



UAlg

UNIVERSIDADE DO ALGARVE

Coastal video monitoring system optimization using computational intelligence methods



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micore

What video can show us-Snapshot

2009-02-27 09:00:00





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What video can show us-Timex

2009-02-27 09:00:00

TIMEX



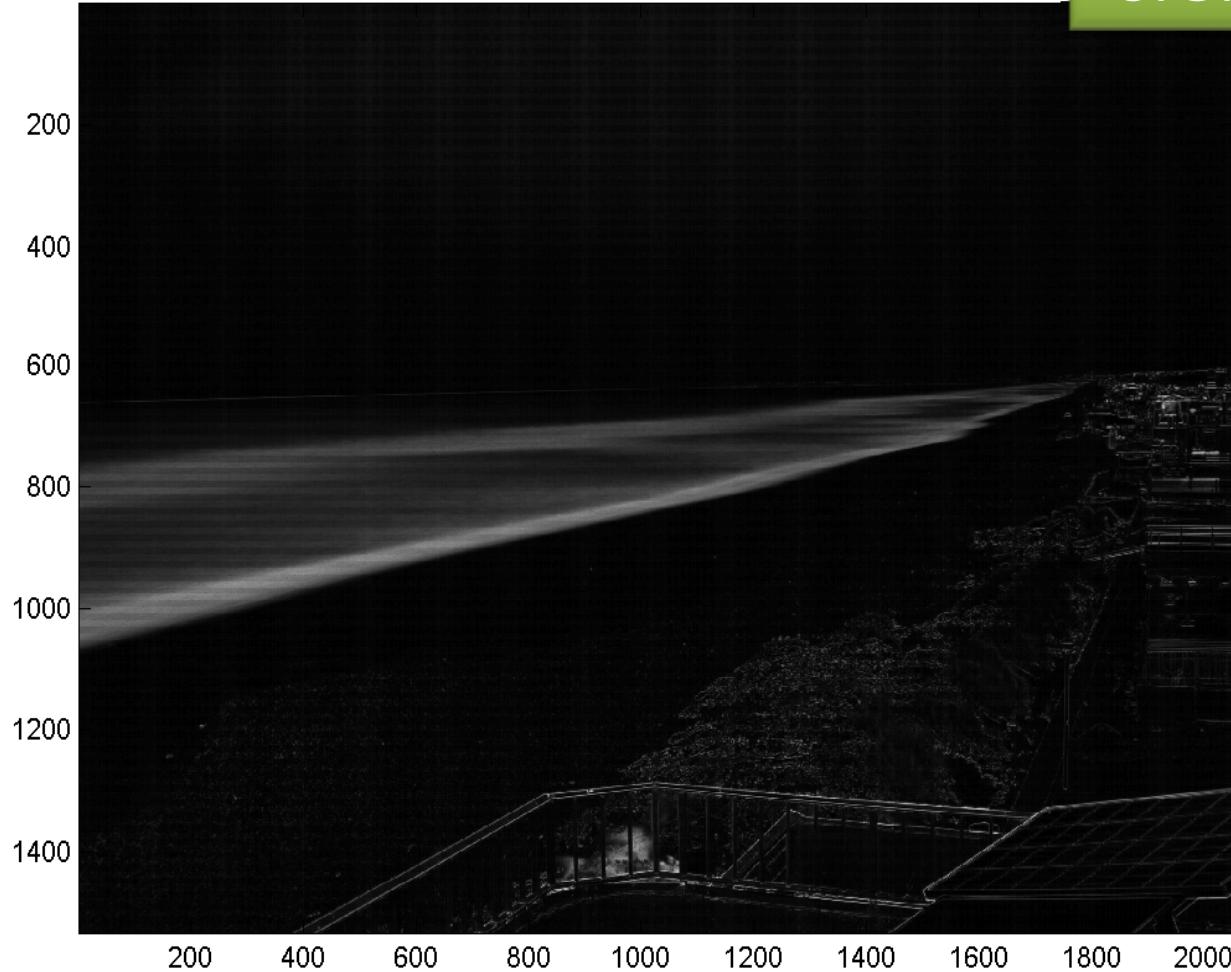


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What video can show us-Sigma

2009-02-27 09:00:00

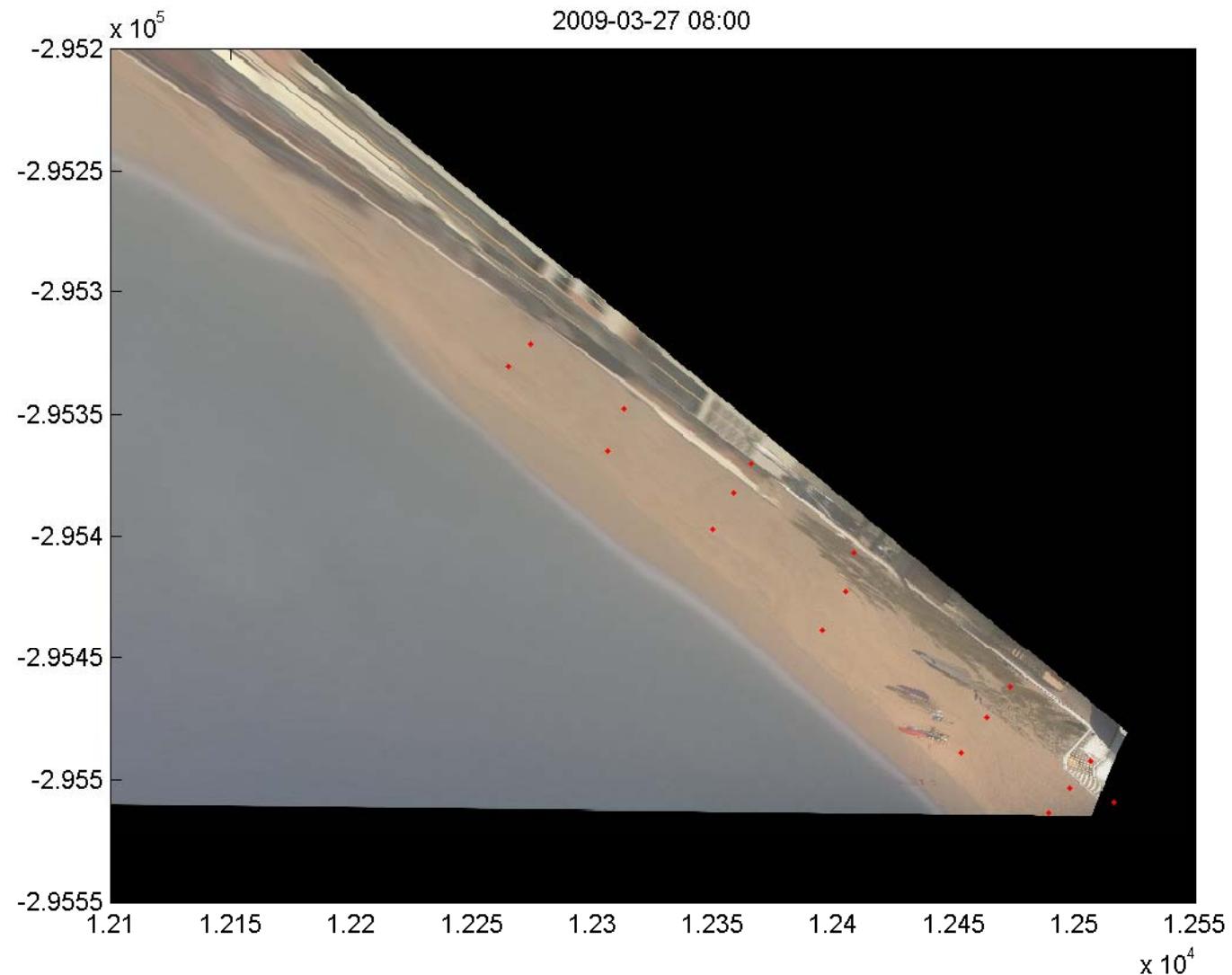
SIGMA





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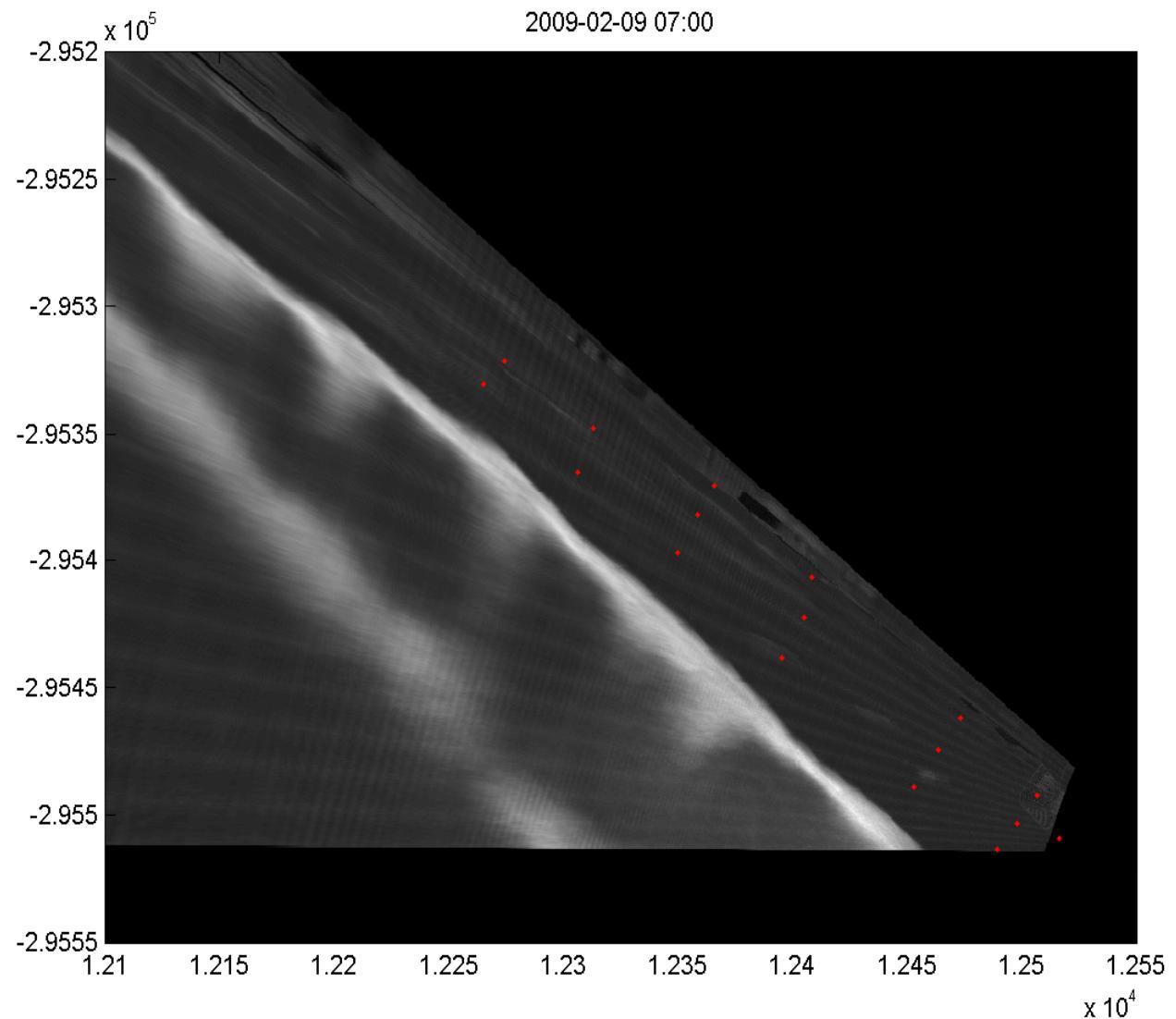
What video can show us-Geo Timex





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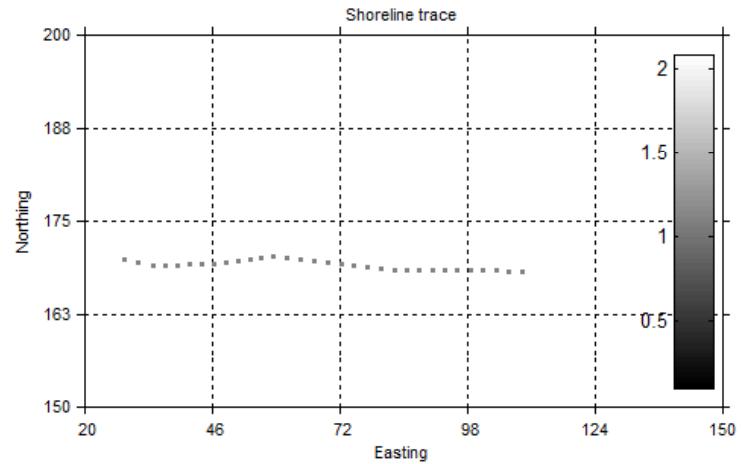
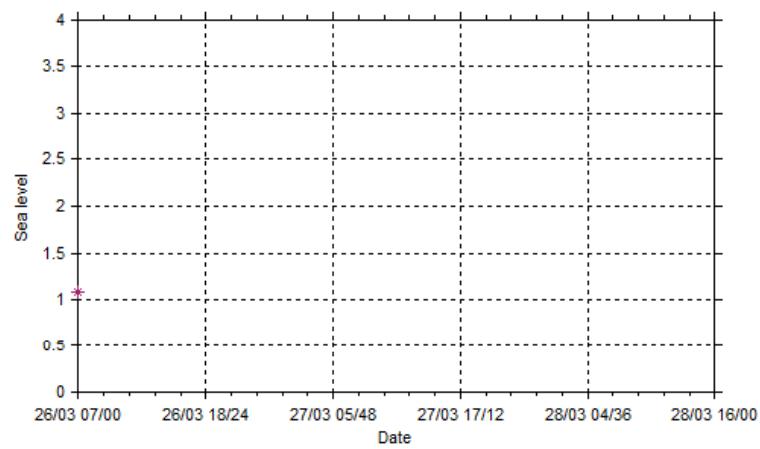
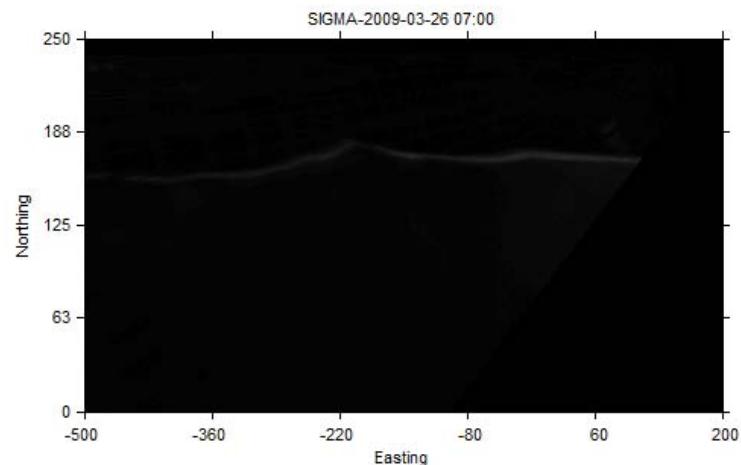
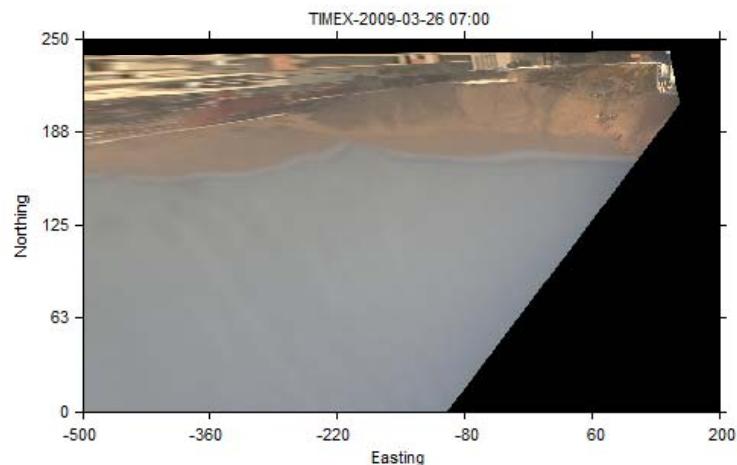
What video can show us-Geo Sigma





What video can show us

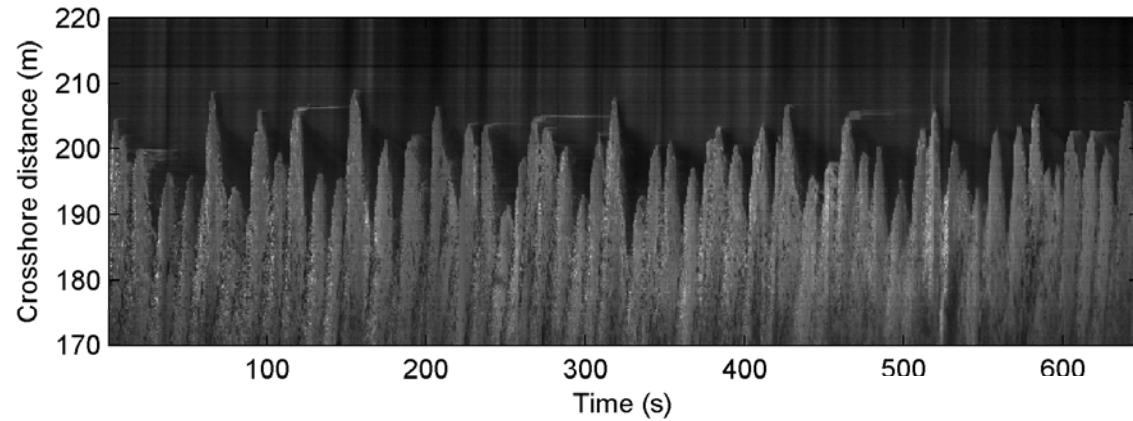
Intertidal topography



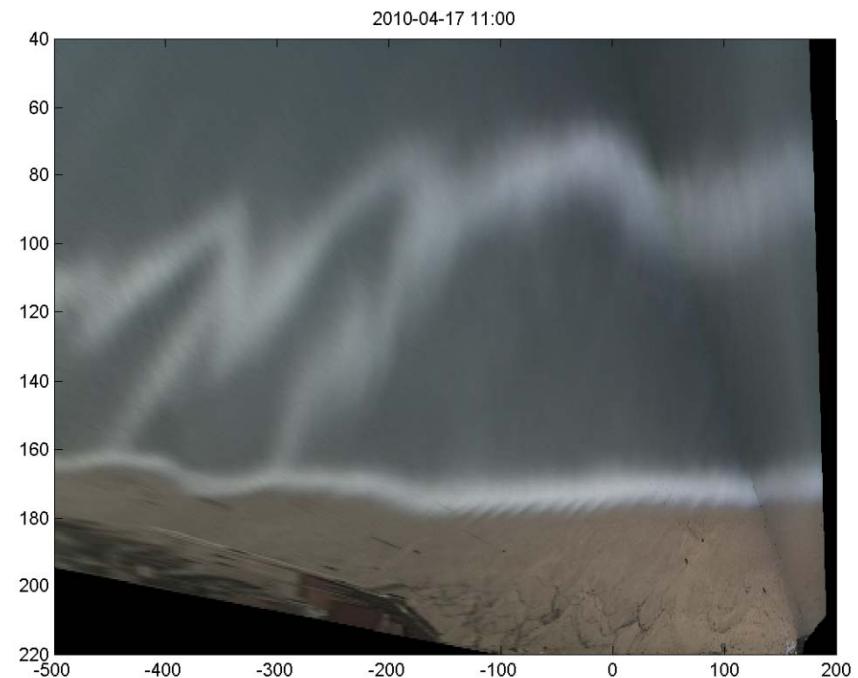


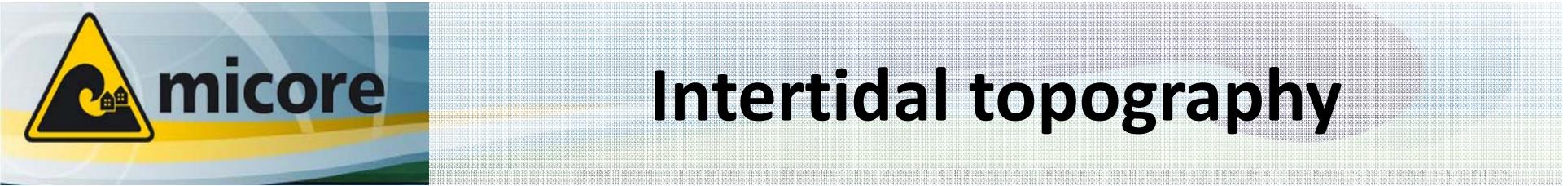
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What video can show us-Timestack

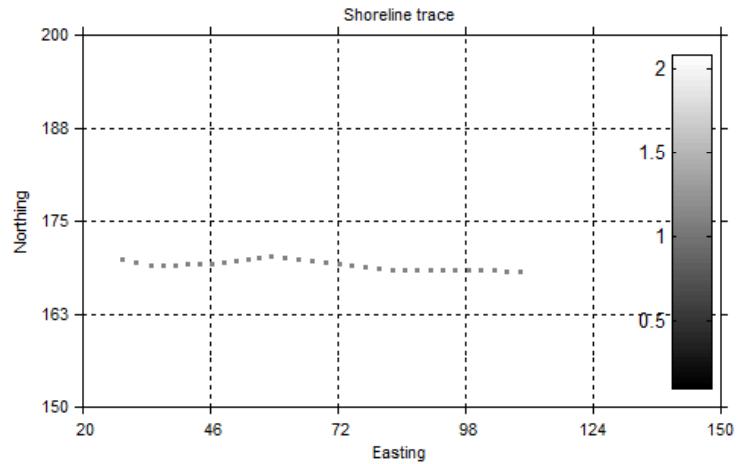
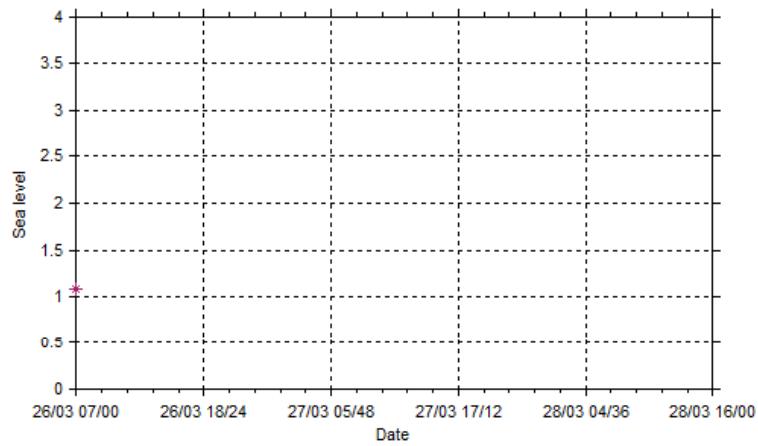
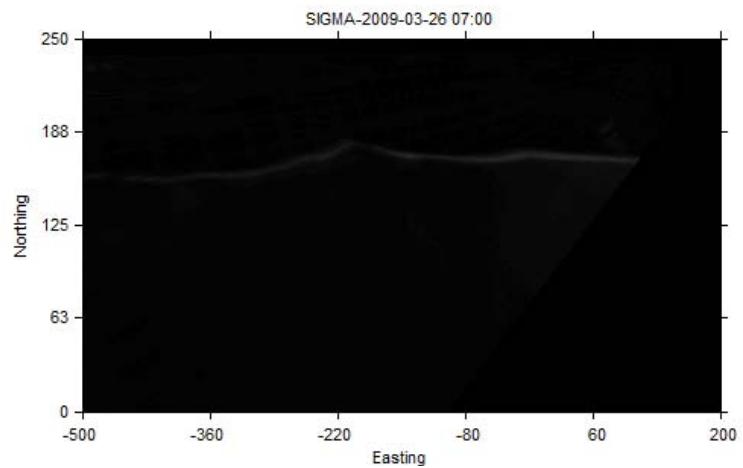
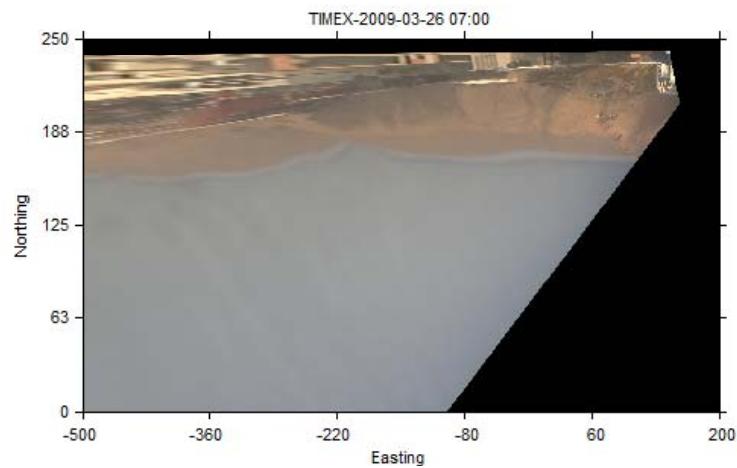


Holman RA, Stanley J (2007) The history and technical capabilities of Argus. *Coast Eng* 54 (6-7):477-491



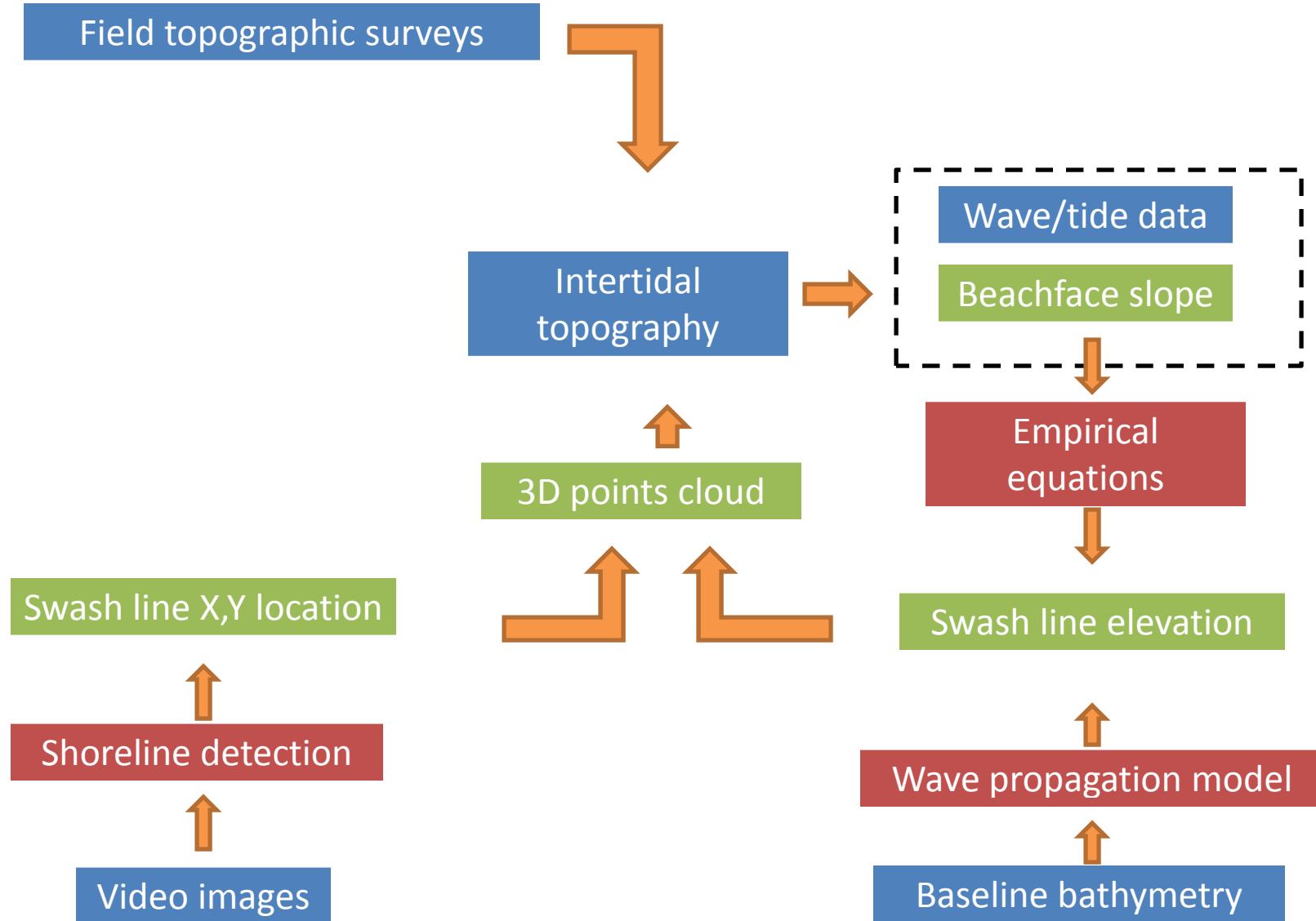


Intertidal topography





A flow diagram

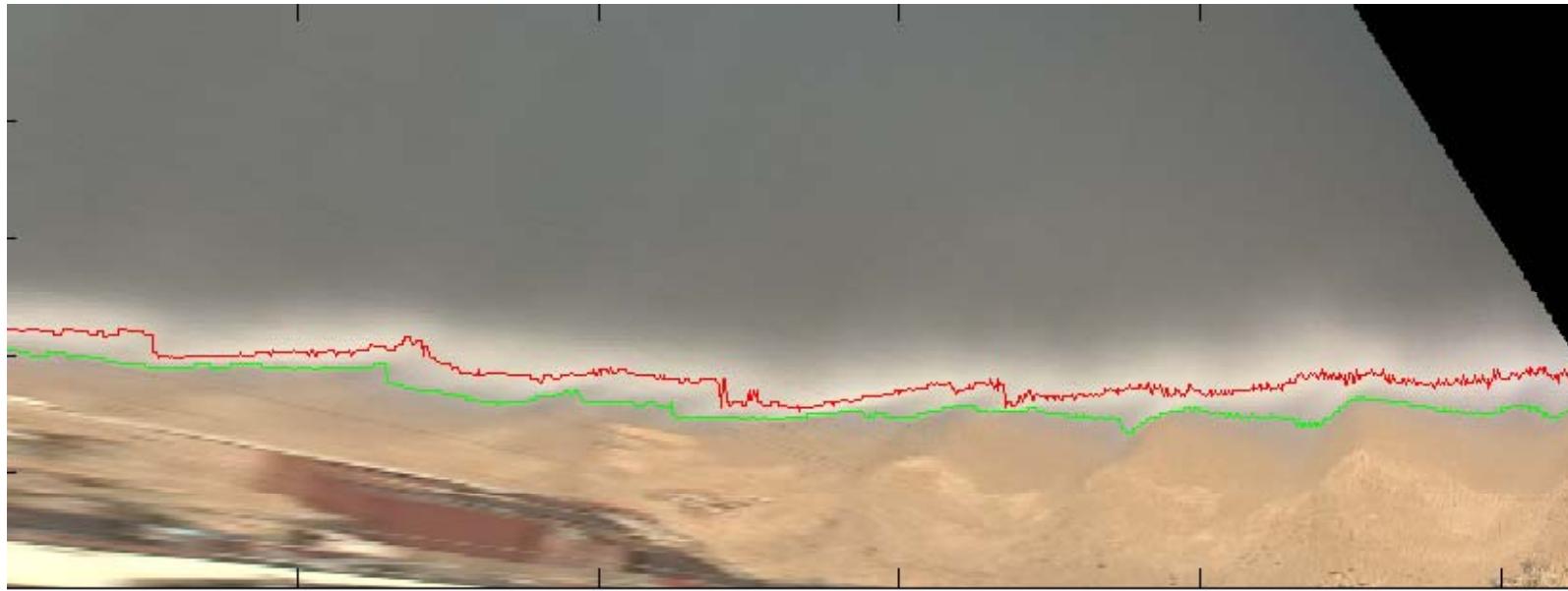




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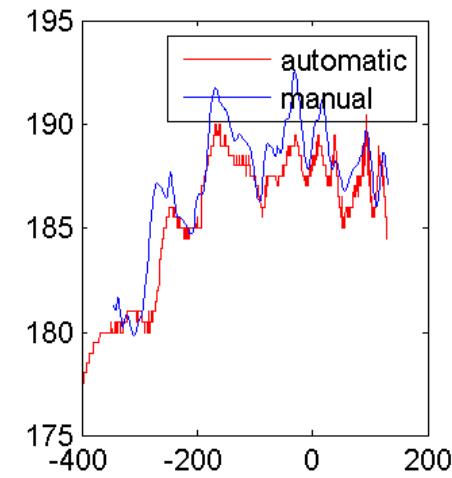
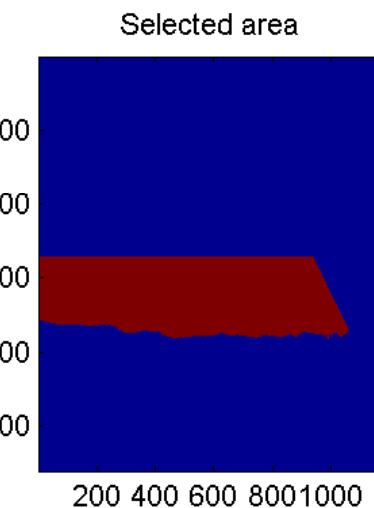
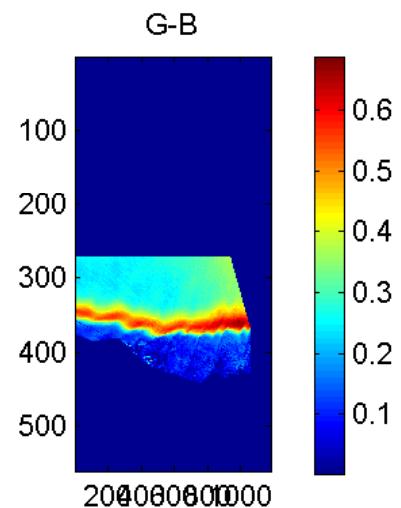
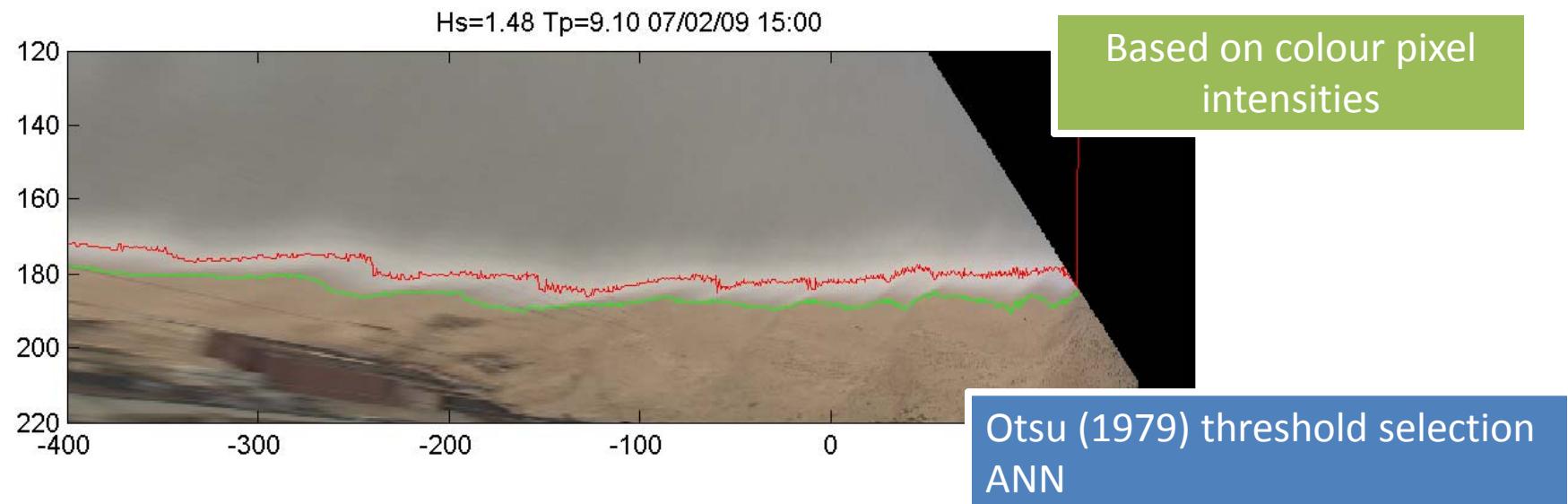
MORPHOLOGICAL IMPACTS AND COASTAL RISKS INDUCED BY EXTREME STORM EVENTS

SHORELINE DETECTION



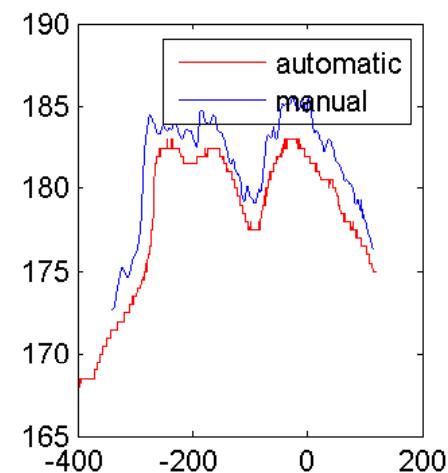
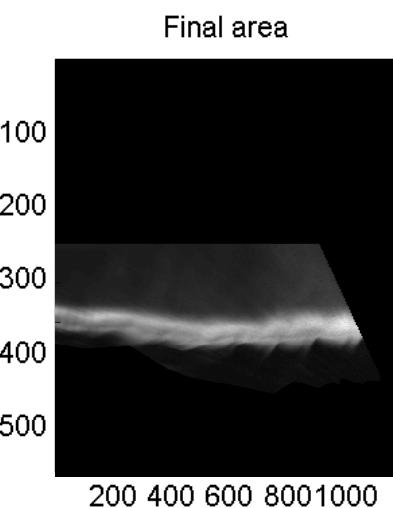
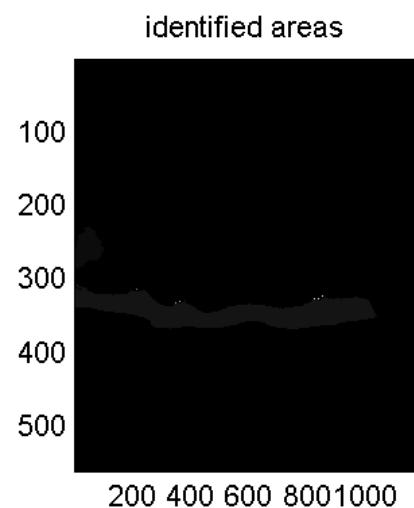
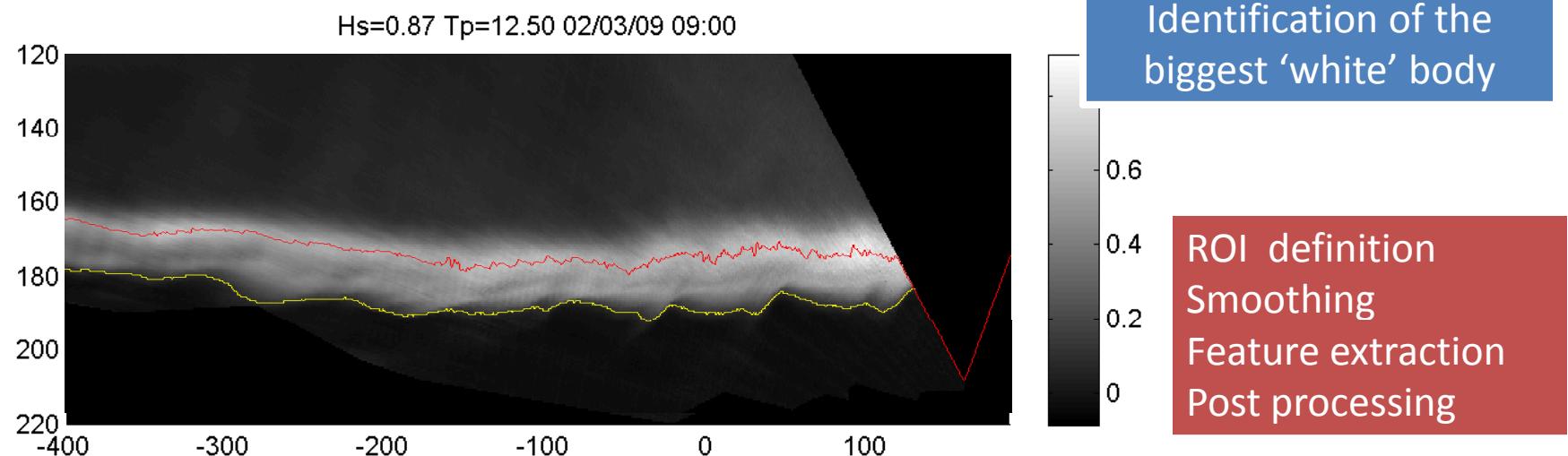


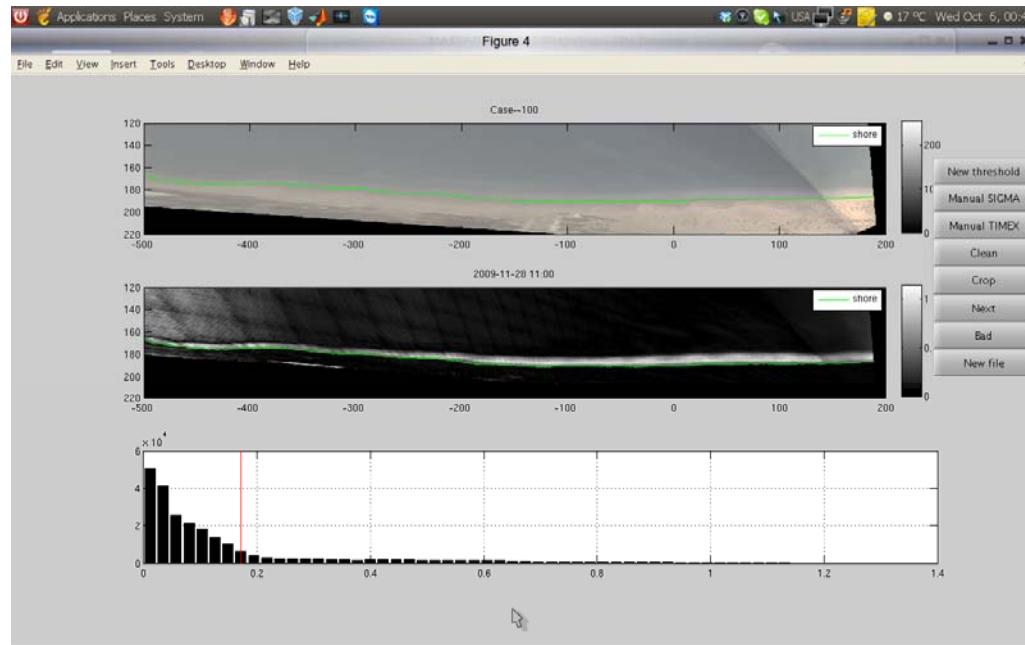
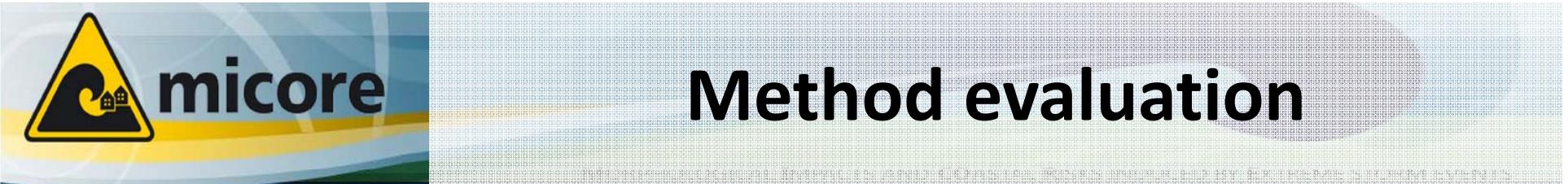
Extract from the timex image





Extract from the sigma image





~2200 test images

Supervised shoreline
extraction (GUI)

Method evaluation on the
grounds of RMS errors

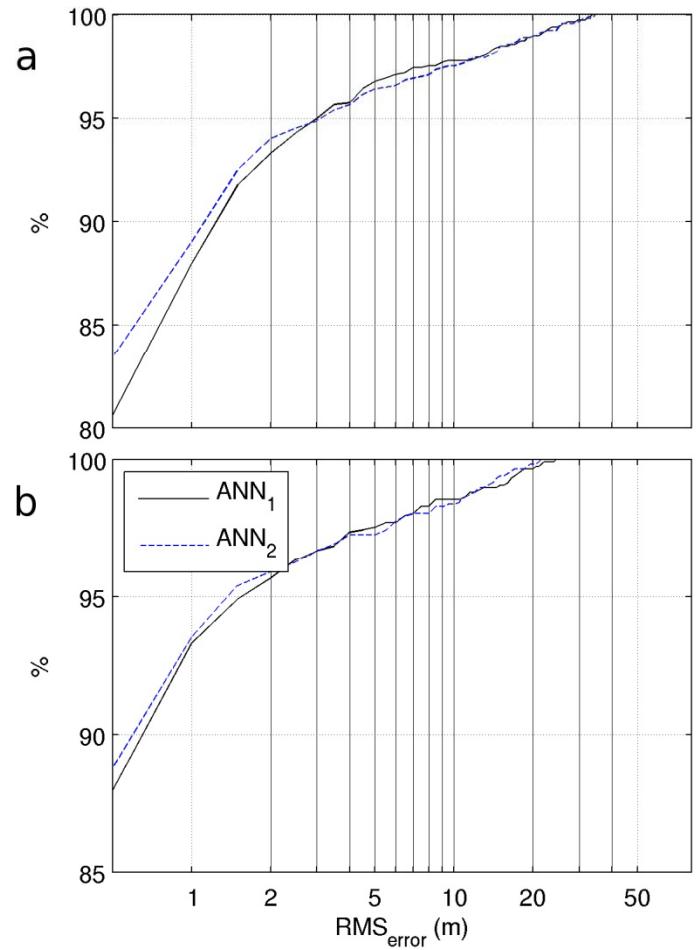
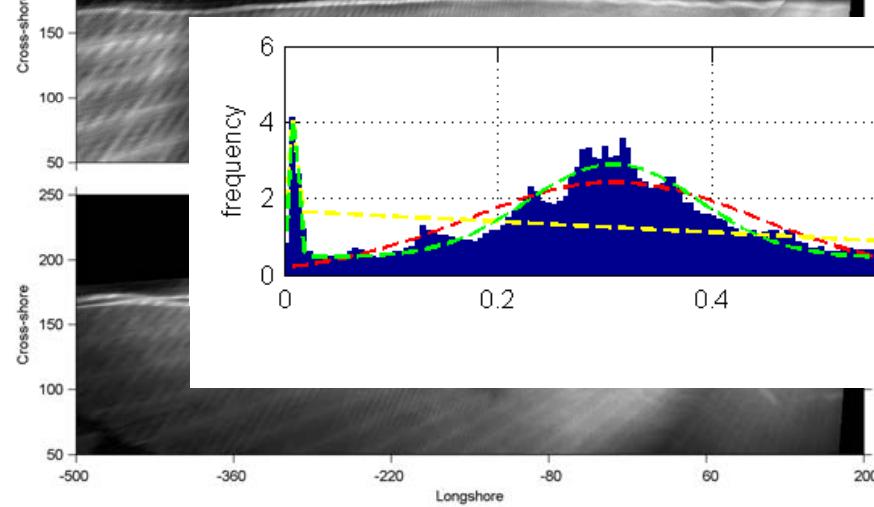
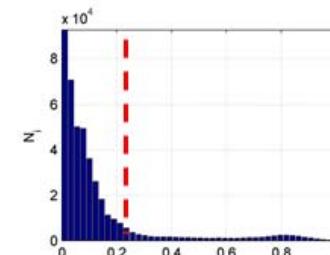
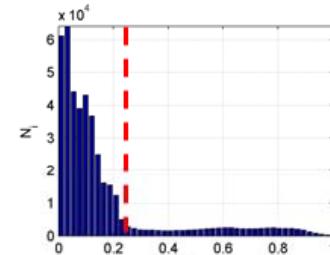
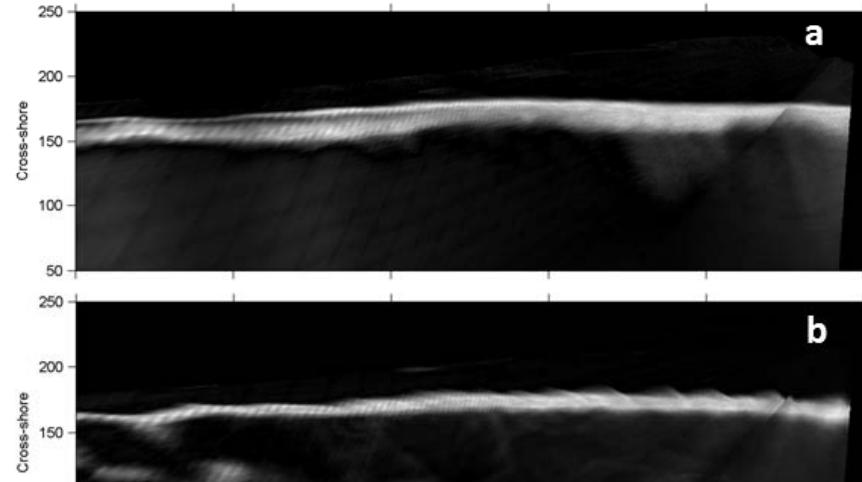




Image evaluation-Inputs



$$n(I) = p_1 + p_2 I + p_3 I^2 + \\ g_1 \exp\left(-\left(\frac{I - g_2}{g_3}\right)^2\right) + \\ k_1 \exp\left(-\left(\frac{I - k_2}{k_3}\right)^2\right)$$

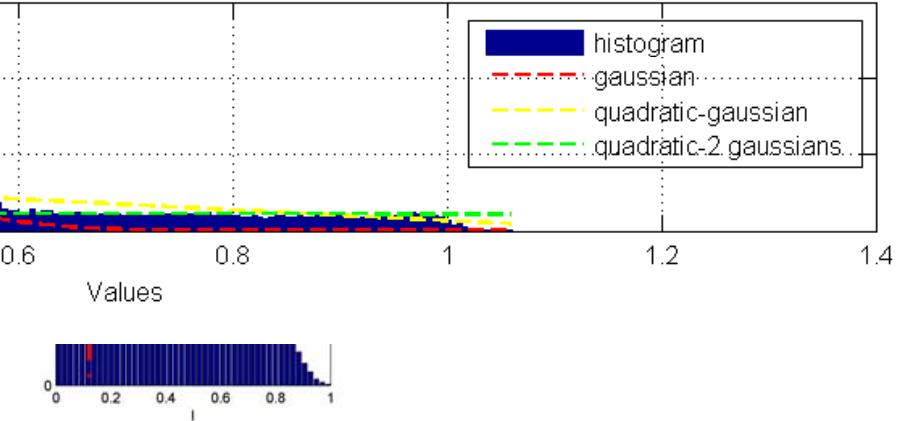
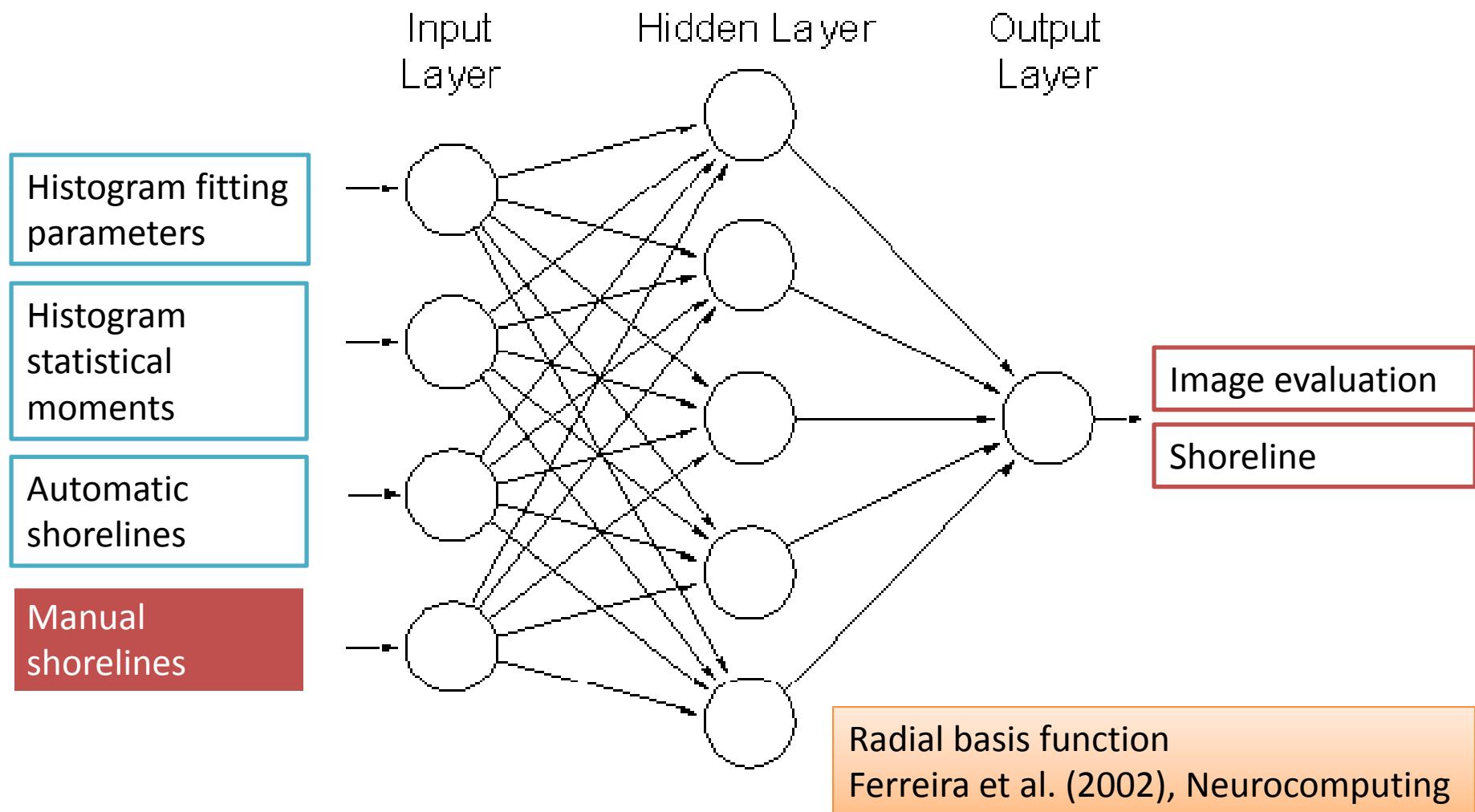


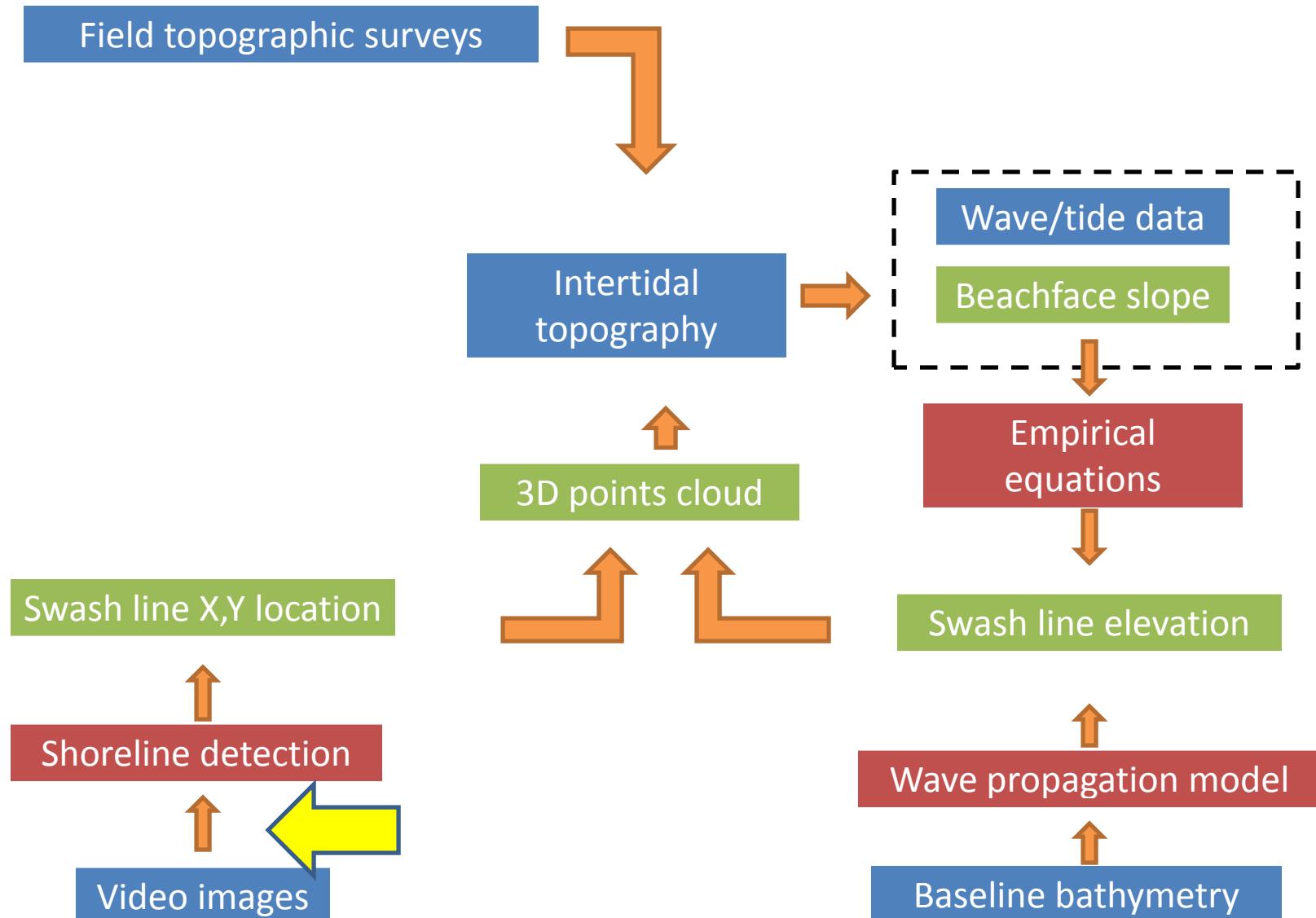


Image evaluation





A flow diagram





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Shoreline detection performance

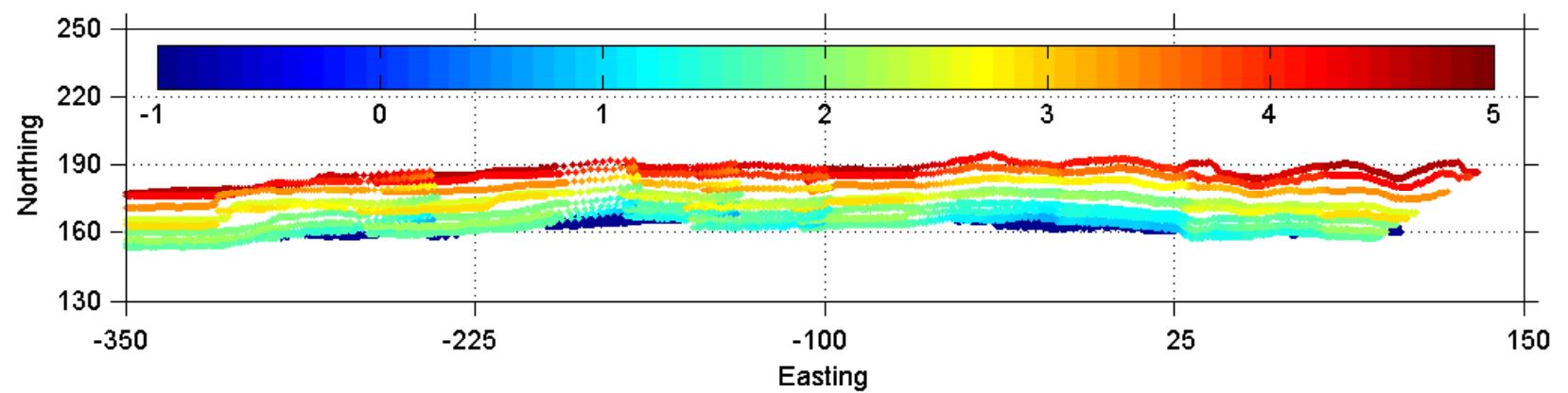
Threshold definition	System topology	All images		Images before 5:00 pm	
		Data return rate	Average RMSE (m)	Data return rate	Average RMSE (m)
Otsu (1979)	-	42%	1.9	65%	1.35
ANN ₁	[10 40 1]	63%	1.67	81%	1.08
ANN ₂	[10 50 1]	65%	1.65	83%	1.06



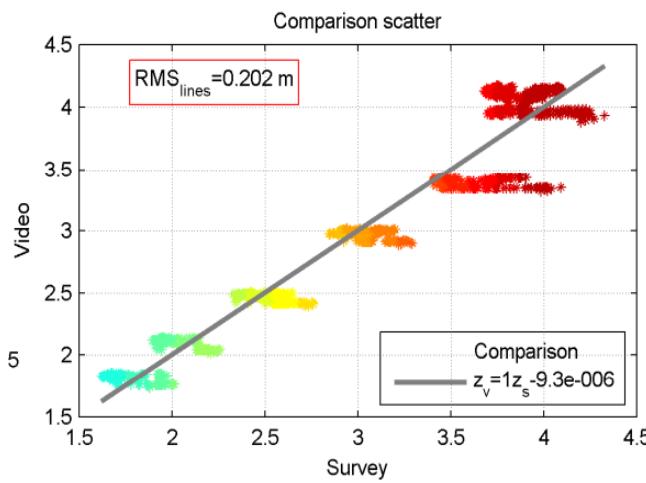
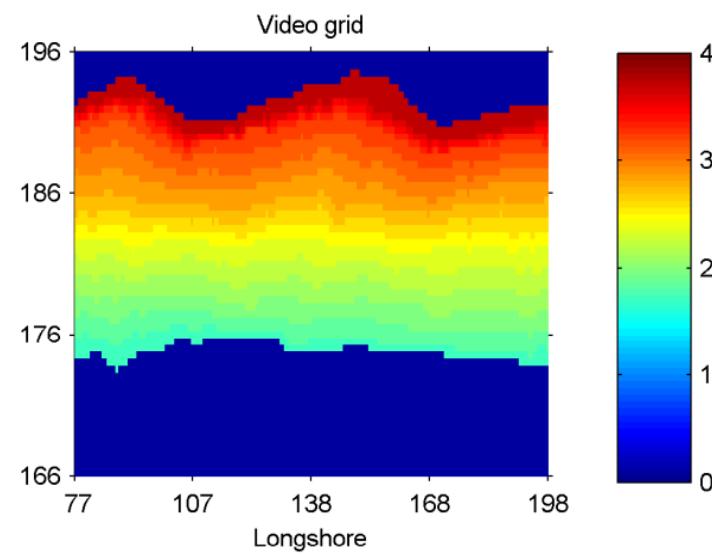
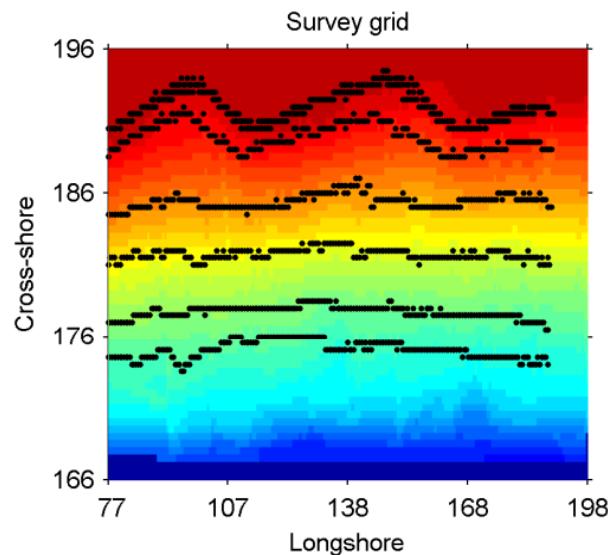
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MORPHOLOGICAL IMPACTS AND COASTAL RISKS INDUCED BY EXTREME STORM EVENTS

The role of hydrodynamic parameters



INTERTIDAL TOPOGRAPHY

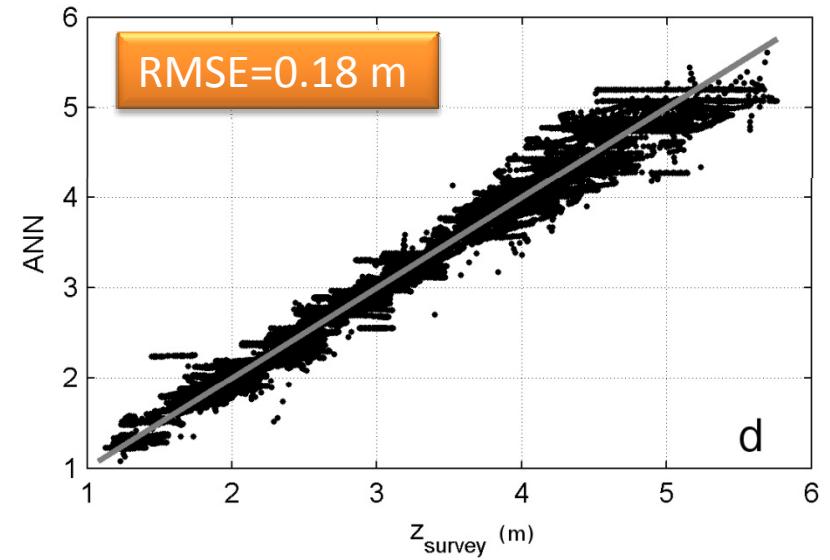
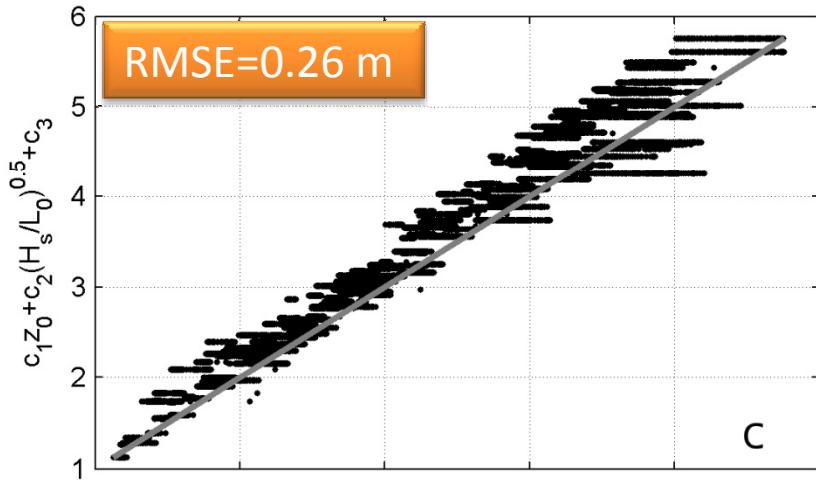
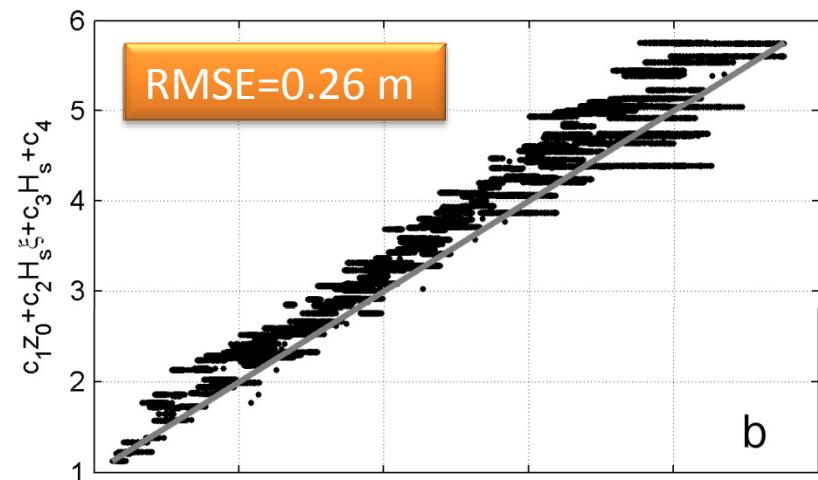
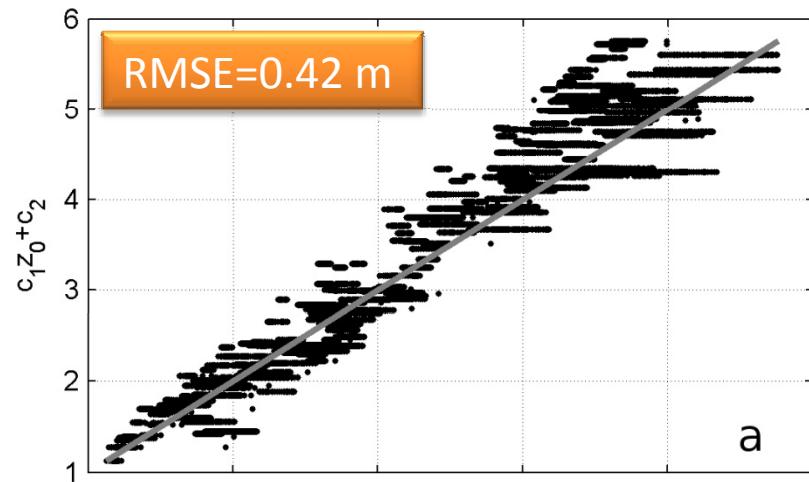


- Empirical equations were estimated
- 40 surveys (2/2009-6/2010)
- ~300 shorelines
- ~20000 points



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Leveling the optical traces





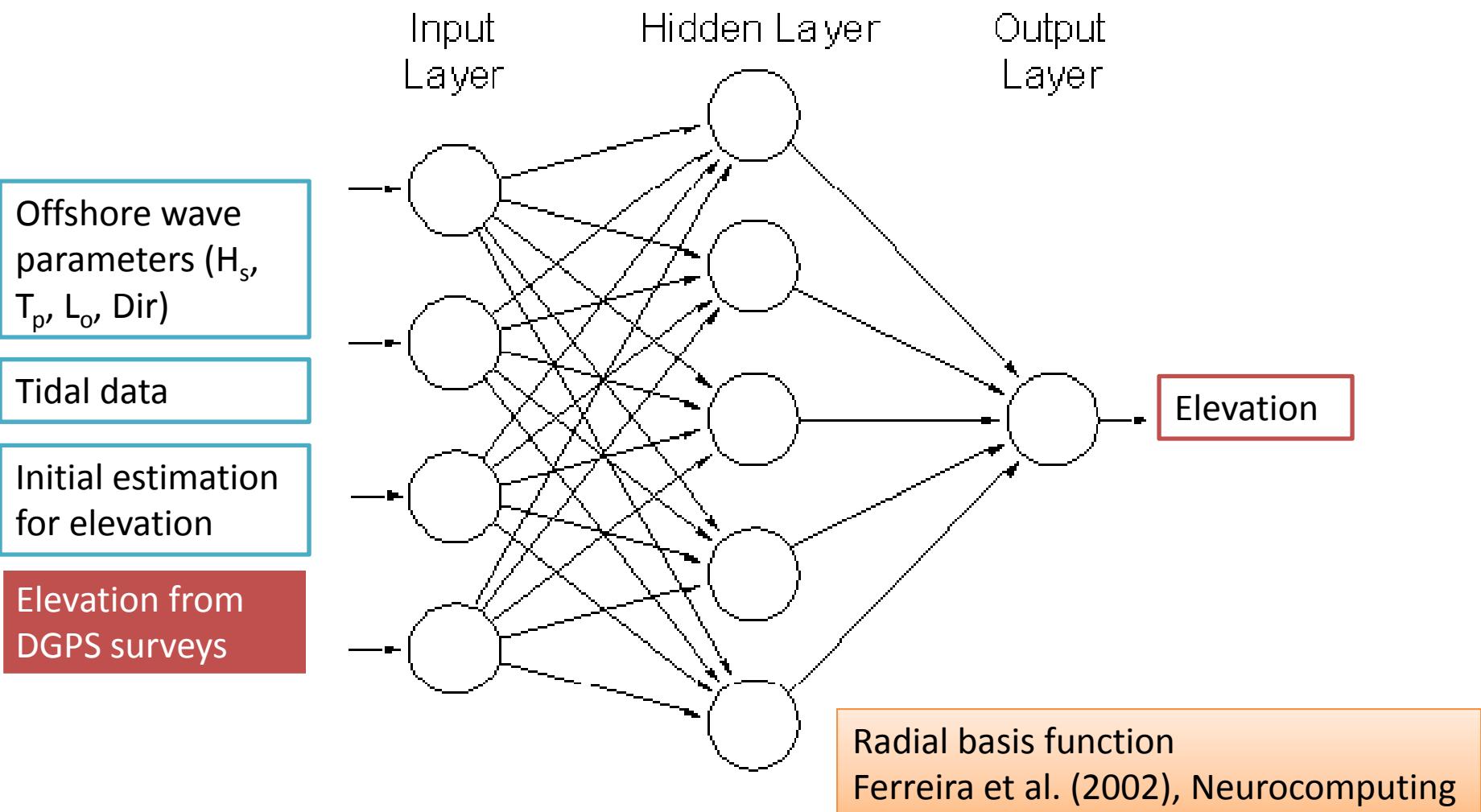
Shoreline elevation

Parameter	Fit-1-RMSE (m)				Fit-2-RMSE (m)			
	$\theta_s=f(x)$		$\tan(\theta_s)=10.3\%$		$\theta_s=f(x)$		$\tan(\theta_s)=10.3\%$	
	0.43	0.42	0.41	0.40	0.30	0.30	0.30	0.30
P1 $Z_{srl}=C_1Z_o+C_2$								
P2 $Z_{srl}=C_1Z_o+C_2H_o\xi+C_3$	0.28	0.26	0.28	0.26	0.30	0.30	0.30	0.30
P3 $Z_{srl}=C_1Z_o+C_2H_o\xi+C_3H_o+C_4$	0.26	0.26	0.26	0.26	0.31	0.31	0.30	0.30
P4 $Z_{srl}=C_1Z_o+C_2(\beta H_o L_o)^{0.5}+C_3$	0.28	0.26	0.28	0.26	0.30	0.30	0.30	0.30
P5 $Z_{srl}=C_1Z_o+C_2H_o(H_o/L_o)^{-0.5}+C_3$	0.27	0.27	0.27	0.27	0.30	0.30	0.30	0.30
P6 $Z_{srl}=C_1Z_o+C_2(H_o L_o)^{0.5}+C_3$	0.27	0.27	0.27	0.27	0.30	0.30	0.30	0.30
P7 $Z_{srl}=C_1Z_o+C_2\beta H_o+C_3$	0.27	0.27	0.27	0.27	0.30	0.30	0.30	0.30
P8 $Z_{srl}=C_1Z_o+C_2(H_o/L_o)^{0.5}+C_3$	0.35	0.33	0.35	0.33	0.31	0.31	0.31	0.31
P9 $Z_{srl}=C_1Z_o+C_2\beta(H_o/L_o)^{0.5}+C_3\beta(H_o L_o)^{0.5}+C_4$	0.33	0.30	0.33	0.30	0.30	0.30	0.30	0.30
P10 Fit-ANN	0.19	0.18	0.19	0.18				



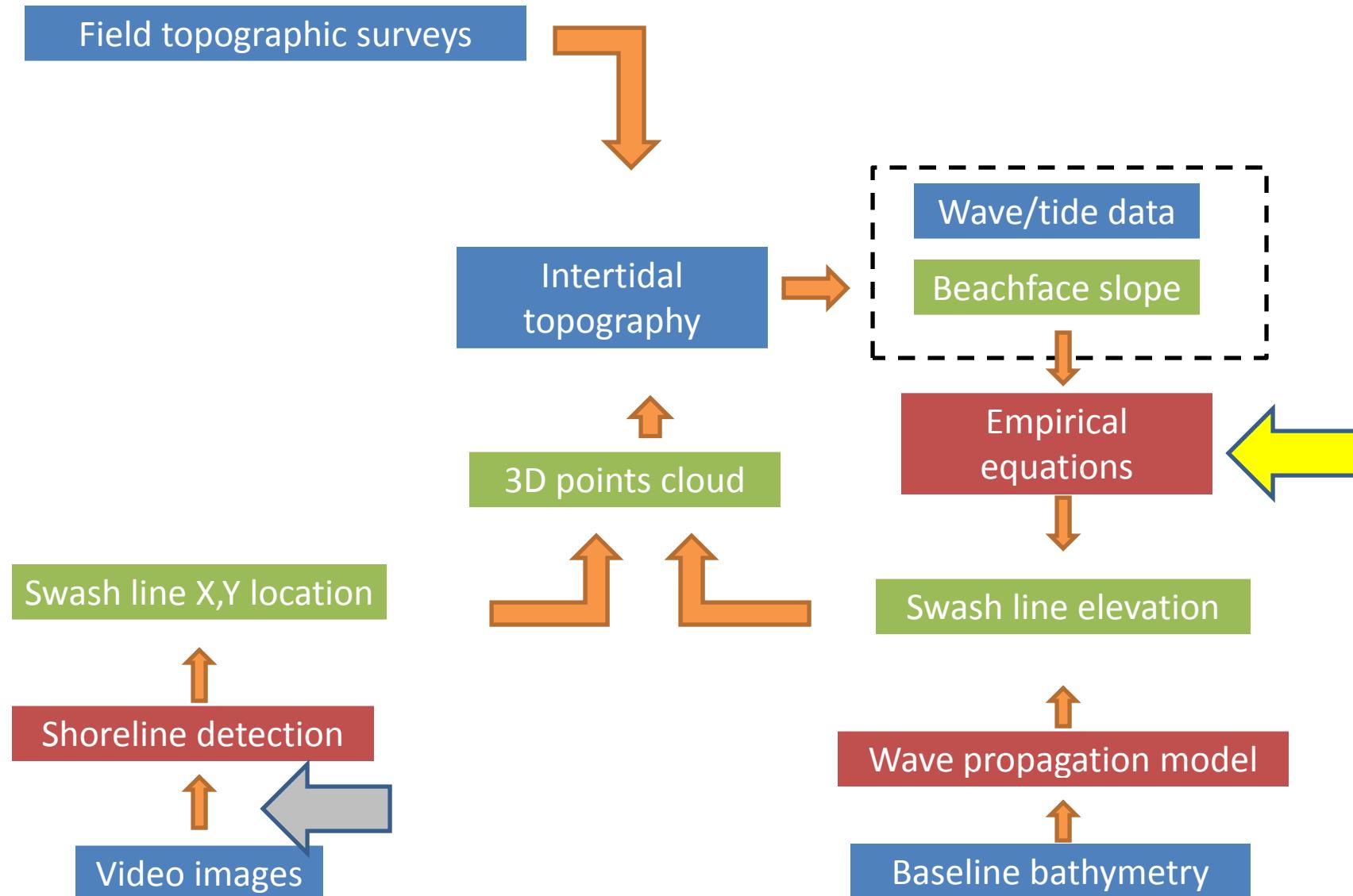
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Shoreline contour elevation





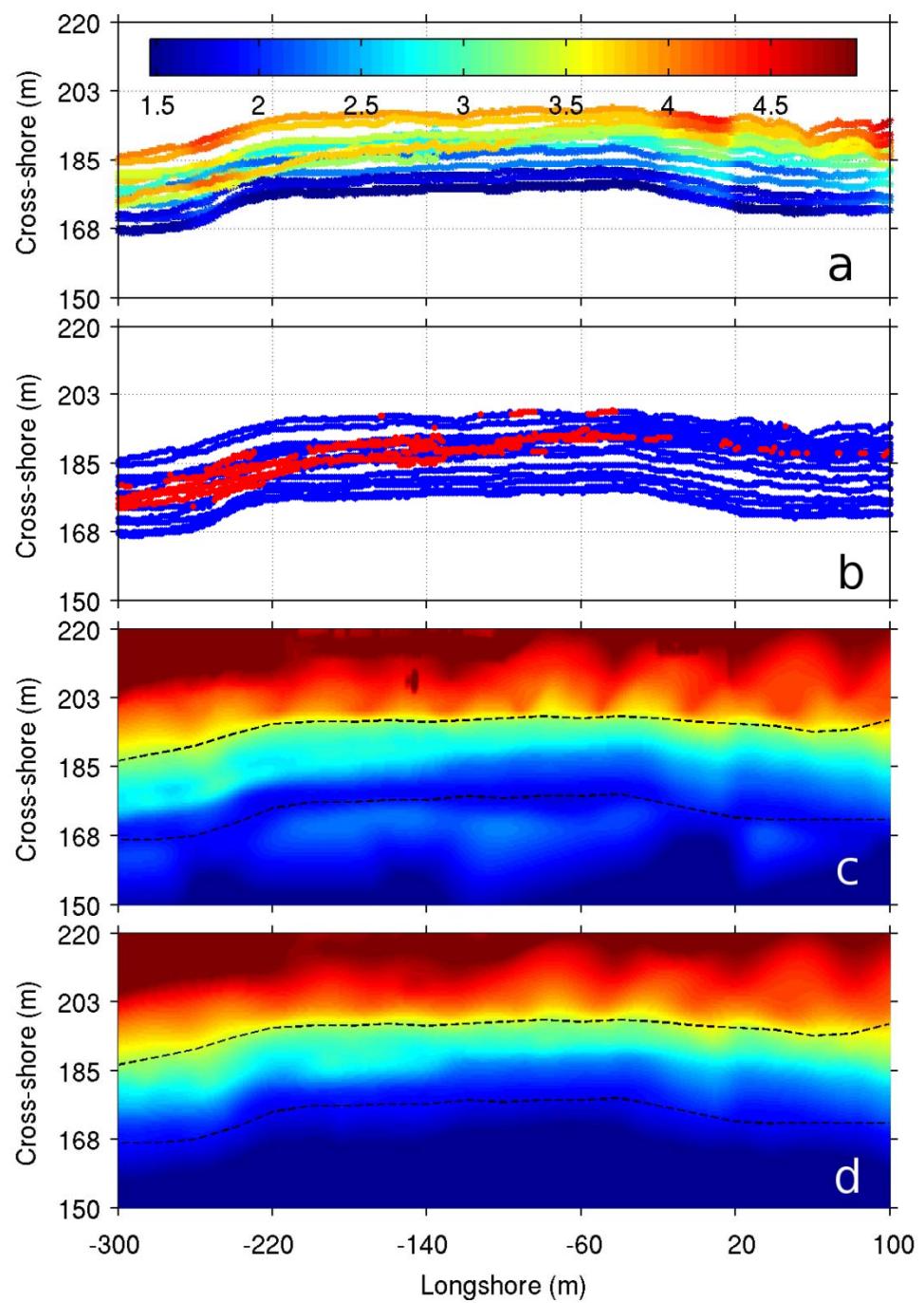
A flow diagram





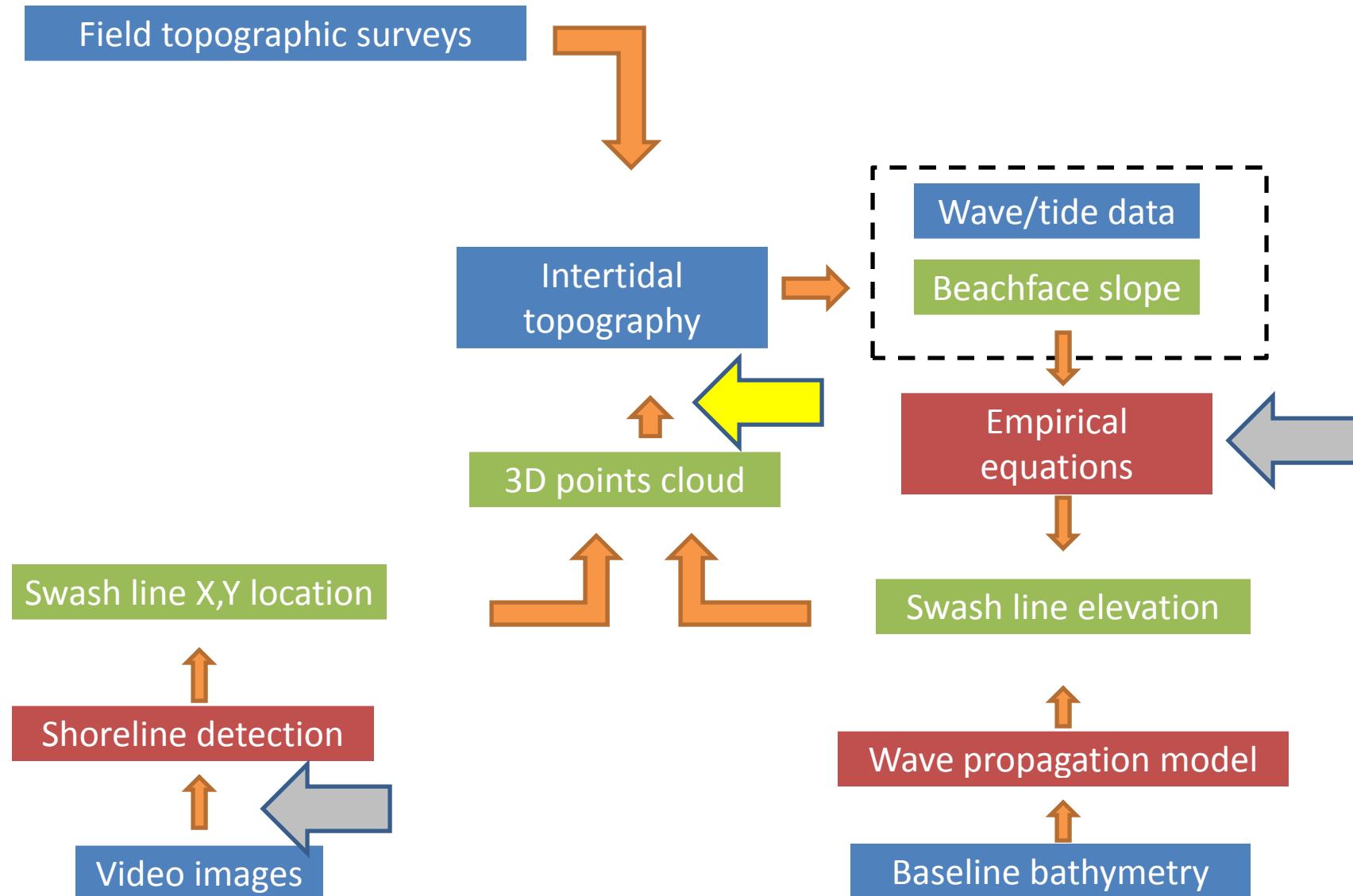
3D data filtering

- Iterative point filtering
- Space scale interpolation
- Baseline grid based on a wider time window (3 days)





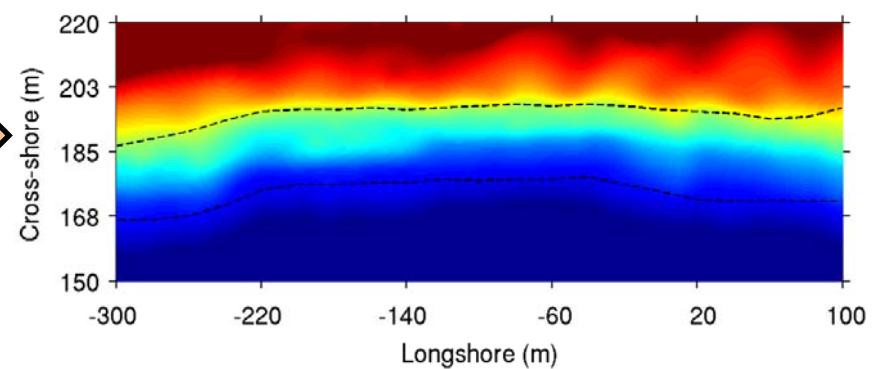
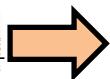
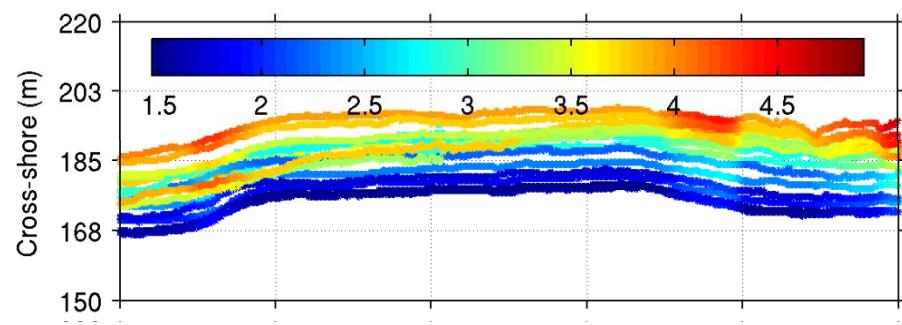
A flow diagram





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MORPHOLOGICAL IMPACTS AND COASTAL RISKS INDUCED BY EXTREME STORM EVENTS



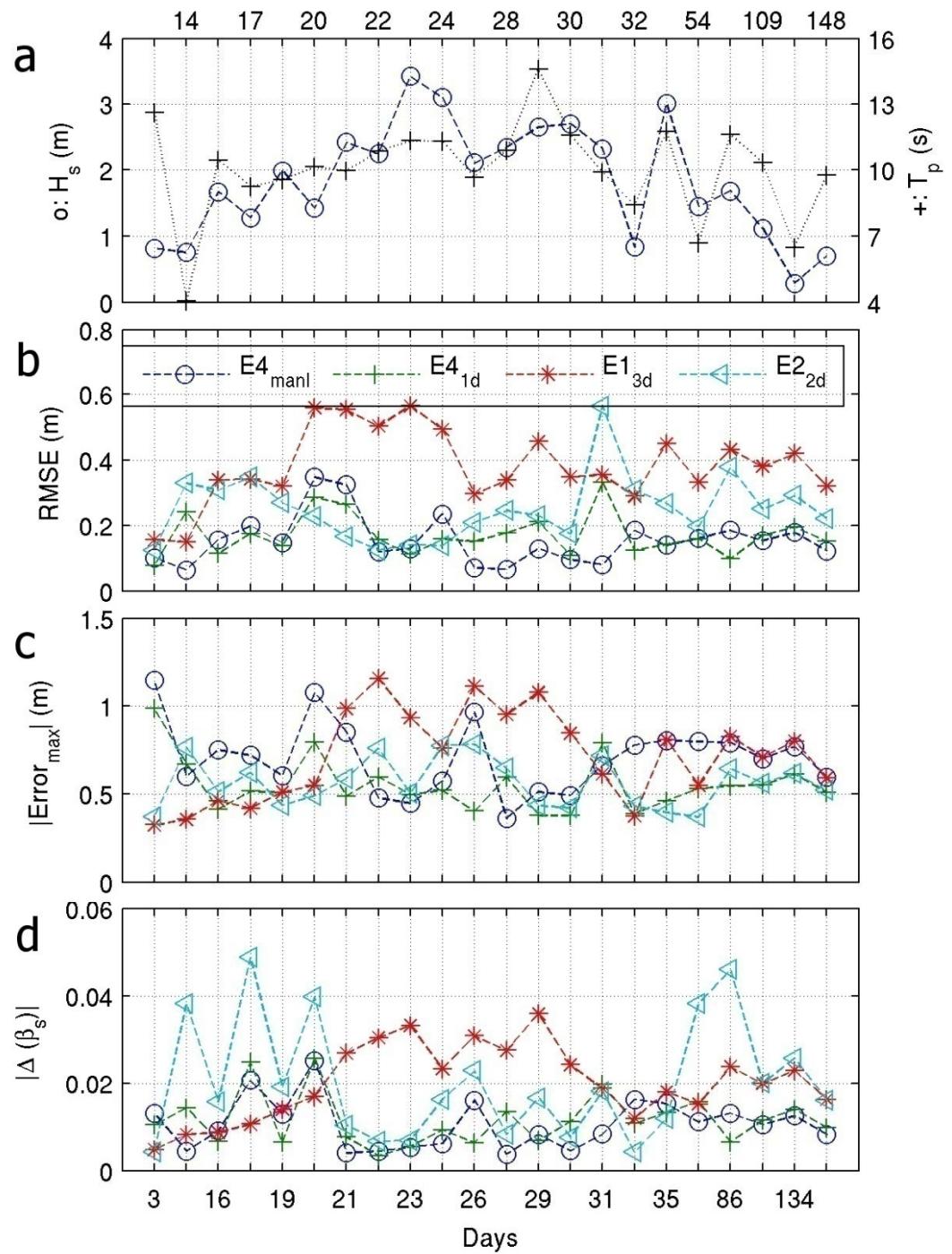
OPERATIONAL PERFORMANCE

- Unsupervised operation
- From 11/2009 till 5-2010
- 30 topographic surveys



Unsupervised operation
from 11/2009 till 5-2010
30 topographic surveys

$E4_{man}$: ANN, manual shorelines, 1 day
 $E4_{1d}$: ANN, 1 day
 $E1_{3d}$: $z_{srl} = c_1 z_o + c_2$
 $E2_{2d}$: $z_{srl} = c_1 z_o + c_2 H_o \xi + c_3 H_o + c_4$





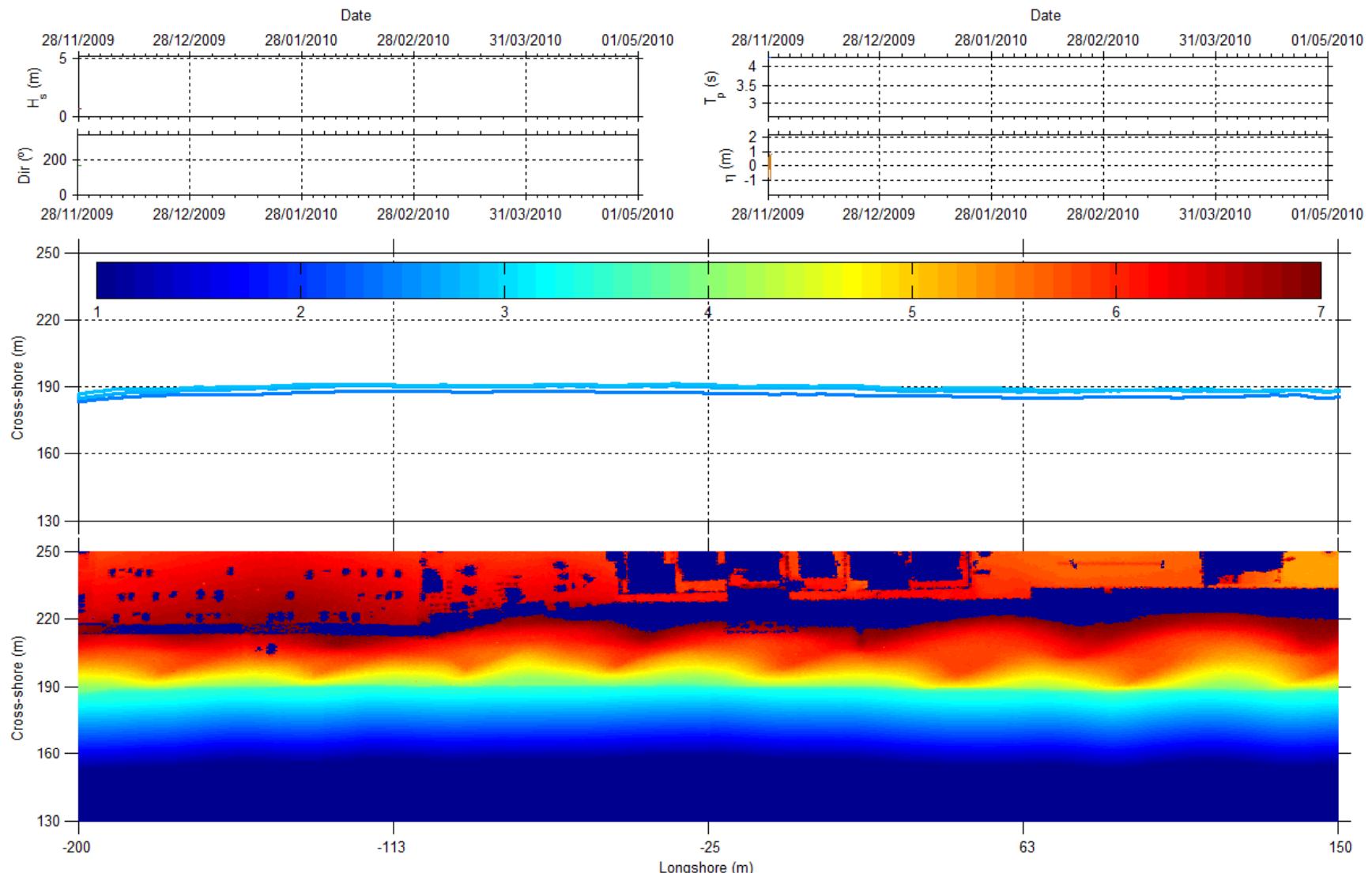
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Summary-Conclusions

- Automatic shoreline extraction (DTR~83%, RMSE~1 m)
- Image classification enhanced performance and computational times
- Site specific empirical formulations improved accuracy
- Best overall intertidal topography-RMSE=0.18 m
- Best unsupervised operation-RMSE=0.22 m



THANK YOU VERY MUCH...





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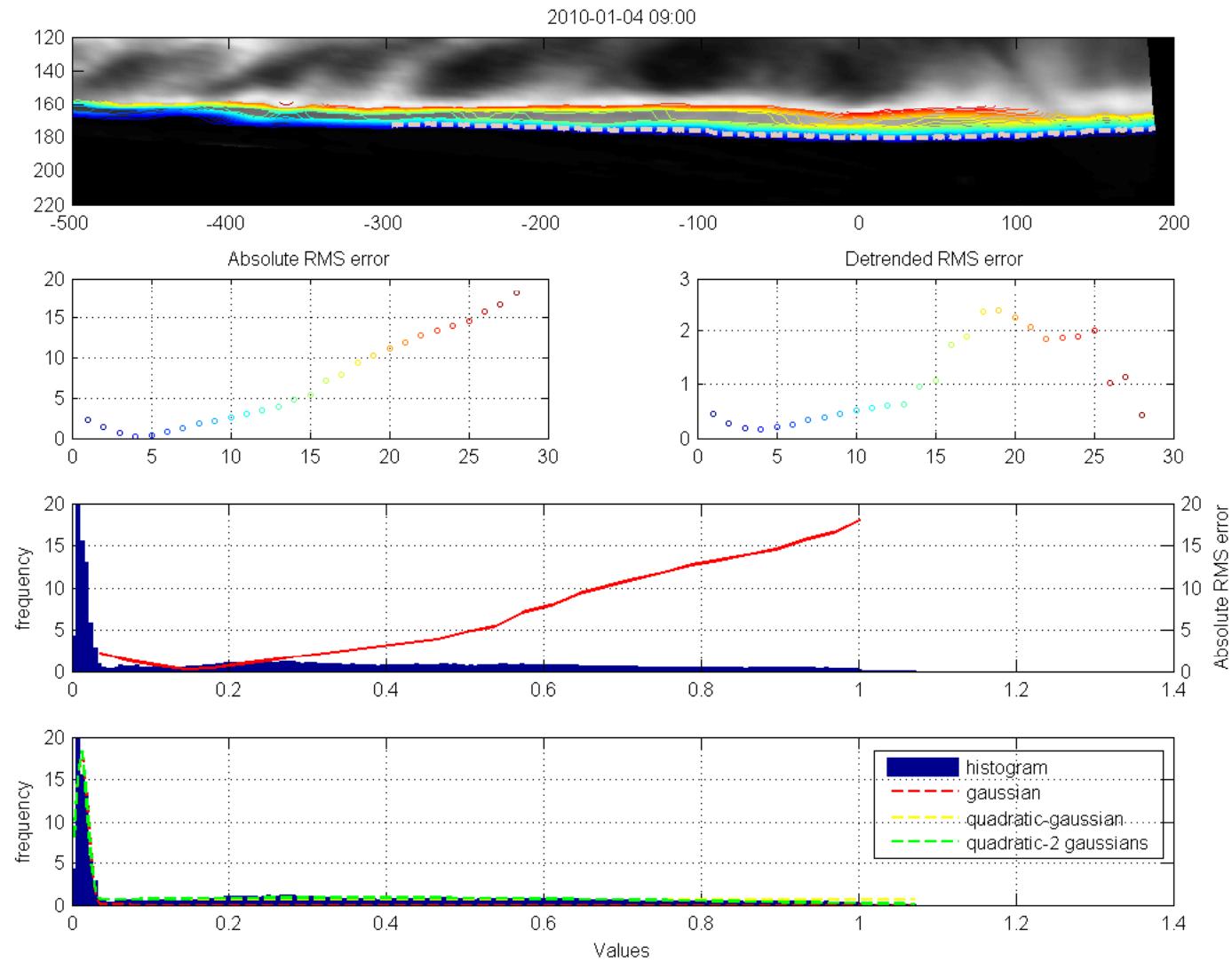
MORPHOLOGICAL IMPACTS AND COASTAL RISKS INDUCED BY EXTREME STORM EVENTS



THANK YOU VERY MUCH...



Automatic threshold definition



$$n(I) = p_1 + p_2 I + p_3 I^2 + \\ g_1 \exp\left(-\left(\frac{I - g_2}{g_3}\right)^2\right) + \\ k_1 \exp\left(-\left(\frac{I - k_2}{k_3}\right)^2\right)$$



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MORPHOLOGICAL IMPACTS AND COASTAL RISKS INDUCED BY EXTREME STORM EVENTS

Non-linear complex systems and the butterfly effect

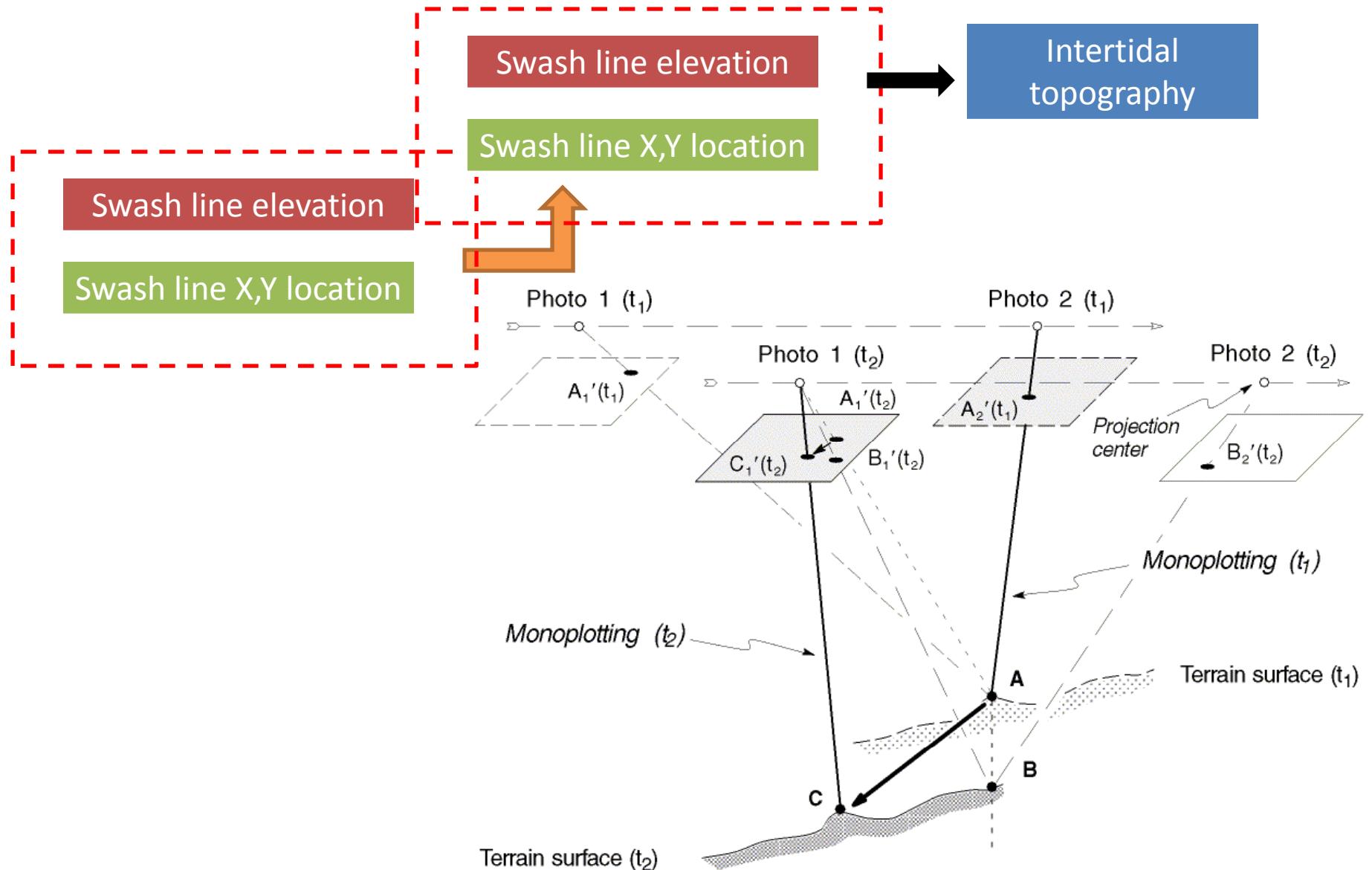


WHAT CAN GO WRONG?



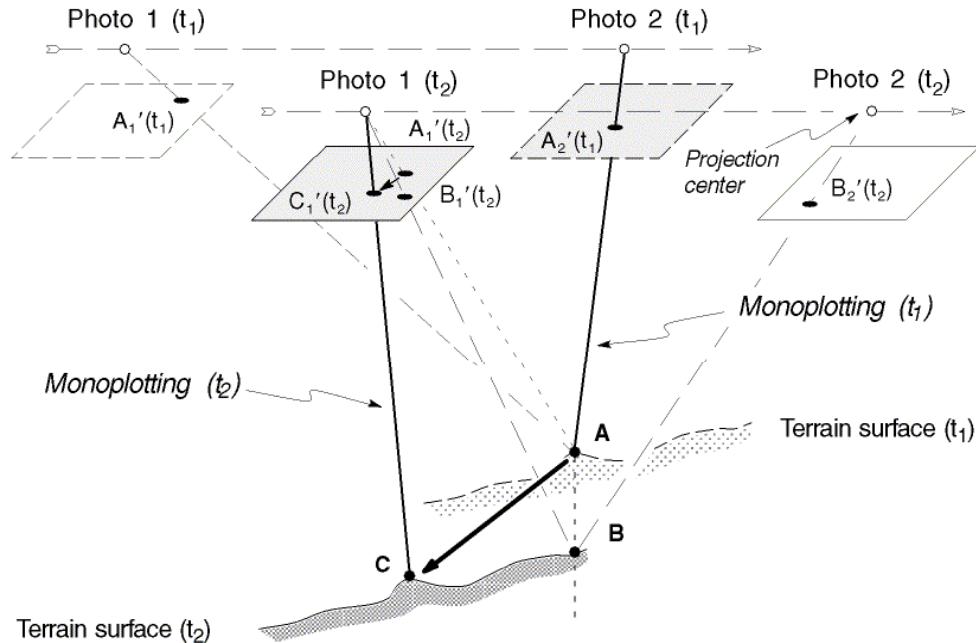
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Object shadowing correction





Shadowing vs fitting



Intertidal topography

Swash line elevation

Swash line X,Y location

New fitting

Intertidal topography

Swash line elevation

Swash line X,Y location

New fitting

A.Käab