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Evaluating the skill of high-resolution WRF-Chem simulations in describing drivers of aerosol direct climate forcing on the regional scale

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Figure S1. Empirical quantile-quantile plot of simultaneous measurements of AE at 470-660 nm between MODIS (Terra) and AERONET (where the AERONET station longitude (E) and latitude (N) are given in the legend). As shown, the MODIS data tend to a bimodal distribution, while in the AERONET observations AE is a continuous variable (or nearly so). Thus, while in comparison with WRF-Chem simulations AE from AERONET is treated as a continuous variable, in the majority of comparisons with MODIS a threshold of 1 is applied to identify the dominance of coarse mode (AE < 1) versus fine mode (AE > 1).

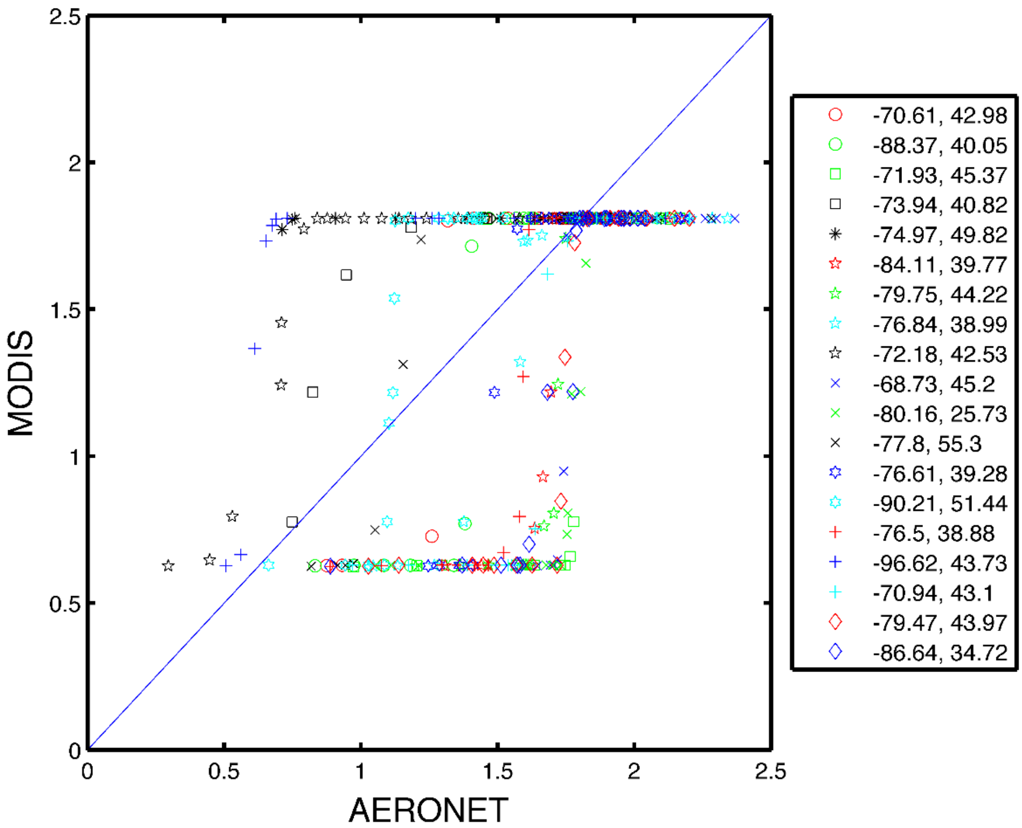

Figure S2. Mean fraction bias (MFB) of near-surface daily mean $PM_{2.5}$ concentrations as simulated by WRF-Chem relative to observations at EPA sites during (a) winter, (b) spring, (c) summer and (d) fall. As shown, near-surface $PM_{2.5}$ concentrations from WRF-Chem exhibit a positive bias (MFB > 0) for most sites and in all seasons, but the bias is largest over the southern states during summer. Note also that the MFB in $PM_{2.5}$ concentrations greatly exceeds that for either AOD or AE (see Fig. 2).

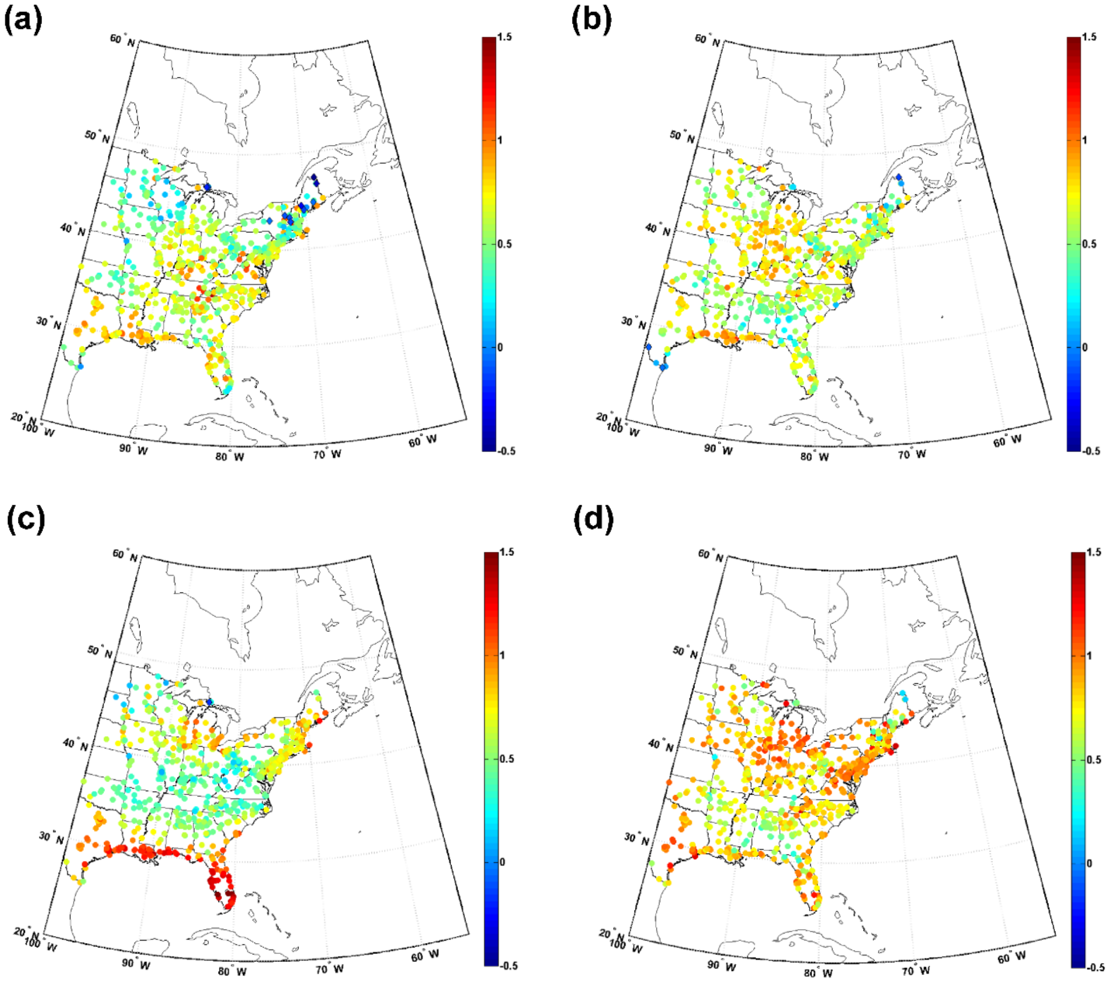

Figure S3. Fraction of near-surface monthly averaged mass concentration of nitrate versus the sum of aerosol nitrate and sulfate as simulated in the accumulation mode by WRF-Chem for each calendar month during 2008.

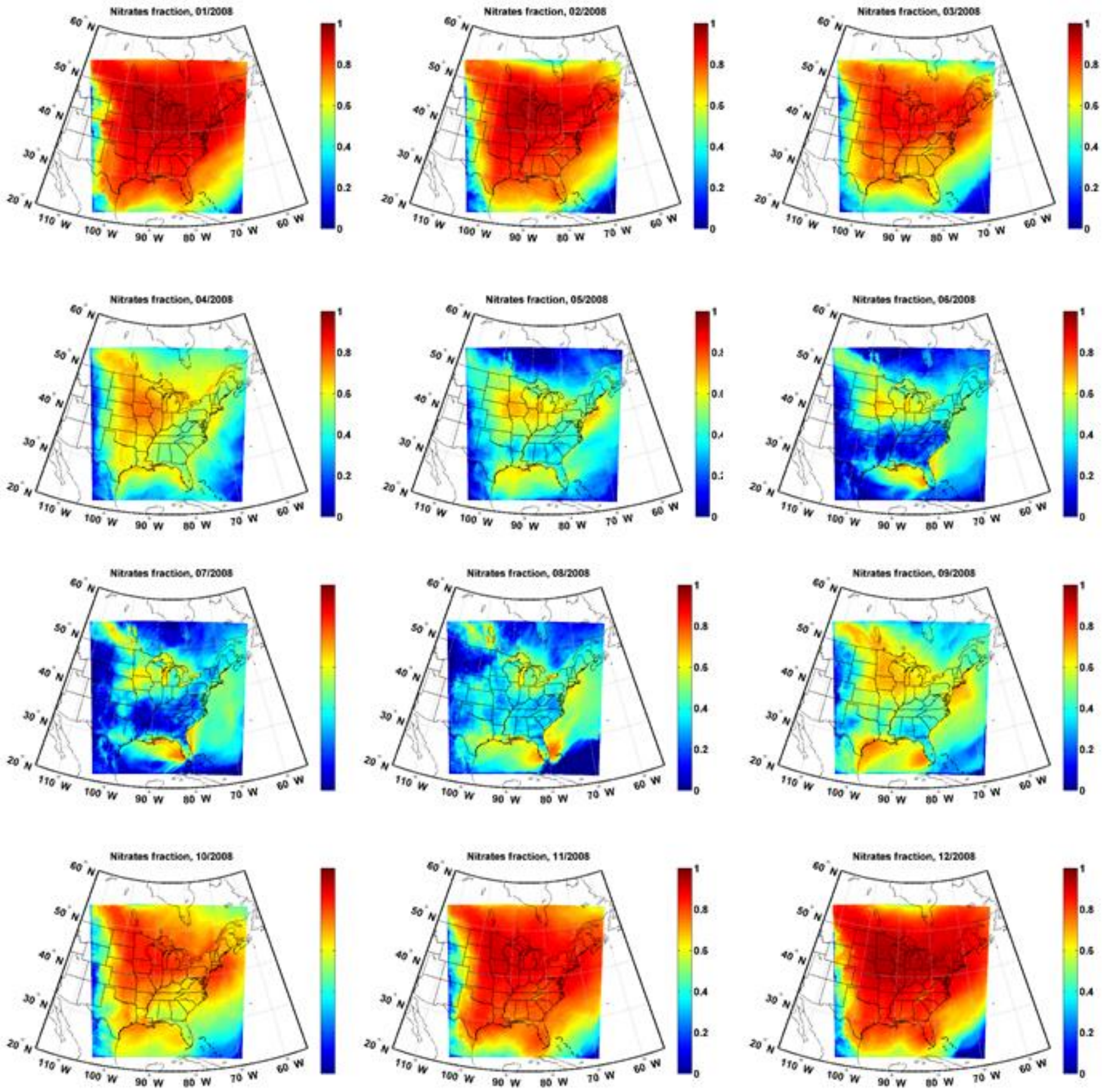

Figure S4. (a) Taylor diagram for monthly accumulated precipitation during 2008 as simulated by WRF-Chem and in the gridded observations (Matsuura and Willmott, 2009), after applying a linear interpolation to match the WRF-Chem grid. Results for the individual calendar months are shown by the numbers (1 = January). Panels (b) and (c) show the difference [mm] between observed and simulated accumulated precipitation during the month of (b) September and (c) October 2008. Values larger than zero indicate the observed precipitation is higher than the simulated one.

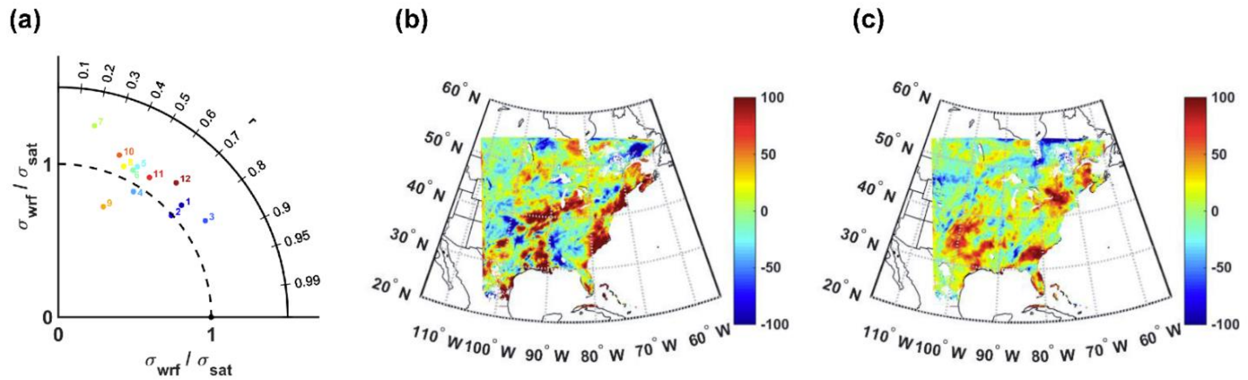

Figure S5. Taylor diagram for AE when MODIS observations and WRF-Chem simulations at 12 km are spatially aggregated to 24, 36, 48, 72 and 96 km. Numbers next to the colored dots/diamonds indicate different months (e.g. 1 = Jan).

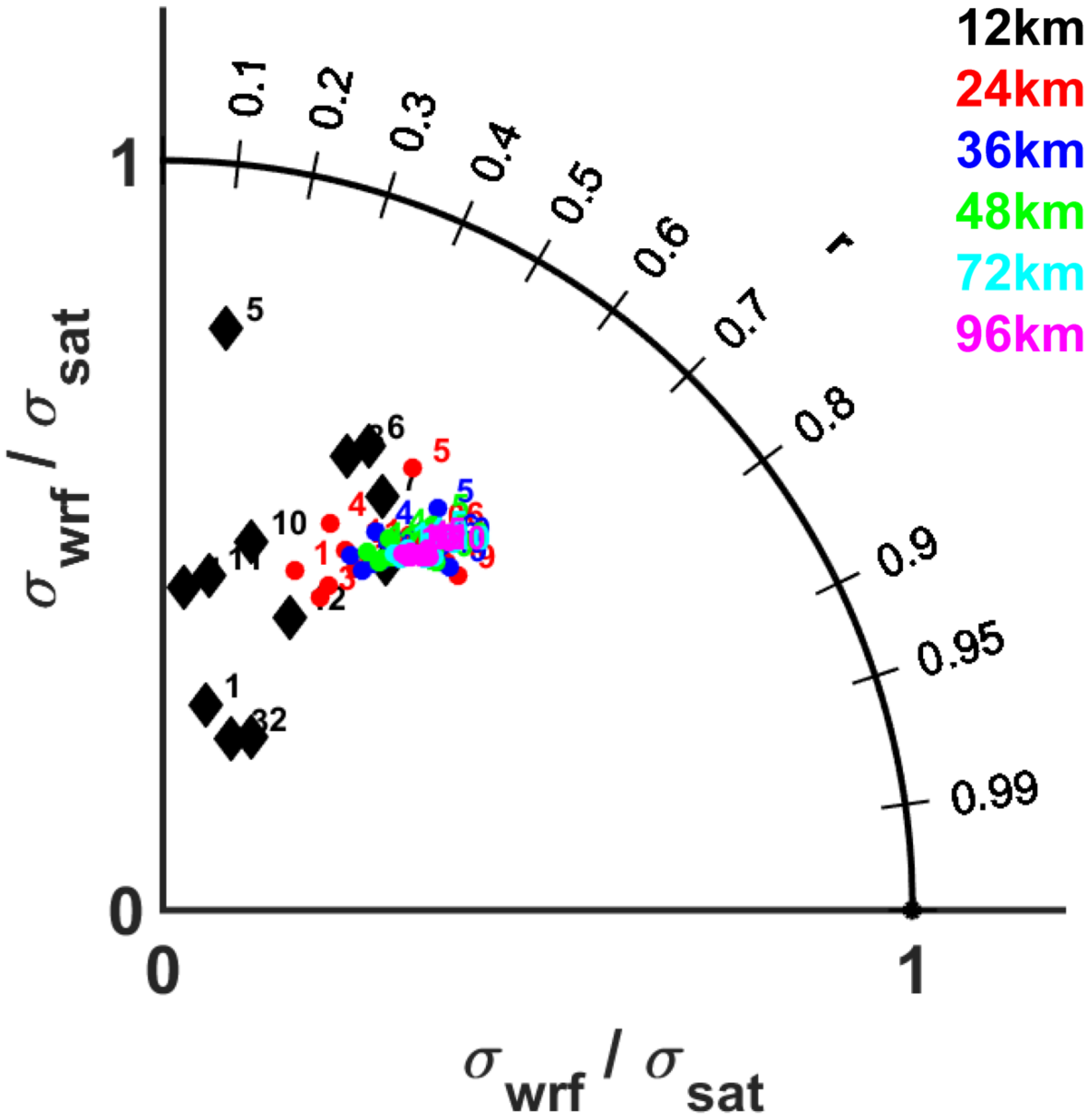

Figure S6. Extreme AOD (i.e. occurrence of AOD > 75th percentile) from WRF-Chem and MODIS Terra (upper panels) and Aqua (lower panels) by month. Green areas denote grid cells defined as experiencing extreme AOD in WRF-Chem, blue pixels indicate extreme values as diagnosed using MODIS, while red pixels indicate areas where the occurrence of extreme values is indicated by both.