HYDROGNOMON: A HYDROLOGICAL DATA MANAGEMENT AND PROCESSING SOFTWARE TOOL

European Geosciences Union (EGU) General Assembly,

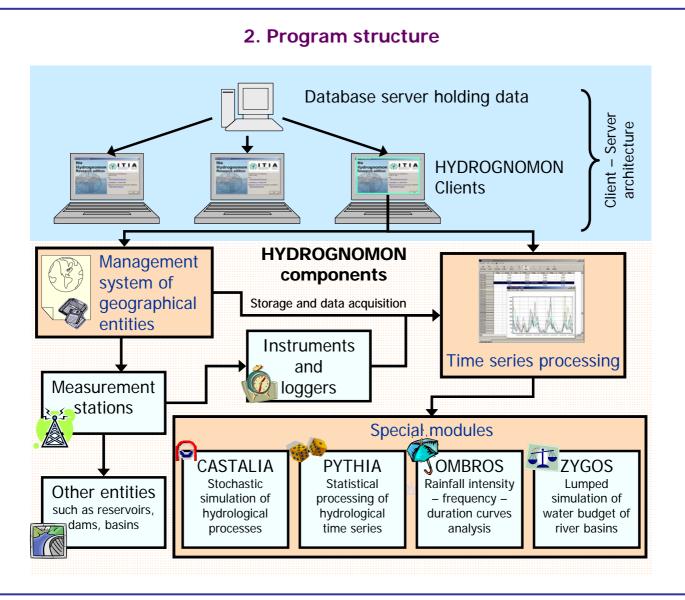
Vienna, Austria, 25 - 29 April 2005

Session HS29: Hydrological modelling software demonstration

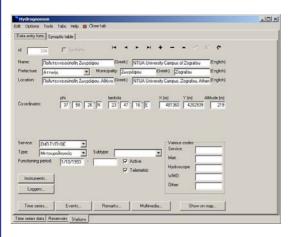
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1. Introduction

HYDROGNOMON is a software tool for the management and analysis of hydrological data. It is built on a standard Windows platform based on client-server architecture; a database server is holding hydrological data whereas several workstations are executing HYDROGNOMON, sharing common data. Data retrieval, processing and visualisation are supported by a multilingual Graphical User Interface.



3. Geographical entities

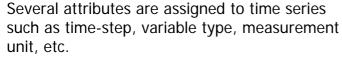


series.

User interface based on single window application. Several entities (e.g., basins, reservoirs, aqueducts, monitoring stations) are organised in Tabs.

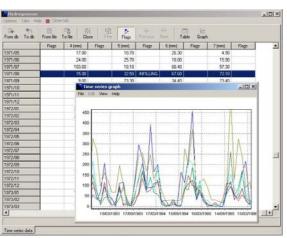
Special properties are stored and displayed for each entity, such as station type for measurement stations.

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Entities system helps the organisation of time

Synoptic tables are included to browse into entities or time series records.



4. Time series data

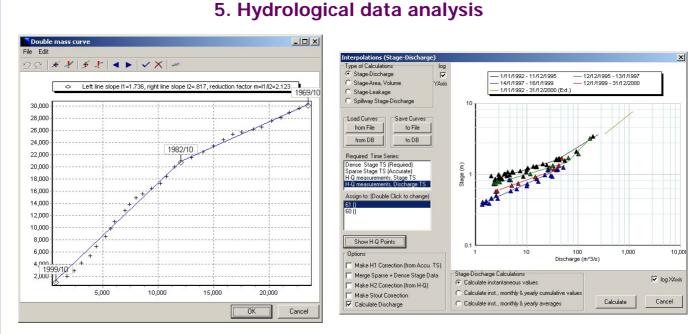
Time series records are displayed on data grids as sets of timestamps, values and flags, or on graphical views.

Time series grids help operation with multiple time series and data exchange between HYDROGNOMON and other applications, such as spreadsheets.

Data representation is extended with tabularisation, data filtering and highlighting capabilities.

Time series processing system may work independently of the database system by using ASCII files for storage.

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1983-84	14.00	05.00	168.60	86.00	89.70	92.10	125.20	10.00	0.50	6.00	32.40	1.90	57.77	55.40	0.96	12	0	168.60	ł.
1984-85	0.90	81.70	108.20	125.30	37.60	88.38	29.90	8.60	1.10	1.40	0.00	10.70	40.43	46.11	1.14	12	0	125.30	
1985-86	62.50	94.50	53.20	38.60	86.20	26.90	6.30	61.70	10.40	0.20	0.00	0.30	36.73	34.47	0.94	12	0	94.50	
1996-87	110.90	15.30	62.80	54.60	58.40	83.70	83.90	5.30	10.80	5.80	15.90	0.00	43.28	39.25	0.91	12	0	110.90	
1987/88	86.20	70.10	55.70	64.40	58.40	65.00	21.80	11.70	12.60	0.00	0.00	9.20	37.92	31.37	0.83	12	0	86.20	
1988-89	50.50	157.10	130.70	5.00	25.30	69.10	11.00	25.90	3.30	12.50	0.00	5.30	41.31	52.45	1.27	12	0	157.10	
1989-90	70.60	37.50	63.20	5.90	23.00	28.60	26.40	15.90	9.60	3.30	73.70	8.00	30.47	28.54	0.84	12	0	73.70	
1990/91	38.40	96.00	135.50	137.40	65.90	97.80	99.70	53.50	0.10	3.70	64.80	0.40	66.10	49.01	0.74	12	0	137.40	
1991-92	61.40	63.50	127.70	32.10	64.00	48.90	17.90	45.60	33.40	3.40	6.20	0.80	42.57	35.90	0.05	12	0	127.70	
1992-93	46.60	30.90	7.00	44.00	66.90	23.60	16.60	111.70	0.40	0.60	0.40	0.90	29.13	34.00	1.17	12	0	111.70	
1993-94	0.00	195.70	19.40	165.30	204.50	37.00	33.30	49.00	0.50	36.20	1.50	0.00	62.00	78.64	1.27	12	0	204.50	
1334-35	146.30	83.60	83.90	117.50	5.00	88.20	33.40	3.40	2.30	0.00	0.00	30.70	50.09	51.43	1.03	12	0	145.30	
1995-96	31.90	83.50	102.40	84.80	105.20	62.60	21.30	69.40	0.00	2.50	22.90	49.60	53.09	37.29	0.70	12	0	105.20	
1996-97	44.00	21.40	50.90	130.90	46.70	102.00	57.40	6.00	5.50	2.20	7.40	0.60	40.03	41.01	1.04	12	0	130.90	
1997/98	50.50	44.10	142.40	22.70	20.40	141.30	14.70	61.20	10.10	2.20	6.60	32.20	45.70	48.39	1.06	12	0	142.40	
1398-99	44.80	103.40	86.60	45.50	64.10	165.30	26.90	15.70	5.90	0.00	7.50	41.80	50.62	48.39	0.96	12	0	165.30	
1999-00	63.70	108.90	43.70	33.40	85.10	30.30	11.90	4.00	0.00	0.00	0.00	2.60	32.97	37.64	1.14	12	0	108.90	
2000-01	45.60	109.00	41.90	93.10	37.50	27.10	43.90	13.99	5.90	12.60			43.03	33.85	0.79	10	2	109.00	
Mean	72.19	88.06	106.27	94.09	79.05	70.51	40.52	33.94	21.05	6.61	12.51	29.90							
itandard deviation	59.99	52.98	58.59	53.23	45.18	43.76	33.10	29.16	25.63	9.98	25.92	35.00							
alarice coefficient	0.83	0.60	0.55	0.56	0.58	0.62	0.82	0.86	1.22	1.51	2.07	1.17							ļ
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Homogeneity analysis by the double mass curve method

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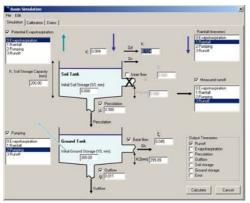
Hydrological balance of reservoirs, with reporting capabilities

Stage-discharge curves

Hydrological data analysis includes the majority of typical hydrological manipulations, such as:

- Range and time consistency tests
- Homogeneity test
- Time step regularisation
- Time series integration and aggregation
- Stage-discharge calculations and other interpolations
- Evapotranspiration modelling
- Time series regression and infilling of missing values
- Time series combinations
- Hydrological balance

6. ZYGOS: Lumped water balance model

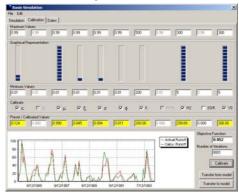


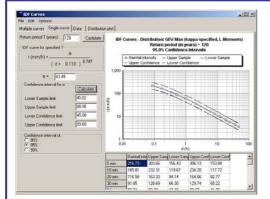
ZYGOS models the main hydrological processes of a watershed, using a lumped approach. It implements a conceptual soil moisture accounting scheme, based on a generalisation of the standard Thornthwaite model, extended with a groundwater tank.

A visual representation of modelling components helps the implementation of different configurations.

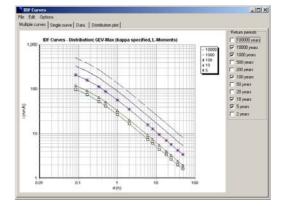
A global optimisation procedure, implementing the evolutionary annealing-simplex algorithm, is included for the automatic estimation of model parameters.

The user interface allows to determine the parameter bounds. Also, it provides graphical tools for monitoring the progress made during optimisation and assessing the model fitting.





7. OMBROS: Intensity – duration – frequency analysis

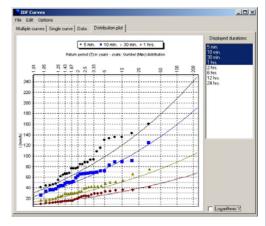


The construction of rainfall intensity – duration – frequency curves is achieved through an original methodology, which allows a unified expression of rainfall intensity using a single equation, in terms of time scale (duration) and return period.

A set of probability distribution functions is offered to describe the intensity values including Exponential, Gamma, Log-Pearson III, Gumbel-Max, GEV-Max and Pareto distributions. A Monte-Carlo simulation procedure allows the estimation of confidence intervals for the curves.

The results are displayed in graphical format (IDF curves, distribution functions), as well as in tabular format, with data exchange capabilities with other software.

The input to the models, i.e. annual time series of extreme rainfalls, either may imported into HYDROGNOMON manually or calculated directly from time series of fine time-step.

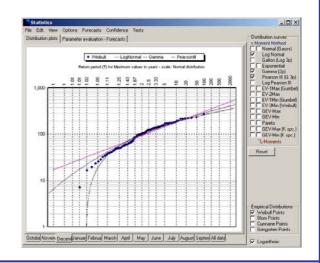


8. PYTHIA: Statistical analysis of hydrological time series

PYTHIA is an advanced statistical analysis tool for time series. Some characteristic features are:

- Calculation of sample statistics
- Parameter estimation of 16 distribution functions, including Normal, Gamma and EV families, using the moment or the L-moment methods
- Visualisation of results and export to spreadsheets and word processors
- Statistical prediction
- Estimation of confidence intervals though Monte Carlo simulation
- Hypothesis testing

and the second second	October .	November	December	January	February	March	Acril	V Moment Method F Normal (Gound
ogNormal sy	.72	56	152	52	February 54	67	21	Log Normal
aton ny	4.82	5.30	5.00	4.95	5.06	5	4.22	Galton (Log 3p)
alon w	42	.25	.16	34	28	28	.42	Gamma (2p)
iaton c	43.00	-124.45	-256.63	-54	-84.14	-03.47	-34.05	Pearson II IG 3
stopential c	12.2	35.07	47.68	41.65	33.67	26.74	7.43	Log Pearson III
sponential Lambda	102	.02	02	02	02	02	.03	EV-1Max (Gunt
anma Lantata	1.45	2.76	3.29	3.18	2.99	2.6	1.5	EV-1Min (Gumb
anma Kappa	102	.03	.03	.03	04	.04	.04	EV-3Min (Webu
warton III Kappa	1.93	6.00	16.76	3.25	5.32	5.22	1.99	C GEV-Max
earson III Lanbda	.02	.05	07	03	05	.05	04	F F Pareto
wattion III c	-12.44	-50.75	-133.62	-1.11	-26.66	-23.45	-613	GEV Max (K tpc
og Prasson III Kappa	1.81	1.86	4.81	2.04	1.96	801	12.7	C GEV-Min (K. spc)
og Pearson III Lambda	1.20	1.74	3.25	2.03	1.86	3.92	3.91	Lange and the second se
og Peacon III c	2.49	3.18	3	3.35	3.11	1.99	12	Beset
V-1 (Gunbel) Max Lambda	46.8	41.33	45.7	41.52	36.02	34.14	25.82	
V-1 (Gunbel) Max Pai	97	1.55	1.75	1.71	1.64	1.49	39	
V-2 Max Kappa	37	.31	3	3	.3	32	36	
V-2 Max Lambda	18.69	20.05	24.37	21.91	10.65	16.00	10.45	
V-1 (Gumbel) Min Lambda	46.8	41.33	45.7	41.52	36.02	34 14	25.B2	
V-1 (Gunbel) Min Pai	2.12	2.71	2.9	2.86	2.79	2.64	215	
V-3 (Weibull Min Kappa	83	59	53	54	56	61	.81	The second second second second
V-3 /Weibull Min Lambda	63.68	57.76	\$3.62	57.86	50.28	47.73	35.24	Empirical Distributions
EV Max Keppe	04	.07	-14	00	- 05	- 05	.04	Bion Points
EV Max Lambda	44.11	44.98	52.95	41.29	38.29	36.21	24.33	Curnene Points
EV Max Pai	1.02	1.45	1.55	1.72	1.56	1.42	1.04	• Cringorten Points



9. CASTALIA: Stochastic simulation of hydrological processes

CASTALIA provides advanced stochastic analysis tools, for the generation of synthetic hydrological time series. Some specific features are:

- Multivariate analysis, for many processes and locations
- Multiple time scales, in a disaggregation framework
- Generalised generating scheme for any covariance structure
- Preservation of essential marginal statistics up to third order (skewness) and joint second order statistics (auto- and cross-correlations)
- Reproduction of long-tem persistence (Hurst phenomenon) and periodicity
- Operation in either steady-state simulation or forecast mode

