atmosphere

Supplementary Materials: Relationships between Aerosols and Marine Clouds during the "Godzilla" Dust Storm: Perspective of Satellite and Reanalysis Products

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The study analyzes the Godzilla event that occurred between June 14 and 25, 2020. The climatology investigation encompasses the same time frame but spans from 2003 to 2019. The climatology analysis shown in Figure S1 reveals a pronounced ascending flow that extends up to 700 hPa over West Africa, while descending motion prevails over the tropical Atlantic Ocean (regions B-D), potentially inhibiting dust transport (as depicted in Figures S1 (a) and (e)). During the Godzilla event, when the dust concentration over the tropical Atlantic Ocean is enhanced, the atmosphere experiences anomalous warming accompanied by an increase in ascending airflow.

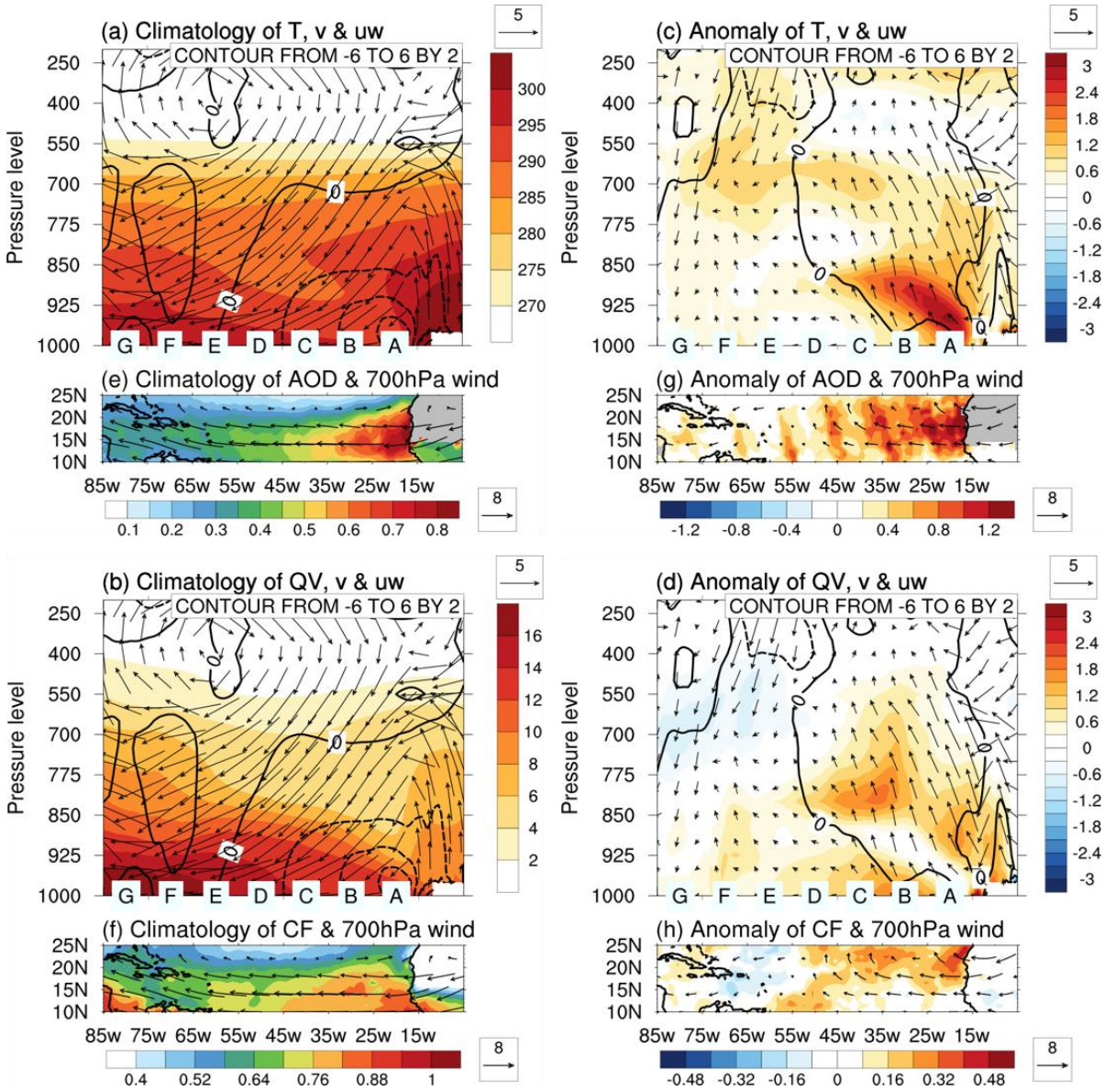

Figure S1. Meridional climatology of v-wind (contour; $m\,s^{-1}$), $u \times -100\omega$ wind (vector; $m\,s^{-1} \times Pa\,s^{-1}$), and (a) temperature (T, shading; K) and (b) specific humidity (QV, shading; $g\,kg^{-1}$); meridional anomaly of v-wind (contour; $m\,s^{-1}$), $u \times -100\omega$ wind (vector; $m\,s^{-1} \times Pa\,s^{-1}$), and (c) temperature (shading; K) and (d) specific humidity (shading; $g\,kg^{-1}$). The climatology of 700 hPa wind and (e) AOD (shading) and (f) CF (shading); the anomaly of 700 hPa wind (vector; $m\,s^{-1}$) and (f) AOD (shading) and (g) CF (shading).

The aerosol effect on shortwave radiative forcing is defined by:

$$(SWTNT - SWTNTCLN) - (SWGNT - SWGNTCLN)$$

where SWTNT represents the top of the atmosphere (TOA) net downward short wave (SW) flux, SWTNTCLN is clean-sky TOA net downward SW flux, SWGNT is the surface net downward SW flux, and SWGNTCLN is the clean-sky surface net downward SW flux.

Figure S2 shows the aerosol effect on shortwave radiative forcing using datasets obtained from the Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA-2). During the "Godzilla" event, the core of absorbing shortwave forcing due to aerosols moves westward. This aerosol radiative effect is relative to the warming in the Saharan air layer.

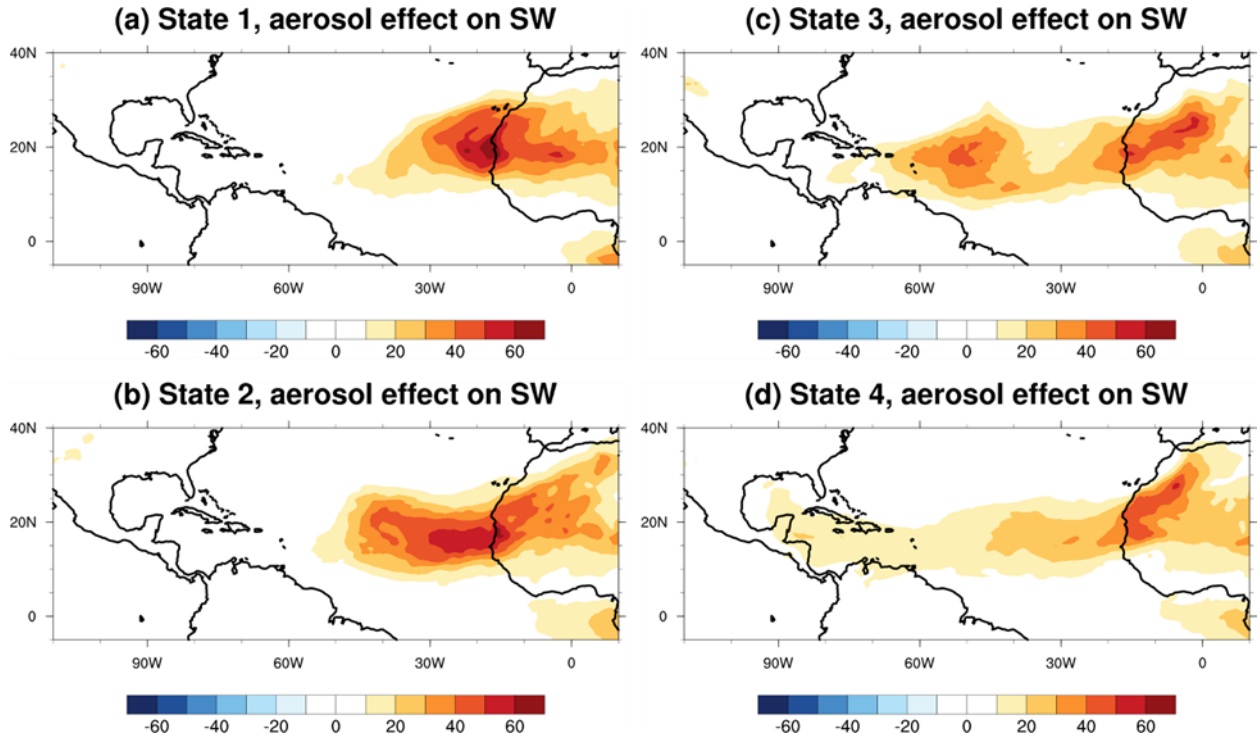

Figure S2. (a-d) The evolution of aerosol shortwave radiative forcing (shading; W m^{-2}). The time range of states can be found in Table 1.

Figure S3 shows the correlation coefficients between CF and the variables used in PCA (Figures 4 and 5). The strong convective system near west Africa (regions A and B) dominates the relationships between the atmospheric parameter and CF at the beginning of the Godzilla event (states 1 and 2). In addition, the coefficients reveal a westward propagation of the systematic influence during the Godzilla event.

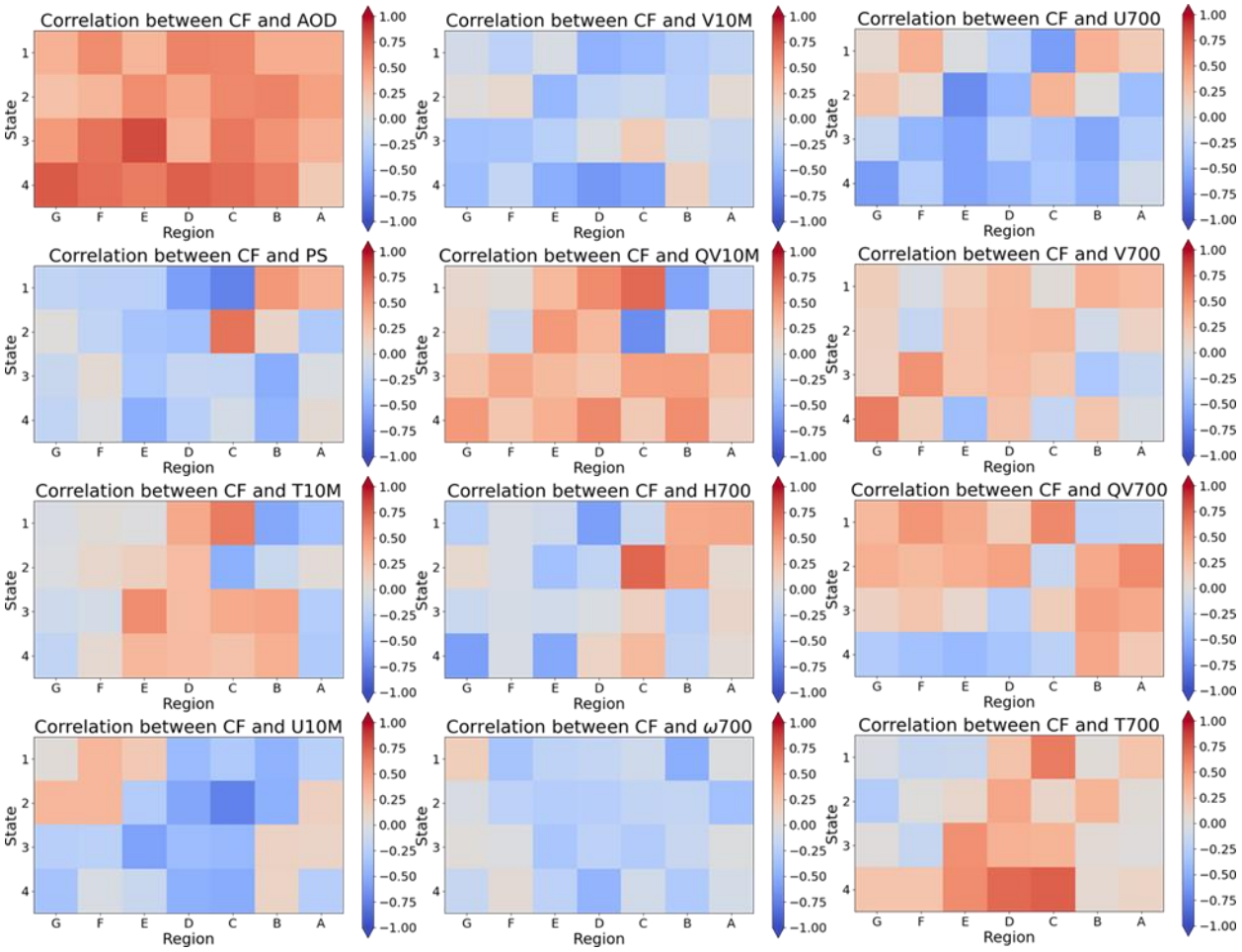

Figure S3. Correlations between CF and the variables used in PCA study.