DAW 11-27-02 Validation Test for Microtopography of KINEROS2.

Using the notation from the figure on p165 and Table 6 in Woolhiser et al (1990) KINEROS Manual

Discharge as a function of depth, h.

$$Q(h) = \alpha\left[\frac{2h}{z}\left(b+\frac{h}{2}\right)\right]^{5/3} \Big/ \left(\frac{2b}{z} + 2h\sqrt{1+1/z^2}\right)^{2/3} \quad (1)\checkmark$$

Top Width as a function of h:

$$w(h) = b_w + 2h/z \quad (2)\checkmark$$

$$\therefore \quad h(w) = (w - b_w)z/2 \quad (3)\checkmark$$

Substituting (3) into (1) get Q as function of w.

$$Q(w) = \alpha\left[(w-b_w)\left(b + \frac{(w-b_w)z}{4}\right)\right]^{5/3}\left(\frac{2b}{z} + z(w-b_w)\sqrt{1+1/z^2}\right)^{-2/3} \quad (4)$$

$$\frac{dQ}{w(Q)} = -K_s\,dx \quad (5)$$

Could solve equation $\frac{dx}{dQ} = \frac{-1}{K_s\,w(Q)}$ (6)

However one cannot obtain an analytic solution for $w(Q)$

DAW 12-17-02 Review of Report
"Simulation of net Infiltration for Modern and Potential Future Climates" by Joseph A. Hevesi, 2000
Report ANL-NBS-HS-000032 REV 00
Office of Civilian Radioactive Waste Management 462 pp.

Enhancements made to the infiltration model documented by Flint et al. (1996). Also uses the model to generate spatial and temporal distributions of net infiltration over a domain encompassing Yucca Mt. Three climate conditions are utilized: present, future Monsoon type and future glacial transition climate.

Issues to consider in comparing results with KINEROS2 studies

1) Differences in parameters
   USGS - 30m X 30m grid : KINEROS - higher resolution
2) Differences in watershed descriptors, such as resolution, soil depths, drainage patterns etc.

3) Differences in time resolution

4) Differences in model structure

5) Modern and future climate simulation techniques

Daw 5-5-03
Simulate 50yr record of Yucca Mtn precipitation tmax, tmin + radiation with R64 (monsoonal seasonality) and SOI-PDO perturbations with parameters from R64.

Refer to Scientific Notebook 363 p 130.

Objective: Prepare file for input to OPUS Model. OPUS runs will be done by R. E. Smith

Program: C:\ \CLIMSIM_03.F95
First run: MAP = 280 mm Use info in MONSOON3.SIM
Control file: C:\SIMULATIONS_02\ YM_MONP~~1~~3.SIM Daw 5-5-03
Output file: C:\ " " \ YM_MONP~~1~~3.PTR Daw 5-5-03

1) Save MONSOON3.SIM as YM_MONP3.SIM ✓
Change name of output file to YM_MONP3.PTR ✓
Enter perturbation parameters from Notebook 363 p 106+107
$a_{00} = 0.12$ $b_{00} = -0.06$ $\tau_{00} = 90$
$a_{10} = 0.08$ $b_{10} = 0.06$ $\tau_{10} = 60$
$C_1 = -0.47$ $C_2 = -0.20$ $\sigma_\mu = 90$
Completed run ✓

Create PSIPLOT file ✓ YM-MONP3.TMP
Create columns of $\tilde{P_{00}} - P_{00} = DP_{00}$ and $\tilde{Mu} - Mu = DMu$
for DMU: Max = 0.77 mm; Min = -0.71 mean = 0.03435 std. dv = 0.22
for DP_{00}: Max = 0.064 ; min = -0.057 mean = -0.0011 std dv = 0.00885

Daw 8-28-03 Runoff and deep Infiltration for Upper Split Wash with simulated 50-yr precipitation input.

Refer to Scientific Notebook 597 pp 4-10 for documentation of rainfall simulations

Single Plane Simulations:
See p 72 for outline of procedures. Use plane 170 as test case to eliminate storms that cause no runoff.
First use summer storms as input

Control files are in directory C:\USW_03\Plane_test and are of the form:
SW_EIP.FIL perturbed by SOI-PDO
Split Wash \series E storm number

Results are tabulated in: (Quattro Pro)
C:\USW-03\~~Y181PE~~S\ RUNFILE_E.QPW
Daw 8-28-03

Daw 8/29/03

Of the 73 summer storms, 37 caused no runoff.

Daw 9/2/03 Now disaggregate the winter storms (Dec-Apr)

Run program DAYDIS4.BAS with C:\USW_03\Y181PE_W\ Y181P2WI.COM as input ✓
output is Y181P2WI.DUR in dir
Random number seed was 3300
Now run program RAINSIM6B.BAS to disaggregate storms.
Input file is Y181P2WI.DUR

DAW 9-2-03 Continue disaggregation of simulated winter storms for E series.

2-day storms are assumed to continue over midnight. 3-day storms > 25.5 mm are documented on pp 7 and 8 of Scientific Notebook 597.

Disaggregation patterns given by RAINSIM6B.BAS were rejected until the intensity pattern was similar to the daily depth sequence on those pages. Random number seed was 3300.

Output to floppy disk.

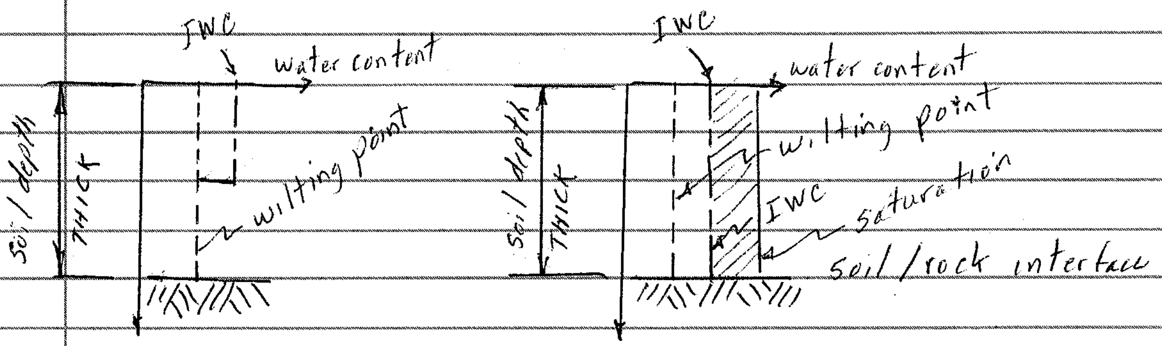
✓ Copy output files from floppy to c:\USW_03\T181PE-W
files are of form JAN21-96.PRE

There were 39 storms of 1, 2 or 3 days with depth >25.5mm
Largest was 64.57 mm

RL 4/14/2008

DAW 9/24/03
Examine effects of Alternative approaches to initial API Condition.

Refer to p138. There are two possible initial soil water profiles for the API model.



Case A Small API
and shallow soil
or deep soil

Case B API sufficiently large to
wet soil layer to average initial water
content (IWC) to the interface.

The FORTRAN PROGRAM KIN02_3.F95 (see p147) treated the flux at the soil/rock interface for Case B as if a wetting front reached the boundary just at the beginning of the run. Therefore there was a flow into the bedrock which removed water from the soil layer even as water was infiltrating at the soil surface. Therefore a greater volume of water was required to saturate the soil than was required under the uniform initial water content option. This inconsistency was corrected. The revised program is KIN03_1. The change made will have no effect on elements with Case A initial conditions, i.e. deep soils or very small API. For Case B initial conditions there will be an increase in saturation-induced overland flow and consequently less bedrock infiltration and greater run-on to downslope elements.

If we refer to the summary table on p148, the greatest differences due to this modification would be for the runoff-producing events APISWA_1, APISWA_12, APISWA_15 and APISWA_17

DAW 9/24/03 Alternate API (Con't)

To compare the output of KIN03-1 with those of KIN03-3, set up a new directory for output.
C:\USW_03\OUTREAL3

control files will be of form: C:\USW_03\APISW_1B.FIL
and will be copied from previous control file and edited to change output file

RUN NO	R.O. vol Channel F	Qp mm/h Tp (min)
APISW_1B ↓	0.02/0.42	0.0205/1224
APISW_12B		
APISW_15B	4.87/0.57	3.63/2066
APISW_17B	16.04/0.55 ✓	3.18/1704 ✓

If we compare the above values with those for comparable events on p148 we see that the runoff volumes are smaller for the low API events (1 and 15) and greater for the high API event (17). Although the differences in the average 9 yr runoff and channel infiltration and the CDFs of infiltration excess, bedrock infiltration and potential bedrock infiltration will probably be very small, it would be best to repeat the runs to be consistent. A minor change was made in the output report so the version used is KIN203_2W
An output summary table in Quattro Pro format will be created

DAW 9/30/03

Compare KIN203_2W output with that on p148.
All 18 runs were completed
Control files are in C:\USW_03 and are of the form:
APISW_XB.FIL
└ run number 1, 2 --- 18
Output files are in C:\USW_03\OUTREAL3 and are of the form:
APISW_XB.OUT
└ run number 1, 2 --- 18
Run summary file (Quattro Pro) is in C:\USW_03\OUTREAL3
" " " " " name is Realtable3.qpw
A printout is shown below. The 9-yr mean annual runoff is 3.59 mm/y, 0.41 mm greater than the average on p148. The mean annual channel infiltration is 0.58 mm/yr, slightly less than the previous result.

Upper Split Wash, Program KIN203_2, Tipping Bucket Rainfall Data, API Option. File: C:\USW_03\OUTREAL3\REALTABLE5 (Quattro Pro 10)

Run Number	Date	Rain file, *.PRE	Precip. mm	API(mm)	*.PAR File	*.FIL & *.OUT	Runoff Vol, mm	Chan. F, mm	Qp, mm/h	Tp, min
APISW_1B	25-Sep-03	G3_88_1	38	2.00	SWCHJ__AM	APISW_1B ✓	0.02	0.42	0.021	1224
APISW_2B	29-Sep-03	G3_91_1	32	2.00	SWCHJ__AM	APISW_2B ✓	0.00	0.29	0.006	600
APISW_3B	29-Sep-03	G3_92_1	26	22.00	SWCHJ__AM	APISW_3B ✓	0.00	0.20	0.000	
APISW_4B	29-Sep-03	G3_92_2	29	2.00	SWCHJ__AM	APISW_4B ✓	0.00	0.19	0.000	
APISW_5B	29-Sep-03	G3_92_3	28	29.00	SWCHJ__AM	APISW_5B ✓	0.00	0.18	0.000	
APISW_6B	29-Sep-03	G3_92_4	31	57.00	SWCHJ__AM	APISW_6B ✓	0.00	0.21	0.000	
APISW_7B	29-Sep-03	G3_92_5	28	2.00	SWCHJ__AM	APISW_7B ✓	0.00	0.18	0.000	
APISW_8B	29-Sep-03	G3_92_6	27	25.00	SWCHJ__AM	APISW_8B ✓	0.00	0.18	0.000	
APISW_9B	29-Sep-03	G3_93_1	27	32.00	SWCHJ__AM	APISW_9B ✓	0.00	0.18	0.000	
APISW_10B	29-Sep-03	G3_93_2	37	5.00	SWCHJ__AM	APISW_10B ✓	0.00	0.33	0.000	
APISW_11B	29-Sep-03	S18_95_1	30.4	26.00	SWCHJ__AM	APISW_11B ✓	0.00	0.20	0.000	
APISW_12B	29-Sep-03	S18_95_2	86.67	10.00	SWCHJ__AM	APISW_12B ✓	11.35	0.63	2.780	5716
APISW_13B	29-Sep-03	G3_87_1	26	8.00	SWCHJ__OM	APISW_13B ✓	0.00	0.22	0.000	
APISW_14B	29-Sep-03	G3_87_2	34	20.00	SWCHNM	APISW_14B ✓	0.00	0.31	0.002	146
APISW_15B	29-Sep-03	G3_92_7	59	2.00	SWCHDM	APISW_15B ✓	4.87	0.57	3.630	2066
APISW_16B	29-Sep-03	S18_94_1	24.4	1.00	SWCHDM	APISW_16B ✓	0.00	0.20	0.000	
APISW_17B	29-Sep-03	S8_3995B	80.18	41.00	SWCHJ__AM	APISW_17B ✓	16.05	0.55	3.180	1704
APISW_18B	29-Sep-03	S8_95_3	35.1	5.20	SWCHJ__AM	APISW_18B ✓	0.00	0.23	0.000	
							32.29	5.25		
						Av. Annual,mm/y	3.59	0.58		

DAW 9-30-03 KINEROS runs with simulated
Upper Split Wash precipitation Series E (50 yr)

Control files will be in C:\USW-03\CONTROL-E\SW_E*.FIL
where * = 1, 2 ... 70
Output files will be in C:\USW-03\OUT_E\SW_E*.OUT

DAW 10-1-03
Summer season storms completed

DAW 10-2-03 Winter Season storms.
All precipitation files in C:\USW-03\Y181PE_W
and are of form XXXYY_ZZ.PRE
month day year

DAW 10-3-03 Winterseason storms (con't)
Winter storm numbers are SW_E74 * to SW_E112
Control files in CONTROL-E
Output " " OUT_E
Precip files in C:\USW_03\Y181PE_W
Summary file is C:\USW_03\RUNFILEE.QPW

For the period May - Nov, the precipitation events were used as input to plane 170, a plane element with shallow soil (120mm). If the runoff from this element was 1 mm or greater, the event was used as input to the entire Upper Split Wash. It is assumed that during the May-Nov period, any deep percolation in upland areas would be utilized by vegetation if there was little runoff-runon. All winter events were used as input to the Upper Split Wash Model (Run numbers SW_E74 - SW E112. The summary table is shown on pages 175-176.

Upper Split Wash, KIN203-2 Simulated precipitation Series E; File: C:\USW_03\RUNFILE_E.QPW

Run No.	Run date	Rain file	Rain Duration	API	*.PAR file	*.FIL & *.OUT	RO Vol, mm	USW Run Date	*PAR File	Precip, mm	RO Vol, mm	Channel F, mm	Qp	Tp
SW_E1 ✓	08/28/03	AUG27_46	65	0.01	TESTJ_O	SW_E1P	2.35	09/30/03	SWCHJ__OM	14.00	1.84	0.51	5.94	54
SW_E2 ✓	08/28/03	JUL02_49	45	0.01	TESTJ_O	SW_E2P	9.04	09/30/03	SWCHJ__OM	25.00	8.61	0.64	14.10	16
SW_E3 ✓	08/28/03	SEP07_49	64	7.96	TESTJ_O	SW_E3P	4.12	09/30/03	SWCHJ__OM	19.20	4.00	0.51	14.14	54
SW_E4 ✓	08/28/03	JUL06_52	60	0.35	TESTJ_O	SW_E4P	0.54	09/30/03	SWCHJ__OM	16.50	0.55	0.50	0.82	62
SW_E5	08/28/03	AUG15_53	160	8.74	TESTJ_O	SW_E5P	0							
SW_E6	08/28/03	SEP29_53	83	0.01	TESTJ_O		0.07							
SW_E7	08/29/03	NOV18_53	720	11.23	TEST_N	etc.	0							
SW_E8	08/28/03	OCT25_54	350	0.01	TESTJ_O		0.02							
SW_E9	08/28/03	SEP24_56	69	14.8	TESTJ_O		0.35							
SW_E10	08/28/03	JUL22_57	219	0.01	TESTJ_O		0.45							
SW_E11 ✓	08/29/03	MAY17_59	241	0.86	TESTM_J		5.43	10/01/03	SWCHM_JM	37.90	0.58	0.44	0.53	224
SW_E12	08/29/03	NOV14_59	192	0.01	TEST_N		0							
SW_E13	08/28/03	AUG15_62	66	2.05	TESTJ_O		0.03							
SW_E14	08/29/03	JULY13_63	234	0.01	TESTJ_O		0.02							
SW_E15	08/29/03	OCT18_63	286	9.08	TESTJ_O		0							
SW_E16 ✓	08/29/03	NOV10_63	224	2.17	TEST_N		2.04	10/01/03	SWCHNM	20.28	1.73	0.50	5.16	152
SW_E17	08/29/03	NOV19_63	594	0.01	TEST_N		0							
SW_E18 ✓	08/29/03	JUN26_64	71	0.01	TESTM_J		1.39	10/01/03	SWCHM_JM	21.40	1.15	0.49	3.55	78
SW_E19 ✓	08/29/03	SEP12_64	21	0.01	TESTJ_O		5.89	09/30/03	SWCHJ__OM	16.35	5.03	0.58	18.48	24
SW_E20	08/29/03	JUN25_65	195	0.01	TESTM_J		0							
SW_E21	08/29/03	OCT09_65	720	11.98	TESTJ_O		0							
SW_E22	08/29/03	OCT31_65	433	22.6	TESTJ_O		0							
SW_E23	08/29/03	NOV01_65	219	38.32	TEST_N		0							
SW_E24	08/29/03	APR12_66	226	4.7	TESTJ_A		0							
SW_E25	08/29/03	AUG13_66	296	0.01	TESTJ_O		0.01							
SW_E26	08/29/03	AUG14_66	91	16.98	TESTJ_O		0.04							
SW_E27	08/29/03	AUG16_66	166	36.07	TESTJ_O		0.41	09/30/03	SWCHJ__OM					
SW_E28 ✓	08/29/03	SEP04_66	202	7.89	TESTJ_O		1.32	09/30/03	SWCHJ__OM	28.77	1.48	0.50	1.68	44
SW_E29	08/29/03	NOV17_66	122	0.01	TEST_N		0.34	09/30/03	SWCHJ__OM					
SW_E30	08/29/03	JUL03_67	480	3.28	TESTJ_O		0							
SW_E31	08/29/03	OCT23_67	720	0.01	TESTJ_O		0							
SW_E32 ✓	08/29/03	SEP13_69	16	0.01	TESTJ_O		7.5	09/30/03	SWCHJ__OM	17.10	7.77	0.65	34.78	18
SW_E33 ✓	08/29/03	SEP29_69	131	0.01	TESTJ_O		1.42	09/30/03	SWCHJ__OM	20.30	1.15	0.50	3.05	48
SW_E34 ✓	08/29/03	AUG02_70	91	12.13	TESTJ_O		7.83	09/30/03	SWCHJ__OM	27.80	8.16	0.55	25.30	36
SW_E35 ✓	08/29/03	AUG16_70	55	0.6	TESTJ_O		1.91	09/30/03	SWCHJ__OM	13.80	0.55	0.50	1.77	52
SW_E36	08/29/03	NOV13_70	375	0.01	TEST_N		0							
SW_E37 ✓	08/29/03	AUG15_72	305	1.49	TESTJ_O		0							
SW_E38 ✓	08/29/03	JUL16_74	52	0.01	TESTJ_O		7.69	09/30/03	SWCHJ__OM	22.00	6.99	0.64	16.80	52
SW_E39 ✓	08/29/03	AUG07_76	53	23.96	TESTJ_O		2.29	09/30/03	SWCHJ__OM	15.00	0.00	0.10	0.00	
SW_E40	08/29/03	AUG22_76	386	2.61	TESTJ_O		0							
SW_E41	08/29/03	NOV11_76	127	4.5	TEST_N		0							
SW_E42 ✓	08/29/03	JUL29_77	23	2.47	TESTJ_O		2.57	09/30/03	SWCHJ__OM	12.88	1.80	0.50	3.80	28
SW_E43	08/29/03	JUL30_77	431	15.35	TESTJ_O		0							
SW_E44 ✓	08/29/03	NOV27_77	195	18.29	TEST_N		1.43	10/01/03	SWCHNM	25.84	1.10	0.44	2.74	40
SW_E45 ✓	08/29/03	NOV11_81	146	0.01	TEST_N		3.76	10/01/03	SWCHNM	21.18	3.21	0.60	11.20	26
SW_E46 ✓	08/29/03	AUG10_82	136	0.5	TESTJ_O		0.21							
SW_E47A ✓	08/29/03	OCT13A82	573	0.01	TESTJ_O		1.64	09/30/03	SWCHJ__OM	34.25	1.33	0.52	2.27	404
SW_E47B ✓	08/29/03	OCT13B82	195	34.25	TESTJ_O		2.97	09/30/03	SWCHJ__OM	27.00	2.57	0.50	6.28	140
SW_E48	08/29/03	NOV01_82	477	0.98	TEST_N		0							
SW_E49 ✓	08/29/03	JUL18_83	37	0.01	TESTJ_O		11.48	09/30/03	SWCHJ__OM	26.60	10.82	0.67	19.80	32
SW_E50	08/29/03	JUL29_83	275	28.05	TESTJ_O		0							
SW_E51 ✓	08/29/03	JUL31_83	480	48.19	TESTJ_O		8.1	09/30/03	SWCHJ__OM	43.40	2.01	0.50	2.35	386
SW_E52 ✓	08/29/03	SEP04_83	480	0.27	TESTJ_O		13.04	09/30/03	SWCHJ__OM	48.5	4.66	0.59	3.76	432 — DAW 10-22-03
SW_E53	08/29/03	NOV21_83	720	0.01	TEST_N		0							
SW_E54	08/29/03	JUN09_84	248	0.01	TESTM_J		0							
SW_E55 ✓	08/29/03	AUG03_84	51	0.01	TESTJ_O		0.94	09/30/03	SWCHJ__OM	13.27	0.55	0.47	1.01	20
SW_E56	08/29/03	APR06_86	279	4.5	TESTJ_A		0							
SW_E57	08/29/03	SEP10_86	81	2.15	TESTJ_O		0.87							
SW_E58 ✓	08/29/03	MAY06_87	33	0.72	TESTM_J		1.52	10/01/03	SWCHM_JM	13.76	0.31	0.42	0.76	22
SW_E59 ✓	08/29/03	JUL07_87	63	5.75	TESTJ_O		3.76	09/30/03	SWCHJ__OM	21.37	3.52	0.51	6.11	52
SW_E60 ✓	08/29/03	JUL13_87	18	30	TESTJ_O		7.8	10/01/03	SWCHJ__OM	17.70	7.22	0.59	19.05	18
SW_E61 ✓	08/29/03	JUL27_87	37	12.74	TESTJ_O		0.97	09/30/03	SWCHJ__OM	13.19	1.12	0.44	3.95	42
SW_E62 ✓	08/29/03	SEP06_88	63	0.37	TESTJ_O		1.13	09/30/03	SWCHJ__OM	14.76	1.34	0.50	1.90	50
SW_E63	08/29/03	NOV30_88	366	0.01	TEST_N		0							
SW_E64	08/29/03	APR03_89	680	10.84	TESTJ_A		0							
SW_E65	08/29/03	AUG18_89	69	0.01	TESTJ_O		0.15							
SW_E66 ✓	08/29/03	SEP10_90	33	0.01	TESTJ_O		3.41	09/30/03	SWCHJ__OM	15.07	2.76	0.57	8.48	20
SW_E67 ✓	08/29/03	JUL23_91	277	0.01	TESTJ_O		7.67	09/30/03	SWCHJ__OM	34.07	7.46	0.67	16.53	42
SW_E68 ✓	08/29/03	AUG29_91	32	0.01	TESTJ_O		3.34	09/30/03	SWCHJ__OM	15.49	2.88	0.56	7.74	26
SW_E69 ✓	08/29/03	JUL22_93	27	0.73	TESTJ_O		10.21	09/30/03	SWCHJ__OM	21.59	6.33	0.64	14.88	10
SW_E70 ✓	08/29/03	AUG28_93	44	1.64	TESTJ_O		6.56	09/30/03	SWCHJ__OM	20.22	4.68	0.59	15.35	16
SW_E71	08/29/03	OCT18_94	330	6.94	TESTJ_O		0							
SW_E72	08/29/03	NOV19_94	637	4.55	TEST_N		0							
SW_E73	08/29/03	NOV21_95	720	0.22	TEST_N	SW_E73P	0							
										Summer sum	115.26	~~17.28~~ 17.87 DAW 10-22-03		
										Summer avg	2.31	0.3~~5~~6 mm/y		
SW_E74 ✓	10/3/03	DEC06_77	237	6.24				10/3/03	SWCHDM	27.50	0.08	0.39	0.20	202
SW_E75 ✓		DEC07_72	800	1.03					SWCHDM	31.90	0.00	0.40		
SW_E76 ✓		DEC09_89	800	0.01					SWCHDM	35.75	0.00	0.34		
SW_E77 ✓		DEC10_56	454	0.01					SWCHDM	36.88	0.41	0.42	0.40	424
SW_E78 ✓		DEC12_86	800	0.58					SWCHDM	36.30	0.00	0.30		
SW_E79 ✓		DEC14_95	800	1.33					SWCHDM	36.60	0.00	0.33		
SW_E80 ✓		DEC19_48	800	1.14					SWCHDM	29.20	0.00	0.28		
SW_E81 ✓		DEC29_51	509	1.31					SWCHDM	33.60	0.00	0.27		
SW_E82 ✓		JAN06_73	800	0.01					SWCHJ__AM	33.20	0.00	0.30		
SW_E83 ✓		JAN07_77	800	0.01					SWCHJ__AM	27.50	0.00	0.18		
SW_E84 ✓		JAN07_91	720	0.01					SWCHJ__AM	26.90	0.00	0.32		
SW_E85 ✓		JAN09_73	2160	34.9					SWCHJ__AM	47.60	1.75	0.51	1.34	1934
SW_E86 ✓		JAN12_87	2160	17.2					SWCHJ__AM	47.60	4.55	0.51	6.17	1962

RUNFILE_E.QPW (Con't)

Run No	Run Date	Rainfile	Duration	API	USW Run	*.DAR File	Precip.	RO vol	Chan F	Qp	Tp
SW_E87 ✓		JAN21_96	1800	0.29	10/3/03	SWCHJ__AM	34.10	0.00	0.22		
SW_E88 ✓		JAN22_63	516	4.47		SWCHJ__AM	35.40	0.16	0.39	0.22	352
SW_E89 ✓		JAN23_82	1840	4.16		SWCHJ__AM	57.90	6.31	0.55	3.59	1730
SW_E90 ✓		JAN25_67	720	0.01		SWCHJ__AM	27.40	0.00	0.23		
SW_E91 ✓		JAN28_64	800	15.23		SWCHJ__AM	39.30	0.33	0.42	0.19	810
SW_E92 ✓		JAN31_93	2120	4.18		SWCHJ__AM	28.10	0.00	0.18		
SW_E93 ✓		FEB05_85	720	0.01		SWCHJ__AM	35.20	0.14	0.41	0.14	628
SW_E94 ✓		FEB07_60	800	0.01		SWCHJ__AM	64.60	8.70	0.58	4.58	640
SW_E95 ✓		FEB11_83	720	18.53		SWCHJ__AM	33.50	0.14	0.37	0.10	634
SW_E96 ✓		FEB11_87	674	0.01		SWCHJ__AM	34.50	0.00	0.40		
SW_E97 ✓		FEB12_47	1640	0.01		SWCHJ__AM	30.40	0.00	0.20		
SW_E98 ✓		FEB14_62	800	2		SWCHJ__AM	43.60	0.28	0.28	0.22	722
SW_E99 ✓		FEB14_83	221	33.54		SWCHJ__AM	25.70	0.00	0.33		
SW_E100 ✓		FEB16_92	2120	26.57		SWCHJ__AM	26.90	0.00	0.17		
SW_E101 ✓		FEB17_77	800	2.17		SWCHJ__AM	46.20	1.02	0.49	1.07	804
SW_E102 ✓		FEB18_94	476	0.74		SWCHJ__AM	41.10	0.43	0.43	0.38	482
SW_E103 ✓		FEB20_68	2200	4.42		SWCHJ__AM	40.20	0.22	0.45	0.24	138
SW_E104 ✓		FEB21_80	2040	11.6		SWCHJ__AM	54.40	5.21	0.53	2.02	1920
SW_E105 ✓		FEB25_57	800	0.01		SWCHJ__AM	38.80	0.02	0.44	0.02	810
SW_E106 ✓		FEB26_88	800	16.31		SWCHJ__AM	31.20	0.00	0.22		
SW_E107 ✓		MAR06_83	800	0.77		SWCHJ__AM	27.80	0.00	0.19		
SW_E108 ✓		MAR09_86	800	0.8		SWCHJ__AM	25.60	0.00	0.32		
SW_E109 ✓		MAR14_79	1800	16.4		SWCHJ__AM	29.10	0.00	0.19		
SW_E110 ✓		MAR17_87	81	1.07		SWCHJ__AM	29.70	4.08	0.56	6.72	60
SW_E111 ✓		MAR22_94	242	0.59		SWCHJ__AM	34.30	0.61	0.46	0.66	218
SW_E112 ✓		MAR25_89	720	0.01	10/3/03	SWCHJ__AM	34.00	0.00	0.31		
						Winter sum		34.44	13.86		
						Winter avg		0.69	0.28 mm/y		
						Annual avg		2.99	0.6~~2~~3 mm/y		

DAW 10-23-03

RL 4/14/2008

DAW 10-7-03 Calculate Cumulative Distribution Functions (CDFs) for Upper Split Wash - Simulated Precipitation Series E.

Run Program C:\USW-02\AVGCDF5.F95

Control file: C:\USW-03\SW_EAVG.CON ✓

List file: C:\USW-03\ CDF_E\ DAW 10/21/03 SUMFILES_E.LST

DAW 10-21-03

Output files will be in C:\USW_03\CDF_E\

Output summary FBI = 19.80 mm/y
Rock Infiltration = 2.28 mm/y over entire area
= 3.03 mm/y over 75% of area
36 toe elements; 21 channel elements, 101 slope elements, 59 ridge
Channel elements are 0.68% of entire area
Ridge: 29.95%
Slope: 59.6%
Toe: 9.77%
Channel: 0.6803%

Now calculate CDFs for the tipping bucket rainfall summary file on p 173

Control file: C:\USW_03\REAL3AVG.CON

List file: C:\USW_03\ CDFREAL3\ CDFREAL3.LST ✓

DAW 10-22-03
Create summary files from output files for tipping bucket data (9 yr).
In directory C:\USW_03\OUTREAL3
File form Same as *.OUT files on p 173, but with extension .SUM

DAW 10-22-03 CDFs of infiltration 9 yr. tipping bucket record (Con't).

Now run program C:\USW_02\AVGCDF5.F95

with control file C:\USW_03\REAL3AVG.CON

Note: There will be seasonal partitioning for Apr-Nov and Dec-Mar for the entire watershed and for the ridge elements.
CDFs of mean annual potential bedrock infiltration are shown on p 179
Summary:
Rock infiltration: 8.65 mm/y over entire area
10.7 mm/y over 81% of area.
Mean PBI = 47.55 mm/y
Now prepare figures showing the differences in CDFs for the 9-yr period and the 50 yr. simulated record

Use program PSIPLOT

All Figures in C:\USW-03\CDF_E
File Names

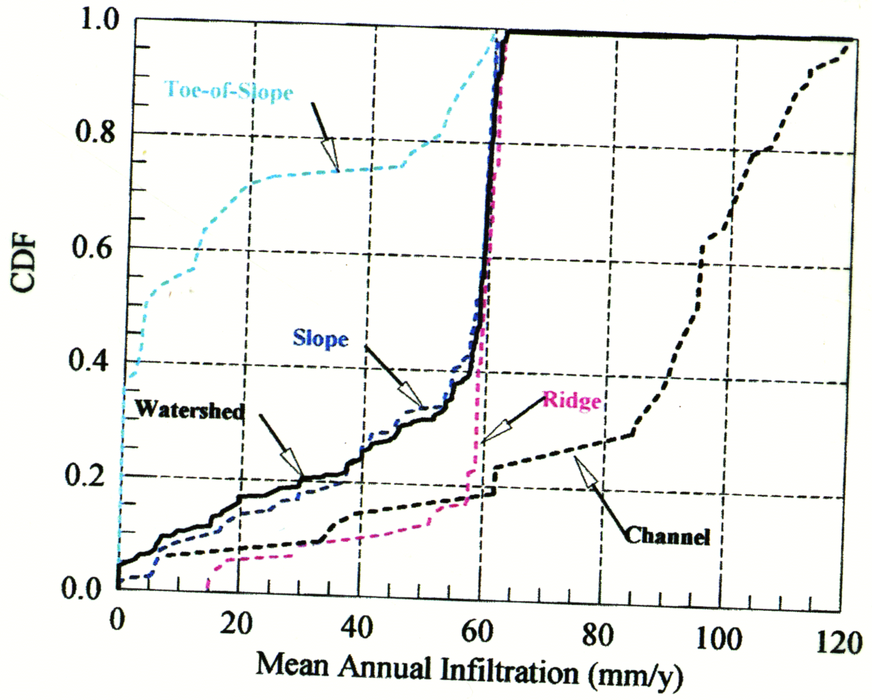
Total Watershed Infiltration excess :	E_EXCESS.PGW
Total Watershed Rock Infiltration :	E_ROCK.PGW
Channel :	E_CHAN.PGW
Slope	E_SLOPE.PGW
Toe	E_TOE.PGW

DAW 10-23-03

Watershed Dec-Mar	E_DEC_MAR.PGW
Potential Bedrock F, Ridge, Slope, Toe - E	E_PB.PGW
Potential Bedrock F, " " " Tipping bucket	C:\USW_03\~~CDFREAL3~~ CDF_E\ REAL3_PB.PGW

DAW 10-23-03

Potential Bedrock Infiltration (PBI)



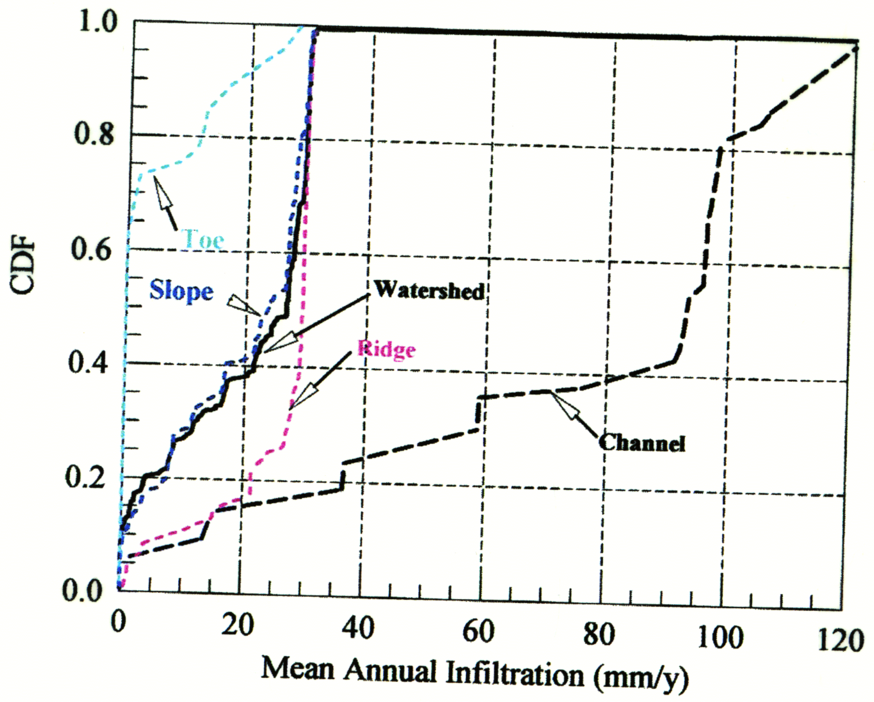
Potential Bedrock Infiltration Upper Split Wash,1987-95
KIN03_2, API Option

File: C: | USW_03 | CDFREAL3 | REAL3_PB.PGW
daw 10-23-03

This figure illustrates the high variability between slope positions and within slope classes. Channel elements have the greatest PBI, but represent a small proportion of the watershed area. Slope elements with shallow soils have mean annual PBI of about 60 mm/yr and because they are a substantial portion of the watershed, are the greatest contributors to PBI for the entire watershed.

DAW 11-11-03

A comparable figure for the 50-yr E series of precipitation is shown below. The CDF for channel infiltration is very close to that for the 9-yr series above. However for other watershed elements PBI for the E series is approximately 30 mm/y smaller.



Potential Bedrock Infiltration Upper Split Wash,
Simulated Precipitation Sequence E; KIN03_2, API Option

File: C: | USW_03 | CDF_E | E_PB.PGW
daw 10-23-03

DAW 12/4/03

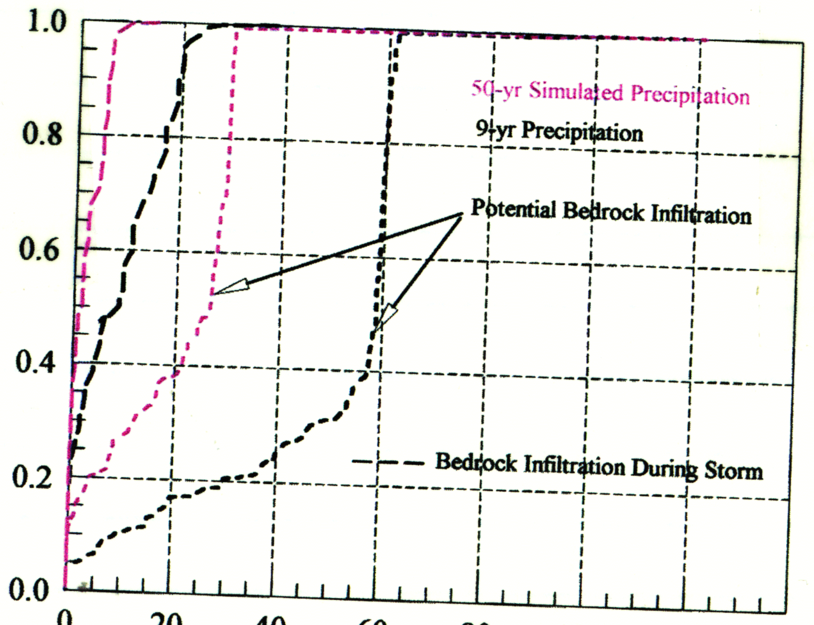
Converted AVGCDF5.F95 to AvgCDF03_2.F95 so that summary information is written to a file named in the control file. The summary information was previously written to the screen. Also added calculations of mean potential bedrock infiltration (PBI) for entire watershed and for each slope class.

Comparative Statistics:

	REAL 3 (mm/y)	SERIES E (mm/y)
Mean Annual PBI, Watershd	47.55	19.80
" Ridge	55.66	25.12
" Slope	47.87	18.90
" Toe	18.17	5.04
" Channel	84.94	76.61

OUTPUT SUMMARY FILES Have extension .TXT

A comparison of the bedrock and PB Infiltration for the 9-yr and 50 yr simulated record is shown below. Obviously, there is a significant difference between the two series.



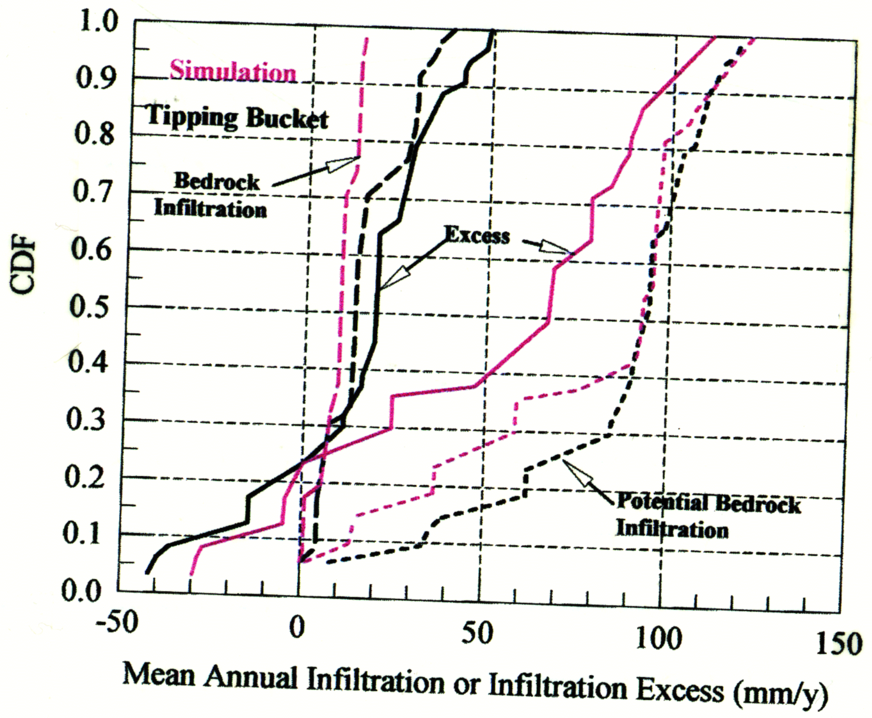
Deep Infiltration, Upper Split Wash
9-yr Record and 50-yr Simulated Record

File : C: | USW_03 | CDF_E | E_ROCK.PGW
daw 10-22-03

CDFs for the channels are shown on p181. The CDFs of PBI are relatively close reflecting greater surface runoff during the summer for the simulated series. Although there was more excess infiltration for the 50 yr sequence, it occurred with lower API and initial water content.

DAW 12-4-03

This led to less bedrock infiltration because the runoff duration was less. However the channel alluvium was recharged more frequently



CHANNEL INFILTRATION, UPPER SPLIT WASH
TIPPING BUCKET DATA AND 50-YR SIMULATION E

File: C: | USW_03 | CDF_E | E_CHAN.PGW
daw ~~19~~-22-03
10 DAW 10-22-03

These differences suggest major differences in the runoff-producing characteristics of the 9-yr measured precipitation sequence and the 50-yr simulated sequence. It appears that further diagnostic checks should be made on the simulated precipitation sequence. Because the 9-yr sequence is too short, the simulated sequence will be compared with the records for two nearby stations - Forty Mile Canyon and Yucca Dry Lake.

Refer to Scientific Notebook 597 pp 11-13 for monthly comparisons. Although the monthly means of total precipitation, wet days per month and the precipitation per wet day are reproduced reasonably well, further examination is required. See Notebook 597 p 14

DAW 1-6-04 Runoff and deep Infiltration for Upper Split Wash with Monsoon Climate. MAP = 281 mm <u>Unperturbed</u> by SOI and PDO

The daily precipitation output file is

C:\SIMULATIONS_02\MONSOON4.PTR (See Notebook #363 p137)
" " \MON4.DAT (Leapdays omitted)

This 50-yr sequence has the seasonal characteristics of RG4 on the Walnut Gulch Experimental watershed, but with parameters adjusted to get a MAP of 281 mm, which is 100 mm greater than present MAP at YM.

File Structure:

C:\USW_04 ✓ DAW 1-6-04
CON~~TROL~~_MON4 ✓ Control files for USW simulations
OUT_MON4 ✓ *.OUT and *.SUM files "
CDF_MON4 ✓ CDF files and graphic files
YM281MON4_S ✓ summer precipitation files
YM281MON4_W ✓ Winter precipitation files

Now select daily amounts where the depth is greater than the threshold. Also calculate 7-day API.

Revise program COND7_3C.BAS, so that it does not require leap days. Revised program is.
C:\CLIMATE02\BASIC_Programs\COND7_3D.BAS
Moved to C:\USW_04\CON_MON4\
Also had to change reading format for the MON4.DAT file which was produced by an older simulation program

There are 2 output files.
C:\USW_04\CON_MON4\MON4_SU.COM summer
" " " \MON4_WIN.COM Winter

DAW 1-7-04 Continue disaggregation of monsoon simulated daily precipitation

There were 264 summer days with precip. depth > 12.5 mm

Now examine the winter storm sequences in the manner shown in Scientific Notebook 597 p 6-8.

Ending Date Precipitation Depth on each day of Sequence

Dec 19 06 13.20 5.63 14.32 0.76 4.99 API = 37.5
Dec 15 33.15 mm

23.7
Jan 1 08 19.13 1.87 2.70 6.32 2.41 API = ~~51.0~~ 31.5 DAW 1-7-04

26.63 35.84
Jan 21 11 9.59 10.07 6.97 0.69 2.76 11.74 0.23 23.87 5.55 0.53
Jan 1 API = 39.8 Jan 6 API = 30.0

34.94 21.13
Dec 12 12 0.59 0.37 19.74 13.36 1.84 6.35 4.8 3.10 13.23 2.23
Dec 4 API = 46.6 Dec 8 API = 87.89 mm

30.92 40.94
Dec 13 28 3.82 19.87 0.39 10.66 10.02
Dec 9 API = 32.3

32.10
Jan 27 36 0.75 17.75 1.20 13.15 5.78
Jan 23 API = 21.8

23.17
Jan 11 46 3.79 0.21 2.13 1.55 0.58 10.04 4.04 9.09 0.50
Jan 7 API = 34.4

28.86
Dec 11 50 14.63 12.67 1.56 3.38 0.30
Dec 6 API = 51.4

The 3 and 4 day sequences will be examined and disaggregated

Daw 1-7-04 USW-Monsoon Climate (Con't)

Daily disaggregation summer storms
Ran DAYD134.BAS with C:\USW_04\CON_MON4\MON4_SU.COM
as input. Random seed was 71.
Output is C:\USW-04\CON-MON4\MON4_SU.DUR

Disaggregate storms:

Run program RAINSIM6.BAS output to a floppy
Copy files from floppy to C:\USW-04\YM281MON4_S
files of form APR08-07.PRE. These are storms
disaggregated into 20 increments
Set up QuattroPro file C:\USW_04\MON4_RUN.QPW

Daw 1-23-04
E-mail files to Fedors, Data for figures in USW_PRESCLIM.

For Figs 15 + 16 C:\USW_03\CDFREAL3\ASW_17B.CDF
For Figs 17a + 17b C:\USW_03\CDFREAL3\REAL3AVG.CDF
Create file " " " \CDF_HEAD.TXT
documenting column headings in above two files.

Daw 1-24-04 Continue editing precipitation series
and set up and enter duration, precip amount, run number
etc. in spreadshet
Daw 1-26-04 Continue
Daw 1-27-04 Complete entries of API, etc in spreadsheet
Daw 1-28-04
There are 206 summer (Apr-Oct) events.
This compares with 74 events for the present climate
simulation series E (50 yrs). It should be noted
that the monsoon climate will have more frequent
summer storms.

Daw 1-28-04 USW with monsoon climate
with MAP = 281 mm.

Create control files: in C:\USW_04\CON-MON4

First run some cases with total precipitation
greater than 20 mm.

Daw 1-30-04 Select events for R.E. Smith to
run with OPUS, a model (continuous) with evapotranspiration
Because the KINEROS runs are only for individual storms,
with a 7-day API, the results may be biased.
Procedure:
1) Select a simulated year in which there are significant
summer storms with varying API
Year 16 appears to meet this criterion
There were 6 disaggregated storms

Run #	Precip. File	Precip (mm)	API	
MON4_109	JUL07_16.PRE	26.25	0.01	one event
✓ MON4_116	JUL08_16 "	25.14	26.25	"
✓ MON4_36	AUG08_16 "	50.7	12.49	"
MON4_201	AUG19_16 "	13.77	9.3	2nd of 2 events 1st was 3.91 mm
✓ MON4_186	NOV17_16 "	20.19	6.33	" 2 events 1st was 6.33 mm
MON4_175	OCT19_16 "	13.51	9.03	" 2 events 1st was 9.03 in 82m

Create a smaller precip file from C:\SIMULATIONS02\
MONSOON4.PTR - Take only year 16.
Name it MON4YR16.PTR
Send above files to R.E. Smith Smith_OPUS.wpd-explanation

Daw 2-5-04 Disaggregate 1st storms on days with
2 storms > threshold
Select from C:\USW_04\CON-MON4\MON4_SU.DUR
write to " " " \MON4ASU.DUR

DAW 2-12-04 Disaggregate winter storms

Files: c:\usw_04\CON_MON4\MON4.DAT ← Daily > threshold
c: " " \MON4_WIN.COM ← winter sequence

Create file " " \MON4_WINPR.COM
shows daily amounts for 3 + 4 day events
all events > 4 days have been lumped into

Create file " " \MON4_WINED.COM
This is file MON4-WIN.COM edited to account for 4-day and greater sequences.

Run program DAYDIS4.BAS with input file DAW 2/12/04
c:\usw_04\CON_MON4\~~MON4-WINED~~.COM
MON4WIED.COM
output file is MON4WIED.DUR (random seed 71)

Now run RAINSIM6B.BAS with above file as input
Note: RAINSIM6.BAS was modified for improved printout
Output files are written on a floppy
Copy to c:\usw_04\YM281MON4-W\

DAW 2-13-04 Sent KIN203_2W.EXE to Fedors

DAW 2-24-04 Continue disaggregating 3-day winter storms.

1440 min/day DEC04_12 0 180 1620 add 180 new increment = 101.25
180 1440

DEC06_50 0 540 1980
1020

DEC08_12 Leave as is

DAW 2-28-04
Set up MON4.LST file for CDF calculation

Col 1	Col 2	Col 3
*. Sum (file name)	Season code 1 = Apr-Nov 0 = Dec-Mar	Precipitation

DAW 3-16-04
Summarize data for years 15 + 16 in spreadsheet for comparison with OPUS runs by Smyth.
c:\usw_04\OPUScompare.qpw (Quattro-pro)

Completed CDF List file using Quattro-pro to copy columns

File name: c:\usw_04\MON4.TXT 231 Lines
Rename " " \MON4.LST for consistency ✓
Move to c:\usw_04\CDF_MON4\MON4.LST ✓
Create control file for program AVGCDF03_2.F95

File name: c:\usw_04\MON4AVG.CON

Output files will be in c:\usw_04\CDF_MON4
MON4AVG.CDF - watershed average
MON4A_N.CDF - Seasonal average Apr-Nov
MON4D_M.CDF " " Dec-Mar
MON4RI - annual average ridge elements
MON4RIDM - Dec-Mar " " "
MON4SL - annual average slope
MON4TO - " " toe-of-slope
MON4CH - " " Channels
MON4SUMMARY.TXT - Summary information

Program run complete From MON4SUMMARY.TXT
Rock F = 2.58 mm/y over entire area
= 3.12 mm/y over 82.6% of area
Potential Bedrock F = 35.17 mm/y; Ridge: 47.4;
slope: 31.6; Toe: 7.0; Channel: 214.9 mm/y

Daw 3-18-04 Continue Analysis of Results -
Upper Split Wash with 50-yr simulated Monsoon precipitation

Prepare Graphics,
First mean annual values (CDFs) for potential bedrock infiltration in a form similar to figs on p 179.

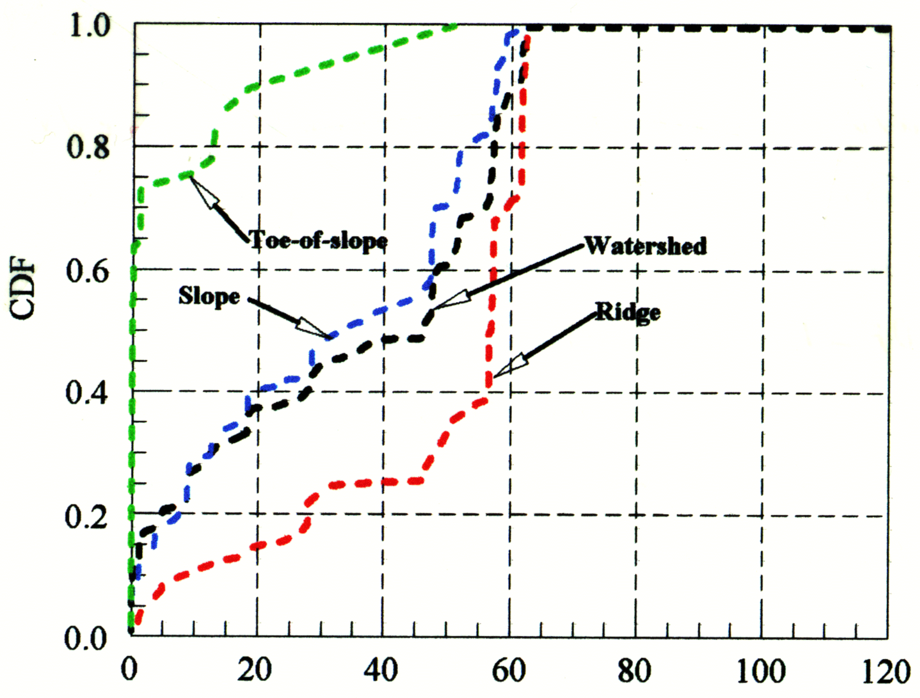
File is: C:\USW_04\CDF_MON4\MON4_PB.PGW
Note: Channel potential bedrock infiltration is not shown because it is much greater than for the 9-yr record or series E. This reflects the greater amount of surface runoff with the monsoon climate

Compare CDFs of Channel Infiltration excess and Potential Bedrock Infiltration for 9-yr record, 50-yr simulation E and 50-yr simulation MON4

Plot file is C:\USW_04\CDF_MON4\CH_COMPARE.PGW
See Figures on p 189.

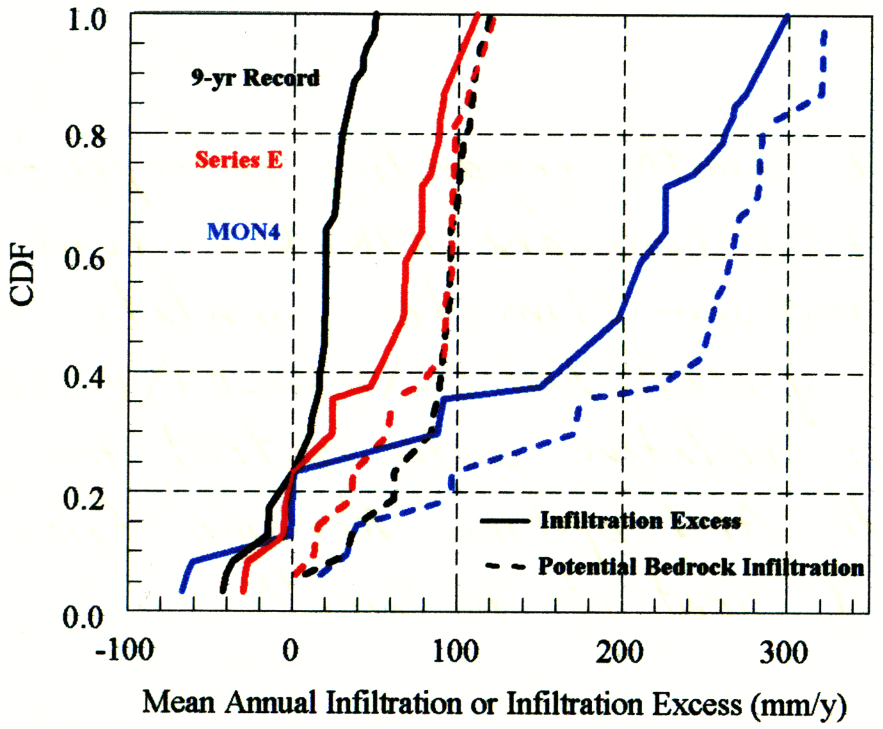
Daw 4-7-04
Conference with R.E. Smith regarding interpretation of comparisons of OPUS runs and KINEROS runs for years 15 and 16 for monsoon climate simulations.
Add a column to the spreadsheet C:\USW_04\opuscompare.qpw with calculated average relative water content for plane element 23 with API option. Renamed file opuscompare3.qpw + sent it to Smith.

Daw 3/18/04



Potential Bedrock Infiltration Upper Split Wash
50-yr Monsoon Precipitation. KIN03_2, API Option

File: C: | USW_04 | CDF_MON4 | MON4_PB.PGW
daw 3-18-04



Channel Infiltration, Upper Split Wash
9-Yr Record, Series E and Mon4 Simulations

File: C: | USW_04 | CDF_MON4 | CH_COMPARE.PGW
daw 3-18-04

DAW 4-20-04 Comparison of KINEROS and OPUS output (Con't).

In discussions with R. E. Smith, we concluded that a comparison based on only 2 years of record was inconclusive, especially since both years 15 and 16 of the simulated monsoon climate had above average precipitation. Therefore I will send him detailed storm files for years 17-24, to make a 10-year record.

Storm files are in C:\USW_04\YM281MON4_S or YM281 MON4_W

sent to Smith Year DAW 4/20/04 Storm Files/Run File

✓✓ 17 AUG04_17/MON4_21; AUG16-17/MON4_49; AUG24_17/MON4_65
SEPT30_17/MON4_89; JUL29_17/MON4_161;

✓✓ 18 AUG22_18/MON4_62; NOV03-18/MON4_178; NOV18_18/MON4_187
AUG08_18/MON4_37

✓✓ 19 AUG01_19/MON4_9; AUG04-19/MON4_22; AUG10_19/MON4_44
SEP24_19/MON4_86; JUL09_19/MON4_113; JUL30_19/MON4_166

✓✓ 20 SEP15_20/MON4_80; JUL25_20/MON4_152; AUG18_20/MON4_197

✓✓ 21 APR28_21/MON4_4; AUG03-21/MON4_16; AUG5_21/MON4_28
AUG17_21/MON4_54; AUG28_21/MON4_69; SEP16_21/MON4_81
MAY25_21/MON4_99; JUL05_21/MON4_108; JUL07_21/MON4_110

✓✓ 22 AUG21_22/MON4_58; JUL17-22/MON4_132;

✓✓ 23 AUG31_23/MON4_97; NOV12_23/Mon4_182

✓ 24 SEP21_24/MON4_84; SEP30-24/MON4_90; AUG30_24A/MON4_93A
AUG30_24B/MON4_93B; OCT03_24/MON4_168; NOV18_24/MON4_188
NOV21_24/MON4_191; DEC24_24/MON4_211

✓ 15 AUG01_15/MON4_8; JUL14_15/MON4_105; JUL19_15/MON4_139
JUN14_15/MON4_100 JUN23_15/MON4_102; SEP03_15/MON4_74
DEC27_15/MON4_213

DAW 4/22/04
Check events for multiple events from file C:\USW_04\CON_MON4\MON4_SD.DUP
Provide information to R.E.Smith for OPUS Rainfall files

Year 17; AUG16_17 5.71 mm before (13.70)
AUG04_17 (12.68) 10.20

Year 18: No multiple showers

Year 19: Aug10-19 10.93 mm before (15.09) 2.84 after.

Year 20 JUL25_20 (14.97) 0.12 after; SEP15_20 0.62 before (35.89) 7.04 after

DAW 4/22/04

Year 21 Aug03_21 5 showers 8.18 (13.77), 2.38, 1.32, 0.47
Aug05_21 3 " (18.28) 6.17, 0.30
Aug28_21 2 " (14.75) 8.07
May25_21 3 " (13.05) 0, 4.93
Jul07-21 2 " (51.27) 1.79

(*.*) is disaggregated shower

DAW 4/26/04

Year 22 AUG21_22 2 showers (21.32), 0.59
JUL17_22 1 showers

Year 23 AUG31_23 2 showers (14.61), 0.61
NOV12_23 " (14.68), 4.53

Year 24 SEP30_24 2 showers (14.36), 7.55
AUG30_24A+B - 2 showers both > threshold
OCT03_24 2 showers (27.85), 3.16
NOV21_24 3 " (31.50), 7.82, 0.63

Year 15 JUN14_15 2 showers (16.61), 0.69
JUN23_15 3 " (14.19), 0.27, 0.91

DAW 4/27/04

Year 16 AUG~~08~~ 19-16 2 showers 3.91, (13.77)
Oct19_16 2 " 9.03, (13.51)
Nov17_16 2 " 6.33, (20.19)

Daw 5-11-04 Comparisons between KINEROS2 and OPUS for single plane element of Upper Split Wash Element #23 (THICK = 300mm)

Spreadsheet for comparisons: C:\USW_04\OPUS_KINEROS\OPUSCO~3.qpw

Transfer run data for KINEROS from C:\USW_04\OPUS_KINEROS\MON4_RUN

Daw 5-26-04 Continue Comparisons

Roger Smith has added data to spreadsheet C:\USW_04\OPUS_KINEROS\OPUSCO~3.qpw

Copy relevant columns from above spreadsheet to " " " \OPUS_KIN_Worksheet.qpw

First delete subtotal and total rows. Then copy to PSIPLOT Plot OPUS runoff vol. vs. KINEROS runoff vol. for element

There are 2 outliers for the dates DEC27_15 and DEC24_24. OPUS showed 31.87mm and 17.99 mm respectively while KINEROS showed no runoff for either event. OPUS showed that the runoff was due to snowmelt with frozen soil leading to a lower K_s. KINEROS2 cannot deal with snowmelt runoff.

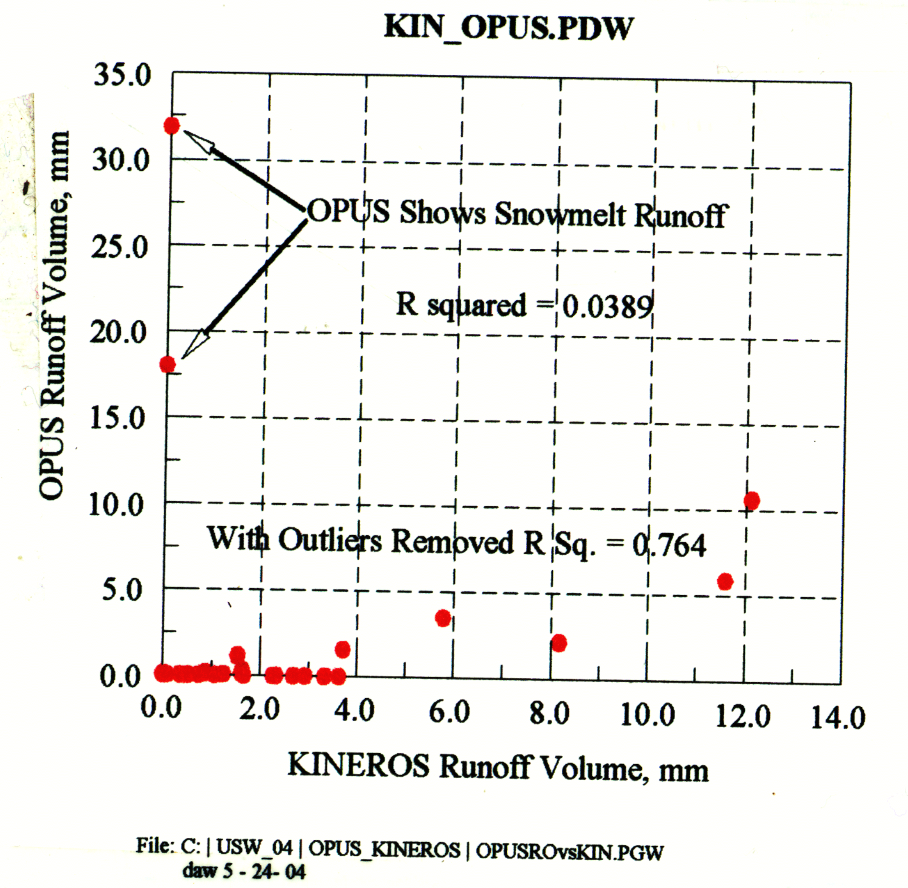
A linear regression with outliers included results in $R^2 = 0.0389$ With the outliers removed the regression equation is

OPUSRO =-0.295 +0.574 KINRO R^2= 0.764

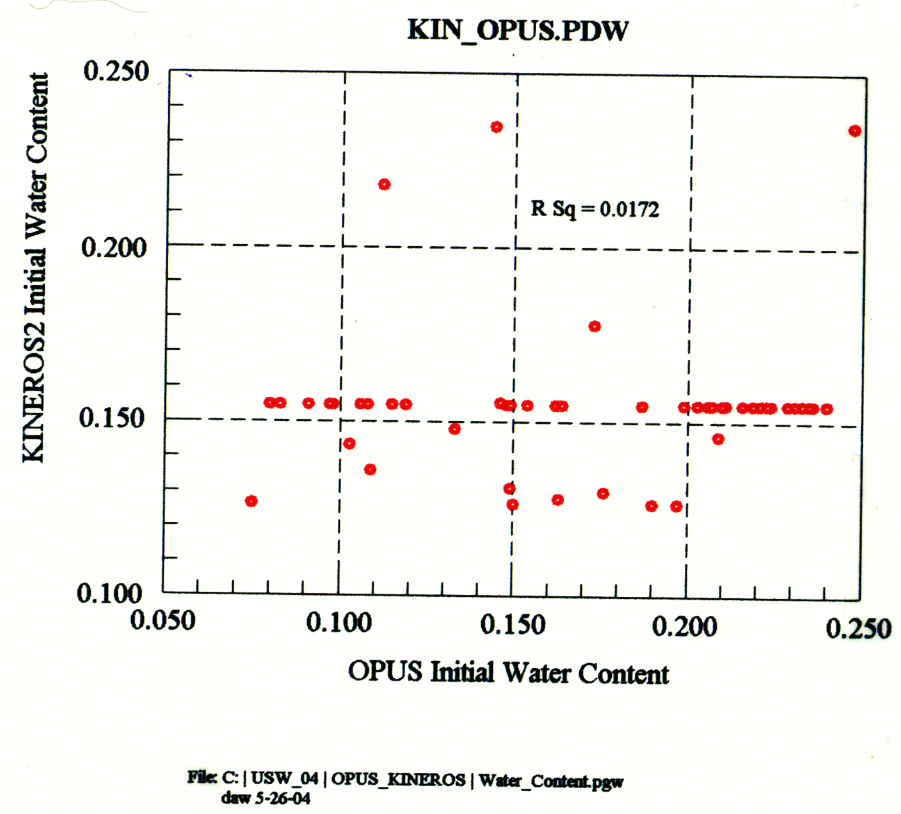
A plot is shown on the following page

This indicates that OPUS shows lower runoff for non snowmelt cases. One possibility that would explain this difference is a difference in the initial water content. The KINEROS2 water content is plotted versus OPUS initial water content in the figure on p 193. A linear regression results in $R^2 = 0.0172$

Daw 5-26-04



File: C: | USW_04 | OPUS_KINEROS | OPUSROvsKIN.PGW
daw 5 - 24- 04



File: C: | USW_04 | OPUS_KINEROS | Water_Content.pgw
daw 5-26-04

The relationship is not significant. An examination of the figure reveals that it is dominated by KINEROS2 initial water content = 0.155, the average water content for the summer season. The API option is constrained by this value during the summer period – obviously a limitation of the approach. The sensitivity of this should be checked

Daw 5-31-04

Another factor that explains the correlation of runoff amounts, is the fact that OPUS cannot accomodate small scale variability of saturated hydraulic conductivity, Ks. Because most of the runoff amounts are small this results in more zero values for OPUS and a bias for smaller runoff amounts. In OPUS K_s varies depending upon the prior rainfall energy to account for soil sealing. Therefore it may not be the same as the average K_s in KINEROS2.