

Oil slick elongation as a result of dispersion

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Introduction

Dispersants as an oil spill response option



- Reduced impacts of surface oil
- Enhanced biodegradation
- Reduced evaporation

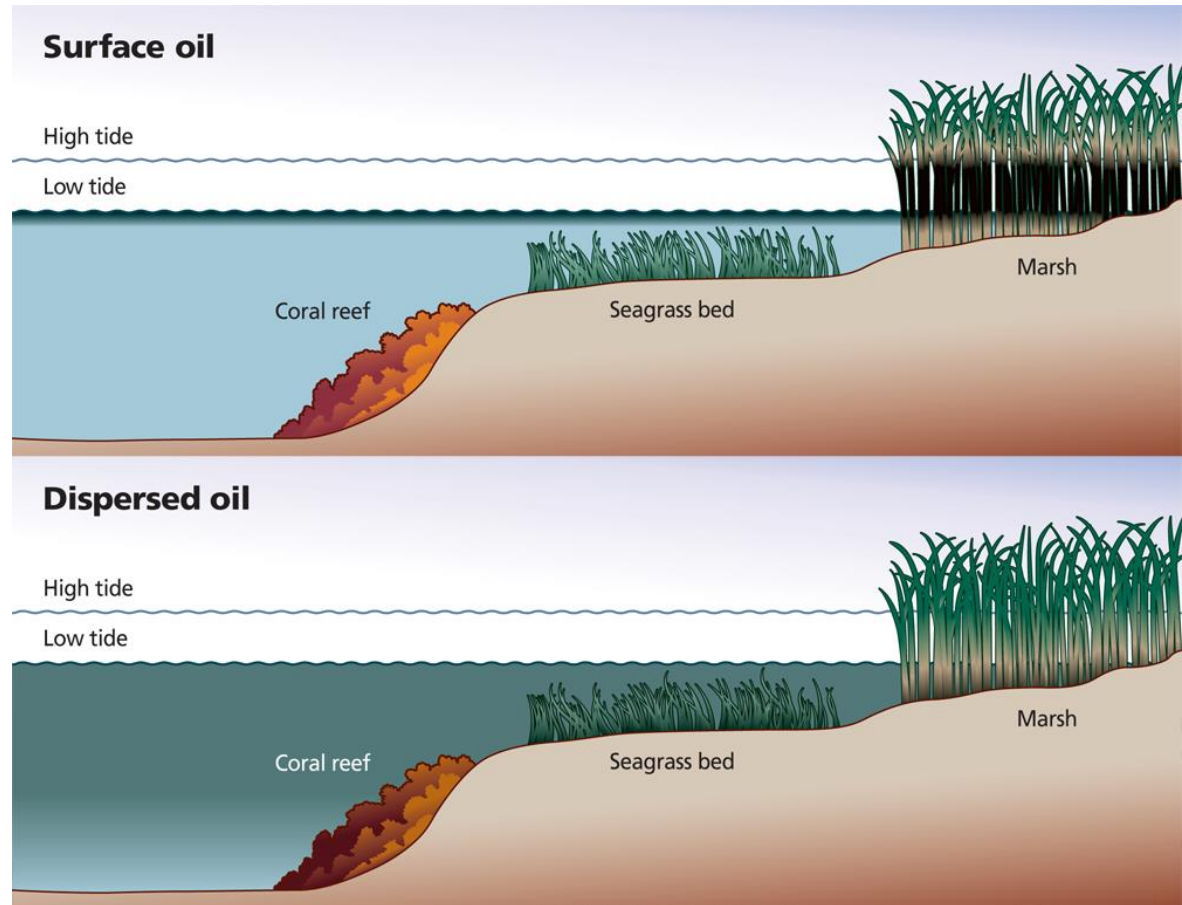
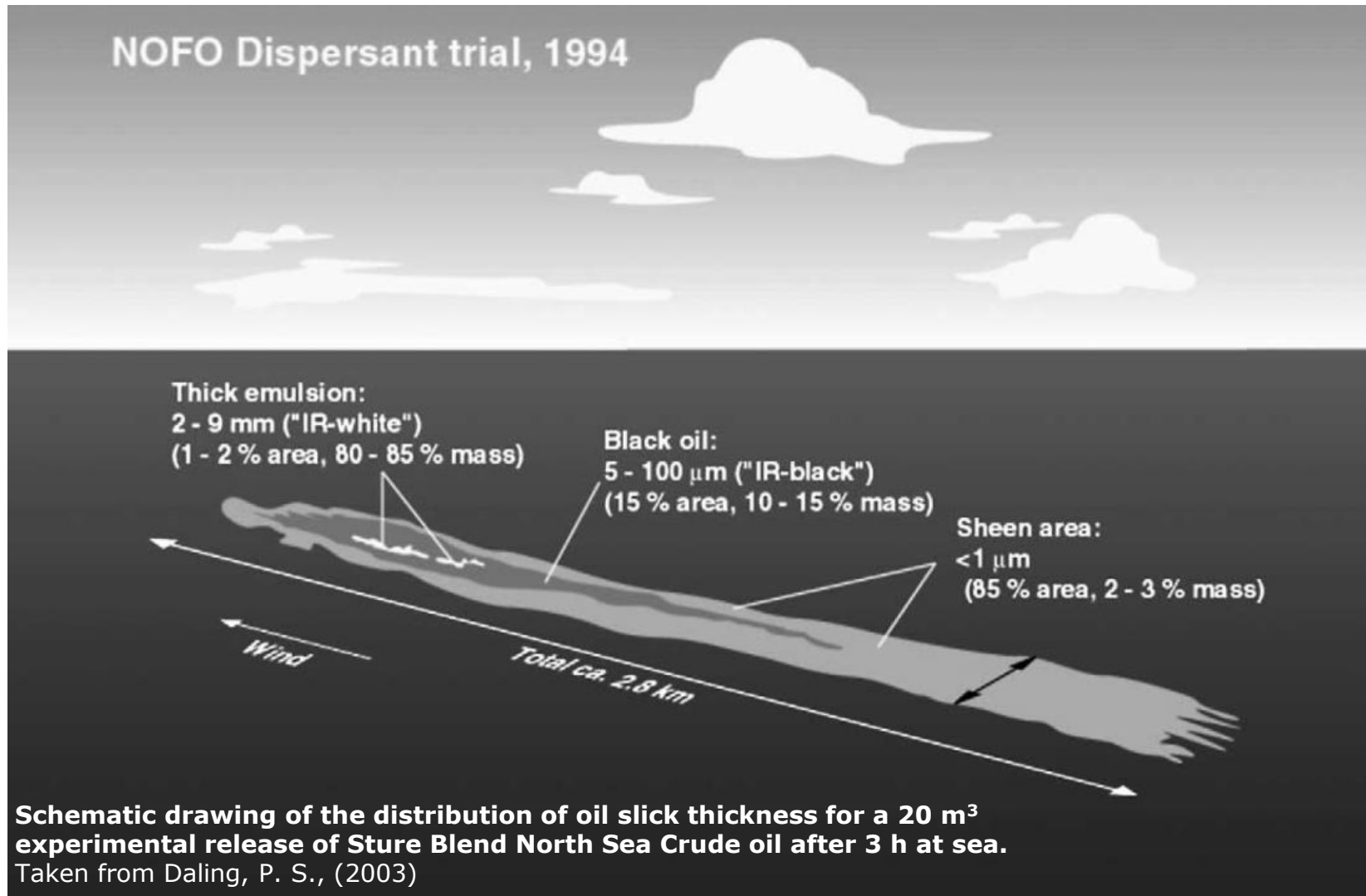


Figure source: <http://ehp.niehs.nih.gov/118-a338/>

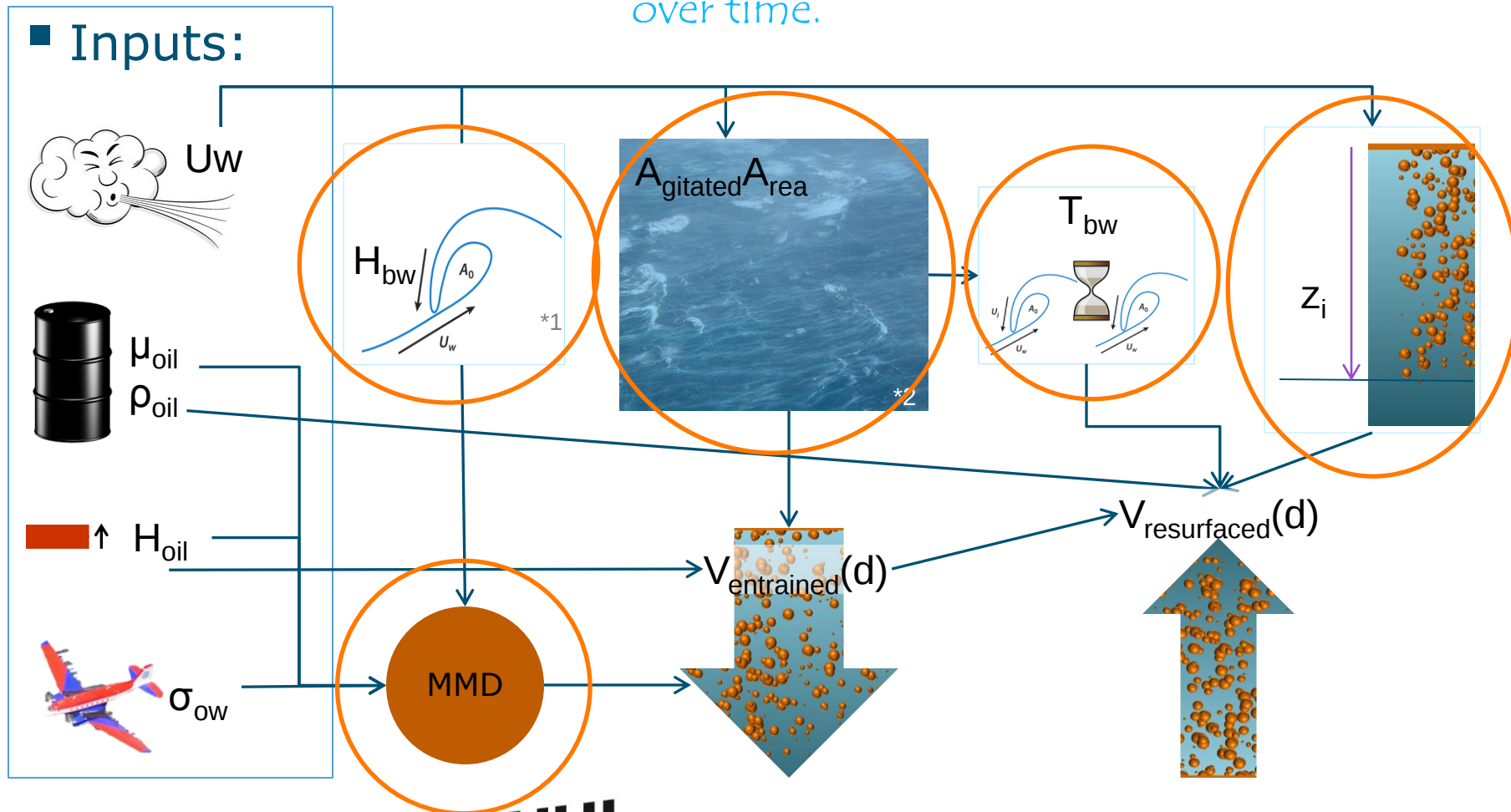
Wind Shear

Elongation as a result of resurfacing of entrained oil



Inputs & main variables

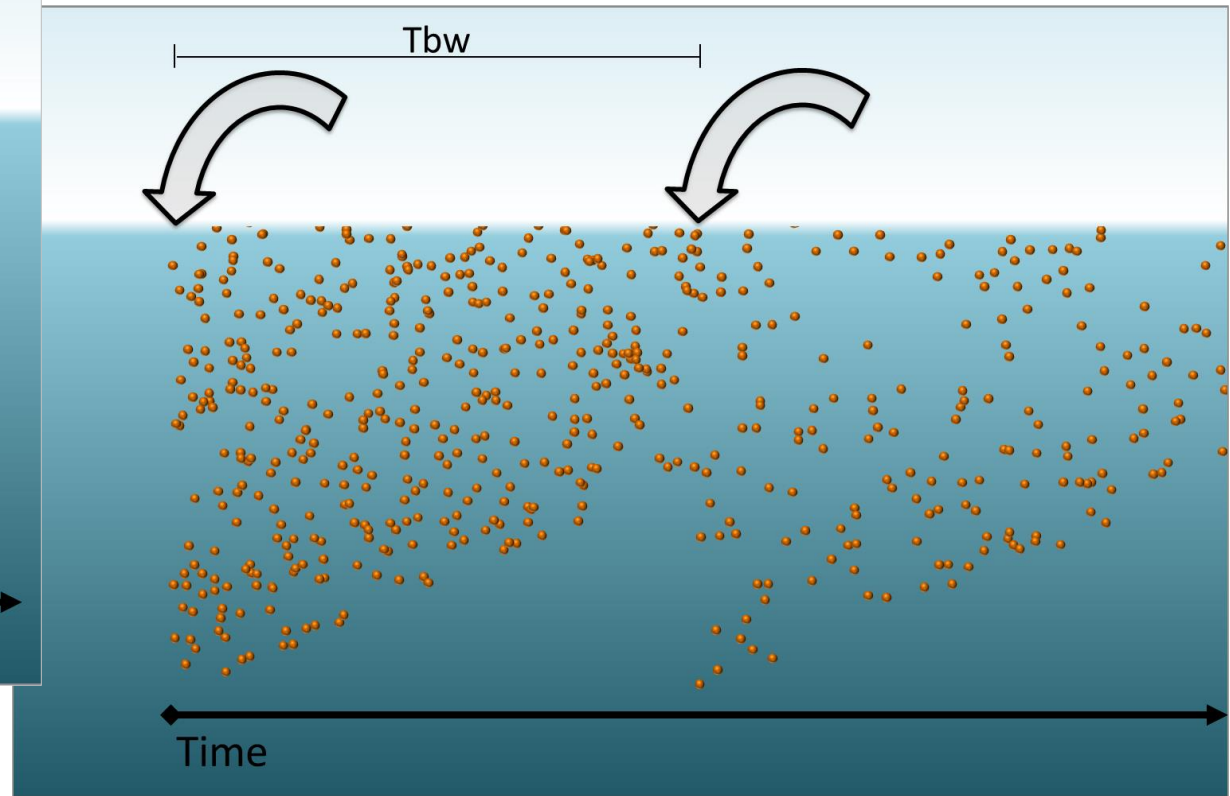
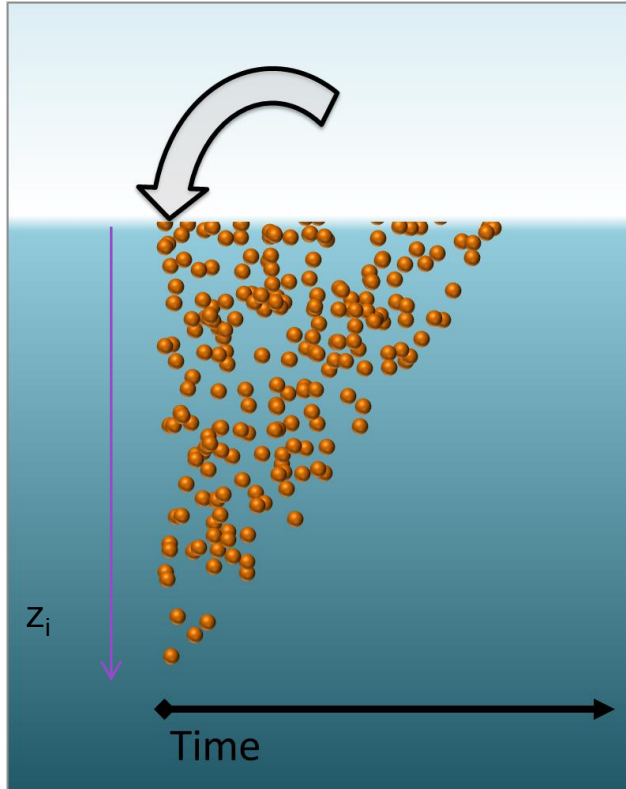
... of the model constructed in this project.
Goal is to investigate oil slick size evolution over time.



Resurfacing

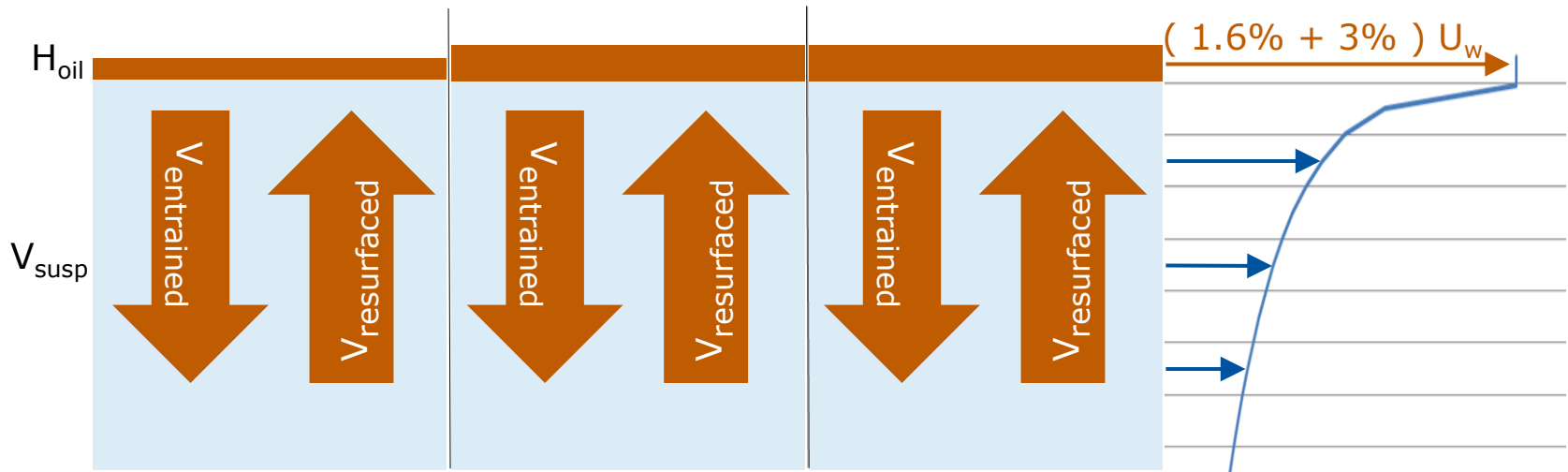
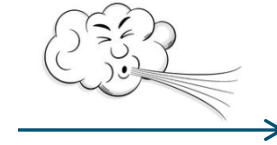
Large droplets resurface quickly (V_{susp}) decreases linearly with time.
Smaller are resuspended by the next breaking wave (V_{susp}) decreases like exponential decay over longer periods

Volume still suspended as a function of time

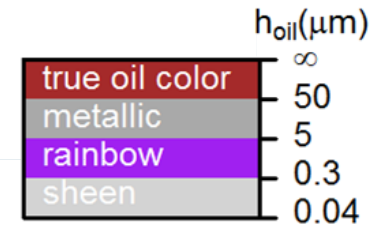


Model

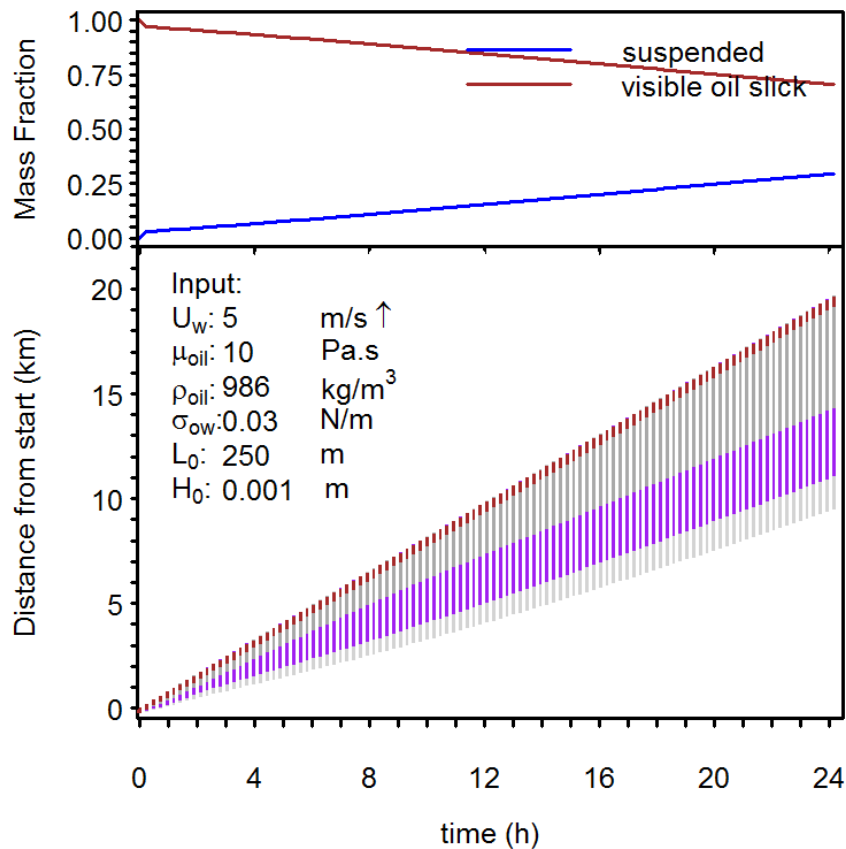
Defined lengthwise grid.
Oil is continuously entrained across the whole grid cell area.
Slick moves with wind drift factor. Underlying water a little slower.



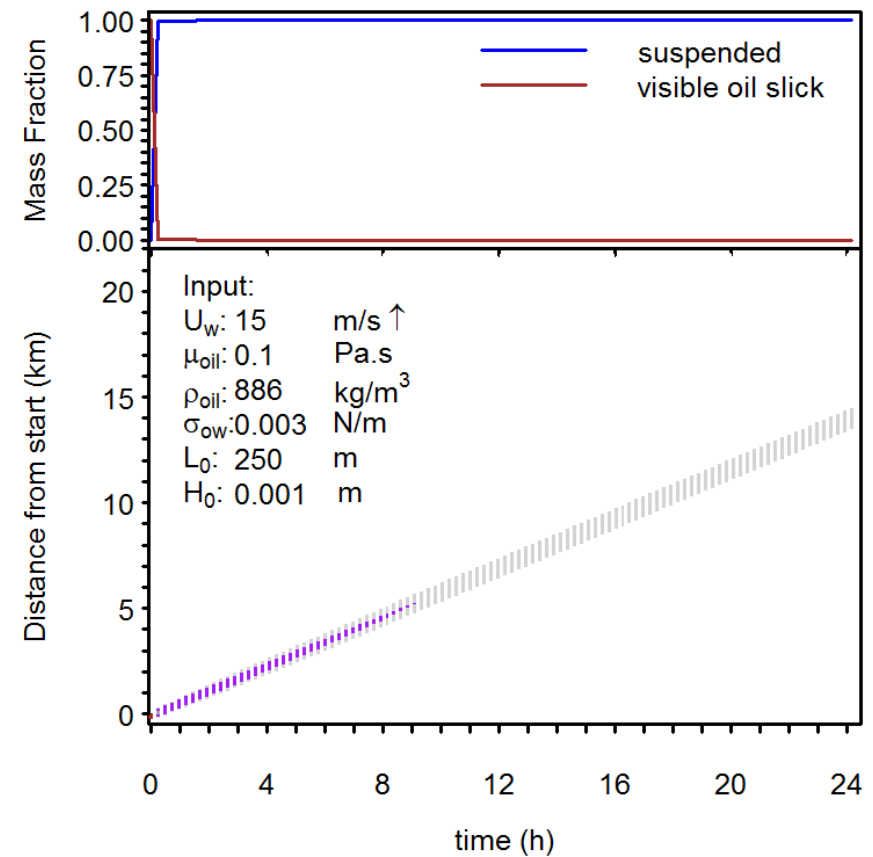
Outputs



Unfavourable conditions



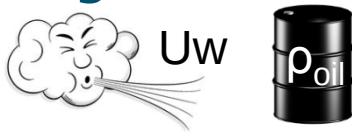
Favourable conditions



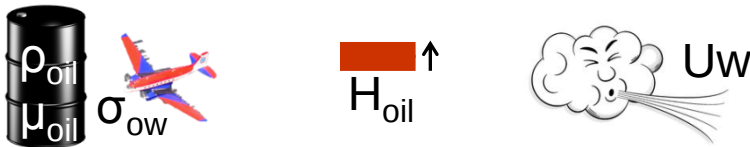
'Dispersability Factor'

Factor we defined to summarize ALL dispersion conditions into 1 value

- D_{lim} = largest diameter that can remain suspended for T_{bw}



- Dispersability Factor (DF) = Volume fraction of entrained droplets $< D_{lim}$



Results

Colour=

Oil type:

■ heavy

■ medium

■ light oil

(un)filled

Dispersant:

■ Untreated

□ Treated

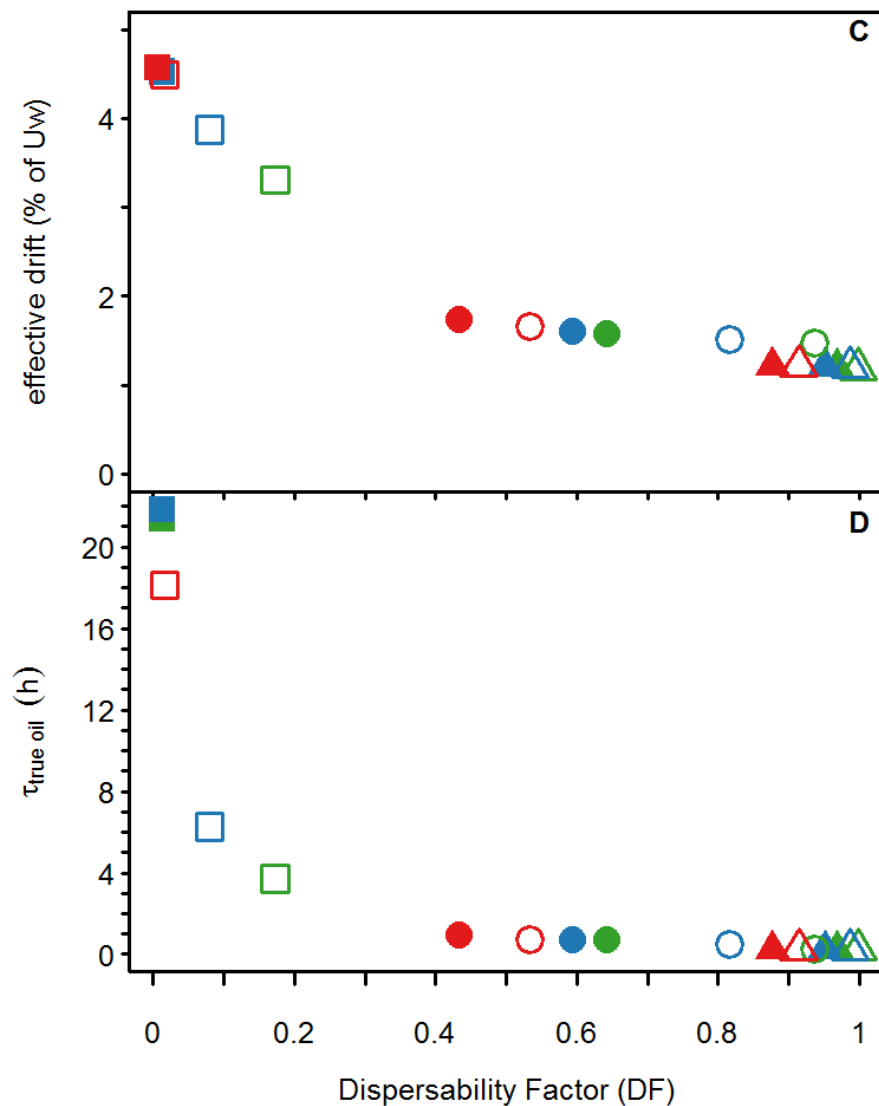
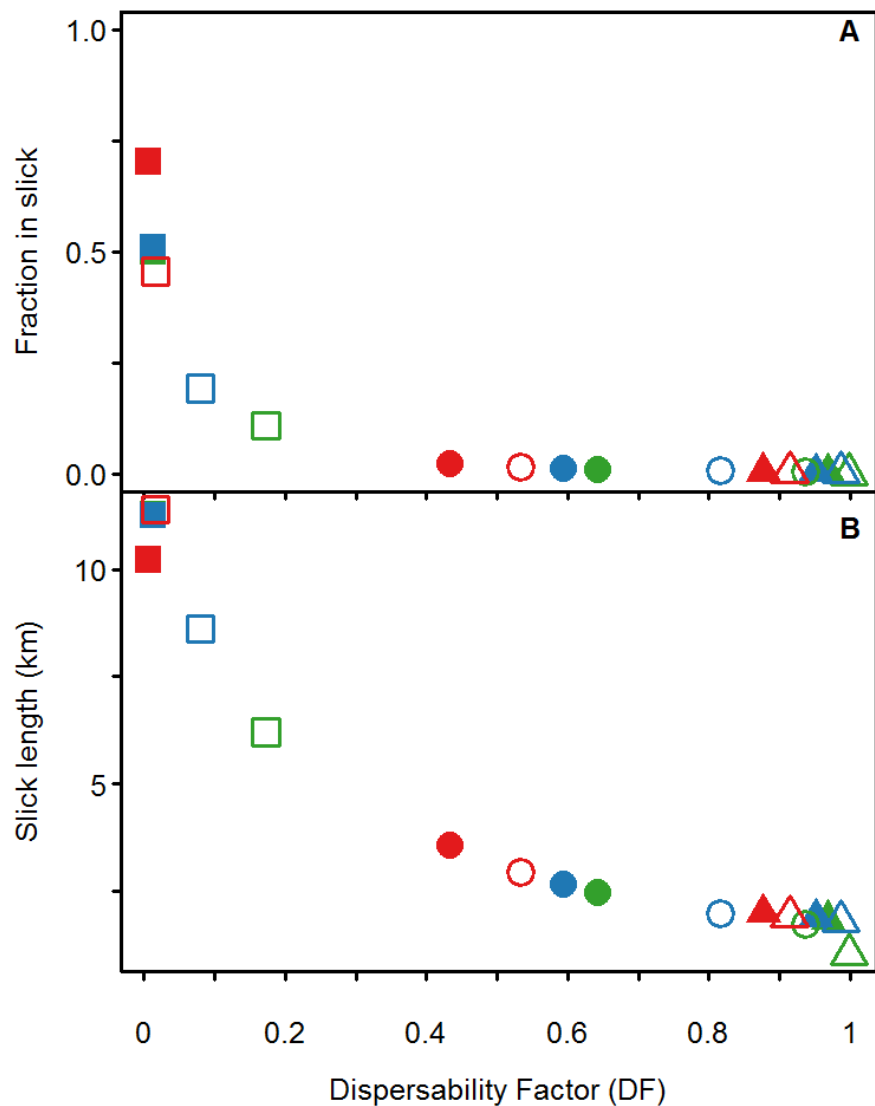
Shape=

Wind speed (m/s):

□ 5

○ 10

△ 15



Effect of dispersant use on slick area

Effects: oil slick thicker than $25\text{ }\mu\text{m}$.
 Length of oil slick $> 25\text{ }\mu\text{m}$, integrated
 over time = total potential effects

$$\int_0^{\tau} L_{\text{slick}_{H>25\mu\text{m}}}$$

Colour=
Oil type:

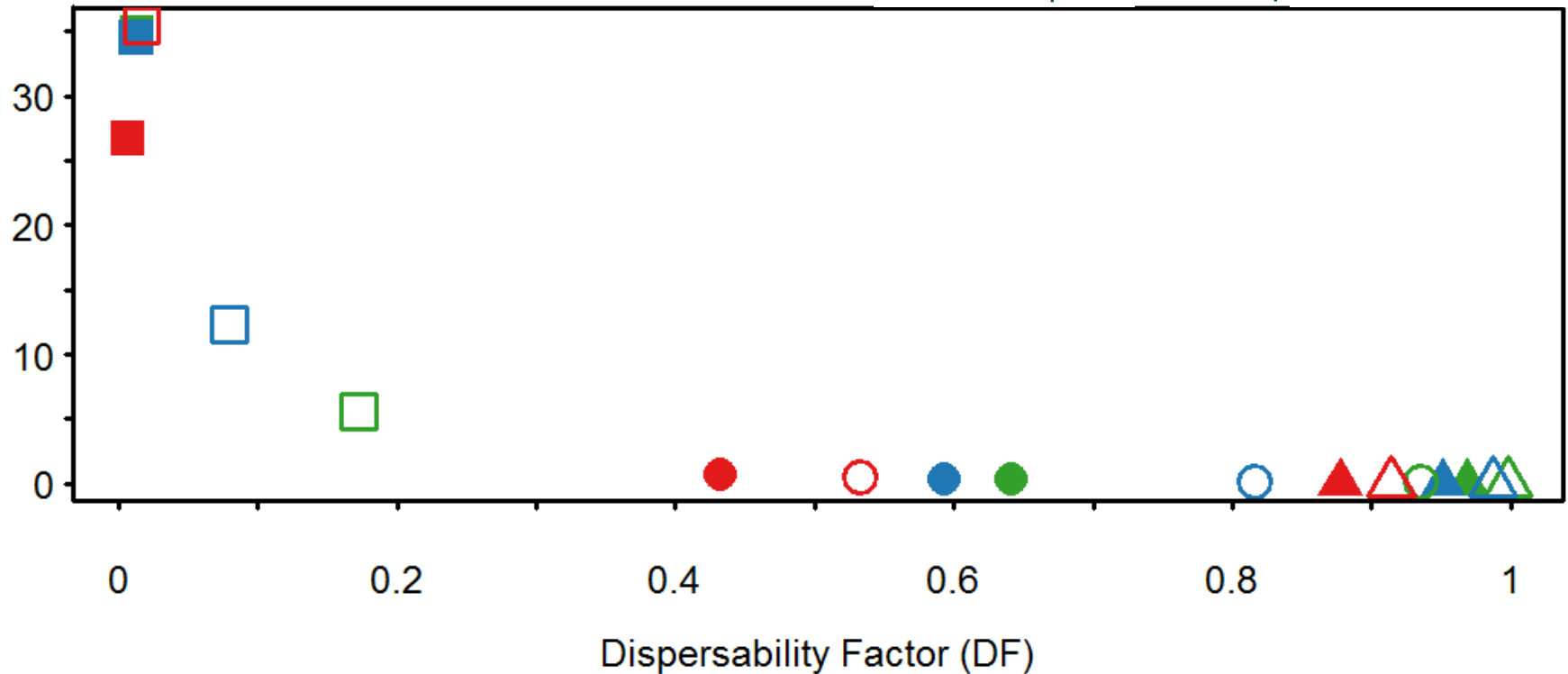
■ heavy
 ■ medium
 ■ light oil

(un)filled
Dispersant:

■ Untreated
 □ Treated

Shape=
Wind speed (m/s):

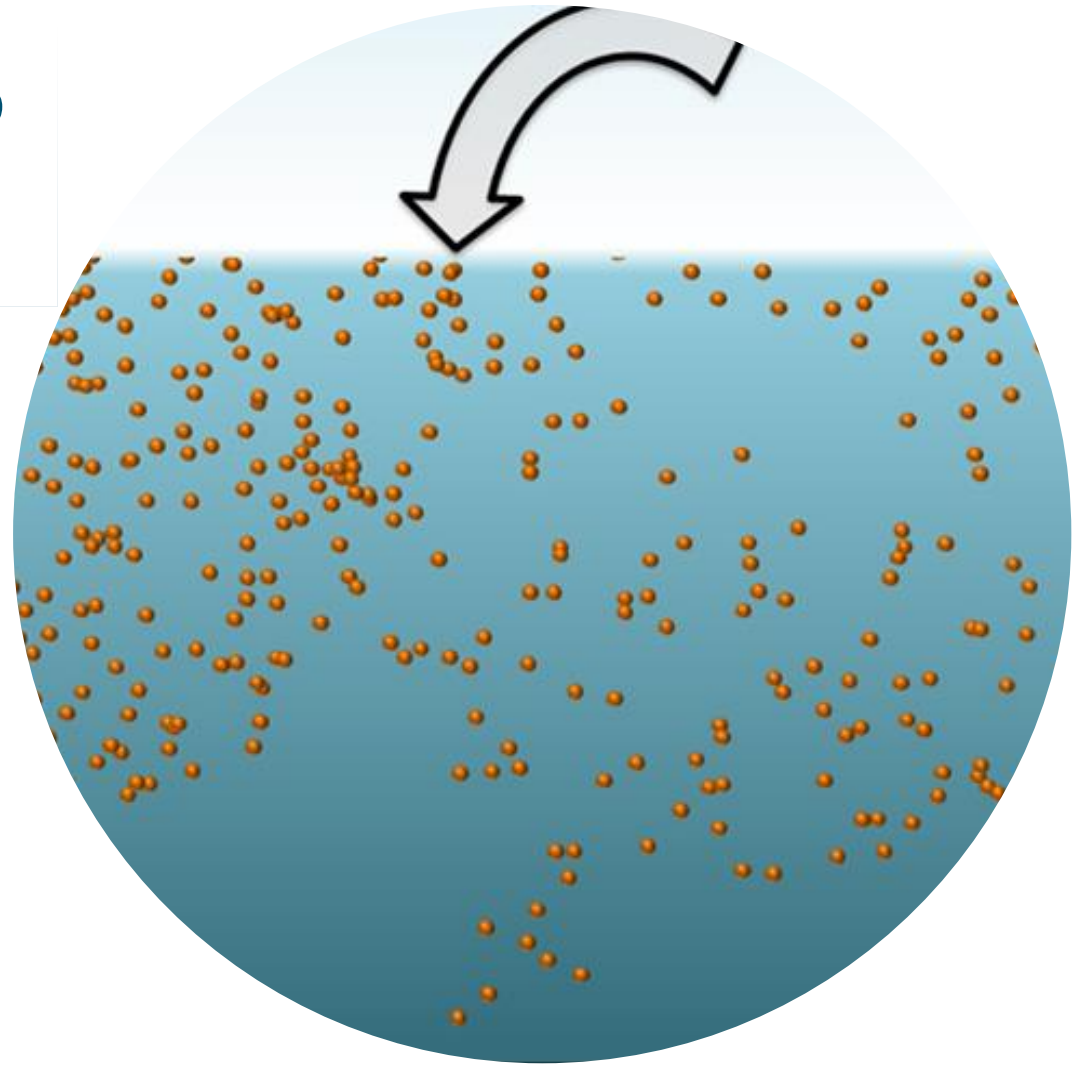
□ 5
 ○ 10
 △ 15



Conclusions & Future perspectives

- Proposed model simulates oil slick elongation and transport over time.
This process cannot be observed in laboratory tests nor wave tank tests.
- Indication of NET effect of dispersants enables decision support.
- To-do:
 - Include other weathering and transport processes

Questions?



Acknowledgements

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