

# Climate ≈ water

**Bridging the gap between adaptation  
strategies of climate change impacts  
and European water policies**



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**R & D National Institute of  
Marine Geology and Geocology  
– GeoEcoMar**

**Partner No. 5**

## **Progress Report 1**

5 April 2009

## Lake Techirghiol

**Lake Techirghiol** is situated in the Romanian seaside area of the Black Sea. The surface of the lake is 1300 ha and has approximately 66 million m<sup>3</sup> water, corresponding to a level of 1.45 m above the Black Sea level.

The lake is separated from the Black Sea by a narrow strip of dunes. The catchment area, the area from which water runs to the lake, is about 165 km<sup>2</sup>.

As a result of low annual rainfall and high evaporation the water of the lake has become hyper saline. In this hyper saline environment, a unique ecosystem in Europe has developed with the specific capacity of producing sludge from organic matter (saprogenic sludge). The lake possesses special chemical, physical and biological characteristics, its therapeutic properties being attributed mainly to this sludge and brine. The curative effects of Lake Techirghiol are similar to those of the Dead Sea. This is why the lake has become an internationally well-known balneary health resort, catering for an important source of income in the area. The results of this balneo-therapeutic treatment are well known in Romania and also in the northern and western countries of Europe.

A supplementary influx of fresh water into the lake, of both surfacewater and groundwater coming from the agricultural irrigation system and probably the Black Sea Danube channel, causes a rise in the water level, thus creating a decrease in the salinity of the water. The lake volume has therefore increased about 7.5 million m<sup>3</sup> the mineralization diminishing (1893-1999) from over 100 g dm<sup>-3</sup> to less than 60 g dm<sup>-3</sup>.



# Techirghiol Lake Hydrographic Basin



## Legend:

- |  |  |  |                               |
|--|--|--|-------------------------------|
|  | Hydrogeologic basin limit                        |  | Hydrometric stations          |
|  | Hydrographic basin limit                         |  | Drillings for studies         |
|  | Canals for water supply of the irrigation system |  | Drillings equipped with pumps |
|  | Drainage   |  | Pumping stations              |
|  | Evacuation pipes                                 |  | Reservoirs                    |
|  |  |  | Dams                          |

Hydrographic basin of the Techirghiol Lake

## Endangered aquatic ecosystems: Ramsar sites: bogs, fens, mires, valleys

**Techirghiol Lake** can be considered as a unique ecosystem: isolated from the Black Sea, in dry climatic conditions, with a limited influx of freshwater, its water level decreased below the Black Sea level parallel with the concentration of salinity; in this extreme environment selected few macroorganisms besides the numerous microorganisms (Bacteria, Cyanobacteria, Fungi, Flagellata, Rhizopoda and other Protozoa), having abundant population contributing to sapropelic mud formation (Tuculescu, 1965).

The therapeutic proprieties of the lake have been well known for a long time and due to the particular balneo-therapeutic qualities of the water, the lake represents a national wealth.

**After 1970, when a large irrigation system started to be developed in the South-West Dobrudja, important hydrological changes have been recorded in the Techirghiol Lake, causing other ecological changes.**

**Ecological disturbances of Techirghiol Lake triggered by increasing fresh water influx are very similar to a chain reaction.**

Three major changes have resulted from the abnormal influx of fresh water into the basin:

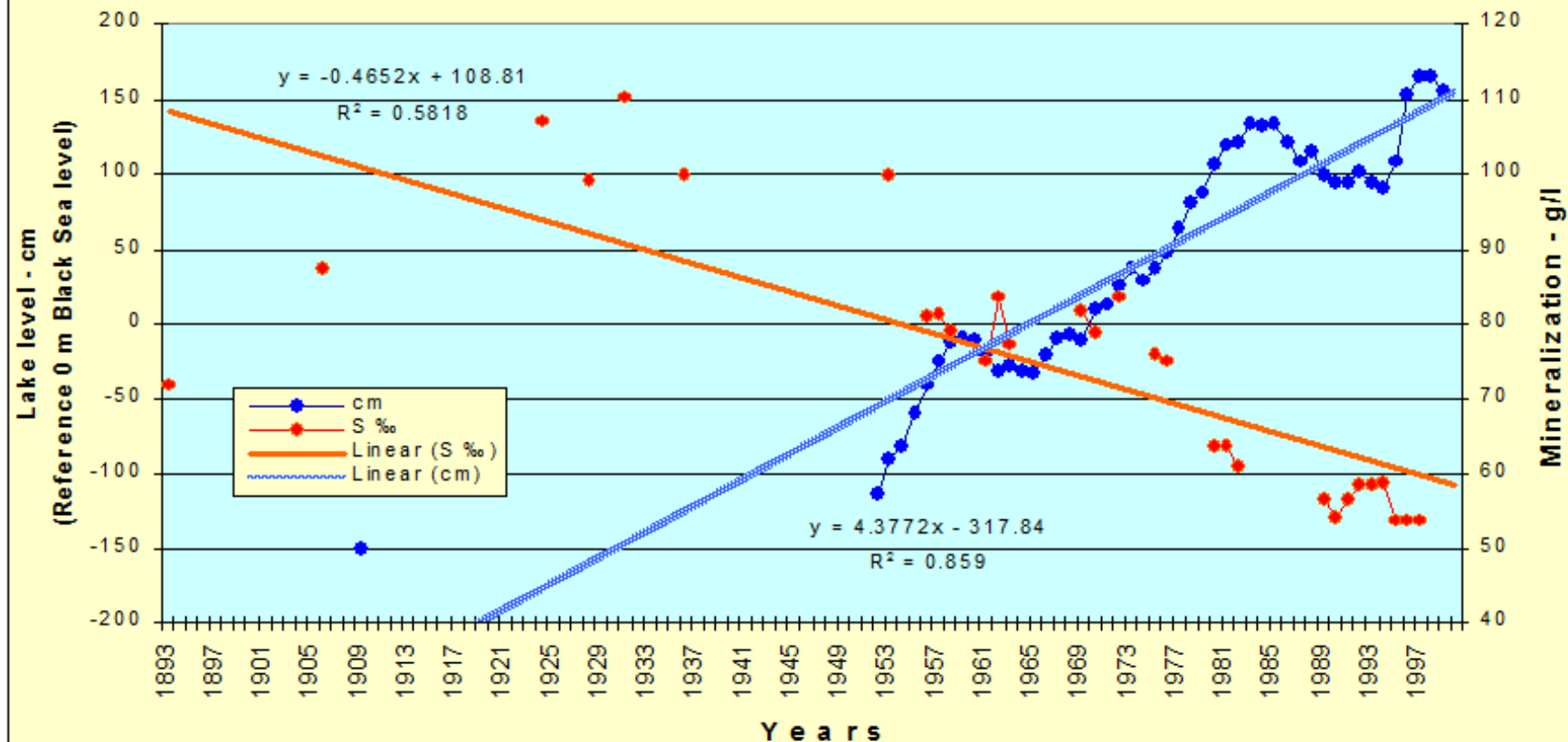
**Changes in the water quality** are consequences of the increasing of freshwater discharge originating in irrigation system, being loaded with some chemical fertilizers and other substances used in agriculture. Other contaminants or domestic wastes from farms can be washed and transported to the lake, thus changing the chemistry of the water.

**Changes in the therapeutical mud regeneration and quality.**

All these changes, which need more understanding through research, have greatly affected the process of mud formation.

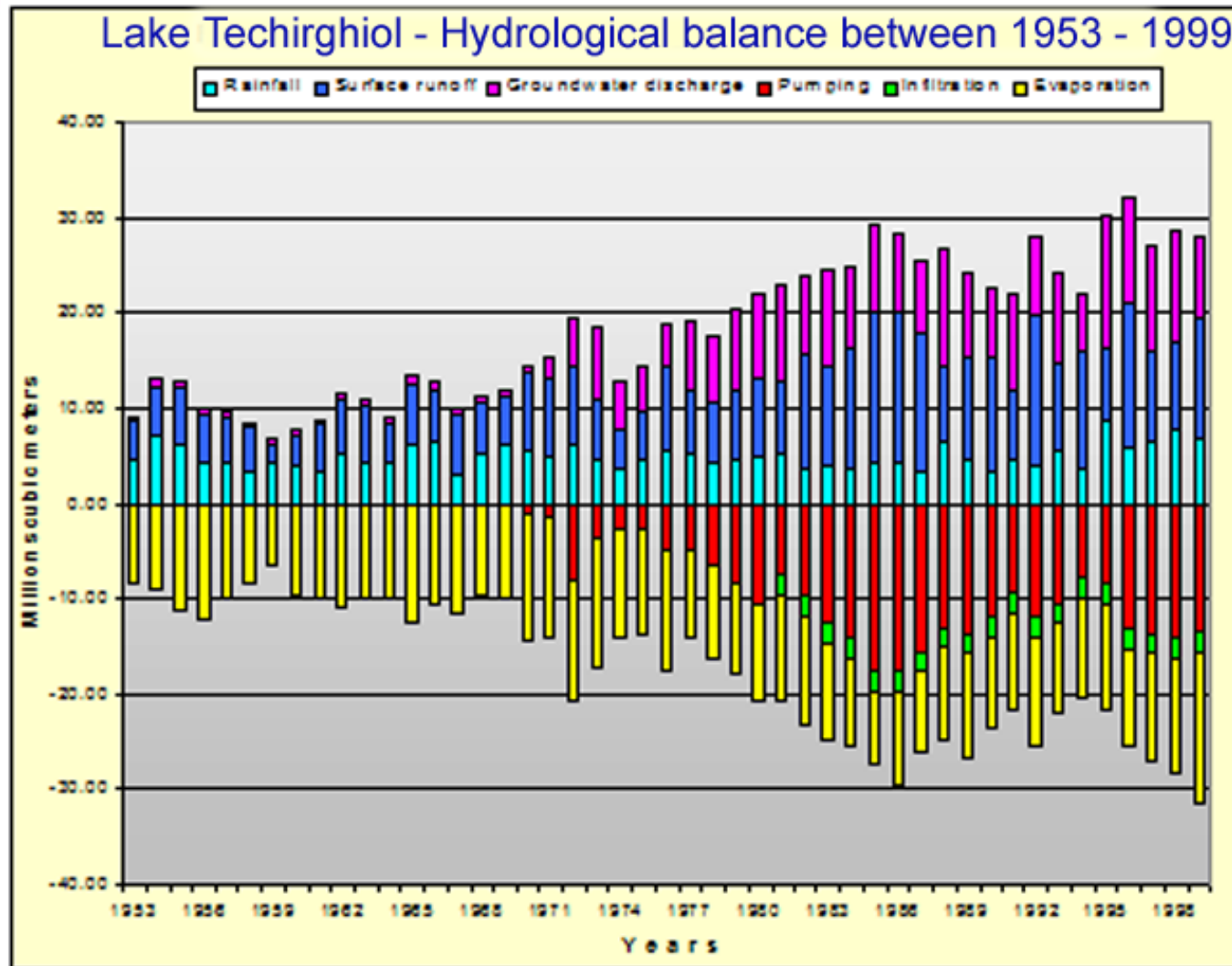
## Lake Techirghiol

multiannual variations of the level and mineralization





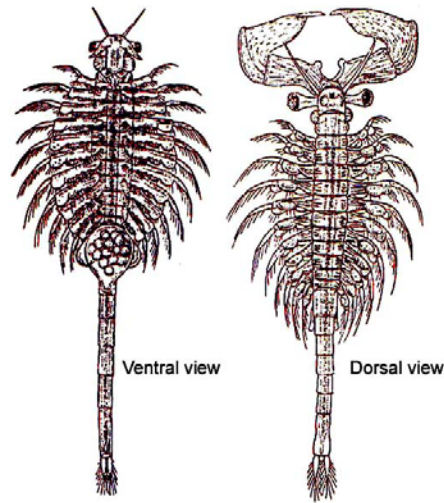
# Lake Techirghiol – Hydrological balance: Rainfall, Surface runoff, Groundwater discharge, Pumping, Infiltration, Evaporation



**Occurred as a succession in which each link can be both a consequence and a cause:**

- decreasing salinity;
- replacement of hyper-saline associations by oligo-haline ones;
- chemical contamination;
- eutrophication;
- occurrence of red tides;
- reduction of the size of benthic populations;
- reduction of water transparency during the microalgae blooming;
- increasing water turbidity;
- diminishing light penetration at the bottoms where *Cladophora vagabunda* lives; that means the limitation of photosynthetic light;
- increasing the frequency and amplitude of population fluctuations;
- impoverishment of benthic life in the lake.

# Lake Techirghiol - organisms forming sapropelic mud

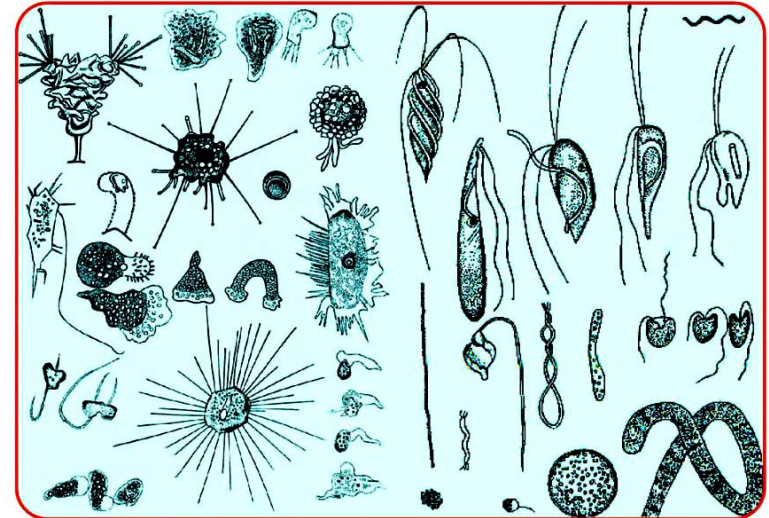


Crustacean - *Artemia salina*

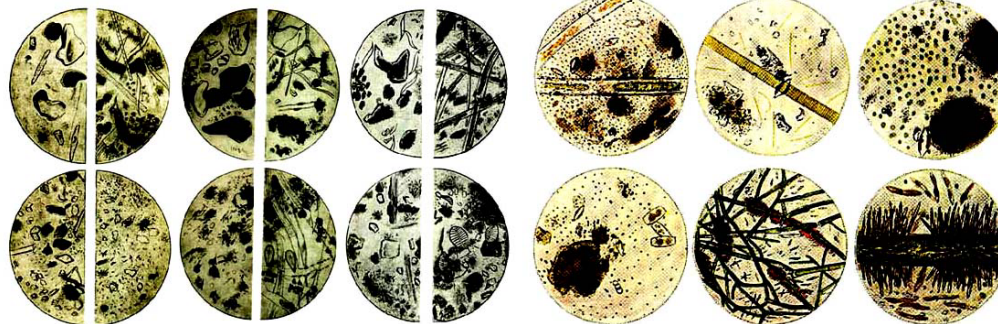


Green algae - *Cladophora*

**Macroorganisms - basic source for sapropelic mud**



**Microorganisms: Bacteria, Cyanobacteria, Flagellata, Rhizopoda and other Protozoa**



Sapropelic mud

*Cladophora* decay with bacteria and microphytic algae

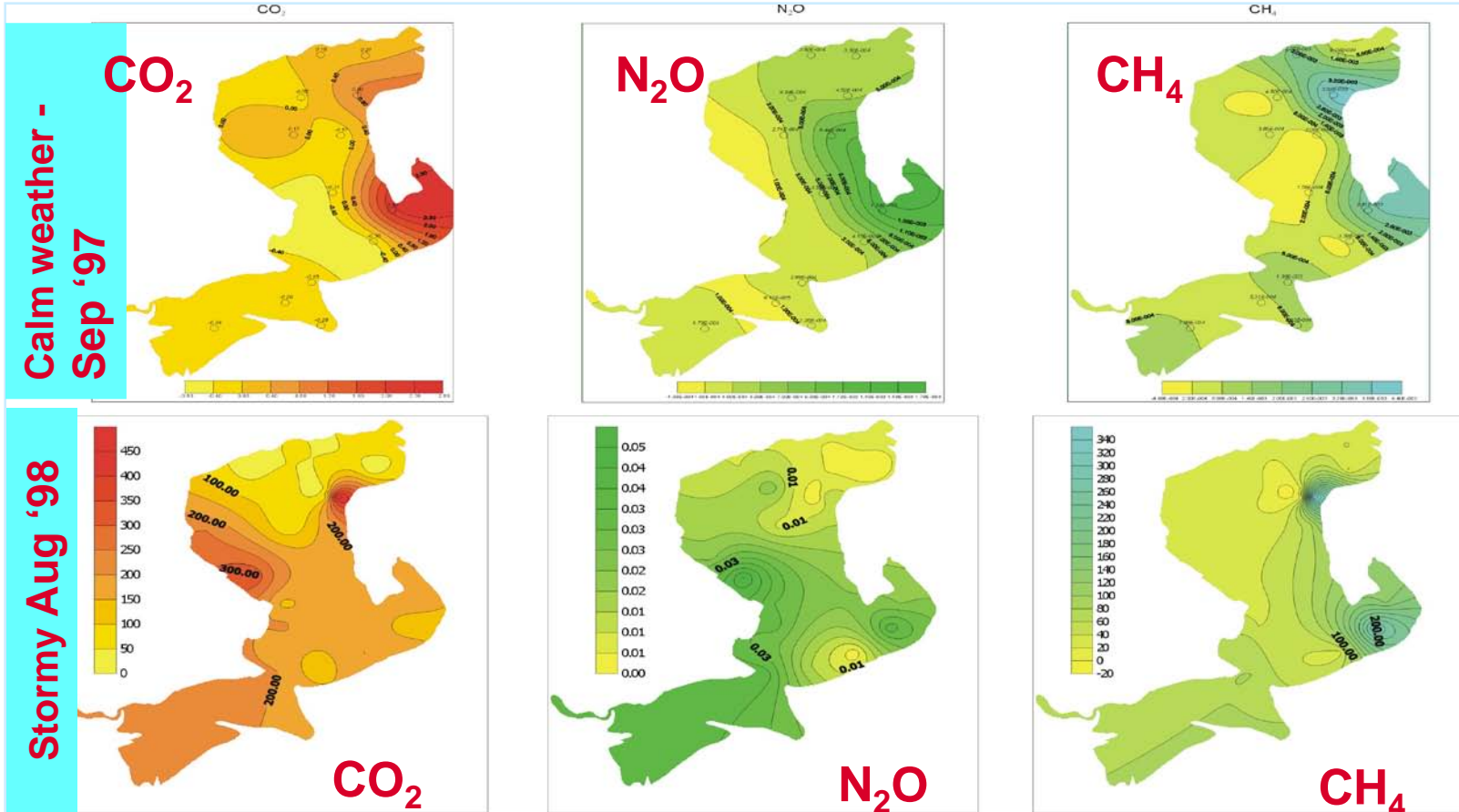
**Microscopical aspects**

**Lake Techirghiol organisms forming sapropelic mud**

## More two examples from Romania

- **Gas fluxes in Lake Razim**
- **Consequences of the Danube River damming at the Iron Gates stretches – decreasing of the solid discharge**

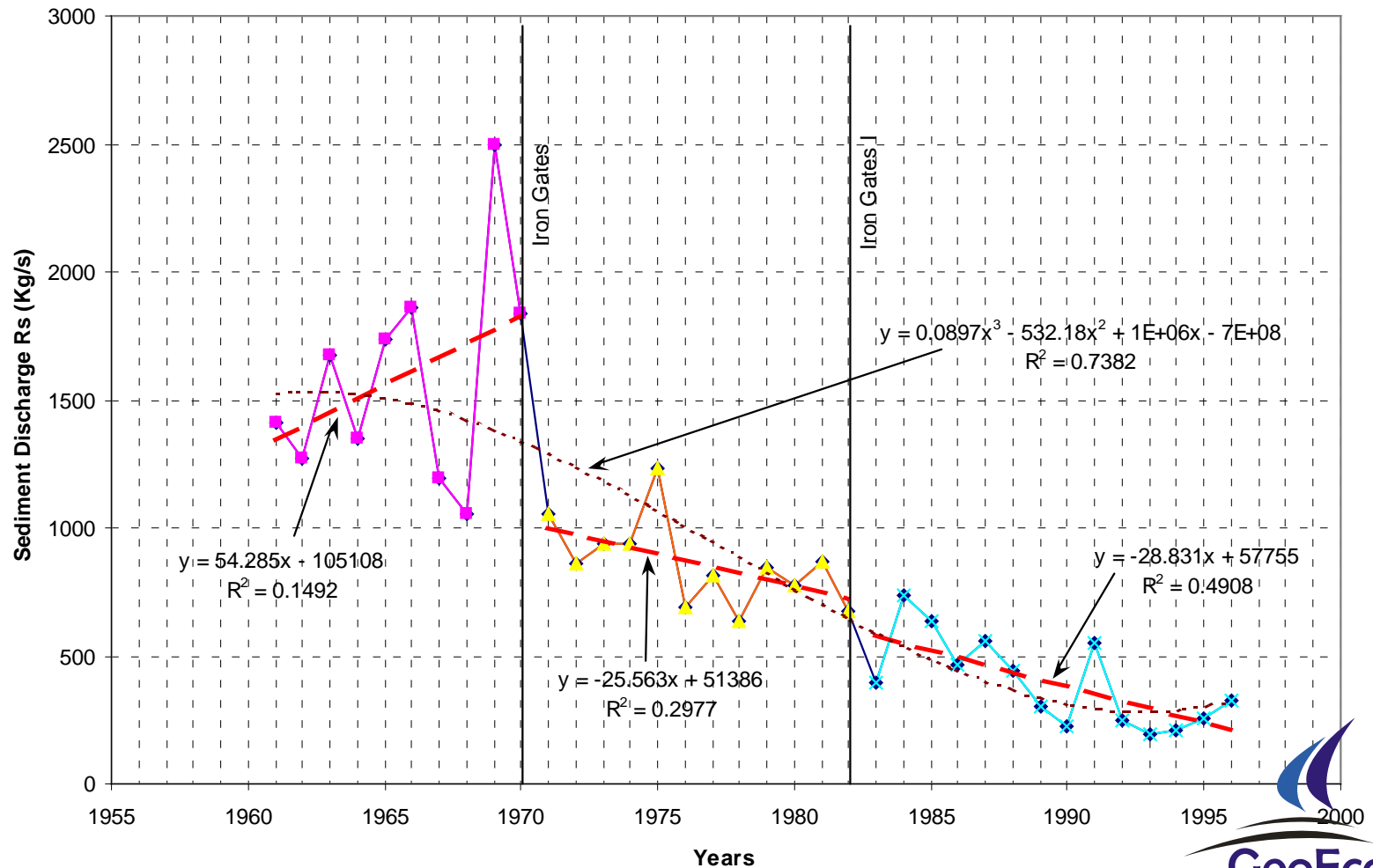
# Gas fluxes in Lake Razim ( $\text{nmol/m}^2\text{s}^{-1}$ ) (S.Radana. In litt.)





# Consequences of the Danube River damming at the Iron Gates stretches – decreasing of the solid discharge

Danube Sediment Discharge at Vadu Oii hydrographic station - Km.247 (1961-1996)





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