

Early warning system for drinking water supply in carinthia

DI Christian Kopeinig, DI Herfried
Zessar, DI Dr. Jürgen Komma,
Mag. Florian Holzeis



Alp-Water-Scarce Project:

**17 Partners
from
5 alpine states,
2008 - 2011**



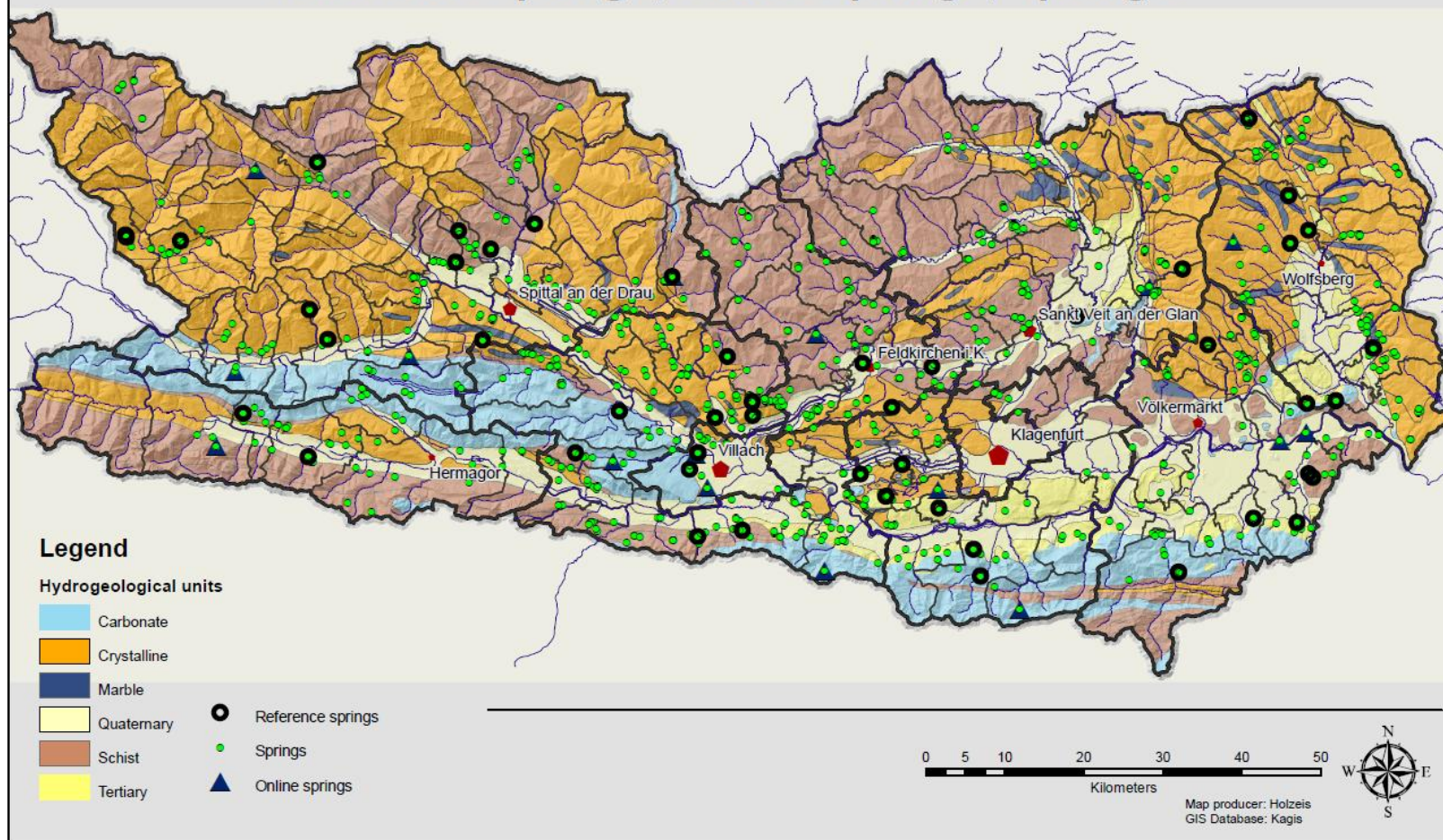
Objectives:

- + Knowledge of the **actual spring discharge**.
- + Estimation of the **future discharge** of springs, based on **normal, dry and very dry meteorological scenarios** for the following 3 month.
- + Estimation of the **water balance** of water suppliers for medium and peak water demand for the above scenarios.
- + Estimation of the **spring discharge** for long-time „**climate change**“ scenarios.

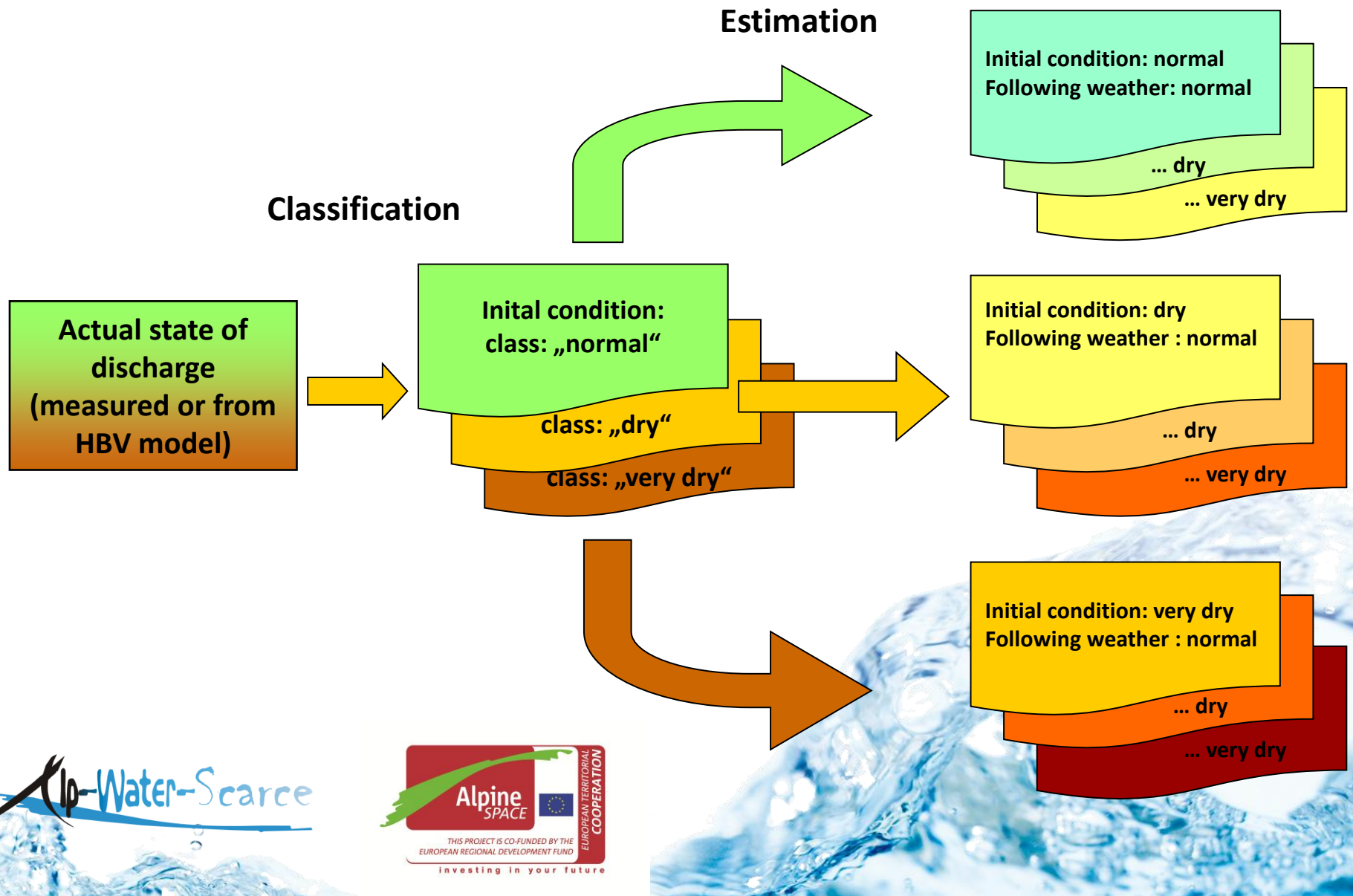


Spring register of Carinthia

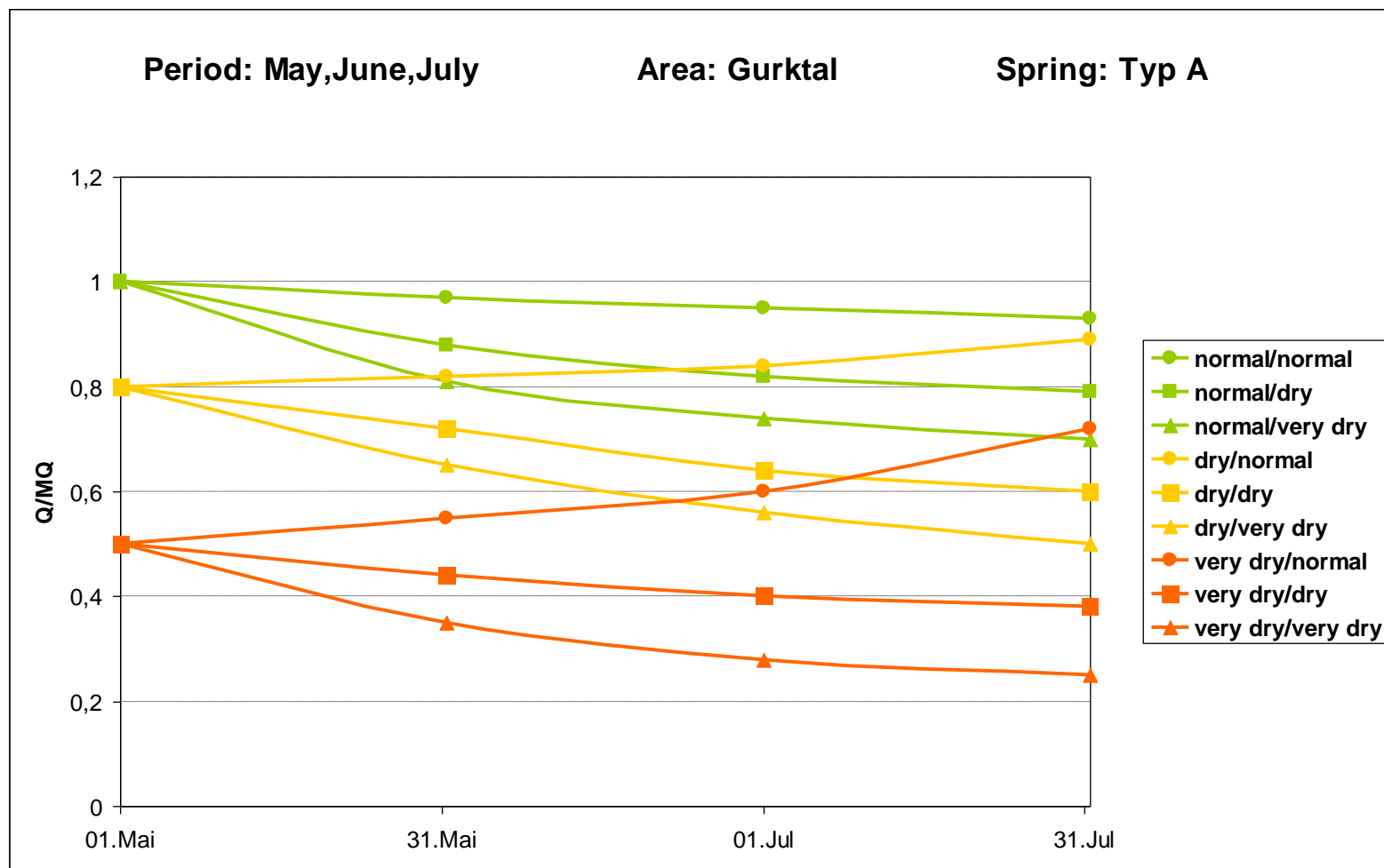
Reference springs, online springs, springs



Basic idea of the early warning system



Prepared Scenarios



Procedure:

- + Calibration of a **hydrological model** for the reference springs, calculation of the **discharge** of the reference springs (1970 – 2010).
- + Statistical **analysis**, classification.
- + Calculation of the short time and the long-time „climate change“ **scenarios**.
- + Compiling of a **database of water management data**.
- + Development of the **software** for the early warning system.

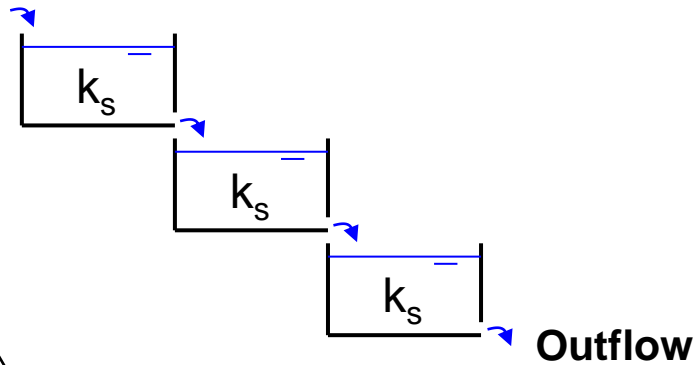
Hydrological model - HBV:

Input data: Precipitation, Temperature from 1970 – 2010
characteristic values for the catchment areas

Modules for: Snow accumulation and snow melt
Soil moisture accounting scheme
Evapotranspiration
Runoff processes (Linear storage cascade)

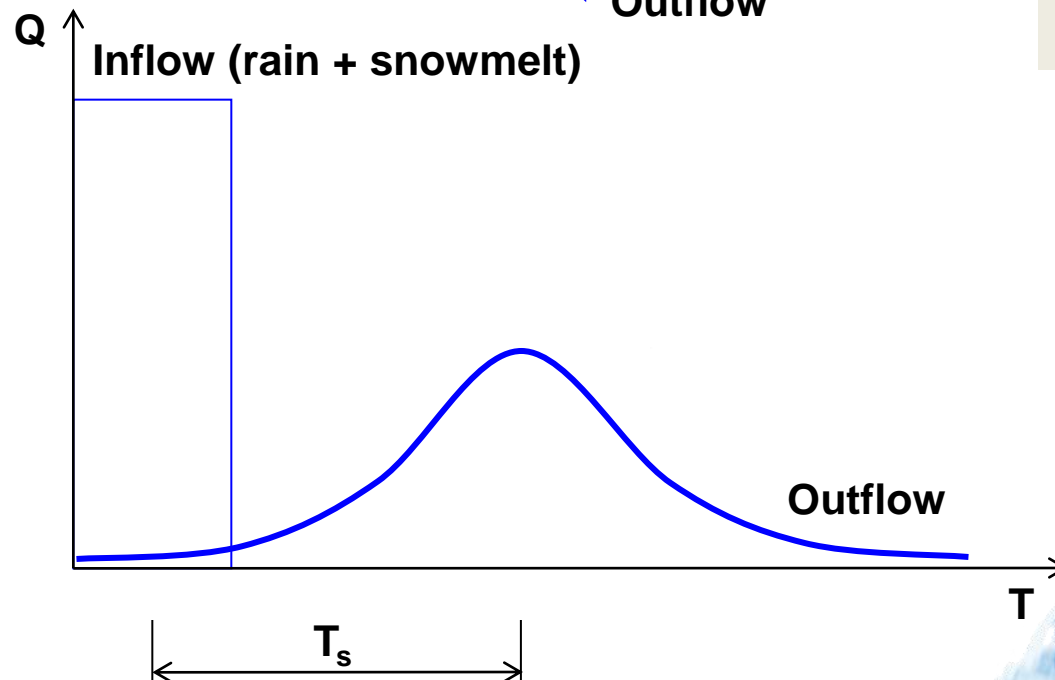
Output data: Discharge of 61 reference springs from 1970 – 2010
Discharge of the different scenarios

Inflow



Linear storage cascade

$$n \times k_s = T_s$$



- n Number of storages
- K_s Storage coefficient
- T_s Medium time shift



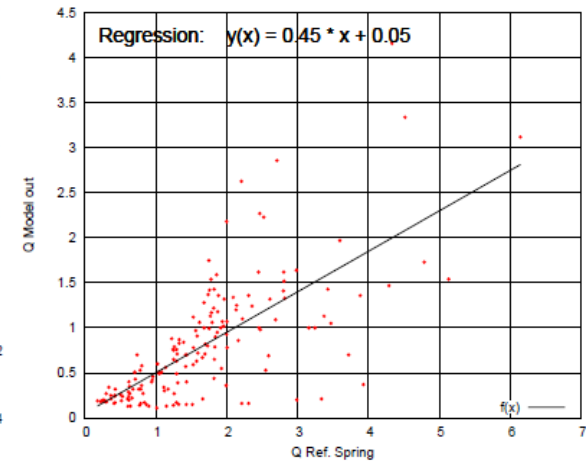
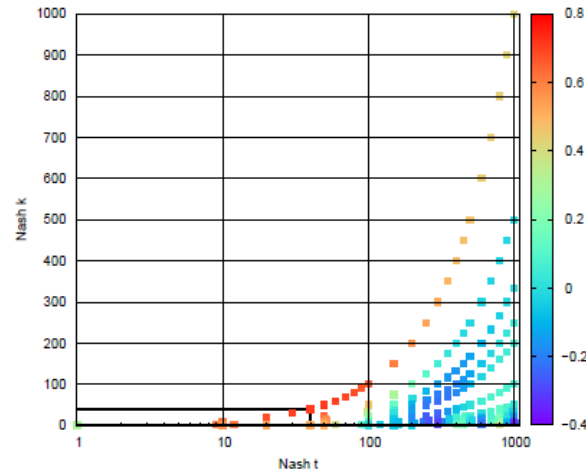
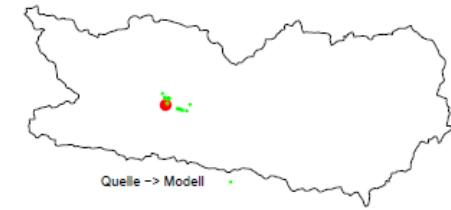
Calibration:

Referenzquelle K2015400

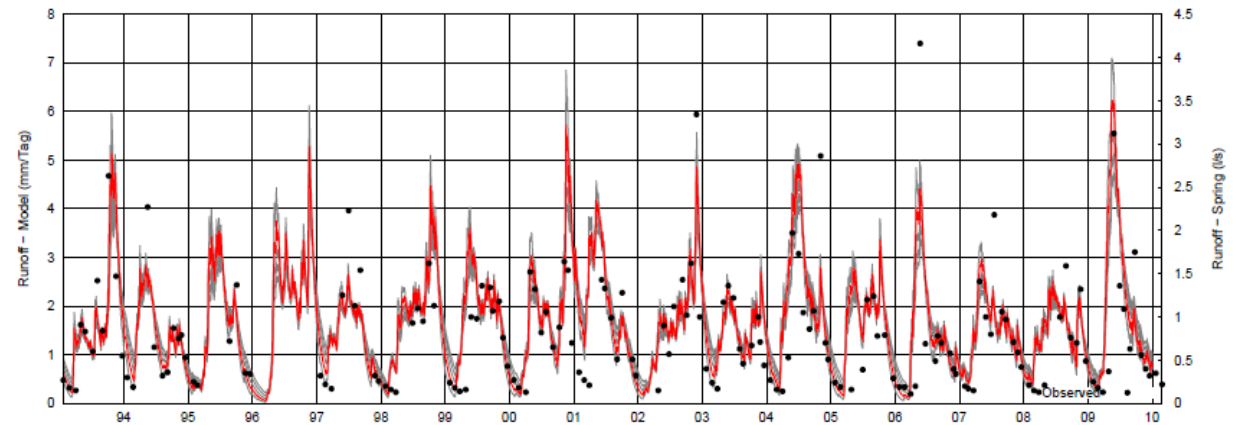
Parameter: $n = 1$, $k = 40 \text{ d}$ $\rightarrow t = 40 \text{ d}$

Korrelation: $r^2 = 0.713$

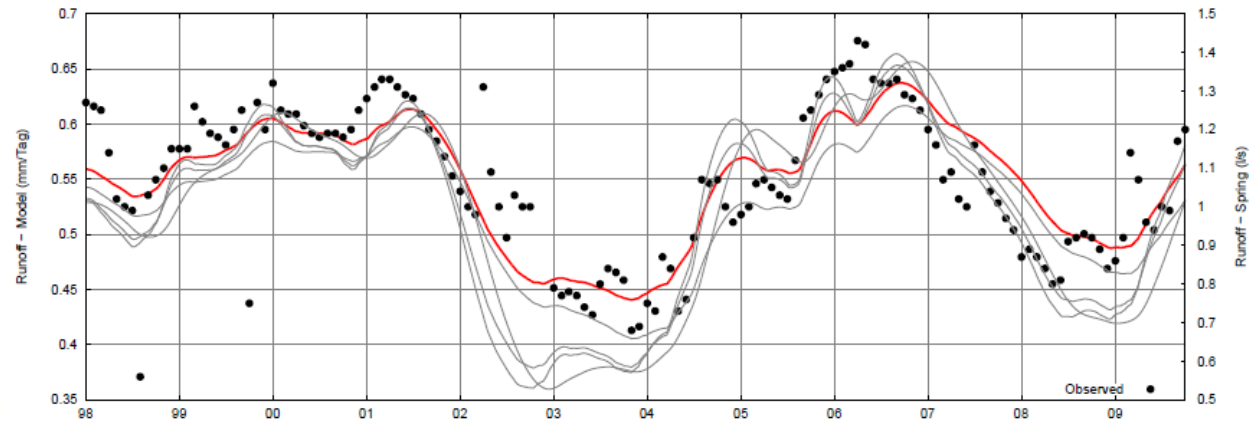
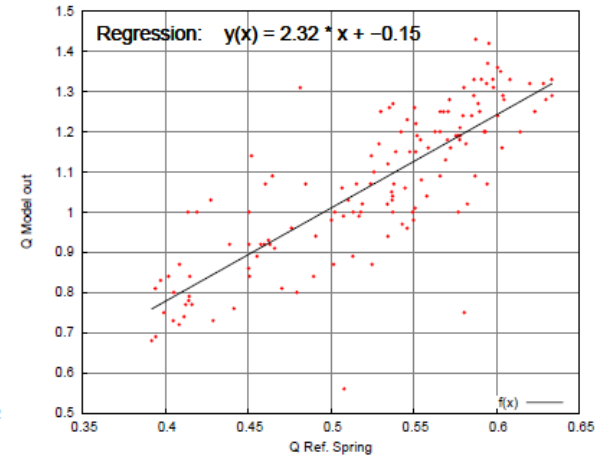
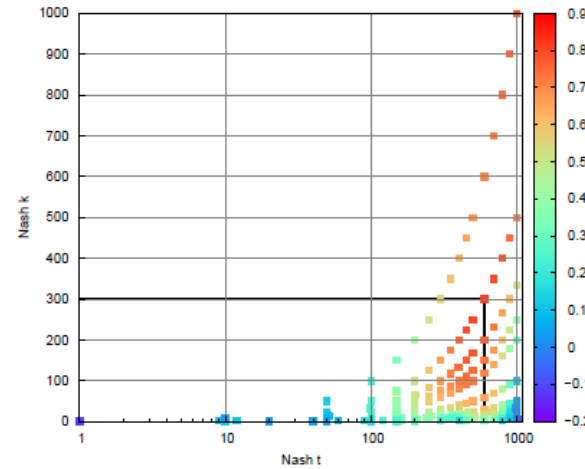
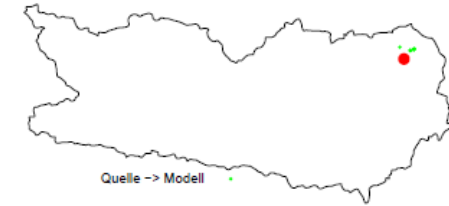
Wertepaare: $n = 166$



Simulated discharge:



Referenzquelle K2015791

Parameter: $n = 2$, $k = 300$ d $\rightarrow t = 600$ Korrelation: $r^2 = 0.813$ Wertepaare: $n = 140$ 

Calibration:

Simulated
discharge:

Statistical analysis of the simulated discharge - time series:

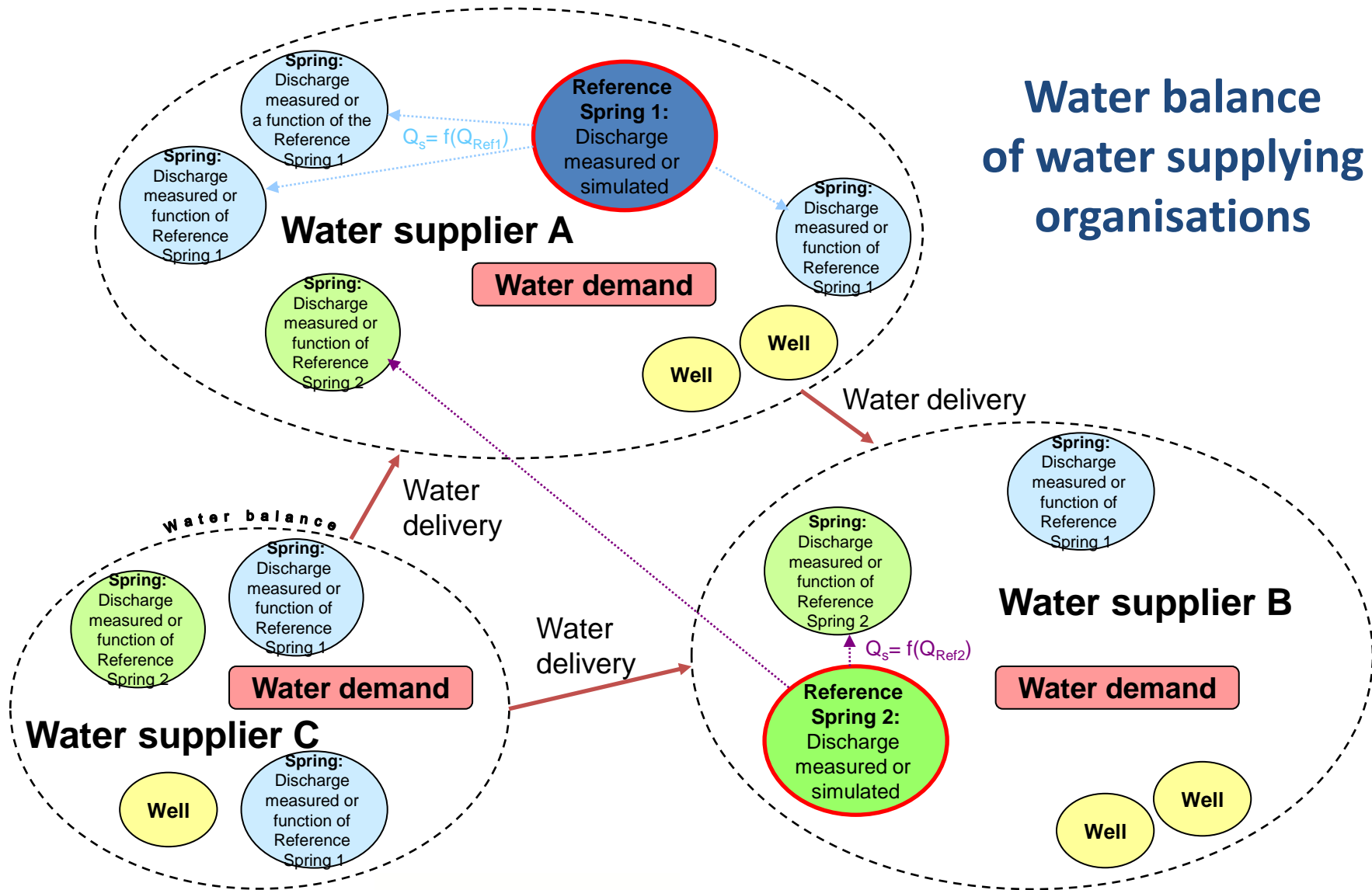
- | | | |
|--------|----------|------------------------|
| Class: | normal | – medium discharge |
| Class: | dry | – annuality ~ 10 years |
| Class: | very dry | – annuality ~ 40 years |

Defining scenarios of different **initial conditions** and **meteorological inputs** to run the hydrologic model for the scenarios, calculating short-time and long-time scenarios.

Calculation of the water balance for a water supplying organisation



Water balance of water supplying organisations



Database of water management parameters

HydroMap - Hochwasserwarnservice Kärnten

Datei Bearbeiten Ansicht Fenster Hilfe

AKTUELLE DATEN ANALYSEN und PROGNOSEN STAMMDATEN WARNUNG

WARNSERVICE DATENEINGABE

Hinweise und Gefährdungen Bordvoller Abfluss Dämme im Vorland HQn-Werte Organisationen - Adressen Wasserversorgung

Gemeinden:

Name	StatusWW	StatusHy
Afritz am See		
Albeck		
Althofen		
Arnoldstein		
Arnach		
Bad Bleiberg		
Bad Kleinkirchheim		
Bad St. Leonhard im Lavant		
Baldramsdorf		
Bleiburg		
Brückl		
Dellach im Drautal		
Deutsch-Griffen		
Diex		
Ebenthal in Kärnten		
Eberndorf		
Eberstein		
Eisenkappel-Vellach		
Feistritz an der Gail		
Feistritz im Rosental		
Feistritz ob Bleiburg		
Feldkirchen im Lavant		
Ferlach		
Friesach		
Fröttach		
Frantschach-St. Gertraud		
Frauenstein		
Friesach		
Gallizien		
Gitschtal		
Glanegg		
Glödnitz		
Gmünd in Kärnten		
Gnesau		
Grafenstein		
Greifenburg		
Griffen		
Großkirchheim		
Gurk		
Gutting		
Heiligenblut		
Hermagor-Pressegger See		
Himmelberg		

Versorgungsorganisationen:

VVA Afritz (GWVA Afritz) 207/706

Name	GroupID	Typ	Datenstatus	Gemeinde	GemKennzahl	Anmerk.
VVA Afritz (GWVA Afritz) 207/706	88	GWVA	a3	Afritz am See	20701	
WG Scherzoboden-West 207/245	0	WG		Afritz am See	20701	
WGEM Lierberg	0	WGEM		Afritz am See	20701	

Wasserbedarf der Versorgungsorganisation:

Bedarf für markierte Gemeinde hinzufügen

Bedarf für andere Gemeinde hinzufügen

Gemeinde	MQ	Qmax	Anmerkung
Afritz am See		1,12	3,1

Wasserabgabe an eine andere Organisation:

Wasserabgabe hinzufügen

An Organisation	Q	Anmerkung
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Quellen:

Alle Quellen:

Name	Gemeinde	MQ
Kressquelle		
Arlingbachquelle		
Draurainquelle		
Fellbachquelle		
Hainschbaurquelle		
Hiplquelle		
Karawankentunnelquelle		
Lappenbachquelle		
Lippitzbachquelle		
Maibachl		
Nötschbachquelle		
Tiebelquelle		
MST WG Scherzoboden - West	Afritz am See	
MST Reicherquelle	Afritz am See	
MST Luckner- und Reicherquelle	Afritz am See	
MST Pirkerquelle	Afritz am See	
MST Hrandquelle	Afritz am See	

Quellen der ausgewählten Organisation:

Name	Typus	Qmin	MQ	Qmax	Nutzung
MST Hrandquelle		0,72	1,8	Falsch	
MST Hrandquelle 2		0,15	0,18	0,34	Falsch
MST Hrandquelle 3		0,12	0,22	0,34	Falsch
MST Pirkerquelle		0,93	1,04	1,1	Wahr
MST Spitalerquelle		1,03	1,6	2,22	Wahr

Wasserbezug von einer anderen Organisation:

Von Organisation	Q	Anmerkung
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Supplying organisations

Water demand for consumers

Water deliveries to other organisations

Springs and wells of actual organisation

Inflow from other organisations

All springs

Community Frantschach-St.Gertraud

Water supplying organisation:

WVA Frantschach (GWVA Frantschach-St. Gertraud) 209/1643

<u>Spring discharge:</u>	Qmin l/s	MQ l/s	Qmax l/s	QAkt l/s
MST Paulibauerquelle 3	0	0,12	0,6	0,08
MST Quelle I (Lobenweinquelle)	0,2	0,32	0,5	0,30
MST Quelle II (Hochwiesenquelle)	0,18	0,3	0,7	0,16
MST Lacknerquelle	0,5	0,98	1,5	1,06
MST Paulibauerquelle 1	0,5	1,02	2	0,37
MST Paulibauerquelle 2	0,26	0,88	2	0,29
MST Paulibauerquelle 4	0,09	0,35	1,2	0,15
MST Prödlquelle I	0,5	1,06	2,5	0,44
MST Prödlquelle II	0,21	0,33	0,6	0,32
Sum of discharges:	2,44	5,36	11,6	3,17

Classification of current discharge:

Sehr geringe Quellschüttungen



Summation of water resources: 2,44 l/s 5,36 l/s 11,6 l/s 3,174943

<u>Delivery to consumer:</u>	MQ l/s	Qmax l/s
Frantschach-St.Gertraud	2,17	4,34
<u>Delivery to other organisations:</u>	Q l/s	
WVA Frantschach (GWVA Frantschach-St. Gertraud)	0 l/s	

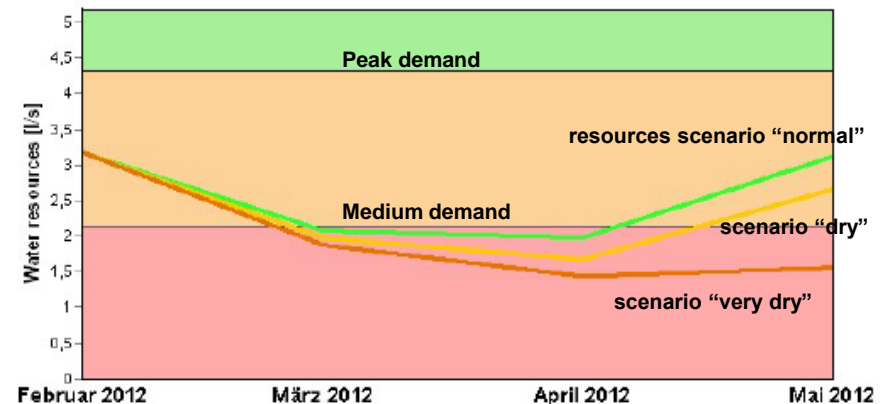
Summation of water consumptions: 2,17 l/s 4,34 l/s

Balance (current resources - medium consumption): 1,00 l/s

Balance (current resources - peak consumption): -1,17 l/s

Assessment of the further development:

Water balance for normal, dry and very dry weather scenarios:



Note: The three curves in the diagram represent the sum of available water by spring discharges, water fountains and contractual water deliveries of other organizations. The green line was determined under the assumption of average weather conditions; the yellow and red lines represent a dry or extremely dry weather scenario.

The area shown values correspond to the medium (red to yellow) and maximum (yellow to green) demand for water supply to consumers and contracted water deliveries to other organizations.

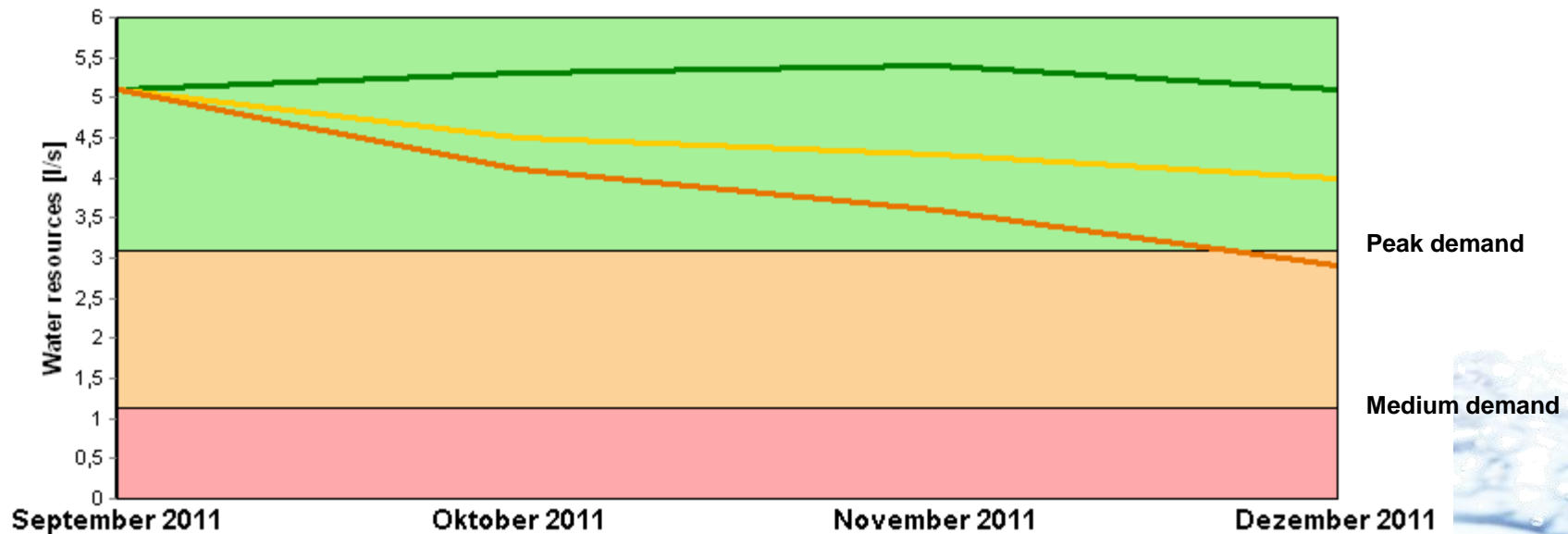
The consumption values were obtained without the buffering effect of a high level water tank.



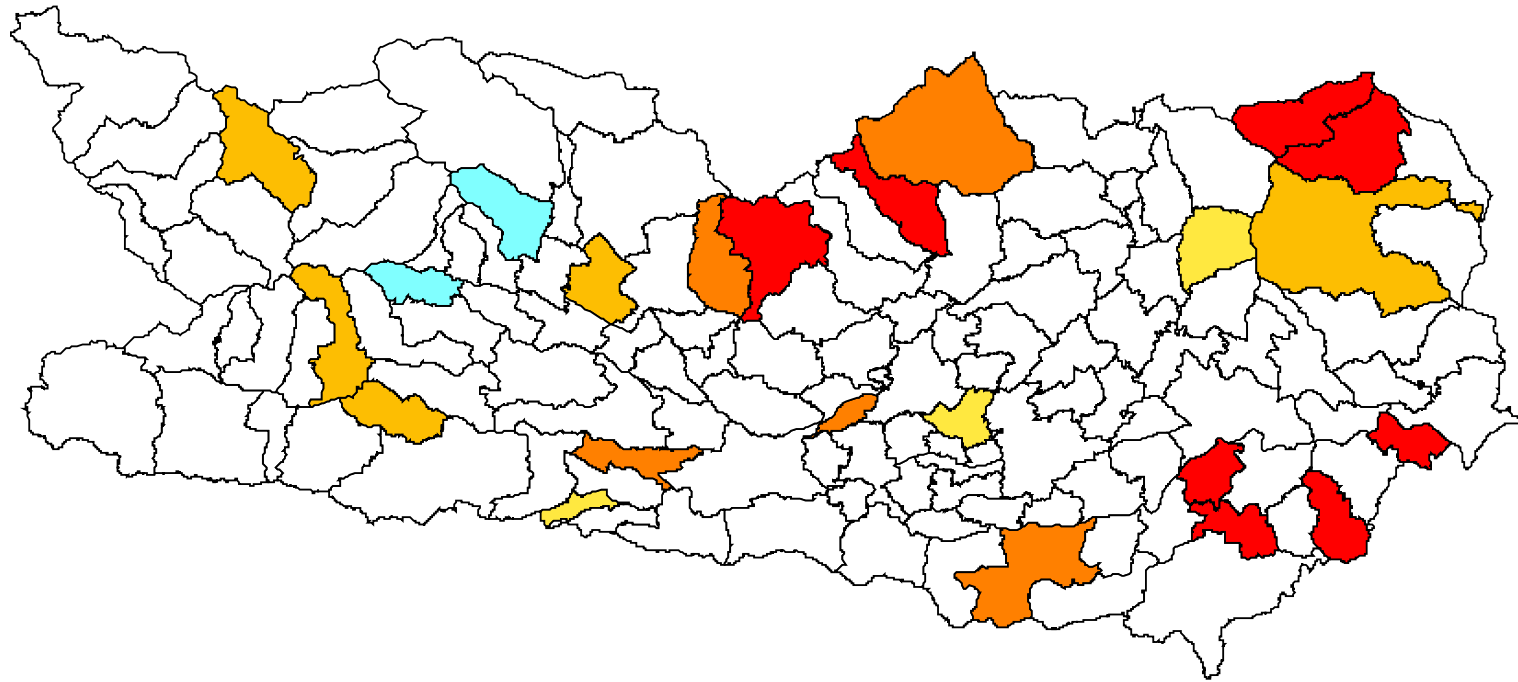
Example of a report for a water supply organisation

Estimation of the water balance of a water supplier for the following three month:

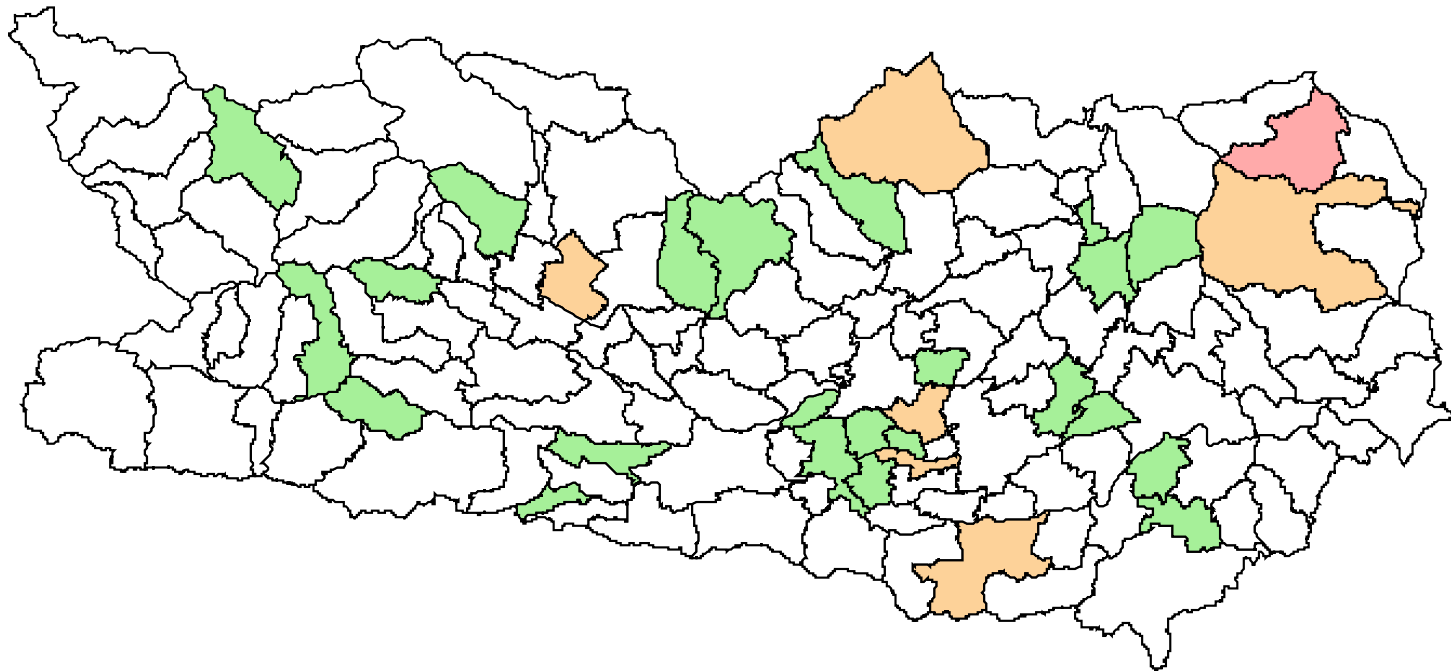
Water balance for normal, dry and very dry weather conditions:



Overview of the hydrological classification of the spring discharge (actual situation):



Overview of the water balance classification of the water suppliers (actual situation):



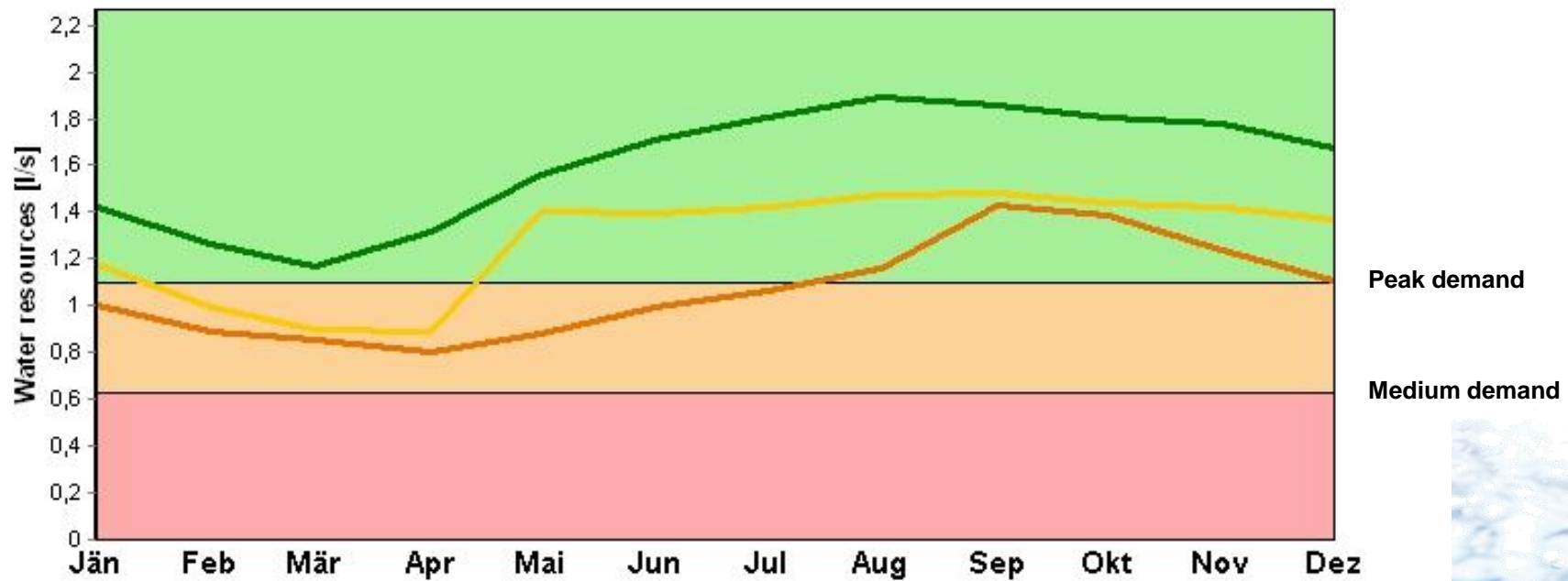
Benefit of the short term forecast:

Activate timely water management measures for expected water scarcity periods!

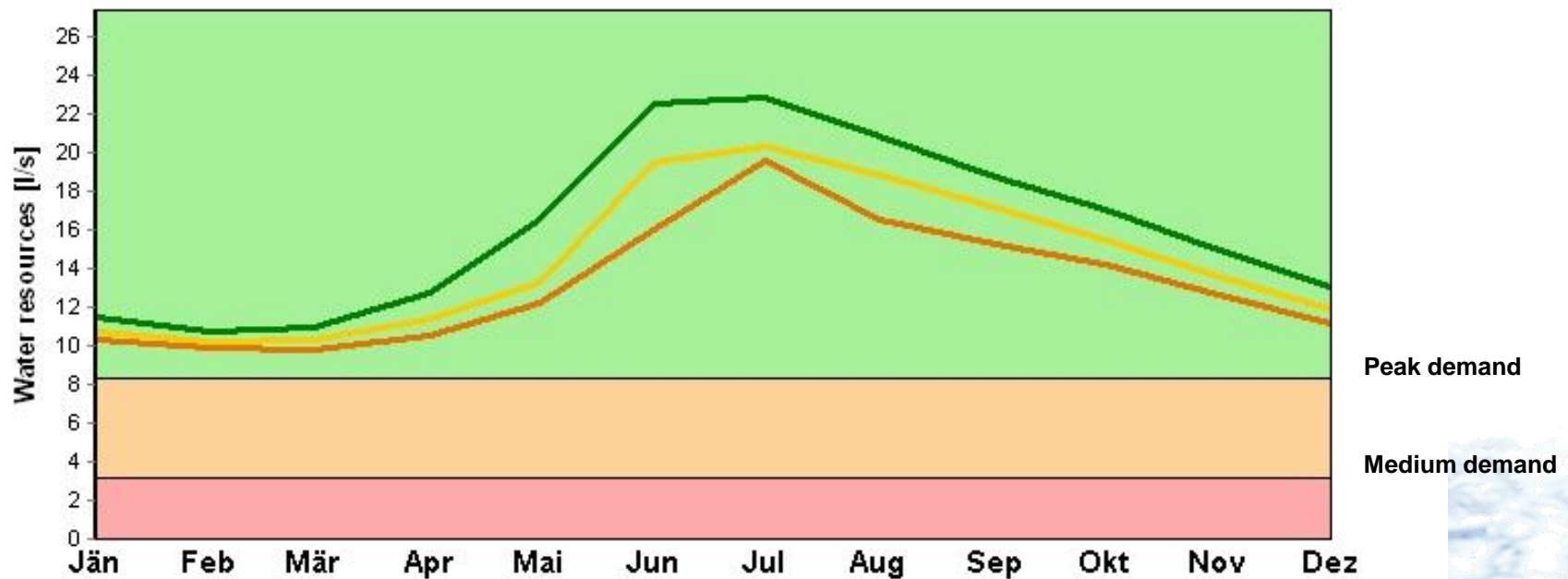
- restrictions of irrigation for private gardens or filling pools, restrictions for car washing;
- activation of additional wells for emergency supply;
- activation of distribution networks (communal or regional);



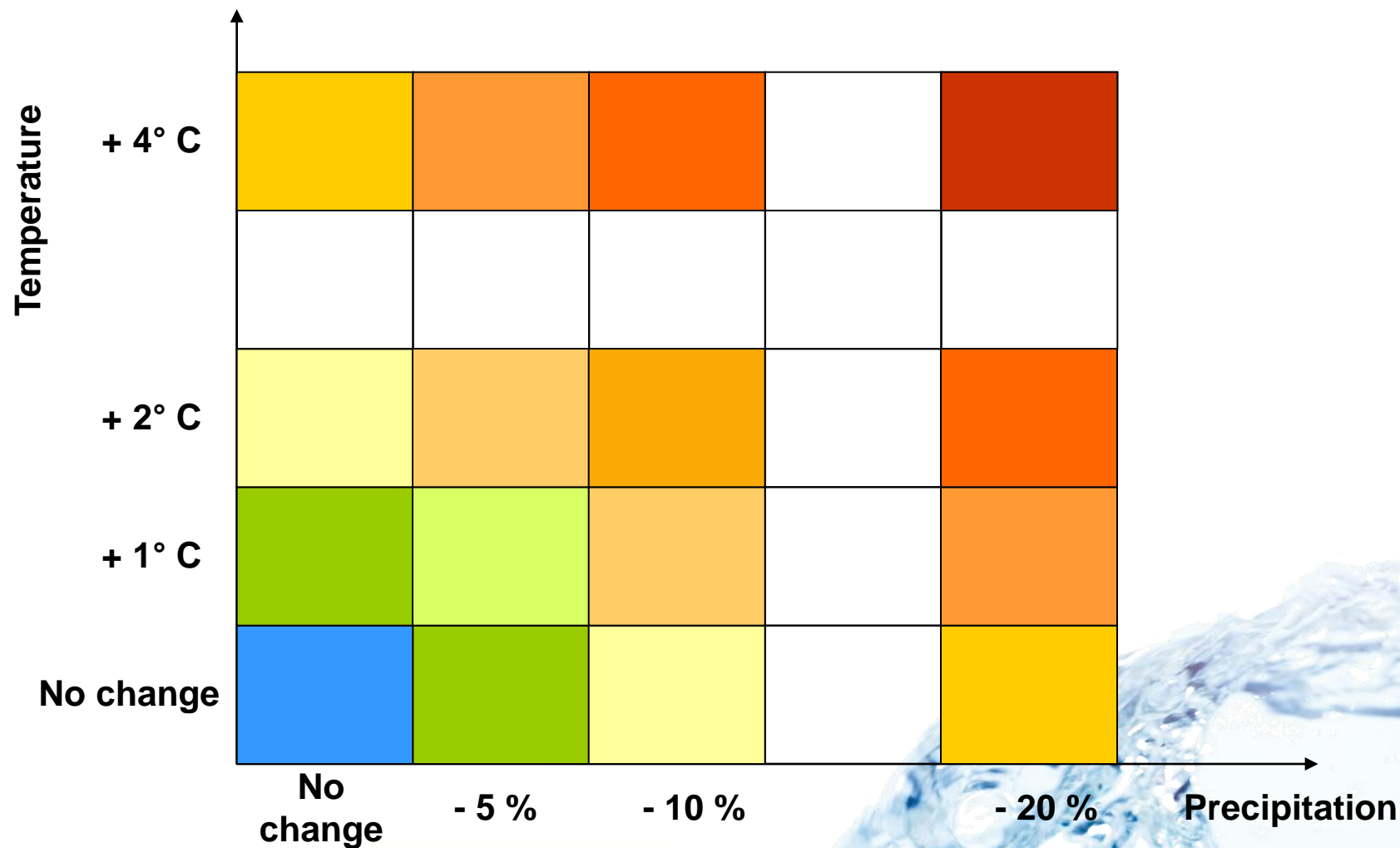
Scenario catalogue for drought conditions:



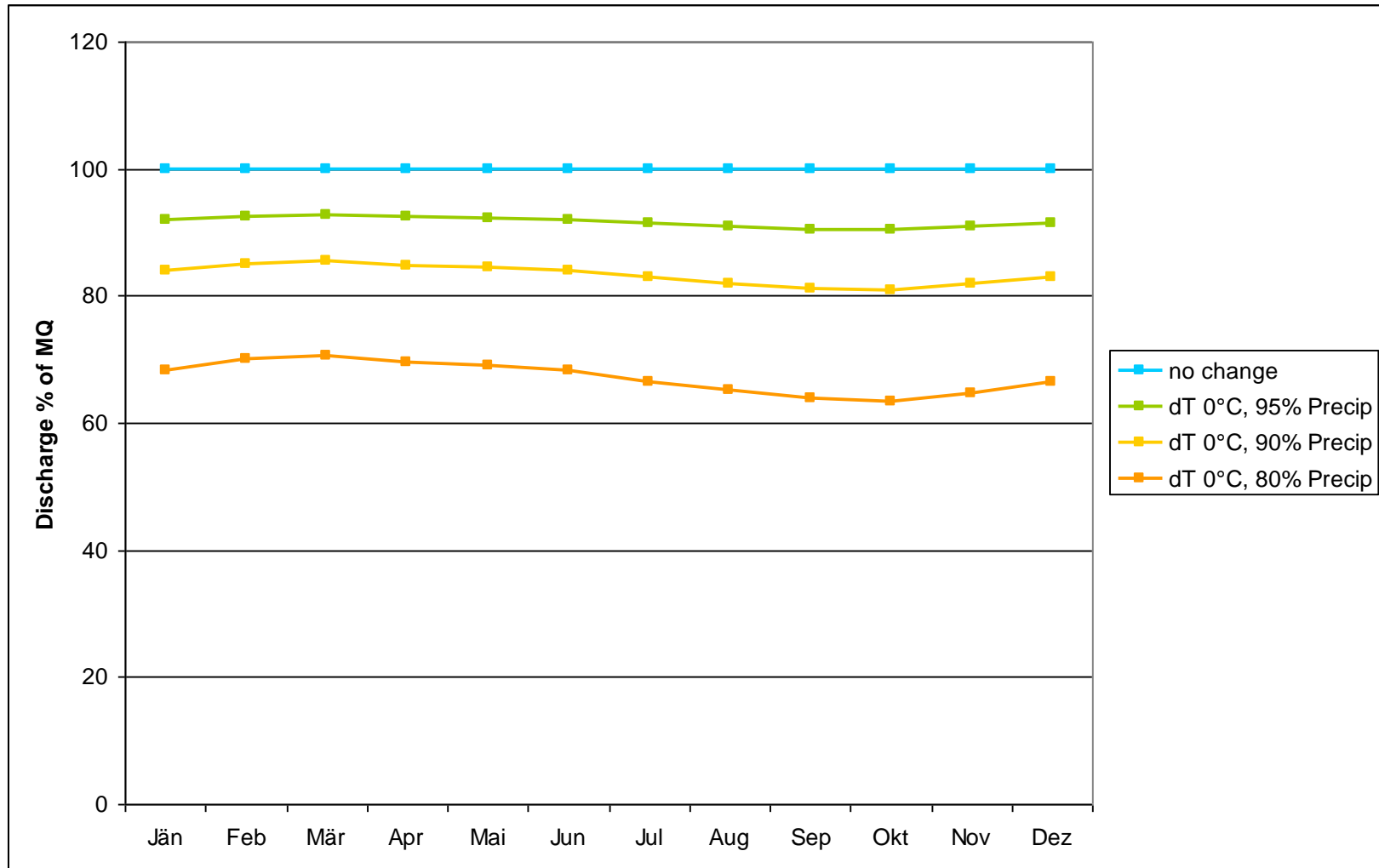
Scenario catalogue for drought conditions:



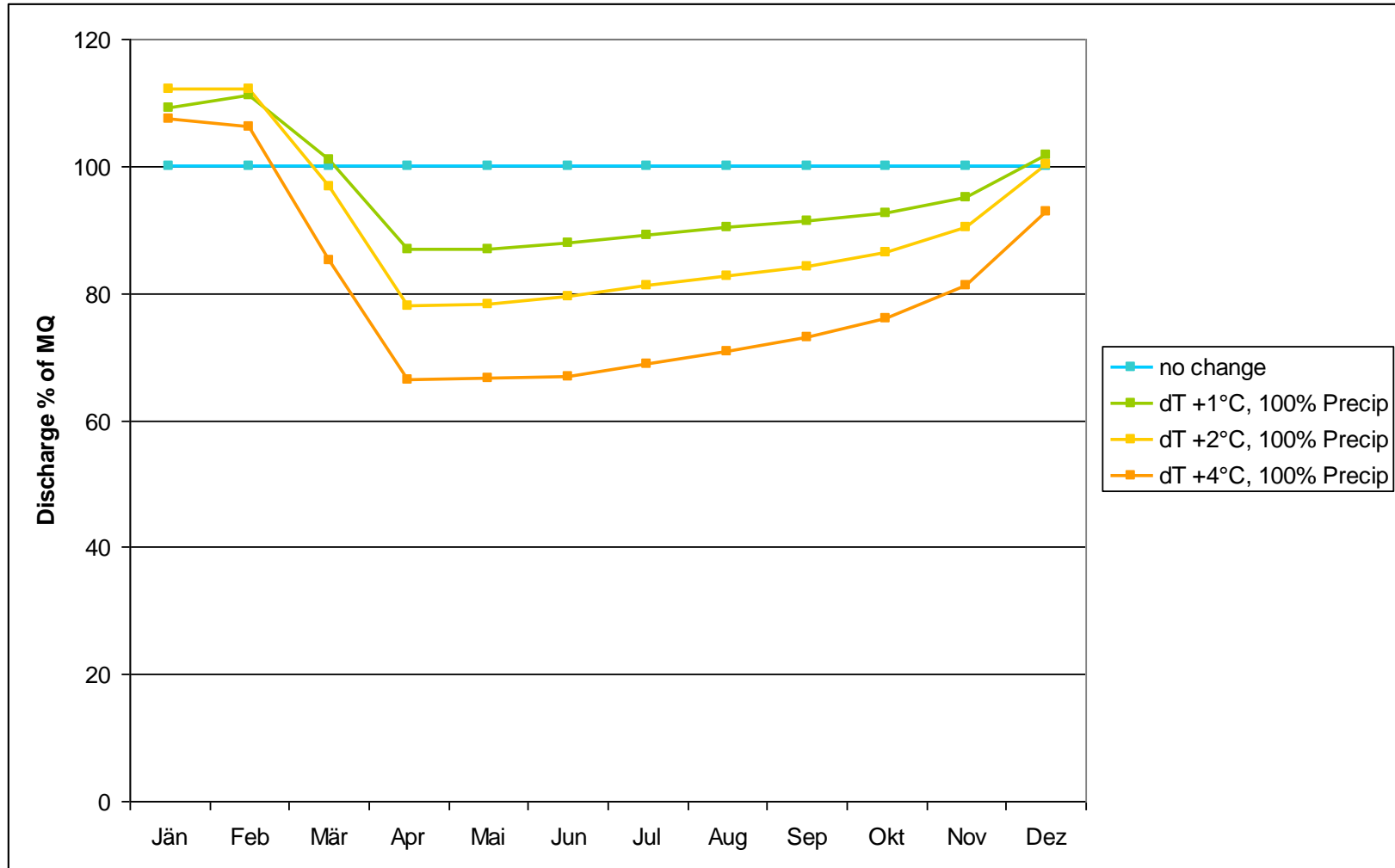
Calculated long term climate change scenarios



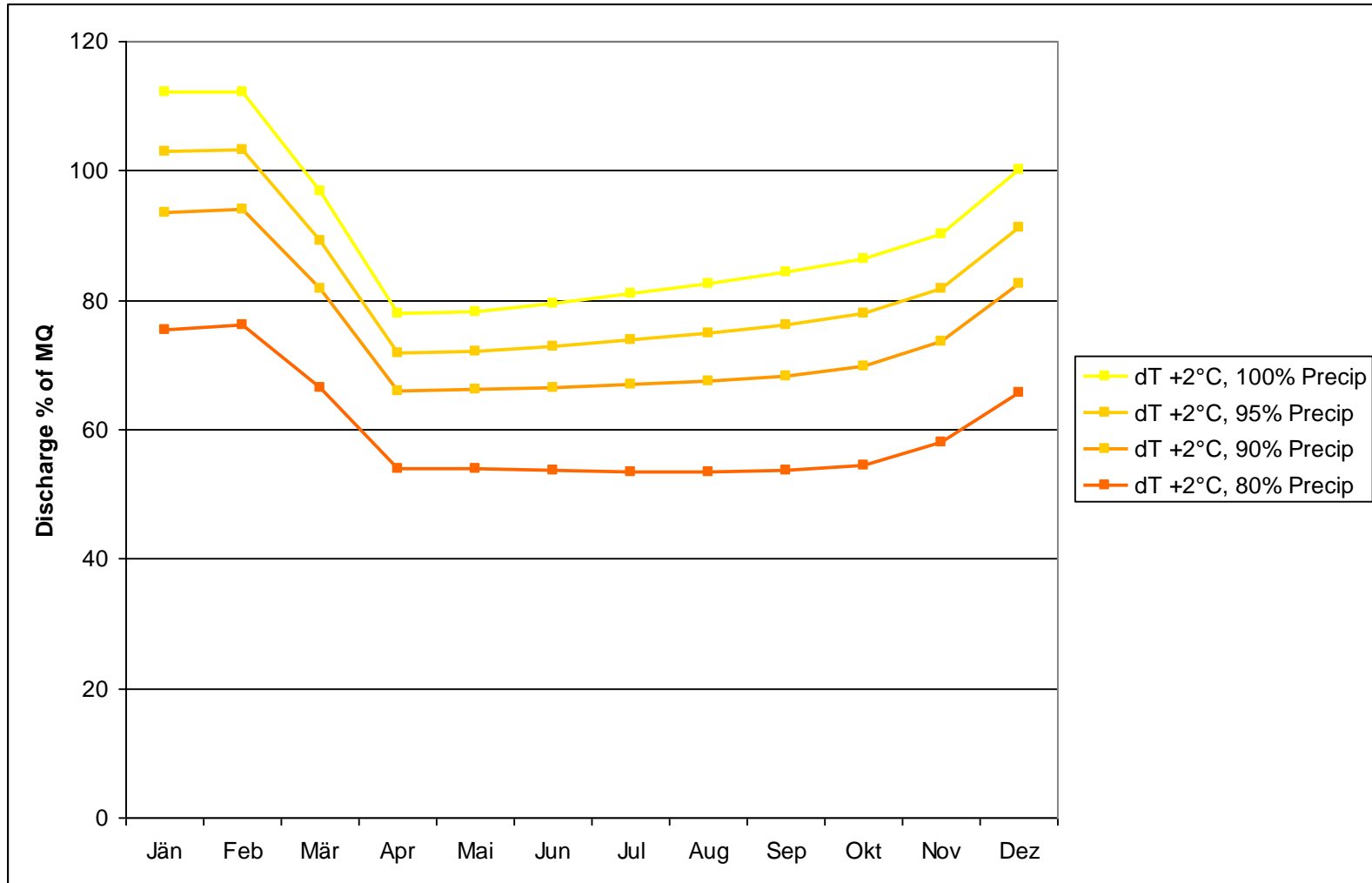
Long term climate change scenarios:



Long term climate change scenarios:



Long term climate change scenarios:



Benefit of long term forecast:

- Proactive water management planning!
- Development of new resources (springs or wells)
- Construction of networks (communal or regional)
- Measures to save water



To do – Outlook:

- Improvement of data quality (calibration and working data like spring discharges, precipitation, water management data).
- Evaluation of the system in collaboration with the water supplying organisations.

