Business from technology

Windcube Measurement Data Correction by CFD Method for Fjeld Region

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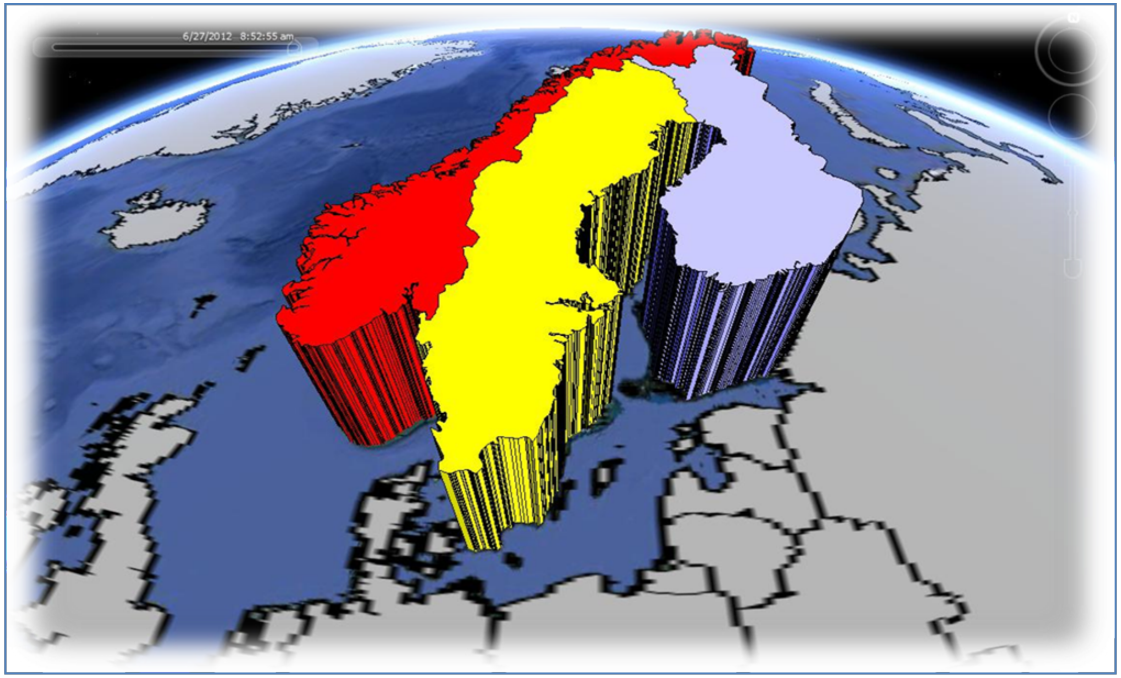
Partners



Norway

windsim

- WindSim CFD Software
- Remote Sensing Correction Tool

Sweden

Skellefteå Kraft

- Sodar Measurement Data
- Meteomast Measurement Data

Finland

VTT

- Lidar Measurement Data
- Data analysis

Content of Presentation

- Description of Measurement Site
- Forecast of Study
- Lidar Operating Performance in Arctic Conditions
- Analysing Methods
- Results of Measurement Campaign
- CFD Based Remote Sensing Correction
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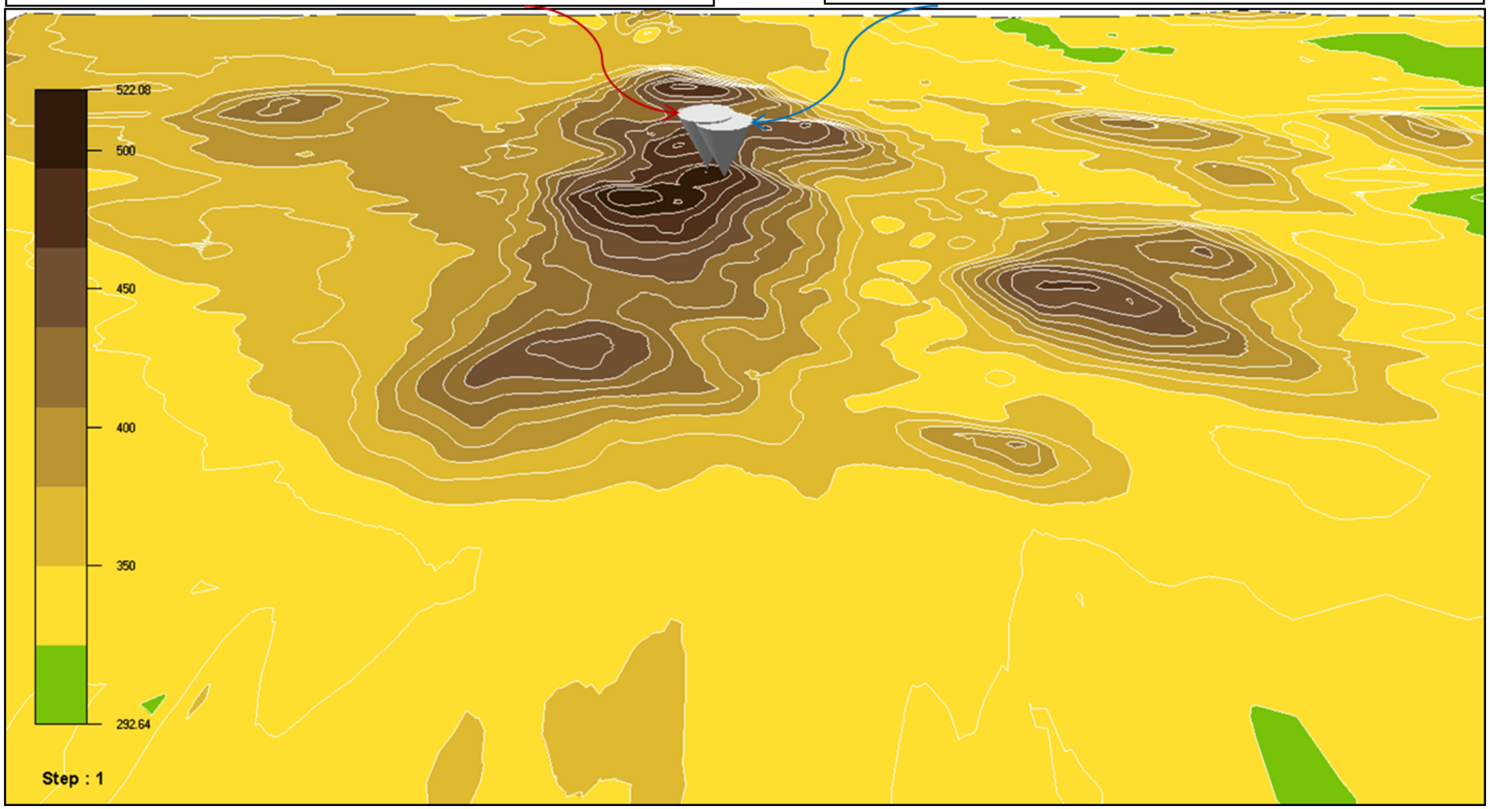
Description of Measurement Site

- VTT & Skellefteå Kraft AB organized a measurement campaign at a site in Northern Sweden

Phase 2. Lidar – Meteomast Comparison 24.03.-11.05.2011	Phase 1. Lidar – Sodar Comparison 24.02.-18.03.2011

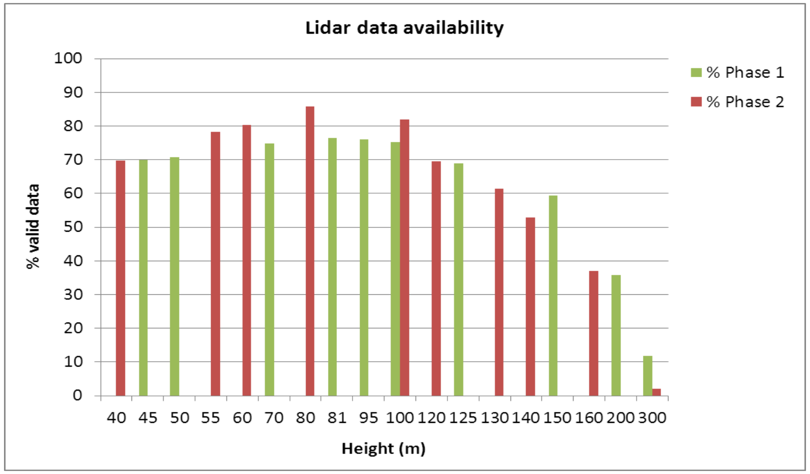


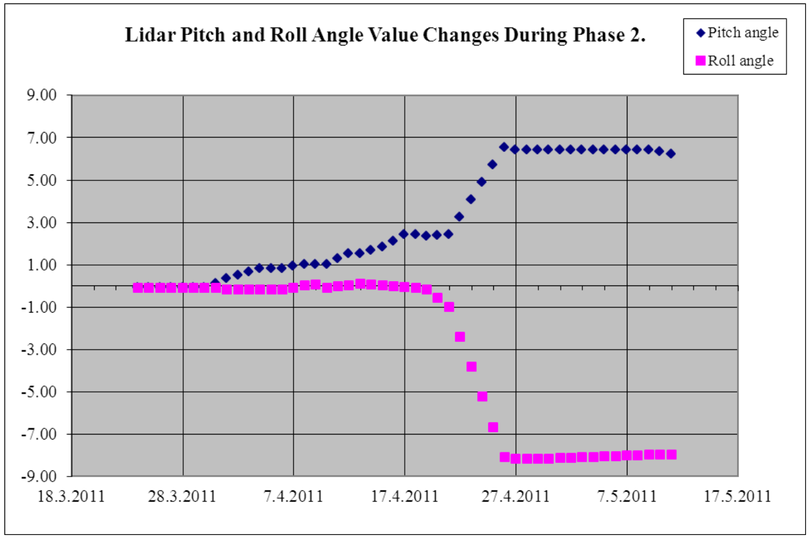
Forecast of Study

Main topics of the measurement campaign:

- to monitor Windcube operating performance in arctic conditions
- to investigate the differences between Windcube & Sodar data
- to investigate the differences between Windcube vs meteomast data
- to analyse and correct the Windcube data which are biased in complex terrain with the Windsim CFD software with neutral atmospheric settings

Lidar Operating Performance in Arctic Conditions

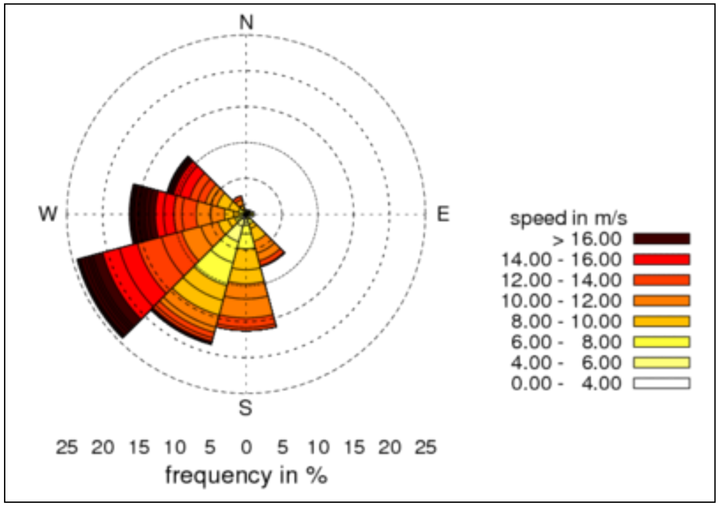


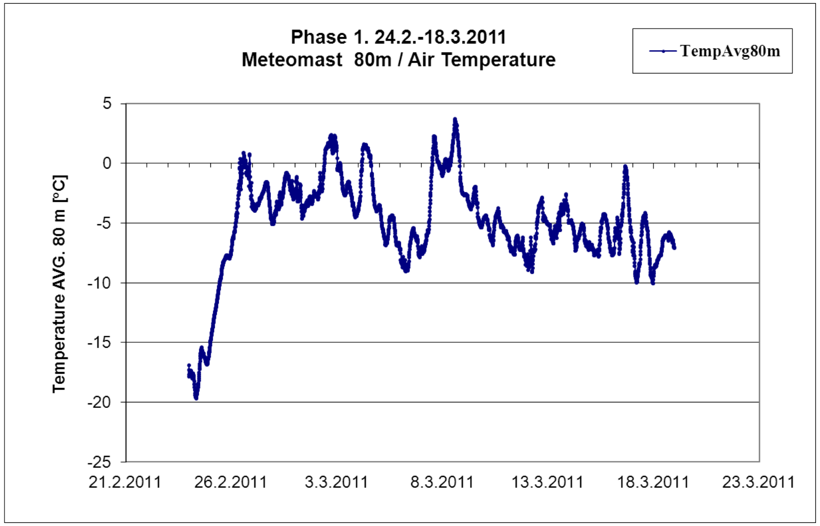


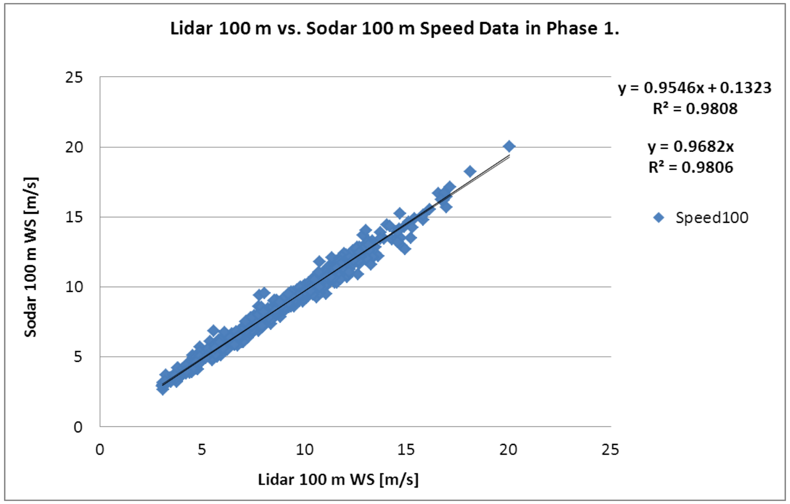
Analysing Methods

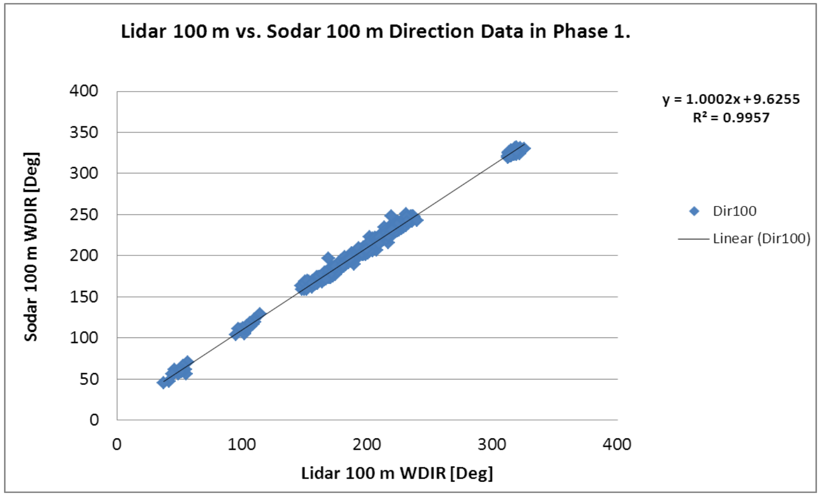
- To quantify the difference between lidar & sodar and lidar & meteomast measurements in complex terrain due to the flow disuniformity
- CFD based remote sensing correction can help to minimize the biased horizontal wind speed values between Lidar & meteomast measurements
- Therefore it was important to carry out sensitivity study to find optimum simulation parameters for lidar data correction
- Five simulations with different roughness values were carried out:
  - R0.001, R0.03, R0.1, R0.5 & R1.0
  - Before using the Remote Sensing Correction Tool, we estimated which roughness value describes well snow and forest conditions

Results of Measurement Campaign Phase 1

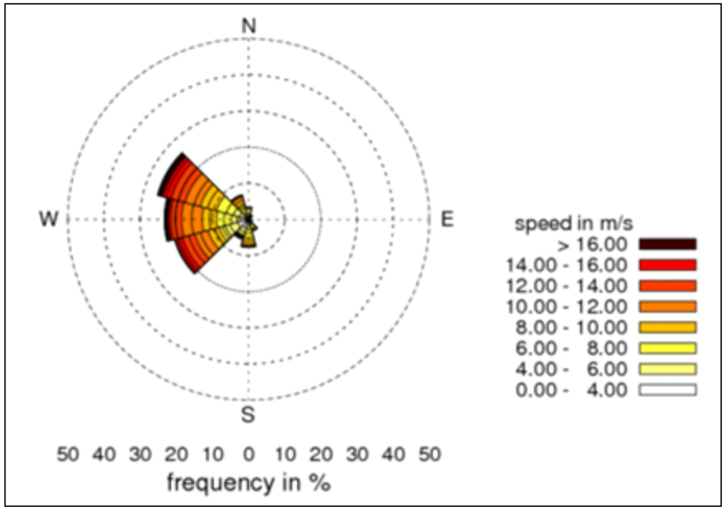


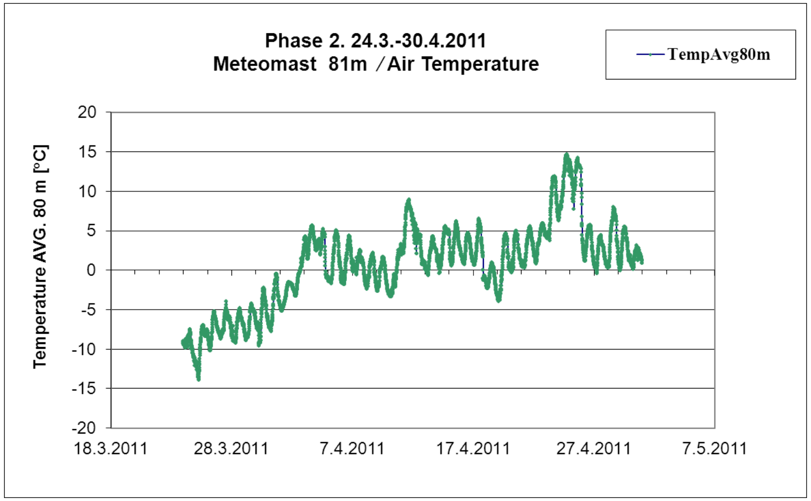


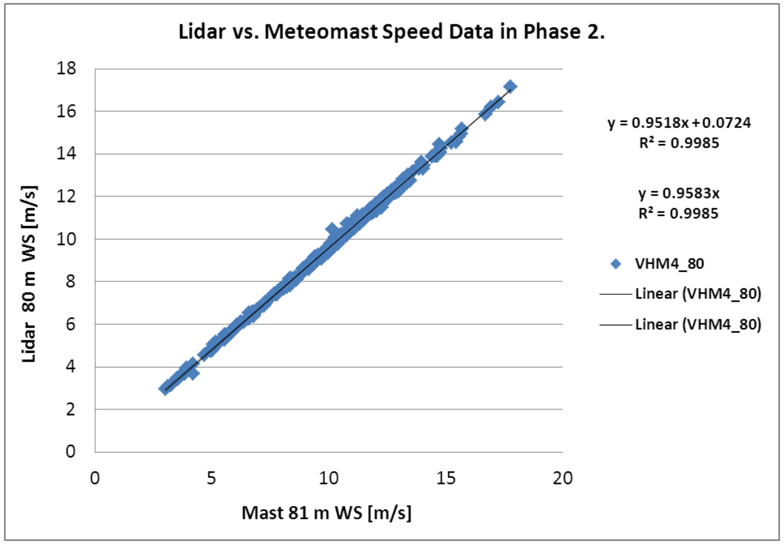


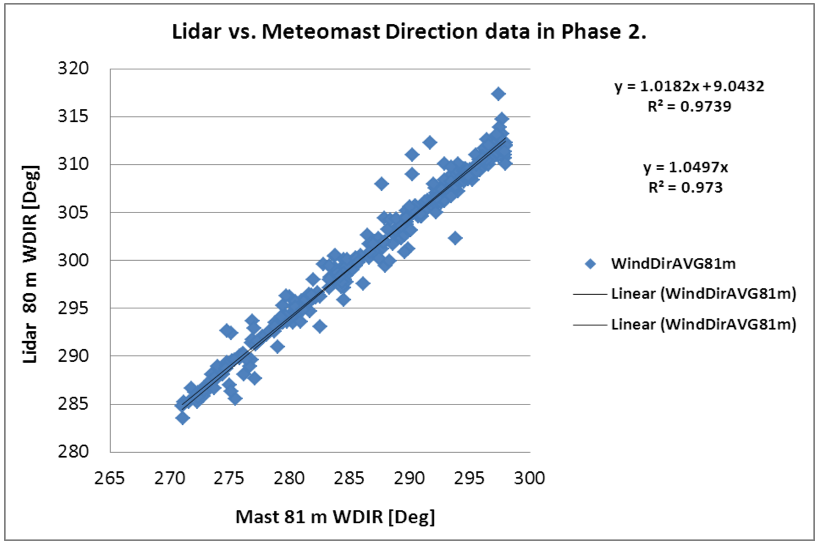


Results of Measurement Campaign Phase 2



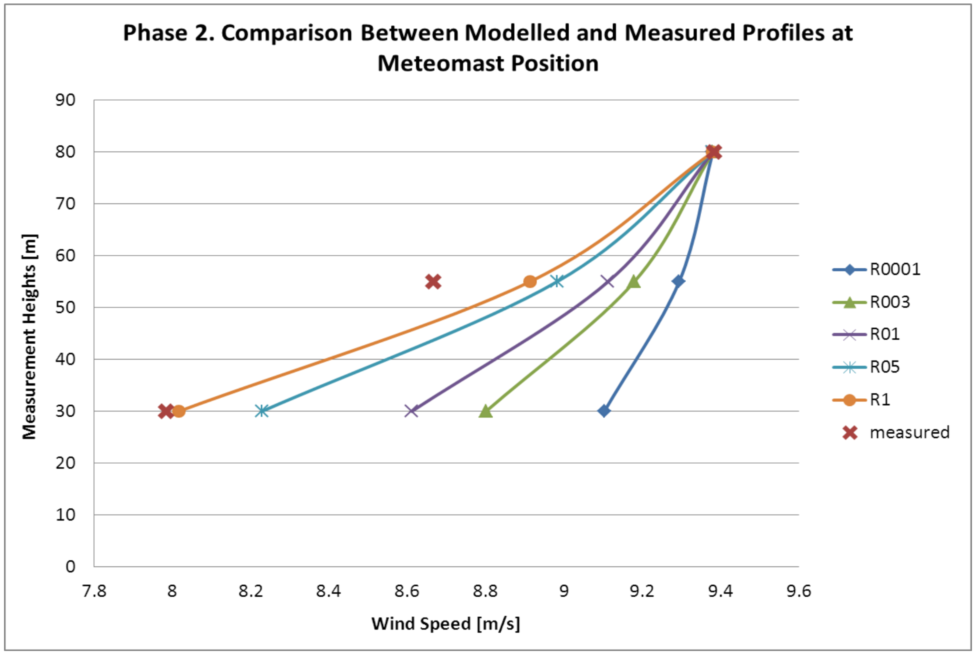






CFD Based Remote Sensing Correction

Sensitivity Study



Data Correction

	WS [m/s] Lidar 80 m vs Meteomast 81 m			
	Measured	Roughness		Corrected (Lidar)
	Correlation	Z0 (m)	type	Correlation
Phase2	95.2 %	0.001	Snow	91.4 %
		0.03	↓	99.2 %
		0.1		99.1 %
		0.5		98.7 %
		1.0	Forest	98.7 %

	WS [m/s] Sodar 100 m vs Lidar 100 m	
	Measured	Lidar Corrected vs Sodar No Corr.
	Correlation	Correlation
Phase1	95.5 %	93.5 %

- **Phase 2:** volume measurement (vectors) vs point measurement (scalars)
- **Phase 1:** volume measurement (laser) vs volume measurement (sound)

Conclusion and Future

Based on this case study our first conclusion is:

- The Lidar campaign completed in Northern Sweden with some challenges
  - Tough deploying conditions: Lidar started tilting,due to melting snow
  - Low data availability during the winter storms
  - Lidar indicated 5 % lower values compared to the mast measurements
  - With CFD simulations it is possible to reduce the 5 % error into 1 %
- CFD software predicts a smaller correction value in Lidar vs Sodar comparison:

→ The wind flow is more uniform on the side of the hill compared to the hilltop

→ It is important to plan where to deploy the Windcube to optimise the data quality

Future:

- It would be important to continue this case study with simulation parameters which take into account the atmospheric stability and forest modelling
- It would be also interesting to study the Lidar correction also with Wasp engineering software and see the difference between these two simulation softwares

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