



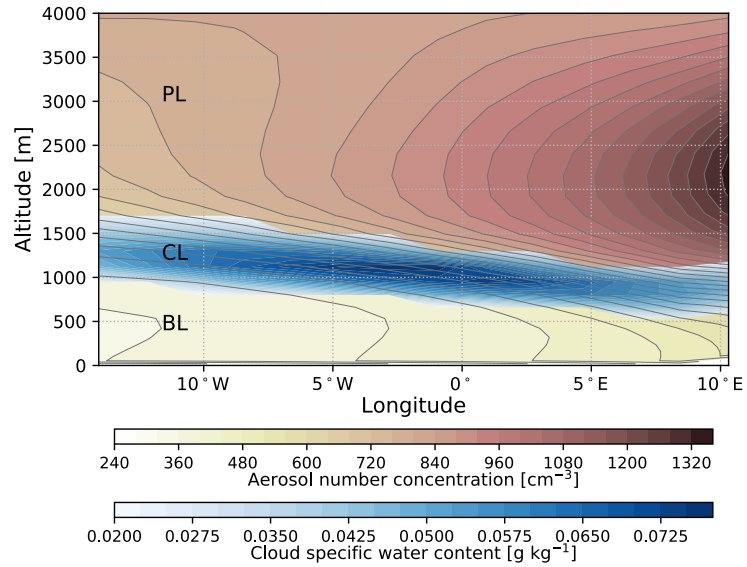
Supplement of

Source attribution of cloud condensation nuclei and their impact on stratocumulus clouds and radiation in the south-eastern Atlantic

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Figure S1. UKESM1 simulated annual mean vertical profiles of cloud specific water content (g/kg) and aerosol number concentration (cm⁻³) at the standard temperature and pressure (STP) in the cloud box region. The BL, CL, and PL represent the boundary layer, cloud layer, and plume layer, respectively. The CL is the region with specific liquid water content > 0.02 g/kg.

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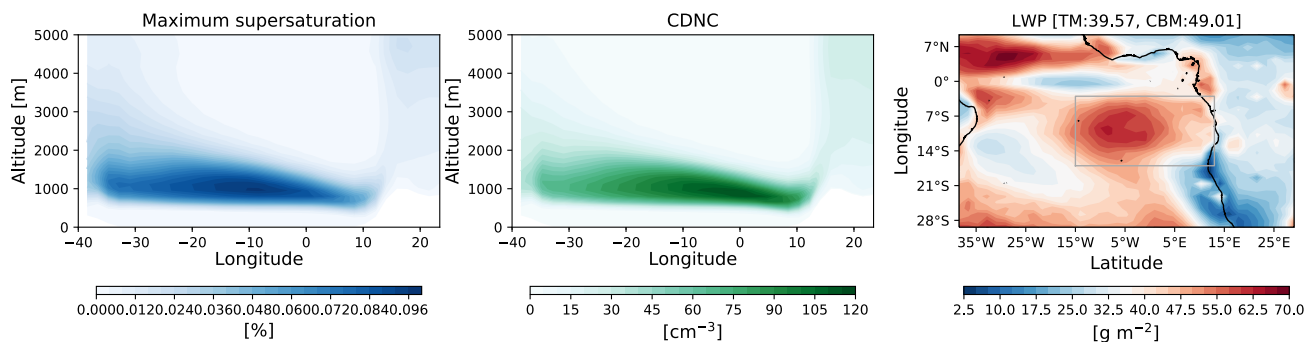


Figure S2. UKESM1 simulated annual mean vertical profiles of maximum supersaturation, cloud droplet number concentration (CDNC), and annual mean of the cloud liquid water path (LWP). The TM is the total mean of the domain, and the CBM is the mean of the cloud box (the grey box on the map).

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Contribution of different sources to CCN number concentration at 0.2% supersaturation during BB season [cm^{-3}]

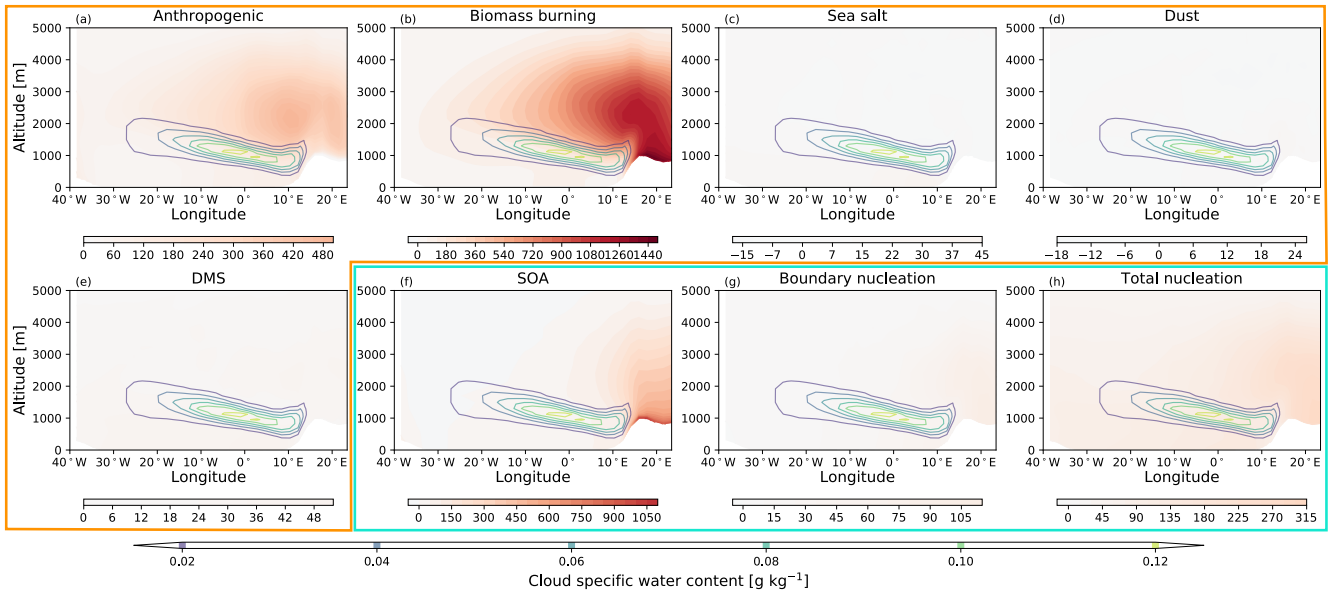


Figure S3. UKESM1 simulated variation in mean vertical profiles of CCN concentration at 0.2% supersaturation ($\text{CCN}_{0.2\%}$) from different sources during BB season (at the standard temperature and pressure STP). Profiles are averaged along the latitudes of the cloud box. The contributions of different sources to $\text{CCN}_{0.2\%}$ are listed in (a) to (h), where the contribution of emissions is shown in the yellow frame, and the contribution of atmospheric processes is shown in the light blue frame. The contour lines in each subplot are the cloud specific water content from the baseline simulation at the same temporal and spatial average. The same colourmap scale is used in each subplot to facilitate comparison, but the range differs for each plot, corresponding to the maximum and minimum of the $\text{CCN}_{0.2\%}$.

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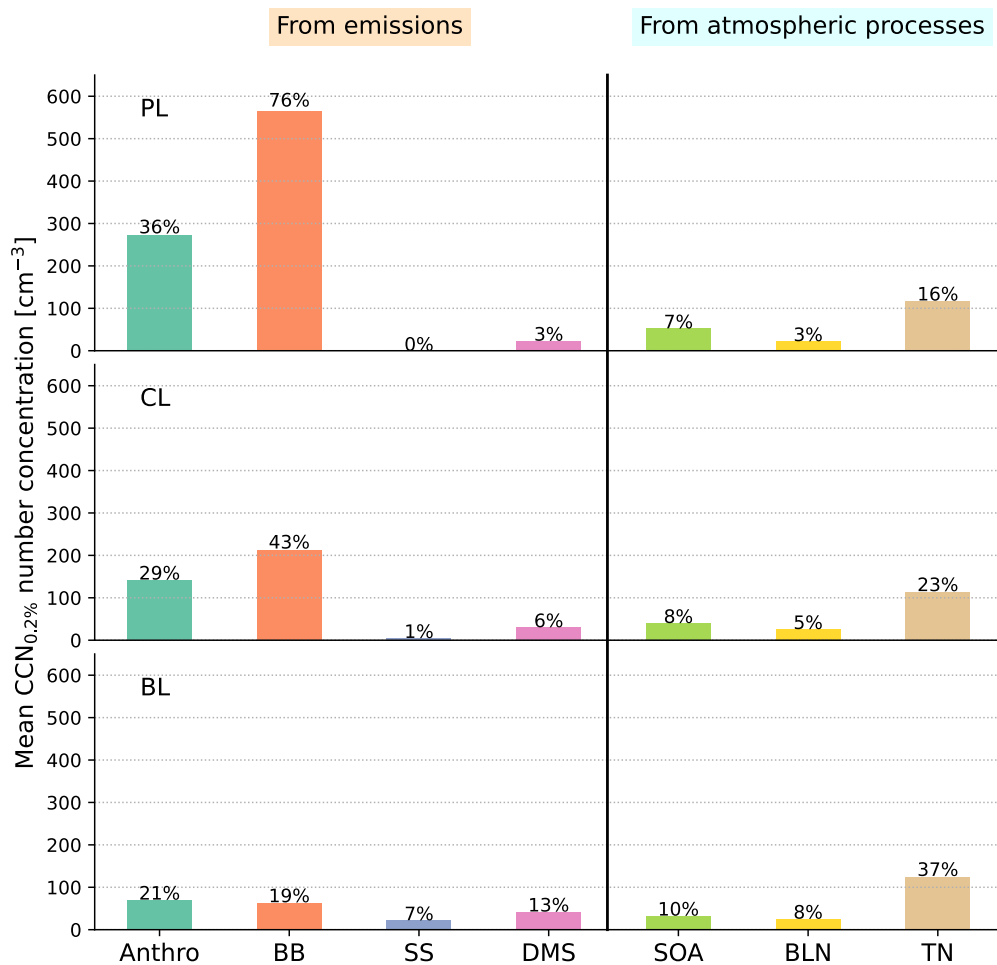


Figure S4. UKESM1 simulated mean CCN concentration at 0.2% supersaturation ($CCN_{0.2\%}$) in the cloud box region from different sources and in different layers during the BB season. The upper, middle, and lower panels represent $CCN_{0.2\%}$ attribution in the plume layer (PL), cloud layer (CL), and the marine boundary layer (BL), respectively. The left part of the black vertical line indicates the contribution to $CCN_{0.2\%}$ from the emission sources, which are anthropogenic (Anthro), BB, sea salt (SS), and DMS. The right part of the black vertical line indicates the contribution to $CCN_{0.2\%}$ from atmospheric processes, which are SOA, boundary layer nucleation (BLN) and total nucleation (TN). Using the simulation of the present day as the baseline (BB seasonal mean $CCN_{0.2\%}$ around 331 cm^{-3}), the contribution of each source to $CCN_{0.2\%}$ is marked at the top of the corresponding bar in percentage.

Contribution of different sources to maximum supersaturation during BB season [%]

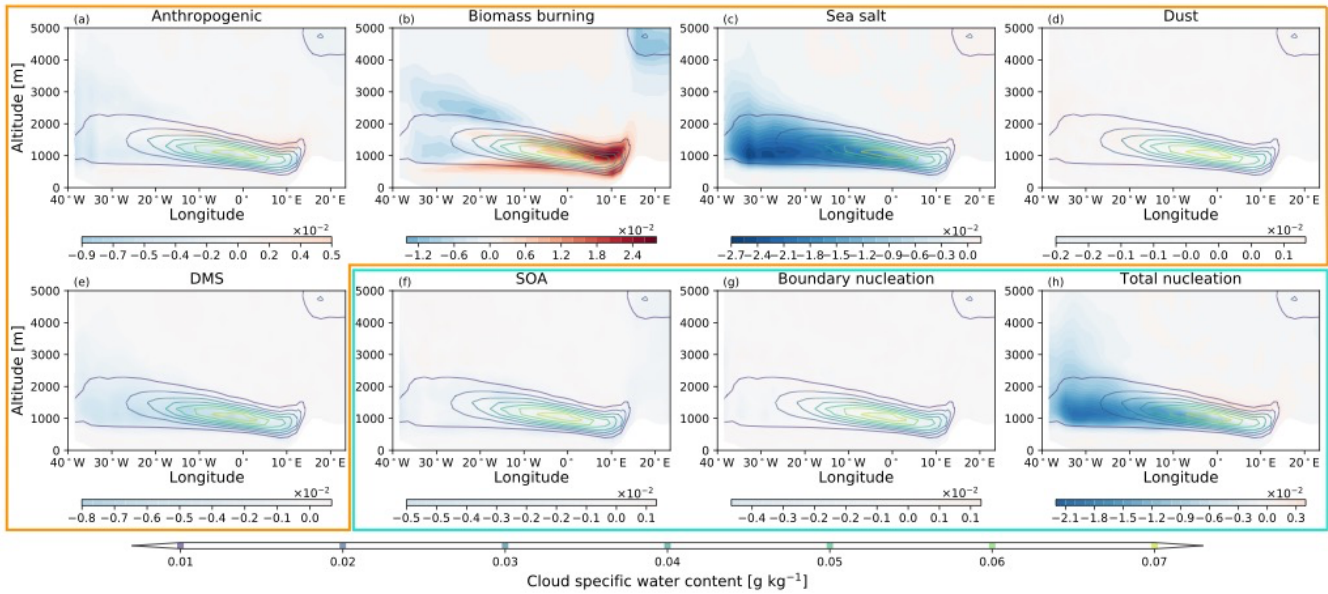


Figure S5. UKESM1 simulated mean variation in vertical profiles of maximum supersaturation (%) from different sources during BB season. Profiles are averaged along the latitudes of the cloud box. The contributions of different sources to maximum supersaturation are listed in (a) to (h), where the contribution of emissions is shown in the yellow frame, and the contribution of atmospheric processes is shown in the light blue frame. The contour lines in each subplot are the cloud specific water content from the baseline simulation at the same temporal and spatial average. The same colourmap scale is used in each subplot to facilitate comparison, but the range differs in each plot, corresponding to the maximum and minimum of the maximum supersaturation.

Contribution of different sources to cloud droplet number concentration during BB season [cm^{-3}]

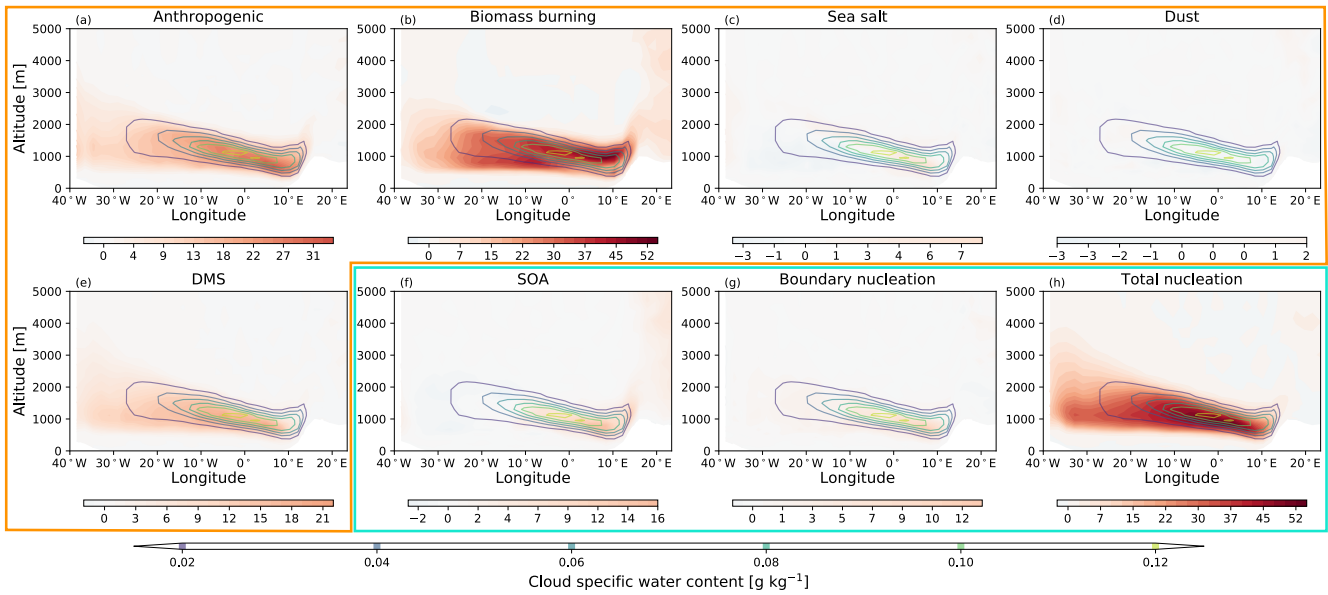


Figure S6. UKESM1 simulated mean variation in vertical profiles of cloud droplet number concentration (CDCN) from different sources during BB season. Profiles are averaged along the latitudes of the cloud box. The contributions of different sources to CDCN are listed in (a) to (h), where the contribution of emissions is shown in the yellow frame, and the contribution of atmospheric processes is shown in the light blue frame. The contour lines in each subplot are the cloud specific water content from the baseline simulation at the same temporal and spatial average. The same colourmap scale is used in each subplot to facilitate comparison, but the range differs in each plot, corresponding to the maximum and minimum of the CDNC.

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Contribution of different sources to liquid water path during BB season [g m⁻²]

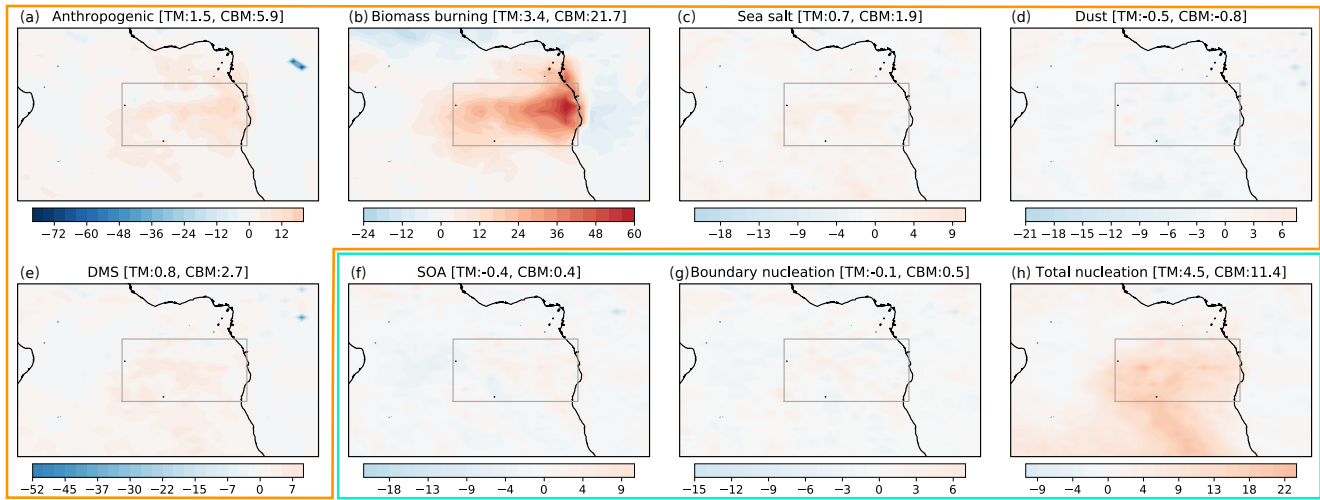
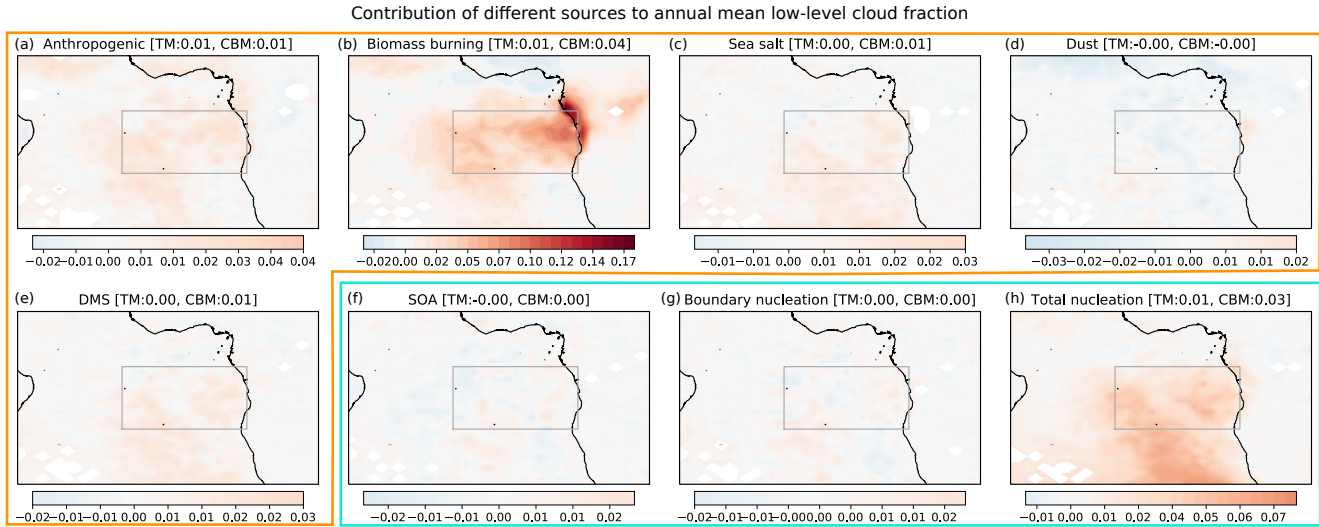


Figure S7. UKESM1 simulated mean variation in liquid water path (LWP) from different sources during BB season. The contributions of different sources to LWP are listed in (a) to (h), where the contribution of emissions is shown in the yellow frame, and the contribution of atmospheric processes is shown in the light blue frame. The domain in each subplot ranges from 30° S to 10° N, and from 40° W to 30° E. The TM is the total mean of the domain, and the CBM is the mean of the cloud box (the grey box on the map). The same colourmap scale is used in each subplot to facilitate comparison, but the range differs for each plot, corresponding to the maximum and minimum of the LWP.

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Figure S8. UKESM1 simulated variation in annual mean low-level cloud fraction from different sources. The contributions of different sources to the cloud fraction are listed in (a) to (h), where the contribution of emissions is shown in the yellow frame, and the contribution of atmospheric processes is shown in the light blue frame. The domain in each subplot ranges from 30° S to 10° N, and from 40° W to 30° E. The TM is the total mean of the domain, and the CBM is the mean of the cloud box (the grey box on the map). The same colourmap scale is used in each subplot to facilitate comparison, but the range differs for each plot, corresponding to the maximum and minimum of the variation in the low-level cloud fraction.

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Contribution of different sources to mean low-level cloud fraction during BB season

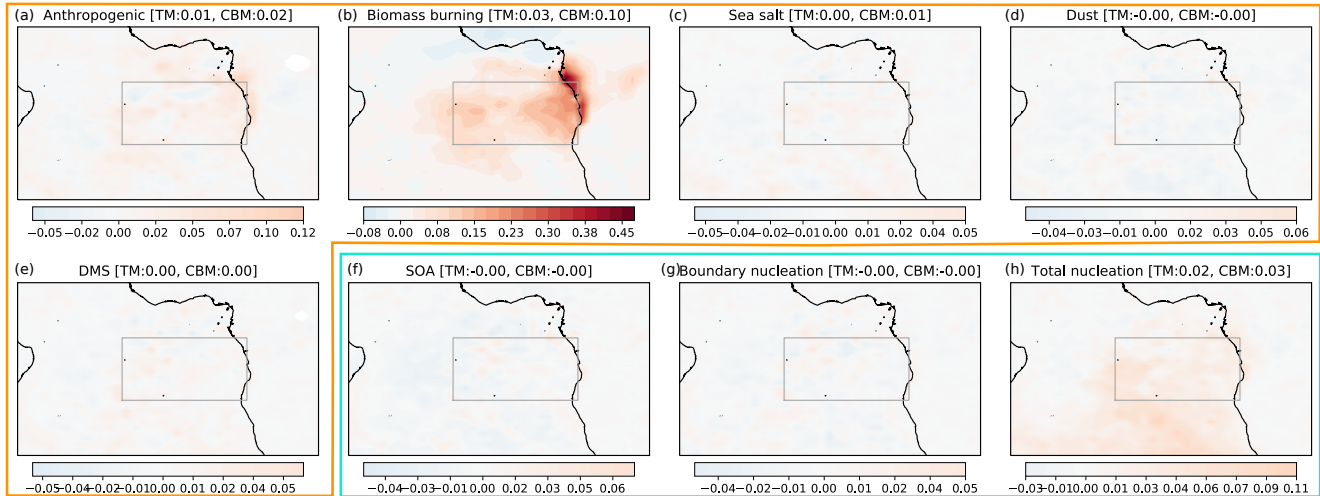


Figure S9. UKESM1 simulated variation in mean low-level cloud fraction from different sources during BB season. The contributions of different sources to the cloud fraction are listed in (a) to (h), where the contribution of emissions is shown in the yellow frame, and the contribution of atmospheric processes is shown in the light blue frame. The domain in each subplot ranges from 30° S to 10° N, and from 40° W to 30° E. The TM is the total mean of the domain, and the CBM is the mean of the cloud box (the grey box on the map). The same colourmap scale is used in each subplot to facilitate comparison, but the range differs for each plot, corresponding to the maximum and minimum of the low-level cloud fraction.