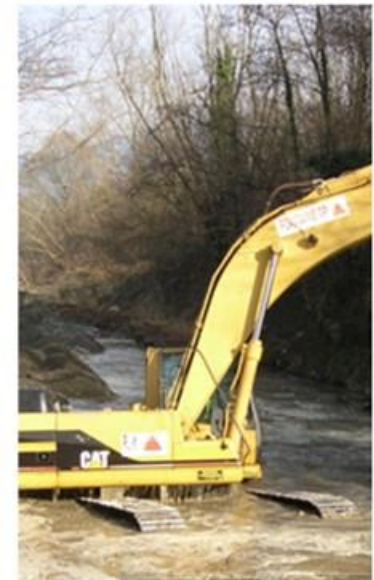


Modelling a severe transient anoxia of continental freshwaters due to a Scheldt accidental release

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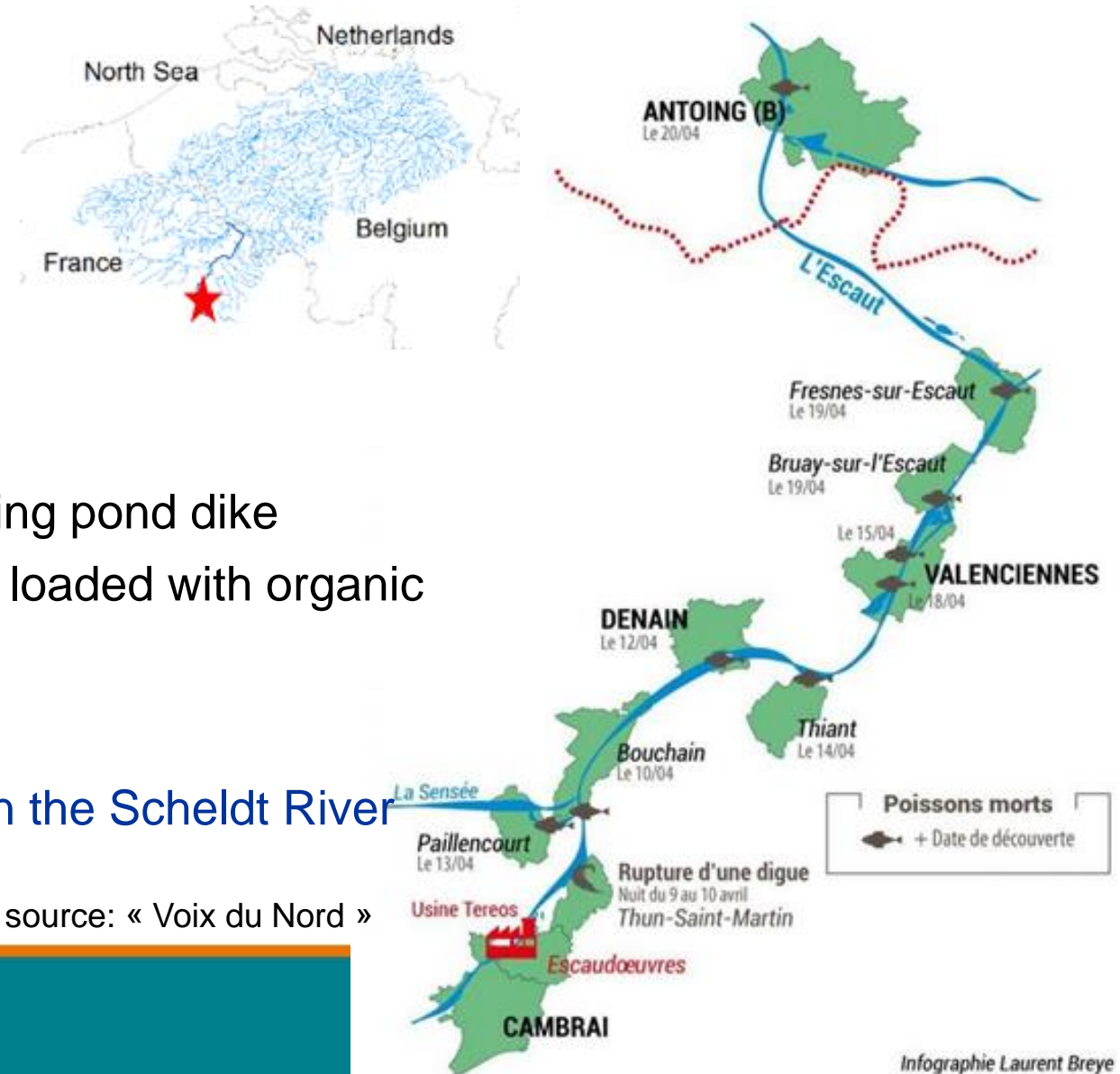


Description of the Industrial Accident

Western Europe

Transnational Basin of the Scheldt

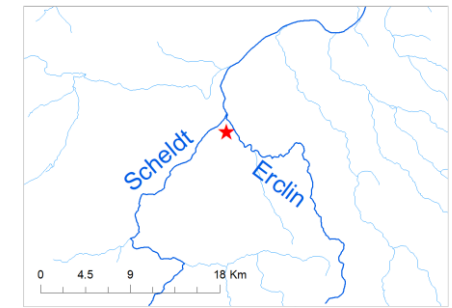
- Area: 20 020 km²
 - Simulated hydrographic network: 858 rivers and 8 702 km of river network
- Tereos sugar industry accident (9th April, 2020)
 - Accidental release from the breakage of a settling pond dike
 - Large-scale pollution due to the release mainly loaded with organic matter
- Severe deoxygenation in water column
- Severe fish mortalities (~100 tons) observed in the Scheldt River (not modelized)



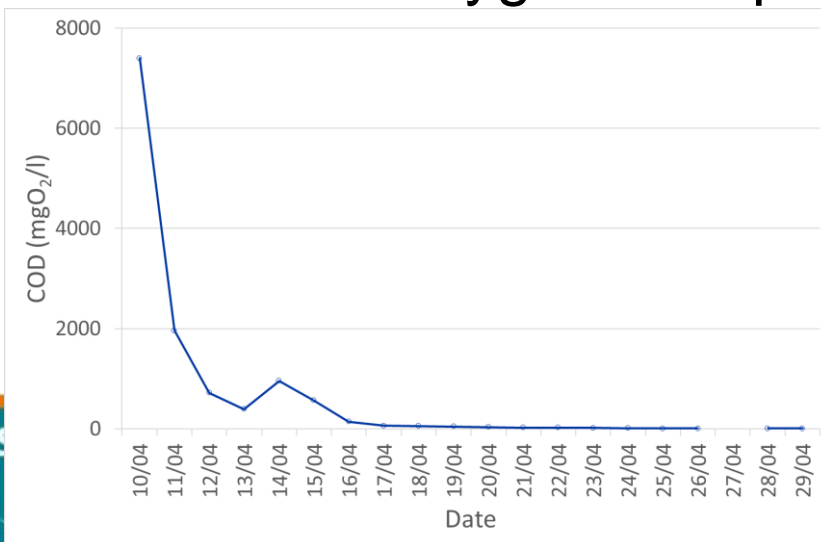
Map source: « Voix du Nord »

Materials and Methods

Data

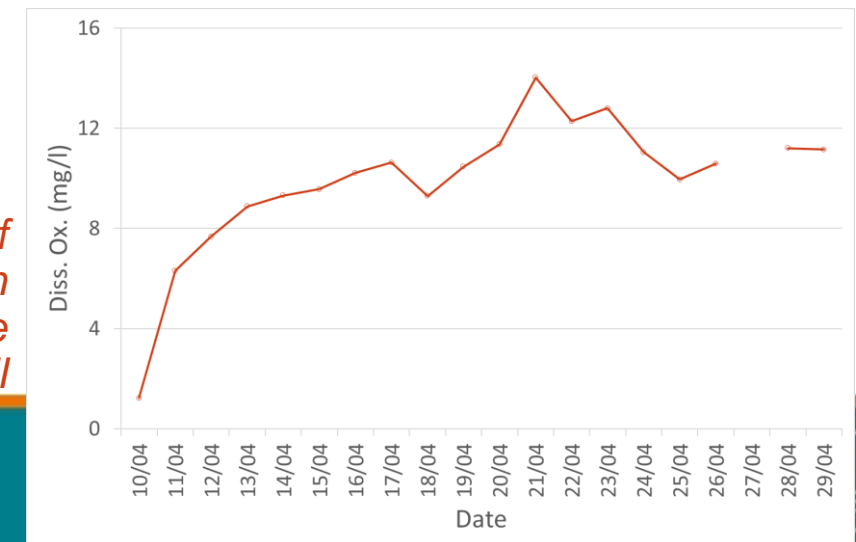


- Accidental discharge in the Erclin river (small tributary of the Scheldt river)
- 108 000 m³ stored water in the settling pond
- 88 000 m³ of beet-washing water flooded an area of 240 000 m²
- 564 tons of COD released in 30 hours
- COD concentrations reached ~7300 mgO₂/l in river at the time of accident
- Dissolved oxygen collapsing to 1.23 mg/l on 10 April



Evolution of the COD concentration in the Scheldt during April

Evolution of Dissolved Oxygen concentrations in the Scheldt during April



Materials and Methods

Mathematical Representation

Processes of Organic Matter Degradation (POMD) in river ecosystem

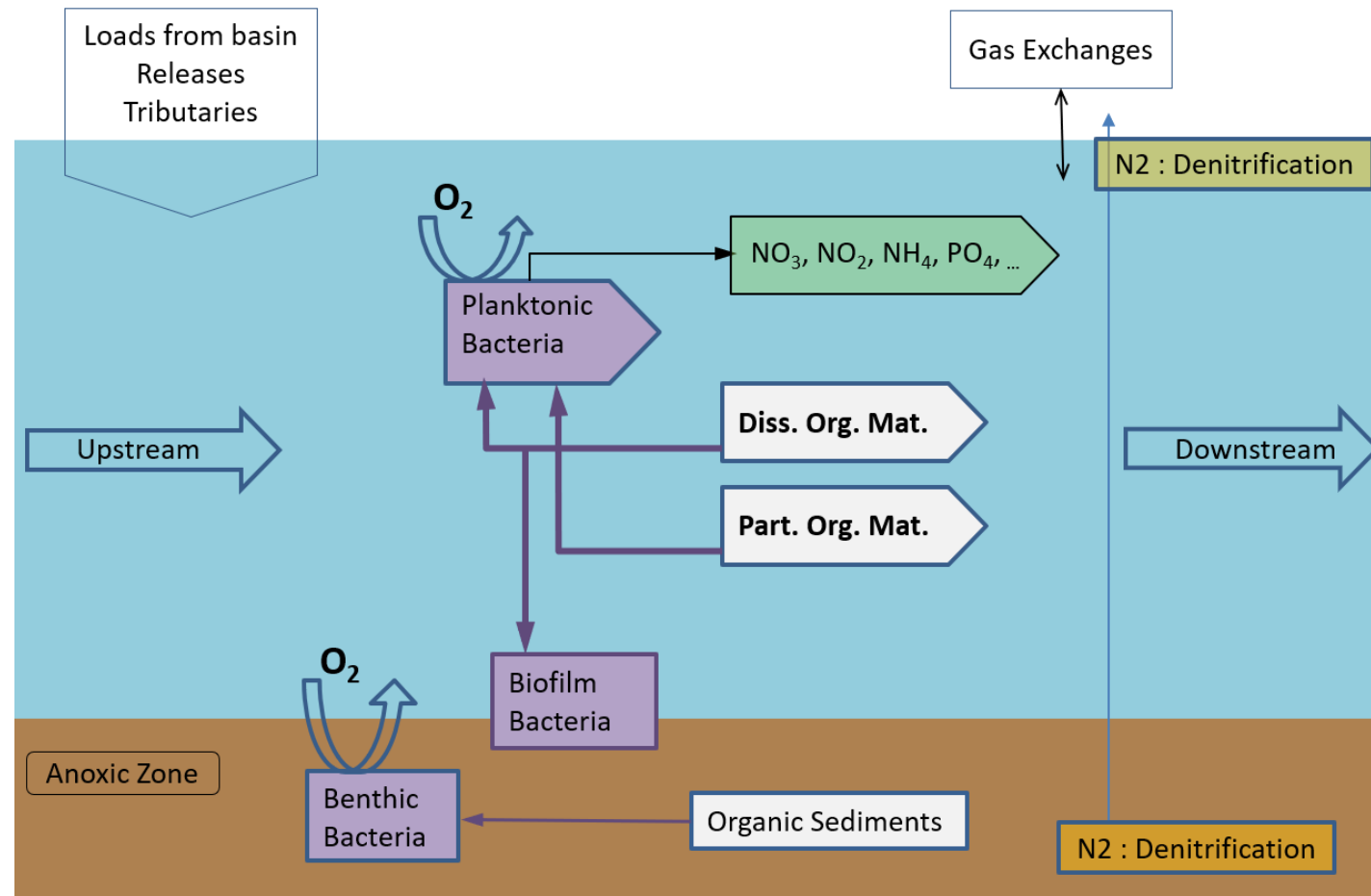
Allowing the description of the downstream pollution in the Scheldt to calculate surface water quality

Representation of Pressure-Impact Relationship

Description of Organic Matter Cycle

Representation of Transport and Dilution processes

Description of aerobic and anaerobic processes in the water column



Results – Validation

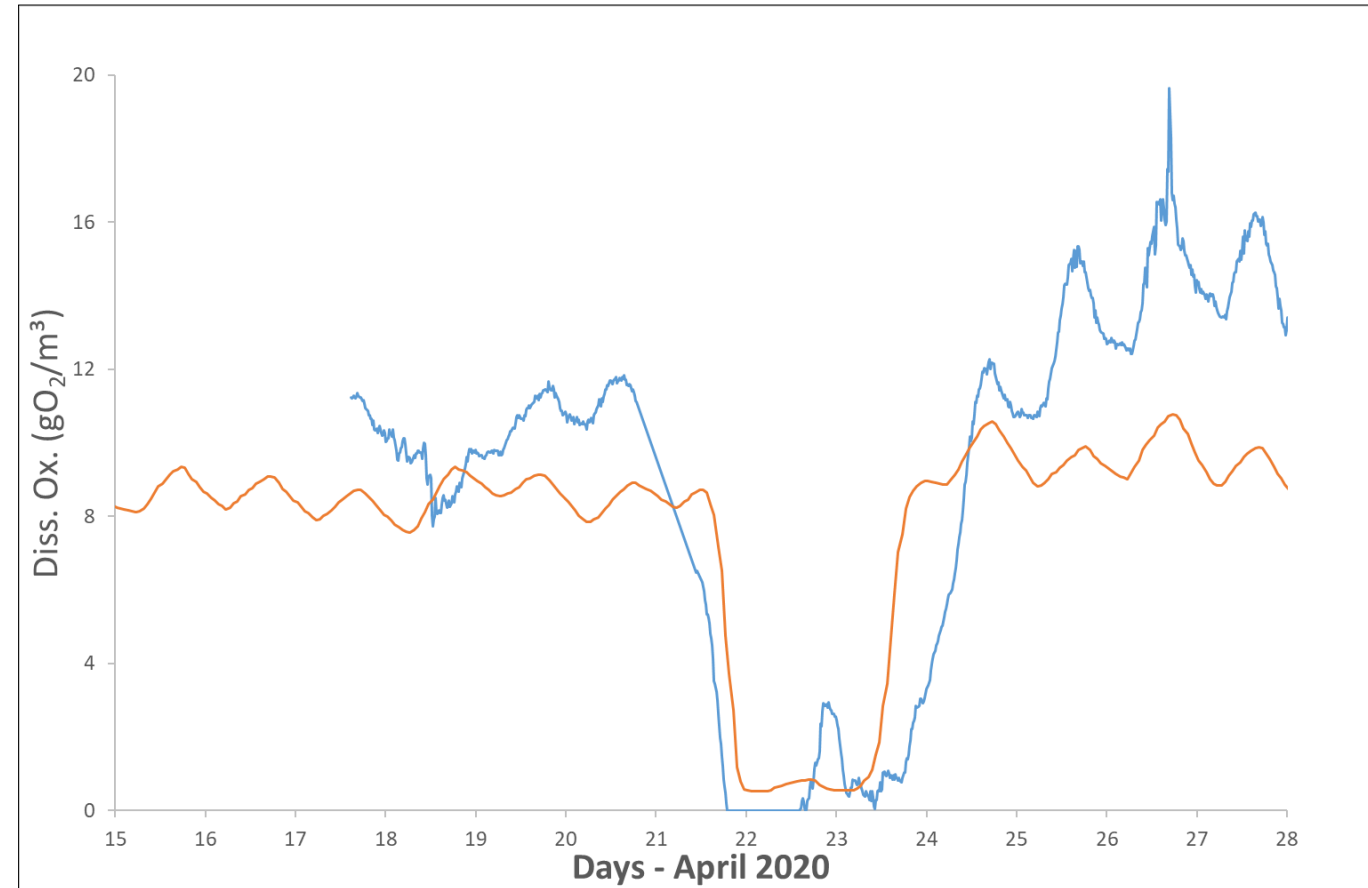
Daily results

River anoxia for many hours / days

Dissolved Oxygen concentrations
calculated and **measured** at Spiere
(Flemish Region, at the border between the
Walloon and the Flemish regions)

Hourly values

Continuous hourly measurements



Results – Organic Matter Loads

Progression of the pollution along the river (longitudinal profile)

Overlapping of the COD concentrations calculated on the French part of the Scheldt - at the 12, 14, 16 and 18 April 2020 at 11:30 AM

Maximum COD concentrations calculated on 12 April around 1000 gO₂/m³ (validated by measurements)

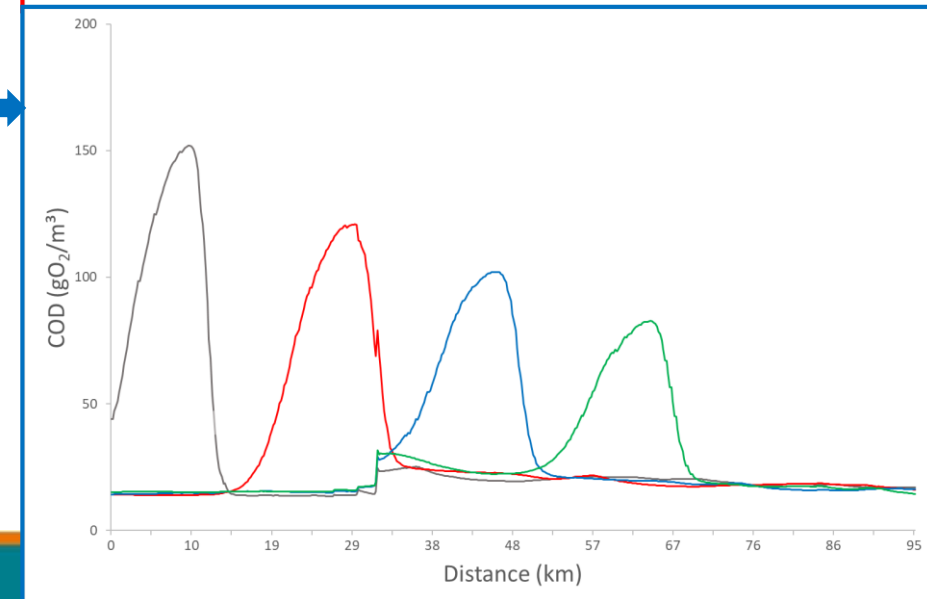
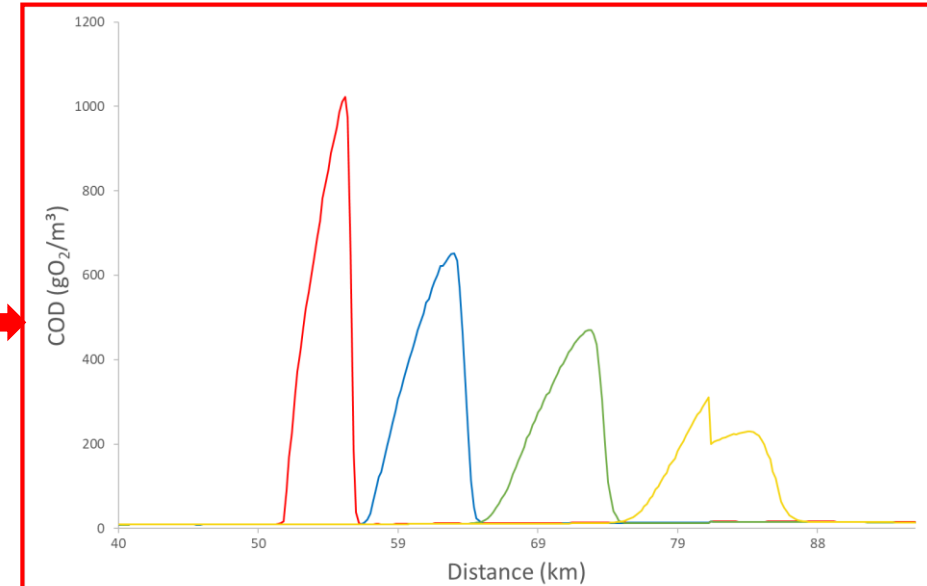
Regular progression of the pollution plume around 5 km/day

Overlapping of the COD concentrations calculated on the Belgian part of the Scheldt - at the 20, 22, 24 and 26 April 2020 at 11:30 AM

Regular progression of the pollution plume around 10 km/day

Gradually decrease of the “COD peak” due to

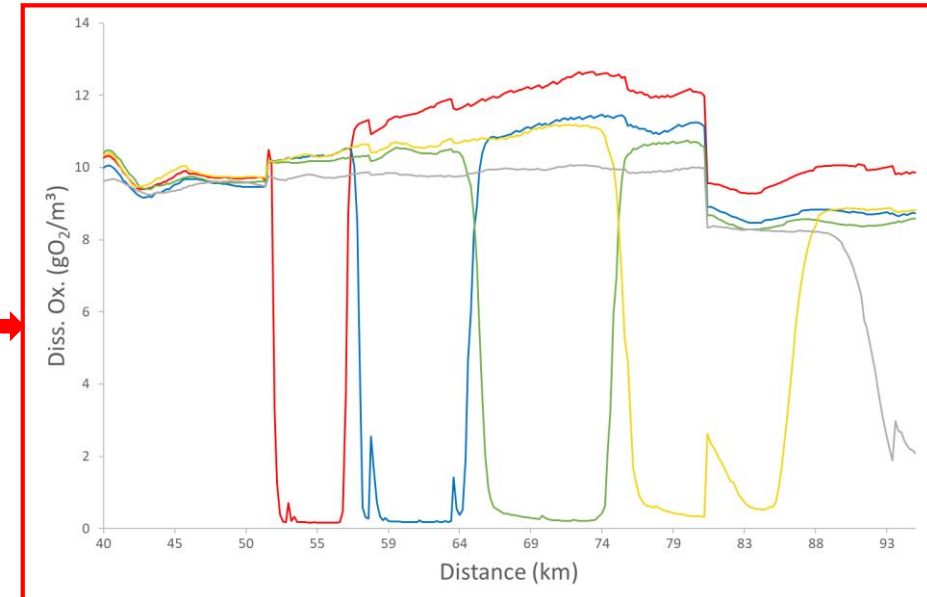
- Degradation of organic matter
- Dilution by tributaries
- Longitudinal dispersion
- Upstream inflow



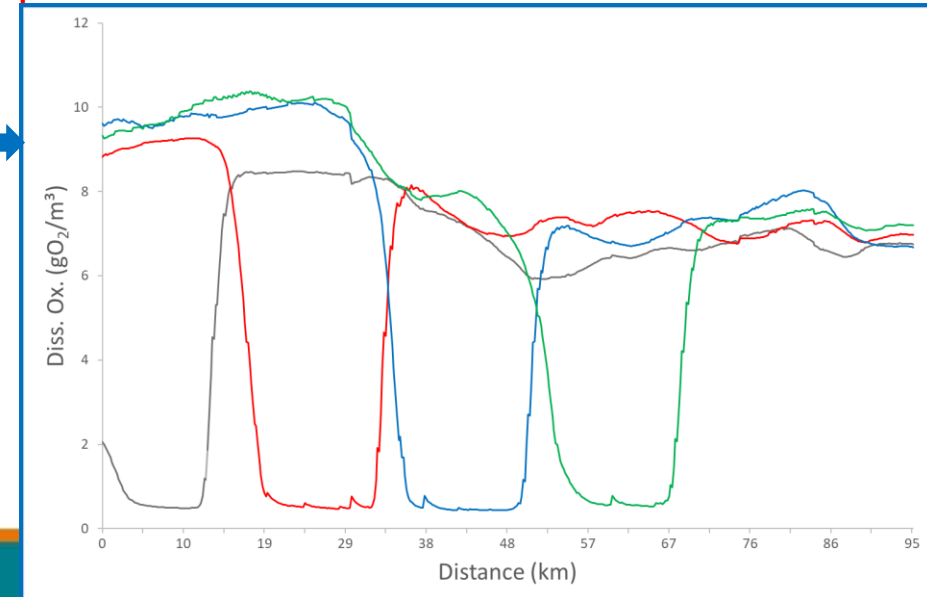
Results – Deoxygenation

Consumption of all dissolved oxygen by degradation of organic matter (longitudinal results) → river anoxia over several km

Dissolved oxygen concentrations calculated on the French part of the Scheldt - at the 12, 14, 16 and 18 April 2020 at 11:30 AM



Dissolved oxygen concentrations calculated on the Belgian part of the Scheldt - at the 20, 22, 24 and 26 April 2020 at 11:30 AM



Representation of aerobic and anaerobic processes considering the organic matter cycle in the water column

Conclusions

- Unfortunated accident, but well instrumented
 - Scientific opportunity to validate the modelling processes and the developments of very non-stationary releases and hourly timescale calculation
 - Accident numerically reproduced and impact calculated on the environment by a modelling-based method
 - **Validation** of the processes of organic matter degradation in river ecosystem
 - Description of the aquatic ecosystem behaviour during this accidental pollution
 - Anoxia not homogeneous and simultaneous throughout the disaster area of the Scheldt (transport of pollution downstream, collapsing the aquatic ecosystem)
- *Understanding the dynamics of the pollution (transport and dilution)*
- *Describing its propagation along the transboundary hydrographic network of the Scheldt*



Thanks for your attention
Merci de votre attention

