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Supplement of

Pollen observations at four EARLINET stations during the ACTRIS-COVID-19 campaign

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1 Synthetic examples for 3 aerosol mixture

The method presented in the manuscript can be applied if there are only two aerosol populations present in the mixture. Here we discussed two cases when there are 3 aerosol types present in the mixture, using synthetic examples. In these cases, we assume there are dust, pollen and non-depolarizing background aerosols in the aerosol mixture and chosen the input characteristic values shown in Table S1. The backscatter coefficients profiles (at 532 nm) of each type were simulated (Fig. S1–S2 a), as well as the total particle backscatter coefficient. Using these initial characteristic values, the particle linear depolarization ratio (PDR, δ) at 532 nm and the backscatter-related Ångström exponent (BAE, $\mathring{A}$) between 355 and 532 nm of total particles were calculated (Fig. S1–S2 b–c). The scatter plot of all bins (black circles) in the simulated profiles is given in Fig. S1–S2 d.

Table S1. Initial characteristic values of dust, pollen and non-depolarizing background aerosols, as input of the synthetic examples.

Aerosol type	Depolarization ratio at 532 nm (δ)	Backscatter-related Ångström exponent 355-532 ($\mathring{A}$)	Half width (Gauss.)	Layer centre case 1 (Fig. S1)	Layer centre case 2 (Fig. S2)
Dust	0.40	0	1 km	2.5 km	1.5 km
Pollen	0.30	0	1 km	1.5 km	1.5 km
Background	0.01	2	3 km	2.0 km	2.0 km

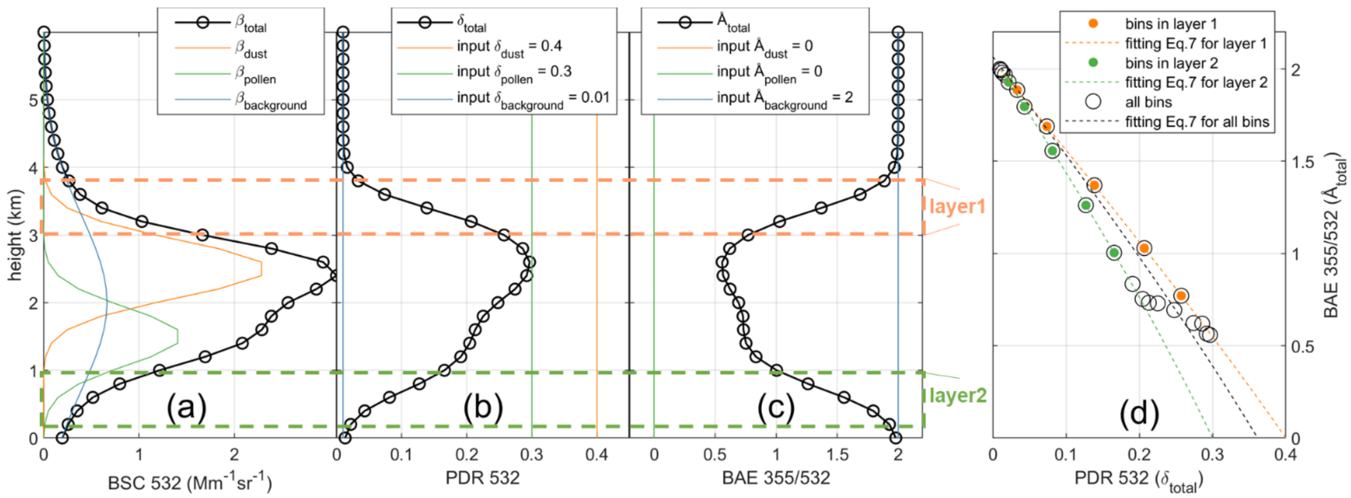

Figure S1. Case 1: (a) Synthetic vertical profiles of the backscatter coefficient (BSC) at 532 nm of dust, pollen, background and total particles. Synthetic profiles of (b) the particle linear depolarization ratio (PDR) at 532 nm, and (c) the backscatter-related Ångström exponent (BAE) between 355 and 532 nm, of total particles, under initial values given in Table S1 – case 1. Two layers are defined (layer 1 – orange, layer 2 – green) in dashed boxes (a–c). (d) Scatter plot of PDR and BAE for the synthetic case. The dashed fitting lines are determined by Eq. (7), for layer 1 (orange), layer 2 (green), and all bins (black). Colour dots (inside each layer) and black circles (entire profile) present each bin.

Case 1:

We defined 2 layers here (orange and green dashed boxes in Fig. S1 a–c): layer 1, from 3.0 to 3.8 km, where there are only dust and background aerosols present; layer 2, from 0.2 to 1.0 km, where there are only pollen and background aerosols present. As in both layers, there are only two aerosol types (one depolarizing and the other non-depolarizing), perfect fitting lines can be found by applying the method, i.e. Eq. (7) in the manuscript (orange and green dashed lines in Fig. S1 d). However, bins outside these 2 layers (black circles without colour) do not fit to either fitting line, but locating between them or on the top-left edge (where there are only background aerosols). When applying the method to all bins, a fitting line (in dashed black) was found between the ones of layer 1 and layer 2. As a result, under the assumptions that there are two aerosol types in the given aerosol mixture and that the BAE of this "depolarizing aerosol" should be zero, the pure depolarization ratio of this "depolarizing aerosol" was estimated as 0.36, which is a value between the initial depolarization ratios of pure dust (0.4) and pure pollen (0.3).

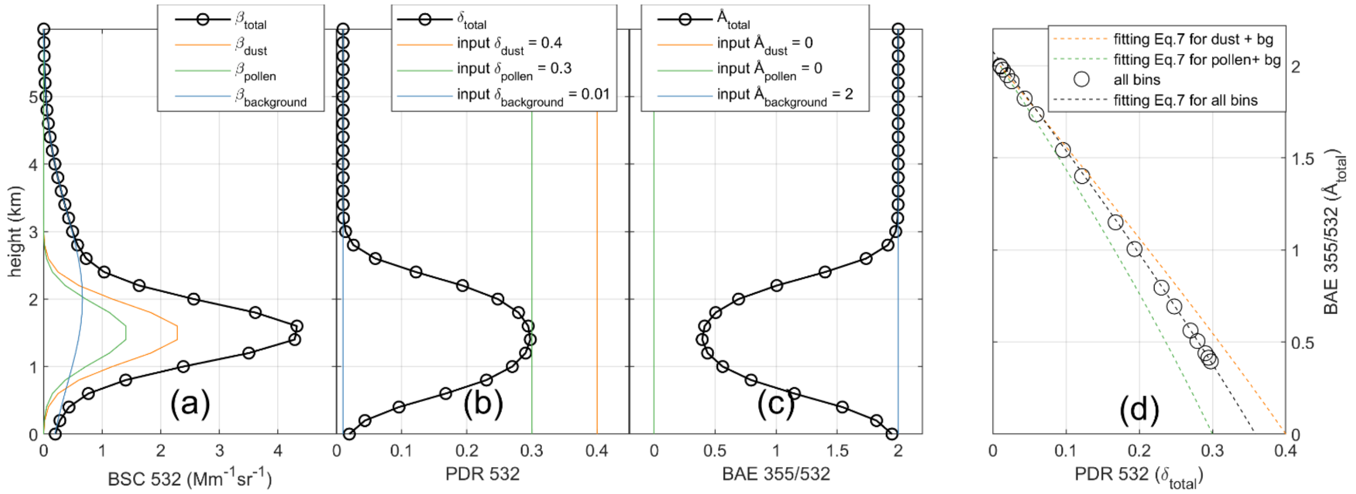

Figure S2. Similar as Fig. S1, but for Case 2 (Table S1).

Case 2:

In this case, the initial layer heights and layer depths of dust and pollen aerosol were selected to be the same (Table S1, Fig. S2 a). As these two depolarizing aerosols are well mixed with homogenous mixing ratio in this case, a perfect fitting line can be found for the PDR and BAE of total particles (black dashed line in Fig. S2 d) with all bins located on the fitting line, resulting a characteristic depolarization ratio of 0.36 under the assumption of characteristic BAE of zero. The theoretical fitting lines (from equations using initial values of Table S1) for dust and background aerosol mixture or pollen and background aerosol mixture are also given as orange or green dashed lines.

Not that the cases in the reality can be more complicated than the considered examples.

For the given examples, we can conclude that for an aerosol mixture of two types of depolarizing aerosols and one non-depolarizing aerosol, the estimated depolarization ratio for “depolarizing aerosols” represent the combination of two present depolarizing aerosols, with a value between the characteristic (pure) depolarization ratios of each type. For aerosol mixture with more types, the estimated depolarization ratio for “depolarizing aerosols” represent a combination of all present depolarizing aerosols, with a value inside the range of the characteristic (pure) depolarization ratio values of each aerosol type.

However, authors recommend using the method under the constraints mentioned in the manuscript.

2 Dust concentration profiles from the NMMB/BSC-Dust model

Images were downloaded from https://ess.bsc.es/bsc-dust-daily-forecast, with data from the NMMB/BSC-Dust model, operated by the Barcelona Supercomputing Center.

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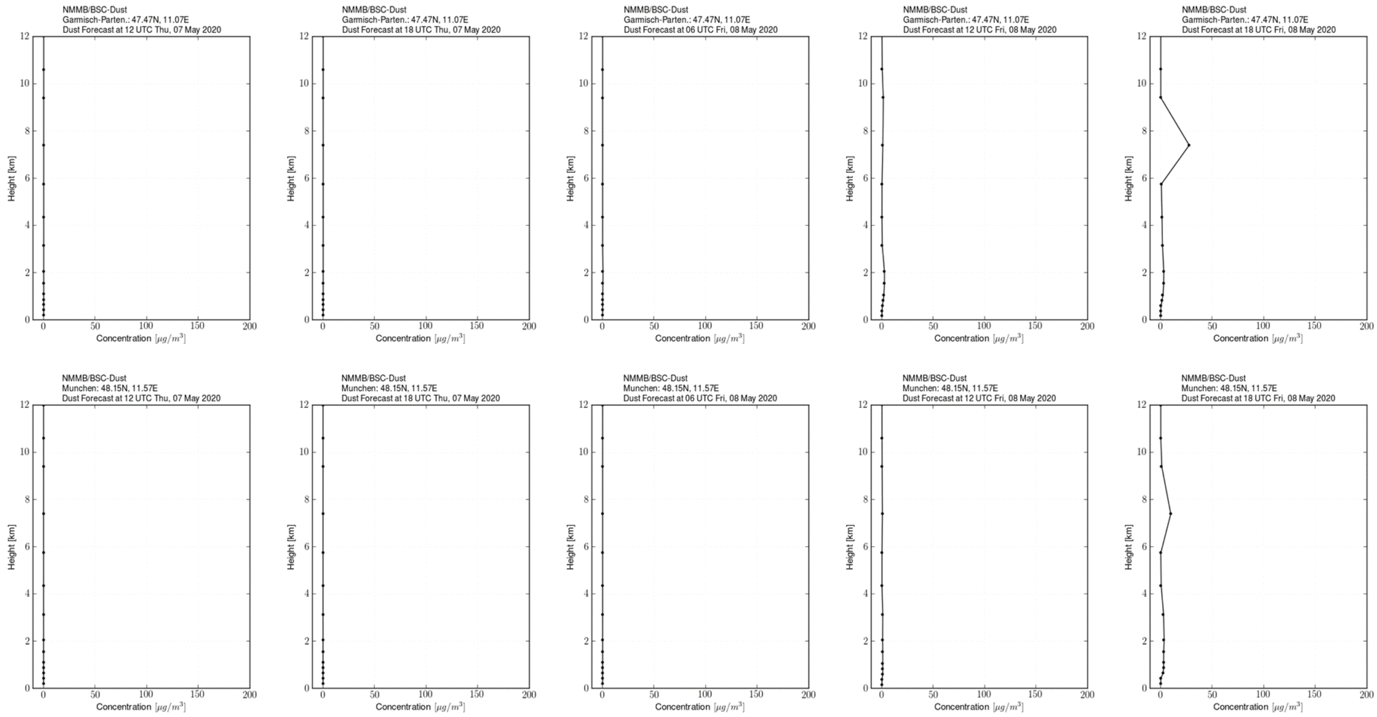

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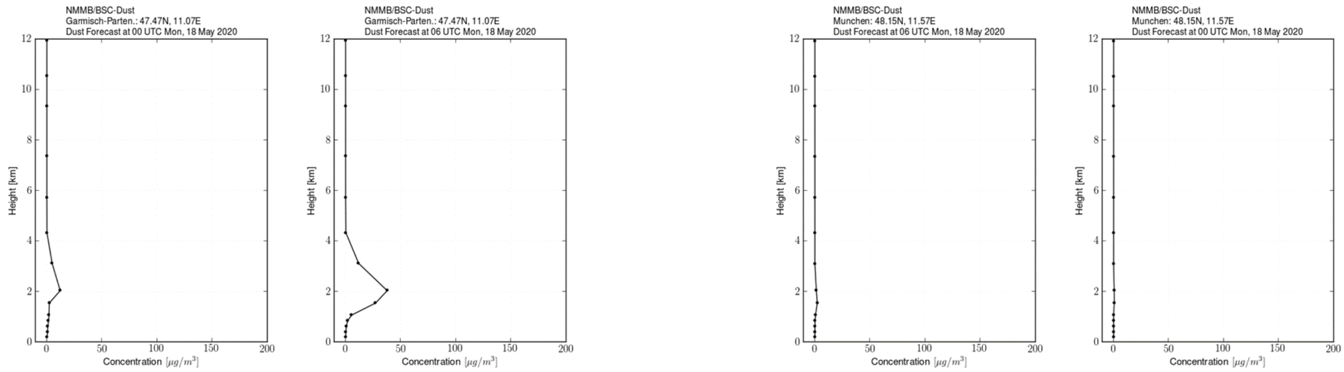
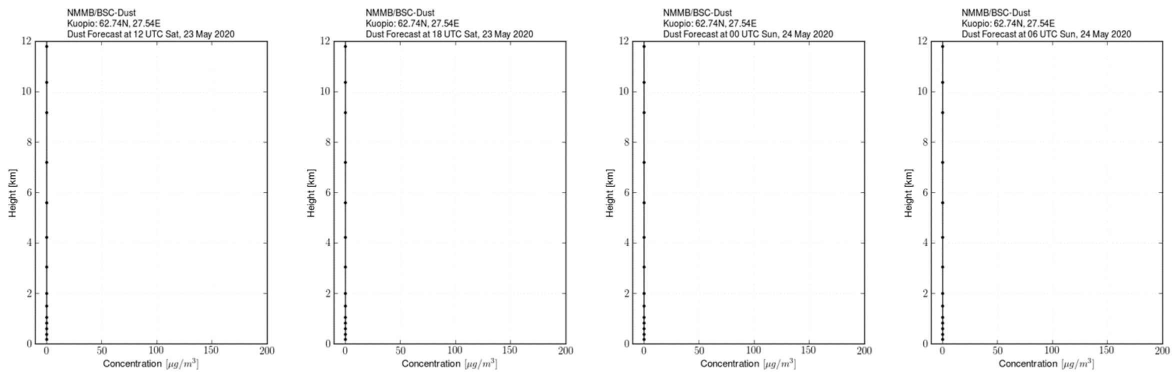
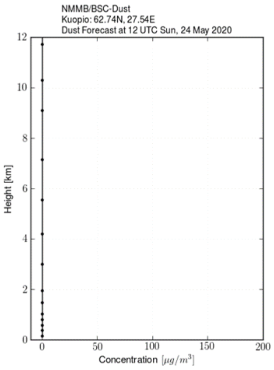
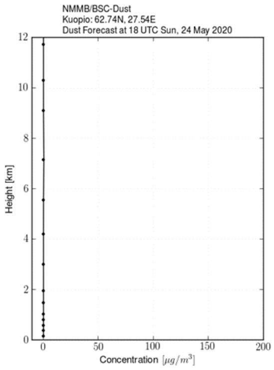
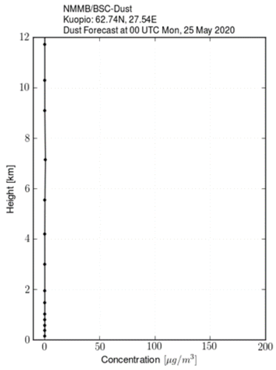


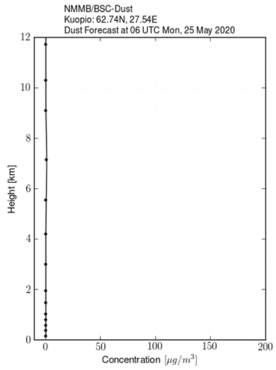
KUO 23–26 May 2020

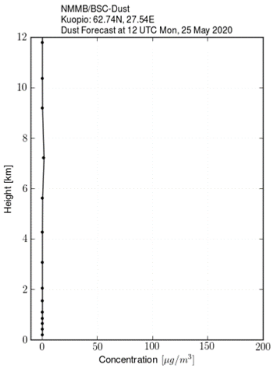


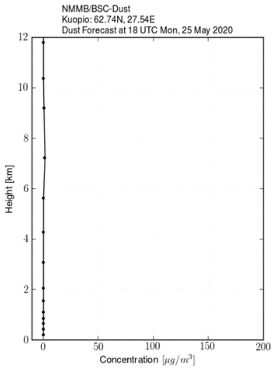


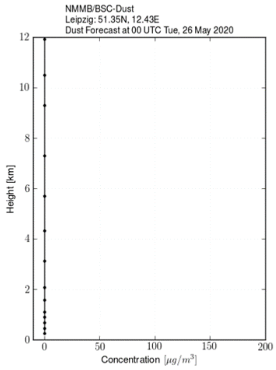


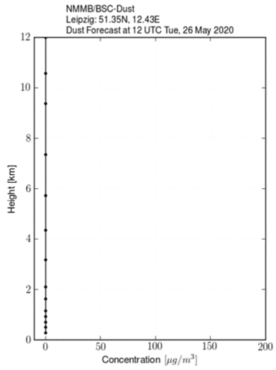


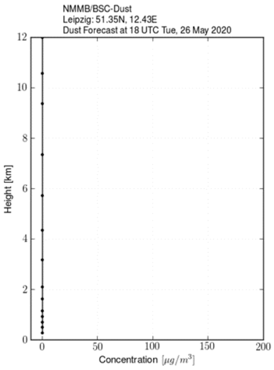




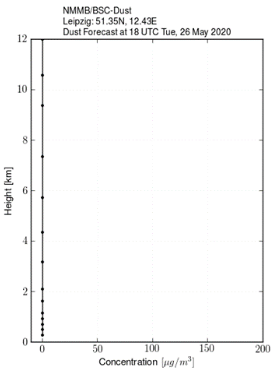


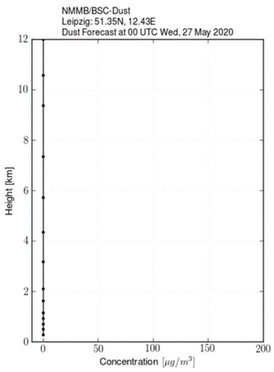


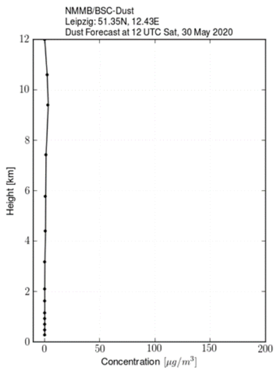


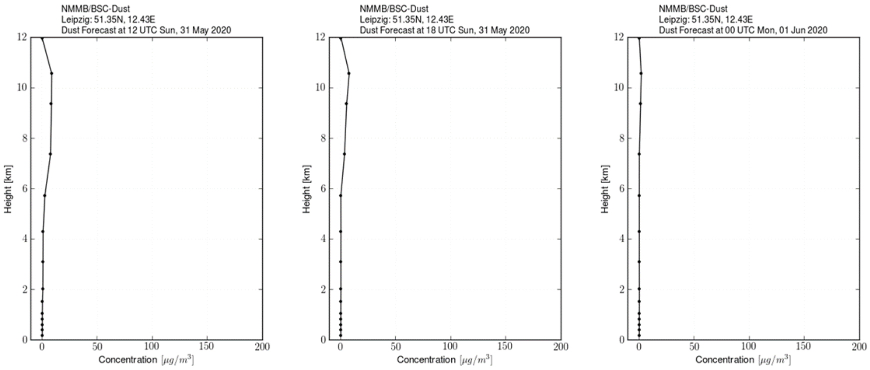


LEI 26–27, 30–31 May 2020









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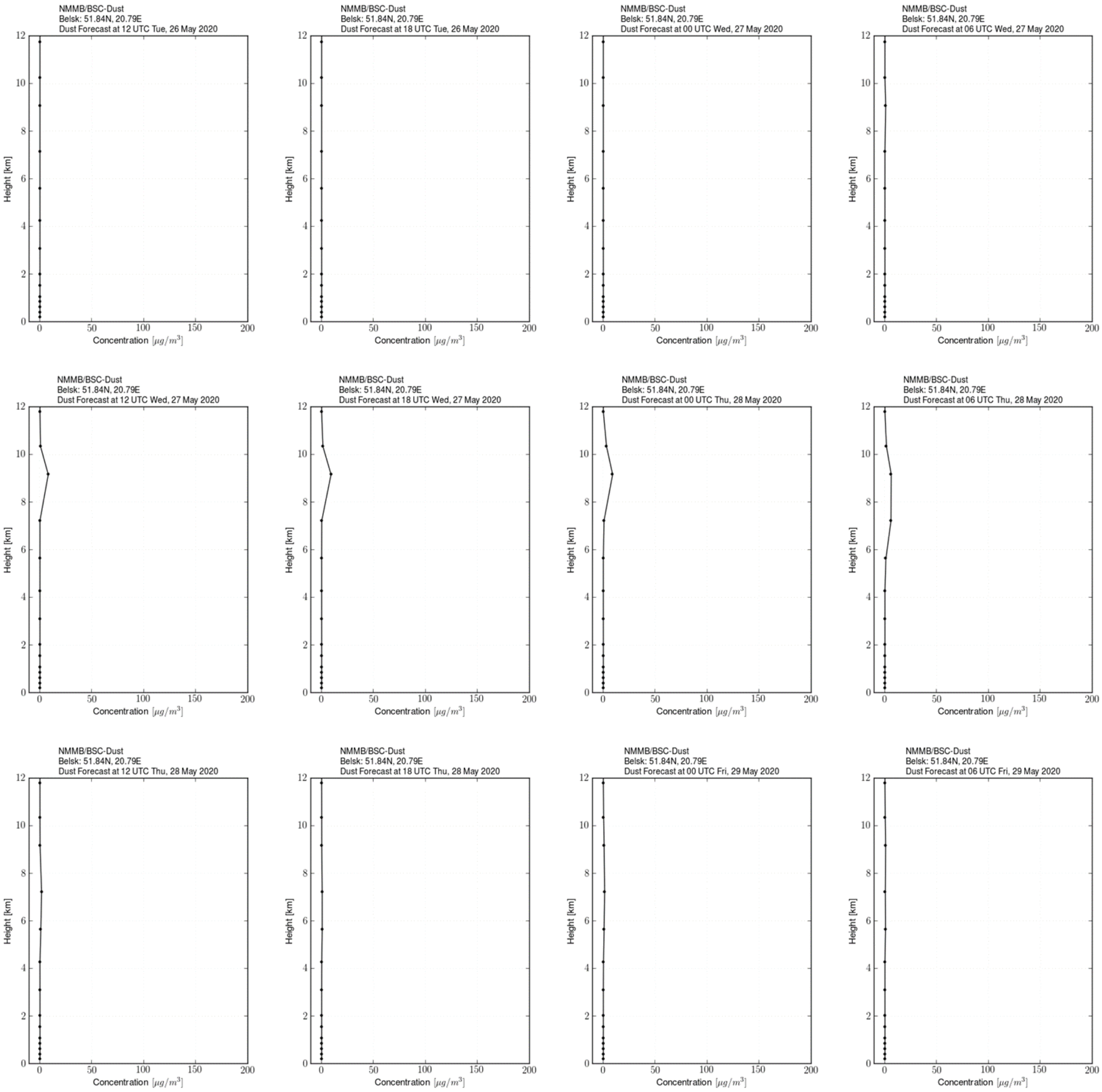
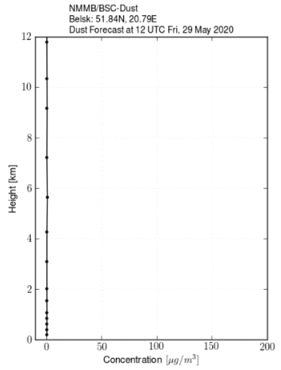
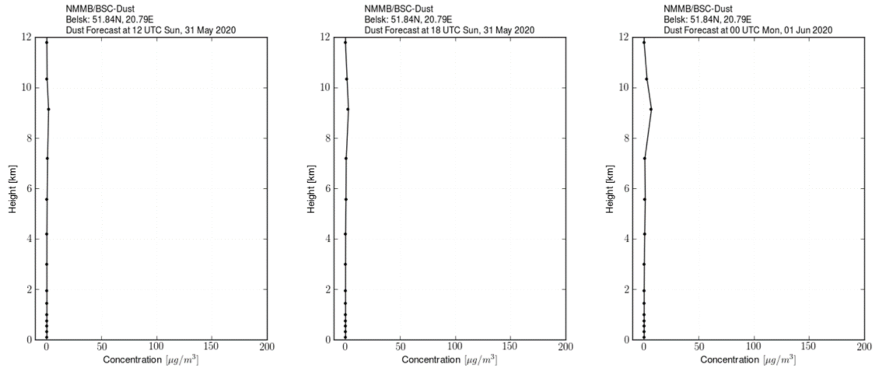




WAW Period no.2: 31 May 2020



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