UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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MEMORANDUM

TO: Dean Wilson (MD-15)
SRAB

FROM: John Notar, Meteorologist
Region VIII

SUBJECT: PM_{10} Modeling Methodologies for Colorado PM_{10} SIPs (Rural)

Region VIII and the State of Colorado have developed modeling methodologies for five rural PM_{10} SIPs and will soon enter into a signed protocol agreement. Please review the facts of each proposed SIP's modeling methodology and provide comments to meet or enhance the modeling methodologies to satisfy OAQPS's criteria.

The rural PM_{10} SIPs are being developed for the following Group I Colorado towns: Pagosa Springs, Telluride, Aspen, Lamar and Canon City. The State of Colorado has proposed the following methodologies listed in the attachment to address the unique meteorological and topographic situations of each Group I site. Region VIII would appreciate the Clearinghouse's reviewing these proposed methodologies. OAQPS's comments and recommendations will then be incorporated in the final protocal between Region VIII and the State of Colorado.

We would appreicate receiving your comments by March 11, 1988. If you have any questions concerning this memorandum and attachment call me at FTS 564-1755.

Attachment

PM-10 Modeling Methodologies
for Five Rural Colorado Communities

Introduction

The rural PM_{10} SIPs are being developed for the following Group I Colorado towns: Pagosa Springs, Telluride, Aspen, Lamar and Canon City. The State of Colorado has proposed the following methodologies listed in this attachment to address the unique meteorological and topographic situations of each Group I site. Region VIII would appreciate the Clearinghouse's reviewing these proposed methodologies. OAQPS's comments and recommendations will then be incorporated in the final protocal between Region VIII and the State of Colorado.

Telluride

The State of Colorado plans to use the Ventilated Valley Diffusion Model (VVDM) to model Telluride. Telluride is located in a "textbook" box canyon with very steep canyon side walls some 2,000 ft. higher than the town which is at 8745 ft. MSL. An intensive study was conducted in Telluride during December of 1985. There were three meteorological stations in town and down valley. There was one TSP monitor in the center of town and three PM_{10} monitors set up for the study. In addition, twice daily mixing heights were taken from balloon measurements. Also vertical profile sampling by tethered balloon was performed within the inversion layer itself. I have included copies of "Tethered Balloon Particulate Sampling of a Wood Smoke Impacted Atmosphere," which summarizes the Telluride study. A paper by the Colorado Department of Health (CDH) entitled "An Analysis of Telluride Wintertime PM_{10} Problems," which provides a comparison between modeled versus predicted concentrations, is also included. PM_{10} monitoring presently continues with one PM_{10} monitor. PM_{10} sampling took place everyday in 1986. The meteorological data shows that windflow in Telluride and the downvalley canyon is described by classic conditions of upslope upvalley flow in the day time, with a nighttime downvalley drainage condition. The winds are seldom calm except possibly briefly during the short morning or evening transition periods. The Telluride canyon is not a valley stagnation situation.

The Office of Research and Development (ORD) review of the three potential "Valley Stagnation" models indicates that the Ventilated Valley Diffusion Model (VVDM), although not suitable for a typical valley stagnation situation, does have merit in a valley drainage situation. The Telluride canyon is definitely a valley drainage situation and therefore the VVDM is applicable to this specific site.

The PM_{10} emission inventory for Telluride is composed entirely of wood burning and road dust. This has been verified by filter analysis. Therefore the PM_{10} emissions are uniformly distributed throughout the town with no real hot spot due to a major point source. The CDH plans to use two worst case emission rate examples which is the Christmas-New Year week for the resort town, and early spring when the unpaved roads are snow free and cold nighttime temperatures still cause the need for residential wood burning. Meteorological data to determine design day concentration will be the worst case during the winter season coupled with the worst case emissions of the Christmas holiday period. The worst case early spring concentrations are coupled with worst case early springtime meterological conditions. This combination will allow prediction of the highest second high concentration. The Region believes that the VVDM is appropriate for this specific situation. This has been verified by the high correlation of monitored data versus the model predicted between the concentrations presented by CDH. For the annual analysis, proportional modeling based on filter analysis will be used.

Canon City

Canon City, Colorado, is a rural location on rolling high plains at an elevation of 5,332 ft. MSL near the Front Range Mountains. The local town topography and the area covered by the model grid are level enough to justify the use of a flat terrain model. CDH has proposed to use the ISCST model. The PM_{10} emissions are almost entirely wood burning and road dust. There is daytime on-site meteorological data from a local radio station, but National Weather Service (NWS) data from Pueblo, Colorado, 36 miles to the east is used to fill in the nighttime missing data. Region VIII agrees with CDH that the additional Pueblo surface meteorological data is representative of Canon City in this flat terrain situation. Denver upper air data will be used to construct the meteorological preprocessor file. The CDH is in the process of starting a PM_{10} monitoring program. The Group I designation was based on TSP data. The CDH has developed a seasonal PM_{10} emission inventory. The large majority of PM_{10} emissions are road dust and wood burning emissions. The winter season with wood burning is the period of time when worst case conditions emissions occur. Worst case meteorological conditions occur during winter nighttime stable situations. ISCST in the rural mode is the most appropriate model for this scenario. CDH has modeled the four highest monitored TSP days in the last three years and will use the highest monitored TSP day with the appropriate PM_{10} inventory for the critical design day.

Lamar

Lamar, Colorado, is another flat terrain Group I site whose designation is based on TSP data. Lamar is located in Southeastern Colorado in very flat terrain. The highest TSP concentration occurred on March 3, 1986, with a value of 501 ug/m^3. Lamar is located in a totally agricultural area. There are no major point sources of TSP or PM_{10}. The large violation of March 9, 1986, was due to spring agricultural tilling. This occurred on a day of very high sustained wind speed. The EPA document "Guideline on the Identification and Use of Air Quality Data Affected by Exceptional Events" EPA-450/4-86-007 states that wind speeds greater than 30 mph for one hour or gusts of 40 mph constitutes exceptional events. The proposed on-site meteorological data shows sustained winds of 19.9 mph and gusts of 55 mph. In addition, Lamar is a steppe climate with only 12" of precipitation annually. These unusual climatic conditions I believe constitute exceptional events along with the uncontrollable agriculture tilling. The second highest TSP monitored values is much lower at only 209 ug/m^3. Therefore, what is the Clearinghouse view for discarding March 9, 1986, as the critical design day in lieu of the second highest monitored value. CDH plans to use ISCST for this flat, rural situation. There is daytime meteorological data from a radio station in town. CDH has proposed to use this data along with NWS surface data from Pueblo, Colorado, and Garden City, Kansas, to fill in the missing data. These two stations' data correlate well with the available in-town data. Region VIII approves the off-site meteorological data as being representative. The PM_{10} emission inventory is primarily dust from agriculture along with small contributions of road dust and winter wood burning emissions. The design day control strategies will address these emission sources. Region VIII feels that Lamar will probably be designated as a rural fugitive dust area.

Pagosa Springs

Pagosa Springs, Colorado, is located in an isolated mountain valley in Southern Colorado. The immediate area around the small town is flat with the Continental Divide to the west of the town and lesser mountains to the north, east and south. The nearest meteorological station to Pagosa Springs is on the other side of the Continental Divide, so the data is therefore unusable. CDH proposed to use proportional modeling for the SIP demonstration. Adequate PM_{10} monitoring data along with filter analysis data exist to perform the proportional modeling analysis. The filter analysis and PM_{10} emission inventory shows that the major sources of PM_{10} are wood burning and road dust. The inventory is seasonal. The worst case conditions are during the winter when strong surface based inversions exist. The emissions are assumed to be homogeneously mixed within this inversion layer.

Therefore, the PM_{10} concentrations can be well represented by the filter data. In this scenario, where no guideline or stagnation models are appropriate, or usable due to the lack of meteorological data, the proportional modeling technique in Region VIII's opinion is the best approach.

In addition, Region VIII believes that this is a situation for a partial SIP approval whereby EPA would approve control measures but not the attainment demonstration. CDH will institute meteorological monitoring along with continuing PM_{10} monitoring. Therefore, in the future, the SIP can be evaluated with the on-site meteorological data if reasonable forward progress must be demonstrated. CDH at this time questions the need for the meteorological data collection. What is the Clearinghouse position on the need for future meteorological data when the original PM_{10} SIP is developed by proportional modeling?

Aspen

Aspen, Colorado is a Group I designated PM_{10} area based on TSP data. Aspen is a town located at 7,908 ft. MSL in a high altitude, broad box canyon, mountain valley. The mountain valley is boxed off by the Continental Divide with 14,000 ft. mountains to the east. This is not a valley stagnation situation but a box canyon valley drainage situation similar to Telluride. A PM_{10} emission inventory has been performed. The inventory, along with the TSP data that is available, shows that road dust and wood burning emissions are the main sources of PM_{10} emissions. These emissions are trapped under the strong nighttime surface based inversion Attached you will find a CDH Inter-Office Communication entitled "Aspen PM_{10} Model Validation Revised". This paper outlines dispersion modeling performed by CDH using the Ventilated Valley Diffusion Model (VVDM). I will summarize the work presented in the CDH paper. CDH used meteorological data taken approximately one mile downvalley outside of town. The meteorological data included wind speed, wind direction, sigma theta at 10 m and between 2 and 60 meters. CDH chose to model the day with the highest TSP concentration during the meterological monitoring period. That day was February 20, 1987 with a measured TSP concentration of 282 ug/m^3. CDH did assume a mixing height of 35 meters which was measured in Telluride a similar high mountain box canyon. With no present PM_{10} measured data available, CDH estimated the PM_{10} concentration from the measured TSP value using a conversion factor of (0.504). This conversion factor was derived from PM_{10} filter analysis performed at Telluride and Aspen have very similar emission inventories. Therefore, the goal of the CDH modeling was to predict the synthetic PM_{10} concentration derived from the measured TSP data at the 2 Hi-Vol locations.

CDH ran the VVDM model using a total of 14 boxes to represent the Aspen valley air shed. CDH used the on site meteorological date of February 20, 1987, to predict the highest synthetic PM-10 concentration which was measured by the Hi-vol in box 3 on February 25, 1986. The Hi Vol location in box 3 had a synthetic PM_{10} concentration of 190.5 ug/m^3 and the VVDM model predicted a PM_{10} concentration of 186.4 ug/m^3 at that location. This is an under prediction of only 2.2%. Although EPA routinely does not accept under predictions when modeling, in order to error on the side on conservatism, OAQPS should note that these predicted concentrations are corrected by a factor of 1.20 to Standard Temperature and Pressure (STP) conditions, thereby reflecting true physics, and a degree of conservatism not employed by the rest of the country.

Region VIII and CDH feel that this modeling approach is superior to the only other alternative of proportional modeling. In addition, Region VIII believes that his is a situation for a partial SIP approval whereby EPA would approve control measures but not the attainment demonstration. CDH will institute meteorological monitoring and has just instituted PM_{10} monitoring. Therefore, in the future, the SIP can be evaluated with the on-site meteorological data if reasonable forward progress must be demonstrated.

This submittal to the Model Clearinghouse does not constitute a formal modeling protocol. It does outline the basic concepts of the rural Colorado PM_{10} SIPs. Please provide any comments to these proposals that will facilitate the acceptance of these PM_{10} SIPs.