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**Comprehensive evaluation of soil moisture
and arable land monitoring**

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chapter:*

V.1.8. Ground water levels and soil moisture

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V.1.13. Comprehensive evaluation of the monitoring of arable soils

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State of the art

- 3 stages of arable soils monitoring
 - The first stage (VI.1989 – X.1992) – the initial state of pre-dam soil conditions
 - The second stage (1993 – 1997) – the first five years of influence of the Gabčíkovo project on the soil and hydrological conditions
 - The third stage (after 1999) – continuing of the monitoring with a reduced number of monitoring plots

Methods

- Network of stationary monitoring plots (in the first and second stage 20, in the third stage 12)
- Taking soil samples and samples of ground water, profile measurements of soil moisture, precipitation, depth of ground water level and its electric conductivity, collecting crop yield
- Soil moisture, precipitation and depth of ground water level measurements:
 - vegetation season: 10 – 14 day intervals
 - winter (IX – II) – once a month

Ecological clasification of soil moisture

- Aquatic state – full saturation of soil water
- Uvidic interval – moisture between FS and FC
- Semiuvidic interval – moisture between FC and PDA
- Semiarid interval – moisture between PDA and WP
- Arid interval – moisture lower than WP

- Taking soil samples – once a year
- Taking samples of ground water – twice a year (May, September)
- Electrical conductivity of ground water measurements - once a month

Monitoring plots distribution

- The Čunovo reservoir – 2 plots
- Bypass canal– 4 plots
- Tail-race canal – 1 plot
- Area downstream from Sap – 2 plots
- Lower Žitný Ostrov Island – 2 plots

Results of monitoring

Water regime and supplies of soil water

The soil water regime depends on:

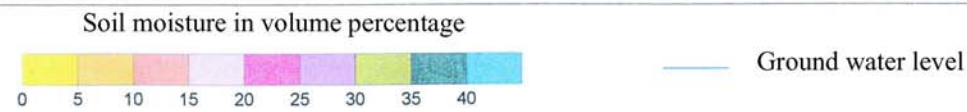
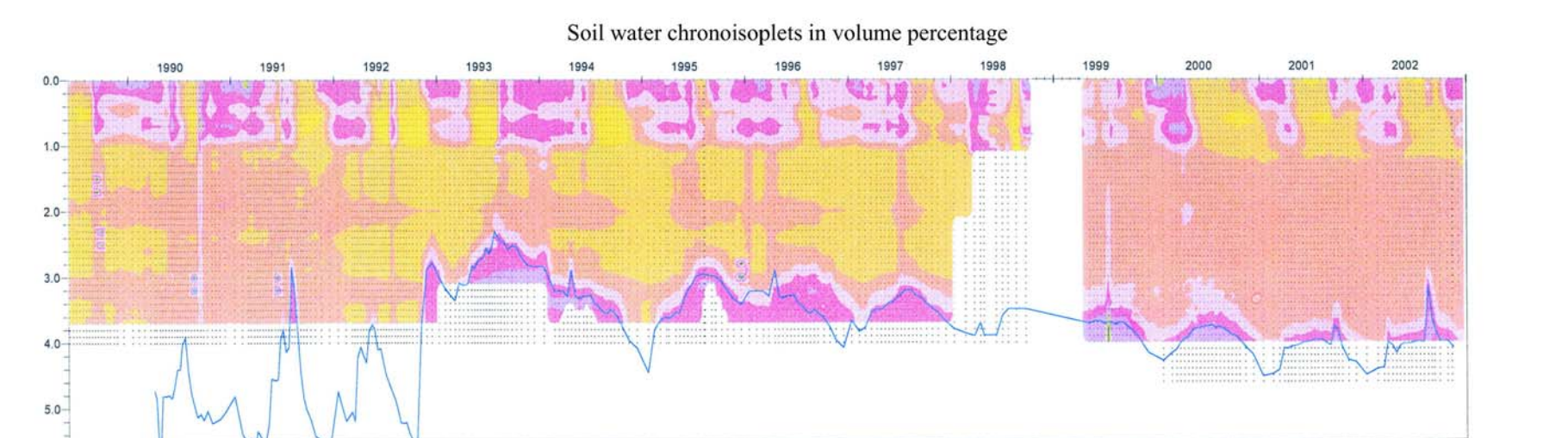
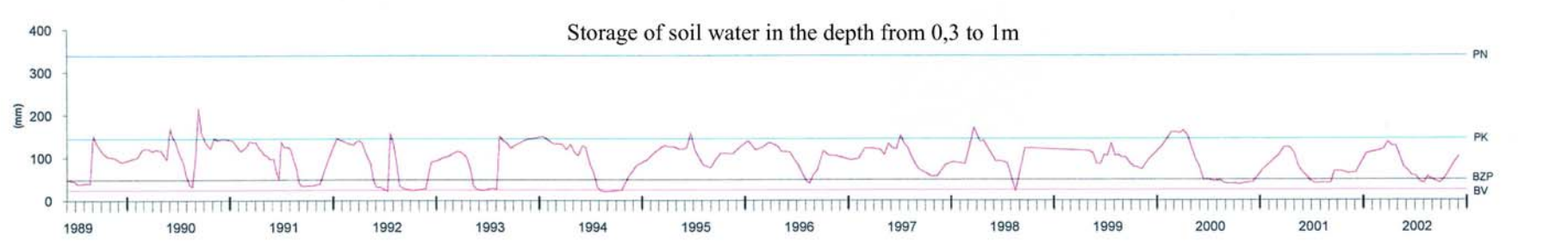
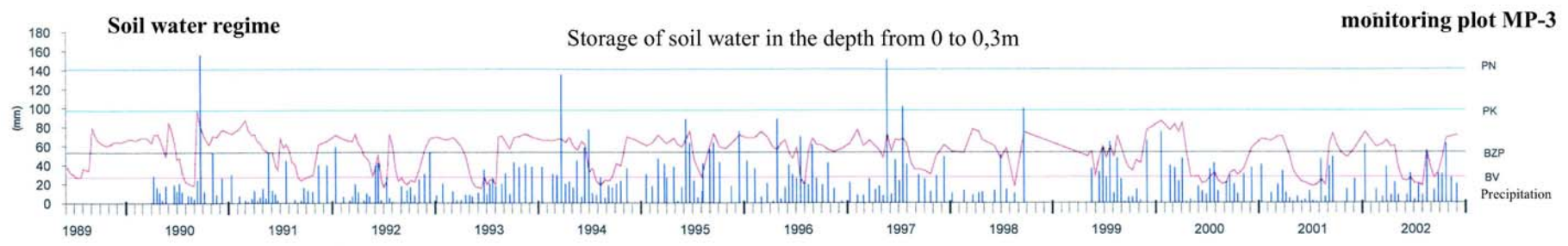
- Seasonal fluctuations of the ground water level
- The ground water level depth
- Contact of the ground water level with fine-grained surface sediments

Soils having water regime:

- without an influence of ground water
- with irregular influence of ground water
- with regular influence of ground water

Soils without an influence of ground water

- Ground water in gravely sediments
- In the vicinity of the Čunovo reservoir and upstream part of the bypass canal



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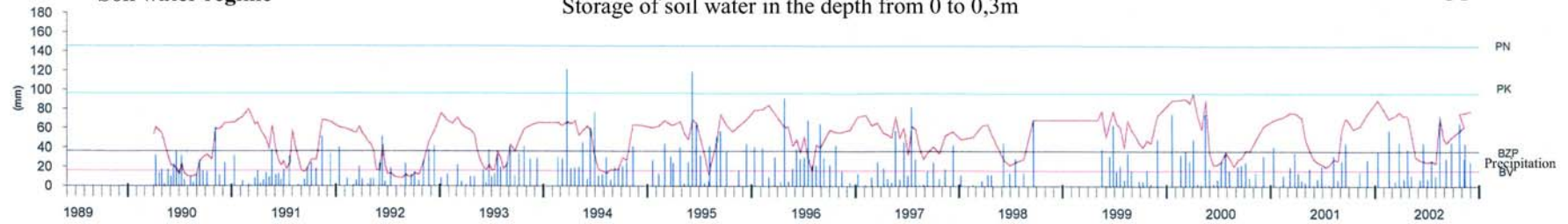
Soils with irregular influence of ground water

- Ground water at the boundary of gravely and fine-grained sediments
- The area of the Čunovo reservoir and upstream part of the bypass canal

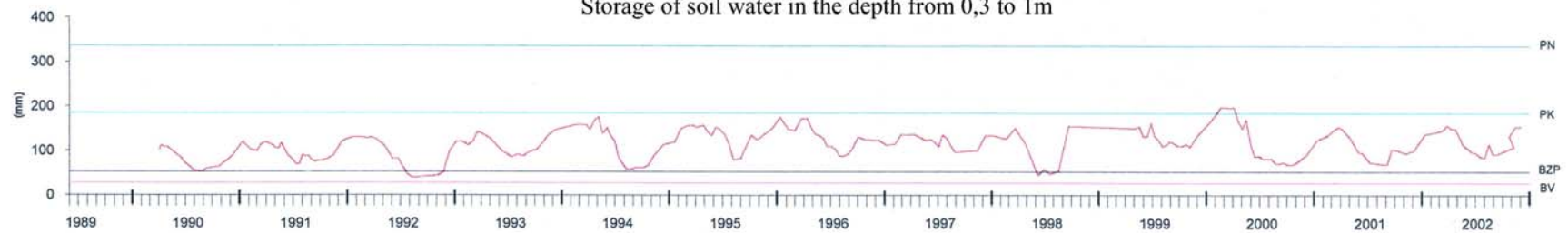
Soil water regime

Storage of soil water in the depth from 0 to 0,3m

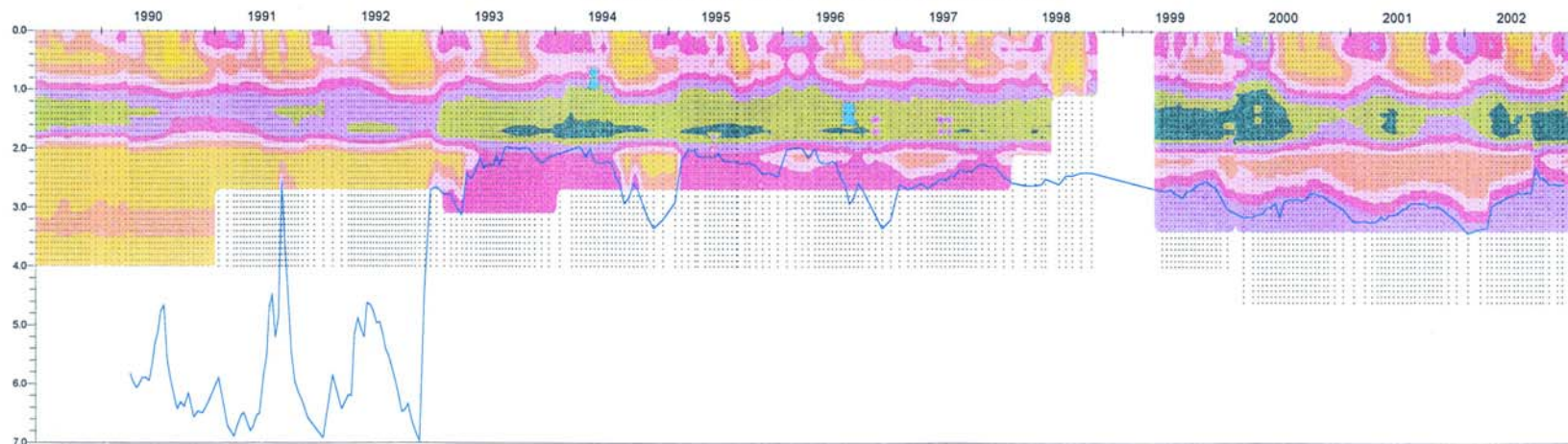
monitoring plot MP-1



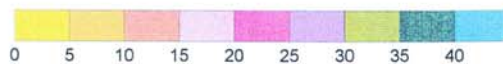
Storage of soil water in the depth from 0,3 to 1m



Soil water chronisopleths in volume percentage



Soil moisture in volume percentage



— Ground water level

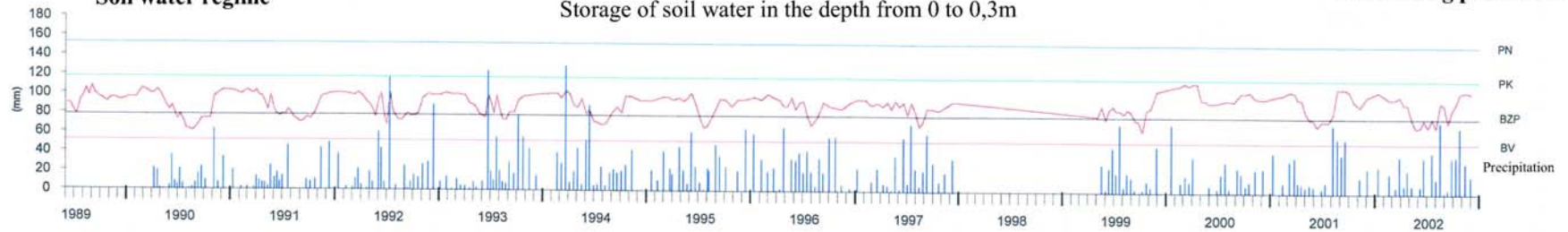
Soils with a permanent influence of ground water

- Ground water permanently present in fine-grained sediments

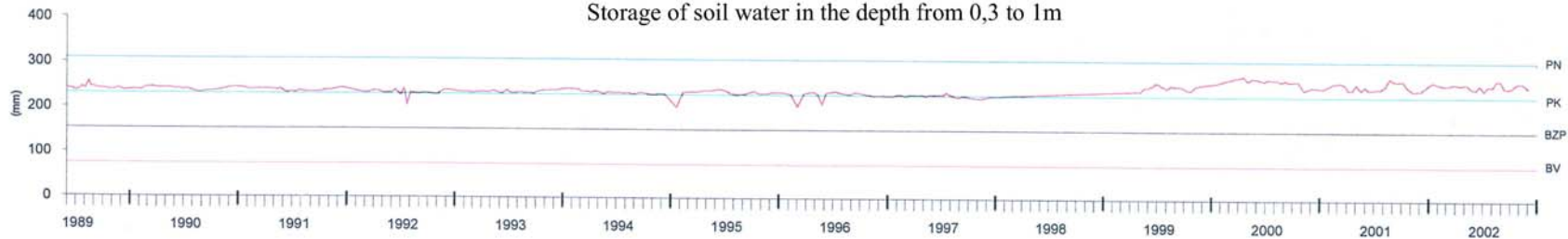
Soil water regime

Storage of soil water in the depth from 0 to 0,3m

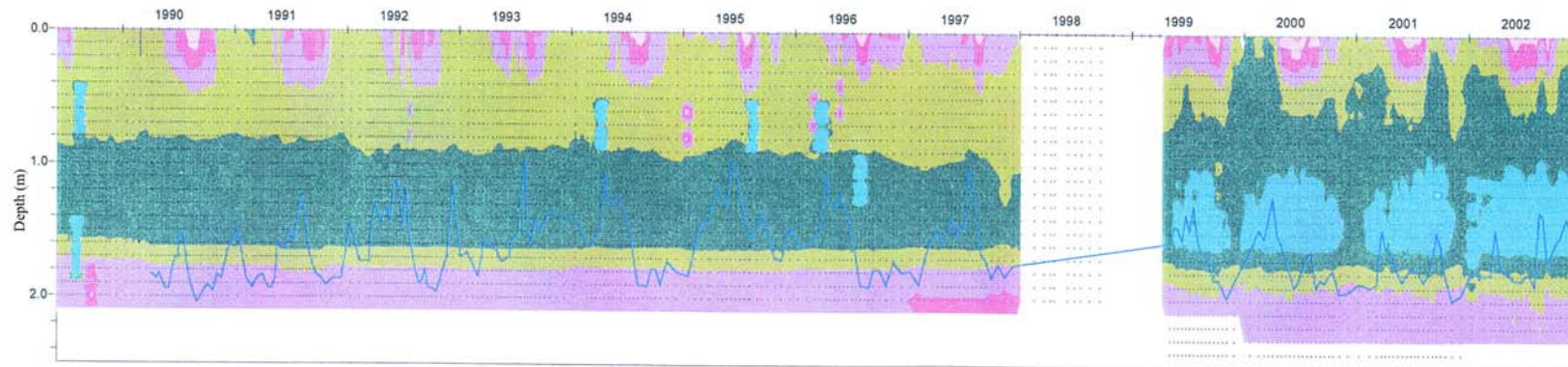
monitoring plot MP-9



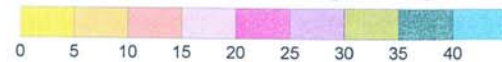
Storage of soil water in the depth from 0,3 to 1m



Soil water chronoisopleths in volume percentage



Soil moisture in volume percentage

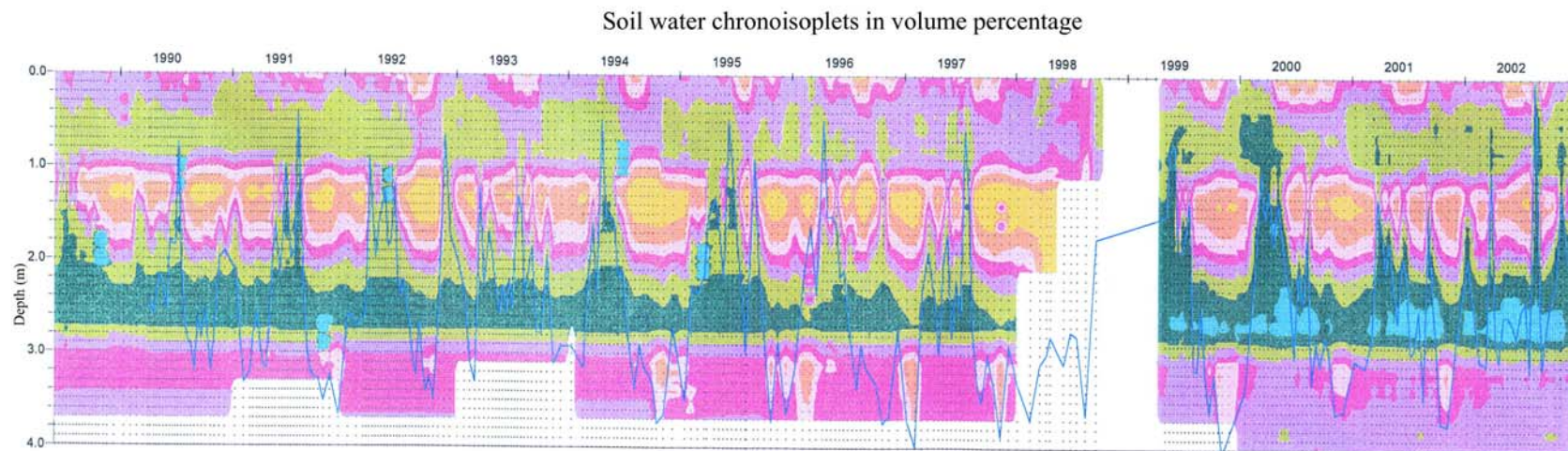
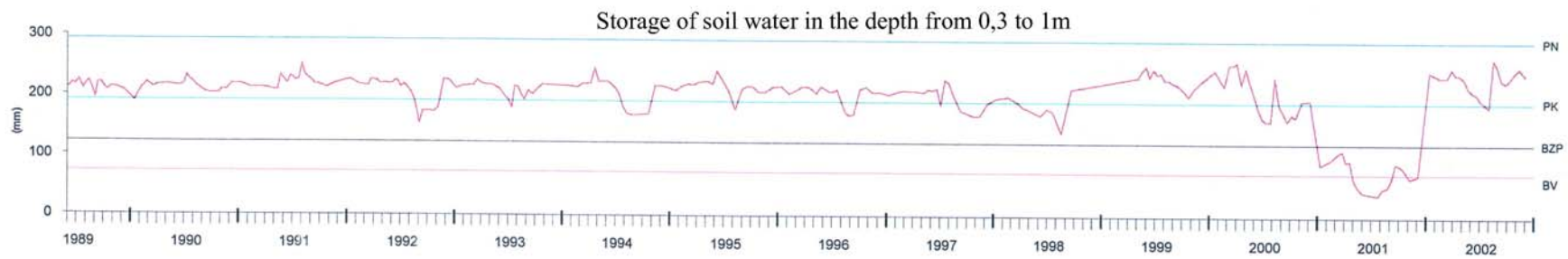
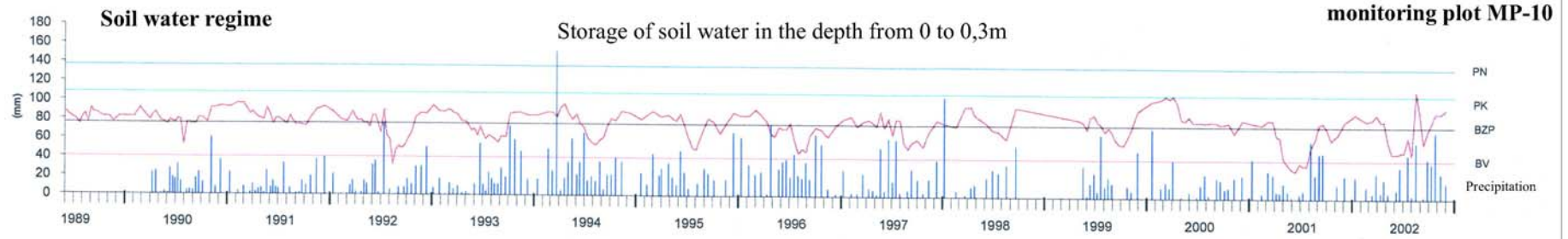


Ground water level

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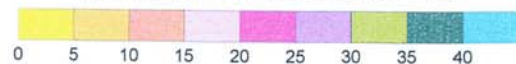
Soils in vicinity of tailrace canal

- Ground water level depends on the water level in the tailrace canal
- Frequent and extensive fluctuations of ground water level, changes of moisture, and of soil water regime



Soil moisture in volume percentage

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— Ground water level

Crop yields in relation to soil water regime

- Soils with irregular or occasional influence of ground water on the soil water regime – increasing the wheat yield by 13.6% and that of maize by 15.7% (1999-2005)
- Soils with permanent influence of ground water on the soil water regime – increasing the wheat yield by 22.5% and that of maize by 23.0% (1999-2005)

Development of salt soils

- Medium to strongly mineralized ground waters
- The evaporation regime of soils
- The coming warming of the climate
- The presence of salt soils in the area, already in the pre-dam conditions

Salinization

- Process of accumulating sodium salt
- In the middle and lower part of monitored area
- In surface horizons – slight or initial
- In deeper deeper profiles – medium degree of salinization

Alkalization

- Process of binding exchangeable sodium to soil
- Slight alkalization – substrate and near-surface horizons during the whole monitoring period

Chemical composition of soils and ground water

- The risk of spreading salt soils is only in the lower Žitný ostrov island:
 - The highest content of exchangeable sodium
 - The highest sodium adsorption ratio
 - The ground waters – highly mineralized

Summary

- Any negative effect of the Gabčíkovo hydraulic structures on arable soils
- Positive effect:
 - Increase of the soil horizon moisture and its water regime and increase of total supplies of soil water in the unsaturated zone in the Čunovo reservoir area
 - Stabilisation of moisture conditions and soil water regime in the vicinity of the bypass canal
 - Positive influence on the height and stability of crop yields, and lower their dependence on precipitation