Supplemental Materials
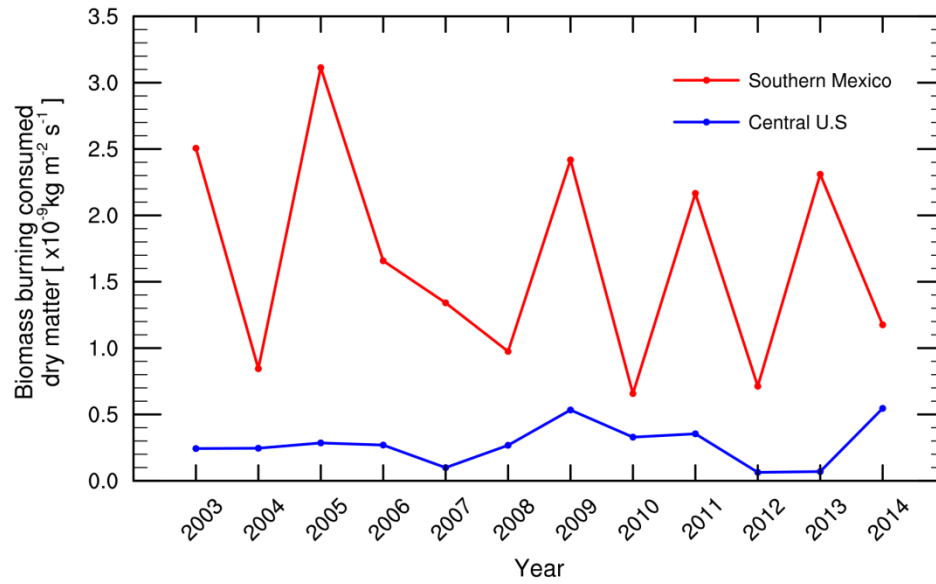
Figure S1. Time series of regional mean biomass burning consumed dry matter during April in central U.S (blue) and Mexico (red) from GFED v4.1.
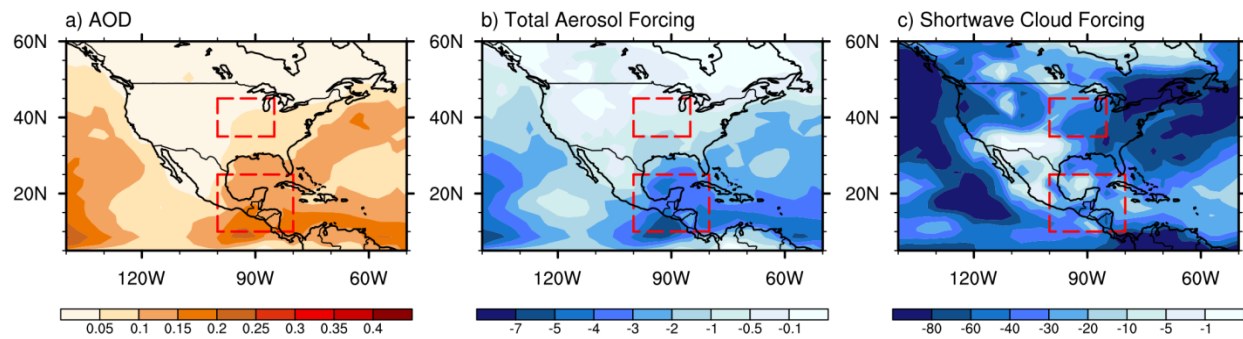
Figure S2. Spatial distributions of 10-day average (Apr. 1-10) ensemble mean a) AOD, b) total aerosol forcing and c) total shortwave cloud forcing($W m^{-2}$) in the simulation without fire emissions (E_NF).
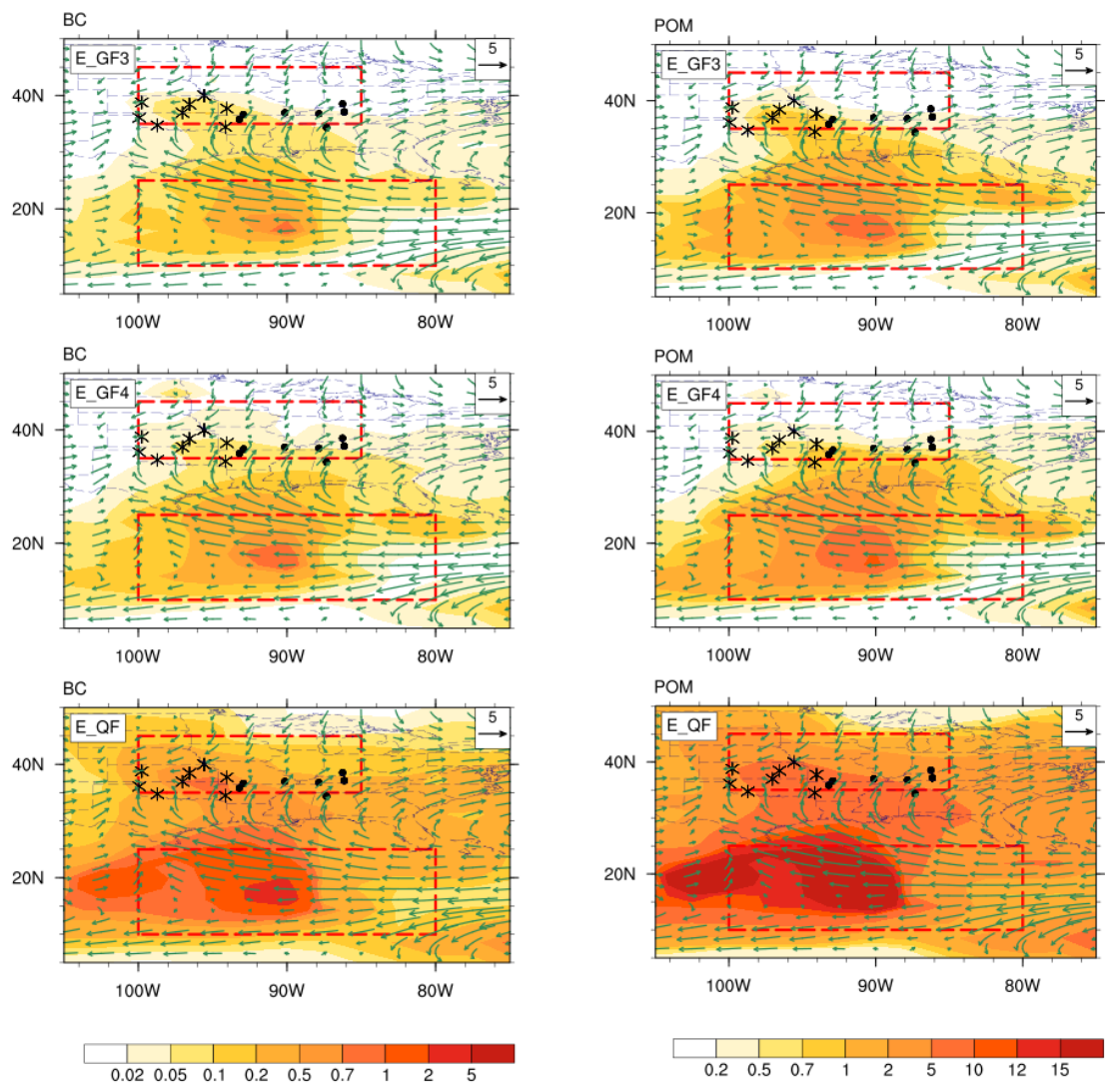
Figure S3. Spatial distributions of April mean fire BC and fire POM burden (shaded) on IMPROVE observation days in group B simulations (E_GF3/E_GF4/E_QF – E_NF). Vectors denote horizontal winds near 850hPa in group B fire simulations (E_GF3/E_GF4/E_NF). IMPROVE data sites are marked with asterisks for sites near the source region and with dots for sites in the downwind region.
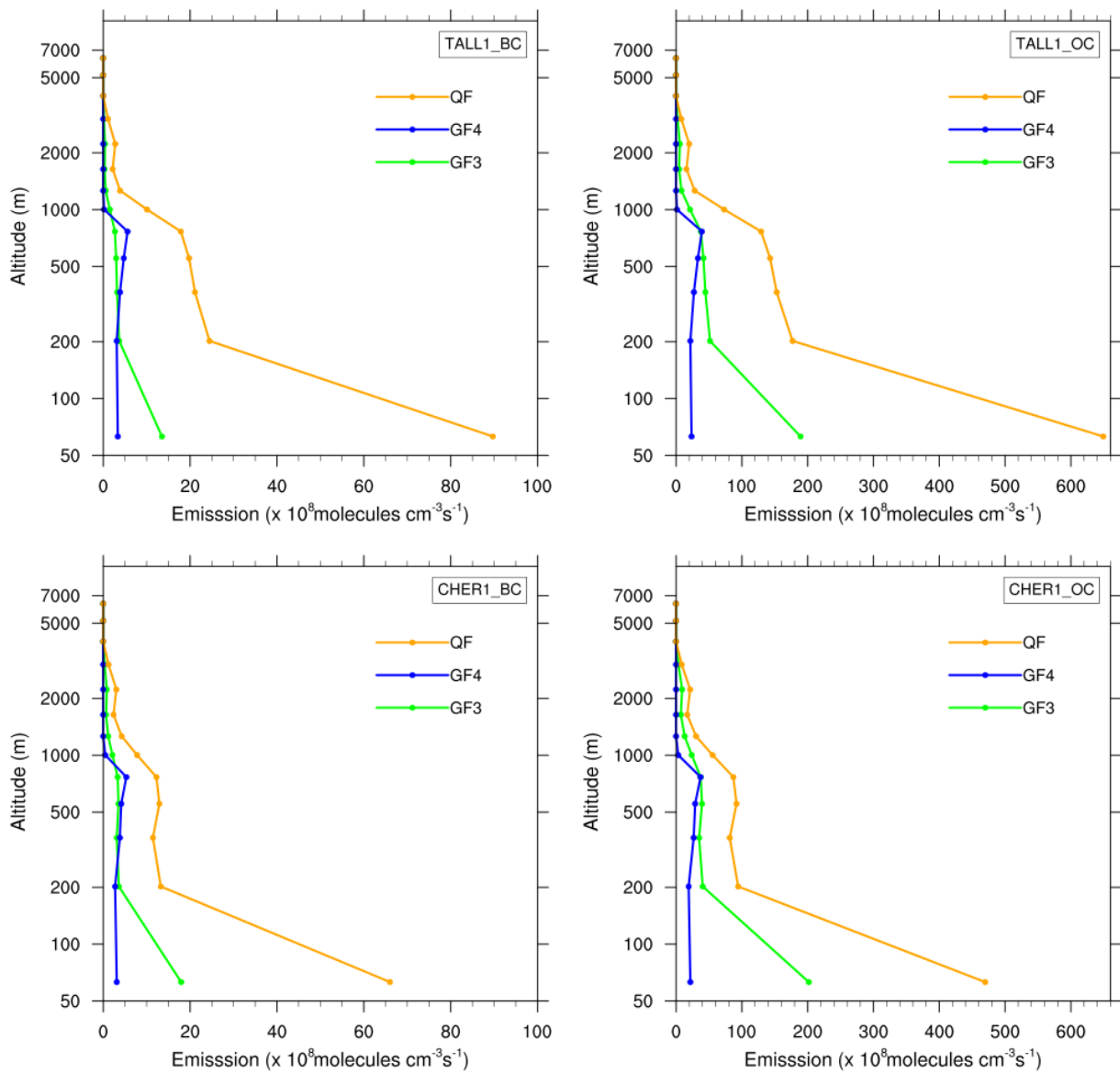
Figure S4. Vertical profiles of fire emissions of BC and OC used in simulations at sites TALL1 $(38.43°N, 96.56°W)$ and CHER1 $(38.77°N, 99.76°W)$.
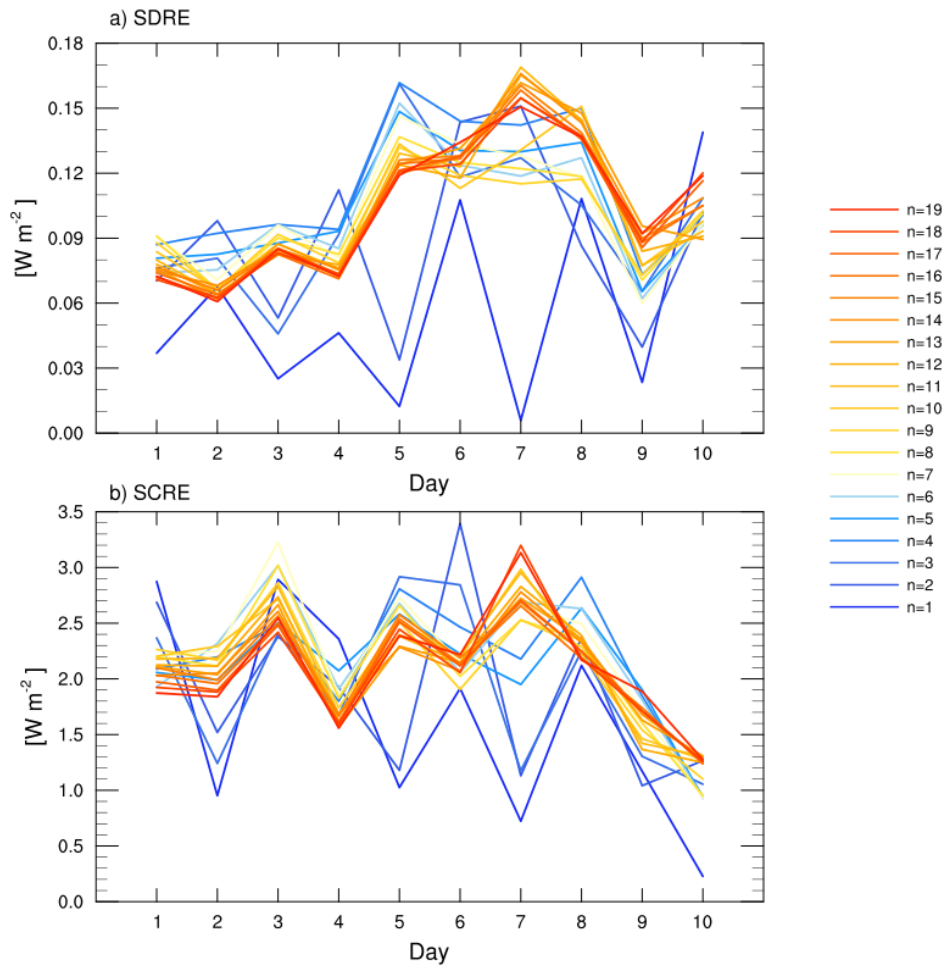
Figure S5. Time series of ensemble spread of daily regional mean fire aerosol a) SDRE and b) SCRE in Southern Mexico during Apr. 1-10, 2009 in QFED forced ensemble simulations with varying the total number of ensemble member (n=1-20).