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Updates to HYDRUS-simulated flux estimates of 1,3-dichloropropene maximum period-averaged flux and emission ratios

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Background

1,3-Dichloropropene (1,3-D) is a fumigant used to control nematodes, insects, and disease organisms in the soil. It is commonly used as a pre-plant treatment that is applied to the soil using an injection line attached to a subsoiler shank or via drip irrigation lines in bedded fields. Regardless of the application method, some amount of off-site transport will inevitably occur following the volatilization and emission of the fumigant from the field surface, creating a pathway for potential human exposure via inhalation. Long-range transport of 1,3-D emissions and its impact on ambient air quality over extended time periods is one concern of DPR's ongoing air monitoring activities (i.e., Collins 2020, Gonzalez 2020).

Modeling of 1,3-D flux from fumigated fields is a key element of the California Department of Pesticide Regulation's (DPR) development of mitigation measures, as it allows quantitative estimation of the variation that may occur in fumigant emissions in response to environmental conditions or application decisions. Such detailed estimates could not practically exist otherwise, due to the enormous time and expensive involved in field studies. Brown (2019a) previously described development of flux time series (i.e., "flux profiles") using the HYDRUS 2-D vadose zone model (Šimunek et al. 2006), a process-based model that simulates the advective and diffusive-dispersive transport of fumigant in the liquid and gas phases from the point of injection until such time that it either degrades or emits from the soil surface. That peer-reviewed document provides a detailed description of the model inputs and underlying assumptions, the sources for each model input, and a description of the uncertainties in model inputs that existed at that time.

This report describes updates made in the development of flux profiles for the fumigant 1,3-D since the time of its original description in the report of Brown (2019a). The three-year period since the time of the original report has allowed for additional time and resources to be dedicated to data collection and refinement of the original model. The changes can be broadly categorized as either 1) simulation of newly introduced application methods 2) inclusion of additional soils data collected during the 2020-2021 1,3-D Pilot Studies (DPR 2020), 3) updates to the soil pedotransfer function used to predict soil hydraulic properties, 4) lengthened tarping periods for application methods using low permeability films, and 5) refinements to reduce model mass balance error and increase efficiency of model runs. Additional work has also been performed to better characterize the soil water content of those fields contained within the DPR soils variability dataset, although it does not directly affect flux profile output. Each development is described separately in the sections below.

Updates to Modeling Procedures

New application methods

The report of Brown (2019a) was published prior to the 2020-2021 1,3-D Pilot Study and therefore predated the introduction of several new proposed methods. While certain field fumigation methods (FFMs) were detailed across other reports in a piecemeal fashion (e.g., 18-inch broadcast 50/50 strip in Brown [2019b], 24-inch broadcast injection in Brown [2019c]), others have yet to be described in formal reports (e.g., 24-inch bedded injection, 24-inch broadcast 50/50 with totally impermeable film [TIF]). Therefore, these additional application methods are described here and simulated using the revisions described in this report. Table 1 lists each of the methods simulated in this report, while Table A-1 (appendix) summarizes the main differences between each application method on the basis of model inputs.

Table 1. List of 1,3-D application methods described in this report.

FFM code	Method Description
1201	1,3-D - Nontarpaulin/Shallow/Broadcast
1202	1,3-D - Tarpaulin/Shallow/Broadcast
1203	1,3-D - Tarpaulin/Shallow/Bed
1204	1,3-D - Nontarpaulin/Shallow/Broadcast w/ 3x Irrigation
1205	1,3-D - Tarpaulin/Shallow/Bed w/ 3x Irrigation
1206	1,3-D - Nontarpaulin/Deep/Broadcast
1207	1,3-D - Tarpaulin/Deep/Broadcast
1208	1,3-D - Tarpaulin/Deep/Bed
1209	1,3-D - Tarpaulin/Chemigation/Bed
1210	1,3-D - Nontarpaulin/Deep/Strip*
1224	1,3-D - Nontarpaulin/24-inch/Broadcast
1225	1,3-D - Tarpaulin/24-inch/Broadcast
1226	1,3-D - Nontarpaulin/24-inch/Strip*
1242	1,3-D - TIF/Shallow/Broadcast
1243	1,3-D - TIF/Shallow/Bed
1245	1,3-D - TIF/Shallow/Bed w/ 3x Irrigation
1247	1,3-D - TIF/Deep/Broadcast
1248	1,3-D - TIF/Deep/Bed
1249	1,3-D - TIF/Deep/Strip
1250	1,3-D - 50% TIF/Deep/Broadcast
1259	1,3-D - TIF/Chemigation/Bed
1264	1,3-D - 50% TIF/24-inch/Broadcast

***** Nontarpaulin strip methods are treated as equivalent to their broadcast counterpart (FFM 1206 = FFM 1210; FFM 1224 = FFM 1226).

Additional soils data

Staff from DPR's Environmental Monitoring Branch analyzed soil properties of fields encountered over the course of a series of five DPR-sponsored field fumigation flux studies performed between 2021 and 2022. The soils data from those five studies were subsequently added to the soils variability dataset for inclusion in the revised 1,3-D flux simulations. The original 1,3-D flux profiles described by Brown (2019a) utilized a soils variability dataset consisting of 16 soils; with the new data, the simulations can now be performed for 21 distinct sets of soil conditions. As was the case for all prior soils data, the newly cataloged soils data is considered representative of pre-fumigation soil conditions due to the retrieval of soils samples from fields within a 24-hour window occurring prior to fumigation and following completion of field preparations (e.g., tillage, irrigation, etc.). The new soils data notably include a number of sandy and sandy loam soils which were under-represented in the earlier dataset; coarse soils are thought to be among those soil types most often fumigated in some areas of California (Johnson and Spurlock 2009).

The soils sampled during the 2020-2021 flux studies additionally included a number of improvements to the sampling methodology, including increased sampling resolution along the soil profile (i.e., five sampling depths instead of three), and inclusion of soil water retention and soil organic carbon (OC) content analyses during processing of each sample. Analysis for total soil organic carbon was performed by the dry combustion method (Nelson and Sommers 1996) using a total organic carbon autoanalyzer according to the standard operating procedure detailed by Goodell (2016). Analysis was performed in-house in DPR's Environmental Monitoring Branch soil laboratory. Detailed soil property data is included in Tables A-1 through A-5 (appendix).

The increased availability in OC data allowed a reassessment of prior assumptions made regarding soil OC content in fumigated soils. Soil OC plays a large role in influencing the partitioning of 1,3-D between aqueous and sorbed phases, and therefore affects emissions over both short- and long-term timescales. The limited OC data was noted as a shortcoming in the available soils data when 1,3-D flux profiles were initially developed in Brown (2019a), and those early simulations therefore relied on conservative estimates of soil OC content due whereby OC was assumed to be entirely absent below depths of 30 cm (i.e., OC = 0). The values used were, on average, lower than the lowest observed value across all of DPR's soil sampling to date. That prior assumption has now been adjusted such that measured OC values are used where such data is available (8 out of 21 soils), and soils without available OC data otherwise use a median value calculated from all available OC data (Table 2). The OC below the lowest depth of sample collection (70 cm) is still conservatively assumed equal to 0 in all cases.

Table 2. Measured soil organic carbon percentage by location and soil depth for each of the 8 sites with data available in DPR's soil variability dataset. The median OC is calculated based on the distribution of available values at each soil depth.

Soil No.	Location	0-10 cm	10-20 cm	20-30 cm	30-50 cm	50-70 cm
1	Lost Hills	0.6	0.5	0.5	0	0
2	Lost Hills	0.66	0.45	0.45	0.15	0.12
3	Lost Hills	0.59	0.45	0.45	0.21	0.17
17	Denair	0.594	0.233	0.168	0.188	0.199
18	Shafter	0.278	0.322	0.281	0.157	0.256
19	Shafter	1.273	1.177	0.402	0.55	0.75

20	Atwater	0.539	0.55	0.66	0.215	0.115
21	Rio Oso	1.117	1.377	1.353	0.737	0.27
Median	--	0.60	0.48	0.45	0.20	0.18

Updated pedotransfer functions

Air Program HYDRUS simulations rely on the use of pedotransfer functions to estimate retention curve shape parameters, saturated hydraulic conductivity, and pore connectivity coefficients for those soils catalogued in the soil variability dataset. These parameters are responsible in large part for determining the rate and direction of water movement in HYDRUS simulations. Pedotransfer functions use several easily measured soil characteristics to estimate these parameters, which would otherwise require challenging and time-consuming laboratory experiments to estimate.

The simulations described by Brown (2019a) used the HYDRUS implementation of the original ROSETTA suite of pedotransfer functions (from Schaap et al. 2001), using a four-parameter model requiring measured soil bulk density and soil texture variables (i.e., measured proportion of sand, silt, and clay) as inputs. This earlier version of the ROSETTA model does not provide output of a pore connectivity coefficient (*l*), and this value was therefore assumed to be a default value of 0.5 for all soils and all soil layers.

The revised flux profiles now utilize the ROSETTA 2.0 pedotransfer function to predict soil hydraulic properties based on available soils data (Schaap et al. 2004). This updated model corrects for a substantial pressure head-dependent bias in estimated water contents which under-estimated water contents by 0.02 to 0.05 cm^3 cm^{-3} at pressure heads larger than 100 cm (Schaap et al. 2001). ROSETTA 2.0 corrects for this bias by applying a linear transformation to the predicted shape parameters, substantially reducing systematic errors and improving water content prediction relative to the prior version (Schaap et al. 2004). This implementation additionally includes prediction of the pore connectivity coefficient based on soil properties. The updated hydraulic parameter estimates are provided alongside other soil properties data in Tables A-1 through A-5 (appendix).

Increased tarp duration for TIF methods

Flux profiles for application methods using totally impermeable film (TIF) currently use a minimum duration of 9 days before cutting and removing a TIF tarp according to DPR’s recommended permit conditions (CDPR 2017). DPR should consider revising the duration to 10 days in order to ensure air concentrations at the setback distance remain no greater than the 55 parts per billion (ppb) regulatory target concentration specified by its 2021 Risk Management Directive (Henderson 2021). This modification is based on the results of a modeling process that coupled HYDRUS output with an air dispersion model to determine the minimum tarping duration necessary to reduce the median setback duration to a period of less than 7 days in order to conform with permit condition requirements.

Preliminary setback modeling, following the methods described by Luo (2022), demonstrated that short-term peaks in 1,3-D emissions occurring at the time of TIF cutting were often of a magnitude sufficient to elevate off-field air concentrations to levels above the 55 ppb 1,3-D regulatory target and therefore require implementation of health-protective setback distances for these application methods. In such cases, the duration of any setback distances or buffer zones must generally be extended to match the tarp duration in order to mitigate potential exposure during a sudden pulse in emissions at the time of tarp cutting. Very low permeability films, such as those used for TIF tarps, can entrap fumigant gases beneath the tarp where they may persist at relatively high concentrations; further lengthening the period prior to tarp-cut provides additional time for degradation and attenuated emission of fumigant through the tarp surface, reducing the magnitude of the emissions peak upon tarp cutting. If the tarp period is sufficiently long, the magnitude of the emissions pulse at the time of tarp cutting could be lowered such that the setback duration would no longer need to bound the entire tarp period. Therefore, we evaluated the feasibility of extending the tarp duration for TIF methods in order to conform to the label-required 7-day setback period.

A coupled modeling approach combined flux profiles generated by the HYDRUS model with around-field air concentration predictions from AERFUM (Luo 2019) to estimate the necessary setback distance and duration for FFMs 1242 (TIF/broadcast/shallow), 1245 (TIF/broadcast/deep), and 1249 (TIF/strip/deep). The selected methods were those that had been demonstrated in preliminary modeling to exceed a median setback duration of 7 days under the base scenario (i.e., tarp duration = 9 days) due to the release of relatively large amounts of 1,3-D upon tarp cutting.

Variations of the base scenario were simulated in the HYDRUS model, with extensions of the tarping duration in 1-day increments to a duration of up to 14 days. A total of 19 flux profiles were generated for each combination of FFM and tarp-cut duration, based on variation in soil properties (soils 20 and 21 having not yet been added to the soils variability dataset at the time of analysis).

Setback modeling in AERFUM assumed worst-case application conditions (application rate of 332 lbs ac^{-1} and application block size of 80 ac) and used meteorological data representative of the San Joaquin Valley (Luo 2022). Setback distance and setback duration estimates were generated for each combination of FFM, tarp duration, and soil type based on the 95th percentile of daily estimates obtained over a 5-year simulation period from 2013-2017. Additional details of the AERFUM setback modeling approach are detailed in Luo (2022).

Output from coupled HYDRUS-AERFUM modeling demonstrated that an increase in tarping duration by a single day (i.e., 10-day tarpcut) reduced median setback duration to 0 days for each of the three FFMs evaluated. The additional day of tarping was estimated by the HYDRUS model to reduce the 72-hr peak in emissions following tarpcut by 26-30% depending on FFM, which was sufficient to reduce the 95th percentile of setback duration to a median value of 0 days for the 19 soils evaluated. An extended TIF tarp duration of 10 days was therefore concluded to provide setback durations of 7 days.

Field capacity estimates

Field capacity (FC) is defined as “the content of water, on a mass or volume basis, remaining in a soil 2 or 3 days after having been wetted with water and after free drainage is negligible” (Soil Science Society of America 1997). Field capacity will vary widely in response to soil properties including texture, organic matter content, and bulk density. Product labels for 1,3-D require a minimum pre-fumigation soil moisture level as a proportion of FC, evaluated according to the "Feel and Appearance Method" of soil moisture assessment (United States Department of Agriculture [USDA] 1998); in other words, product labels gauge acceptable soil moisture not based on an absolute, scientific measure such as volumetric water content, but on the relative scale of percent field capacity, and therefore it is impossible to say whether some volumetric water content value measured in the field via core sampling, say 0.1 cm^3 cm^{-3}, is an acceptable pre-fumigation soil condition without knowing the FC of that soil. Therefore, DPR sees value in measuring FC for soils within its soils modeling dataset, and in developing a model-based estimation process for soils where no empirical FC estimates are available; such FC estimates allow DPR staff to place volumetric water content measurements (such as those in tables A-1 and A-2) in the context of label-required soil moisture requirements.

A series of field experiments were performed over the course of the 2020-2021 1,3-D pilot studies to estimate a soil's FC *in situ* based on the saturation and subsequent drainage of water from that soil over a two-day period (Tuli et al. 2022). A method of modeling soil FC in HYDRUS was subsequently developed and validated against field estimates, and that modeling method was then applied to the estimation of FC for all soils contained within the DPR soils variability dataset (Brown et al. 2022). Measured soil water content in each layer of the soils described in the DPR soils variability dataset (measured via mass water loss from soil core samples upon oven drying) was compared to the FC estimate in order to estimate the observed water content as a percentage of field capacity in the region of interest on product labels (3 to 9 inch [7.6-to-22.9 cm] depth). The resulting estimates are summarized in Table 3: estimated FC in units of volumetric soil water content, and the observed volumetric water content (from tables A-1 and A-2) as a percentage of estimated FC (pFC).

Table 3. Estimates of field capacity (as volumetric water content) and observed soil water content (as percentage of field capacity, pFC) for each of 21 soils in the CDPR soil variability dataset based on a field capacity definition of "negligible drainage" (-2% change in water volume over a 24-hour period). The pFC values are calculated as the quotient of the average observed water content in the 3-to-9-inch soil layer (based on mass water loss from oven-dried soil core samples) and the modeled field capacity estimate multiplied by 100. A pFC value of greater than 100 indicates that gravitational drainage of soil water is thought to have still been occurring at the time of soil sampling. Texture classes correspond to those used for the USDA Soil and Appearance method: Coarse = sand, loamy sand, sandy loam; Medium = sandy clay loam, loam, silt loam; Fine = clay loam, silty clay loam, sandy clay, silty clay, and clay.

Soil no.	Texture Class	Field Capacity (cm^3 cm^{-3})	pFC
1	Medium	0.264	81%
2	Medium	0.291	92%
3	Medium	0.295	88%
4	Fine	0.271	50%
5	Medium	0.161	25%
6	Coarse	0.190	40%
7	Medium	0.258	76%
8	Fine	0.248	49%
9	Fine	0.266	42%
10	Fine	0.284	69%
11	Coarse	0.211	61%
12	Fine	0.350	50%
13	Coarse	0.265	51%

14	Fine	0.299	67%
15	Medium	0.318	54%
16	Fine	0.316	68%
17	Coarse	0.220	72%
18	Coarse	0.162	63%
19	Coarse	0.207	53%
20	Coarse	0.098	116%
21	Coarse	0.258	50%
Mean	-----	-------	

Other model refinements

Small refinements were made to modeling domain design to accommodate the higher resolution soil profile data (i.e., 6 layers instead of 3), reduce water and solute mass balance errors, and increase computational efficiency of model runs. Those changes included a simplified domain design for broadcast applications, minor adjustments to initial temperature distribution, revised handling of evaporative losses, and forced reduction in time steps during periods of rapid change at the atmospheric or tarp boundary condition (e.g., tarp removal or irrigation events). With these changes, water and solute mass balance errors were consistently below 1%, both at end-of-simulation and throughout intermediate timesteps, indicating very low simulation numerical error.

Results

Table 4 summarizes maximum 24-h flux, maximum 72-h flux, and emission ratio (ER) at 21 days post-application from HYDRUS simulation output, and results are broken down further by soil type in Table A-6 (appendix). Maximum period flux is calculated as the maximum value returned by a 24- or 72-h sampling window shifted in 1-hour increments across the entirety of each simulated flux profile (i.e., a moving average), whereas ER is calculated as the quotient of cumulative emissions at the end of the simulation (21-day period) and the total mass of fumigant initially applied (i.e., ER = [cumulative 1,3-D emissions] / [total 1,3-D applied]). Standard deviation is provided as a measure of variability around the mean of each value resulting from variation across the 21 soil types included in the simulation of each application method. Quantile-comparison plots (not shown) indicated that the distribution of maximum flux and ER values follow an approximately normal distribution within each application method. Max 24-h flux, max 72-h flux, and ER were strongly correlated across application methods (i.e., $r^2 > 0.80$).

Across all simulations, mean ER varied from a low of 0.08 +/- 0.04 (where +/- represents the range of 1 standard deviation) for an 18” deep broadcast injection treatment with TIF (FFM 1247) and up to a maximum of 0.52 +/- 0.05 for bedded chemigation with polyethylene tarp (FFM 1209). Mean max 24-h flux varied from a minimum of 1.92 +/- 0.85 ug m^{-2} s^{-1} for 18” deep strip treatments with TIF (FFM 1249) to a maximum of 36.89 +/- 4.08 ug m^{-2} s^{-1} (FFM 1209). Mean max 72-h flux varied from a minimum of 1.16 +/- 0.50 ug m^{-2} s^{-1} (FFM 1247) to a maximum of 18.94 +/- 2.31 ug m^{-2} s^{-1} (FFM 1209).

Except for FFM 1209 (polyethylene-tarped chemigation), the flux estimates presented here are lower than those previously described in Brown (2019a,b,c). The overall reduction is attributed mainly to the revised OC assumptions. Simulated using the prior OC assumptions described in Brown (2019a) but otherwise implementing all other modifications described in this document, three benchmark methods (FFM 1206, FFM 1224, FFM 1242) demonstrated either no change or a small increase in mean 24-hour flux (+3% to +7%), 72-hour flux (0% to +5%), and ER (0% to +2%) compared to the original flux profiles described by Brown (2019a). Therefore, the differences in the revised flux estimates (typically in the range of -20% to -40% compared to the initial version) result primarily from the use of measured OC data in the revised estimates. The changes in estimated flux are consistent with prior evaluation of parameter sensitivity performed by Spurlock et al. (2013), which found that phase partitioning parameters (including OC) were among those parameters having the greatest influence on fumigant flux over both short- and long-term time periods in broadcast and bedded shank applications.

Table 4. Mean estimates of maximum 24-h flux, maximum 72-h flux, and emission ratio (ER) at 21 days post-application as obtained from HYDRUS simulations of each application method performed across a series of 21 soil types. Standard deviation (SD) is provided for each estimate as a measure of the variability associated with each method in response to variability in soil characteristics. Results are normalized to 100 lbs ac^{-1} broadcast equivalent per DPR convention.

FFM code	**Method Description**	**Max 24-h Flux (µg m^{-2} s^{-1})**	**SD**	**Max 72-h Flux (µg m^{-2} s^{-1})**	**SD**	**ER @ 21 days**	**SD**
1201	1,3-D - Nontarpaulin/Shallow/Broadcast	23.93	8.64	15.52	4.28	0.49	0.10
1202	1,3-D - Tarpaulin/Shallow/Broadcast	16.79	5.97	11.83	3.42	0.40	0.09
1203	1,3-D - Tarpaulin/Shallow/Bed	23.20	8.40	15.25	4.43	0.46	0.10
1204	1,3-D - Nontarpaulin/Shallow/Broadcast w/ 3x Irrigation	14.80	6.81	9.79	3.98	0.35	0.11
1205	1,3-D - Tarpaulin/Shallow/Bed w/ 3x Irrigation	22.61	8.04	14.76	4.18	0.45	0.10
1206	1,3-D - Nontarpaulin/Deep/Broadcast	8.41	4.78	6.95	3.51	0.29	0.11
1207	1,3-D - Tarpaulin/Deep/Broadcast	6.39	3.33	5.46	2.68	0.25	0.10
1208	1,3-D - Tarpaulin/Deep/Bed	11.23	6.48	8.83	4.46	0.33	0.13
1209	1,3-D - Tarpaulin/Chemigation/Bed	36.89	4.08	18.94	2.31	0.52	0.05
1210	1,3-D - Nontarpaulin/Deep/Strip*	8.41	4.78	6.95	3.51	0.29	0.11
1224	1,3-D - Nontarpaulin/24-inch/Broadcast	3.94	2.92	3.57	2.52	0.19	0.11
1225	1,3-D - Tarpaulin/24-inch/Broadcast	3.48	2.14	3.03	1.94	0.17	0.10
1226	1,3-D - Nontarpaulin/24-inch/Strip*	3.94	2.92	3.57	2.52	0.19	0.11
1242	1,3-D - TIF/Shallow/Broadcast	2.30	0.74	2.00	0.55	0.11	0.04
1243	1,3-D - TIF/Shallow/Bed	4.99	2.65	4.31	2.07	0.18	0.08
1245	1,3-D - TIF/Shallow/Bed w/ 3x Irrigation	4.06	2.02	3.52	1.54	0.15	0.06
1247	1,3-D - TIF/Deep/Broadcast	2.06	0.96	1.16	0.50	0.08	0.04
1248	1,3-D - TIF/Deep/Bed	4.30	2.90	3.73	2.38	0.17	0.09
1249	1,3-D - TIF/Deep/Strip	1.92	0.85	1.33	0.63	0.09	0.05
1250	1,3-D - 50% TIF/Deep/Broadcast	4.43	2.54	3.80	1.99	0.18	0.08
1259	1,3-D - TIF/Chemigation/Bed	5.50	0.75	4.07	0.84	0.16	0.04
1264	1,3-D - 50% TIF/24-inch/Broadcast	2.25	1.57	2.03	1.44	0.13	0.08

* Results for nontarpaulin strip methods are identical to the broadcast counterpart (1210 = 1206, 1226 = 1224).

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Appendix

Table A-1. Summary of soil physical properties used in HYDRUS simulations for each soil layer. Soil cores were obtained by DPR staff from prepared fields within 24 hours prior to fumigation. 'Location' indicates the nearest incorporated area or census-designated place to the fumigated field. Number suffixes for listed parameters correspond to soil layer code and associated depth interval: 1 = 0-10 cm, 2 = 10-20 cm, 3 = 20-30 cm, 4 = 30-50 cm, 5 = 50-70 cm, 6 = 70-120 cm. Parameters are coded as BD = bulk density, theta = measured volumetric water content, thetaR = residual volumetric water content, thetaS = saturated volumetric water content. BD and theta are measured values from core samples. ThetaR is estimated from measured soils data using the ROSETTA 2 pedotransfer function. ThetaS is estimated as soil sample porosity (1 – (BD/2.65)). Additional parameters are summarized in subsequent tables.

Soil No.	Location	Code	BD1	theta1	thetaR1	thetaS1	BD2	theta2	thetaR2	thetaS2	BD3	theta3	thetaR3	thetaS3
1	Lost Hills	LH1	1.18	0.17	0	0.55	1.45	0.22	0	0.45	1.45	0.22	0	0.45
2	Lost Hills	LH2	1.20	0.20	0	0.55	1.45	0.27	0	0.45	1.45	0.27	0	0.45
3	Lost Hills	LH3	1.23	0.21	0	0.53	1.38	0.26	0	0.48	1.38	0.26	0	0.48
4	Crow's Landing	cro1	1.27	0.07	0	0.52	1.26	0.14	0	0.52	1.26	0.14	0	0.52
5	Dinuba	din1	1.47	0.01	0	0.44	1.69	0.04	0	0.36	1.69	0.04	0	0.36
6	Dinuba	din2	1.50	0.03	0	0.43	1.67	0.08	0	0.37	1.67	0.08	0	0.37
7	Merced	mer1	1.14	0.12	0	0.57	1.35	0.20	0	0.49	1.35	0.20	0	0.49
8	Santa Maria	san1	1.29	0.15	0	0.51	1.38	0.12	0	0.48	1.38	0.12	0	0.48
9	Stockton	sto1	1.24	0.26	0	0.53	1.19	0.10	0	0.55	1.19	0.10	0	0.55
10	Stockton	sto2	1.24	0.20	0	0.53	1.44	0.19	0	0.46	1.44	0.19	0	0.46
11	Visalia	vis1	1.32	0.08	0	0.50	1.62	0.13	0	0.39	1.62	0.13	0	0.39
12	Watsonville	wat1	1.34	0.14	0	0.49	1.34	0.18	0	0.49	1.34	0.18	0	0.49
13	Watsonville	wat2	1.28	0.10	0	0.52	1.40	0.14	0	0.47	1.40	0.14	0	0.47
14	Watsonville	wat3	1.37	0.12	0	0.48	1.39	0.21	0	0.47	1.39	0.21	0	0.47
15	Watsonville	wat4	1.30	0.13	0	0.51	1.25	0.18	0	0.53	1.25	0.18	0	0.53
16	Salinas	sal19	1.14	0.18	0	0.57	1.15	0.22	0	0.57	1.15	0.22	0	0.57
17	Denair	den21	1.39	0.12	0	0.47	1.46	0.15	0	0.45	1.57	0.20	0	0.41
18	Shafter	sha20	1.41	0.10	0	0.47	1.56	0.11	0	0.41	1.69	0.09	0	0.36
19	Shafter	sha21	1.33	0.12	0	0.50	1.29	0.10	0	0.51	1.59	0.13	0	0.40
20	Atwater	atw21	1.34	0.08	0	0.49	1.38	0.12	0	0.48	1.57	0.11	0	0.41
21	Rio Oso	rio21	1.04	0.10	0	0.61	1.00	0.12	0	0.62	1.09	0.15	0	0.59

Table A-2. Summary of soil physical properties used in HYDRUS simulations for each soil layer, continued from Table A-1. Refer to Table A-1 for descriptions of parameters BD, theta, thetaR, and thetaS. Solids describes the fraction of solids per unit soil volume and is calculated as 1 – porosity (i.e., 1 – thetaS). Additional parameters are summarized in subsequent tables.

Soil No.	BD4	theta4	thetaR4	thetaS4	BD5	theta5	thetaR5	thetaS5	BD6	theta6	thetaR6	thetaS6	solids1	solids2
1	1.44	0.24	0	0.46	1.44	0.24	0	0.46	1.44	0.24	0	0.46	0.45	0.55
2	1.38	0.31	0	0.48	1.38	0.31	0	0.48	1.38	0.31	0	0.48	0.45	0.55
3	1.37	0.30	0	0.48	1.37	0.30	0	0.48	1.37	0.30	0	0.48	0.46	0.52
4	1.41	0.18	0	0.47	1.41	0.18	0	0.47	1.41	0.18	0	0.47	0.48	0.48
5	1.67	0.07	0	0.37	1.67	0.07	0	0.37	1.67	0.07	0	0.37	0.55	0.64
6	1.66	0.09	0	0.37	1.66	0.09	0	0.37	1.66	0.09	0	0.37	0.57	0.63
7	1.37	0.23	0	0.48	1.37	0.23	0	0.48	1.37	0.23	0	0.48	0.43	0.51
8	1.47	0.16	0	0.44	1.47	0.16	0	0.44	1.47	0.16	0	0.44	0.49	0.52
9	1.31	0.14	0	0.50	1.31	0.14	0	0.50	1.31	0.14	0	0.50	0.47	0.45
10	1.50	0.24	0	0.43	1.50	0.24	0	0.43	1.50	0.24	0	0.43	0.47	0.54
11	1.56	0.13	0	0.41	1.56	0.13	0	0.41	1.56	0.13	0	0.41	0.50	0.61
12	1.47	0.41	0	0.44	1.47	0.41	0	0.44	1.47	0.41	0	0.44	0.51	0.51
13	1.55	0.21	0	0.41	1.55	0.21	0	0.41	1.55	0.21	0	0.41	0.48	0.53
14	1.42	0.29	0	0.46	1.42	0.29	0	0.46	1.42	0.29	0	0.46	0.52	0.52
15	1.45	0.26	0	0.45	1.45	0.26	0	0.45	1.45	0.26	0	0.45	0.49	0.47
16	1.25	0.23	0	0.53	1.25	0.23	0	0.53	1.25	0.23	0	0.53	0.43	0.43
17	1.70	0.19	0	0.36	1.68	0.19	0	0.37	1.68	0.19	0	0.37	0.52	0.55
18	1.74	0.10	0	0.34	1.71	0.11	0	0.35	1.71	0.11	0	0.35	0.53	0.59
19	1.52	0.10	0	0.43	1.43	0.11	0	0.46	1.43	0.11	0	0.46	0.50	0.49
20	1.63	0.11	0	0.39	1.62	0.09	0	0.39	1.62	0.09	0	0.51	0.52	1.63
21	1.41	0.20	0	0.47	1.32	0.24	0	0.50	1.32	0.23	0	0.50	0.39	0.38

Table A-3. Summary of soil physical properties used in HYDRUS simulations for each soil layer, continued from Table A-2. Refer to Table A-2 for a description of parameter 'solids'. Parameters alpha and n are hydraulic retention function shape parameters and Ks is saturated hydraulic conductivity (cm/day), all of which are estimated by the ROSETTA 2 pedotransfer function based on measured soil properties. Additional parameters are summarized in subsequent tables.

Soil No.	solids3	solids4	solids5	solids6	alpha1	n1	Ks1	alpha2	n2	Ks2	alpha3	n3	Ks3	alpha4
1	0.55	0.54	0.54	0.54	0.04	1.28	84.23	0.03	1.27	28.54	0.03	1.27	28.54	0.03
2	0.55	0.52	0.52	0.52	0.04	1.27	63.80	0.02	1.27	15.10	0.02	1.27	15.10	0.01
3	0.52	0.52	0.52	0.52	0.05	2.10	134.10	0.05	1.50	63.95	0.05	1.50	63.95	0.05
4	0.48	0.53	0.53	0.53	0.02	1.26	21.63	0.02	1.25	24.52	0.02	1.25	24.52	0.02
5	0.64	0.63	0.63	0.63	0.03	1.21	14.84	0.04	1.21	13.17	0.04	1.21	13.17	0.04
6	0.63	0.63	0.63	0.63	0.03	1.27	34.47	0.04	1.21	12.71	0.04	1.21	12.71	0.04
7	0.51	0.52	0.52	0.52	0.01	1.33	80.91	0.02	1.31	25.59	0.02	1.31	25.59	0.02
8	0.52	0.55	0.55	0.55	0.02	1.30	19.60	0.01	1.34	19.61	0.01	1.34	19.61	0.01
9	0.45	0.49	0.49	0.49	0.01	1.34	24.42	0.01	1.34	32.67	0.01	1.34	32.67	0.01
10	0.54	0.57	0.57	0.57	0.01	1.34	24.66	0.01	1.32	7.80	0.01	1.32	7.80	0.01
11	0.61	0.59	0.59	0.59	0.03	1.29	59.98	0.03	1.23	14.39	0.03	1.23	14.39	0.04
12	0.51	0.55	0.55	0.55	0.02	1.24	11.74	0.02	1.25	10.19	0.02	1.25	10.19	0.01
13	0.53	0.58	0.58	0.58	0.03	1.29	82.27	0.02	1.29	31.87	0.02	1.29	31.87	0.03
14	0.52	0.54	0.54	0.54	0.01	1.32	11.40	0.01	1.34	11.01	0.01	1.34	11.01	0.01
15	0.47	0.55	0.55	0.55	0.01	1.34	19.19	0.01	1.34	23.26	0.01	1.34	23.26	0.01
16	0.43	0.47	0.47	0.47	0.02	1.27	47.71	0.02	1.27	45.76	0.02	1.27	45.76	0.01
17	0.59	0.64	0.63	0.63	0.06	1.33	206.16	0.05	1.32	143.44	0.04	1.31	76.05	0.04
18	0.64	0.66	0.65	0.65	0.06	1.37	218.02	0.05	1.37	134.05	0.04	1.32	58.47	0.03
19	0.60	0.57	0.54	0.54	0.06	1.36	184.92	0.06	1.38	200.10	0.05	1.36	55.53	0.06
20	0.61	0.61	0.61	0.61	0.07	1.70	624.85	0.07	1.69	429.63	0.06	1.84	483.19	0.06
21	0.41	0.53	0.50	0.50	0.06	1.34	349.62	0.06	1.32	341.02	0.06	1.35	326.54	0.05

Table A-4. Summary of soil physical properties used in HYDRUS simulations for each soil layer, continued from Table A-3. Refer to Table A-3 for a description of parameter 'alpha','n', and 'Ks'. Parameters b1, b2, and b3 are soil thermal conductivity parameters based on HYDRUS defaults (from Horton and Chung, 1987) for sandy, loamy, or coarse *soil types (numbers in this instance do not correspond to soil layer). Texture Class describes the soil texture classification (via the USDA Soil Textural Classification guidelines) based on the measured particle size distribution in the topmost layer of each soil. Additional parameters are summarized in subsequent tables.*

Soil No.	n4	Ks4	alpha5	n5	Ks5	alpha6	n6	Ks6	b1	b2	b3	Texture Class
1	1.25	22.52	0.03	1.25	22.52	0.03	1.25	22.52	1.57E+16	2.53E+16	9.89E+16	Loam
2	1.29	16.20	0.01	1.29	16.20	0.01	1.29	16.20	1.57E+16	2.53E+16	9.89E+16	Loam
3	1.52	69.07	0.05	1.52	69.07	0.05	1.52	69.07	1.57E+16	2.53E+16	9.89E+16	Loam
4	1.24	11.05	0.02	1.24	11.05	0.02	1.24	11.05	-1.27E+16	-6.20E+16	1.63E+17	Clay Loam
5	1.21	14.08	0.04	1.21	14.08	0.04	1.21	14.08	-1.27E+16	-6.20E+16	1.63E+17	Sandy Clay Loam
6	1.22	18.41	0.04	1.22	18.41	0.04	1.22	18.41	1.57E+16	2.53E+16	9.89E+16	Sandy Loam
7	1.31	24.96	0.02	1.31	24.96	0.02	1.31	24.96	1.57E+16	2.53E+16	9.89E+16	Loam
8	1.30	8.65	0.01	1.30	8.65	0.01	1.30	8.65	-1.27E+16	-6.20E+16	1.63E+17	Clay Loam
9	1.32	15.85	0.01	1.32	15.85	0.01	1.32	15.85	-1.27E+16	-6.20E+16	1.63E+17	Clay Loam
10	1.27	5.47	0.01	1.27	5.47	0.01	1.27	5.47	-1.27E+16	-6.20E+16	1.63E+17	Clay Loam
11	1.27	32.39	0.04	1.27	32.39	0.04	1.27	32.39	1.57E+16	2.53E+16	9.89E+16	Sandy Loam
12	1.34	6.85	0.01	1.34	6.85	0.01	1.34	6.85	-1.27E+16	-6.20E+16	1.63E+17	Silty Clay
13	1.25	21.21	0.03	1.25	21.21	0.03	1.25	21.21	1.57E+16	2.53E+16	9.89E+16	Sandy Loam
14	1.31	8.35	0.01	1.31	8.35	0.01	1.31	8.35	-1.27E+16	-6.20E+16	1.63E+17	Clay Loam
15	1.32	9.40	0.01	1.32	9.40	0.01	1.32	9.40	1.57E+16	2.53E+16	9.89E+16	Loam
16	1.32	23.17	0.01	1.32	23.17	0.01	1.32	23.17	-1.27E+16	-6.20E+16	1.63E+17	Clay
17	1.29	33.47	0.02	1.30	14.92	0.02	1.30	14.92	1.57E+16	2.53E+16	9.89E+16	Loamy Sand
18	1.28	24.04	0.04	1.29	32.96	0.04	1.29	32.96	-1.27E+16	-6.20E+16	1.63E+17	Sandy Loam
19	1.44	92.90	0.05	1.35	100.09	0.05	1.35	100.09	1.57E+16	2.53E+16	9.89E+16	Sandy Loam
20	1.83	336.85	0.06	2.00	512.33	0.06	2.00	512.33	1.47E+16	-1.55E+17	3.17E+17	Sand
21	1.49	177.16	0.05	1.43	195.96	0.05	1.43	195.96	1.57E+16	2.53E+16	9.89E+16	Loamy Sand

*Table A-5. Summary of soil physical properties used in HYDRUS simulations for each soil layer, continued from Table A-5. ‘OM’ describes the organic matter fraction of each soil and is from measured data where available (soils 1-3, 17-21); values for soils 4-16 is based on the median of available measurements at each soil depth. ‘kd’ is the soil-water partitioning coefficient calculated as (OM * 0.58 * Koc), where Koc is the organic carbon-water partitioning coefficient (here equal to 28 ml [g OC]$^{-1}$; see Brown 2019) and 0.58 is* *a standard conversion factor to calculate organic carbon fraction from OM fraction. ‘l’ is the pore connectivity factor estimated via the ROSETTA 2 pedotransfer function based on measured soil properties.*

Soil No.	OM1	OM2	OM3	OM4	OM5	OM6	kd1	kd2	kd3	kd4	kd5	kd6	l1	l2	l3	l4	l5	l6
1	0.010	0.010	0.009	0.005	0.000	0	0.168	0.140	0.140	0.000	0.000	0	-0.32	-0.69	-0.69	-0.66	-0.66	-0.66
2	0.011	0.011	0.008	0.006	0.003	0	0.180	0.126	0.126	0.042	0.030	0	-0.31	-0.60	-0.60	-0.53	-0.53	-0.53
3	0.010	0.010	0.008	0.006	0.004	0	0.165	0.126	0.126	0.060	0.048	0	-0.47	-0.66	-0.66	-0.64	-0.64	-0.64
4	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.68	-0.79	-0.79	-0.86	-0.86	-0.86
5	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-1.28	-1.62	-1.62	-1.52	-1.52	-1.52
6	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.91	-1.50	-1.50	-1.47	-1.47	-1.47
7	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	0.11	-0.38	-0.38	-0.40	-0.40	-0.40
8	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.39	-0.17	-0.17	-0.43	-0.43	-0.43
9	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.09	-0.04	-0.04	-0.23	-0.23	-0.23
10	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.07	-0.29	-0.29	-0.57	-0.57	-0.57
11	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.59	-1.29	-1.29	-1.15	-1.15	-1.15
12	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.76	-0.62	-0.62	-0.12	-0.12	-0.12
13	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.71	-0.69	-0.69	-1.09	-1.09	-1.09
14	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.24	-0.12	-0.12	-0.30	-0.30	-0.30
15	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-0.11	-0.07	-0.07	-0.32	-0.32	-0.32
16	0.010	0.008	0.008	0.003	0.003	0	0.167	0.133	0.126	0.056	0.052	0	-1.11	-1.08	-1.08	-0.84	-0.84	-0.84
17	0.005	0.006	0.005	0.003	0.004	0	0.078	0.090	0.079	0.044	0.072	0	-1.22	-1.24	-1.18	-1.41	-0.62	-0.62
18	0.010	0.004	0.003	0.003	0.003	0	0.166	0.065	0.047	0.053	0.056	0	-1.18	-1.26	-1.39	-1.37	-1.43	-1.43
19	0.022	0.020	0.007	0.009	0.013	0	0.356	0.330	0.113	0.154	0.210	0	-1.19	-1.15	-1.39	-1.23	-1.32	-1.32
20	0.009	0.009	0.010	0.004	0.002	0	0.151	0.154	0.192	0.060	0.032	0	-0.89	-0.91	-0.89	-0.89	-0.89	-0.89
21	0.019	0.024	0.023	0.013	0.005	0	0.312	0.385	0.378	0.206	0.075	0	-0.81	-0.86	-0.78	-0.82	-0.80	-0.80

Table A-6. Summary of individual simulation results for HYDRUS-estimated maximum 24-h flux, 72-h flux, and emission ratio (ER). Results are normalized to a 100 lb ac^{-1} application rate, per DPR convention.

FFM Code	Soil No.	Max 24-h flux (µg m^{-2} s^{-1})	Max 72-h flux (µg m^{-2} s^{-1})	ER @ 21 days
1201	1	14.82	11.49	0.40
1201	2	7.26	6.17	0.26
1201	3	9.01	7.49	0.29
1201	4	36.65	21.32	0.61
1201	5	37.20	21.50	0.64
1201	6	29.70	18.45	0.56
1201	7	23.03	15.40	0.48
1201	8	30.53	18.90	0.56
1201	9	32.51	19.55	0.58
1201	10	15.93	12.03	0.41
1201	11	21.08	14.38	0.47
1201	12	18.54	12.76	0.41
1201	13	31.58	19.50	0.57
1201	14	16.83	12.25	0.41
1201	15	28.05	17.84	0.53
1201	16	23.86	15.76	0.49
1201	17	23.55	15.92	0.50
1201	18	35.48	20.37	0.59
1201	19	20.65	14.03	0.46
1201	20	28.07	18.06	0.55
1201	21	18.21	12.69	0.43
1202	1	10.78	8.76	0.32
1202	2	5.46	4.69	0.20
1202	3	6.74	5.67	0.23
1202	4	24.87	16.30	0.51
1202	5	25.89	17.00	0.56
1202	6	21.73	14.64	0.48
1202	7	16.39	11.79	0.39
1202	8	21.13	14.31	0.46
1202	9	21.47	14.30	0.46
1202	10	11.40	9.17	0.34
1202	11	15.62	11.39	0.39
1202	12	13.31	9.89	0.34
1202	13	22.20	14.97	0.47
1202	14	12.39	9.64	0.34
1202	15	19.77	13.60	0.43
1202	16	16.61	11.83	0.40

1202	17	18.03	12.84	0.42
1202	18	25.27	16.21	0.50
1202	19	13.15	9.79	0.36
1202	20	19.71	13.49	0.44
1202	21	10.60	8.17	0.32
1203	1	15.72	11.79	0.39
1203	2	7.75	6.41	0.25
1203	3	9.68	7.85	0.29
1203	4	32.00	19.62	0.56
1203	5	37.59	22.79	0.65
1203	6	31.56	19.73	0.57
1203	7	21.94	14.71	0.45
1203	8	29.13	18.43	0.53
1203	9	33.14	20.34	0.58
1203	10	15.90	11.79	0.39
1203	11	24.12	16.16	0.49
1203	12	14.95	10.55	0.34
1203	13	27.76	17.56	0.51
1203	14	16.25	11.79	0.39
1203	15	24.78	16.02	0.47
1203	16	23.26	15.49	0.47
1203	17	22.80	15.15	0.45
1203	18	34.31	20.49	0.58
1203	19	20.77	14.33	0.46
1203	20	29.55	18.68	0.53
1203	21	14.23	10.59	0.38
1204	1	7.41	6.01	0.26
1204	2	2.34	2.21	0.13
1204	3	3.53	3.32	0.18
1204	4	23.51	14.45	0.47
1204	5	25.45	15.36	0.51
1204	6	19.84	12.53	0.43
1204	7	14.74	9.90	0.36
1204	8	17.83	11.75	0.41
1204	9	21.57	13.57	0.45
1204	10	6.71	4.91	0.23
1204	11	13.85	9.23	0.34
1204	12	8.57	5.13	0.20
1204	13	21.96	14.00	0.45
1204	14	7.14	5.05	0.22
1204	15	17.90	11.83	0.40

1204	16	13.70	9.21	0.34
1204	17	14.44	10.18	0.37
1204	18	21.07	13.03	0.43
1204	19	14.03	9.81	0.36
1204	20	22.00	14.57	0.47
1204	21	13.13	9.59	0.36
1205	1	15.34	11.46	0.38
1205	2	7.52	6.20	0.25
1205	3	9.46	7.64	0.28
1205	4	31.16	18.92	0.54
1205	5	35.52	21.30	0.62
1205	6	29.96	18.54	0.54
1205	7	21.60	14.39	0.44
1205	8	28.12	17.64	0.52
1205	9	31.51	19.24	0.56
1205	10	15.57	11.46	0.38
1205	11	23.07	15.37	0.47
1205	12	14.80	10.37	0.34
1205	13	27.44	17.27	0.50
1205	14	15.99	11.50	0.38
1205	15	24.56	15.81	0.47
1205	16	22.63	14.96	0.46
1205	17	22.58	14.91	0.45
1205	18	33.14	19.62	0.56
1205	19	20.08	13.80	0.45
1205	20	30.58	19.20	0.54
1205	21	14.12	10.46	0.38
1206	1	4.95	4.51	0.22
1206	2	1.57	1.50	0.10
1206	3	2.07	1.96	0.12
1206	4	12.90	10.39	0.40
1206	5	18.09	13.53	0.51
1206	6	13.60	10.81	0.42
1206	7	7.43	6.41	0.28
1206	8	11.61	9.52	0.37
1206	9	15.87	12.02	0.44
1206	10	3.96	3.65	0.19
1206	11	9.18	7.74	0.33
1206	12	2.13	2.01	0.12
1206	13	8.78	7.52	0.32
1206	14	3.63	3.34	0.18

1206	15	6.90	6.08	0.27
1206	16	8.34	7.12	0.30
1206	17	5.53	4.98	0.24
1206	18	13.44	10.53	0.40
1206	19	8.09	6.92	0.31
1206	20	13.12	10.46	0.40
1206	21	5.44	4.96	0.25
1207	1	3.89	3.67	0.18
1207	2	1.60	1.32	0.08
1207	3	1.99	1.71	0.10
1207	4	9.48	8.03	0.34
1207	5	13.25	10.83	0.46
1207	6	10.39	8.70	0.36
1207	7	5.73	5.02	0.24
1207	8	8.58	7.28	0.32
1207	9	10.96	8.92	0.36
1207	10	3.36	3.12	0.16
1207	11	7.25	6.18	0.28
1207	12	1.92	1.76	0.10
1207	13	6.78	5.89	0.27
1207	14	3.07	2.93	0.15
1207	15	5.36	4.79	0.23
1207	16	6.28	5.43	0.25
1207	17	4.56	4.14	0.20
1207	18	10.19	8.48	0.35
1207	19	5.62	4.90	0.25
1207	20	9.64	7.98	0.33
1207	21	4.42	3.68	0.20
1208	1	7.10	6.16	0.27
1208	2	3.09	2.64	0.14
1208	3	3.55	3.19	0.16
1208	4	15.17	11.76	0.41
1208	5	24.40	17.40	0.57
1208	6	19.45	14.45	0.49
1208	7	9.48	7.97	0.32
1208	8	14.86	11.62	0.41
1208	9	21.40	15.29	0.50
1208	10	5.21	4.71	0.23
1208	11	14.17	11.37	0.41
1208	12	2.16	1.81	0.10
1208	13	10.01	8.33	0.32

1208	14	4.68	4.33	0.21
1208	15	7.90	6.66	0.28
1208	16	10.98	9.10	0.35
1208	17	7.02	5.99	0.26
1208	18	17.36	13.00	0.45
1208	19	11.64	9.71	0.39
1208	20	19.23	13.93	0.46
1208	21	6.99	6.12	0.29
1209	1	34.54	17.32	0.48
1209	2	30.08	14.91	0.42
1209	3	29.81	15.05	0.43
1209	4	40.83	21.09	0.57
1209	5	41.00	21.95	0.60
1209	6	39.06	20.74	0.57
1209	7	42.95	20.64	0.55
1209	8	37.06	19.74	0.54
1209	9	37.14	20.35	0.56
1209	10	34.64	17.11	0.48
1209	11	39.28	20.03	0.55
1209	12	32.39	15.18	0.42
1209	13	38.95	20.00	0.54
1209	14	34.65	16.99	0.47
1209	15	37.99	18.95	0.52
1209	16	34.83	18.40	0.52
1209	17	38.56	19.44	0.53
1209	18	40.65	21.66	0.58
1209	19	31.18	17.65	0.50
1209	20	44.47	22.83	0.60
1209	21	34.73	17.67	0.50
1224	1	2.00	1.91	0.12
1224	2	0.46	0.45	0.04
1224	3	0.64	0.63	0.05
1224	4	5.73	5.22	0.27
1224	5	10.42	8.97	0.42
1224	6	7.54	6.67	0.33
1224	7	3.05	2.87	0.17
1224	8	5.47	4.99	0.26
1224	9	8.74	7.56	0.35
1224	10	1.30	1.26	0.09
1224	11	4.87	4.46	0.24
1224	12	0.16	0.16	0.02

1224	13	3.20	3.02	0.18
1224	14	1.00	0.97	0.07
1224	15	2.14	2.04	0.13
1224	16	3.66	3.41	0.19
1224	17	1.85	1.77	0.12
1224	18	6.20	5.58	0.28
1224	19	4.30	3.99	0.23
1224	20	7.57	6.67	0.31
1224	21	2.46	2.35	0.15
1225	1	2.24	1.79	0.10
1225	2	0.39	0.39	0.03
1225	3	0.62	0.58	0.04
1225	4	4.88	4.41	0.24
1225	5	8.15	7.19	0.39
1225	6	6.06	5.48	0.29
1225	7	3.17	2.66	0.14
1225	8	4.42	4.12	0.22
1225	9	6.42	5.64	0.29
1225	10	1.51	1.24	0.08
1225	11	4.19	3.88	0.21
1225	12	0.14	0.14	0.01
1225	13	3.54	2.85	0.16
1225	14	1.14	0.98	0.06
1225	15	2.48	1.97	0.11
1225	16	3.45	3.01	0.16
1225	17	2.12	1.73	0.10
1225	18	5.03	4.73	0.25
1225	19	4.30	3.45	0.20
1225	20	5.78	5.15	0.26
1225	21	3.12	2.26	0.13
1242	1	1.86	1.63	0.09
1242	2	1.22	1.03	0.06
1242	3	1.41	1.20	0.07
1242	4	2.70	2.58	0.15
1242	5	4.87	2.96	0.21
1242	6	2.65	2.43	0.15
1242	7	2.11	1.93	0.10
1242	8	2.46	2.29	0.13
1242	9	2.38	2.25	0.13
1242	10	1.94	1.73	0.09
1242	11	2.14	1.96	0.11

1242	12	1.98	1.81	0.09
1242	13	2.58	2.39	0.12
1242	14	2.00	1.81	0.10
1242	15	2.38	2.19	0.11
1242	16	2.09	1.92	0.11
1242	17	2.74	2.51	0.12
1242	18	3.04	2.85	0.15
1242	19	1.90	1.35	0.09
1242	20	2.28	2.09	0.11
1242	21	1.52	0.99	0.07
1243	1	3.20	2.92	0.12
1243	2	1.80	1.54	0.07
1243	3	2.08	1.82	0.08
1243	4	5.95	5.19	0.21
1243	5	10.61	8.63	0.35
1243	6	8.27	6.86	0.27
1243	7	3.85	3.60	0.15
1243	8	6.02	5.25	0.21
1243	9	9.68	7.60	0.29
1243	10	2.78	2.51	0.11
1243	11	6.28	5.50	0.22
1243	12	1.95	1.79	0.08
1243	13	3.92	3.68	0.15
1243	14	2.63	2.37	0.11
1243	15	3.22	3.07	0.13
1243	16	4.55	4.18	0.17
1243	17	3.64	3.37	0.14
1243	18	7.39	6.21	0.25
1243	19	5.61	4.88	0.21
1243	20	8.56	7.01	0.25
1243	21	2.84	2.64	0.12
1245	1	2.73	2.54	0.11
1245	2	1.65	1.40	0.07
1245	3	1.92	1.66	0.08
1245	4	4.44	3.84	0.17
1245	5	6.76	5.53	0.26
1245	6	5.46	4.60	0.20
1245	7	3.38	3.17	0.14
1245	8	4.39	3.83	0.17
1245	9	6.85	5.48	0.23
1245	10	2.31	2.14	0.10

1245	11	4.63	4.18	0.18
1245	12	1.90	1.75	0.08
1245	13	3.57	3.25	0.14
1245	14	2.35	2.18	0.10
1245	15	3.07	2.85	0.12
1245	16	3.66	3.35	0.15
1245	17	3.41	3.15	0.13
1245	18	5.63	4.77	0.20
1245	19	4.53	4.03	0.18
1245	20	9.92	7.79	0.27
1245	21	2.69	2.52	0.12
1247	1	1.48	0.80	0.06
1247	2	0.91	0.52	0.03
1247	3	1.01	0.58	0.04
1247	4	2.81	1.47	0.11
1247	5	5.33	2.77	0.19
1247	6	3.01	1.64	0.12
1247	7	1.67	0.98	0.07
1247	8	2.33	1.35	0.10
1247	9	2.57	1.53	0.11
1247	10	1.61	0.88	0.06
1247	11	2.21	1.21	0.09
1247	12	0.89	0.51	0.04
1247	13	2.06	1.15	0.08
1247	14	1.37	0.77	0.05
1247	15	1.59	0.98	0.07
1247	16	1.83	1.05	0.08
1247	17	1.68	0.98	0.07
1247	18	2.76	1.67	0.12
1247	19	2.20	1.21	0.07
1247	20	2.15	1.35	0.09
1247	21	1.70	0.94	0.05
1248	1	2.59	2.38	0.12
1248	2	0.99	0.90	0.06
1248	3	1.28	1.13	0.07
1248	4	4.66	4.34	0.20
1248	5	10.47	8.59	0.36
1248	6	8.04	6.81	0.28
1248	7	3.23	2.99	0.14
1248	8	4.97	4.62	0.21
1248	9	9.35	7.53	0.30

1248	10	1.80	1.59	0.09
1248	11	6.04	5.38	0.23
1248	12	0.84	0.47	0.03
1248	13	2.90	2.62	0.13
1248	14	1.56	1.35	0.08
1248	15	2.27	2.00	0.10
1248	16	3.82	3.59	0.17
1248	17	2.32	2.06	0.10
1248	18	5.73	5.27	0.24
1248	19	5.24	4.79	0.22
1248	20	9.05	7.21	0.27
1248	21	3.04	2.77	0.14
1249	1	1.42	0.87	0.06
1249	2	0.89	0.51	0.03
1249	3	0.99	0.57	0.04
1249	4	2.58	1.83	0.13
1249	5	4.68	2.78	0.22
1249	6	2.73	2.12	0.14
1249	7	1.58	1.16	0.08
1249	8	2.19	1.71	0.12
1249	9	2.37	2.13	0.14
1249	10	1.57	0.87	0.06
1249	11	2.04	1.53	0.10
1249	12	0.64	0.38	0.03
1249	13	1.95	1.34	0.09
1249	14	1.33	0.75	0.05
1249	15	1.54	1.08	0.07
1249	16	1.74	1.28	0.09
1249	17	1.65	1.08	0.08
1249	18	2.58	2.07	0.14
1249	19	2.11	1.18	0.09
1249	20	2.17	1.93	0.12
1249	21	1.52	0.84	0.06
1250	1	2.60	2.41	0.13
1250	2	0.79	0.76	0.06
1250	3	1.07	1.02	0.07
1250	4	6.78	5.70	0.25
1250	5	9.83	7.74	0.35
1250	6	7.33	6.11	0.27
1250	7	3.85	3.47	0.17
1250	8	6.04	5.14	0.23

1250	9	8.13	6.53	0.28
1250	10	2.10	1.94	0.12
1250	11	5.01	4.34	0.21
1250	12	1.06	0.99	0.07
1250	13	4.58	4.09	0.19
1250	14	1.94	1.79	0.11
1250	15	3.57	3.24	0.16
1250	16	4.32	3.82	0.18
1250	17	3.01	2.73	0.15
1250	18	7.06	5.87	0.26
1250	19	4.33	3.79	0.19
1250	20	6.84	5.68	0.24
1250	21	2.79	2.57	0.15
1259	1	5.31	3.62	0.13
1259	2	4.96	3.32	0.12
1259	3	4.92	3.31	0.12
1259	4	5.88	4.45	0.18
1259	5	6.94	5.83	0.24
1259	6	6.27	4.97	0.20
1259	7	6.08	4.09	0.15
1259	8	5.41	4.18	0.17
1259	9	5.98	5.13	0.21
1259	10	5.27	3.56	0.13
1259	11	5.97	4.41	0.17
1259	12	5.18	3.45	0.12
1259	13	5.42	3.81	0.14
1259	14	5.31	3.57	0.13
1259	15	5.38	3.64	0.13
1259	16	5.22	3.83	0.15
1259	17	6.03	4.12	0.15
1259	18	6.04	4.76	0.19
1259	19	4.11	3.32	0.14
1259	20	6.30	5.64	0.22
1259	21	3.59	2.45	0.11
1264	1	1.10	1.04	0.08
1264	2	0.45	0.32	0.02
1264	3	0.58	0.41	0.03
1264	4	3.22	2.95	0.18
1264	5	5.90	5.23	0.30
1264	6	4.24	3.89	0.22
1264	7	1.70	1.59	0.11

1264	8	3.03	2.79	0.17
1264	9	4.69	4.18	0.23
1264	10	1.01	0.68	0.06
1264	11	2.77	2.57	0.16
1264	12	0.16	0.13	0.01
1264	13	1.78	1.69	0.11
1264	14	0.82	0.56	0.05
1264	15	1.18	1.12	0.08
1264	16	2.03	1.89	0.12
1264	17	1.16	1.01	0.08
1264	18	3.50	3.19	0.19
1264	19	2.40	2.25	0.15
1264	20	4.13	3.78	0.19
1264	21	1.38	1.28	0.10