SAID integrated web application for easier dam operation

Sergio Romero
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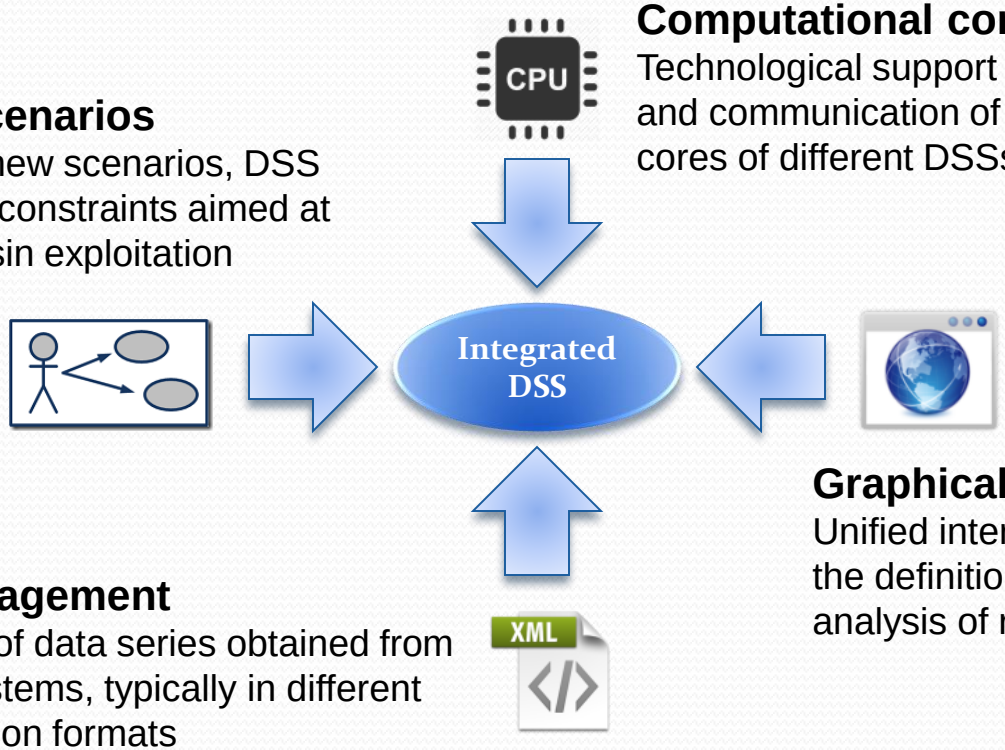
Co-funded by the seventh framework programme (FP7), under grant agreement no. 619132, within the Water Inno & Demo-1

Integration dimensions

Integration scenarios
Identification of new scenarios, DSS interactions and constraints aimed at efficient river basin exploitation

Computational cores
Technological support for the coordination and communication of the computational cores of different DSSs



Graphical user interface
Unified interface oriented to final users for the definition of scenario parameters and analysis of results

Data management
Repository of data series obtained from external systems, typically in different representation formats

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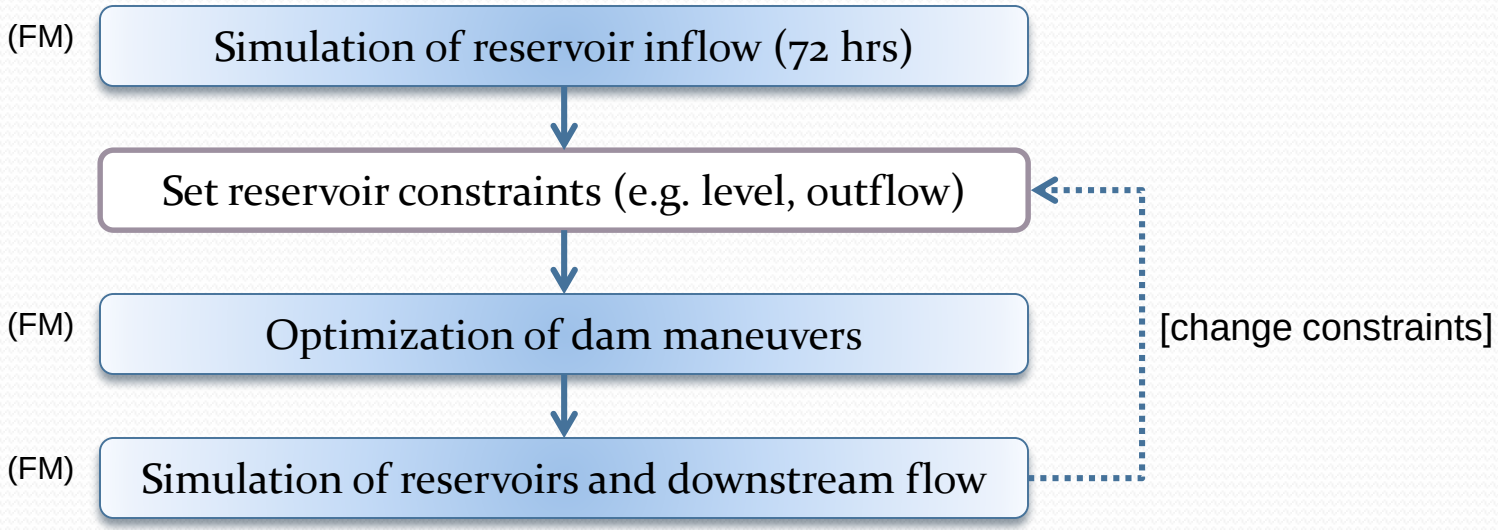
Integration scenario: Flood



NOTES

- Guadalhorce & Guadalteba modeled as one single reservoir
- Water quality and energy concerns not considered
- Results include the dynamic state of dam elements (outlets, spillways, …)

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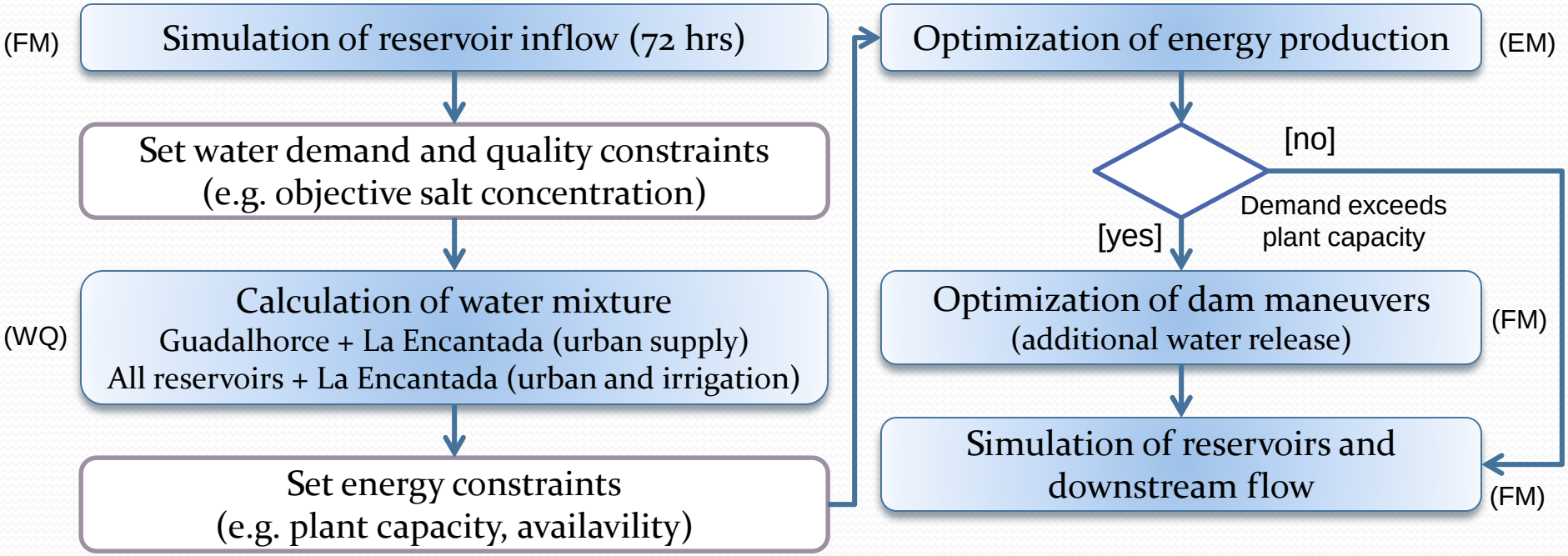
Integration scenario: Ordinary



NOTES

- Objective salt concentration below 6 g/L (urban) and 0.8 g/L (urban+irrigation)
- WQ-DSS provides daily results and EM-DSS produces detailed hydrographs

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Technological requirements

- **Distributed computing**: DSSs and peer applications running on different computers and networks require communication
- **Application heterogeneity**: windows-linux OSs, java-.net languages, web-desktop applications, consumer-producer patterns
- **Extensibility**: new DSSs could be added to the framework or the entire solution migrated to a different river basin
- **Real-time execution**: applications should react and produce results as soon as new input data are available (e.g. river flood)
- **Feasibility**: Moderate efforts to incorporate integration technology into existing DSSs (project deadlines)

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Service orientation

- SAID DSSs provide integration functionality by means of simulation, configuration and data query **machine-to-machine services**

DSS	Description	Input	Output
FM-DSS Hydroview	*Run forecast simulation*	• Time period • Reservoir outflow	• Reservoir volume and inflow • Water flow and level at control points • Resultant flood plain
FM-DSS BeDam	*Synthesis of maneuvers*	• Reservoir inflow • Optimization mode • Constraints	• Reservoir volume • Outlet and spillway opening degree • Total outflow of each reservoir
WQ-DSS	*Water mixture calculation*	• Water demand • Salt concentration • Reservoir balance	• Composition of water mixture
EM-DSS ELD	*Power plant optimization*	• Plant capacity • Service time • Released volume	• Optimal power plant hydrograph • Energy production • Total profit

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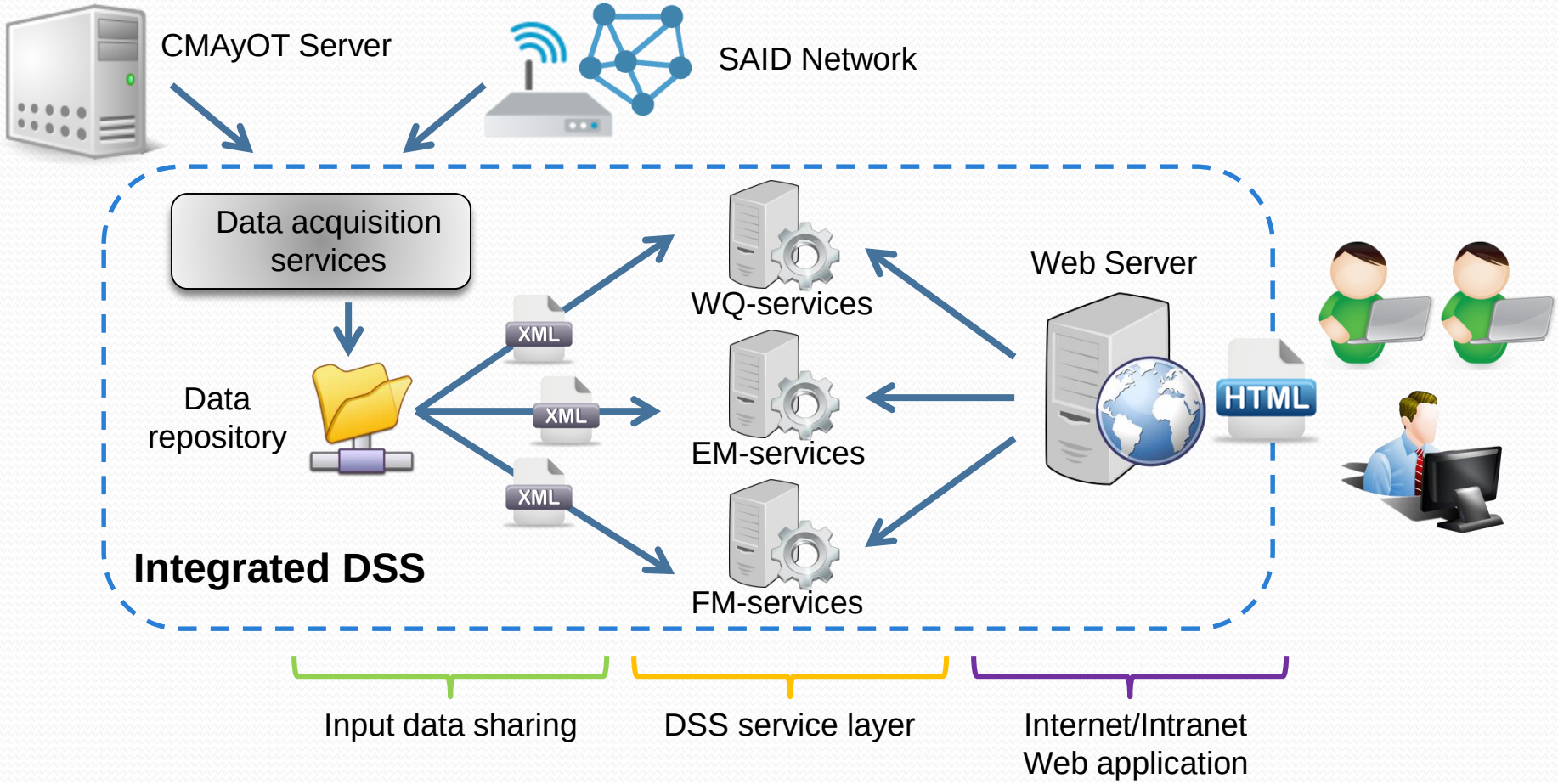
Integrated DSS architecture



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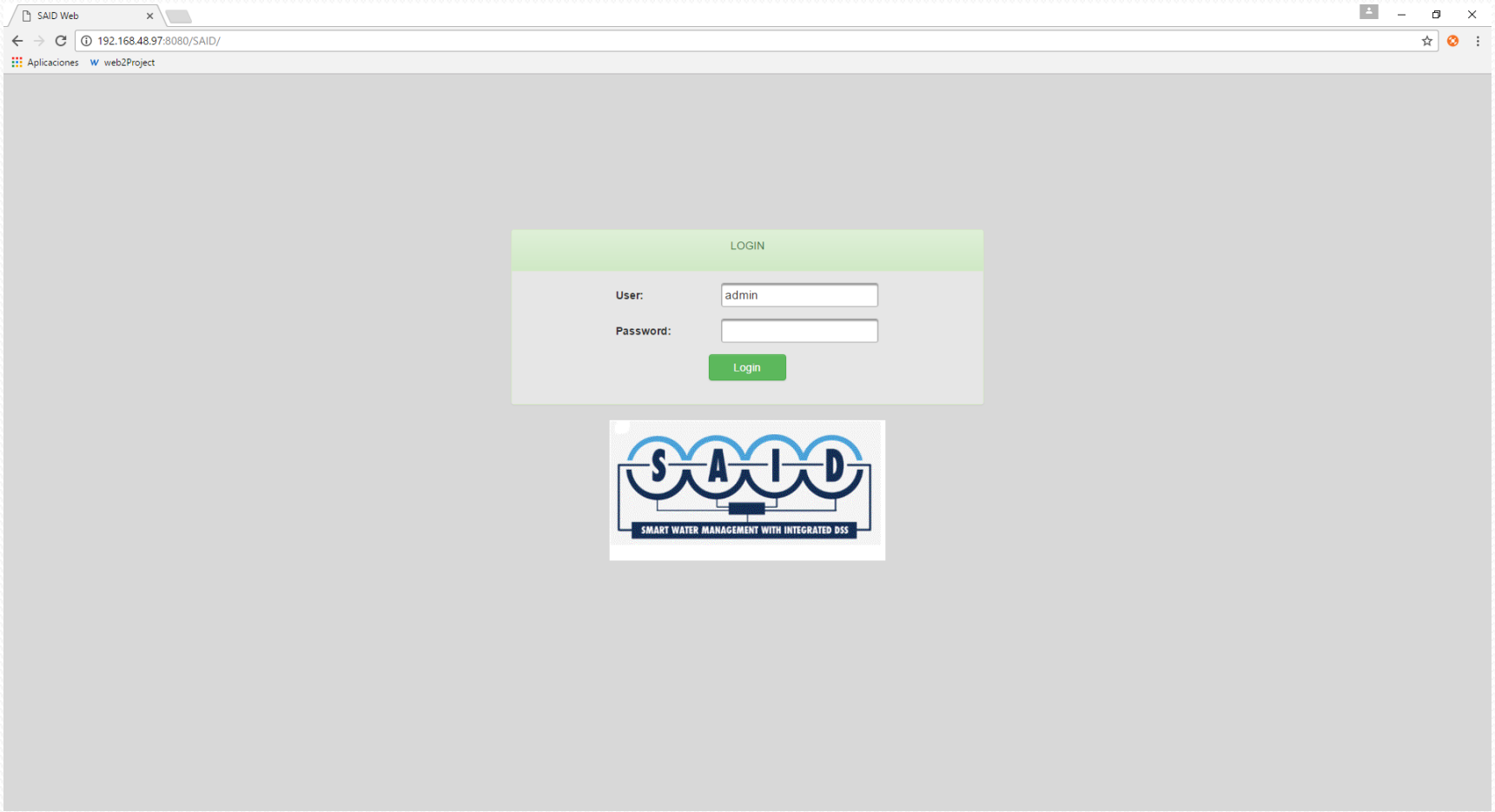
Integrated DSS: web interface



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Tool for observed data

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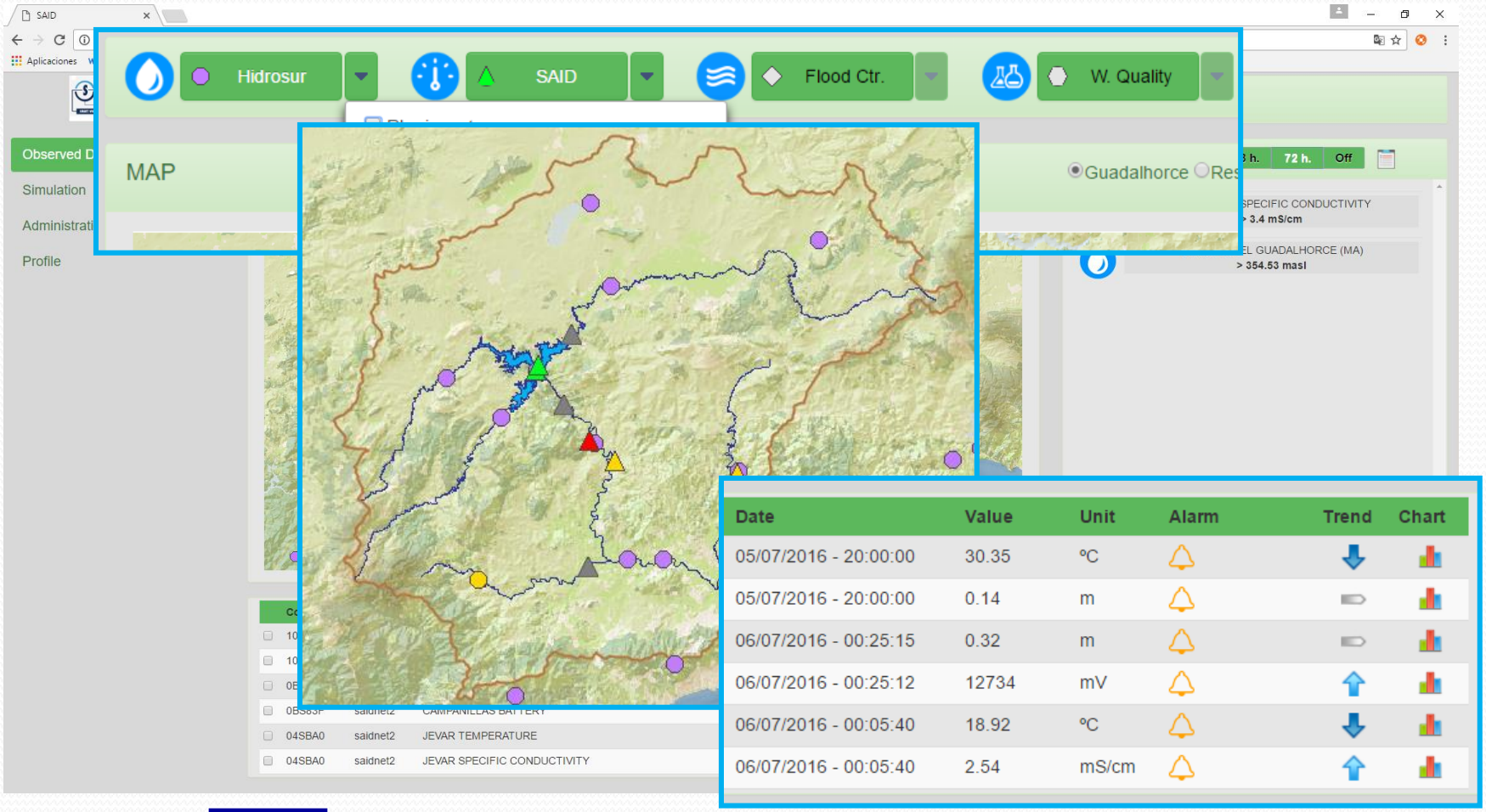
Observed data: networks



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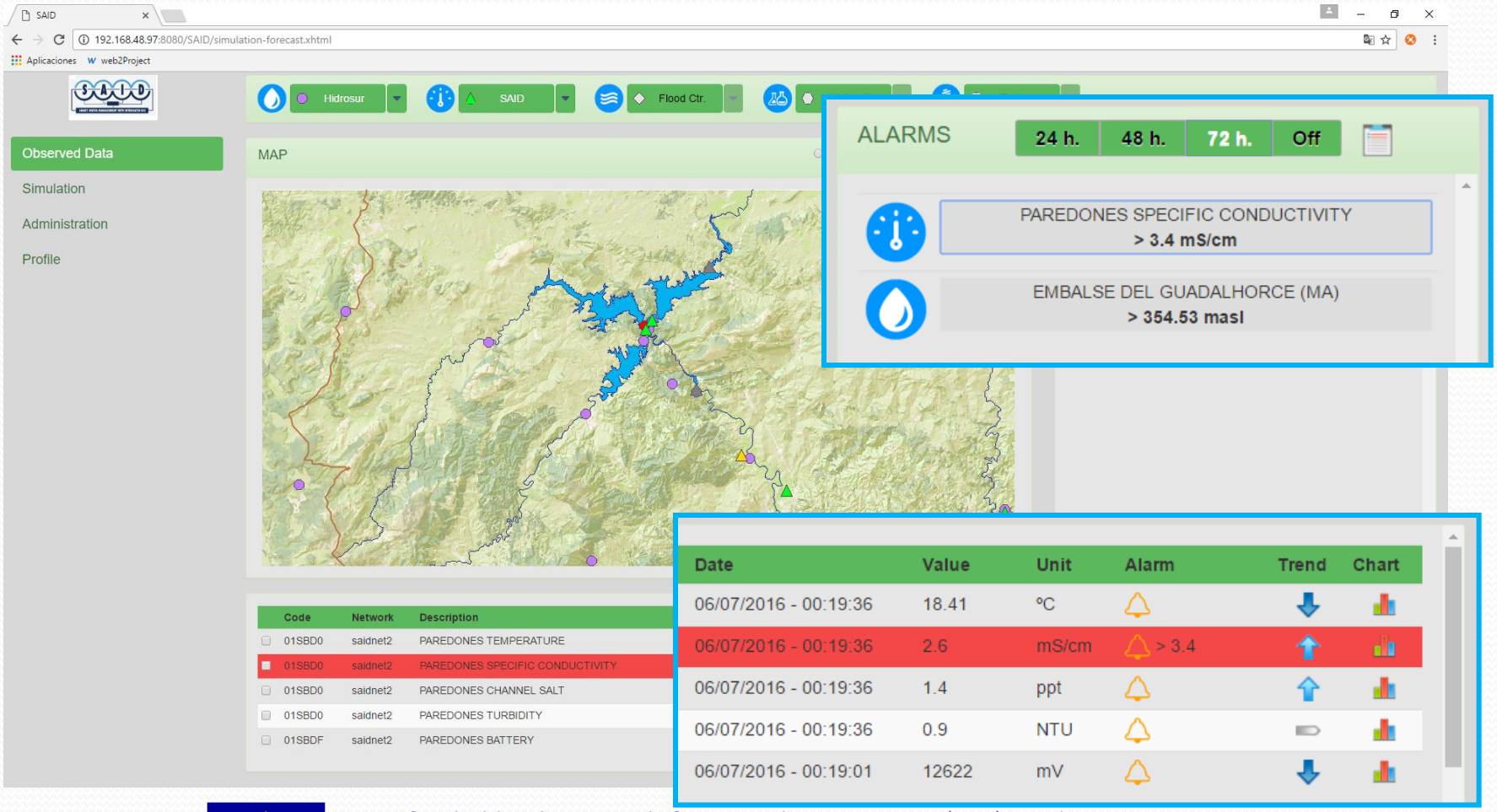
Observed data: alarms



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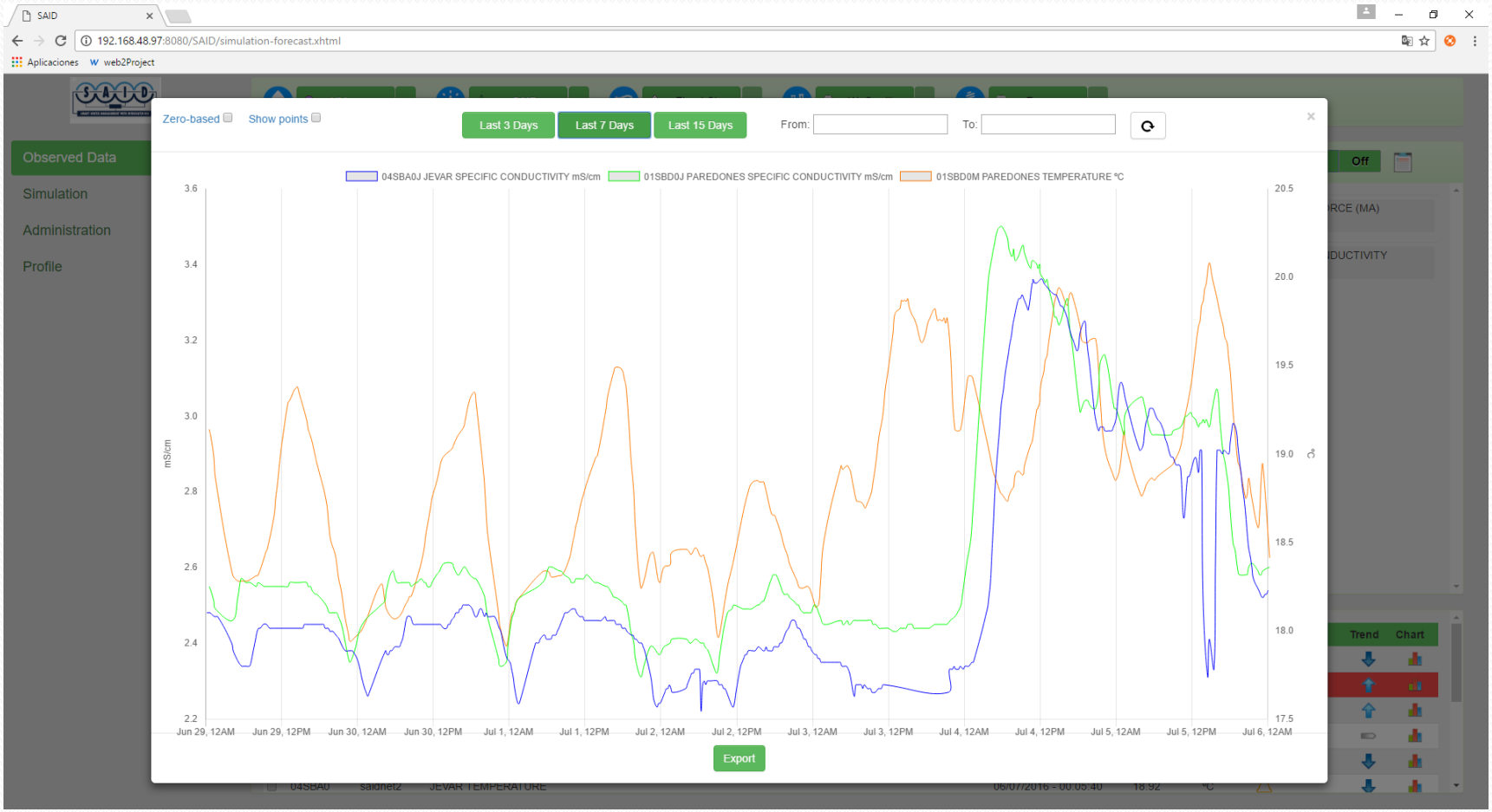
Observed data: graphs



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Flood scenario simulation

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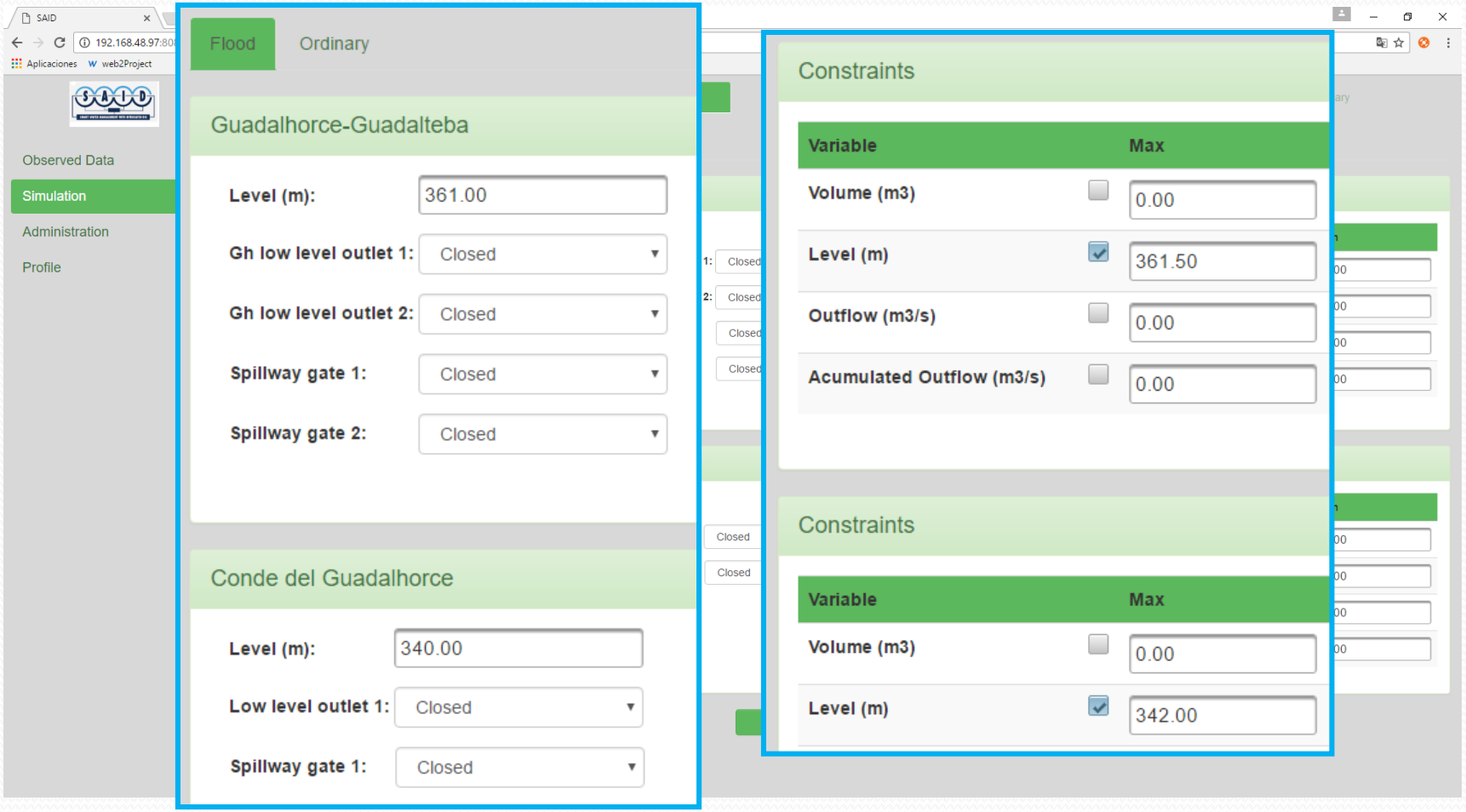
Flood mode: constraints



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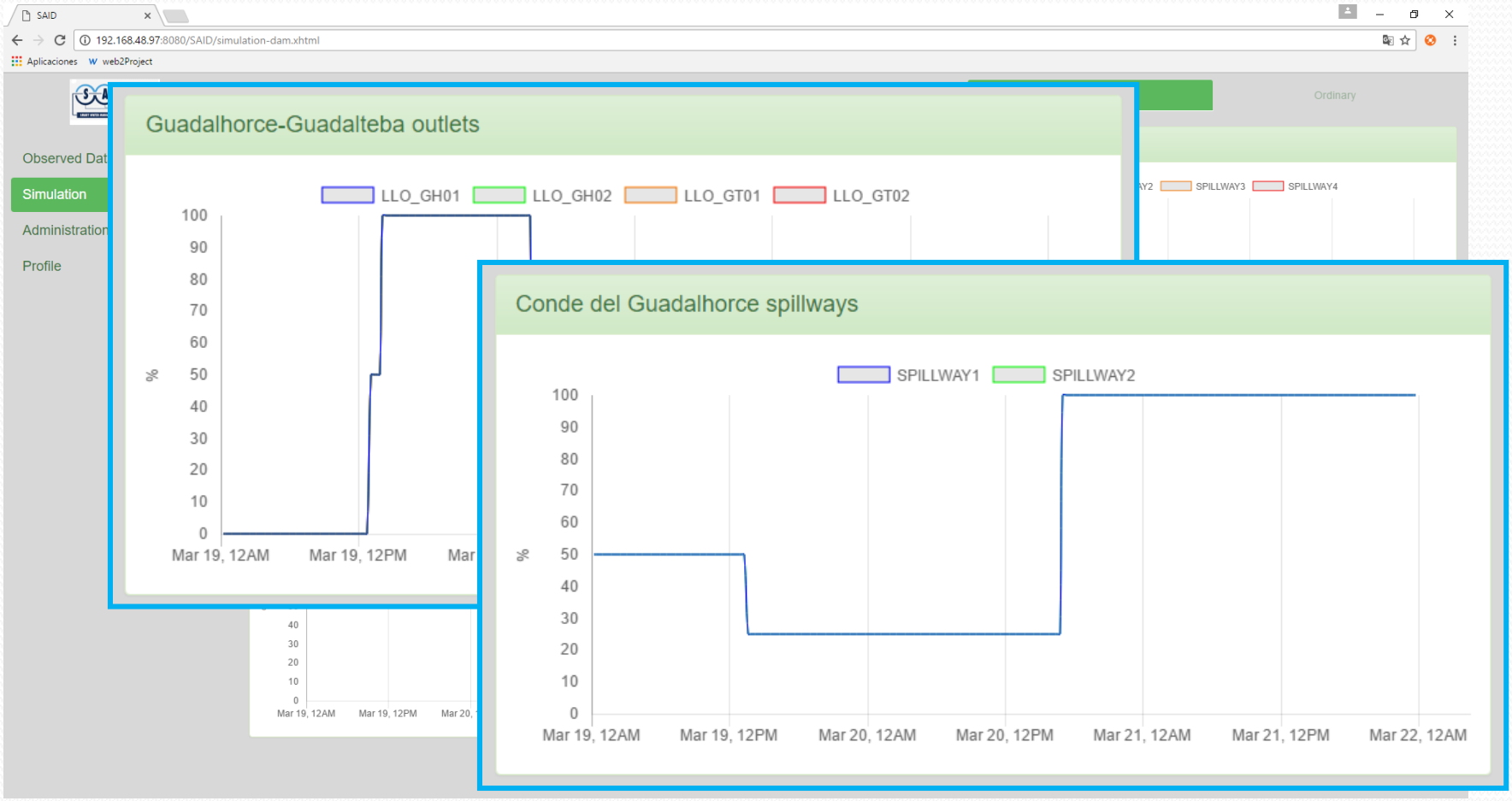
Flood mode: manoeuvres



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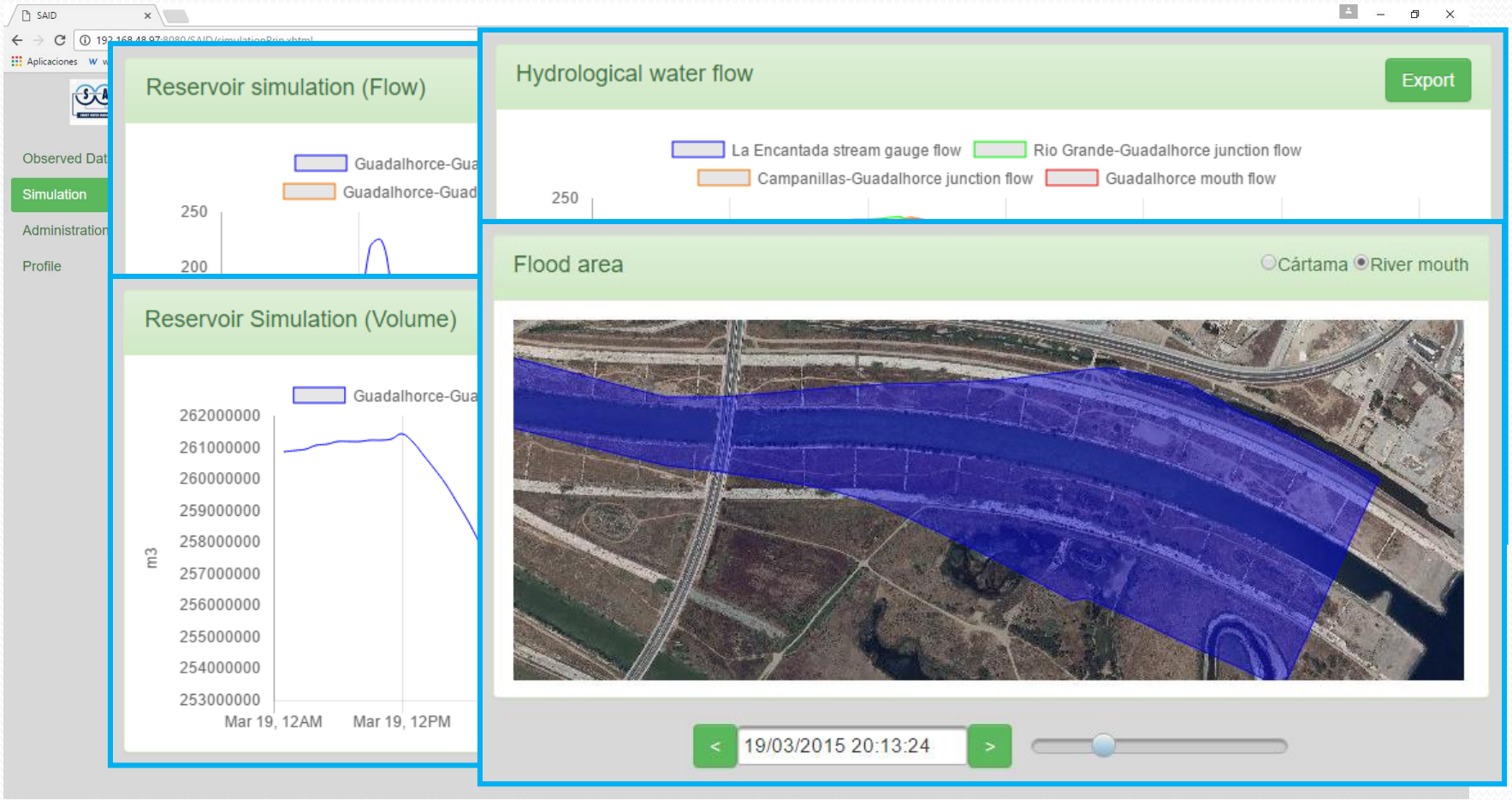
Flood mode: simulation



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Ordinary scenario simulation

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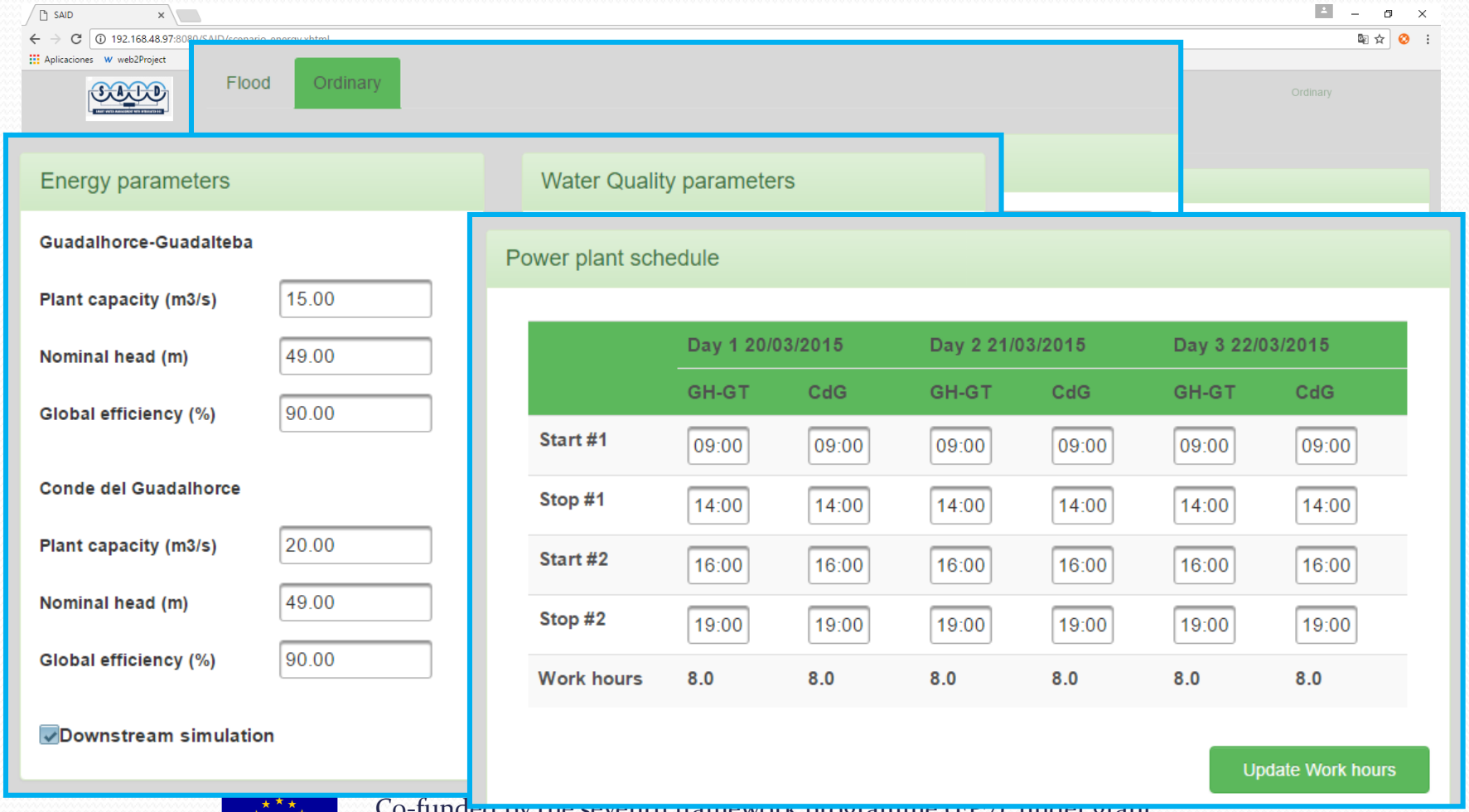
Ordinary mode: constraints



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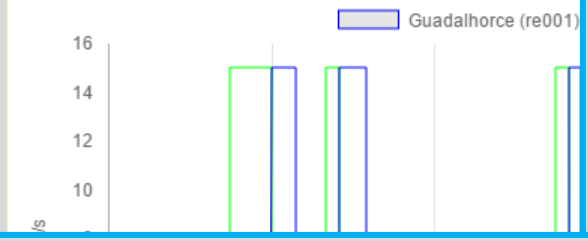
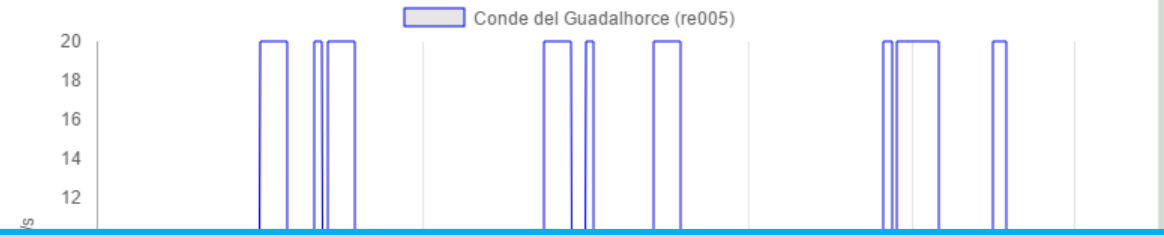
Ordinary mode: simulation (I)

Guadalhorce-Guadalteba hydropower plant



Conde del Guadalhorce hydropower plant

Export



Energy results

Guadalhorce-Guadalteba

	Day 1 20/03/2015	Da
Total profit (€)	3340.28	16
Production (MW)	51.86	51

Conde del Guadalhorce

	Day 1 20/03/2015	Da
Total profit (€)	2996.82	13
Production (MW)	43.22	43

Water mixture simulation

	Day 1 20/03/2015	Day 2 21/03/2015	Day 3 22/03/2015
	Water release (hm3)	Water release (hm3)	Water release (hm3)
Guadalhorce	0.21	0.21	0.21
Guadalteba	0.38	0.38	0.38
Conde del Guadalhorce	0.33	0.33	0.33
Total mixture	0.92	0.92	0.92

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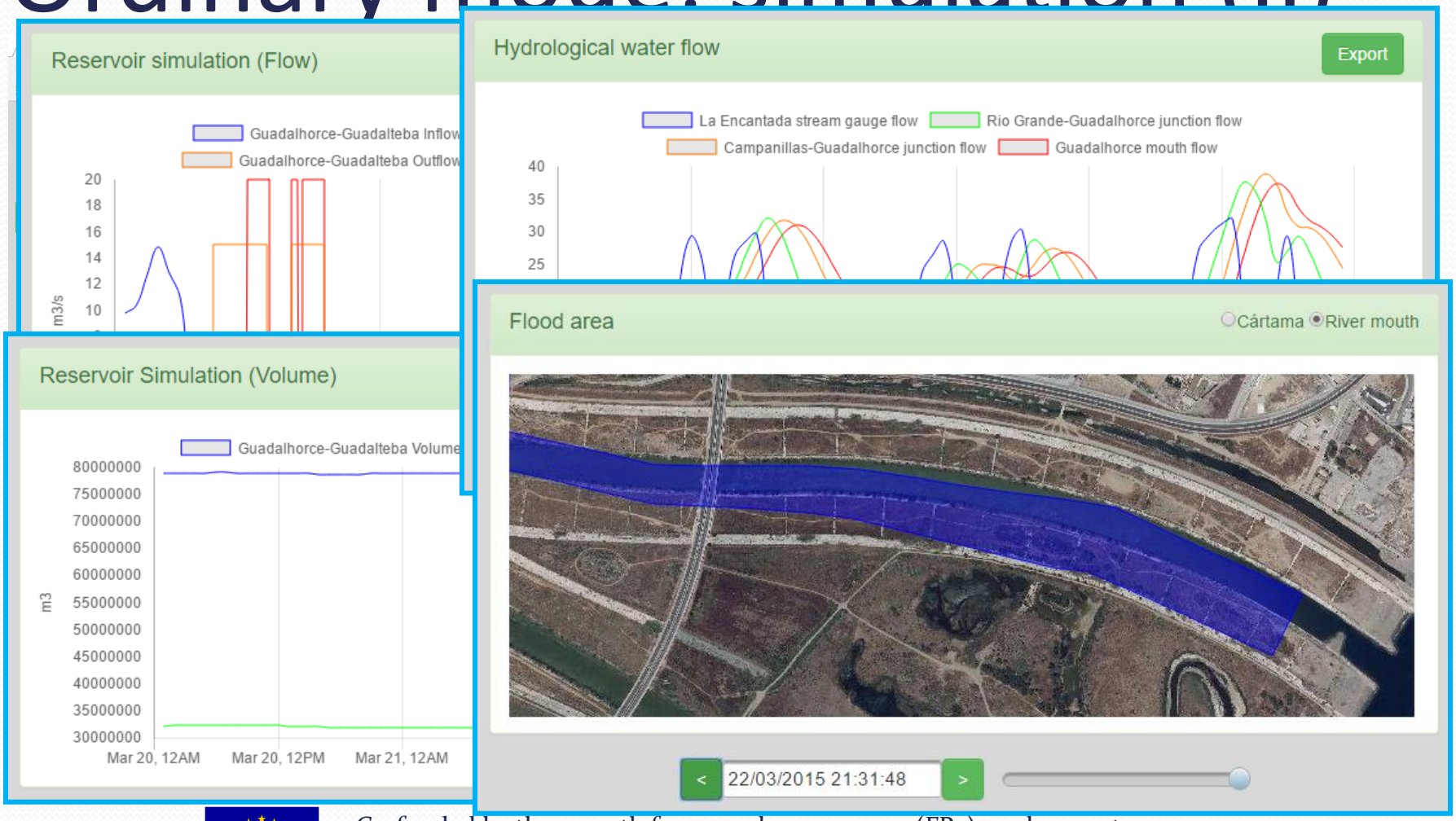
Ordinary mode: simulation (II)



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Other features

- Predefined user roles and information levels
  - Access to specific collections of observed data/forecasts
  - Permissions to launch ordinary and/or flood simulations
- Concurrent access to the DSS
  - Multiple users can explore SAID data with a web browser
  - Simulations limited to a number of concurrent users
- Automatic update of river basin response
  - River model executed in a continuous basis (once a day)
  - Climate data and dam discharges in the last 24 hours used

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Conclusions

- The Integrated DSS allows complex decision making based on parameters and objectives of different domains (flood control, water quality, energy production)
  - Monitoring of observed data and DSS variables
  - Predictive simulations involving multiple DSS interactions
- Required user interactions are greatly simplified
- The proposed framework is modular and reusable, and can be exported to other river basins with reasonable efforts
- Integration in SAID is being addressed using modern practices of distributed systems and software engineering

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Thank you for your attention

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