ENVIRON

December 15, 2011

MEMORANDUM

To: Duane Ono – Great Basin Unified APCD

From: Ken Richmond - ENVIRON

Subject: CALPUFF Simulations of the February 8, 2011 Dust Event
Assessment of Owens Lake Dust Source Contributions to PM_{10} Concentrations in the Coso Junction PM_{10} Attainment Area

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1 Introduction

ENVIRON conducted CALPUFF simulations to assess PM_{10} concentrations within the Coso Junction Attainment Area (CJAA) during a dust event on February 8, 2011.[1] During this event the 24-hour PM_{10} concentration observed at the Coso Junction monitoring site was 205 µg/m^3. This observation exceeds the 150 µg/m^3 24-hour PM_{10} National Ambient Air Quality Standard (NAAQS). The objective of the current analysis was to simulate Owens Lake windblown dust sources and estimate their contribution to the Coso Junction observation. The analysis supports a broader investigation into whether required dust control measures were properly implemented as directed by the CJAA State Implementation Plan (SIP). The remainder of this memorandum describes the dispersion modeling techniques and presents the results of the analysis.

2 Dispersion Modeling Methods

Dispersion model simulations were performed with the regulatory Version 5.8 of the CALPUFF modeling system following the techniques of the attainment demonstration in the 2010 CJAA SIP. These techniques are an extension of the same methods used by the Owens Lake Dust ID Program summarized in the 2003 and 2008 Owens Valley SIPs. The data collected by the Owens Lake Dust ID Program include surface meteorological data, upper air meteorological soundings, source area delineations, and horizontal sand flux observations. Sand flux measurements are used as the basis for PM_{10} emission rates from windblown sources on Owens dry lakebed. Some of the features of the Coso Junction CALPUFF model simulation were:

- The 48-hour model simulation period was from February 7 to February 8, 2011 using data available from the Owens Lake Dust ID Program. The simulations were started one day before the period of interest to account for the contribution of any plumes emitted in the last few hours of February 7th to concentrations in the early hours of February 8th.

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[1] A preliminary simulation of the February 8, 2011 dust event was previously described in an April 22, 2011 Memorandum. The previous analysis used near real-time data from the Owens Lake Yesterday simulations. Data in the current analysis have undergone the full quality assurance reviews/audits performed quarterly and semi-annually by the District.

- The modeling domain used in this analysis and in the 2010 CJAA SIP is depicted in Figure 1. The study domain is 36 km-by-67 km and is an extension of the 34 km-by-48 km Owens Valley domain used in the Owens Lake Dust ID Program. Figure 1 also shows the PM_{10} monitoring sites, meteorological monitoring sites and the common boundary of the southern Owens Valley and northern Coso Junction PM_{10} Planning Areas

- Data collected at six additional surface meteorological stations in the southern portions of the domain were used to construct the hourly wind fields for the February 7-8, 2011 simulation. As shown in Figure 1, four of the meteorological sites are just off the southern end of the domain. These sites influence winds within the domain but to a lesser extent than the two sites within the southern end of the domain.

- PM_{10} concentration predictions were obtained at 90 receptors placed along the southern Owens Valley PM_{10} Planning Area boundary. The receptor interval shown in Figure 1 is 300-600 m. Receptors were also placed along a horizontal 500-m mesh size grid to examine the spatial extent of predicted plumes from Owens Lake dust sources. A receptor was also placed at the Coso Junction site.

- Dust source activity was characterized using hourly Sensit sand motion data from the network shown in Figure 2.

- The area source delineations in Figure 2 are from the Owens Lake Dust ID Program for the period January 5 to March 20, 2011. Following procedures used by the Owens Lake Dust ID Program, the 199 irregular shaped source areas were divided into 3,236 125 m-by-125 m square area sources for simulation by the CALPUFF modeling system.

- Area source PM_{10} emission fluxes were calculated from the hourly Sensit sand motion data using the 75^{th} percentile seasonal proportionality constants (K-factors) derived using the procedures described in the 2003 and 2008 Owens Valley SIPs. The February 7-8, 2011 simulation used the January 4 to March 20, 2011 75^{th} percentile K-factors shown in Table 1.

- As in the 2003 and 2008 Owens Valley SIP attainment demonstrations, and the 2010 CJAA SIP, the current simulation only includes windblown emissions from sources on the lakebed and the Keeler Dunes. In order to account for background and miscellaneous sources, model predictions were added to a background concentration of 20 $\mu g/m^3$. This same background concentration is also included in the modeling for the Owens Valley SIPs and 2010 CJAA SIP.

The next section describes the results of the simulations using the methods above applied to the February 8, 2001 dust event.

Table 1: Owens Valley 75th Percentile Seasonal K-Factors

General Source Area [1]	K-Factor (x 10^{-5}) January 4, 2011 to March 20, 2011
North	25.7
Keeler Dunes	2.1
Central	27.1
South	5.8
Other [2]	5.0

1. The General Source Areas are defined in the 2003 and 2008 Owens Valley PM10 SIPs
2. The "other" source refers to Sensit locations outside the General Source Areas. In the current simulation the only Sensit classified as "other" is Sensit 9810 near the Flat Rock monitoring site.

3 Dispersion Modeling Results and Discussions

The dispersion modeling methods described in the previous section were used to simulate the February 8, 2011 dust event. The event was characterized by persistent northerly winds that transported dust plumes from Owens Lake toward Coso Junction. The majority of the Owens Lake source activity occurred during the first few hours of the morning, but some activity was detected for every hour of the event. In addition to windblown dust from Owens Lake source areas, sources upwind of Owens Lake appear to have contributed to regional PM_{10} concentrations. Observed PM_{10} concentrations at North Beach and Lizard Tail also exceeded 150 µg/m^3. Observed concentrations were considerably higher downwind of the Owens Lake source areas with a 24-hour concentration of 781 µg/m^3 at the Dirty Socks monitoring site.

Figure 3 shows the CALPUFF predicted 24-hour PM_{10} concentrations throughout the model domain with the added background concentration of 20 µg/m^3. The model predicts the observed enhanced PM_{10} concentrations at Dirty Socks, Olancha, and Keeler sites, and to a lesser extent higher concentrations at the Shell Cut, Flat Rock, and Stanley sites. The highest predictions follow the valley floor with the plumes passing just west of the Coso Junction monitoring site. Secondary plumes are predicted to be diverted by the higher portions of the Coso range and pass well east of the Coso Junction site.

Figure 4 shows the maximum 24-hour predictions at the northern boundary of the Coso Junction PM_{10} Planning Area and at the Coso Junction monitoring site. The highest predicted concentrations at the Coso Junction site and on the boundary between the two planning areas are

133 µg/m^3 and 272 µg/m^3, respectively. On February 8, 2011 the observed concentration at Coso Junction was 205 µg/m^3.

The model under predicts the observed concentration at the Coso Junction monitoring site. Figure 5 shows a plot of the hourly time series comparing predicted to observed concentrations at the Coso Junction site. The plot also shows the maximum hourly predictions at the boundary. The observations are bounded by the predictions at the actual site and those at the southern boundary. Examination of Figure 3 shows observed concentrations at the Coso Junction could be explained by concentrations predicted for plumes travelling just west of the actual site. We hypothesize that small errors in plume trajectories influenced by the absence of meteorological data between Olancha and Coso Junction may have accounted to differences between predictions and observations.

The assumed background concentration of 20 µg/m^3 may also be too low for this event. The 24-hour concentration upwind of the Owens Lake sources at Lone Pine was 130 µg/m^3 on February 8, 2011. If this background concentration also represents conditions at Coso Junction, the model prediction at Coso Junction would be 263 µg/m^3, somewhat higher than the 24-hour observed concentration of 205 µg/m^3.

Figures

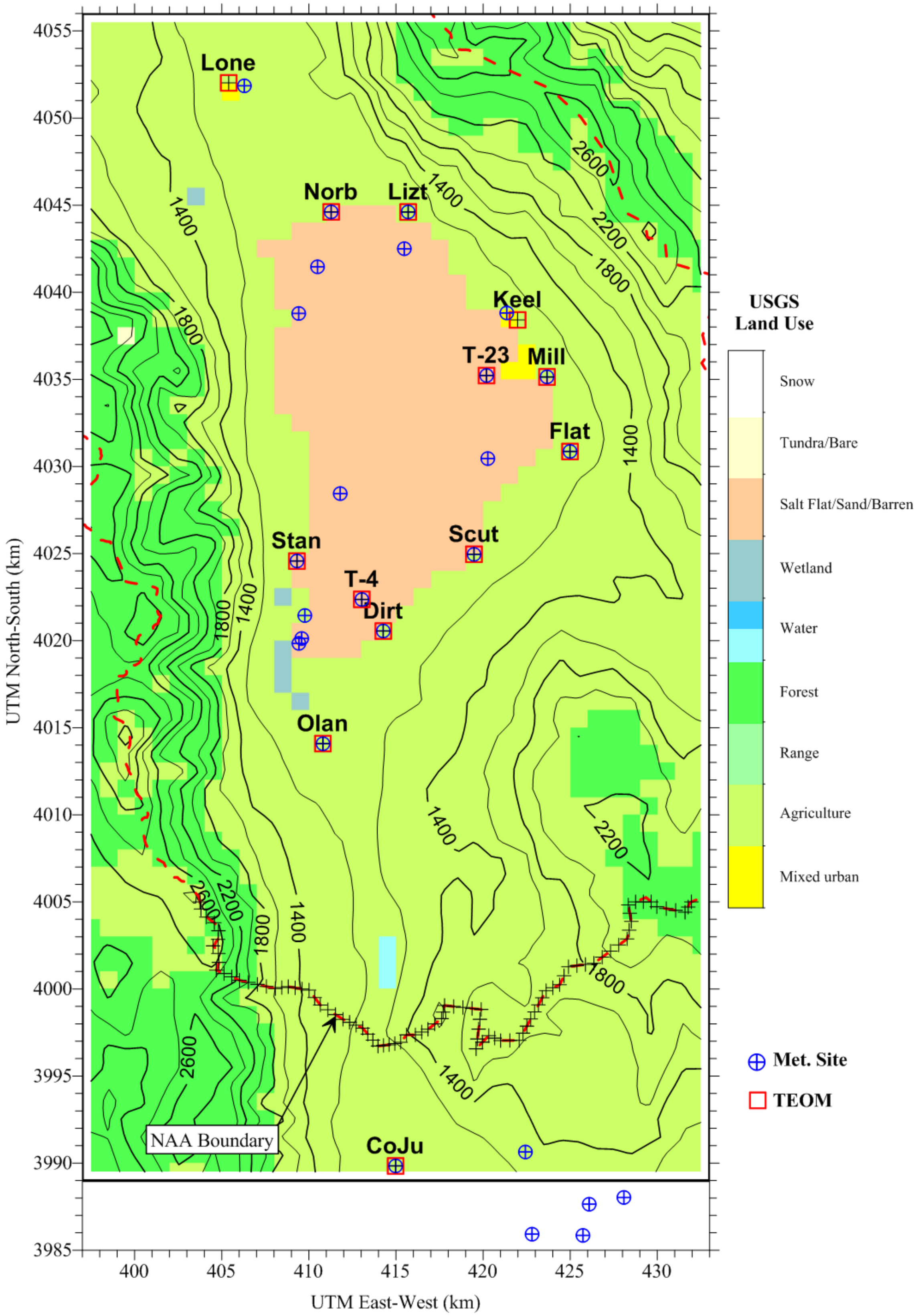

Figure 1: Dispersion Modeling Domain, Monitoring Stations, 1-km Mesh Size Land Use (USGS Categories) and Terrain Elevations (Contours in Meters)

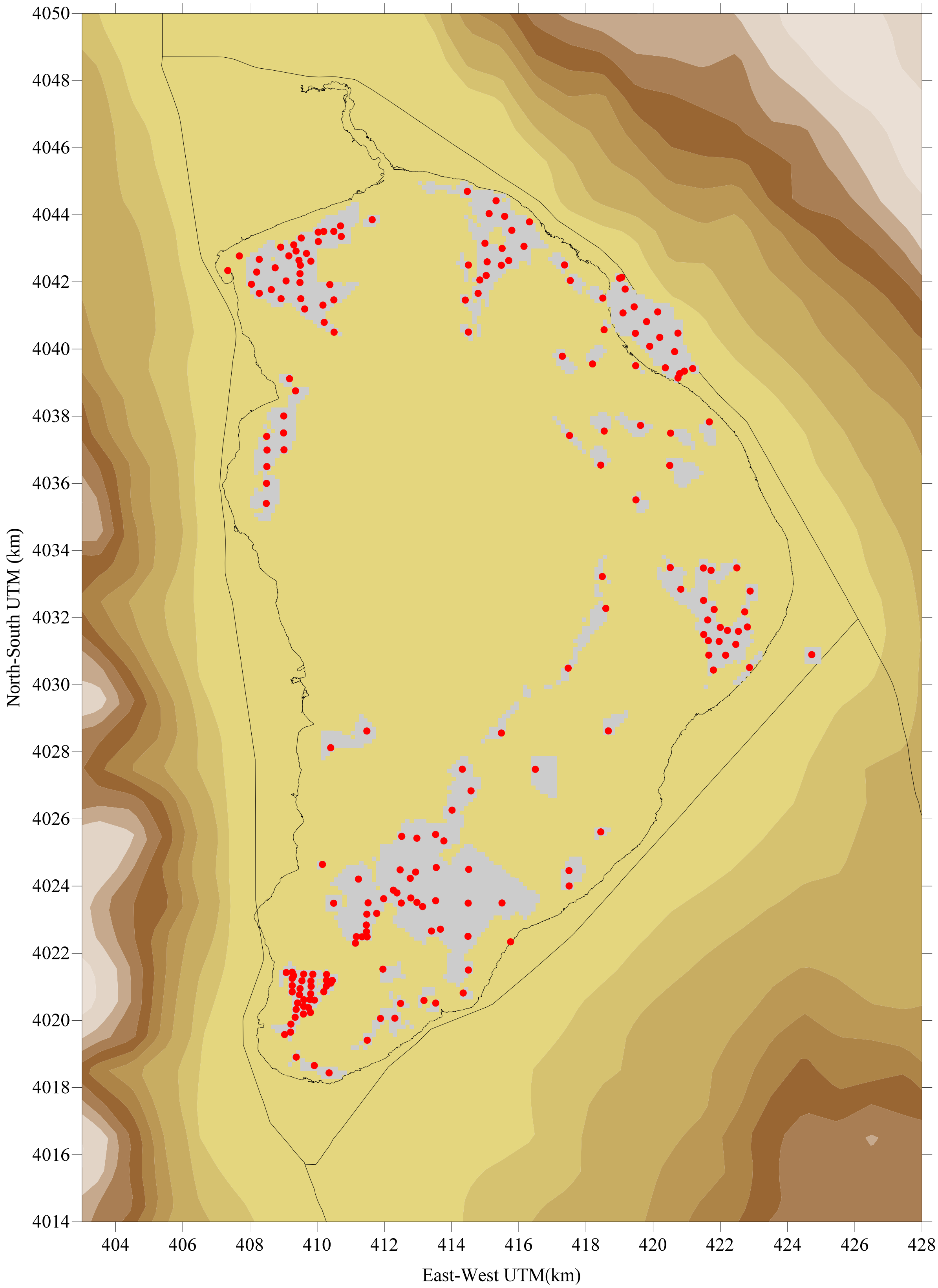

Figure 2: Source Areas and Sensit Locations

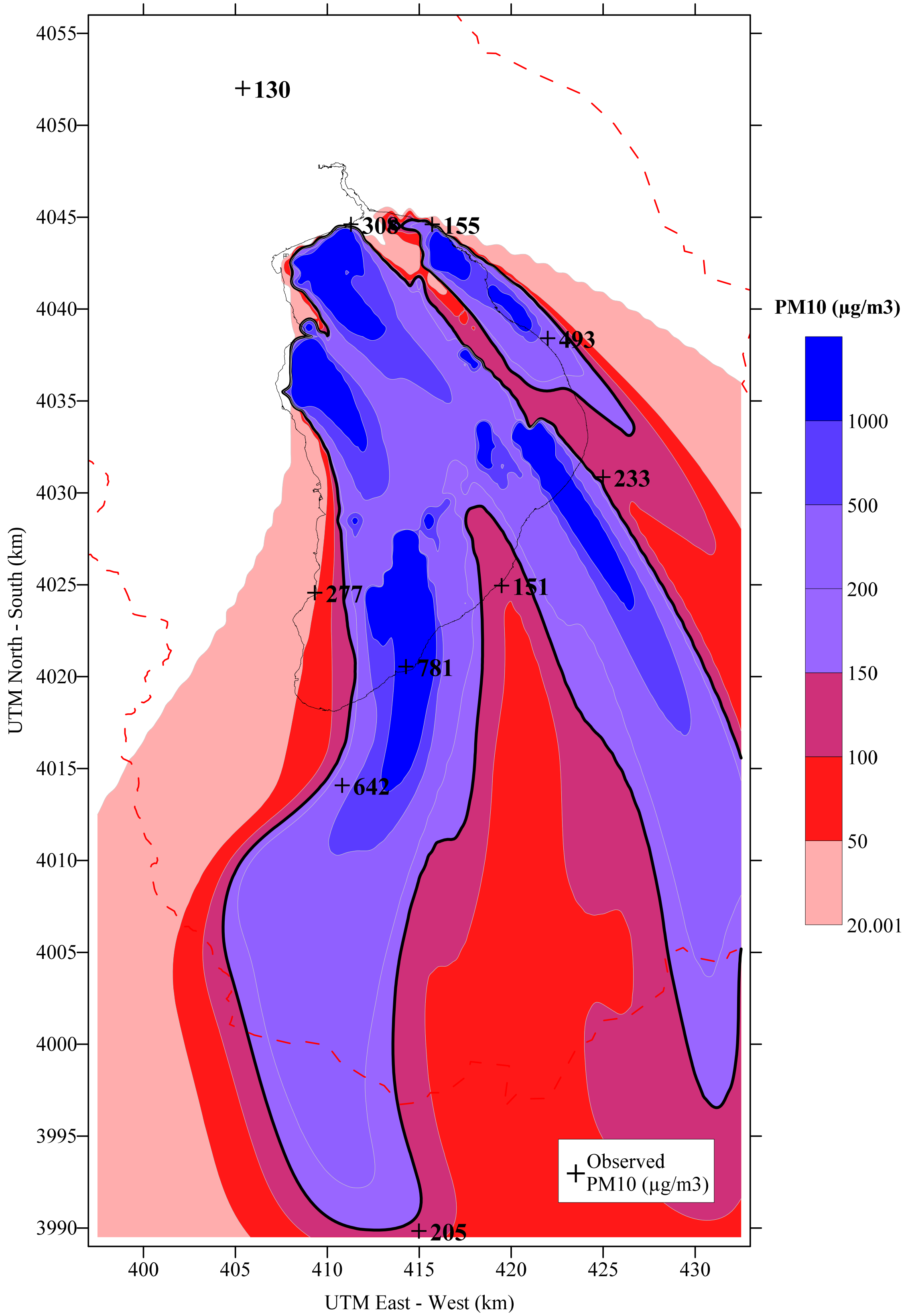

Figure 3: Predicted 24-Hour PM_{10} ($\mu g/m^3$) on February 8, 2011, RSIP Default K-Factors, Background of 20 $\mu g/m^3$

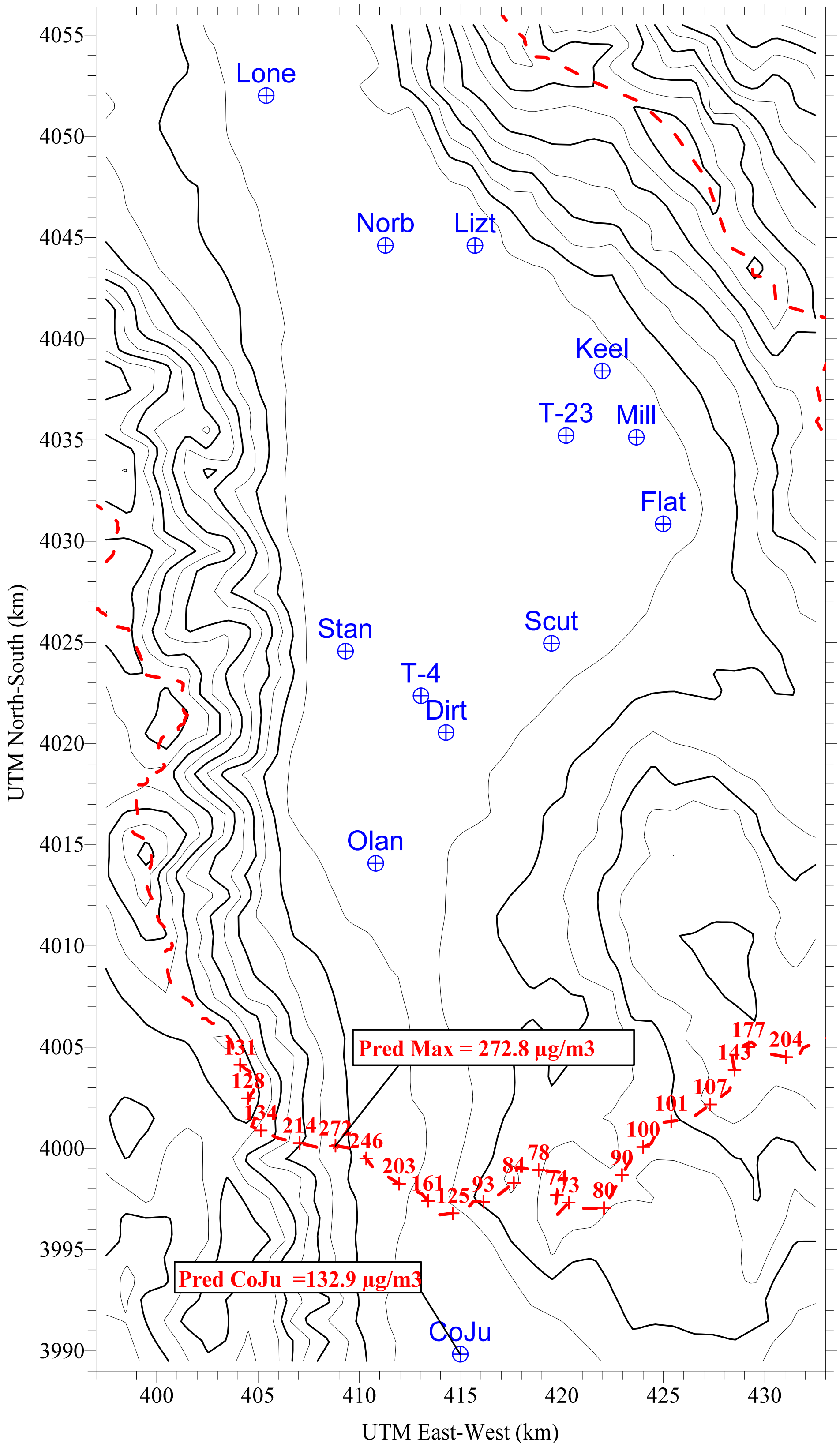

Figure 4: Predicted 24-hour PM_{10} (µg/m3), Receptors at Southern Limit of Owens Valley Planning Area, February 8, 2011, Every 4th Prediction Plotted

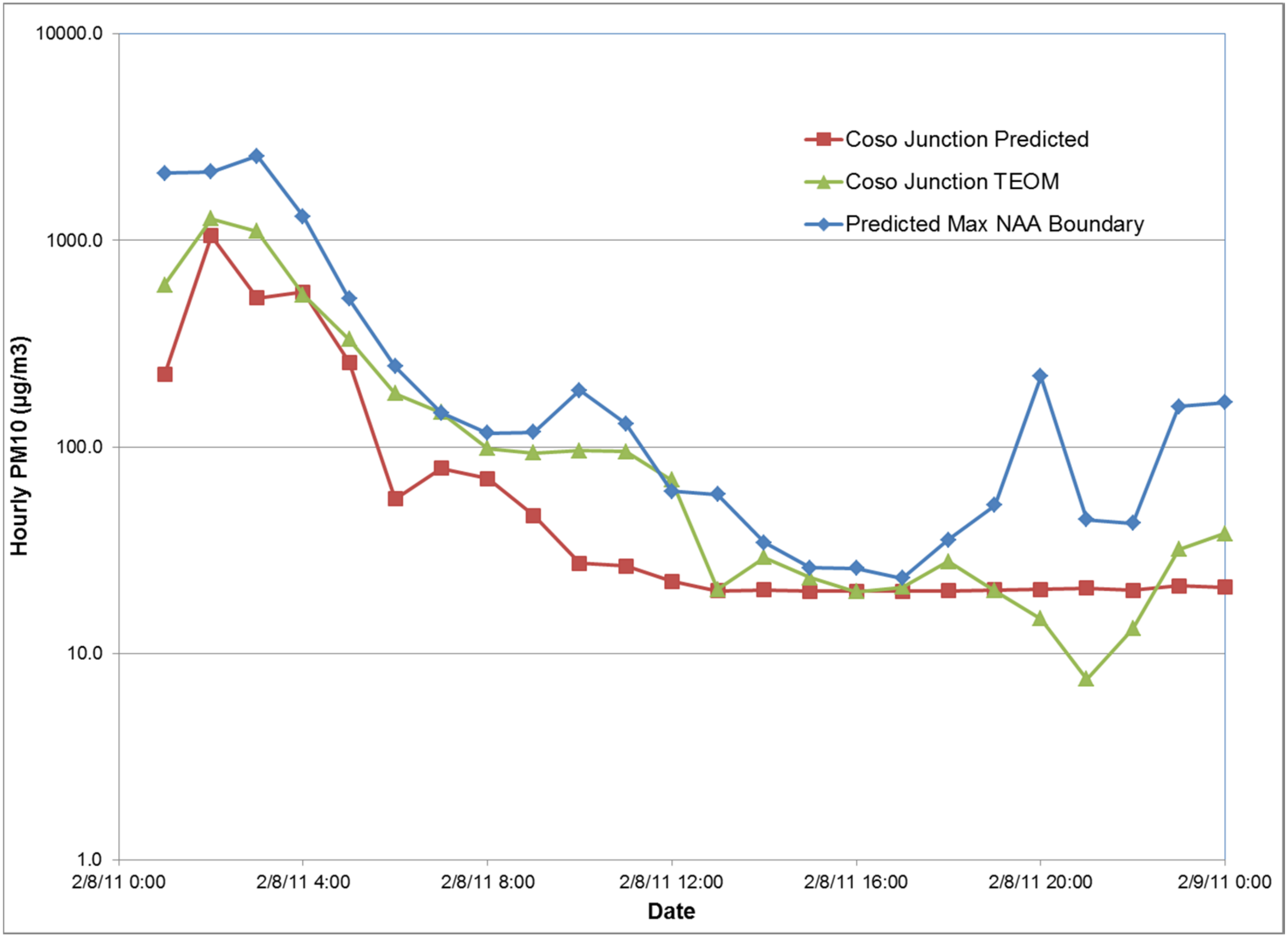

Figure 5: Predicted vs. Observed Hourly PM_{10} for February 8, 2011