Agreement and availability of Doppler velocity measurements from co-located Doppler Wind Lidar and X-band weather radar

Jenna Ritvanen[1,2], Ewan O'Connor[1], Dmitri Moisseev[1,2],
Ludovic Thobois[3], Raisa Lehtinen[4], Jani Tyynelä[1]

Contact: jenna.ritvanen@fmi.fi / ludovic.thobois@vaisala.com

[1]Finnish Meteorological Institute, Helsinki, Finland
[2]INAR, University of Helsinki, Helsinki, Finland
[3]Vaisala France SAS, Paris-Saclay, France
[4]Vaisala Oyj, Vantaa, Finland

04.Synergistic use of multiple instruments and techniques, networks and campaigns

27 June 2022

Monday_ 04_P02

The 30th International Laser Radar Conference (ILRC) virtual conference, June 26th – July 1st, 2022.

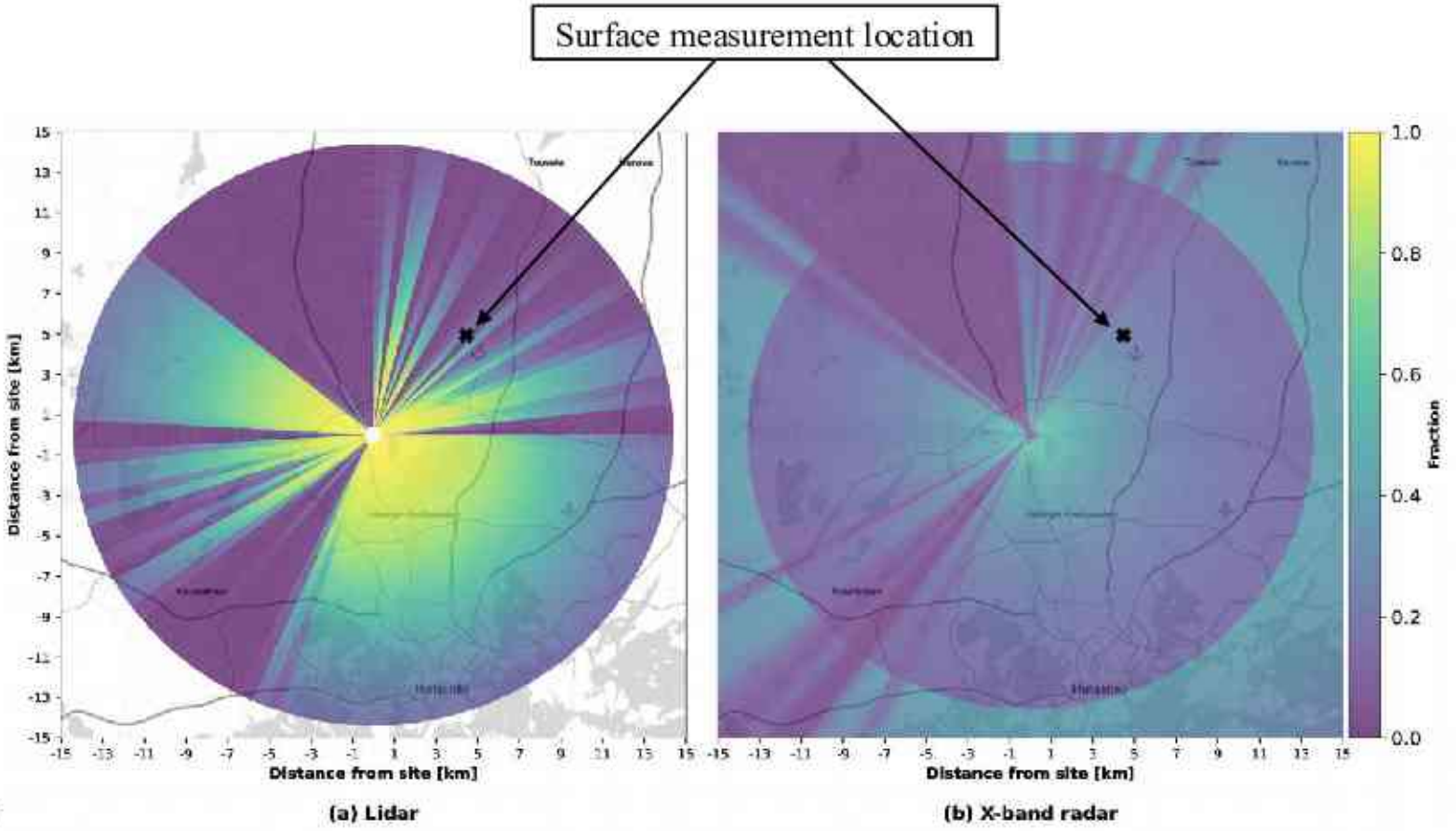
Introduction

- Measurement campaign in Vantaa, Finland from May 2021 to November 2021

- Instruments
  - Vaisala WindCube400S Doppler lidar
  - Vaisala WRS400 X-band weather radar

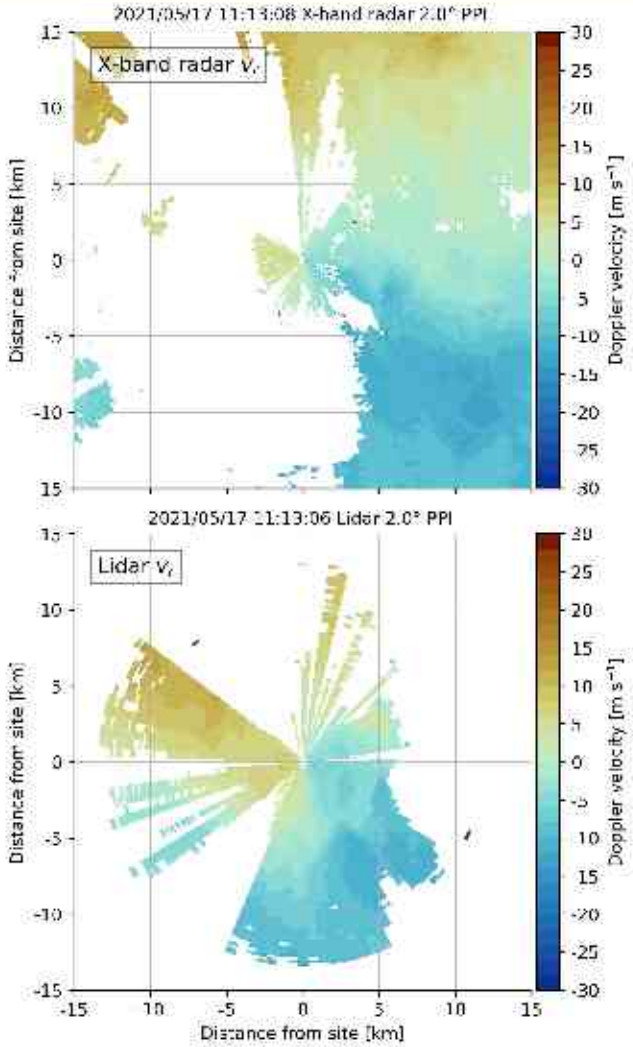
- Aim to quantify differences in measurement performance in different conditions:
  → Horizontal visibility
  → Cloud base height
  → Precipitation intensity

- The work was funded through the MWS-A project funded by the European Space Agency (4000132768/20/UK/ND).

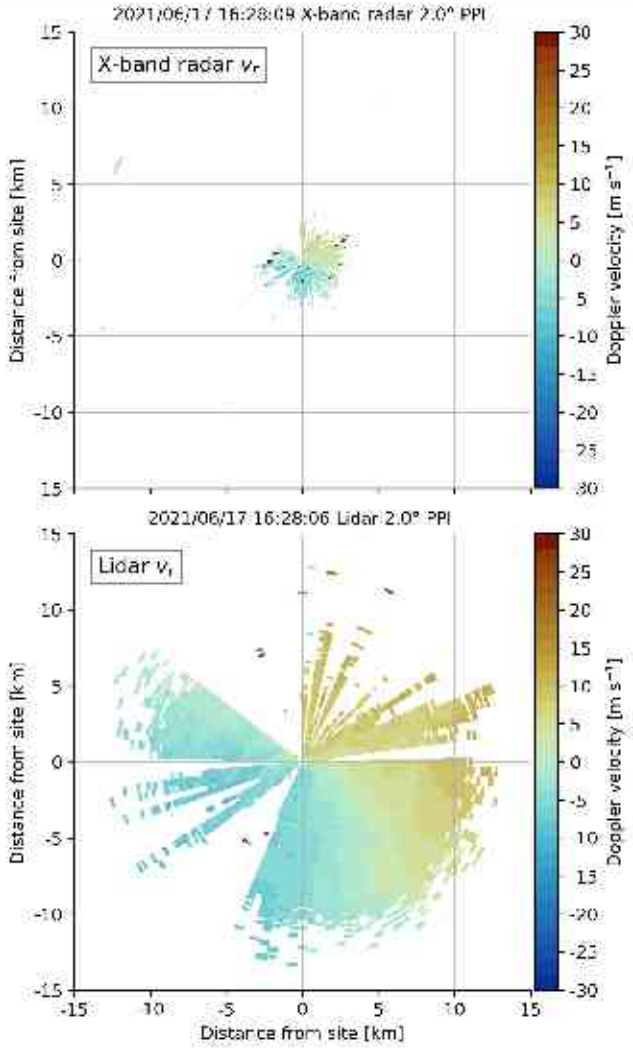


Data availability during the entire campaign

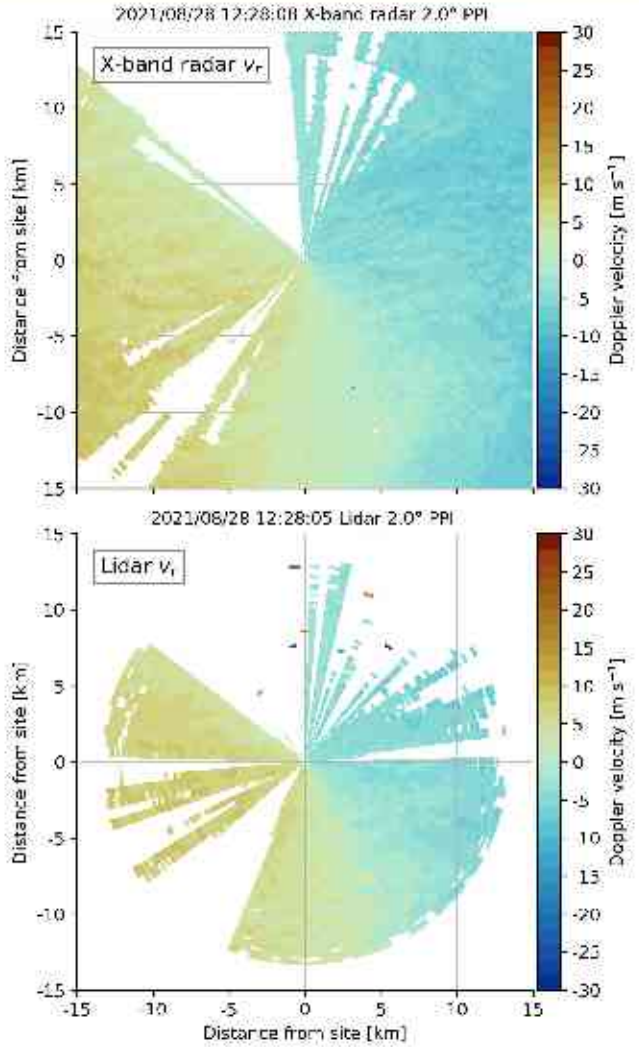
Case examples



Thunderstorm/
precipitation



Clear air, no insects,
horizontal visibility > 60km



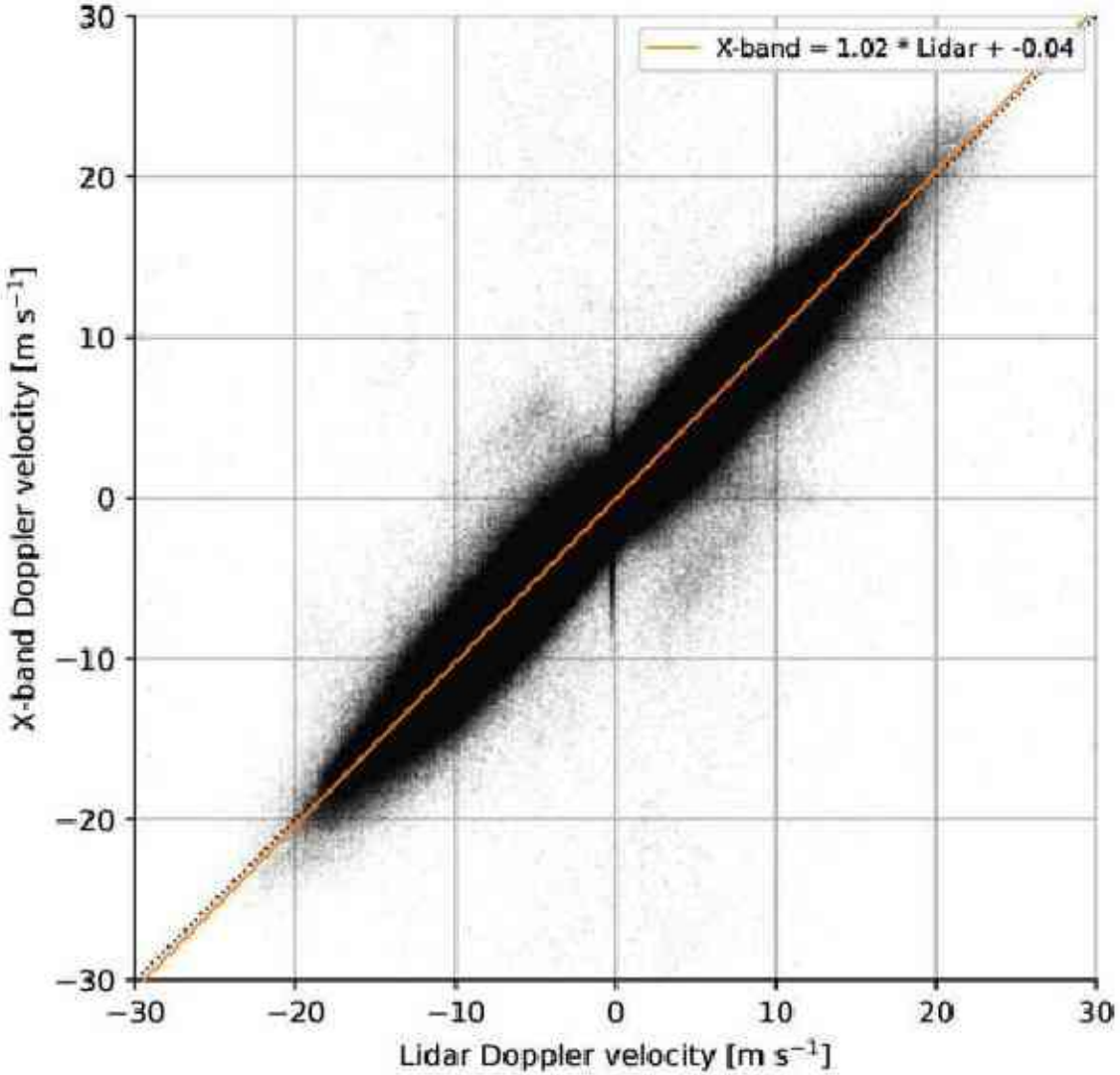
Clear air, insects,
horizontal visibility ~45km

Agreement of Doppler velocity measurements

- Radial velocity measurements interpolated to a common Cartesian grid for comparison.

- Measurements have good agreement:
  → R2 = 0.96
  → RMSD = 1.31 m/s
  → ME = -0.047 m/s

- Some artefacts visible that suggest using clutter filtering for Doppler lidar might be necessary.

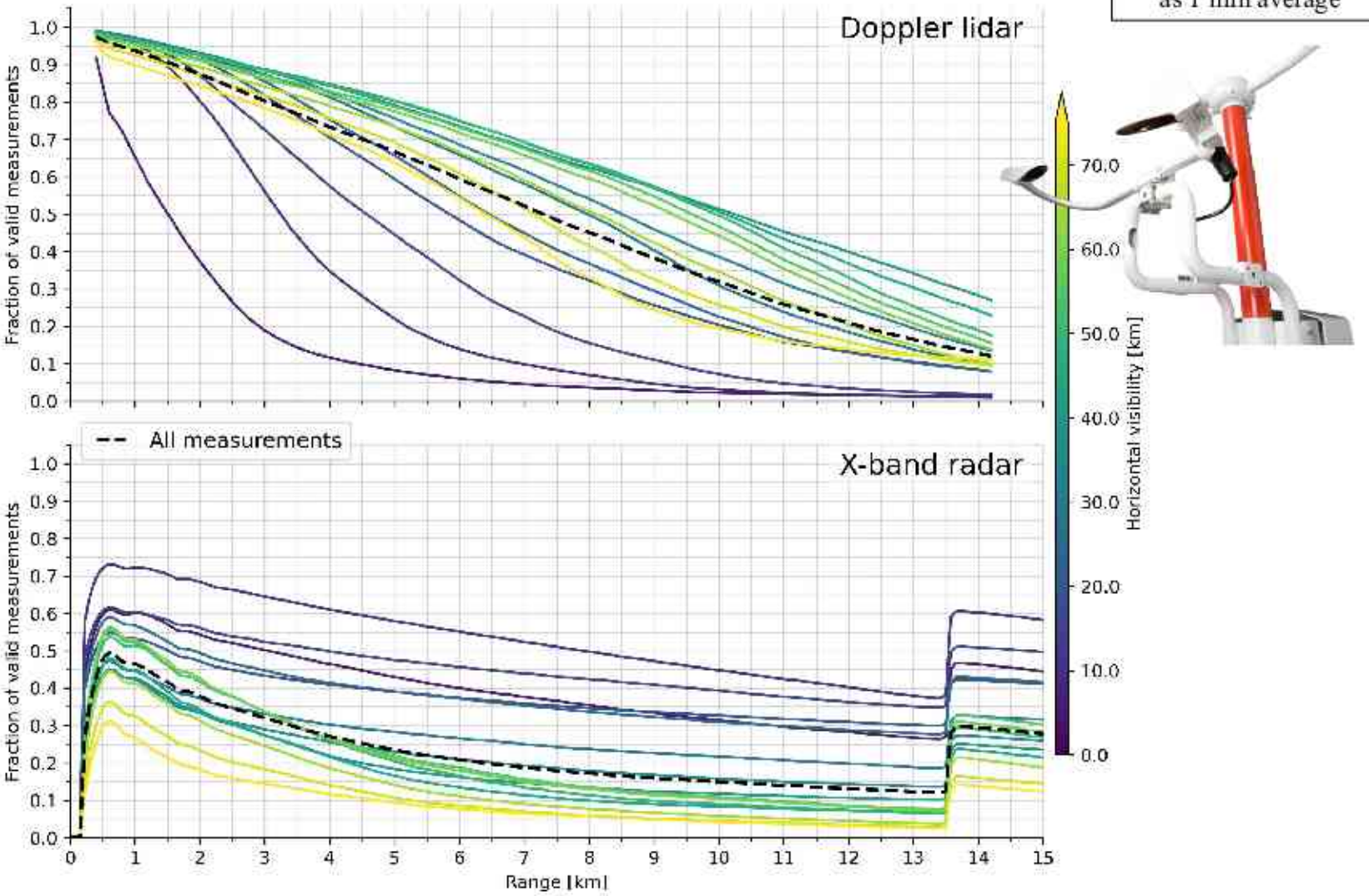


Data availability as function of horizontal visibility

Doppler lidar has
→ low data availability in low visibility conditions.
→ highest data availability when horizontal visibility is 40-50km.

X-band radar has high data availability in conditions with low horizontal visibility.

Horizontal visibility: Vaisala FS11P sensor as 1 min average

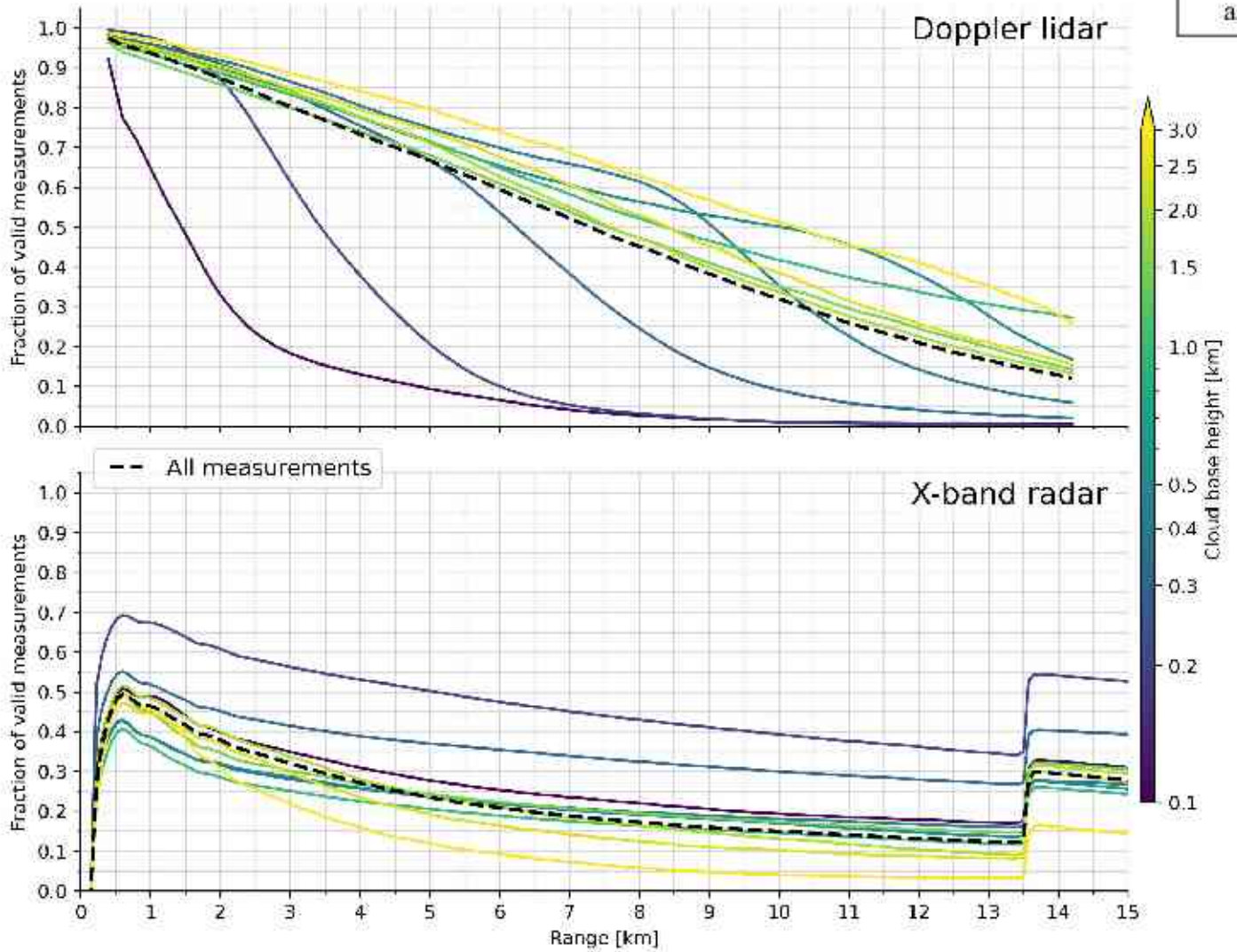


Vaisala FS11P sensor image from https://www.vaisala.com/en/products/weather-environmental-sensors/visibility-present-weather-fs11-fs11p

Data availability as function of cloud base height

Doppler lidar cannot measure past cloud base.

X-band radar has best data availability in low cloud base height conditions.



Cloud base height: Vaisala CL31 ceilometer as 1 min measurement

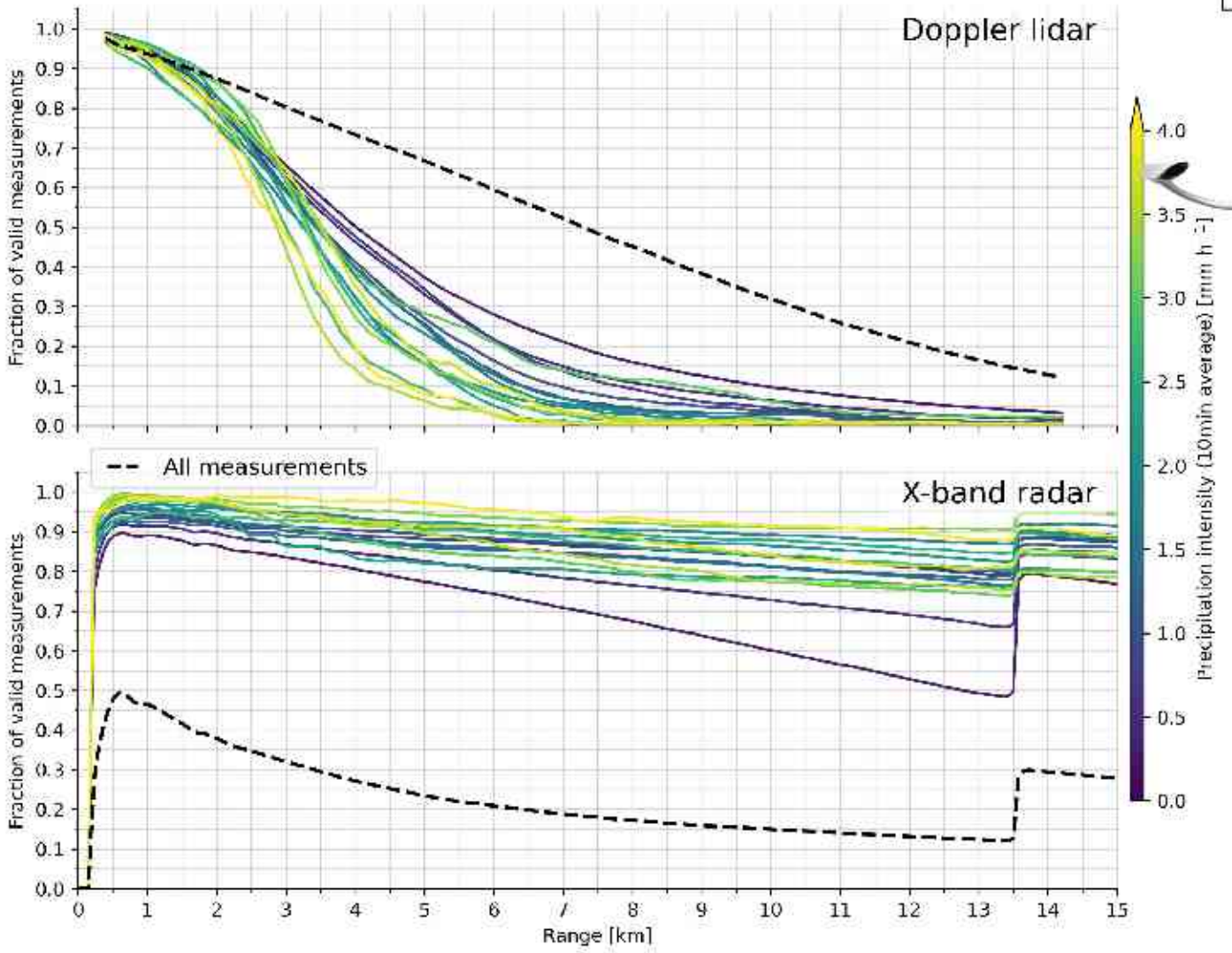
Vaisala CL31 sensor image from https://www.vaisala.com/en/products/weather-environmental-sensors/ceilometers-CL31-CL51-meteorology

Data availability as function of precipitation intensity

Precipitation intensity:
Vaisala FS11P sensor
as 10 min average

Doppler lidar: any precipitation indicates low data availability beyond first kilometers in range.

X-band radar: any precipitation indicates high data availability.



Vaisala FS11P sensor image from https://www.vaisala.com/en/products/weather-environmental-sensors/visibility-present-weather-fs11-fs11p