



# ESA-JAXA Pre-Launch EarthCARE Science and Validation Workshop

13 – 17 November 2023 | ESA-ESRIN, Frascati (Rome), Italy

## Norwegian initiative for EarthCARE Validation of Aerosol uncertainties and Radiation products in the Arctic – NEVAR

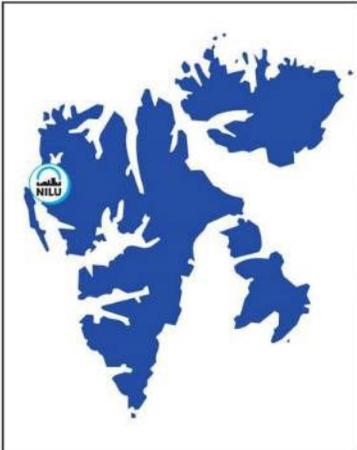
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# Ground-based remote sensing

**Ny-Ålesund**  
solar-/lunar PFR (2002-)  
collaboration PMOD/WRC  
Pandora (2020-)



**Birkenes**  
Cimel solar/lunar photometer (2009 -)  
CL61 ceilometer (2021-)



**Troll/Trollhaugen**  
PFR (2006/07-)  
Pandora (2022/23-)



# NEVAR phase 1

KO: 11 Nov. 2022



**WP 1 Inventory of correlative instrumentation and institutional capabilities in the Arctic**

WP 5 Engagement of the Arctic community



**WP 2 Contribution to best practice protocol for validation of aerosol and cloud profiles**





# 1. Inventory of correlative instrumentation and institutional capabilities in the Arctic and Antarctica

## → NEVAR Country Reports

A common overview of all instalments and projects, including data quality, relevant for EarthCARE Cal/Val is currently missing

- Compile an overview of research projects, datasets, and research infrastructure instruments from all Arctic and Antarctic areas that are relevant to the validation of the 44 data products of EarthCARE
- Identify, and give further recommendations of data availability gaps, data quality gaps, uncertainty, access gaps or bottlenecks





## Actual results are based on inputs to AO proposals for all EVID-projects EVID1-EVID42

- Arctic is defined as European countries/regions  $> 60^{\circ}\text{N}$ : Norway, Sweden, Finland, Greenland/Denmark, Iceland, Atlantic Ocean, Alaska and Canada
- Antarctic areas refers to the Antarctic Ice Shelf and the surrounding southern waters

Arctic countries with contribution from EARLINET stations



Arctic countries with contribution from CLOUDNET stations





Country	Number of Institutions involved	Number of Countries involved	Number of Instruments in use for EarthCARE Cal/Val	Number of Sites	Number of Networks
Norway	10	6	14	3	6
Denmark	2	2	3	3	3
Finland	4	4	6	4	6
Sweden	2	2	5	1	5
Antarctica	3	3	10	8	6

Arctic countries with BSRN stations



- Norway/Svalbard is the country with highest number of institutions (10) involved with contributions from six nations, from 14 instruments types, and at three sites
- Two institutions have reported to perform measurements in Greenland, none of these are national (Danish)
- Campaigns/measurements at eight sites in Antarctica, performed by three institution, three countries and ten instrument types
- Norway is the only country with a BSRN station





Table 2: Norway

Line	Institution	Country	EVID	Network	Observation Type	Station	Instrument Owner
1	AWI	DE	EVID05	ACTRIS	(ARS)	Ny-Ålesund	
2	CNRS	FR	EVID15	AERONET/ACTRIS-FR	Sun/sky photometer	ALOMAR	
3	CNRS	FR	EVID15		RAMAN LIDAR	ALOMAR	
4	MET	NO	EVID18		SONDE	ALOMAR	MET
5	MET	NO/ES	EVID18		Photometer	ALOMAR	
6	NASA	US	EVID21	RADAR-NETWORKS	Weather Radars + others		
7	ROCKETRANGE	NO	EVID18		LIDAR	ALOMAR	
8	TROPOS	DE	EVID03	Individual ship	PollyXT_OCEANET (multiwavelength-Raman-polarization lidar)	POLARSTERN	TROPOS
9	TROPOS	DE	EVID03	AERONET	CIMEL	Ny-Ålesund	
10	TROPOS	DE	EVID03		Profiling cloud radar	Ny-Ålesund	
11	TROPOS	DE	EVID03	BSRN	Pyrheliometers, shaded+unshaded pyranometers, pyrgeometers	Ny-Ålesund	
12	SMHI	SE	EVID16		LIDAR	Ny-Ålesund	
13	SMHI	SE	EVID16		RADAR	Ny-Ålesund	
14	SMHI	SE	EVID16	AERONET	Sun photometer		
15	SMHI	SE	EVID16	MOSAIC	Cloud radar, lidar, MWR		
16	UiO	NO	EVID18	Individual probe	Nevzorov-probe		UIO
17	U-KÖLN	DE	EVID05	ACTRIS	.Disdrometer + Doppler non-scanning cloud radar	Ny-Ålesund	U-KÖLN
18	Statens Kartverk	NO	EVID18		GPS Water vapour column	ALOMAR	

There is still a need for harmonisation on how the Cal/Val teams report on their measurements

Lack of common wording across the measurement principles, instrument types and parameter descriptions

E.g., use of: CIMEL, Photometer, Sun Photometer, ...

→ Feedback to the Cal/Val teams and reported in the Best Practices document





## Next steps → 5. Engagement of the Arctic community

- The country reports will include an overview of national data providers, projects, and products and a count of data delivered (upstream) as well as use of EarthCARE products and data within the country (downstream)
- Produce the inventory to attract and involve stakeholders and liaise with national organizations on the design of a Polar Cal/Val strategy
- Foster prospective and existing Cal/Val teams in the region, including preparation of AO proposals and helping them identify possible sources of regional, national, and international funding





## 2. Contribution to best practice protocol for validation of aerosol and cloud profiles

Main contribution to Chapter 4 on Correlative Metadata and Data Format

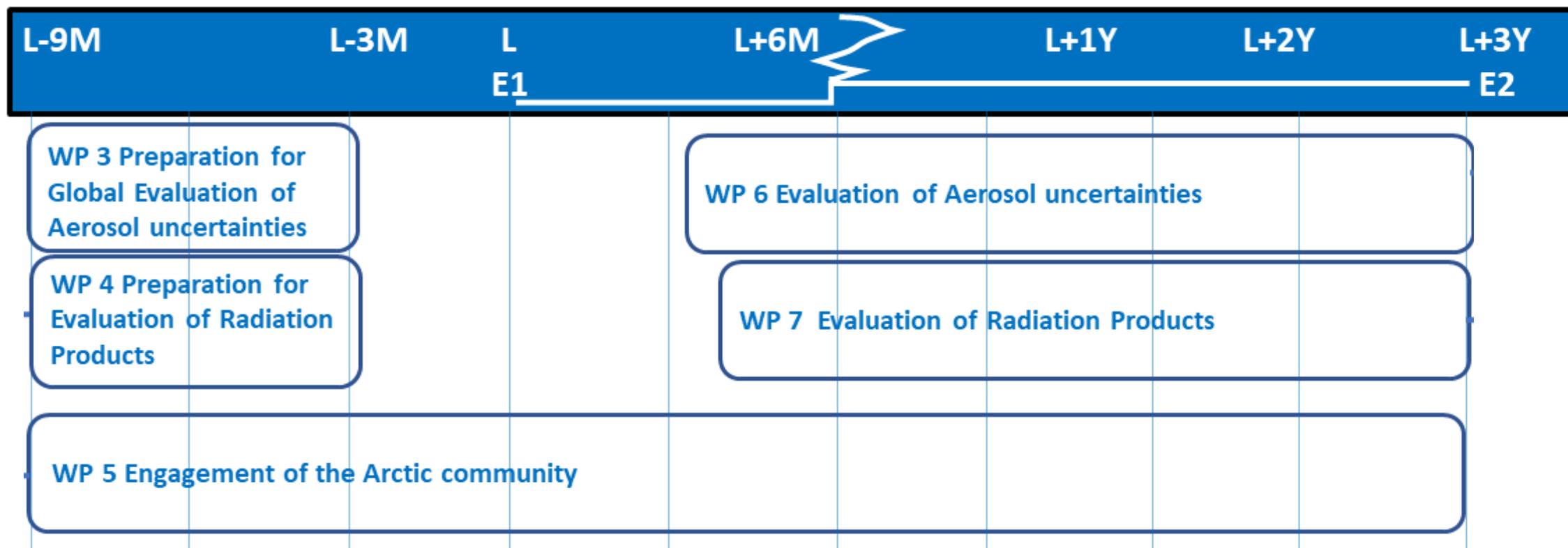
- Regulated by the EarthCARE data exchange protocol and FAIR data principles
- Use the GEOMS HDF/NetCDF data format
- Data to EVDC – ESA Atmospheric Validation Data Centre

→ Presented in detail at DEMO session and EVDC talk Thursday at 17:18





## NEVAR phase 2



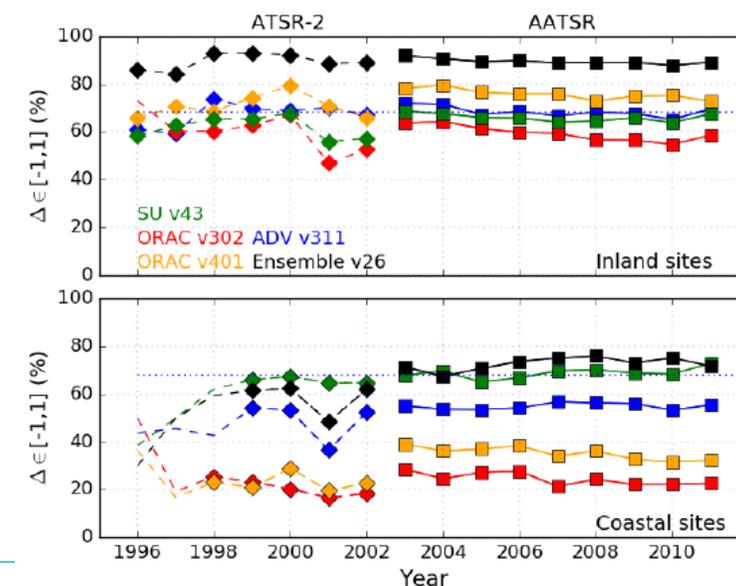


### 3. Preparation for Global Evaluation of Aerosol uncertainties

#### BEFORE LAUNCH

- Goal is the evaluation of “AOD” pixel-level uncertainties
- Methodology was developed during the ESA Aerosol\_CCI (Popp et al., 2016, and Kinne et al., 2017; see also review and framework of pixel level uncertainty evaluation (Sayer et al., 2020)
- Prepare software; utilizing simulated EarthCARE data
- Can the methodology be applied to other geophysical variables of EarthCARE ?

$$\Delta = \frac{AOD_{ATSR} - AOD_{AERONET}}{\sqrt{(\sigma_{ATSR}^2 + \sigma_{AERONET}^2 + \sigma_{RE}^2)}} \approx \frac{AOD_{ATSR} - AOD_{AERONET}}{\sigma_{ATSR}}$$





## 6. Evaluation of Aerosol uncertainties

### EARTH-CARE DATA AVAILABLE

- Global validation of EarthCARE Level-2 AOT products against AERONET/MAN
- Evaluation of EarthCARE multi-wavelengths AOD uncertainties
- Focussed regional assessments in the **Arctic** and/or extend the uncertainty evaluation to other suitable geophysical datasets (if applicable)



## 4. Evaluation of Radiation Products BEFORE LAUNCH

- Preparation for evaluation of the EarthCARE radiation products by building an interface between the EarthCARE data products and the 3D MYSTIC radiative transfer model (RTM, Mayer, 2009; Emde et al., 2011) run within the libRadtran environment (Mayer and Kylling, 2005; Emde et al., 2016).
- Test runs will be made both for 1D and 3D geometries using simulated EarthCARE data, and the results will be compared with existing simulated EarthCARE radiation products.



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## 7. Evaluation of Radiation Products

### EARTHCARE DATA AVAILABLE

- Use the above-mentioned software together with combined EarthCARE ATLID, CPR and MSI data products to simulate BBR data products.
- The simulated BBR data will be evaluated against the EarthCARE BBR data.
- Horizontal cloud variability and how that affects the uncertainty and variability in the BBR data will be evaluated by comparing 1D and 3D RTM results.
- The evaluation will be done for selected locations in the Arctic where relevant surface data are available to give further constraints and for locations with large seasonal changes in surface albedo (snow/not snow).



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