

# Supplement of Aerosol emissions estimation with POLDER

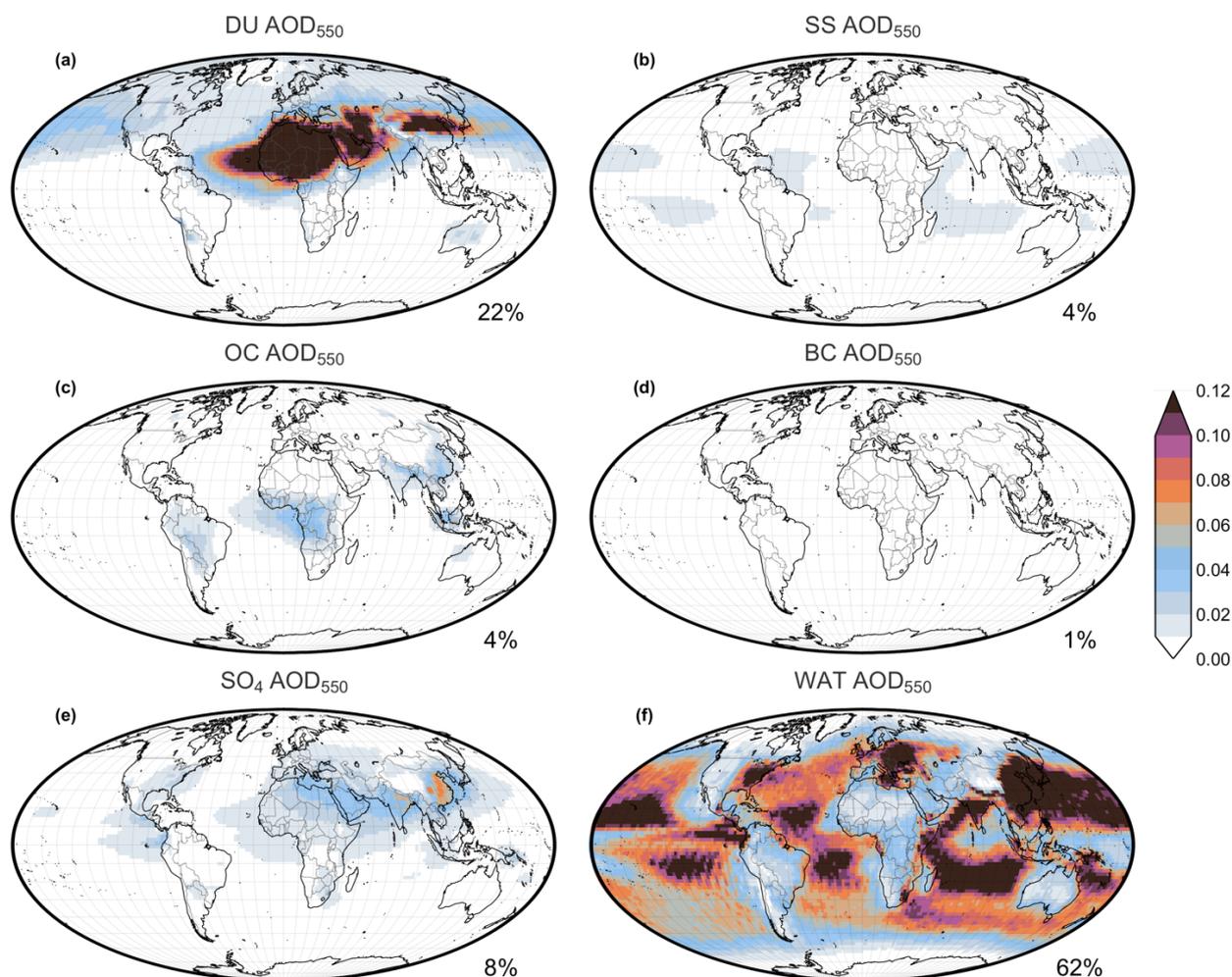
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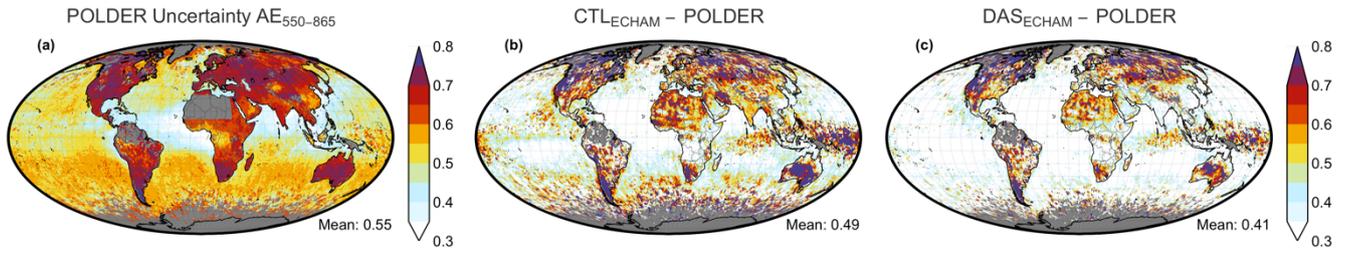
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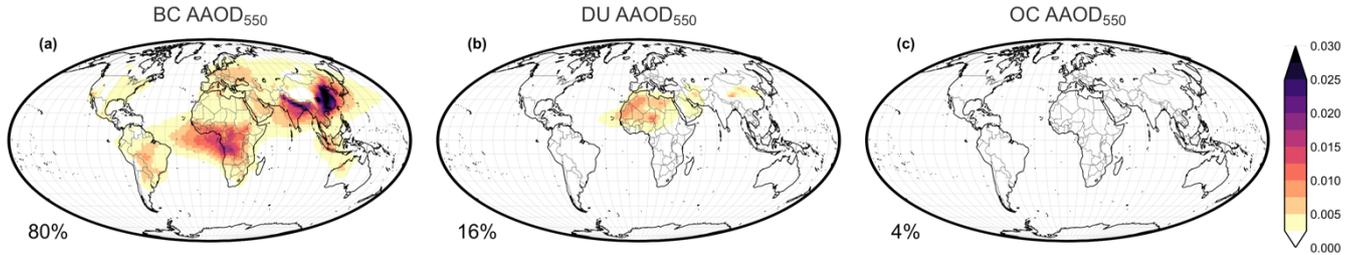
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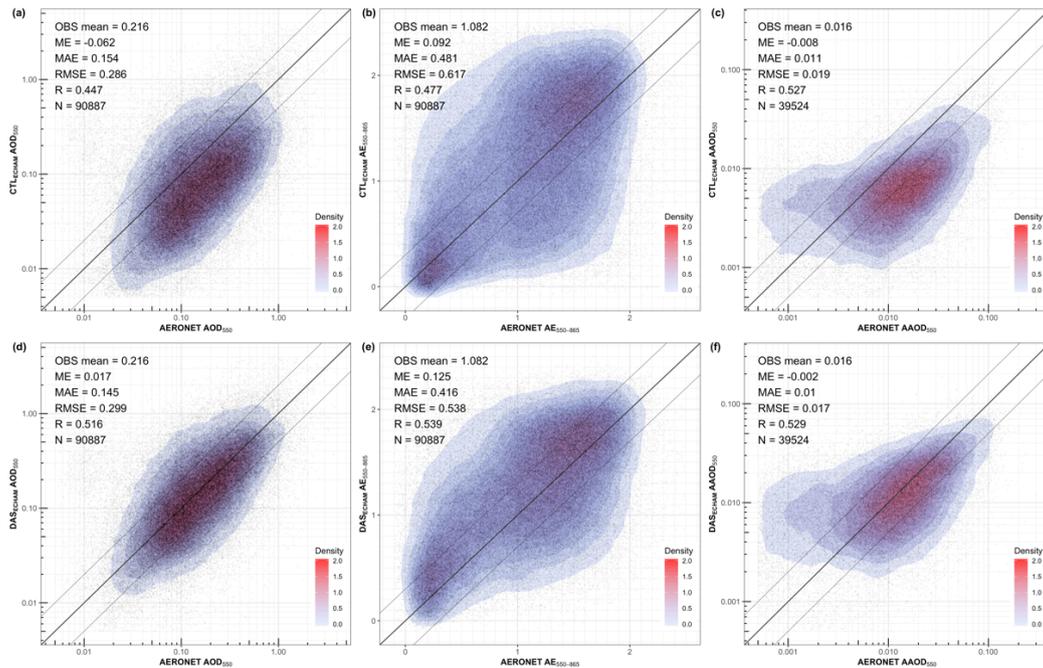
10 **FigureS 1.** Aerosol optical depth at 550nm of CTL<sub>ECHAM</sub> for (a) dust (DU), (b) sea salt (SS), (c) organic carbon (OC), (d) black carbon (BC), (e) sulphates (SO<sub>4</sub>) and (f) sulphur dioxide (SO<sub>2</sub>). The contribution of each species to the total aerosol optical depth at 550nm is depicted at the right bottom corner.



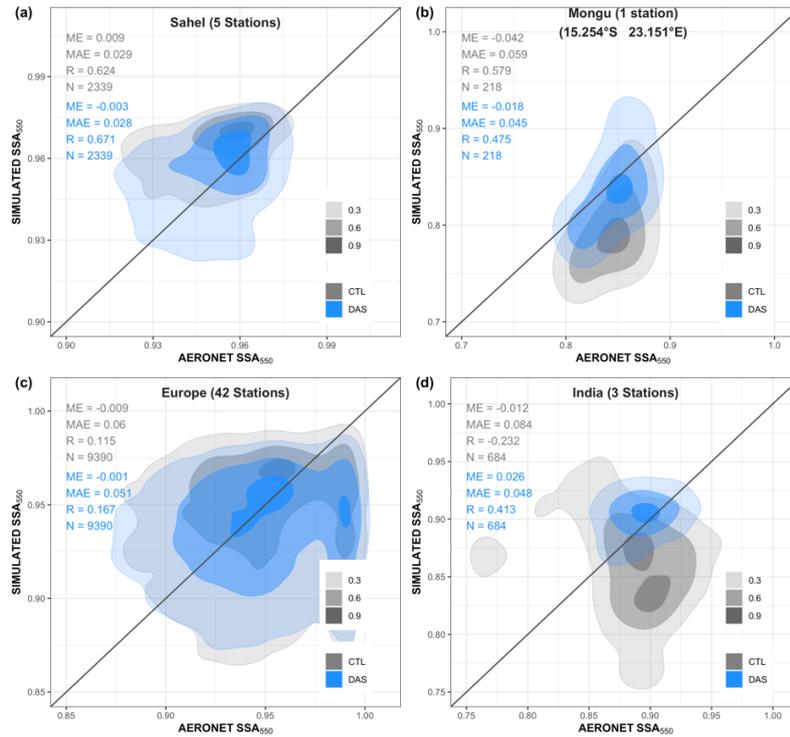
15 **FigureS 2.** The (a) POLDER AE550-865 uncertainty along with the averaged 3-hourly mean absolute error of AE550-865 based on POLDER for (b) CTLECHAM and (c) DASECHAM. The global mean is depicted at the right bottom corner of each plot.



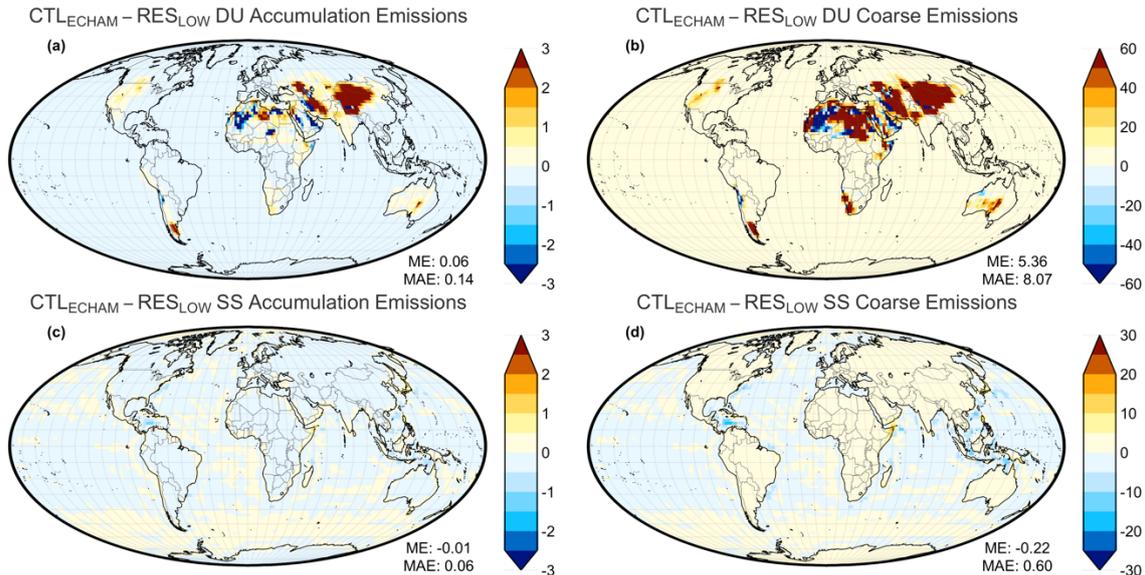
**FigureS 3.** Absorption aerosol optical depth at 550nm of CTLECHAM for (a) black carbon, (b) dust and (c) organic carbon. The global mean is depicted at the left bottom corner of each plot. The contribution of each species to the total absorption aerosol optical depth at 550nm is depicted at the left bottom corner.



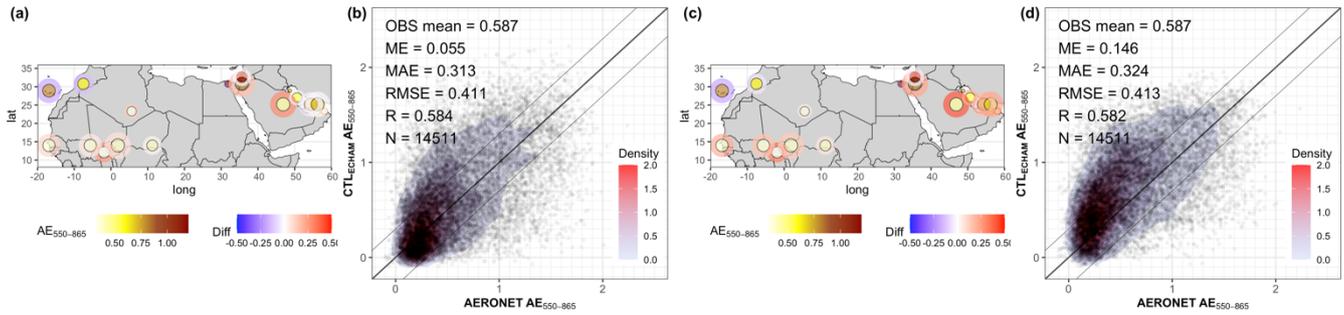
20 **FigureS 4.** An evaluation of CTLECHAM and DASECHAM based on AERONET for the year 2006 (not collocated with POLDER). The first, second and third column corresponds to the variables AOD550, AE550-865 and AAOD550 respectively. The Mean Error (ME), Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Pearson Correlation (R) and the number of data points used in each case (N) is depicted at the top-left of each subplot. The AOD550 and AE550-865 evaluation is based on  
 25 AERONET Version 3 Direct Sun Algorithm Level 2.0, while the AAOD550 and SSA550 evaluation is based on AERONET Version 3 Direct Sun and Inversion Algorithm Level 1.5.



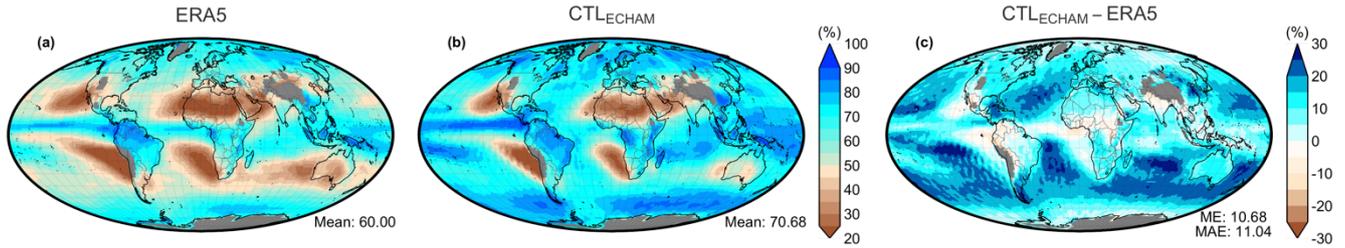
30 **FigureS 5. SSA550 evaluation of CTLECHAM and DASECHAM based on selected AERONET sites (cyan points in Figure 2g) for the year 2006. These stations are selected over regions where natural and anthropogenic emissions of BC occur. The shaded areas depict the 2D density estimate scaled to a maximum of one for 0.3, 0.6 and 0.9 intervals. The Mean Error (ME), Mean Absolute Error (MAE), Pearson Correlation (R) and the number of data points used in each case (N) is depicted for each subplot. The evaluation is based on AERONET Version 3 Direct Sun and Inversion Algorithm Level 1.5.**



35 **FigureS 6. Differences of CTLECHAM - RESLOW for dust (DU) and sea salt (SS) emissions. The global mean error (ME) and the global mean absolute error (MAE) is depicted at the right bottom corner of each plot.**



40 **FigureS 7.** An AE550-865 evaluation of CTLECHAM (a,b) and DASECHAM (c,d) against AERONET. In the maps the inner circle depicts the mean AE550-865 of all AERONET stations within a grid cell of the model while the outer circle depicts the difference between experiments minus AERONET. The size of the points is analogous to the number of the available data points in each case. The scatterplots use all the available data points of the displayed stations.



**FigureS 8.** The relative humidity of (a) ERA5, (b) CTLECHAM and the difference (c) CTLECHAM – ERA5 for 2006 at 800hPa. The global mean, the global mean error (ME) and the global mean absolute error (MAE) is depicted at the right bottom corner of each plot.