Attachment 3-9
Mexico Emissions Inventory

This attachment is an excerpt from ***Big Bend Regional Aerosol and Visibility Observational (BRAVO) Study Emissions Inventory*** (November 16, 2001), prepared by Hampden Kuhns, Ph.D. (hkuhns@dri.edu), Mark Green, Ph.D., and Vicken Etyemezian, Ph.D. of Desert Research Institute, for BRAVO Technical Steering Committee. To obtain the complete report please contact:

Hampden Kuhns

Desert Research Institute

755 E. Flamingo Rd.

Las Vegas NV 89119

(702) 895 0433.

4. MEXICO EMISSIONS

This section describes the data sources and methods used to generate the BRAVO EI for the 10 states in Northern Mexico.

4.1 Domain and FIPS Coding

The domain of the BRAVO Northern Mexico Emissions Inventory includes the 10 Mexican states listed below in Table 4-1. The Mexican emissions data is organized with the same state and county FIPS format as the US counties. Since the current IDA text file format used to store the emissions data does not include a country code, emissions from the Gulf of Mexico, the United States, and Mexico are stored is separate files.

Table 4-1. List of States in BRAVO Northern Mexico EI.

State	MX State ID
San Luis Potosi	24
Baja California Norte	2
Sonora	26
Chihuahua	8
Coahuila De Zaragoza	5
Nuevo Leon	19
Tamaulipas	28
Sinaloa	25
Durango	10
Zacatecas	32

States in Mexico are subdivided into "municipios". The geographic area of the municipios varies depending on the location of natural borders (i.e. rivers and mountains) and population density. In general municipios are comparable in size to counties in the U.S. The Mexican government refers to municipios using a similar convention to the U.S. FIPS coding. Each state has a unique 2 digit ID and each municipio has a unique 3 digit ID. For the purpose of the BRAVO emissions inventory, each municipio is designated with its 2 digit Mexican state ID and the Mexican 3 digit municipio ID.

4.2 Emissions Data Sources

At present, there is no municipio level national emissions inventory for Mexico for area and mobile sources. These emissions must be extrapolated from existing Mexican EI's that are limited to a small number of urban areas.

The process is further complicated by regulatory restrictions in Mexico that prevent the reporting of emissions from individual Mexican point source facilities. As a result, estimates of point source emissions cannot be reconciled at the facility level and are therefore are likely to be more uncertain than emissions in the United States.

The list of data sources used to assemble the BRAVO EI for Mexico is presented below.

4.2.1 Instituto Nacional de Ecologia (INE)

Emissions inventories were produced for a limited number of cities by the National Environmental Protection Agency Instituto Nacional de Ecologia (INE) in Mexico (INE, 2001).

These inventories were constructed for base years 1994-1996 for the urban areas shown in Table 4-2. Emissions are calculated for PM, SO_2, NO_x, hydrocarbon (HC), and CO.

Table 4-2. INE emissions inventories for 20 major cities in Mexico. Emissions are in U.S. tons per year.

City	Base Year	PM	SO_2	CO	NO_x	HC
Cd.Juárez	1996	51,267	4,561	498,036	28,727	83,745
Tijuana	1998	30,176	35,230	345,798	34,942	91,837
Tula - Vito –Apaxco	1994	22,405	355,158	2,418	50,937	13,781
Mexicalli	1996	93,488	4,177	293,412	20,402	56,552
Zona Metropolitana de Guadalahara	1996	331,962	8,894	987,845	40,904	158,219
Zona Metropolitana de Monterrey	1995	897,191	33,513	998,538	58,603	137,913
Zona Metropolitana del Valle Mexico	1995	496,775	50,015	2,593,955	141,511	1,128,335
Zona Metropolitana del Valle Toluca	1996	135,713	11,574	295,616	23,528	51,129

Emissions from the three municipios Tula, Vito, and Apaxco are the largest grouping of SO_2 sources in Mexico. Because of the high emissions at this location, a separate point inventory file was created for this source area. The centroid of the Tula municipio (20.048 deg N, -99.365 deg E) was assigned as the geographic reference of the source. Tula-Vito-Apaxco's emissions are largely due to industrial sources including power generation, oil refining, glass manufacturing, and concrete manufacturing (Ortiz, 1997). Emissions from Mexico City (Zona Metropolitana del Valle Mexico) were also appended as a separate record in this file. Mexico City emissions were geocoded to (19.45 deg N, –99.18 deg E). Since multiple sources are responsible for the emissions from these areas an artificial SCC of "0000000000" was assigned to represent all emissions.

Emissions inventories categorized by source type are available on the INE webpage for the later four metropolitan areas listed in Table 4-2 (INE, 2001). The emissions inventory for the Zona Metropolitana de Monterrey has a base year of 1995 and covers the entire metropolitan area of Monterrey which includes the six municipios: Apodaca, San Pedro Garza Garcia, General Escobedo, Guadalupe, Monterrey, and San Nicolas de Los Garza.

4.2.2 System Nacional de Informacion de Fuentes Fijas (Manufacturing Emissions)

Emissions factors for Mexican manufacturing sources was downloaded from the World Bank New Ideas in Pollution Regulation web page (World Bank, 2001). This dataset has been produced by DECRG-IE of the World Bank in collaboration with Mexico's Instituto Nacional de Ecologia (INE), using a database they provided, the Sistema Nacional de Informacion de Fuentes Fijas (SNIF). The SNIF database was updated in November 1997 and lists average emissions factors from over 5300 manufactures in Mexico. Emissions factors for CO, NO_x, SO_2, PM, and hydrocarbons (HC) are aggregated by number of employees employed and business type based on International Standard Industrial Classification (ISIC) code. The source data files used to assemble the SNIF database are not publicly available and therefore could not be used to assemble the BRAVO EI.

Activity data on employment in each manufacturing sectors was obtained from the INEGI Economic Census report for base year 1998 (INEGI, 1999). The report lists the number of people employed by business size in each state based on the top four manufacturing sectors in that state. The report also lists the number of people employed in Industrial parks, cities, and corridors in each of the municipios. These data were used to estimate the number of people

employed in each of the top four manufacturing sectors for small, medium, and large businesses in each municipio.

The emissions factors were applied to the employment activity data to calculate emissions for each municipio. The mapping of ISIC codes to SCC codes was performed using the transformation shown in Table 4-3.

Table 4-3. Conversion between international standard industrial classification (ISIC) codes and source classification codes (SCC).

ISIC3	Description	SCC Code	SCC Genearal Description	SCC Specific Description
311	Food products	2302000000	Food and Kindred Products: SIC 20	All Processes
312	Other food products	2302000000	Food and Kindred Products: SIC 20	All Processes
313	Beverages	2302000000	Food and Kindred Products: SIC 20	All Processes
314	Tobacco	2302000000	Food and Kindred Products: SIC 20	All Processes
321	Textiles	2330000000*		
322	Wearing apparel, except footware	2330000000*		
323	Leather products	2330000000*		
324	Footwear, except rubber or plastic	2330000000*		
331	Wood products, except furniture	2307000000	Wood Products: SIC 24	All Processes
332	Furniture, except metal	2307000000	Wood Products: SIC 24	All Processes
341	Paper and products	2307000000	Wood Products: SIC 24	All Processes
342	Printing and publishing	2360000000*		
351	Industrial chemicals	2301000000	Chemical Manufacturing: SIC 28	All Processes
352	Other chemicals	2301000000	Chemical Manufacturing: SIC 28	All Processes
353	Petroleum refineries	2306000000	Petroleum Refining: SIC 29	All Processes
354	Miscellaneous petroleum and coal products	2306000000	Petroleum Refining: SIC 29	All Processes
355	Rubber products	2308000000	Rubber/Plastics: SIC 30	All Processes
361	Pottery, china, earthenware	2325040000	Mining and Quarrying: SIC 14	Clay, Ceramic, and Refractory
362	Glass and products	2305014010*		
369	Other non-metallic mineral products	2305000000	Mineral Processes: SIC 32	All Processes
371	Iron and steel	2303020000	Primary Metal Production: SIC 33	Iron and Steel Foundries
372	Non-ferrous metals	2304050000	Secondary Metal Production: SIC 33	Nonferrous Foundries (Castings)
381	Fabricated metal products	2309000000	Fabricated Metals: SIC 34	All Processes
382	Machinery, except electrical	2312000000	Machinery: SIC 35	All Processes
383	Machinery, electric	2312000000	Machinery: SIC 35	All Processes
384	Transport equipment	2314999990*		
385	Professional and scientific equipment	2399000000	Industrial Processes: NEC	Industrial Processes: NEC
390	Other manufacturing products	2399000000	Industrial Processes: NEC	Industrial Processes: NEC

*Not official SCC Code

Because, no detailed process information was available for these sources, assumptions were made about the characterization of the particle size distribution and the ratio of volatile organic carbon to hydrocarbons. Emissions of hydrocarbons were assumed to be identical to those volatile organic carbon (VOC). PM_{10} was arbitrarily assumed to be 100% of the total particulate emissions while $PM_{2.5}$ was assumed to be 50% of the total particulate emissions.

4.2.3 Eastern Research Group (Area, Mobile, and Point Sources)

Eastern Research Group (ERG) developed an emissions inventory for the northwestern states of Mexico: Chihuahua, Sonora, and Baja California Norte. The ERG EI was prepared for the Western Regional Air Partnership (WRAP) with a base year of 1996 (Wolf and Fields, 2001). The inventory will be used to assess the impact on visual air quality in Class I visibility-protected areas in the Western United States.

Area and mobile source emissions factors were extracted from existing emissions inventories in Tijuana, Mexicalli, and Juarez (GBC et al., 1999; GBC et al., 2000; GCh et al., 1998). Average emissions factors were calculated for major source categories for each of these inventories based on the activity parameters: population, households, total number of registered vehicles, agricultural acreage, and number of cattle. Activity data was acquired from the Mexican Census Agency Instituto Nacional De Estadistica Geografia E Informatica (INEGI, 2000). These factors were then used with the activity data to calculate emissions for areas of the states not represented by the urban emissions inventories.

Point emissions were obtained from three separate sources and included emissions from Carbon I/II Power Plants (Yarborough, 2000), Cananea and Nacozari Smelters (P&BE, 1999a; P&BE, 1999b), and 15 SO_2 sources in the states of Chihuahua, Coahuila, Nuevo Leon, and Tamalipas (Watson, 1998).

4.2.3.1 BRAVO EI Mexican Area and Mobile Sources

The approach used in the ERG EI to calculate area and mobile emissions was modified slightly for the BRAVO EI. Average emissions factors were calculated using the inventories from Tijuana, Mexicalli, and Juarez. Data from the Monterrey emissions inventory (INE, 2001) was also included in calculating the average emissions factors. The emissions factors for each source are shown in Appendix A. For the Monterrey EI, emissions from trucks were not categorized by fuel type as they were for Tijuana, Mexicali, and Monterrey. The emissions from trucks in Monterrey were therefore not used in the calculation of average emissions factors.

Population data for Mexico in 1999 was interpolated using the 1990 and 2000 Mexican census data (INEGI, 2001) for each municipio in the modeling domain. Household data was estimated by reducing the 2000 Census household data by the percent reduction in population between 2000 and 1999. Total vehicle registration data was available for base year 1999 using the INEGI SIMBAD database (INEGI, 2000). The number of agricultural hectares and head of cattle in 1999 were reported at the state level for 1999 by the Mexican Center of Agricultural Statistics (SAGAR, 1999). Agricultural hectares were spatially allocated to the municipio level by multiplying the 1999 state number of hectares by the fraction of state hectares within the municipio based on the 1991 Agricultural Census (INEGI, 1994). Similarly, the number of cattle was allocated to municipios based on their spatial distribution in the 1991 Agricultural Census.

Municipio level area and mobile source data were applied to areas not covered by the original emissions inventories in Monterrey, Juarez, Tijuana, and Mexicalli. Emissions for these cities for base year 1999 were calculated using the city specific emissions factors from the original emissions inventories. Activity data for 1999 from these areas was used to grow the emissions in these cities to the BRAVO EI base year.

The Metropolitan Area of Monterrey covers 6 municipios. Emissions for non point sources were spatially allocated based on the 1999 activity data from each municipio. Since no

information was available about individual point sources in Monterrey, all point source data was allocated to the municipio of Monterrey. All truck emissions including Heavy Duty Diesel, Heavy Duty Gas, and Light Duty Diesel in the greater Monterrey area are categorized as Heavy Duty Diesel with the SCC 2230070000.

4.2.3.2 BRAVO EI Mexican Point Sources

An annual estimate of CO, NO_x, SO_2, and PM_{10} emissions from the Carbon I and Carbon II coal fired power plants was provided by U.S. E.P.A. Region VI staff (Yarborough, 2000). This estimate was for 1994, but it is assumed that emissions for 1999 are of a similar magnitude. The emissions from these two facilities are listed in the Table 4-4. Wolf and Fields (2001) estimated $PM_{2.5}$ emissions based on the assumption that 37.5% of PM_{10} from coal-powered electricity generation is $PM_{2.5}$ (ARB, 1999).

No information is available about the seasonal or diurnal temporal profiles of the Carbon I/II facilities. In addition, there is no information available regarding periods when the plant operation may have been interrupted due to routine maintenance or process upset. Because of their low power costs, most coal-fired power plants are base loaded (i.e. operating a full capacity 24 hours per day).

The Carbon I/II purchases some coal from mines in the western United States however much of the coal burned on site is mined from the lignite belt that runs Northeast-Southwest through the eastern side of Texas and Mexico. The Carbon I/II power plants were assigned an SCC of 10100300 that corresponds to an external combustion boiler burning pulverized lignite coal.

The Cananea copper smelter in the state of Sonora was shut down in April 1999 and is not included in the BRAVO EI since it was not operating during the field study period between July and October 1999. The Cananea smelter operated with no emissions controls. The Nacozari smelter is also located in Sonora, but utilizes emission controls (i.e., double-contact sulfuric acid plants) in order to reduce SO_2 emissions. Wolf and Fields (2001) estimated the annual emissions of SO_2 from the Nacozari smelter to be 13,600 tons. Emissions of other species were not estimated for this facility. The Nacozari smelter was geocoded to the center of the Nacozari de Garcia municipio in the state of Sonora. The smelter was assigned the SCC of 30300500 for general copper smelting.

An additional set of point source sulfur dioxide information was provided by Watson (2000). A partially complete table from an internal report was obtained from a staff member at PROFEPA in Mexico. The table was dated March 1997. The table lists 34 sources in the states of Tamaulipas, Nuevo Leon, Chihuahua, and Coahuila. Of these sources, 23 are either power generation facilities whose emissions are estimated in the following subsection, located in a city that has already incorporated their emissions in the emissions inventory, low emitting sources with less than 30 tpy of SO_2, or were not listed with a location so they can not be geocoded. The remaining 11 sources are shown in Table 4-4. The location of these sources was geocoded to the centroid of the municipio in which they are located.

Table 4-4. Emissions from major point sources in Northern Mexico.

PLANT	State	Locality	Process	SCC	Lat (deg)	Lon (deg)	CO (tpy)	NO_x (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)
Carbon I	Coahuila	De Nava	Coal fired power plant	10100300	28.47	-100.68	2,112	36,786	9,002	3,384	111,942	NA
Carbon II	Coahuila	De Nava	Coal fired power plant	10100300	28.47	-100.68	2,577	42,919	11,259	4,232	129,341	NA

Nacozari Smelter	Sonora	Nacozari de Garcia	Copper smelter	2303005000	30.516	-109.457	NA	NA	NA	NA	13,600	NA
Cementos Chihuahua S.A. de C.V.	Chihuahua	Chihuahua	Cement manufacturing	2305000000	28.8728	-106.175	NA	NA	NA	NA	107	NA
Papelera de Chihuahua, S.A. de C.V.	Chihuahua	Chihuahua	Paper and pulp	2307000000	28.8728	-106.175	NA	NA	NA	NA	212	NA
Pemex Refinería, Ing. Héctor Lara Sosa	Nuevo Leon	Cadereyta, Jimenez	Petroleum refining	2306000000	25.51453	-99.96602	NA	NA	NA	NA	18,269	NA
Altos Hornos de México, S.A. de C.V.	Coahuila	Monclova	Iron and steel foundary	2303020000	26.91491	-101.25944	NA	NA	NA	NA	10,986	NA
Cementos Apasco S.A. de C.V.	Coahuila	Ramos Arizpe	Cement manufacturing	2305000000	25.88485	-101.08416	NA	NA	NA	NA	933	NA
Met-Mex Peñoles, S.A. de C.V.	Coahuila	Torreón	Nonferrous foundry	2304050000	25.23742	-103.34429	NA	NA	NA	NA	7,411	NA
Industria Minera México, S.A. de C.V.	Coahuila	San Juan de Sabinas	Coking	2390009000	28.08954	-101.38134	NA	NA	NA	NA	355	NA
Refinería de Cd. Madero	Tamaulipas	Cd. Madero	Petroleum refining	2306000000	22.31405	-97.84345	NA	NA	NA	NA	29,621	NA
Dupont S.A. de C.V.	Tamaulipas	Altamira	Chemical manufacturing	2301000000	22.51381	-98.09277	NA	NA	NA	NA	712	NA
Química Fluor	Tamaulipas	Matamoros	Chemical manufacturing	2301000000	25.5556	-97.49681	NA	NA	NA	NA	4,527	NA
Polimar S.A. de C.V.	Tamaulipas	Puerto Industrial Altamira	Chemical manufacturing	2301000000	22.51381	-98.09277	NA	NA	NA	NA	438	NA

4.2.4 Acosta y Associados (Power Plant Emissions)

Data on power output, fuel use, fuel type, and fuel sulfur content for public Mexican power generation facilities in the BRAVO inventory domain were provided by Acosta y Associados (Acosta, 2001). These data were obtained from PEMEX to produce a mercury emissions inventory for Northern Mexico. The mercury report is being prepared for the Center of Environmental Control (CEC) and will be completed later in 2001. The base year of this dataset is 1999.

Data on volume of diesel, natural gas, and heavy fuel oil usage were obtained for 37 sources in the Mexican states of the BRAVO EI domain as well as Baja California Norte and Sonora. Facilities were categorized as “Steam”, “Gas Turbine”, or “Combined Cycle”. Emissions factors for the power generation facilities were obtained from the AP-42 (U.S. E.P.A., 1998; U.S. E.P.A., 2000). Sulfur content of fuels is required to calculate SO_2 emissions from diesel and heavy oil combustion. Acosta (2001) indicated that the maximum sulfur content of heavy fuel oil is 2% based on CFE test results. Material Safety Data Sheets for diesel fuel from PEMEX state that sulfur content of diesel fuel is 0.05%. Sulfur contents of 2% and 0.05% were used to calculate emissions from fuel oil and diesel sources, respectively. The default sulfur content of natural gas from AP-42 was use to estimate SO_2 emissions. Annual average emissions were calculated based on totals of each type of fuel consumed at each facility. Ozone season day emissions were calculated by dividing the annual emissions by 365 days. Source classification codes were assigned to the process of burning each fuel type in each facility type. Emissions are

only estimated for the combustions processes and do not include fugitive emissions from fuel handling or spills.

Acosta (2000) also indicated that unconfirmed sources reported the Carbon I power plant also burned between 9-12 million liters of diesel in 1999 in addition to coal. Since this source can not be confirmed at this time, this data was not included in the emissions inventory. The emissions from burning 10 million liters of diesel are quite small (32 tpy of NO_X and 10 tpy of SO_2) with respect to the emissions from coal combustion at this facility (88,000 tpy of NO_x and 265,000 tpy of SO_2).

The locations of each facility were assigned based on the center of the municipio in which they are located. Total emissions from each facility along with their location are shown in Table 4-5.

Table 4-5. List of criteria pollutant emissions from power generation facilities in Northern Mexico.

PLANT	State	Locality	Latitude (deg)	Longitude (deg)	CO (tpy)	Nox (tpy)	PM10 (tpy)	PM2.5 (tpy)	SO2 (tpy)	VOC (tpy)
Altamira	Tamaulipas	Tampico	25.833	-97.954	2903	22019	6344	4645	127764	366
Arroyo de Coyote	Tamaulipas	N. Laredo	27.484	-99.518	3	10	0	0	1	0
Benito Juarez	Chihuahua	C. Juarez	28.632	-106.072	958	7264	2093	1532	42151	121
Caborca Industrial	Sonora	Caborca	29.099	-110.954	17	61	2	2	5	1
Cd. Obregón II	Sonora	C. Obregón (Cajeme)	30.716	-112.159	5	17	1	1	1	0
Chavez	Coahuila	Fco. I. Madero	28.421	-100.768	15	54	2	2	4	1
Chihuahua	Chihuahua	Chihuahua	17.604	-93.196	13	46	1	1	3	1
Culiacán	Sinaloa	Culiacán	24.799	-107.384	13	48	2	2	4	1
E. Portes Gil	Tamaulipas	Río Bravo	22.396	-97.937	1394	10576	3047	2231	61364	176
Esperanzas	Coahuila	Múzquiz	28.280	-101.931	2	7	0	0	0	0
Fco. Villa	Chihuahua	Delicias	28.186	-105.471	1449	10990	3167	2318	63770	183
Fundidora I	Nuevo Leon	Monterrey	25.785	-100.051	8	28	1	1	2	0
Gómez Palacios	Durango	Gómez Palacios	25.536	-103.524	1388	5417	117	117	1517	36
GuadalupeVictoria	Durango	Lerdo	25.561	-103.498	1373	10418	3002	2198	60450	173
Guaymas I	Sonora	Guaymas	27.489	-109.935	120	913	263	193	5295	15
Guaymas II	Sonora	Guaymas	29.906	-112.683	1681	12750	3674	2690	73983	212
Hermosillo	Sonora	Hermosillo	27.918	-110.899	166	594	19	19	44	8
Huinalá	Nuevo Leon	Pesquería	25.671	-100.308	2726	10636	231	231	2978	70
J. Aceves Pozos	Sinaloa	Mazatlán	25.630	-109.056	2127	16133	4648	3403	93608	268
La Laguna	Durango	Gómez Palacios	25.561	-103.498	245	1471	336	249	6569	23
Leona	Nuevo Leon	Monterrey	25.671	-100.308	16	58	2	2	4	1
Los Cipreses	BCN	Ensenada	32.519	-115.385	11	39	1	1	3	1
Mexicali	BCN	Mexicali	32.491	-115.425	7	25	1	1	2	0
Monclova	Coahuila	Monclova	28.606	-100.640	19	68	2	2	5	1
Monterrey	Nuevo Leon	San Nicolas de los Garza	23.806	-100.427	1742	13211	3806	2787	76654	220
P. Ind. Zaragoza (Industrial)	Chihuahua	C. Juarez	28.632	-106.072	2	9	0	0	1	0
P. Ind. Zaragoza (Parque)	Chihuahua	Chihuahua	28.632	-106.072	21	75	2	2	6	1
Pres. Juárez I	BCN	Rosarito	32.342	-117.056	1641	12445	3586	2625	72210	207
Pres. Juárez II	BCN	Rosarito	32.663	-115.468	139	496	16	16	37	7

Pto. Libertad	Sonora	Pto. Libertad (Pitiquito)	27.918	-110.899	2287	17346	4998	3659	100649	288
Samalayuca	Chihuahua	Chihuahua	31.735	-106.478	4492	17530	380	380	4908	115
San Jerónimo	Nuevo Leon	Monterrey	25.671	-100.308	126	957	276	202	5554	16
Tecnológico	Nuevo Leon	Monterrey	25.671	-100.308	4	15	0	0	1	0
Topolobampo II	Sinaloa	Topolobampo (Ahome)	23.236	-106.415	1232	9348	2693	1972	54239	155
Universidad	Nuevo Leon	Monterrey	25.671	-100.308	16	55	2	2	4	1
V. de Reyes	SLP	SLP	22.151	-100.976	2259	17134	4937	3615	99418	285
Total					**30626**	**198297**	**47655**	**35104**	**953219**	**2954**

4.2.5 Instituto de Geofisica (Popocatepetl Volcano Emissions)

The Popocatepetl volcano is located 70 km southeast of downtown Mexico City at 19.02 deg N, -98.62 deg E, 5452 m a.s.l. Carbon 14 measurements of pyroclastic deposits near the crater show that over the last 22 thousand years, the volcano has erupted at time intervals ranging from 1000 to 3000 years (Siebe et al., 1996). Historic records indicate that the volcano has remained relatively dormant between 1927 and 1993, however increased seismic activity and fumaroles (emissions of gases and ash) have been observed since late 1993 (Goff et al., 1998). Popocatepetl is currently one of the world's largest emitters of SO_2 and other volcanic gases. The proximity of the volcano to urban areas prompted a monitoring program of volcanic activity to provide emergency warnings to nearby residents. The Centro Nacional de Prevencion de Desastres (CENAPRED) sponsors routine monitoring of seismic activity and gas emissions from this source.

SO_2 emissions from the volcano are measured with a correlation spectrometer (COSPEC) two to three times per week. The highest measured SO_2 emissions from the crater since 1994 were 50,000 tons per day while typical emissions are approximately 3000-5000 tons per day (Smithsonian Institute, 2000). These emissions are approximately 6 to 75 times greater than the SO_2 emissions from the Carbon I/II power facilities. In addition to SO_2, hydrochloric and hydrofluoric acids are also emitted from the volcano. Large amounts of ash and dust are also emitted. Galindo et al., (1998) estimated particle emissions rates of 38,000 tpd for total particulate matter and 5000 tpd for SO_2 from Popocatepetl for an eruption occurring between December 24 and December 27, 1995. Air borne particle size distribution measurements indicated high variability in the particle size distribution. The PM_{10} fraction of the total particulate matter ranged from 3 to 80% with a mass weighted average of ~10%.

In the same study, chemical speciation using X-Ray Fluorescence was also performed on filters collected at the Puebla airport 45 km east of the volcano. Most of the particulate mass was crustal material however, major non crustal species of the samples collected include phosphorus, sulfur, chlorine, and potassium. This data set may be useful for Chemical Mass Balance source attribution studies.

SO_2 missions from the volcano for the base year 1999 had not been completely process at the time of this report. Delgado (2001) estimated annual SO_2 emissions from the volcano at 1.7 million tons with daily emissions of 5000 +/- 3000 tons.

A point source emissions record was added to the BRAVO EI. The SCC for volcanic emissions was applied and the annual and daily estimates of SO2 emissions from Delgado (2001) were used. PM_{10} and $PM_{2.5}$ emissions were estimated based on the results of the Gilando et al.,

(1998) study. From that study, the ratio of total particulate matter to SO_2 emissions was 7.5 to 1. The fraction of PM_{10} and $PM_{2.5}$ to total particulate matter in the volcano emissions were chosen to be 10% and 2%, respectively. The annual emissions for PM_{10} and $PM_{2.5}$ from the volcano for 1999 are estimated to be 3750 and 750 tons per day, respectively. Typical plumes from the volcano rise 1 km above the crater. A stack height of 1000 m was assigned to the source.

It should be emphasized that the measurement of emissions from volcanoes are highly uncertain due to the logistic difficulties of conducting these tests. In addition, the activity of the volcano is dynamic and changes rapidly from hour to hour. The emissions presented here are rough estimates. For a particular day real emissions from the volcano are likely to differ from these estimates by more than an order of magnitude.

4.3 Mexican Emissions Integration

This subsection describes how emissions from the Mexican data sources were combined to create the emissions inventory for the BRAVO states in Mexico. Care was taken to prevent double counting of emissions when integrating data from the multiple sources listed above.

4.3.1 Area and Mobile Sources

Although, emissions from manufacturing processes were included in the inventories for Tijuana, Mexicali, Juarez, and Monterrey, these emissions were not allocated to areas outside of the urban areas. As a result, manufacturing emissions (Section 4.2.2) calculated from the SNIF database and economic census data are nearly exclusive from the area and mobile emissions database (Section 4.2.3) calculated using the modified ERG emissions factors.

The only exception is food production (i.e. SCC 2302000000). For this category, the SNIF database categorized emissions of “agricultural product milling” and “non-processed food production”. The Area and Mobile database allocates emissions from “charbroiling” and “baking” based on population. In general, emissions from these categories are in general quite small (less than 5% of particulate emissions from Heavy Duty Diesel Trucks). In order to prevent double counting, all emissions relating to food production from the SNIF database were removed from the BRAVO EI.

Area and mobile source data for Mexico were assembled beginning with municipio level emissions calculated using the modified ERG emissions factors (Section 4.2.3). These emissions were replaced with the 1999 base year urban emissions inventories that also include point source emissions for the cities of Monterrey, Tijuana, Mexicali, and Juarez. Finally, manufacturing emissions from the SNIF data corresponding municipios outside of the inventoried cities were appended to the mobile and area sources database.

4.4 Source Classification Coding (SCC) of Mexican Sources

Since the method and source data used to produce the Mexican Emissions inventory differed from the US NEI, in some cases not enough information was available to assign an accurate SCC for each source. Fictitious SCC’s were created for these sources. A description of these SCC’s is provided in Table 4-6.

Table 4-6. Description of fictitious SCC's.

SCC	Data Source	Source Description
2101000000	ERG EI	Point Source (Electricity Generation, Fuel Not Specified)
2103000000	ERG EI	Commercial/Institutional Fuel Combustion (unknown fuel type)
2104000000	ERG EI	Residential Fuel Combustion (unknown fuel type)
2201001900	ERG EI	Border Crossings
2230070900	ERG EI	Bus Terminals
2305014010	SNIF	Glass Manufacturing
2305090000	ERG EI	Brick Manufacturing
2313000000	ERG EI	Point Source (Miscellaneous Consumer Products)
2314000000	ERG EI	Point Source (Printing Products)
2314999990	SNIF	Transportation Equipment Manufacturing (Not Specified)
2315000000	ERG EI	Point Source (Vegetable and Animal Products)
2330000000	SNIF	Wearing apparel except footwear
2801700000	ERG EI	Fertilizer Application
2845000000	ERG EI	Domestic Ammonia Emissions
99999999	DRI	Miscellaneous SCC for all emissions from Mexico City and Tula-Vitro-Apaxco