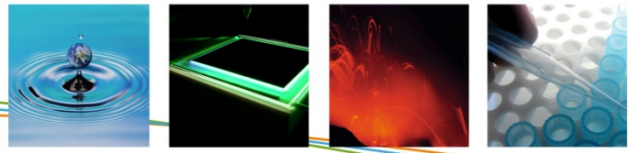


SAVEWATER

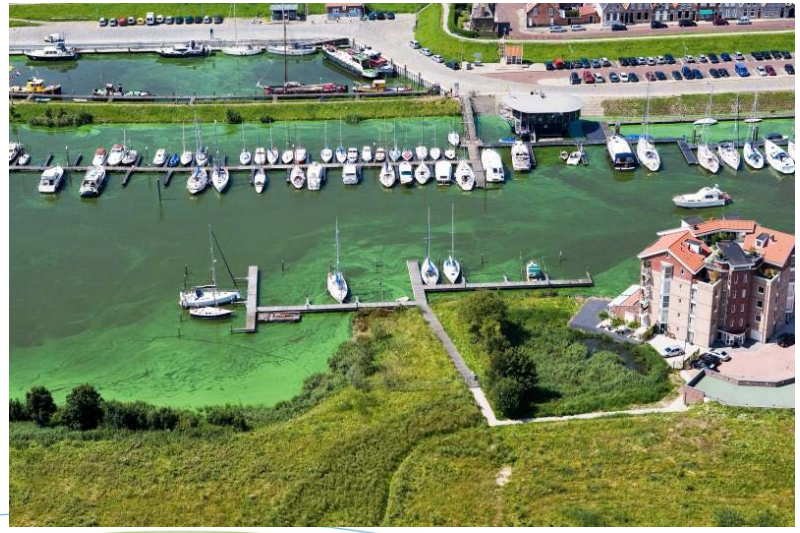
Integrated SAtellite-AUV services for sustainable WATER management

P. Seuntjens – VITO NV

Water management challenges

- Flooding
- Drought
- Water quality
- Sediment management

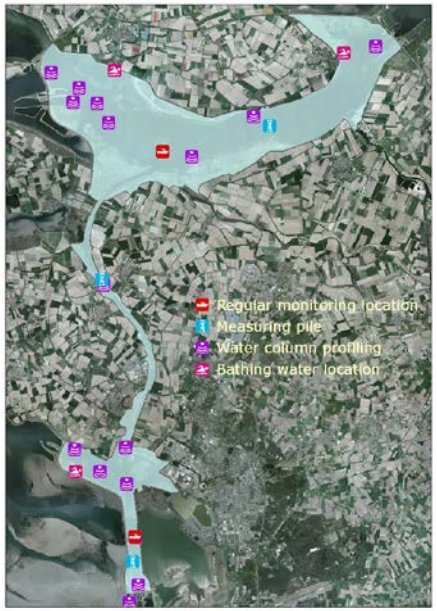
- Traditional monitoring is **far too costly** vis-a-vis the information gained



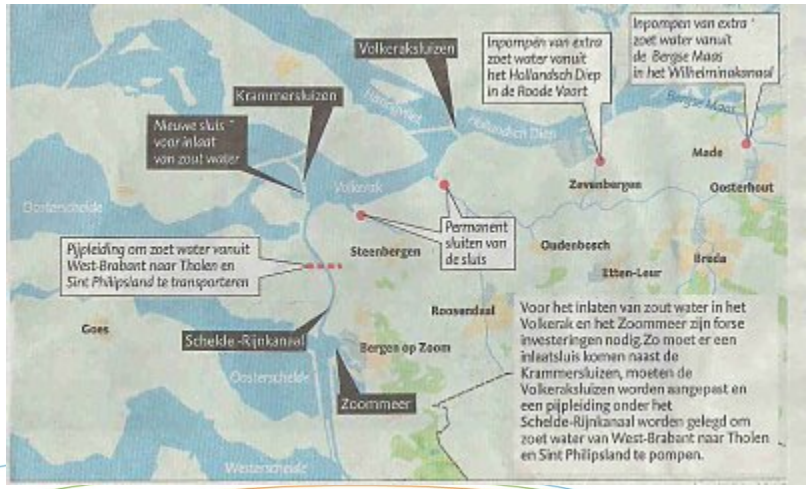
- Water management (treatment, restoration) **costs are huge**

User needs

- **Reduce monitoring costs** and at the same time generate **more information** over large areas

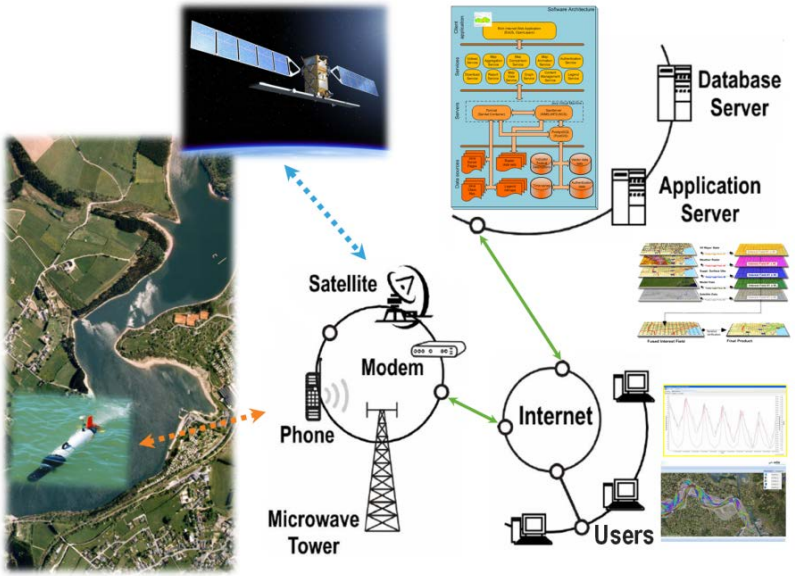


- Manage water more cost effectively: **avoid costly and ineffective measures** to restore the water system



Aim of Savewater

- **integrate** earth observation data with geo-referenced in-situ data delivered by monitoring with automated sensors mounted on **a**utonomous **u**nmanned **v**essels in water (AUVs)
- provide **water status monitoring and decision support** service
- provide **cost-effective solution** to water managers to improve their monitoring and programme of measures



User requirements Savewater

- **Derived from interviews of a big user group in the feasibility study (20+): drinking water companies, environmental agencies, maritime access, provinces, water boards**

- Coverage: 10s-100s km
- Spatial resolution: 10s-100s m
- Operational monitoring: usable scenes at least biweekly
- Rapid availability: < 5 d
- Depth: 3D information < 30 m
- Multiple water status indicators at the same time
- Specific software for integration of earth observation data with in situ measurements

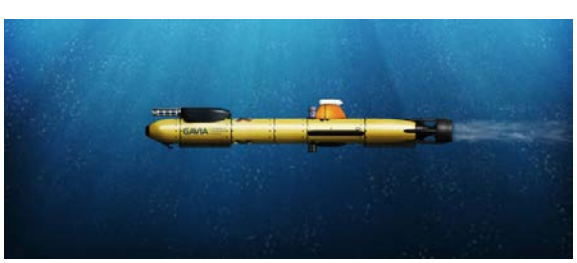
Earth observation

- Coverage
- Potential satellites/sensors
  - **Sediments**: TM, SPOT, ASTER, ALI, LISS-3, LISS-4, IKONOS, Quickbird, DMC, Formosat-2
  - **Algae**: MERIS (historical), Landsat, SPOT, ASTER, Rapideye, future Sentinel2, EnMap
- Trade-offs between spatial resolution and revisit and number of spectral bands
- Nowadays comes with a cost
- Low cost solutions highly needed and also expected
- **But**: low information content for water management

Sensor	SPOT				ASTER				Rapideye			
Availability:	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011
Upper Sûre	7	3	0	4	5	7	6	3	0	7	5	15
Ijselmeer	11	0	4	8	1	2	3	2	0	2	1	15
Markermeer	11	0	4	8	1	3	4	5	0	2	3	14
AWW Broechem	4	9	7	37	2	1	4	7	0	1	1	5
AWW Lier-Duffe	0	0	0	2	2	4	1	6	0	1	1	6
De Gavers	2	0	1	16	0	1	0	0	0	0	0	2
Total:	24	12	12	65	10	17	17	18		9	8	30
Technical:												
Resolution (m)	2,5 / 5 / 10 / 20				15 / 30 / 90				6.5			
Coverage (km)	60 Km x 60 Km to 80 Km at nadir				60				25			
Number of bands / bandwidth (nm)	4 / 70 - 90				VNIR 3 / 70 SWIR 6 / 100 TIR 5 / 350				5 / 40 - 125			
Centre wavelength or range (µm)	0.50 - 0.59 0.61 - 0.68 0.78 - 0.89 1.58 - 1.75				0.560 0.660 0.810				0.475 0.555 0.660 0.710 0.805			
Revisit (days)	up to 2 days, depending on latitude				16				up to daily			
Cost for minimum order size (US$)	1600 $ for archived data, higher rates on programmed or priority				free for NASA approved users				for 24-48h service: min. 650 $ add. 1%			
Cost per km² (US$)	3 $ for 1/8 scene from archive, higher rates for other products				free for NASA approved users				1.28 $			

In situ: AUVs

- Various AUV types available depending on size of water body: **mature**
- Mounted with sensors for positioning and water status monitoring: **mature**
- Collect high resolution data in 4D
- GNSS (EGNOS) and GBAS navigation
- Sense and avoid strategies

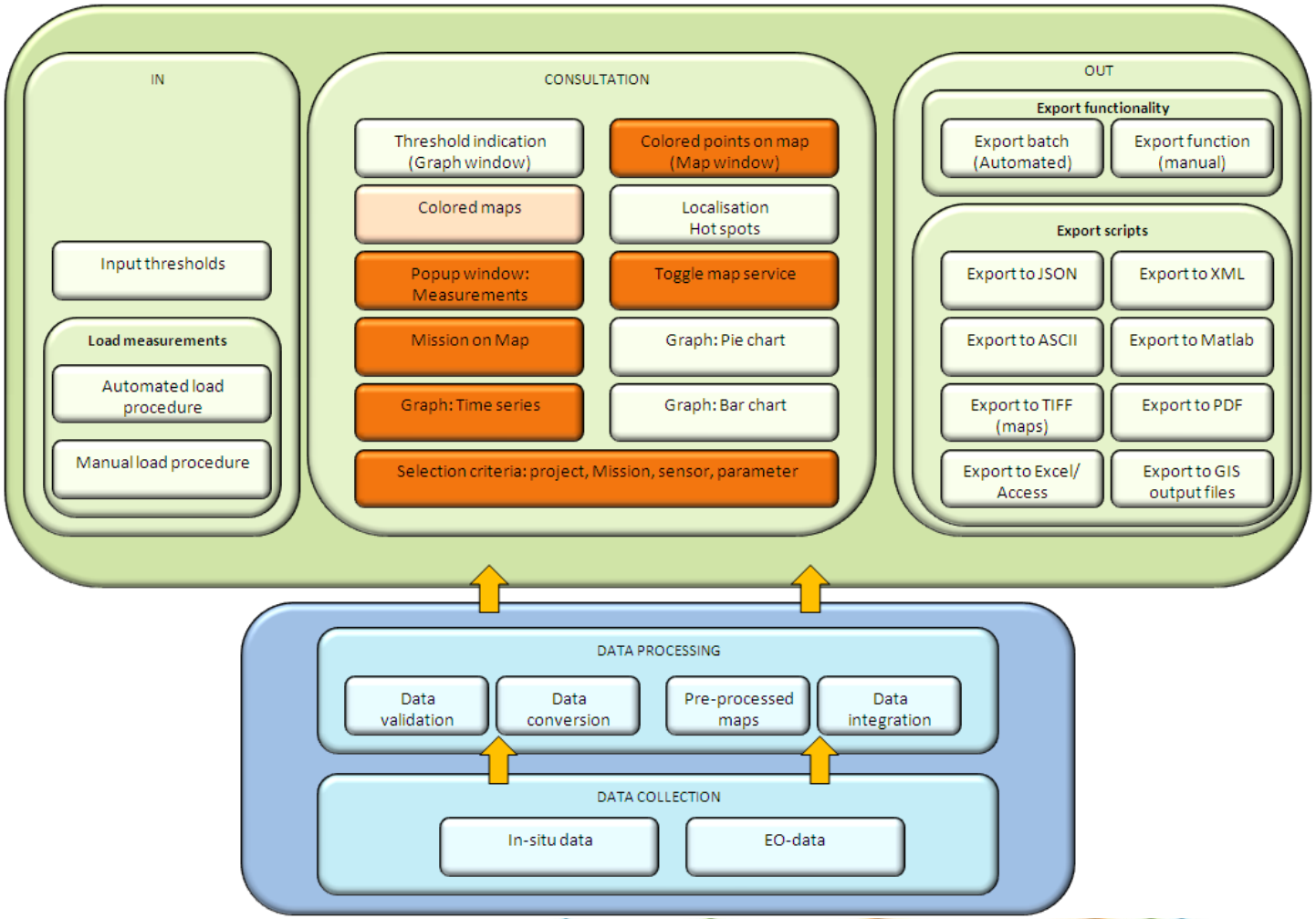








Savewater SS requirements/specifications



Proof of Concept demonstration

1. Freshwater reservoir at Broechem (Belgium) — 50 ha
   - » User AWW (drinking water production)
2. Salt water recreation pond “Spuikom” at Ostend (Belgium) — 100 ha
   - » User VMM (WQ monitoring)
3. Upper Sûre Lake (Luxembourg) — 5 km^2
   - » user SEBES (drinking water production)
4. Wadden Sea at the North Sea passage “Marsdiep” (the Netherlands) — 100 km^2
   - » User Rijkswaterstaat (WQ monitoring)
5. Lake IJssel, Lake Marker and Wadden Sea (the Netherlands) — 1000 km^2 / 2500 km^2
   - » User Rijkswaterstaat (WQ monitoring)

Proof of concept demonstration

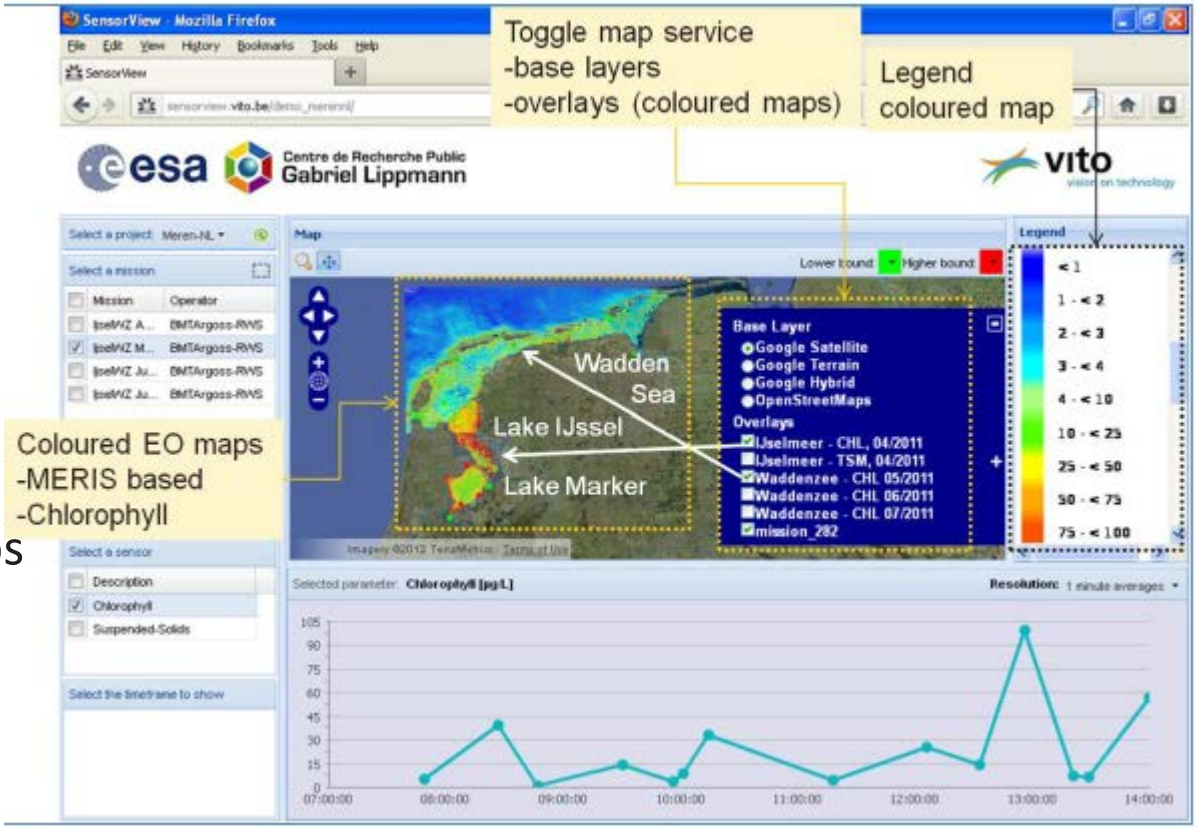
GeoServer and interface (webclient) functionalities

- Selection
- Mission on map
- Map navigation
- Coloured points on map
- Pop-up window individual point
- Graph time series

Proof of concept demonstration

GeoServer and interface (webclient) functionalities

- Toggle map service
  - Base layers
  - Overlays
- Coloured maps
  - EO images/maps
  - IS interpolated maps



Working environment/interface

» Drinking water reservoir in Broechem (user AWW)

SensorView - Mozilla Firefox

File Edit View History Bookmarks Tools Help

SensorView

sensorview.vito.be/demo_aww/

esa Centre de Recherche Public Gabriel Lippmann

vito vision on technology

Select a project: AWW

Select a mission

Mission	Operator	Date
Broec...	VITO	17 Sep '12
Broec...	VITO	17 Sep '12
Broec...	VITO	17 Sep '12
Broec...	VITO	11 Sep '12

Select a sensor

Description

Depth

Turbid

Chla

Select the timeframe to show

Map

Lower bound: Higher bound:

Imagery ©2012 Aerodata International Surveys, Cnes/Spot Image, DigitalGlobe, GeoEye - Terms of Use

Legend

20.00 <= x < 25.00

25.00 <= x < 30.00

30.00 <= x < 35.00

35.00 <= x

Broechem_CHL

< 3

3 - < 4

4 - < 5

5 - < 6

6 - < 7

7 - < 8

> 8

Selected parameter: **Chla [µg/l]**

Resolution: 1 minute averages

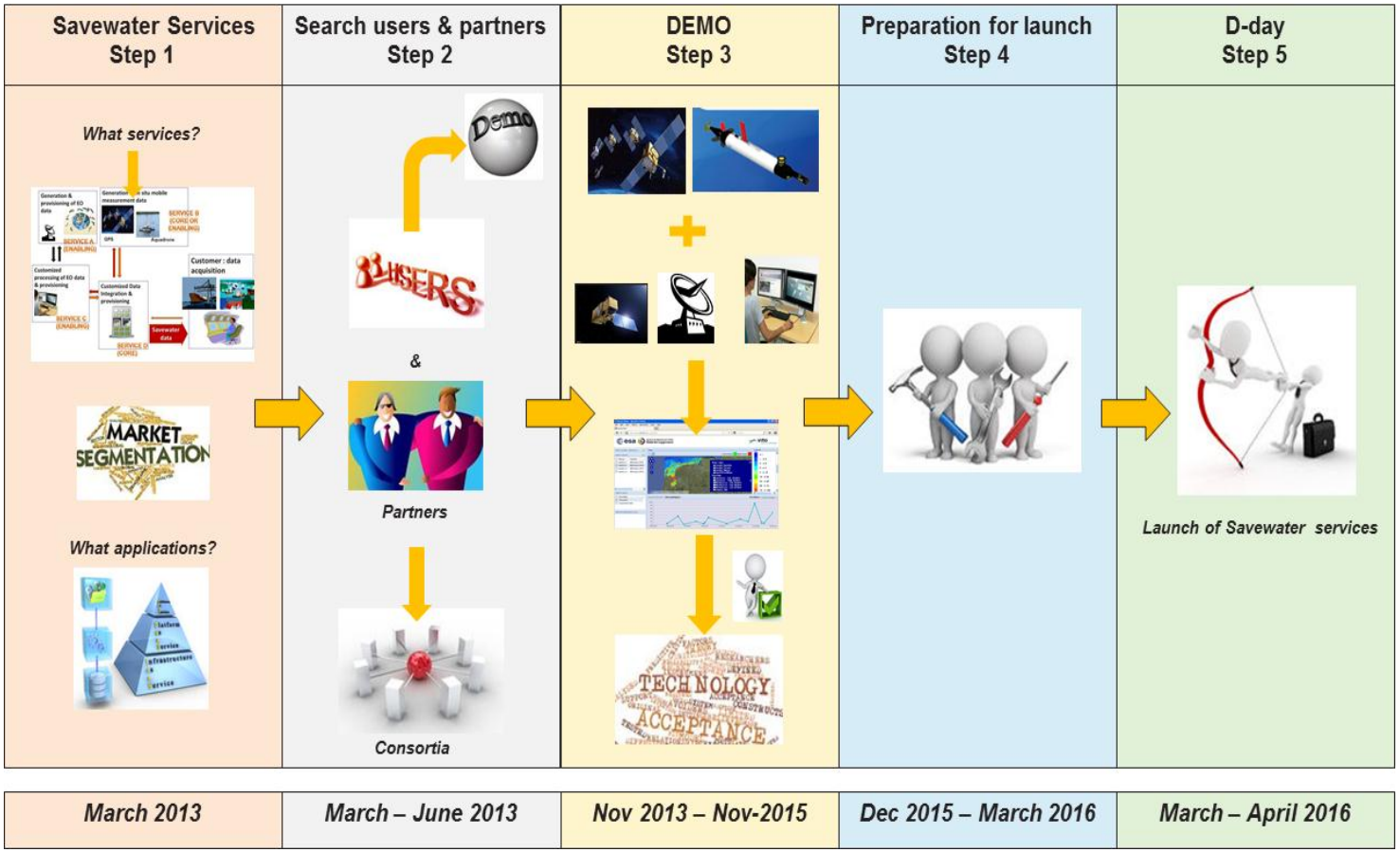
8 7 6 5 4 3 2 1 0

08:00:00 09:00:00 10:00:00 11:00:00 12:00:00 13:00:00 14:00:00

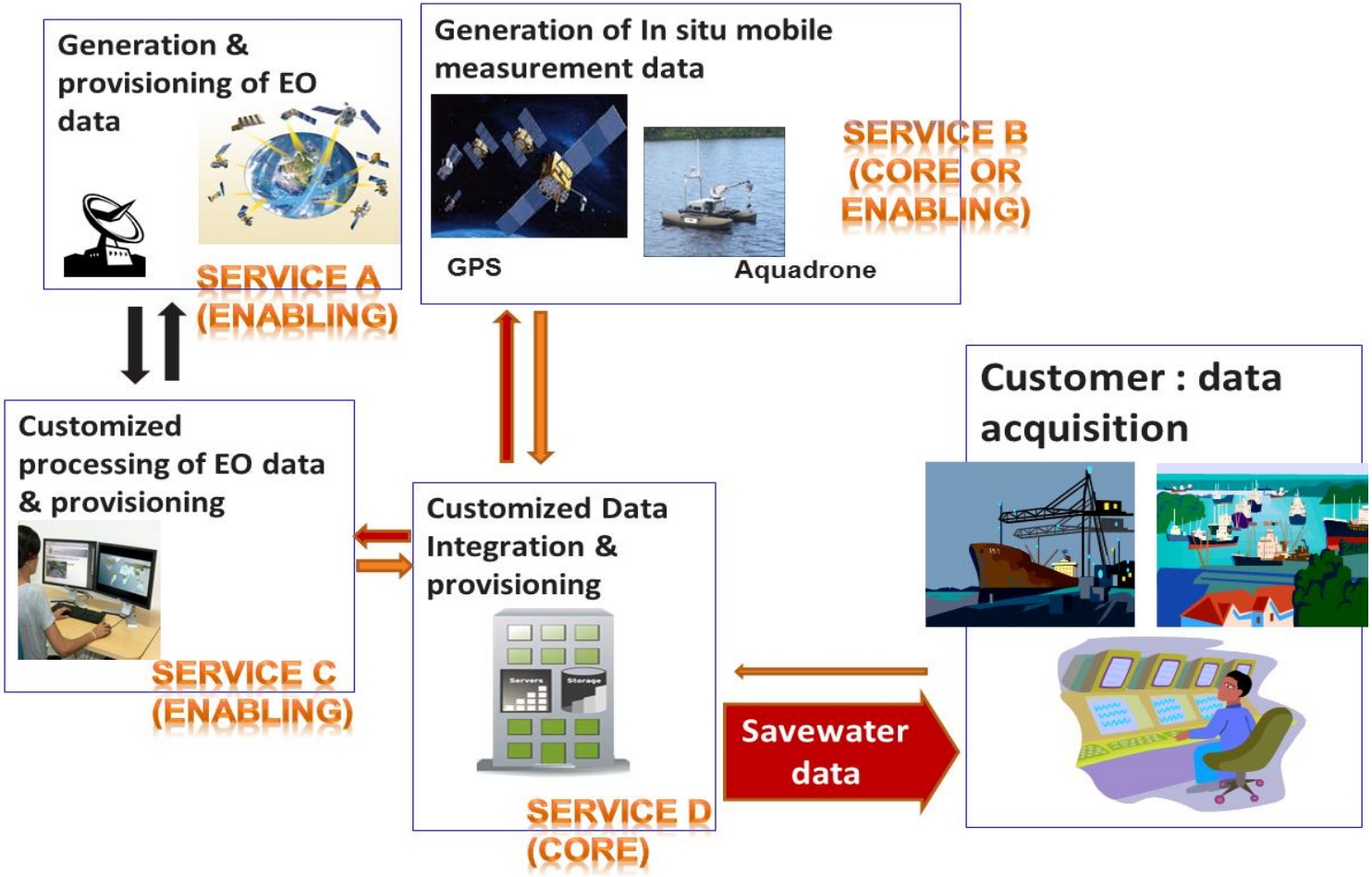
General outcome feasibility study

- **Feasible** for: frequent (biweekly) algal bloom and sediment monitoring in large water bodies (10s-100s km)
- **Viable** for: national monitoring agencies and port authorities and when treating more than one water issue –> high replication potential
- Successful proof of concept of integration, validated by the users

Roadmap to demonstration



Savewater service model

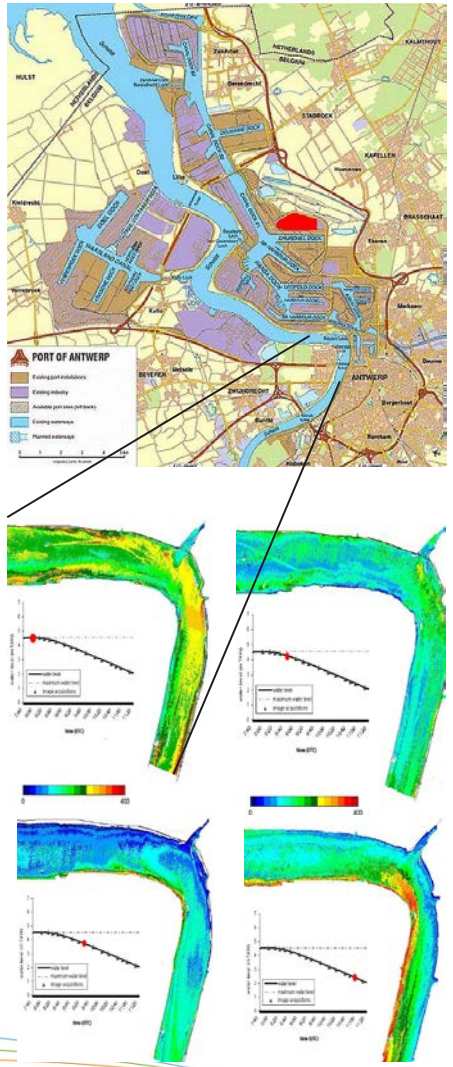


Intended consortium for the demo

- Core: Geo-ICT (negociating): integration software service provider (SME)
- Enabling: AUV provider (negociating) : operational (L)AUV service (SME)
- Enabling: Sensor provider (negociating): operational sensors for blue green algae, TSM (SME)
- VITO NV: development/verification of algorithms, models and updated software products
- Rijkswaterstaat (NL)
- Port of Antwerp (BE)

Demo case: Port of Antwerp

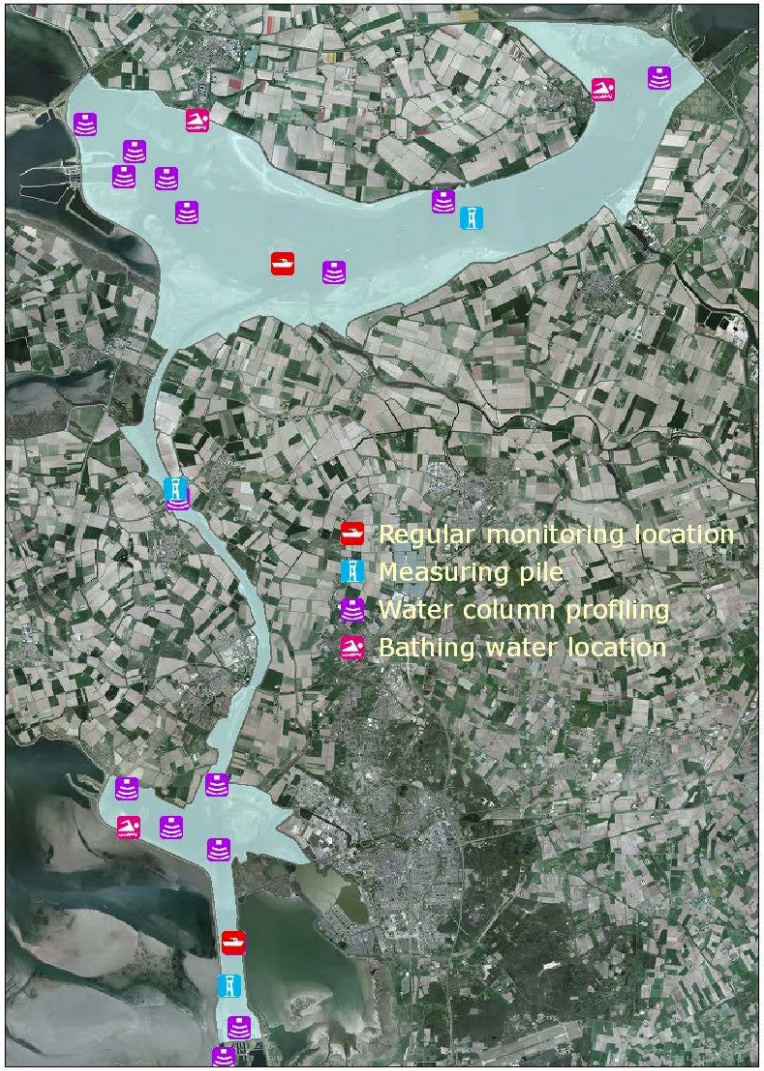
- **User needs**:
  - Decrease dredging costs
  - Map sediment resuspension, relocation and deposition due to ship movements, sluice movements and dredging operations
  - Map impacts on water quality
- **Savewater solution**:
  - Sediment maps in two and three dimensions on a regular basis
  - integrate maps in the GIS of the Port of Antwerp, delivering regularly updated spatial information on suspended matter distribution
  - Connect maps to models for sediment transport used by the PoA

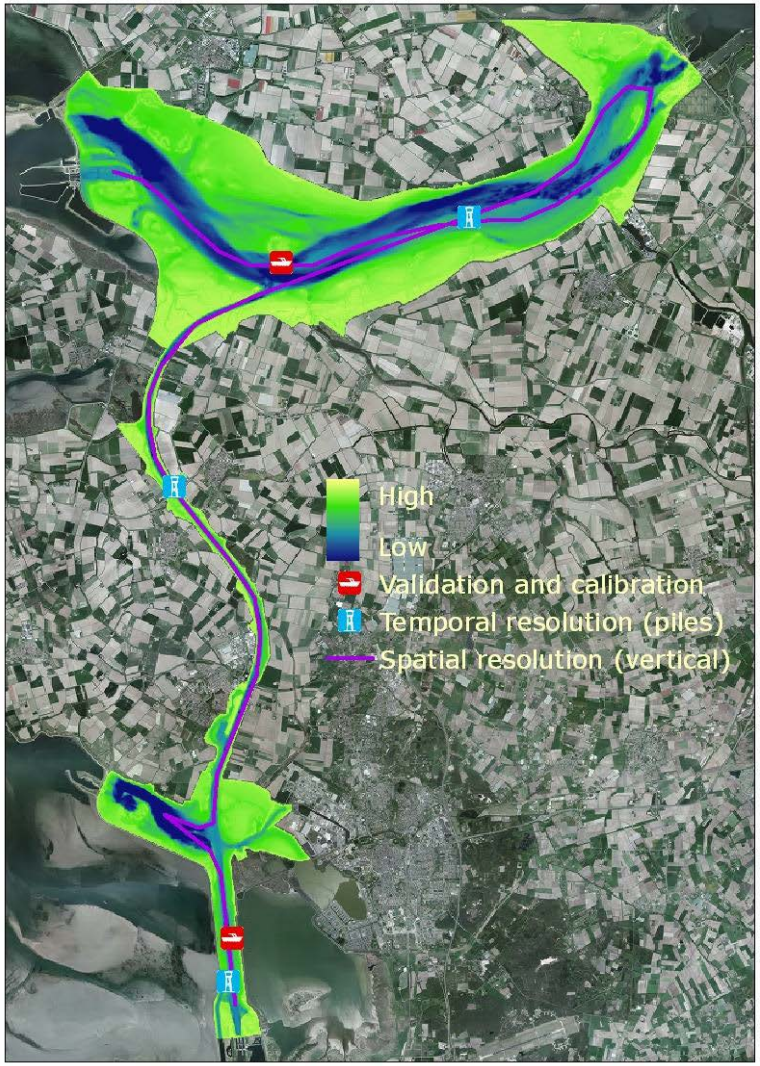


Demo case: Volkerak and Zoommeer

- Blue-green algae since 1994
- Salinisation
- Water manager = Rijkswaterstaat (NL)
- **User needs**:
  - Lower cost of monitoring < 0.5M€ and deliver coverage
  - Cost-effective management < 100 M€
- **Savewater solution**:
  - Ideal monitoring network
  - Integration with models and decision support used by RWS

Volkerak and Zoommeer





Conclusions

- ESA IAP feasibility study successfully proved the concept of integrating satellite services with mobile platform services for monitoring blue green algae and suspended sediments in large water bodies, lakes and ports

- The service is viable for water bodies managed by institutional monitoring agencies and authorities. A challenge for the future will be to acquire low cost earth observation products at a sufficient spatial resolution such that the SAVEWATER service will be viable for small water bodies and a large group of (local) users.

Acknowledgements

- ESA IAP programme: Stefan Gustaffson, Cesar Baston Canosa, Eva Rodriguez, Norbert Huebner
- VITO and CRP-GL “crew” members: Lieve Decorte, Nele Desmet, Wesley Boënne, Martin Schlerf, Kim Knauer, Lucien Hoffman
- VITO Innovation Liaison Officer: Danielle Coosemans

- Want to know more ?
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