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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Dependence of solar radiative forcing of forest fire aerosol on ageing and state of mixture" *by* M. Fiebig et al.

M. Fiebig et al.

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Referee #2 raises helpful points in which the described approaches and used techniques should be stated more precisely to improve the comprehensibility of the article. The points are addressed individually below:

1. Since this point has also been made by referee #1, it has been taken care of in the response on his/her comment.

2. In order to explain how the contribution of the accumulation mode aerosol to the layer's extinction has been calculated, the sentence on page 1277, lines 16 - 17:

   It contributes more than 90% to the layer's extinction coefficient at λ = 550 nm.

   has been changed to:

   By using Mie-calculation and integrating the particle extinction cross-section over

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the particle size distribution (Fiebig et al., 2002), the accumulation mode is found to contribute more than 90% to the layer's extinction coefficient at λ = 550 nm.

3. The coagulation calculations have been done once assuming particle free air as dilution air and once assuming a dilution aerosol with a particle size distribution representative for the free troposphere for all cases where dilution was involved. The parameters for the free tropospheric size distribution, N_{Ait} = 500 cm^{-3}, $\overline{D}_{Ait}$ = 0.047 μm, $\sigma_{g,Ait}$ = 2.0 for the Aitken mode, N_{acc} = 20 cm^{-3}, $\overline{D}_{acc}$ = 0.23 μm, $\sigma_{g,acc}$ = 1.4 for the accumulation mode, were taken from the LACE 98 measurements (Petzold et al., 2002, upper tropospheric aerosol, flight M1, polar air masses approaching Lindenberg, Germany, from north-west). The comparison between runs with particle free and particle laden dilution air show that the assumptions on the particle size distribution in the dilution air have no significant effect on the accumulation mode parameters after 6 days of coagulation. This result is plausible since, in this special case, the accumulation mode particle concentration is 2 - 3 orders of magnitude smaller in the dilution air than in the forest fire plume. The particles in the Aitken mode which are present in addition to the accumulation mode particles in the cases with particle laden dilution air are too small to be significant with respect to aerosol optical properties.

   Although the assumption on the particle size distribution in the dilution air has no significant consequences for the evolution of the accumulation mode in the present case, Referee #2 is right in pointing out that this issue has not been discussed adequately in the manuscript. Consequently, the following changes have been made:

   page 1285, line 11:

   The following paragraph has been added:

   To investigate the influence of particles contained in the dilution air on the evo-

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lution of the forest fire aerosol, all cases that include dilution were calculated once assuming particle free dilution air and once assuming a free tropospheric aerosol as dilution air. The modal parameters for the free tropospheric particle size distribution, N_{Ait} = 500 cm^{-3}, $\overline{D}_{Ait}$ = 0.047 μm, $\sigma_{g,Ait}$ = 2.0 for the Aitken mode, N_{acc} = 20 cm^{-3}, $\overline{D}_{acc}$ = 0.23 μm, $\sigma_{g,acc}$ = 1.4 for the accumulation mode, were taken from the LACE 98 measurements (Petzold et al., 2002, upper tropospheric aerosol, flight M1, polar air masses approaching Lindenberg, Germany, from north-west). As a result, it is found that the assumptions on the particle size distribution in the dilution air have no significant effect on the accumulation mode parameters after 6 days of coagulation. The particles in the Aitken mode present in addition to the accumulation mode particles in the cases with particle laden dilution air are too small to be significant with respect to aerosol optical properties.

4. To give more information on the used radiative transfer model, the following changes were done to the manuscript:

   page 1286, lines 8 - 10:

   The sentence:

   It uses measured aerosol microphysical and optical properties as input data (Wendisch et al., 2002).

   has been changed to:

   For solving the radiative transfer equation for a vertically inhomogeneous atmosphere, the “Discrete Ordinate Method” for each homogeneous sub-layer is combined with the “Adding Method” for linking the sub-layers. The vertical column is resolved by 250 layers below 5 km altitude, 7 layers between 5 - 12 km altitude, and three layers in the stratosphere. The model takes into account multiple scattering, also absorption by 7 major (H_2O, CO_2, O_3, N_2O, CO, CH_4, O_2) and 21 further minor trace gas species (Wendisch et al., 2002).

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page 1286, lines 18 - 19:

The sentence:

Scenarios 2 and 3 of Table 3 are assumed as aerosol microphysical input parameters as a function of time for the radiative transfer model.

has been changed to:

Scenarios 2 and 3 of Table 3 are assumed as microphysical input parameters of the forest fire aerosol as a function of time for the radiative transfer model. The forest fire aerosol layer is located between 3.8 and 4.3 km altitude.

page 1287, line 3:

The following sentence has been added:

Apart from the forest fire plume, the aerosol properties in the remaining atmospheric column have been assumed to be the same as measured during LACE 98 on 10 August, 1998 (Petzold et al., 2002) with the boundary layer aerosol replaced by the one found in the lower free troposphere.

5. **Technical comment**

   The sentence concerned has been removed (see response on referee #1's comment).

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 1273, 2003.

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