Groundwater Vulnerability Assessments for the San Joaquin Valley *

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* circa 2004

Toward Sustainable Groundwater in Agriculture:
An International Conference Linking Science and Policy

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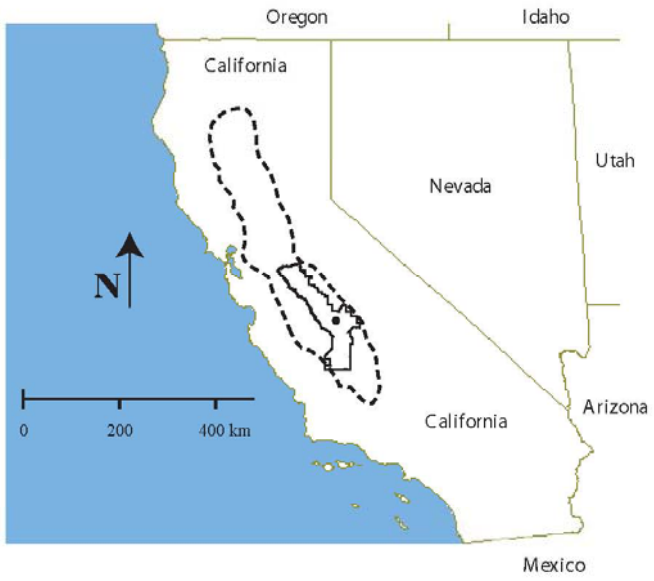
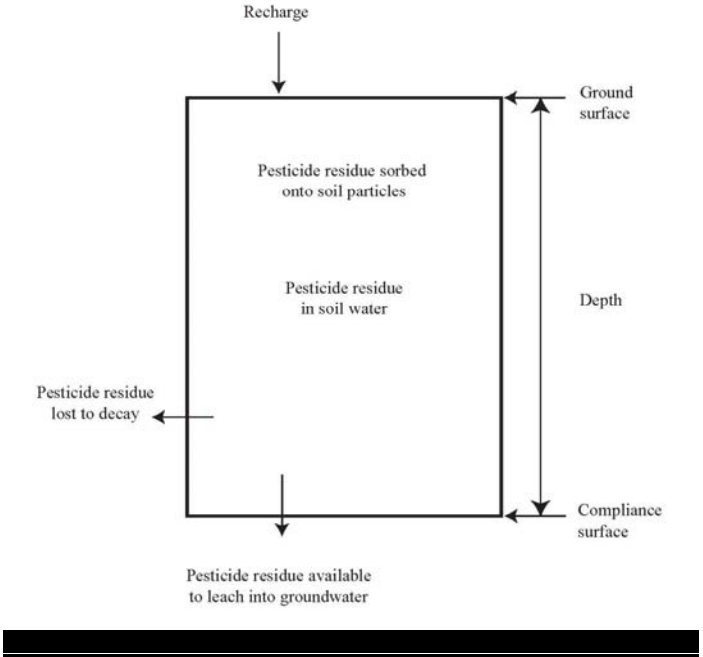




Attenuation Factor

$$AF = \exp\left(\frac{-0.639 d RF \theta_{FC}}{q t_{1/2}}\right)$$

$$RF = 1 + \frac{\rho_b f_{oc} K_{oc}}{\theta_{FC}}$$

$$t_{1/2} = \frac{0.693}{k}$$

- d distance to some compliance depth from the surface [L]
- RF retardation factor [-]
- θ_{FC} soil-water content at field capacity [L^3L^{-3}]
- ρ_b soil bulk density [ML^{-3}]
- f_{oc} soil organic carbon [-]
- K_{oc} pesticide sorption coefficient [L^3M^{-1}]
- q net groundwater recharge [LT^{-1}]
- $t_{1/2}$ pesticide half-life [T]
- k first-order degradation rate coefficient [T^{-1}]

AF

≥ 0.0 and < 0.001 **Very Unlikely**

≥ 0.001 and < 0.01 **Unlikely**

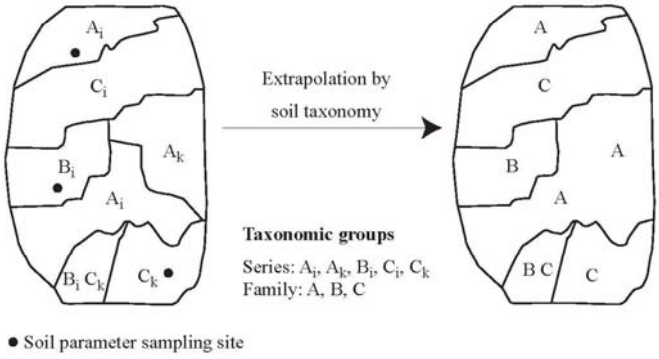
≥ 0.01 and < 0.1 **Moderately Likely**

≥ 0.1 and < 0.25 **Likely**

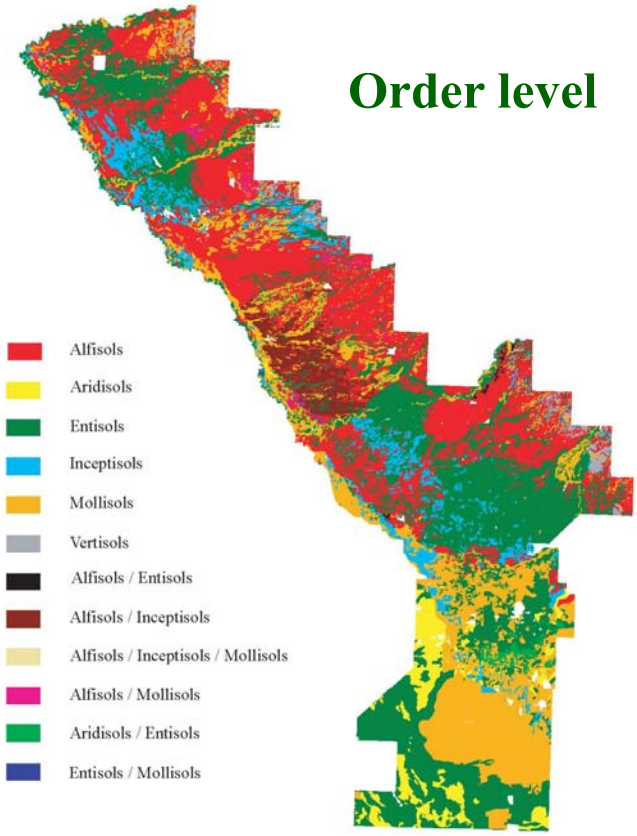
≥ 0.25 and ≤ 1.0 **Very Likely**

Chemical	K_{oc} (mL/g)	S_{Koc} (mL/g)	$t_{1/2}$ (days)	$S_{t1/2}$ (days)
1,2-Dichloropropane	50	1.4	700	320.7
2,4-D	20	12.1	10	
2,4-DP	1000	285.2	10	
Alachlor	170	204.7	15	
Aldicarb	30	21.1	30	
Atrazine	100	39.3		
Bromacil	32	13.6		86.6
Carbaryl	300	296.8		5.2
Carbofuran	22	22.8		22.8
Carboxin	260	72.5		1.7
Chlorothalonil	1380	127	30	24.8
Cyanazine	190	110	14	27.7
Dalapon	1		30	4.3
DBCP	70	26	180	43.9
DCPA	5000	592.8	100	24.8
Diazinon	1000		40	7.8
Dicamba	2	3	14	9.2
Dinoseb	30	32.8	30	8.7
Diphenamid	210	42.4	30	8.7
Disulfoton		1008.1	30	24.8
Diuron		252	90	86
EDB	3	43.3	100	53.4
Methomyl		38.1	30	11.5
Metolachlor	20	60	90	48.5
Metribuzin	60	25.1	40	28
Oxamyl	25	6.4	4	4.6
Prometon	150	157	500	559.5
Pronamide	400	644	60	102.2
Propazine	154	31.8	135	93
Simazine	130	34.1	60	39.8
Tebuthiuron	80	177.8	360	282.3
Trifluralin	8000	3608.4	60	20.8

32 pesticides



Soil Survey & Soil Taxonomy



Agrochemical ranking for the San Joaquin Valley

Chemical	Soil Order					
	Alfisols	Aridisols	Entisols	Inceptisols	Mollisols	Vertisols
1,2-Dichloropropane	1	1	1	1	1	1
Tebuthiuron	2	2	2	2	2	2
Prometon	3	3	3	3	3	3
DBCP	4	4	4	4	4	4
EDB	5	5	5	5	5	5
Dalapon	6	6	6	6	6	6
Bromacil	7	8	8	8	8	8
Carbofuran	8	7	7	7	7	7
Propazine	9	9	9	9	10	9
Aldicarb	10	10	10	10	11	10
Dinoseb	11	11	11	11	12	11
Atrazine	12	13	13	13	14	13
Dicamba	13	12	12	12	9	12
Metribuzin	14	14	14	14	13	14
Metolachlor	15	15	15	15	15	15
Simazine	16	16	16	16	16	16
Methomyl	17	17	17	17	17	17
2,4-D	18	18	18	18	18	18
Diuron	19	19	19	19	19	19
Prometryn	20	20	20	20	20	20
Diphenamid	21	21	21	21	21	21
Alachlor	22	23	23	23	23	23
Oxamyl	23	22	22	22	22	22
Cyanazine	24	24	24	24	24	24
Disulfoton	25	25	25	25	25	25
Diazinon	26	26	26	26	26	26
Carbaryl	27	27	27	27	27	27
Chlorothalonil	28	28	28	28	28 (tie)	28
DCPA	29	29	29	29	28 (tie)	29
Carboxin	30	30 (tie)	30	30	28 (tie)	30 (tie)
Trifluralin	31 (tie)	30 (tie)	31 (tie)	31 (tie)	28 (tie)	30 (tie)
2,4-DP	31 (tie)	30 (tie)	31 (tie)	31 (tie)	28 (tie)	30 (tie)

Very Likely
Likely
Moderately Likely
Unlikely
Very Unlikely

FIRST-ORDER UNCERTAINTY ANALYSIS

$$Y = g(X) =^{1} g(\mu_X) + b^{T}(X - \mu_X)$$

$$b_i = \frac{\partial g(X)}{\partial X_i} \qquad \mu_Y =^{1} g(\mu_X)$$

$$\sigma_Y^2 =^{1} b^{T} C_X b \qquad \sigma_Y^2 = \sum_i \left(\frac{dg}{dX_i}\right)^2 \sigma_{X_i}^2 \qquad C_i =^{1} \left|\frac{\partial I}{\partial P_i}\right| S_{P_i}$$

$$S_{RP} = \left(\sum_{1}^{n} C_i^2\right)^{1/2} \qquad S_{AP} = \left(\sum_{1}^{t} C_i^2\right)^{1/2}$$

X column vector of random variables

$=^{1}$ equal in the first-order sense

μ_X vector of means

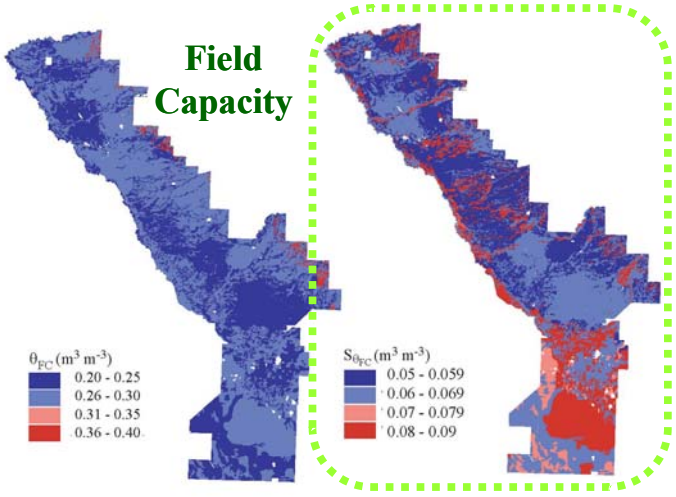
b^T transpose of a vector of partial derivatives

C_X covariance matrix of the functionally dependent variables X_i

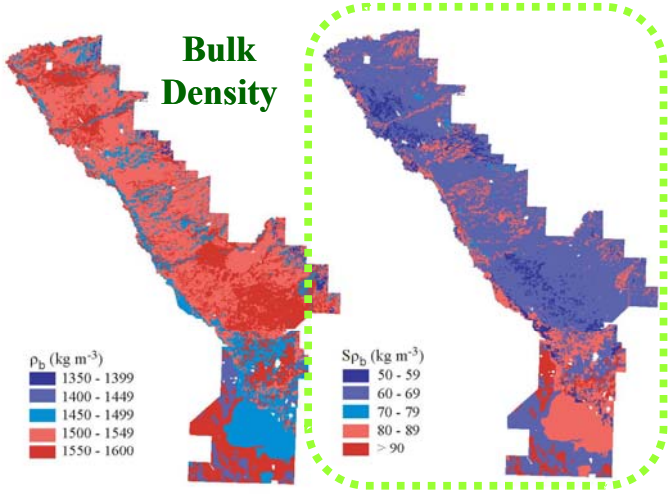
I index

S_{pi} standard deviation of the parameter P_i

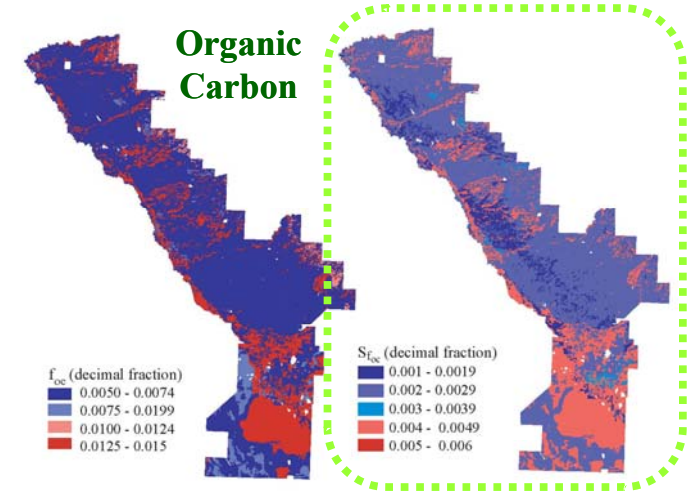
Field Capacity



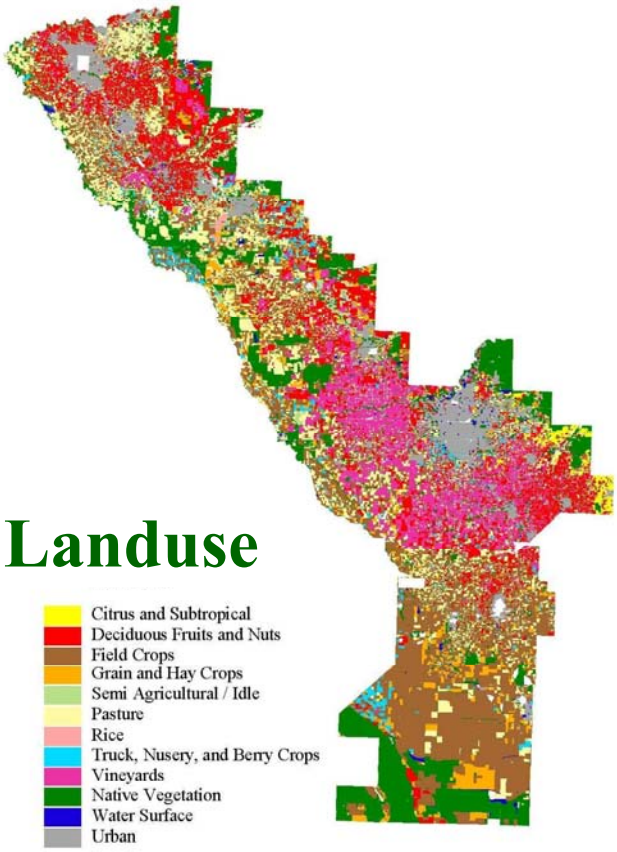
Bulk Density



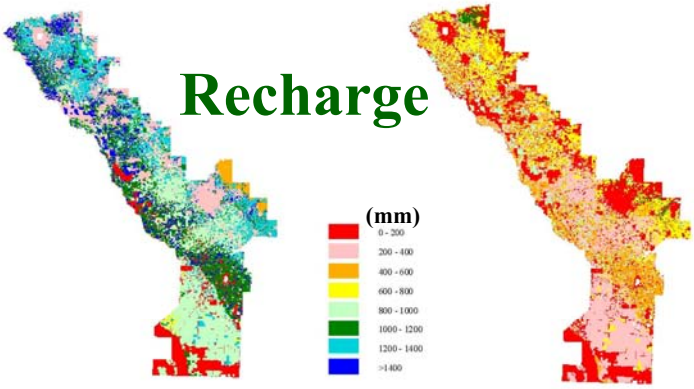
Organic Carbon



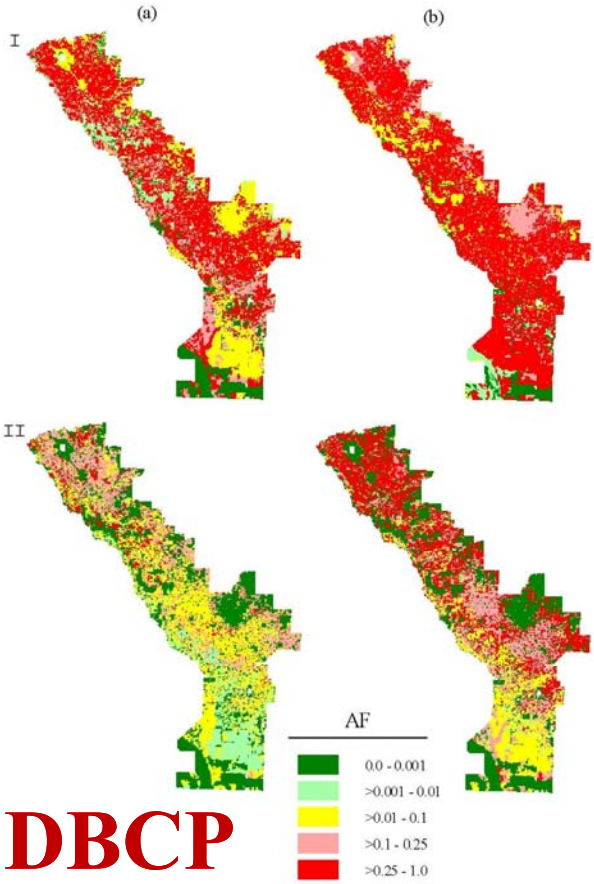
Landuse

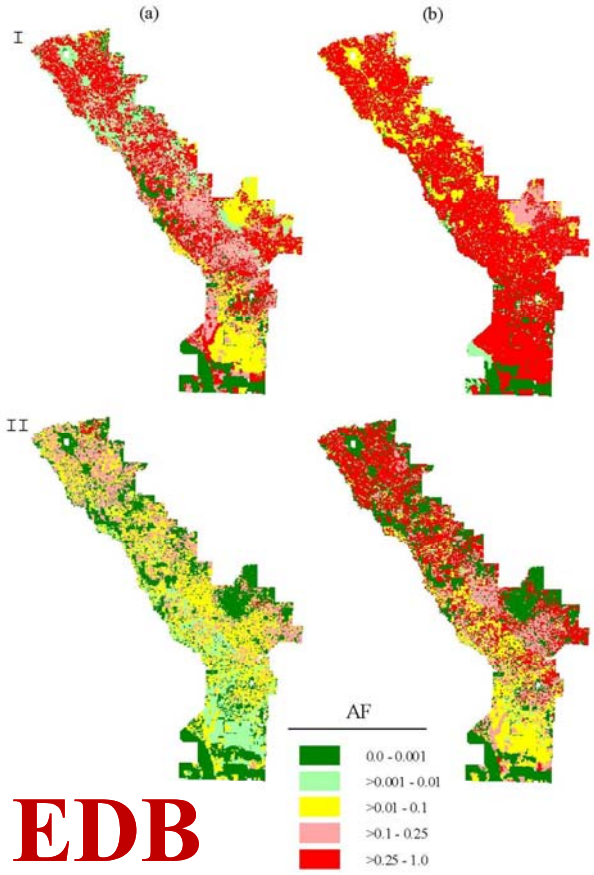


Recharge

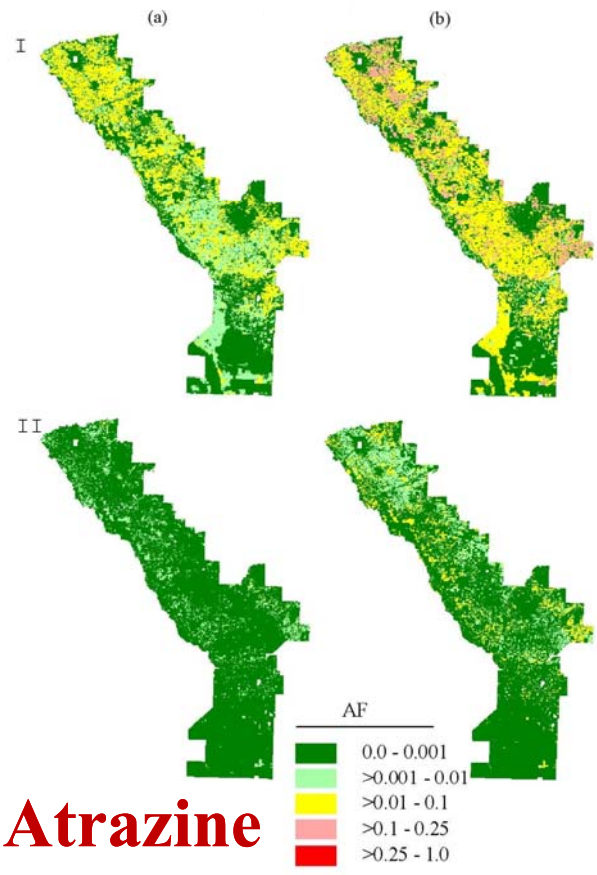


DBCP





EDB



Atrazine

Regulate

/

Remediate

Hey farmer farmer put away that DDT

Joni Mitchell, **Big Yellow Taxi**