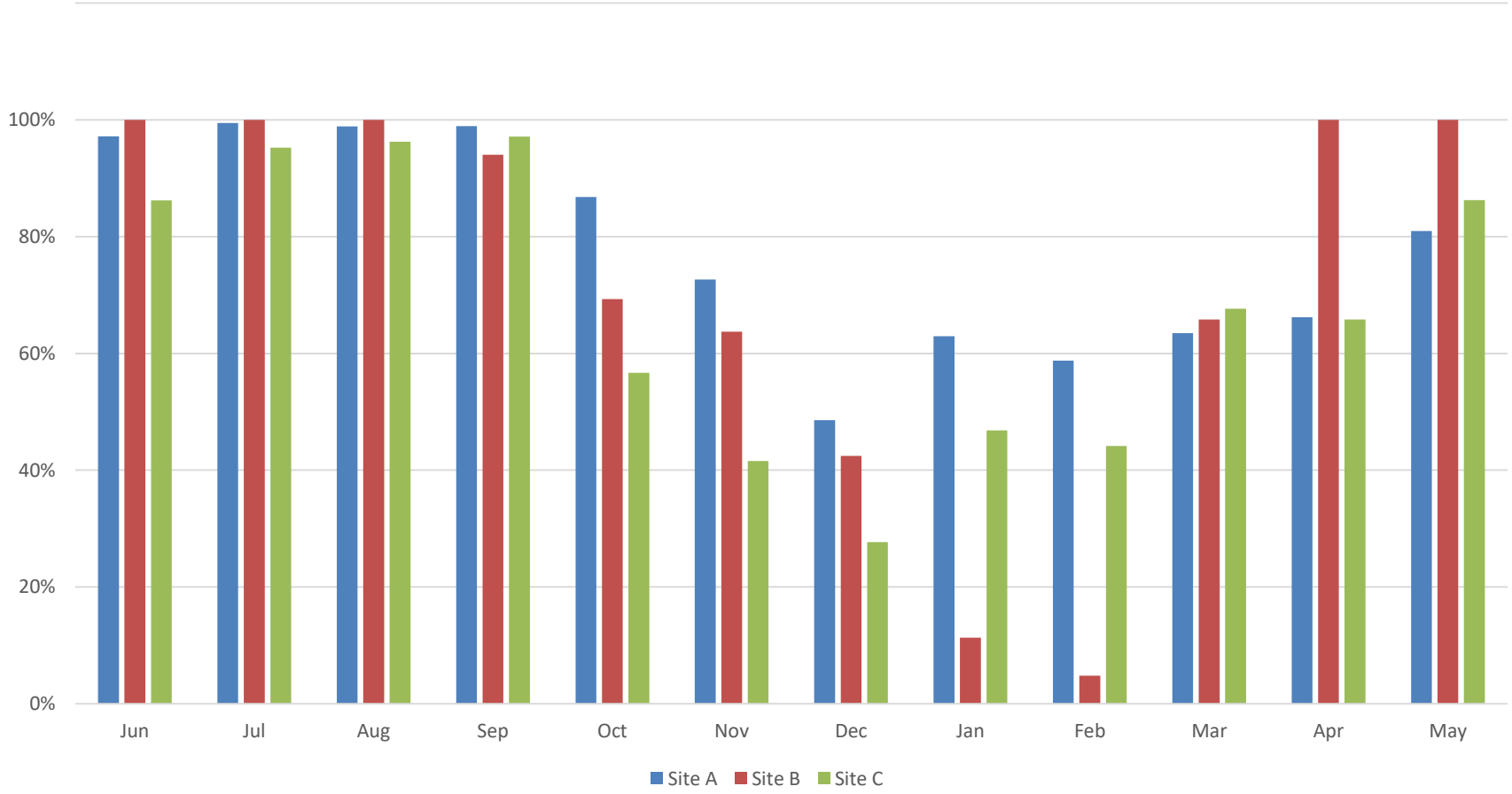
Lidar Availability, Dec - Jan



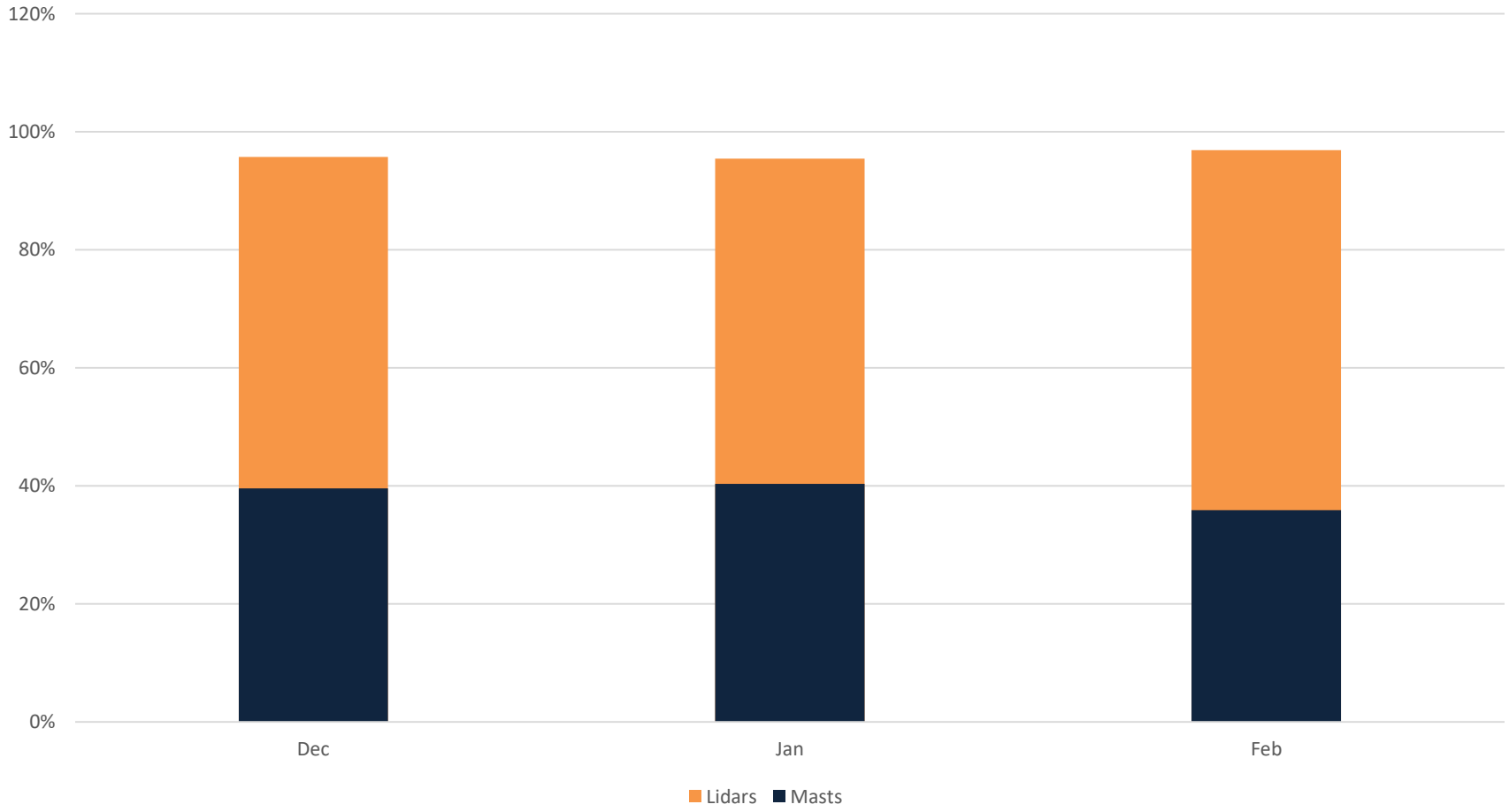
Variation Across Height Range



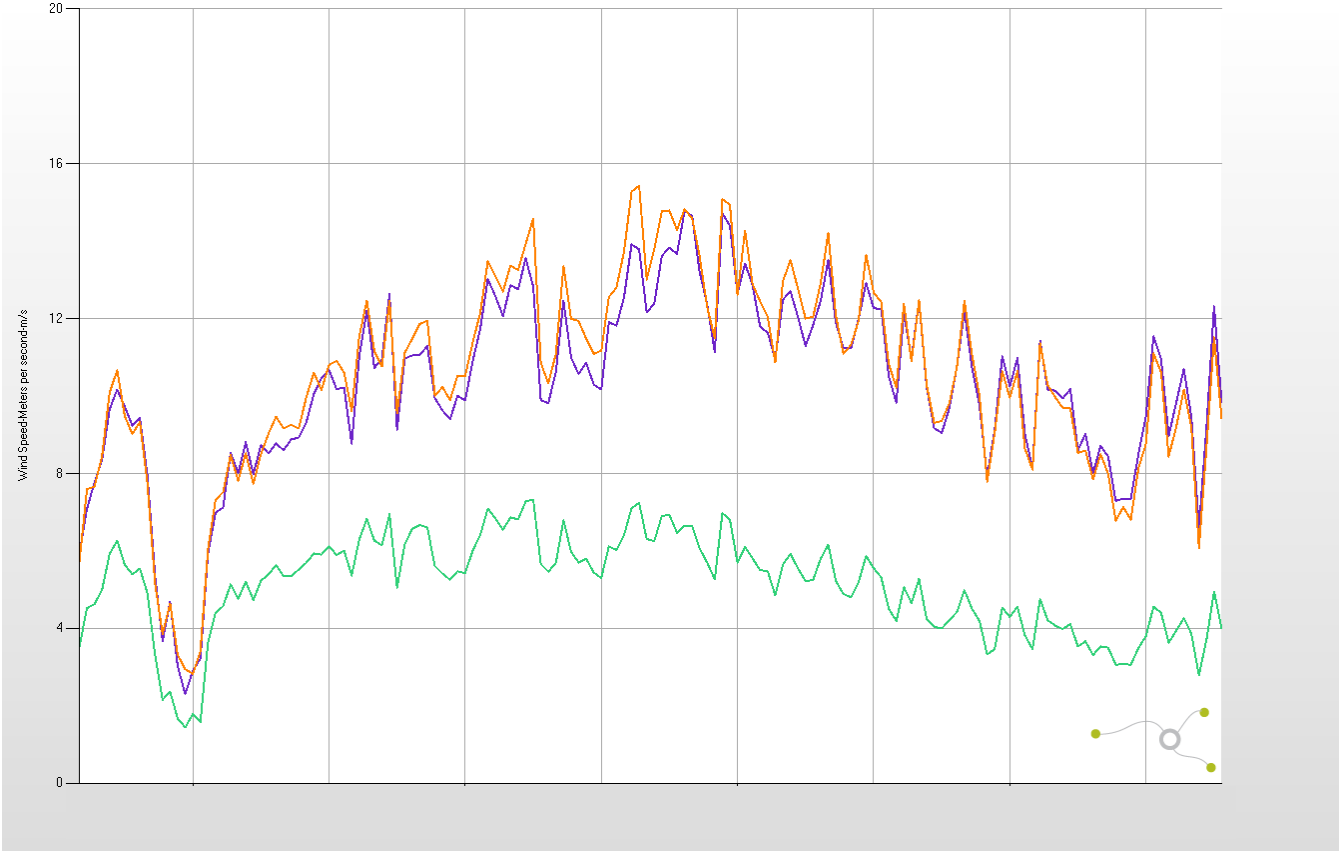
Seasonal Mast Availability



Filling the Availability Gap



BONUS! Cup-ice Data Cleaning



Why measure during icing?

- Use of anti-icing systems becoming more widespread
- Understanding of ice formation becoming more sophisticated
- It’s now not enough to simply correlate cup-icing events with non-generation
- Lidar can play a role in the move to more efficient and appropriate wind measurement campaigns

Summary

- Lidar availability demonstrated in some of the harshest conditions with > 90% quality checked data at all heights
- Consistently outperformed co-located masts during winter months
- Cleansed the mast data while simultaneously filling the gaps
- Campaign planning remains critical for all measurement devices, but using Lidar helps to reduce those risks significantly
- Local knowledge and support, as always, make a significant difference.

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