Three-dimensional time evolution of aerosols during winter pollution events.

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Abstract

Utah’s Wasatch Front and other montane urban environments can suffer from fine particulates (aerosols) becoming trapped in winter thermal inversions. These inversions result in a persistent cold air pool (PCAP) that is trapped between the mountains on the sides and warm air above. Inside the PCAP fine particulates can build up resulting in a pollution event with serious health ramifications. Understanding how particulates move and evolve through the atmosphere during these times of poor air quality is an important part of solving the problem. The 2017 Utah Winter Fine Particulate Study resulted in a detailed dataset on the vertical evolution of aerosols near downtown Ogden, UT. Notably, clearly defined layering was detected in the vertical evolution of particulates near sunrise. The sunset layering patterns were less distinct and less uniform.

The PurpleAir network of citizen-science particulate counters provides a time-resolved two-dimensional, ground-level, aerosol dataset. This project is comparing horizontal flows with the vertical profiles. Specifically, we are looking for flow patterns that might explain the layers in the vertical profiles. The horizontal flow of aerosols was mapped using ArcGIS to make interpolations between sensor data. These horizontal interpolations were converted into time animations. Time intervals near local sunrise are of the greatest interest, because sunrise is when the greatest increase in particulate counts typically occurs. The biggest limitation is the wide spatial distribution of PurpleAir monitors and that at least one monitor has an artificially high count rate due to poor positioning of the sensor.