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EUMETNET

Operational data processing for ground-based remote sensing of the atmosphere on the EWC

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With contribution from the E-Profile and EULIAA teams

EWC user workshop, 18.09.2025

Funded by
the European Union

E-Profile

Observation networks for the vertical profiling of wind, aerosols, temperature, clouds and humidity

EUMETNET Observation Programme for atmospheric vertical profiling

- Centralized data processing, monitoring and real-time data distribution
- Focus on operational meteorology and data assimilation in NWP (ECMWF)
- 3 networks of ground-based remote sensing instruments:

Wind:

- Radar wind profilers (RWP) / Weather radar wind profilers (WRWP) / Doppler wind lidars (DWL)

Ash, Aerosols and clouds

- Automatic lidars and ceilometers (ALC)

ABL temperature profiles and humidity

- Microwave radiometers (MWR)

MWR

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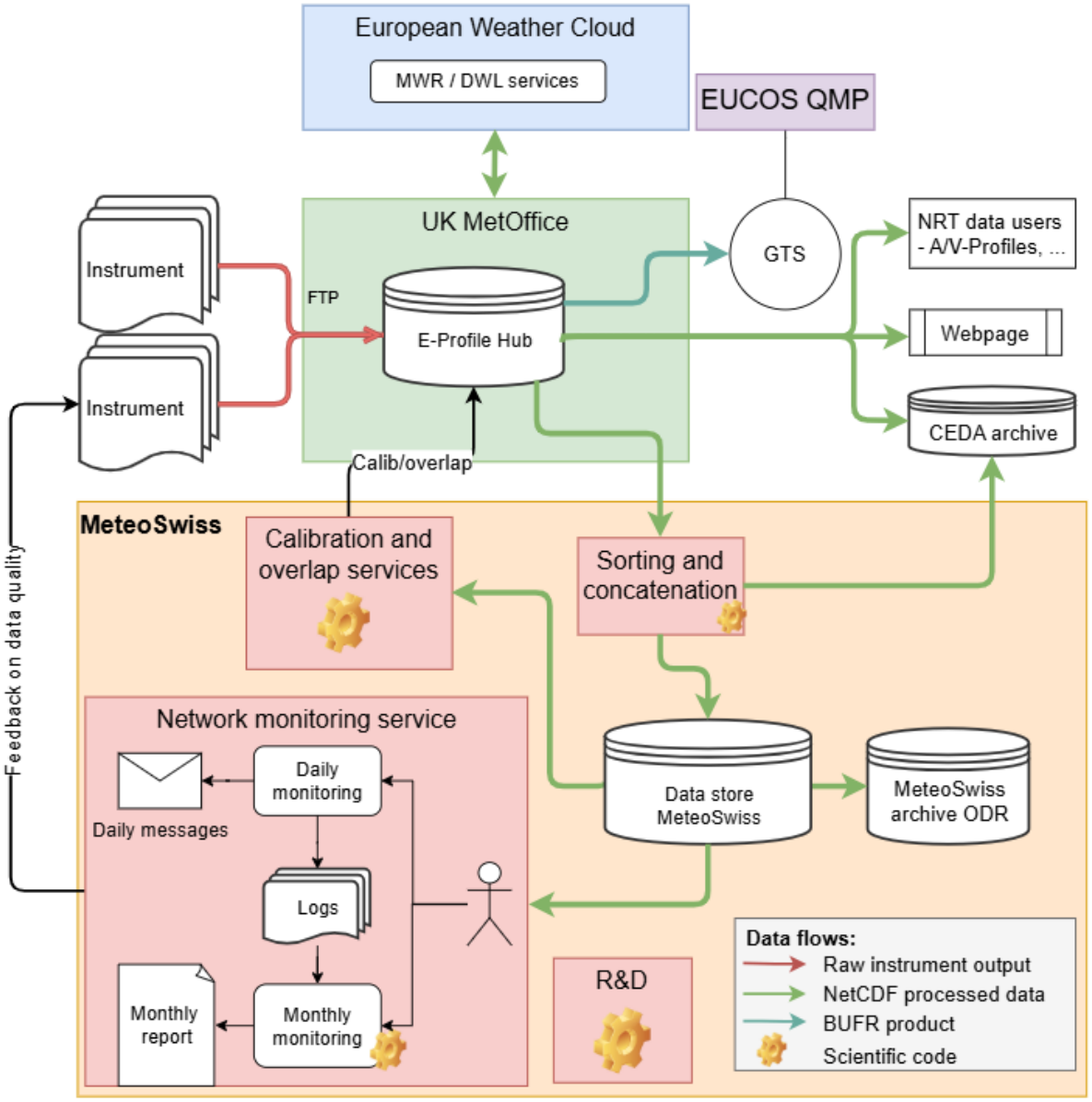
https://www.eumetnet.eu/observations/vertical-profile-observations/

E-Profile data processing pipeline

Overview

- Raw measurements from members or partners
- E-Profile hub @UK MetOffice
  - Real-time data processing
  - Conversion to BUFR and distribution to the GTS
- Processing at MeteoSwiss / MetNorway
  - Additional services
    - E.g. Calibration, monitoring
- European Weather Cloud (EWC)
  - Some more recent services (since 2023)
  - Retrievals, O-B statistics, ECMWF data access



The EWC at MeteoSwiss (Atmospheric Measurement and Data)

Motivations

- Our projects often involve european collaboration
  - EWC is a European solution
  - Built for (and funded by) MetServices
- Access to ECMWF forecasts
- Data exchange
- MeteoSwiss has its own cloud infrastructure BUT
  - Not ready at the time
  - More advanced features but less flexible (collaboration)
  - Less accessible for scientist
    - No dedicated IT support for many projects

How we use the EWC ?

- Ubuntu virtual machines
  - «Low» computing ressources, no GPU needs
  - Running Python scripts and some containers
- Manual VM management through Morpheus
  - No automation
- Deployment scripts on GitHub for:
  - Python environment and packages
  - Instrument configuration (from other GitHub repo)
  - S3: policies, notification service, …

Only scientist involved, no IT support

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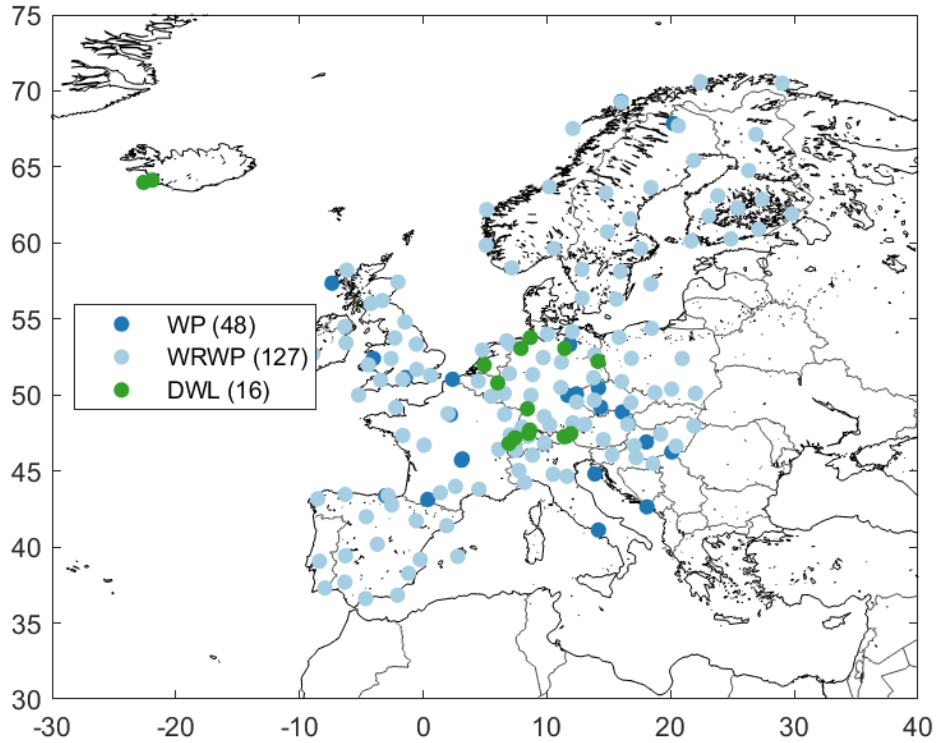
E-Profile wind profiling network

Real-time wind retrieval from Doppler Wind Lidar (DWL) on EWC

- Integration of 16 DWL from 5 countries (GER, NLD, CHE, AUS, ISL)
  - Measure wind profiles at high spatial and temporal in the ABL
  - Increasing operation of DWL in Europe and potential to improve short-term wind forecast
  - Toolbox from DWD to retrieve vertical wind profile from raw measurements:
    - Open source Python package (dl_toolbox)
    - HALO photonics and VAISALA WindCube with multiple scan strategies
  - Centralized processing with
    - Event-based real-time processing (10 min mean winds) on the EWC
  - Data are distributed on the GTS (WMO) in real-time since November 2024
  - ECMWF started data assimilation in June 2025 !
  - Real-time monitoring by EUCOS and E-Profile



https://www.vaisala.com/

https://halo-photonics.com/

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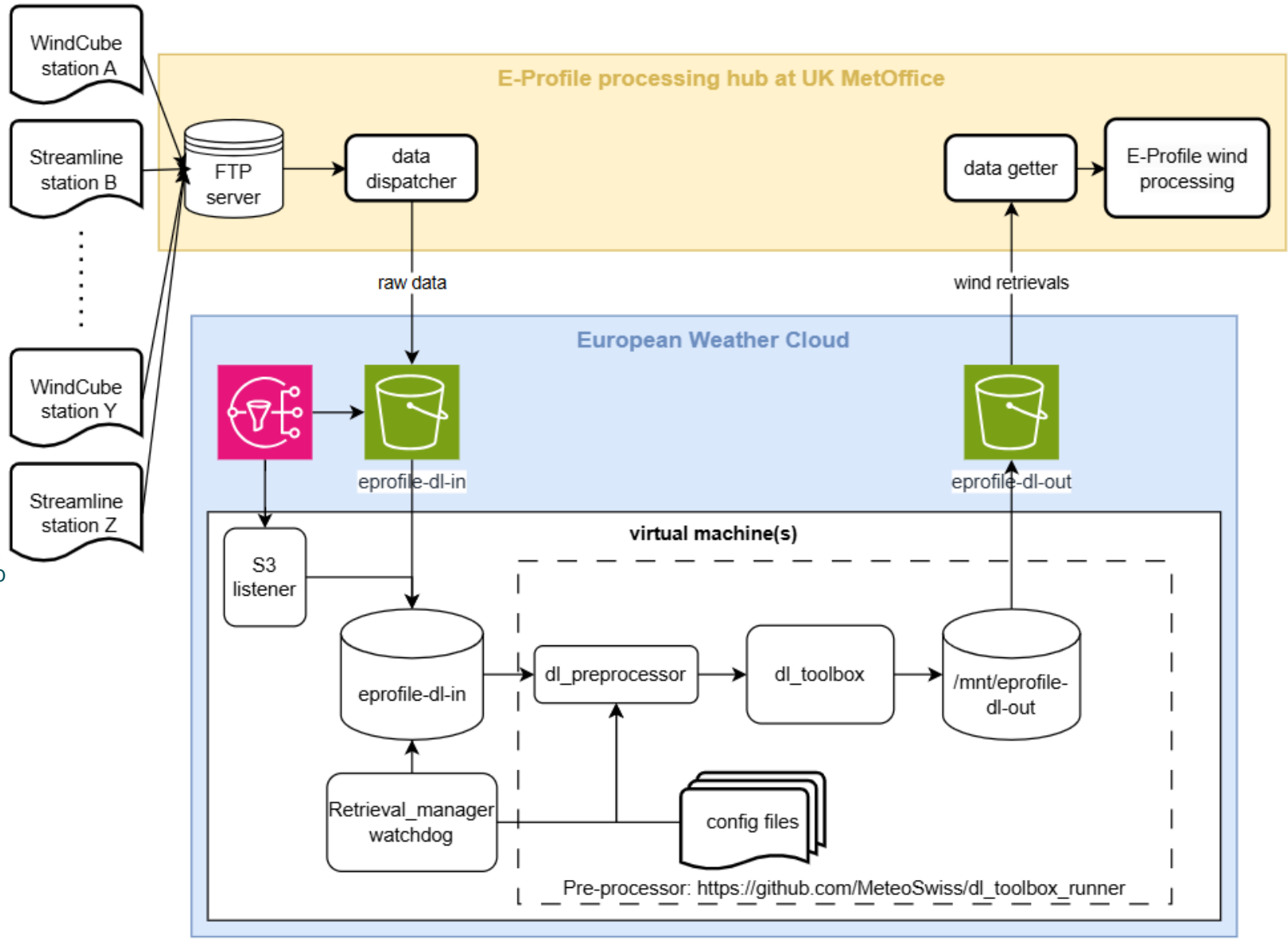
Real-time DWL processing on EWC

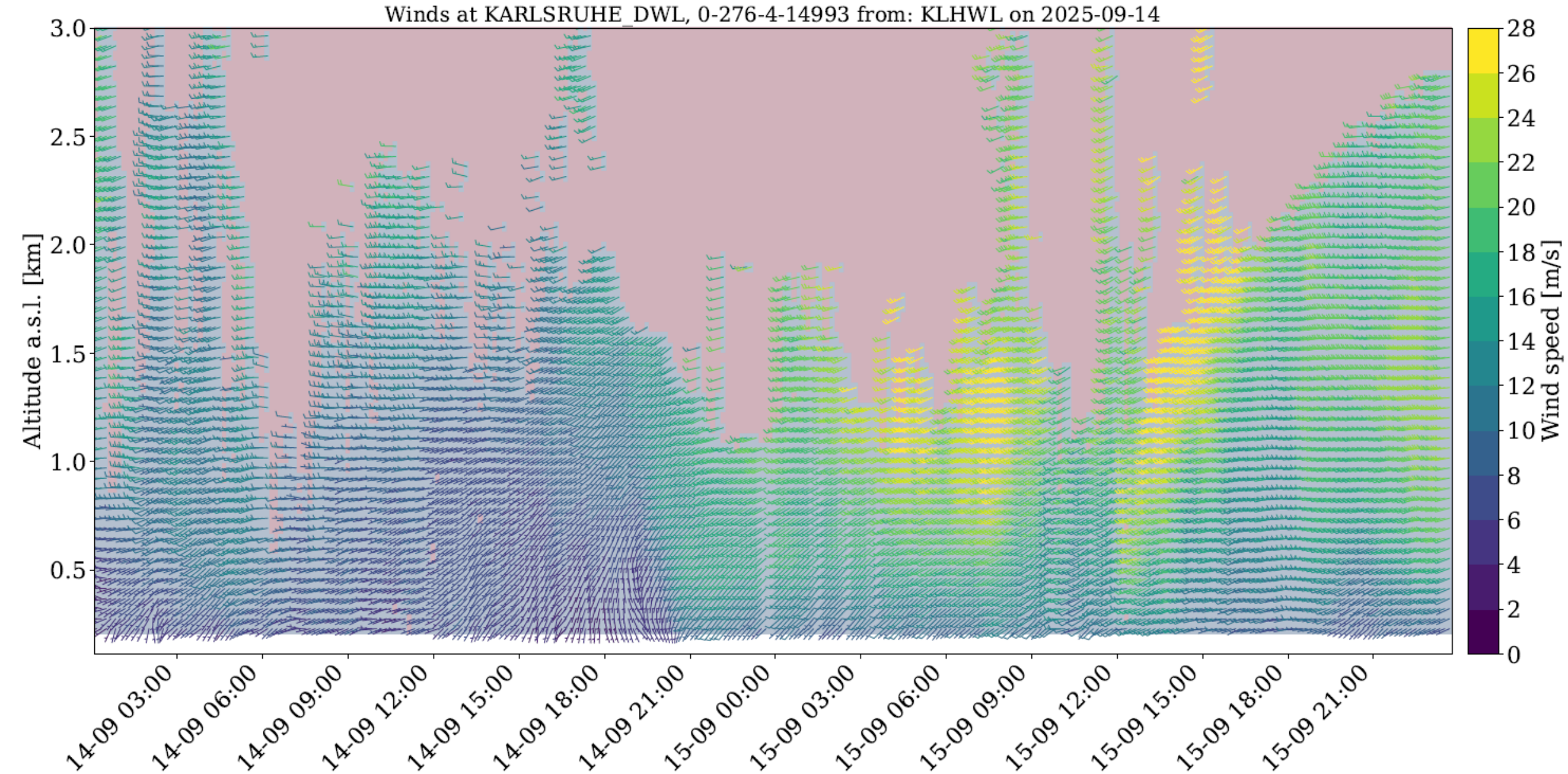
Operational since 11.2024

- Relatively simple processing in Python
- Incoming 1600 files/h, 24/7
- Processing toolbox prevents reading directly from S3
- Mounted buckets quickly became a limitation
  - Unstable connectivity (?)
  - Notification service on EWC S3
  - Real-time data availability increased by 4-5% !
- No queuing service on EWC S3 yet (?)
- → Watchdog for real-time processing



Example of wind time series at Karlsruhe (GER):

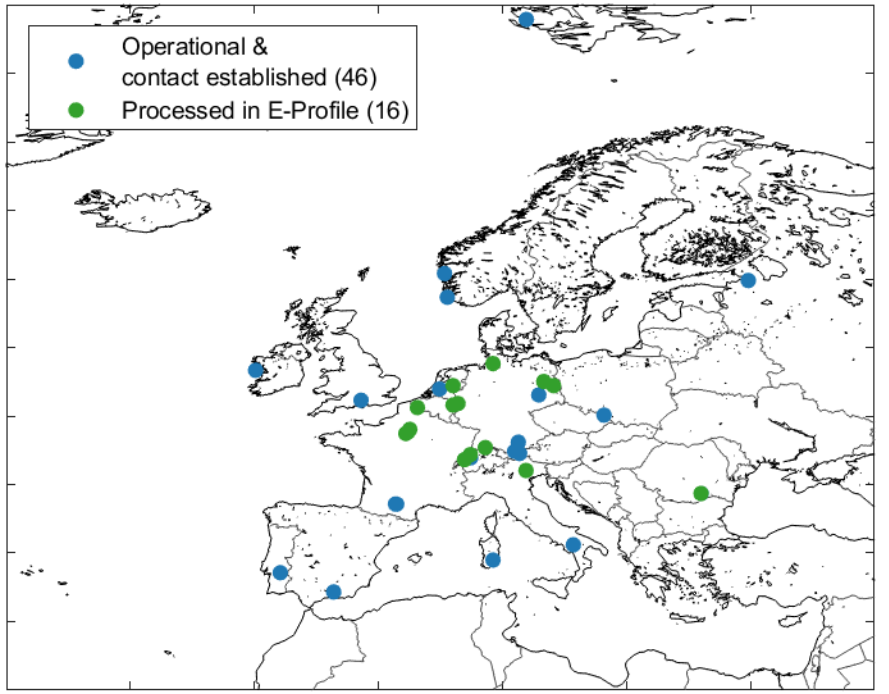
10 min mean winds, 25 min timeliness



E-Profile microwave radiometer (MWR) network

Real-time humidity and temperature profiling

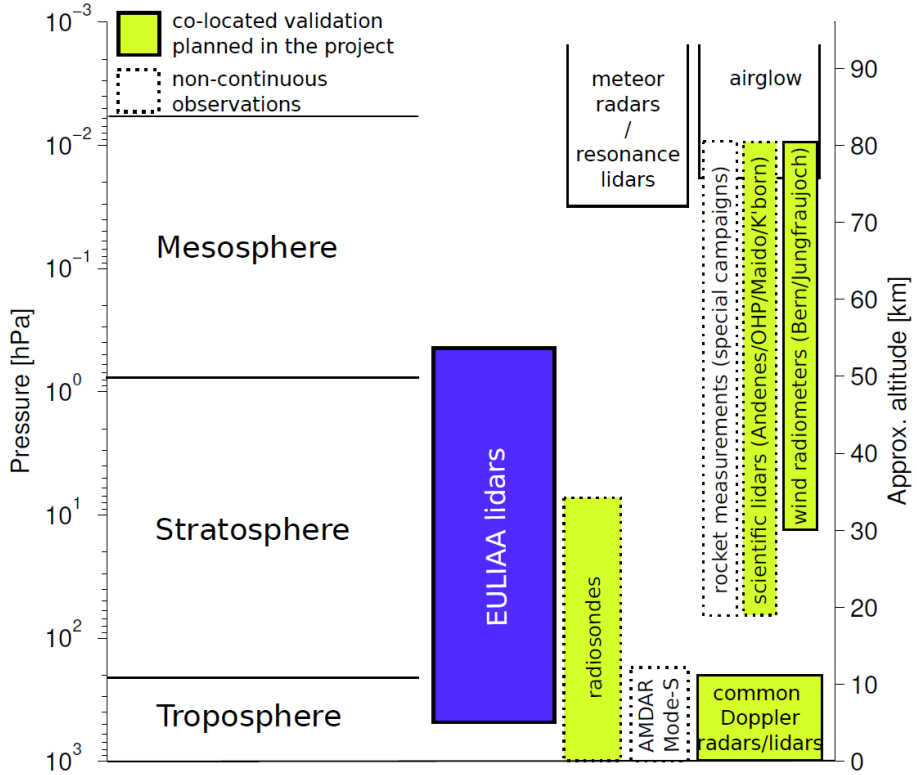
- ABL temperature profiles and humidity
  - Continuous, near real-time, high temporal resolution
- Pilot network of 16 instruments from 7 countries
  - 3 manufacturers (RPG, Radiometrics, Appex)
- Centralized processing since 12.2023 on EWC
  - Physically-based retrievals using TROPoe software
    - Alternative to manufacturer retrievals
    - Containerized Python code → easy deployement
  - O-B statistics with ECMWF IFS (work in progress)
- Code is open source (GitHub MeteoSwiss)



EULIAA

European lidar array for atmospheric climate monitoring

- Horizon project (EU funding)
- New compact Doppler lidars (UV) for 3-D wind, temperature, aerosol
  - Range : 5 - 50 km (current observational gap)
  - High resolution + accuracy
  - 24/7, low-maintenance
- Validation campaigns across diverse environments from October 2025

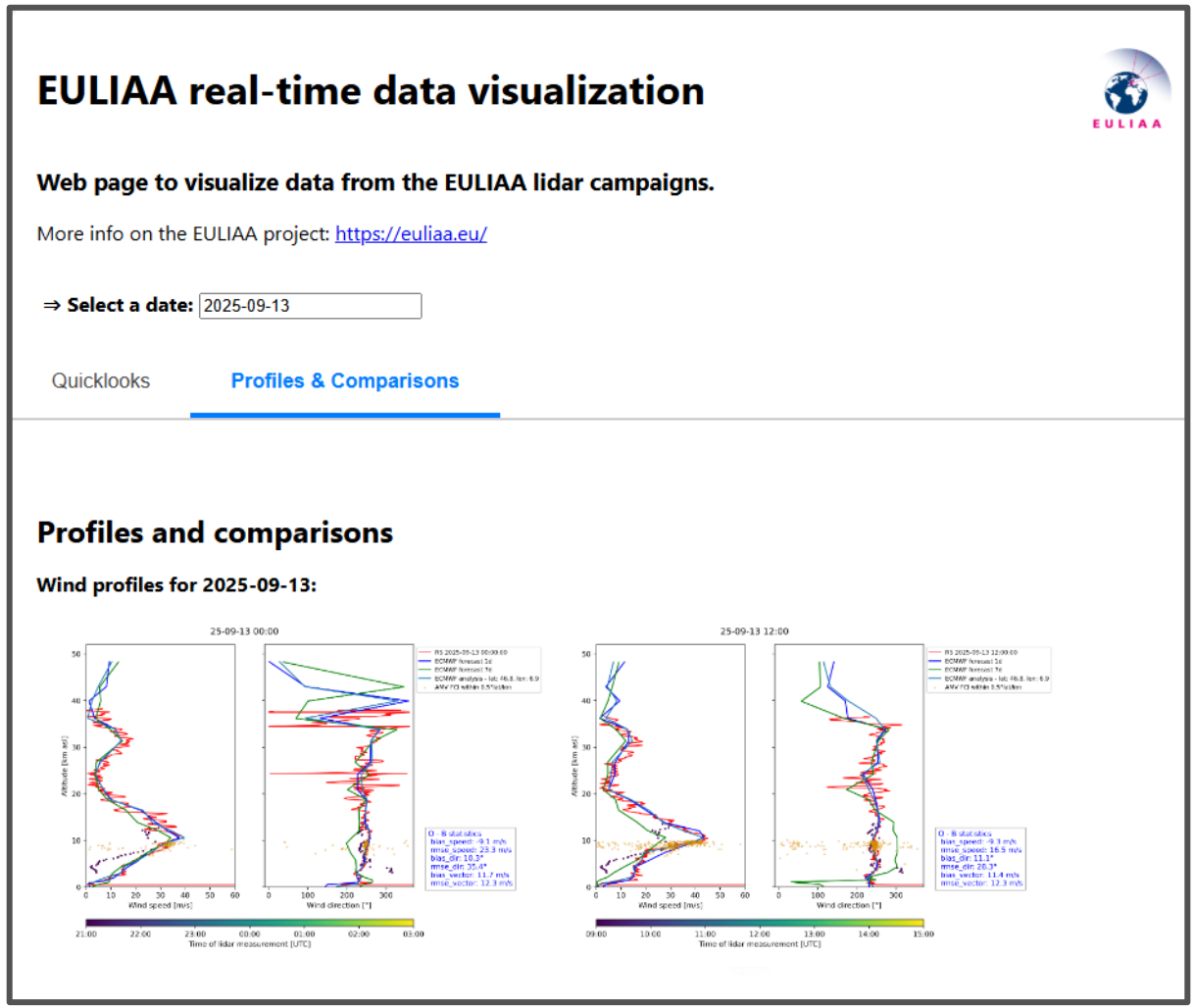


EULIAA data processing

Relies heavily on EWC for processing, validation and dissemination

- Virtual machines for:
  - Data processing
    - L1 to L2, quality control, etc..
  - Validation (download of ECMWF data + other sources)
  - Quicklook page (React + node.js)

- S3 buckets
  - Transfer data from instrument (bucket notifications)
  - Send data to operational services (E-Profile / MeteoSwiss)
  - Upload data to public database (GEO knowledgehub)



Summary and Outlook

- EWC is used **operationally** at MeteoSwiss
  - Runs the first international **DWL** real-time measurement network → now assimilated at ECMWF
  - **EULIAA** project and future **E-Profile MWR** network will rely extensively on the EWC for **data processing and quality monitoring**
- EWC is a great tool for scientific data processing or international projects
  - Good alternative, easy-to-use, flexible
  - External data exchange
  - Sovereign cloud and funding scheme
  - Reactive support is VERY appreciated
- Internal IT project will NOT use EWC at MeteoSwiss BUT
  - Easy access to computing ressources for science / external project are VERY valuable

Big thanks to the EWC team !

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Funded by the European Union

Thank you for your attention !

Questions ?

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Project EULIAA

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The End