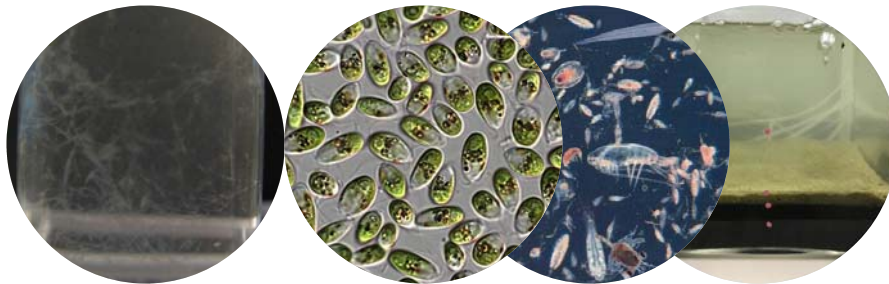


Dispersants and algae, a deadly cocktail...

New insights in the fate of oil should lead to reconsidering alternative response strategies during algal blooms

Tinka Murk and Edwin Foekema
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C-IMAGE NL team



Edwin Foekema
(Feb 6, MOSSFA Workshop)



Tinka Murk
(Feb 8, 12.15 pm, session 010)



Justine van Eenennaam
(Feb 8, 12.00 pm, session 010)



Sophie Vonk



Marieke Zeinstra
(Feb 9, 10.00 am, session 018)



Alette Langenhoff
(Feb 8, 12.00 pm, session 012)



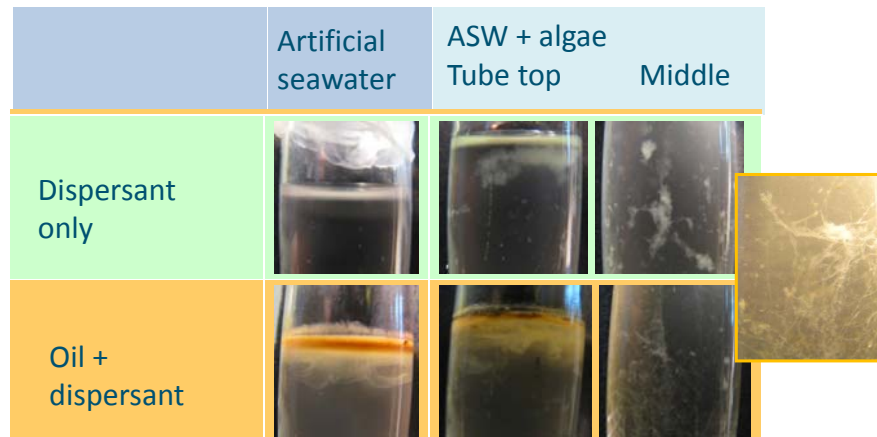
Wierd Koops



Shokouh Rahsepar



Dispersants in the presence of algae induce EPS ('flocs' or 'webs') (2012)



= > formation of EPS by phytoplankton-associated bacteria exposed to dispersants

- *Dunaliella tertiolecta* & *Phaeodactylum tricornutum*
- EPS: proteins, carbohydrates & more
- Monosaccharide composition: phytoplankton species dependent
- Axenic algae (PenStrep treated) do not produce EPS
- In the dark far less EPS production

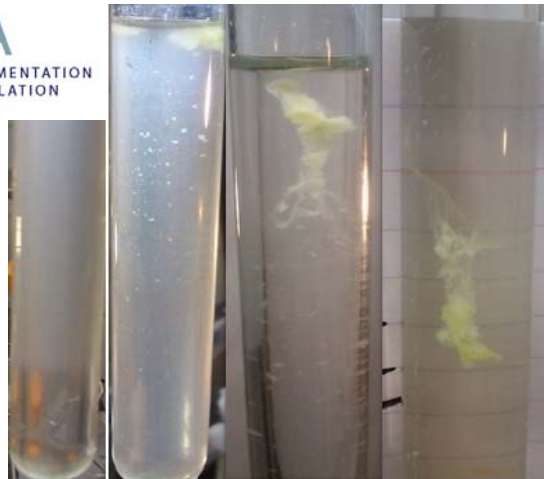
Van Eenennaam et al. 2016,
Marine Pollution Bulletin 104: 294–302



Consequences of MOSSFA for oil toxicity?



MOSSFA
MARINE OIL SNOW SEDIMENTATION
& FLOCCULENT ACCUMULATION

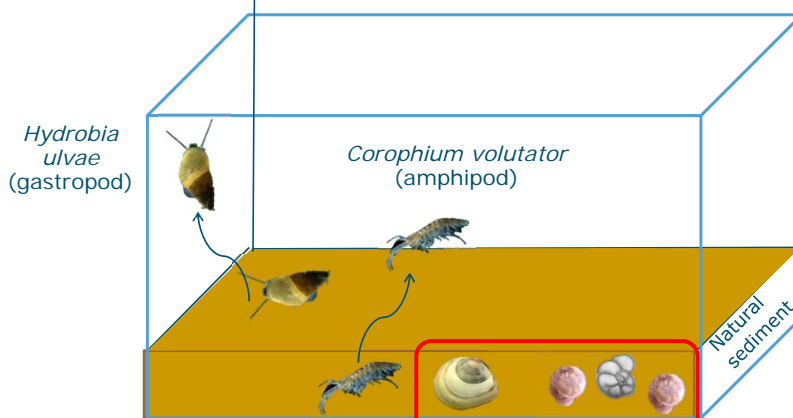


a. 24 hours b. 48 hours c. 6 - 8 days



Van Eenennaam et al. 2016

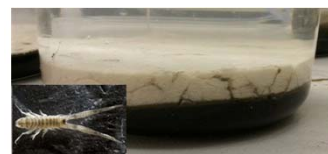
Testing effects of MOSSFA in mesocosms



Macoma balthica
(bivalve)

Foraminifera

Van Eenennaam
(Poster 183)



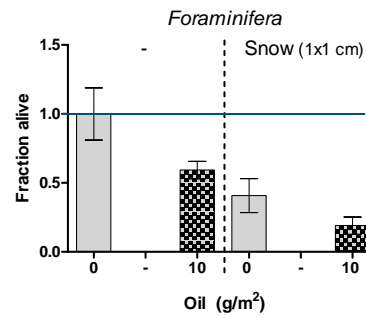
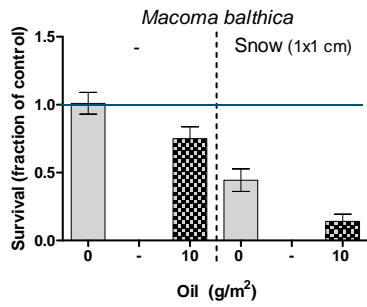
Animals that cannot 'escape'



Macoma balthica



Foraminifera

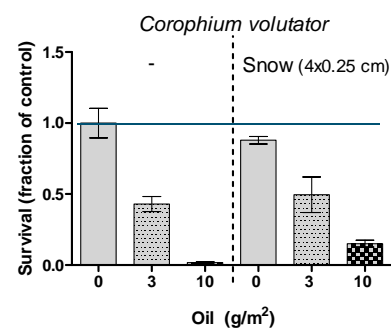
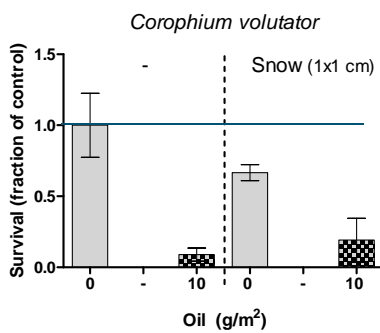


- Effect of snow
- Additional effect of oil



Van Eenennaam et al. in prep.

Mobile bio-turbator can handle gradual snow addition



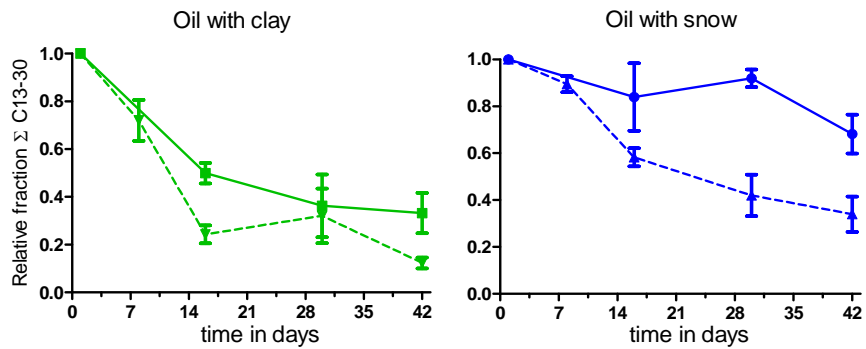
- Effect of 1 cm snow
- Strong effect of oil

- No effect of 4x0.25 cm snow
- Dose related effect of oil



Van Eenennaam et al. in prep.

Oil degradation greatly reduced by snow & by reduced bioturbation

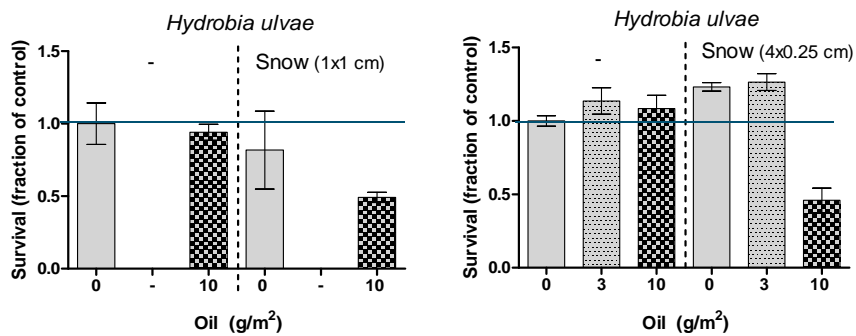


— Without invertebrates
 - - - With invertebrates



Rahsepar et al. in prep.
 Van Eenennaam et al. in prep.

Can choose to stay and to eat



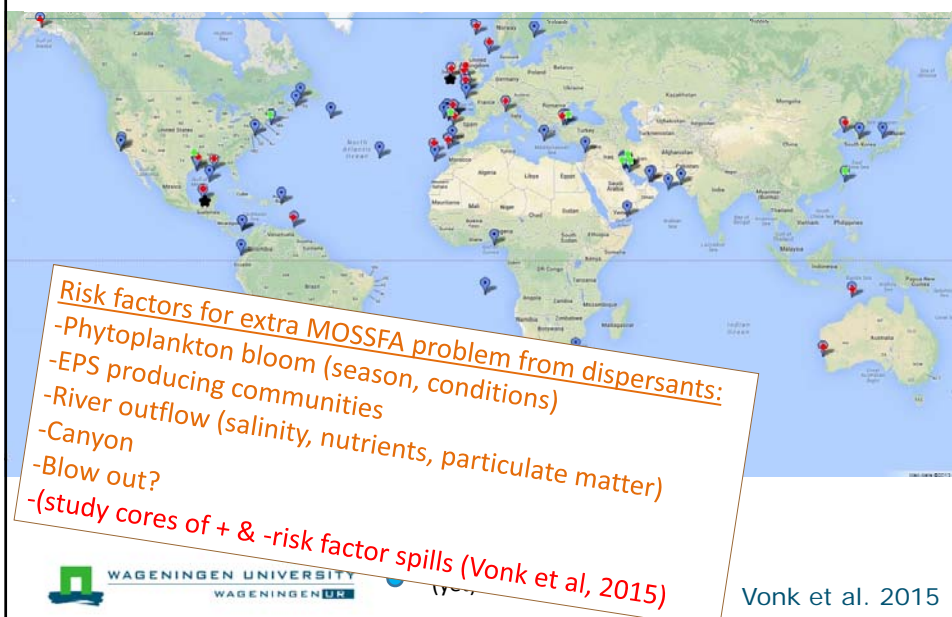
- No effect of oil alone
- No effect of 1 cm or 4x0.25 cm snow
- Animals seem to feed on snow
- Clear effect of oil in snow



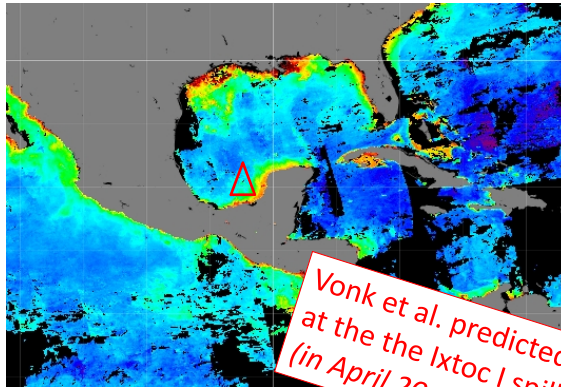
A MOSSFA event increases impact and persistence of oil on the seabed

- Smothering and suffocating of animals that cannot escape => benthic fauna, oyster- and coral reefs => impact on food chain, nursery-, habitat- and filtering function, economic damage
- Luring animals into consuming oil (oiled fluff); invertebrates, probably also fish => oil in food chain
- Strongly reduced oil biodegradation => prolonged toxic exposure => reduced bioturbation => further prolonged toxicity & delayed re-colonisation (toxicity needs to get below effect levels)
- **Think about consequences and MOSSFA sensitive conditions (seasons) before you need to choose how to respond to a spill !**

Meta-analysis 60 historical oil spills > 10,000 t.



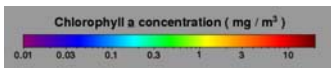
Chlorophyll-a concentration Ixtoc I oil spill, Mexico, Bay of Campeche, GoM monthly June 1979, CZCS- satellite image



Coastal Zone Color Scanner (CZCS) - Ocean Color – National Aeronautics and Space Administration (NASA), USA.

Date of operation- November 1978- 22 June 1986.

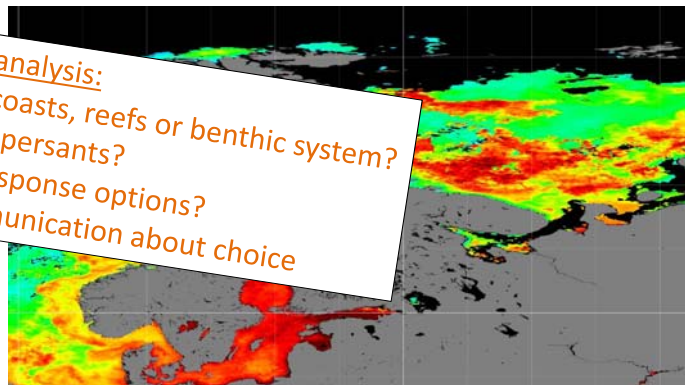
Vonk et al. predicted MOSSFA at the the Ixtoc I spill (in April 2013)



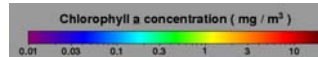
Vonk et al. 2015

MOSSFA risk (e.g. spill during spring bloom in Arctic waters)?

Cost-benefit analysis:
 -Smothering coasts, reefs or benthic system?
 -Dedicated dispersants?
 -Alternative response options?
 -Prepare communication about choice



April 2013
 MODIS/TERRA, monthly average. Ocean color.



Thank you !

