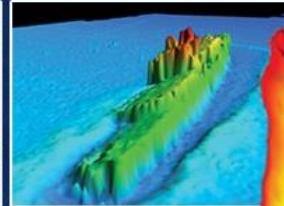
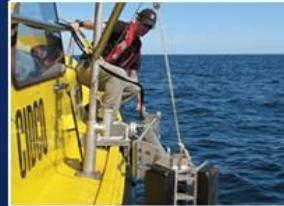




# CIDCO

Centre interdisciplinaire de développement  
en cartographie des océans

Interdisciplinary Centre for the Development  
of Ocean mapping



# Deformation Analysis of Harbour and Dam Infrastructure using Marine GIS

## U.S. Hydro 2015

Mathieu Rondeau<sup>1</sup>, Camille Stoeffler<sup>1</sup>, Davis Brodie<sup>2</sup> and Matt Holland<sup>2</sup>

<sup>1</sup> CIDCO ; <sup>2</sup> CARIS



# Context



The diagram illustrates the complementarity of two surveying methods:

- 1) First diagnostic:** Represented by a ship emitting red concentric waves, indicating a surface-based remote sensing operation.
- 2) Validation, details:** Represented by a diver in an underwater environment, indicating an underwater visual inspection.

**Complementarity** is highlighted in the center between the two methods.

<b>Coverage perf.</b>	30 000m <sup>2</sup> /h
<b>Resolution</b>	10-15cm
<b>Accuracy</b>	cm
<b>Visibility sens.</b>	no
<b>Current sens.</b>	no
<b>Products</b>	3D points cloud

<b>Coverage perf.</b>	300m <sup>2</sup> /h
<b>Resolution</b>	mm
<b>Accuracy</b>	50cm->2m
<b>Visibility sens.</b>	yes
<b>Current sens.</b>	yes
<b>Products</b>	Sketch, videos



# Hybridised MBES/LiDAR capture solution

2010->2012

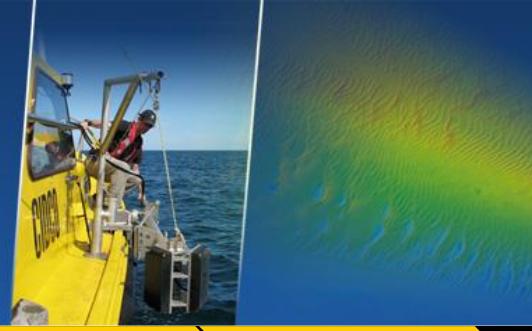
Intro. ➤ Proto. ➤ EAM ➤ UseCase1 ➤ UseCase2 ➤ Concl.





# Problem

## 2010->2012



Intro.

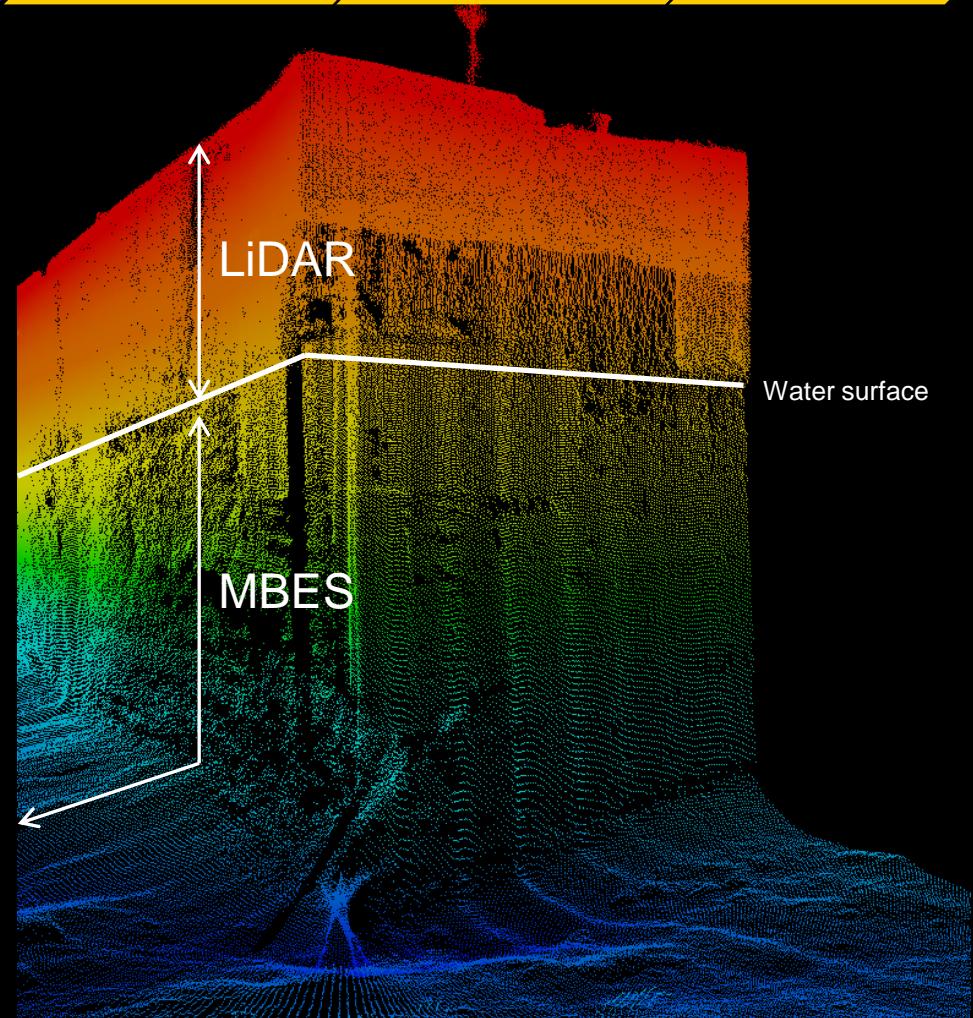
Proto.

EAM

UseCase1

UseCase2

Concl.

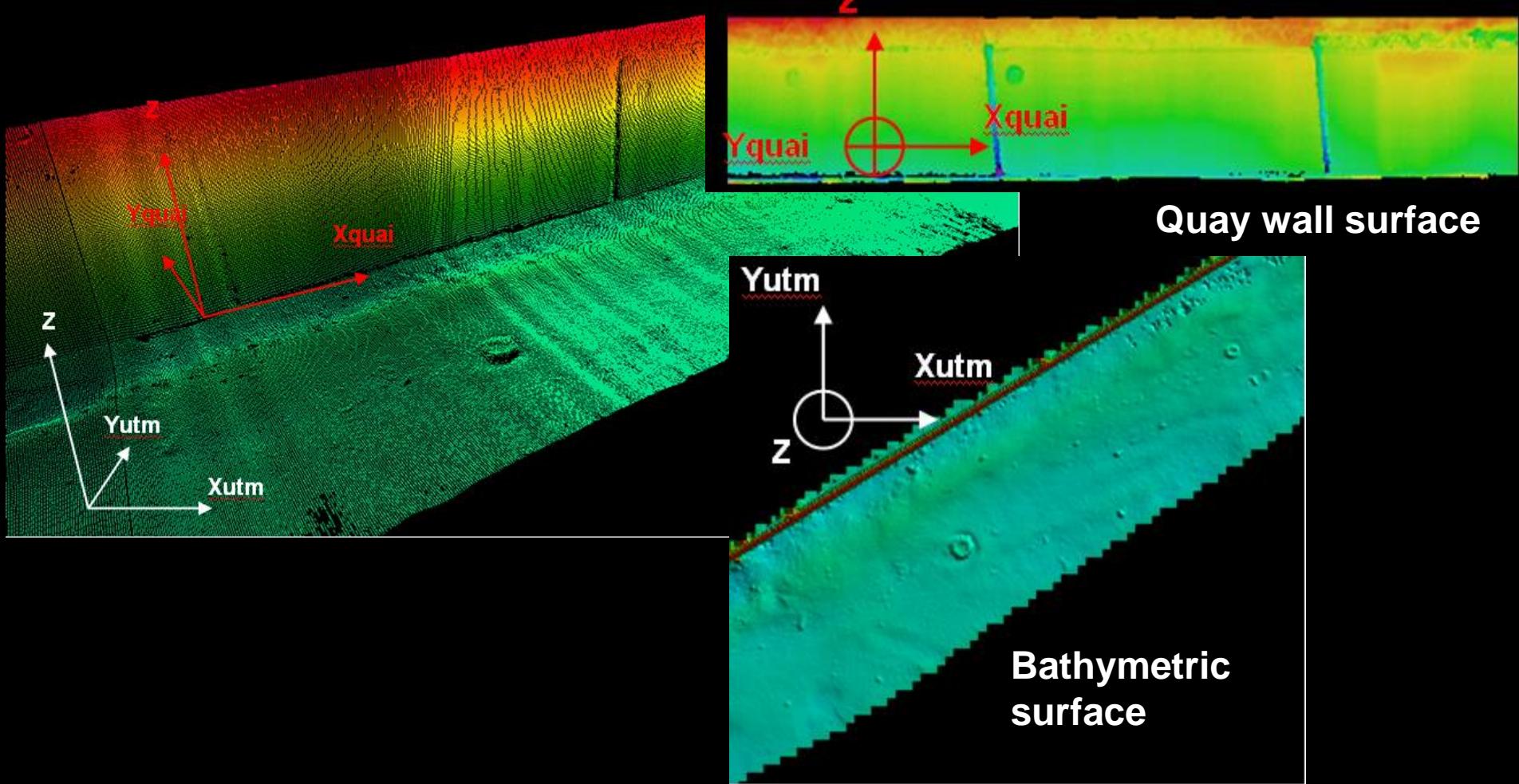
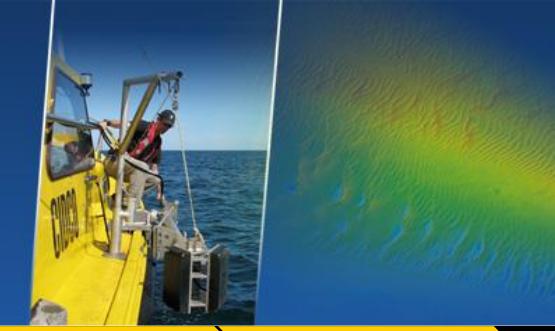


+	-
For the first time, port management bodies have a full view of the submerged part of their structures	3D points cloud is not easily usable by engineers
Precious information to better plan maintenance and repair	Vertical surface processing is not yet supported in CARIS
Recurring inspection -> evolutive diagnostic possible	



# Objective

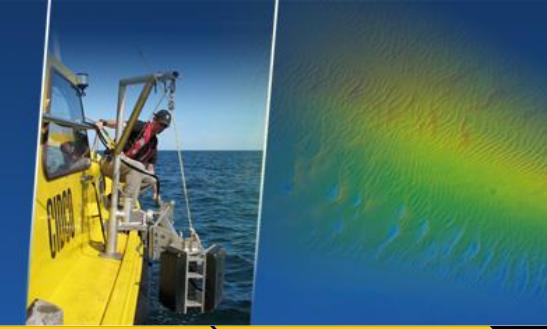
2010->2012





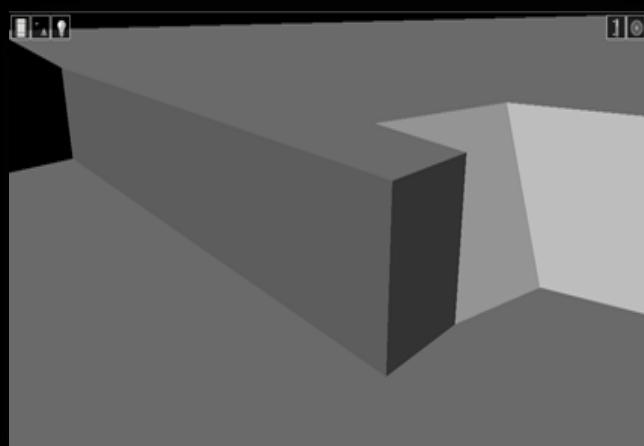
# Engineering Analysis Module

## 2013->2014

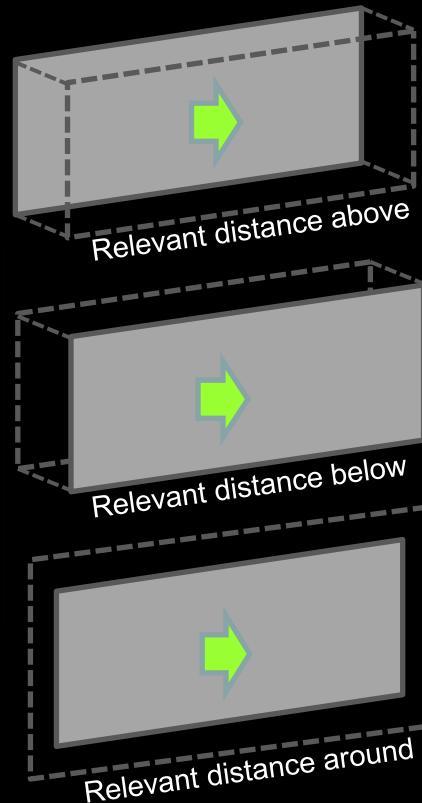


Intro. >>> Proto. >>> EAM >>> UseCase1 >>> UseCase2 >>> Concl.

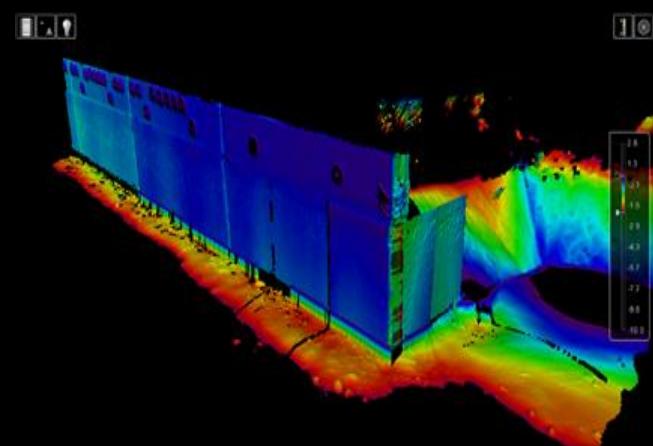
Create a 3D model  
(collection of inclined and horizontal planes)



Define contributing soundings



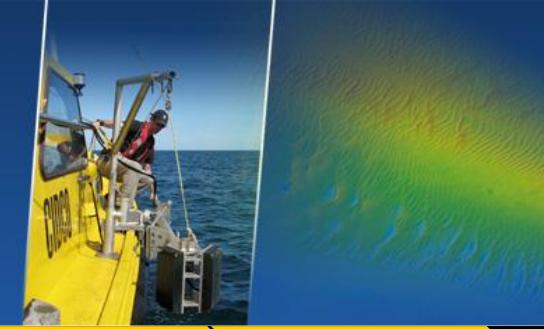
Grid contributing soundings on each plane of the 3D model



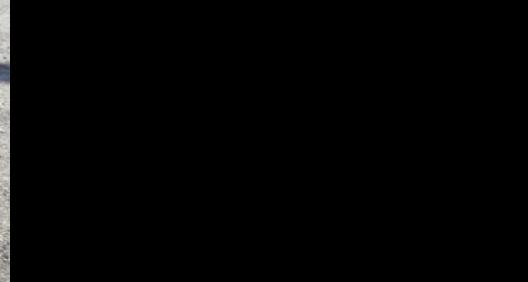
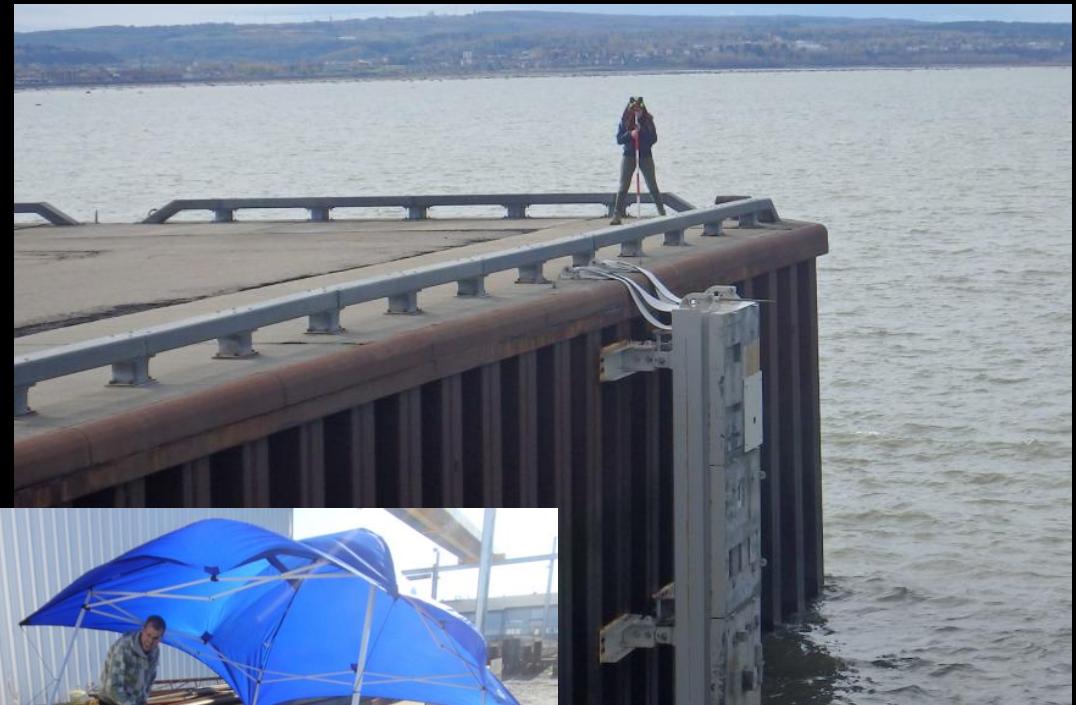
Datasets courtesy of Montreal Port Authority



# Case Study: CIDCO Test Bench Installation - 2014



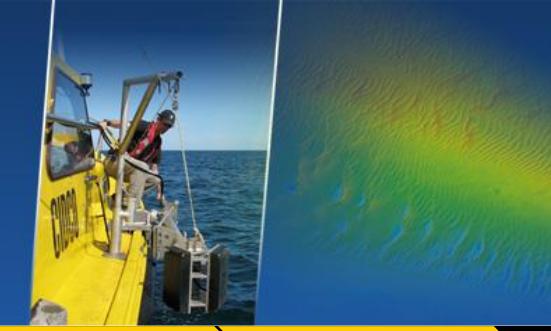
Intro. > Proto. > EAM > UseCase1 > UseCase2 > Concl.





# Case Study: CIDCO Test Bench

## Accuracy evaluation



Intro.

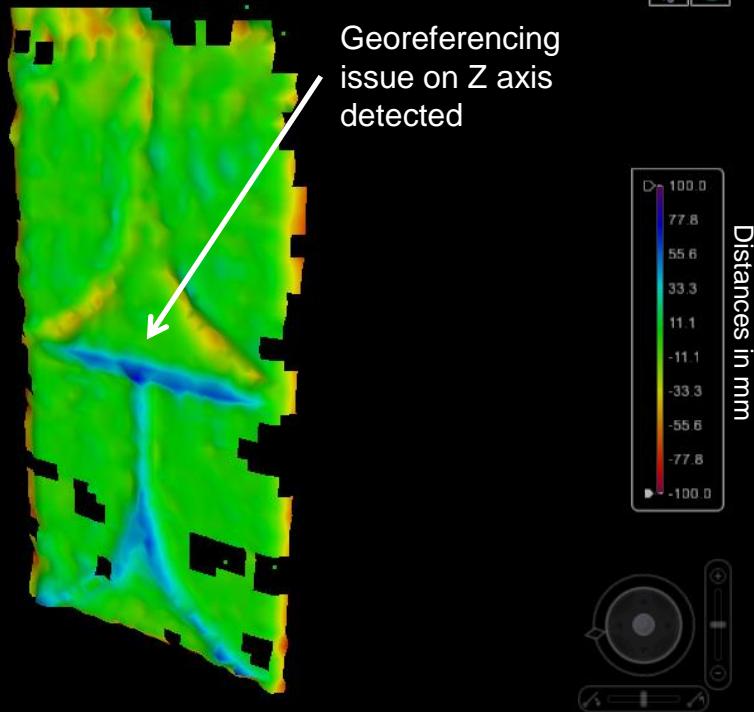
Proto.

EAM

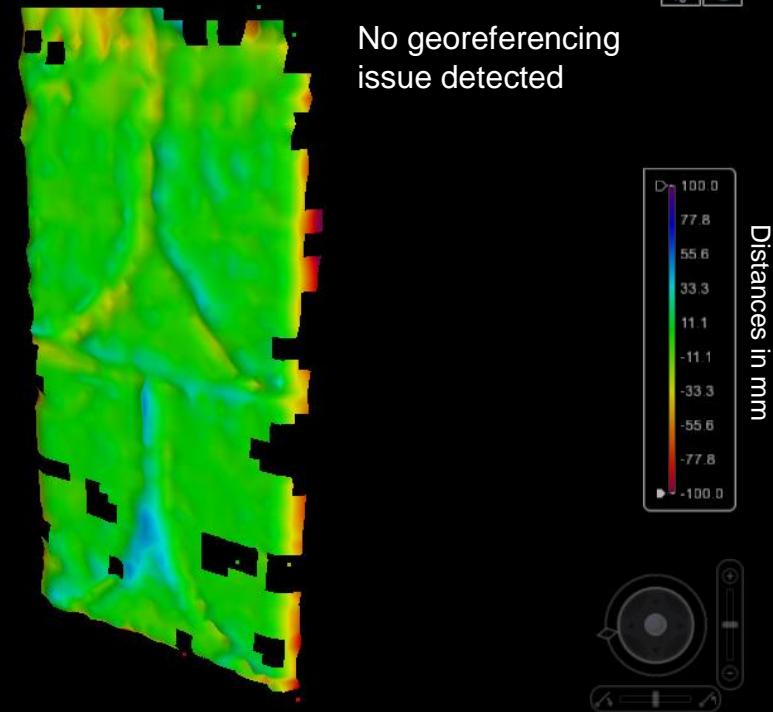
UseCase1

UseCase2

Concl.



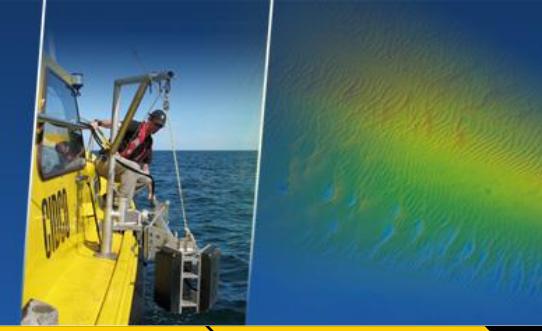
Ref VDTM – MBES line1 VDTM



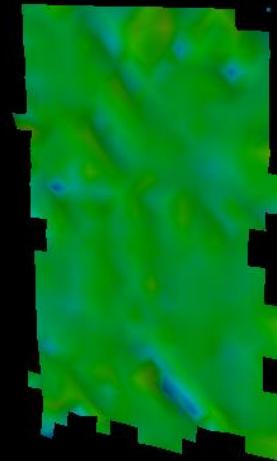
Ref VDTM – MBES line2 VDTM



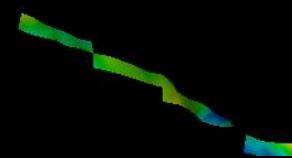
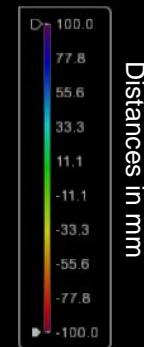
# Case Study: CIDCO Test Bench Precision evaluation



Intro. > Proto. > EAM > UseCase1 > UseCase2 > Concl.



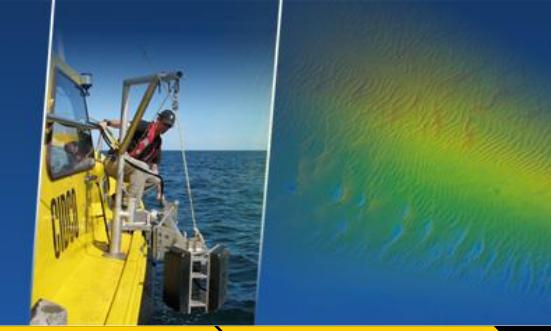
No precision issue detected



MBES line1 VDTM – MBES line2 VDTM



# Case Study: CIDCO Test Bench Resolution evaluation



Intro.

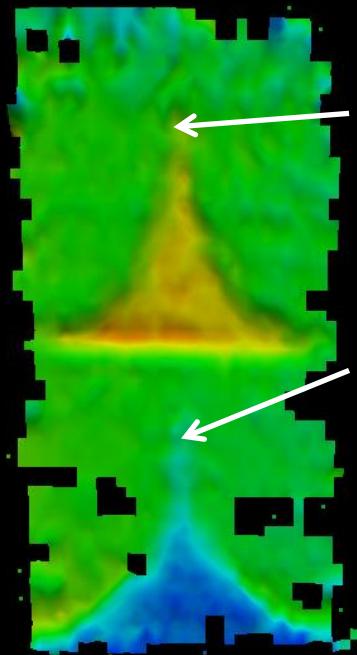
Proto.

EAM

UseCase1

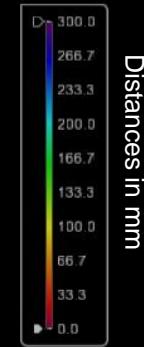
UseCase2

Concl.



Smallest gouging  
feature detected  
(3cm)

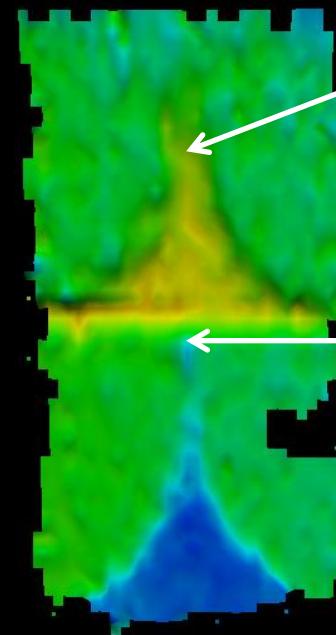
Smallest protruding  
feature detected  
(3cm)



Distances in mm



Survey line speed	= 1 knot
Distance from test bench	= 2m
Swath angle	= 90°
Steering angle	= 40°



Smallest gouging  
feature detected  
(8cm)

Smallest protruding  
feature detected  
(2cm)



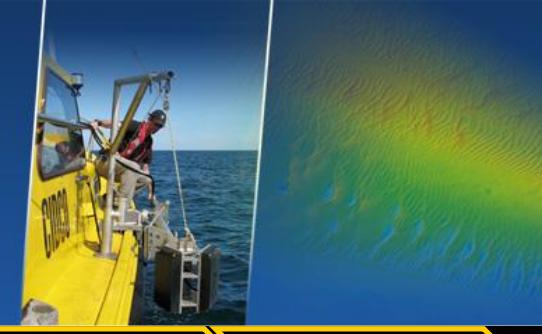
Distances in mm



Survey line speed	= 1 knot
Distance from test bench	= 5m
Swath angle	= 90°
Steering angle	= 40°

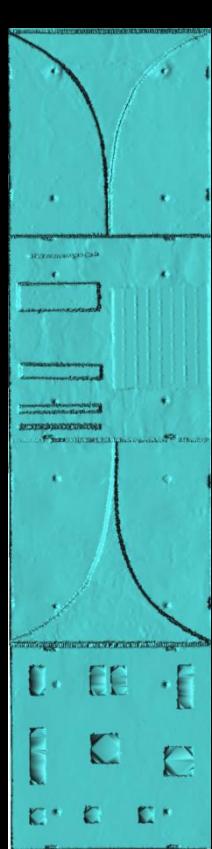


# Case Study: CIDCO Test Bench MBES comparison

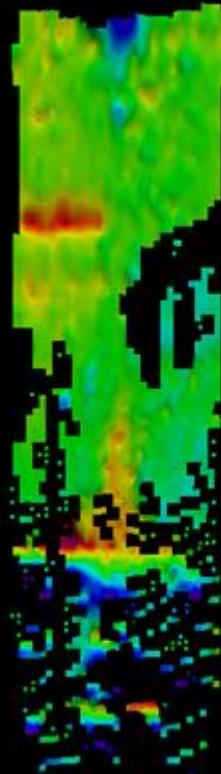


Intro. > Proto. > EAM > UseCase1 > UseCase2 > Concl.

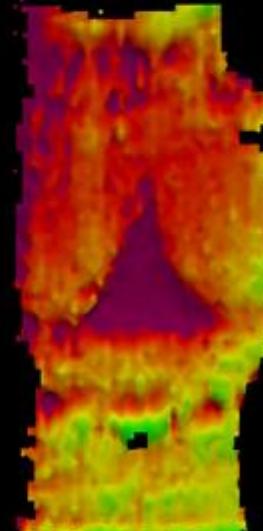
Reson SeaBat 7125SV2



Reson SeaBat T20P

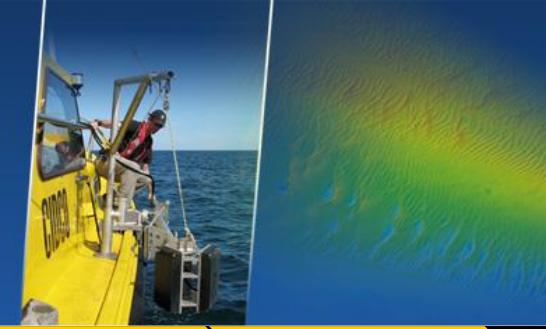


Norbit iWBMSc





# Case Study: CIDCO Test Bench Head tilt / Beam steering



Intro. > Proto. > EAM > UseCase1 > UseCase2 > Concl.

