LIDAR ALGORITHM COMPARISON OF PSC MEASUREMENTS AT NY-ÅLSEUND, SODANKYLAE AND ALOMAR

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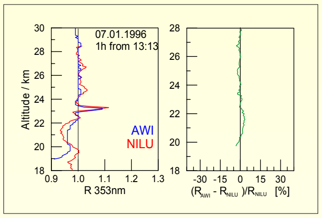

Fig.1: Backscatter ratio R of the 353 nm lidar measurement at ALOMAR on January 07, 1996, analysed by *AWI* (blue) and *NILU*(red) [*left*]. Deviation of the algorithm results [*right*].

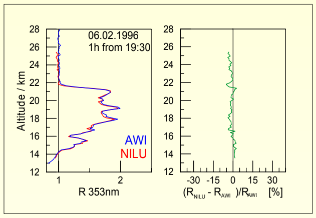

Fig.2: R at 353 nm of the Ny-Ålesund lidar measurement on February 06, 1996, analysed by *NILU* (red) and *AWI* (blue).

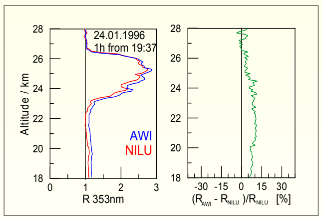

Fig. 3: R at 353 nm of the lidar measurements at ALOMAR on January 24, 1996 analysed by *AWI* (blue) with fitting range 26.5–27.6 km and *NILU* (red).

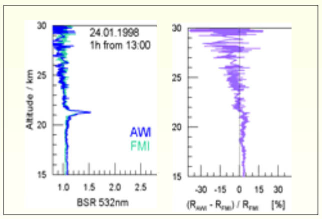

Fig. 4: R at 532 nm of the Sodankylä lidar measurement on January 24, 1998, analysed by *FMI* (green) and *AWI* (blue).

Alfred-Wegener-Institute (AWI): Lidar in Ny-Ålesund, Spitsbergen (78.55°N, 11.55°E), since 1991, Nd:YAG/XeCl Excimer laser, 60 cm telescope

Detected wavelengths: 308, 353 (since 91/92),387, 607 (since 93/94), 332 (93/94-95/96), 532u (93/94,94/95), 532p and 532s (not 93/94), 1064 nm (only 92/93)

Analysis: based on Klett's inversion algorithm

Corrections/input: background, deadtime, polarization cross-talk, daily radiosondes/CIRA, LR = 30 (353 nm), 40 (532 nm); fitting range: 26-30 km

Standard output: 10 min., 150 m, Matlab/NASA Ames format, backscatter ratios, volume depolarization (only 532), temperature, density

Norwegian Institute for Air Research (NILU): Lidar at ALOMAR, Andøya (69.28ºN,16.01ºE), Norway, since December 1994, jointly run by the Norwegian Defence Research Establishment (FFI), NILU, and the Andøya Rocket Range; XeCl Excimer laser, 1m telescope; since 1998: daylight capability

Detected wavelengths: 308, 353 nm

Analysis: R at 353 nm: based on ratio between range corrected lidar profile and a reference density profile (ECMWF, radiosondes); R at 308 nm: the ozone extinction is corrected using an external ozone profile

Corrections/input: background deadtime, nearest radiosonde/ECMWF, fitting range: below PSC layer, visually identified

Standard output: 5 min, 97.433 m, NASA Ames format, ozone, backscatter ratio, temperature

The results for thin clouds show an excellent consistency with deviations smaller than 5 % (**Fig. 1**). Also for the solid PSC type Ia enhanced (**Fig. 2)** the deviations are small (< 5%) throughout the whole altitude range. For a medium thick PSC measurement from ALOMAR small deviations (< 5%) are found above the cloud, while in and below the cloud the deviations were much higher (10–15 %) (**Fig. 3**). Problems seem to occur if the analysed cloud is optically thick and extinction may not be neglected. Lidar data from Sodankylä (**Fig. 4**) compared to output from AWI's algorithm show a good correlation with small deviations around 5 %.

Finnish Meteorological Institute (FMI): Lidar at Sodankylä Observatory (67.37°N, 26.63°E) , 1996 - 1999 (SAONAS campaign), Nd:YAG laser, 60 cm telescope

Detected wavelengths: 1064, 532p, 532s, 355 nm

Analysis: based on Klett's inversion algorithm

Corrections/input: density from 2x daily radiosondes, US-standard atmosphere above, LR=24 (353 nm), 41 (532 nm); fitting point between: 26-30 km, visually defined

Standard output: 4 min, 75 m, Ascii format, backscatter ratio/coefficient at 355 nm and 532 nm wavelengths

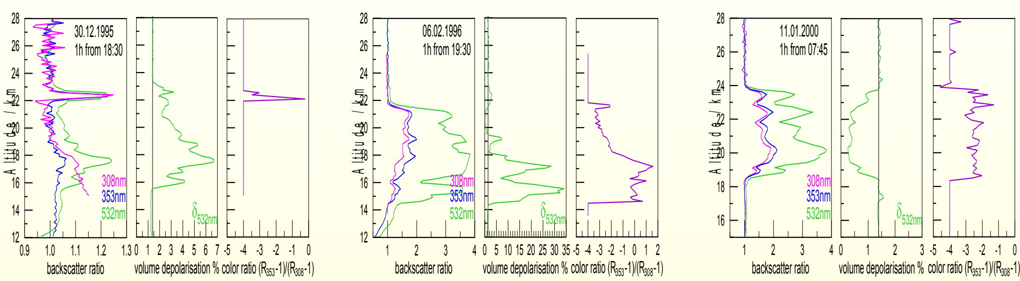

Fig. 4a, b, and c: Examples for December 30, 1995, February 06, 1996 and January 11, 2000. For each day the backscatter ratio for 308 nm using *NILU* O_3 correction, as well as for 353 nm and 532nm from *AWI* aerosol algorithm, the volume depolarisation at 532 nm from *AWI* aerosol algorithm, and the Color ratio C = $(R_{353}-1)/(R_{308}-1)$ from *NILU* O_3 correction algorithm are shown.

The main advantage of the *NILU* algorithm is the retrieval of another backscatter ratio (308 nm) and thus additional information by gaining the color ratio C = $(R_{353}-1)/(R_{308}-1)$. This information source is very helpful to analyse PSCs with a rather strong backscatter signal. As shown in the example for the weak PSC type I a (**Fig.4a**), and according to the definition of the color ratio, this method does not work for small backscatter ratios. Different particle types in the PSC layer are indicated by the difference in color ratio, even if no depolarisation signal would be is available (**Fig.4b**). If case of a cloud consisting of liquid particles (**Fig.4c**), this color index value may even be used with others as an input for Mie calculation on the size of spherical particles. The method works best if the PSC is rather uniform in particle consistency through a certain altitude range.

Conclusions: The agreement between the results from the PSC algorithm comparison between AWI/NILU and FFI is good and the analysis of the backscatter ratio at 308 nm turned out to be a useful tool in case of PSC measurements. Here some recommendations to improve the results:

[*AWI:*] For the evaluation of high altitude PSC, the adaption of the fitting range should be default to avoid a shifting of the evaluated profile to *R<1*. Estimation of an actual Lidar ratio using the available Raman-channel could further improve the analysis.

[*NILU:*] An additional correction factor for non-neglectable background aerosol loading may be needed in future. Stepwise analysis can be recommended for widely seperated PSC layer.

[*FMI:*] The data should be re-analysed in a uniform way concerning height resolution of different measurement periods, and corrections/input parameter used need to be documented.

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REFERENCE:
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