

The increasing use of nanoparticles for numerous materials and products raises questions about the risks they might pose for both individual and industrial users.

As such, nanotechnologies and their products represent a serious challenge to the authorities responsible for environmental policies and human safety.

The NANOGRa project proposes a global approach to nanoparticles risks by a multidisciplinary assessment of explosion/fire, ecotoxicity and toxicity risks. This presentation focuses on preliminary results of ecotoxicological effects of titanium dioxide nanoparticles.

### NP choice in NANOGRa

Criteria for nanoparticles choice :

- Production or significant use in Wallonia
- Specific risks according to scientific literature
- Data availability on risk assessment
- Use as « benchmark »
- Opportunity to evaluate the substance on the 3 categories of hazard
- Nanomaterials availability

Selected substance	Grade/Type	Explosivity Flammability	Ecotoxicology	Toxicology Health risk
MWCNT	MC7000	X	X	X
Black Carbon	Thermal Black N990	X		X
Al	40-60nm partially passivated	X	X	X
TiO <sub>2</sub> (Anatase)	10-30 nm		X	X

### Chemical results

#### Nanopowder

##### BET

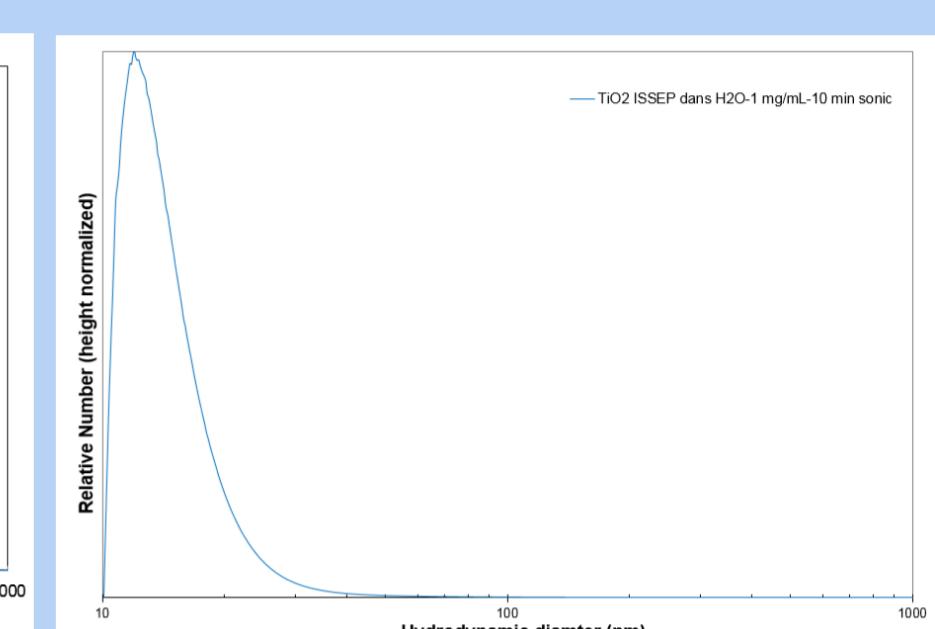
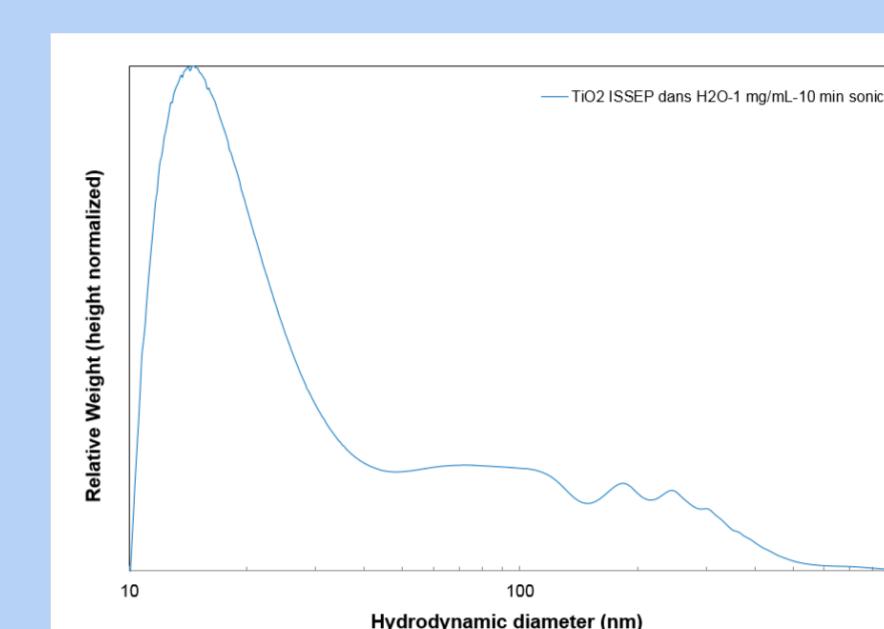
Specific surface	64,21	m <sup>2</sup> /g
Pore volume	0,26	cm <sup>3</sup> /g
Pore Size	151,80	Å

##### XPS

TiO <sub>2</sub> powder	% Atomic
Ti2p	29.11
O1s	58.14
C1s	12.08
Cl2p (traces)	0.67

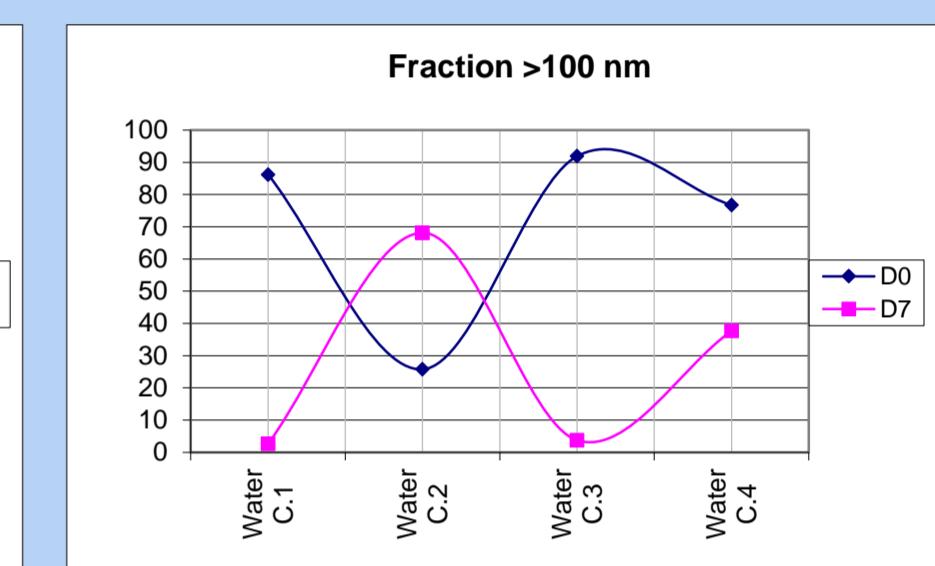
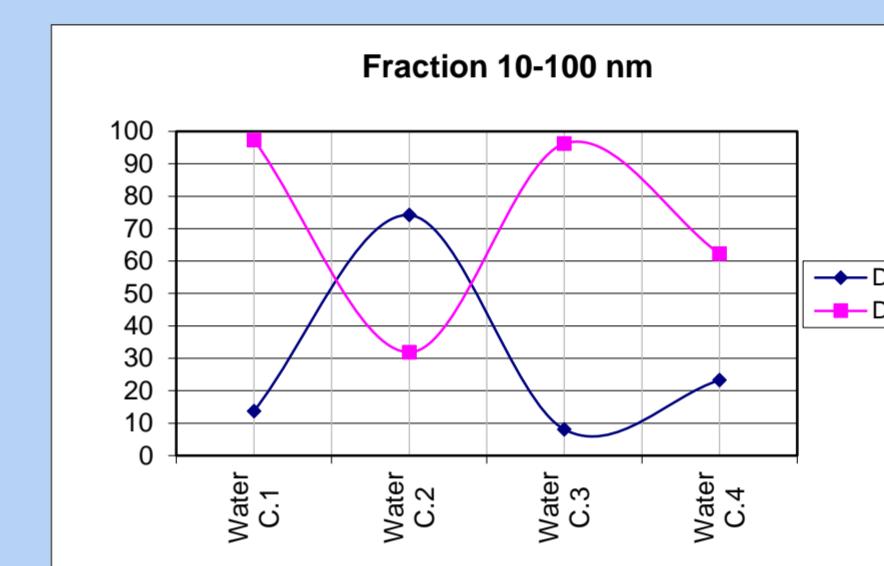
#### Weight distribution : 4 populations

- 10 – 20 nm (majority)
- 50 – 100 nm
- 180 – 200 nm
- 250 – 300 nm



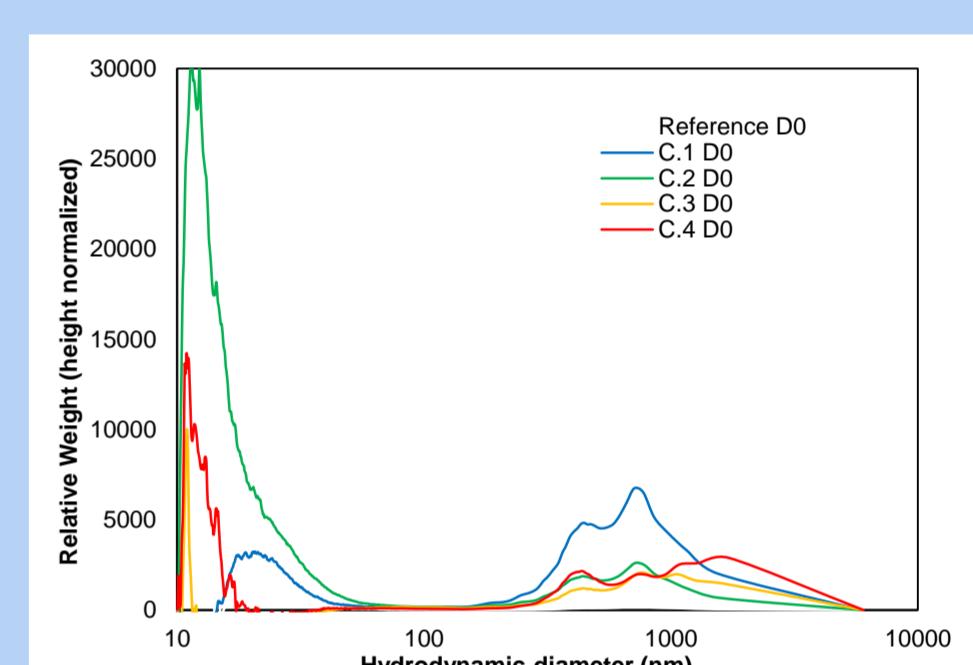
#### Water column

- D0 : many agglomerates in the water column for every concentration except for concentration 2
- D7 : less agglomerates for all concentrations except for concentration 2.



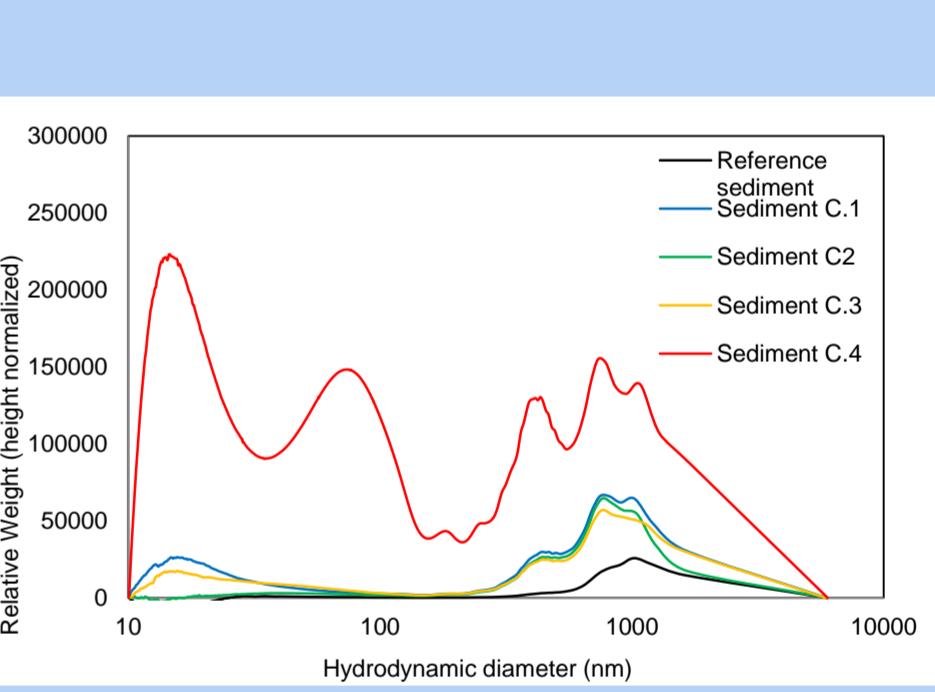
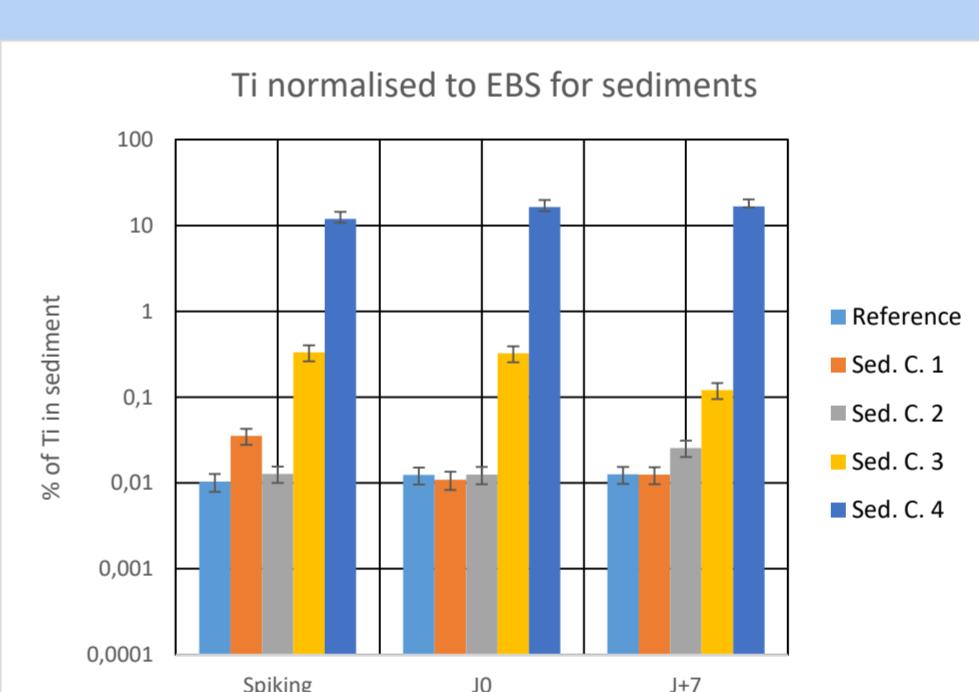
#### Sampling artefact in the concentration N°2

by resuspension of spiked sediment particles ?



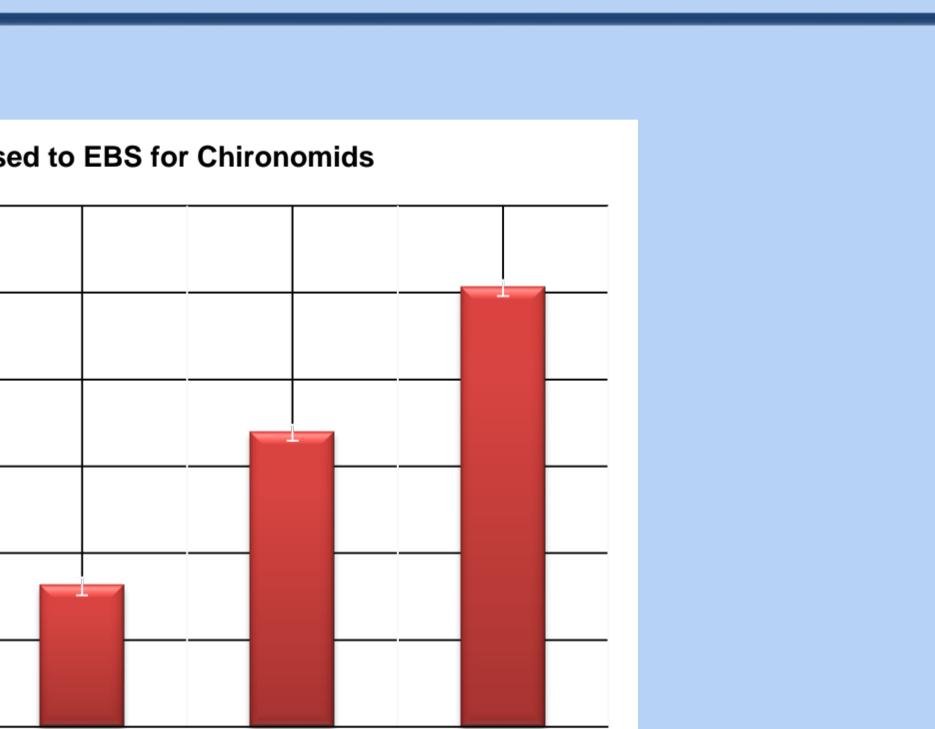
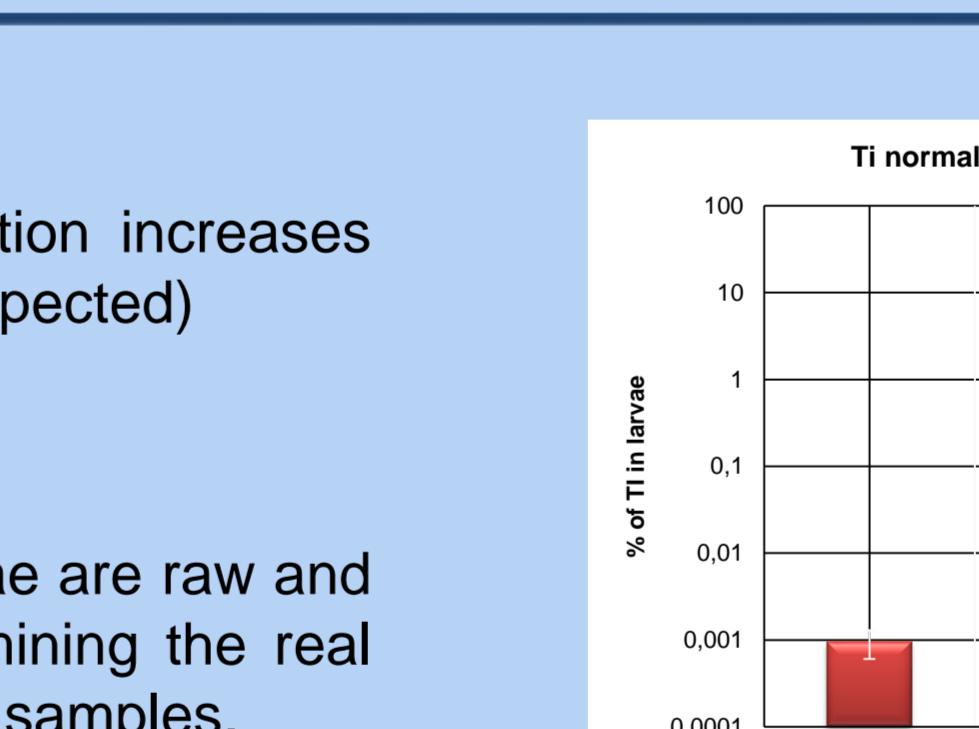
#### Sediment

- D0 : Same hydrodynamic diameter profile as the water column with an additional peak around 80 nm (preferential agglomeration size of TiO<sub>2</sub> NP?).
- D7 : No significant change of TiO<sub>2</sub> sediment concentration over time for every concentration.



#### Chironomids larvae

- D7 : Chironomids TiO<sub>2</sub> concentration increases with sediment concentration (as expected)



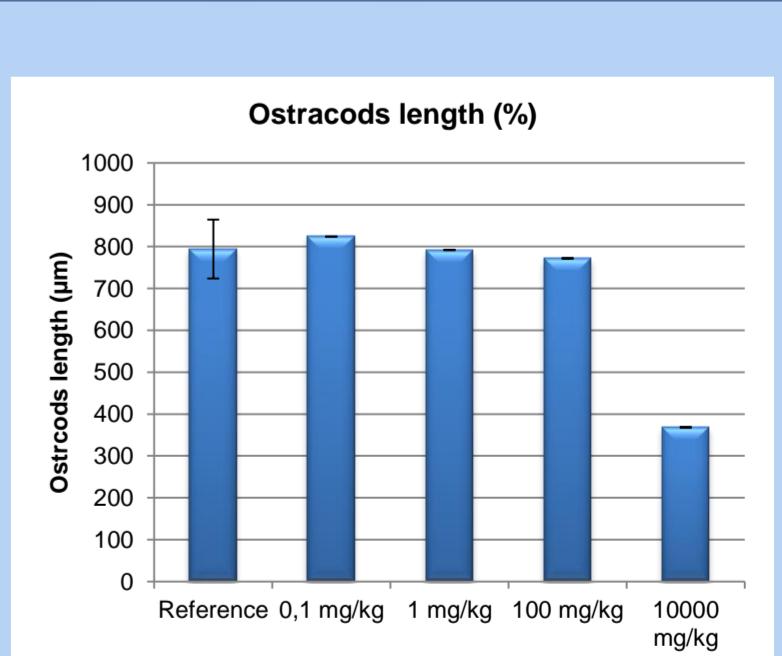
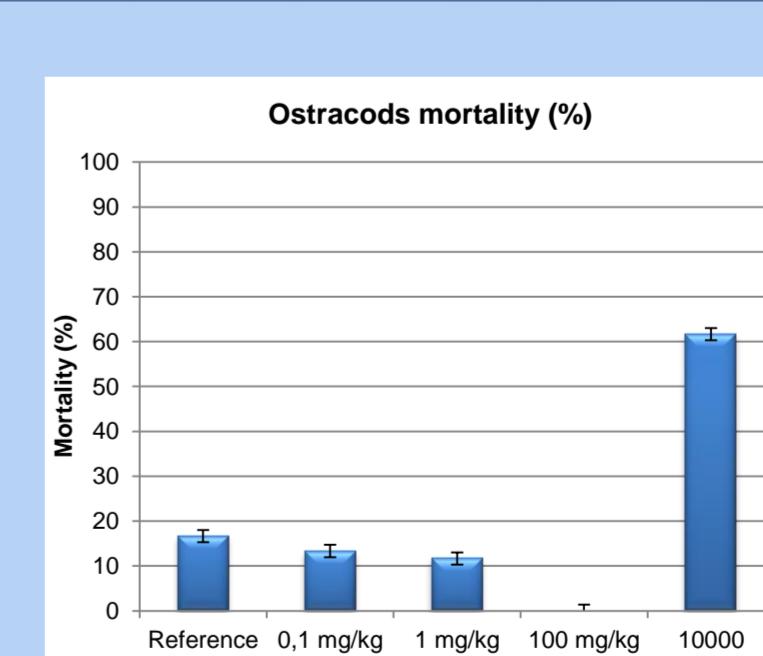
### Ecotoxicological results

#### Ostracods

##### MORTALITY AND GROWTH INHIBITION :

###### After a 6-day exposure :

- No effect of TiO<sub>2</sub> NP for the 3 lowest concentrations.
- Effects on mortality (66 %) and growth inhibition (71 %) at the highest concentration.

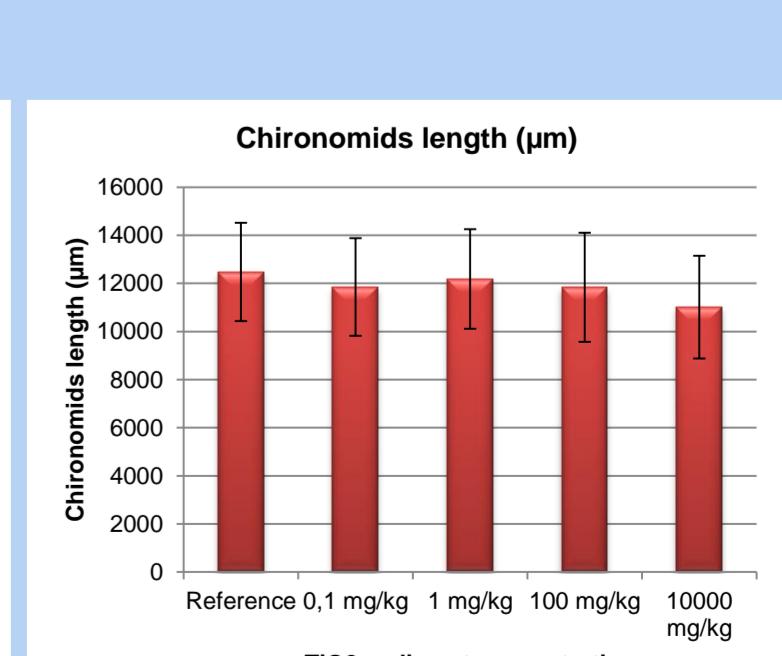
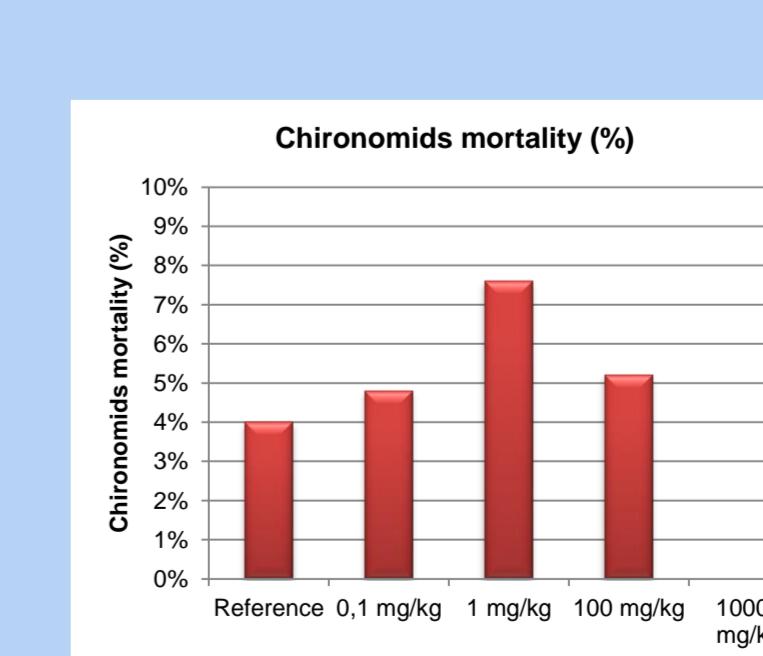


#### Chironomids larvae

##### MORTALITY AND GROWTH INHIBITION :

###### After a 7-day exposure :

- No significant effect of TiO<sub>2</sub> NP on mortality or growth inhibition for the 4 concentrations.
- *Chironomus riparius* is less sensitive to metal pollution than *Heterocypris incongruens* even as a nanoparticle form.

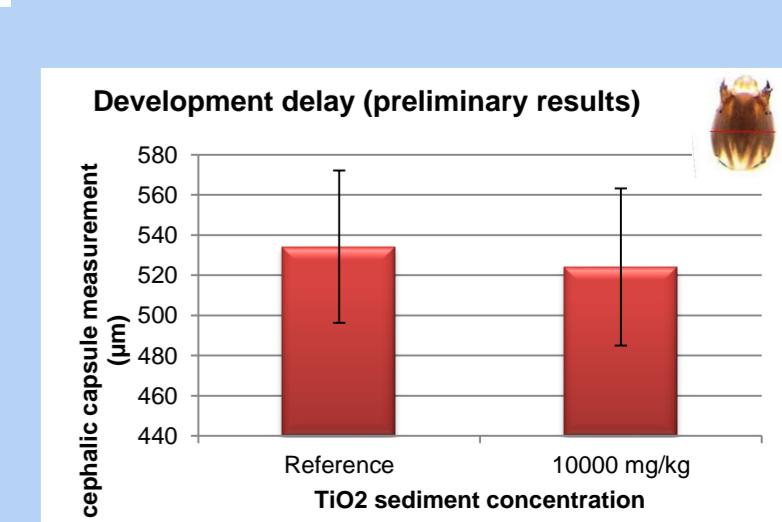


##### DEVELOPMENT DELAY :

Preliminary results show no difference between the reference and the highest concentration. More observations at each concentration are necessary to confirm these results.

##### TERATOGENICITY :

Mouthpieces preparation technique has to be improved in order to obtain useful images.



### NP characterisation in the different media of the Chironomids bioassay

performed at Namur Nanosafety Center and SIAM platform from University of Namur

Sampling time	Sediment	Water column	Chironomids
D-2 / spiking : Just at the end of the spiking (after 28-day rolling)	X		
D0 : Start of the test (after 2 days of equilibrium with the water column)	X	X	
D7 : End of the bioassay	X	X	X

Parameters	Granulometry	Zeta Potentiel	Specific Area	Surface Elementary Composition	Elementary Composition (up to 40 μm deep)
Technical data (MSDS)	X	X	X		
Analysis technic	CLS (Disk Centrifuge Sedimentation)	-	BET (from Brunauer, Emmett, Teller)	XPS (X-ray photoelectron spectroscopy)	PIXE (Particle-induced X-ray emission)
Analysed material	• Nanomaterial • Sediment • Water column	-	• Nanomaterial	• Nanomaterial • Sediment • Water column • Chironomids	

- This study is one of the few that tries to investigate the nanoparticle sediment contamination at environmentally relevant concentration.
- The TiO<sub>2</sub> experiments show no impact at low concentrations for *C. riparius* and *H. incongruens*.
- Work is still on progress for development delay evaluation and teratogenicity.
- Chemical characterisation shows that NP from the sediment can be resuspended in the water column and then be dispersed through the river.
- TiO<sub>2</sub> content of sediment and larvae using PIXE technique is still under evaluation.
- The same protocol is now being applied to carbon nanotubes and aluminium nanoparticles.