

Sulina branch - Suspended sediment transport and monitoring improvement

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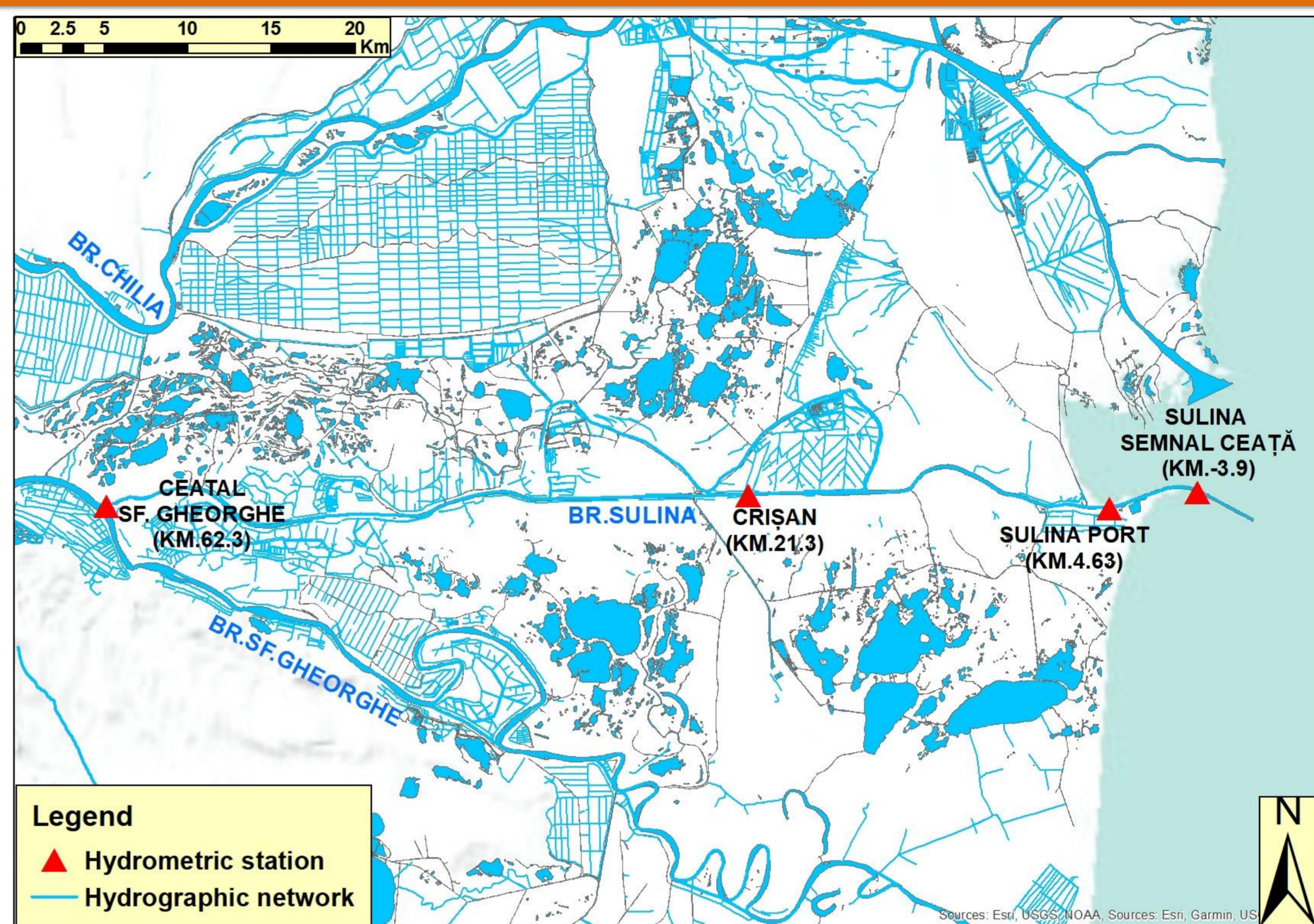
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Abstract:

The aim of the study, accomplished in the framework of Dalia project (Danube Region Water Lighthouse Actions) is to improve the monitoring of sediment supply in the Black Sea through the Sulina branch, as well as the knowledge of the sediment transport by the Danube River in the Danube Delta. This branch is hydrologically monitored by four main hydrometric stations (h.s.) located at Ceatal Sfântu Gheorghe (Mm 33.6), Crisân (Mm 11.5), Sulina Port (Mm 2.5) and Sulina Semnal Ceață (Hm72+18m). The study highlighted the decreasing process of suspended sediment transport to the Black Sea, as well as the predominance of sediment deposition processes in recent years, due to decrease of the liquid flows. Also, the analysis of suspended sediment transport revealed that the highest sediment deposits were recorded in the first 41 km and the lowest sediment deposits in the last 11 km. It was found that the solid input is consistently deposited annually on the Sulina branch, along its entire length. The sediment deposition phenomenon at the mouth of the Sulina branch can cause serious navigation issues in the area. As a part of the DALIA project, an automated station was installed at the Sulina Semnal Ceață, allowing continuous monitoring of suspended sediment concentrations and a better estimation of the sediment input to the Black Sea. This station is equipped with five sensors: radar-type sensor for water level, sensors for air temperature, water temperature, turbidity and salinity. Also, field campaigns are accomplished to improve the knowledge of the sediment budget along the branch.



The Sulina branch was extended with a 10 km long breakwater, helping to remove the sediments brought by the circular current of the sea, in order to maintain navigation on the branch. Regular dredging of the channel is carried out.



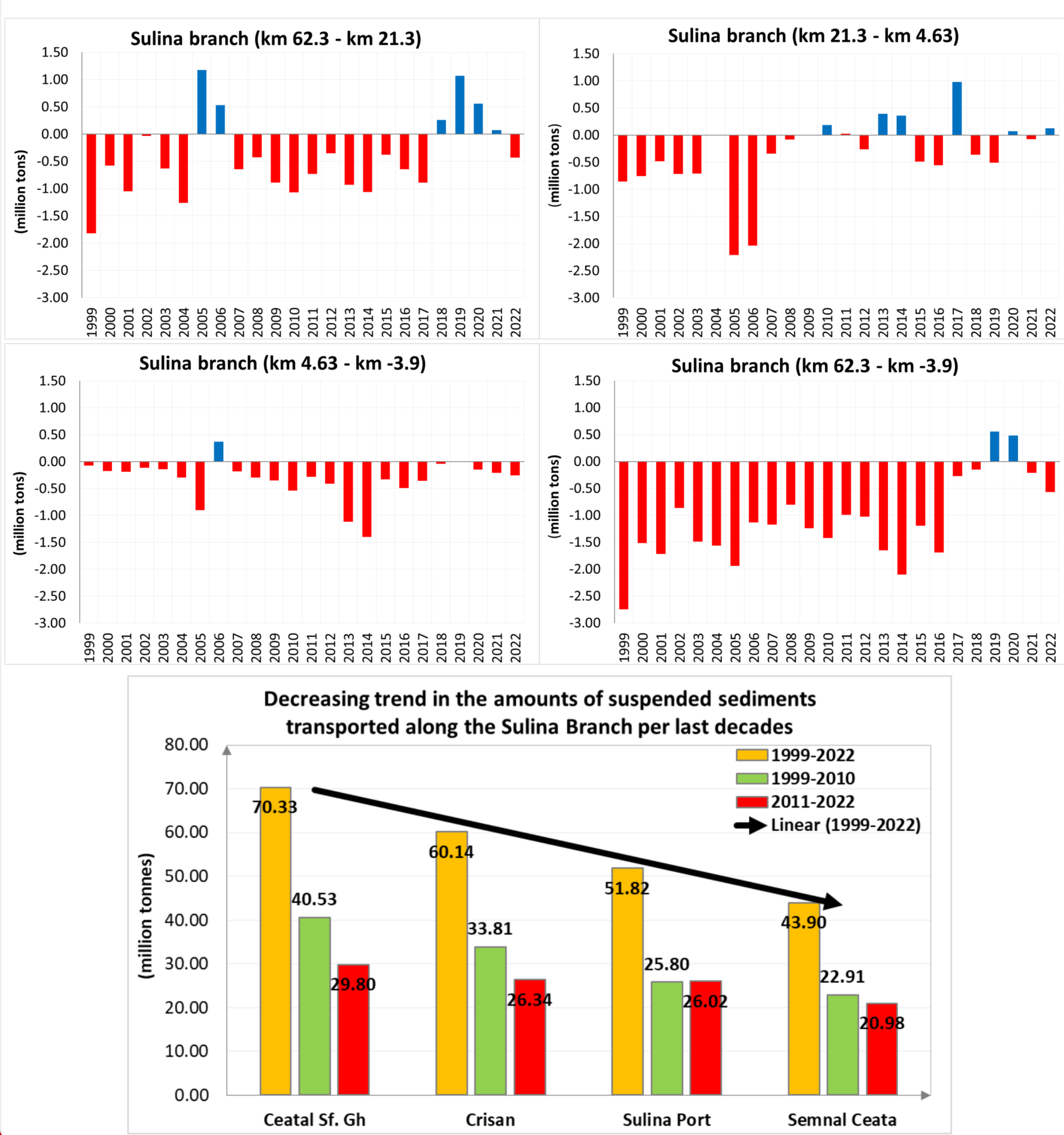
Data: Series of liquid and suspended sediments discharges at four hydrometric stations on the Sulina branch

Results

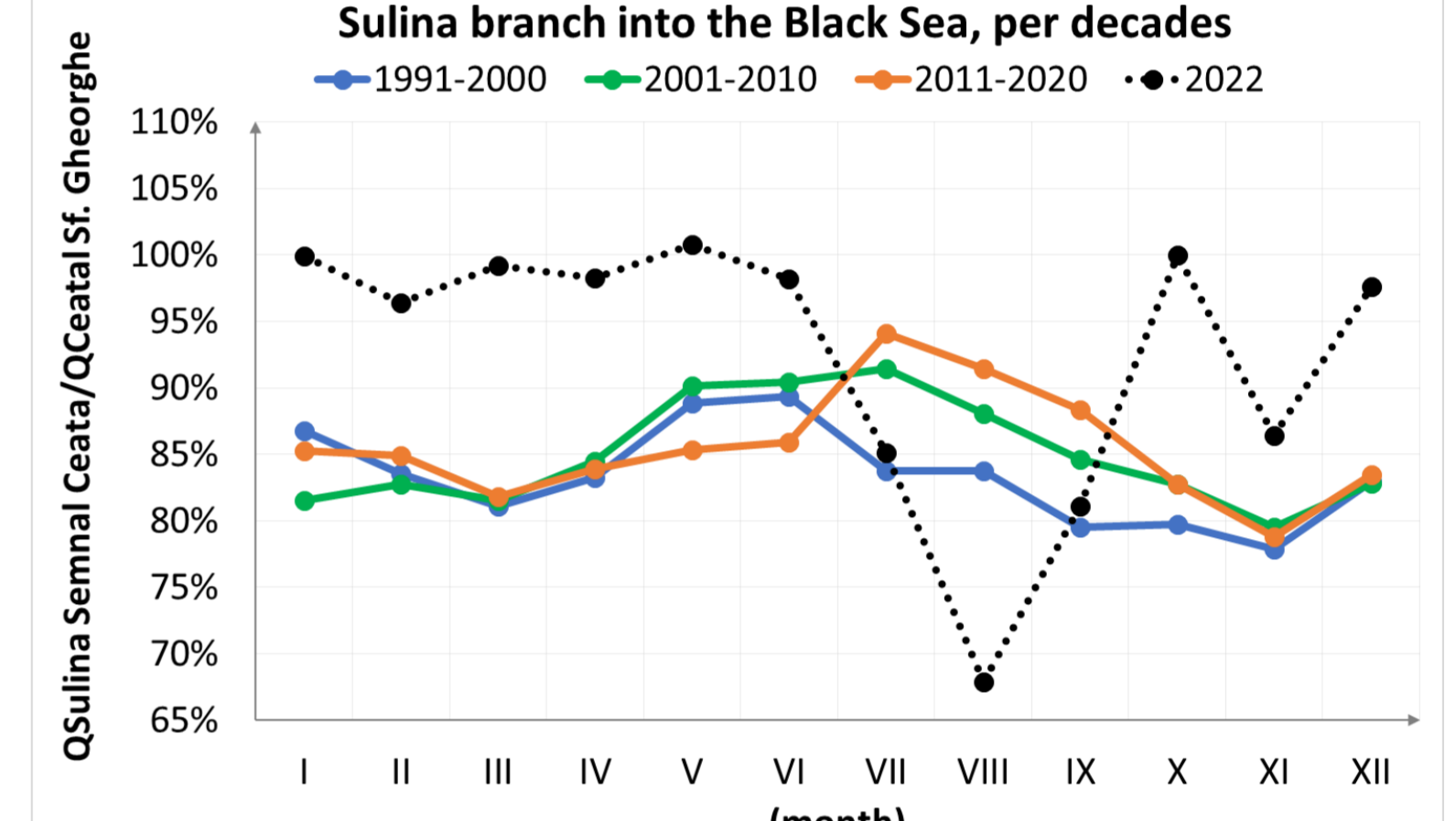
Trend in the annual evolution of mean, maximum and minimum liquid and suspended sediment discharges at h.s. Sulina Semnal Ceaata (2000 – 2022)



Annual amounts of sediments (1999 - 2022) between the hydrometric stations (deposition - red color; erosion - blue color)



Average monthly liquid flow contribution (%) of the Sulina branch into the Black Sea, per decades

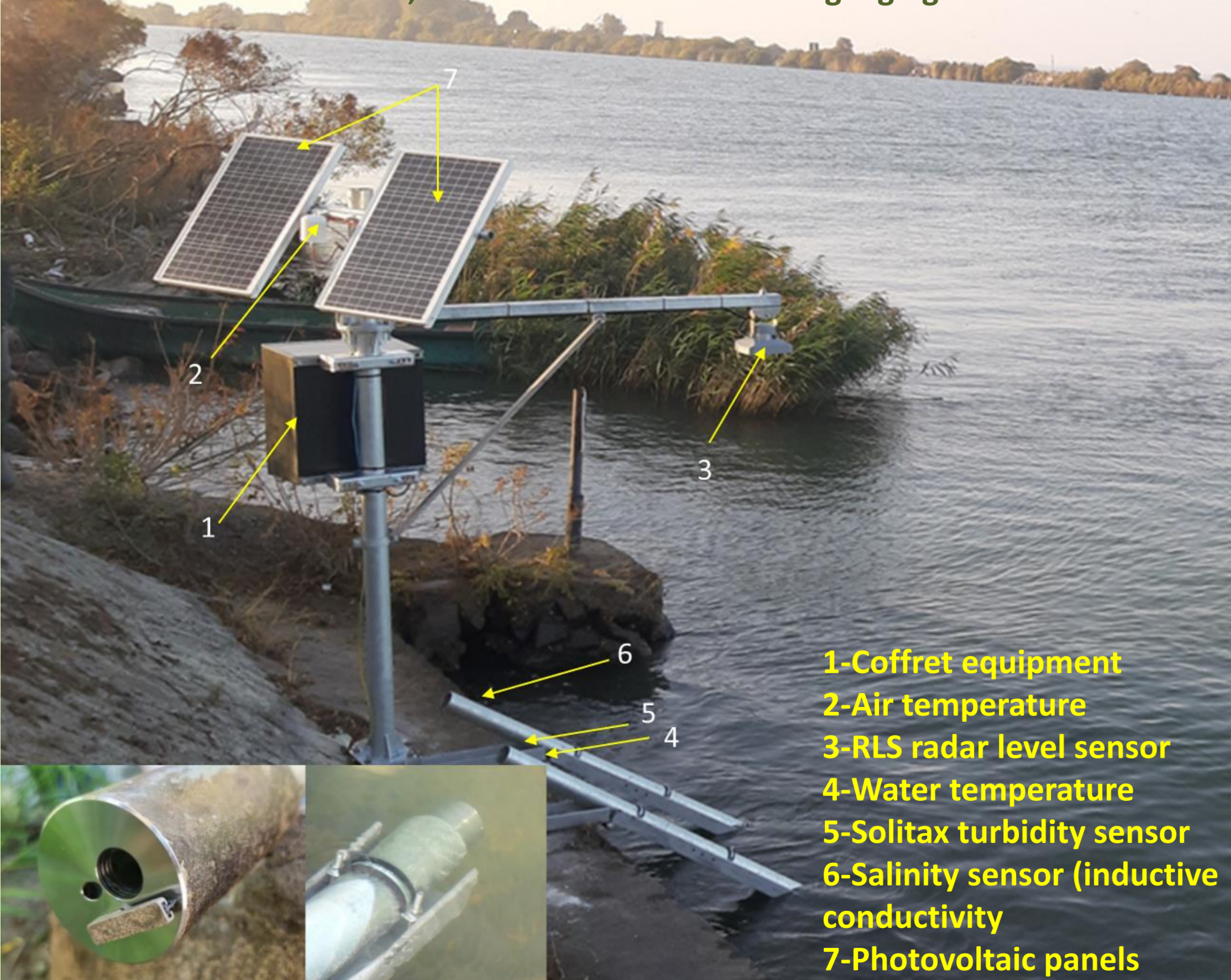


Conclusions

- ❖ For the last two decades (2000 – 2022), the water flow evolution at h.s. Sulina Semnal Ceaata, shows a decreasing trend in all three phases of the runoff regime.
- ❖ The year 2022, in comparison with the last three decades, shows that the average monthly liquid flow contribution (%) of the Sulina branch into the Black Sea has a very high decreasing evolution starting from July, having the smallest value in August.
- ❖ Under conditions of not very high flow variability given the small differences in the evolution of the maximum values, an increasing trend is revealed in the case of solid transport, the values ranging from 113 kg/s (in the years 2003, 2011 and 2022) to 976 kg/s (in 2005) and, especially, of the minimum values ranging from 0.27 kg/s (in 2001) to 8.88 kg/s (in 2021).
- ❖ The largest alluvial deposits are found between km 21.3 (h.s. Crisân) and km 4.63 (h.s. Sulina Port), while the most numerous deposits are found in the first 41 km, between h.s. Ceatal Sf. Gheorghe and h.s. Crisân.
- ❖ The spatial analysis of the total amounts of sediments along the Sulina branch, over the last 24 years (1999 - 2022), revealed a progressive decrease of the sediment volumes transited from the entrance to the exit of the branch, in the Black Sea, i.e. a decrease of 37.6%, while the total water volumes decrease only with 14%.
- ❖ Also, the lowest amounts of suspended sediment were observed in the last period (2011 – 2022), that its ranging from 29.80 to 20.98 million tons from entrance to the exit of the branch.
- ❖ Installation of the automated station equipped with five sensors for continuous monitoring of the temporal variability of water level, water and air temperature, salinity, suspended sediment concentrations, as well as solar panel for energy and GPRS transmission, could lead to improved monitoring of suspended sediment transport through the Sulina branch.

Monitoring improvement

The automatic station is located about 4 km from the mouth of the Danube River, at the Sulina Semnal Ceaata gauging station.



- 1-Coffret equipment
- 2-Air temperature
- 3-RLS radar level sensor
- 4-Water temperature
- 5-Solitax turbidity sensor
- 6-Salinity sensor (inductive conductivity)
- 7-Photovoltaic panels



Results from the continuous monitoring equipment

