Supplementary Text S3. Comparison of measurements in complex terrain with model output.

A few of the sites are located in relatively complex terrain, and there is uncertainty as to which output model level should be most reasonably compared to the measurements. During all of the simulations carried out for this analysis, the HYSPLIT-Hg model was configured to provide output at 6 different concentration levels: 100, 500, 1000, 2000, 3000, and 4000 meters above ground level. Since “level 1” is defined in the model as the ground level, and is used to track deposition, the 6 levels above the surface are numbered 2-7, i.e., the 100m level is level-2, and 500m level is level-3, etc.

During the Eulerian-only simulations used in this analysis, the elevations above ground level for the first several 3-dimensional Eulerian grid layers were approximately the following: 0-400, 400-1100, 1100-2700, and 2700-3800 m. Due to variations in the vertical variation of atmospheric pressure, the thickness and heights of the Eulerian model levels did vary somewhat over time and space during the simulation. Concentrations are assumed to be uniform within a given Eulerian layer at a given location. No interpolation was done for the vertical concentration estimates. So, the 100m output concentration level (L2) was essentially always determined by the concentration in the lowest Eulerian layer (0m - ~400m). Both the 500m and 1000m output concentration levels (L3 and L4) were generally (but not always) determined by the 2nd Eulerian layer (~400m - ~1100m). Because of this, the L3 and L4 output concentrations were essentially the same. The 2000m output level (L5) was almost always determined by the 3rd Eulerian layer (~1100m - ~2700m), and the 3000m output level (L6) was almost always determined by the 4th Eulerian layer (~2700m - ~3800m). Most of the monitoring sites considered here are located in relatively flat terrain, and the most relevant output concentration model layer is L2, determined by the 1st Eulerian model layer. However, the coarseness of the 3-dimensional Eulerian model grid leads to limited accuracy in the vertical resolution of simulation results, especially in areas of relatively complex terrain.

The Underhill, Mt. Bachelor, and Reno monitoring sites are located in areas with relatively complex terrain. The Underhill monitoring site is located at ~400m above sea level, on the side of a mountain. However, the “height” of the surface of the 2.5o x 2.5o Eulerian grid square containing Underhill is ~335m above sea level. This can be regarded as the average terrain height over the entire grid cell. Relative to this cell “floor”, the Underhill site is only ~65m above the “Eulerian model surface”. So, for the Underhill site, the most relevant output concentration level might be L2 (100m), although the possible relevance of L3 (500m) cannot be ruled out. The Mt. Bachelor Observatory (MBO) site is a more extreme case of complex terrain. It is located at ~2700m above sea level, near the peak of Mt. Bachelor in Oregon, ~2100 m above the ~600 m floor of its grid cell. However, the regional terrain at the base of the peak (within ~50 km) is at an elevation of approximately 1000 m. From this perspective, the MBO site is at an elevation of roughly 1700 m above “local” ground level. Given all of the above, the model output levels most relevant would seem to be L4 (1000m) and L5 (2000m), but the possible relevance of L6 (3000m) cannot be ruled out. Finally, the University of Nevada (Reno, UNR)-operated Desert Research Institute (DRI) site is located at ~1509m above sea level, 159 m above the 1360 m cell floor height. The UNR-DRI site is ~5 km north of downtown Reno, Nevada, located in a somewhat hilly region, is about 165m above the level of the city. Therefore, the most relevant model output concentration level data will likely be L2 (100m) or L3 (500m).