The Swedish contribution to ESA's EarthCARE Cal/Val activities (SweVal)

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Validation needs to be comprehensive and multi-perspective

- **The EarthCARE poses to be the next de facto reference for cloud and aerosol retrievals.**

- **Over the years, we have learned that no single validation approach can fully characterize strengths and weaknesses of a particular observing system.**

- **It can rather be argued that the combination of various approaches, such as insitu-to-satellite, satellite-to-satellite, flight-to-satellite, are needed in this context.**

SweVal contribution

The proposed Swedish initiative will contribute to fulfil two specific objectives of the EarthCARE's Cal Val activity.

1) Comparison of cloud and aerosol properties with independent ground based observations.

2) Comparison with other space-borne sensors (at the instantaneous level and statistical).

· The proposed project is expected to run 3 years from 2020-2022.

· A part of the funding will be sought from the Swedish National Space Board (SNSB, Swedish Space Agency), while the other part will be made available in the framework of EUMETSAT's NWCSAF and CMSAF projects, wherein SMHI will carry out routine validation/comparison studies as a part of the respective project requirements.

In-situ references

- FRAM4RADAR (94 GHz) to be located in Norunda (Sweden), as a part of ACTRIS network.
- In-situ measurements made at Zeppelin station, Ny-Ålesund, Svalbard (performed by SU).
- Measurements from the Swedish Ice-Breaker Oden within ACAS, Arctic Survey and MOSAiC projects.
- AERONET

Satellite-to-satellite

Instantaneous pixel level comparisons

- Since the availability of CALIPSO+CloudSat data from 2006, the need for developing software architecture for the collocation of different sensor retrievals with CALIPSO was recognized and thereafter acted upon.

- This collocation architecture now forms the basis for the routine evaluations and inter-comparisons of retrievals and data products from NWCSAF and CMSAF at SMHI.

- This collocation architecture will be adapted for collocating EarthCARE products with products from other satellite sensors.

- In particular, the following collocation configurations are envisaged at this stage: EarthCARE-AVHRR (NOAA and MetOp), EarthCARE-MODIS (Aqua), EarthCARE VIIRS (S-NPP, JPSS-1, products based on SMHI local reception only).

- Depending on additional funding to be sought later, NWCSAF cloud algorithms might be adapted also to SLSTR (Sentinal 3).

Satellite-to-satellite

Statistical comparisons

· In addition to these evaluations based on instantaneous collocations, the statistical comparisons (monthly and seasonal means) will also be carried out to bracket the systematic biases and differences among different sensor systems with respect to EarthCARE.

· In particular, the cloud property climatologies from CM-SAF, ESA Cloud CCI, CATS and CloudSat+CALIPSO will be evaluated.

List of relevant EarthCARE products

Product name/group	Responsible entity	Validation/comparison reference
Cloud products		
A-CTH	SMHI	FRM4RADAR MOSAiC CATS NWCSAF CMSAF ESA Cloud CCI CloudSat+CALIPSO GMI/MHS/ATMS (Chalmers)
C-TC		
C-CLD		
M-CM		
M-COP		
AM-CTH		
AC-TC		
Aerosol products		
A-AER	SMHI	CATS
M-AOD	SMHI	AERONET
AM-ACD		AERONET
A-TC	SU	Zeppelin/Ny Ålesund
A-EBD		Zeppelin/Ny Ålesund