Droplet Size Distribution in Wave Tank Studies on Dispersant Effectiveness

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- Team members:

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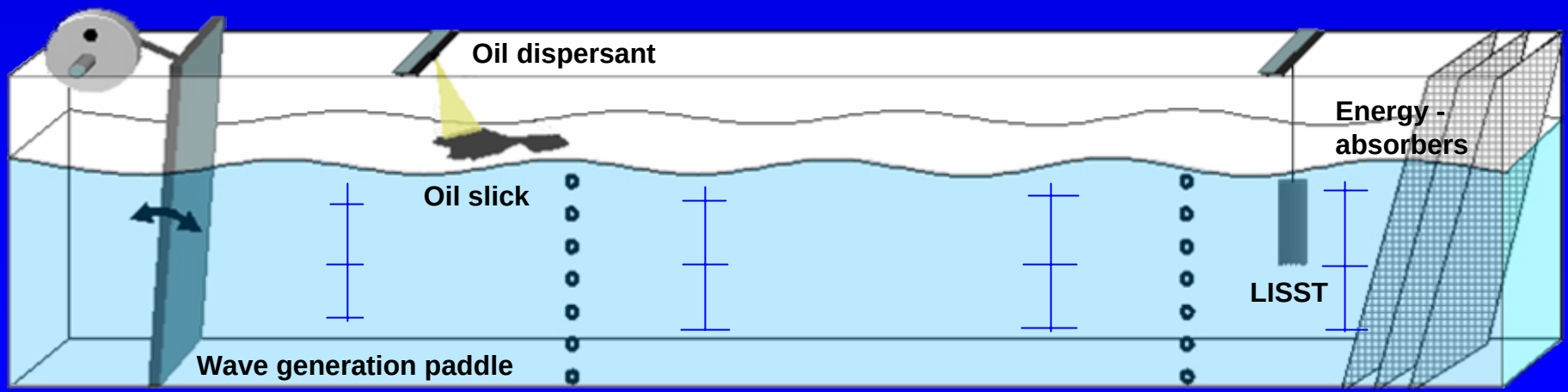
- Supporting engineers:

  Dan Moffatt, Merle Pittman

Wave Tank Facilities at BIO



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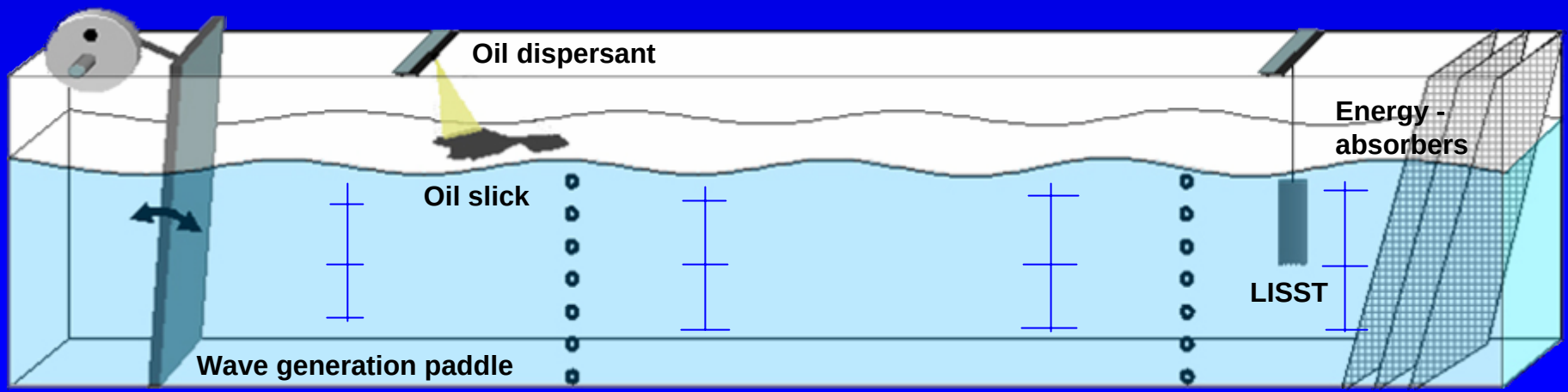


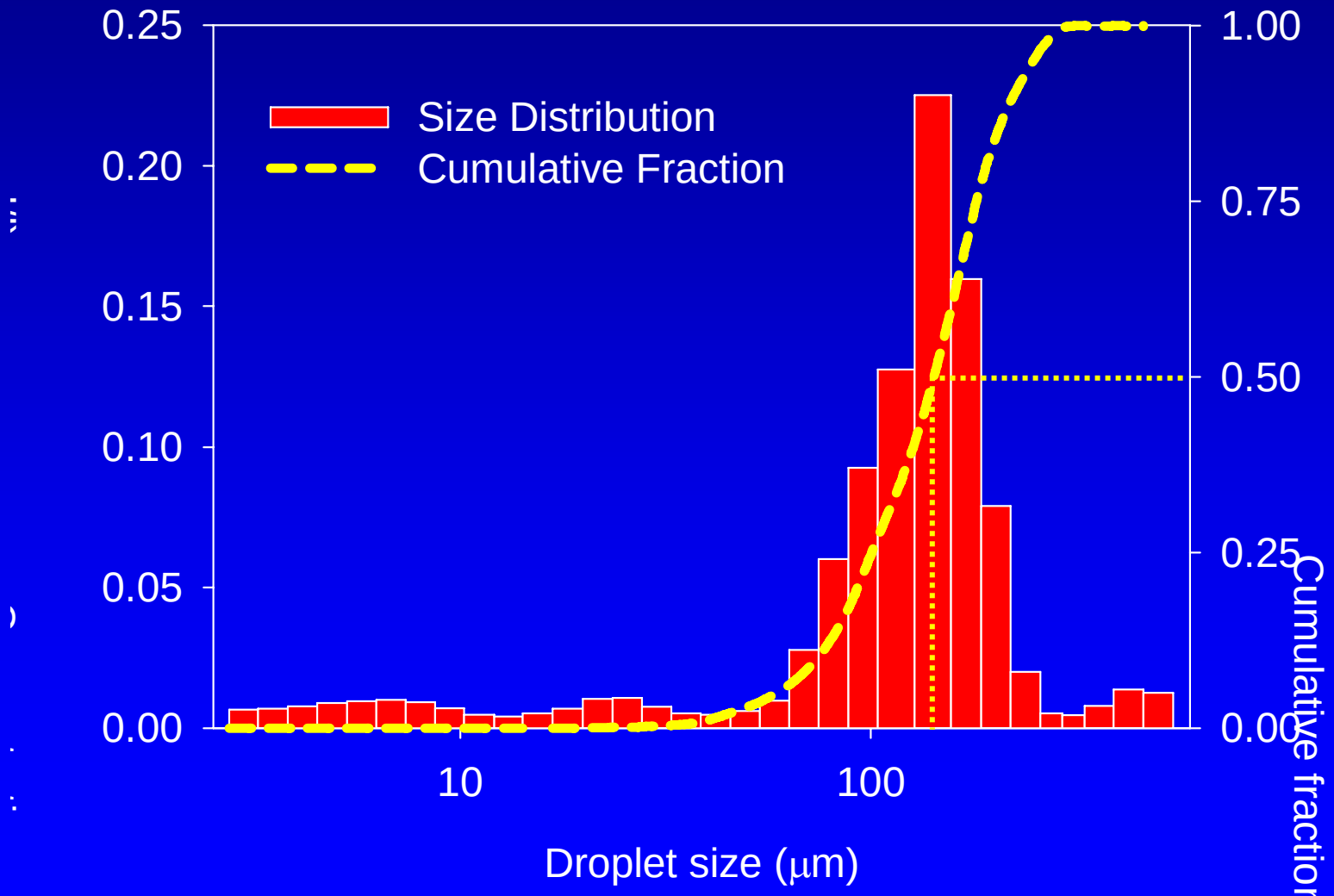
Factorial Experimental Design

- Factors:
  - Dispersants: Corexit, SPC, Water (control)
  - Waves: regular non-breaking wave; spilling breaker, plunging breaker,
  - Oil types: MESA, ANS
- Effectiveness indicators:
  - Oil concentration
  - Droplet size distribution
- Analytical methods
  - Ultraviolet Spetrophotometry
  - Ultraviolet Fluoremetry
  - Laser In-Situ Scattering and Transiometry
  - Epifuorescent microscopy

Factorial Experimental Design Matrix

Treatment	Dispersants	Oils	Waves	Replicates
1	Water	MESA	Regular	A, B, C
2	Corexit	MESA	Regular	A, B, C
3	SPC	MESA	Regular	A, B, C
4	Water	ANS	Regular	A, B, C
5	Corexit	ANS	Regular	A, B, C
6	SPC	ANS	Regular	A, B, C
7	Water	MESA	Spilling	A, B, C
8	Corexit	MESA	Spilling	A, B, C
9	SPC	MESA	Spilling	A, B, C
10	Water	ANS	Spilling	A, B, C
11	Corexit	ANS	Spilling	A, B, C
12	SPC	ANS	Spilling	A, B, C
13	Water	MESA	Plunging	A, B, C
14	Corexit	MESA	Plunging	A, B, C
15	SPC	MESA	Plunging	A, B, C
16	Water	ANS	Plunging	A, B, C
17	Corexit	ANS	Plunging	A, B, C
18	SPC	ANS	Plunging	A, B, C

Particle Size Distribution Measured with LISST-100X (no dispersant)



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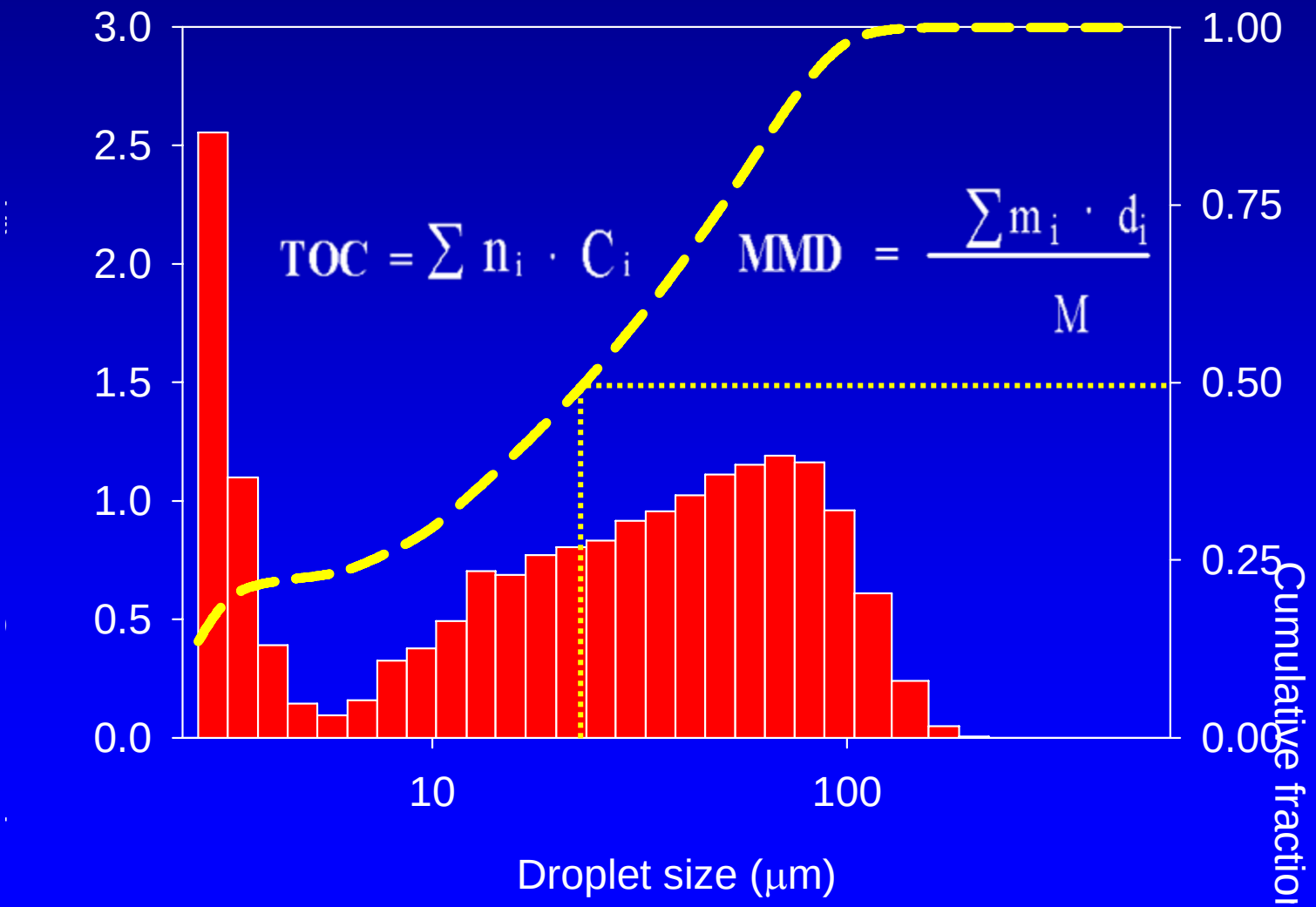
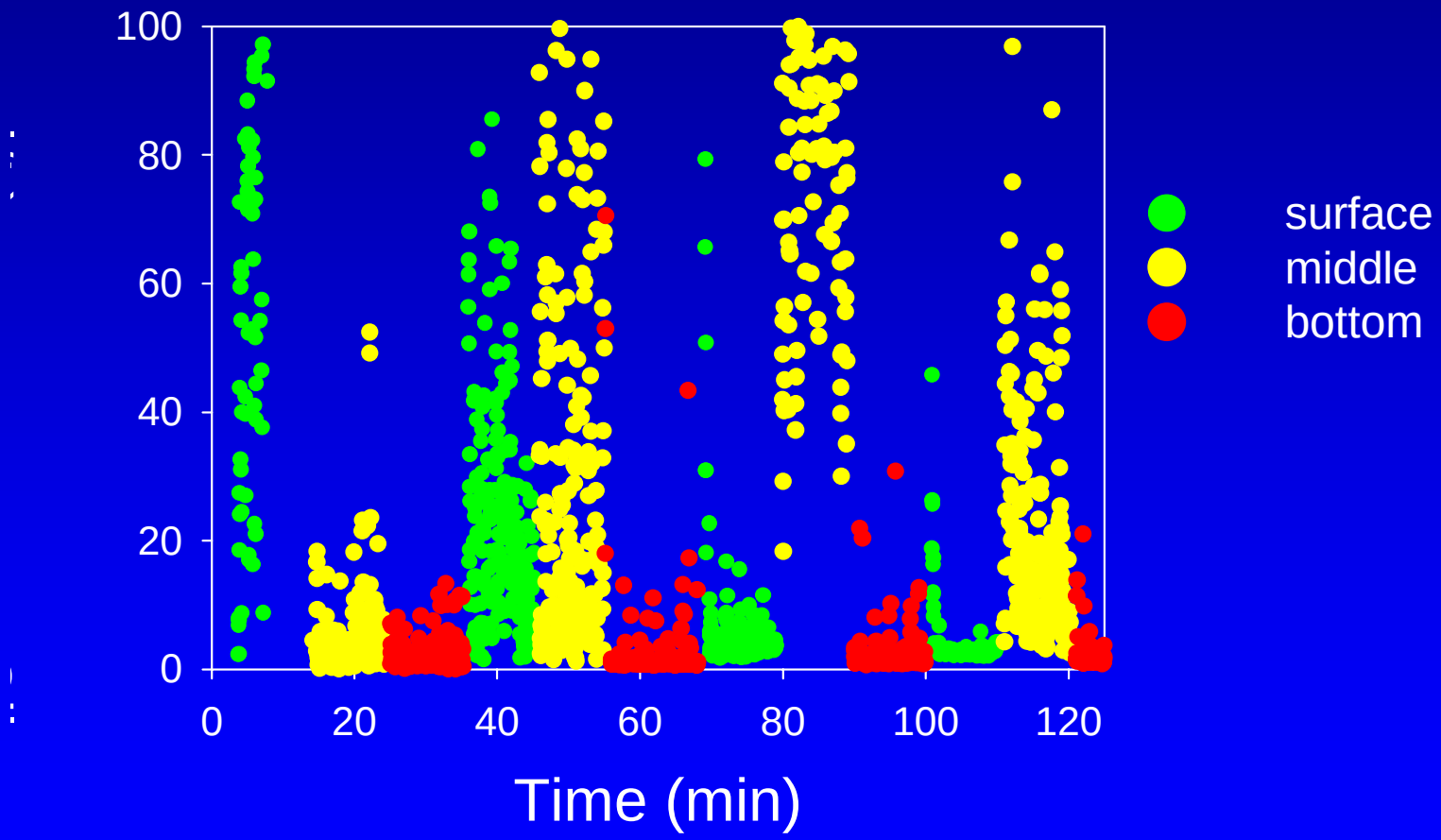
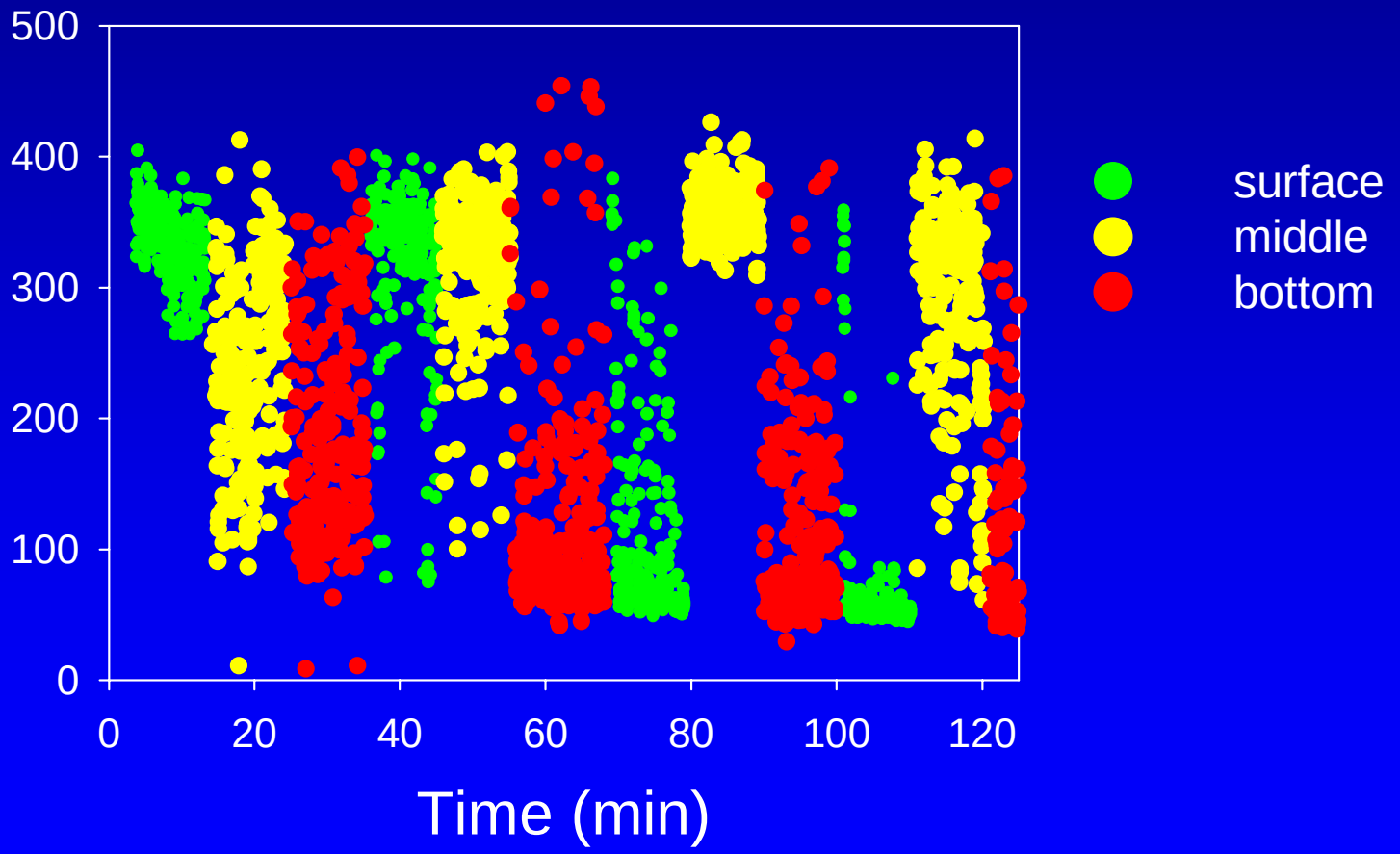


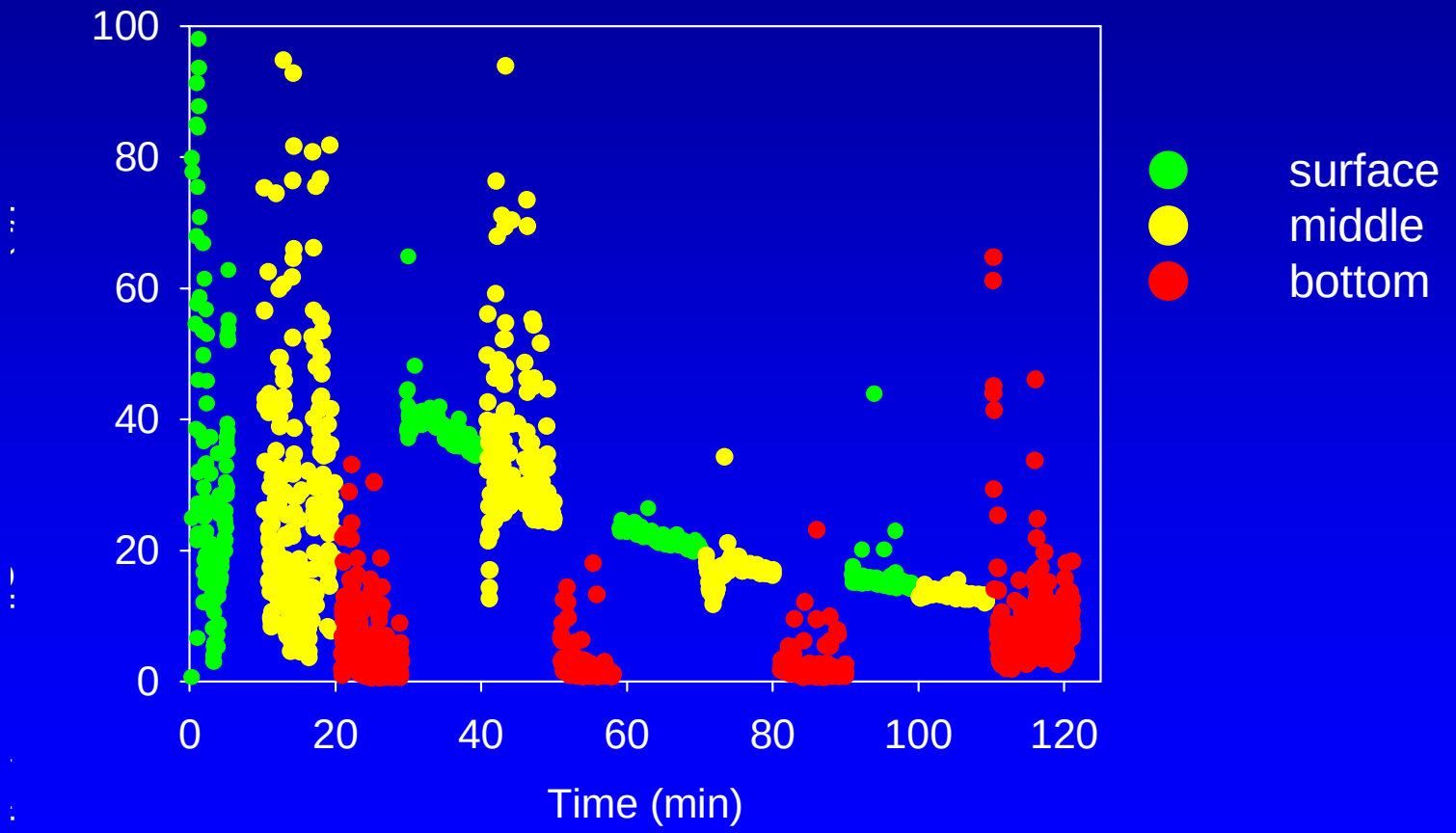
Total Oil Concentration under Spilling Breakers w/o Dispersant



Mass Mean Diameter under Spilling Breakers w/o Dispersant



Total Oil Concentration under Spilling Breakers with Dispersant



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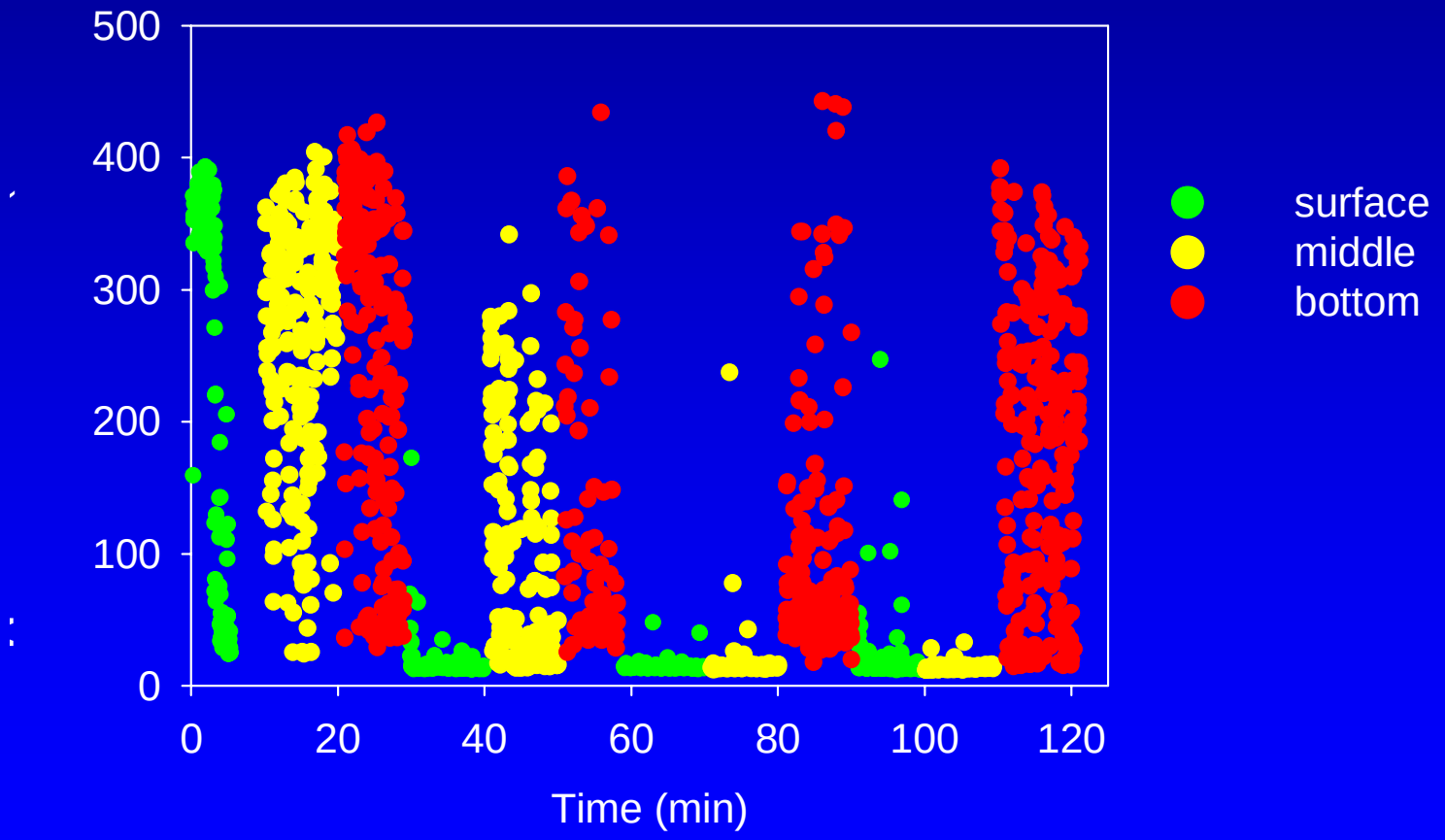
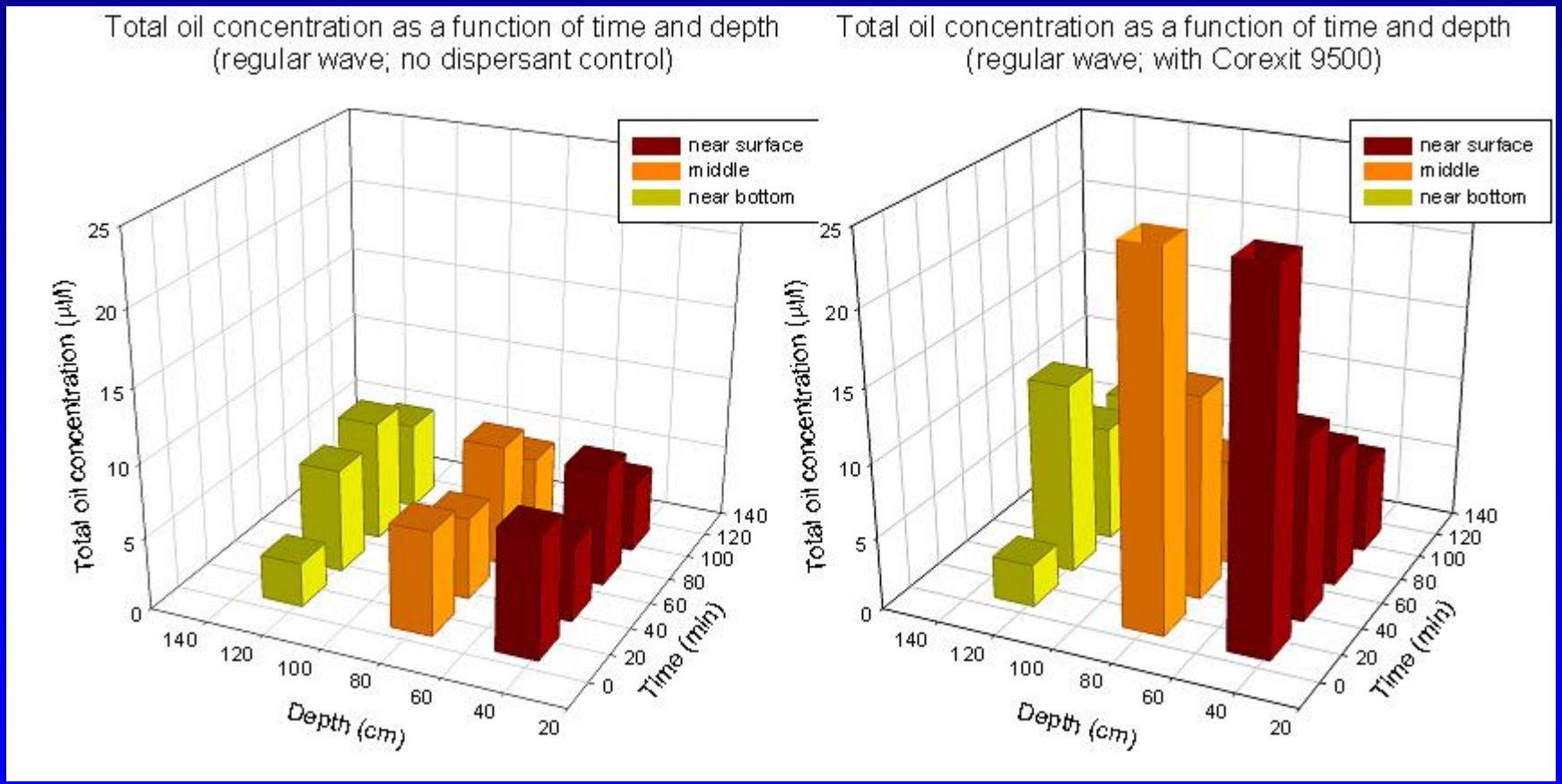


Total Oil Concentration under Regular Non-breaking Waves



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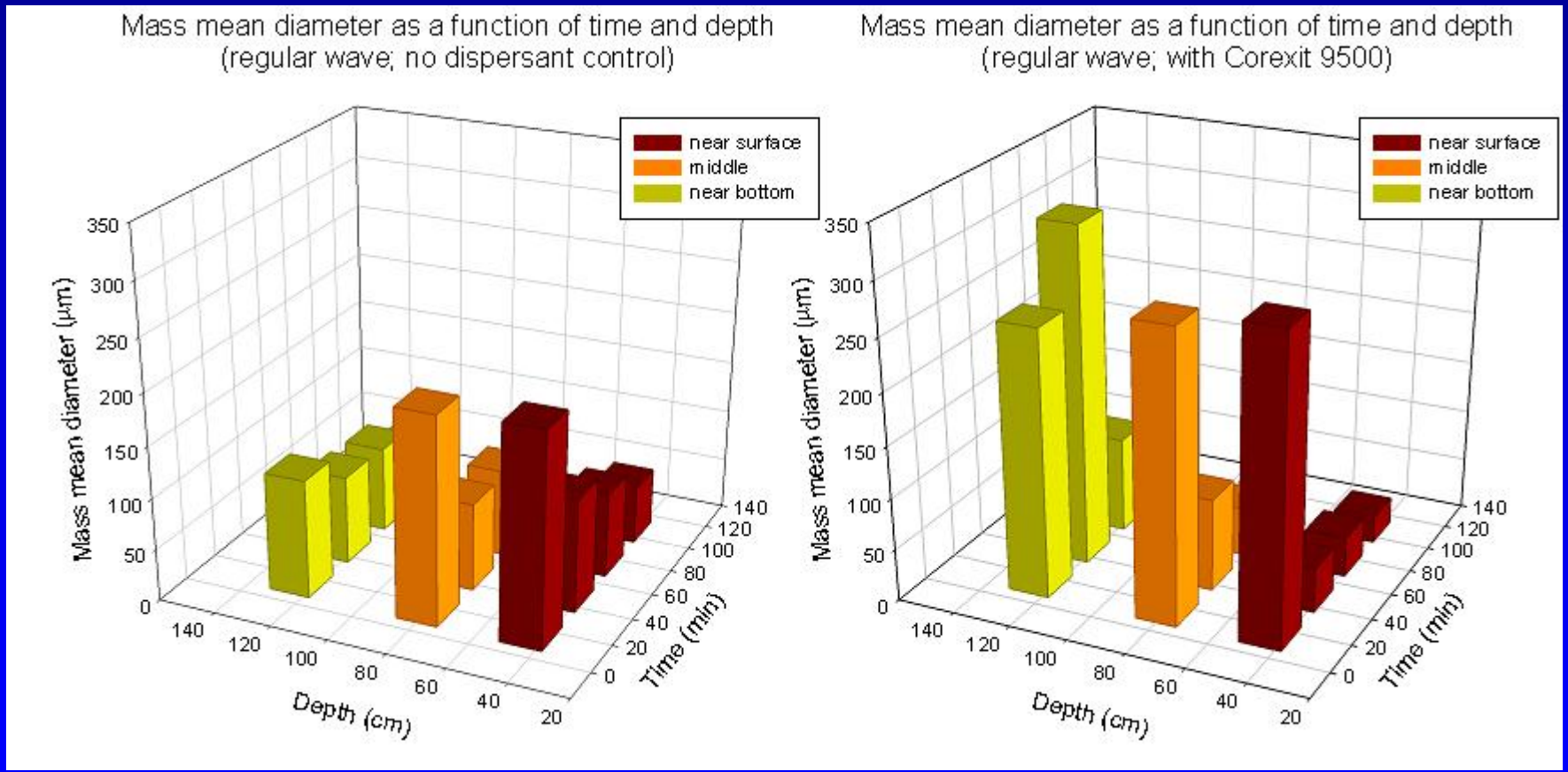

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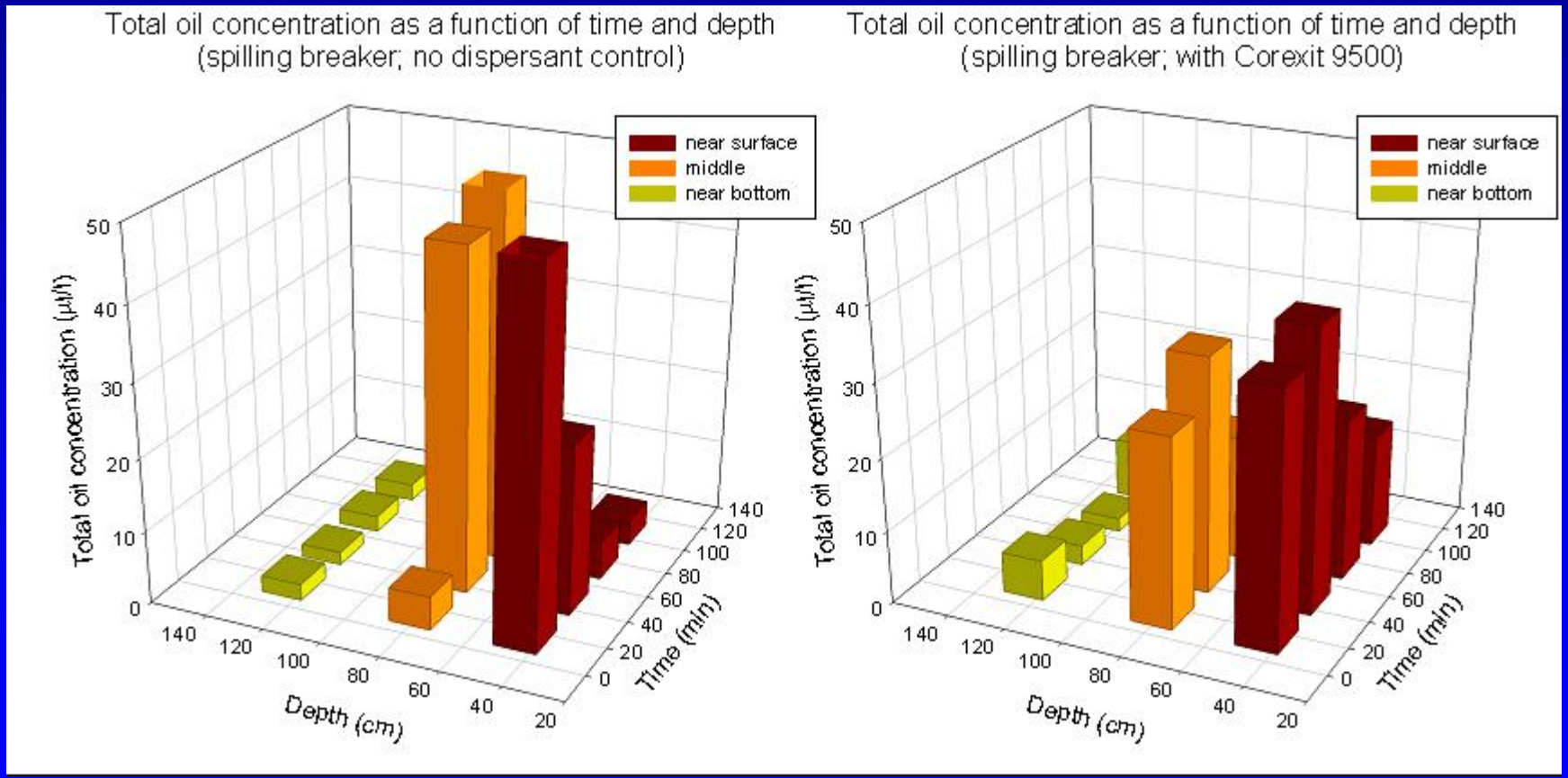

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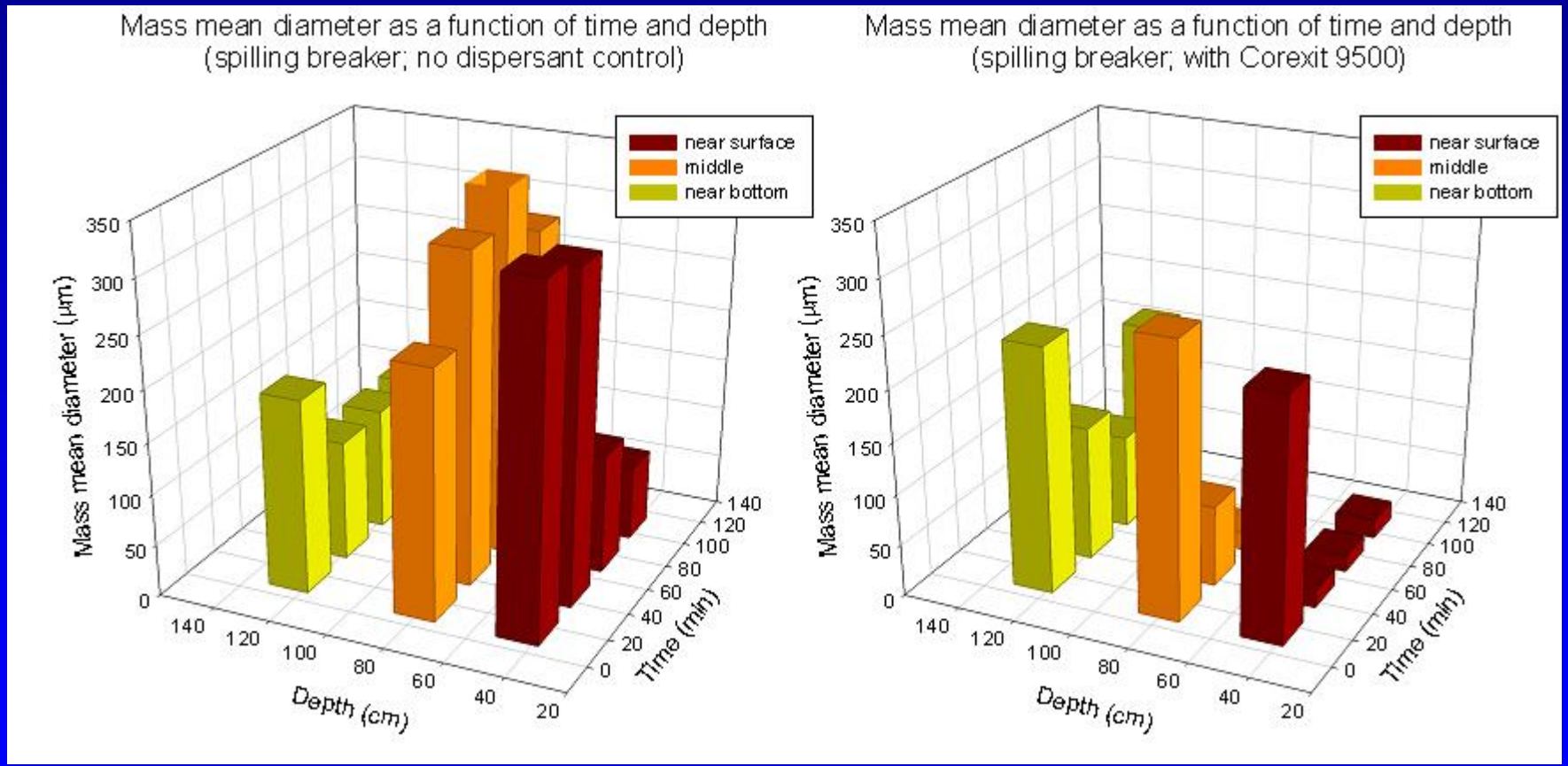
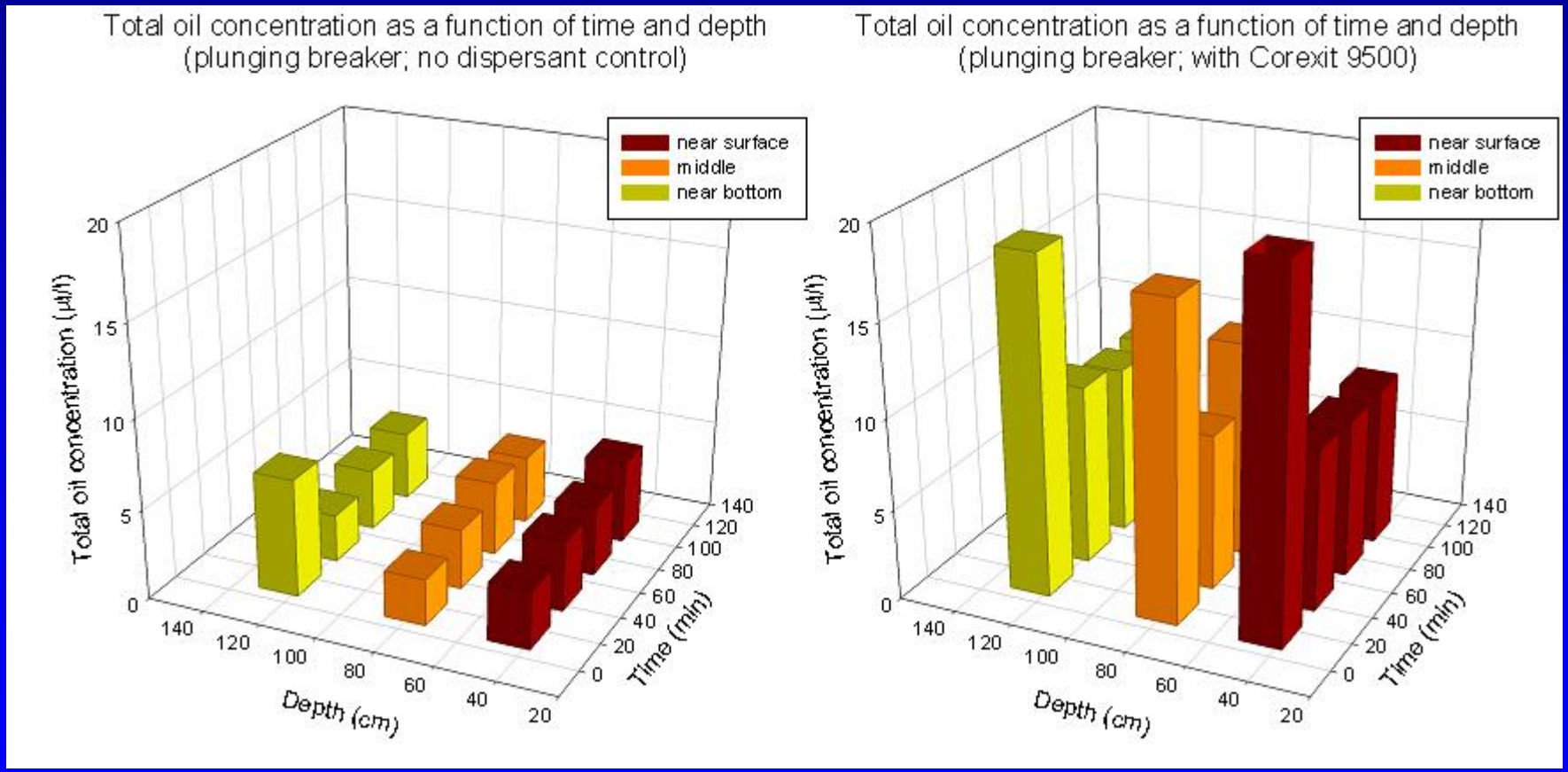


Total Oil Concentration under Plunging Breakers



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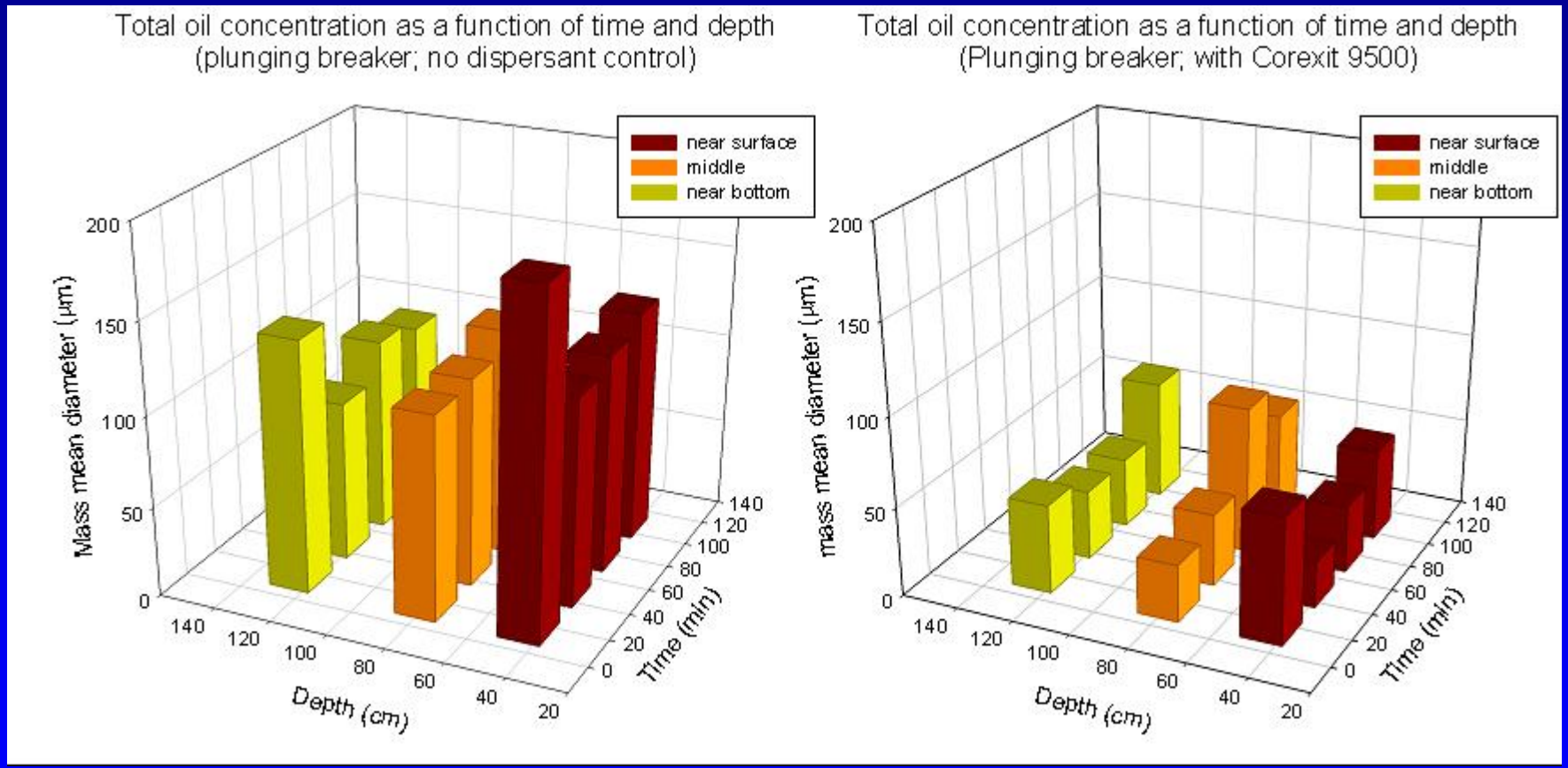
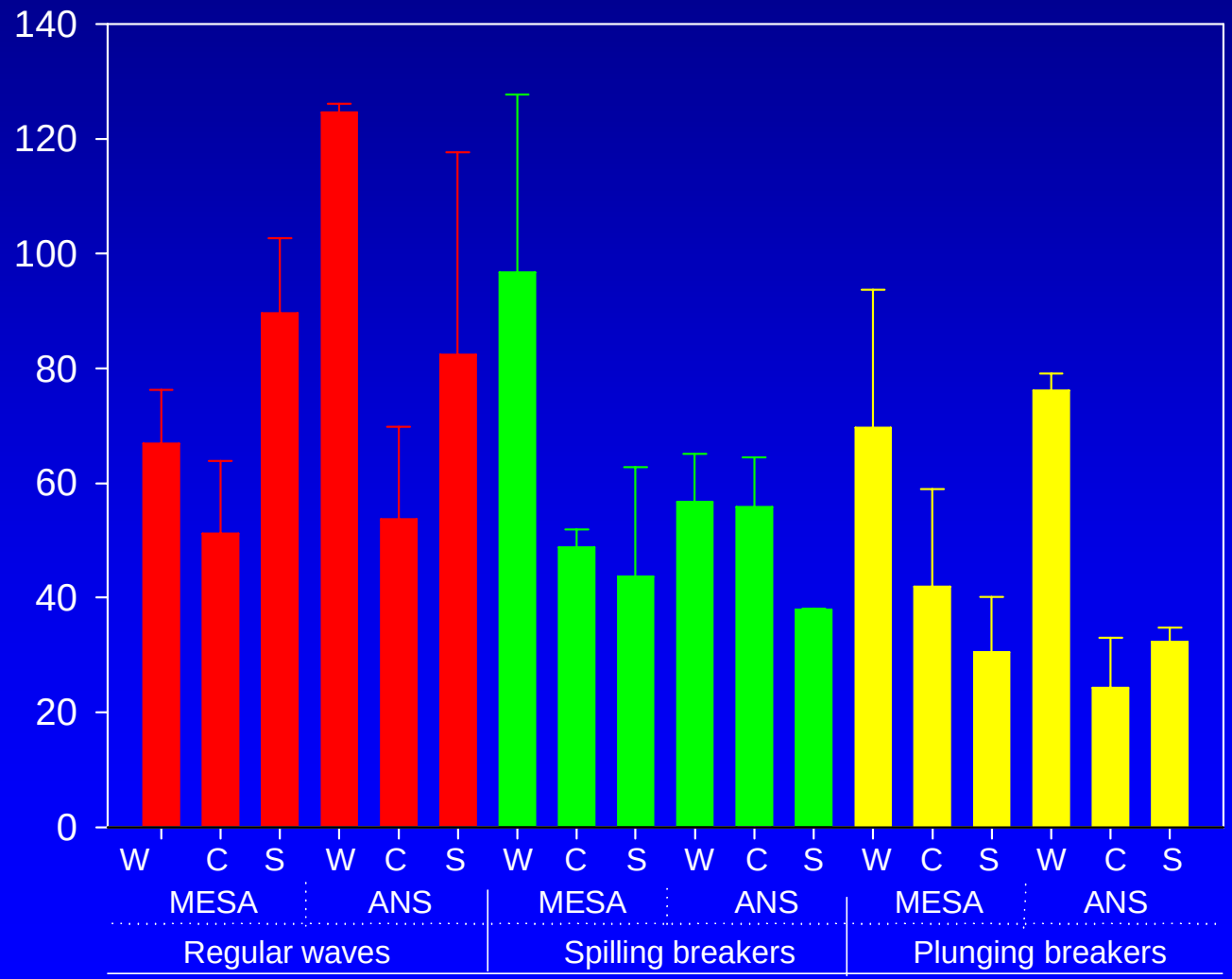


Effects of Waves, Dispersants, and Oil Type on MMD Near Bottom after 2 h Dispersion



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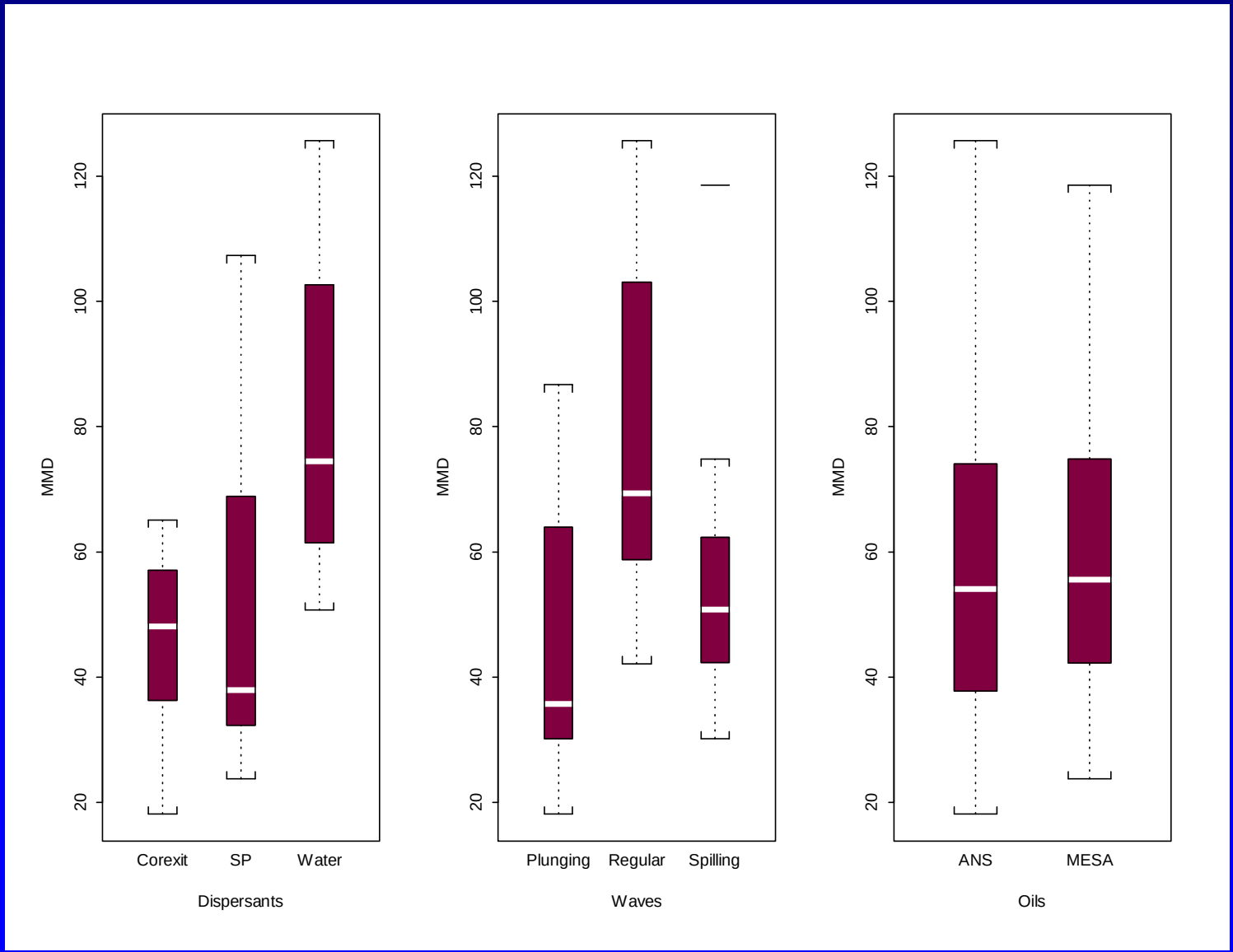
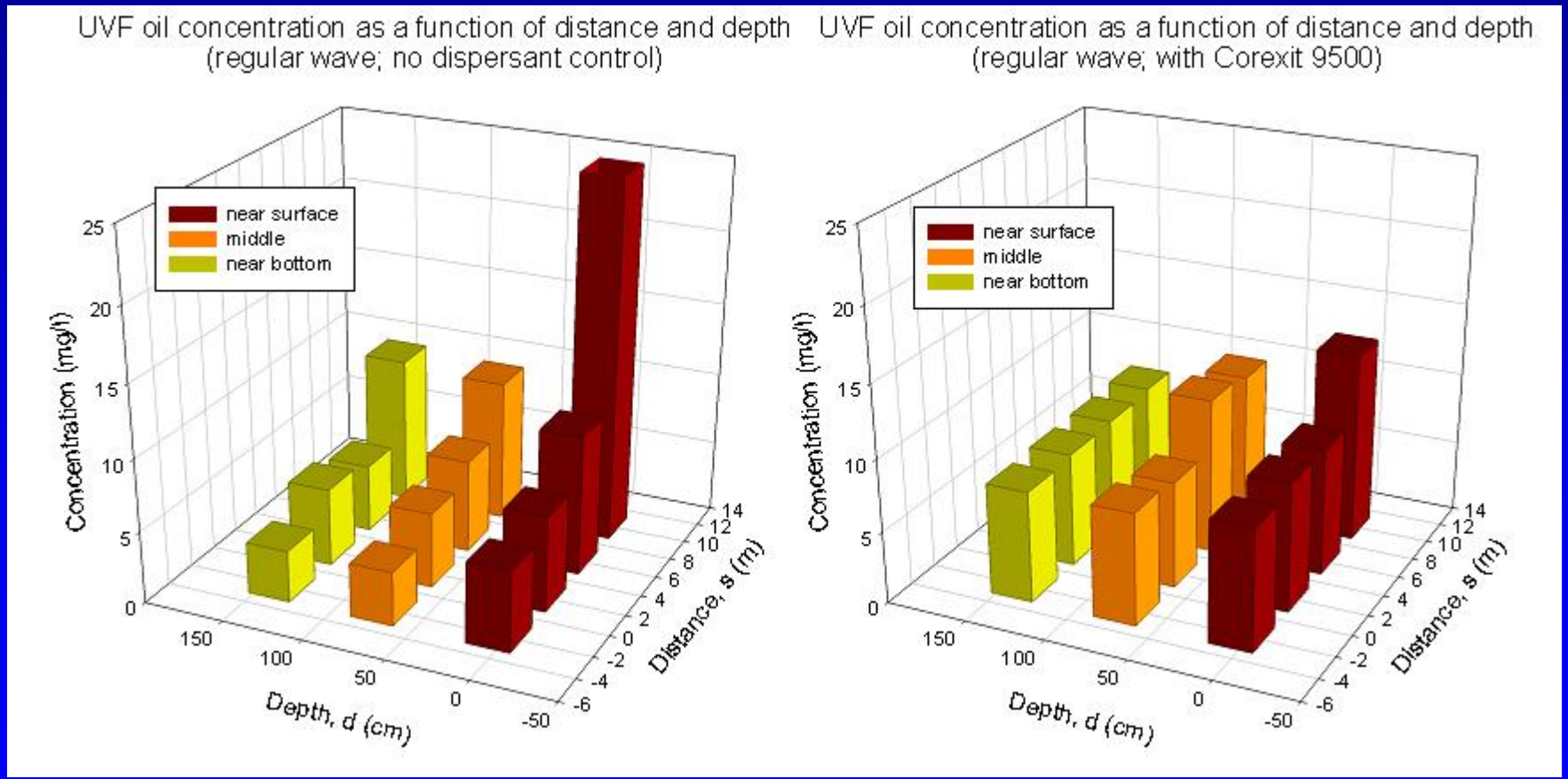


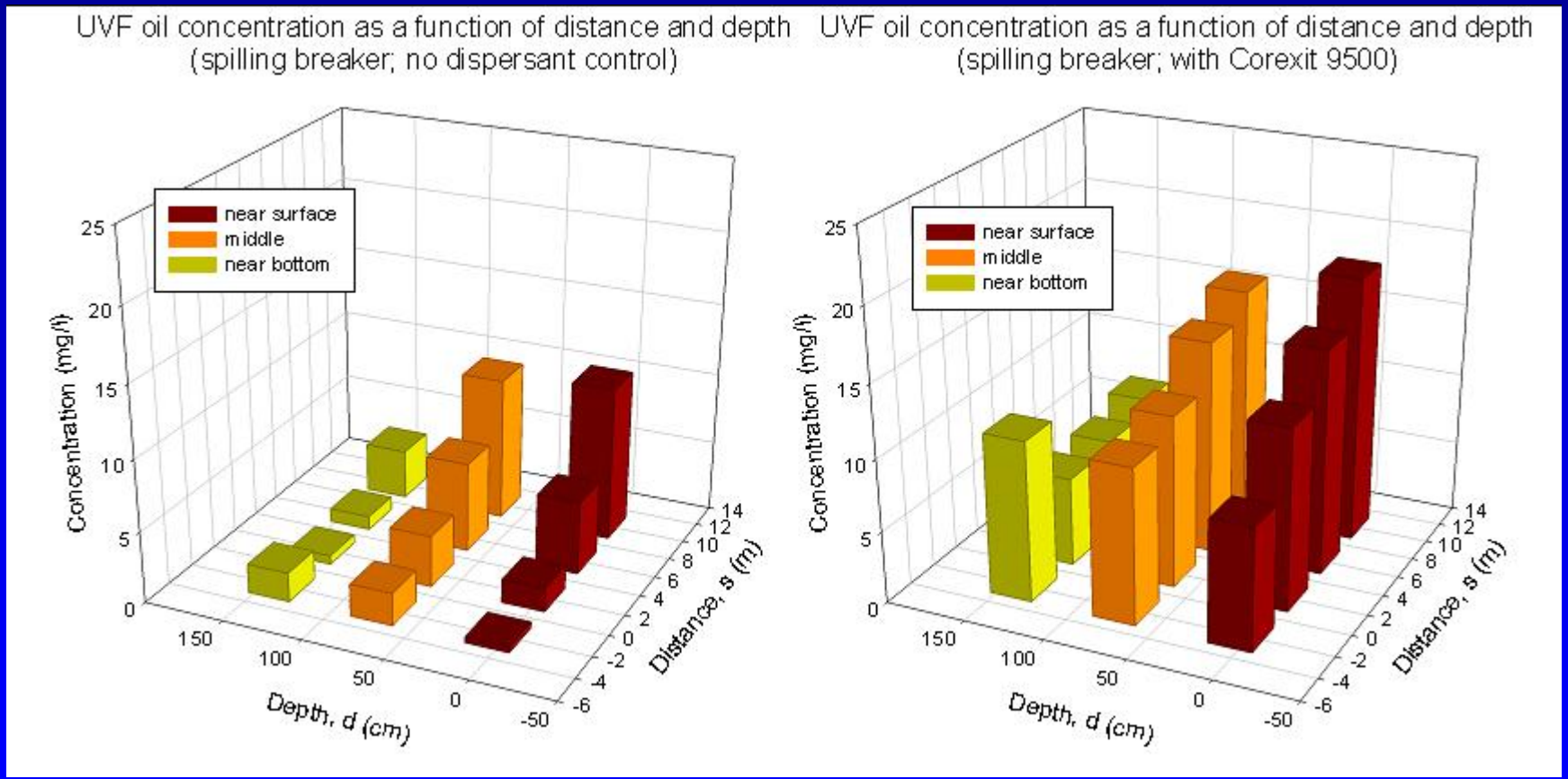
Effects of Waves, Dispersants, and Oil Types on Dispersed Oil Droplet Size

Factors	Df	Sm of Sq	Mean Sq	F Value	Pr (F)
Dispersant	2	8711.662	4355.831	17.57963	0.0000585
Wave	2	6461.343	3230.671	13.03862	0.0003159
Oil	1	2.555	2.555	0.01031	0.9202444
Dispersant : Wave	4	2531.817	632.954	2.55453	0.0744745
Dispersant : Oil	2	254.805	127.403	0.51418	0.6065120
Wave : Oil	2	1460.530	730.265	2.94727	0.0781206
Dispersant : Wave : Oil	4	3704.931	926.233	3.73817	0.0220105
Residuals	18	4459.988	247.777		

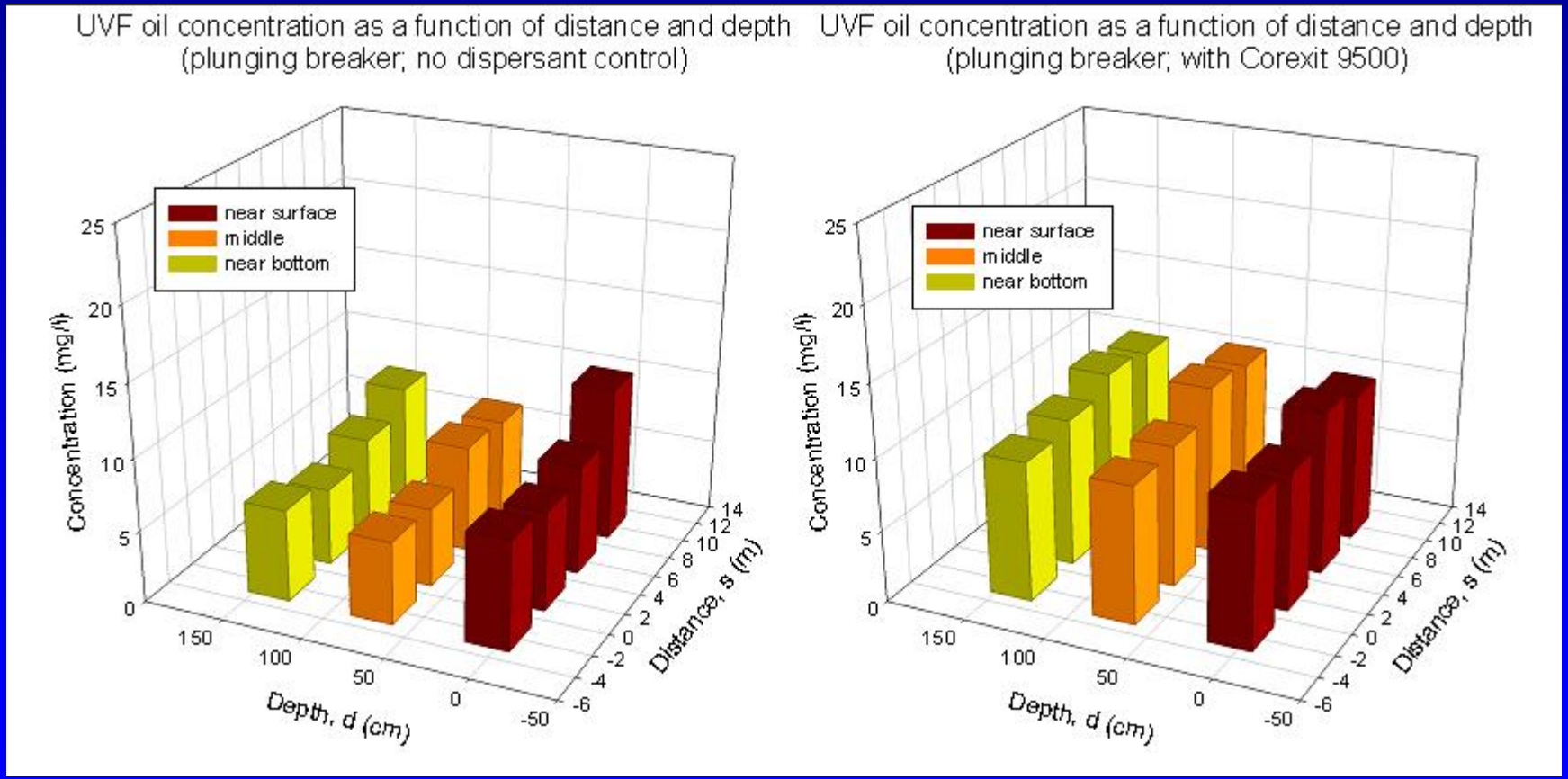
Oil Distribution in the Wave Tank Under Regular Waves



Oil Distribution in the Wave Tank Under Spilling Breakers



Oil Distribution in the Wave Tank Under Plunging Breakers



Conclusions

- Dispersants:
  - Dispersant reduced oil droplet size and the accelerated the break up of large oil into small oil droplets
  - Dispersant increased the dispersed oil concentration
  - The two tested chemical dispersants are similar in their effectiveness from the preliminary data analysis
- Waves:
  - Plunging and spilling breaking waves increased oil concentration compared to non-breaking wave
  - Breaking waves also decreased oil droplet size
- Oils:
  - No significant effect of tested oil types on dispersed oil concentration and droplet size distribution