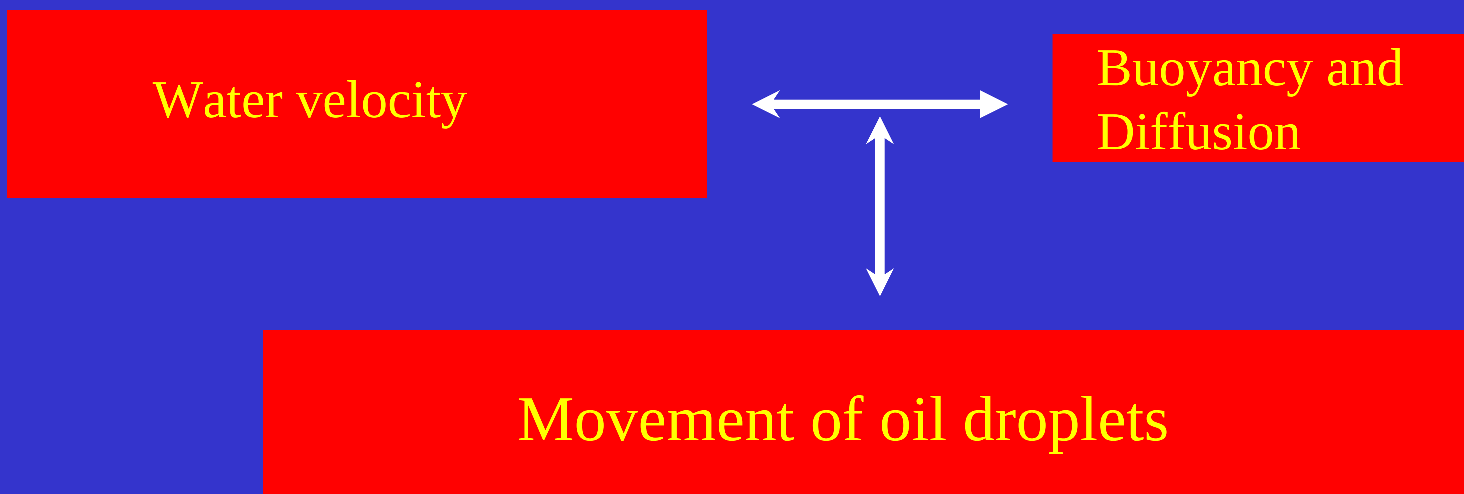
WAVES

OUTLINE

- Transport of oil droplets due to waves
  Generalization of results

- The breakup of droplets due to waves

Transport of Droplets



•Boufadel, Bechtel, and Weaver , Marine Pollution Bulletin, 2006
•Boufadel, Du, Kaku, and Weaver, Environmental Modeling & Software, 2006

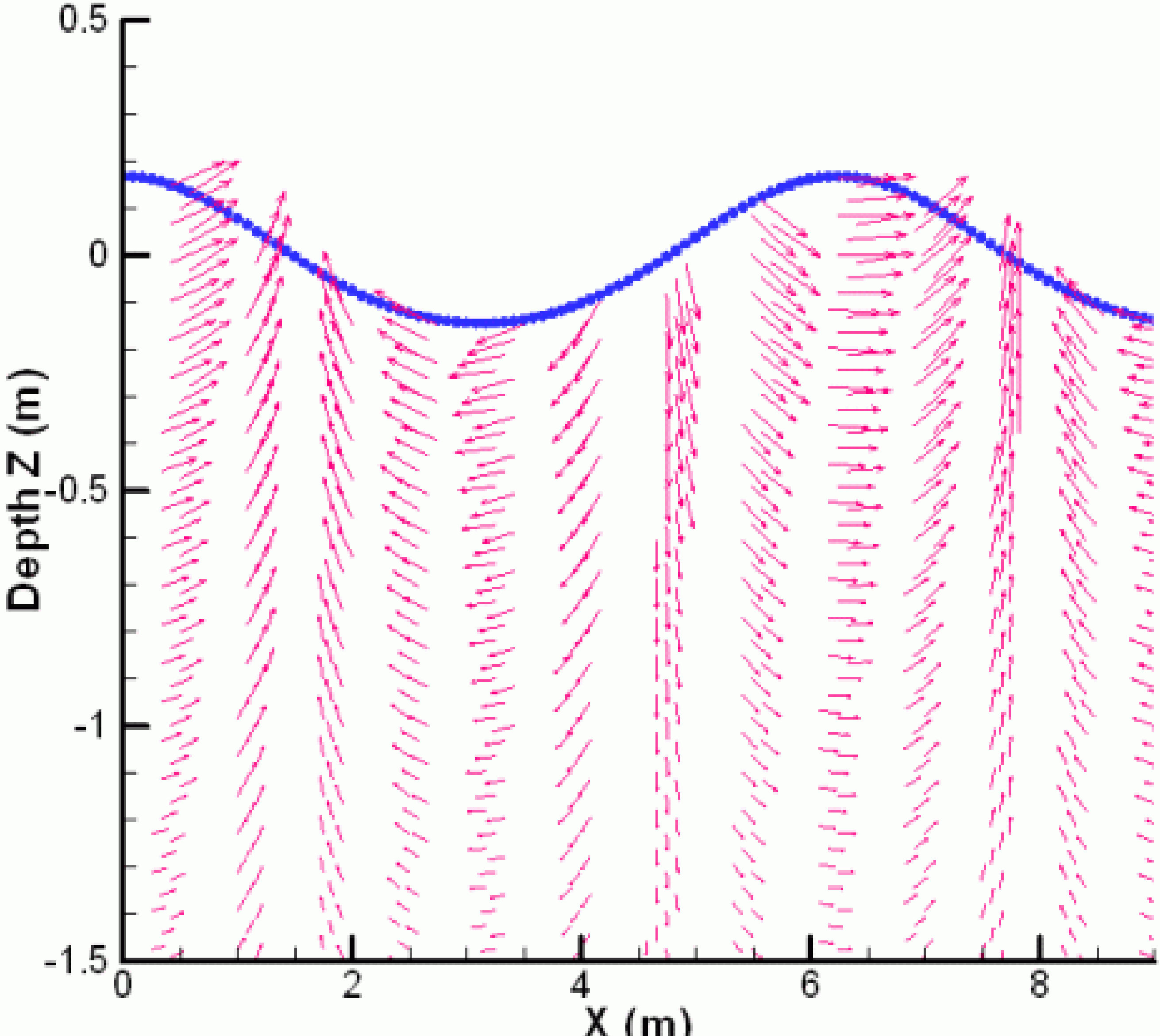
Particle Tracking

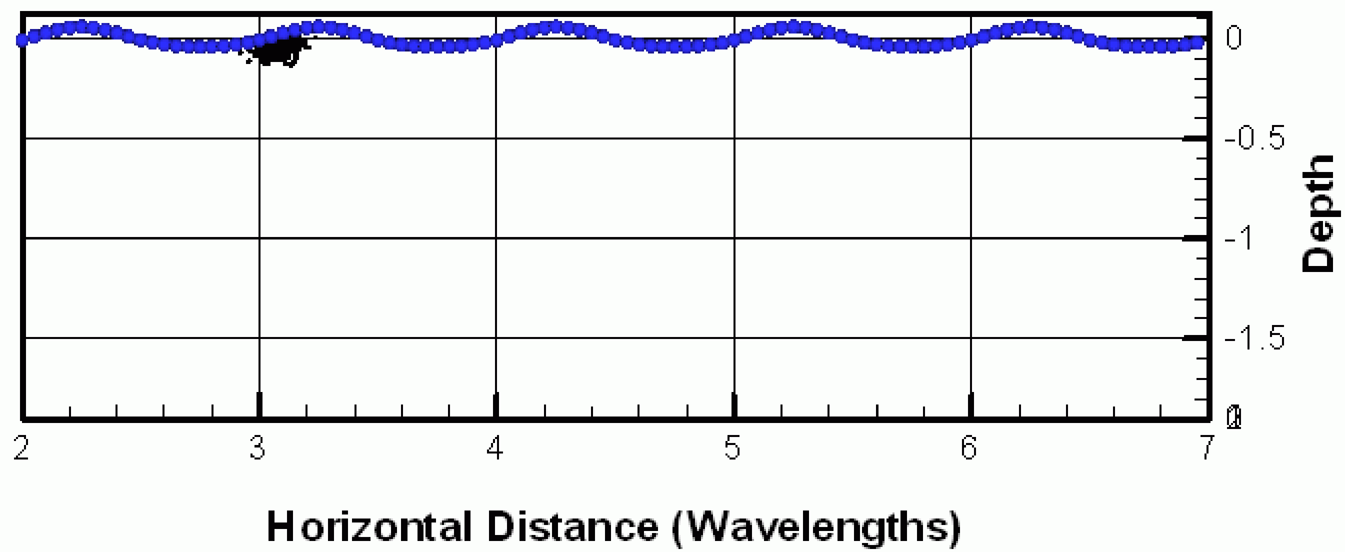
$$x_{n+1} = x_n + u\Delta t + aaR\sqrt{2D\,\Delta t}$$

$$z_{n+1} = z_n + aa\left[\,w + w_B\,\right]\Delta t \;\; + aaR\sqrt{2D\,\Delta t}$$

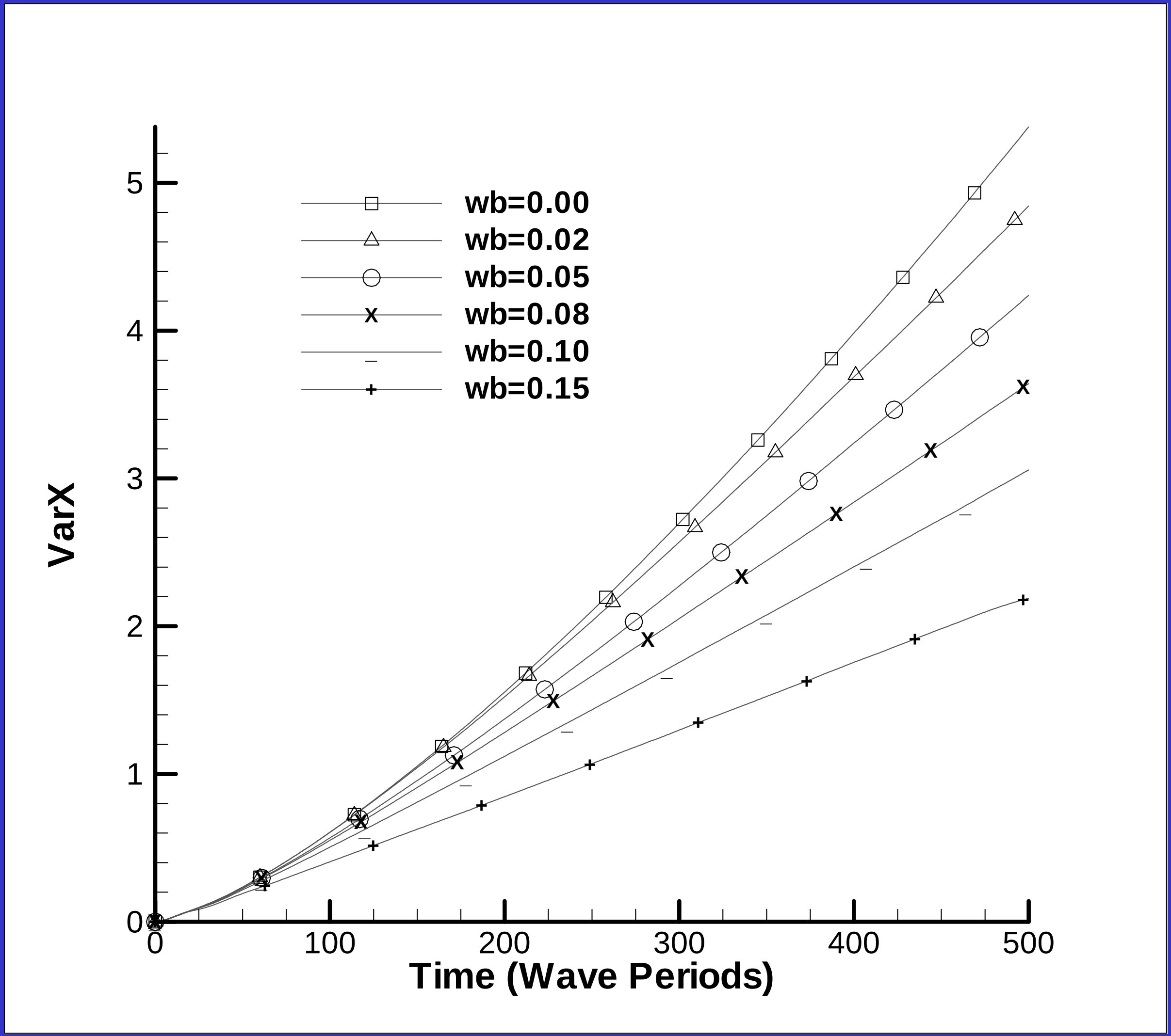
$$aa = \frac{H}{L}; \qquad D = \frac{D^*}{D_o} = \frac{D^*}{\frac{H^2}{T}}; \qquad w_B = \frac{w_B^{\ *}}{\frac{H}{T}} = \frac{w_B^{\ *}}{\varepsilon\frac{L}{T}}$$

$$x = \frac{x^*}{L}; z = \frac{z^*}{L}; t = \frac{t^*}{T}; h = \frac{h^*}{L}$$

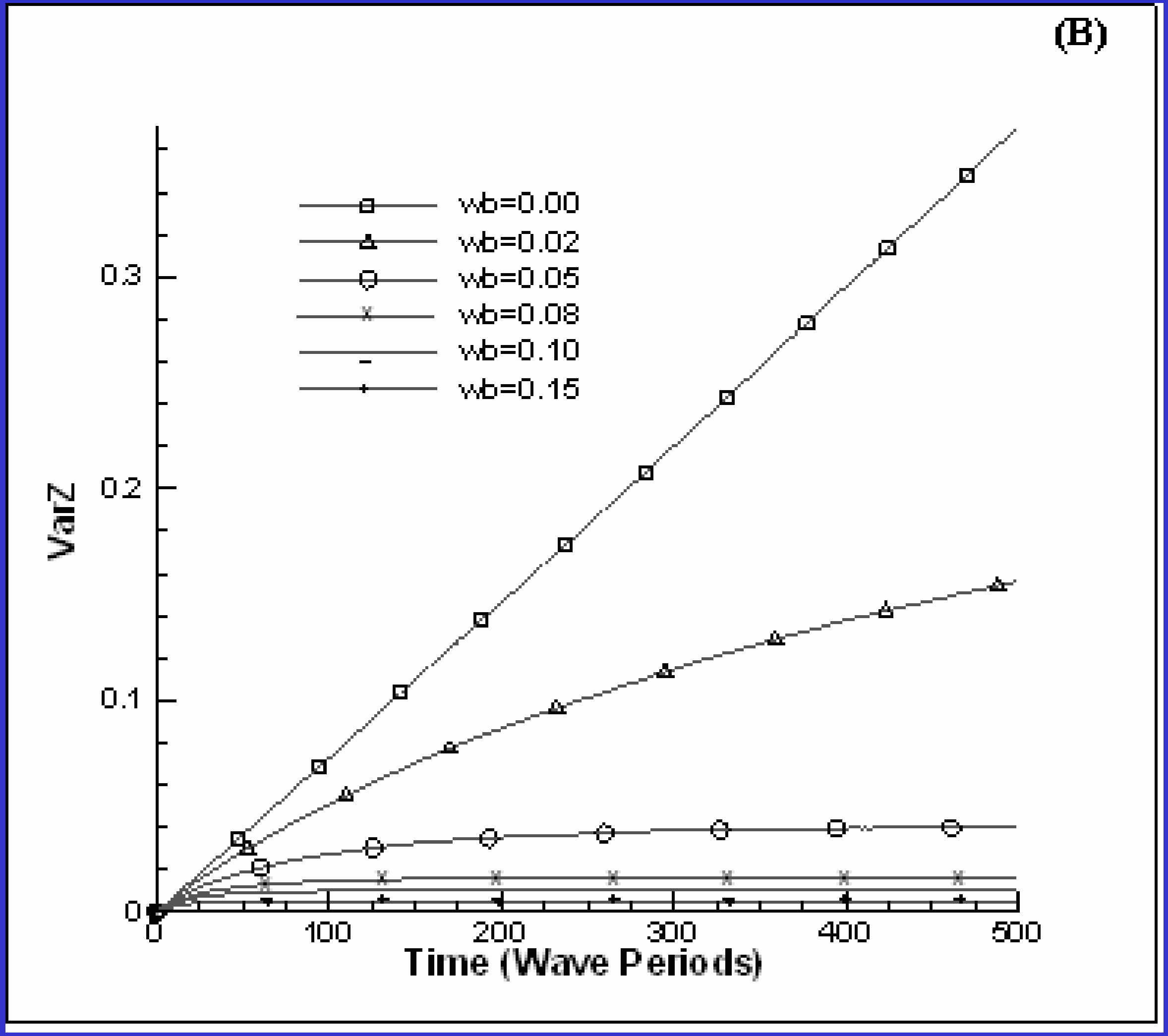

0.5
0
-0.5
-1
-1.5
Depth Z (m)
0
2
4
6
8
X (m)



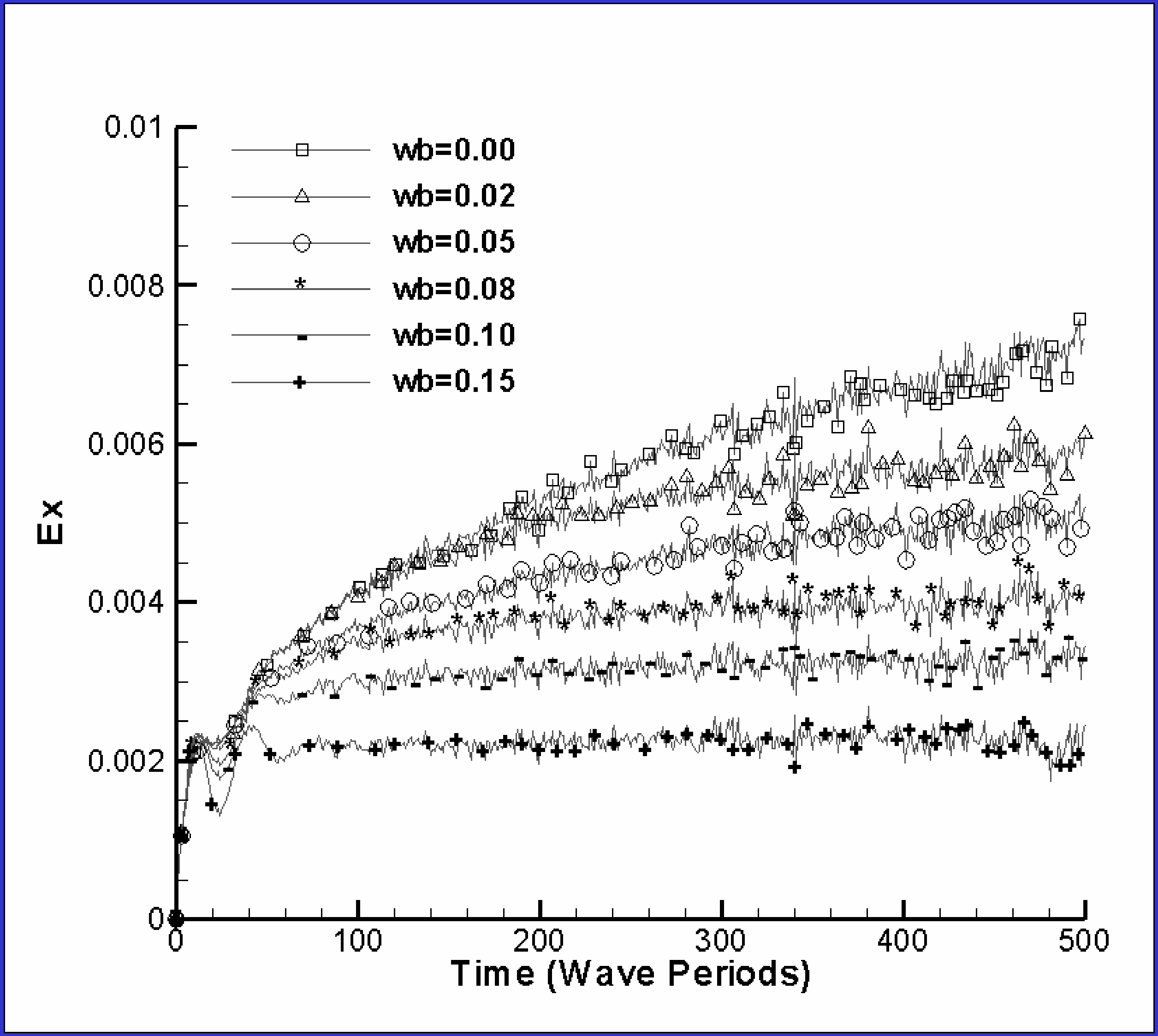
0
-0.5
-1
-1.5
Depth
2
3
4
5
6
7
Horizontal Distance (Wavelengths)



Effect of buoyancy on the dimensionless horizontal variance, σ_x^2 for ε=0.1.



Effect of buoyancy on the dimensionless vertical variance, σ_z^2 for H/L= ε=0.1.



Dimensionless spreading coefficients E_x as function of time for H/L 0.10.

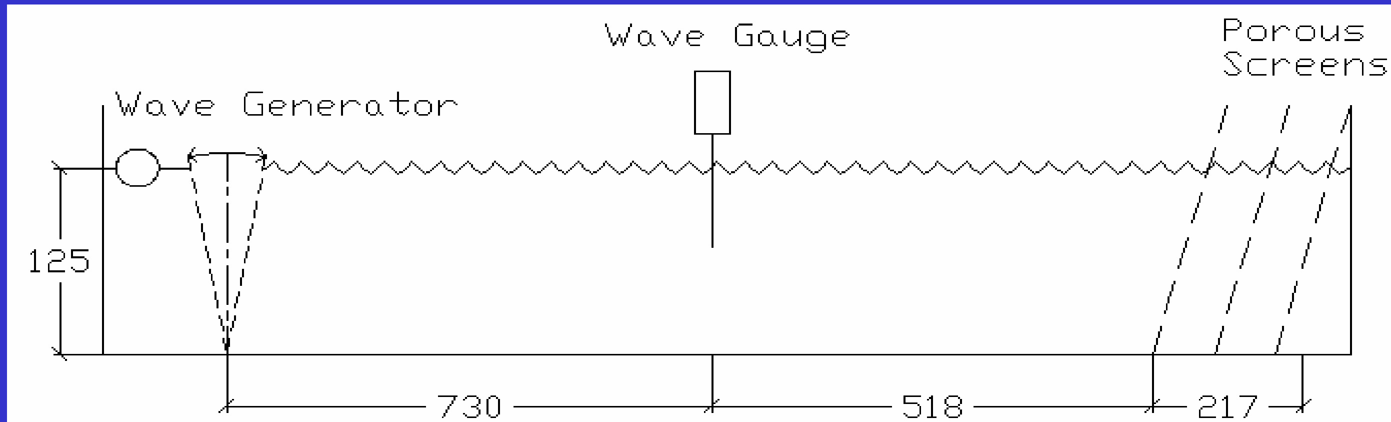
Monte Carlo Simulation

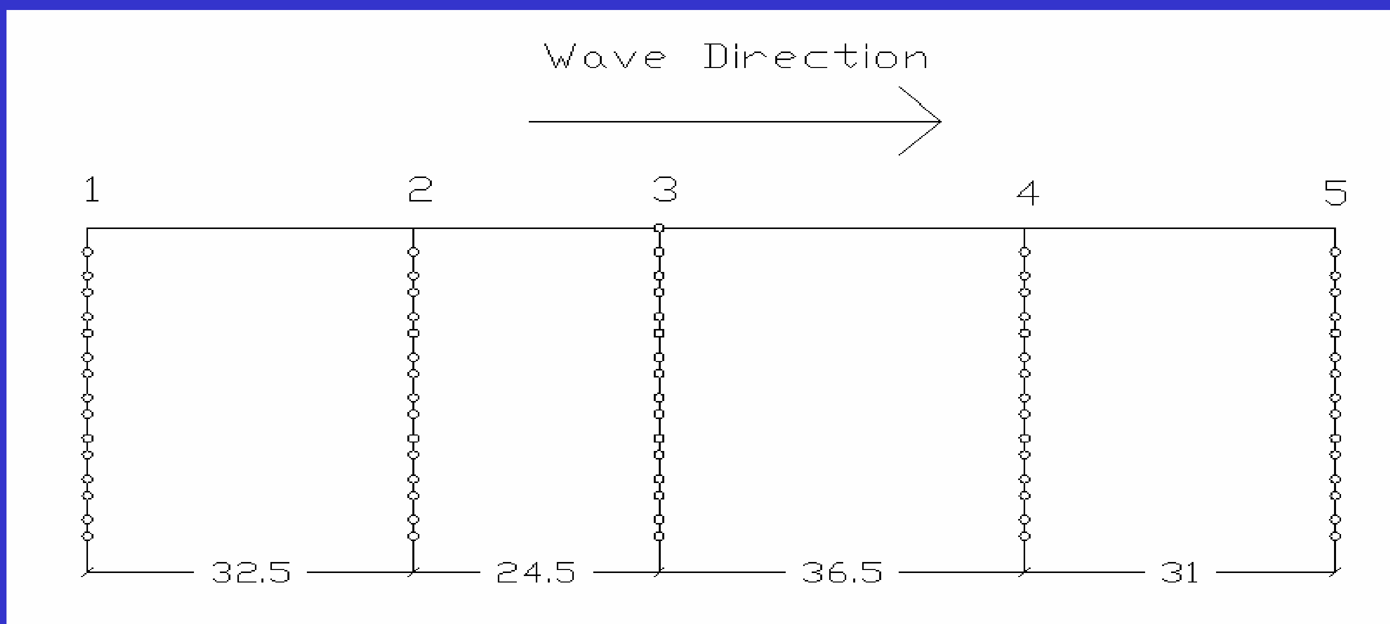
$$\varepsilon = \frac{H}{L} = 0.05\ and\ 0.1$$

$$w_b = \frac{w_b^*}{\frac{H}{T}} = 0.0;\ 0.02;\ 0.05;\ 0.08;\ 0.1;\ and\ 0.15$$

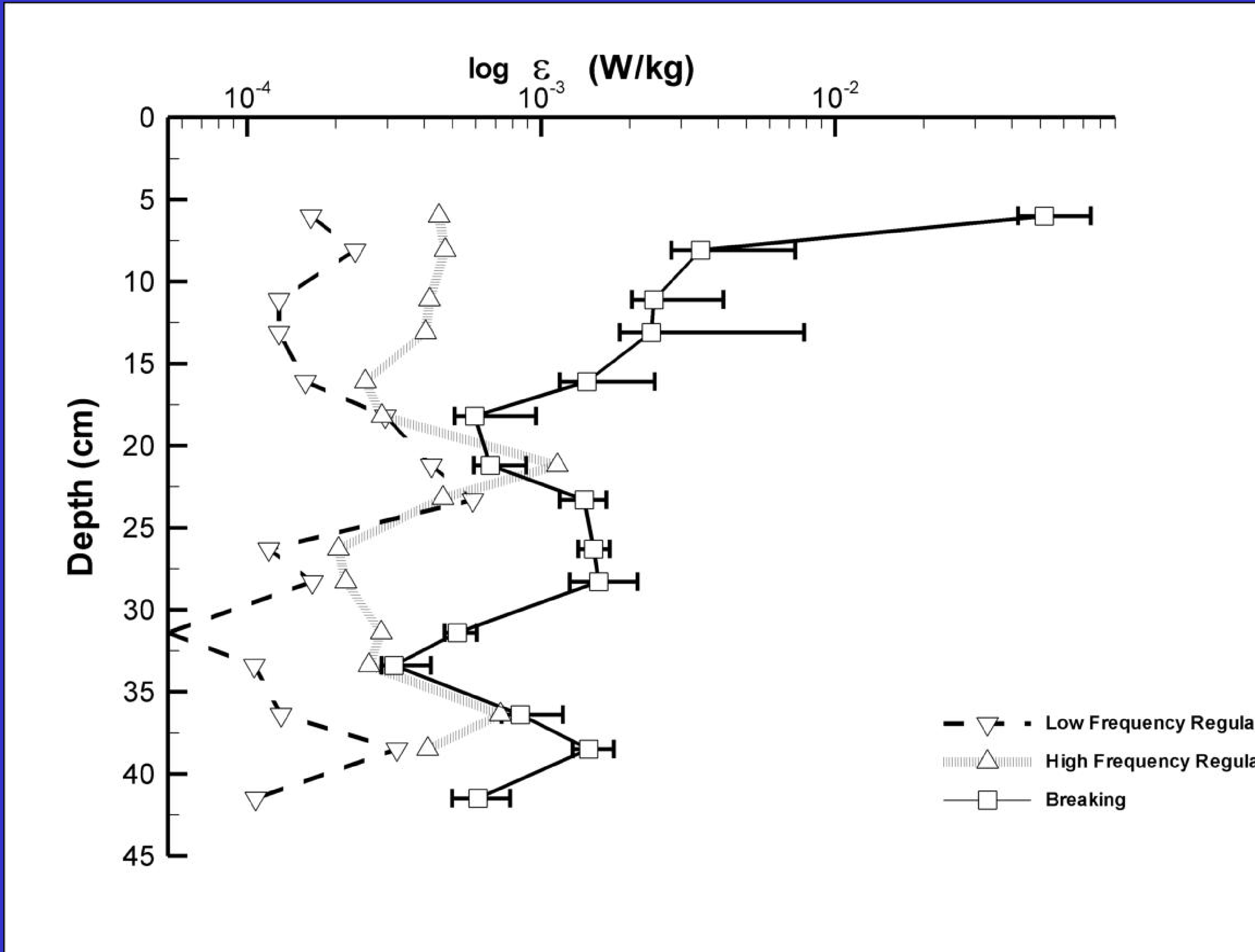
$$D = \frac{D^*}{\frac{H^2}{T}} = 0.1$$

600 particles and 500 wave periods

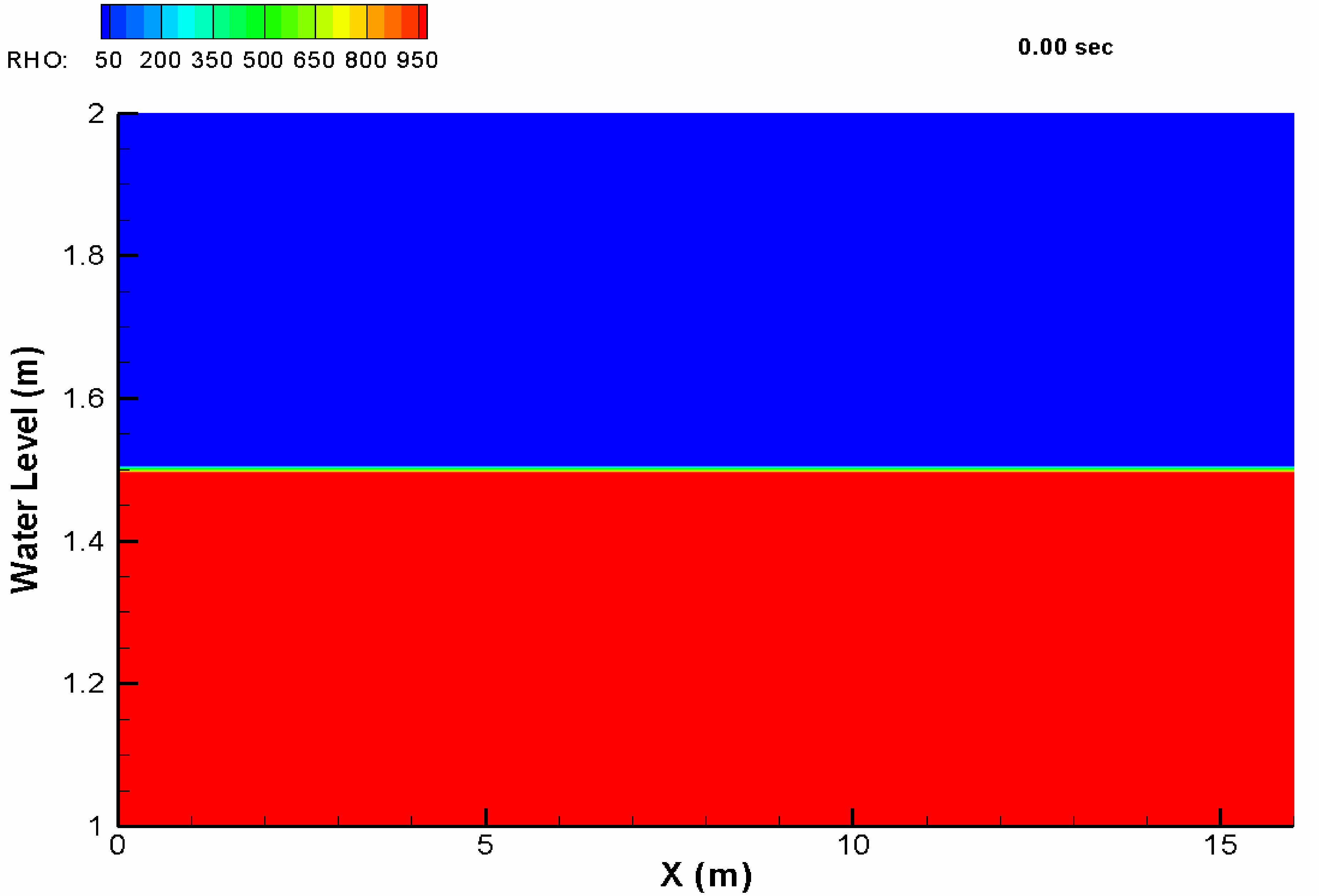


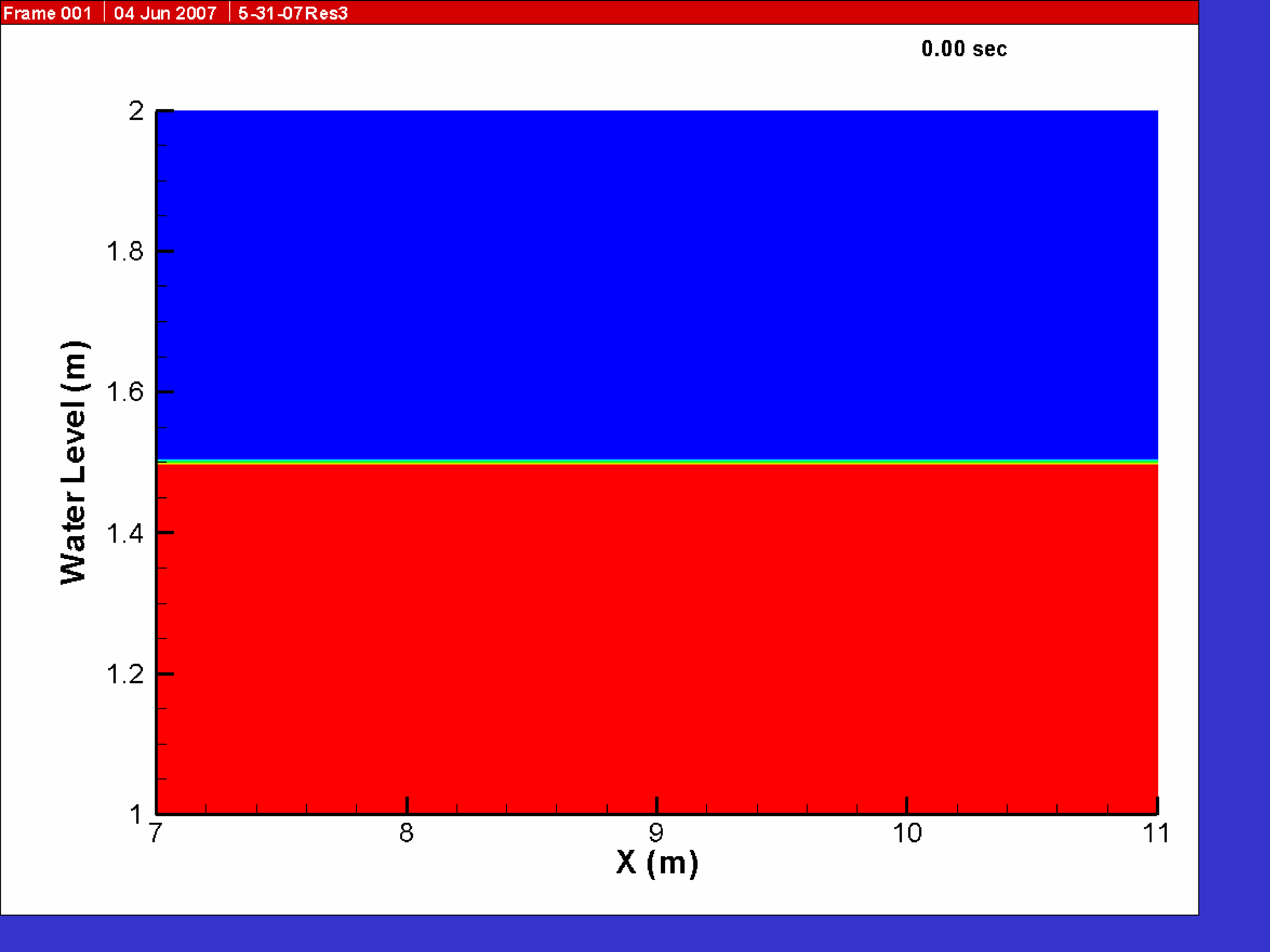


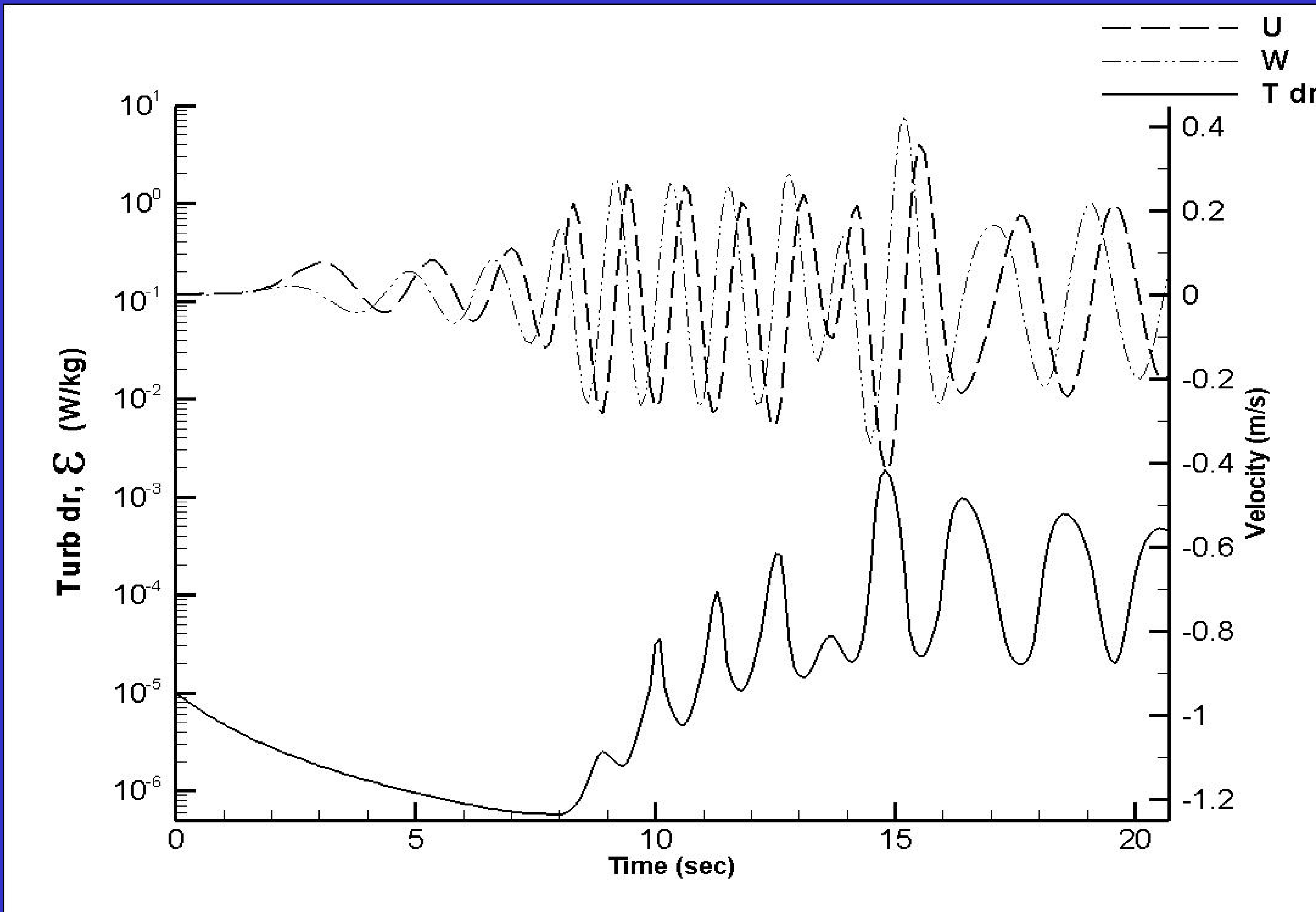
Locations at which the ADV was placed for measuring velocity. The wave gauge was at location 3. Position 1 is at 673 cm from the wavemaker



log ε (W/kg)
10^{-4}
10^{-3}
10^{-2}
Depth (cm)
0
5
10
15
20
25
30
35
40
45
Low Frequency Regular
High Frequency Regular
Breaking


RHO: 50 200 350 500 650 800 950
0.00 sec
Water Level (m)
2
1.8
1.6
1.4
1.2
1
0
5
10
15
X (m)


Frame 001
04 Jun 2007
5-31-07Res3
0.00 sec
Water Level (m)
2
1.8
1.6
1.4
1.2
1
7
8
9
10
11
X (m)



U
W
T dr
Turb dr, ε (W/kg)
Velocity (m/s)
Time (sec)
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
0
5
10
15
20

RECOMMENDATIONS

- ❑ Transport due to irregular waves.
- ❑Evaluation of transport parameters due to irregular waves.
- ❑ Evaluation of the energy dissipation rate as a function of time and space.

Droplet experiments and models that account for the variation of the energy dissipation rate.