



The logo for ACTRIS features a blue arc above the word 'ACTRIS' in a teal, sans-serif font. A vertical teal line extends from the top of the 'A' to a teal circle that forms the 'O'. To the right of this line are three teal circles of increasing size. Below 'ACTRIS' is the word 'CCRES' in a dark blue, sans-serif font.

ACTRIS

CCRES

DL Unit – Operational Services

Ewan O'Connor, Niko Leskinen,
Pyy Pentikäinen

CCRES/CLU Workshop, Matera, 7th November, 2024



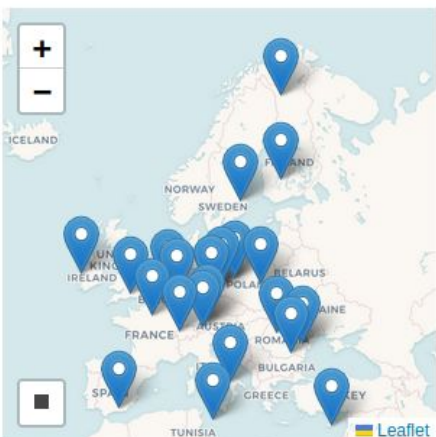
This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreements No 871115

DL processing

- Software-based processing and calibration for Doppler lidar
 - SOP (Standard Operation Procedures) documentation
 - Processing Framework incorporating QC and product algorithms
- Tasks
 - Ensure calibration and uncertainty propagation for Doppler lidars in ACTRIS
 - Pointing angle
 - Doppler velocity
 - Winds
 - Signal-to-noise ratio
 - Attenuated backscatter, uncertainties
 - Products
 - Dissipation rate, wind shear, boundary layer classification



Doppler lidar – products



Location

Select

Show all sites

Date

Current year Last 30 days Today

2024-10-08 — 2024-11-06

Show date range

Product

Doppler lidar wind x
 Doppler lidar x

Show experimental products

Instrument model

Select

Specific instrument

Results

Found 508 results

volatile experimental

| Data object | | Date |
|--|--|------------|
| Doppler lidar from RADO-Bucharest | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar wind from RADO-Bucharest | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar wind from Cabauw | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar from Chilbolton | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar wind from Chilbolton | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar from Jülich | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar wind from Jülich | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar from Leipzig | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar wind from Leipzig | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar from Limassol | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar from Lindenberg | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar wind from Lindenberg | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar from Mindelo | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar wind from Mindelo | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |
| Doppler lidar wind from Payerne | <input type="checkbox"/> <input checked="" type="checkbox"/> | 2024-11-06 |

Click a search result to show a preview.

Support for new instruments



Alphabetical Hierarchy

- data source
- experiment
- instrument
 - instrument model
 - instrument type
 - aerosol particle filter sampler
 - aerosol particle sampler
 - cloud radar
 - electrochemical sensor
 - electron paramagnetic resonance spectrometer
 - gas chromatograph
 - gas sampler
 - gas-phase mass spectrometer
 - high performance liquid chromatograph
 - in situ particle optical parameter instrument
 - inductively coupled plasma spectrometer
 - instrument type unknown
 - ion beam analysis
 - ion chromatograph
 - lidar
 - depolarisation lidar ceilometer
 - differential absorption lidar
 - Doppler lidar**
 - HALO Photonics StreamLine
 - HALO Photonics StreamLine Pro
 - HALO Photonics StreamLine XR
 - HALO Photonics StreamLine XR+
 - Vaisala WindCube 100S
 - Vaisala WindCube 200S
 - Vaisala WindCube 400S
 - Vaisala WindCube WLS70
 - elastic lidar
 - elastic polarization lidar
 - lidar ceilometer
 - multiwavelength Raman lidar
 - multiwavelength Raman polarization lidar
 - Raman lidar
 - Raman polarization lidar

data source > instrument > instrument type > lidar > Doppler lidar

PREFERRED TERM

Doppler lidar

DEFINITION

Active remote sensing instrument operating at near-infrared wavelengths for detecting the scattering and Doppler shift of particles in the atmosphere.

BROADER CONCEPT

[lidar](#)

NARROWER CONCEPTS

- [HALO Photonics StreamLine](#)
- [HALO Photonics StreamLine Pro](#)
- [HALO Photonics StreamLine XR](#)
- [HALO Photonics StreamLine XR+](#)
- [Vaisala WindCube 100S](#)
- [Vaisala WindCube 200S](#)
- [Vaisala WindCube 400S](#)
- [Vaisala WindCube WLS70](#)

CREATOR

<https://orcid.org/0000-0001-9834-5100>

URI

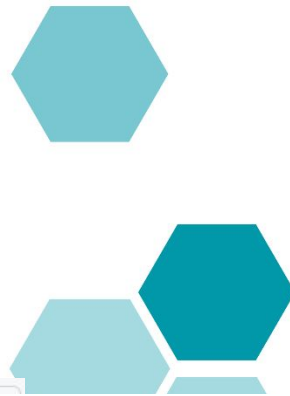
https://vocabulary.actris.nilu.no/actris_vocab/Dopplerlidar

Download this concept:

[RDF/XML](#) [TURTLE](#) [JSON-LD](#)



Processing software



- Doppler lidar processing is a Python package (with some Rust)
 - *doppy*: <https://github.com/actris-cloudnet/doppy>

The screenshot shows the GitHub repository page for 'Doppy - Wind doppler lidar p'. The page is divided into two main sections: the left sidebar and the main content area.

Left Sidebar:

- act
- README
- MIT license
- <> Co

Main Content Area:

Doppy - Wind doppler lidar p

CI passing pypi package 0.2.2

Products

- [Stare: Examples](#)
- [Wind: Examples](#)

Instruments

- HALO Photonics Streamline lidars (stare, wind)
- Leosphere WindCube WLS200S (wind)
- Leosphere WindCube WLS70 (wind)

Install

```
pip install doppy
```

Usage

```
import doppy

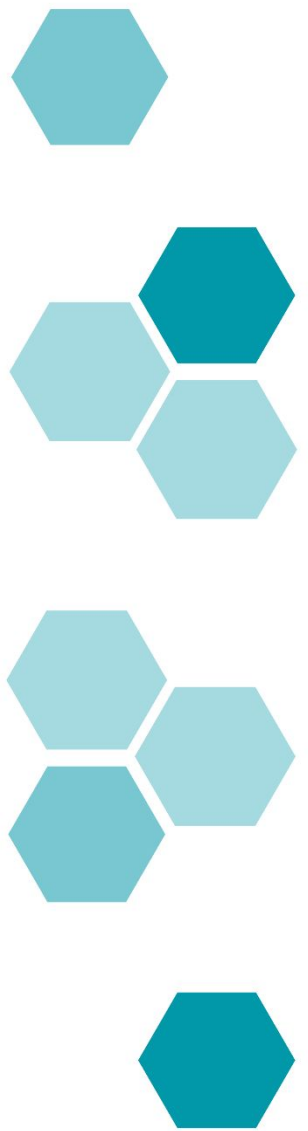
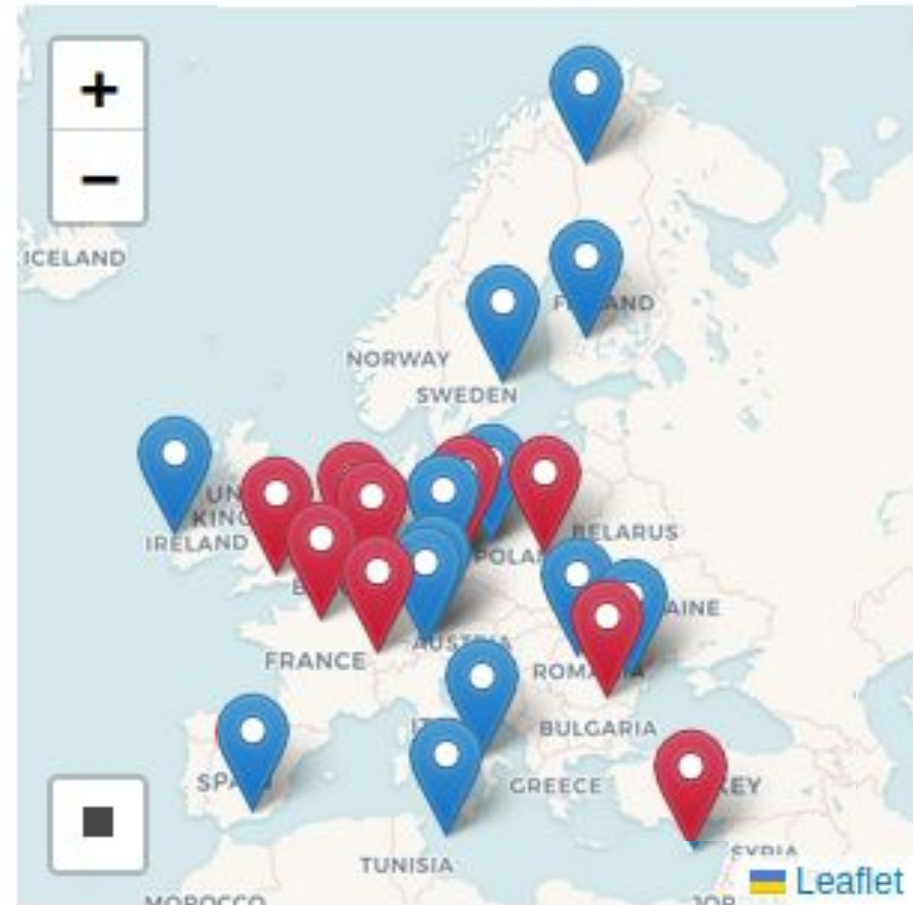
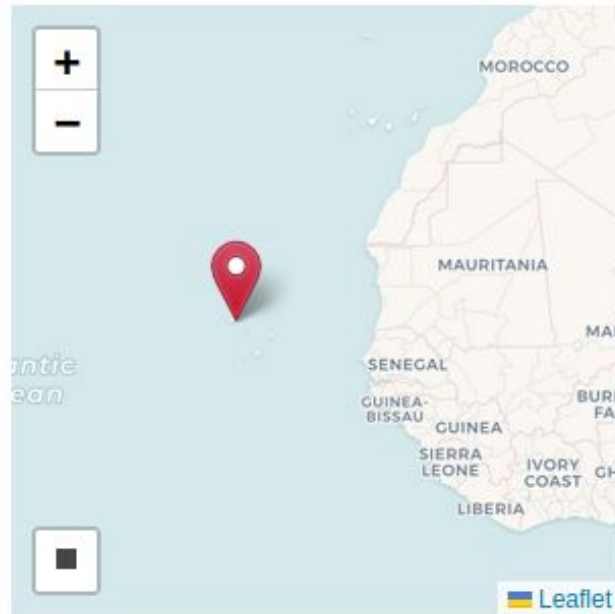
stare = doppy.product.Stare.from_halo_data(
    data=LIST_OF_STARE_FILE_PATHS,
    data_bg=LIST_OF_BACKGROUND_FILE_PATHS,
    bg_correction_method=doppy.options.BgCorrectionMethod.FIT,
)

(
    doppy.netcdf.Dataset(FILENAME)
    .add_dimension("time")
    .add_dimension("range")
    .add_time(
        name="time",
        dimensions=("time",),
        standard_name="time",
        long_name="Time UTC",
        data=stare.time,
        dtype="f8",
    )
    .add_variable(
        name="range",
        dimensions=("range",),
        units="m",
        data=stare.radial_distance,
        dtype="f4",
    )
)
```



Doppler lidar instruments

- 12 systems operational
- Another 9 in the database



Instrument – landing page

INOE HALO

HALO Photonics StreamLine Doppler lidar

[Overview](#) [Raw files](#) [Calibration](#)

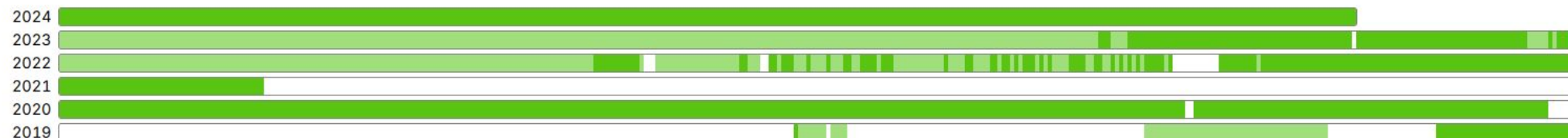
Instrument

| | |
|----------------------|---|
| PID | https://hdl.handle.net/21.12132/3.db58480f58ca49ad |
| Owner | National Institute of Research and Development for Optoelectronics (INOE) |
| Model | StreamLine XR |
| Type | Doppler lidar |
| Serial number | 158 |

Locations

2019-06-26 – now [RADO-Bucharest](#)

Product availability



All products Some products No products


Visualisation

Products

Year

Select

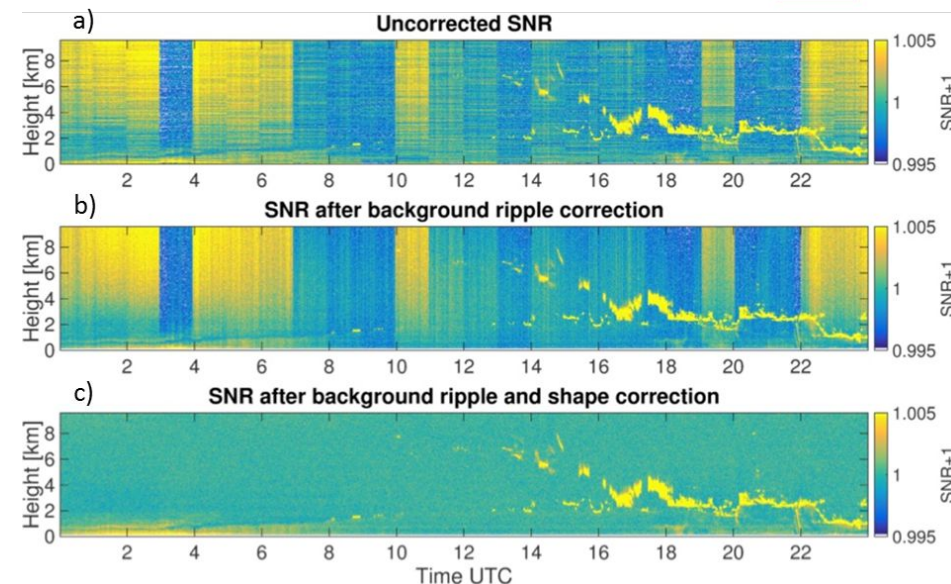
Instrument - overview

|  Cloudnet DATA PORTAL | Search data | Visualise data | Documentation | Sites | Instruments | Publications | Contact |
|---|-------------|----------------|---------------------|---------------------|-------------|--------------|---------|
| VAD_118_20241030_202514.hpl | 268.5 kB | processed | 2024-10-30 20:30:44 | 2024-10-30 20:30:44 | | | |
| VAD_118_20241030_203518.hpl | 268.8 kB | processed | 2024-10-30 21:00:38 | 2024-10-30 21:00:38 | | | |
| VAD_118_20241030_204520.hpl | 268.1 kB | processed | 2024-10-30 21:00:34 | 2024-10-30 21:00:35 | | | |
| VAD_118_20241030_205523.hpl | 268.2 kB | processed | 2024-10-30 21:00:38 | 2024-10-30 21:00:38 | | | |
| VAD_118_20241030_210523.hpl | 268.6 kB | processed | 2024-10-30 21:30:50 | 2024-10-30 21:30:50 | | | |
| VAD_118_20241030_211525.hpl | 268.3 kB | processed | 2024-10-30 21:30:47 | 2024-10-30 21:30:47 | | | |
| VAD_118_20241030_212527.hpl | 268.6 kB | processed | 2024-10-30 21:30:48 | 2024-10-30 21:30:48 | | | |
| Background_301024-000014.txt | 5.9 kB | uploaded | 2024-10-30 01:30:38 | 2024-10-30 01:30:38 | | | |
| Background_301024-010013.txt | 5.9 kB | uploaded | 2024-10-30 01:30:32 | 2024-10-30 01:30:33 | | | |
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| Background_301024-060013.txt | 5.9 kB | uploaded | 2024-10-30 06:30:45 | 2024-10-30 06:30:45 | | | |
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| Background_301024-080014.txt | 5.9 kB | uploaded | 2024-10-30 08:30:46 | 2024-10-30 08:30:46 | | | |
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| Background_301024-100011.txt | 5.9 kB | uploaded | 2024-10-30 10:30:31 | 2024-10-30 10:30:31 | | | |
| Background_301024-110013.txt | 5.9 kB | uploaded | 2024-10-30 11:30:51 | 2024-10-30 11:30:51 | | | |
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| Background_301024-130011.txt | 5.9 kB | uploaded | 2024-10-30 13:30:43 | 2024-10-30 13:30:43 | | | |
| Background_301024-140011.txt | 5.9 kB | uploaded | 2024-10-30 14:30:43 | 2024-10-30 14:30:43 | | | |
| Background_301024-150014.txt | 5.9 kB | uploaded | 2024-10-30 15:30:47 | 2024-10-30 15:30:47 | | | |
| Background_301024-160014.txt | 5.9 kB | uploaded | 2024-10-30 16:30:33 | 2024-10-30 16:30:33 | | | |
| Background_301024-170015.txt | 5.9 kB | uploaded | 2024-10-30 17:30:46 | 2024-10-30 17:30:46 | | | |
| Background_301024-180013.txt | 5.9 kB | uploaded | 2024-10-30 18:30:37 | 2024-10-30 18:30:37 | | | |
| Background_301024-190014.txt | 5.9 kB | uploaded | 2024-10-30 19:30:46 | 2024-10-30 19:30:46 | | | |
| Background_301024-200015.txt | 5.9 kB | uploaded | 2024-10-30 20:30:47 | 2024-10-30 20:30:47 | | | |

Automatic calibration procedures

Background correction and uncertainty calculation

- Uncertainty (SNR and v) depends on SNR
- Correct SNR – Halo systems
 - May be temperature dependent
 - [Manninen et al. 2016, Vakkari et al., 2019](#)
- Update SNR and radial velocity uncertainties



Automatic calibration procedures

Background correction and uncertainty calculation

- Uncertainty (SNR and v) depends on SNR
- Correct SNR – Vaisala (Leosphere) systems
 - Issues noted for some (older?) systems
 - Similar but not quite the same as for Halo
 - [Work in progress!](#)
- Update SNR and radial velocity uncertainties



Automatic calibration procedures

Wind calibration – together with PROBE

- Pointing angle check (azimuth and elevation)
 - Comparison with NWP (not all sites)
 - Comparison with weather station
- Uncertainty provision and turbulent impact
 - Scan sequence and retrieval method



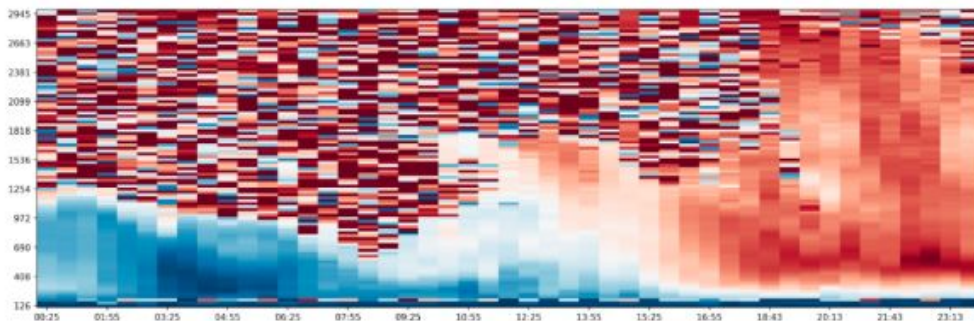
Instrument monitoring - winds

- Start with NWP – will also use weather station, mast, radiosondes where possible
- Model-observation intercomparison

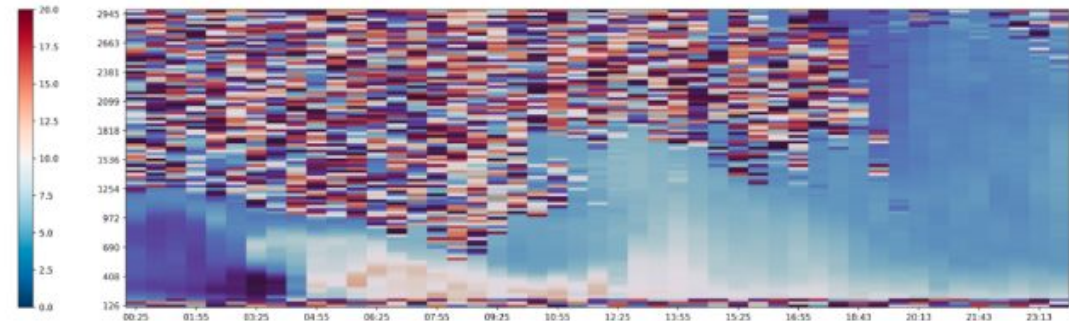
Pentikäinen, P., O'Connor, E. J., and Ortiz-Amezcu, P.: Evaluating wind profiles in a numerical weather prediction model with Doppler lidar, Geosci. Model Dev., 16, 2077–2094, <https://doi.org/10.5194/gmd-16-2077-2023>, 2023.

Warsaw
2023-10-13

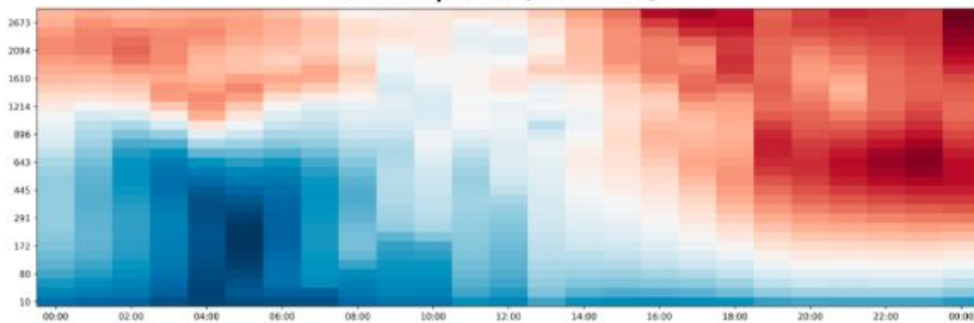
Wind speed (Halo)



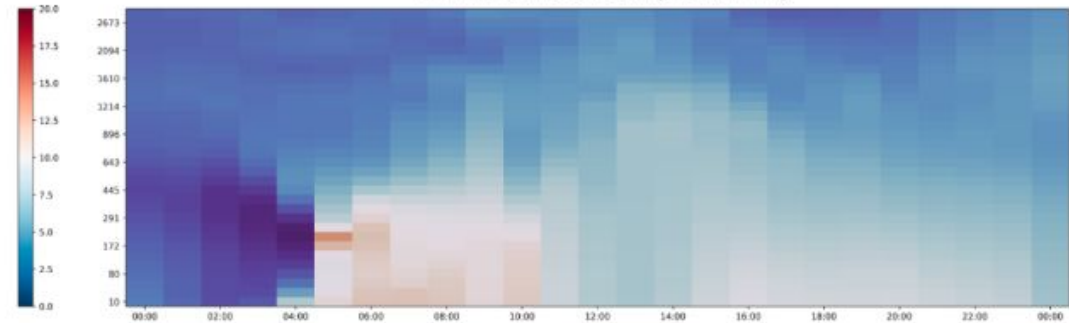
Wind direction (Halo)



Wind speed (ECMWF)



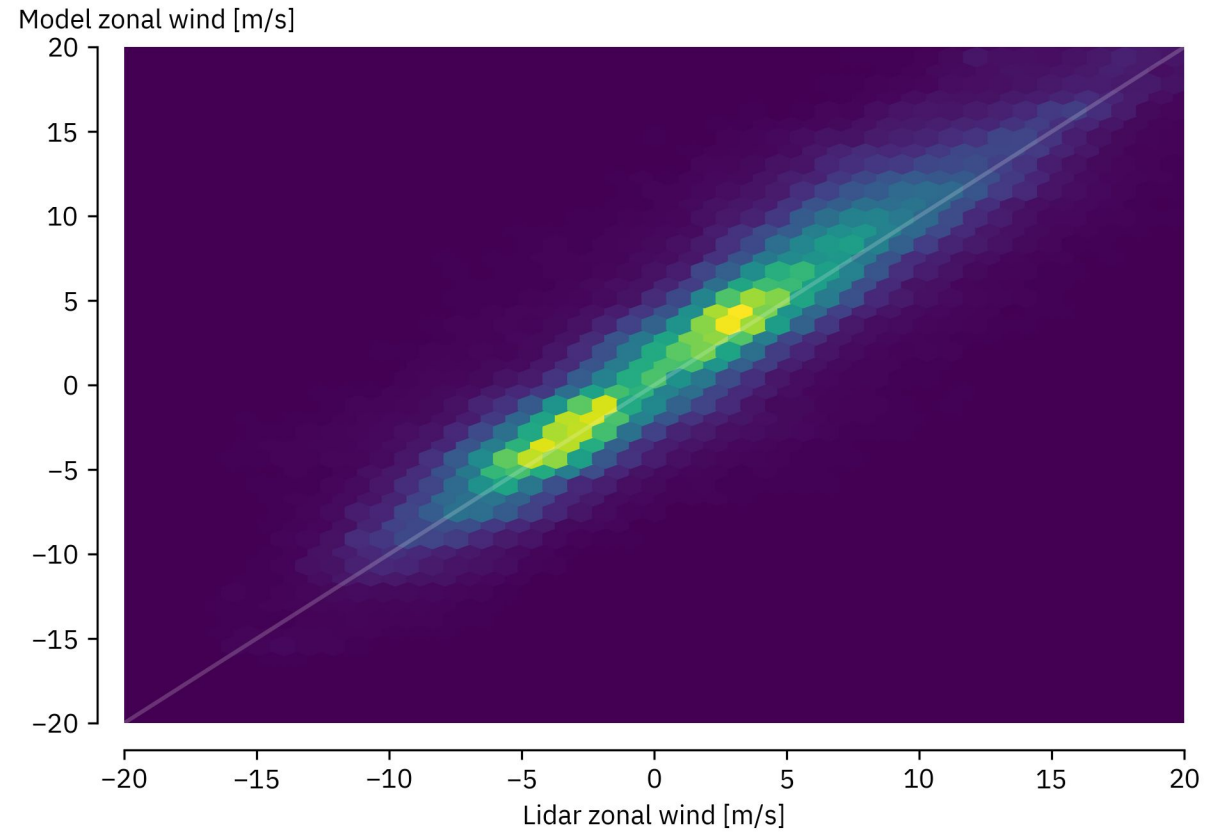
Wind direction (ECMWF)



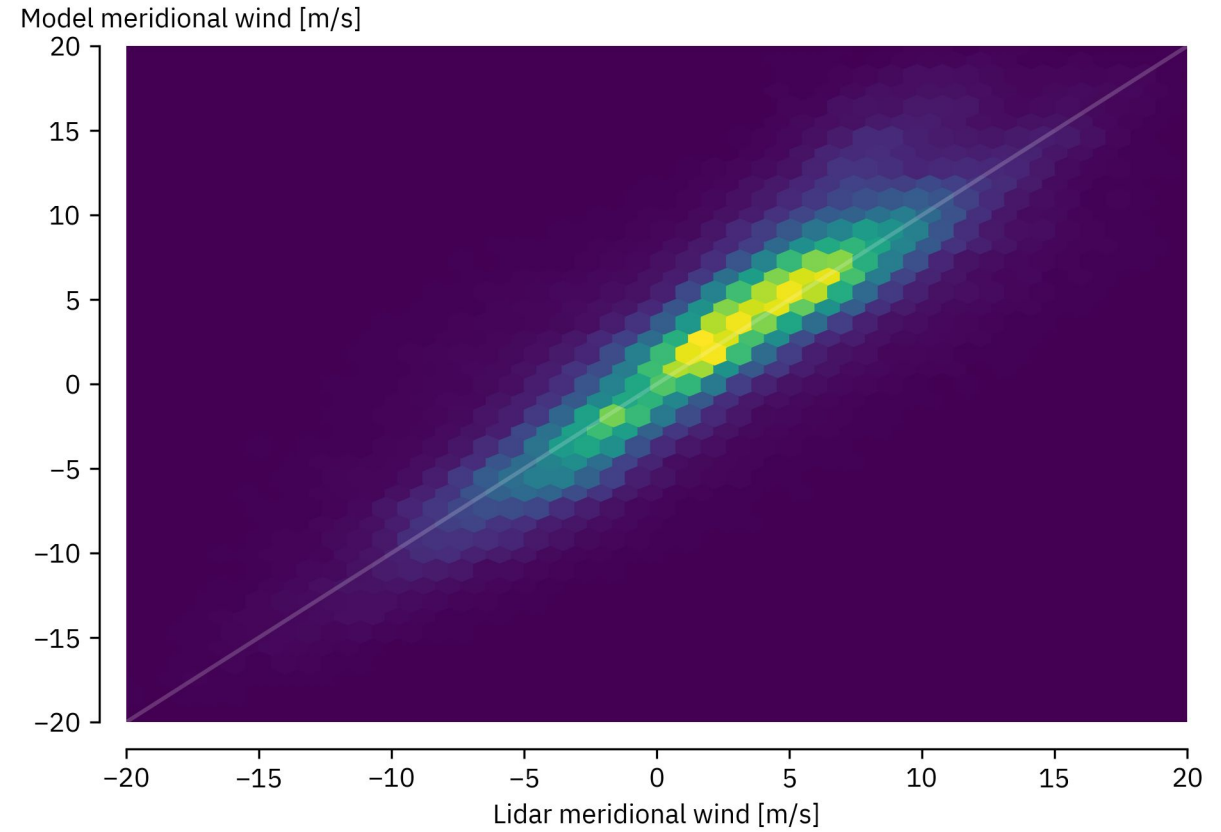
Monitoring with NWP



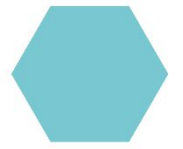
warsaw 2024-01-01 - 2024-12-31



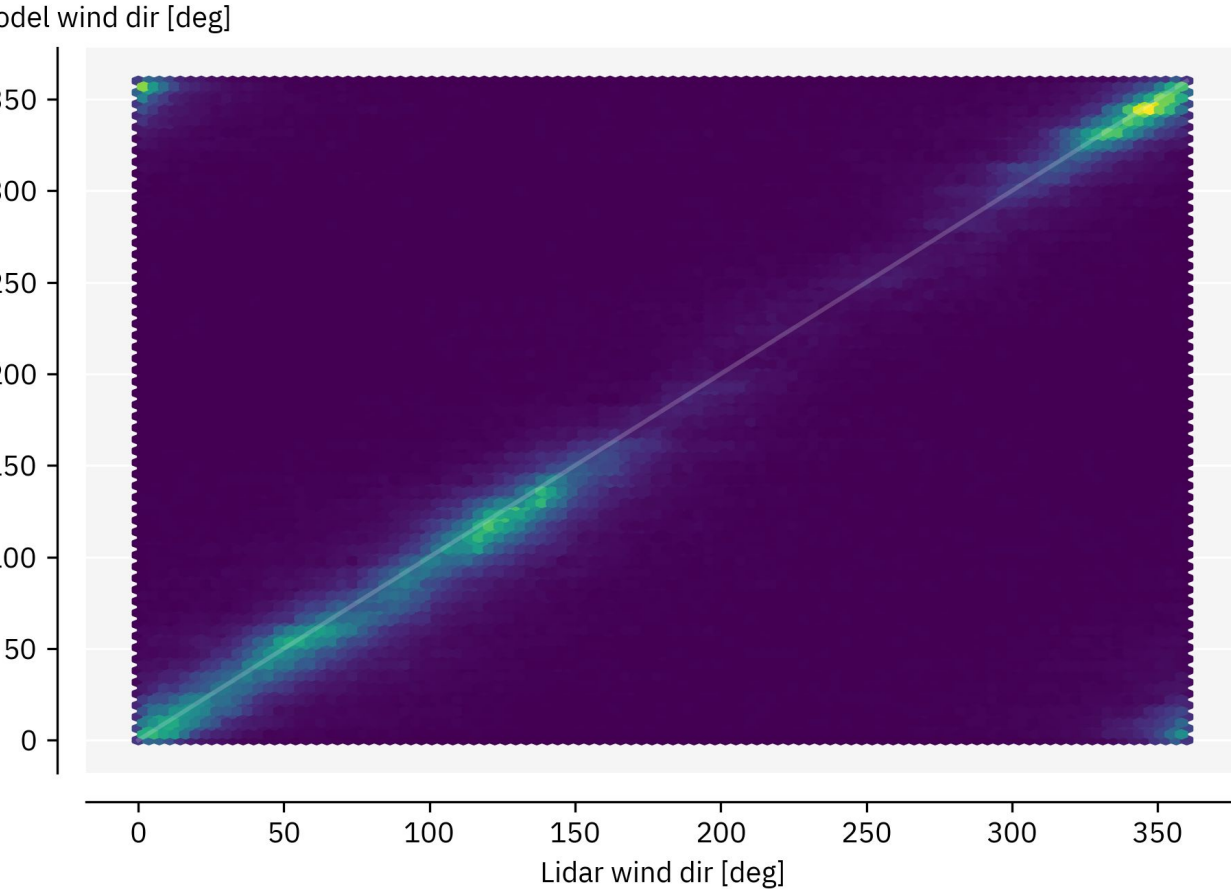
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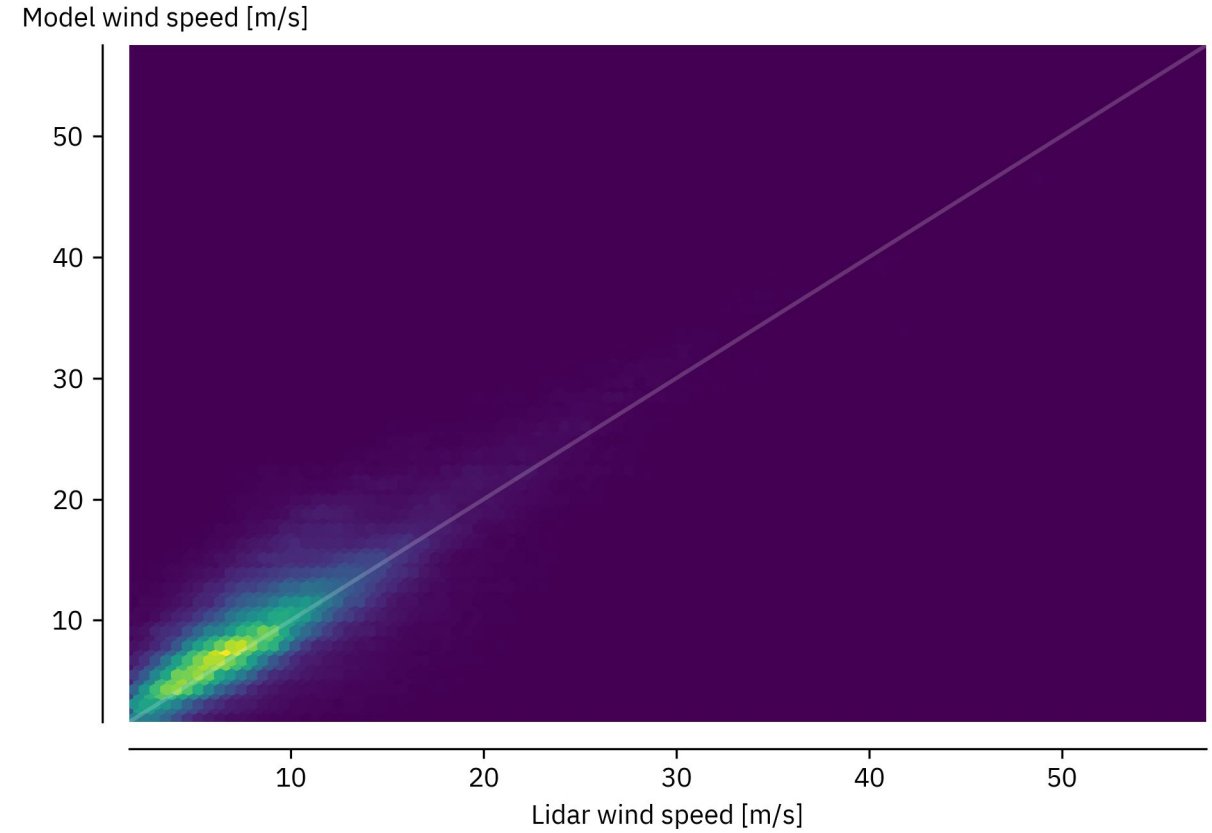
Monitoring with NWP



warsaw 2024-01-01 - 2024-12-31



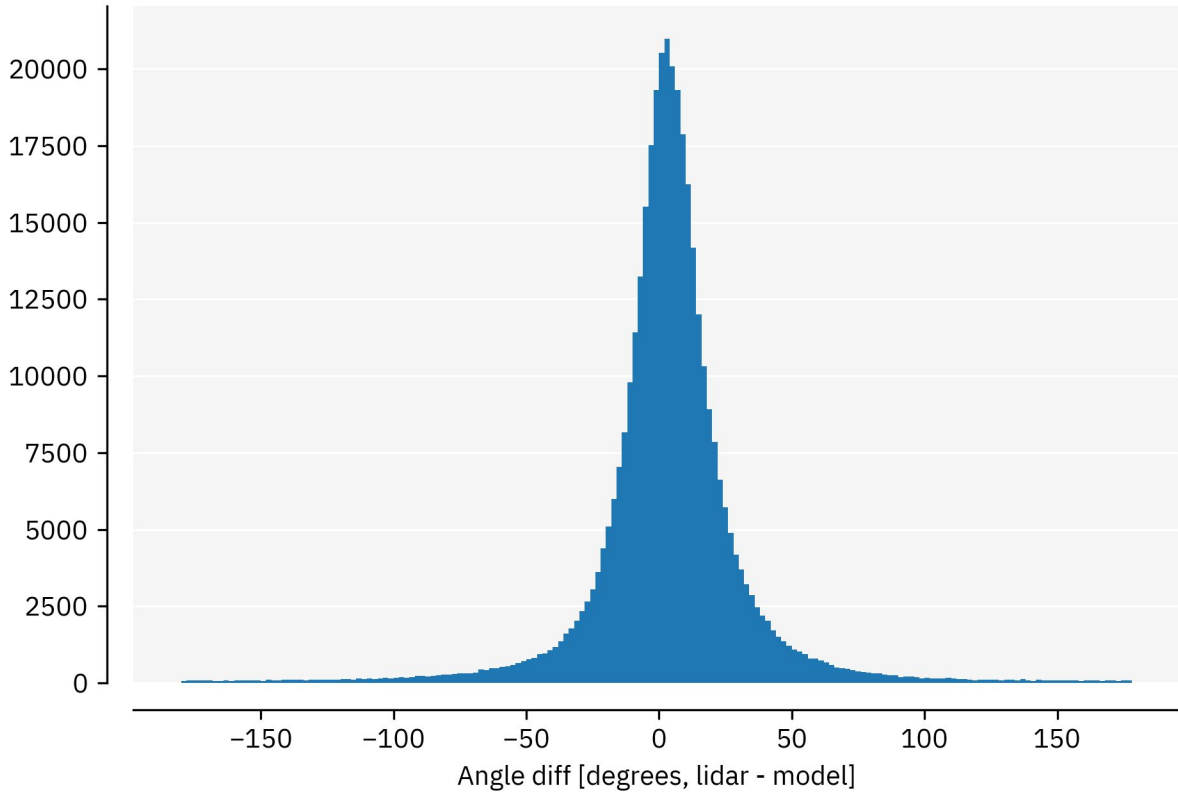
warsaw 2024-01-01 - 2024-12-31



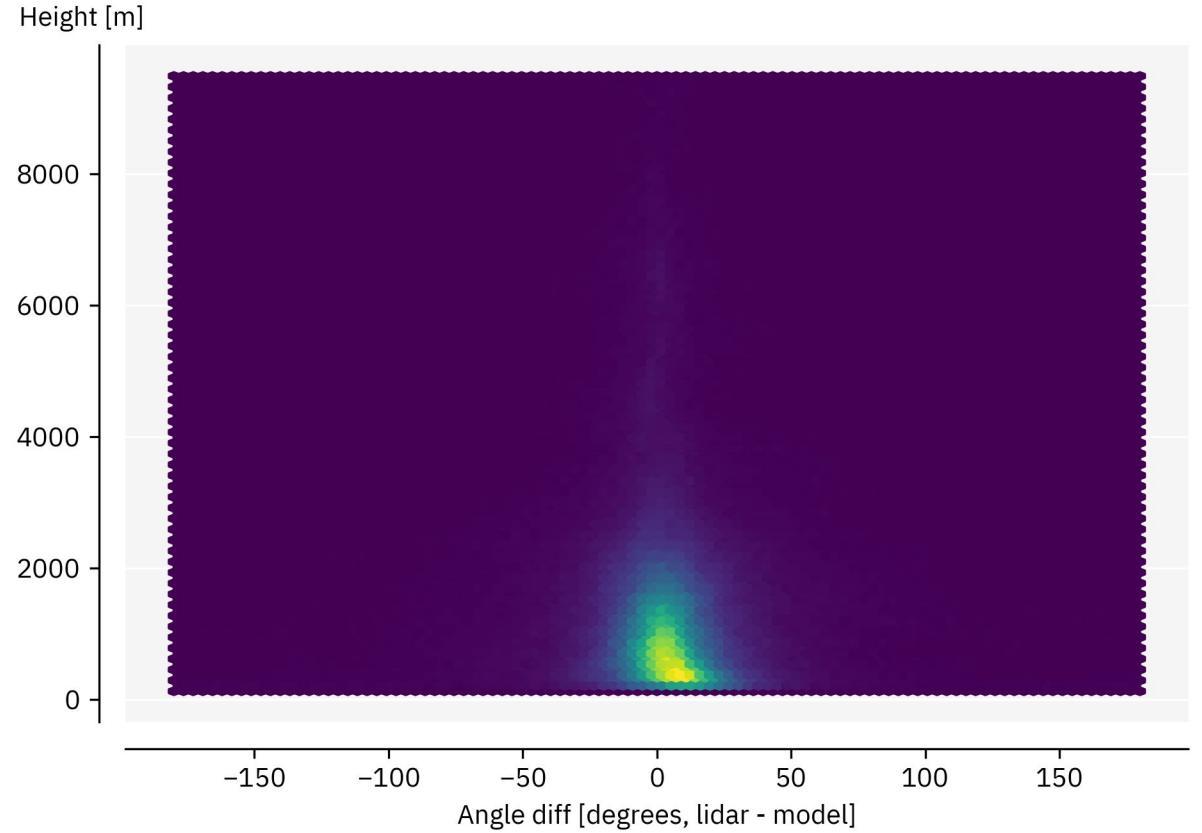
Monitoring with NWP



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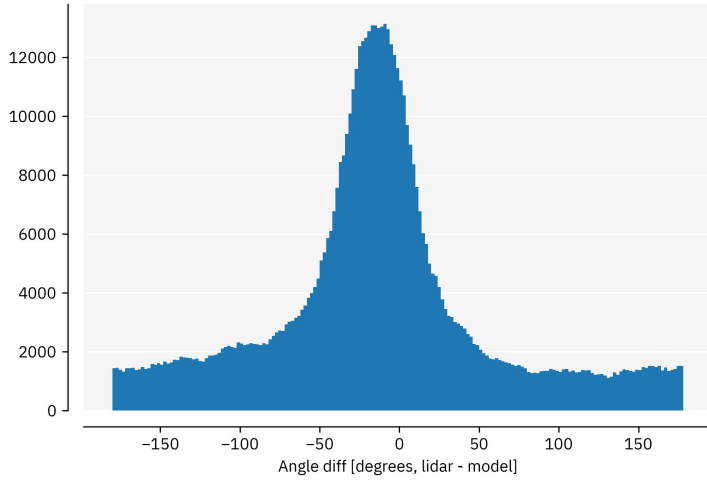


warsaw 2024-01-01 - 2024-12-31

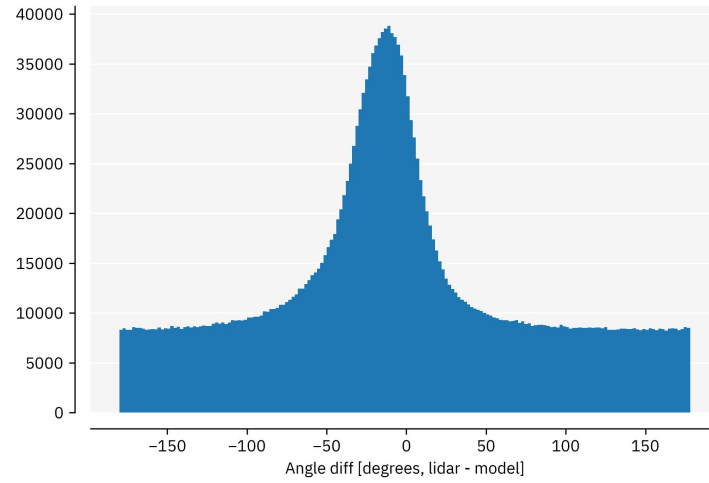


Monitoring with NWP

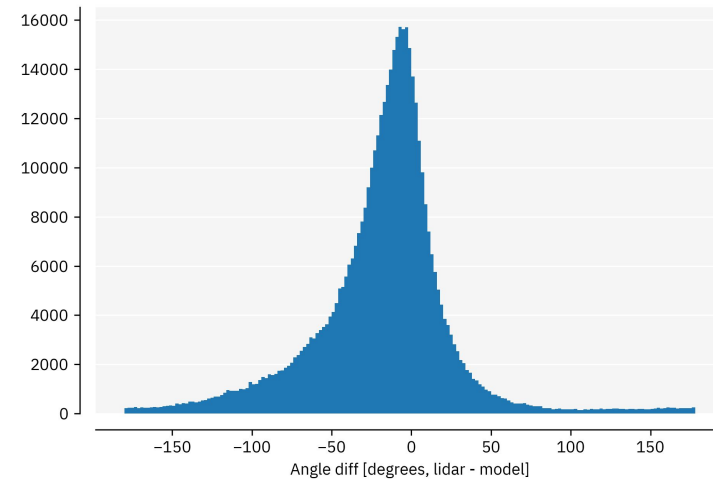
bucharest 2023-01-01 - 2023-12-31



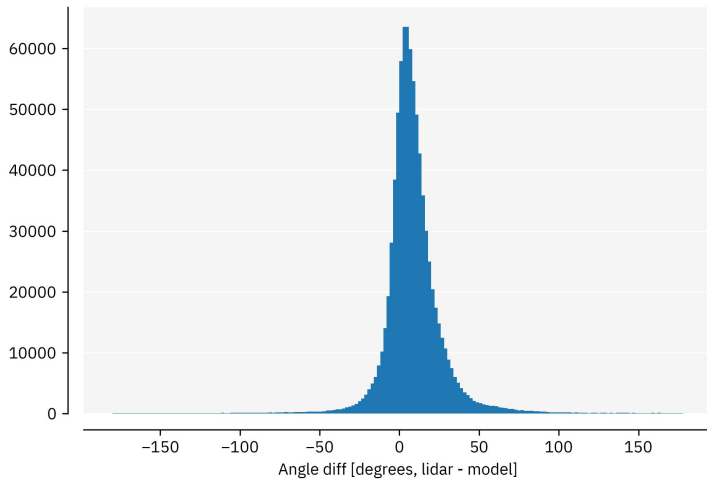
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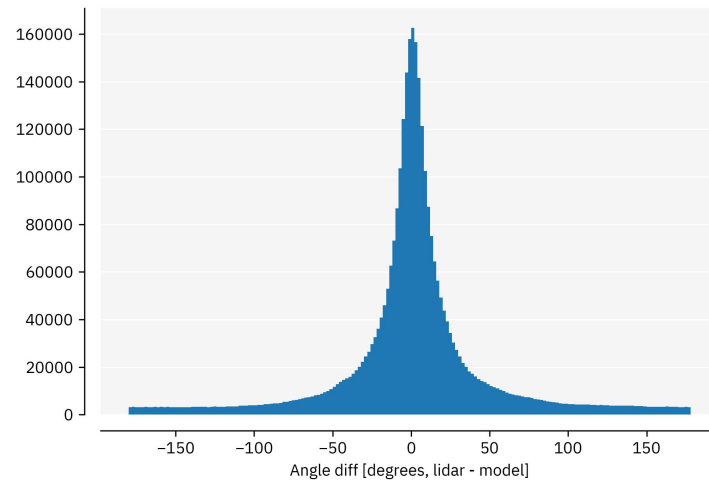
juelich 2024-01-01 - 2024-12-31



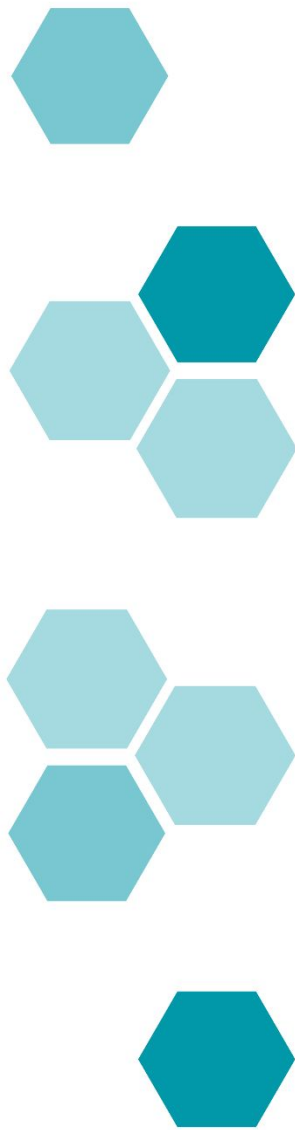
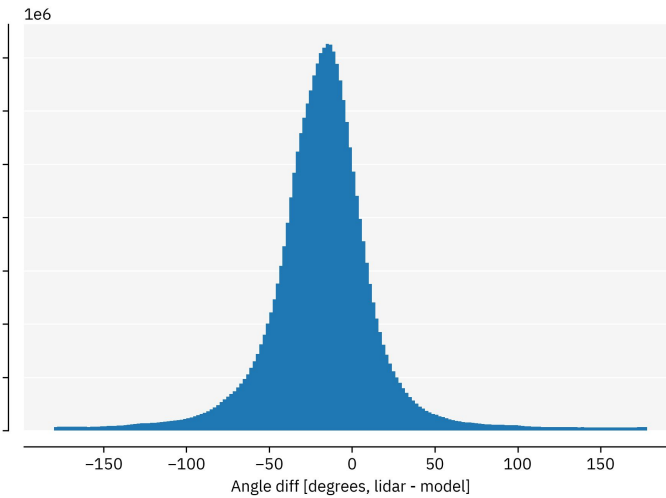
lindenberg 2023-01-01 - 2023-12-31



neumayer 2024-01-01 - 2024-12-31



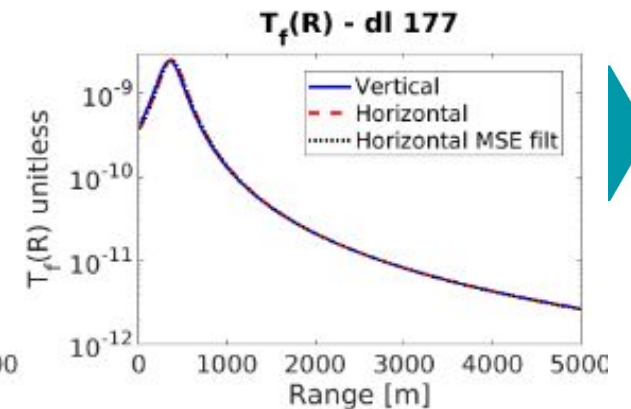
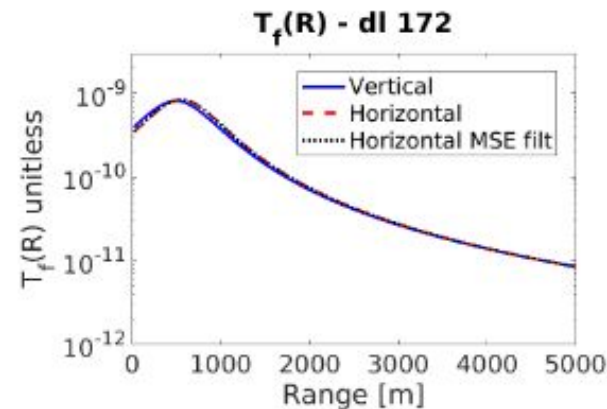
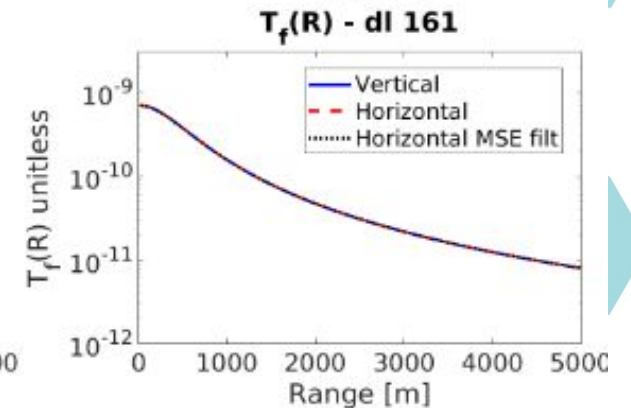
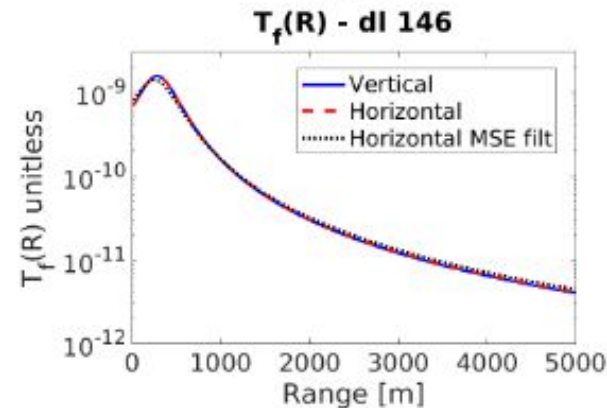
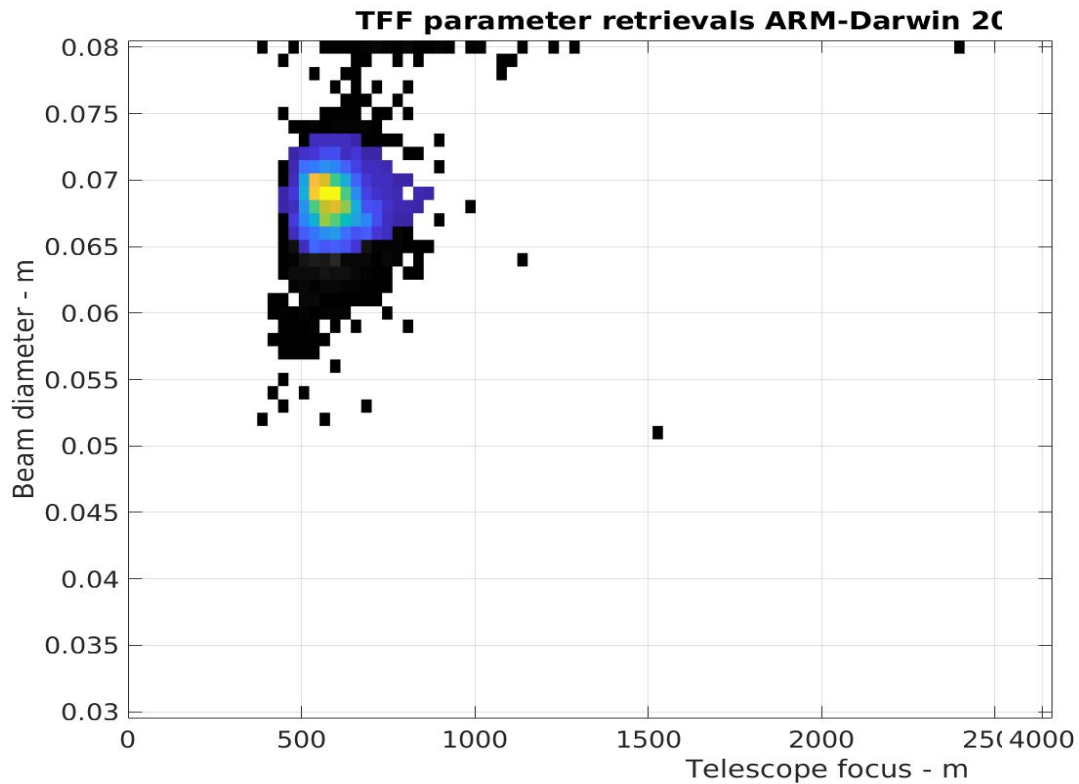
palaiseau 2023-01-01 - 2023-12-31



Automatic calibration procedures

Attenuated backscatter calibration

- Liquid cloud calibration ([O'Connor et al. 2004](#), [Hopkin et al. 2019](#))
- Telescope focus function required ([Pentikäinen et al. 2020](#))



Instrument – landing page

INOE HALO

HALO Photonics StreamLine Doppler lidar

[Overview](#) [Raw files](#) [Calibration](#)

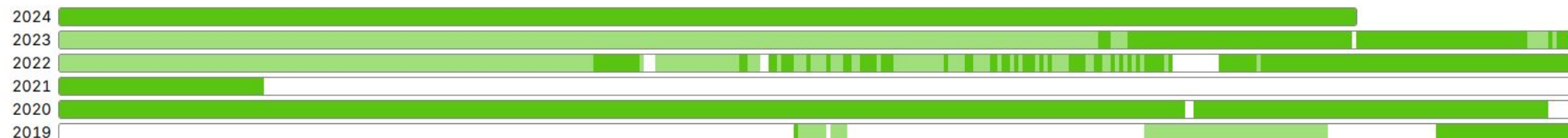
Instrument

| | |
|----------------------|---|
| PID | https://hdl.handle.net/21.12132/3.db58480f58ca49ad |
| Owner | National Institute of Research and Development for Optoelectronics (INOE) |
| Model | StreamLine XR |
| Type | Doppler lidar |
| Serial number | 158 |

Locations

2019-06-26 – now [RADO-Bucharest](#)

Product availability



All products Some products No products

Visualisation

Products

Year

Select

Instrument - calibration

FMI HALO 146

HALO Photonics StreamLine Doppler lidar

[Overview](#)

[Raw files](#)

[Calibration](#)

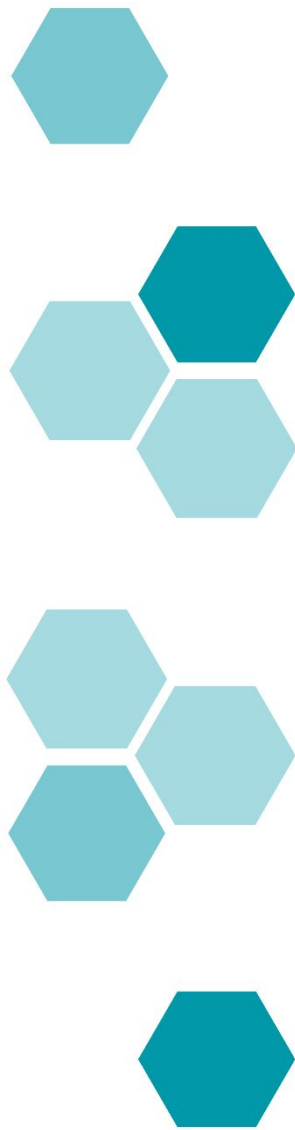
Azimuth offsets

| Date | Azimuth offset (deg) | Updated at |
|------------|----------------------|-------------------------|
| 2022-08-23 | -30 | 2024-08-06 13:44:53 UTC |
| 2023-05-08 | -120 | 2024-08-06 13:41:00 UTC |

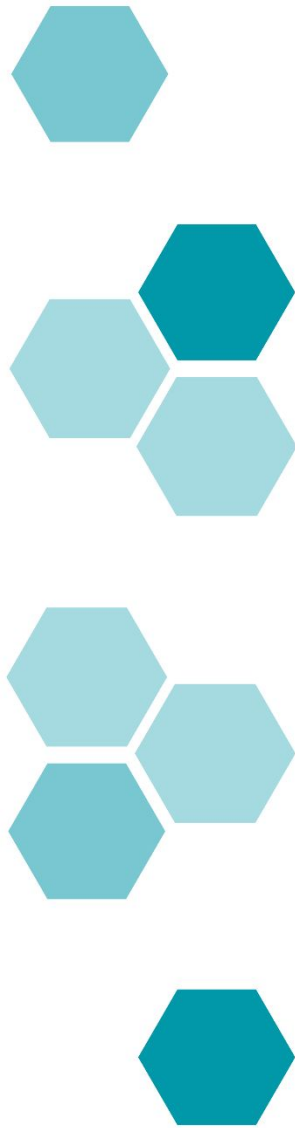
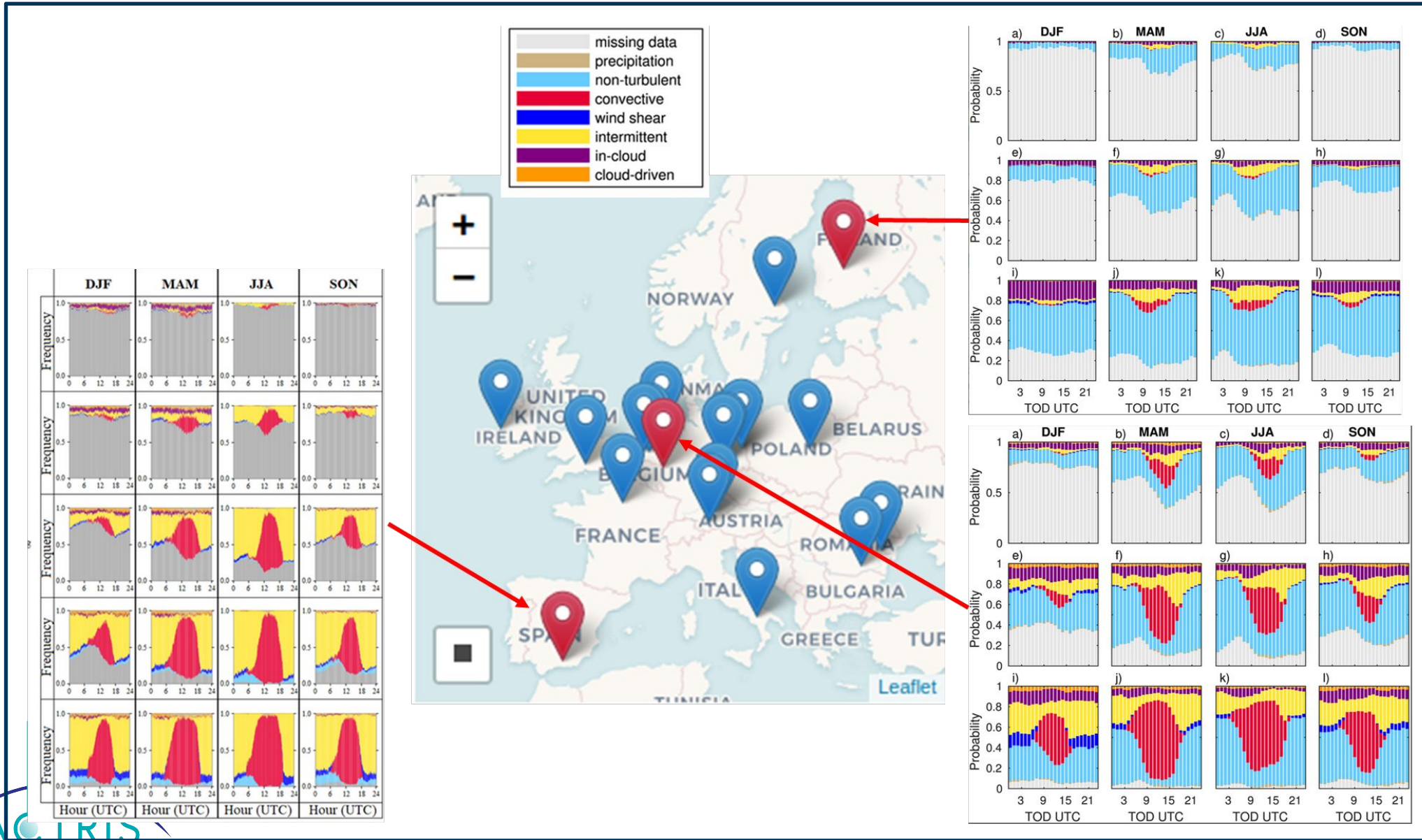
[Data in calibration API](#)

Roadmap

- This year
 - Monitoring
 - Background and horizontal winds (azimuth correction)
 - Housekeeping data (to Grafana dashboards)
- Next year
 - Focus correction
 - Calibration
 - Attenuated backscatter coefficient
 - Extend products
 - Turbulent classification
 - Low level jets
 - Level 3 (climatologies and model evaluation)



Roadmap





Thank you

CCRES DL Unit

Doppler lidar: Halo Photonics,
Vaisala



Doppler lidar products:
Winds, wind shear, skewness,
dissipation rate,
BL classification

