

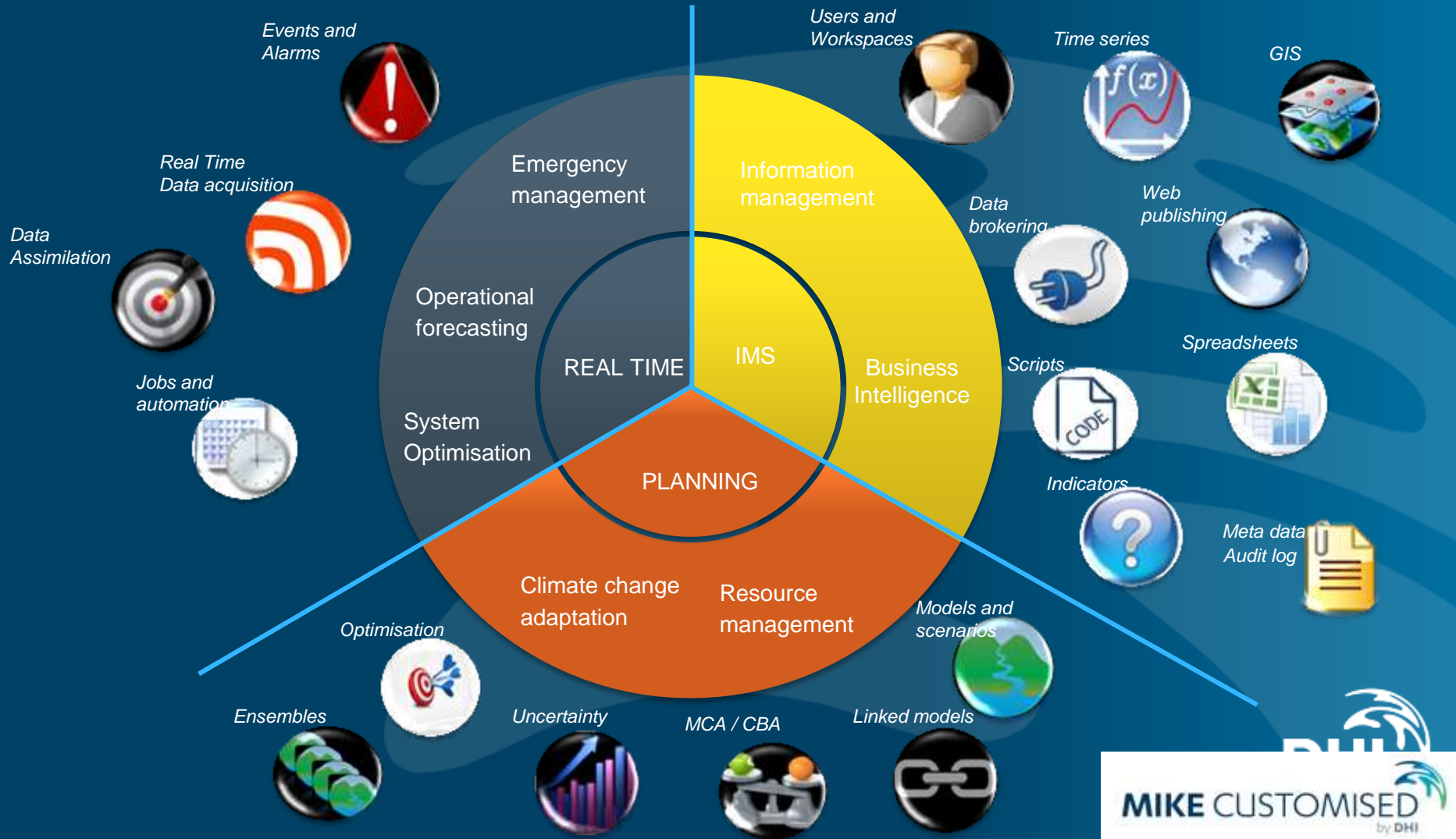
Gestione avanzata delle acque in ambito urbano: distribuzione, collettamento e depurazione, esperienze internazionali

Ing. Davide Persi

Torino, 14-15 Ottobre 2015



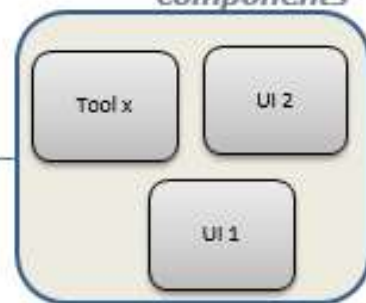
Italian DHI Conference 2015



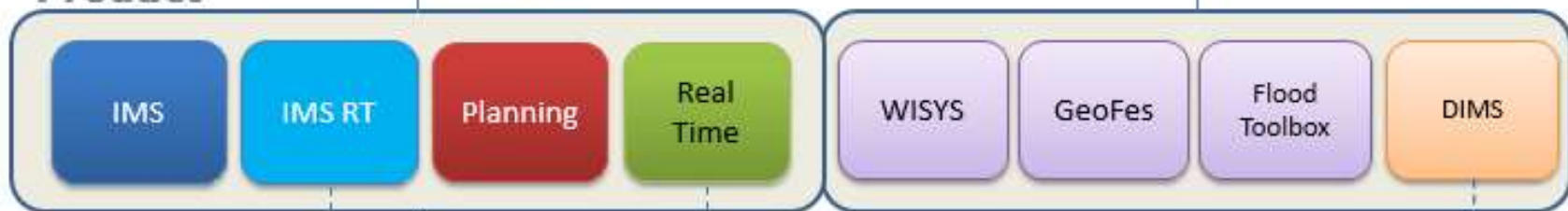
Client Solutions



Tailor made components



Product



Generic Components (the Platform)



Il Sistema di Zurigo

Online model for hydraulic and water quality analysis



Acquedotto di Zurigo - Dati

- 50 000 000 m³/anno
- 390 000 abitanti
- 13 zone di servizio
- > 100 000 condotte in GIS

Finalità del sistema on-line

- Dettagliata conoscenza della rete
- Pianificazione interventi di manutenzione
- Ottimizzazione qualità dell'acqua
- Verifica di fattibilità dell'estensione all'intera rete



Obiettivi

- **Funzionamento in tempo reale della rete**
- **Età dell'acqua**
- **Miscelamento diverse fonti**
- **Analisi di eventi passati**
- **Previsione**
- **Comunicazione allarmi**
- **Valutazione del posizionamento di nuovi sensori**



VISUALIZATION
UOW MONITOR, EXCEL,
EPANET, MIKE URBAN, (MC)



ON-LINE MODELS
(CASCADE MODELING)



PRE-PROCESSING

Data collection, pre-processing, validation...

PRESENT
(Real time)

Results calculation in real time

- Calculation pressures, flows, WQ anywhere
- Checking of model calibration

PAST
(Hind cast)

Analyses of nonstandard events in past

- Emergency situation – learning, understanding

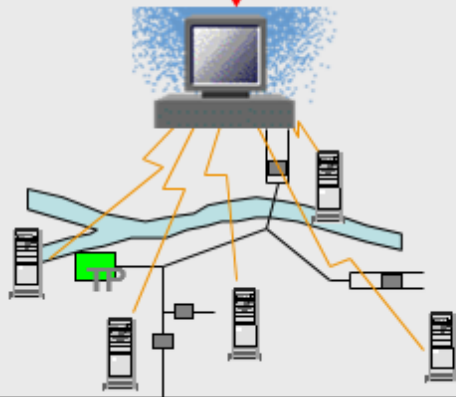
FUTURE
(Forecast)

Checking of future system operation:

- Analysis, warning, optimization

**ALARMS, BACKUP,
FILE MANAGEMENT**

Checking of system functionality, model accuracy, advanced data managements



PLS (SCADA) -
Process station
- measured data
collection in
selected
location

**PIPE
MAINTENANCE**



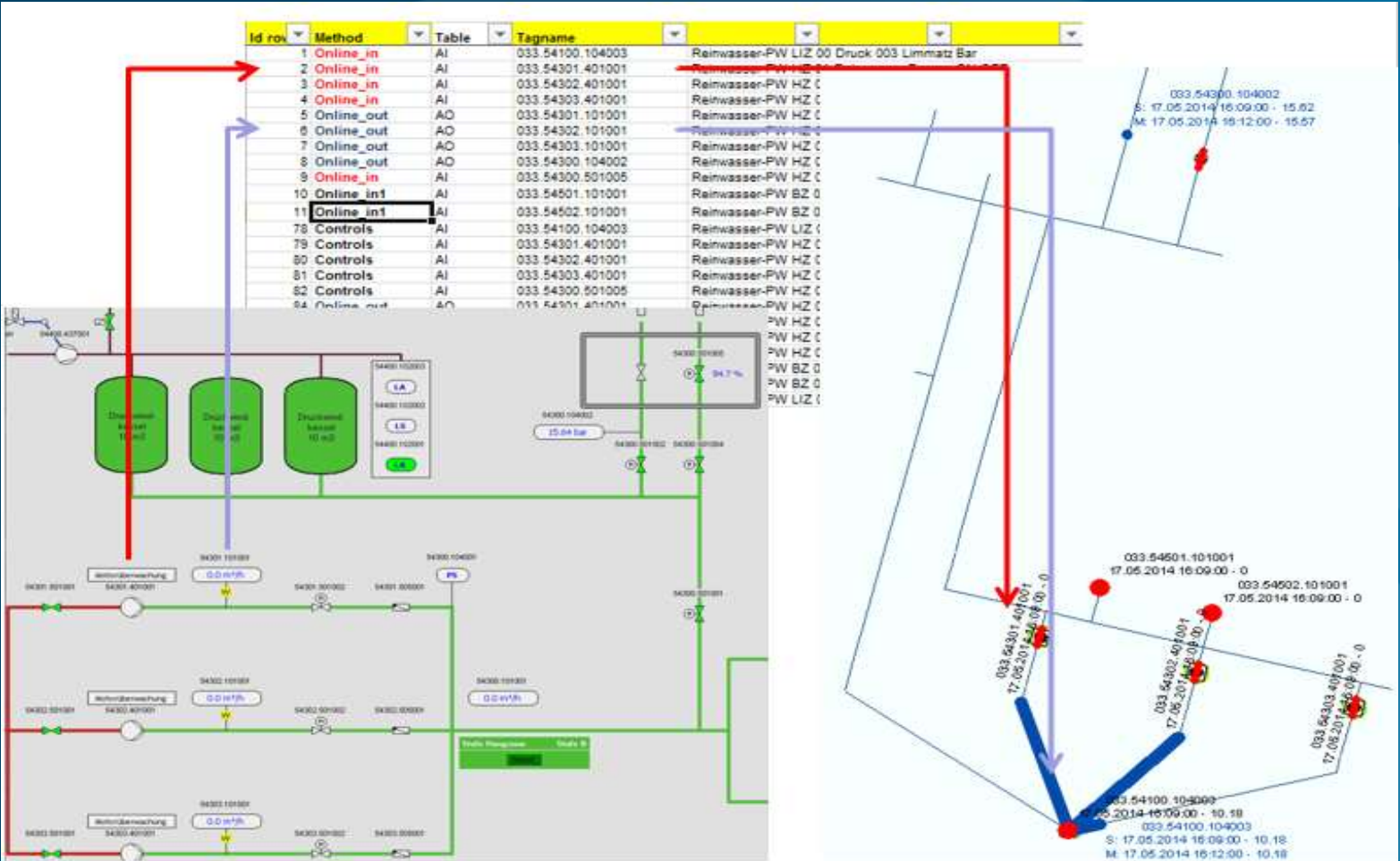
**Off-line
models**



GIS



Project description: Model-SCADA interconnection



Validazione dati – MIKE CUSTOMISED

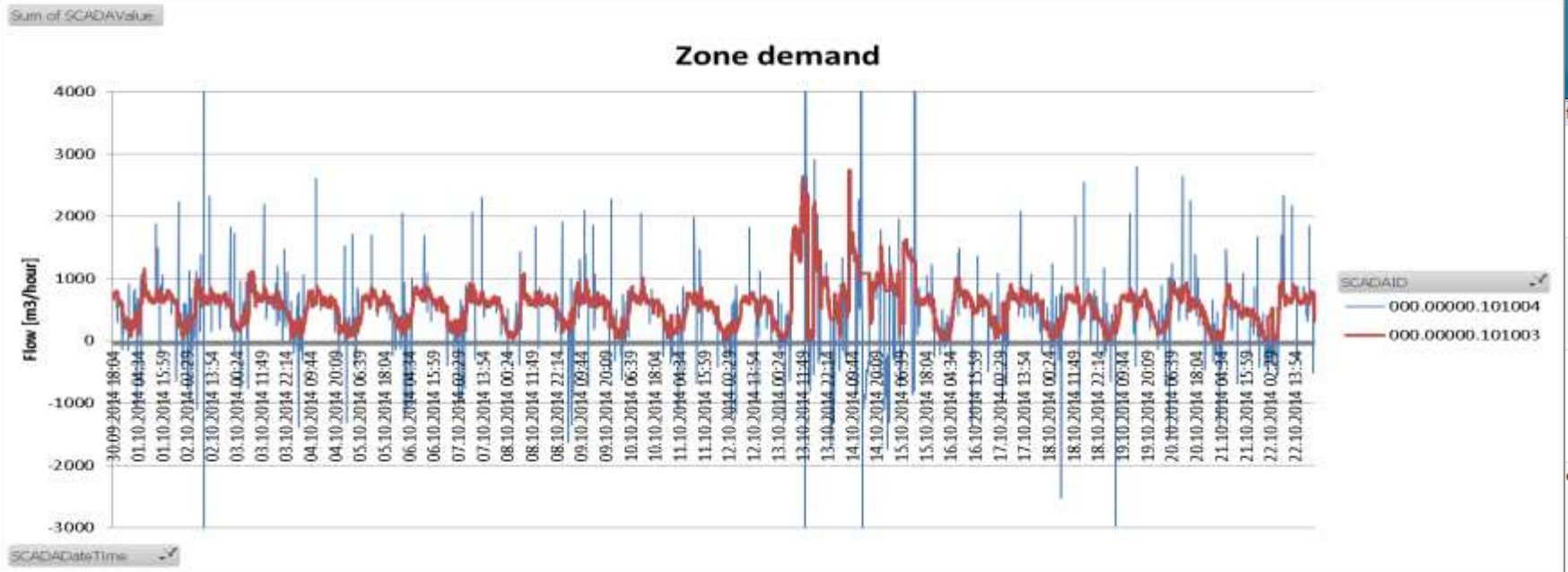
Data failure detection

- Method D1
- Method D2
- ...

Failure Repair

- Method R1
- Method R2
- ...

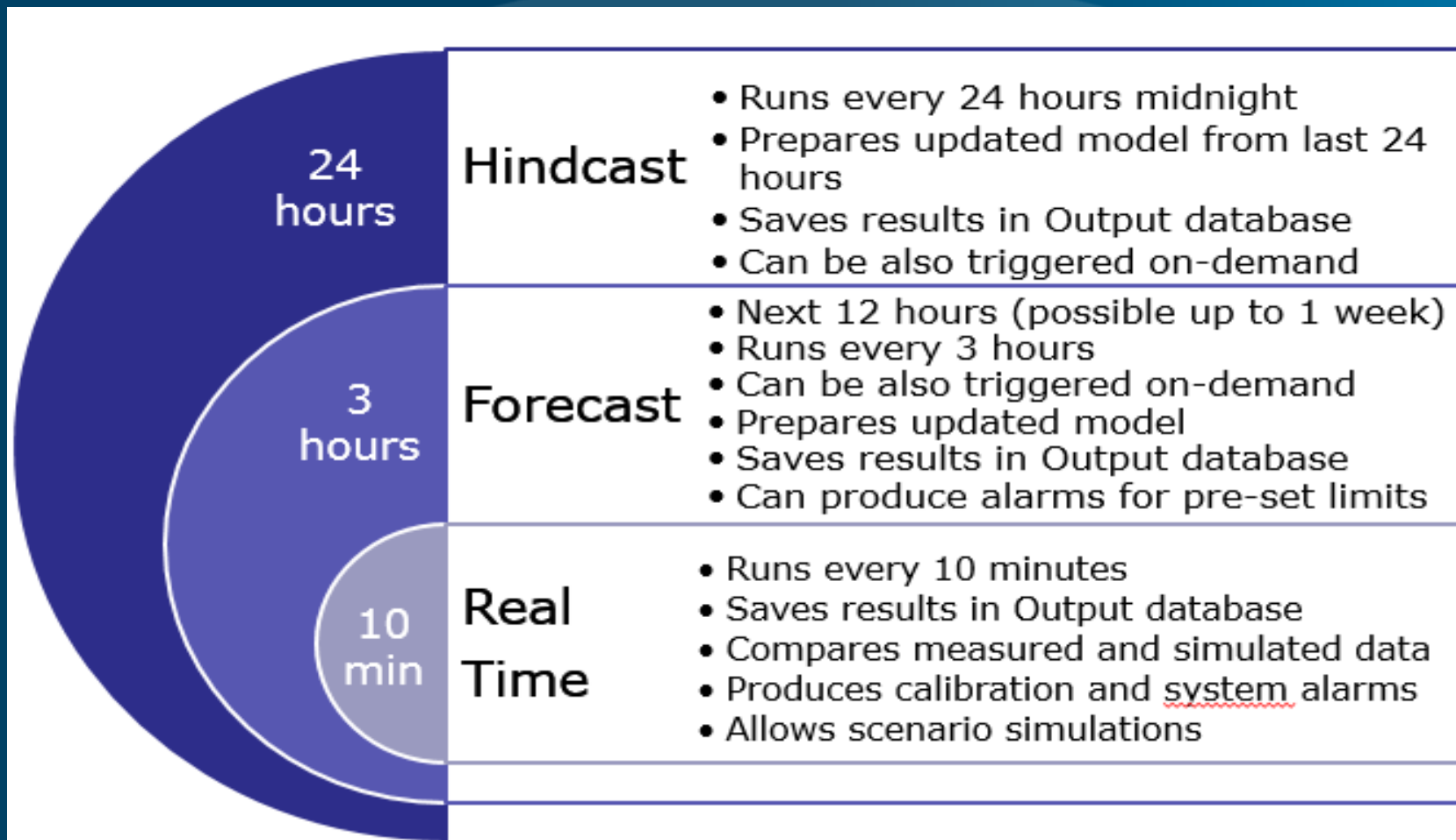
ShortName
D1
D2
D3



finition

es

SCHEMA FUNZIONAMENTO

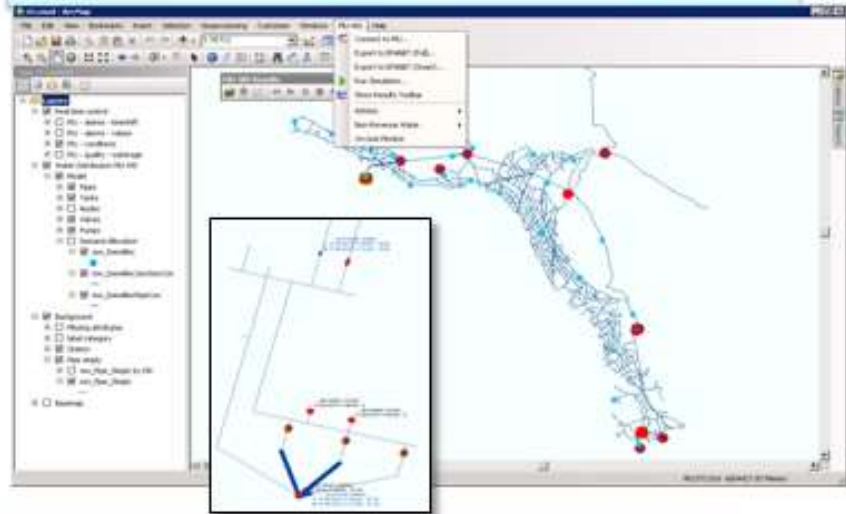


Maintenance Module



GIS_ID	MU-ID	DN	Street	Pressure Zone	ClosingBeginningDate	ClosingBeginningTime	ClosingEndDate	ClosingEndTime	Cause
120824	5762	900	Reservoir Strickhof	HZS	03.12.2013	07:50	05.12.2013	10:00	Leitungsinspektion
108829	1 10605	800	Buecheggstrasse	HZS	06.01.2014	08:00	31.01.2014	15:00	Sicherheitsabstellung
82504	1 3322	800	Buecheggstrasse	HZS	06.01.2014	08:00	31.01.2014	15:00	Sicherheitsabstellung
94647	1 14925	150	Gladbachstrasse 96	HZS	04.02.2014	15:00	26.02.2014	12:00	Rohrbruch
92020	6338	150	Schaffhauserstrasse 59	HZS	27.02.2014	11:00	28.02.2014	16:00	Rohrbruch
9215	1 1466	100	Höhensteig 4	HZS	18.03.2014	10:00			Rohrbruch
376696	1 10420	150	Lenggstrasse 1	HZS	18.03.2014	10:00			Rohrbruch
82505	5883	800	Buecheggstrasse bei Nr. 21	HZS	14.04.2014	08:00	21.05.2014	16:00	Klappeneinbau
24208	3932	800	Buecheggstrasse bei Guggächstr.	HZS	14.04.2014	08:00	21.05.2014	16:00	Klappeneinbau

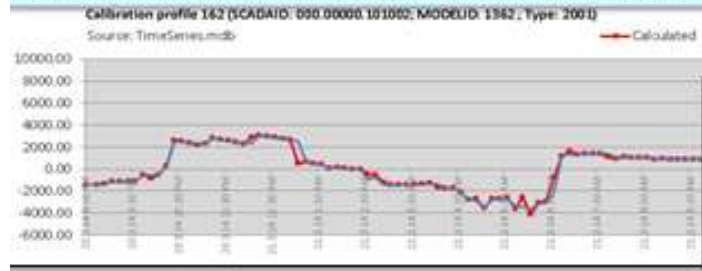
Presenting on-line results in UOW monitor, alarming



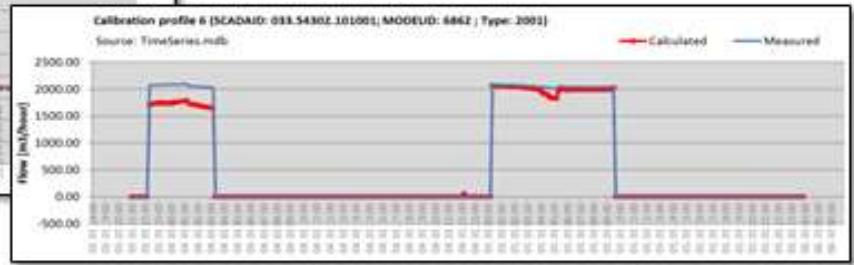
On-line water quality simulation - Water age



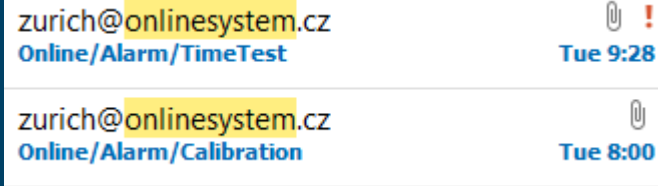
Comparison of measured and simulated values, model calibration



Comparison of operational scenarios



ALLARMI – MIKE CUSTOMISED



- Errori di sistema

RunTime	OCI2Time	OCI2TimeDiff	OCI2TimeDiffLimit	Comment
19.05.2014 05:56:42	19.05.2014 04:09:00	0.07	0.01	Error: online connector - Import 2 - stopped

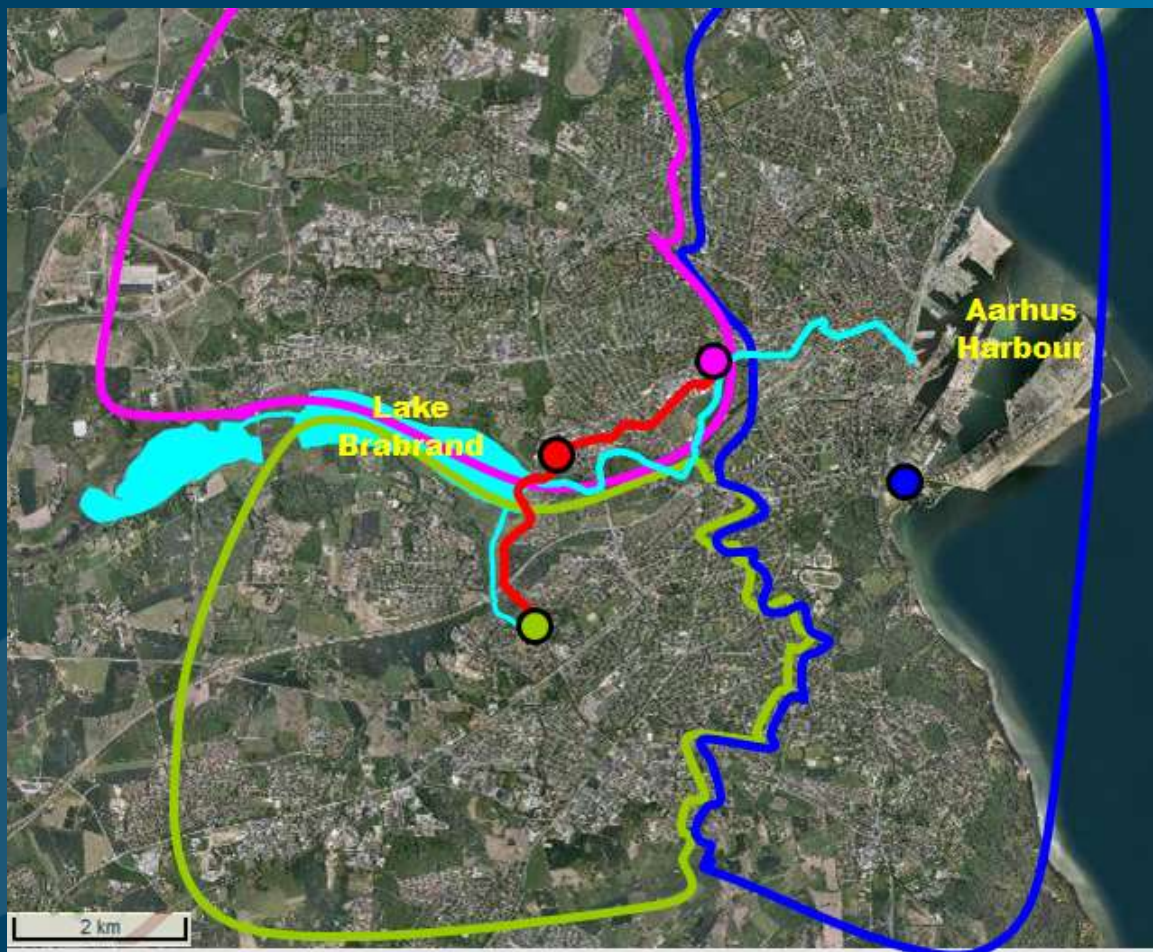
- Livello di calibrazione
- Differenza calcolato/osservato
- Superamento di limiti predefiniti

Zurich – On-line model – Benefits overview

Scenario	Benefits for client
Online	The calibrated model of the system
	Supporting the system control
	Alarms of any unexpected situations, water quality risks
	Results presentation in GIS environment – thematic maps analysis in a wider context and in real time.
	Monitoring of hydraulic quantities in the locations without possibility of measurement.
	Water turbidity assessment on the basis of water velocity in the pipe.
	Creation of professional map outputs (ESRI) prepared with actual results
Cascade modelling	Precise modelling of boundary conditions between models
	Dividing of big models in parts of reasonable size -> modelling of big cities
Past	Analysis of non-standard operational situations which occurred in the past (accidents,).
	Verification of system operational rules
Forecast	System assessment in future (day - week) – gap analysis and optimization.
	Maintenance planning
	Dispatcher “games” and decision support
	Planning during electric power failure

INTEGRATED REAL-TIME CONTROL AND WARNING FOR URBAN AREAS AND RECEIVING WATERS

Aarhus, Denmark



- WWTP Marselisborg and catchment
- WWTP Viby and catchment
- WWTP Aaby and catchment
- Pump. St. AabyVest and trunk sewers

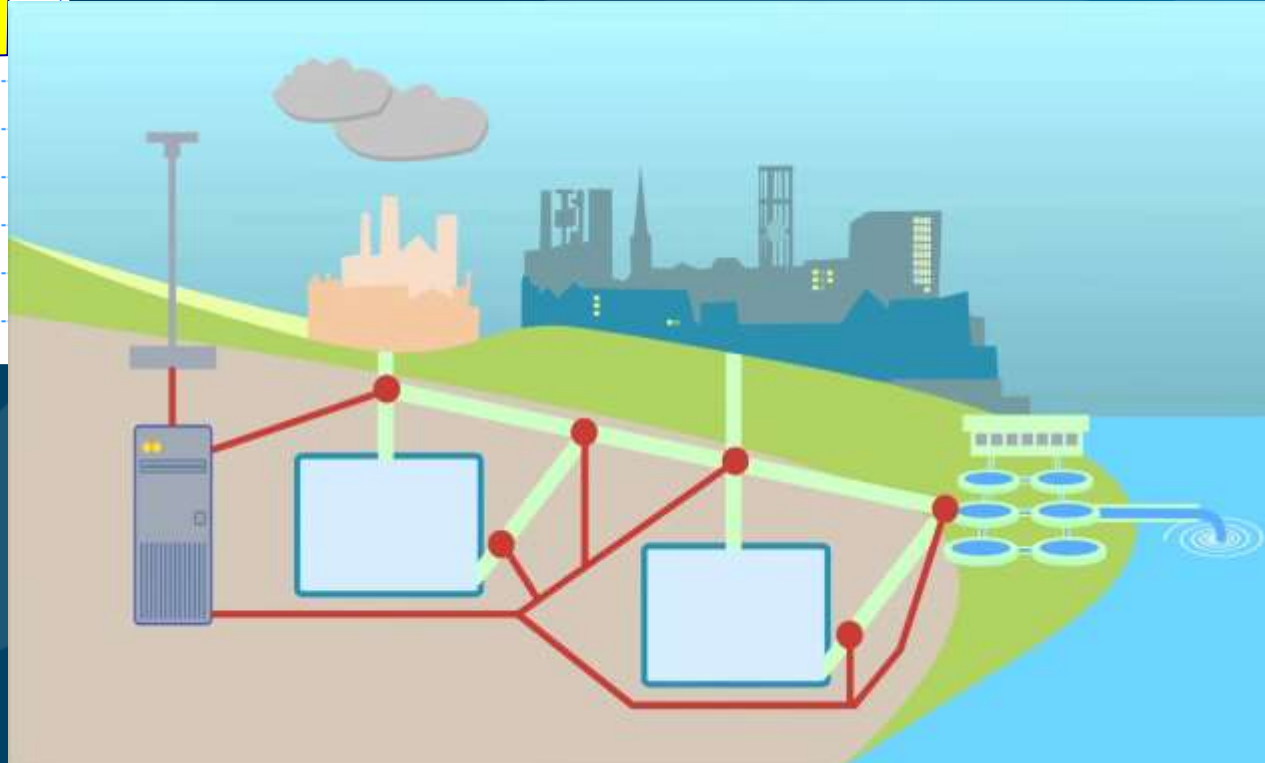
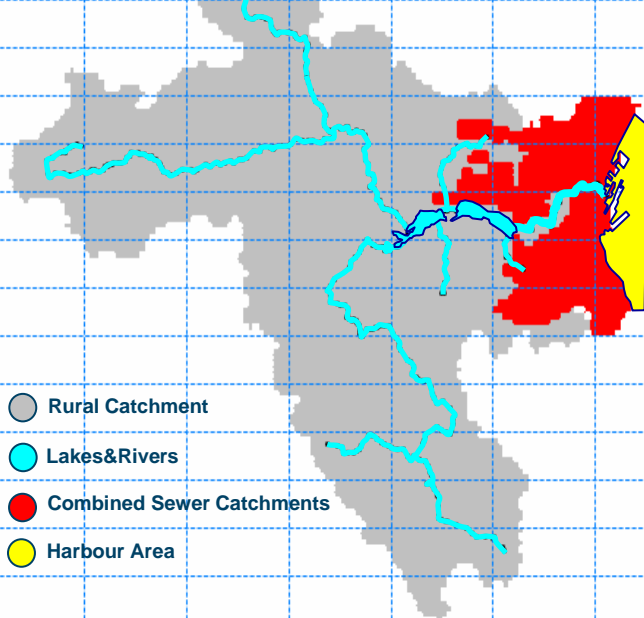
Punti chiave

- Water Framework Directive & Bathing water - Lake Brabrand
- Miglioramento qualità Fiume Aarhus
- Bathing water - Harbour

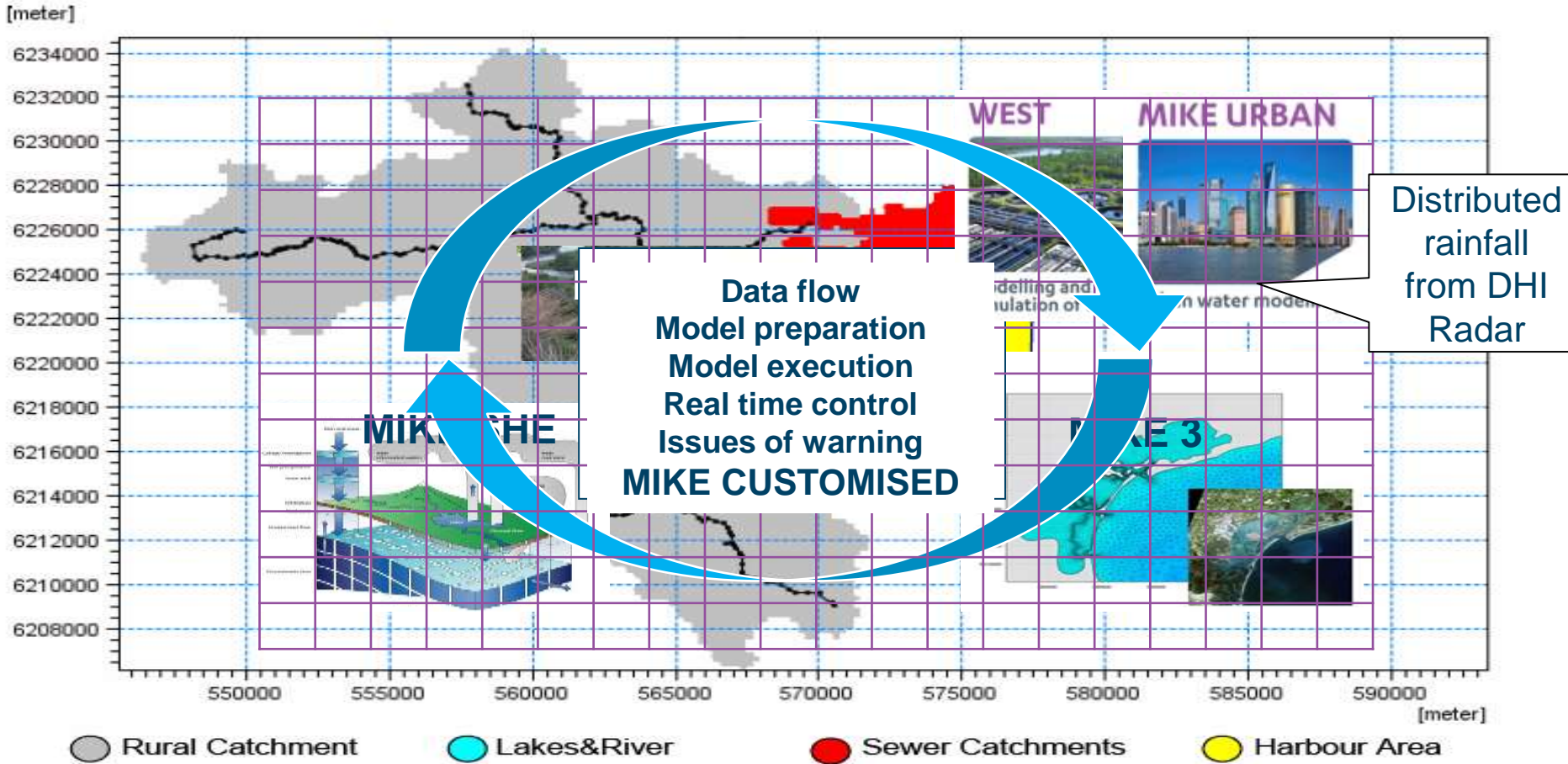


Schema concettuale e aree di applicazione

Modelling areas/boundaries



Schema modellistico



Obiettivi/necessità

A livello di infrastrutture

- Volume di ritenzione (limitato a causa di costi e spazi)
- Qualità scarichi (dipendenti dalla capacità idraulica e di disinfezione degli impianti)
- Cambi climatici (incremento intensità piogge e livelli mare)

A livello di monitoraggio

- Previsione della distribuzione spaziale delle piogge
- Modellazione in tempo reale
- Aumento della capacità di controllo (scaricatori, impianti di pompaggio,...)

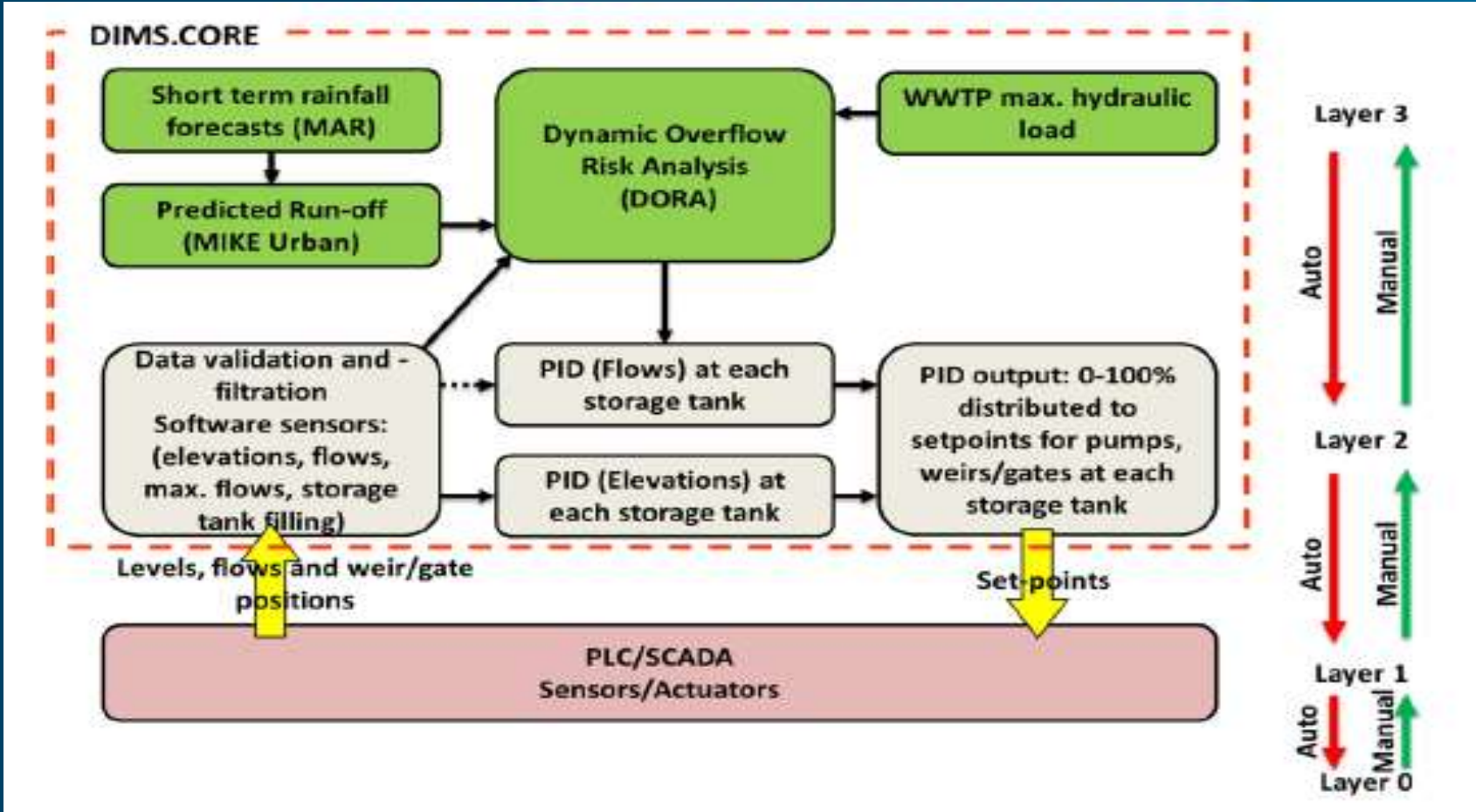


Soluzioni

- A livello di infrastrutture
 - Nuove vasche (approx. 55.000 m³)
 - Incremento della capacità idraulica agli impianti
- A livello di monitoraggio
 - Modellazione in tempo reale integrata (drenaggio, superficiale, WWTP)
 - Sistema di allertamento per la qualità delle acque di balneazione
- Costi
 - 50 mill. Euro con il DSS
 - 67 mill. Euro senza il DSS



Funzionamento del DSS – Livelli di operatività



Layer 1: Local Control

GATE/VALVE			
PI number	SM-TB010		
Description	Valve Dr. Margrethesvej		
Component	Knife gate valve DIN 400		
Actuator	Sipos 5 PROFITRON		
Location	Well road Dr. Margrethesvej		
Well number	Q01030K		
Elevations (meters)	Terrain	Cover lid	Top of pipe
	21.24	21.24	18.46
Valve movement (meters)	0.285		
Valve indication	Opening percentage		
PLC valve position address	TB747:DB96.DBDW 454		
Underbase /profibus add.	ET 200M /Profibus add. 13		
PLC located at	Trøjborg Basin		
SCADA node	Eskelund		
SCADA Tag Name	CO-SM-TB010-POS		
SCADA error Tag Name	CO-SM-TB010-DRIFTFEJL		
Image doc. files	IMG0097; IMG0100		



Layer 2 e 3

CBMB-Parameters

CBIP-Parameters

Tank vol: 14475 m3;
Red.Area: 67,5 ha

Used vol: 2223 m3
Filling: 15 %
Used depth: 3,3 mm
Aval. depth: 19,2 mm
MAR: 0,00 um/s

MBKB-Parameters

CBMBKB-Parameters

MBKB-Parameters

Tank vol: 1450 m3;
Red.Area: 18,9 ha

Used vol: 595 m3
Filling: 41 %
Used depth: 3,1 mm
Aval. depth: 4,5 mm
MAR: 0,00 um/s

KBIP-Parameters

Tank vol: 3675 m3;
Red.Area: 21,6 ha

Used vol: 2326 m3
Filling: 63 %
Used depth: 10,0 mm
Aval. depth: 6,2 mm
MAR: 0,00 um/s

HBIP-Parameters

Tank vol: 3275 m3;
Red.Area: 38,4 ha

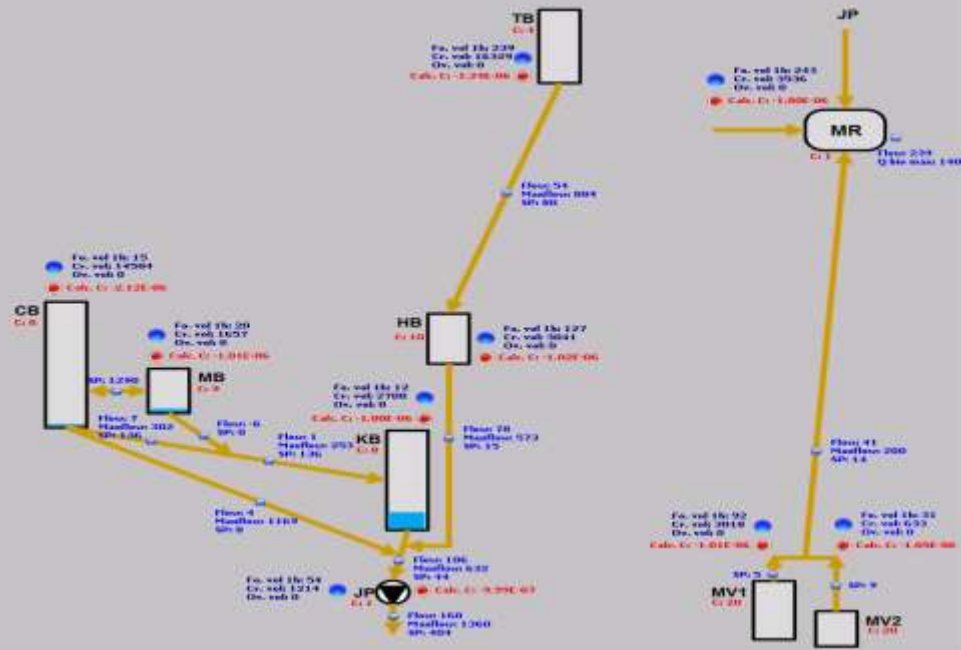
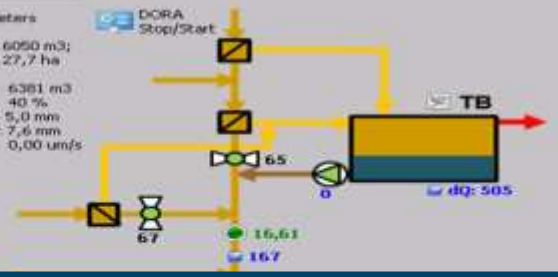
Used vol: 0 m3
Filling: 0 %
Used depth: 0,0 mm
Aval. depth: 0,5 mm
MAR: 0,00 um/s

TBIB-Parameters

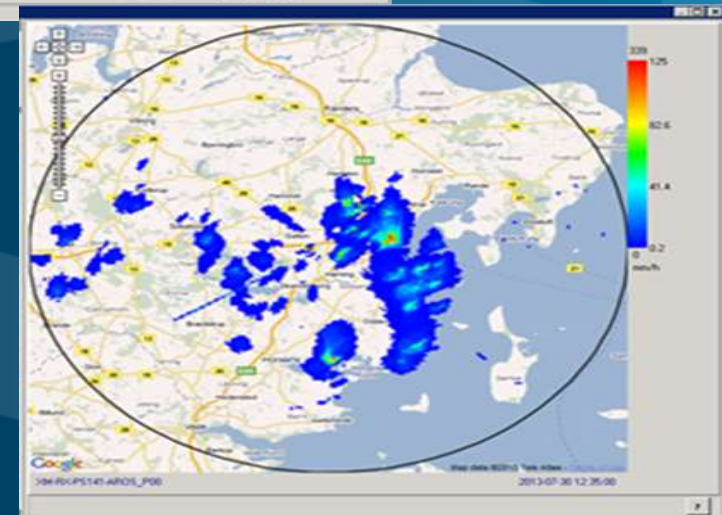
Tank vol: 16050 m3;
Red.Area: 127,7 ha

Used vol: 6381 m3
Filling: 40 %
Used depth: 5,0 mm
Aval. depth: 7,6 mm
MAR: 0,00 um/s

DORA Stop/Start



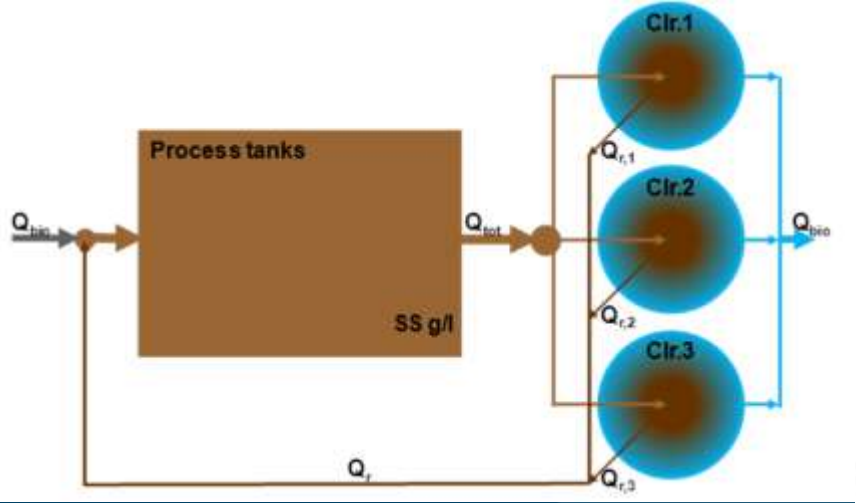
RADAR: calcolo della pioggia distribuita



Impianti: aumento della capacità idraulica

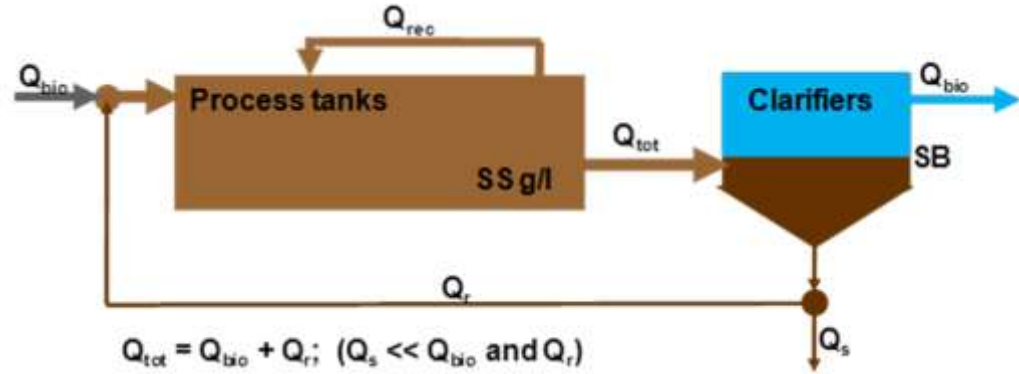
Potenziamento strutturale

Aumento dei sedimentatori secondari



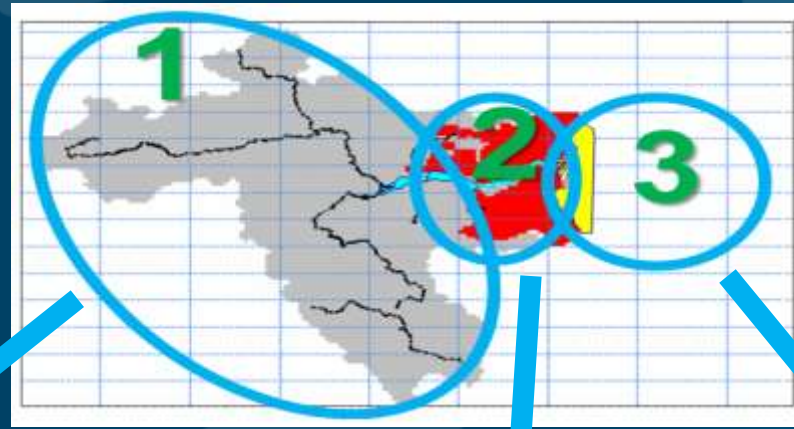
Potenziamento gestionale

Aumento temporaneo in fase di evento della velocità di sedimentazione



SISTEMA DI ALERTAMENTO IN TEMPO REALE

3 "ambienti" – 3 Autorità



Internet

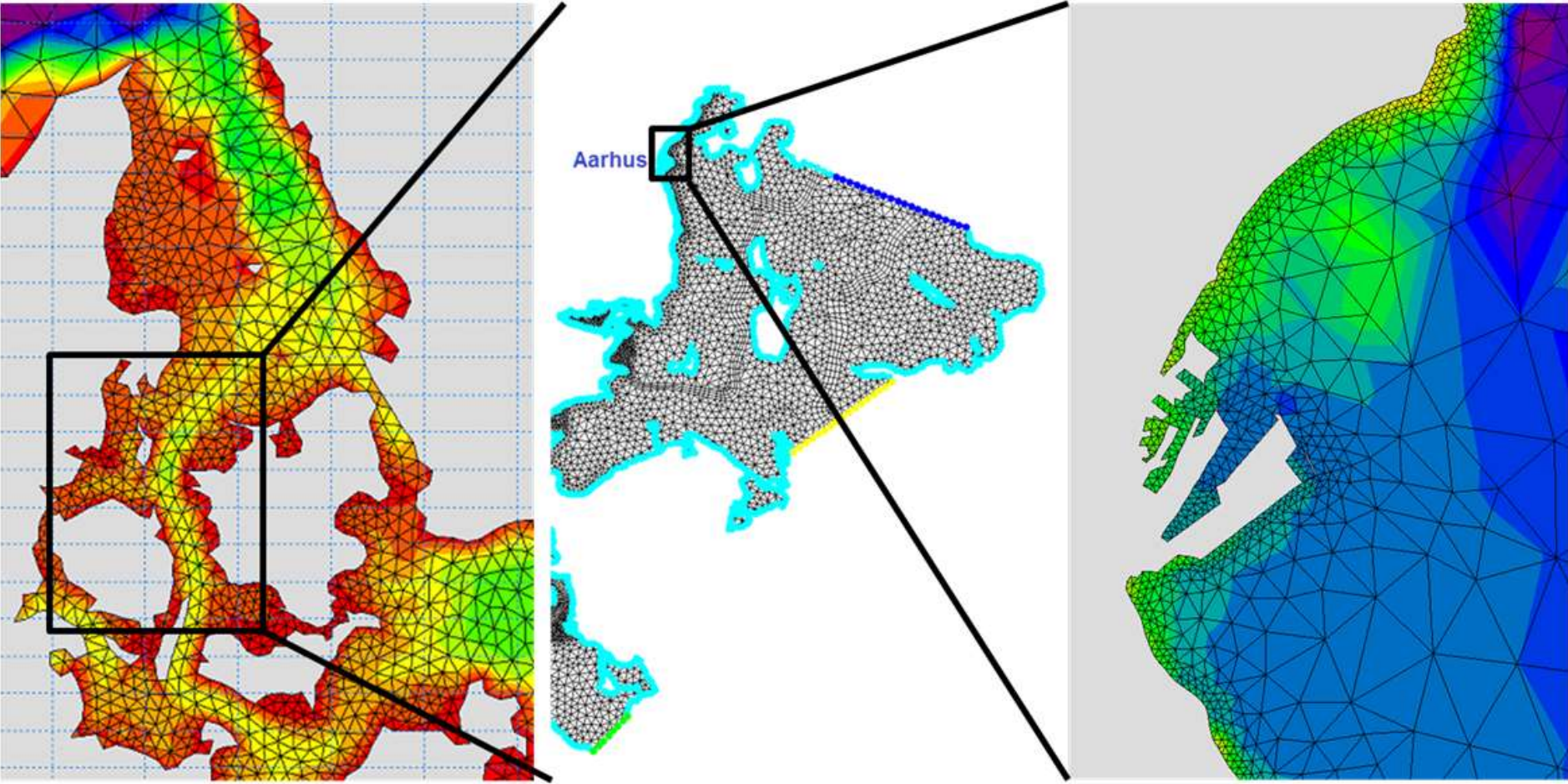
Environmental Section
Aarhus Municipality

Aarhus Water
Utility company

Waterforecast
Operated by DHI



Waterforecast System



Early Warning System: Web-site and smartphone/tablet App

Badning kan i nogle tilfælde medføre sundhedsrisiko. Flagene på kortet viser badevandskvaliteten i dag. Klik på et flag viser prognose for badevandskvalitet og strandvejr de kommende dage.

 **God** badevandskvalitet

 **Dårlig** badevandskvalitet

 Badevandsprognose under udvikling

 Badested lukket for sæsonen

Spring direkte til din kommune eller strand.

Aarhus

Se badevandsprognose for strand...









Du kan også få badevandsprognosen til **iPhone** og **Android**. Søg efter "badevand" eller klik herunder.



Badevandsudsigten bygger på en avanceret computersimulering af strøm, vandtemperatur, m.m. langs kysterne, samt - når der sker udledning af spildevand til havmiljøet - af koncentrationen af fækale indikatorbakterier ved badestrandene (badevandskvaliteten). Læs om detaljerne i [den tekniske beskrivelse](#).

Badevandsudsigten er udarbejdet af [DHI](#) i samarbejde med [Århus](#), [Vejele](#) og [Kolding](#) kommuner.



Alle strande		
 Bøllevej Aarhus	Luf: 18°C Vand: 13°C	3 km
 Den Femmønstrede	Luf: 19°C Vand: 13°C	3 km
 Open Water sportsbane	Luf: 18°C Vand: 13°C	4 km
 Åkragen	Luf: 18°C Vand: 13°C	3 km
 Havnbadet Aarhus	Luf: 18°C Vand: 13°C	3 km
 180 Ege B	Luf: 18°C Vand: 13°C	3 km
 Ege Mølle	Luf: 19°C Vand: 13°C	3 km
 Våhø Strand	Luf: 18°C Vand: 13°C	
 Tangkrogen	Luf: 18°C Vand: 13°C	
 Værst	Luf: 18°C Vand: 14°C	
 Skæring Strandpark	Luf: 18°C Vand: 14°C	
 Bøllevej	Luf: 18°C Vand: 13°C	
 Strandpark Strandpark	Luf: 18°C Vand: 14°C	



Havnbadet Aarhus			
1 DAG	16. september	17. sep.	18. sep.
			
Luf:	18°C	14°C	14°C
Vand:	14°C	13°C	13°C
Regn:	0 mm	0 mm	0 mm
Direkte afstand 5 km			



Grazie

Torino, 14-15 Ottobre 2015