

**Foreseen hydrological changes drive efforts to formulate  
water balance improvement measures as part of the  
management options of adaptation  
at Lake Balaton, Hungary**

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HS10.2: Lakes and climate change – impacts, vulnerability, risk  
assessment and adaptation strategies  
EGU General Assembly 10th April, 2013; Vienna, Austria/

# Background

## PROJECT:

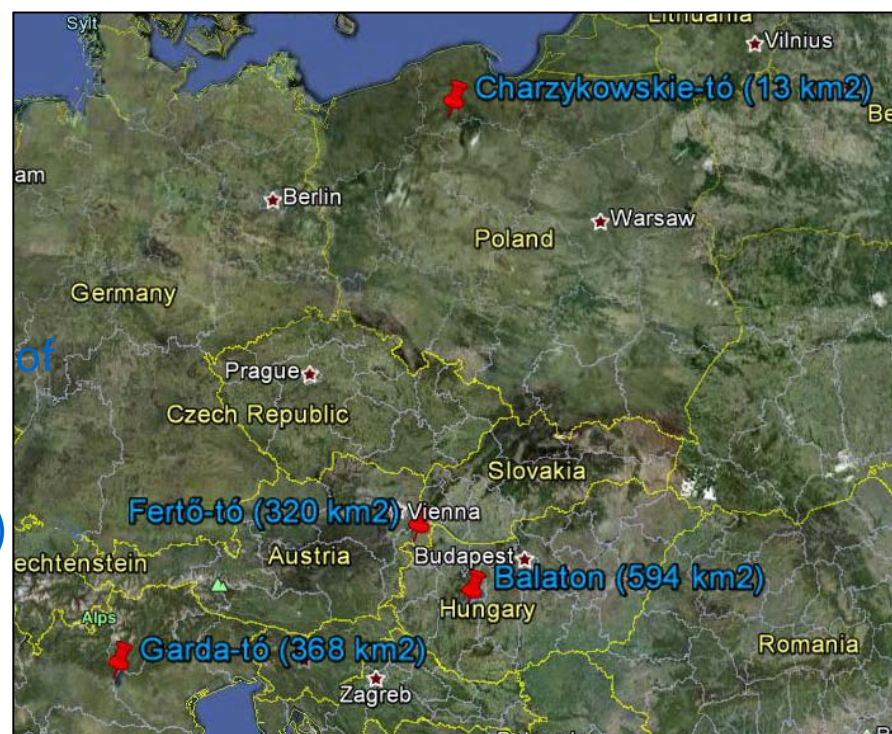
### European Lakes Under Environmental Stressors

*(Supporting lake governance to mitigate the impact of climate change)*

It is implemented through the EU  
CENTRAL EUROPE Program  
co-financed by ERDF

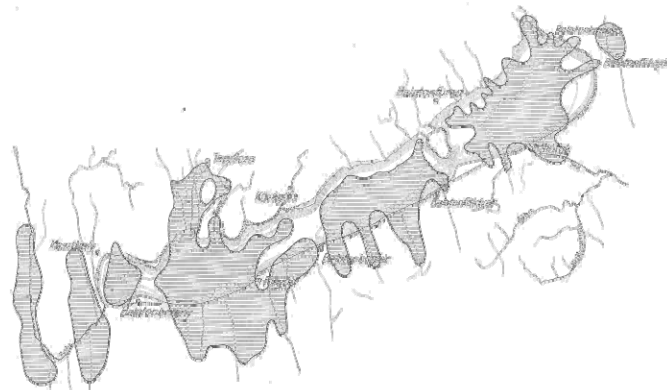
## PARTNERSHIP:

- Lake Garda Community (Italy)
- Environmental protection Agency of Trento (Italy)
- Edmund Mach Foundation (Italy)
- National Council of Research (Italy)
- Austrian Institute of Technology
- Austrian League of nature conservation Burgerland
- The Institute of Meteorology and Water Management (Poland)



Base map from Google

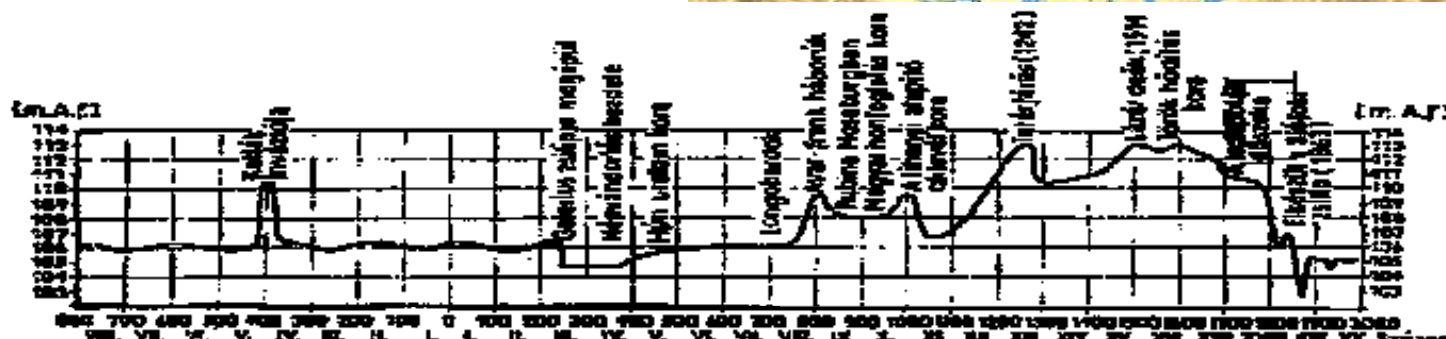
# Historical Development of the Lake Balaton



1876. évi. A Balaton medencéjének történelvi alakját és a környékét. Mérés: 1:500,000.



Sió-canal  
(1863)





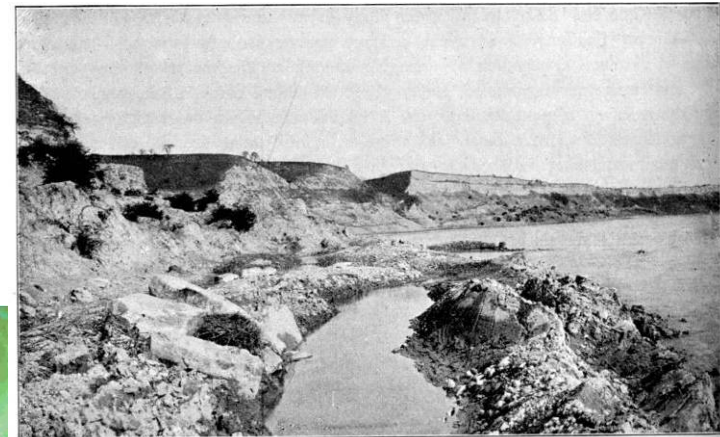
# Maximum Water Level lowered

Railway developments mid-1800's

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276. ábra. Az 1908 április 19-iki akaratyai partszakadás északról nézve.  
A kiemelkedett tőfenékkal és annak gátjától elzárt kis lagunával.



## Fact and Figures: Environment

one of the most significant natural assets of Hungary

- natural shallow lake
- size of the lake: 594 km<sup>2</sup>
- catchment area: 5775 km<sup>2</sup> (only 10x the lake)
- maximal depth: 10.2 m
- average depth: 3.2 m
- the lake's length: 77 km
- the lake's width: 12 km (at the widest point)
- the length of the shore: 235 km
- average summer temperature: 20 °C
- average ice-thickness: 20-25 cm



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# Facts and Figures: Economy

Balaton region generates 1/3 of tourism income of Hungary

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- Bathing in Lake Balaton started in **19th century**.
- The permanent population is about **275.000** people, considering the families of weekend house owners it rises above **500.000** people. In summer time with tourists and visitors, the number of population increases up to **1-2 million** people.

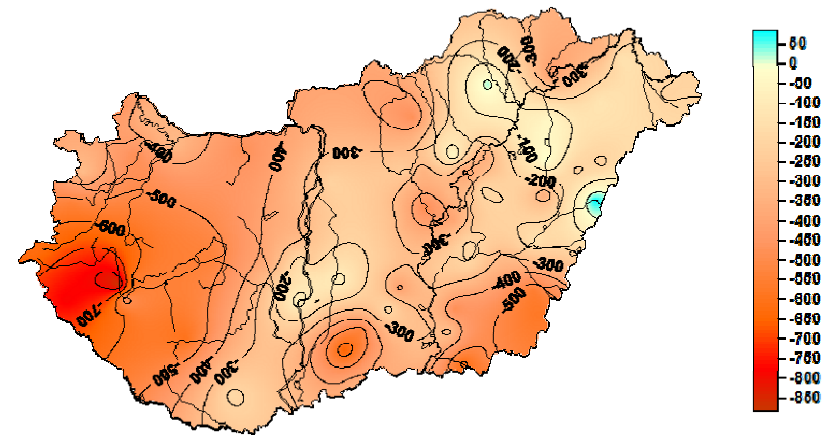
# Environmental trends I.

new and emerging issue 2000-2004: drop of water level

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Accumulated precipitation deficit between 2000-2003 [mm]



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# Lake Water Issues Arisen

## QUALITY

- Lake water quality is still much weather dependent
- Urban and rural runoff represent high P load
- Continuous WQ monitoring and telemetry should be developed

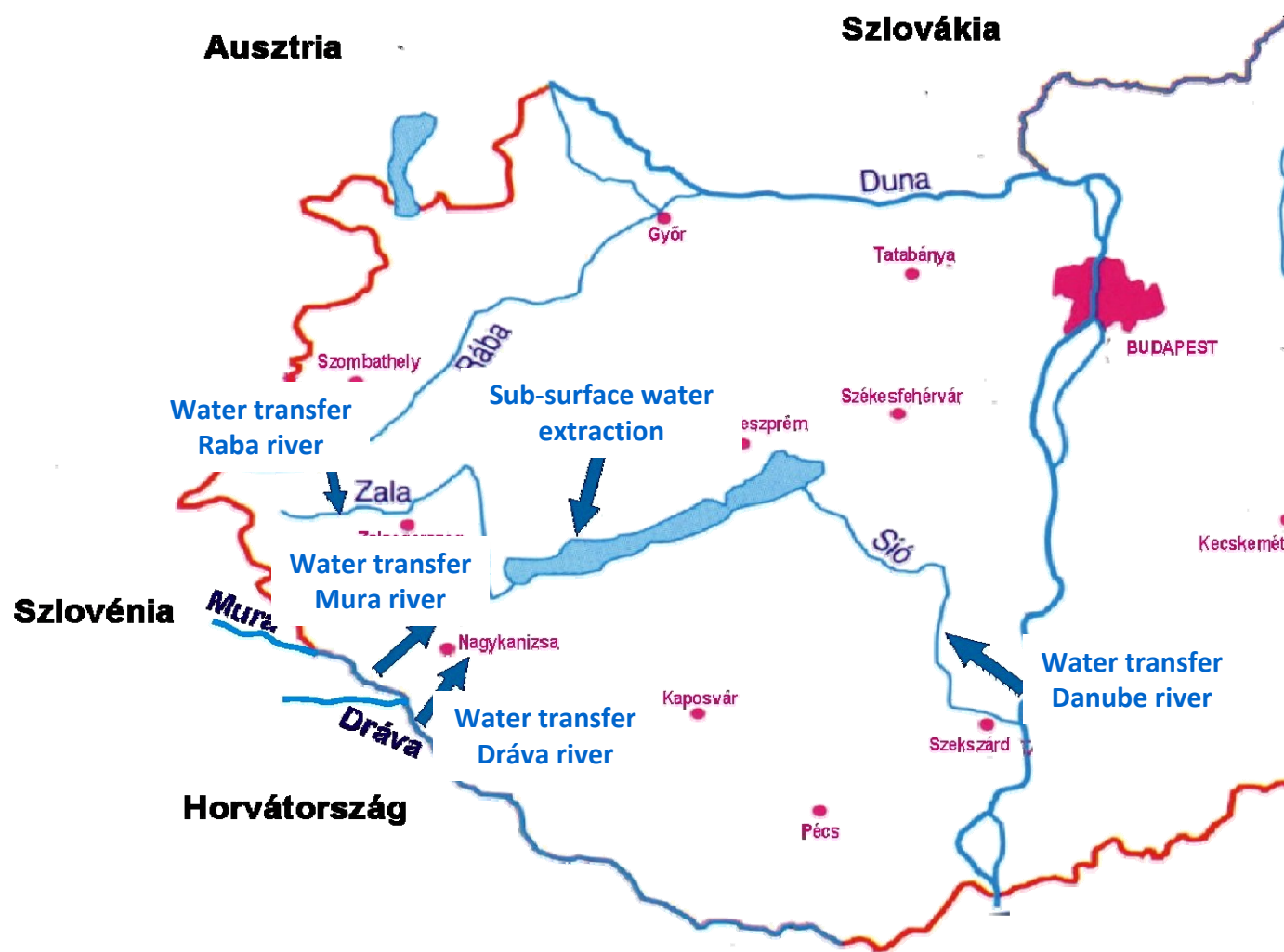
## QUANTITY

- bathing is affected (“swamp, mud” )
- commercial fishing
- boat services and sailing in the lake are difficult
- Sió channel cannot be used commercially
- excessive bottom productivity
- all P load accumulates in the lake and sediment
- salt concentration increases
- others (not yet known)



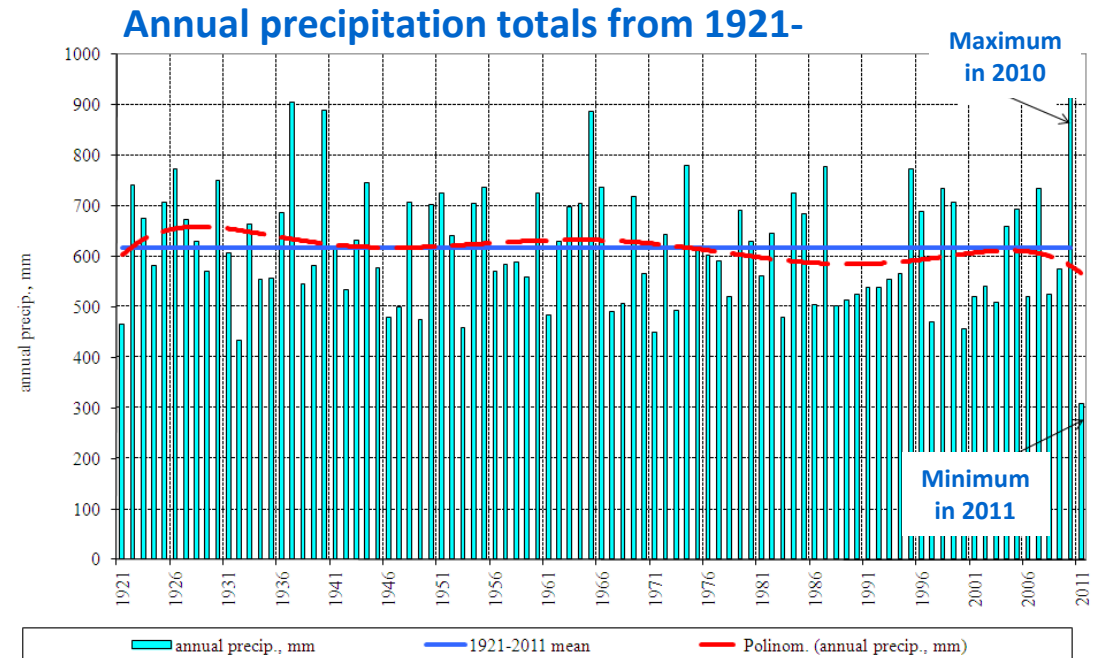
# Investigated water quantity improvement measures (2003)

- water transfer
- sub-surface water extraction (from old bauxite mines)



## Environmental trends II.

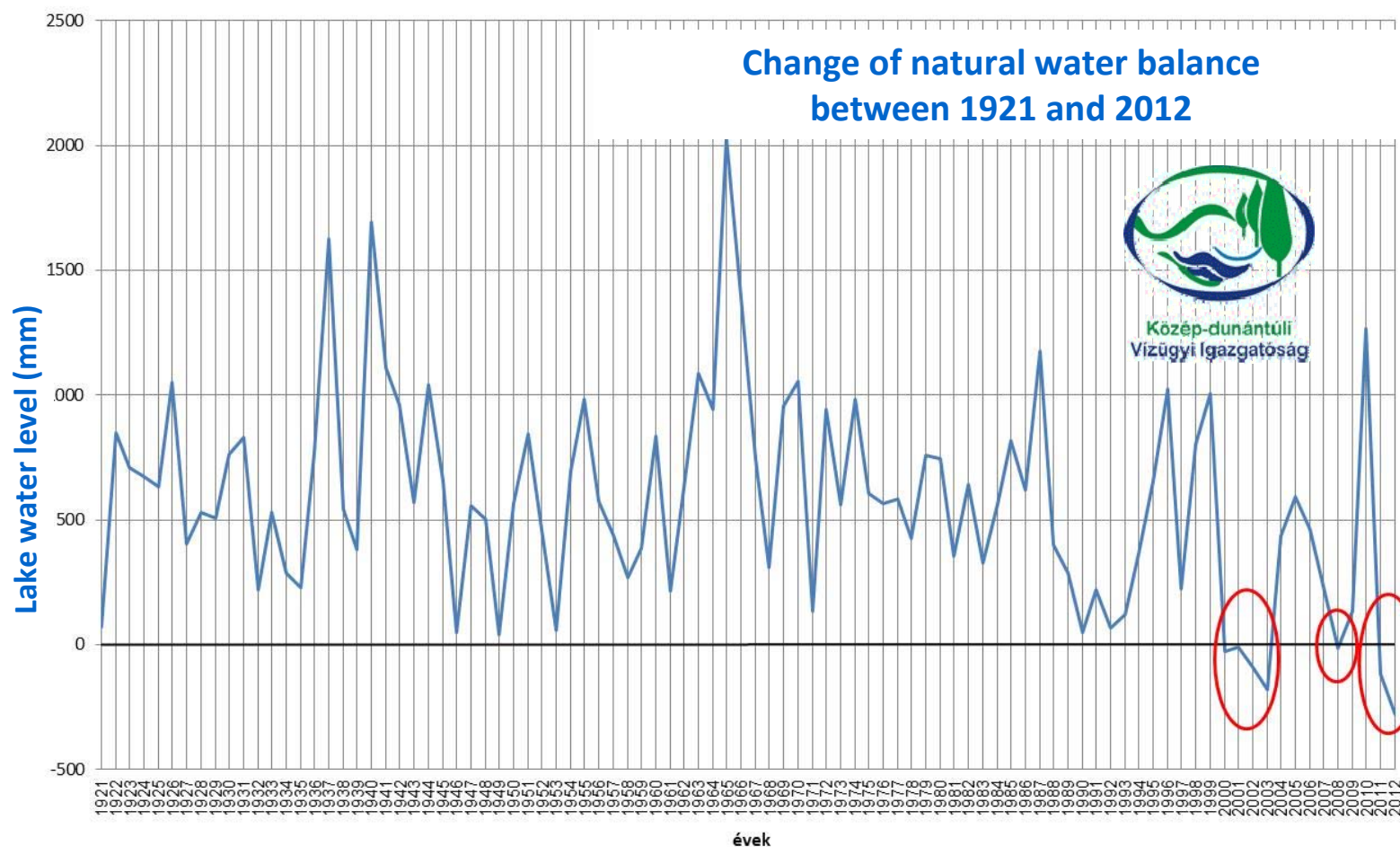
2010 extremely wet year, while 2011 and 2012 is extremely dry



Source: EULAKES

# Water budget of 2012 and before

deficit (negative balance) again



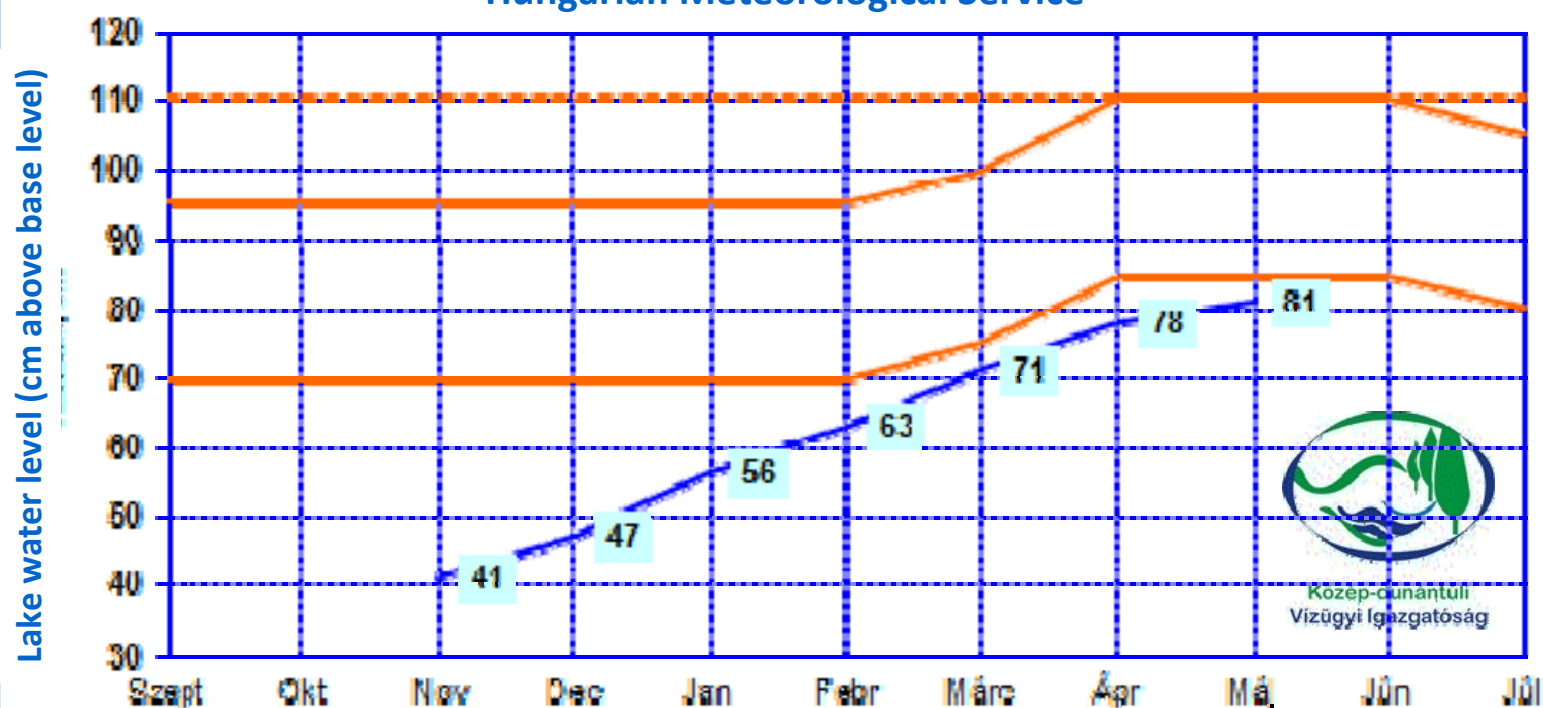
Source: Gabriella Kravinszkaja (Central-Transdanubian Water Management Directorate)



# Water Level Prediction for spring the spring of 2013

in November, 2012

The predicted lake water level based on  
the 6 months (Nov. 2012 – April 2013) weather forecast of the  
Hungarian Meteorological Service



Source: Gabriella Kravinszkaja (Central-Transdanubian Water Management Directorate)

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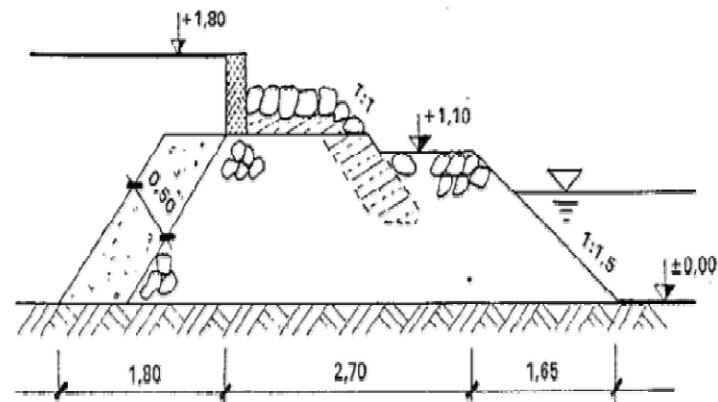
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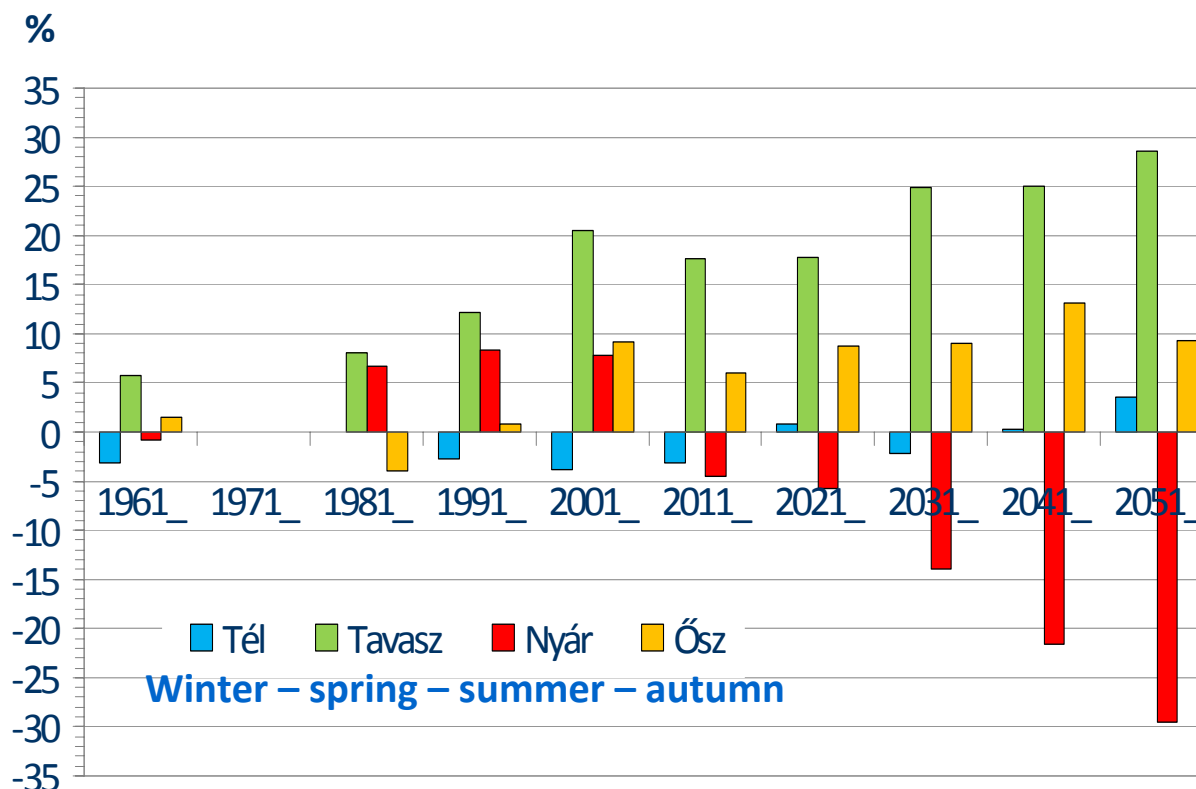
# Increase the In-lake water storage capacity

elevate embankments by 20 cm



# Precipitation change predictions by EULAKES

Average seasonal precipitation change in the catchment area of lake Balaton



Source: EULAKES

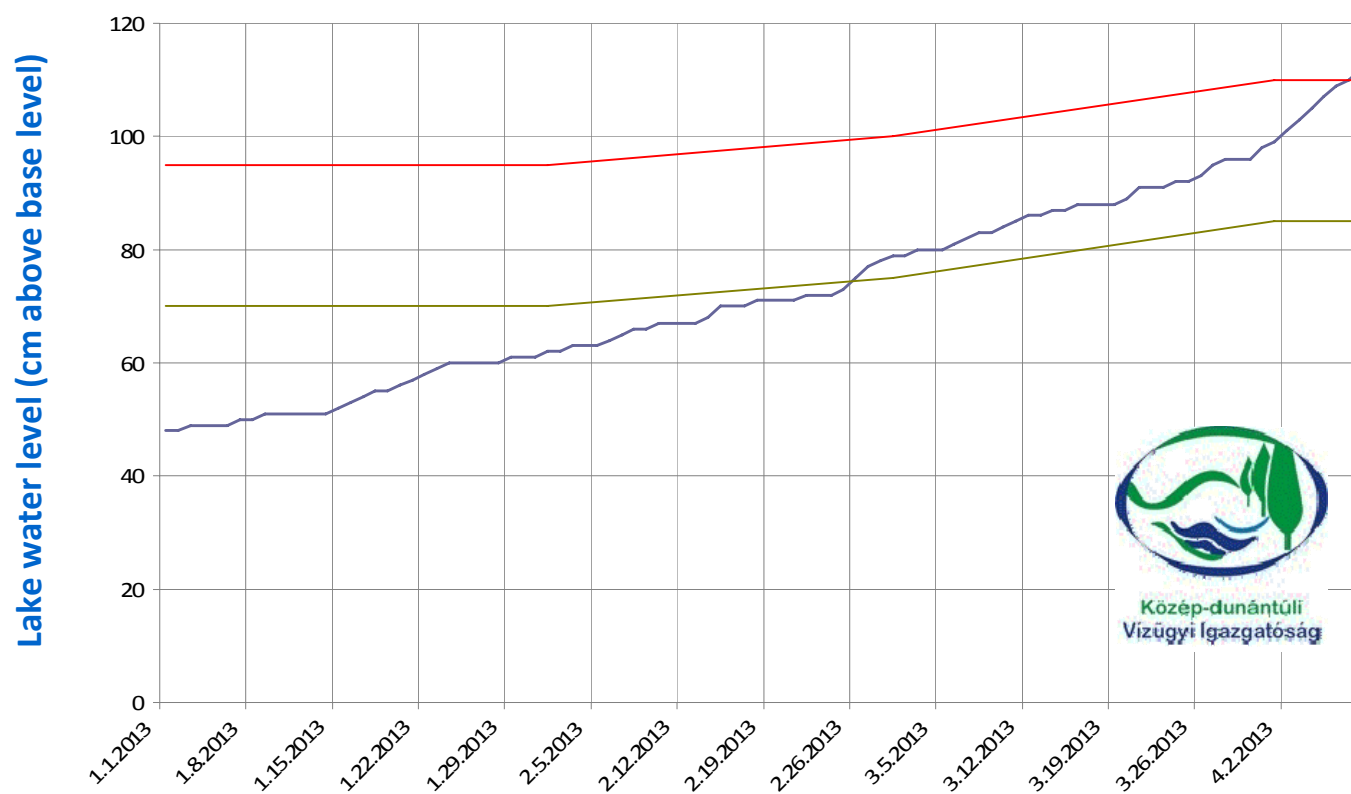
- The annual precipitation amount will not change much, however the seasonal distribution will change considerably.
- Nowadays, the snow amount is already less compared to the reference years, and after 2031 it is predicted to continue to decrease drastically.



# Observed water level

in 2013

Measured lake water level between 1 January and 8 April, 2013



Source: Gabriella Kravinszkaja (Central-Transdanubian Water Management Directorate)

## ... and consequent impacts

flooding and inundations by excess waters

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# Integrated measure – shore line rehabilitation

solution for more problems

- To restore/ keep good environmental quality
- To ensure free public access to the lake  
(min 30% of the shore area that belongs to the built up area of the settlement)

## MEANWHILE

- To ensure the increase of in-lake water storage capacity







**... if you have any questions,  
please contact us:**

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**or visit the project website: [www.eulakes.eu](http://www.eulakes.eu)**