

# Best Practice Scour Predictions vs. Scour Survey Data of a Subsea Structure

**Scott Draper**, Weidong Yao, Liang Cheng, Phil Watson

Meysam Banimahd

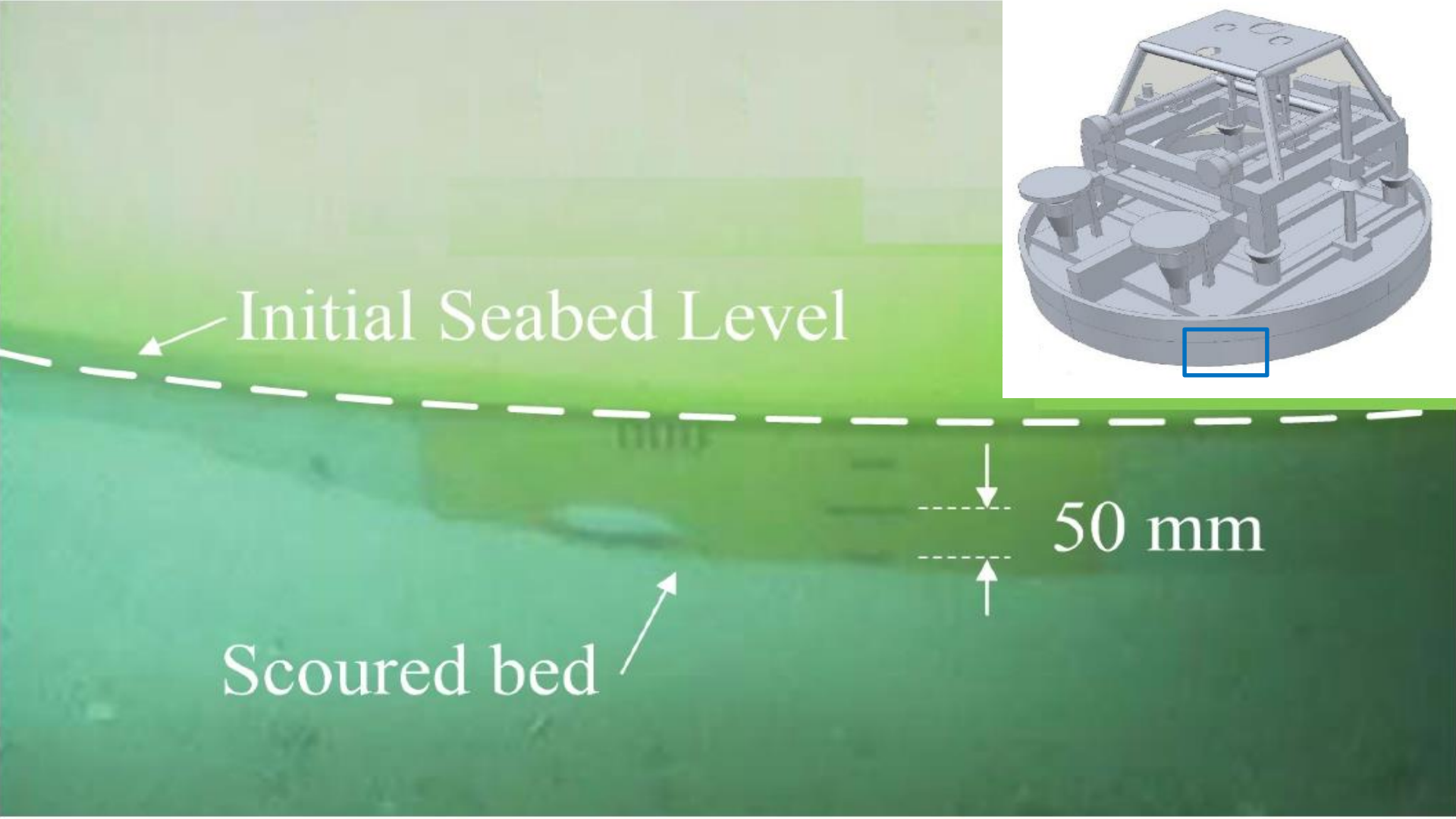
Antonio Borges Rodriguez

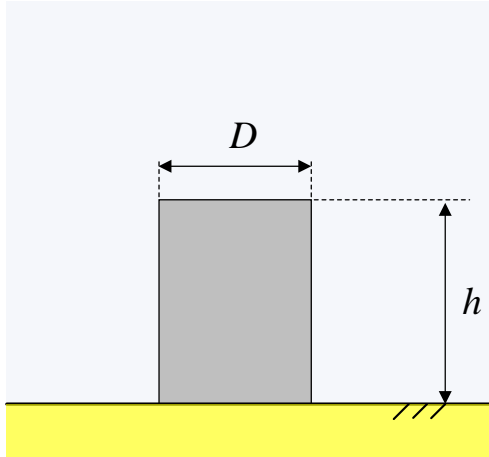






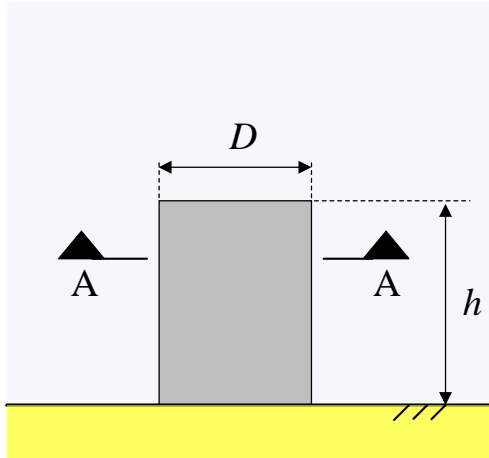






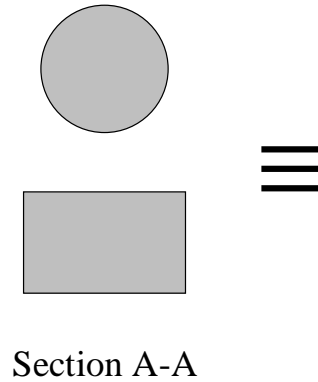
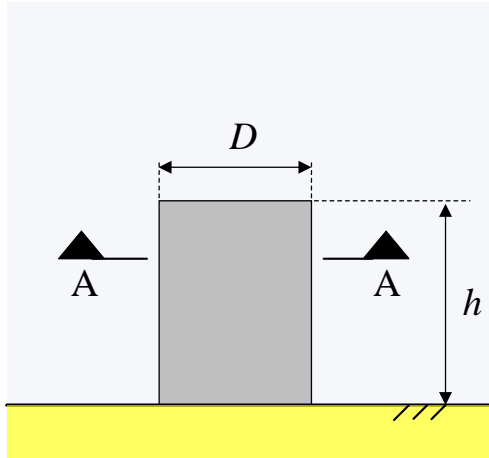
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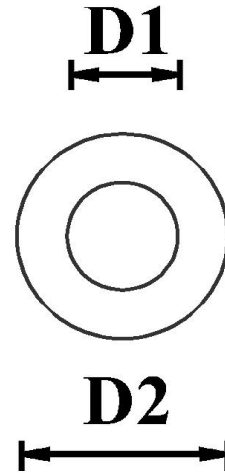
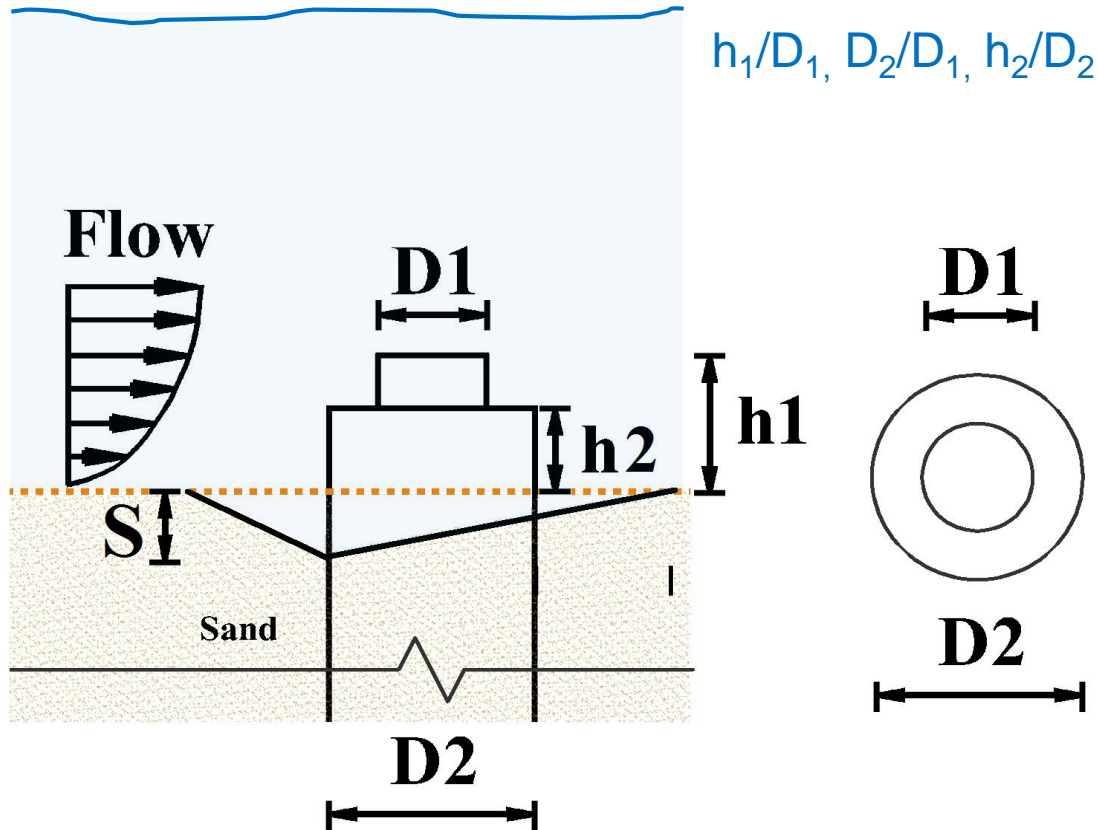
## How do we improve on this ...

1. Increase the parameter space spanned by experiments
2. Use structure-specific best-practice method



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Yao et al. (2018,  
 2019 a,b)

## How do we improve on this ...

1. Increase the parameter space spanned by experiments

2. Use structure-specific 'best-practice' method

**FOCUS OF TODAYS TALK!**

# Best Practice Scour Predictions vs. Scour Survey Data of a Subsea Structure

Field observations and data

Laboratory experiments

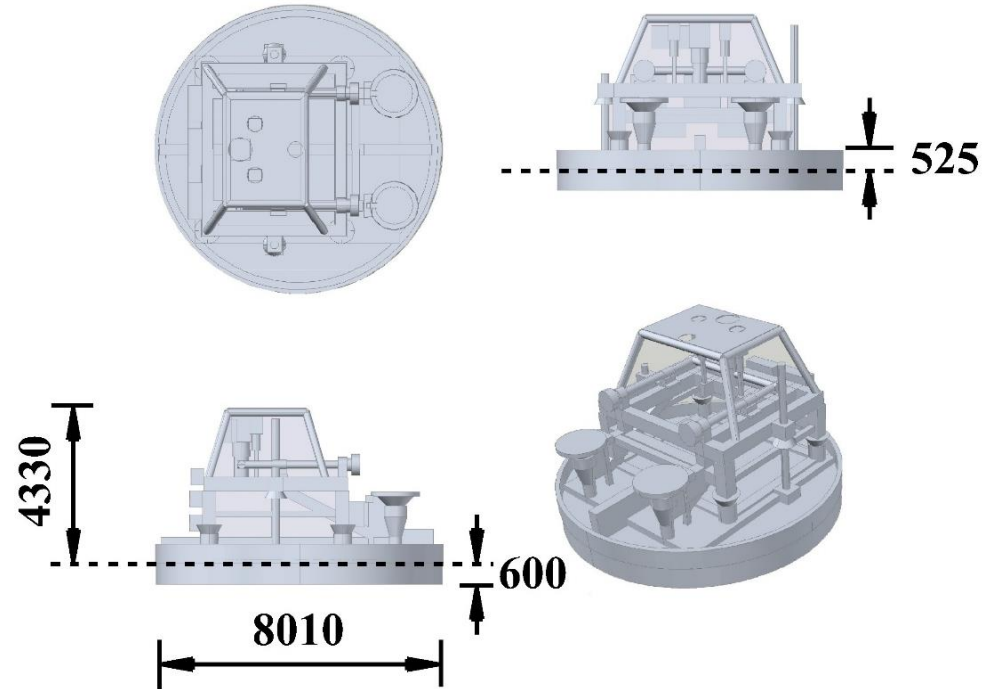
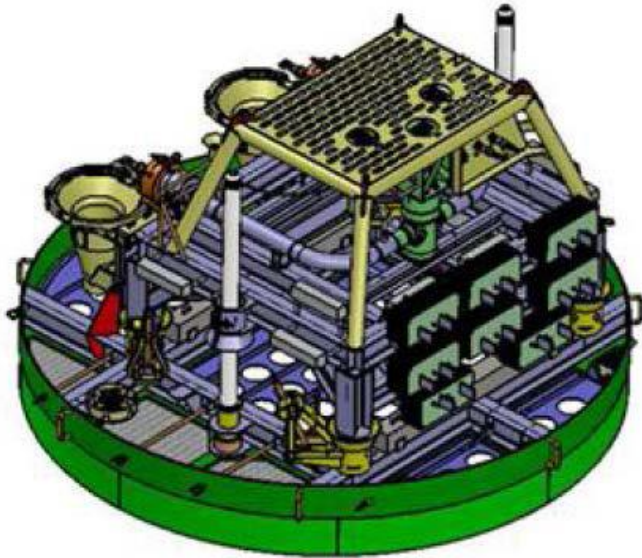
Laboratory-based estimates of scour

Comparison to field observations

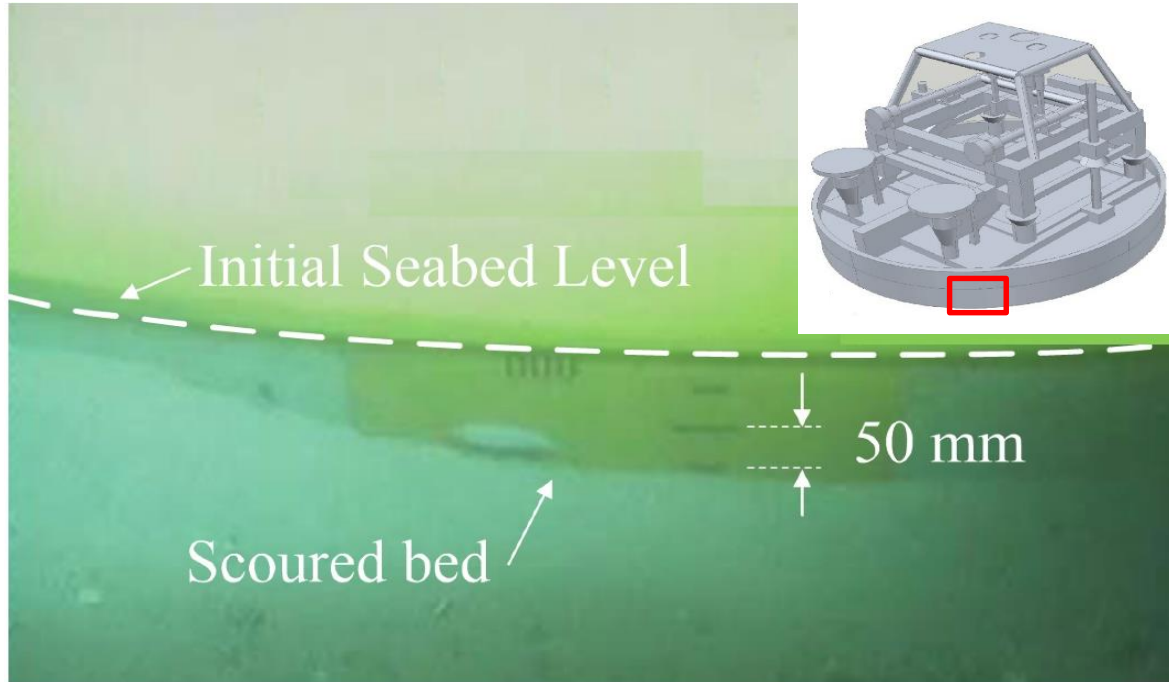


## Two 'identical' structures

Unit: [mm]



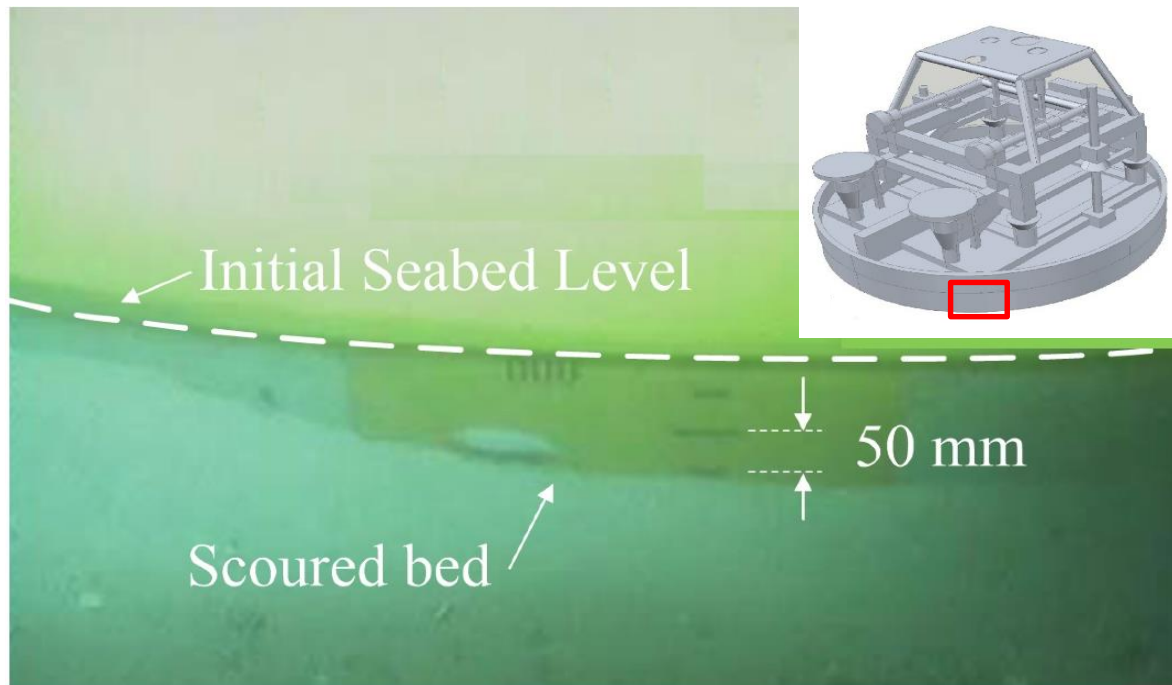
# ROV survey data



## Scour surveys

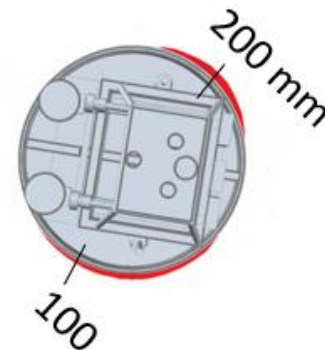
- 4.5 months
- 17.5 months

# ROV survey data

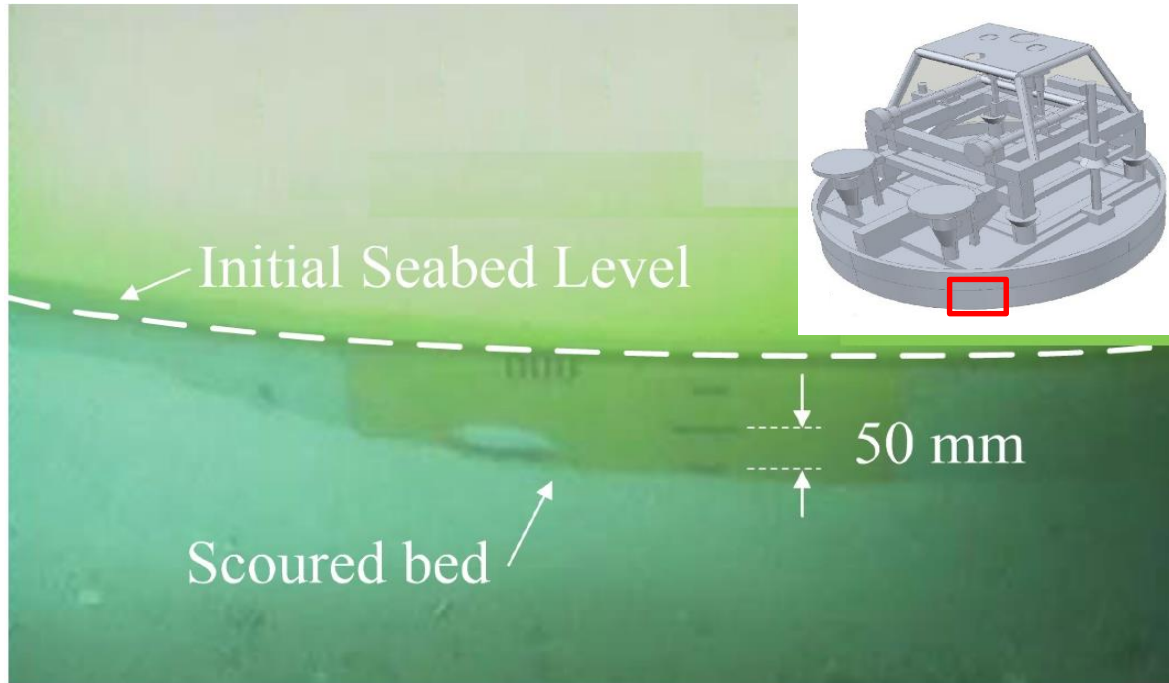


## Scour surveys

- 4.5 months
- 17.5 months

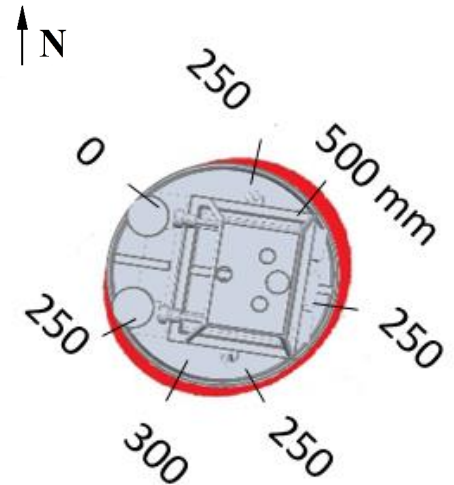


# ROV survey data



## Scour surveys

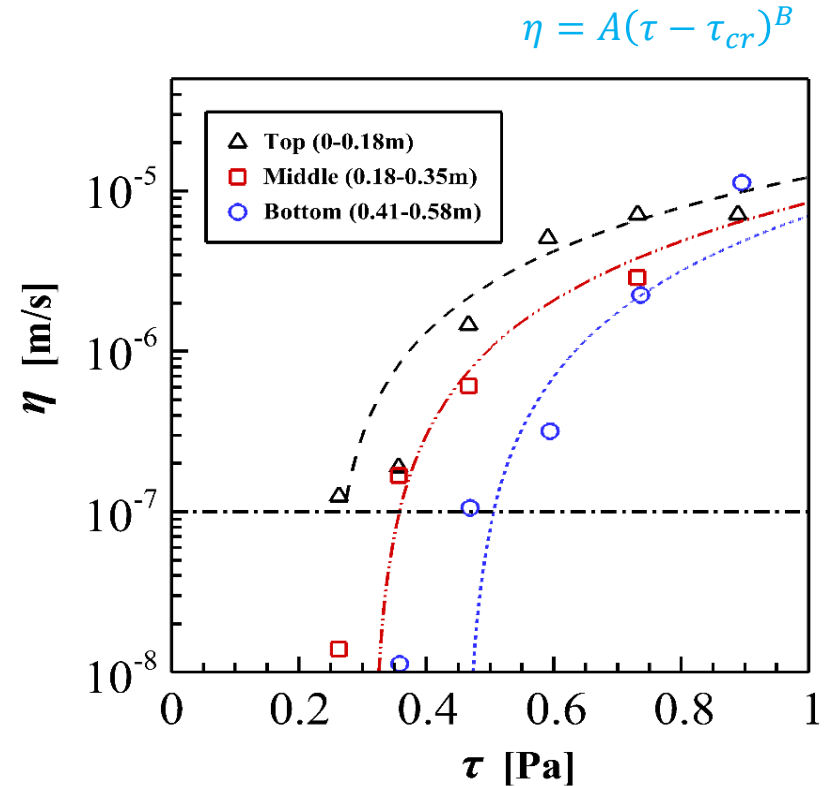
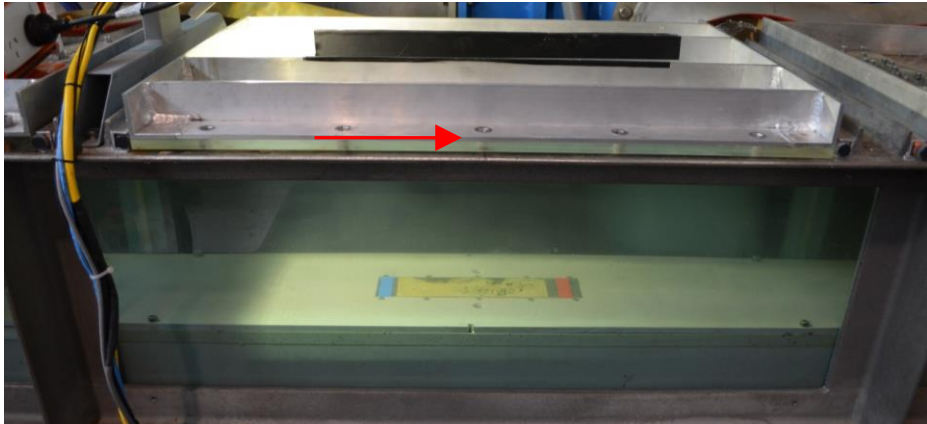
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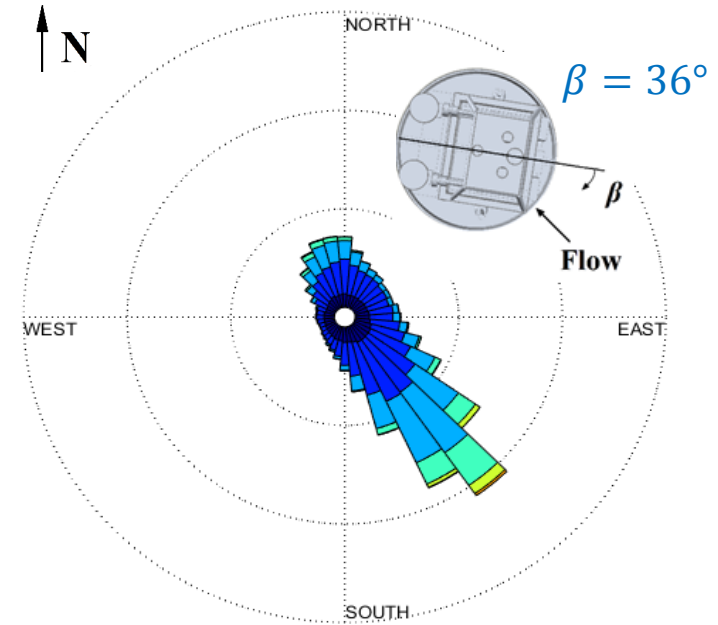
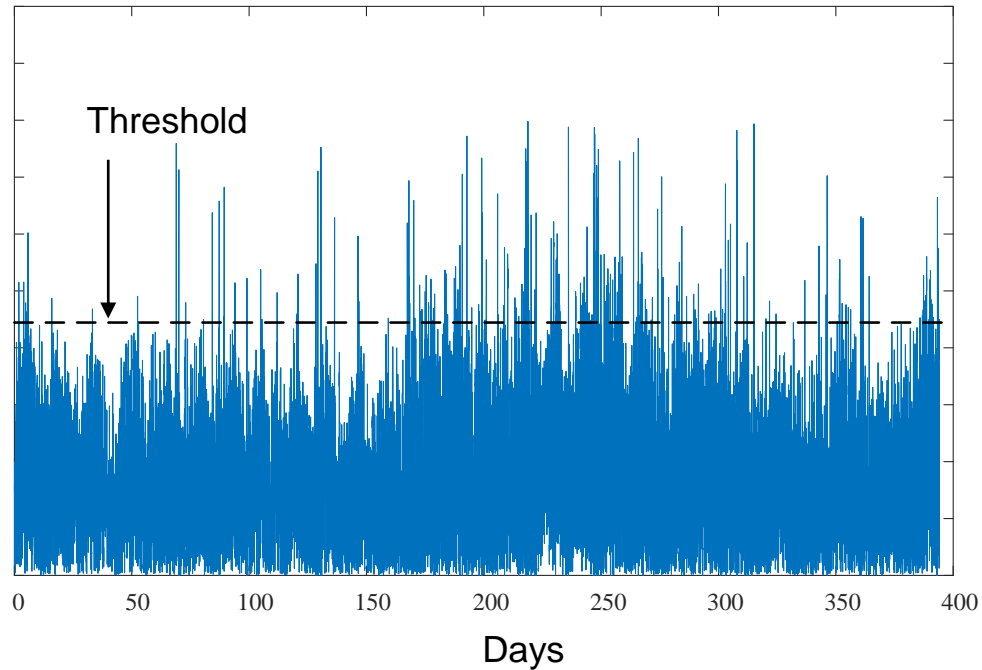


# Site specific sediment properties

Core sample located <100 m from structures



# Site specific metocean conditions



Field observations and data

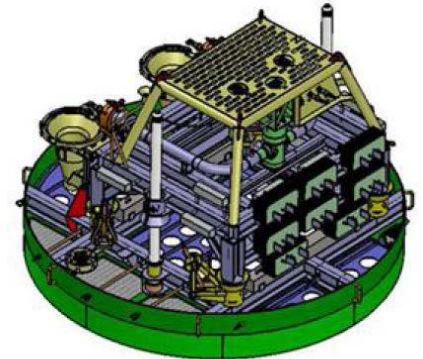
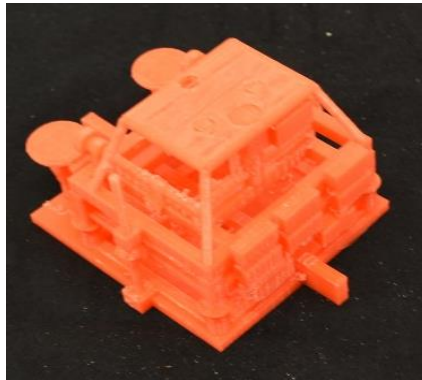
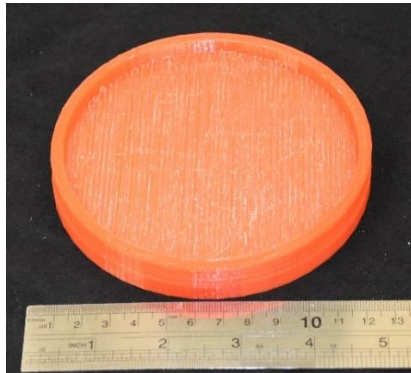
**Laboratory experiments**

Laboratory-based estimates of scour

Comparison to field observations

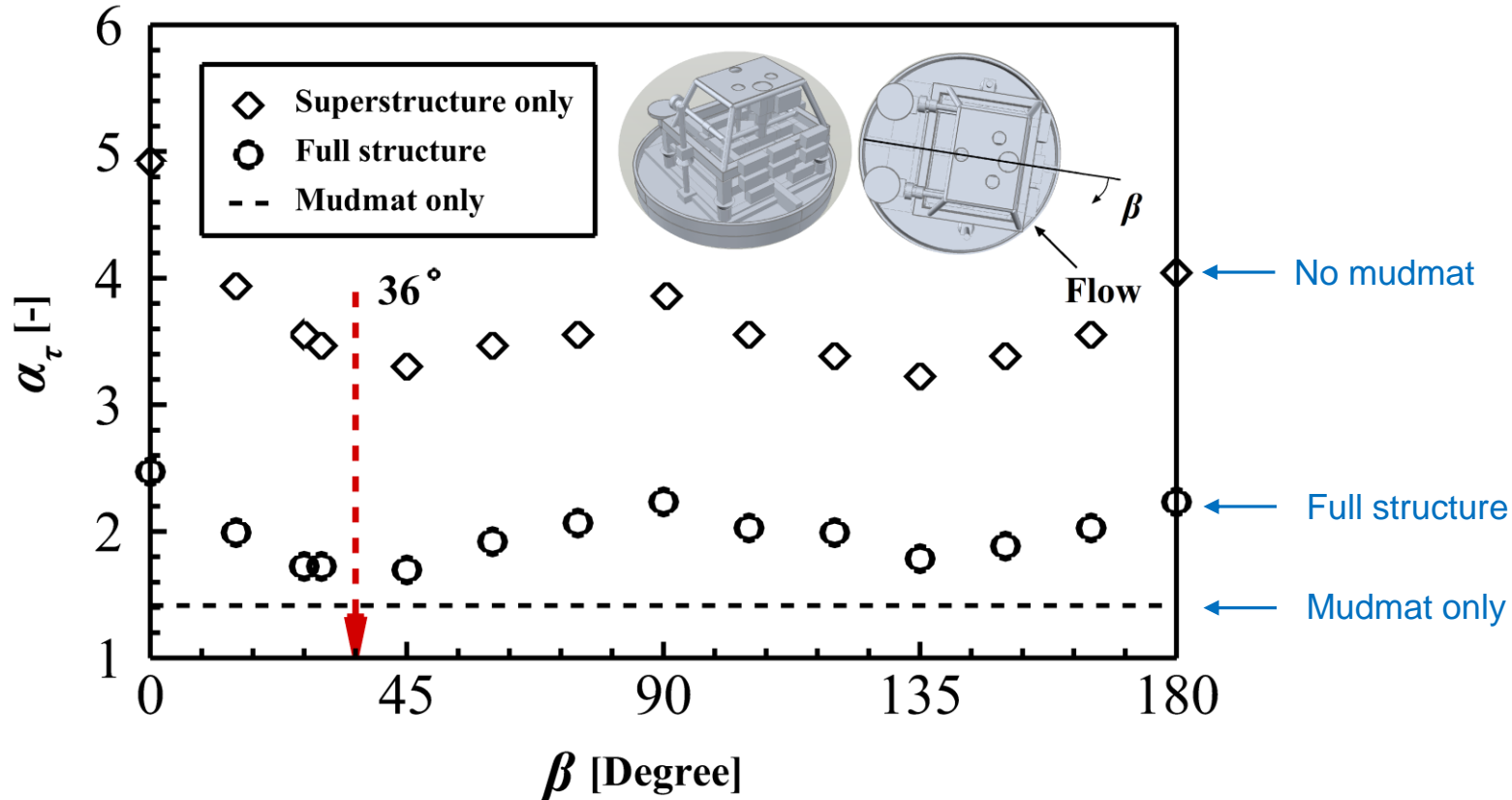
# Experiments

1. Experiments to assess shear stress amplification factor
2. Experiments to simulate shallow' scour

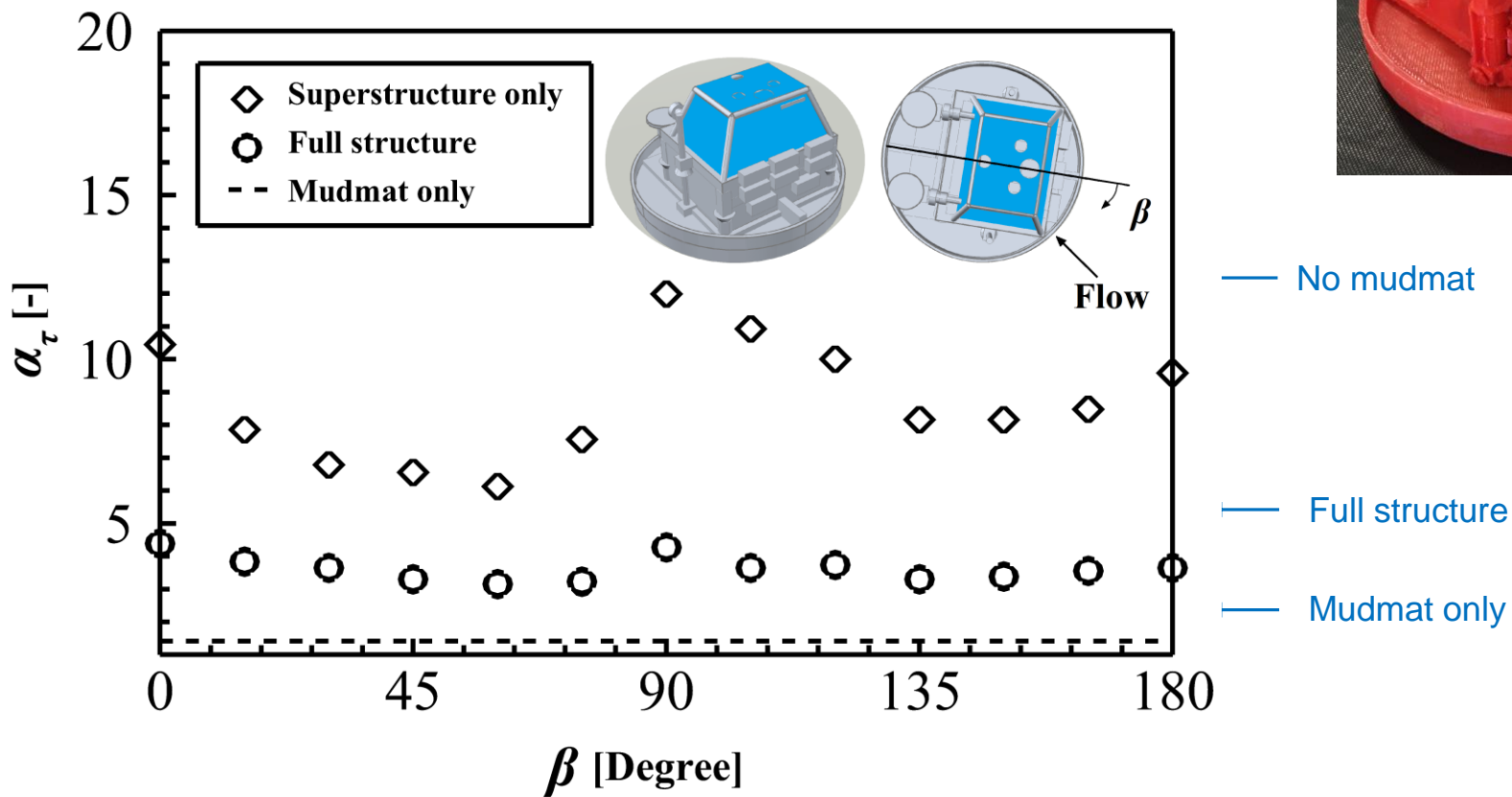
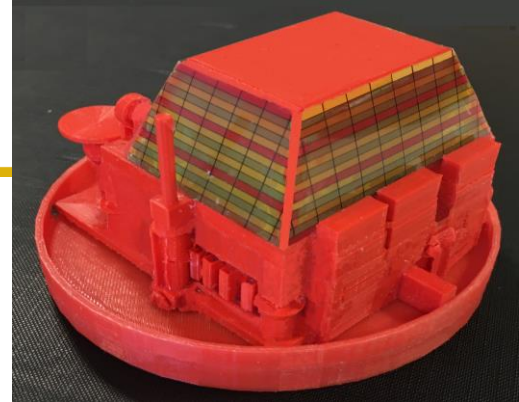




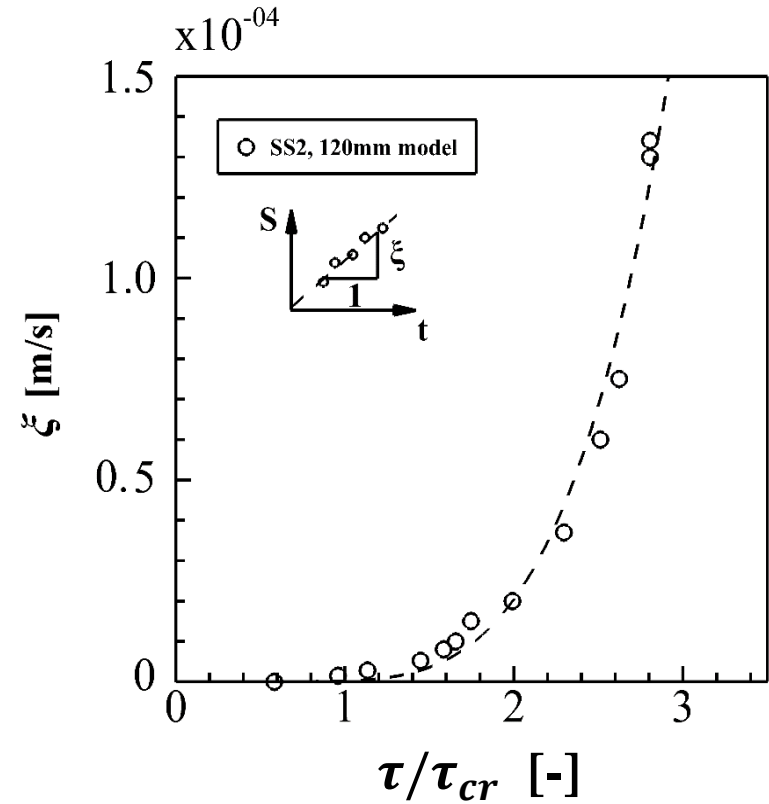
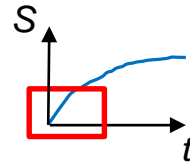
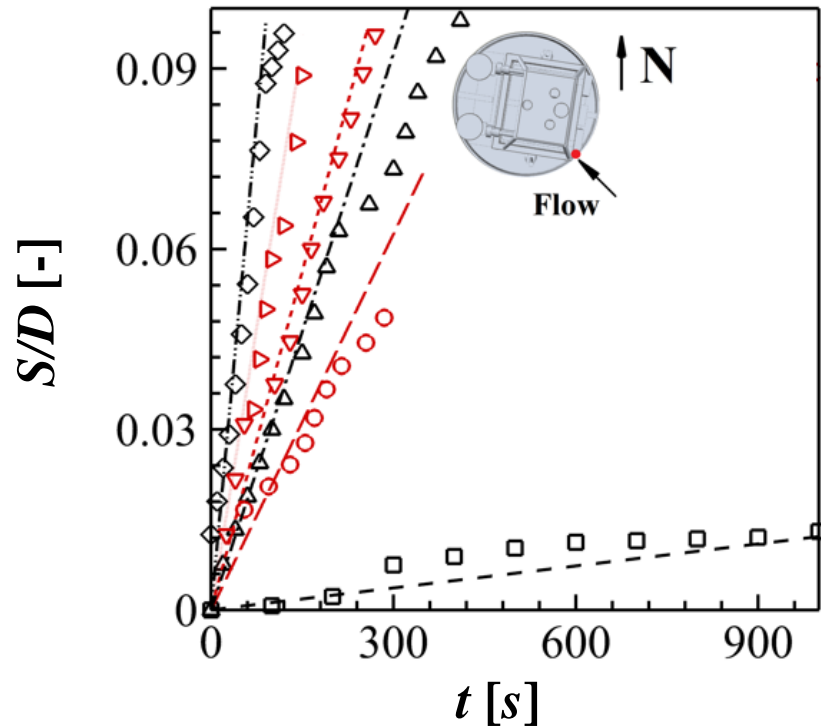
# Amplification factors



## Amplification factors



# Shallow scour experiments



Field observations and data

Laboratory experiments

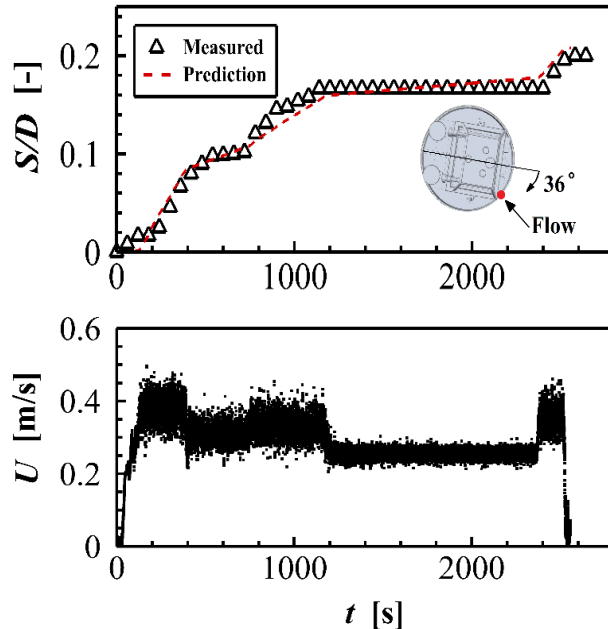
**Laboratory-based estimates of scour**

Comparison to field observations

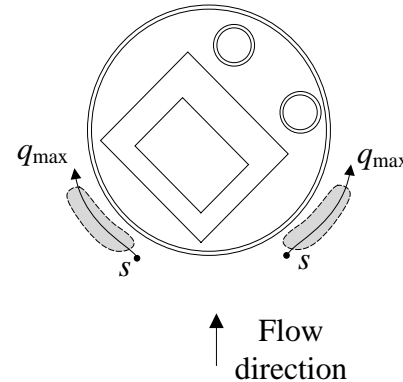
# Laboratory-based estimates of scour

(i) Account for time varying currents

$$S(t) = \int_0^t \frac{dS}{dt} dt = \int_0^t \xi[\tau(t, \tau_{cr})] dt$$



(ii) Scale results to field conditions



$$\xi = \frac{\partial S}{\partial t} \propto \frac{\partial q}{\partial s},$$

$$\xi \propto \frac{\partial q}{\partial s} \propto \frac{q_{max}}{D},$$

$$\frac{\xi_F}{\xi_L} = \frac{q_{max,F}}{q_{max,L}} \frac{D_L}{D_F},$$

$$\frac{\xi_F}{\xi_L} = \frac{A_F(\alpha_\tau \tau - \tau_{cr,F})^{B_F}}{A_L(\alpha_\tau \tau - \tau_{cr,L})^{B_L}} \frac{D_L}{D_F}$$

Field observations and data

Laboratory experiments

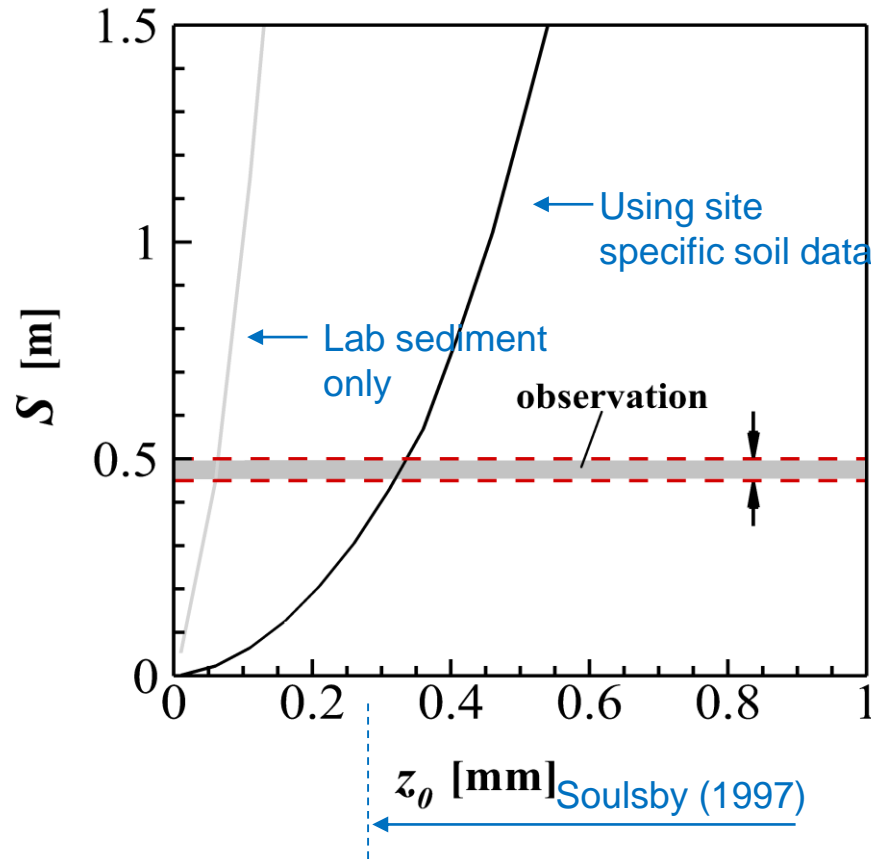
Laboratory-based estimates of scour

**Comparison to field observations**

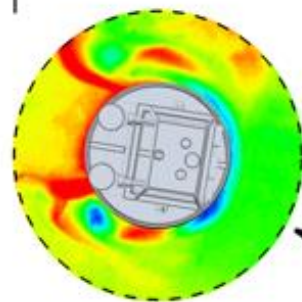


# Scour calculations

17.5 month survey

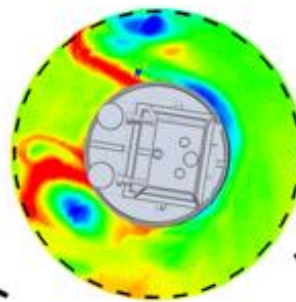


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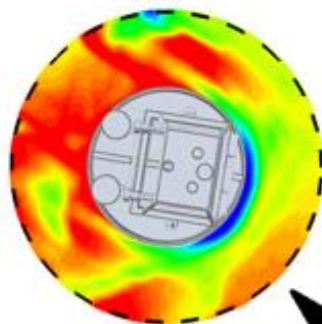
**Flow**

(a)  $18^\circ$



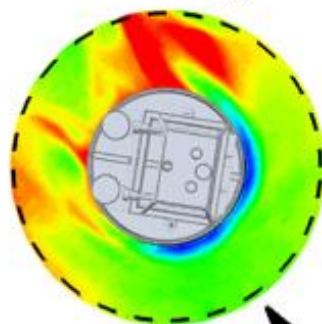
**Flow**

(b)  $27^\circ$



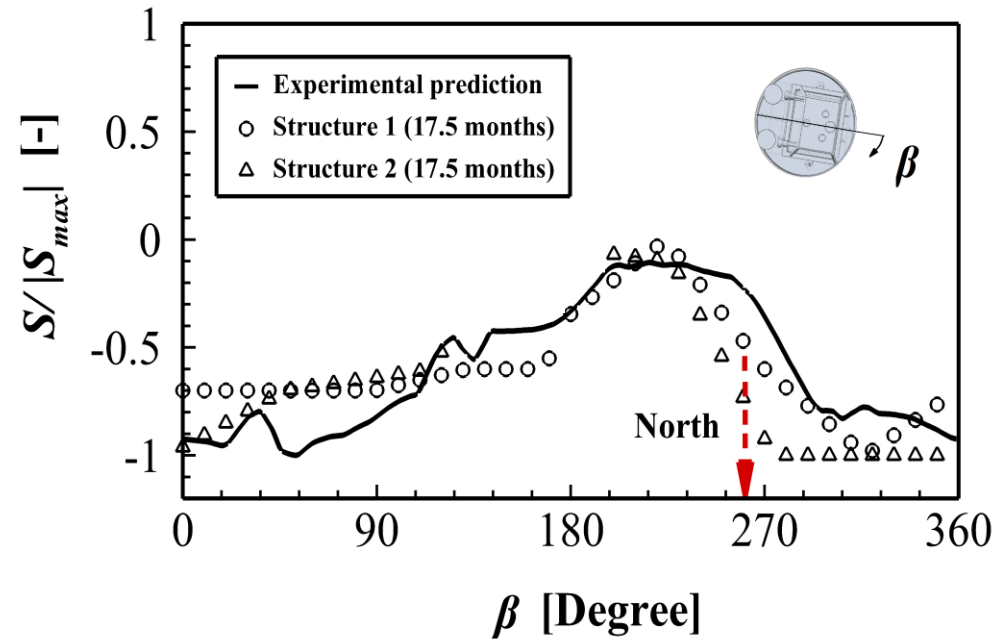
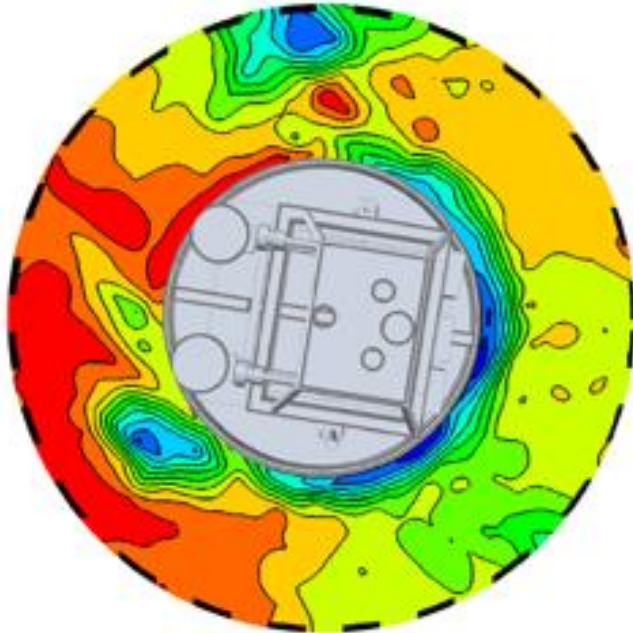
**Flow**

(c)  $36^\circ$



**Flow**

(d)  $45^\circ$



# Conclusions

Field data is invaluable for better understanding scour and reducing uncertainty in predictive methods

Reasonable agreement is obtained using laboratory-based scour estimates if site specific soil and metocean conditions are considered together with specific geometry of structure

3D printing and appropriate scaling arguments can make bespoke laboratory-based estimates practical in design

The mudmat does provide inherent scour protection – reduced amplification factor and reduced scour rate (more systematic study on this aspect is under peer review)

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