

(기술정보)

도시수문학 분야에 활용되고 있는 마이크로 컴퓨터용 소프트웨어

정 상 만*

1. 서언

미국 토목학회의 도시공학에 활용되고 있는 마이크로 컴퓨터용 소프트웨어 조사 특별위원회(Task Committee, TC)에서는 최근에 미국에서 사용되고 있는 40개에 달하는 도시수문학 관련 마이크로 컴퓨터용 소프트웨어에 대한 조사를 완료하였다.

수자원 기술자들이 관련 분야의 설계를 위해 소프트웨어 패키지를 선택해야 할 경우, 널리 쓰이고 있는 소프트웨어 패키지가 어떤 것들인가에 대한 정보의 부족 때문에 곤란을 겪는 경우가 많다. 이러한 문제의 해결에 도움을 주고자 HYDATA(A Bi-monthly Publication of the American Water Resources Association) 9월호에 게재된 도시수문학에 활용되고 있는 마이크로 컴퓨터용 소프트웨어 목록을 제시하고 그 특징을 소개하고자 한다.

2. 도시수문학 분야에 활용되고 있는 마이크로 컴퓨터용 소프트웨어의 특징

특별위원회에서 조사한 소프트웨어 목록을 요약한 결과는 Table 1과 같다. Table 1에 수록되어 있는 40개의 소프트웨어 패키지의 주요특징을 Table 2에 수록하고 있는데 마지막 항목의 내용 즉, 실측치에 대해 검정을 실시하였는가에 대해 많은 소프트웨어 공급자들이 실측치에 대한 검정을 수문과정을 연구하는 기관에 의뢰했다고 언급하고 있다. 이러한 소프트웨어들로서는 TR20, TR55, HEC-1 등을 들 수 있다.

수문과정을 모의하는 측면에서 볼때 대부분의 소프트웨어들이 단일 설계 호우에 대해 보다 단순한 과정을 택하고 있는 것으로 나타났다. 예를 들어 SCS curve number와 합리식의 C계수가 Green과 Ampt, Horton 등의 보다 복잡한 과정으로 되어있는 침투방정식들 보다 압도

적으로 많이 사용되고 있는 것으로 나타났다.

수문곡선의 합성방법으로는 SCS 단위 수문곡선법이 가장 많이 사용되고 있으며 수정 Rational Method, Snyder방법, Kinematic wave방법, 기타 다양한 합성단위 수문곡법 등의 순서이다. 수문곡선 추적은 주로 도달시간의 해석에 의해 수행되고 있으며 다음으로는 주로 Muskingum 추적 또는 Saint-Venant 방정식을 사용하는 Kinematic 추적에 의해 수행되고 있다.

이러한 수문학적인 방법의 선택해 대한 세부적인 자료가 Table 3, 4, 5에 제시되고 있다. 조사된 마이크로 컴퓨터용 소프트웨어들이 필요로 하는 주기억용량은 64K 내지 3MB에 걸쳐있는 것으로 파악되었고 평균은 512K 정도이다. 사용되고 있는 프로그래밍언어로는 FORTRAN, PASCAL, BASIC, "C", ASSEMBLY 등이며 BASIC이 가장 많이 쓰이고 있고 "C"는 그래픽 루틴(Graphic routine)에 많이 이용되고 있는 것으로 나타났다.

Table 2에서 볼 수 있는 바와같이 40개의 소프트웨어 패키지중 12개만이 copy right이 풀려있는 상태에 있고 나머지 28개는 이미 copy right이 설정되어 있거나 copy right을 취득하는 중에 있는 것으로 파악되고 있다.

이 조사에 의하면 소프트웨어 패키지중 74%를 공급자가 자체적으로 개발하였으며 수문학적인 접근방법은 HEC-1, SWMM4, TR20, TR55 등에서 이미 확립된 방법을 따랐다고 보고하고 있다. 또한 마이크로소프트웨어 패키지의 가격은 무료에서부터 가장 비싼 가격인 \$10,000에 이르기까지 넓은 영역에 걸쳐있으며 평균가격은 약 \$ 500이다.

3. 결언

지금까지 도시수문학에 활용되는 마이크로컴퓨터용

소프트웨어의 종류와 특징에 대하여 살펴보았다. 더욱 세부적인 정보를 원하는 독자는 아래 제시된 두 교수의 주소로 연락하면 많은 도움을 받을 수 있으리라 사료된다.

Professor
B.A. Tschantz,
Dept. of Civil Engineering
University of Tennessee

Knoxville, TN 37996
U.S.A.

Professor
D.F. Kibler,
Dept. of Civil Engineering,
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061-0105
U.S.A.

TABLE 1. Preliminary ASCE TC Inventory of Micro Software in Urban Drainage Design.

No. and Name of Vendor	Address and Telephone of Vendor	Name of Program	Software Package Cost	Hydrograph Synthesis Method	Storm Sewer Design Option?	Detention Basin Option?
(1)Hydrologic Engineering Center, U.S.Army Corps of Engineers	609 2nd St. Davis, CA 95616 (916)551-1748	HEC-1 Flood Hydrograph Package	Variable	Kinematic Wave Clark UH Synder UH SCS UH User Specified	No	Yes
(2) Dodson and Associates, Inc.	7015 W.Tidwell Suite 107 Houston, TX 77092 (713)895-8322	ProHEC1 Professional HEC-1 System	\$495 List Discounts Apply	Kinematic Wave Clark UH Synder UH SCS UH	No	Yes
(3) Dodson and Associates, Inc.	7015 W. Tidwell Suite 107 Houston, TX 77092 (713)895-8322	ProPIBS	\$795 Discounts are Available	Time Area Curve	Yes	Yes
(4) Dodson and Associates, Inc.	7015 W. Tidwell Suite 107 Houston, TX 77092 (713)895-8322	Dodson Hydro Calc Hydrology Library	\$295 Discounts are Available	Clark Synder SCS Diam. U.H.	No	Yes
(5) Galileo Software	16 Ranch Rd. Chelsoford, MA01824 (508)256-7801	Hydropak	\$500 All Six Modules or \$100 Per Module	SCS Curvilinear Unit Hydrograph	No	Yes
(6) Advanced Engineering Software (R.E.S.)	17782 Sky Park Circle Irvine, CA92714 (714)385-3546	RES Hydrology and Hydraulics	Variable	S-Graph Clark U.H. SCS Curvilinear UH.	Yes	Yes
(7)Haestad Methods Inc.	37 Brookside Rd. Waterbury, CT06708 (800)727-6555	Pond2 Quick TR-55 Link-2	QTR-55 \$495 Pond2 \$990 Package QTR-55 Pond2 \$995 Link-2 \$795	1986 TR-55 Tabular Hyd. Any Method Supported by HEC-1 and SCS	No	Yes
(8) Haestad Methods Inc.	37 Brookside Rd. Waterbury, CT06708 (800)727-6555	The Friend	Program \$495 Interfaces to The Friend are N. C With Model Purchase	HEC1 TR20	Thysys HEC2	HEC1 TR20

No. and Name of Vendor	Address and Telephone of Vendor	Name of Program	Software Package Cost	Hydrograph Synthesis Method	Storm Sewer Design Option?	Detention Basin Option?
(9) Myers Engineering Co.	3829 Birch St. Newport Beach, CA92660 (714)852-8627	Garden Variety Software Drain Check	\$50	N A	Yes	No
(10) B. Tanovan Water Resources Consultants	11995 SW Burnett Lane Beaverton, OR97005 (503)643-3149	Water-Drainage	Approximately \$500	SCS Curvilinear UH.	Yes	Yes
(11) Center for Exposure Assessment USEPA	College Station Rd. Athens, GA30613 (404)546-3123	Storm Water Management Model Version 4 SWMM4	Free EPA \$40 from U of FL Documentation \$56 from U of FL	Nonlinear Reservoir	Yes	Yes
(12) Center for Exposure Assessment USEPA	College Station RD. Athens, GA30613 (404)546-3123	Hydrologic Simulation Program Fortran HSPF	Free From EPA	Stanford Watershed Model	Yes	Yes
(13) Civil Concepts	P.O. Box 483 Sacramento, CA95803 (916)427-1011	Civil Concepts' Hydrology Planner	Hydrology Planner \$295 Hplot \$595	Application of Santa Barbara Urban Hydrograph Method	No	Yes
(14) Intergraph Corporation	One Madison Industrial Pk. Huntsville, AL35807-4201 (800)826-3515	Inflow Storm Drainage Design	Inflow Database \$3000 \$600	Modified Rational to Compute Runoff Hydrograph	Yes	Yes
(15) McTRANS The Center for Microcomp.on Transp.	Univ.of Florida 512 Heil Hall Gainesville, FL32611 (904)392-0378	Highway Drainage Micro Programs	To be Determined	Synder UH (Constants Application) USGS Semi-Arid UH	Yes	No
(16) Computational Hydraulics Inc.	36 Stuart St. Guelph, Ontario Canada N1E 4S5 (519)767-0197	Stormwater Management Model for the IBMPC PCSWMM3	\$780	SWMM3	Yes	Yes
(17) Penn State Univ. Dept.of Civil Engineering	212. Sackett Bldg. Univ.Park, PA16802 (814)863-2786	Penn State Urban Hydrology Model PSUHM	\$550 for Short Course and Software Package	1986 TR55 Tabular Hydrog. SCS Curvilinear UH Universal Rational Mod.Rational	Yes	Yes
(18) Abacus Computer Service	P.O. Box 1137 Sebastopol, CA95472 (707)823-6731	Hydrol Hydraul	Check with Vendor	Variation of the Rational Method	Yes	No
(19) Applied Microcomp. Systems	Page Hill Rd. Chocorua, NH03817 (603)323-8666	HydroCRO Stormwater Modeling System	\$2795	SCS Curvilinear UH Rational Method	Yes	Yes
(20) NTIS US Deptof Commerce	Springfield, VA22161 (703)487-4650	Hydrology for Small Urban Watersheds TR-55 1986 Ver.	\$90	SCS Curvilinear UH	No	Yes

No. and Name of Vendor	Address and Telephone of Vendor	Name of Program	Software Package Cost	Hydrograph Synthesis Method	Storm Sewer Design Option?	Detention Basin Option?
(21)Sierra-Misco Inc.	1900 Point West Way Suite 208 Sacramento,CA95815 (800)422-5111	Enhanced ALERT Data Collection and Analysis	\$3500	Sacramento Soil Moisture Accounting Model with Unit Hydrograph	No	No
(22)IRRISCO	632 W.Slaughter Lane Suite 206 Austin, TX78748 (512)282-0809	PC-DAMBRK NETWORK DWOPEP	\$50	N A	Yes	No
(23)Penn State University Dept.of Civil Engineering	212 Sackett Bldg. Univ.Park, PA16802 (814)863-2932	Penn State Runoff Model PSRM	\$75	Overland Flow by by Kinematic Wave	Yes	Yes
(24)Scientific Software Group	P.O.Box 23041 Washington, DC20226-3041 (703)620-9214	SWAMP Stormwater Management	SWAMP \$795 IDF-PAR \$200 POND \$275 CHICAGO \$200 SANTTY \$275 STORM \$275	Information N A	Yes	Yes
(25)Pizer Inc.	3214 W.McGraw Suite 300 Seattle,WA98199 (800)222-5332	HYDRA	HYDRA Ver1 \$495 HYDRA Ver2 \$495 HYDRA Ver3 \$990 HYDRA Ver4 \$1295 Includes Ver 1.2.3	Continuous Simulation. SCS Method- (Santa Barbara Modifications) Rational Method	Yes	Yes
(26)Alan A.Smith Inc.	1463 Ontario St. Burlington, Ontario Canada 17S1G6 (416)333-4191	Microcomp. Design of Urban Stormwater Systems	\$750 (Canadian)	SCS Triangular UH Rectangular UH Single Linear Reservoir UH EPA SWMM Runoff	Yes	Yes
(27)PLUS III Software Inc.	One Dunwoody Park Suite 250 Atlanta, GA30338 (800)235-4972	HYDRO PLUS	\$1595	SCS Curvilinear DEKALB Rational Method Variations	No	Yes
(28)Joseph B.Bonadiam & Software Associates, Inc.	250 S. Lena Court San Bernardino,CA92408 (714)889-4661	Civil Design Civil Cadd	Unit Hydrology \$595 Rational Progm. \$845 L.A. Cnty. WSPG \$625	SCS Curvilinear UH S-Graph Formulated by U.S.Army Corps of Engineers	Yes	Yes
(29)Western Hydrologic Systems	3037 Grass Valley Hwy. Suite 8701 Auburn,CA95603 (916)885-2480	Computation of surface Water Resources	Several Prices for Packages \$100-\$10,000 Digitizers (\$1,000-\$2,500)	Information N A	No	No
(30)U.S. Geological Survey	Building 2101 Stennis Space Center,MS39529 (601)688-1508	National Flood Frequency NFF	No Charge	USGS Dimensionless Hydrograph Verified in Six States	No	Yes

No. and Name of Vendor	Address and Telephone of Vendor	Name of Program	Software Package Cost	Hydrograph Synthesis Method	Storm Sewer Design Option?	Detention Basin Option?
(31)U.S.Geological Survey	Building 2101 Stennis Space Center,MS39529 (601)688-1508	Distributed Roution Rainfall-?Runoff Model DR3M	No Charge	Kinematic Wave Technique	Yes	Yes
(32)Engineering & Surveying Computer Systems Inc.	191 Woodport Rd. Sparta, NJ07871 (800)537-6166	Design Plus	\$1495	TR-55 1986 Ver. SCS UH Modified Rational Method	Yes	Yes
(33)Texas Computer Consultants	3165 Greenwood St. Winter Park, FL32792 (407)677-7759	Rational	\$250	Rational Method (no hydrograph is produced)	No	No
(34)Texas Computer Consultants	3165 Greenwood St. Winter Park, FL32792 (407)677-7759	Rational	\$250	Rational Method (no hydrograph is produced)	No	No
(35)James C.Y. Guo	Campus Box 113 Civil Eng. Dept. Univ. of Colorado Denver, CO 80204 (303)566-2849	Urban Drainage Hydrology Library	\$150 Package There are seven packages for This library.	Rational Method Synder UH- Colorado Urban Hyd.Procedures Kinematic Wave	Yes	Yes
(36)Engenious Systems Inc.	P.O. Box30188 Seattle,WA98103 (206)628-0167	WaterWorks	\$850 Complete	Santa Barbara UH SCS Curvilinear UH	Yes	Yes
(37)Walker Properties Inc.	9040 Executive Pk.Dr. Suite 209 Knoxville,TN37923 (615)690-7342	TFNN-U	\$295	Normalized Unit Response Function Convolution	No	No
(38)BIG-O INC.	254 Thames Rd.East Exeter Ontario Canada N0M 1S3 (800)265-7622	BOSS	No Charge	SCS Triangular UH with dynamic variation of TC	Yes	Yes Used for recharge / detention storage
(39)Illinois State Water Survey	2204 Griffith Dr. Champaign, IL 61820 (217)333-4959	Illinois Urban Drainage Area Simulator	\$200 to \$375	Routed Time-area UH convolution	Yes	Yes
(40)Advance Engineering Technologies Inc.	5456 Hoffner Ave. Suite 202 Orlando, FL32812 (407)273-9338	Adv.ICPR / RUNNYD	\$995 to \$1995	SCS UH Santa Barbara UH Kinematic Wave	Yes	Yes

TABLE2. Summary of Software Characteristics.

Number of Public Domain Packages	12
Number of Commercial Packages W/ Copyright	25
Number of Commercial Packages W/O Copyright	3
Number of Packages Offering Some Technical Support	38
Number of Packages With Full Hydrograph Option	35
Number of Packages With Storm Sewer Option	29
Number of Packages With Detention Basin Option	31
Number of Packages Tested Against Gaged Data	30

TABLE3. Summary of Hydrologic Abstraction Methods.

Hydrologic Abstraction Methods	No.of Times Used
SCS Curve Number	17
Rational Method C Coefficient	7
Green-Ampt Infiltration Equation	6
Horton Infiltration Equation	6
Constant / Uniform Loss Rate	5
Initial Loss	3
Holtan Infiltration Equation	3
HEC 1 Exponential Loss Function	2
Phi-Index	1
Depression Storage Loss Function	1
Stanford Watershed Model	1
Sacramento Soil Moisture Accounting Model	1

TABLE4. Summary of Hydrograph Synthesis Methods.

Hydrograph Synthesis Methods	No.of Times Used
SCS UH	14
Rational Method	9
Snyder UH	6
Kinematic Wave	5
Clark UH	4
TR55 Tabular Hydrograph(1986)	3
S-Hydrograph	2
Santa Barbara Urban Hydrograph Method	2
SWMM4	2
User-Specified UH	2
Time-Area Curve	1
Nonlinear Reservoir	1
Stanford Watershed Model	1
USGS Semi-Arid UH	1
Sacramento Soil Moisture With UH	1
Continuous Simulation	1
Rectangular UH	1
Single Linear Reservoir UH	1
USGS Dimensionless Hydrograph	1
Colorado Urban Hydrograph Procedure	1

TABLE5. Summary of Hydrograph Routing Methods.

Hydrograph Synthesis Methods	No.of Times Used
Time-of-Travel Translation	10
Muskingum	9
Kinematic Wave	7
Modified Puls	4
Storage Indiation	2
Convex	2
Full Hydrodynamic Saint-Venant Equations	2
Average Ordinates	1
Working R&D	1
Tatum	1
Straddle-Stagger	1
Normal Depth	1
SCS Travel Time in TR55	1
Gutter Routing	1
Nonlinear Reservoir	1
Linear Time Shift	1
SWMM4	1