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Assessing annual and seasonal changes in the free-water reservoir surface state and turbidity conditions: implications for dam management in the Guadalquivir River Basin (Spain)

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Introduction

Reservoir water availability in Mediterranean areas:

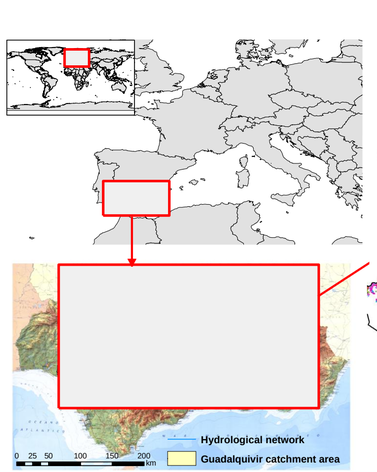
- High seasonal and annual variability in precipitation
- Water demands
- Land uses upstream with serious effects on the water quality

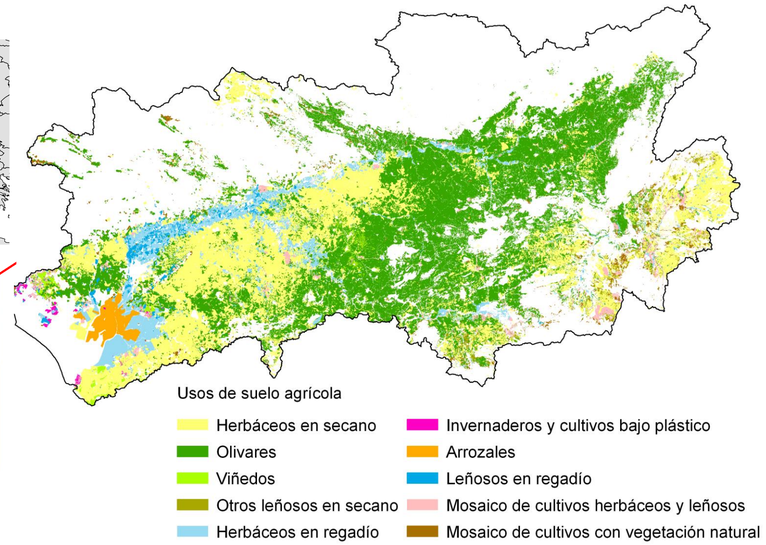
Remote sensing and SIG + real time hydrological data + water quality data

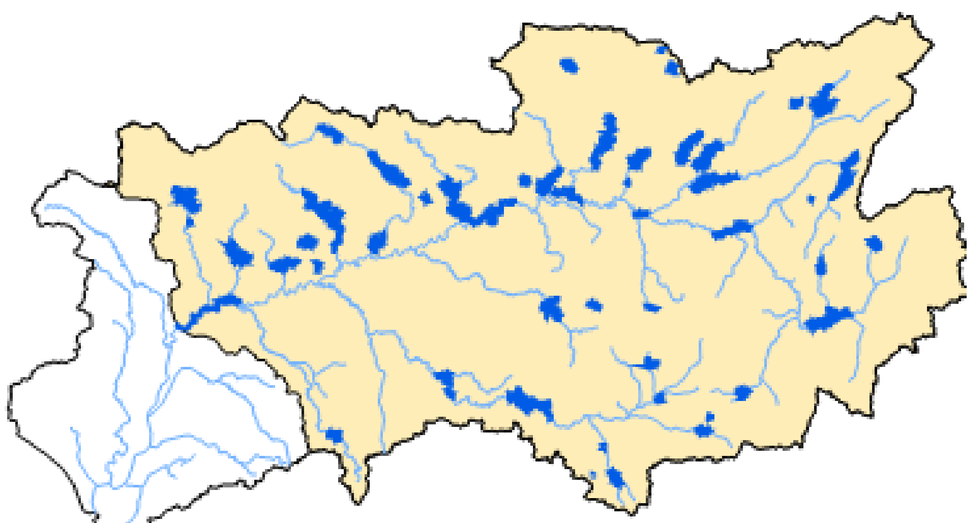
Analyze the evolution of the state of the water bodies in terms of the free-water and stored volume, to determine the effects in the contributions of suspended sediments

Study site

Guadalquivir River Basin (southwest Spain)



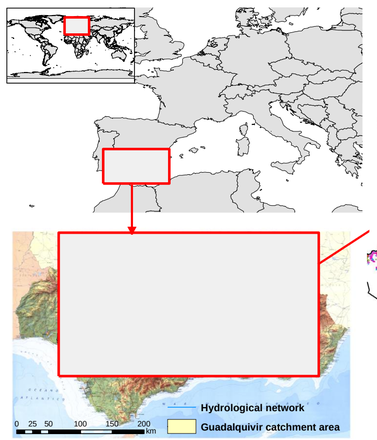


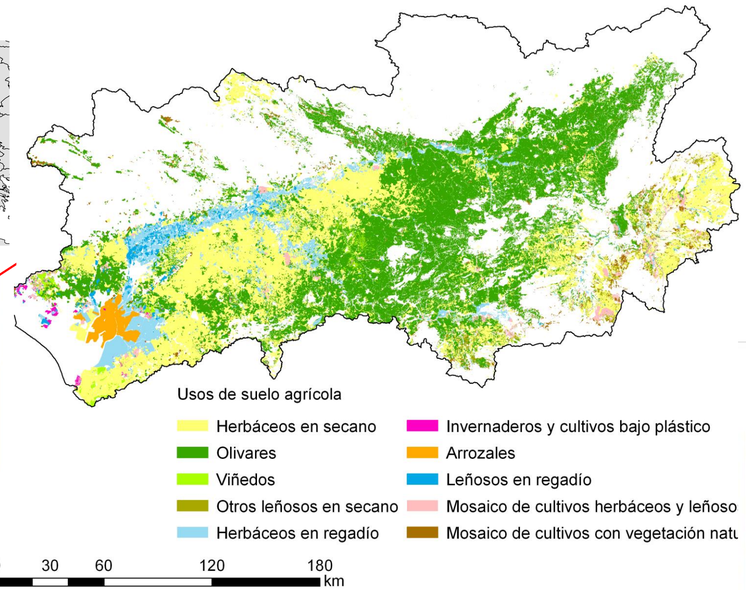


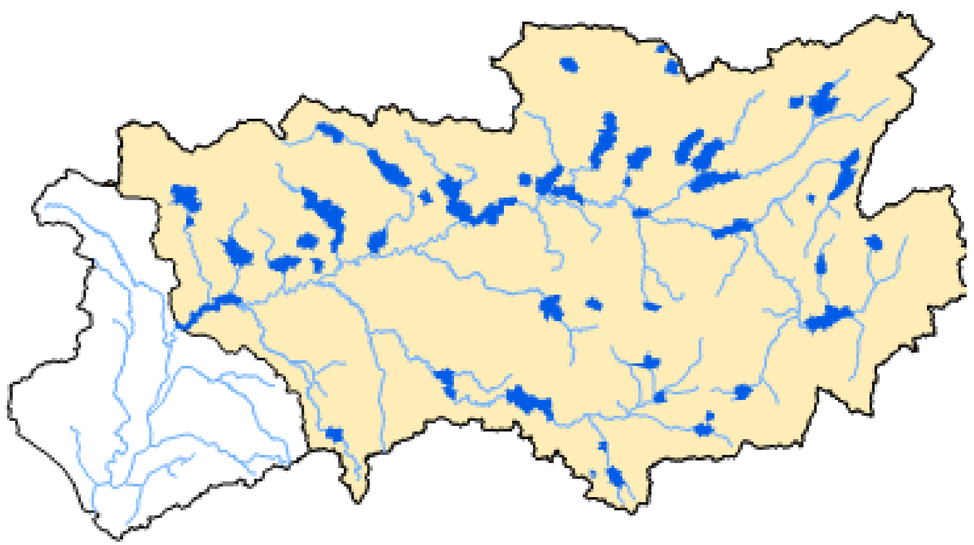
- ✓ Gradual and intense development of large irrigated areas during the past 50 years (extensive olive crops areas upstream)
- ✓ Increase in the storage capacity in the basin.
- ✓ Turbidity events.

Study site

Guadalquivir River Basin (southwest Spain)

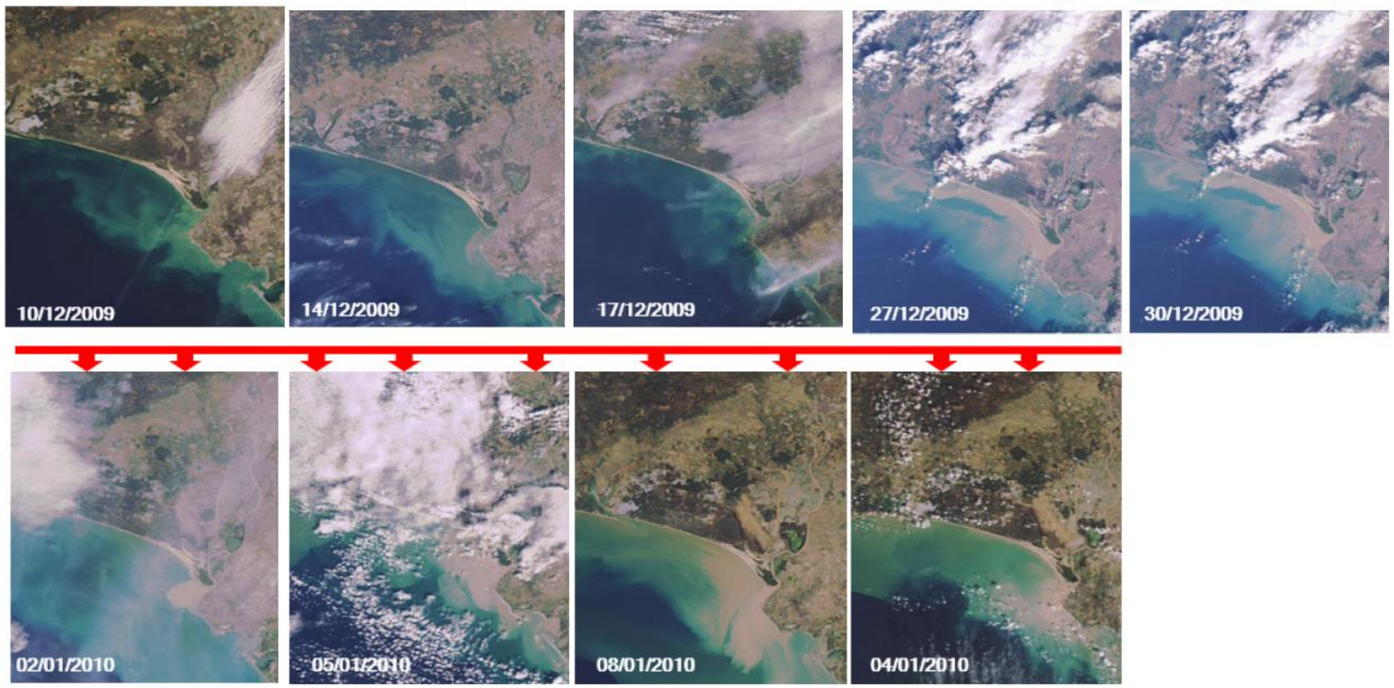




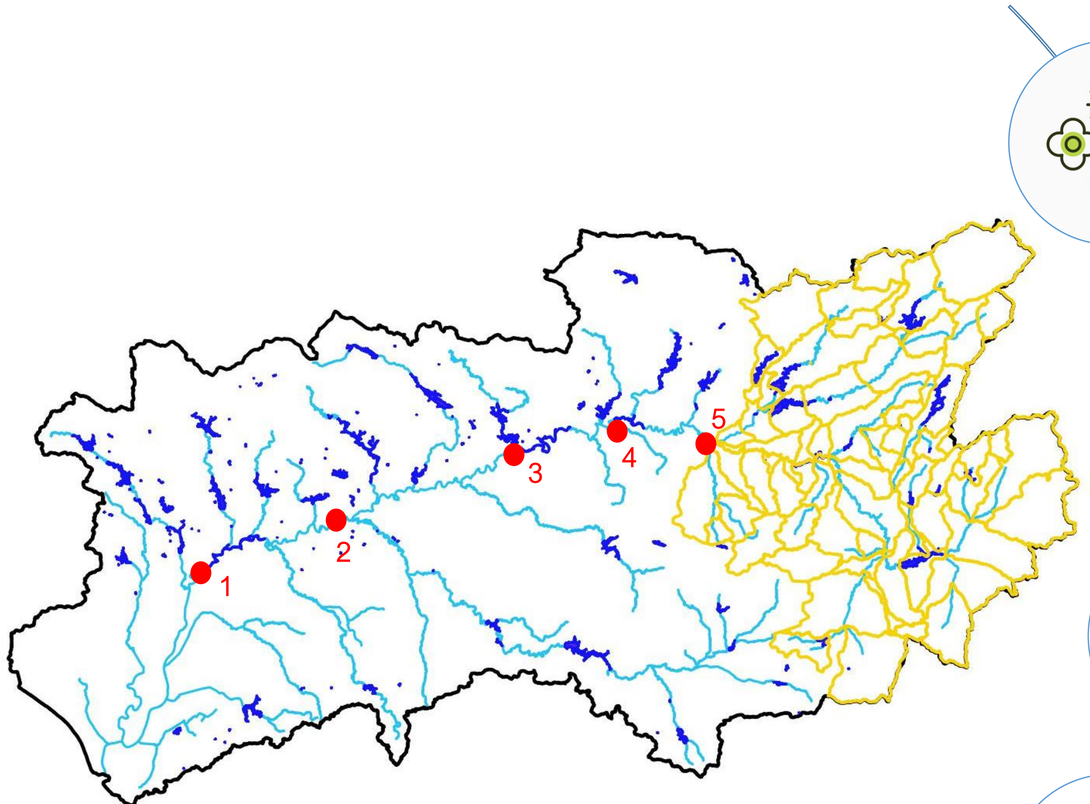


- ✓ Gradual and intense development of large irrigated areas during the past 50 years (extensive olive crops areas upstream)
- ✓ Increase in the storage capacity in the basin.

Imágenes MERIS tomadas en diciembre 2009 y enero 2010, antes y después de una descarga desde la presa de Acalá del Río.



Methodology



Data collection

* **Suspended sediments concentration and river flow** data in **5 control points** in the main river (July 2011 – January 2022)

* **Reservoir storage volume, water contributions and discharges** from the reservoirs located in the **upstream watershed** (July 2011 – January 2022)

Global Surface Water (GSWE) online machine

Spatially quantify **free-water reservoir surface** during the period 1984-2020

ss loads estimation and water balance approach

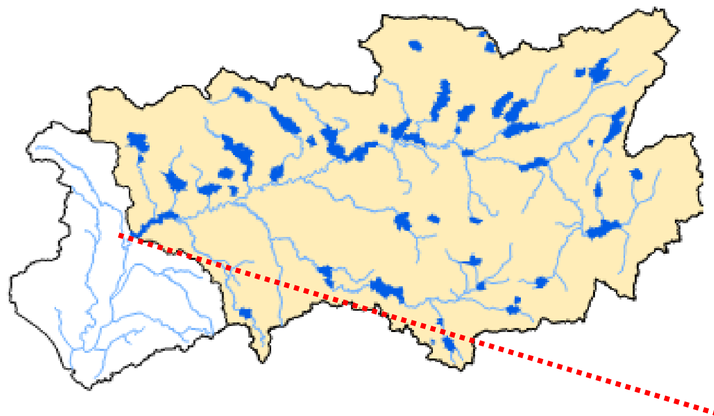
Estimation of ss loads in the **5 control points** and analysis of the reservoir **storage volume, inputs and outputs** in the **upstream watershed** to analyze the **changes** at monthly time scale

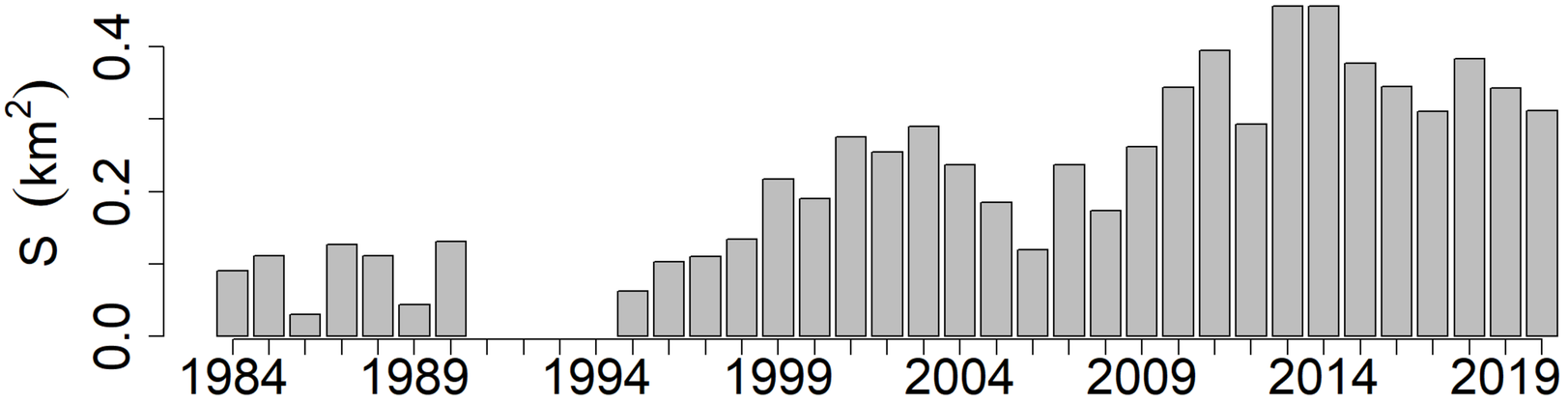
Analysis of the dam operation effects

Changes in water quality in terms of sediments loads in the **5 control points** with different state reservoirs conditions in the **upstream watershed**

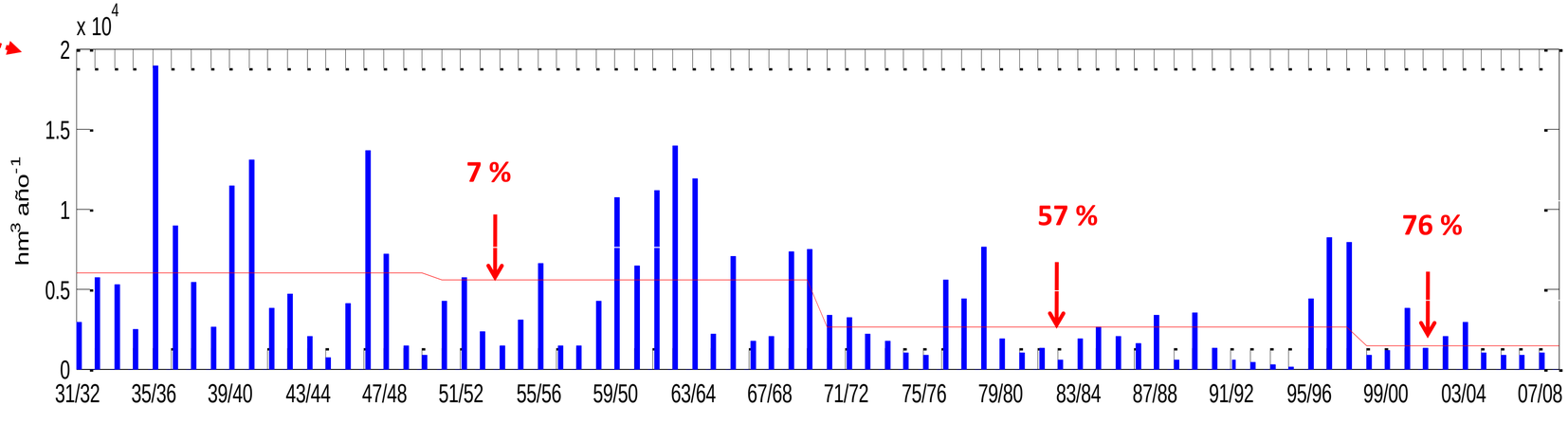
Results

Increase of the free-water reservoir surface along the study period 1984-2020.



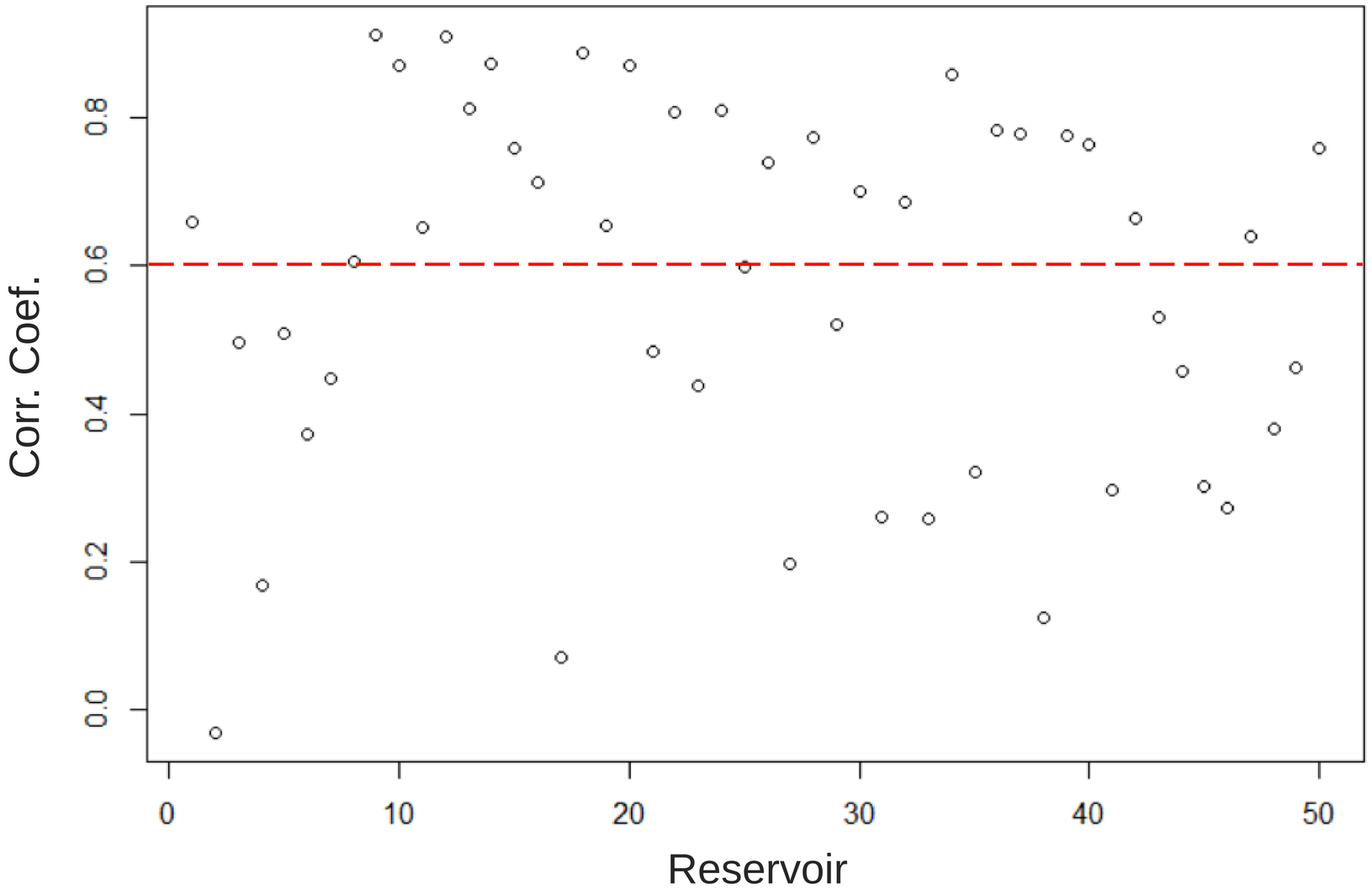


Dramatic **decrease of the contribution** of the water flowing into the last receiver of the network of reservoirs



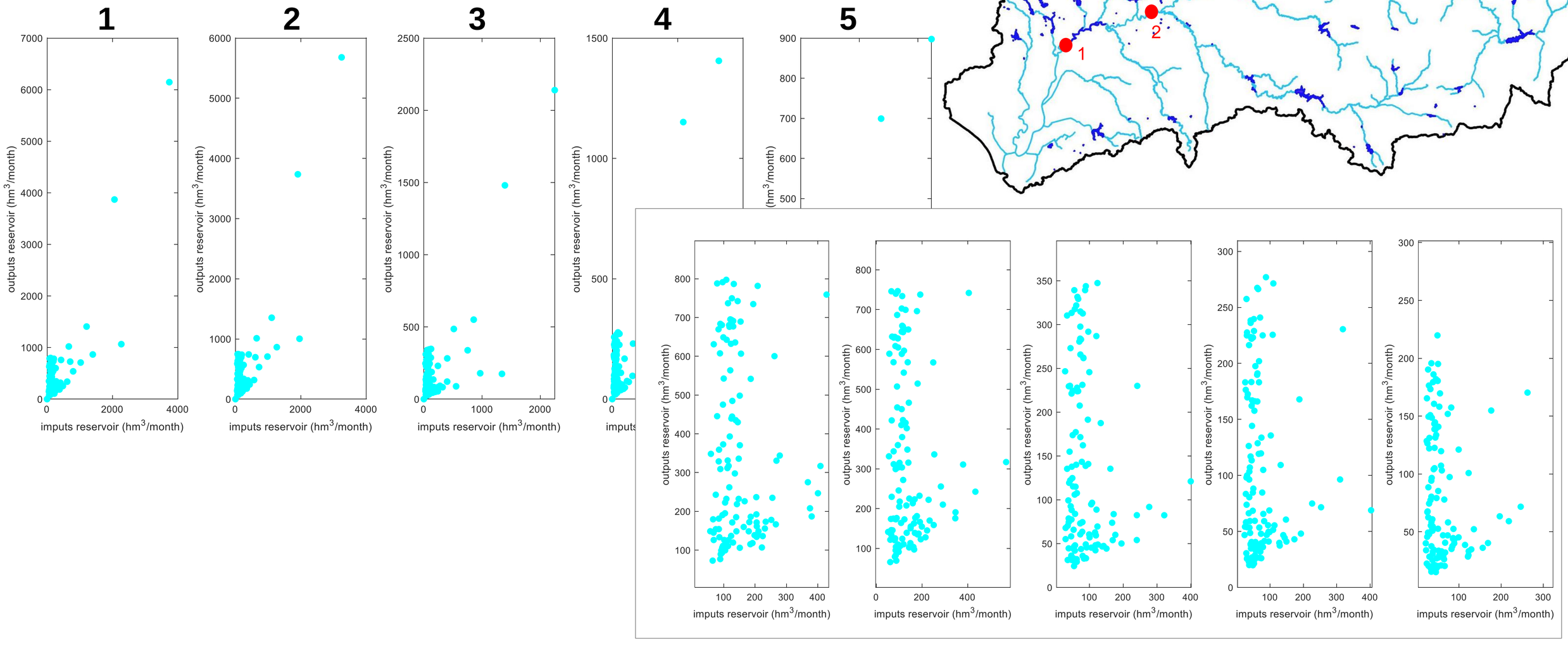
Results

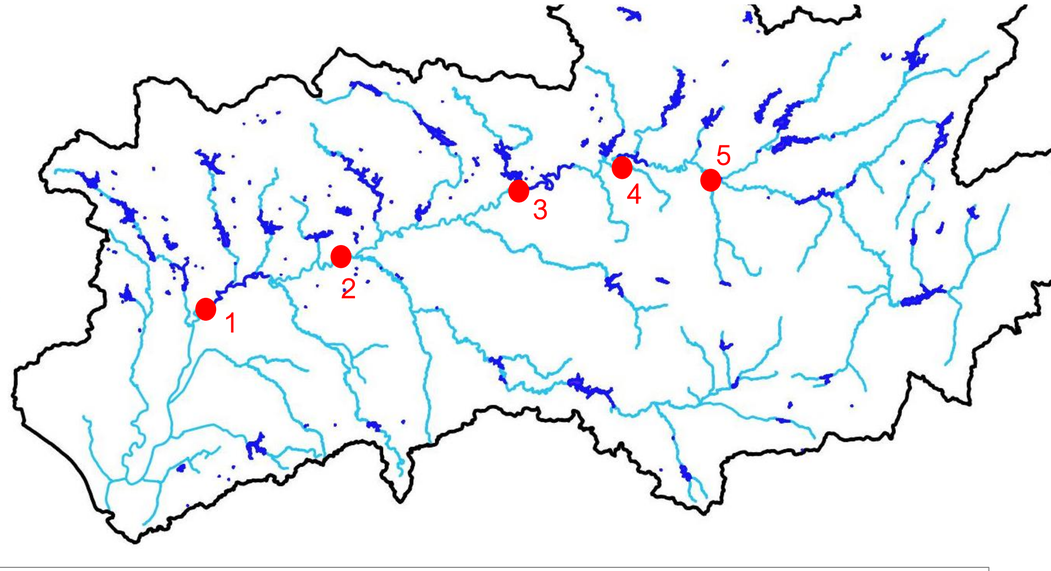
Relation between *free water reservoir surface (GSWE) – reservoir storage volumen (real time measurements)*



Results

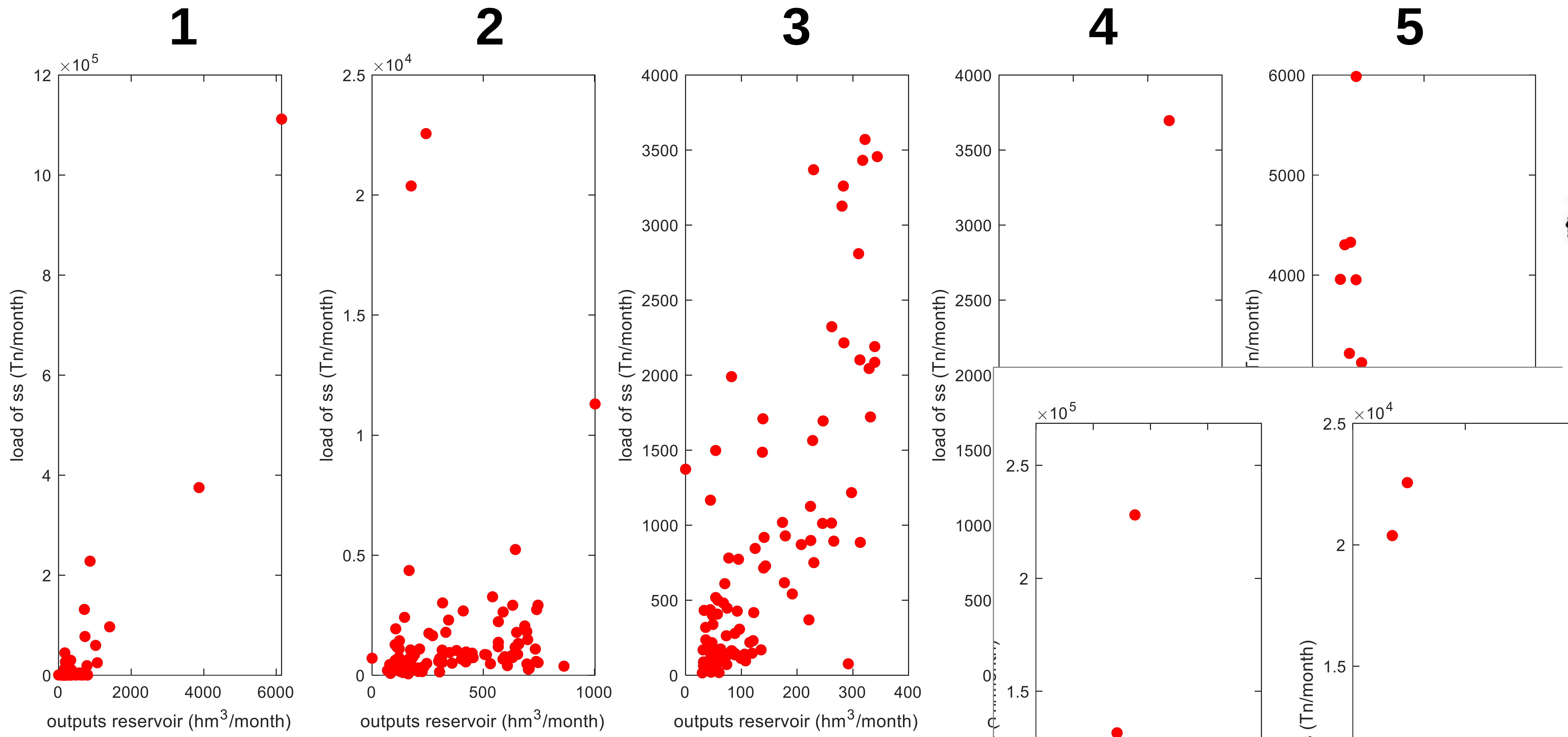
Total inputs Vs total outputs of the reservoirs located in the watersheds upstream the 5 control points

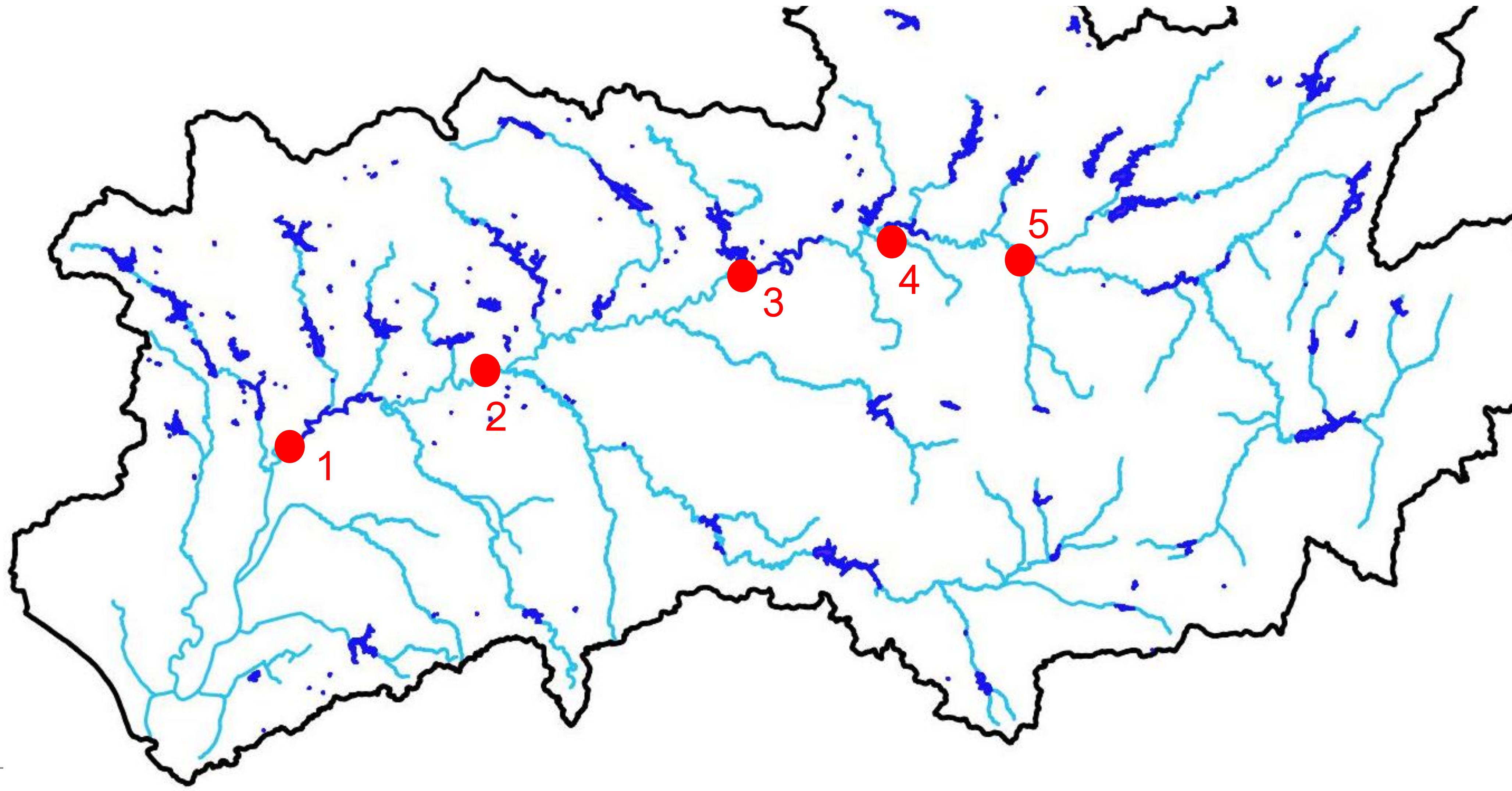


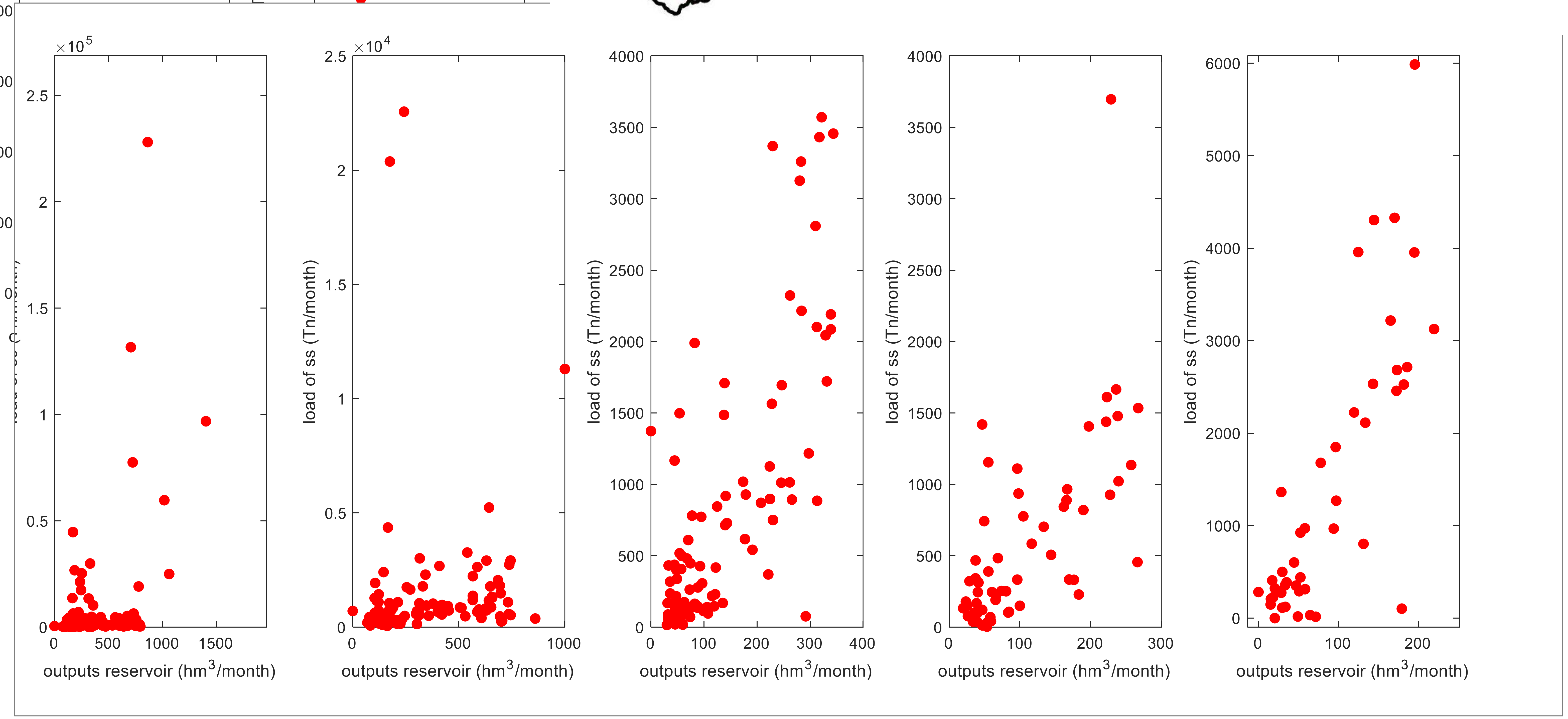


Results

Total outputs of the reservoirs upstream Vs ss load in the control points

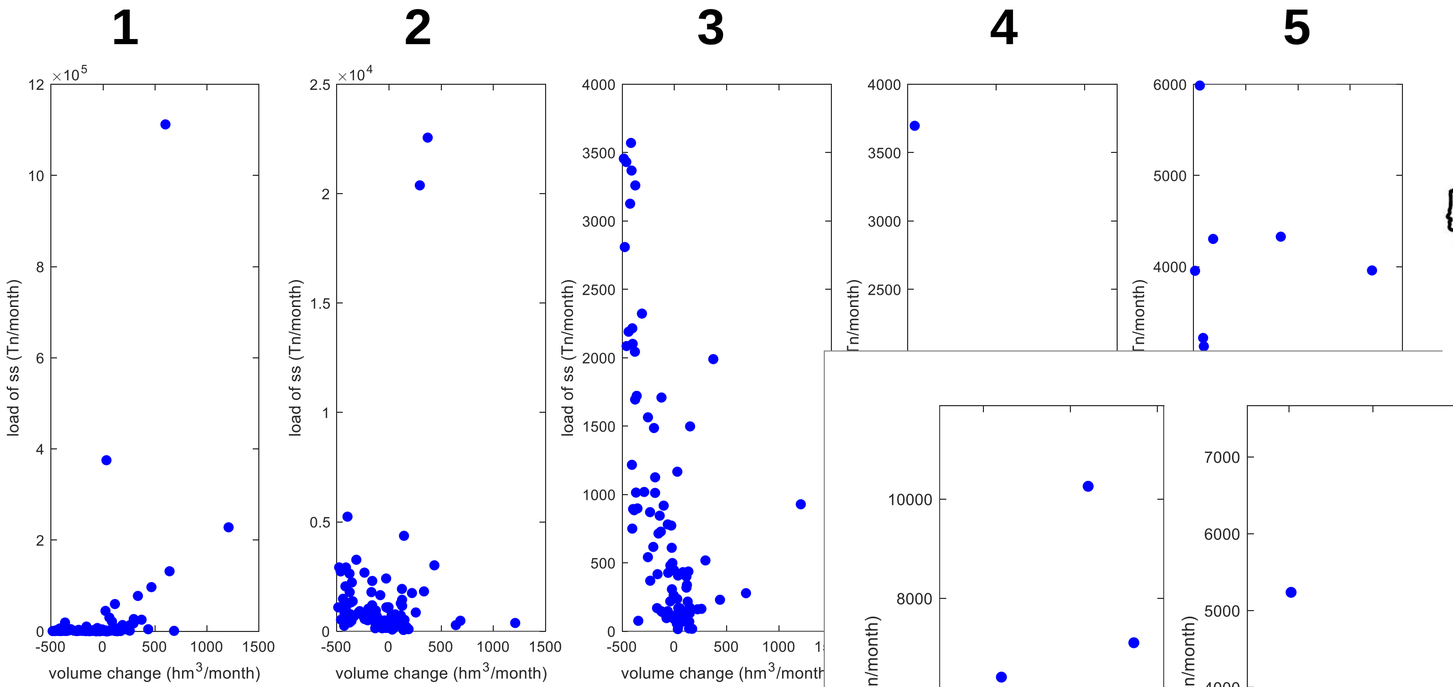


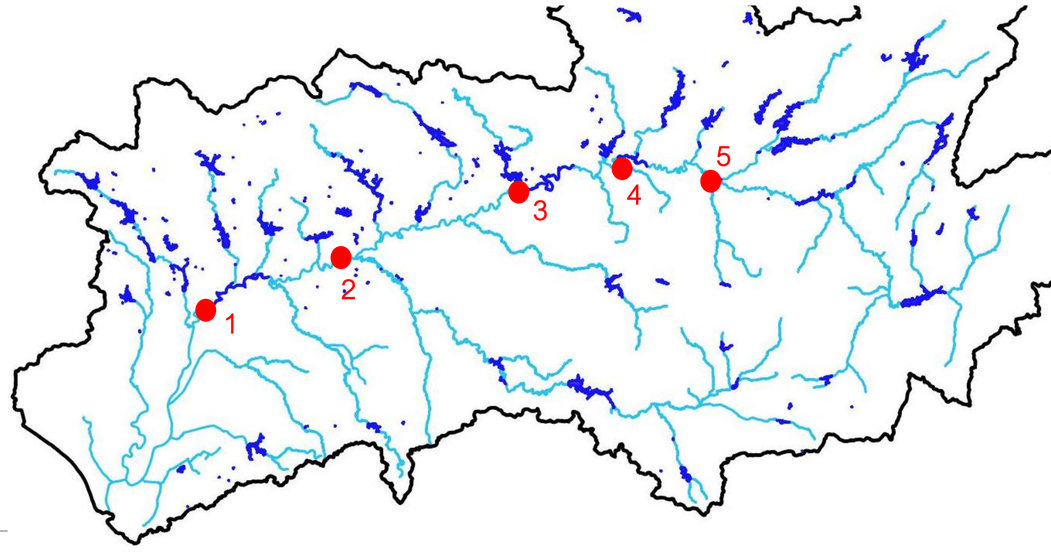


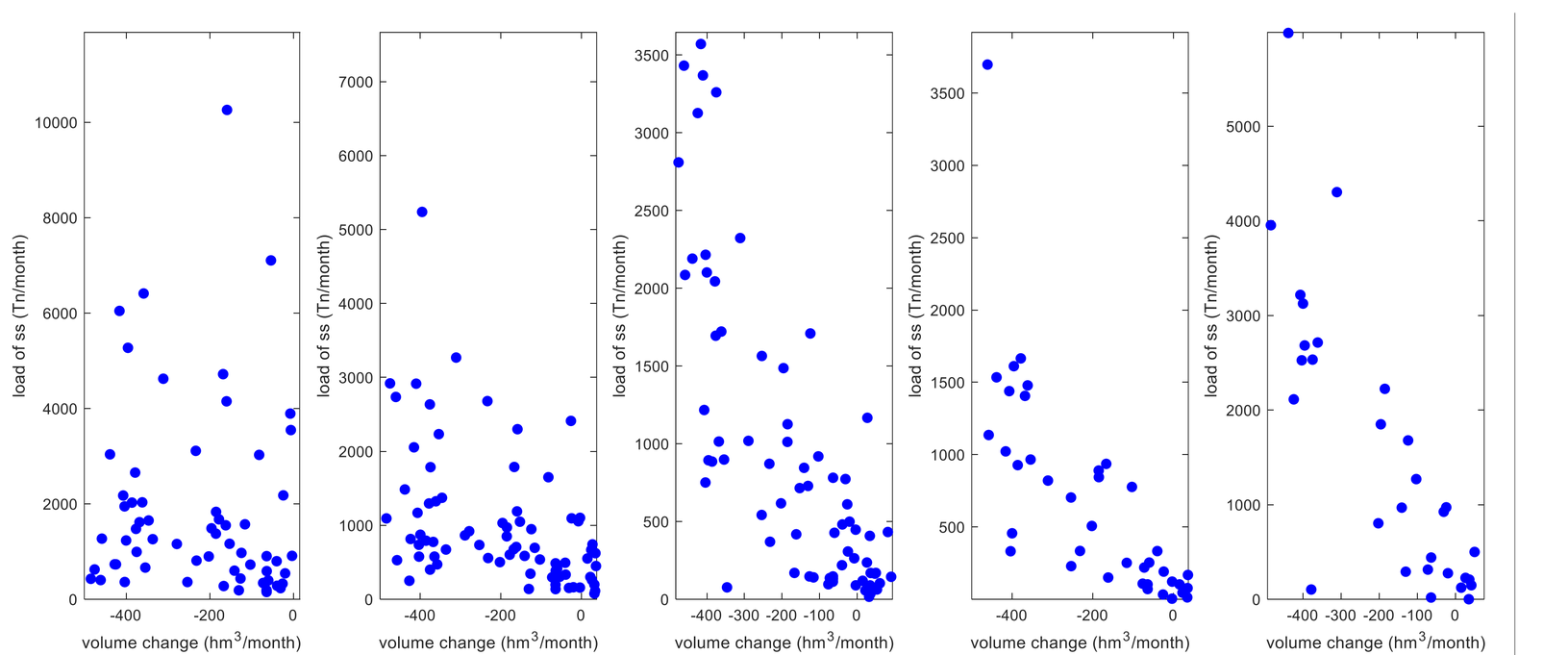


Results

Change of volumen in the contribution watersheds **Vs Load of ss** in the control points







Final remarks

✓ **Remote sensing can be an alternative to traditional methods** , to measure automatically trends of stored volumes and its relations with other variables.

✓**An increase of the free-water reservoir surface** along the study period 1984-2020 was found in the Guadalquivir River basin.

✓ This also implies the storage of associated substances such as sediments (mainly from the extensive olive groves areas located upstream) that produce the filling of the reservoirs, and **turbidity episodes in flood events which are delivered with large discharges from the dams**, which was verified with field measurements in the control points of the main river.

THANK YOU VERY MUCH!

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