Early warning system for drinking water supply in carinthia

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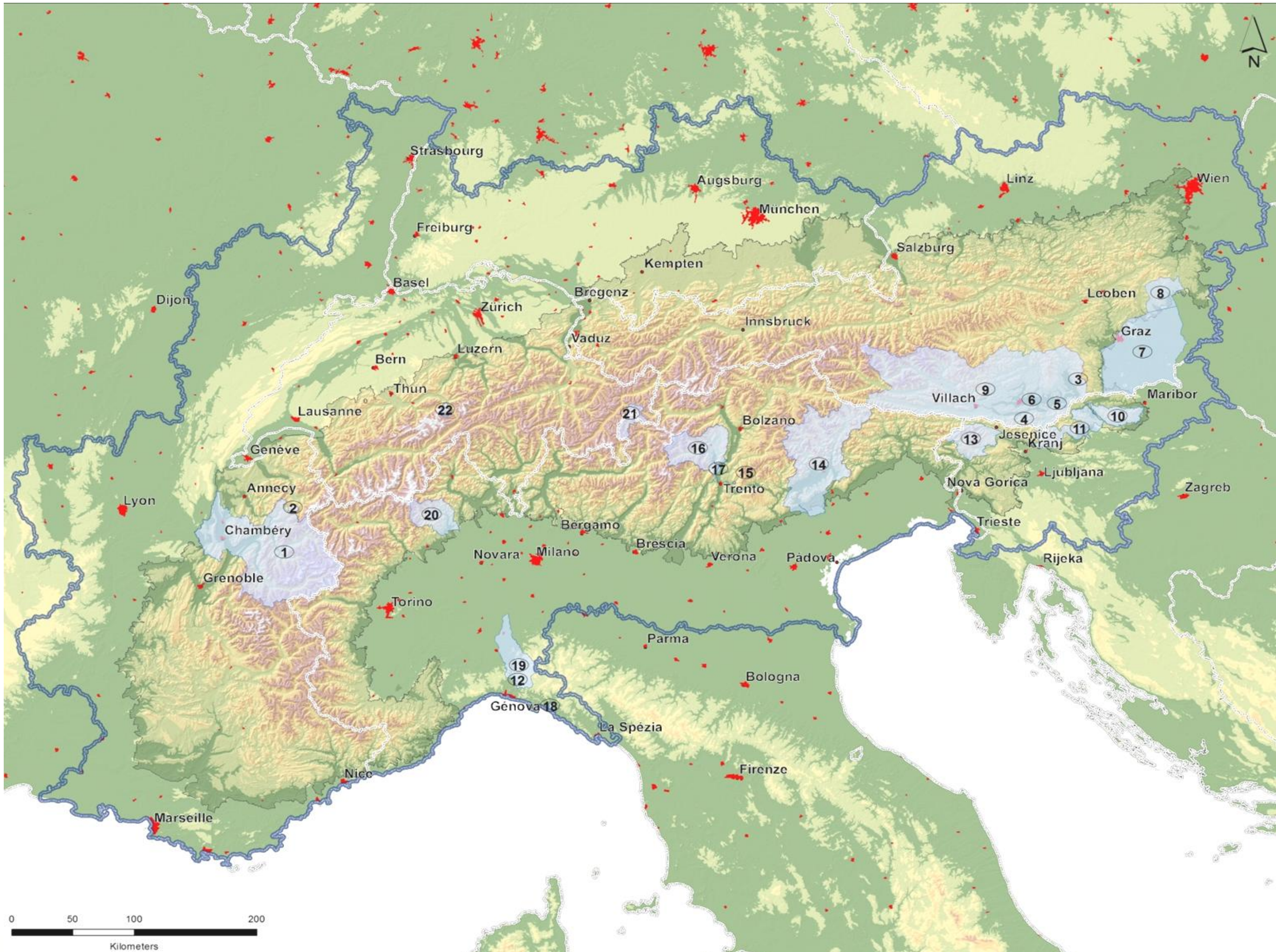
Alp-Water-Scarce Project:

17 Partners
from
5 alpine states,
2008 - 2011



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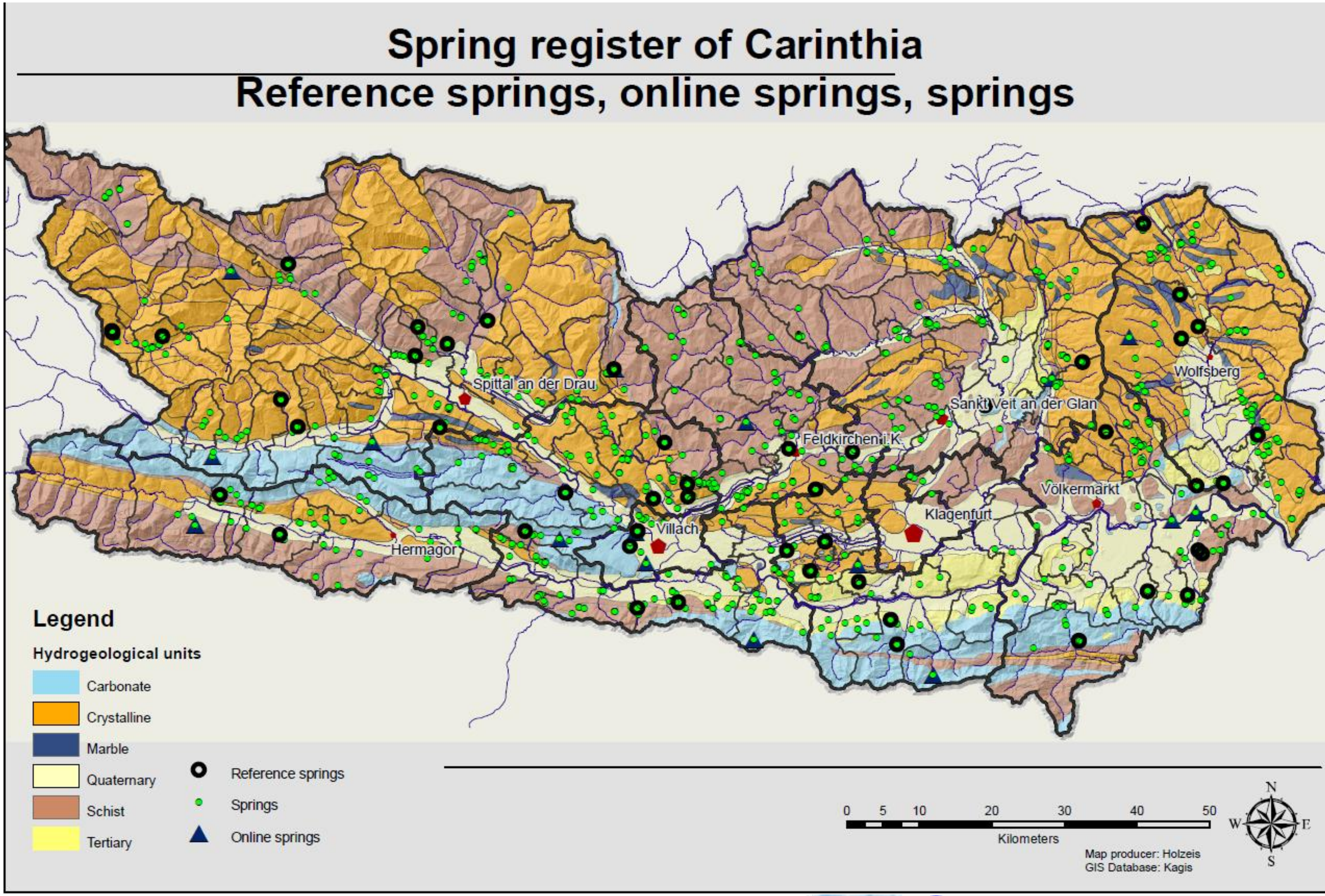
Objectives:

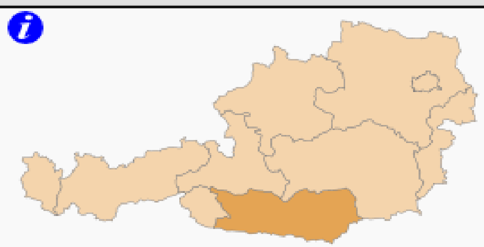
- Knowledge of the actual spring discharge.

- Estimation of the future discharge of springs, based on normal, dry and very dry meteorological scenarios for the following 3 month.

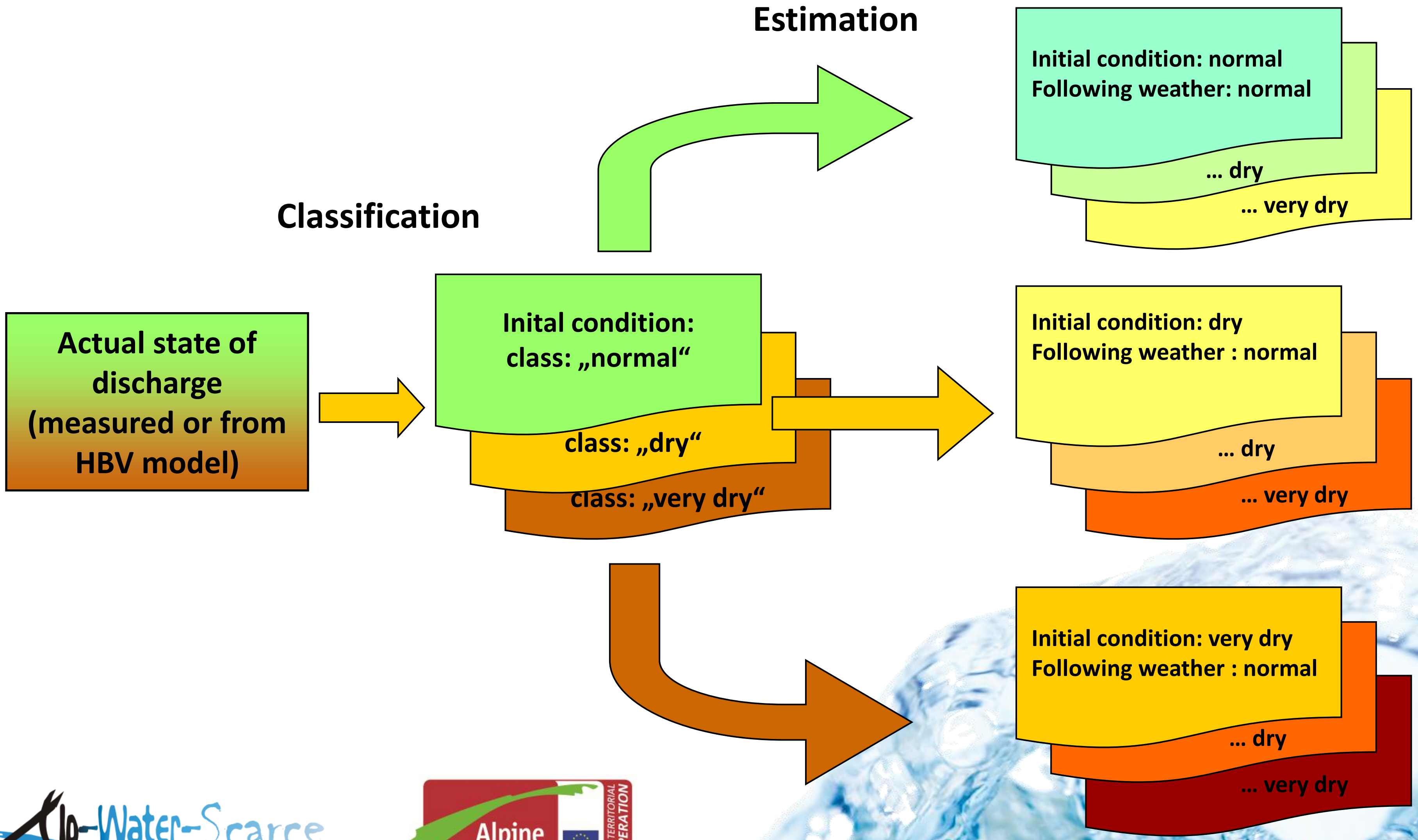
- Estimation of the water balance of water suppliers for medium and peak water demand for the above scenarios.

- Estimation of the spring discharge for long-time „climate change“ scenarios.


Spring register of Carinthia
Reference springs, online springs, springs
Spittal an der Drau
Sankt Veit an der Glan
Wolfsberg
Feldkirchen i.K.
Völkermarkt
Klagenfurt
Villach
Hermagor
Legend
Hydrogeological units
Carbonate
Crystalline
Marble
Quaternary
Schist
Tertiary
Reference springs
Springs
Online springs
0 5 10 20 30 40 50
Kilometers
Map producer: Holzeis
GIS Database: Kagis
N
W
E
S



Basic idea of the early warning system



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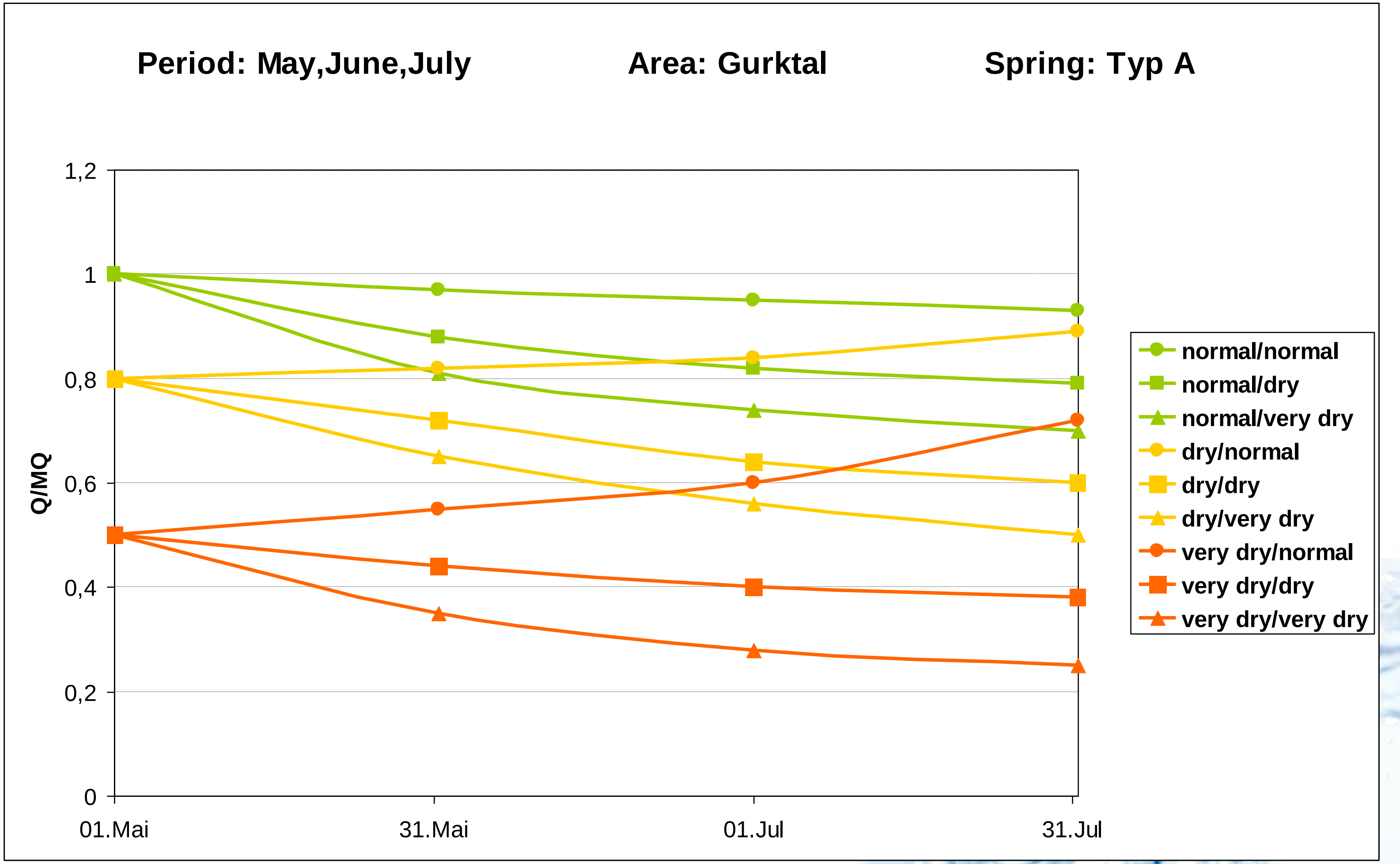
Prepared Scenarios



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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.

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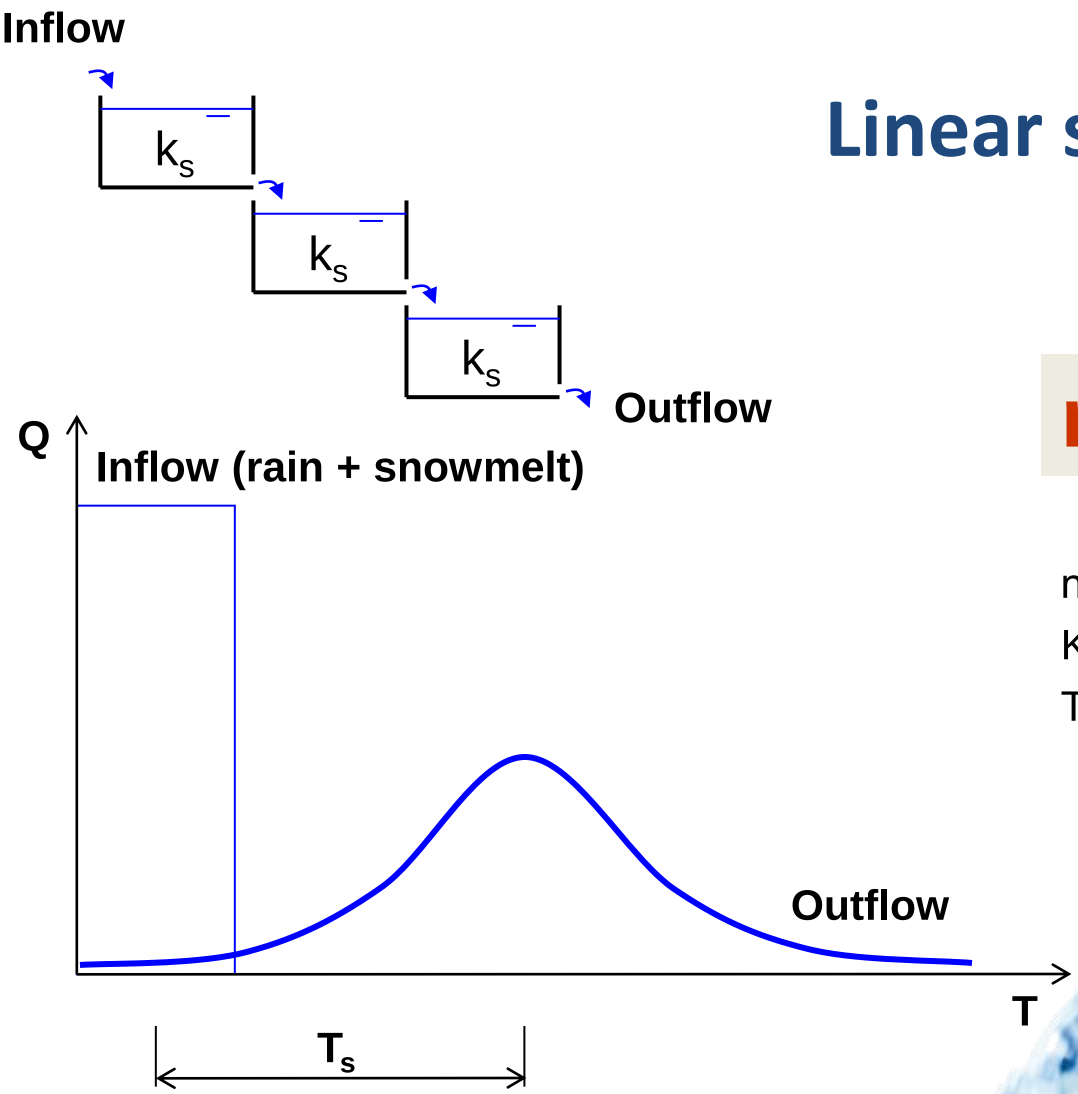
Hydrological model - HBV:

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

Linear storage cascade



$$n \times k_s = T_s$$

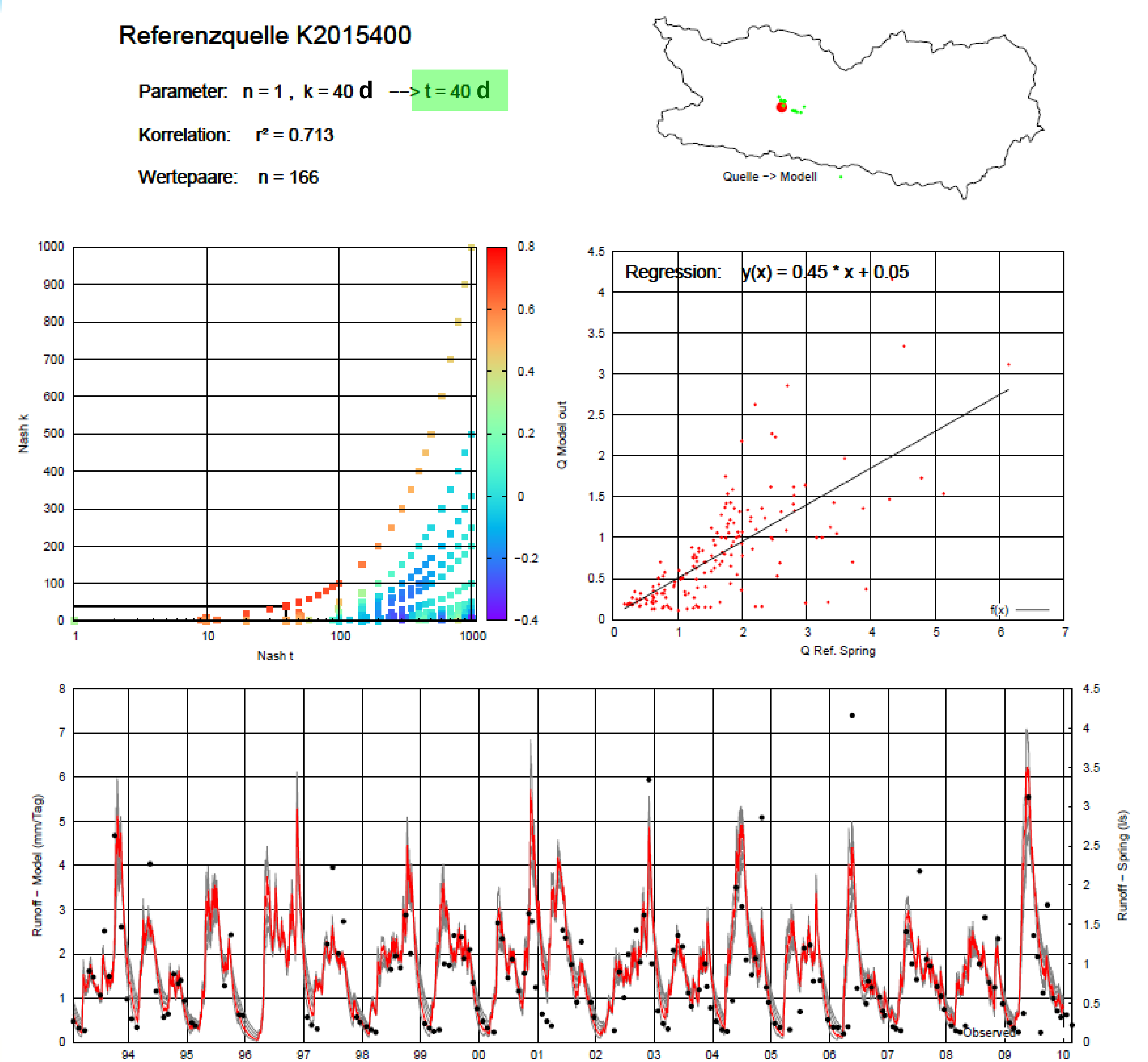
n ….. Number of storages

K_s …. Storage coefficient

T_s …. Medium time shift

Calibration:

Simulated discharge:



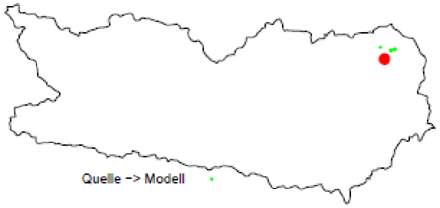
Calibration:

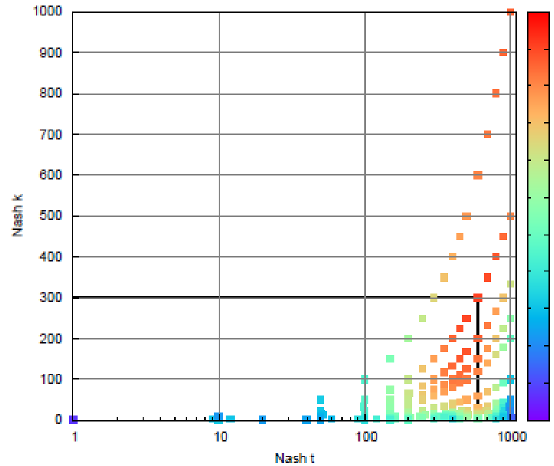
Referenzquelle K2015791

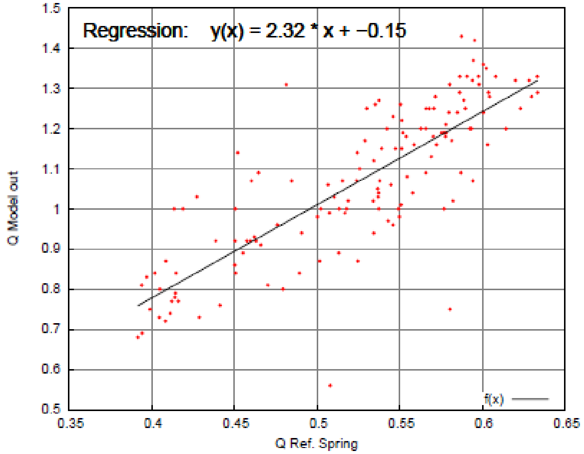
Parameter: n = 2 , k = 300 d --> t = 600

Korrelation: r² = 0.813

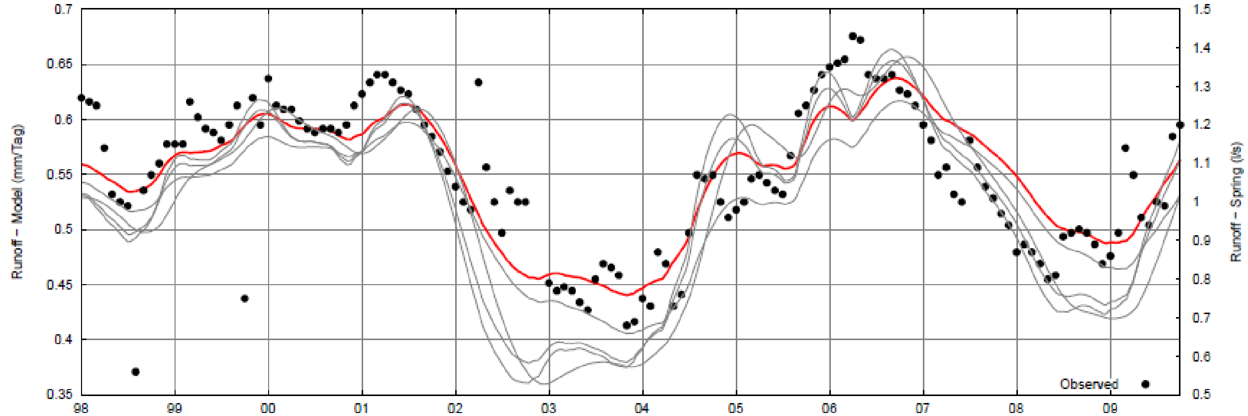
Wertepaare: n = 140







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.

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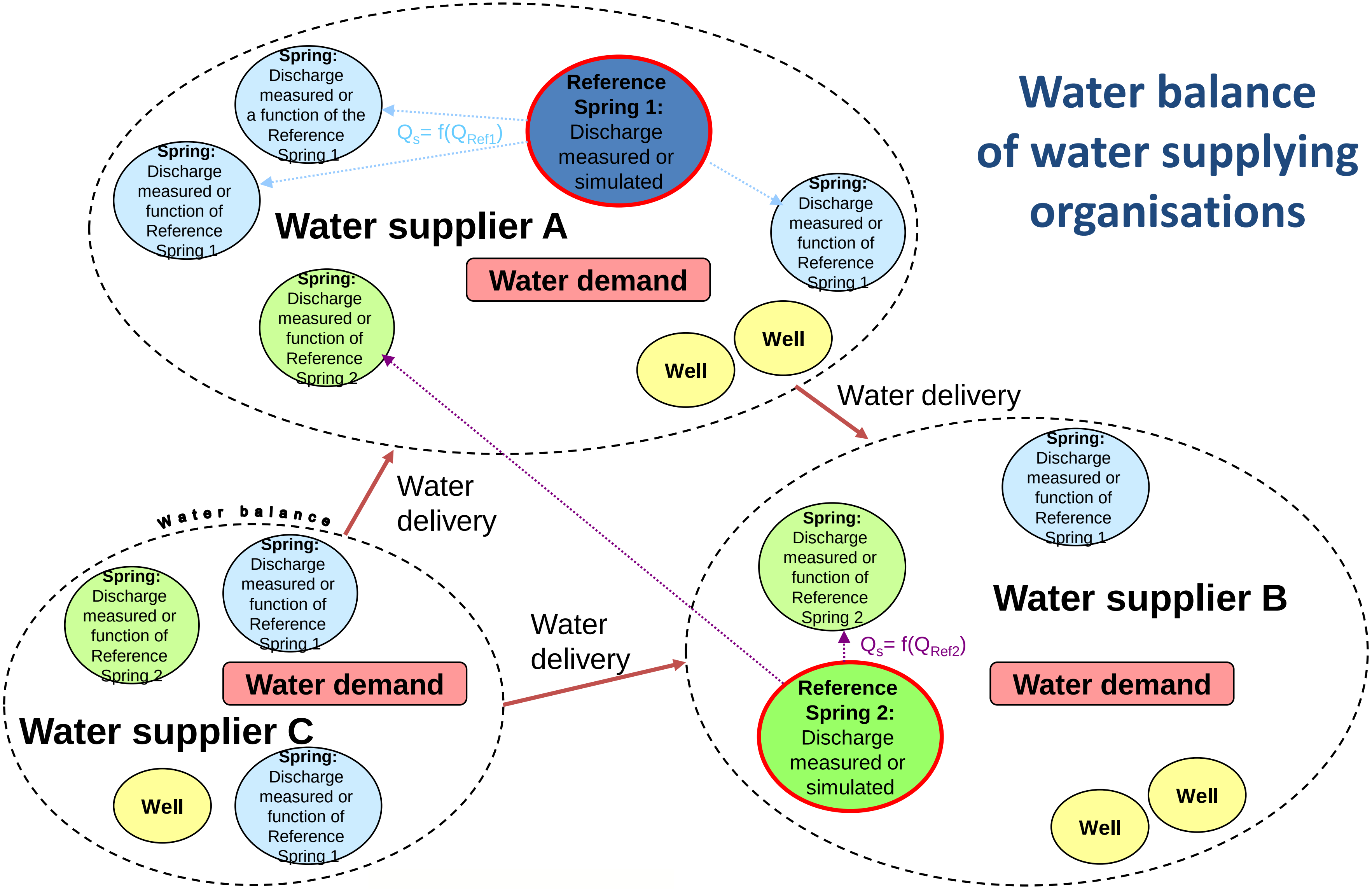
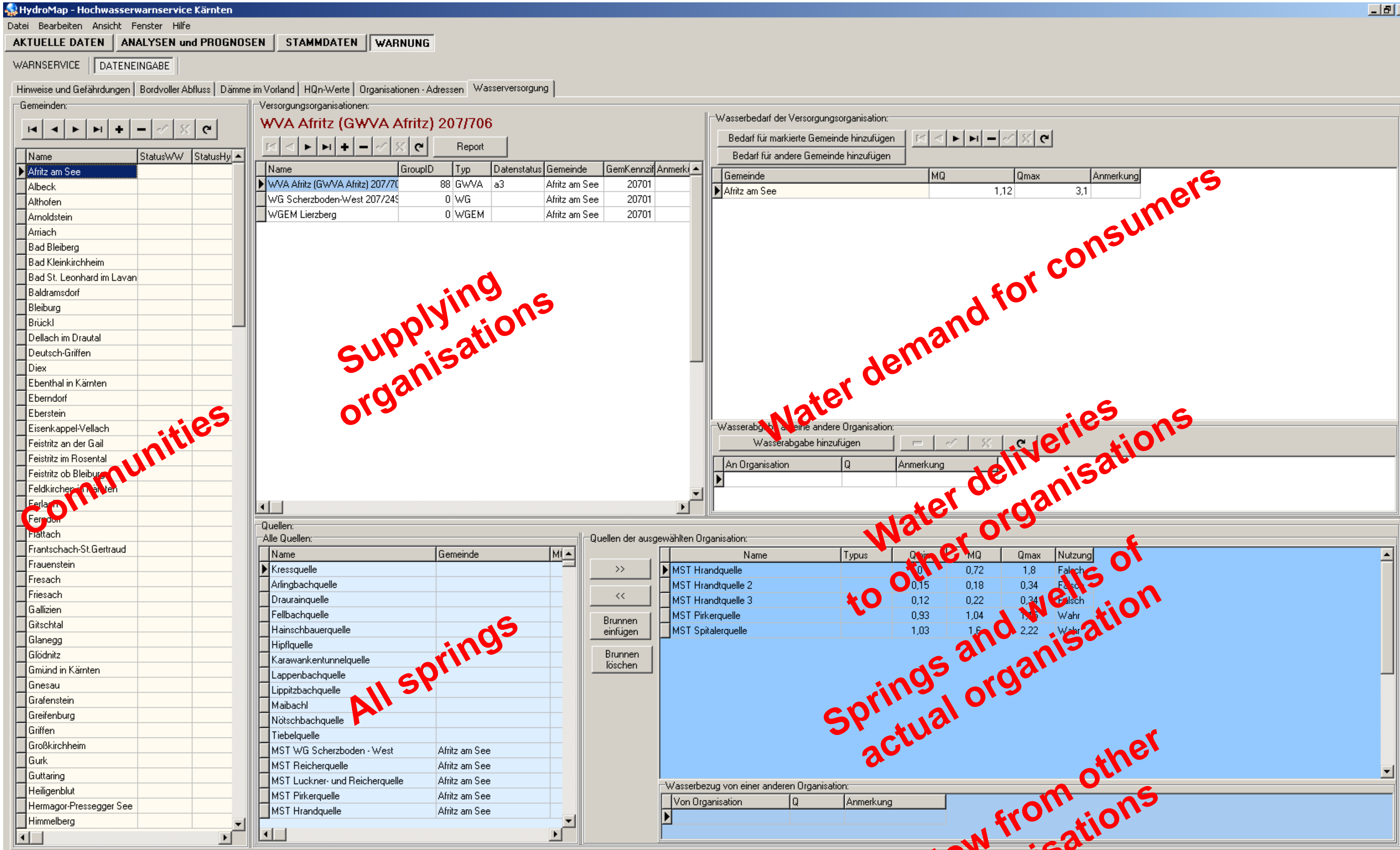
Calculation of the water balance for a water supplying organisation

Water balance of water supplying organisations



Database of water management parameters



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Department for water management of the Carinthian Regional Government

Community Frantschach-St.Gertraud

Water supplying organisation:

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

Spring discharge:	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**

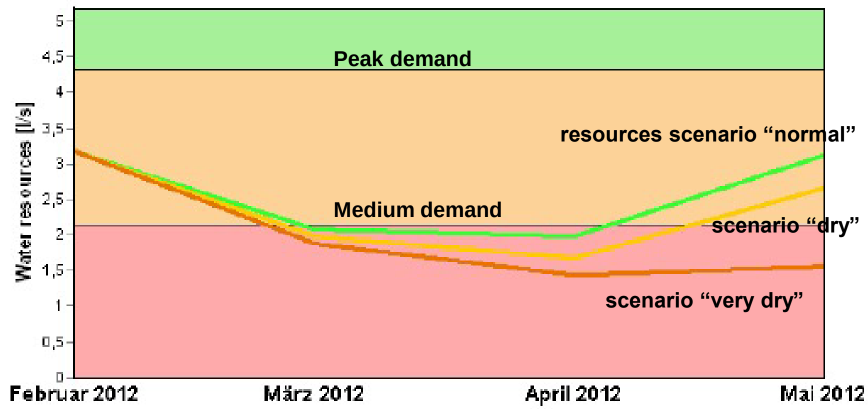
Delivery to consumer:	MQ l/s	Qmax l/s
Frantschach-St.Gertraud	2,17	4,34
Delivery to other organisations:	Q l/s	
WVA Frantschach (GWVA Frantschach-St. Gertraud)	0 l/s	
Summation of water consumptions:	**2,17 l/s**	**4,34 l/s**

Balance (current resources - medium consumption):	1,00 l/s
Balance (current resources - peak consumption):	-1,17 l/s

Department for water management of the Carinthian Regional Government

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.

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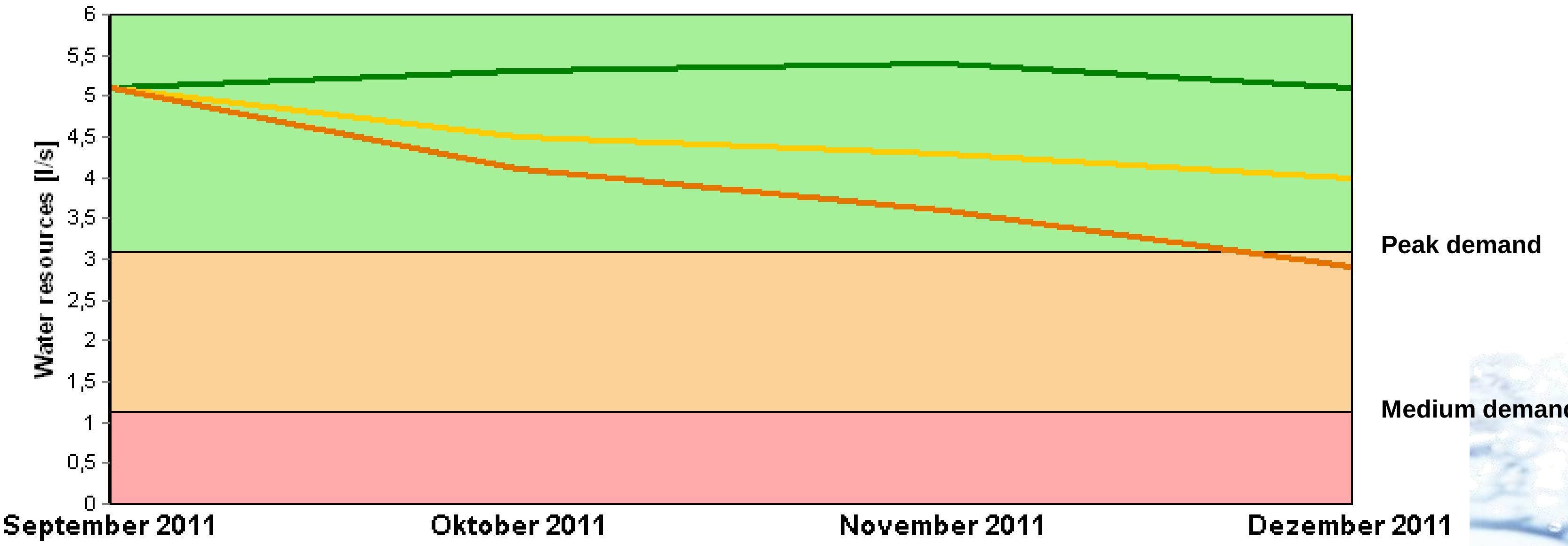
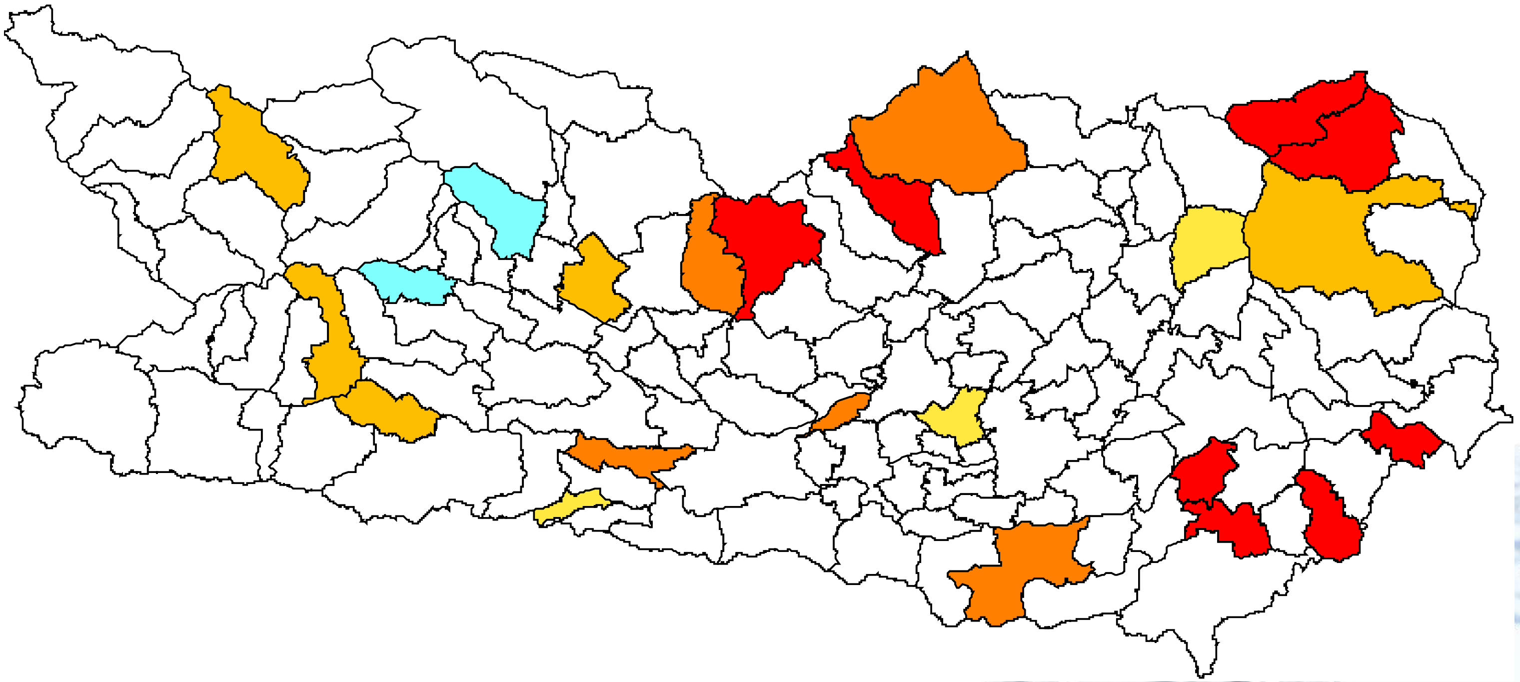
Example of a report for a water supply organisation

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

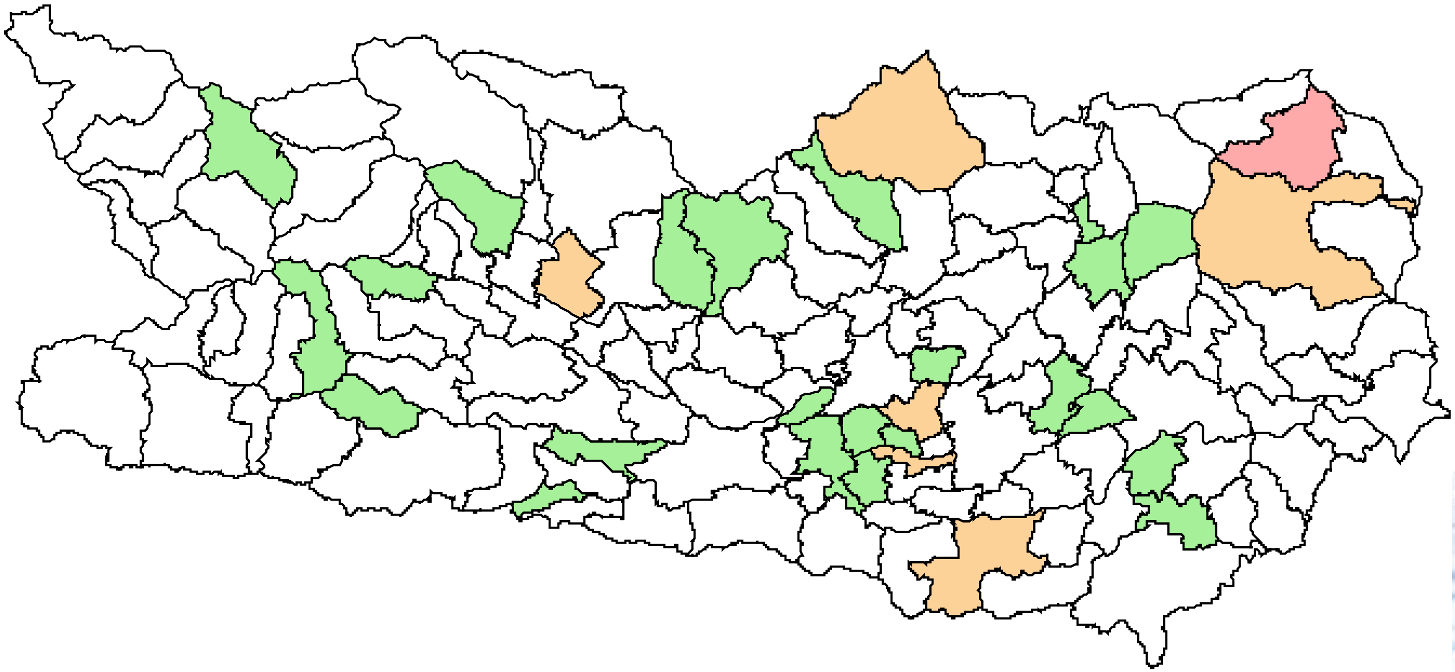
Water balance for normal, dry and very dry weather conditions:



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



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

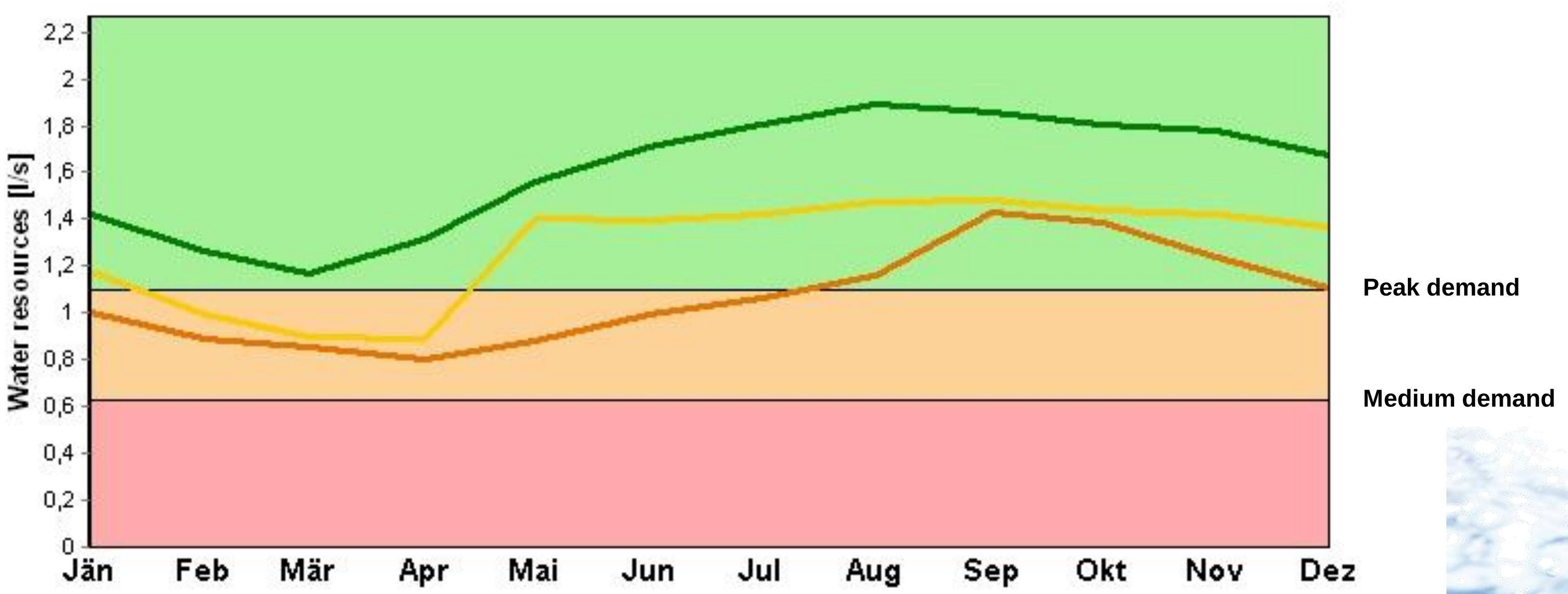


Benefit of the short term forecast:

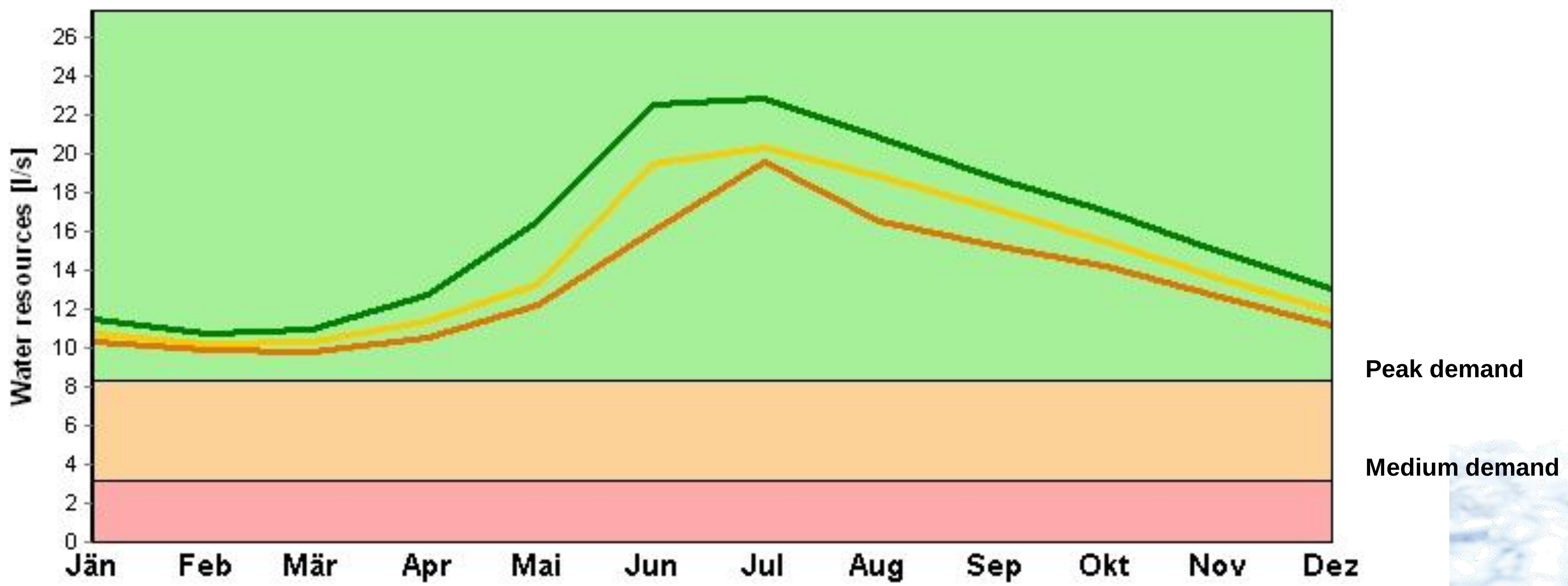
Activate timely water management measures for expected water scarcity periods!

- 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);

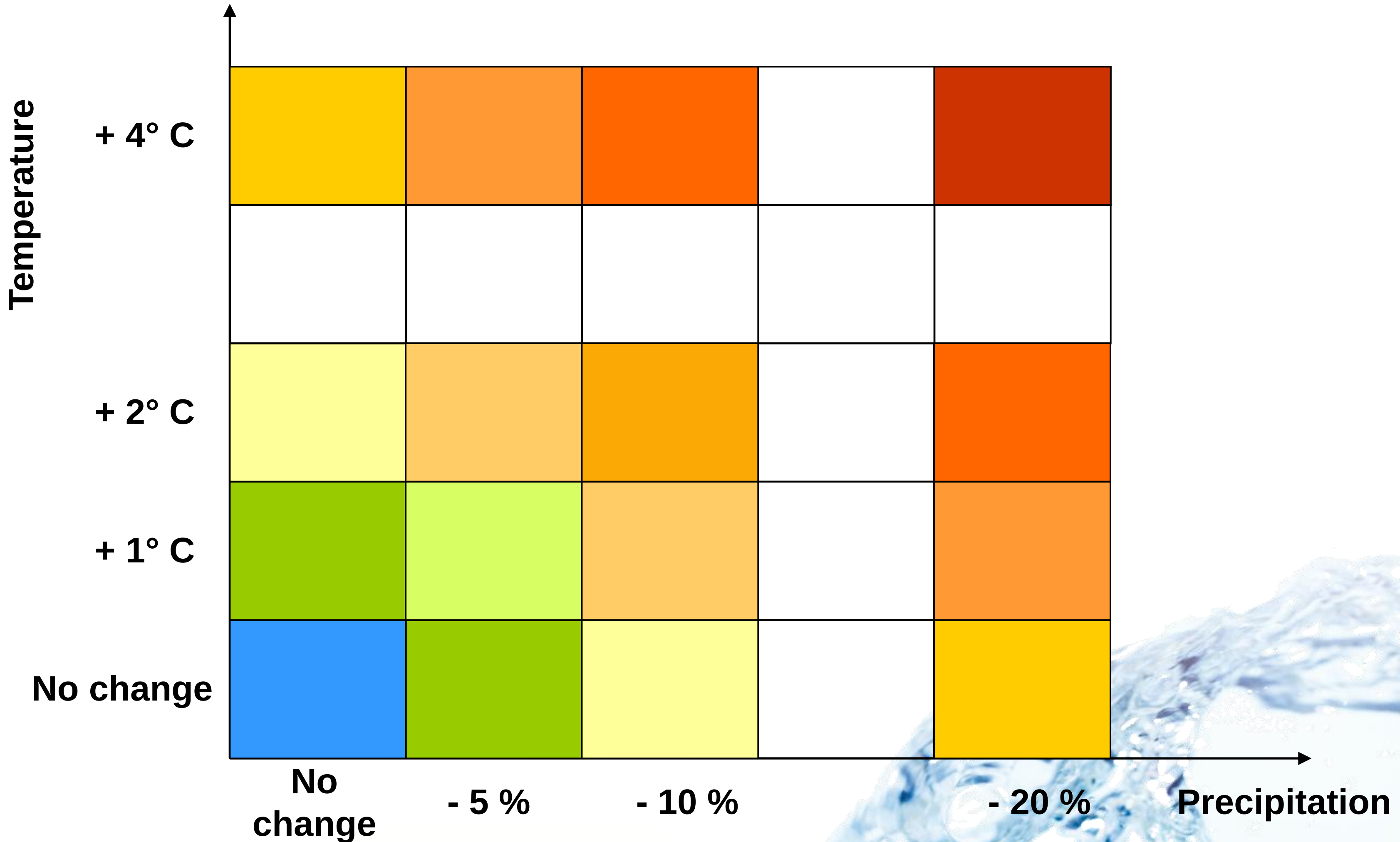
Scenario catalogue for drought conditions:



Scenario catalogue for drought conditions:



Calculated long term climate change scenarios



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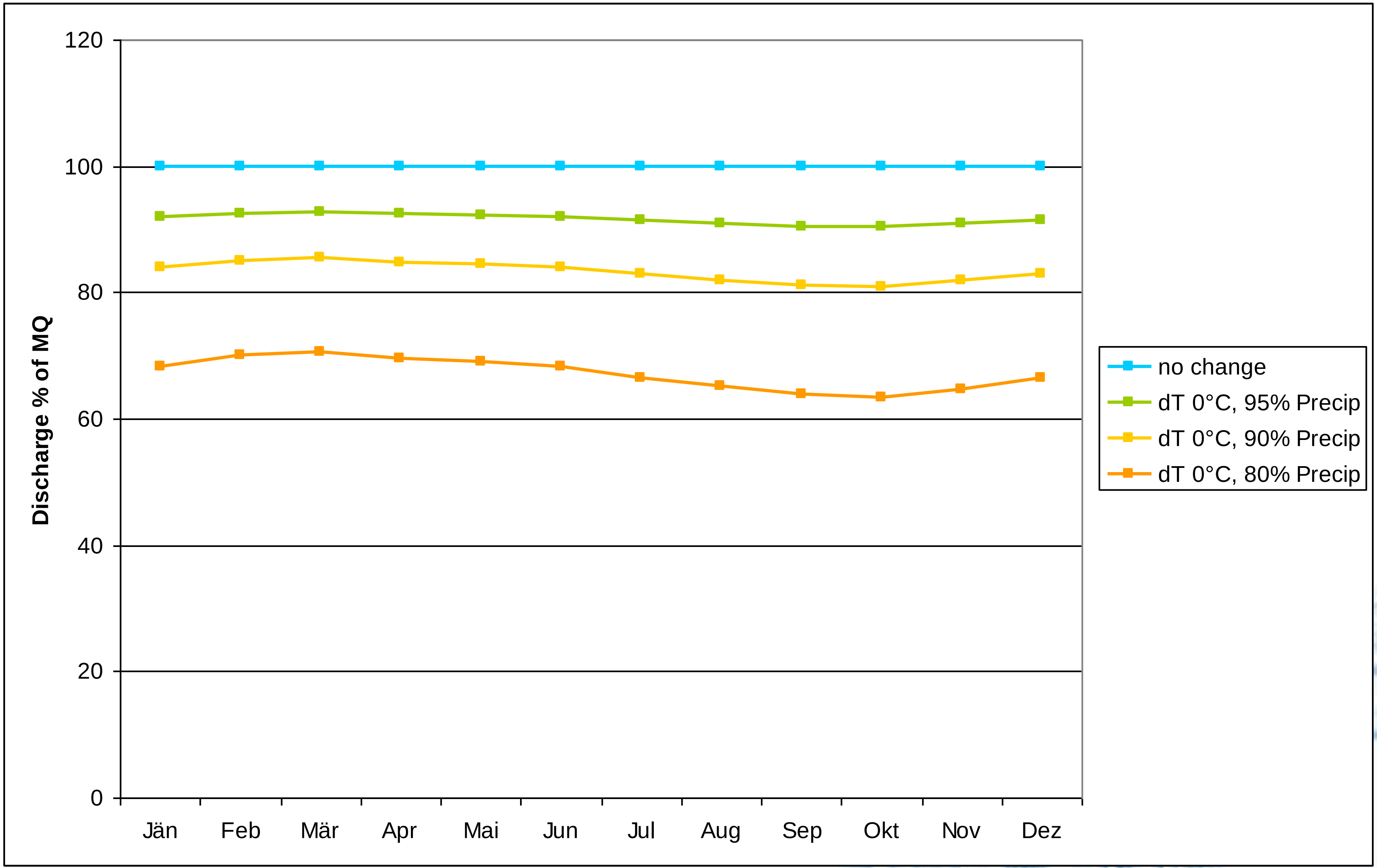
Long term climate change scenarios:



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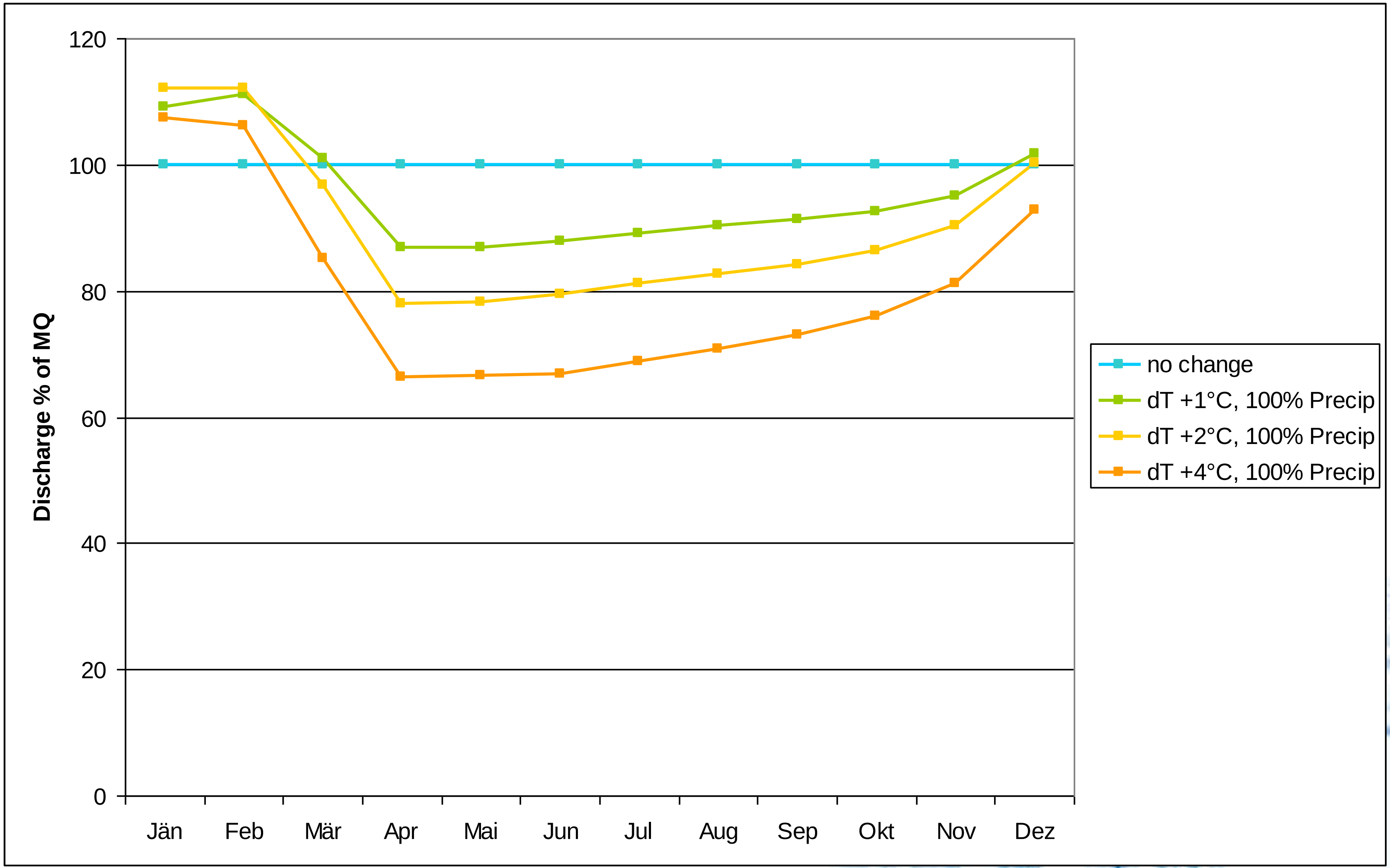
Long term climate change scenarios:



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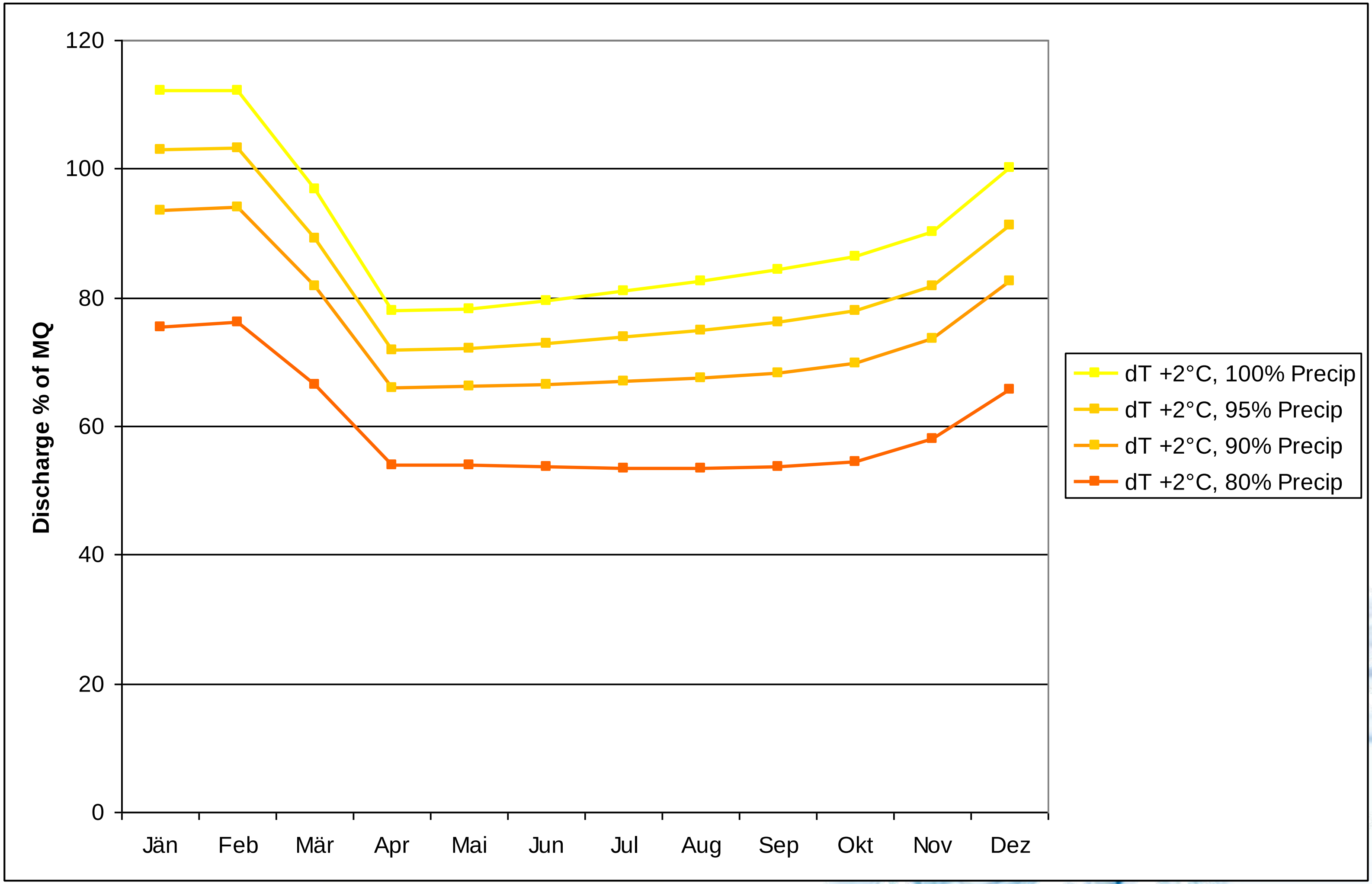
Long term climate change scenarios:



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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

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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.