

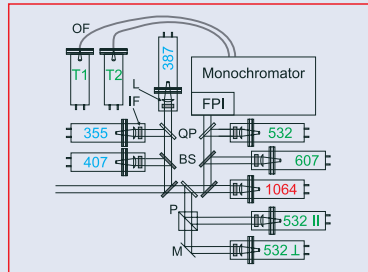
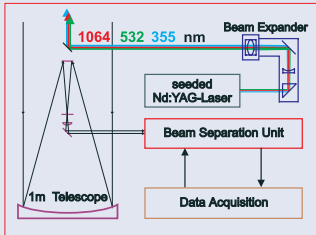


Statistical analysis of extinction and lidar ratio profiles observed with Raman lidar over Leipzig, Germany

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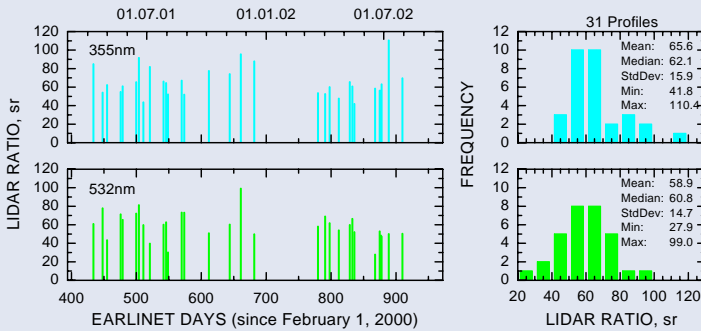
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Humidity-temperature-aerosol Raman lidar



Backscatter at 355 532 1064 nm
Extinction at 355 532 nm
Lidar ratio at 355 532 nm
Depolarization at 532 nm
H₂O Mixing ratio
Temperature
Relative humidity

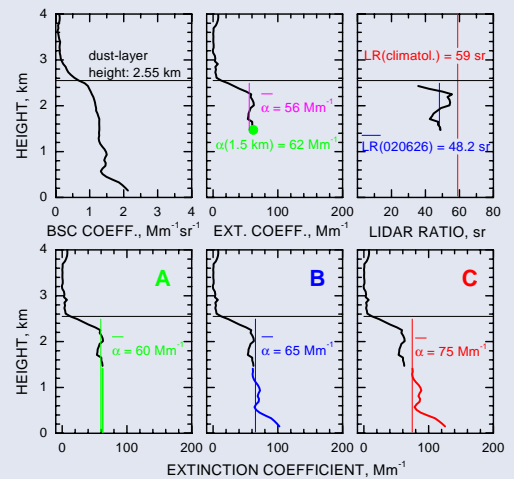
Dust-layer mean lidar ratios



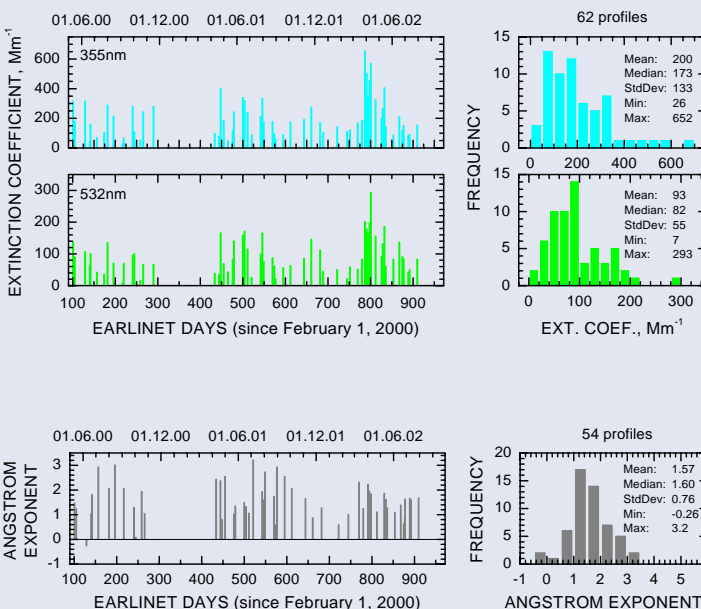
Extrapolation of extinction profiles down to the ground

- Incomplete overlap between the laser beam and the receiver field of view up to 3 km
- Overlap correction possible, but only down to 1.5 km
- Below 1.5 km no α -profiles can be calculated

Extrapolation methods



Dust-layer mean extinction coefficients and Angstrom exponents



Method A:

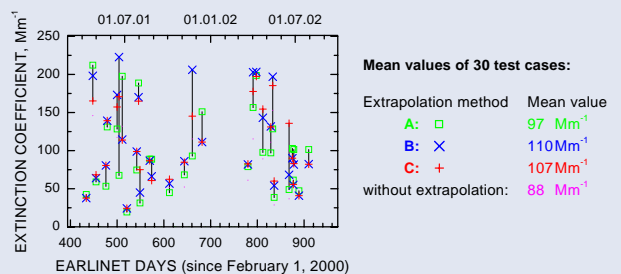
use the α -value of the lowest valid point

Method B (31 profiles):

Parallel to the β -profile, multiplied by the actual lidar ratio

Method C (62 profiles):

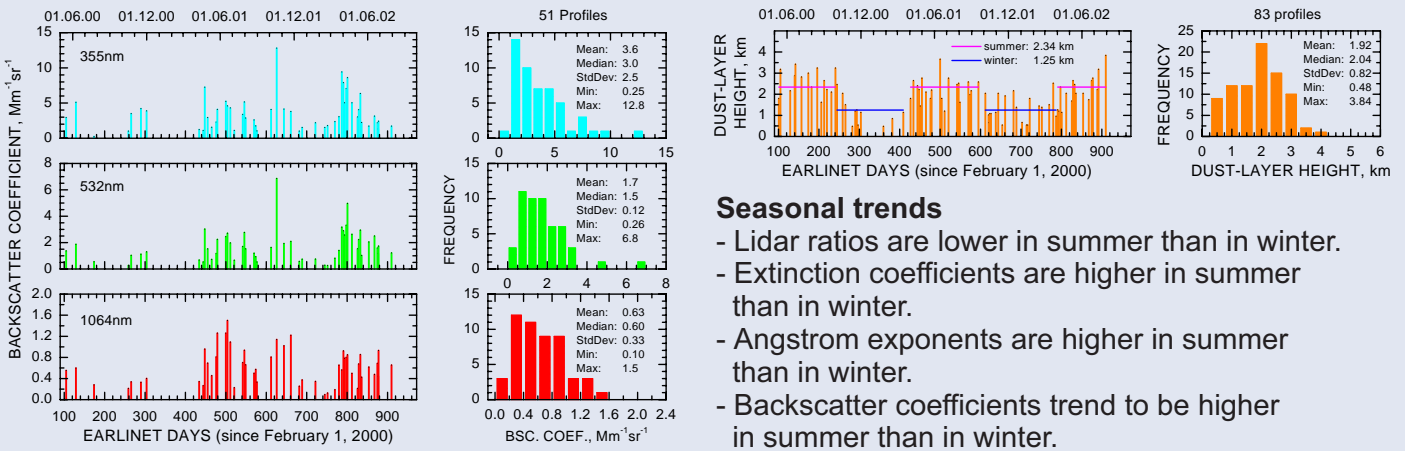
Parallel to the β -profile, multiplied by the climatological lidar ratio.



- Mean values of method B and method C are similar.
- More profiles available for method C.

→ Use method C

Dust-layer heights and Dust-layer mean backscatter coefficients

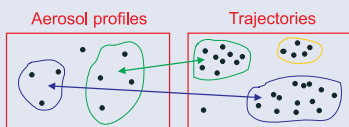


Part 2: Combined statistical analysis of lidar profiles and trajectories

Classification method

- Number of measured aerosol profiles is not sufficient for statistical analysis
- Number of available DWD trajectories is much larger
- Trajectories provide information about the synoptic pattern corresponding to the measurements
- Divide trajectories into distinct classes by means of cluster analysis!
- Assign aerosol profiles to the corresponding trajectory cluster!

RESULT: Distinct classes of aerosol profiles



→ Dependence of aerosol profiles on the corresponding weather regime

Cluster analysis

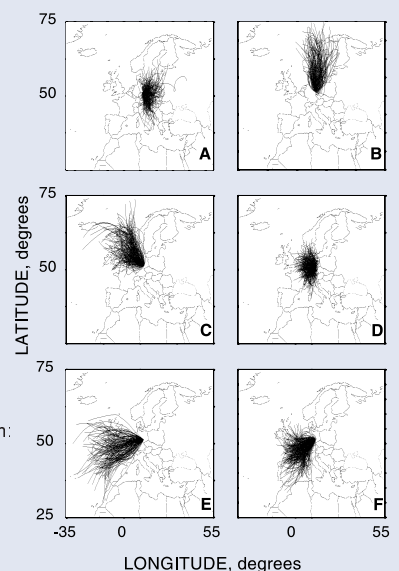
- Separate a large number of data sets into groups
- similar trajectories are within one cluster
- dissimilar trajectories are in different clusters

Clustering Algorithm:

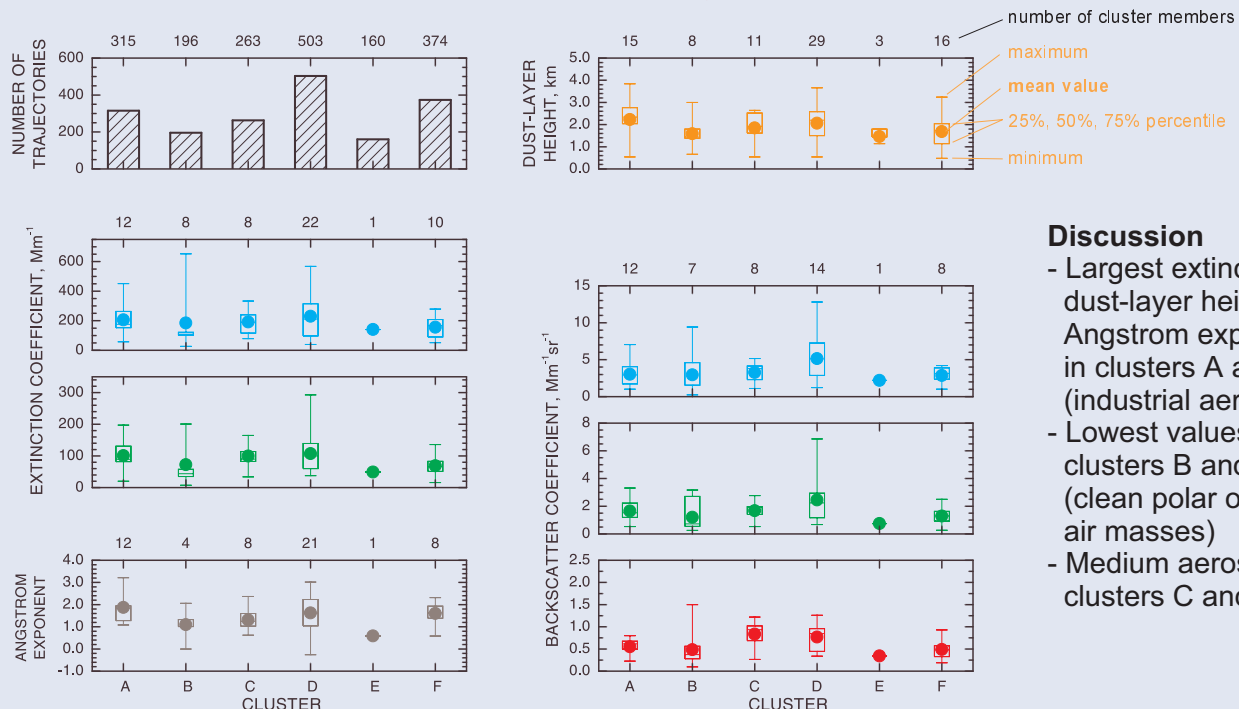
- based on *Dorling et al. 92*
- Advantage: Optimum number of clusters follows from the algorithm itself
- Modification: Variation of initial conditions provides information on the uncertainty of the derived results
- Measure of similarity / dissimilarity: 2-dim Euclidian distance
- Applied to the last 48 hours before arrival at Leipzig of the 850-hPa trajectories from April 2000 to September 2002

Results:

- The optimum number of clusters was found to be six.
- The six cluster represent weather regimes with different wind directions and speeds.
- The air masses corresponding to the six clusters are advected from:
 - A** easterly directions with low speeds
 - B** north with higher wind speeds
 - C** northwest with higher wind speeds
 - D** westerly directions with low speeds
 - E** the Atlantic Ocean with very high wind speeds
 - F** from the Mediterranean Sea, from north Africa, and from western Europe



Classification of aerosol properties (dust-layer mean values)



Discussion

- Largest extinction values, dust-layer heights, and Angstrom exponents are in clusters A and D. (industrial aerosol)
- Lowest values are in clusters B and E (clean polar or marine air masses)
- Medium aerosol load in clusters C and F.