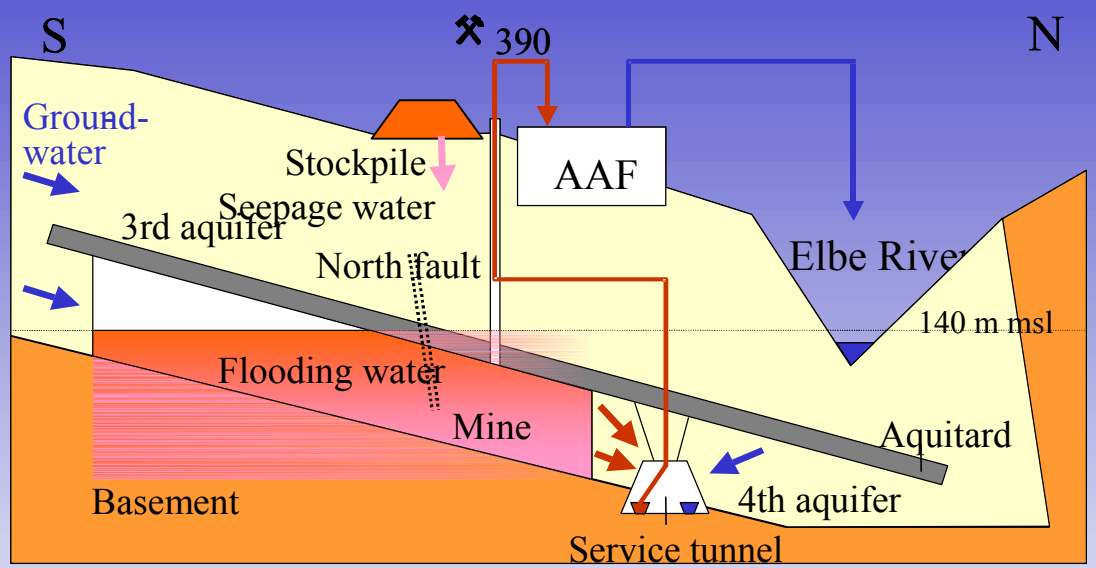
# Uranium Mining and Hydrogeology 2005

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## Hydrochemical Aspects of the Flooding of the Mine Koenigstein – A Water Mixing Model for Recognizing the Influence of Groundwater by Contaminated Water

Presentation
12.09.2005

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# Contents

# 1. Mining History

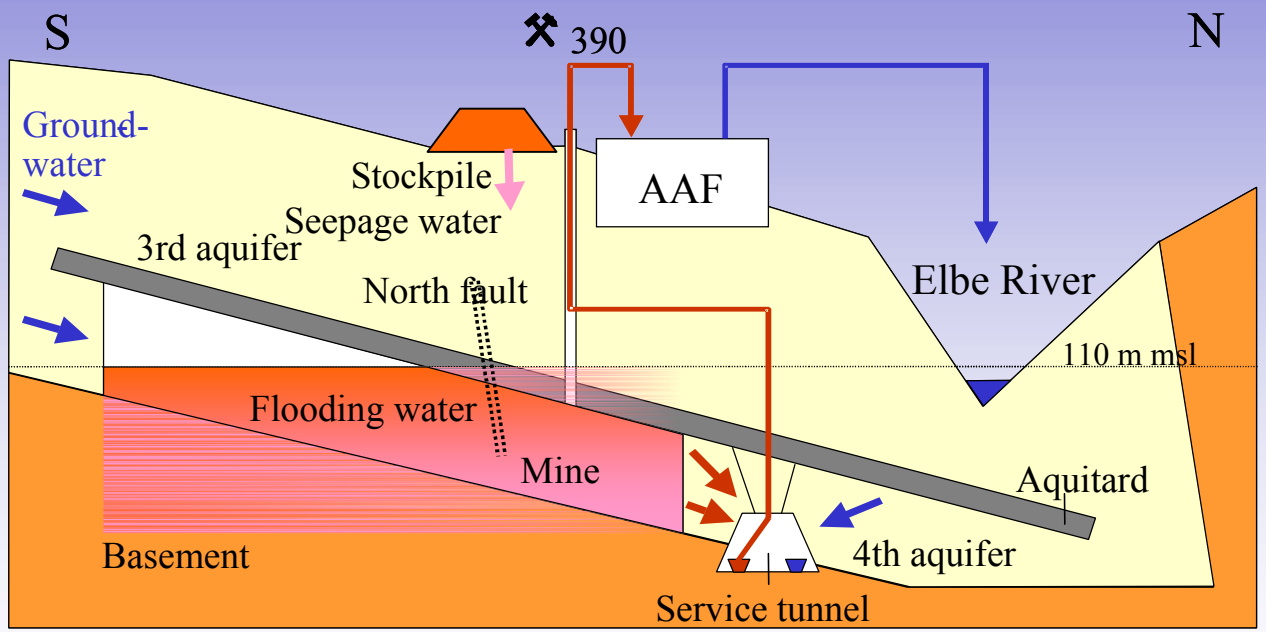
- Situated in the Elbsandstein mountains
- Depth 300 m
- Area 6 km²
- From 1967 to 1990 production of 18,000 t U
- Since 1984 production by leaching

# 1. Flooding History

- since 2001 flooding of the mine
- complex monitoring program
- control influence of groundwater
  by contaminated water during flooding
- 330 measuring points
- 12 km service tunnels

# 2. Geologocal situation

## Schematic profile of the mine Koenigstein during flooding



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## 3. Task in 2004

Mainobject of interest during the flooding process:
Protection of the aquifer „3rd GWL“

## 3. Task in 2004

- Based onthe monitoring data :
  characterize the hydrochemical behaviour of all observed water classes in all measuring points

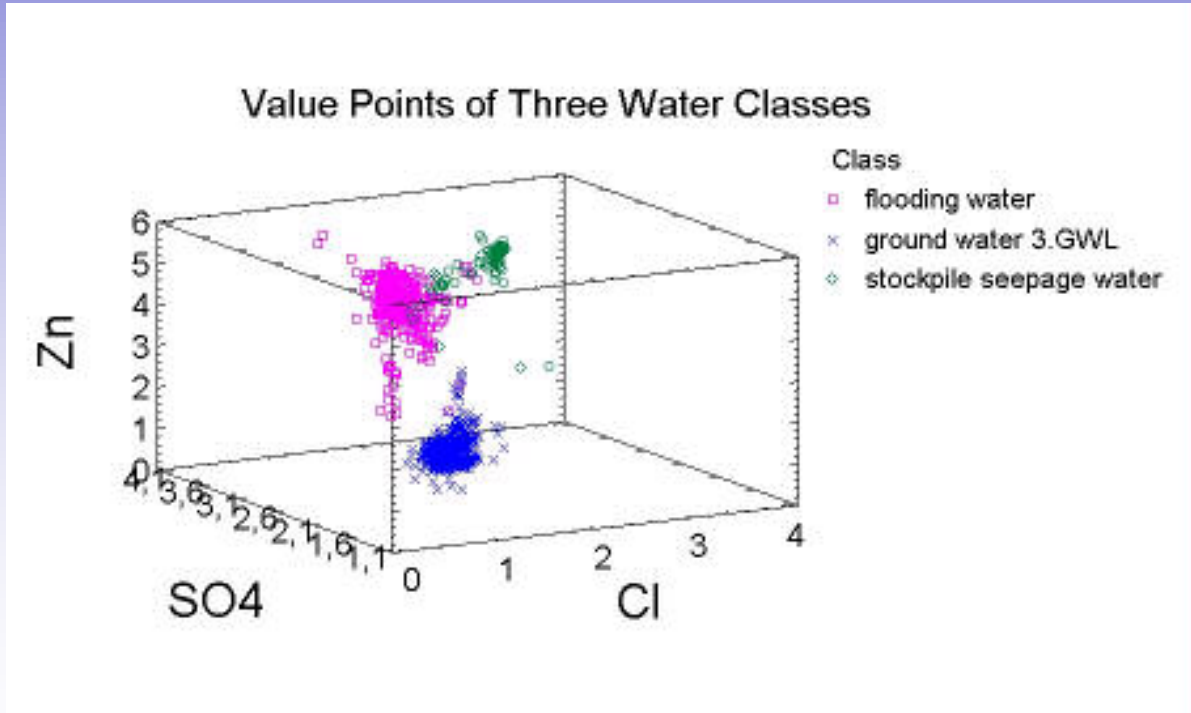
Special task:

- development of a decision support for determining the source of influenceof the ground water by flooding water or stockpile seepage water

=> Water mixing model

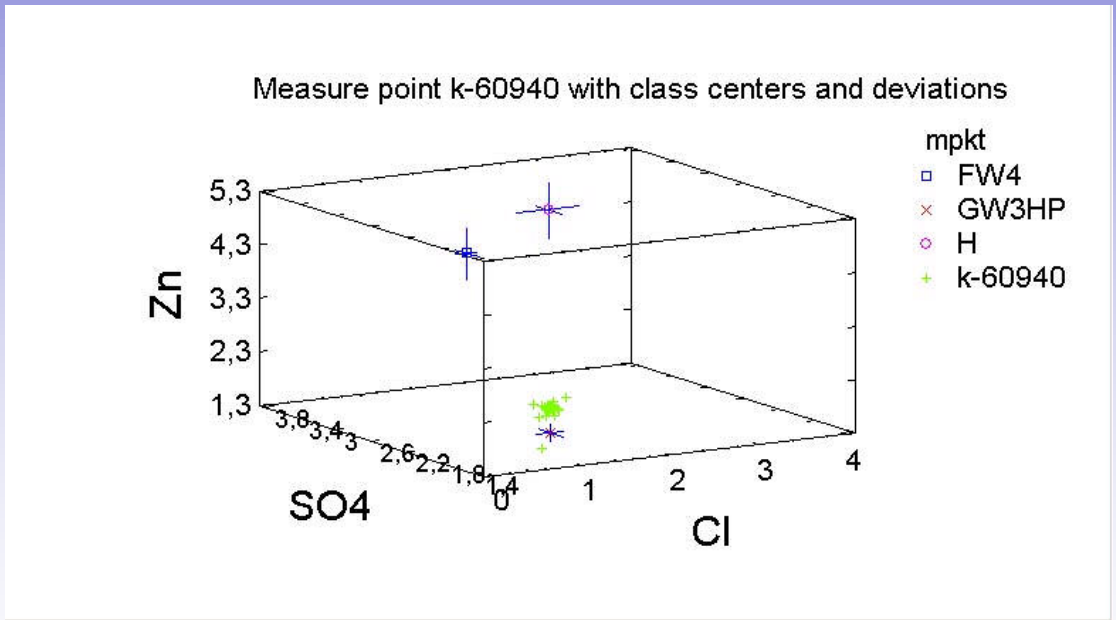
# 4. Water mixing model – Basic ideas 1

## Representation of all measurement values as points in the value space



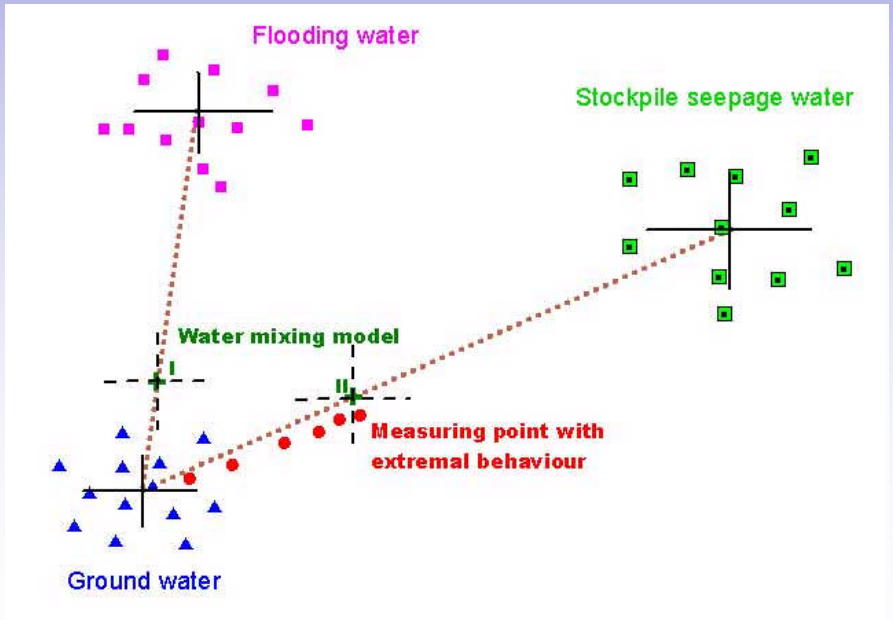
# 4. Water mixing model – Basic ideas 2

describe the point clouds by average vectors and standard deviations vectors



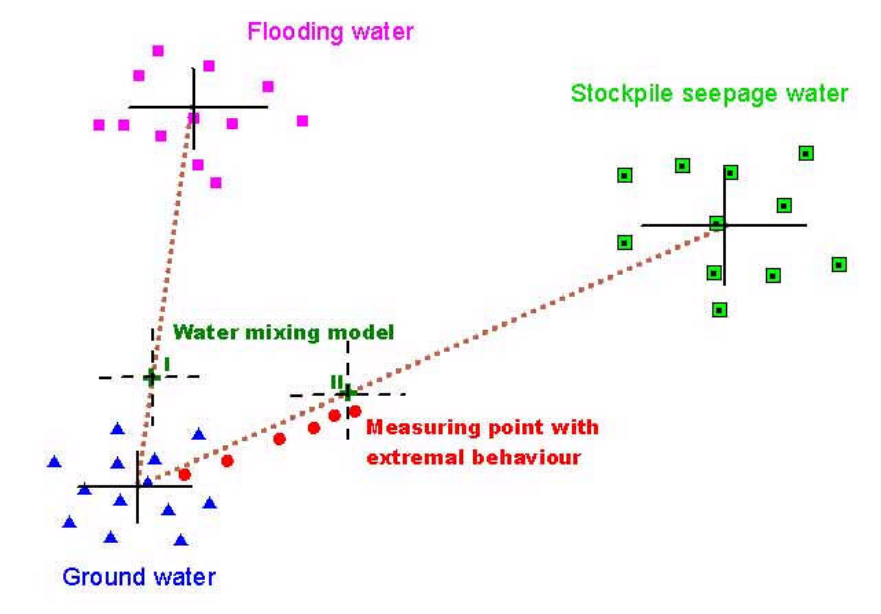
# 4. Water mixing model – Basic ideas 3

The influence of ground water by contaminated water is expressed in the measurement vectors of the ground water measuring points. They move away from the average vector of the ground water class.
-> „measuring point with extremal behaviour“.



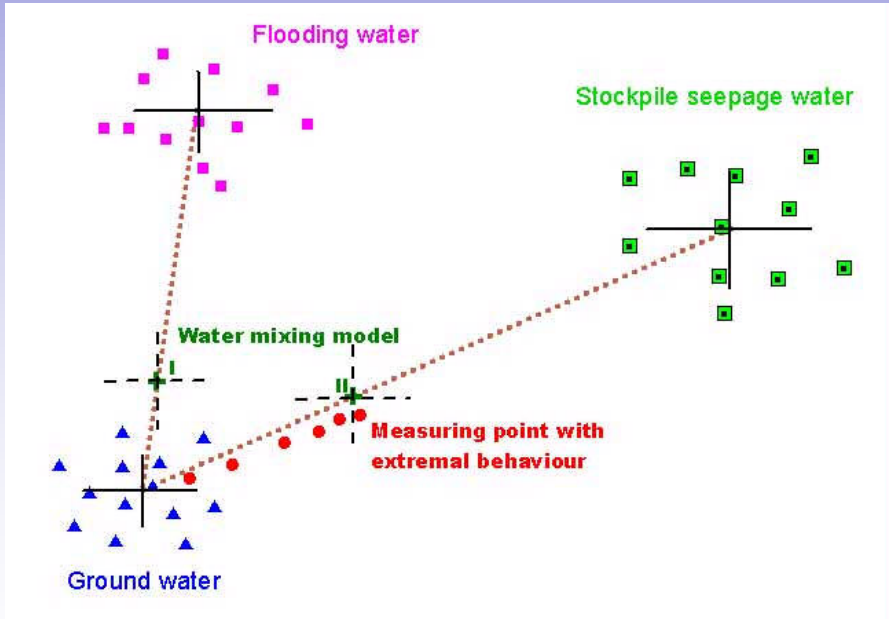
# 4. Water mixing model – Basic ideas 4

the measurement vectors of a point with extremal behaviour will move along the line connecting the ground water average vector and the average vector of the contaminated water



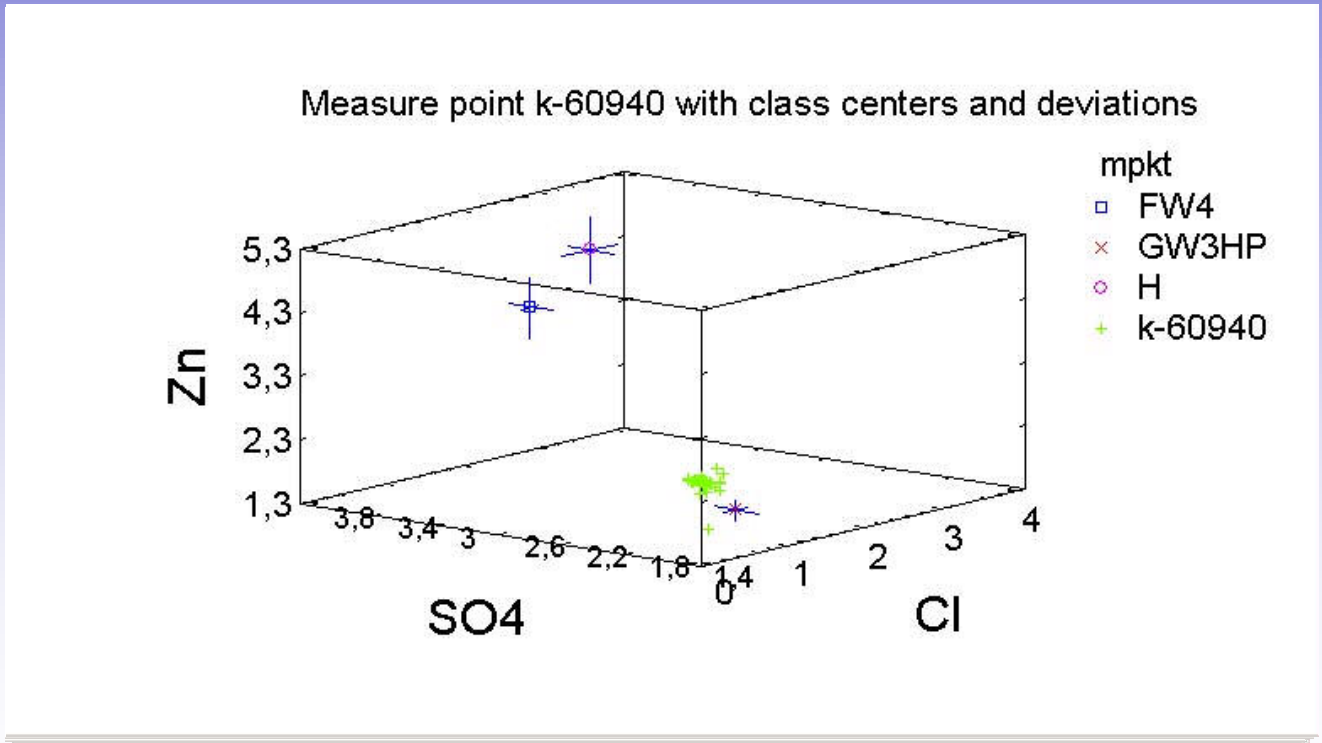
# 4. Water mixing model – Basic ideas 5

the closest connecting line to the measurement vectors defines the class of influence



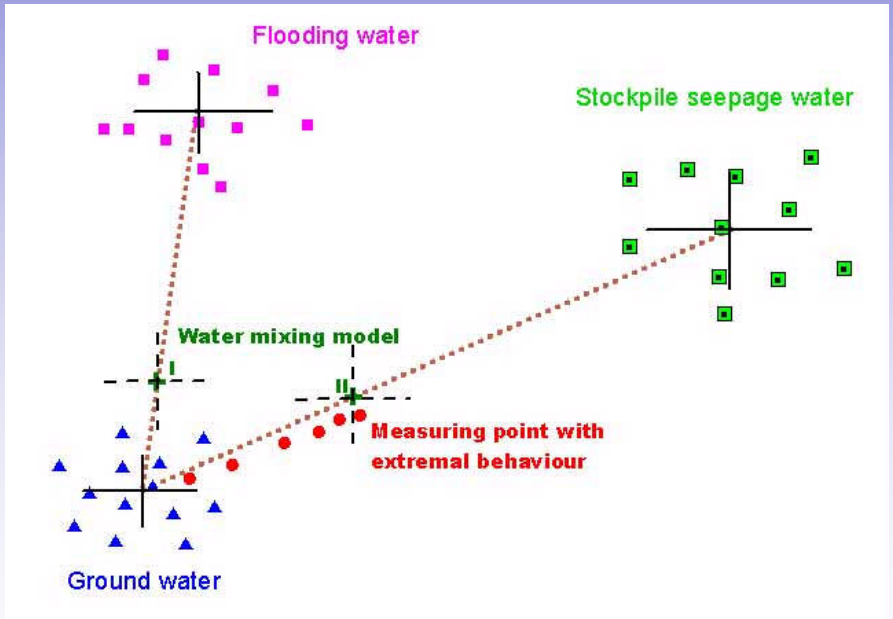
# 4. Water mixing model – Basic ideas 6

## ExamplePosition of the measurement values of a measuring point to the average vectors



# 5. Modeling – Step 1

## Choose the relevant water classes

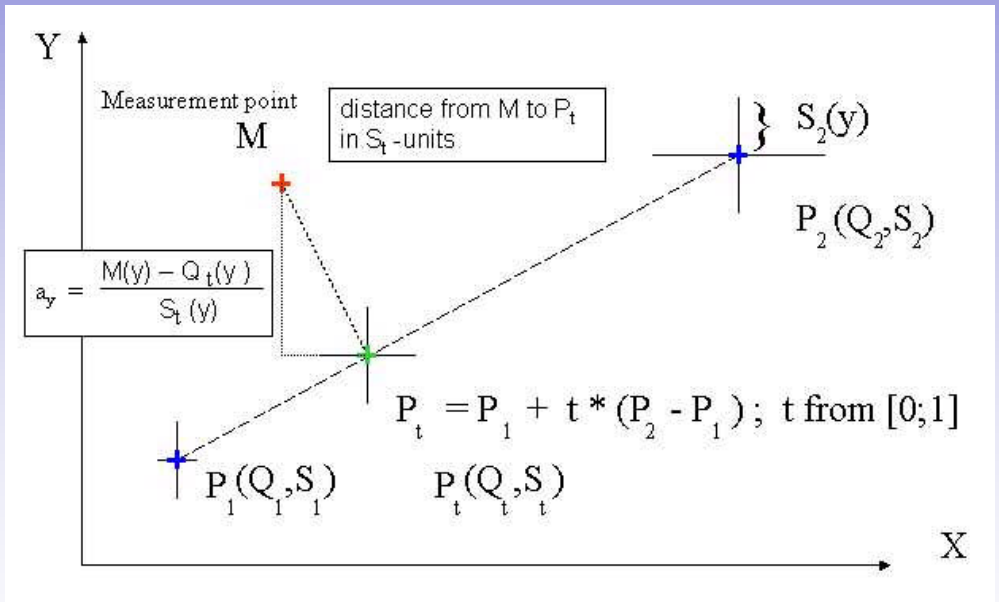


# 5. Modeling – Step 2

Choose the analysis values for modeling
Cl, SO4, Zn, U, Lf from over100parameters

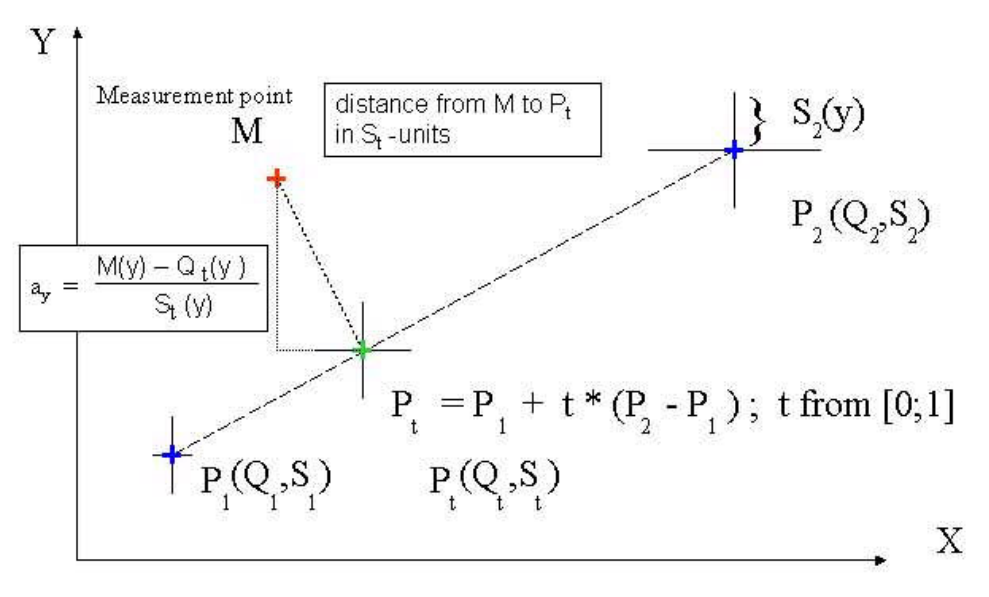
# 5. Modeling – Step 3

define water mixture of 2 water classes depending on rate parameter t



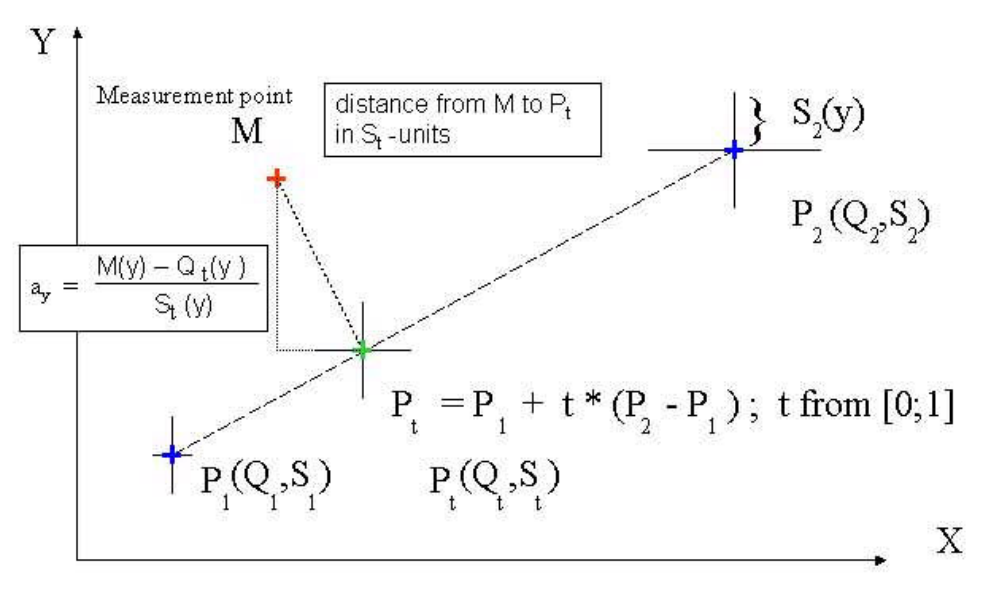
# 5. Modeling – Step 4

## define the distance measure between a value vector and awater mixture



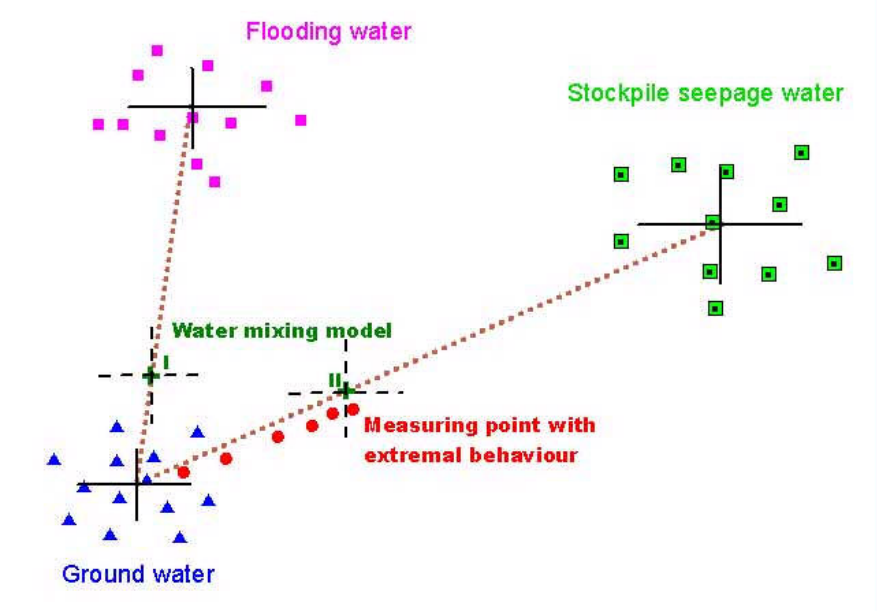
# 5. Modeling – Step 5

determine the fitted rate parameter $t_0$ realizing the minimum distance for a given value vector – most likely water mixture



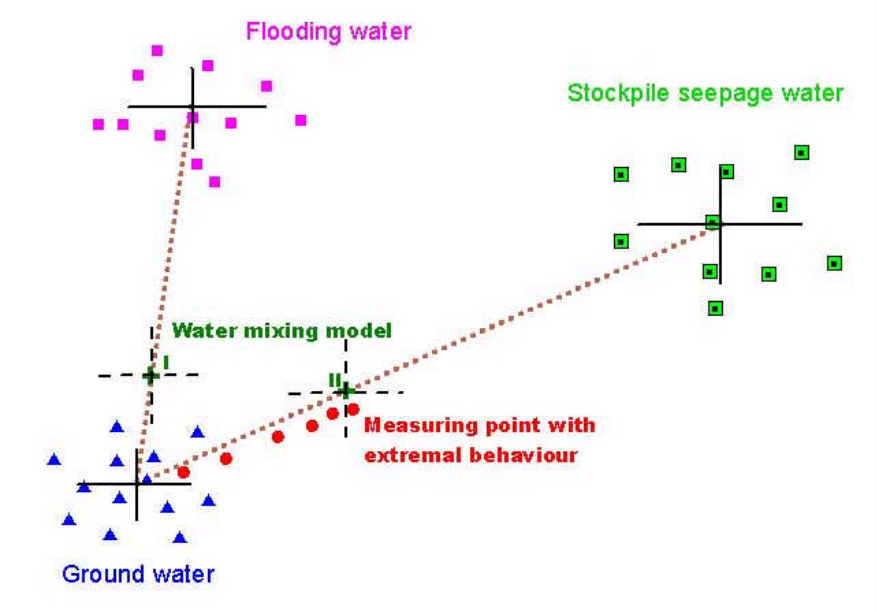
# 5. Modeling – Step 6

determine a threshold separating random variability of pure groundwater class from real water mixture



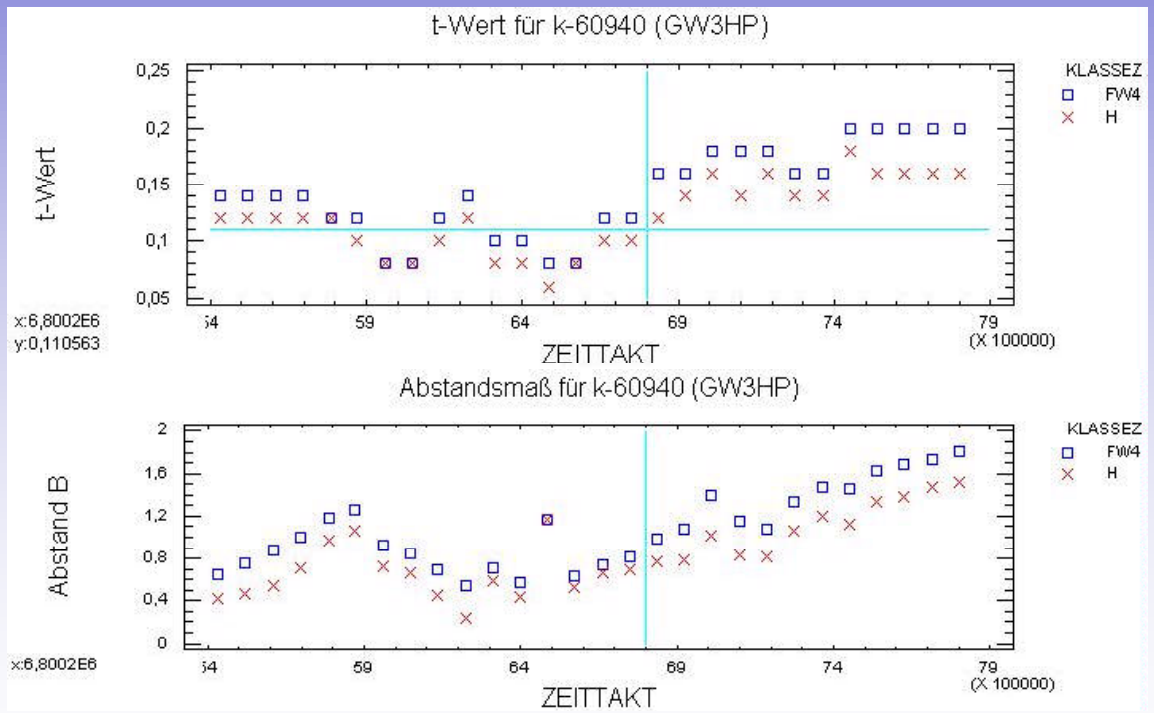
# 5. Modeling – Step 7

## Make a decision for the most likely influence class in the case of real water mixture



# 6. Example:

rate parametert and distance measure
for a given measuring point over the time axis



# 6. Example - Allocation results
## of the measuring points with extremal behaviour

- 8 measuring points in 3rd GWL with extremal behaviour
  - 7 with influence of stockpile seepage water
  - 1 undefined
- 2 measuring points in 4th GWL with extremal behaviour
  - 2 with influence of flooding water