ifakFAST

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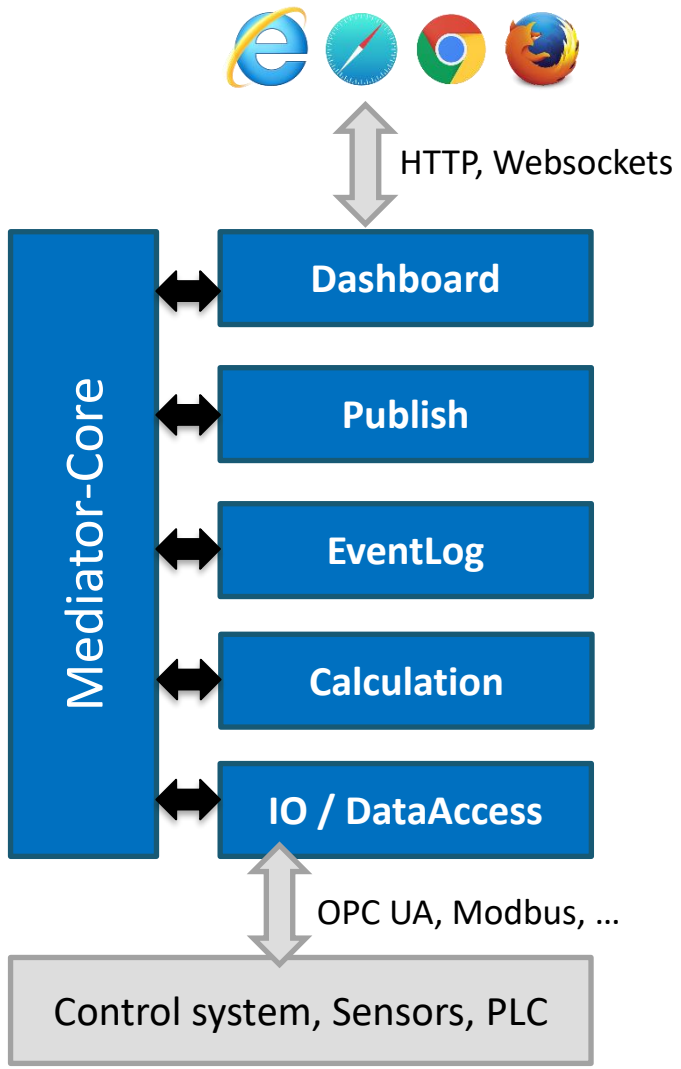
ifak***FAST*** – Overview (1)

- ifak***FAST***: **F**ramework for integrated **a**utomation and **s**imulation **t**echnologies
- Developed for many years for use in research and industrial projects
- Web: https://fast.ifak.eu/
- Mediator: Platform for process monitoring and supervisory control of e.g. WWTPs
  - Modular and extensible design
  - Timeseries database (SQLite, PostgreSQL)
  - Role based user access management
  - Web based user interface
  - Implemented in .NET => platform independent: Windows, Linux, Mac OS
  - Open Source (MIT license): https://github.com/ifakFAST

ifak*FAST* – Overview (2)

- Freely available generic modules
  - **IO** for data acquisition and integration (e.g. OPC UA, MQTT, SQL, ModbusTCP)
  - **EventLog** for management of events likes warnings and alarms
  - **Calculation** for control and key performance metrics using C#, SIMBA, Python (> 1.5.5)
  - **Dashboard** for Web-based user interface
  - **Publish** for sending data (to the cloud) via MQTT, SQL, OPC UA
- Custom modules can be developed for specific needs, e.g. for senor quality management

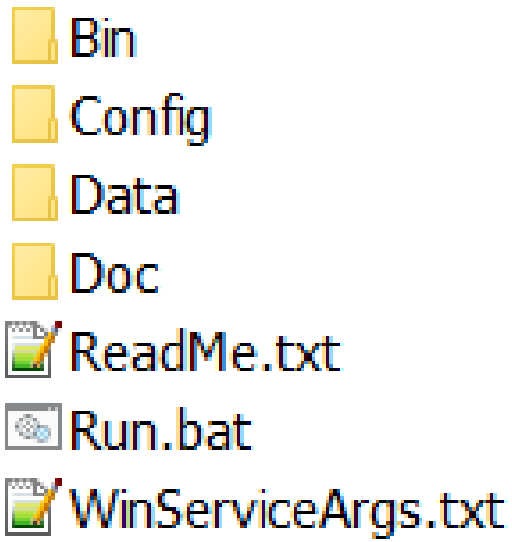


ifak*FAST* – Download and Installation

- Download latest ifak*FAST* Mediator release from GitHub: https://github.com/ifakFAST/Mediator.Net/releases/latest
- Unzip downloaded file, e.g. Mediator_v1.6.1_Win64.zip
- Run: Either start *Run.bat* on Windows or *Run.sh* on Linux
- Navigate to http://localhost:8082/ using the browser for web dashboard
- Login with user name and password, for default values see ReadMe.txt
- Recommendation: Make sure to uncheck the option “Quick edit mode” in the properties of the console window otherwise program will freeze when you click into window!
- Installation as Windows service for auto start on Windows boot:
  - Run *Install_Service.bat* in folder *Bin/WinService*
  - Start/Stop service “ifakFAST” using standard Windows tools, e.g. Task Manager

ifak*FAST* – Directory structure

- Directory structure can be adjusted in config files but it is recommended to keep the default structure
  - **Bin** – Contains all binaries (MediatorCore + Modules)
  - **Config** – Contains all configuration files
  - **Data** – Contains log files, last values of all variables, timeseries database files (only if SQLite is used as Timeseries storage)
  - **Doc** – Documentation of how to create your own modules, IO adapters, Dashboard views

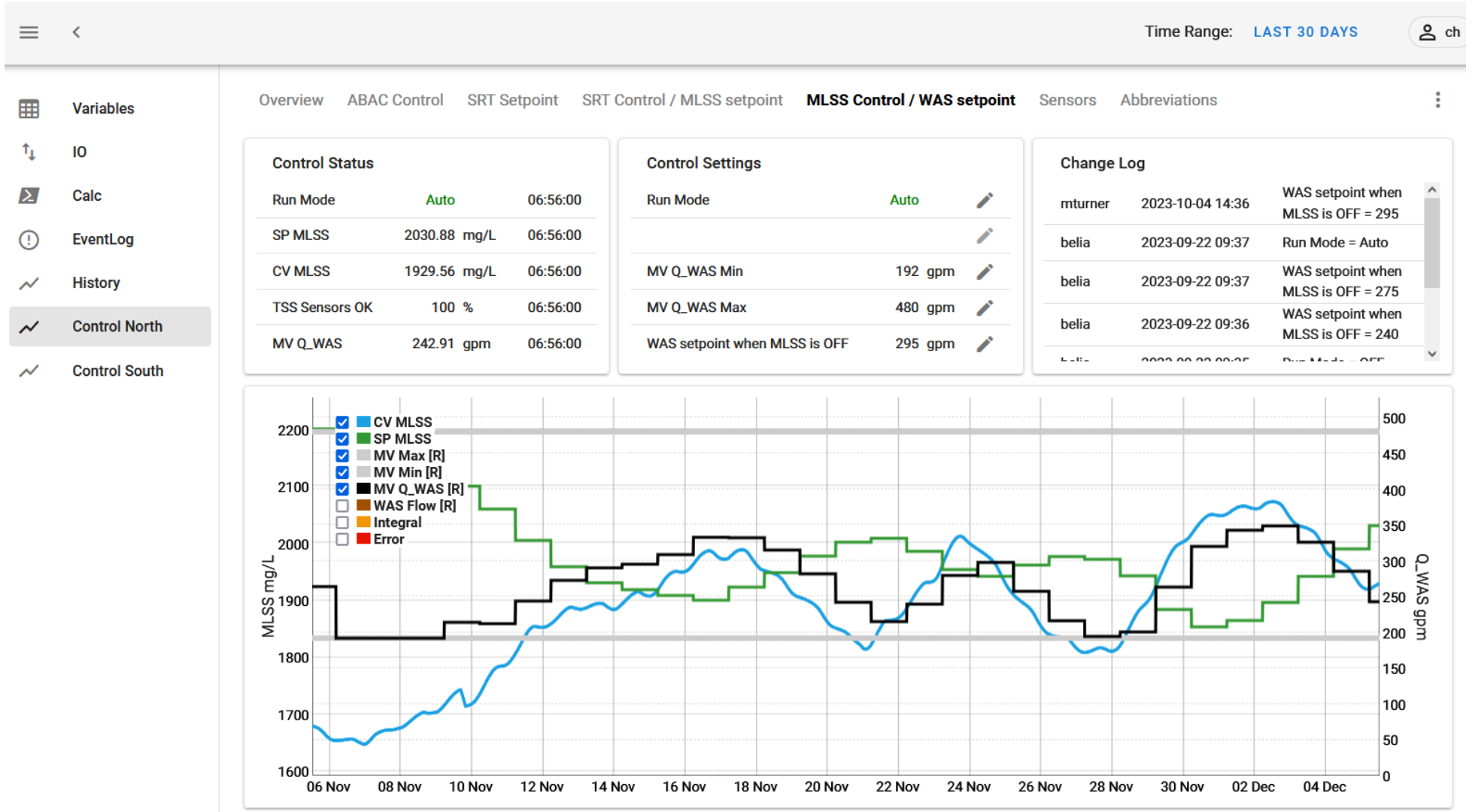


ifak*FAST* – AppConfig.xml

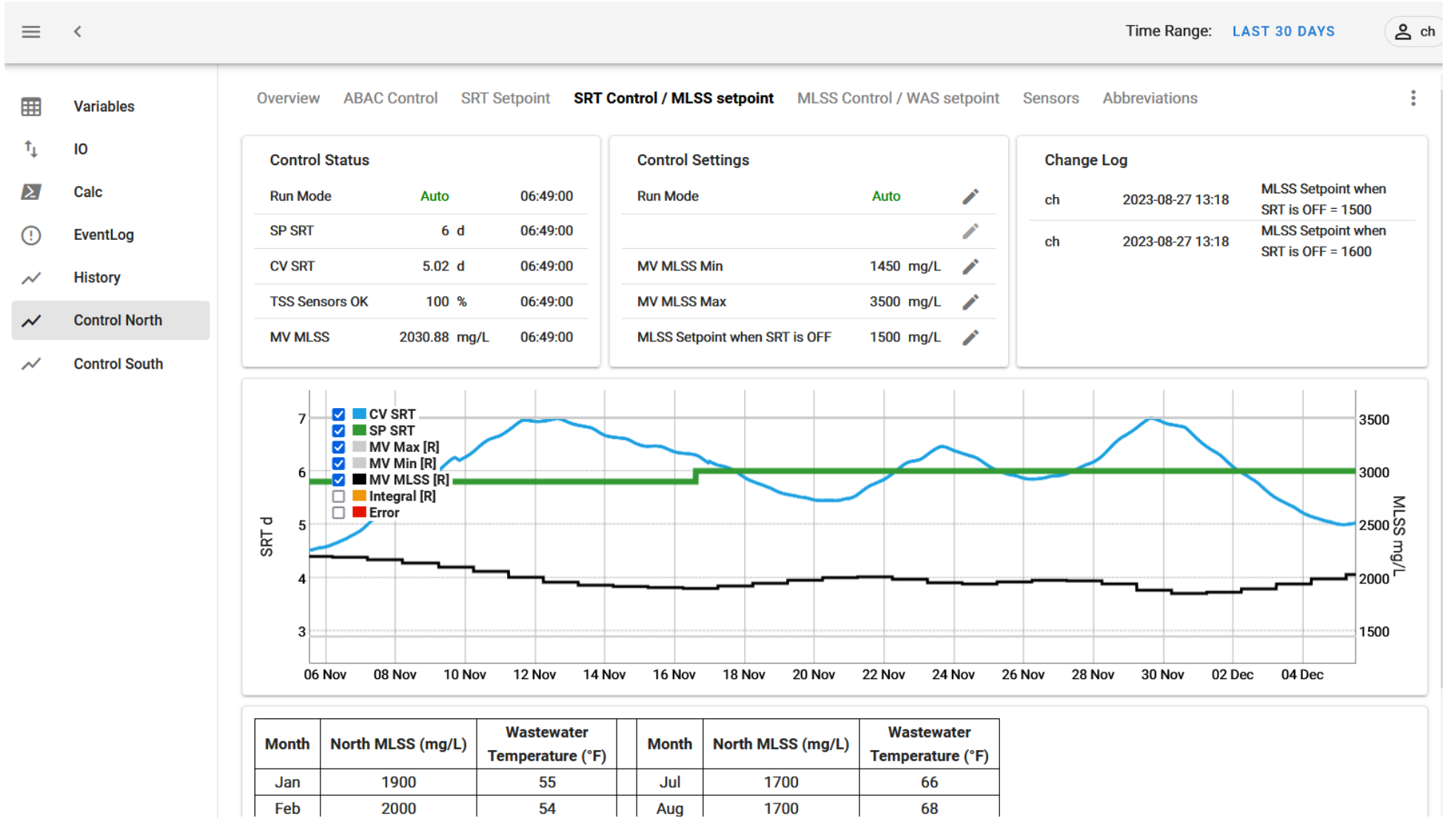
- AppConfig.xml is the main configuration file and defines:
  - **ClientListenPort**: The port number to listen on mainly for module to core communication but also for other clients (default value: 8081)
  - **ClientListenHost**: the corresponding host part, e.g. localhost or IP address
  - **Modules**: All module instances and provides immutable high level config options
  - **UserManagement**: Users and roles
  - **Locations**: Set of named entities arranged in a tree structure that can be referred to when defining objects (e.g. a Sensor object specifies at what part of a WWTP it is located)
- All configuration options can be inspected by looking at: https://github.com/ifakFAST/Mediator.Net/blob/master/Mediator.Net/MediatorCore/Configuration.cs

ifak*FAST* Dashboard – Example screenshot – ABAC

ifak*FAST* Dashboard – Example screenshot – MLSS control

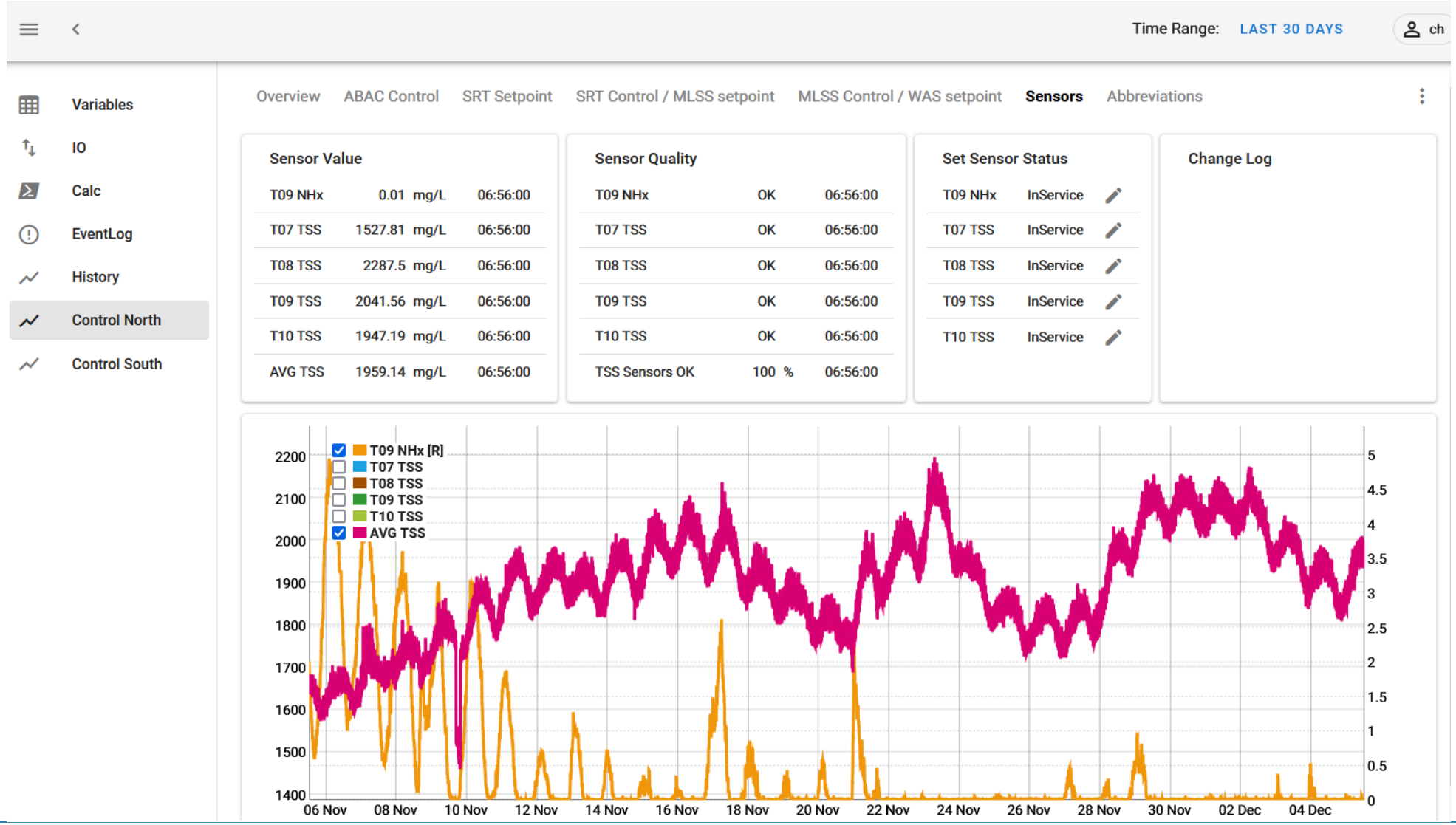


ifak*FAST* Dashboard – Example screenshot – SRT control



Month	North MLSS (mg/L)	Wastewater Temperature (°F)		Month	North MLSS (mg/L)	Wastewater Temperature (°F)
Jan	1900	55		Jul	1700	66
Feb	2000	54		Aug	1700	68

ifak*FAST* Dashboard – Example screenshot – Sensors

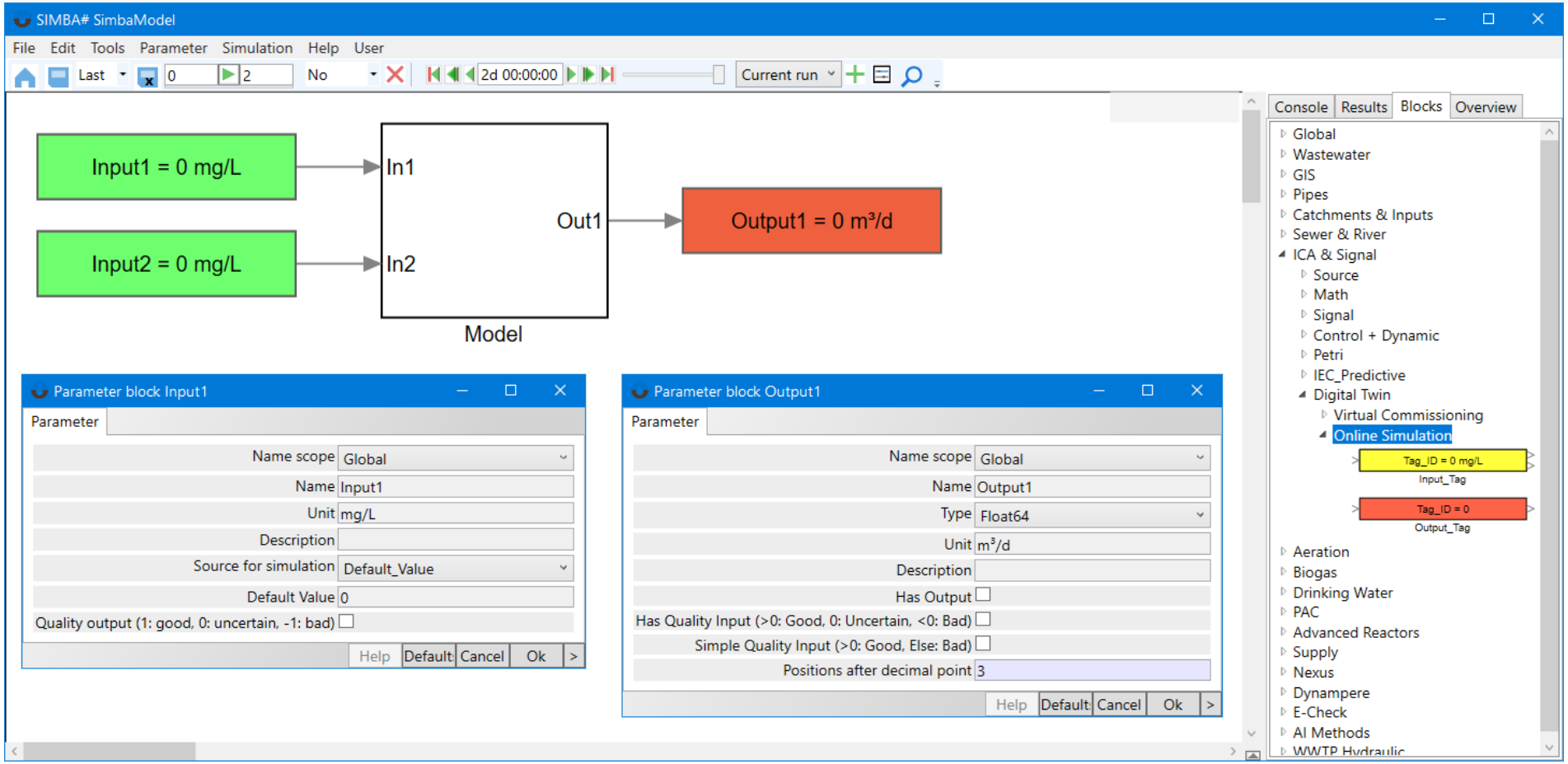


Digital Twin Applications with SIMBA

There are two main approaches for using SIMBA with ifak*FAST* :

1. Use the SIMBA **HTTP REST API** inside of an ifak*FAST* calculation (either using C# or Python)
   - Full control / maximum flexibility but requires good understanding of the HTTP API
   - Using the HTTP API from within ifak*FAST* allows for leveraging the IO and visualization capabilities of ifak*FAST*, e.g. read/write of tags via OPC UA, timeseries plots
2. Use the special ifak*FAST* **calculation type "SIMBA"** and exchange data with the model using dedicated Input/Output blocks
   - No knowledge of the SIMBA API required
   - The SIMBA model is simulated continuously in real time (orchestrated by ifak*FAST*)
   - Everything interesting happens inside of the SIMBA model itself, e.g. prediction of measurements/states using observer/predictor blocks
   - Clear separation between modelling and data integration for online use

Digital Twin Applications with SIMBA – Input / Output blocks



- The input and output blocks define abstract tags
- The mapping to specific variables from e.g. the IO module needs to happen in Model_Calc.xml
- Quality output ports can be enabled for the Input blocks in order to define alternative behavior when inputs become unavailable
- The simulation state is persisted in the Data folder (regular .ssi file)

References (1)

ifak***FAST*** is used in several research projects for data acquisition, visualization and calculations, e.g.:

- **DynaWater4.0** – Dynamic value added networks through digital collaboration between industrial water management and production: https://www.ifak.eu/en/projects/dynawater40
- **ZwillE** – Digital twin for AI-supported management of extreme water events in urban areas: https://www.ifak.eu/en/projects/zwille
- **OSCAR** – Innovative process control system for the reliable and efficient operation of wastewater treatment on board (cruise) ships: https://www.isah.uni-hannover.de/en/institute/news-and-events/news/news-details/news/projekt-oscar-abgeschlossen
- **KKAOnline** – Reduction of environmental pollution from small wastewater treatment plants KKA by online monitoring with digital twins for sustainable water resource management: https://www.ifak.eu/en/projects/kkaonline-reduction-environmental-pollution-small-wastewater-treatment-plants-kka-online
- **ELEMENT** – Energy Management System for the Coordinated Charging of Electric Cars in Apartment Buildings: https://www.ifak.eu/en/projects/element

References (2)

Customers/installations of ifak***FAST*** outside of research projects:

- **inCTRL Solutions**: https://www.inctrl.com/
  - Several installations on municipal WWTPs and Biogas plants in the US
  - Use cases: Data acquisition, visualization, supervisory control in combination with SIMBA#, transfer of process data to the cloud, online simulation
- **SEWACO**: https://sewaco.cz/
  - Several installations on municipal WWTPs and pumping stations in Czech Republic
  - Use cases: Data acquisition, visualization, supervisory control in combination with SIMBA#
- **Jacobs**: https://www.jacobs.com/
  - Several installations to collect waste water timeseries data in the US
  - Use cases: Data acquisition, Data processing, visualization / dashboards