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

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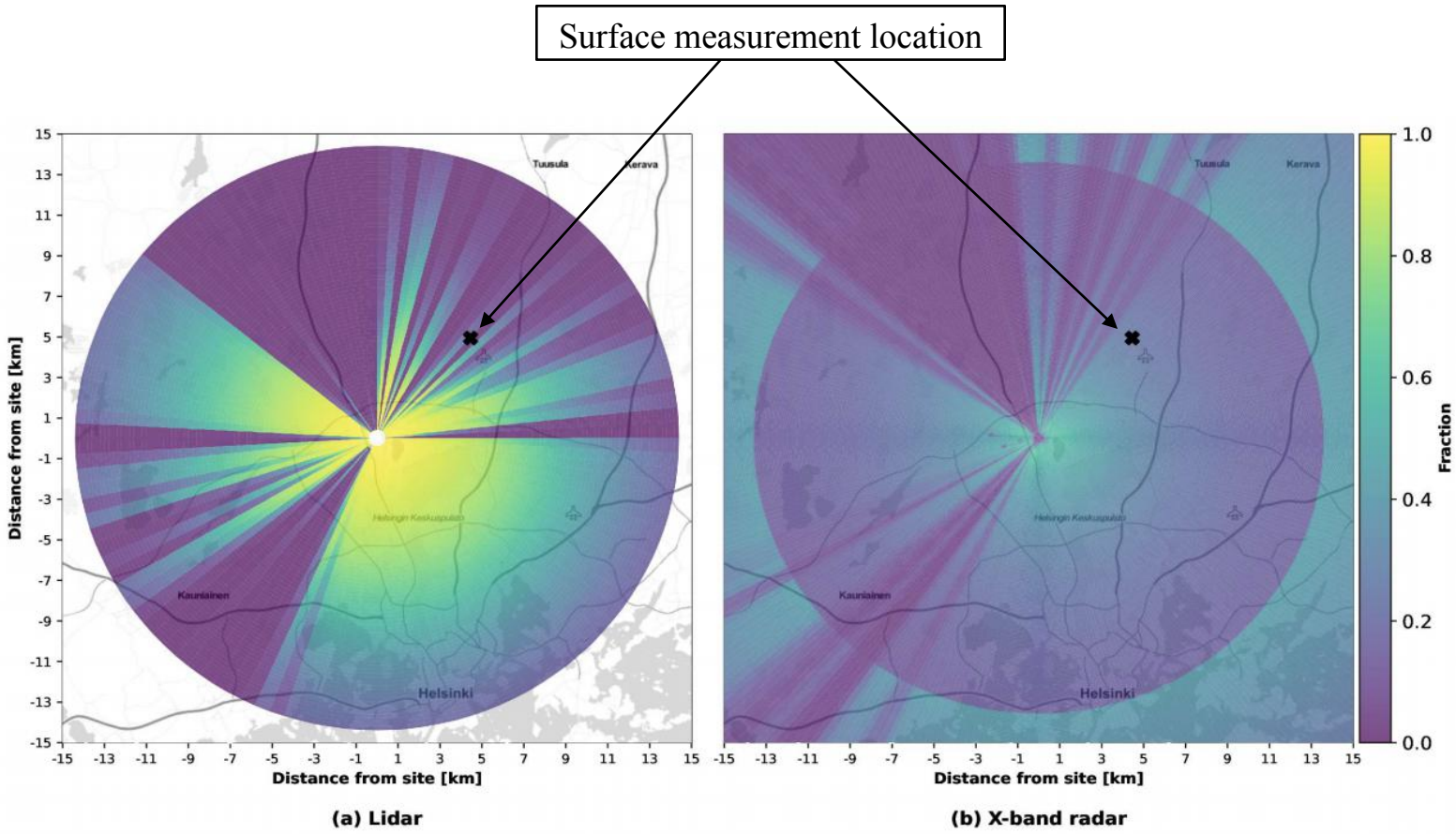
Introduction

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

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

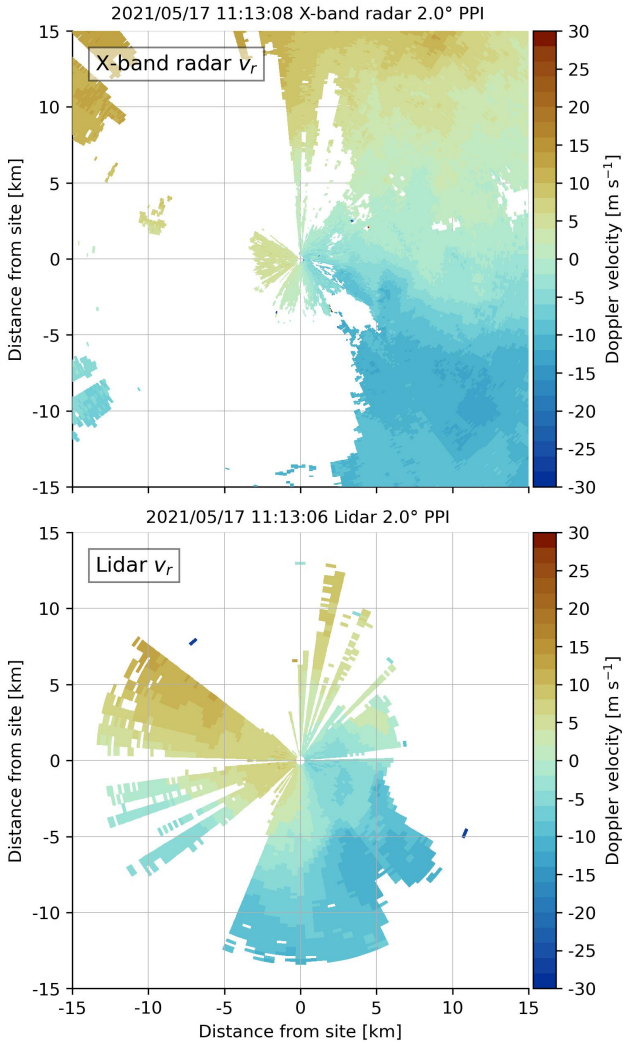
- Aim to quantify differences in measurement performance in different conditions:
  → Horizontal visibility
  → Cloud base height
  → Precipitation intensity

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

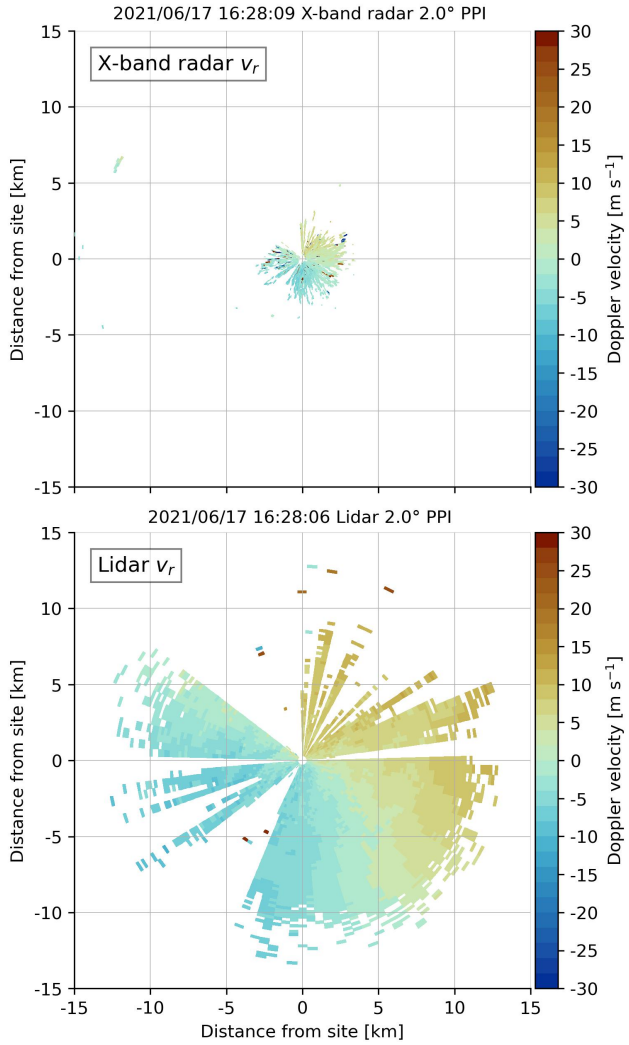


Data availability during the entire campaign

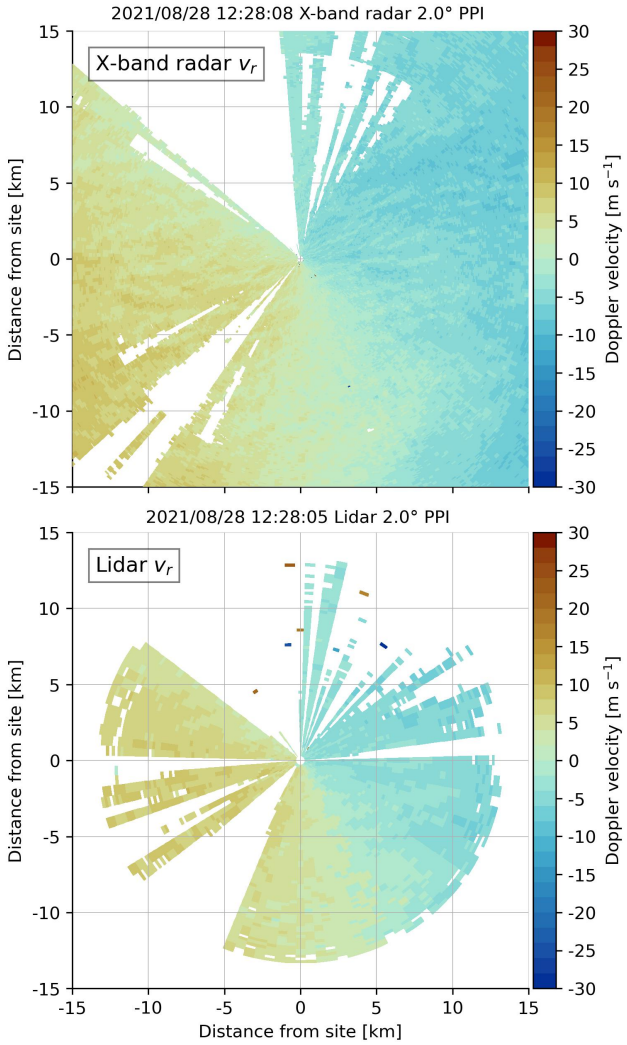
Case examples



Thunderstorm/
precipitation



Clear air, no insects,
horizontal visibility > 60km



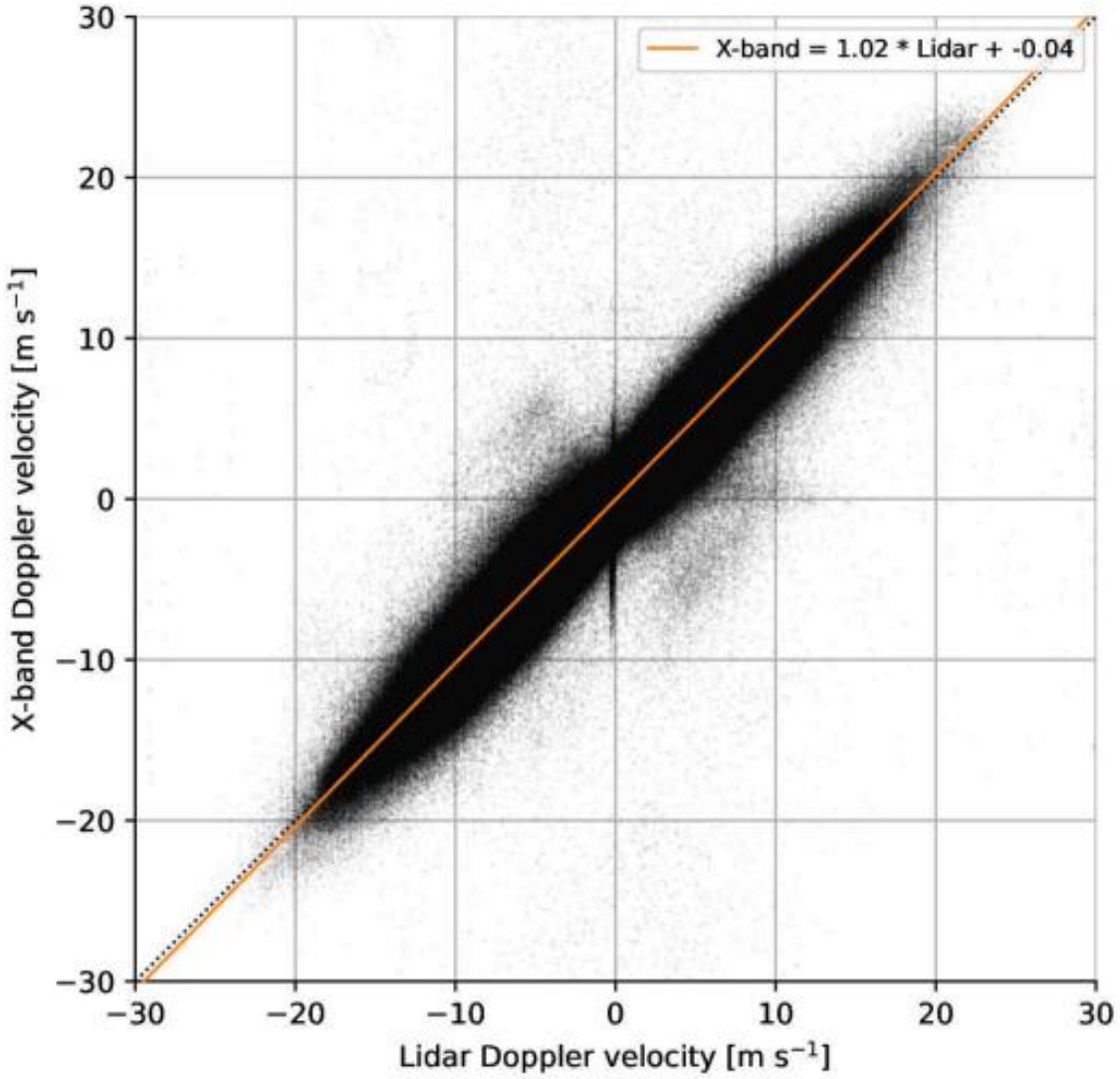
Clear air, insects,
horizontal visibility ~45km

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.

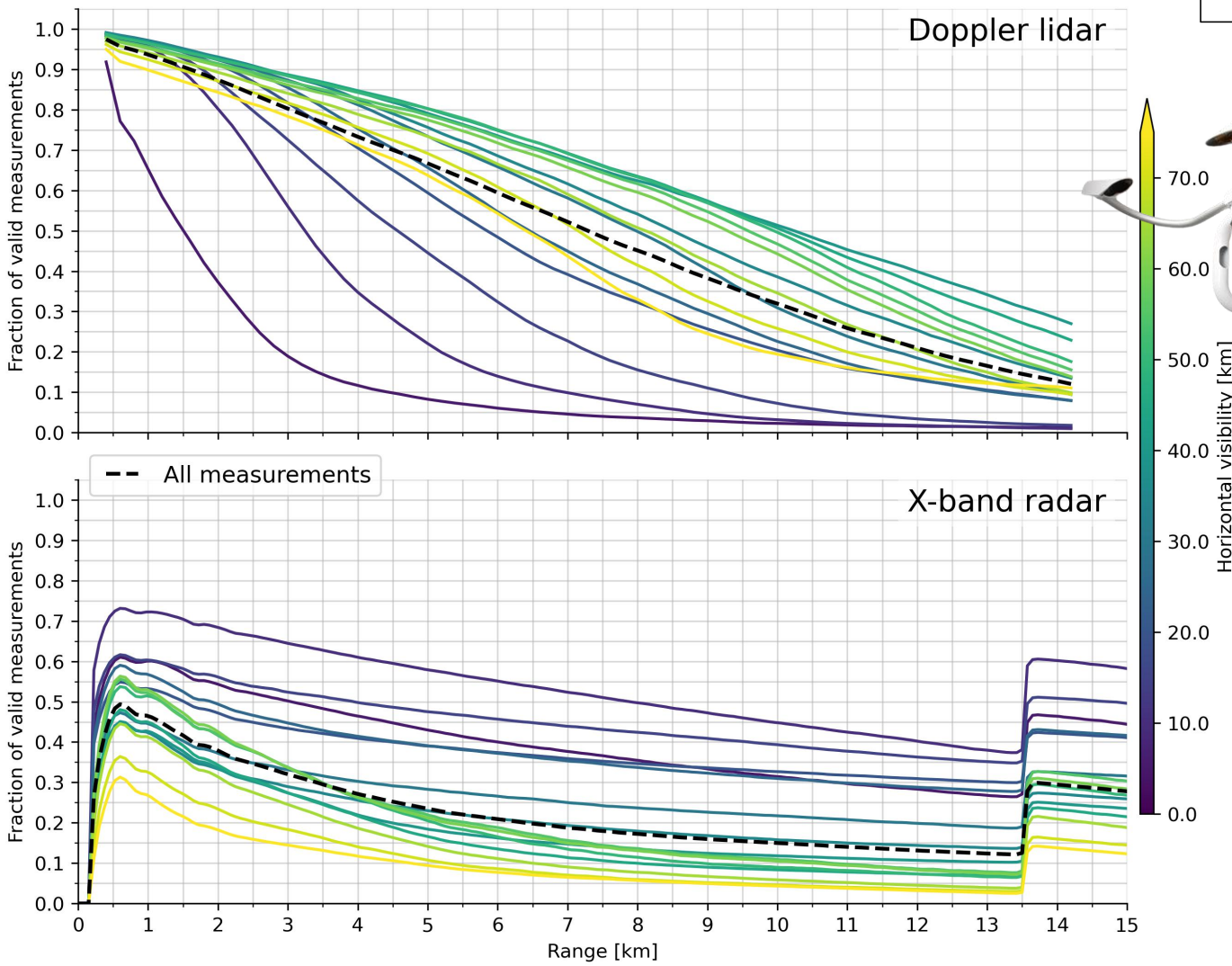


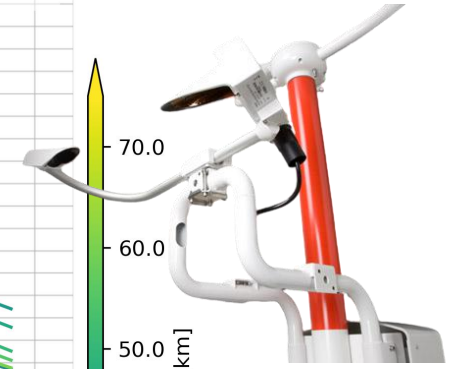
Data availability as function of horizontal visibility

Horizontal visibility: Vaisala FS11P sensor as 1 min average

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.



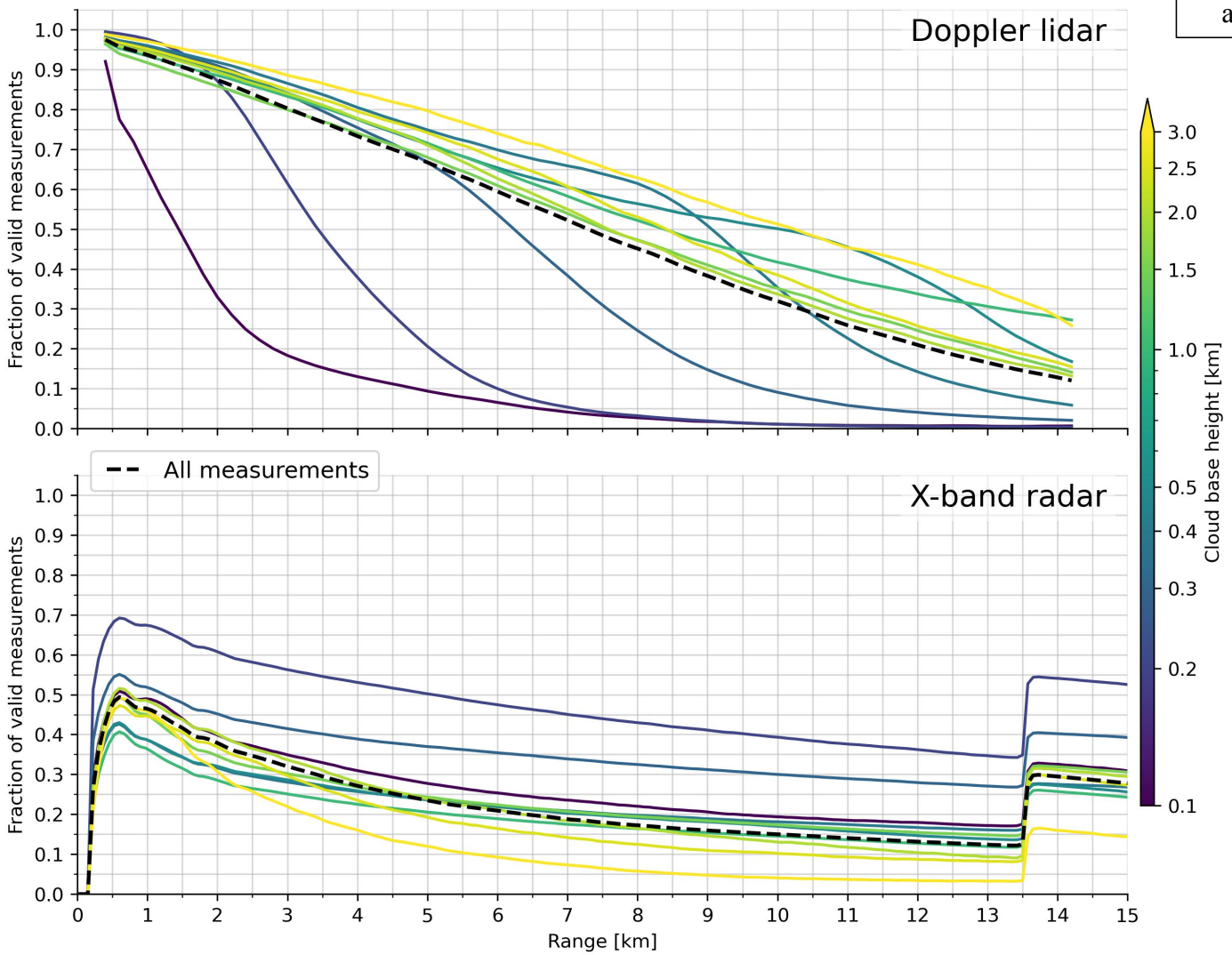


Vaisala FS11P sensor image from https://www.vaisala.com/en/products/weather-environmental-sensors/visibility-present-weather-fs11-fs11p

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

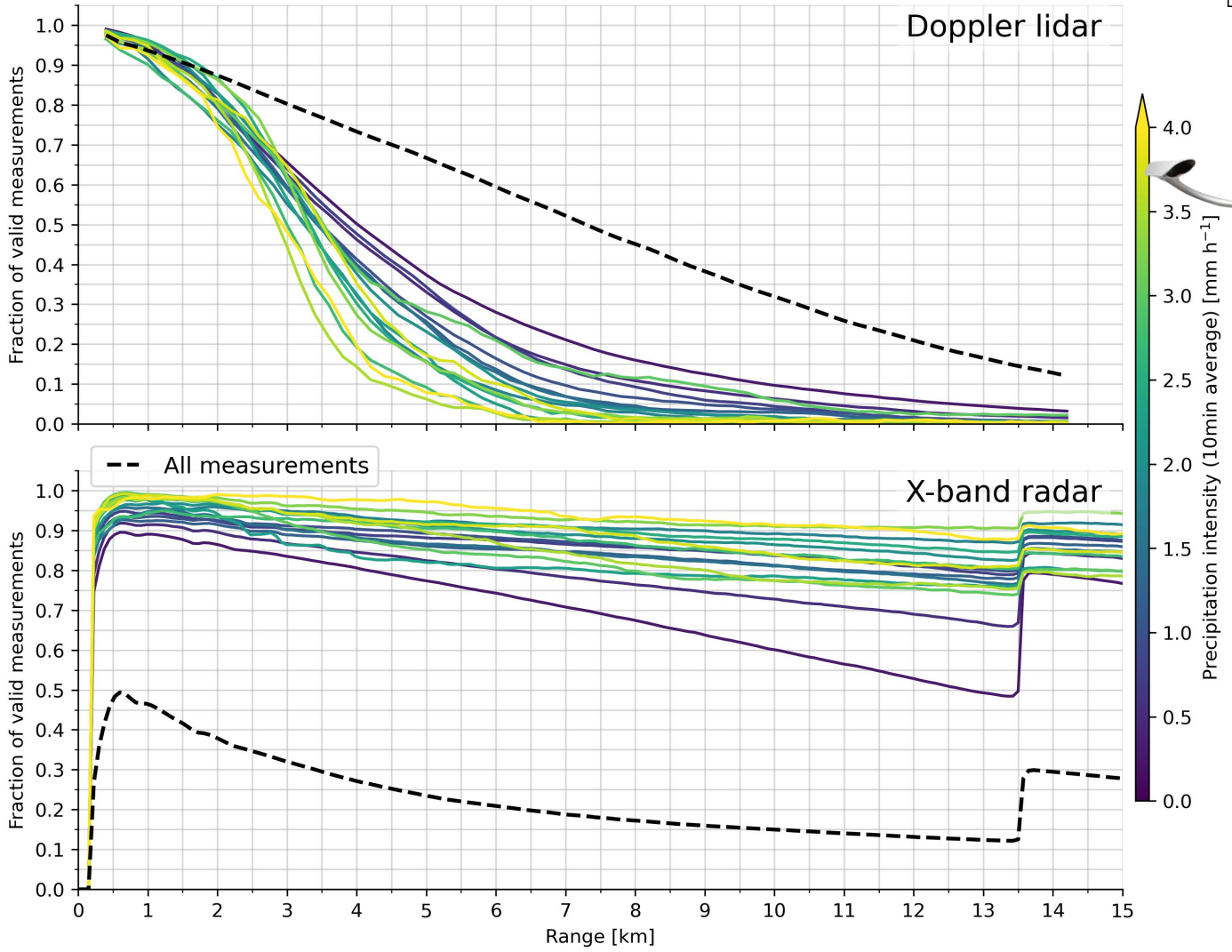
Vaisala CL31 sensor image from https://www.vaisala.com/en/products/weather-environmental-sensors/ceilometers-CL31-CL51-meteorology

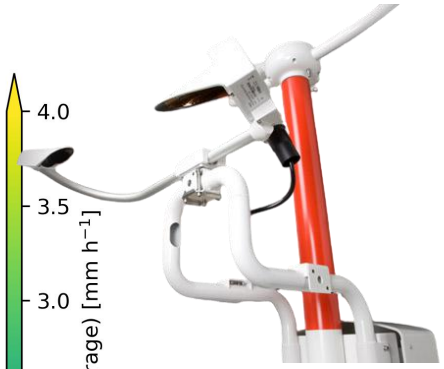
Data availability as function of precipitation intensity

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.





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