Supplement of Atmos. Chem. Phys., 24, 9339–9353, 2024
https://doi.org/10.5194/acp-24-9339-2024-supplement
© Author(s) 2024. CC BY 4.0 License.

Supplement of

Observed and CMIP6-model-simulated organic aerosol response to drought in the contiguous United States during summertime

Wei Li and Yuxuan Wang

Correspondence to: Yuxuan Wang (ywang246@central.uh.edu)

The copyright of individual parts of the supplement might differ from the article licence.

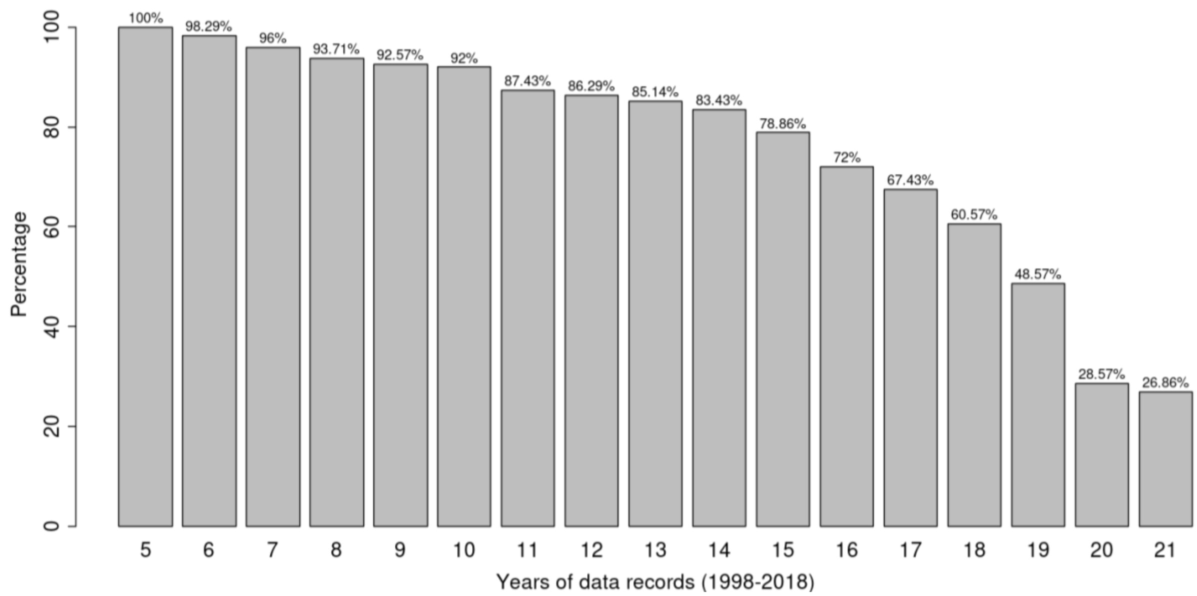

Figure S1: Percentage of sites with data records greater or equal to certain years. There are a total of 175 sites selected for interpolation with a minimum of 5-year data records during the study period.

Table S1. Information of the ten CMIP6 models selected for evaluation.

Models	Resolution (lat×lon)	Aerosol scheme	SOA formation	Model references
BCC-ESM1	2.81°×2.81°	BCC-AGCM3-Chem	volatility basis set (VBS) scheme	Wu et al. (2020)
CESM2-WACCM	0.95°×1.25°	MAM4	volatility basis set (VBS) scheme	Danabasoglu et al. (2020)
CNRM-ESM2-1	1.40°×1.40°	TACTIC	prescribed from a monthly inventory	Séférian et al. (2019)
EC-Earth3-AerChem	2.00°×3.00°	TM5	two-product scheme	van Noije et al. (2021)
GFDL-ESM4	1.00°×1.25°	Bulk aerosol scheme	10% per-carbon yield from VOCs	Dunne et al. (2020)
GISS-E2-1-G	2.00°×2.50°	TCADI	two-product scheme	Kelley et al. (2020)
MIROC6	1.40°×1.40°	SPRINTARS	two-product scheme	Tatebe et al. (2019)
MRI-ESM2-0	1.87°×1.87°	MASINGAR	14% of monoterpene and 1.68 % of isoprene emissions are assumed to form SOA	Yukimoto et al. (2019)
NorESM2-LM	1.87°×2.50°	OsloAero6	15% and 5% yield from oxidation of monoterpenes and isoprene	Seland et al. (2020)
UKESM1-0-LL	1.25°×1.87°	UKCAl	26% yield from gas-phase oxidation of VOCs	Senior et al. (2020)

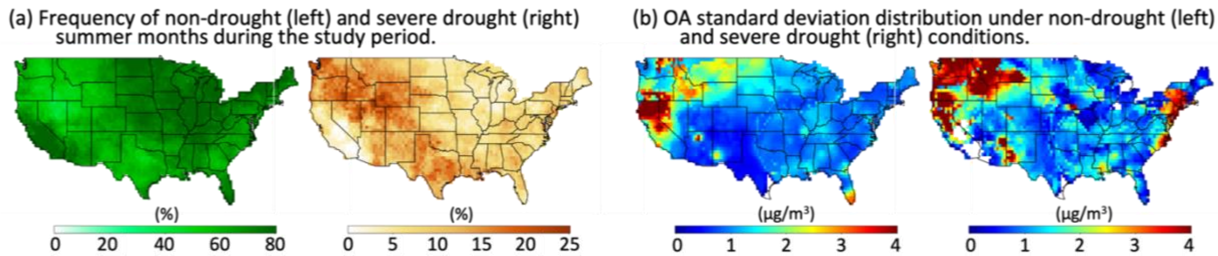

Figure S2: (a) Maps of the frequency for non-drought (left) and severe drought (right) summer months during the study period. (b) Same as a, but for the standard deviation of OA.

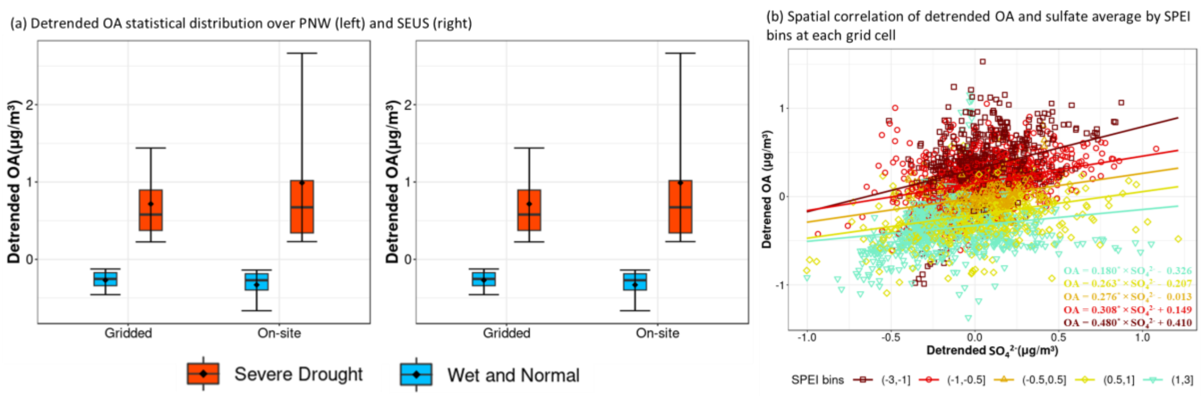

Figure S3: (a) Statistical distributions of gridded and on-site detrended OA mass concentrations under severe drought (red boxes) and non-drought (blue boxes) conditions in the PNW (left) and SEUS region (right) (b) Scatter plot of the SPEI bin-averaged detrended sulfate and OA at each grid in the SEUS with solid lines representing the linear regressions between OA and sulfate. The corresponding linear formula of each SPEI bin is listed in the bottom-right corner. The star marks in the formula indicate the regression significance at a 95% confidence level.

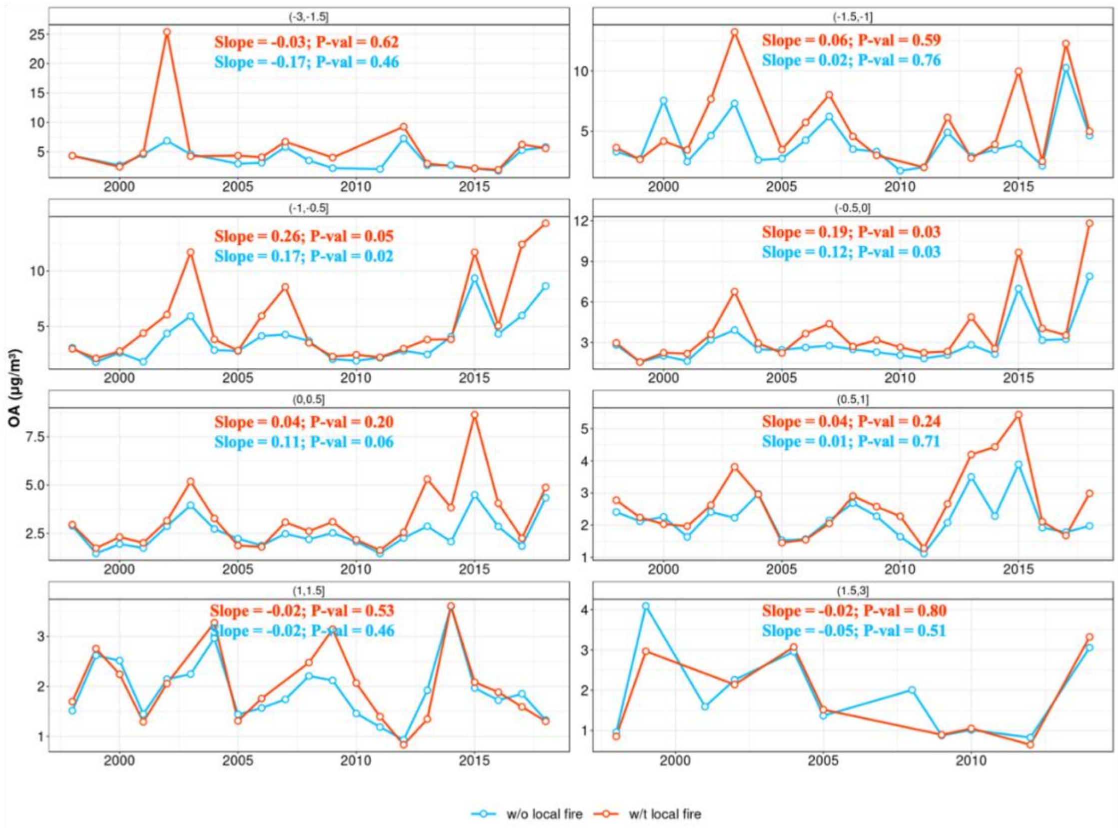

Figure S4: Time series of averaged OA in the PNW region separated into periods with (red) and without (blue) local fire emissions within each SPEI bin (panel). The respective trend (Slope) and P-value (P-val) of the trend are listed in each panel.

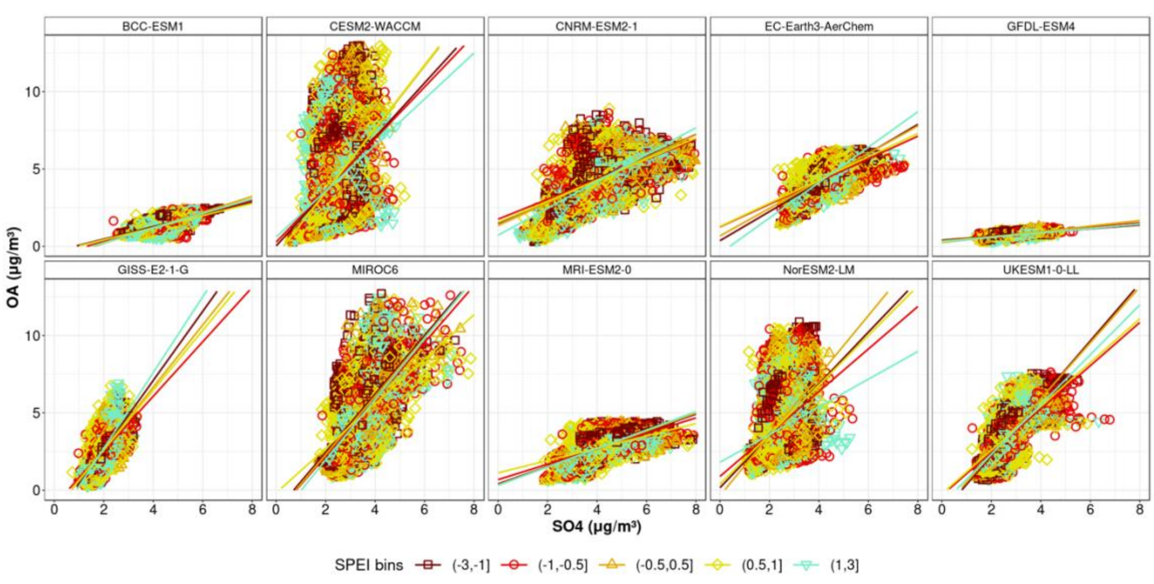

Figure S5: Scatter plot of the SPEI bin-averaged sulfate and OA simulations at each grid in the SEUS with solid lines representing the linear regressions between OA and sulfate.

References

Danabasoglu, G., Lamarque, J.-F., Bacmeister, J., Bailey, D. A., DuVivier, A. K., Edwards, J., Emmons, L. K., Fasullo, J., Garcia, R., Gettelman, A., Hannay, C., Holland, M. M., Large, W. G., Lauritzen, P. H., Lawrence, D. M., Lenaerts, J. T. M., Lindsay, K., Lipscomb, W. H., Mills, M. J., Neale, R., Oleson, K. W., Otto-Bliesner, B., Phillips, A. S., Sacks, W., Tilmes, S., van Kampenhout, L., Vertenstein, M., Bertini, A., Dennis, J., Deser, C., Fischer, C., Fox-Kemper, B., Kay, J. E., Kinnison, D., Kushner, P. J., Larson, V. E., Long, M. C., Mickelson, S., Moore, J. K., Nienhouse, E., Polvani, L., Rasch, P. J., and Strand, W. G.: The Community Earth System Model Version 2 (CESM2), J. Adv. Model. Earth Syst., 12, e2019MS001916, https://doi.org/10.1029/2019MS001916, 2020.

Dunne, J. P., Horowitz, L. W., Adcroft, A. J., Ginoux, P., Held, I. M., John, J. G., Krasting, J. P., Malyshev, S., Naik, V., Paulot, F., Shevliakova, E., Stock, C. A., Zadeh, N., Balaji, V., Blanton, C., Dunne, K. A., Dupuis, C., Durachta, J., Dussin, R., Gauthier, P. P. G., Griffies, S. M., Guo, H., Hallberg, R. W., Harrison, M., He, J., Hurlin, W., McHugh, C., Menzel, R., Milly, P. C. D., Nikonov, S., Paynter, D. J., Ploshay, J., Radhakrishnan, A., Rand, K., Reichl, B. G., Robinson, T., Schwarzkopf, D. M., Sentman, L. T., Underwood, S., Vahlenkamp, H., Winton, M., Wittenberg, A. T., Wyman, B., Zeng, Y., and Zhao, M.: The GFDL Earth System Model Version 4.1 (GFDL-ESM 4.1): Overall Coupled Model Description and Simulation Characteristics, J. Adv. Model. Earth Syst., 12, e2019MS002015, https://doi.org/10.1029/2019MS002015, 2020.

Kelley, M., Schmidt, G. A., Nazarenko, L. S., Bauer, S. E., Ruedy, R., Russell, G. L., Ackerman, A. S., Aleinov, I., Bauer, M., Bleck, R., Canuto, V., Cesana, G., Cheng, Y., Clune, T. L., Cook, B. I., Cruz, C. A., Del Genio, A. D., Elsaesser, G. S., Faluvegi, G., Kiang, N. Y., Kim, D., Lacis, A. A., Leboissetier, A., LeGrande, A. N., Lo, K. K., Marshall, J., Matthews, E. E., McDermid, S., Mezuman, K., Miller, R. L., Murray, L. T., Oinas, V., Orbe, C., García-Pando, C. P., Perlwitz, J. P., Puma, M. J., Rind, D., Romanou, A., Shindell, D. T., Sun, S., Tausnev, N., Tsigaridis, K., Tselioudis, G., Weng, E., Wu, J., and Yao, M.-S.: GISS-E2.1: Configurations and Climatology, J. Adv. Model. Earth Syst., 12, e2019MS002025, https://doi.org/10.1029/2019MS002025, 2020.

van Noije, T., Bergman, T., Le Sager, P., O'Donnell, D., Makkonen, R., Gonçalves-Ageitos, M., Döscher, R., Fladrich, U., von Hardenberg, J., Keskinen, J.-P., Korhonen, H., Laakso, A., Myriokefalitakis, S., Ollinaho, P., Pérez García-Pando, C., Reerink, T., Schrödner, R., Wyser, K., and Yang, S.: EC-Earth3-AerChem: a global climate model with interactive aerosols and atmospheric chemistry participating in CMIP6, Geosci. Model Dev., 14, 5637–5668, https://doi.org/10.5194/gmd-14-5637-2021, 2021.

Séférian, R., Nabat, P., Michou, M., Saint-Martin, D., Voldoire, A., Colin, J., Decharme, B., Delire, C., Berthet, S., Chevallier, M., Sénési, S., Franchisteguy, L., Vial, J., Mallet, M., Joetzjer, E., Geoffroy, O., Guérémy, J.-F., Moine, M.-P., Msadek, R., Ribes, A., Rocher, M., Roehrig, R., Salas-y-Mélia, D., Sanchez, E., Terray, L., Valcke, S., Waldman, R., Aumont, O., Bopp, L., Deshayes, J., Éthé, C., and Madec, G.: Evaluation of CNRM Earth System Model, CNRM-ESM2-1: Role of Earth System Processes in Present-Day and Future Climate, J. Adv. Model. Earth Syst., 11, 4182–4227, https://doi.org/10.1029/2019MS001791, 2019.

Seland, Ø., Bentsen, M., Olivié, D., Toniazzo, T., Gjermundsen, A., Graff, L. S., Debernard, J. B., Gupta, A. K., He, Y.-C., Kirkevåg, A., Schwinger, J., Tjiputra, J., Aas, K. S., Bethke, I., Fan, Y., Griesfeller, J., Grini, A., Guo, C., Ilicak, M., Karset, I. H. H., Landgren, O., Liakka, J., Moseid, K. O., Nummelin, A., Spensberger, C., Tang, H., Zhang, Z., Heinze, C., Iversen, T., and Schulz, M.: Overview of the Norwegian Earth System Model (NorESM2) and key climate response of CMIP6 DECK, historical, and scenario simulations, Geosci. Model Dev., 13, 6165–6200, https://doi.org/10.5194/gmd-13-6165-2020, 2020.

Senior, C. A., Jones, C. G., Wood, R. A., Sellar, A., Belcher, S., Klein-Tank, A., Sutton, R., Walton, J., Lawrence, B., Andrews, T., and Mulcahy, J. P.: U.K. Community Earth System Modeling for CMIP6, J. Adv. Model. Earth Syst., 12, e2019MS002004, https://doi.org/10.1029/2019MS002004, 2020.

Tatebe, H., Ogura, T., Nitta, T., Komuro, Y., Ogochi, K., Takemura, T., Sudo, K., Sekiguchi, M., Abe, M., Saito, F., Chikira, M., Watanabe, S., Mori, M., Hirota, N., Kawatani, Y., Mochizuki, T., Yoshimura, K., Takata, K., O'ishi, R., Yamazaki, D., Suzuki, T., Kurogi, M., Kataoka, T., Watanabe, M., and Kimoto, M.: Description and basic evaluation of simulated mean state, internal variability, and climate sensitivity in MIROC6, Geosci. Model Dev., 12, 2727–2765, https://doi.org/10.5194/gmd-12-2727-2019, 2019.

Wu, T., Zhang, F., Zhang, J., Jie, W., Zhang, Y., Wu, F., Li, L., Yan, J., Liu, X., Lu, X., Tan, H., Zhang, L., Wang, J., and Hu, A.: Beijing Climate Center Earth System Model version 1 (BCC-ESM1): model description and evaluation of aerosol simulations, Geosci. Model Dev., 13, 977–1005, https://doi.org/10.5194/gmd-13-977-2020, 2020.

Yukimoto, S., Kawai, H., Koshiro, T., Oshima, N., Yoshida, K., Urakawa, S., Tsujino, H., Deushi, M., Tanaka, T., Hosaka, M., Yabu, S., Yoshimura, H., Shindo, E., Mizuta, R., Obata, A., Adachi, Y., and Ishii, M.: The Meteorological Research Institute Earth System Model Version 2.0, MRI-ESM2.0: Description and Basic Evaluation of the Physical Component, J. Meteorol. Soc. Jpn. Ser II, 97, 931–965, https://doi.org/10.2151/jmsj.2019-051, 2019.