

Detection and 24-year climatology of the frequency and mass of Saharan dust at the high-altitude site Jungfrauoch

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Introduction: Saharan dust (SD) contributes to the aerosol load in Europe with a large impact in southern Europe and a decreasing influence towards Northern and Eastern Europe. SD events occur 30 to 150 times each year at the Jungfrauoch (JFJ, 3580m a.s.l.) in the Swiss Alps. The SD optical detection method is compared to detections based on size distribution, CAMS dust index and FLEXPART source sensitivity. The long time series at JFJ allows presenting the 2001-2024 dust climatology.

SD detection

The presence of SD can be detected by a negative single scattering albedo (SSA) Ångström exponent (AE) caused by the higher coarse-mode fraction and the chemical composition of dust. This optical method depends however on the nephelometer's type.

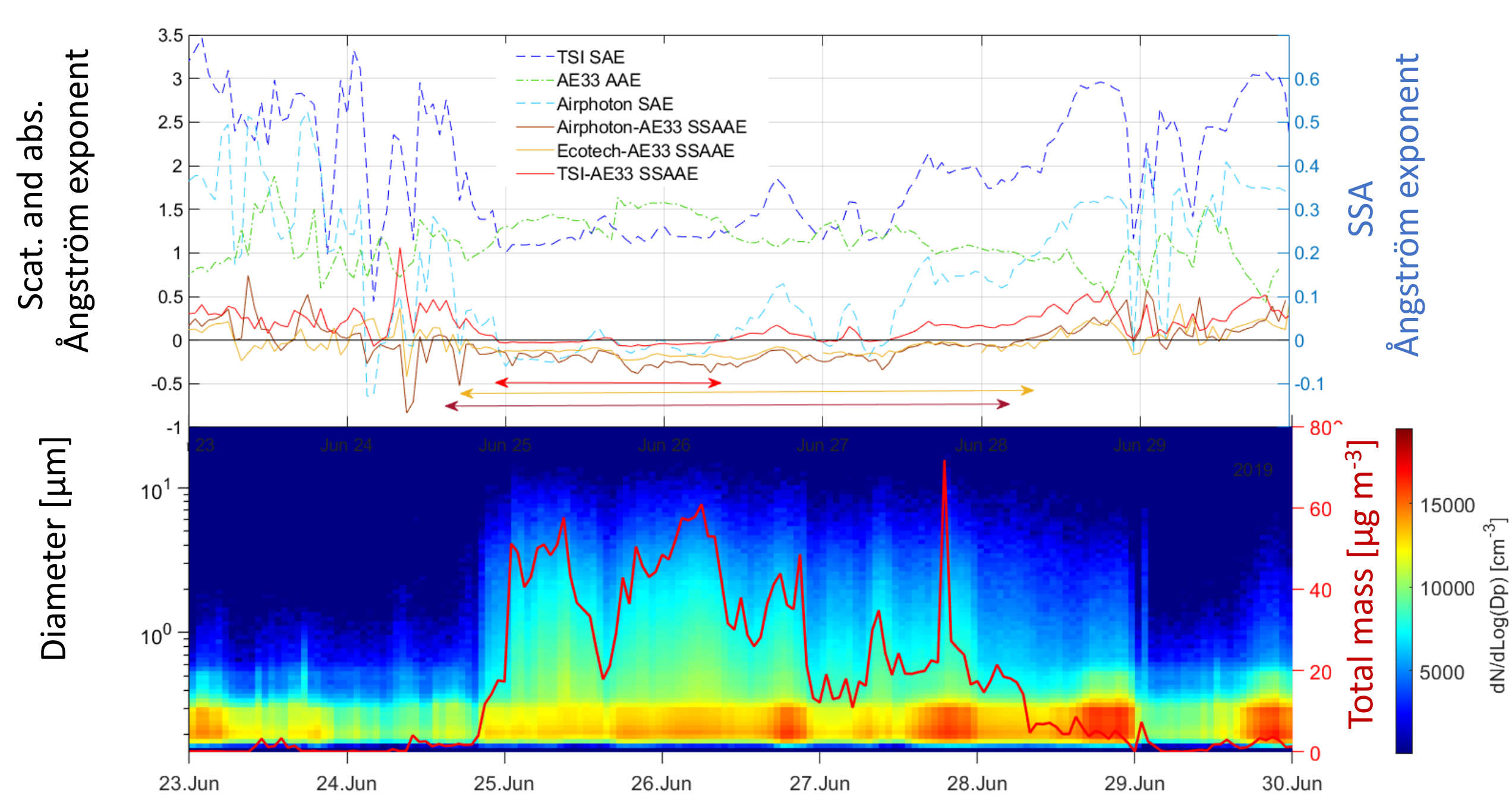


Fig. 1: a) Scattering, absorption and SSA AE from various instruments. \leftrightarrow are the length of the detected SD event.

b) Particle size distribution and SD mass.

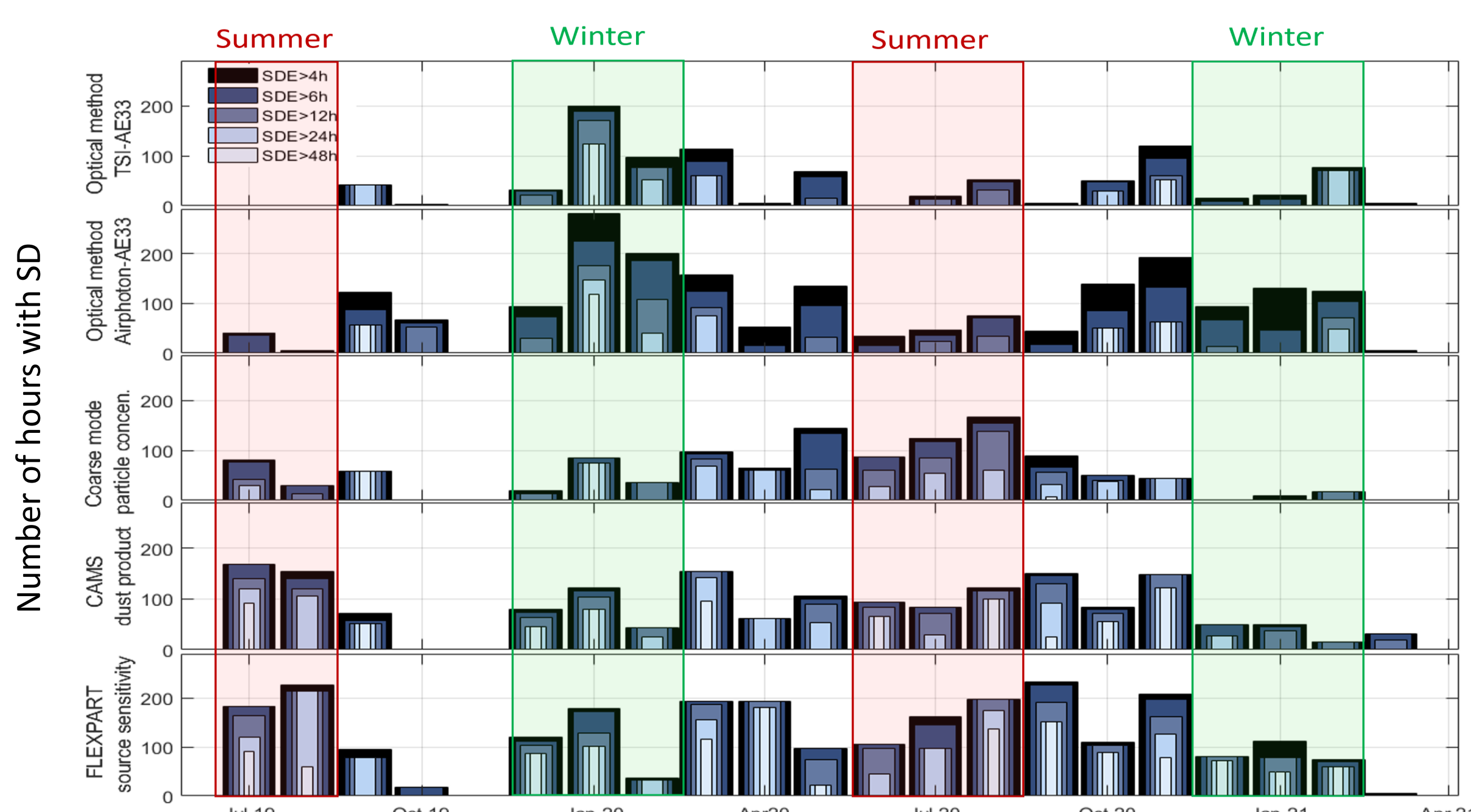


Fig. 2: SD hours for the optical method for a) TSI-AE33 and b) Airphoton-AE33, c) coarse-mode particle concentration (number concentration of particle $> 1 \mu\text{m}$ higher than the background), d) CAMS dust index and e) FLEXPART source sensitivities.

- lowest SD hours for both methods based on in-situ data
- higher detection in winter/summer for the optical/coarse mode particle concentration
- similar SD hours for CAMS and the coarse mode particle concentration
- highest SD hours for FLEXPART source sensitivity due to the absence of selecting conditions for dust activation over Sahara

None of the used methods can be considered as a reference method. The use of several methods together is recommended.

SD frequency and mass climatology (optical method)

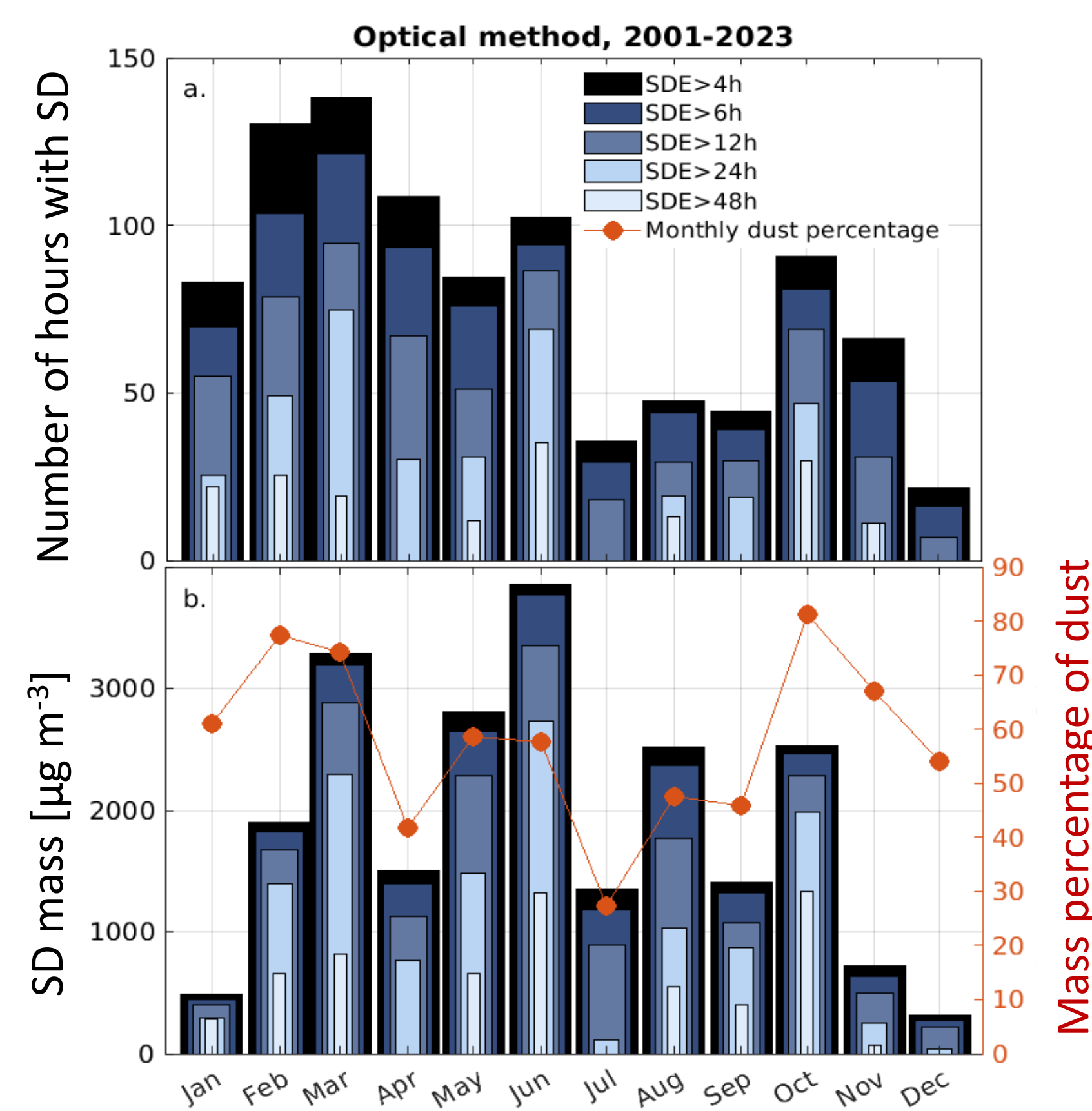


Fig. 3: 24-y climatology of a) the dust frequency and b) the dust mass and mass percentage.

- frequent SDEs in February-June and in fall
- low dust mass in November-January
- very high inter-annual variability
- high SD hours and mass in 2020-2022
- SD mass is 94-100% of the total aerosol mass during the event
- SD mass is 20-80% of the mean monthly mass

FLEXPART source sensitivity

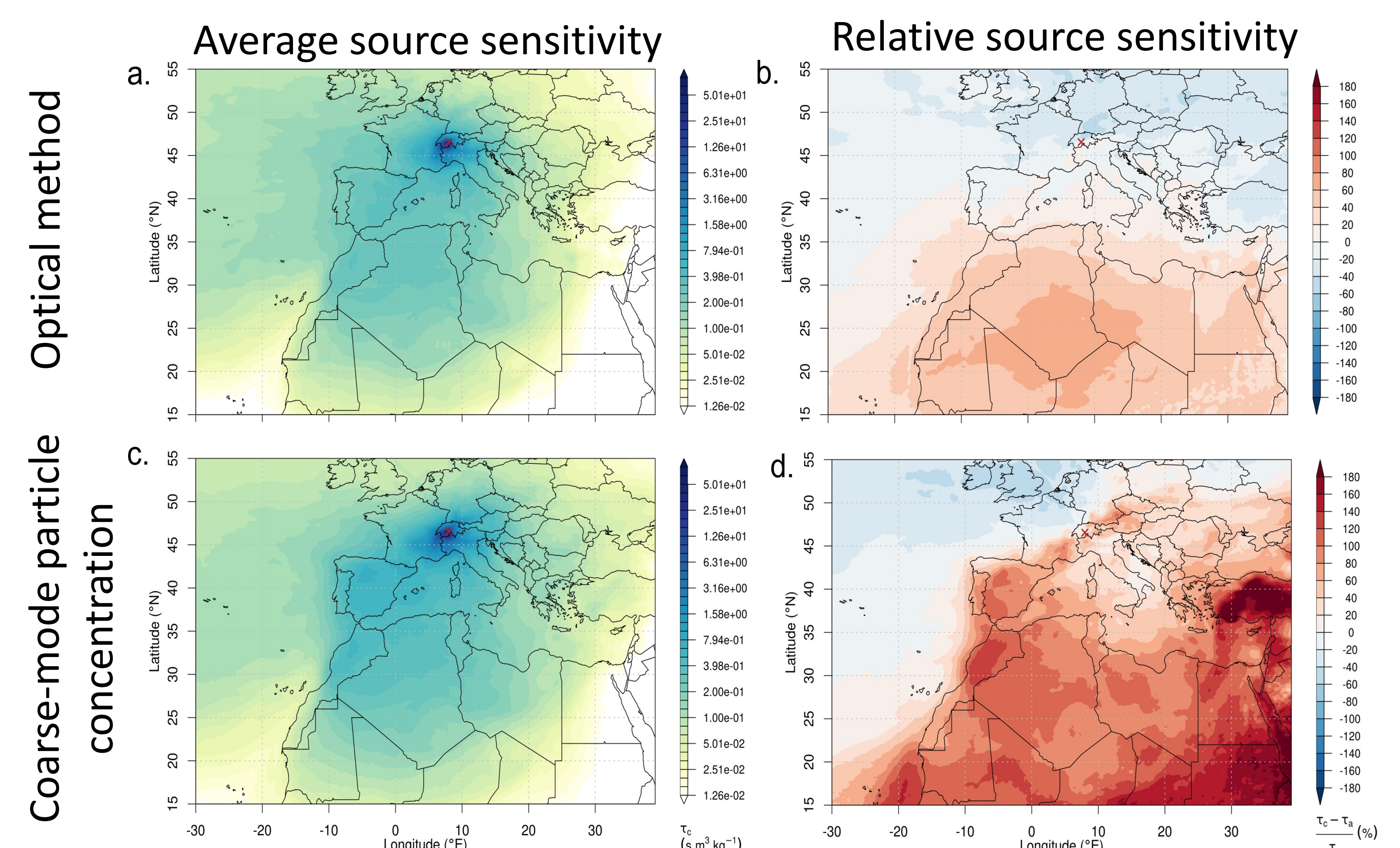


Fig. 4: 2018-2023 FLEXPART source sensitivities

- SD detected by the optical method: direct pathway from the Sahara to the Alps and homogeneous path probability over the Mediterranean
- SD detected by the coarse-mode particle concentration: higher relative footprints over eastern Mediterranean and south eastern Europe for and direct paths over the Iberian peninsula

SDE alert

To receive the SDE alert from the JFJ per email, please contact martine.collaudcoen@meteoswiss.ch

