Development of a Snow Monitoring System for EUMETSAT EPS-SG/METimage

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The area extent of the seasonal snow cover is a key parameter for a wide range of applications in meteorology, climate monitoring, global change research, hydrology, water management and ecology. Observations of snow-cover extent from visible and infrared sensors, operating on polar-orbiting and geostationary satellites, have been widely used during the last decades. The different data sets vary in spatial resolution, repeat coverage and performance.

The medium resolution optical sensor METimage onboard of the upcoming EPS-SG satellites will offer excellent new capabilities for operational monitoring the seasonal snowpack at medium-scale spatial resolution. Complementary to the advancement by METimage on its own, the synergistic use of METimage and Copernicus Sentinel-3 SLSTR data will offer the basis for further progress in generating consistent, high quality, long-term data sets on snow cover extent from regional to global scale.

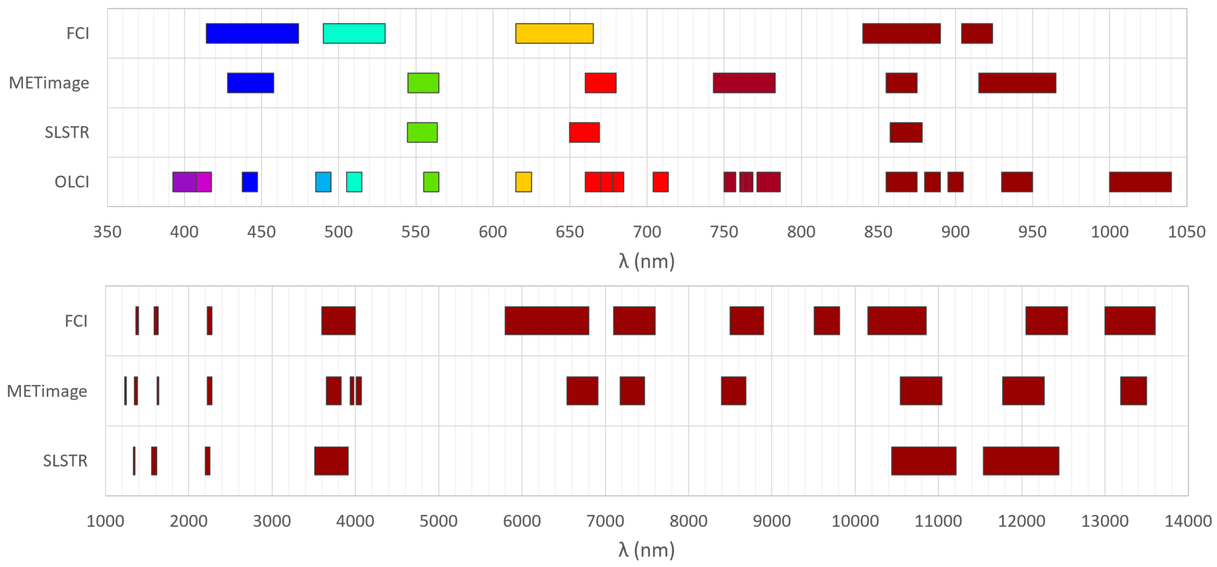
Within the EUMETSAT project SEDOS (Snow Cover / Extent Demonstrator from Optical Sensors) a snow retrieval algorithm is developed and implemented dedicated for METimage. The system is tested, and demonstration products are generated using similar spectral bands from Sentinel-3 SLSTR and OCLI. The product performance is assessed using high resolution snow products from other sources.

METimage Sensor Characteristics

METimage – a passive cross-track scanning imaging spectro-radiometer

Spectral domain: 20 spectral bands in the visible & infrared range, from 0.443 to 13.345 µm
Spatial Sampling: 0.25, 0.5, 1.0 km
Swath width: ~2670 km
Altitude: ~830 km
Orbit: sun synchronous

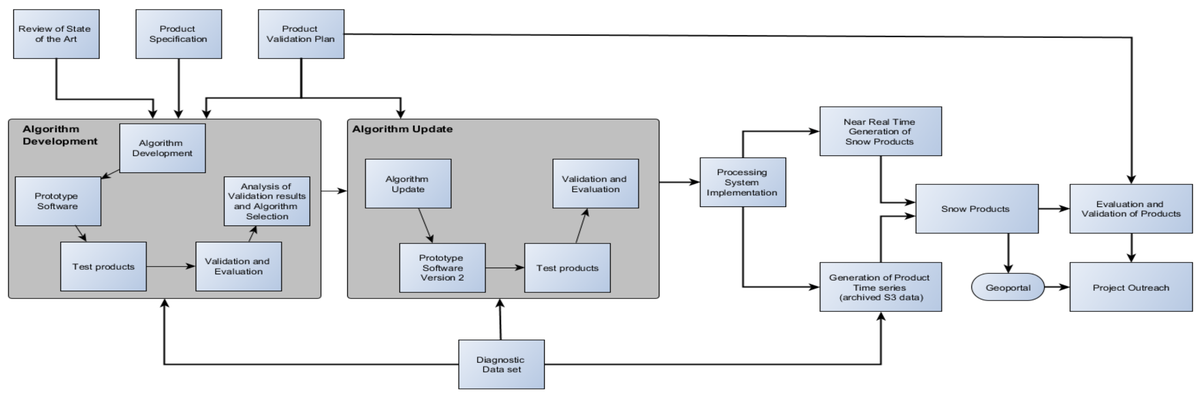




Spectral bands of METimage / EPS-SG, FCI / MTG, SLSTR and OLCI / Sentinel-3.

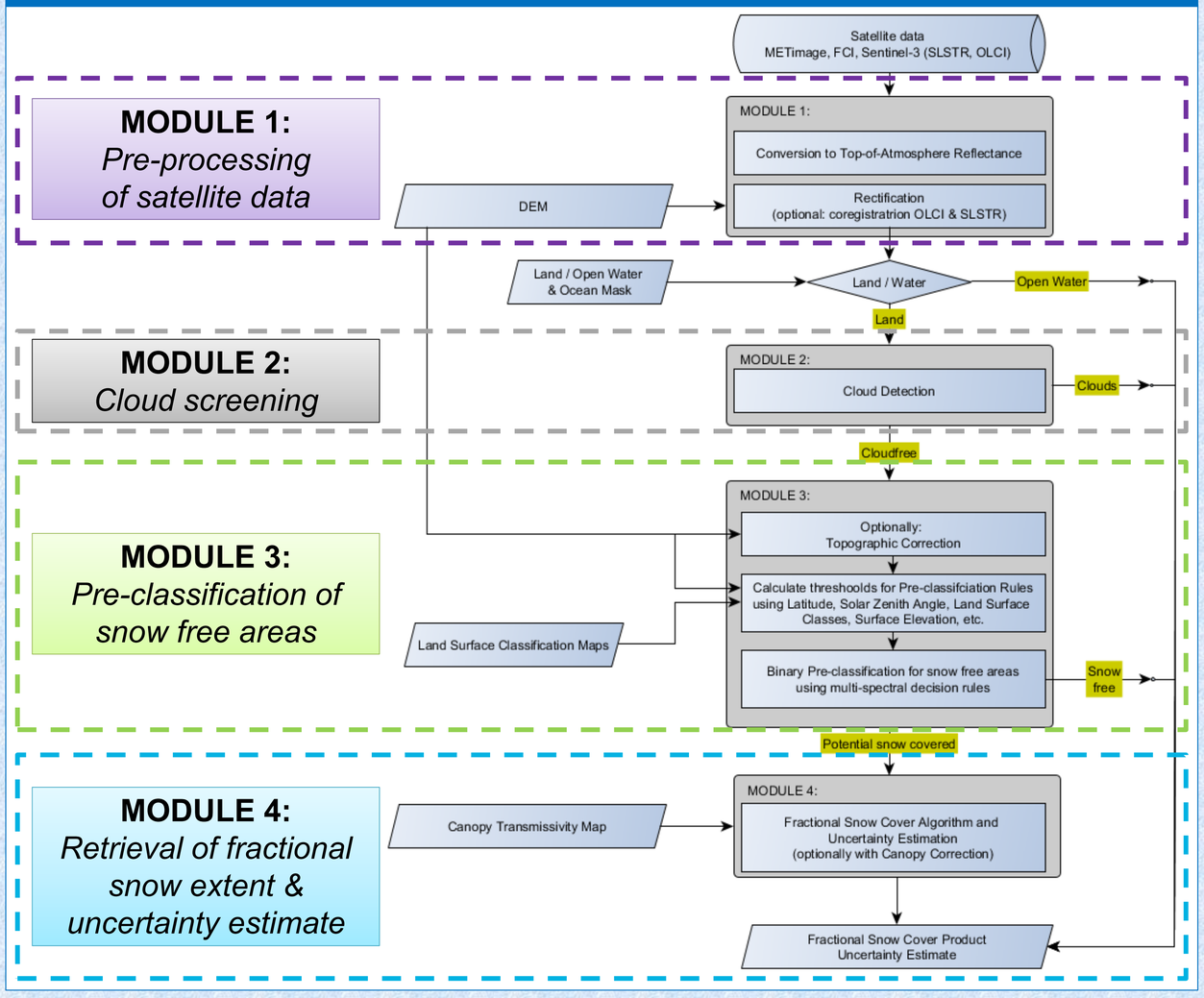
Main Objectives, Study Logic & Validation Concept

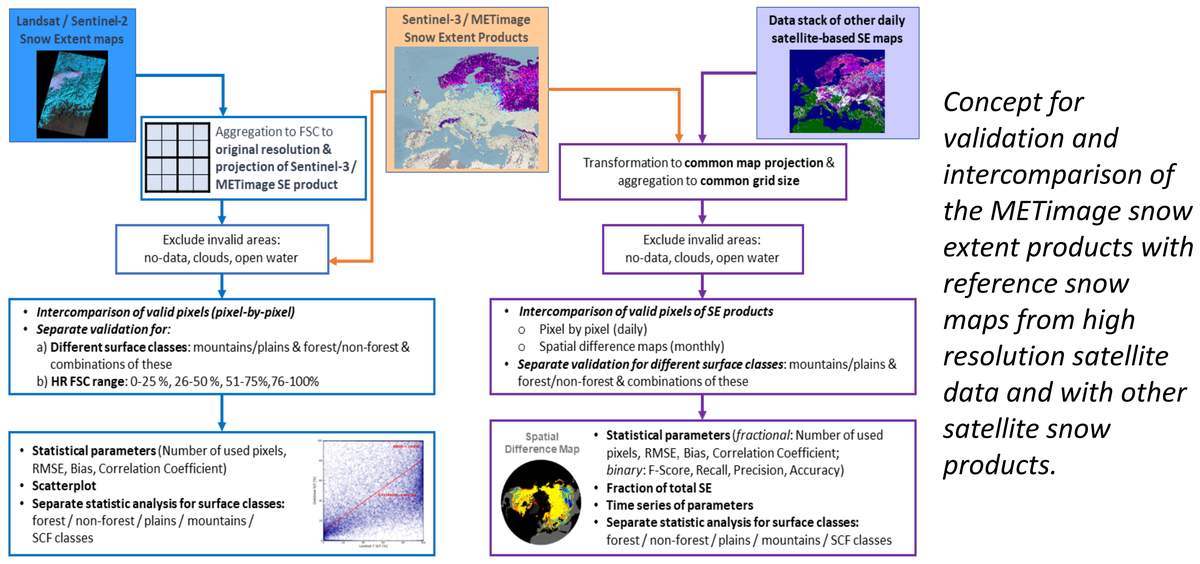
- Development, implementation and validation of an algorithm and prototype processing system to prepare for the generation of snow extent products from METimage which will be flown on EPS-SG, and FCI onboard of MTG.
- Demonstrate and evaluate the developed methods and prototype system using data of the optical sensors SLSTR and OLCI on board of Sentinel-3 featuring similar spectral imaging bands as METimage. This task will include the generation and validation of a 1-year time series of daily snow cover products over Europe.
- Demonstrate the operational capabilities of the prototype processing system by generating a time series of Pan-European snow products from Sentinel-3 data in Near Real time.



Study logic of the Snow Monitoring System development.

Concept for Snow Processing System



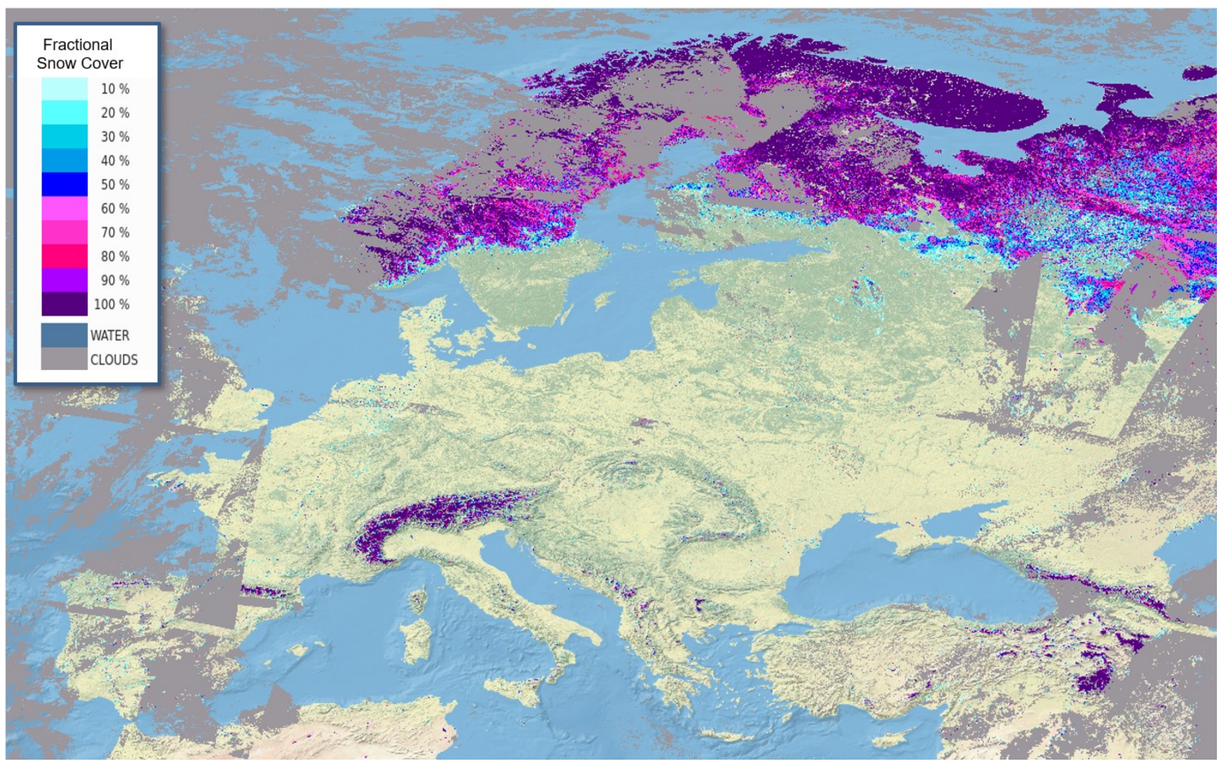


Concept for validation and intercomparison of the METimage snow extent products with reference snow maps from high resolution satellite data and with other satellite snow products.

Selected baseline algorithms for snow retrieval

- **Cloud detection** based on SCDA v2.0 adapted for METimage bands
- **Fractional snow cover retrieval** will be tested with
  - *Adapted SCAmod* (based on Metsämäki et al., 2015; 2012), using one spectral band at 550 nm as input, and corrects for masking of the ground by the canopy layer using a tree density mask as auxiliary data
  - *Multi-spectral algorithms* (e.g. NDSI based, Salomonson and Appel, 2006; multi-spectral unmixing) are tested for fractional snow extent estimation.

Fractional Snow Map Demonstration for the Pan-European Domain



Fractional snow extent map from synergistic Sentinel-3 SLSTR and OLCI data, 21-23 April 2018, 500 m pixel spacing.