COMPARISON BETWEEN THE ARCTIC AND SUB-ARCTIC STATIONS HORNSUND (77ºN, 16ºE) AND ALOMAR (69ºN, 16ºE)

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INTRODUCTION

We present the results from the Aerosol Optical Depth (AOD) and the Ångström exponent (AE) at the Arctic station of Hornsund, which is located at the Norwegian archipelago of Svalbard, and compare the results with the sub-Arctic area of ALOMAR (Arctic Lidar Observatory for Middle Atmosphere Research), located in the Andøya Island. Data from the stations can be found in the AERONET database under "Hornsund" and "Andenes". At Hornsund we have used the AERONET level 2.0 data between 2005 and 2007. For ALOMAR station most of the data are in the AERONET database at level 1.5 (from 2002 to 2007, no data in 2004). For the processing of those data that are not included in AERONET, GOA-UVA has developed a processing algorithm that includes the AERONET protocols and is adapted to the analysis of the measurements at Arctic and sub-Arctic areas (Ortiz de Galisteo et al., 2008).

SITE, MEASUREMENTS AND INSTRUMENTATION

FIGURE 1. Location of Hornsund and ALOMAR (left). View of both sites: Hornsund (center) and ALOMAR (right).

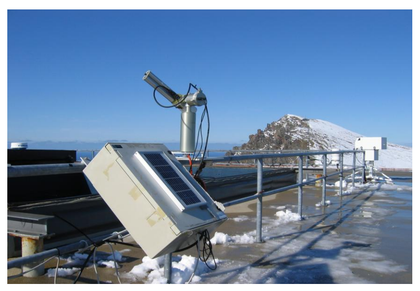

FIGURE 2. Cimel sun photomer

- **Channels: 340, 380, 440, 500, 670, 870, 936, 1020 (and also 1640nm at ALOMAR).**
- **Sampling resolution: 15 minutes (possible 3 min)**
- **2 detectors: Silicon for UV and visible, InGaAs for IR. Collimator with fov 1.2°.**

- **The Cimel in Hornsund belongs to AERONET. The Cimel at ALOMAR is integrated in the Spanish Network for Aerosol Measurements (RIMA), federated to AERONET.**

AEROSOL CHARACTERIZATION AND CLASSIFICATION

1. ALOMAR: sub-Arctic

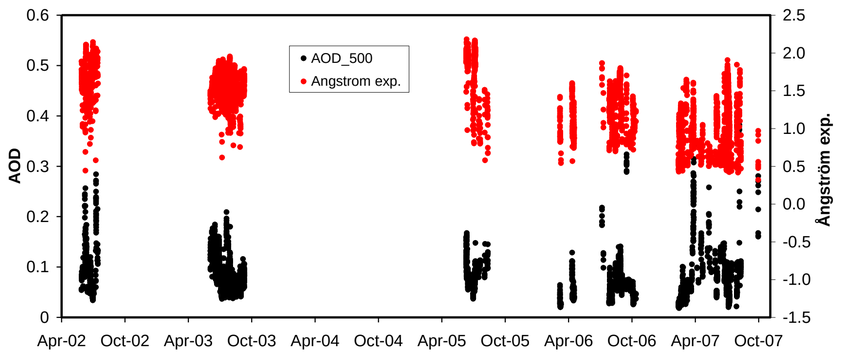

FIGURE 3. Time series of AOD and Ångström exponent at ALOMAR

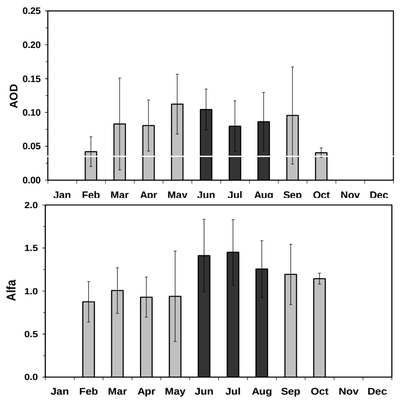

FIGURE 4. Interannual monthly means of AOD (500nm) and Ångström exp. for the period 2000-2007. The bars indicate ±1 standard deviation.

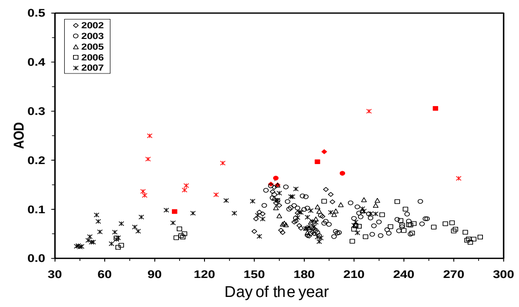

FIGURE 5. Daily mean values of AOD (500nm) for all measurements, as a function of the day of the year. Red dots indicate events with transported aerosols.

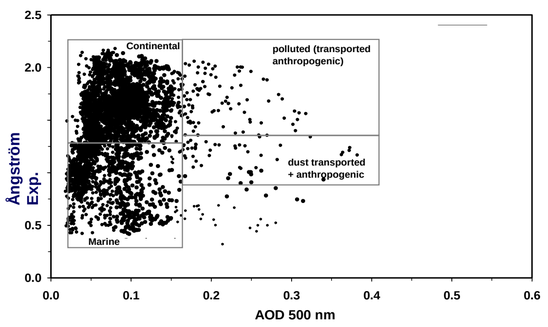

FIGURE 6. Scatter plot of AOD (500nm) vs. AE for all measurements. The proposed aerosol classification is also indicated.

2. Hornsund: Arctic

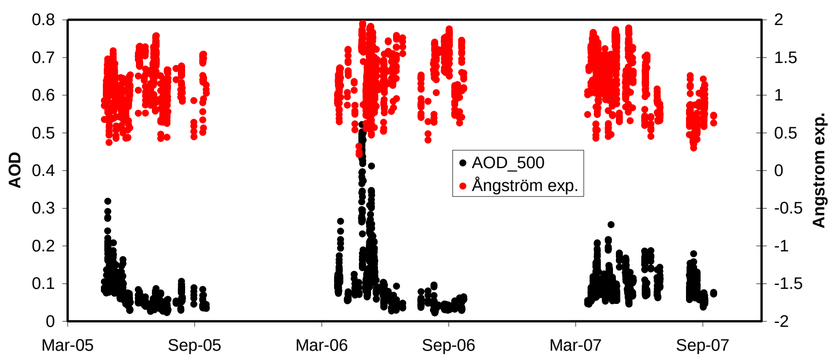

FIGURE 7. Time series of AOD and Ångström exponent at Hornsund

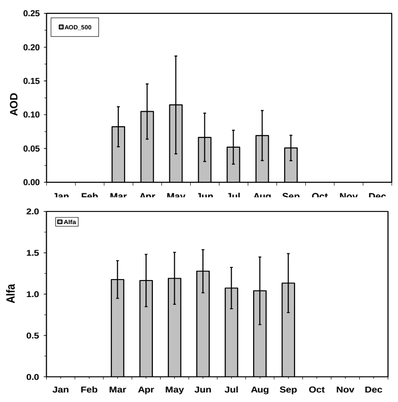

FIGURE 8. Interannual monthly means of AOD (500nm) and Ångström exponent for the period 2005-2007 at Hornsund.

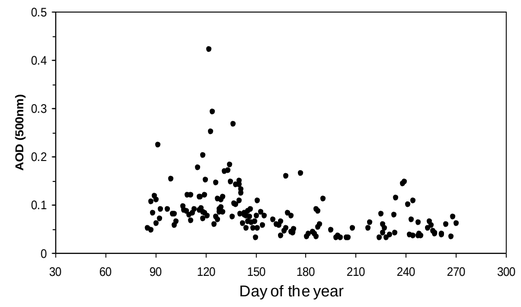

FIGURE 9. Daily mean values of AOD (500nm) for all data, as a function of the day of the year.

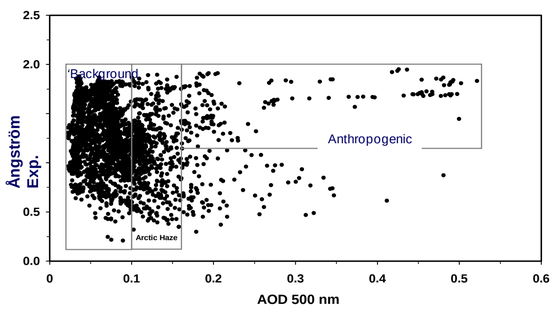

FIGURE 10. Scatter plot of AOD (500nm) vs. AE for all measurements. The proposed aerosol classification is also indicated.

CONCLUSION

The average AOD (500 nm) is similar in both stations (0.08 at ALOMAR and 0.09 at Hornsund), but the seasonal patterns are different. At ALOMAR the spring and summer do not show significant differences in the AOD level, but the AOD is higher in summer. It is possible to have pollution events in spring, but no long periods with Arctic haze have been detected. On the other hand, Hornsund presents the usual behavior for Arctic sites (Herber et al., 2002, see fig. 11), with large AOD values in spring due the Arctic haze and pollution events (Myhre et al., 2007), and low AOD in summer, when the background AOD decreases. The Ångström exponent values show the prevalence of fine particles at both sites. The average values at ALOMAR and Hornsund are 1.42 and 1.25, respectively, being lower at Hornsund, and is close to the values reported by Tomasi et al (2007), who indicates that the AE is higher in sub-Arctic areas than in the Arctic. At ALOMAR, pollution events were registered in summer in most of the years. According to all the above data, we can not considerer that ALOMAR station has an aerosol Arctic character.

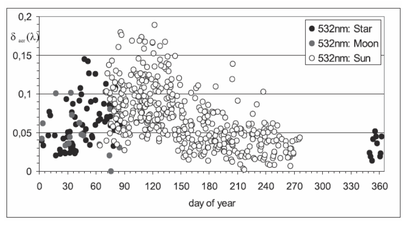

FIGURE 11. Daily mean values of AOD (500nm) in Ny-Alesund, Svalbard (from Herber et al., 2002).

BIBLIOGRAPHY

- Herber, A., L. W. Thomason, H. Gernandt, U. Leiterer, D. Nagel, K. Schulz, J. Kaptur, T. Albrecht, and J. Notholt. 2002. Continuous day and night aerosol optical depth observations in the Arctic between 1991 and 1999. J. Geophys. Res., 107(D10), 4097, doi:10.1029/2001JD000536.
- Myhre, C.L., C. Toledano, G. Myhre, K. Stebel, K. E. Yttri, M. Frioud, V. Cachorro, A. de Frutos, V. Aaltonen, H. Lihavainen, A.P. Chaikovsky, M. Shiobara, and K. Tørseth. Aerosol optical properties and regional radiative impact of the extreme Arctic haze event in spring 2006. Atmospheric Chemistry and Physics 7, 5899-5915, 2007.(PDF)
- Ortiz de Galisteo, J.P., C. Toledano, V.E. Cachorro, E. Rodríguez, A. de Frutos. Analysis of aerosol optical depth evaluation in polar regions and associated uncertainties. Advances in Science and Research, 2, 5-8, 2008.
- Tomasi, C., V. Vitale, A. Lupi, C. Di Carmine, M. Campanelli, A. Herber, R. Treffeisen, R. S. Stone, E. Andrews, S. Sharma, V. Radionov, W. von Hoyningen-Huene, K. Stebel, G. H. Hansen, C. L. Myhre, C. Wehrli, V. Aaltonen, H. Lihavainen, A. Virkkula, R. Hillamo, J. Ström, C. Toledano, V. E. Cachorro, P. Ortiz, A. M. de Frutos, S. Blindheim, M. Frioud, M. Gausa, T. Zielinski, T. Petelski and M. Shiobara. Aerosols in polar regions. J. Geophys. Res., 112, D16205, doi:10.1029/2007JD008432, 2007.

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