

Constraining Global Models of Black Carbon (BC) Aerosol with Pole-to-Pole Observations

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We have completed a comparison of the full HIAPER Pole-to-Pole Observations (HIPPO) mission data set to AeroCom Phase II model fields. Over 700 vertical profiles of BC Mass Mixing Ratio (MMR) obtained from 85N to 67S in five seasons and three years reveal climatological features of the BC distribution of particular significance for evaluating model performance. These include low variability in BC MMR in the lower stratosphere, and minima in tropical BC MMR near 200 hPa altitude pressure, consistent with convective outflow. The comparison expands earlier results focused on only the first of five deployments, and more clearly and robustly identifies systematic model biases in the remote regions. Individual and ensemble model skill will be presented by both season and geographic location as a function of altitude. Work tying these results, and those of other field missions, to BC direct Radiative Forcing (RF) identify BC lifetime as a critical parameter for reproducing remote and high altitude observations, and suggest significant biases in global BC RF due to far-field biases.

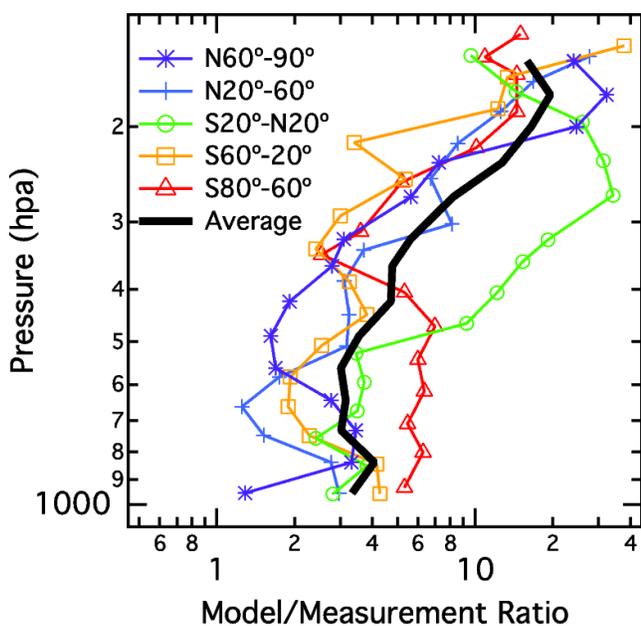


Figure 1. The ratio of modeled to measured vertical BC profiles for individual latitude bands (colored lines) and averaged over all latitudes (black line). These results are averaged over all seasons/HIPPO series and show consistent large biases at high altitude at all latitudes.

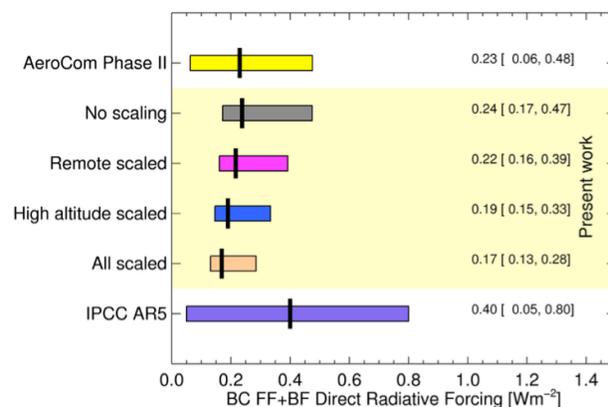


Figure 2. Model median and 5%-95% range for BC FF+BF forcing, for 1750-2010, with various scalings applied. The yellow bar shows the AeroCom Phase II result (Myhre, 2013). The grey bar shows unscaled values from the present work, then with remote scaling (pink) and high altitude scaling (blue) applied. The All scaled bar shows the lower limit on BC FF+BF forcing from the present work, with both scalings applied. In the bottom IPCC AR5 bar we compare with the recent estimate in IPCC WG1's AR5.