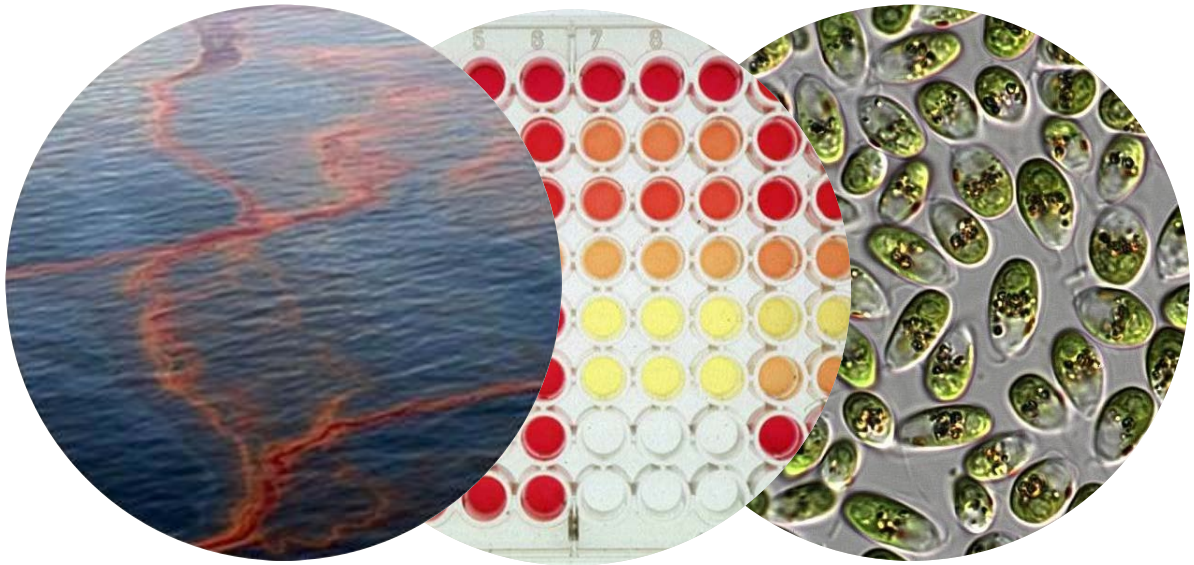
Removing oil from water (& bioassays...)

- Environmental technology Department, Wageningen University, NL
- IMARES: Institute for Marine Resources and Ecosystem Studies, NL



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IMARES
WAGENINGEN UR

http://www.lib.utexas.edu/maps/europe/europe_ref04.jpg

NL: max 360 x 257 km
Population: 16,845,600
(April 2014)

WAGENINGEN UR

Why bioassays?


donderdagetalage 7 ebruari

Pillenwater

Wat zit er allemaal aan **chemie** in ons glasheldere drinkwater?

Chemie im Wasser
ARTE, 22.30-23.25 UUR

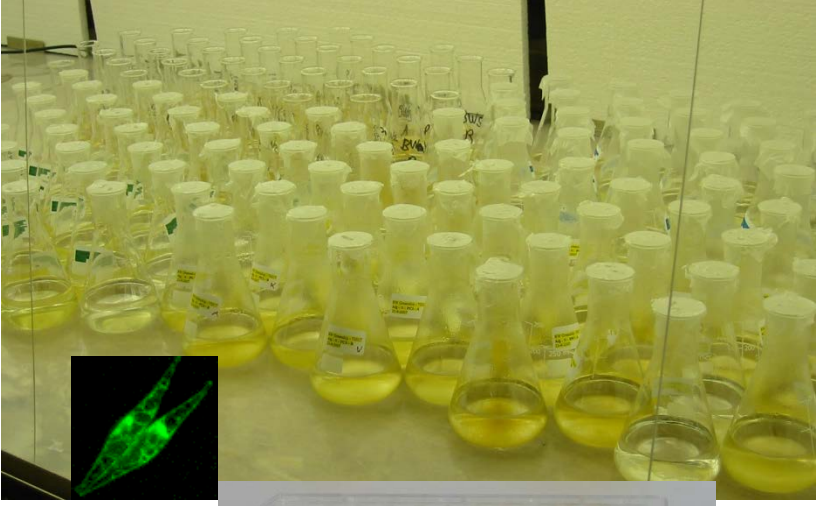
NA het zien van de Arte-docu-

lieutoxicologie aan de Wageningen Universiteit. 'Dit water wordt uitgebreid gezuiverd en getest. De kwaliteit daarvan is uitstekend. Probleem is wel dat goed zuiveren steeds duurder wordt. Onzorgvuldig gebruik van be-

Worries in society

Good water quality?

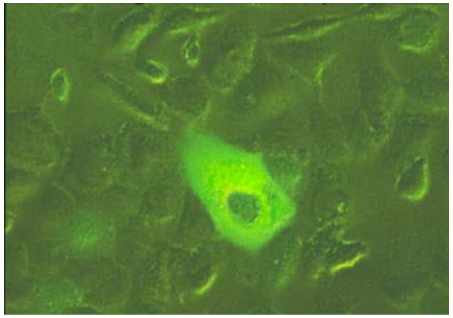
Success / by-products of treatments?

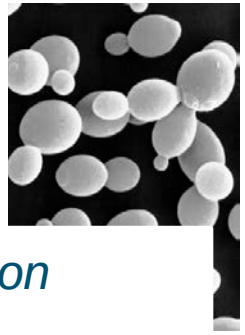


Microtiter
Algae test

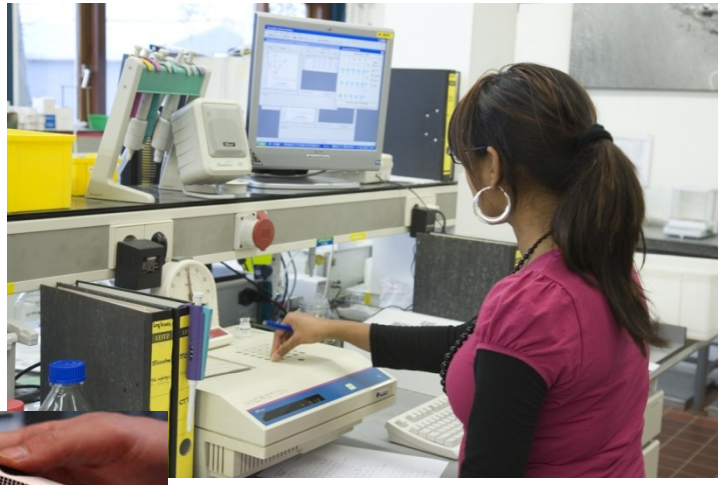
In vivo & in vitro bioassays

In vitro (reporter gene) assays

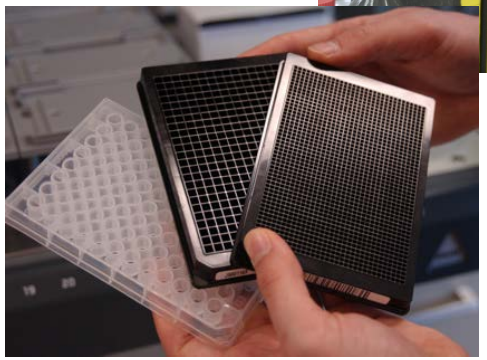




Endocrine disruption
Genotoxicity

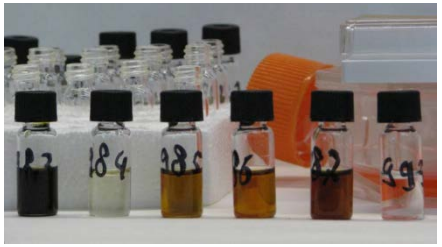


Microtox



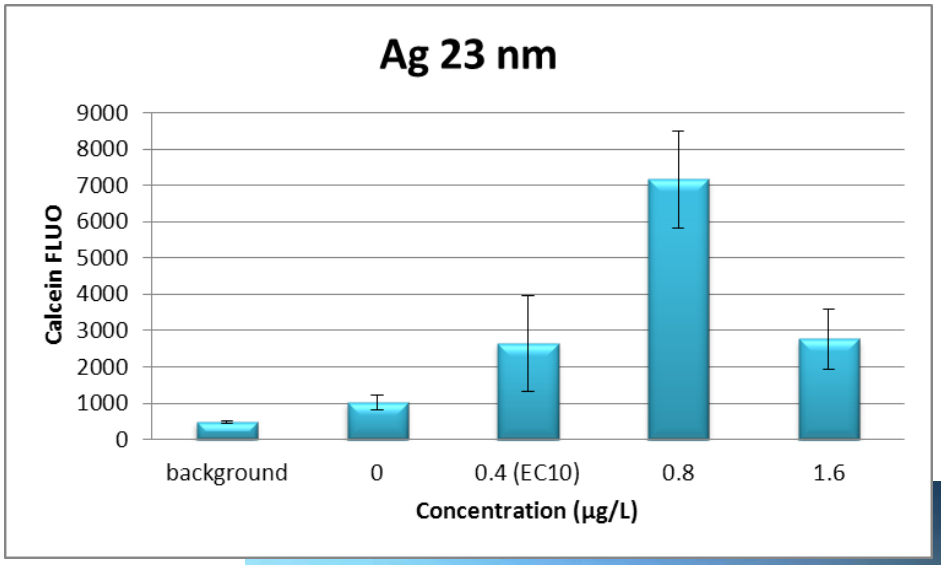
Microtiter
'Microtox'
Hamers et al., 2001

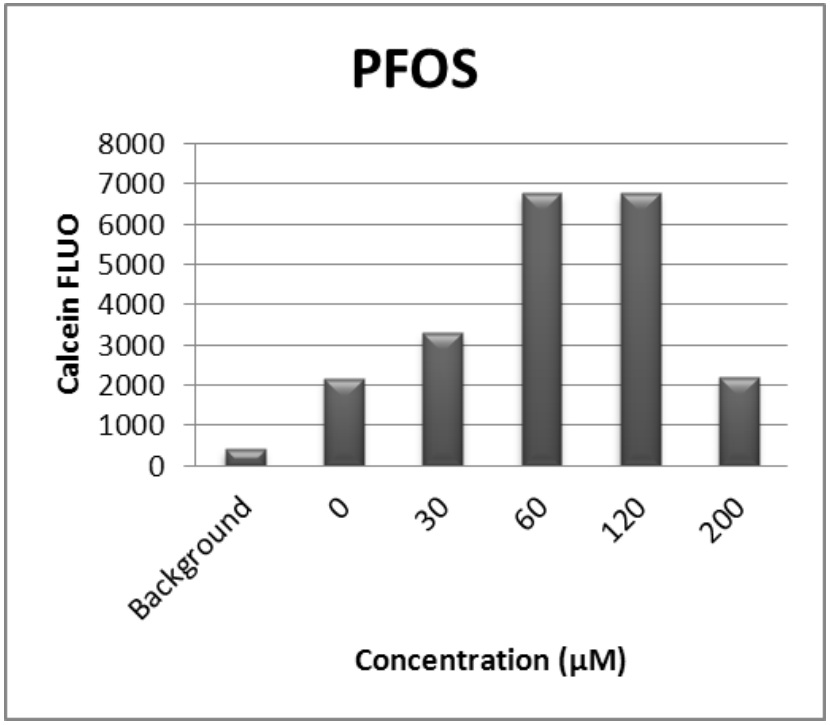
Examples of bioassays

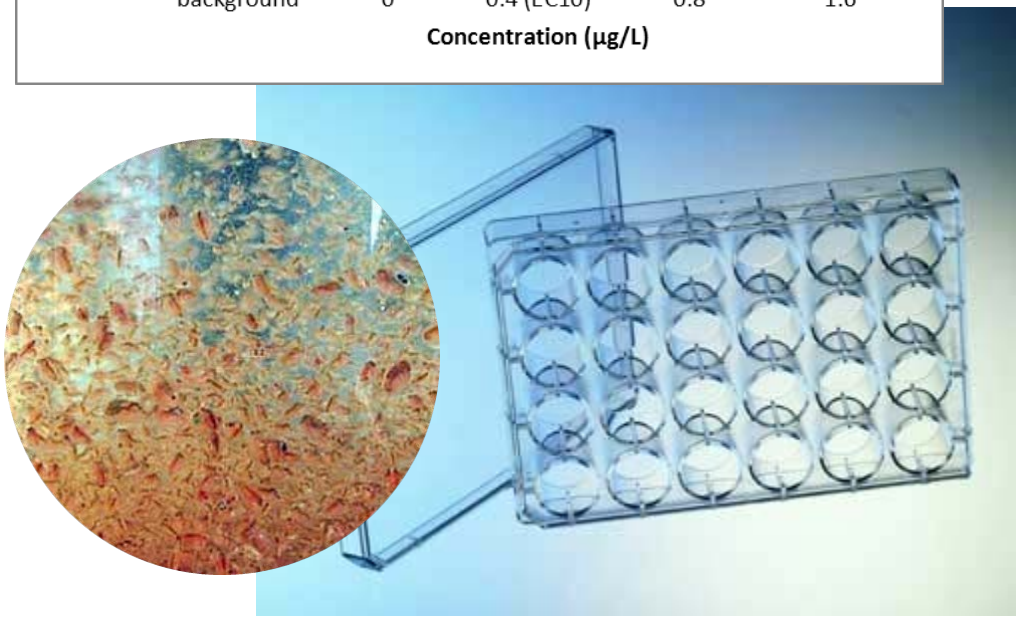


In vivo bioassays	In vi*vtro* bioassays general tox	In vitro bioassays specific tox
Daphnia	mini-Microtox (Vibrio fischeri)	Reporter gene assays (yeast or mammalian) ERa, ERb, AR, TR, etc.
Fish	Artoxkit (Artemia franciscana)	CEPIA
pELS (fish, amphibians)	Thamnotoxkit (Thamnocephalus platyurus)	Gram+&- bact
CEPIA	YTA Yeast Toxicity Assay	Oxidative stress
Algae	Algae	Genotoxicity
		Pamgene

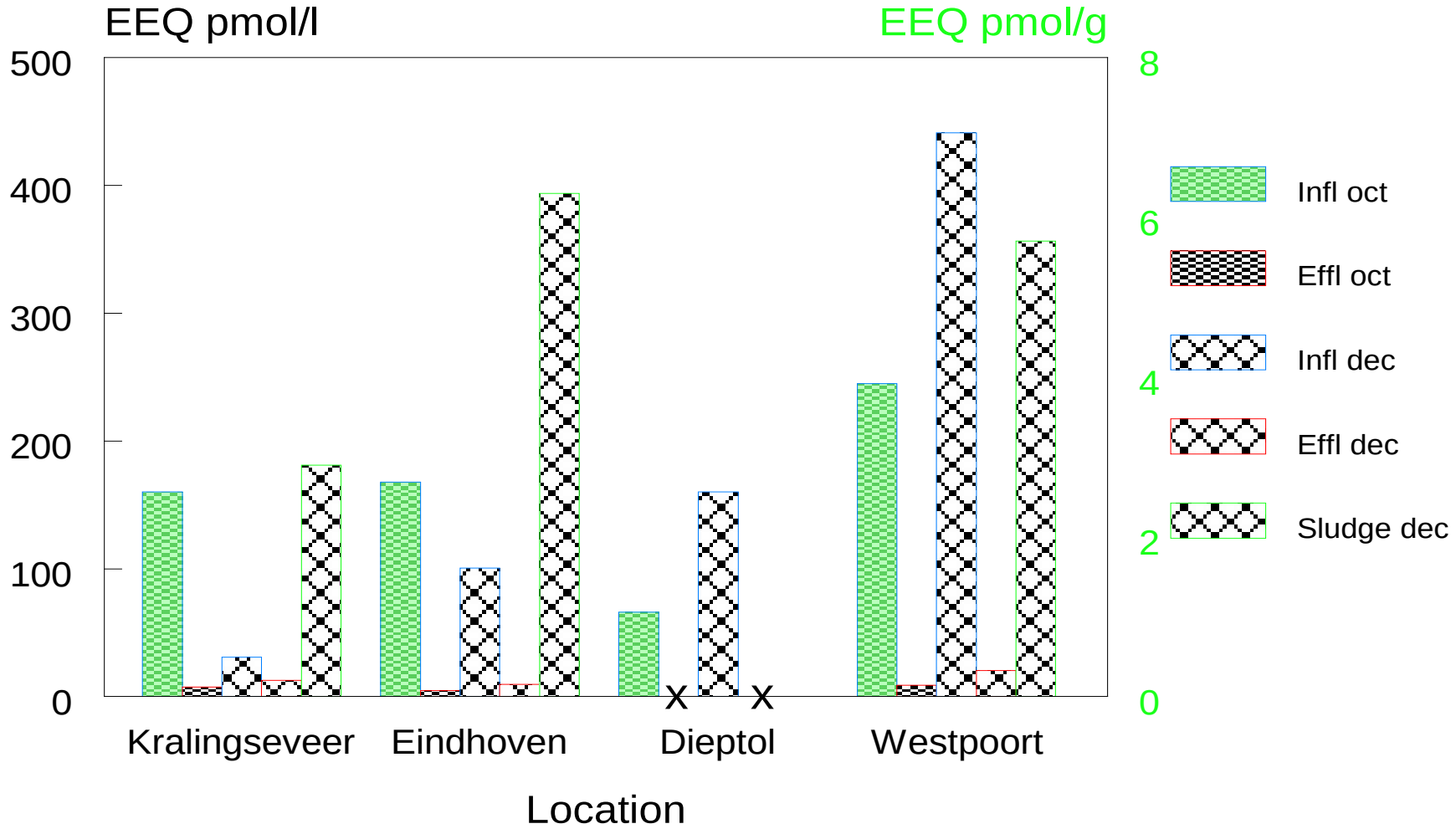
In vivo CEPIA with daphnia's and Ag NPs (blocking cellular efflux pumps => mixtox)





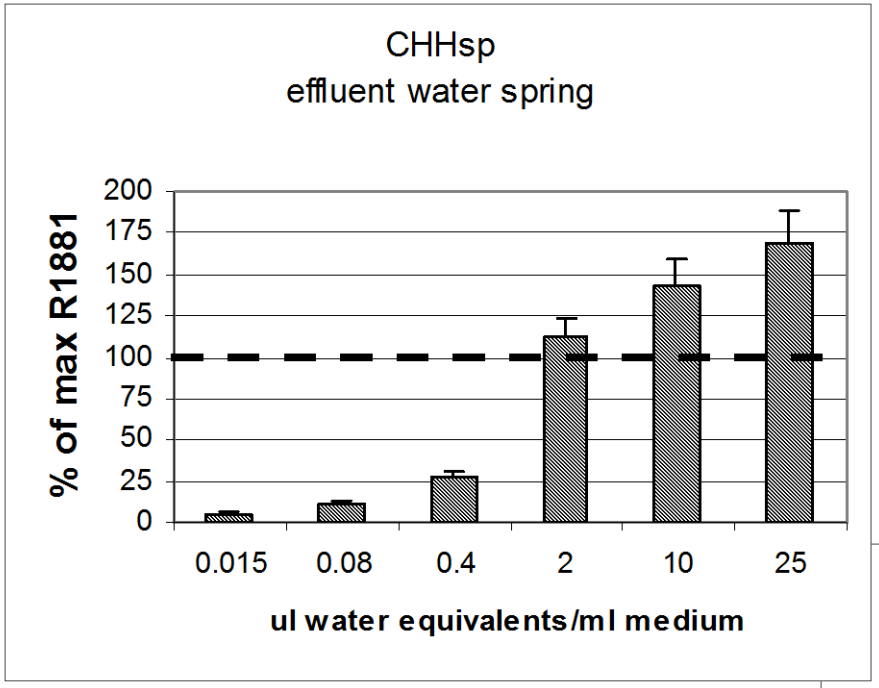


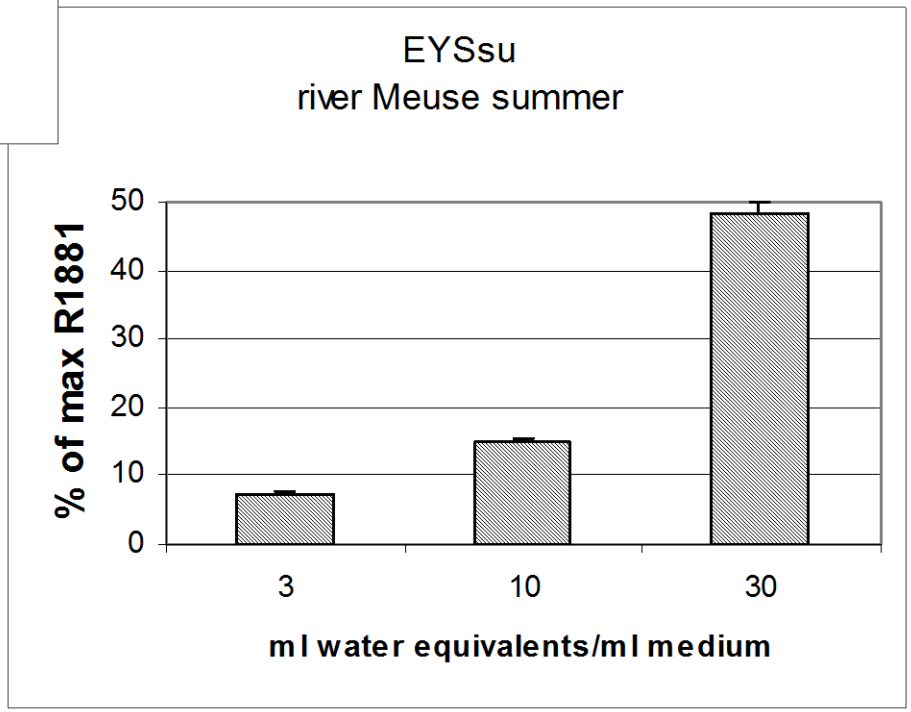
Effect treatment on domestic WTP influent (infl), effluent (effl) and sludge



Murk et al, 2002

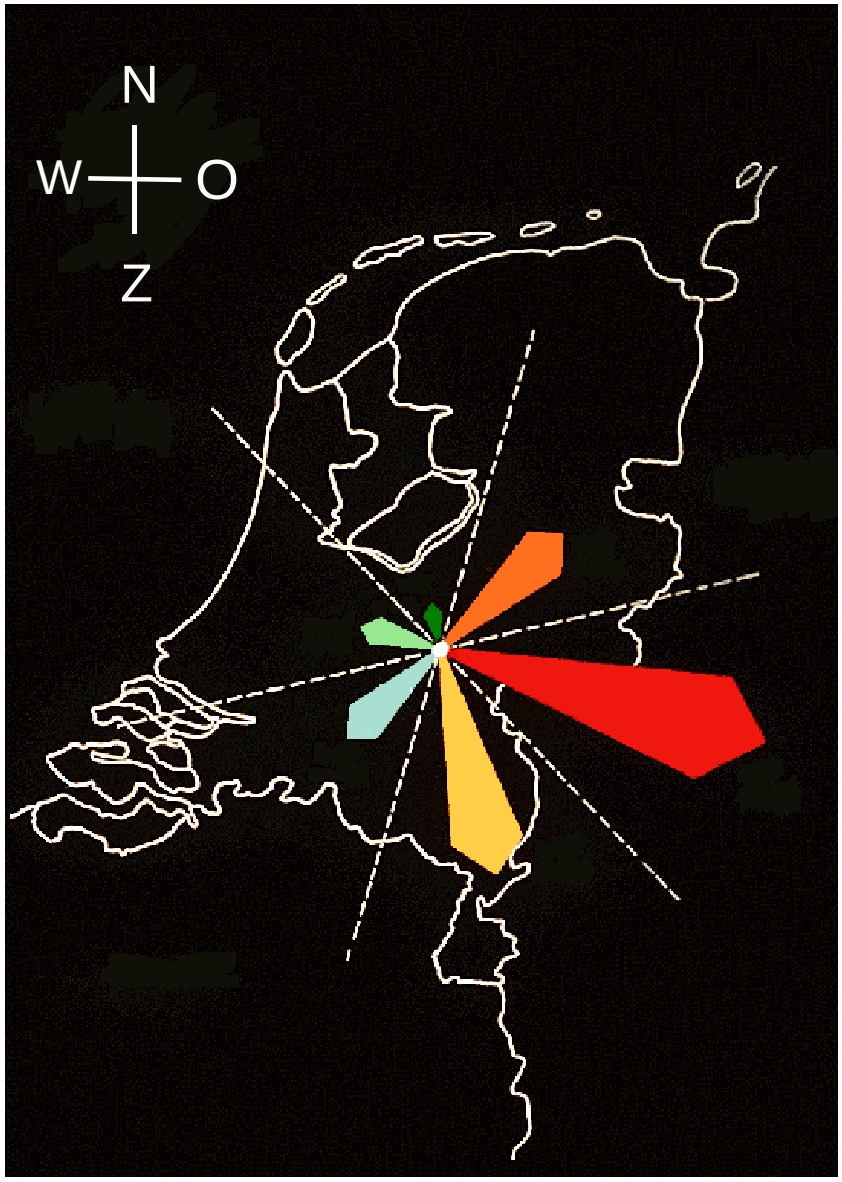
Androgenic activity in wastewater and surface water with AR-Luc



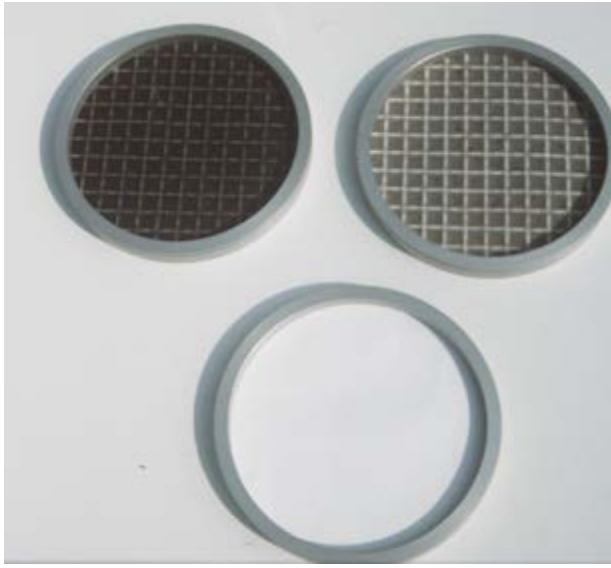


CHH: 699 nmol REQ/l
EYS: 20 pmol REQ/l

Blankvoort, 2003



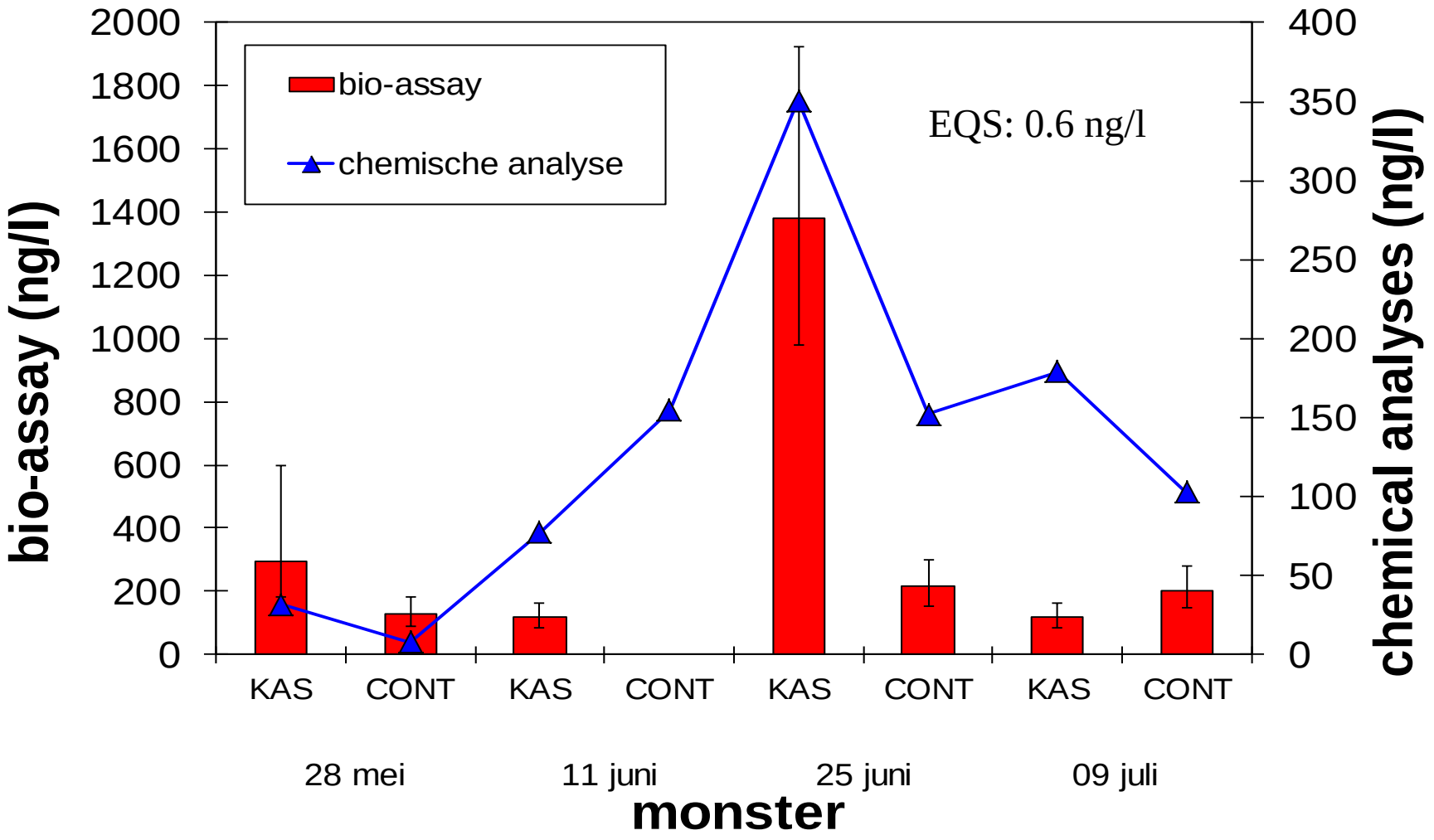
UMU-assay for mutagenicity



Mutagenicity of airborne particulate matter in Wageningen collected on days with different wind direction

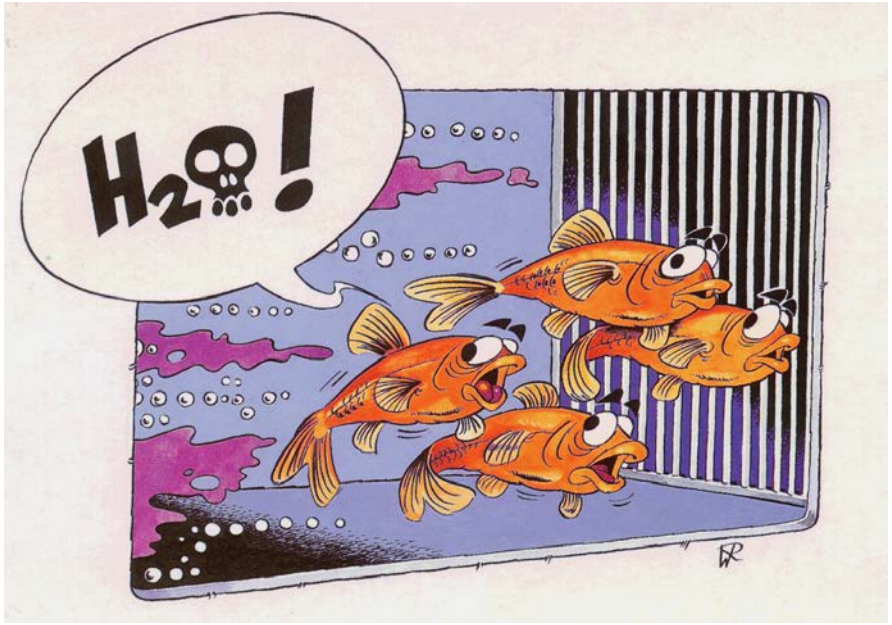
Hamers et al., 2002

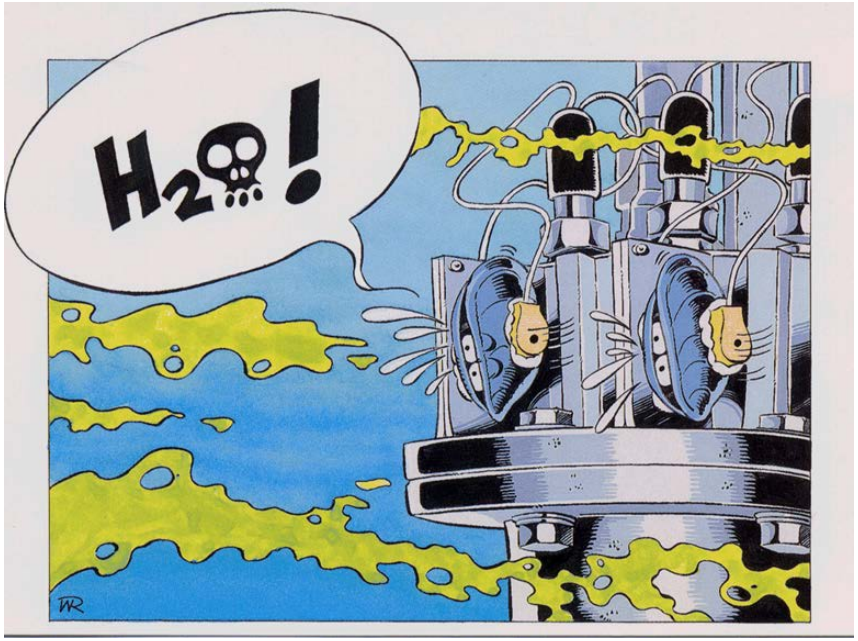
Bio- and chemical analysis of pesticides in rainwater (ng dichlorvos-equivalents/liter)

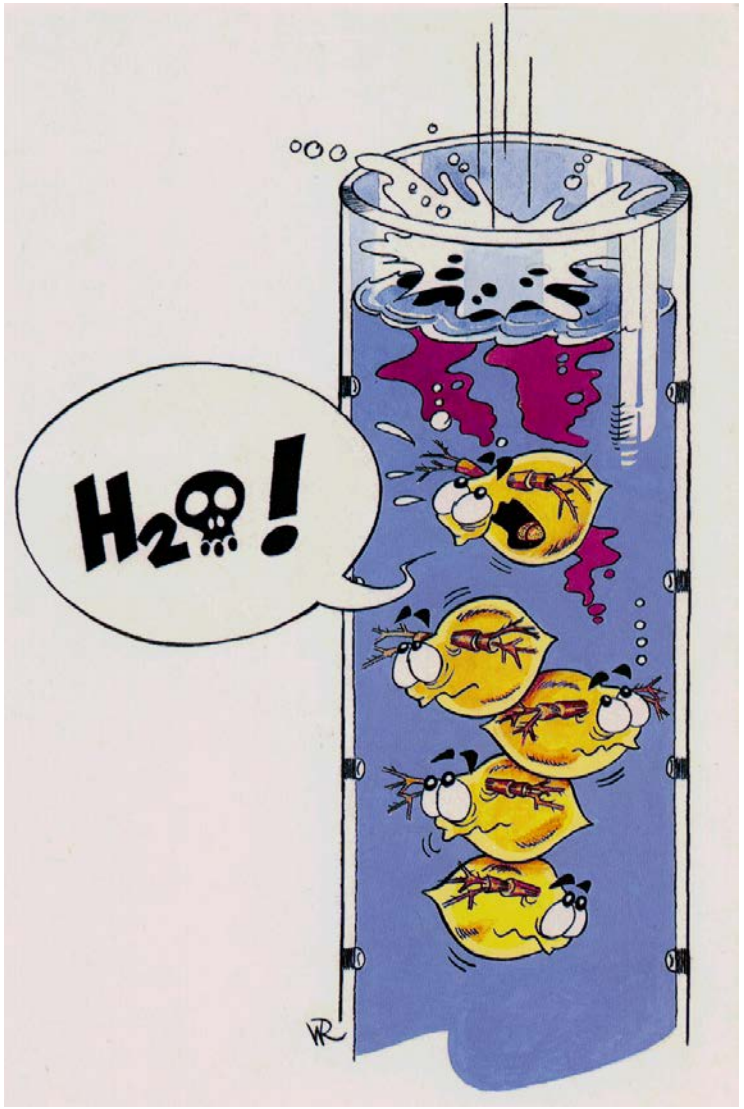


Hamers et al, 2000

Bioalarm







Bioassay application?

- (New) hazard identification
- Toxic potency quantification
- Sources identification
- Micro pollutant prioritization
- Technological improvement assessment (+/-)
- Eco(toxico)logical safety assessment
- Trend analyses (time, space)
- Water quality/safety communication

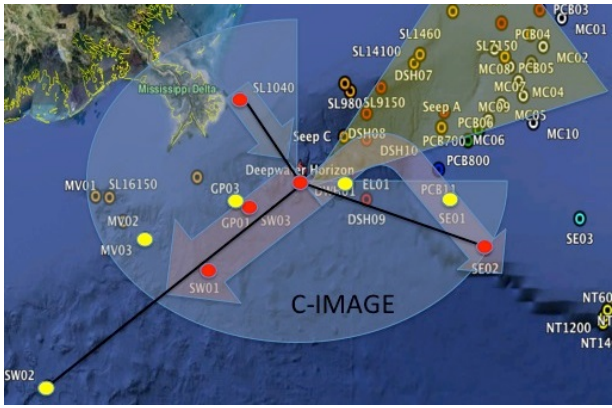
Oil spill in the Gulf of Mexico

April 2010: Drill platform Deepwater Horizon explodes and 780 million liter crude oil leaks from the well at 1500 m depth

What is the most persistent environmental problem after the DWH oil spill?

An oily, fluffy, toxic layer at the sediment

Including diatom skeletons from surface species



Core Collected
At 1500m deep

DWH-01

David Hollander

USFSP UNIVERSITY OF SOUTH FLORIDA ST. PETERSBURG

C-IMAGE

Purpose of dispersant application (if depth < 20m):

-less contamination of warm blooded vertebrates

-less coastal contamination

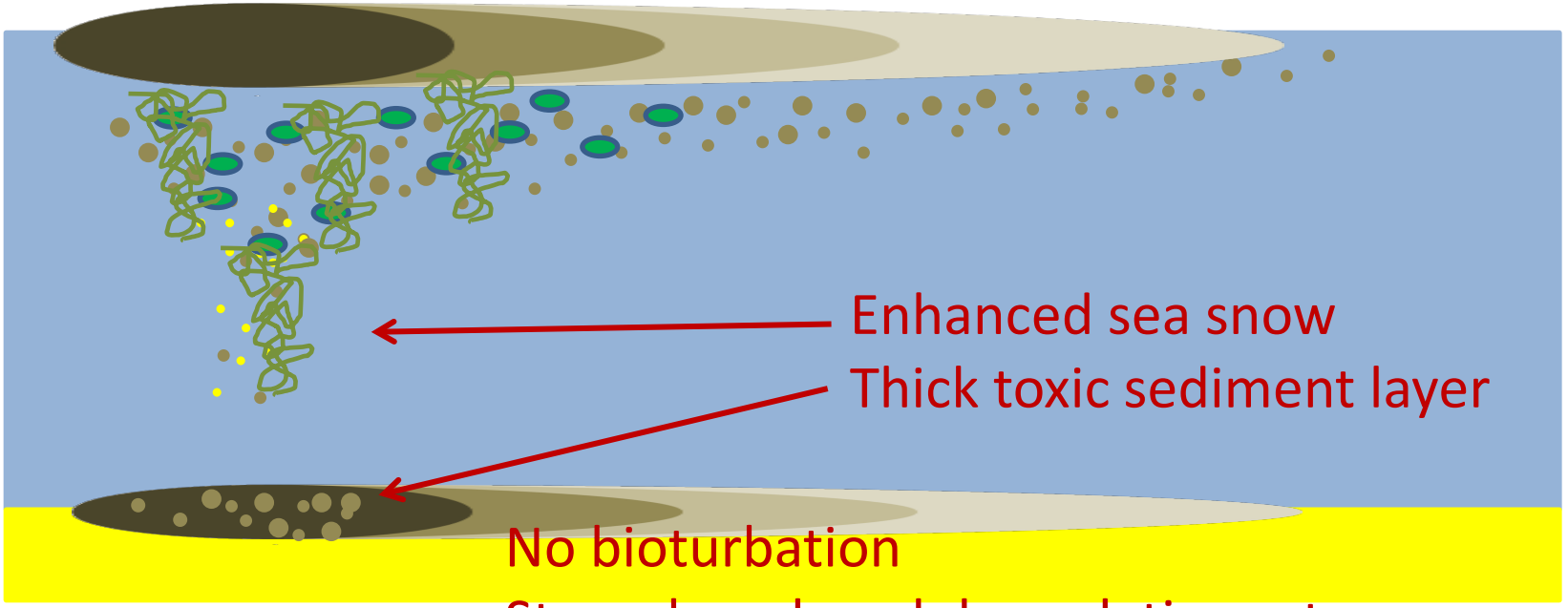
-higher toxicity in water column

-less visible oil

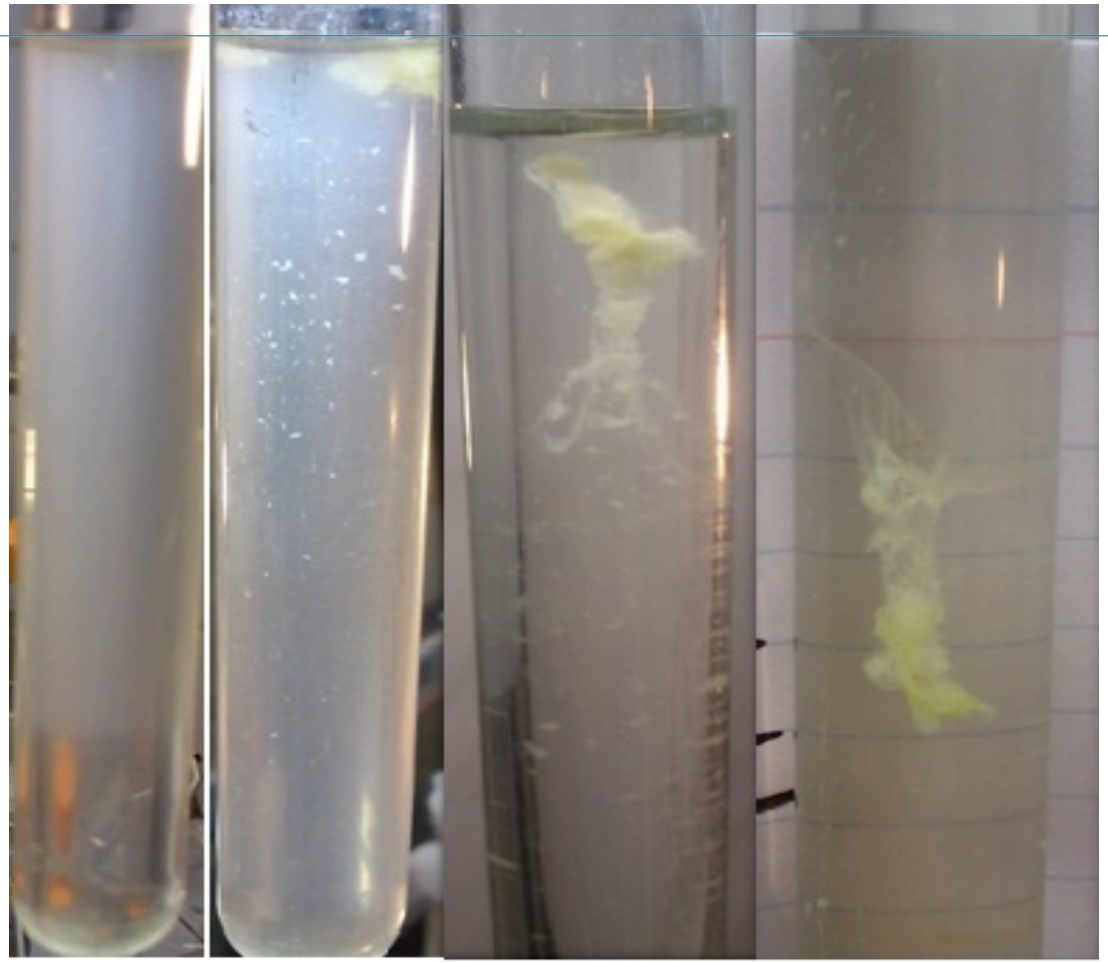
-enhanced biodegradation

However..... DWH GoM spill:

-sea snow => enhanced sedimentation
(incl diatoms from surface)
-toxic sediment layer (hardly bioturbation/degradation)
-instead of reduced period of toxic problems => longer duration (weeks => years)



In lab: marine snow formation induced by dispersants in presence of marine algae

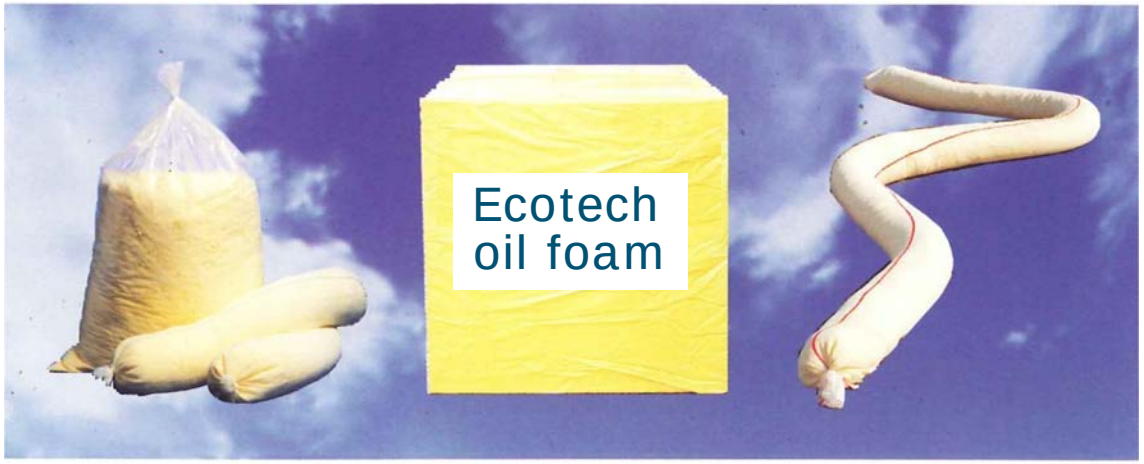


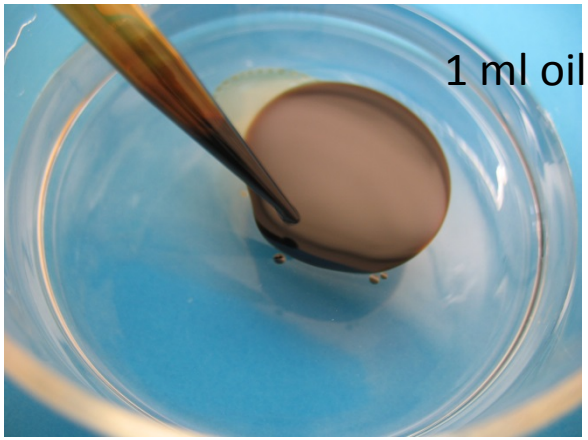
a. 24 hours b. 48 hours c. 6 - 8 days

Why bother about a toxic sludge at 800 m deep?

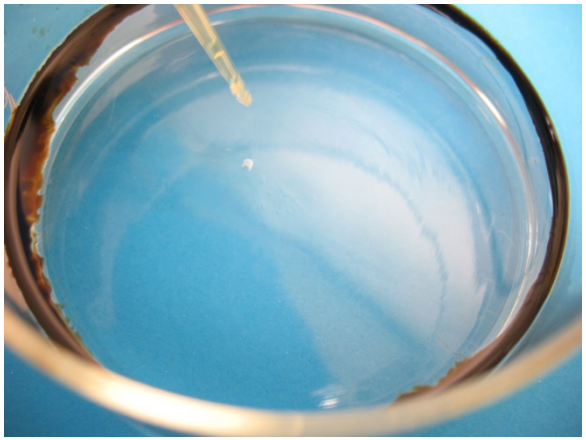
- Explanation for absence of Red snapper juveniles? *(no recruitment in 4 years)*
- Early life stages of fish a.o. marine species depend on very specific habitats for specific periods of their life cycle
- Direct effects of oil toxicity?
- Relevance of benthos for the food web?

Additional oil spill response options for problematic conditions?



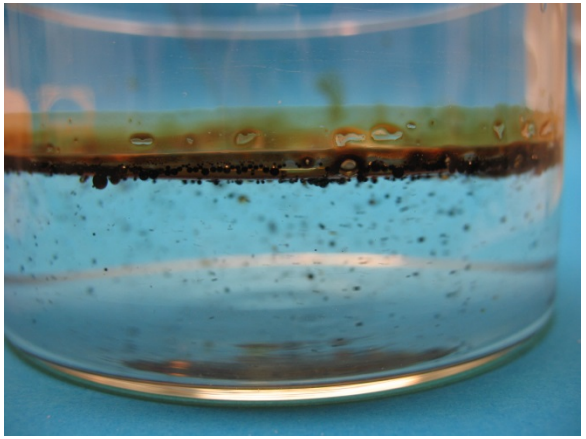


1 ml oil on water

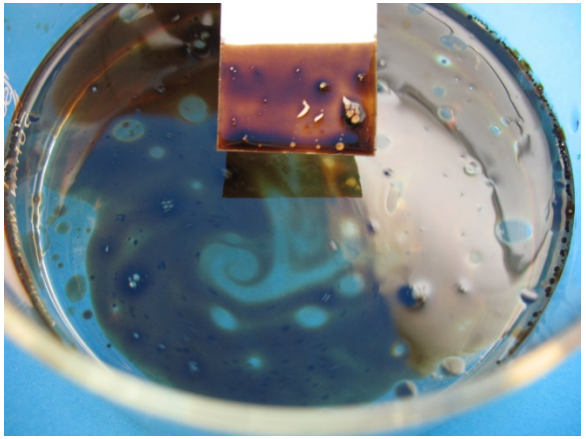


Second after
1:20 dispersant

Stirring

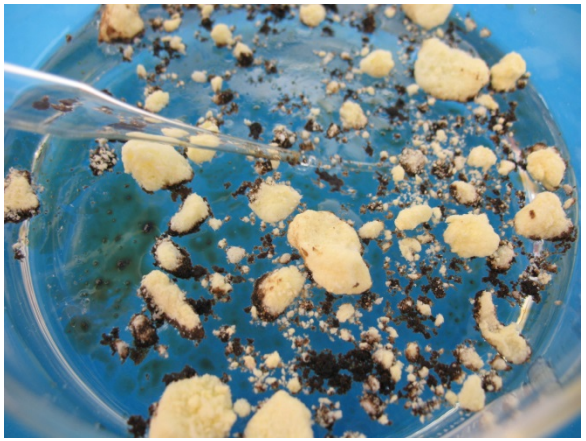


Shortly after stirring

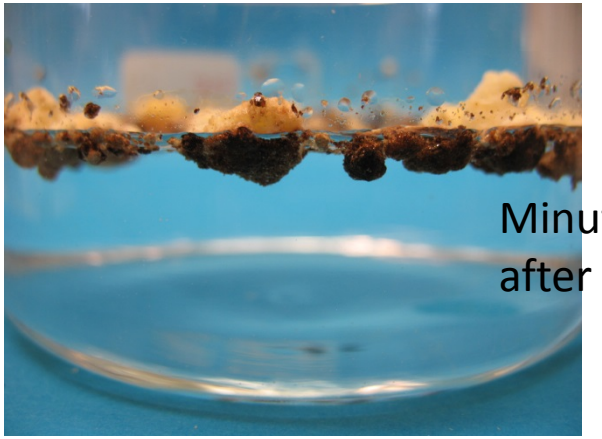


White paper
(dipped
immediately
after stirring)

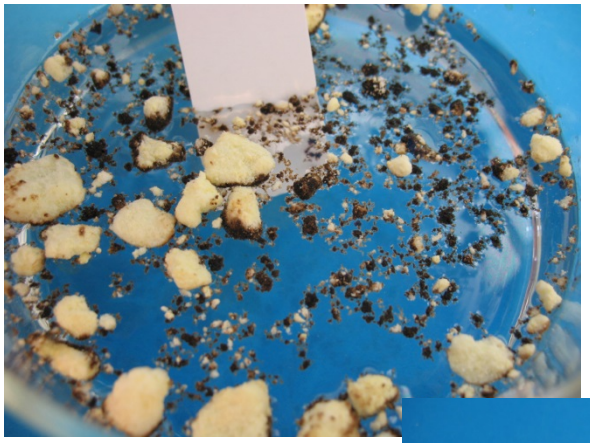
1 ml oil on water



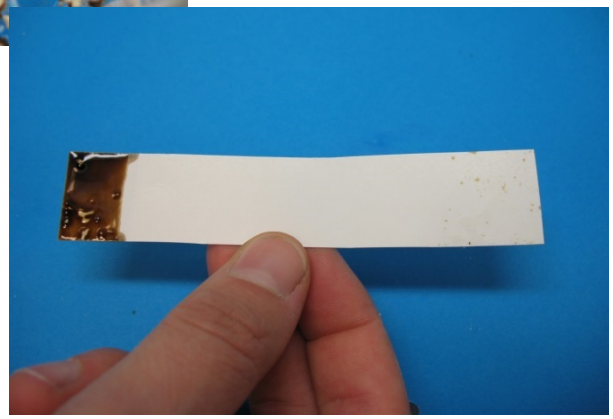
Seconds after adding ‘Ecotech oil foam’



Minute after stirring

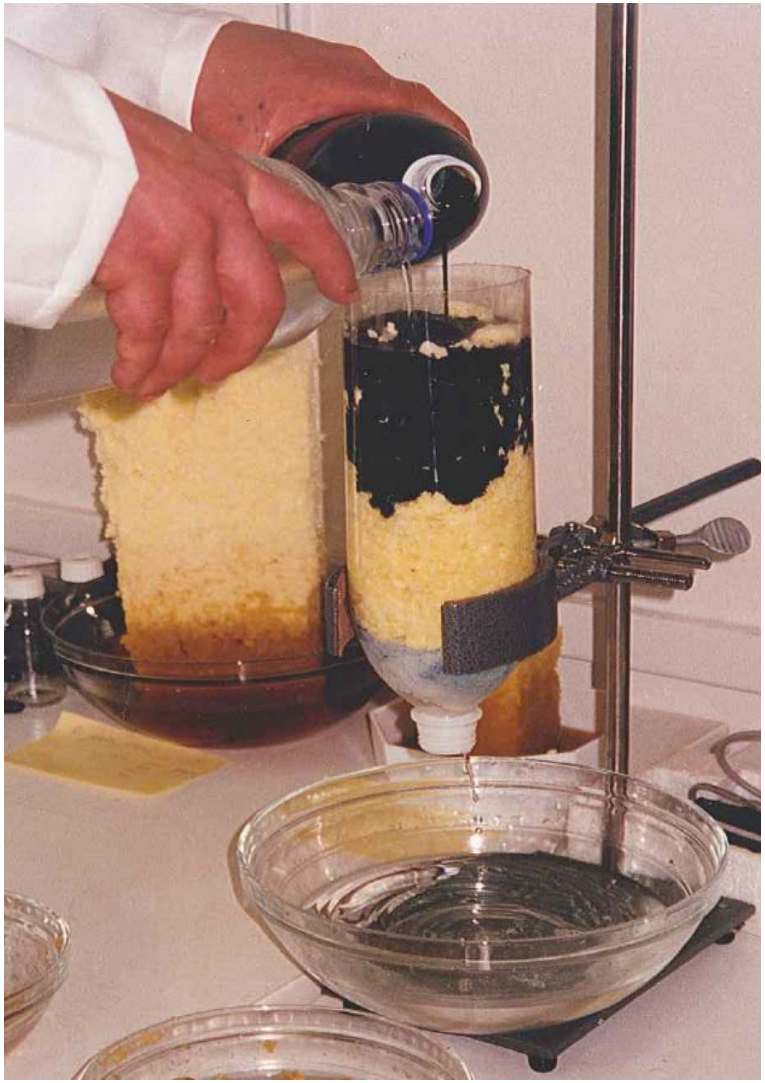


White paper (dipped immediately after stirring)



Treatment 1:20 dispersant or ‘Ecotech foam’ (right)

Remove oil from water

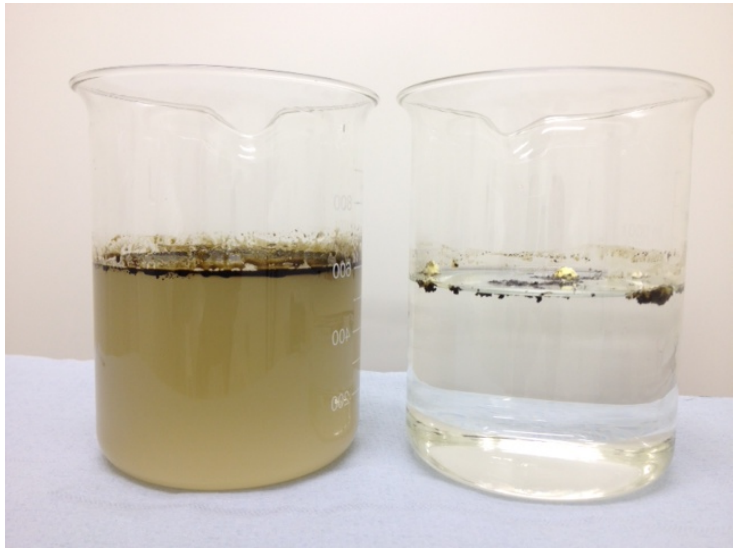


Ecotech oil foam

Recovery of oil from e.g.
-Skimming water
-Production water

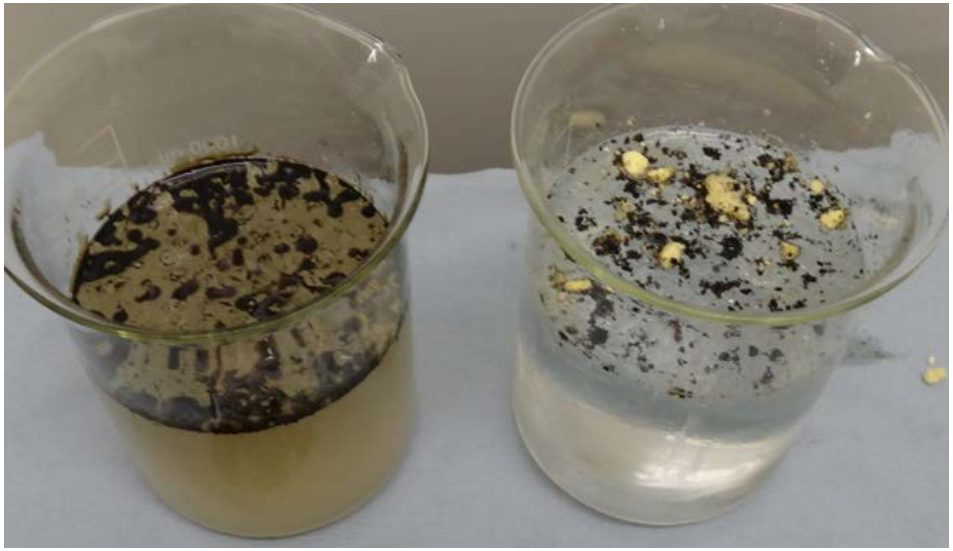
5% oil in seawater
purification

Try-out 4°C +/- ice



4°C no ice

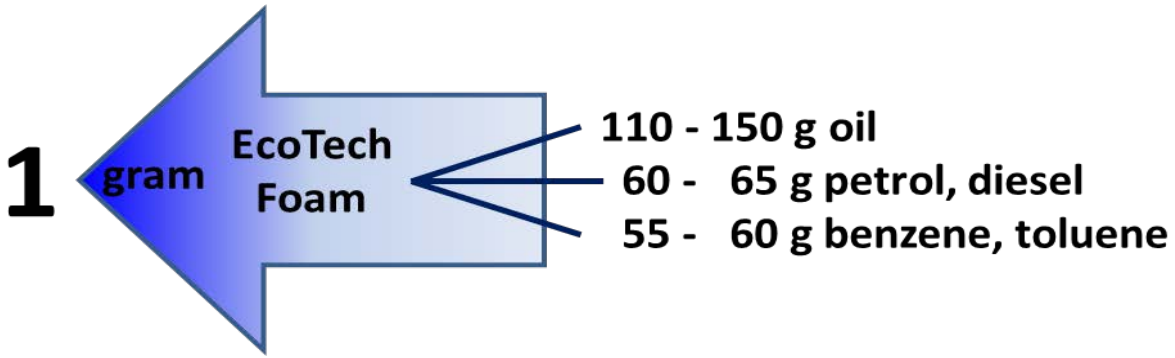
4°C + ice



Additional solutions for problematic conditions with Ecotech oil foam?

- On site oil from water collection
- Use booms or cushions that also absorb the oil
- Secure oil until it can be removed
- Research idea: (enhanced) in situ biodegradation?

The foam can fully mineralize



Advantages Ecotech oil foam

- Environmental friendliness (mineralisation to N and P)
- Flexibility (on site production, 6 min/m^3, 25 kg)
- Oiled water can run through fast (also very saline)
- No algal stress responses
- Works at low temperatures/ice
- Oil could be recovered *(by pressing)*

- Next: characterisation & step to field practise

Thank you for your attention!

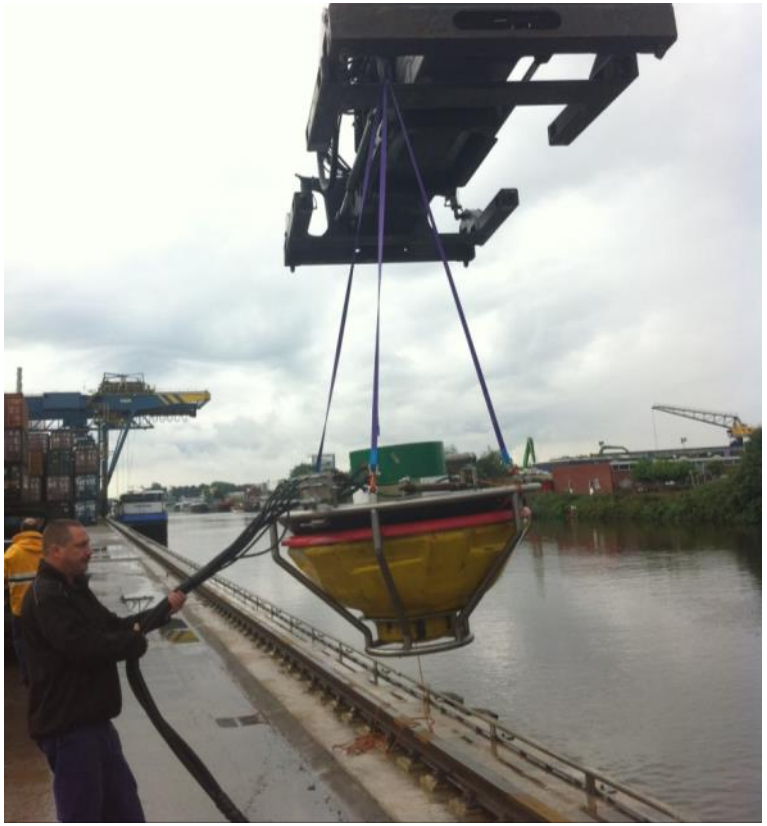
More info:

Tinka.Murk@WUR.nl

www.youtube.com/watch?v=jaWyXKjacE8

(keywords: offshore energy Amsterdam Murk)

Successful informal trial removing oil from skimming water of Oil Swallow



Research needs for application

Short term:

- Optimal ‘ball and pore’ sizes for oil types/conditions (°C)
- Analyse compounds in cleaned skimming water (more hydrophilic compounds?)
- Recovery of oil from absorbent
- Demonstrate safety for marine life in mesocosms

Long term:

- Develop enhanced in situ degradation of collected oil
- Field tests and development with experienced & business partners!

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