Satellite remote sensing of aerosol and surface spectral reflectance properties in the Arctic

B02

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1 Summary

- Role of **aerosol and surface scattering and absorption** in **Arctic Amplification** will be investigated by retrieving and studying spectral reflectance (SSR) and aerosol optical thickness (**AOT)**
- Temporal changes in aerosol loading, type and SSR are investigated using data products retrieved from satellite-borne spectrometers from 60° to 90°N during the past 2-3 decades

Hypothesis

Changes in aerosol and surface spectral reflectance, SRR play a significant role in arctic amplification and related feedback in cloud free regions.

2 Research rationale

What? - **Arctic Amplification** is result of radiation balance changing, as a consequence of changes and feedback between different components of the Earth System

- **Changes in SSR and AOT** impact on Arctic Amplification in cloud free conditions

Why? - Assess quantitatively the role of **AOT and SSR** in the **Arctic climate**

- **Requires accurate knowledge** of these **parameters** in the solar spectral region

How? - Impact of **anthropogenic activity and natural phenomena** on climate in the Arctic is **inadequately measured/sampled or understood**

- Current **data products** from remote sensing retrieval algorithms for **AOT** using passive single/multi-viewing multi spectral and or multi polarisation instrumentation in the Infrared, visible and UV or active remote sensing have limited effective coverage
- High AOT is attributed to **transport of pollution from Europe and biomass burning plumes (Siberia Alaska and Canada)**

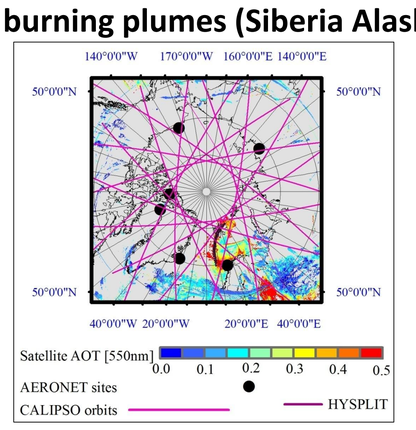


Figure 1: Remote sensing coverage of active, passive and ground based observations

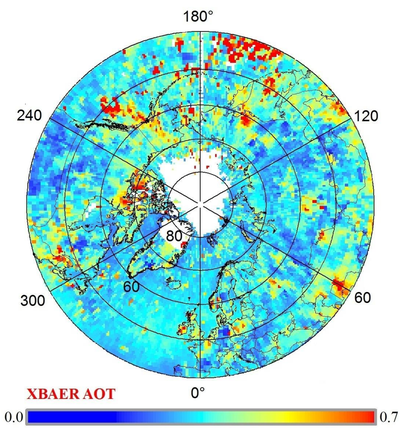


Figure 2: Preliminary composite data for XBAER and AOT product over the Arctic

- **Adapting three AOT and SSR retrieval algorithms** including novel **eXtensible Bremen Aerosol Retrieval (XBAER)** for use in the **Arctic**
- Use of observations made by **SeaWIFS**, **ATSR-2**, **MERIS, AATSR** and **AVHRR-3** to derive consolidated data sets for **AOT and SSR from 60° to 90°N**
- Resultant **consolidated data products** will be **validated** and **statistically analyzed** together with data for surface conditions to **establish** the role of changing **aerosol parameters** and **SSR**
- Within $(AC)^3$ data products will be used within cluster D and E to test models

3 Research plan

Work packages

Year	2016				2017				2018				2019			
Quarter	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
WP1 (UNI–B)																
WP2 (UNI–B)																
WP3 (UNI–B)																
WP4 (UNI–B)																
WP5 (UNI–B)																

WP1: - Adaptation and optimisation of AOT and SSR retrieval algorithms

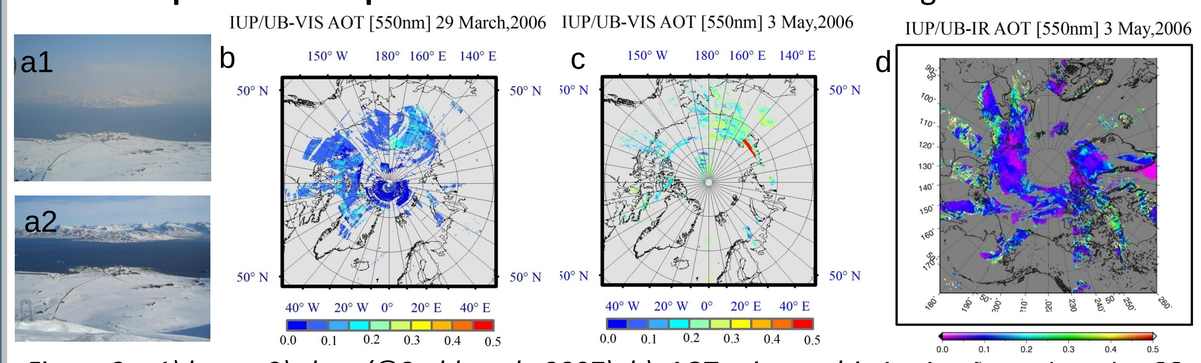


Figure 3: a1) haze a2) clear (©Stohl et al., 2007), b) AOT using multi-viewing for a clear day 29. March, 2006 c) same for haze event 3. May,2005, d) same day AOT for haze using Infrared.

WP2: - Cloud screening achieved with data from Multi-viewing, multi-spectrum observations utilising spatial/temporal variability, cloud height

WP3: - Verification and Validation achieved by comparison with data from

- ARM, AERONET, AEROCAN and Maritime Aerosol, IAOOS etc.
- CALIOP/MODIS/MISR
- within $(AC)^3$ Cooperation

WP4: - Case studies using new validated data analyses: Surface: Land/sea with snow/ice; Aerosol: Fine/coarse absorption dust and related

WP5: - Statistical analyses of **long term data products** and surface conditions to assess role of **AOT and SSR**

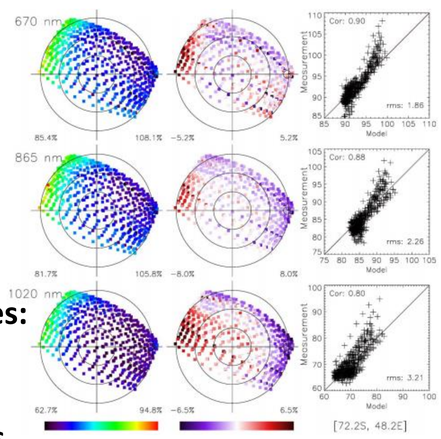
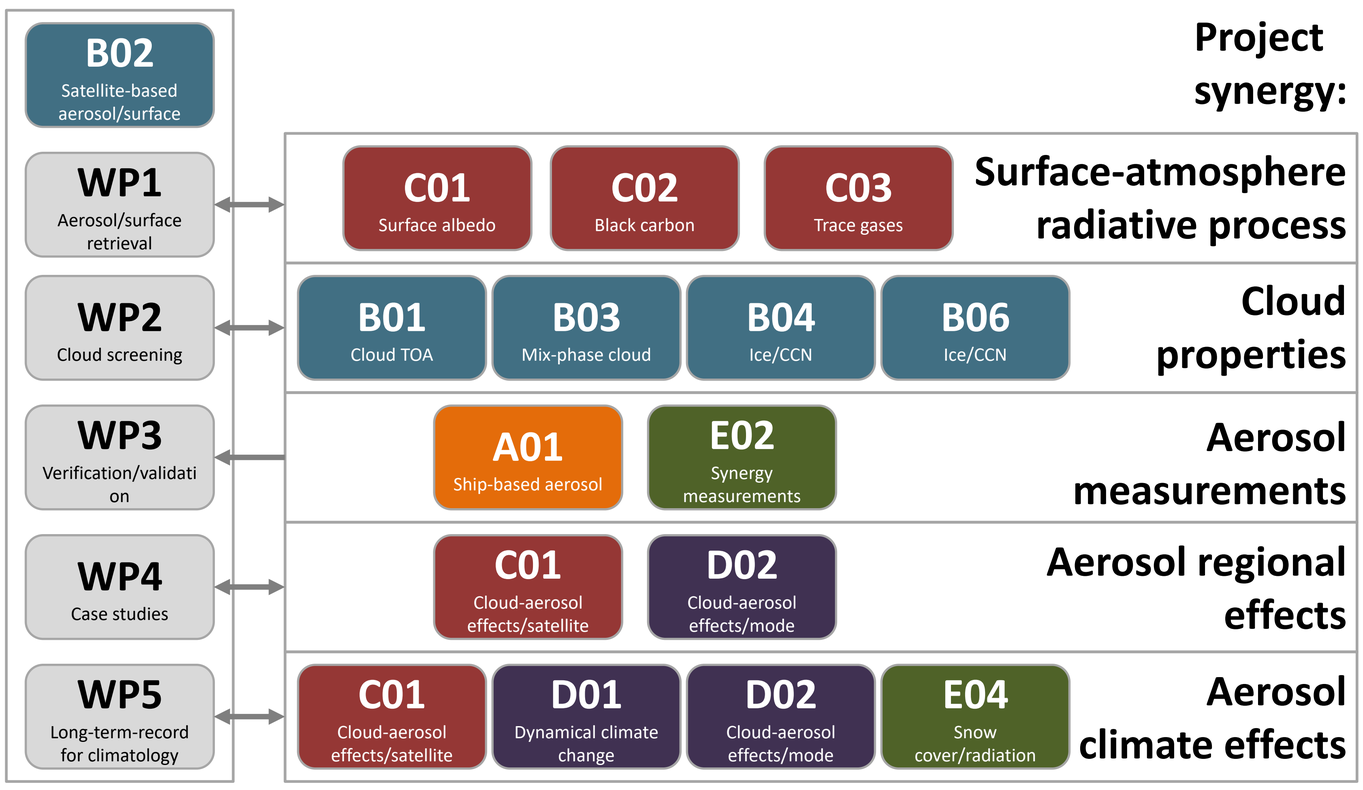


Figure 4: Comparison of model and retrieved SSR IUP_UB

4 Role within $(AC)^3$ & perspectives



Collaboration within $(AC)^3$

- Knowledge obtained from analyses of surface-atmosphere interaction and processes in Cluster C feed back into WP1
- Cloud characteristics derived by B01, B03, B04 and B06 to be used in the development of accurate cloud screening algorithm in WP2
- Verification / validation in WP3 will benefit from validation activities in projects of cluster A and E02
- Case studies for different aerosol/surface conditions in WP4 can be tested in C01 and D02
- Long-term dataset created by WP5 can be validated in part by comparisons with data products from C01, D01, D02 and E04
- Analysis of datasets in WP5 basis for Cluster E model evaluation and attributions studies

Perspectives

- Focus will be using data from MERIS/AATSR and SeaWiFS
- Afterwards the generic algorithm is applied to MODIS and other relevant data sources
- Generation of consolidated and consistent set of data, comprising many sources of data (potentially EarthCARE) will be one of the objectives of the later phases of the project

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