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DATE: August 20, 2014

SUBJECT: COMPARISON OF ONE-YEAR TOWNSHIP MONITORING RESULTS FROM MERCED TO SOFEA SIMULATION RESULTS

Summary

A SOFEA simulation based on the patterns of 1,3-dichloropropene applications in Merced County (field size, application date, application rate) between 2007-2011, adjusted township total applied 1,3-d pounds from the DAS township use report and 2011 Merced meteorological data produced concentration distributions which covered the 9 township area in which Dow AgroSciences monitored for 1,3-d air concentrations. The SOFEA simulation results were segregated by township and for each township, the SOFEA results were formed into cumulative concentration distributions. The 72 hour air concentrations for 2011 from the DAS monitoring study were averaged, producing 9 average annual air concentrations. For each township, the average measured concentration was compared to the SOFEA-produced distribution for that township. For four townships, the average measured concentration was larger than the largest SOFEA-estimated concentration. For the other five townships, the average measured concentration was larger than 99% of the SOFEA estimated concentrations in that township. The SOFEA model underpredicted the monitored air concentrations. I recommend discontinuing use of SOFEA at this time.

Introduction

DAS completed a 15 month monitoring study. They monitored 1,3-d air concentrations with monitoring stations located near the center of each of 9 townships: 06S10E, 06S11E, 06S12E, 07S10E, 07S11E, 07S12E, 08S10E, 08S11E, 08S12E. This 3x3 region historically contains some of the highest 1,3-d use townships and has been the subject of previous simulation work (van Wesenbeeck 2004 and 2005, Johnson 2007). The previous simulation work utilized a modeling system called SOFEA (Van Wesenbeeck and Cryer 2004). The SOFEA model was built by DAS personnel and CDPR had some input into the model design. Until the Merced study, such an extensive set of monitoring data was not available for comparison to the SOFEA modeling results.

DAS made some major modifications to the SOFEA model and called the result SOFEA2 (Van Wesenbeeck et al. 2013). SOFEA2 differed from SOFEA in several ways: (1) SOFEA2 utilized intrinsic procedures for Monte Carlo sampling instead of a third party stochastic simulator; (2) SOFEA2 did not use measured flux, but estimated flux with another model (formerly called CHAIN2D, now called VEFE, which stands for Volatile Organic Chemical Estimates of Flux and Exposure, described on pg 57 of Van Wesenbeeck et al.2013); and (3) allowed a mode of running in SOFEA2 called 'validation' which permitted specification of a particular set of applications. Validation mode is not a part of the DPR version of SOFEA. With the DPR version, Monte Carlo sampling is utilized to build a synthetic database of applications which satisfy various constraints. Two simulations of SOFEA with identical control files will produce two somewhat different realizations because of the Monte Carlo sampling; presumably the validation mode for SOFEA2 would produce two identical results.

I reviewed the SOFEA2 validation report and concluded that SOFEA2 underestimated the measured concentrations (Johnson 2014). However, in this memorandum it is my aim to compare the SOFEA model that DPR has been using to the Merced monitoring results.

Methods

SOFEA. The methods for running SOFEA have been described previously (Johnson 2007abc). Here is a short summary specific to this run:

1. Crops in the pesticide use report for Merced were categorized into perennial and annual.
2. Five years (2007-2011) of Merced County-wide PUR data were used to create annual/perennial distributions for
    a. Application date
    b. Application rate
    c. Field size
    d. Field acreage split between annual and perennial.
3. Meteorological data for 2011 was obtained from CIMIS station #92 (Kesterson, 37.23N, 120.88W, approximately 15.5 km from center of 3x3 Merced township study area) and processed according to established procedures (Vidrio and Johnson 2011, rev 2014). Stations #92 does not measure net solar radiation. Net solar radiation from station #206 was substituted (Denair, 37.55N, 120.75W, approximately 24 km from center of 3x3 Merced township study area).
4. Township use levels for 2011 based on adjusted pounds of 1,3-d were taken from Brett (2012). The SOFEA system uses an optimization module to match these use levels as it develops the synthetic use database.
5. The same five year PUR data (2007-2011) used to create the various distributions for Monte Carlo sampling, were also used to create an updated set of section factors based on

applied acreage, also called section weights, which SOFEA uses to place more applications into sections with historically higher use.

Tables and figures providing the details for the results above can be found in the Appendix. Results from the run called J1375 are presented. A total of 7 runs were made and one other run was analyzed and the percentile results were largely the same as those presented here. SOFEA produces annual concentrations estimates for 11664 receptors which uniformly cover the 3x3 township area of simulation. Each township has 1296 receptors covering it. The modeling results were segregated by township and formed into cumulative histograms of modeled annual concentrations in preparation for comparison to the monitoring results.

Monitoring Results The monitoring results from Merced (Van Wesenbeeck et al. 2013) were provided as electronic files containing both the SOFEA2 and 3-day monitoring results for each of the 9 'receptors' where monitoring took place. The monitoring at each receptor lasted for approximately 15 months, including the last three months of 2010 and for some receptors a few days of 2012. These three day monitoring results were truncated to exclude monitoring from 2010 and 2012, leaving just the 2011 yearly results. For each of the 9 receptors, these results were averaged to give 9, one-year average annual monitored concentrations.

Comparing the modeling to the monitoring results. Each of the 9 average monitored values, representing a one year annual average, was compared to the annual concentration distribution for the corresponding township estimated by SOFEA. From this comparison the percentile of the measured annual average was determined in relation to the cumulative distribution from the SOFEA estimates. In a statistical sense, the SOFEA model generated null distributions and the measured values were compared in each township to the null distribution. The monitoring locations were chosen to be near the center of each township. SOFEA itself utilizes 5x5 townships in the simulation with the outer ring of townships populated by applications reflecting the historical use patterns in order to avoid an 'edge effect'. Consequently, the 9 inner townships can be viewed as a systematic random sample from within each township in relation to the method that SOFEA allocates. In other words, the monitors were not located with respect to use patterns, but were located as close as practicable to the township geographic center. If SOFEA predicted concentrations without bias, about half of the measured annual concentrations would fall below the 50^{th} percentile and about half would go above the 50^{th} percentile of the corresponding SOFEA generated distribution.

The township numbering scheme used in SOFEA and in the monitoring study were different. In SOFEA, the townships were numbered starting at the south west township (8S10E) as #1, moving east to #2 (8S11E) and #3 (8S12E), then up to the center west township as #4 (7S10E) and so on. The DAS monitoring study started at the northwest township as #1 (6S10E), moving to the east and down. So that 1,2,3,4,5,6,7,8,9 in SOFEA corresponded to 7,8,9,4,5,6,1,2,3 in the monitoring study, respectively.

Results

Table 1 shows the average measured values for each of the 9 townships, the upper 1% of the township SOFEA distributions, and the estimated percentile for the monitored township annual average within each SOFEA distribution. In four cases the measured annual concentration exceeded the highest SOFEA-estimated concentration within the township. In the other five cases, the measured concentration was above the 99th percentile of the SOFEA-estimated concentration distribution. The clear implication is that SOFEA underestimated the monitored concentrations. Based on this analysis, I recommend that DPR discontinue using SOFEA for regulatory assessment unless SOFEA can be modified in some way to more adequately estimate air concentrations.

	Township SOFEA-estimated Annual Concentrations from Upper 99th Percentile (ug/m3)									Cumulative
	8S:10E	8S:11E	8S:12E	7S:10E	7S:11E	7S:12E	6S:10E	6S:11E	6S:12E	Fraction
	0.0575	0.5570	0.4124	0.5674	1.0218	0.9379	0.4172	0.8027	0.8294	0.9907
	0.0578	0.5639	0.4139	0.5728	1.0433	0.9397	0.4223	0.8400	0.8429	0.9915
	0.0582	0.5723	0.4220	0.6150	1.0510	0.9708	0.4576	0.8402	0.8677	0.9923
	0.0587	0.5968	0.4382	0.6512	1.1083	0.9828	0.4637	0.8652	0.8695	0.9931
	0.0587	0.6078	0.4699	0.7797	1.1292	0.9949	0.4824	0.9260	0.9103	0.9938
	0.0594	0.6440	0.4730	0.8421	1.1372	1.0879	0.4854	0.9835	0.9197	0.9946
	0.0600	0.6635	0.5119	1.0036	1.1381	1.0989	0.4876	1.0297	0.9308	0.9954
	0.0615	0.6670	0.5224	1.0473	1.1585	1.1257	0.4915	1.0445	0.9499	0.9961
	0.0633	0.6825	0.5365	1.0678	1.2322	1.1291	0.5758	1.0675	0.9604	0.9969
	0.0635	0.6843	0.5548	1.1651	1.2555	1.1817	0.5971	1.0692	1.0293	0.9977
	0.0645	0.7596	0.6006	1.2215	1.2883	1.3251	0.6025	1.2367	1.3498	0.9985
	0.0651	0.8293	0.7314	1.3768	1.4746	1.3255	0.9587	1.4577	1.4460	0.9992
	0.0665	1.1891	0.9198	1.4236	1.6868	1.3387	1.0245	1.5041	1.6293	1.0000
Average Measured Annual (ug/m3)	0.2652	0.8831	0.5188	1.4020	7.9132	2.9416	0.8476	4.6502	0.8390	
Corresponding Cumulative Fraction	1.0000	0.9992	0.9954	0.9992	1.0000	1.0000	0.9985	1.0000	0.9907	

Table 1. Upper 99th percentile concentration distributions for each Merced County township as estimated by SOFEA for 2011. Comparison of annual measured concentration to SOFEA-generated cumulative distributions within the township. In four of the 9 comparisons, the measured annual concentration was higher than the highest SOFEA-estimated value for that township. These cases were assigned a cumulative fraction of 1.000.

Additional Artificial Efforts to Increase SOFEA Concentrations. I attempted to artificially increase SOFEA-estimated concentrations by trying a variety of changes to the 2011 SOFEA met data. I wanted to find out if it was possible to get SOFEA to provide higher concentration estimates by manipulating the meteorological data. The changes consisted of including calm hours and various mixing height reductions. As a start, I substituted 1 m/s for all calm hours. Calm hours are assigned 0 m/s wind speed and are excluded from model calculations. By assigning these hours 1m/s wind speed, they will be included in the concentration calculations. Since there are generally more calm hours during the winter months and since many calm hours occur during the night, the effect of including these calm hours is to increase the percentage of F stability hours, which increases concentration estimates. This change by itself increased concentrations estimates but did not produce sufficiently high concentrations compared to the measured concentrations. Then I tried a series of mixing height changes. The default mixing height is 320m. Generally, lower mixing heights produce higher concentrations. At first I tried lowering mixing heights for January and December to an arbitrary level of 50m. This effect was insufficient. Then I tried both including calms and the Jan and Dec 50m mixing height. This was insufficient. After several more attempts with the mixing height, I simulated a mixing height of 5m for all 12 months in addition to including all calms (simulation J1386). This produced higher concentrations, but also compressed the distributions for each township.

Table 2 extracts from the low end and the high end of the SOFEA-produced distributions using the meteorology data set (J1386) with all calms included and 12 months at 5m high mixing height. The maximum values are much higher than those in Table 1 (simulation J1375, with 2011 meteorological data unchanged). For example, the 1.000 cumulative fraction line for J1375 exhibits all values less than 2.0 ug/m3. However, in the maximum value line for J1386 simulation (Table 2), 8 of the 9 values are well above 2 ug/m3. While this appears to be promising, an unwanted side effect is that the distributions become compressed. For example in township 8S:11E the coefficient of variation decreased from 92% to 33% (0.92 to 0.33). The compression of the distributions in J1386 compared to J1375 seems counter intuitive when, if anything, the SOFEA distributions should have larger variances in order to accommodate the range of concentrations. Six of the nine township's measured annual concentrations are less than the minimum SOFEA-produced distributional value; yet one measured value, 7.9 ug/m3 in 11S:7E, is still at the 99^{th} percentile of the township distribution even with the extreme meteorological conditions. This supports the need for greater, not lesser variance. In summary, these highly unrealistic meteorological conditions did increase the concentrations, but at the same time, reduced the within-distributional variance and resulted in six of the measured values being pegged at less than the minimum SOFEA generated township concentration.

If SOFEA is to be utilized to produce concentration distributions that more realistically encompass those measured in Merced, other factors should be considered: (1) variability in flux (2) meteorological conditions that are perhaps not captured by the ISCST3 model (3) other sources of variability, such as variability in application rates.

	Extract from Township SOFEA-estimated Annual Concentrations (ug/m3) with Artificial Meterological Data for 2011: (1) all calm hours included by setting wind speed to 1m/s (2) 5 m mixing height all 12 months (J1386)									Cumulativ
	8S:10E	8S:11E	8S:12E	7S:10E	7S:11E	7S:12E	6S:10E	6S:11E	6S:12E	Fraction
	0.5831	0.9755	2.5458	0.6866	1.9100	3.0023	1.0137	1.8573	2.1693	0.0008
	0.5856	0.9790	2.5501	0.6874	1.9327	3.0083	1.0142	1.8749	2.1780	0.0015
	0.5857	0.9858	2.5625	0.6899	1.9512	3.0318	1.0159	1.8928	2.1821	0.0023
	Middle of Distributions Omitted									
	1.6943	4.4307	3.9812	3.5520	6.6967	7.1673	4.0472	6.1311	8.4099	0.9907
	1.6958	4.4835	4.0417	3.6028	6.7050	7.1786	4.0751	6.2195	8.4644	0.9915
	1.7122	4.5486	4.0984	3.6293	6.7632	7.2197	4.2169	6.3263	8.5827	0.9923
	1.7506	4.5691	4.1158	3.7263	6.8662	7.2629	4.2988	6.4065	8.7036	0.9931
	1.7520	4.6993	4.2147	3.7419	6.8926	7.4172	4.3040	6.5078	8.8481	0.9938
	1.7543	4.8672	4.3261	3.7475	6.9256	7.4241	4.4028	6.5840	8.8882	0.9946
	1.7612	4.8934	4.3393	3.7533	6.9611	7.7161	4.6007	7.3090	8.9274	0.9954
	1.7983	4.9902	4.3543	3.7535	7.0026	7.9805	4.6664	7.3122	9.1526	0.9961
	1.8025	5.3199	4.5574	3.7948	7.1218	8.2784	4.7427	7.3661	9.4526	0.9969
	1.8064	5.7892	4.6639	3.8669	7.1623	8.4595	4.8320	7.9694	10.8612	0.9977
	1.8401	6.1635	4.7546	3.9394	7.7371	8.7184	5.2169	7.9790	11.6742	0.9985
	1.8410	6.5300	5.0069	3.9440	8.0238	9.0620	7.7670	8.8313	13.0362	0.9992
	1.8651	7.5226	5.0392	4.1439	8.3584	10.0712	7.8393	10.9507	13.9885	1.0000
Average Measured Annual (ug/m3)	0.2652	0.8831	0.5188	1.4020	7.9132	2.9416	0.8476	4.6502	0.8390	
Corresponding Cumulative Fraction	Below min	Below min	Below min	0.3966	0.9985	Below min	Below min	0.8881	Below min	
Mean (J1386), with artificial met	0.9266	2.2462	3.0699	1.7191	3.4149	4.3071	1.7961	3.5457	3.5493	
Standard dev (J1386), with artificial met	0.2287	0.7493	0.2980	0.6427	1.0319	0.7621	0.6676	0.9157	1.2720	
CV	0.2469	0.3336	0.0971	0.3739	0.3022	0.1769	0.3717	0.2582	0.3584	
Mean (J1375), unaltered met	0.0364	0.0959	0.1000	0.0737	0.2089	0.2411	0.1120	0.2281	0.2229	
Standard dev (J1375), unaltered met	0.0076	0.0883	0.0586	0.1062	0.1646	0.1414	0.0703	0.1324	0.1378	
CV	0.2102	0.9206	0.5858	1.4414	0.7877	0.5864	0.6281	0.5805	0.6180	

Table 2. Lower and upper portions of township concentration distributions resulting from SOFEA simulation (J1386) where mixing height was 5m for the entire year and all calms were included by setting wind speed for calms to 1m/s. Also shown cumulative fraction of measured concentrations within the context of these distributions. And the bottom of the table compares coefficient of variation (CV) for J1386 and J1375.

References

Brett, Brian L. 2012. Letter to Susan Sutherland on "Historical Use Data of Adjusted Pounds of 1,3-Dichloropropene in California from 1995 to 2011" dated 10 May 2012.

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

Johnson, Bruce. 2007b. 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-d. Dated March 27, 2007.

Johnson, Bruce. 2007c. Memorandum to Tobi L. Jones, Ph.D., on Simulation of concentrations and exposure associated with DAS-proposed township caps for Merced County for 1,3-d. Dated March 29, 2007.

Johnson, Bruce. 2014. Evaluation Report – Pesticide. 1,3-Dichloropropene, 263794, Dow AgroSciences, LLC, 50046-0210 (replaces 0209).

Van Wesenbeeck, Ian. 2004. Results of township cap simulations in 25 (5x5) contiguous Merced townships all treated with 90,250 or 180,250 adjusted pounds of 1,3-D. Letter dated February 16, 2004.

Van Wesenbeeck, Ian. 2005. Letter to Dr. Bruce Johnson dated January 17, 2005 RE: Results of township cap simulations in 25 (5x5) continguous [sic] Merced and Ventura townships.

Van Wesenbeeck, Ian J. and Steven A. Cryer. 2004. SOFEA (Soil Fumigant Exposure Assessment system) User's Guide. August 2004. Dow AgroSciences 9330 Zionsville Rd., Indianapolis, IN 46268 Docket Number EPA HQ OPP 2004 0242 0004,

Van Wesenbeeck I.J., S.A. Cryer and O. de Cirugeda Helle. 2013. Validation of SOFEA2 with 1,3-Dichloropropene ambient monitoring data in Merced County California – REVISED report [revised March 2014]. Regulatory Science and Governnment Affairs, Dow AgroSciences LLC 9330 Zionsville Road, Indianapois, Indiana 46268-1054. Lab Study ID 131271.

Vidrio, Edgar and Bruce Johnson. 2011 (rev 2014). Part 1: ISCST3 data preparation from CIMIS weather station data. July 2011, Revised January 2014. California Environmental Protection Agency Department of Pesticide Regulation Environmental Monitoring Branch Air Program P.O. Box 4015 Sacramento, California 95812-4015.

Appendix.

Annual/Perennial	Crop
A	ASPARAGUS (SPEARS, FERNS, ETC.)
A	ASPARAGUS (SPEARS, FERNS, ETC.)
A	CANTALOUPE
A	CANTALOUPE
A	ENDIVE (ESCAROLE)
A	MELONS
A	N-OUTDR CONTAINER/FLD GRWN PLANTS
A	N-OUTDR GRWN TRNSPLNT/PRPGTV MTRL
A	RYE (ALL OR UNSPEC)
A	SUGARBEET, GENERAL
A	SUGARBEET, GENERAL
A	SWEET POTATO
A	TOMATO
A	TOMATOES, FOR PROCESSING/CANNING
P	ALMOND
P	CHERRY
P	GRAPES, WINE
P	PEACH
P	PISTACHIO (PISTACHE NUT)
P	PISTACHIO (PISTACHE NUT)
P	WALNUT (ENGLISH WALNUT, PERSIAN WALNUT)

Table A1. Classification of PUR Merced crops into annual and perennial categories.

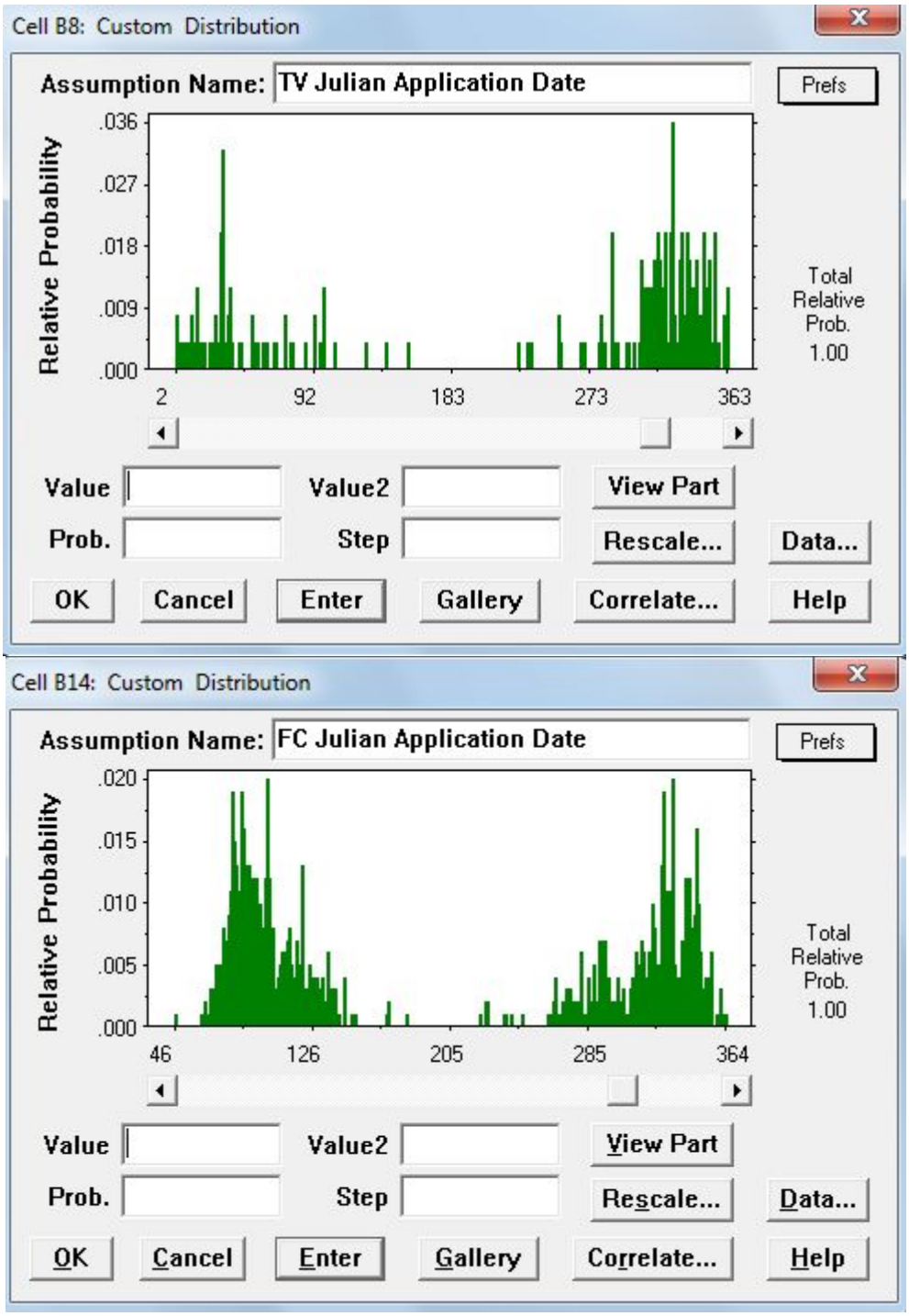

Table A2. Perennial (TV) and annual (FC) application date probabilities..

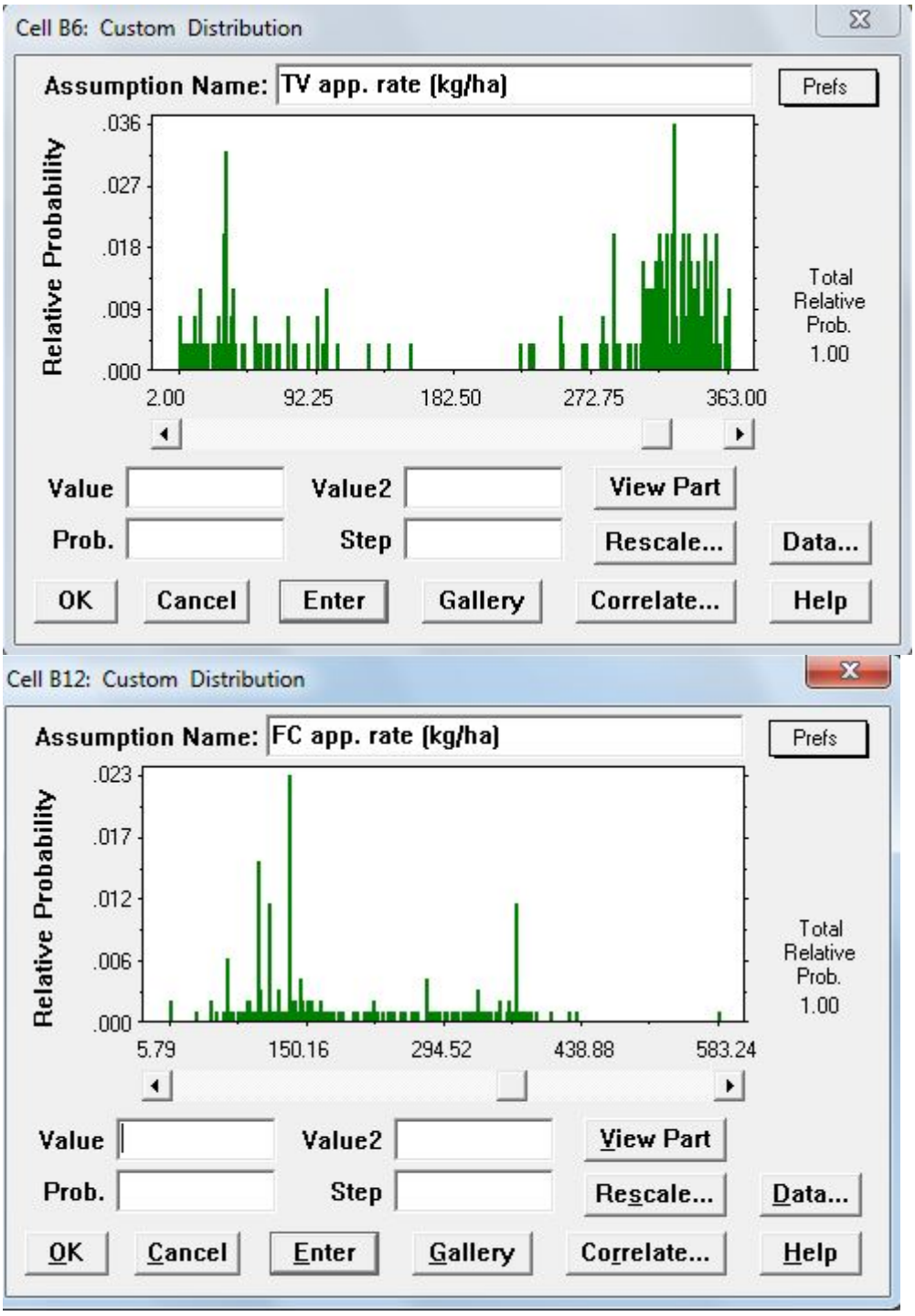

Table A3.. . Perennial (TV) and annual (FC) application rate (kg/ha) probabilities

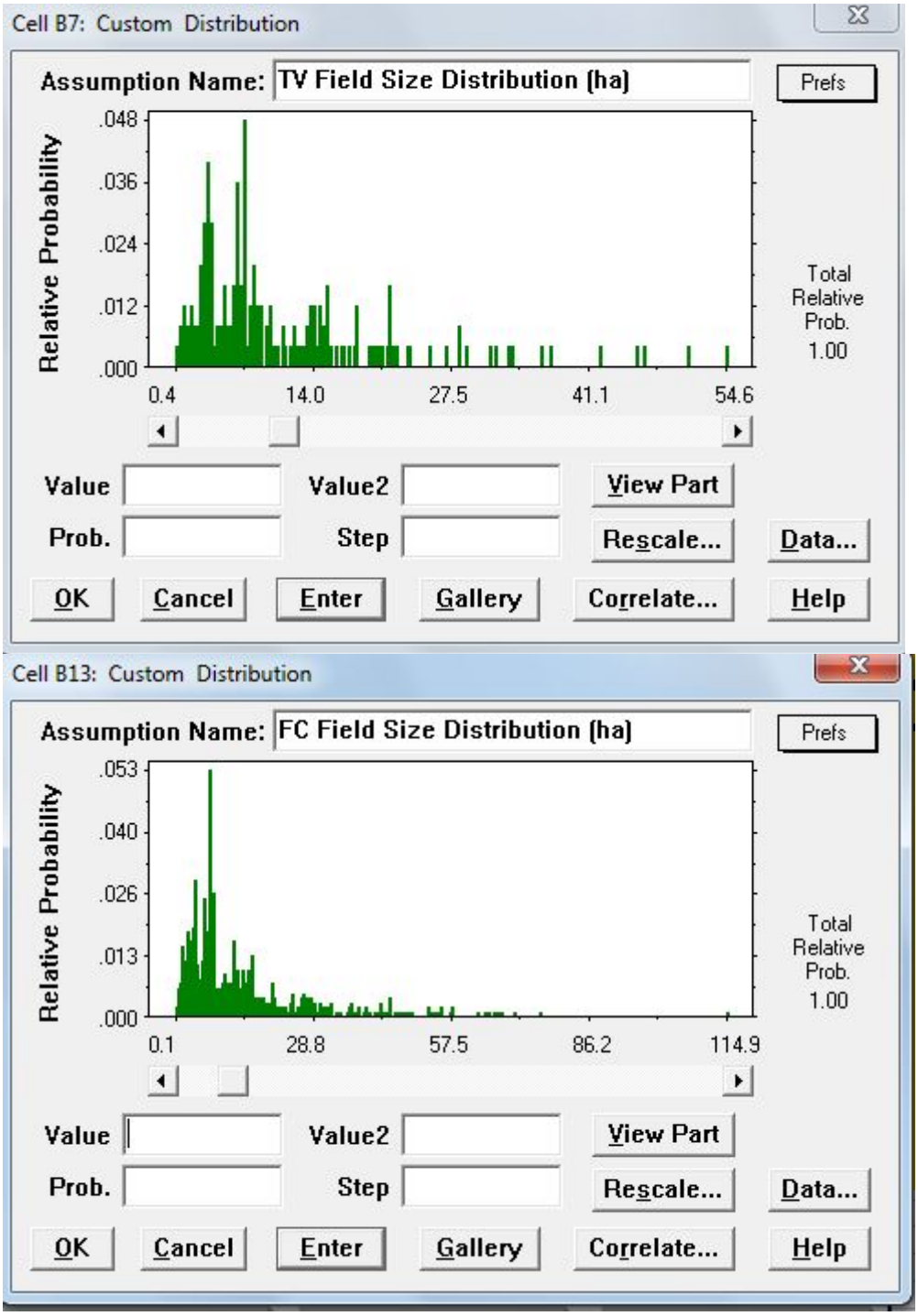

Table A4. Perennial (TV) and annual (FC) field size (ha) probabilities.

	Acres Treated				Fraction	
Year	Annual	Perennial	Total		Annual	Perennial
2007	5694	1253	6946		0.82	0.18
2008	7602	1503	9105		0.83	0.17
2009	6888	859	7746		0.89	0.11
2010	7175	1844	9019		0.80	0.20
2011	1979	440	2420		0.82	0.18
				Avg	0.83	0.17

Table A5. Crop fractions by acreage.

	9e	10e	11e	12e	13e
5s	0	8441	60005	6558	71367
6s	0	55992	148439	111890	63949
7s	4632	37783	132781	137394	20555
9s	0	0	66353	18192	0
9s	3368	0	77446	20172	0
	9e	10e	11e	12e	13e
5s	0.00	0.09	0.66	0.07	0.79
6s	0.00	0.62	1.64	1.24	0.71
7s	0.05	0.42	1.47	1.52	0.23
9s	0.00	0.00	0.74	0.20	0.00
9s	0.04	0.00	0.86	0.22	0.00

Table A6. Township use levels for 2011. Top: adjusted pounds (Brett 2012). Bottom: as fraction of township cap (90250 lbs).

		10E						11E						12E				
	0.000	0.017	0.000	0.032	0.029	0.000	0.011	0.035	0.049	0.004	0.000	0.008	0.029	0.012	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.015	0.065	0.014	0.044	0.001	0.007	0.007	0.020	0.003	0.005	0.000	0.015	0.000	0.005	0.023
6S	0.000	0.000	0.000	0.000	0.126	0.000	0.000	0.024	0.009	0.000	0.000	0.023	0.018	0.000	0.034	0.012	0.047	0.008
	0.000	0.000	0.000	0.000	0.000	0.286	0.015	0.051	0.017	0.156	0.000	0.022	0.027	0.019	0.015	0.024	0.065	0.025
	0.000	0.015	0.062	0.000	0.056	0.000	0.033	0.007	0.027	0.085	0.000	0.000	0.023	0.145	0.015	0.065	0.015	0.000
	0.000	0.000	0.166	0.000	0.000	0.117	0.000	0.005	0.107	0.091	0.054	0.086	0.222	0.072	0.036	0.019	0.007	0.000
	0.000	0.000	0.000	0.000	0.211	0.364	0.046	0.018	0.029	0.016	0.068	0.024	0.022	0.021	0.003	0.019	0.014	0.001
	0.032	0.000	0.000	0.036	0.078	0.000	0.021	0.006	0.020	0.050	0.037	0.023	0.038	0.070	0.028	0.100	0.039	0.034
7S	0.118	0.000	0.000	0.082	0.055	0.024	0.014	0.045	0.167	0.074	0.072	0.025	0.057	0.038	0.000	0.039	0.061	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.000	0.000	0.011	0.000	0.000	0.044	0.033	0.036	0.025	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.065	0.038	0.012	0.000	0.000	0.000	0.020	0.161	0.087	0.003	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.037	0.000	0.003	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000
	0.028	0.028	0.028	0.028	0.028	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.028	0.028	0.028	0.028	0.028	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8S	0.028	0.028	0.028	0.028	0.028	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.028	0.028	0.028	0.028	0.028	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.028	0.028	0.028	0.028	0.028	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.028	0.028	0.028	0.028	0.028	0.028	0.077	0.000	0.000	0.000	0.307	0.615	1.000	0.000	0.000	0.000	0.000	0.000

Table A7. Annual crops section weights based on average 1,3-d applied acreage (2007-2011) for these 9 townships. Double lines separate the 9 townships. Note that within each township, section weights total 1.00. Section numbering within each township shown in this Table follows the Public Land Survey System for numbering sections within a township.

	10E						11E						12E					
	0.000	0.000	0.233	0.018	0.000	0.038	0.091	0.000	0.026	0.014	0.033	0.034	0.015	0.031	0.026	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.024	0.077	0.000	0.000	0.016	0.006	0.088	0.003	0.000	0.000	0.000	0.064	0.000
6S	0.000	0.000	0.000	0.000	0.043	0.022	0.000	0.033	0.153	0.000	0.180	0.087	0.043	0.052	0.066	0.000	0.000	0.025
	0.000	0.044	0.000	0.000	0.000	0.329	0.052	0.000	0.043	0.000	0.035	0.023	0.000	0.023	0.022	0.022	0.025	0.056
	0.000	0.000	0.000	0.000	0.224	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.011	0.110	0.108	0.019	0.000
	0.000	0.000	0.024	0.000	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.145	0.011	0.094	0.022	0.000
	0.000	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.046	0.119	0.200	0.000	0.001	0.144	0.066	0.041	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	0.025	0.238	0.015	0.000	0.000	0.043	0.000
7S	0.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.152	0.030	0.048	0.000	0.000	0.000	0.000	0.032	0.211
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.271	0.210	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	0.070	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	0.000
	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
8S	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028

Table A8. Perennial crops section weights based on average 1,3-d applied acreage (2007-2011) for these 9 townships. Double lines separate the 9 townships. Note that within each township, section weights total 1.00. Section numbering within each township shown in this Table follows the Public Land Survey System for numbering sections within a township.

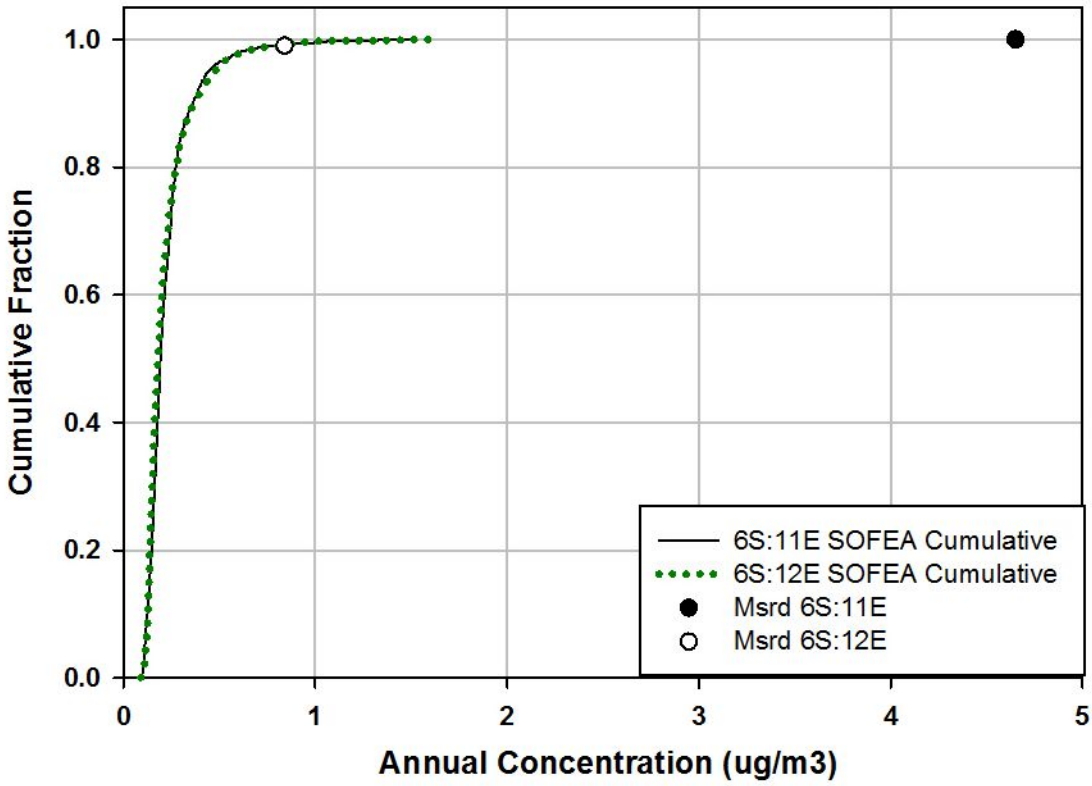

Figure A1. Two example plots, townships 06S:11E and 06S:12E, showing the relationship between the SOFEA-generated cumulative concentration distributions (lines) and the corresponding single average annual concentration estimate from the monitoring data (circles). For 06S:11E the measured value exceeded all model-estimated concentrations. For 06S:12E the measured value was at the 99th percentile of SOFEA-estimated concentrations for that township.

bcc: Johnson Surname File