Department of Pesticide Regulation

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M E M O R A N D U M

Arnold Schwarzenegger
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Environmental Program Manager II
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FROM: Bruce Johnson, Ph.D.
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916-324-4106

Original signed by

DATE: November 19, 2009

SUBJECT: REPORT ON PARLIER SOFEA-HEE5CB SIMULATION

Summary

The Soil Fumigant Exposure Assessment Tool (SOFEA) and associated High End Exposure Version 5 Crystal Ball (HEE5CB) simulations were conducted to estimate risk associated with 1,3-Dichloropropene (1,3-D) use in 2006 in the Parlier area. Based on five, one-year SOFEA simulations oncogenic risk ranged from 1.17E-5 to 1.33E-5 at the 95th percentile (Table 1).

Table 1. Summary of 95th percentile risk based on 2006 Meteorology and average 1,3-D use in the Parlier, CA area. Estimates created using SOFEA simulation (J1370-74) and HEE5CB exposure analysis.

	Lower Bound		Upper Bound	
	Male	Female	Male	Female
Low Mobility	1.21E-05	1.19E-05	1.31E-05	1.28E-05
Intermediate Mobility	1.20E-05	1.17E-05	1.33E-05	1.28E-05

Input data for these simulations consisted of application data for 1,3-D from recent years within the 3x3 township area centered on Parlier and on Fresno and Tulare county-wide 1,3-D application data. Meteorological data from 2006 from two stations close to Parlier was used.

Introduction

I was requested to run the SOFEA/HEE5CB modeling procedures (Johnson 2007abc and references therein) to estimate the 95th percentile exposure and risk for the township area surrounding the community of Parlier, California. A soon-to-be-completed air monitoring study offers an opportunity for comparison of modeled to measured values for 1,3-D. This memorandum will not address the comparison. This memorandum will describe the modeling procedures used to estimate the population chronic exposure in the nine township area centered on Parlier.

Methods

Detailed methods descriptions are provided in Johnson 2007ab and references therein. Customizations for the Parlier analysis included the following:

1. Processed meteorological data was based on hourly data for 2006 from California Irrigation Management Information System (CIMIS) station #39 (Appendix 1) and San Joaquin Air Pollution Control District (SJAPCD) Parlier monitoring station (Appendix 2). Both stations are located within about two km of Parlier and near each other. The final meteorological data set used for modeling contained wind speed data from the Parlier SJAPCD station and wind direction data from CIMIS station #39. Wind direction data from the Parlier SJAPCD Parlier station for 2006 was evidently incorrect (Jaime Contreras, personal communication) and therefore the CIMIS wind direction data was used instead.

2. Probability distributions (Julian application date, application rate, field size, fraction shank vs. drip, fraction deep vs. shallow for shank) were based on California Data Management Systems (CDMS) data supplied by Dow AgroSciences for Fresno and Tulare Counties from 2004-2007. While this expands the area considerably beyond the townships surrounding Parlier, it is necessary in order to provide a reasonably sized base of use upon which to construct probability distributions. Key probability distributions are shown in Appendices 3-5.

3. Township 1,3-D use levels were based on CDMS adjusted total pounds for 2006 for those 25 townships centered on Parlier. These 25 township were M (13S:17S X 20E:24E).

4. Section weights were based on summed 1,3-D acreages from the Pesticide Use Report (PUR) for applications during 2005-2007 years for the specific sections within each of the nine townships centered on Parlier. Perennial section weights were based on tree crops and annual section weights based on non-tree crops (Appendices 6, 7, and 8). Section weights were reformatted for ease of input using REFORM.FOR (Appendix 9.)

5. Crop percentages were based on CDMS 1,3-D acreages for Fresno and Tulare for 2004-2007.

6. Five one-year replicate simulations with SOFEA were conducted based on the listed input information. These simulations were designated J1370-J1374.

7. Lower bound distributions consisted of spatially averaged concentrations over the five one-year simulations and upper bound distributions consisted of percentile-averaged distributions over the five one-year simulations.

8. The four HEE5CB simulations were all conducted with n=50000. The HEE5CB simulations were designated exp0109-exp0112. These four exposure simulations consisted of the upper and lower bound concentration distributions crossed with intermediate and low mobility. Further explanation of upper and lower bound methodology can be found in Johnson and Powell (2005) and Appendix 2 of Johnson (2007c).

9. Intermediate mobility consisted of using the concentration distribution from the township 15S22E (contains Parlier) for section 1 in HEE5CB and the 3x3 townships for sections 2-5. Low mobility consisted of using the concentration distribution from the township 15S22E (contains Parlier) for sections 1-5 in the HEE5CB program. 'Section' here refers to cell locations within the HEE5CB worksheet where distributions are assigned for Monte Carlo sampling.

10. Screen shots of the main input worksheet are shown in Appendix 10.

Results

Table 2 shows how the SOFEA crop categories were defined in relation to the CDMS data. Figure 1 depicts the 25 township area surrounding Parlier. The area spans Fresno, Tulare and a small portion of Kings Counties. The township use of 1,3-D in 2006 in this 25 township area varied with the top row of five townships showing no 1,3-D use, while four townships exceeded the 90,250 adjusted pound level (Table 3). The center township, containing Parlier, showed use at the 0.73X level. The two townships to the east and northeast both exceeded the 1X level. Four townships within the 5x5 township area exceeded the 1X level. Three townships contiguous with the center township containing Parlier exceeded the 1X level.

The realized crop fractions based on acreage are shown Table 4. In Johnson and Powell (2005), the almond acreage was input as NC and all other tree and vine as TV. This was done due to technical limitations in Crystal Ball on the size of inputted data sets which are used as the basis for the probability distributions. In the current Parlier simulation, almonds were included with TV because the data set was smaller than the Crystal Ball limitation on size of input data sets. The average crop fractions for FC, PP, and SB as realized in the model exceeded the input model crop acreage fractions. Complementarily, the realized TV fraction at 0.51 was less than the input value of 0.65. TV generally exhibit higher application rates. TV acreage fractions in individual simulation years ranged from 0.35 to 0.60. This underestimation by the model of the inputted TV fractions may affect the concentration distributions since TV application rates are generally higher than the other FC, PP and SB application rates. Appendix 3 shows the probability densities for application rates that were input into the model. FC shows a bimodal distribution with an average rate of 273 kg/ha. TV (tree and vine) shows less of a bimodal distribution and the mean application rate was 347 kg/ha. Higher application rates would probably lead to locally higher air concentrations which may influence the upper ends of the concentration distributions. As a potential offset to application rate, field sizes for FC crops were about double that of TV. Field sizes for FC averaged 13 ha (Appendix 4) compared to 7 ha for TV. All other factors being equal, smaller field sizes would probably lead to lower air concentrations. Thus, it is unclear how the underutilization of the TV crop type compared to the other crops would affect the overall concentration distributions.

The realized levels of mass of 1,3-D used closely approximated the target use levels (Table 5). Note that Table 5 omits zero-use townships. The adjusted pounds of 1,3-D applied within each township were scaled by the township cap level of 40,937 kg (90,250 lbs) and the average township factors over the 7 runs were compared to the target use level (Table 5). Most of the township use factors were identical to the target use levels to two decimal places. Generally, the optimization features in SOFEA produce realizations that are closer for the township use levels, than for the crop percentage targets.

Upper and lower bound concentration distributions for the 3x3 center townships and the individual township 5 (15S22E, containing the City of Parlier) are shown in Figure 2. The distributions were similar until about the 94th percentile where they begin to diverge. In contrast to past work, (for example, Johnson 2007a), the center township in this simulation work was not amongst the highest use townships in this region. The center township was chosen because it contained the City of Parlier. Notably, 16S21E at 1.21X and 14S23E at 1.64X received nearly double the adjusted total mass compared to the Parlier township of 15S22E at 0.73X. Consequently, the upper and lower bound distributions for the 3x3 township area exceeded the corresponding upper and lower concentration distributions for township 5 at the highest percentiles.

Concentration contours based on the average of five one-year SOFEA simulations are depicted in Figure 3. These numerical concentrations correspond to the lower bound 3x3 cumulative distribution in Figure 2. The higher concentrations resulting from higher use are evident in townships 14S23E and 15S23E. Figure 3 should give broad indications of areas of higher concentrations (higher use) in contrast to areas of lower concentrations (lower use). There are some limitations to this graphic which should be mentioned. SOFEA utilizes idealized township/range/sections. For example, the bottom township row of the 5x5 township area around Parlier is actually shifted about half mile to the west (see Figure 2). In the simulated surface, however, the townships are not shifted. SOFEA distributes application locations according to a structured random selection based on sectional weights. The sectional weights, in turn, reflect three years of use. The application patterns in each simulated year are based on random selections from the inputted distributions of application date, field size and application rate. The

Monte Carlo aspect of SOFEA means that each one-year simulation will produce somewhat different results, even though the starting conditions are the same. In addition, the historical PUR use information which goes into the calculation of section weights is only reported to the nearest square mile in resolution. As a consequence, SOFEA provides concentration estimates in relation to geography which are somewhat fuzzy. The concentration contours shown in Figure 3 are intended to represent one year average values. The actual concentrations used in creating Figure 3 are an average over five one-year runs, with each one-year run being an average of 365x24=87600 hourly concentrations

The exposure and risk distributions are displayed in Figure 4 and 5 for the low mobility and intermediate mobility scenarios, respectively. The 95th percentile risks are shown in Table 1. The lower graph in Figures 4 and 5 zooms in on the higher percentiles in order to show finer detail. The 95th percentile risks for low mobility ranged from 1.19E-5 to 1.31E-5. For intermediate mobility the risks ranged from 1.17E-5 to 1.33E-5. The slightly higher upper bound values for male and females in the intermediate mobility scenario compared to the low mobility scenario probably resulted from the apparently higher concentration distributions in 14S23E and 15S23E (Figures 2 and 3 and Table 3), which led to the 3x3 township distribution exhibiting a higher concentration distribution at the upper percentiles, than the corresponding distribution based only on the center township (low mobility), which contained Parlier. The estimated risks all exceeded the 1.0E-5 reference level (Gosselin 2001).

Conclusion

Five one-year simulations of the SOFEA modeling tool were conducted for the Parlier area. Input distributions were based on 1,3-D use patterns in the Parlier area. Meteorology from 2006 was obtained from two nearby meteorological stations. Concentration distributions from the SOFEA simulations were input into HEE5CB to estimate oncogenic risk. For the 9 township area containing Parlier, risks at the 95th percentile over two mobility scenarios ranged from 1.17E-5 to 1.33E-5, which exceeded the reference level of 1.0E-5.

References

Gosselin, Paul. 2001. Memorandum to Tobi L. Jones, Ph.D., Ron Oshima and Doug Okumura on Managing 1,3-dichloropropene (Telone) chronic risks dated April 9, 2001

Johnson, Bruce and Sally Powell. 2005. Memorandum to Tobi Jones on Interim Statewide Caps Analysis for 1,3-Dichoropropene dated Dec 28, 2005.

Johnson, Bruce. 2007a. Memorandum to Tobi L. Jones, Ph.D., on SIMULATION OF CONCENTRATIONS AND EXPOSURE ASSOCIATED WITH UPDATED TOWNSHIP USE Of 1,3-DICHLOROPROPENE IN VENTURA COUNTY, CALIFORNIA dated July 10, 2007.

Johnson, Bruce. 2007b. Memorandum to Tobi L. Jones, Ph.D., on SIMULATION OF CONCENTRATIONS AND EXPOSURE ASSOCIATED WITH UPDATED TOWNSHIP CAPS FOR MERCED COUNTY FOR 1,3-DICHLOROPROPENE dated April 9, 2007.

Johnson, Bruce. 2007c. Memorandum to Tobi L. Jones, Ph.D., on Simulation of concentrations and exposure associated with DAS-proposed township caps for Ventura County for 1,3-dichloropropene. Dated March 27, 2007.

Table 2. Crop codes used for Parlier simulation. These are the same as in Johnson and Powell (2005) with the addition of blueberries, kiwi, limes, oats/winter, persimmons, pomegranates, tangelos, tangerines and taro and the inclusion of almonds with TV.

ALFALFA	FC	BEETS (TABLE)	PP	ALDER,EUROPEAN	TV
ARTICHOKES	FC	BEETS (TOP)	PP	ALMONDS	TV
ASPARAGUS	FC	CARROTS	PP	APPLES	TV
BASIL	FC	NON CROP AREAS	PP	APRICOTS	TV
BEANS (DRY)	FC	POTATOES	PP	AVOCADOS	TV
BEANS (LIMA DR	FC	RADISHES	PP	BLACKBERRIES	TV
BEDDING PLANTS	FC	SUGAR BEETS	PP	BLUEBERRIES	TV
BITTER MELON	FC	SWEET POTATOES	PP	CHERRIES, SAND	TV
BROCCOFLOWER	FC	YAMS	PP	CHERRIES-SWEET	TV
BROCCOLI	FC	BRUSSELS SPRTS	SB	CHERRY,BLACK	TV
CABBAGE	FC	FLOWERS	SB	CITRUS HYBRIDS	TV
CANTALOUPE	FC	HONEYDEW MELON	SB	CITRUS(NURSERY	TV
CAULIFLOWER	FC	PEPPERS (BELL)	SB	CITRUS-ORN	TV
CELERY	FC	PEPPERS, CHILE	SB	CONIFER NURSRY	TV
CORN/SWEET	FC	PEPPERS-NO BEL	SB	GRAPES (FRESH)	TV
COTTON	FC	STRAWBERRIES	SB	GRAPES (RAISN)	TV
CUCUMBERS	FC	STRAWBERRY,BCH	SB	GRAPES (WINE)	TV
EGGPLANT	FC	WATERMELONS	SB	KIWI	TV
FALLOW GROUND	FC			LEMONS	TV
LETTUCE (HEAD)	FC			LIMES	TV
LETTUCE (LEAF)	FC			MAHALEB CHERRY	TV
LETTUCE,ROMAIN	FC			MANDARIN/ORANG	TV
LILY	FC			NECTARINES	TV
MELONS	FC			ORANGES (NAVEL	TV
MUSTARD	FC			ORANGES(SWEET)	TV
NAPA CABBAGE	FC			ORANGES(VALEN)	TV
NURSERIES	FC			PEACHES	TV
NURSERY STOCK	FC			PEARS	TV
OATS/WINTER	FC			PERSIMMONS	TV
ONIONS (DRY)	FC			PLUMS	TV
ONIONS (SEED)	FC			POMEGRANATES	TV
ONIONS,SPANISH	FC			PRUNES	TV
ORNAMENTALS	FC			RASPBERRIES	TV
PARSLEY	FC			TANGELOS	TV
PUMPKINS	FC			TANGERINES	TV
RED BEETS	FC			WALNUT (ORN)	TV
ROSES	FC			WALNUTS (BLCK)	TV
RYEGRASS	FC			WALNUTS (ENGL)	TV
SPINACH	FC				
SQUASH (SUMMR)	FC				
TARO	FC				
TOMATO SEEDED	FC				
TOMATO TRSPLT	FC				
TOMATOES FRESH	FC				
TURFGRASS	FC				
Unknown	FC				

Table 3. 1,3-D use levels (based on adjusted active ingredient pounds) in 25 townships surrounding Parlier during 2006 expressed as ratio to 90,250 adjusted pounds.

	20E	21E	22E	23E	24E
13S	0.00	0.00	0.00	0.00	0.00
14S	0.13	0.33	0.75	1.64	0.13
15S	0.43	0.51	0.73	1.43	0.40
16S	1.31	1.21	0.85	0.93	0.89
17S	0.20	0.17	0.72	0.92	0.03

Table 4. Realized crop fractions compared to input crop fractions (acreages).

	FC	PP	SB	TV	Total
J1370	0.40	0.02	0.03	0.55	1.00
J1371	0.44	0.02	0.03	0.50	1.00
J1372	0.43	0.05	0.10	0.42	1.00
J1373	0.35	0.05	0.06	0.54	1.00
J1374	0.33	0.03	0.04	0.60	1.00
Mean	0.390	0.036	0.051	0.523	
Std Dev.	0.050	0.014	0.030	0.069	
Model Input	0.31	0.03	0.01	0.65	

Table 5. Summary of realized township use levels in five model runs. Ideally the Mean Level would be identical to the Target Township Level.

Model Township Number	Township Range	Run Designator					Mean Level	Std Dev	Target Township Level
		J1370	J1371	J1372	J1373	J1374			
1	16S21E	1.21	1.21	1.21	1.21	1.21	1.21	0.00	1.21
2	16S22E	0.85	0.85	0.85	0.85	0.85	0.85	0.00	0.85
3	16S23E	0.93	0.93	0.93	0.93	0.93	0.93	0.00	0.93
4	15S21E	0.51	0.51	0.51	0.51	0.51	0.51	0.00	0.51
5	15S22E	0.94	0.73	0.73	0.73	0.73	0.77	0.10	0.73
6	15S23E	1.43	1.43	1.43	1.43	1.43	1.43	0.00	1.43
7	14S21E	0.33	0.33	0.33	0.33	0.42	0.35	0.04	0.33
8	14S22E	0.75	0.75	0.75	0.75	0.78	0.76	0.01	0.75
9	14S23E	1.64	1.64	1.64	1.64	1.64	1.64	0.00	1.64
10	14S20E	0.47	0.15	0.13	0.13	0.13	0.20	0.15	0.13
11	14S24E	0.13	0.13	0.13	0.13	0.06	0.12	0.03	0.13
12	15S20E	0.43	0.44	0.43	0.43	0.39	0.42	0.02	0.43
13	15S24E	0.40	0.40	0.40	0.40	0.40	0.40	0.00	0.40
14	16S20E	1.31	1.31	1.31	1.31	1.31	1.31	0.00	1.31
15	16S24E	0.89	0.82	0.89	0.89	0.89	0.88	0.03	0.89
16	17S20E	0.20	0.24	0.20	0.20	0.20	0.21	0.02	0.20
17	17S21E	0.01	0.17	0.21	0.21	0.38	0.20	0.13	0.17
18	17S22E	0.72	0.72	0.72	0.72	0.72	0.72	0.00	0.72
19	17S23E	0.92	0.92	0.92	0.92	0.92	0.92	0.00	0.92
20	17S24E	0.11	0.03	0.03	0.03	0.03	0.04	0.04	0.03

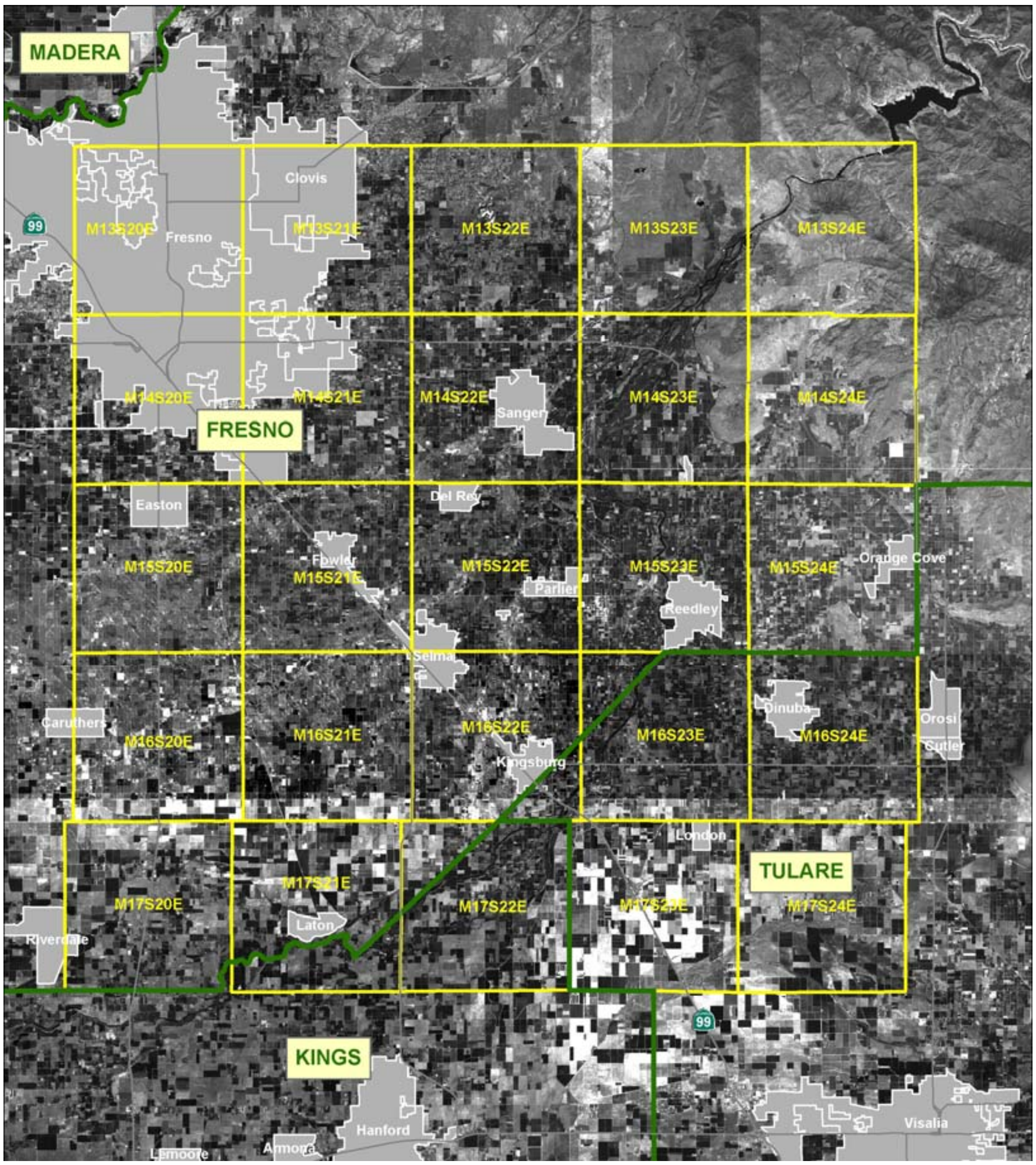


Figure 1. 25 townships surrounding Parlier, California. Credit to Craig Nordmark for this lovely graphic. The area spans portions of Fresno, Tulare and Kings counties. Parlier is located in the center township (M15S22E) along the eastern edge.

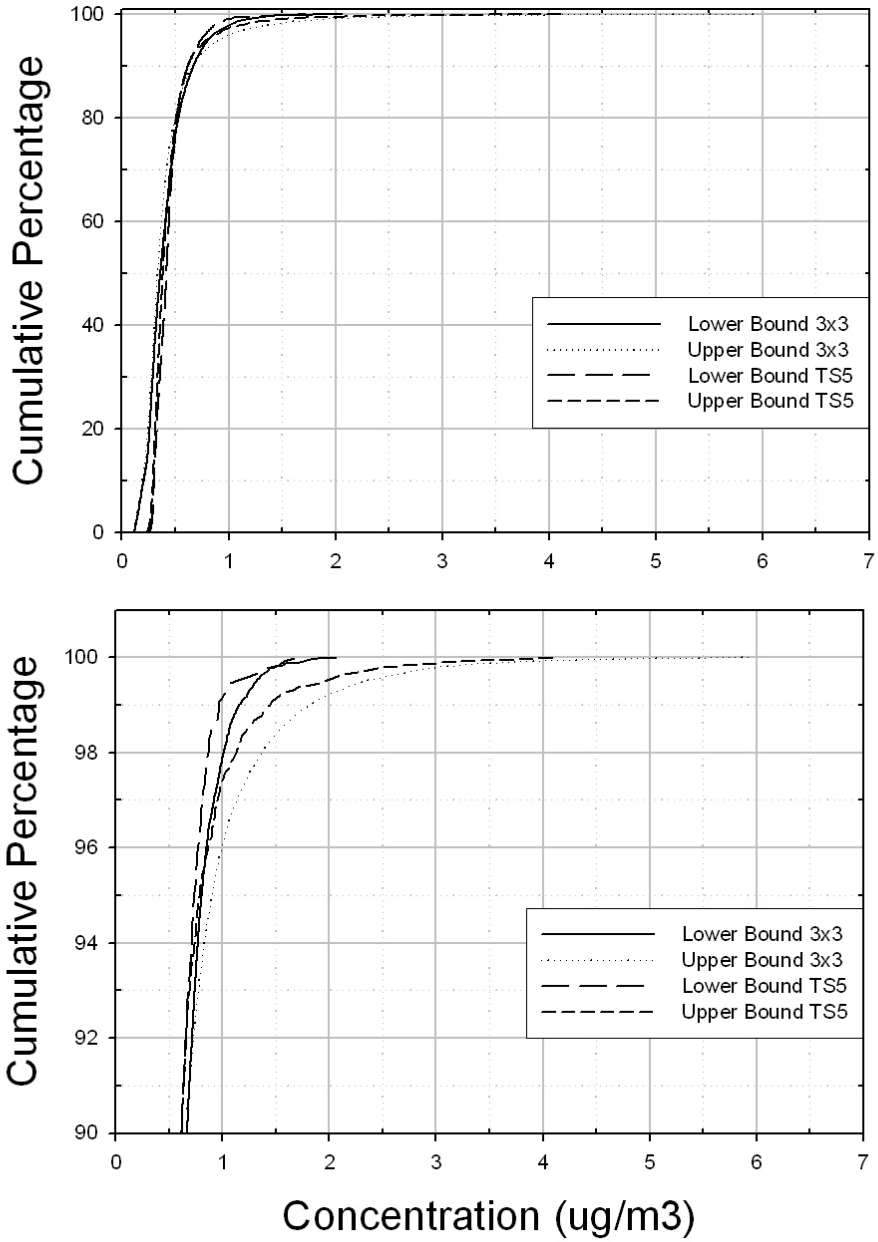
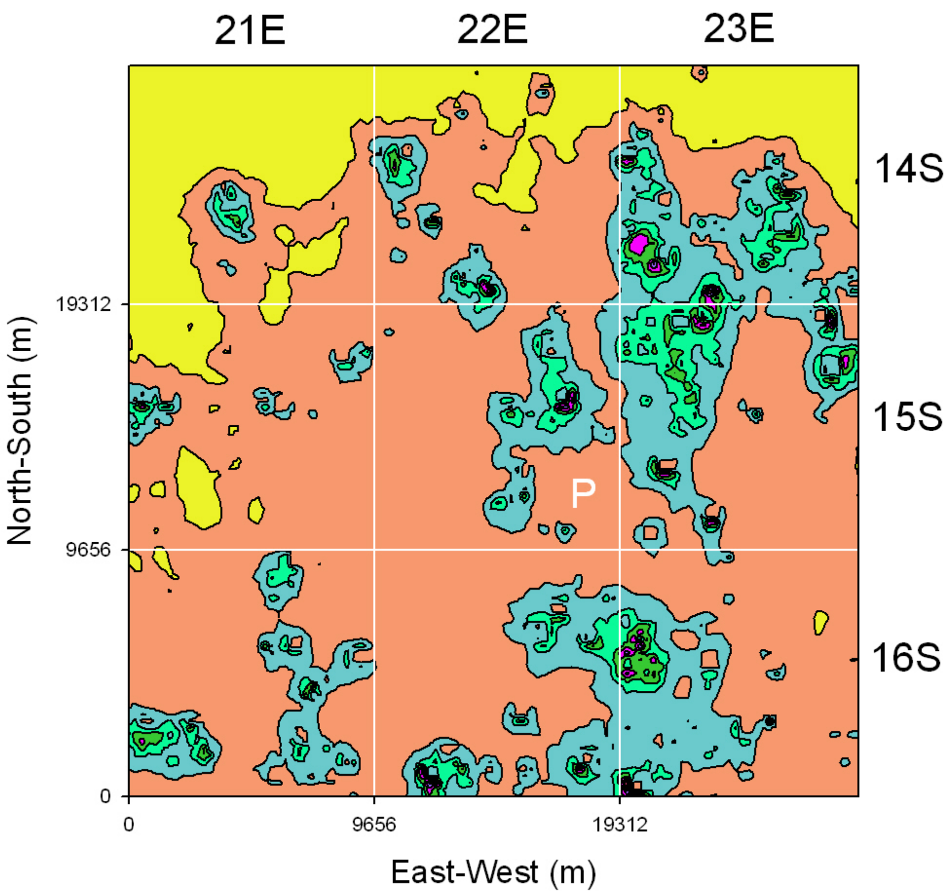


Figure 2. Cumulative distributions for upper and lower bounds for 3x3 township area and township 5 (center township). Lower graph is zoomed on upper percentiles. Simulations J1370-J1374.



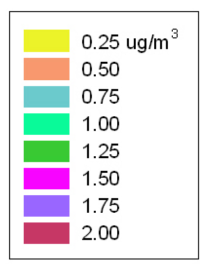


Figure 3. Average of five one-year simulations (J1370-1374) for 2006 using SOFEA with Parlier meteorology and use information. Units are average 1,3-D concentrations (ug/m^3). Small P in center township denotes approximate location of Parlier. This is the 9 township area centered on Parlier township.
Note: 6 miles=9656m. See text for limitations on this graphic.

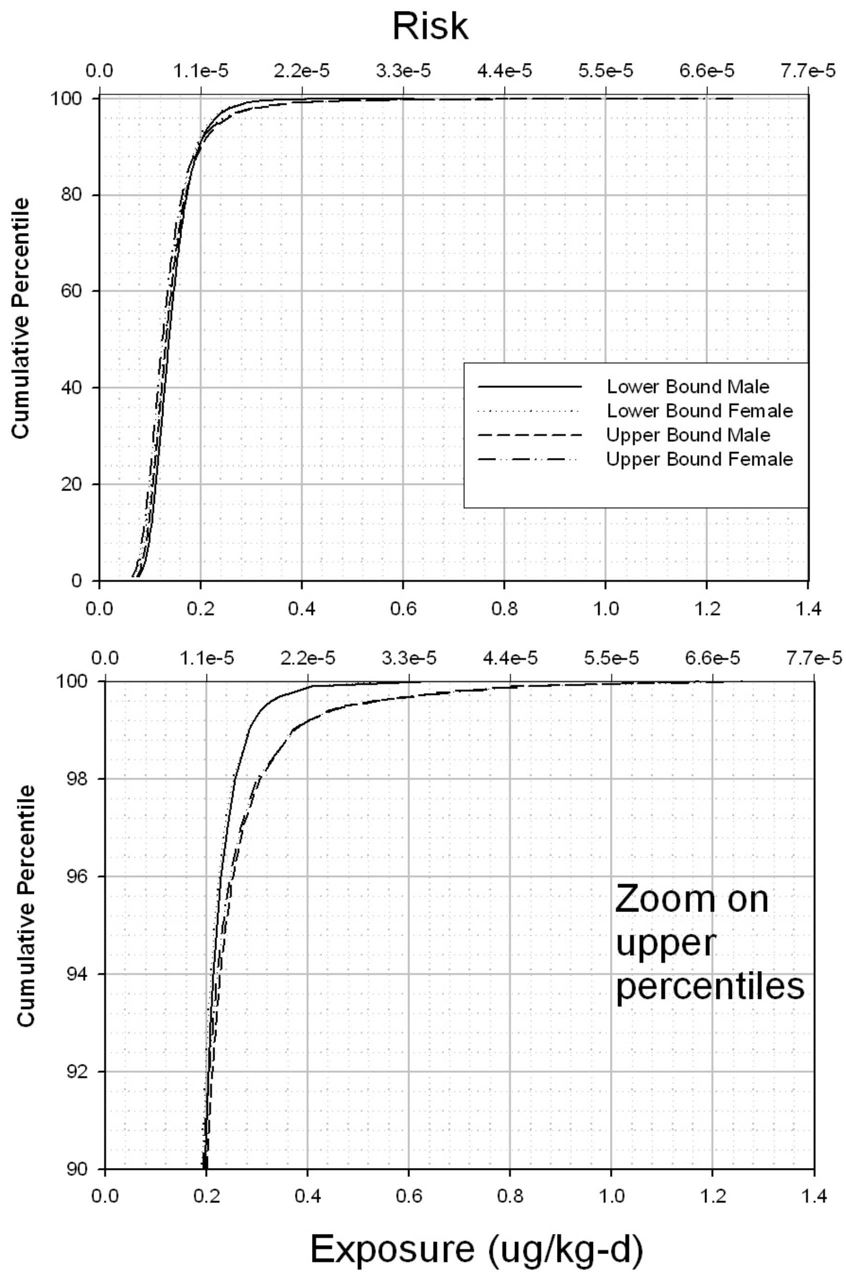


Figure 4. Cumulative exposure/risk distributions for low mobility scenario. SOFEA runs J1370 to J1374. HEE5CB runs exp0109, exp0110.

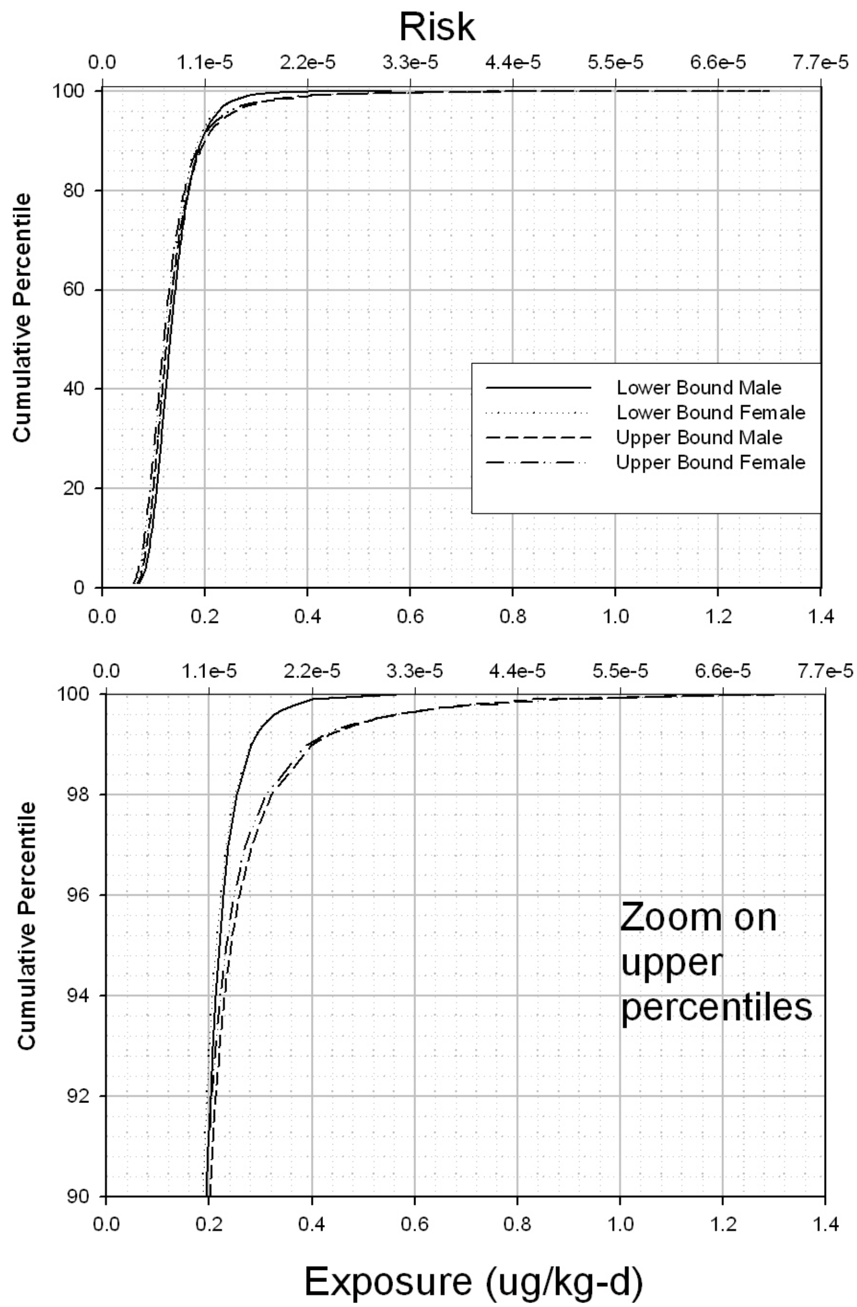


Figure 5. Cumulative risk/exposure distributions for intermediate mobility scenario. SOFEA runs J1370-74. HEE5CB runs exp0111 and exp0112.

References

Johnson, Bruce and Sally Powell. 2005. Memorandum to Tobi L. Jones, Ph.D.,on Interim Statewide Caps Analysis for 1,3- Dichoropropene dated Dec 28, 2005.

Johnson, Bruce. 2007a. Memorandum to Tobi L. Jones, Ph.D.,on SIMULATION OF CONCENTRATIONS AND EXPOSURE ASSOCIATED WITH UPDATED TOWNSHIP USE Of 1,3-DICHLOROPROPENE IN VENTURA COUNTY, CALIFORNIA dated July 10, 2007.

Johnson, Bruce. 2007b. Memorandum to Tobi L. Jones, Ph.D.,on SIMULATION OF CONCENTRATIONS AND EXPOSURE ASSOCIATED WITH UPDATED TOWNSHIP CAPS FOR MERCED COUNTY FOR 1,3-DICHLOROPROPENE dated April 9, 2007.

Johnson, Bruce. 2007c. Memorandum to Tobi L. Jones, Ph.D., on Simulation of concentrations and exposure associated with DAS-proposed township caps for Ventura County for 1,3-dichloropropene. Dated March 27, 2007.

Appendix 1. CIMIS station #39 information from
<http://wwwcimis.water.ca.gov/cimis/frontStationDetailInfo.do?stationId=39>

CALIFORNIA THE GOLDEN STATE | CALIFORNIA HOMEPAGE | GOVERNOR'S HOMEPAGE

CIMIS
CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM
DEPARTMENT OF WATER RESOURCES
OFFICE OF WATER USE EFFICIENCY

WELCOME | INFO CENTER | DATA | RESOURCE CENTER | MY CIMIS

General
- CIMIS Overview
- CIMIS Data Uses

Weather Stations
- Station List
- Location Maps
- Sensor Specs
- Siting Info
- Network Maintenance

Evapotranspiration
- ET Overview
- Equations
- Crop Coefficients
- ETo Zones Map

Irrigation
- Irrigation Overview
- Water Budget
- Irrigation Scheduling
- Mobile Labs
- Software
- Consultants

Station Detail Report

The **Station Detail Report** provides detailed information on CIMIS stations including the region in which they are located, nearby city, installation dates, termination dates (if inactive), geographic locations (latitude and longitude), elevations above see level, zip codes, surface types (grass or alfalfa), station site descriptions, and photographs of the stations.

Parlier #39

San Joaquin Valley Region Fresno County San Joaquin District
Nearby city is Parlier

- Activated On May 23, 1983
- Station is Active
- ETo Reported
- Reference Surface is Grass
- Datalogger is CR10

Station Picture Unavailable

Station 39
North | South | East | West |

Geographic Information

Elevation (ft):	337
Latitude:	36°35'52"N / 36.6
Longitude:	119°30'11"W / -119.5

Associated Zip Codes

93648, 93161, 93618, 93654, 93657, 93662

Station Siting Description

DATE: 11-12-02

STATION#:39
STATION NAME: Parlier
ETO ZONE: 12
PREVAILING WINDS: NW
LOCAL CHARACTER: Primarily agricultural area. Large fields of cotton, grapes and orchards characterize regional farming operations.

DESCRIPTION OF STATION SITE:
Located on a University of California research facility. The station is in a flood-irrigated plot with a mixed clover/grass cover.

Appendix 2. Site information for San Joaquin Air Pollution Control District Parlier Site from <http://www.arb.ca.gov/qaweb/site.php?s_arb_code=10230>. The red dot in the map below indicates the location of both the SJAPCD and CIMIS meteorological stations.

California Environmental Protection Agency
AIR RESOURCES BOARD

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Quality Assurance
Site Information for Parlier

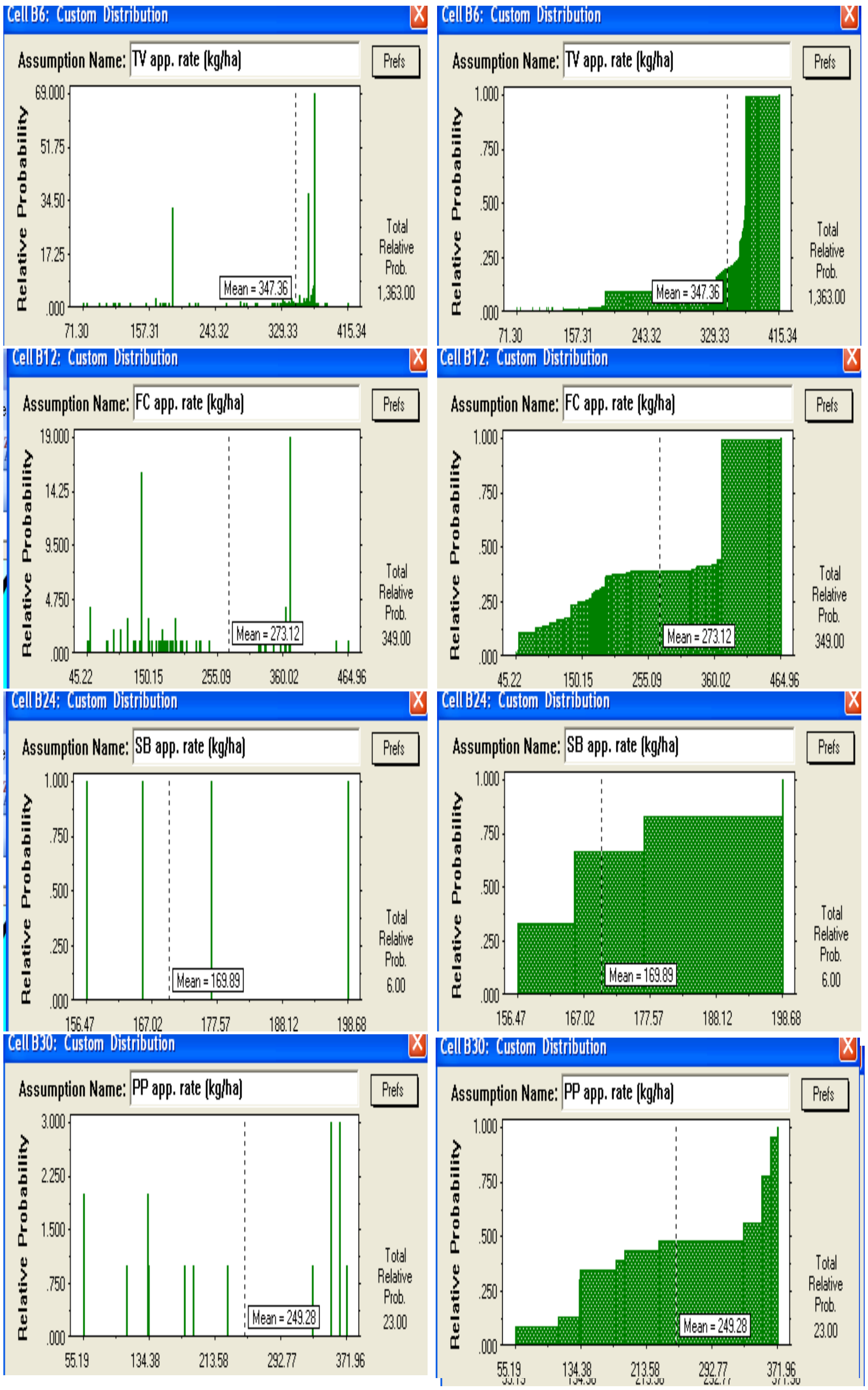
This page updated May 15, 2008

AIRS Number	ARB Number	Site Start Date	Reporting Agency and Agency Code
060194001	10230	3/1/83	San Joaquin Valley Unified APCD (069)

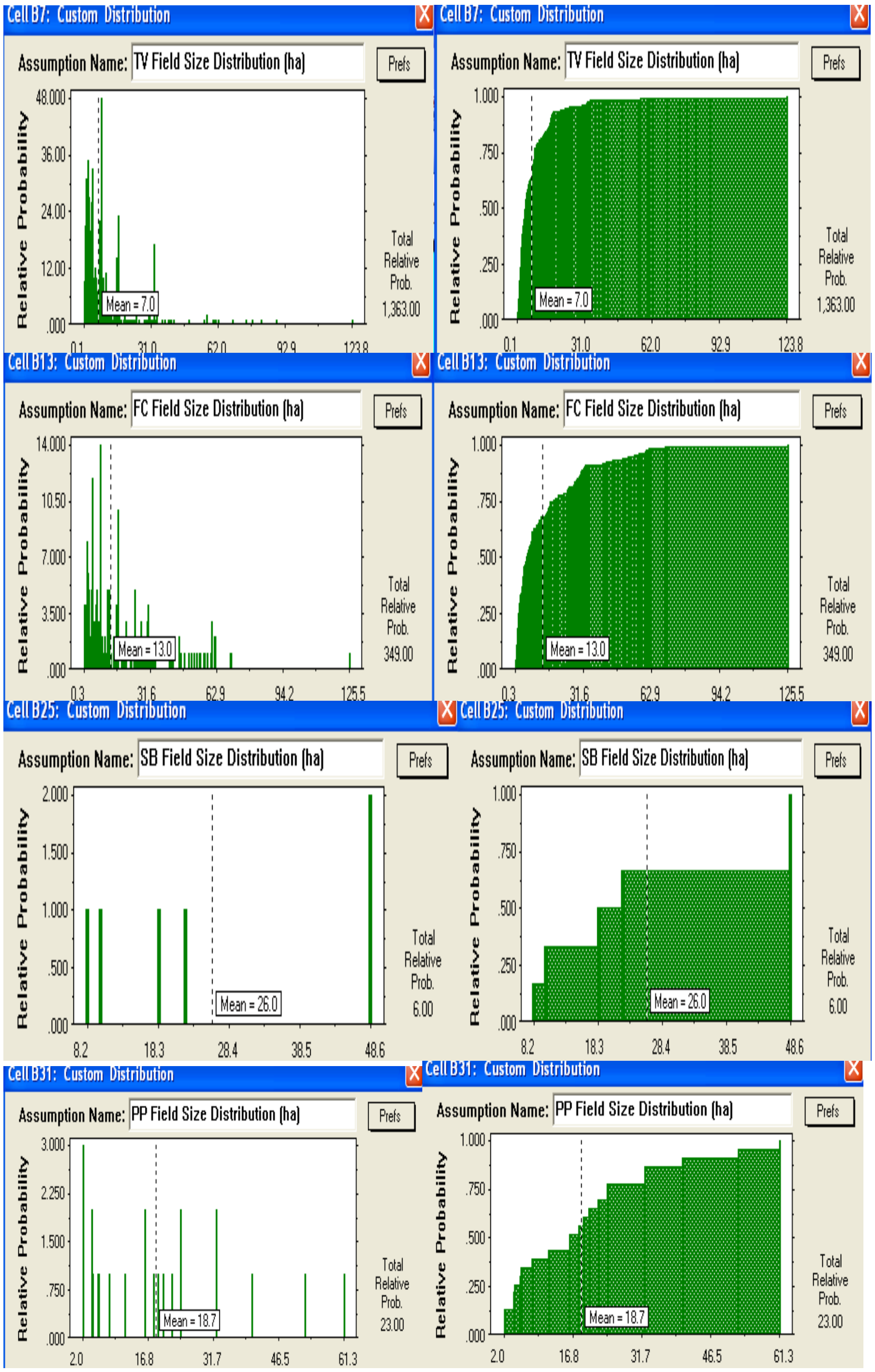
Site Address	County	Air Basin	Latitude	Longitude	Elevation
9240 S. Riverbend Av, Parlier CA 93648	Fresno	San Joaquin Valley	36° 35' 50"	119° 30' 15"	96

Pollutants Monitored (click on parameter link for real-time data)
NO_2, O_3, Total NMHC, Outdoor Temperature, Relative Humidity, Wind Direction, Horizontal Wind Speed, Barometric Pressure, Solar Radiation

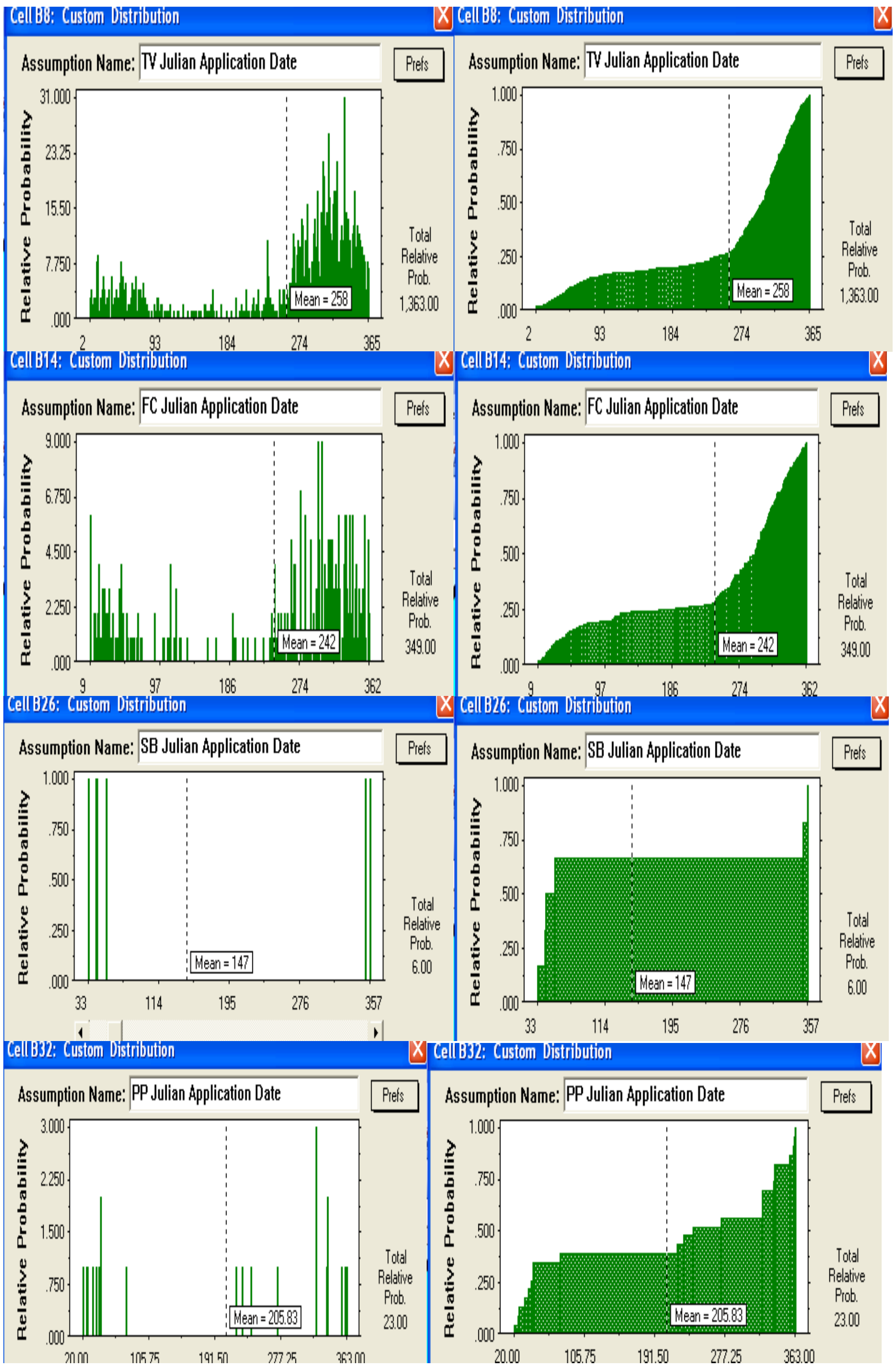
Appendix 3. Distributions used for Monte Carlo sampling. Application rate (kg/ha). Based on CDMS 2004-2007 application rates for 1,3-D for Tulare and Fresno Counties. Probability densities on left and equivalent cumulative distributions on right.



Appendix 4. Field Size (ha).



Appendix 5. Application Date (Julian Date).



Appendix 6.

Annual versus Perennial classification for crops in the PUR with 1,3-D applications in the 5x5 township area centered on Parlier.

Crop	A-P
ALMOND	Perennial
APRICOT	Perennial
BLUEBERRY	Perennial
CHERRY	Perennial
CUCUMBER (PICKLING, CHINESE, ETC.)	Annual
EGGPLANT (ORIENTAL EGGPLANT)	Annual
GRAPES	Perennial
GRAPES, WINE	Perennial
KIWI FRUIT	Perennial
LEMON	Perennial
LIME (MEXICAN LIME, ETC.)	Perennial
NECTARINE	Perennial
OATS (FORAGE - FODDER)	Annual
ORANGE (ALL OR UNSPEC)	Perennial
PEACH	Perennial
PLUM (INCLUDES WILD PLUMS FOR HUMAN CONSUMPTION)	Perennial
POMEGRANATE (MISCELLANEOUS FRUIT)	Perennial
SOIL APPLICATION, PREPLANT-OUTDOOR (SEEDBEDS,ETC.)	Annual
SQUASH (ALL OR UNSPEC)	Annual
TANGERINE (MANDARIN, SATSUMA, MURCOTT, ETC.)	Perennial
TARO (ALL OR UNSPEC)	Annual
UNCULTIVATED AGRICULTURAL AREAS (ALL OR UNSPEC)	Annual
WALNUT (ENGLISH WALNUT, PERSIAN WALNUT)	Perennial

Appendix 7. Annual section weights for 9 township region centered on Parlier based on crop acreage from the PUR.

	21E						22E						23E					
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.069	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14S	0.000	0.000	0.000	0.000	0.000	0.000	0.671	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.048	0.024	0.000	0.000
	0.000	0.000	0.524	0.000	0.127	0.000	0.073	0.000	0.000	0.000	0.000	0.000	0.093	0.000	0.055	0.065	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.094	0.000	0.000	0.000	0.020	0.000	0.368	0.032	0.033	0.036	0.010	0.000
	0.000	0.033	0.276	0.000	0.000	0.000	0.000	0.073	0.000	0.000	0.000	0.000	0.000	0.000	0.189	0.000	0.045	0.000
	0.000	0.000	0.000	0.079	0.000	0.028	0.000	0.000	0.000	0.000	0.079	0.117	0.000	0.107	0.052	0.085	0.046	0.000
	0.000	0.041	0.000	0.000	0.019	0.244	0.000	0.000	0.107	0.000	0.000	0.000	0.000	0.010	0.015	0.000	0.045	0.086
15S	0.057	0.000	0.000	0.154	0.069	0.114	0.000	0.034	0.000	0.048	0.143	0.041	0.066	0.000	0.045	0.013	0.021	0.045
	0.000	0.000	0.000	0.058	0.000	0.000	0.000	0.000	0.011	0.213	0.000	0.000	0.000	0.047	0.000	0.023	0.000	0.000
	0.000	0.126	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.137	0.000	0.000	0.011	0.089	0.051	0.000	0.000	0.010
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.000	0.036	0.014	0.046	0.028	0.046	0.000	0.000	0.013
	0.000	0.000	0.023	0.000	0.018	0.000	0.000	0.000	0.000	0.063	0.000	0.031	0.015	0.005	0.008	0.012	0.027	0.000
	0.000	0.000	0.012	0.000	0.000	0.006	0.042	0.000	0.000	0.089	0.117	0.107	0.009	0.043	0.004	0.049	0.024	0.003
16S	0.000	0.000	0.000	0.075	0.048	0.119	0.000	0.000	0.020	0.029	0.000	0.009	0.006	0.027	0.037	0.059	0.022	0.005
	0.000	0.000	0.000	0.000	0.028	0.019	0.000	0.000	0.008	0.017	0.000	0.116	0.029	0.037	0.054	0.028	0.011	0.005
	0.054	0.000	0.000	0.000	0.018	0.000	0.000	0.022	0.000	0.000	0.000	0.136	0.009	0.032	0.071	0.008	0.010	0.006
	0.000	0.000	0.000	0.335	0.098	0.149	0.000	0.030	0.045	0.044	0.029	0.044	0.112	0.056	0.079	0.007	0.033	0.056

Appendix 8. Perennial section weights for 9 township region centered on Parlier based on perennial crop acreage from the PUR.

	21E						22E						23E					
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.000	0.022	0.047	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.209	0.000	0.000	0.000	0.028	0.000	0.000	0.000	0.000	0.000
14S	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.103	0.000	0.000	0.084	0.000	0.000
	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.075	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.092	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.000	0.167	0.000	0.000	0.000	0.162	0.000	0.000	0.093	0.085	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.309	0.000	0.072	0.000	0.000	0.000	0.117	0.028	0.039	0.101
	0.000	0.000	0.000	0.000	0.000	0.094	0.041	0.000	0.000	0.000	0.014	0.000	0.181	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.023	0.070	0.000	0.073	0.069	0.007	0.091	0.032	0.041	0.127	0.096	0.000	0.000	0.088
15S	0.674	0.000	0.000	0.000	0.091	0.000	0.000	0.000	0.050	0.144	0.228	0.012	0.070	0.127	0.019	0.046	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.041	0.000	0.019	0.000	0.000	0.000	0.000	0.032	0.005	0.000	0.000	0.022
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.011	0.020	0.009	0.000	0.000	0.017
	0.000	0.000	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.084	0.081	0.019	0.006	0.013	0.000	0.028	0.022
	0.000	0.000	0.000	0.359	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.096	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.121	0.251	0.100	0.000	0.000	0.000	0.000	0.000
16S	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.804	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.238	0.355	0.000	0.000	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.248	0.350	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 9. Listing of REFORM.FOR.

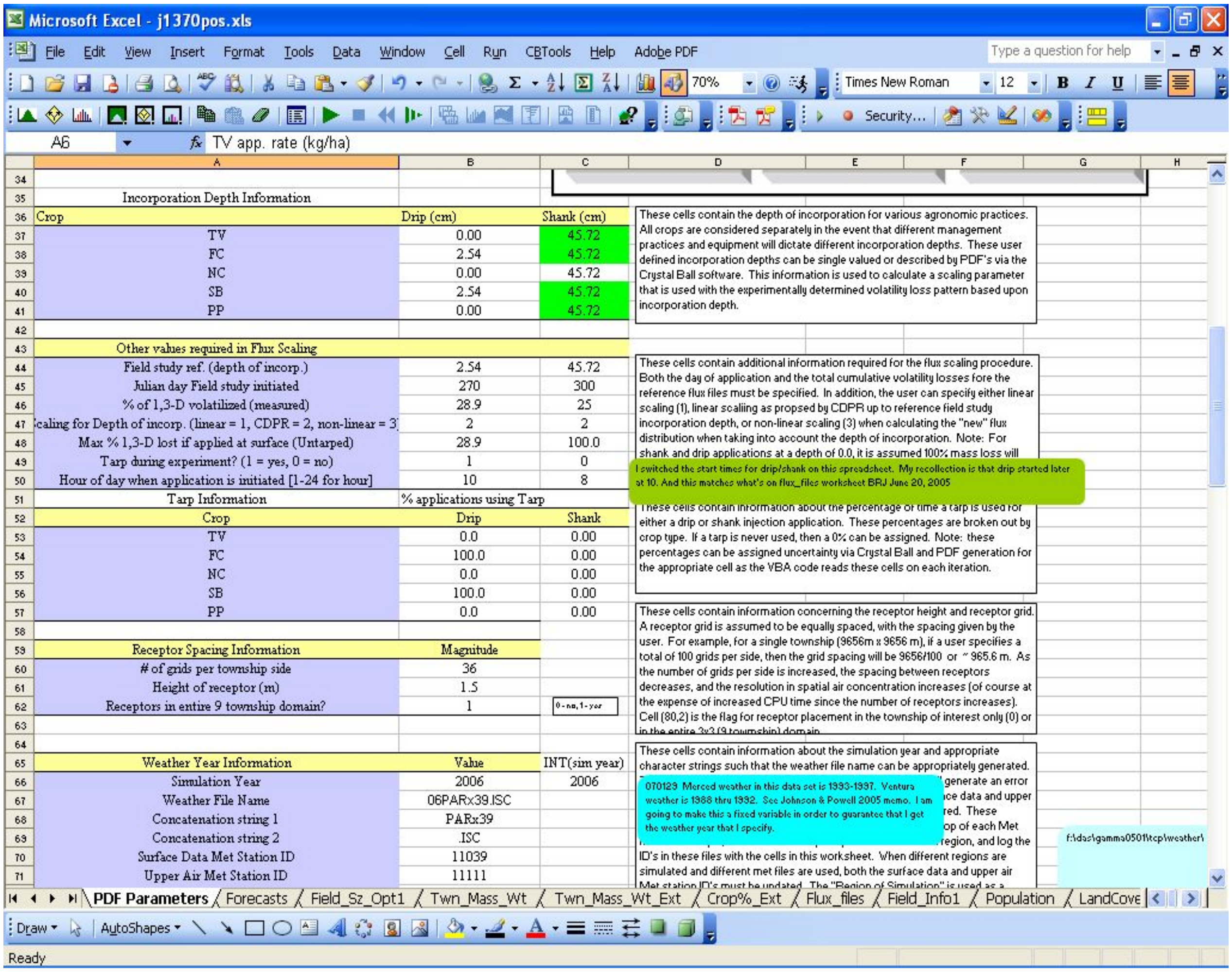
```
C     Last change:  BJ   13 Mar 2009   11:37 am
                PROGRAM REFORM
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C INPUT FILE IS REFORM.IN, OUTPUT FILE IS REFORM.OUT
C 090313 I CHECKED 13 DIFFERENT VALUES FROM ALL THREE ROWS AND ALL 3 COLUMNS AND
C THEY WERE IN THE CORRECT PLACE
C PROGRAM SECT-WT-PREP TAKES THE 9 ROWS (FOR THE INNER 3X3 TOWNSHIPS)
C OF 36 SECTION WEIGHTS, READS THEM IN, THEN CONVERTS THEM INTO A NINE
C TOWNSHIP SPATIAL ARRAY GOING 3X3 WITH 36 SECTIONS WITHIN EACH TOWNSHIP
C IN ORDER TO BE ABLE TO READ THAT INTO EXCEL AND COPY AND PASTE IT INTO
C THE SECTION_PROB WORKSHEET OF SOFEA.
C
C IN OTHER WORDS,
C TS1  W11 W12 W13 W14...W1,36
C TS2  W2,1 W2,2...W2,36
C ...
C TS9  W9,1 W9,2    W9,36
C WHERE TOWNSHIPS ARE LOCATED AS
C   1 2 3
C   4 5 6
C   7 8 9
C (FOR EXAMPLE IN PARLIER STUDY
C
C M14S21E  M14S22E  M14S23E
C M15S21E  M15S22E  M15S23E
C M16S21E  M16S22E  M16S23E)
C
C THEN THE SECTION WEIGHTS GET WRITTEN OUT AND CAN BE READ CONVENIENTLY
C INTO EXCEL AND THEN COPIED INTO THE SOFEA SECTION_PROB WORKSHEET
C
C THE INPUT FILE IS EXPECTED TO BE FORMATTED AS FOLLOWS:
C12345678901234567890123456789012345678901234567890123456789012345678901
CTR       M14S21E M14S22E M14S23E M15S21E M15S22E M15S23E M16S21E M16S22E M16S23E C
C01         0.000   0.000   0.000   0.028   0.141   0.000   0.000   0.042   0.000
C02         0.000   0.000   0.000   0.000   0.057   0.036   0.016   0.000   0.027
C03         0.000   0.000   0.000   0.079   0.000   0.092   0.000   0.001   0.012
C
C USE EXCEL AND SAVE FILE AS "PRN" TO GET FIXED FORMATTING
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
C THE NUMBERING SCHEME FOR SECTION MATRIX ADDRESSING IS
C   1   2   3   4   5   6   I ACROSS TOP, J DOWN
C 1 6   5   4   3   2   1
C 2 7   8   9  10  11  12
C 3 18  17  16 15  14  13
C 4 19  20  21 22  23  24
C 5 30  29  28 27  26  25
C 6 31  32  33 34  35  36
c
c numbering scheme to print out 3x3 townships
c
c    1   2   3
```

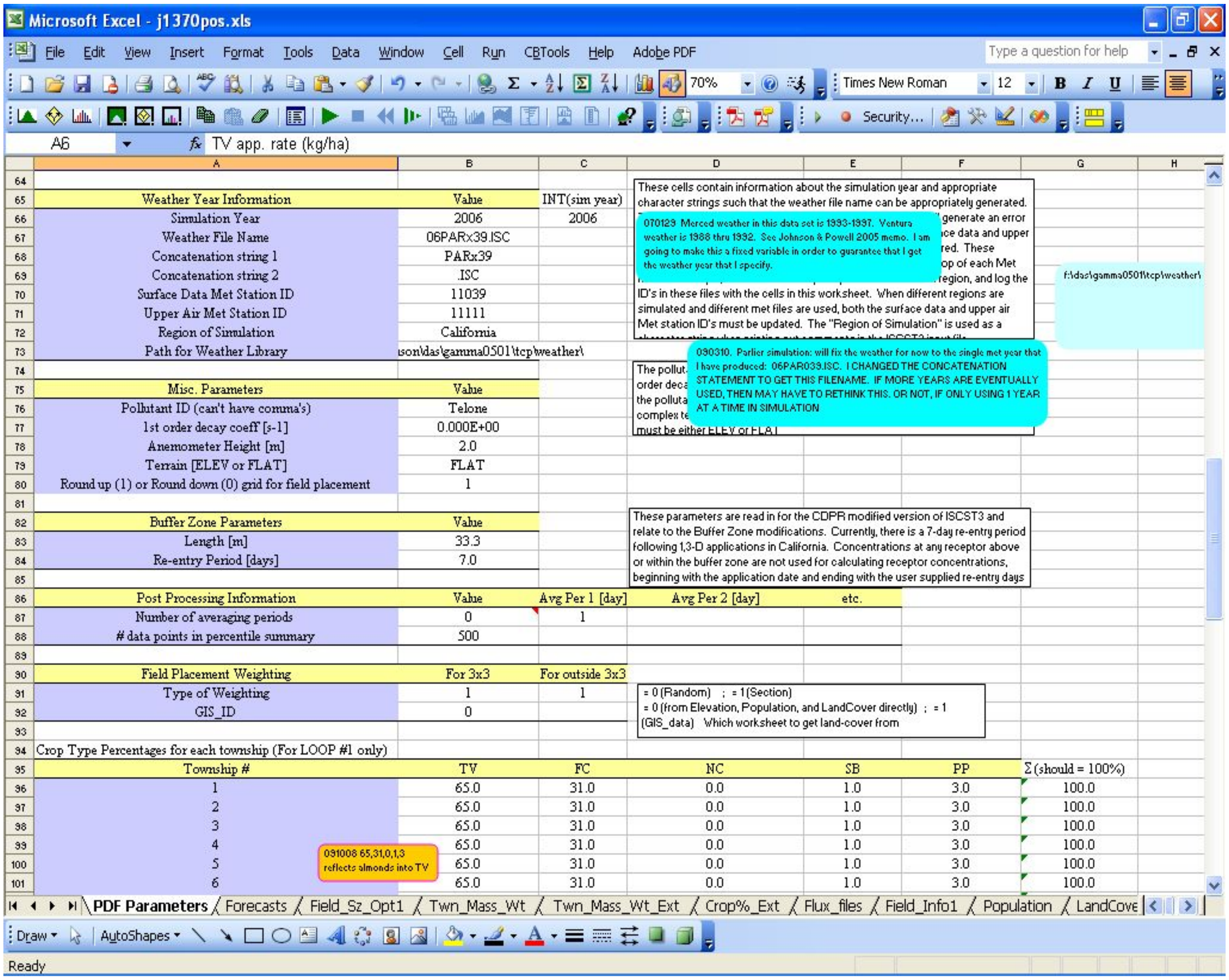
```
c  1
C  2
c  3
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        IMPLICIT NONE
        REAL ARRW(9,36)  !ARRAY OF WEIGHTS FOR 9 TOWNSHIPS X 36 SECTIONS
        REAL ARROUT(18,18) !ARRY TO PRINT OUT FOR EVENTUAL UPLOAD INTO EXCEL
        INTEGER SECNO(36)
        CHARACTER A
        INTEGER I,IH,IV,KH,KV,J,IDUM,JDUM


        REAL DUM(6,6) !DUMMY ARRAY
        OPEN(UNIT=1,STATUS='OLD',FILE='REFORM.IN')
        READ(1,100)A  !SKIP FIRST LINE
100     FORMAT(A1)
        DO I=1,36
           READ(1,133)SECNO(I),(ARRW(J,I),J=1,9)
133        FORMAT(I2,T9,9F8.3)
C12345678901234567890123456789012345678901234567890123456789012345678901
CTR       M14S21E M14S22E M14S23E M15S21E M15S22E M15S23E M16S21E M16S22E M16S23E C
C01         0.000   0.000   0.000   0.028   0.141   0.000   0.000   0.042   0.000
C02         0.000   0.000   0.000   0.000   0.057   0.036   0.016   0.000   0.027

        END DO
        DO I=1,36
         WRITE(6,115)SECNO(I),(ARRW(J,I),J=1,9)
115      FORMAT(1X,I3,9(F4.2,' '))
        END DO

        DO I=1,9
          CALL LDTO2D(I,ARRW,DUM)
           DO IDUM=1,6
            WRITE(6,1515)(DUM(JDUM,IDUM),JDUM=1,6)
1515        FORMAT(1X,6F8.2)
           END DO
           !GET UPPER LEFT I,J, VALUES WHERE TO START LOADING INTO ARROUT
           !IV IS UPPER VERTICAL VALUE, IH IS LEFT HORIZONTAL VALUE
           !ARROUT(IH,IV)  I.E. (ARROUT (HORIZONTAL, VERTICAL))
           IH=6*(MOD(I-1,3))+1  !HORIZONTAL POSITION START
           IV=6*((I-1)/3)+1  !VERTICAL POSITION START
C             WRITE(6,2223)IH,IV
C2223         FORMAT(1X,'IH= ' I4,'  IV=  ',I4)
             DO KH=IH,IH+5
             DO KV=IV,IV+5
               ARROUT(KH,KV)=DUM(kH-iH+1,kV-iV+1)
C WRITE(6,888)kh-ih+1,kv-iv+1
C888            FORMAT(1x,'dumh indices ',2i5)
             END DO
             END DO
C          CALL DUMPER(ARROUT)
C           READ(5,100)A
         END DO
         OPEN(UNIT=3,STATUS='unknown',FILE='reform.out')
         do i=1,18
```

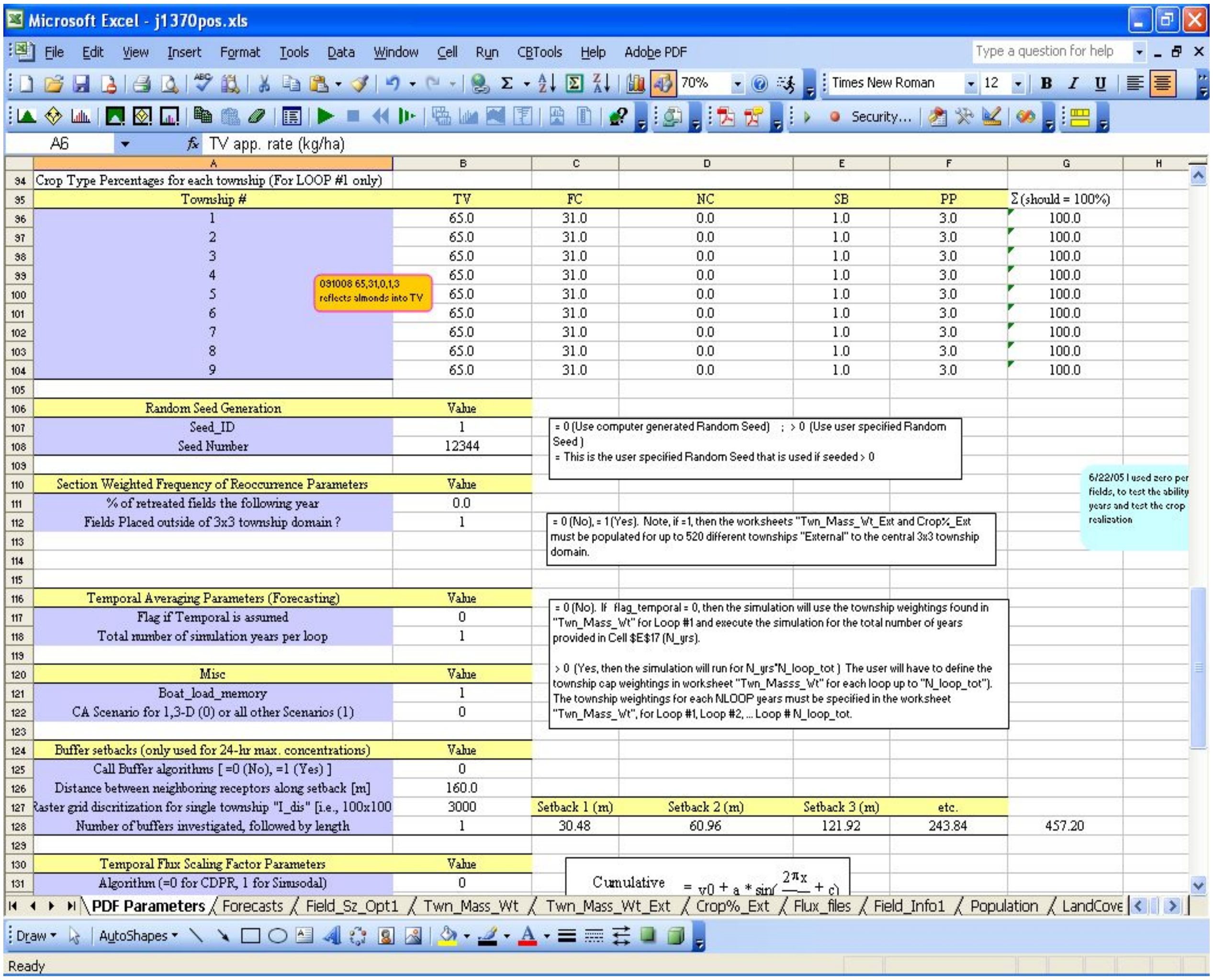
```
          WRITE(3,991)(arrout(j,i),j=1,18)
991       FORMAT(1x,18(f5.3,' '))
         end do


        STOP

        END
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        SUBROUTINE DUMPER(ARROUT)
        IMPLICIT NONE
        REAL ARROUT(18,18)
        INTEGER I,J
        DO I=1,18
         WRITE(6,100)(ARROUT(J,I), J=1,18)
100      FORMAT(1X,18(F5.2,' '))
        END DO
        END SUBROUTINE

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

        SUBROUTINE LDTO2D(IR,ANN,DUM)
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C LOADS LINEAR ARRAY IN ANN INTO 6X6 ARRAY DUM
C USING SPECIAL FUNCTIONS FOR INDICES TO CONVERT
C THE WEIRD SECTION NUMBERS
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        IMPLICIT NONE
        INTEGER IR  !TELLS WHICH TOWNSHIP WEIGHTS TO USE
        REAL ANN(9,36)  !THIS HOLDS ALL OF THE WEIGHTS FOR USE (EITHER ANNUAL, OR
PERENNIAL)
        REAL DUM(6,6) !WILL LOAD INTO THIS ARRAY
        INTEGER I,J,SN2I,SN2J
        INTEGER N
        DO N=1,36
         WRITE(50,5000)ir,n,sn2i(n),sn2j(n),ann(ir,n)
5000     FORMAT(/1x,'ir,n,sn2i(n),sn2j(n),ann(ir,n) - from ldto2d ',2i3
     1          ,2i3,f10.4)
         DUM(SN2I(N),SN2J(N))=ANN(IR,N)
        END DO
        RETURN
        END SUBROUTINE
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        SUBROUTINE DUMCLR(DUM)
        IMPLICIT NONE
        REAL DUM(6,6)
        INTEGER I,J
        DO I=1,6
         DO J=1,6
          DUM(I,J)=0.
         END DO
        END DO
        RETURN
```

```
        END SUBROUTINE

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
        INTEGER FUNCTION SN2J(SN)
C DETERMINES THE J COORDINATE OF SECTION NUMBER, ITS THE N-S DIRECTION
        IMPLICIT NONE
        INTEGER SN
        SN2J=((SN-1)/6)+1
        RETURN
        END
```

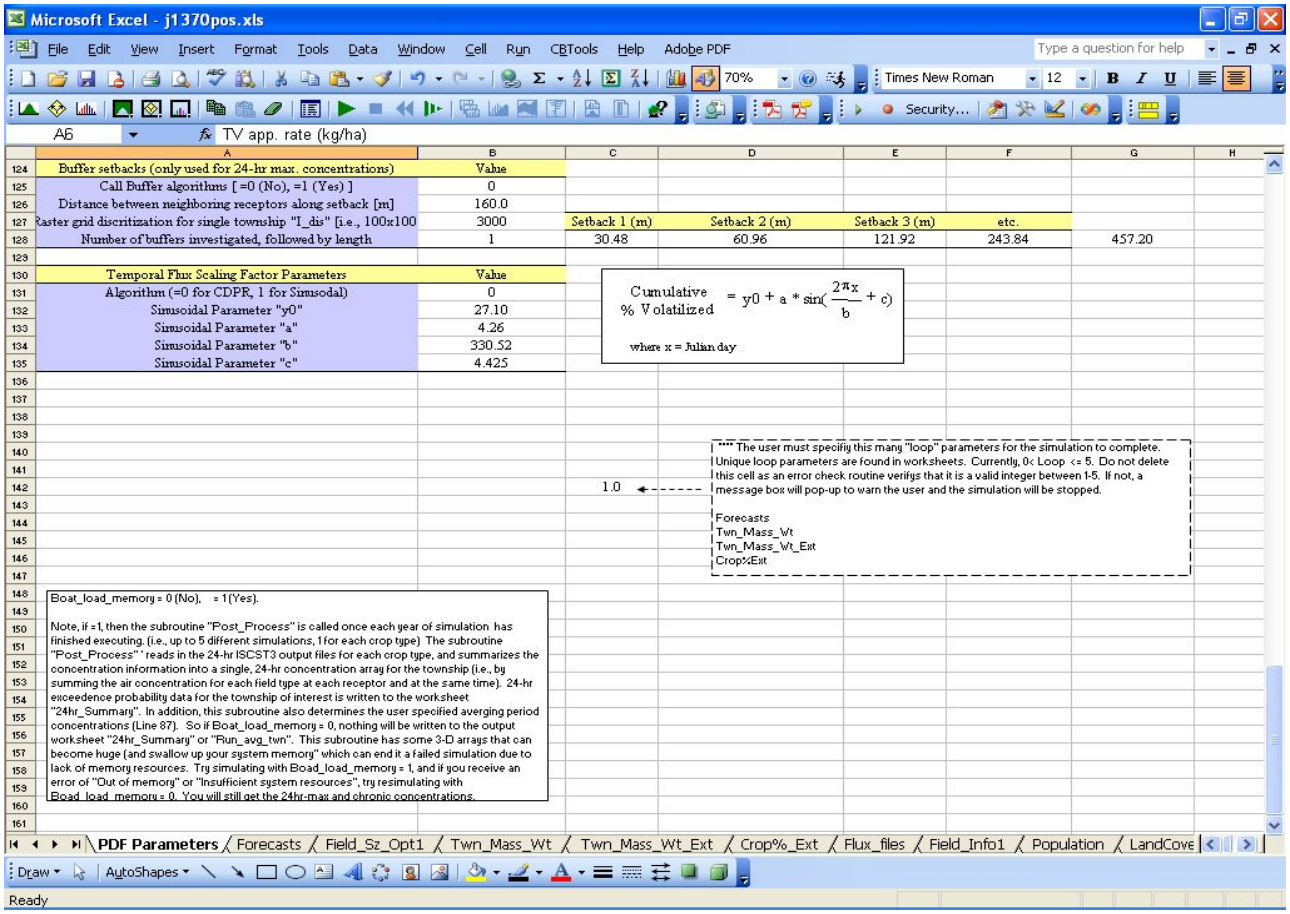
Appendix 10. Screenshots of main input worksheet for SOFEA runs J1370-J1374 for Parlier area simulation.




Microsoft Excel - j1370pos.xls
A6
TV app. rate (kg/ha)
Weather Year Information | Value | INT(sim year)
Simulation Year | 2006 | 2006
Weather File Name | 06PARx39.ISC
Concatenation string 1 | PARx39
Concatenation string 2 | .ISC
Surface Data Met Station ID | 11039
Upper Air Met Station ID | 11111
Region of Simulation | California
Path for Weather Library | son\das\gamma0501\tcp\weather\
These cells contain information about the simulation year and appropriate character strings such that the weather file name can be appropriately generated.
generate an error
ice data and upper
red. These
op of each Met
region, and log the
ID's in these files with the cells in this worksheet. When different regions are simulated and different met files are used, both the surface data and upper air Met station ID's must be updated. The "Region of Simulation" is used as a
070129 Merced weather in this data set is 1993-1997. Ventura weather is 1988 thru 1992. See Johnson & Powell 2005 memo. I am going to make this a fixed variable in order to guarantee that I get the weather year that I specify.
f:\das\gamma0501\tcp\weather\
Misc. Parameters | Value
Pollutant ID (can't have comma's) | Telone
1st order decay coeff [s-1] | 0.000E+00
Anemometer Height [m] | 2.0
Terrain [ELEV or FLAT] | FLAT
Round up (1) or Round down (0) grid for field placement | 1
The pollut
order deca
the polluta
complex te
must be either ELEV or FLAT
090310. Parlier simulation: will fix the weather for now to the single met year that I have produced: 06PAR039.ISC. I CHANGED THE CONCATENATION STATEMENT TO GET THIS FILENAME. IF MORE YEARS ARE EVENTUALLY USED, THEN MAY HAVE TO RETHINK THIS. OR NOT, IF ONLY USING 1 YEAR AT A TIME IN SIMULATION
Buffer Zone Parameters | Value
Length [m] | 33.3
Re-entry Period [days] | 7.0
These parameters are read in for the CDPR modified version of ISCST3 and relate to the Buffer Zone modifications. Currently, there is a 7-day re-entry period following 1,3-D applications in California. Concentrations at any receptor above or within the buffer zone are not used for calculating receptor concentrations, beginning with the application date and ending with the user supplied re-entry days
Post Processing Information | Value | Avg Per 1 [day] | Avg Per 2 [day] | etc.
Number of averaging periods | 0 | 1
data points in percentile summary | 500
Field Placement Weighting | For 3x3 | For outside 3x3
Type of Weighting | 1 | 1
GIS_ID | 0
= 0 (Random) ; = 1 (Section)
= 0 (from Elevation, Population, and LandCover directly) ; = 1 (GIS_data) Which worksheet to get land-cover from
Crop Type Percentages for each township (For LOOP #1 only)
Township # | TV | FC | NC | SB | PP | Σ (should = 100%)
1 | 65.0 | 31.0 | 0.0 | 1.0 | 3.0 | 100.0
2 | 65.0 | 31.0 | 0.0 | 1.0 | 3.0 | 100.0
3 | 65.0 | 31.0 | 0.0 | 1.0 | 3.0 | 100.0
4 | 65.0 | 31.0 | 0.0 | 1.0 | 3.0 | 100.0
5 | 65.0 | 31.0 | 0.0 | 1.0 | 3.0 | 100.0
6 | 65.0 | 31.0 | 0.0 | 1.0 | 3.0 | 100.0
091008 65,31,0,1,3 reflects almonds into TV
PDF Parameters | Forecasts | Field_Sz_Opt1 | Twn_Mass_Wt | Twn_Mass_Wt_Ext | Crop%_Ext | Flux_files | Field_Info1 | Population | LandCove
Ready



	A	B	C	D	E	F	G
94	Crop Type Percentages for each township (For LOOP #1 only)						
95	Township #	TV	FC	NC	SB	PP	Σ (should = 100%)
96	1	65.0	31.0	0.0	1.0	3.0	100.0
97	2	65.0	31.0	0.0	1.0	3.0	100.0
98	3	65.0	31.0	0.0	1.0	3.0	100.0
99	4	65.0	31.0	0.0	1.0	3.0	100.0
100	5	65.0	31.0	0.0	1.0	3.0	100.0
101	6	65.0	31.0	0.0	1.0	3.0	100.0
102	7	65.0	31.0	0.0	1.0	3.0	100.0
103	8	65.0	31.0	0.0	1.0	3.0	100.0
104	9	65.0	31.0	0.0	1.0	3.0	100.0
105							
106	Random Seed Generation	Value					
107	Seed_ID	1					
108	Seed Number	12344					
109							
110	Section Weighted Frequency of Reoccurrence Parameters	Value					
111	% of retreated fields the following year	0.0					
112	Fields Placed outside of 3x3 township domain ?	1					
113							
114							
115							
116	Temporal Averaging Parameters (Forecasting)	Value					
117	Flag if Temporal is assumed	0					
118	Total number of simulation years per loop	1					
119							
120	Misc	Value					
121	Boat_load_memory	1					
122	CA Scenario for 1,3-D (0) or all other Scenarios (1)	0					
123							
124	Buffer setbacks (only used for 24-hr max. concentrations)	Value					
125	Call Buffer algorithms [=0 (No), =1 (Yes)]	0					
126	Distance between neighboring receptors along setback [m]	160.0					
127	Raster grid discritization for single township "I_dis" [i.e., 100x100	3000	Setback 1 (m)	Setback 2 (m)	Setback 3 (m)	etc.	
128	Number of buffers investigated, followed by length	1	30.48	60.96	121.92	243.84	457.20
129							
130	Temporal Flux Scaling Factor Parameters	Value					
131	Algorithm (=0 for CDPR, 1 for Sinusodal)	0					


Microsoft Excel - j1370pos.xls
A6
TV app. rate (kg/ha)
Buffer setbacks (only used for 24-hr max. concentrations)
Value
Call Buffer algorithms [=0 (No), =1 (Yes)]
0
Distance between neighboring receptors along setback [m]
160.0
Raster grid discritization for single township "I_dis" [i.e., 100x100
3000
Setback 1 (m)
Setback 2 (m)
Setback 3 (m)
etc.
Number of buffers investigated, followed by length
1
30.48
60.96
121.92
243.84
457.20
Temporal Flux Scaling Factor Parameters
Value
Algorithm (=0 for CDPR, 1 for Sinusodal)
0
Sinusoidal Parameter "y0"
27.10
Sinusoidal Parameter "a"
4.26
Sinusoidal Parameter "b"
330.52
Sinusoidal Parameter "c"
4.425
Cumulative % Volatilized = y0 + a * sin(2πx / b + c)
where x = Julian day
1.0
**** The user must specifiy this many "loop" parameters for the simulation to complete. Unique loop parameters are found in worksheets. Currently, 0< Loop <= 5. Do not delete this cell as an error check routine verifys that it is a valid integer between 1-5. If not, a message box will pop-up to warn the user and the simulation will be stopped.
Forecasts
Twn_Mass_Wt
Twn_Mass_Wt_Ext
Crop%Ext
Boat_load_memory = 0 (No), = 1 (Yes).
Note, if =1, then the subroutine "Post_Process" is called once each year of simulation has finished executing. (i.e., up to 5 different simulations, 1 for each crop type) The subroutine "Post_Process" ' reads in the 24-hr ISCST3 output files for each crop type, and summarizes the concentration information into a single, 24-hr concentration array for the township (i.e., by summing the air concentration for each field type at each receptor and at the same time). 24-hr exceedence probability data for the township of interest is written to the worksheet "24hr_Summary". In addition, this subroutine also determines the user specified averging period concentrations (Line 87). So if Boat_load_memory = 0, nothing will be written to the output worksheet "24hr_Summary" or "Run_avg_twn". This subroutine has some 3-D arrays that can become huge (and swallow up your system memory" which can end it a failed simulation due to lack of memory resources. Try simulating with Boad_load_memory = 1, and if you receive an error of "Out of memory" or "Insufficient system resources", try resimulating with Boad_load_memory = 0. You will still get the 24hr-max and chronic concentrations.
PDF Parameters
Forecasts
Field_Sz_Opt1
Twn_Mass_Wt
Twn_Mass_Wt_Ext
Crop%_Ext
Flux_files
Field_Info1
Population
Ready