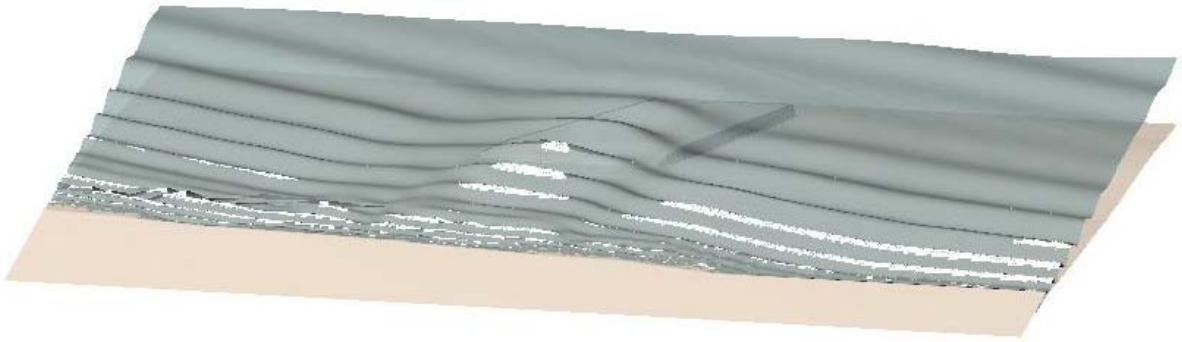
Modelling of Wave Focussing Sand Slug at Cronulla



SurfReefs

Project	Modelling of wave focussing sand slug at Cronulla
Prepared for	Surfing Ramps
Prepared by	SurfReefs Koninginnegracht 108 2514 AL The Hague The Netherlands www.surfreefs.nl info@surfreefs.nl
Period	May – July 2011
Author	H.D. van Ettinger MSc.

Introduction

This August 2011 the navigation channels in Port Hacking will be dredged to maintain safe boating access. Approximately 45,000m3 of dredged sand will be transported via barge to a placement zone located 250m offshore the Prince Street Seawall at Cronulla Beach. Previous dredging/placement works in 2003 and 2007 created sand banks that influenced wave breaking patterns for up to six months. Local surfers sought a better outcome.

The 2011 dredging/placement works will trial an innovative sand placement configuration, as similar projects have been successful in the USA and The Netherlands. The Cronulla trial will add no financial cost to the project, yet will provide additional benefits for the local surfing community. The dredged sand will be strategically released within a placement zone/template, located 250 to 400m offshore the Prince Street seawall, in waters -4m to -8m deep. The resulting sand-only feature will be a submerged, elongated mound, a ridge-like sand bar that is transverse to the shoreline. It will be a temporary wave focusing sand slug, with an indirect influence on wave breaking patterns. Providing **improved surfing** opportunities inshore of the sand feature, by inducing wave 'peaks' with longer length of surfing ride, rather than wave 'close outs', there will be no surfing directly over the sand feature, with head high and smaller waves.

SurfReefs performed computer modelling in order to verify and optimize the design of the sand slug. In the following the results are showed.

Computer modelling

Whether a wave is surfable or not depends on the surfability parameters: wave height, wave shape (i.e. barrelling or crumbling) and the peel angle. The peel angle is a measure related to the rate at which the wave breaks along its crest. For surfable waves the peel angle need to be sufficiently large. When the peel angles is too small, the waves close out. Table and Figure 1 show what the necessary peel angle α has to be for a given wave height *H* and surfer skill.

Table 1

Rating of the skill level of surfers (Hutt *et al.* , 2001).

Rating	Description of Rating	α $[deg]$	H $[m]$
1	Beginner surfers not yet able to ride the face of a wave and simply moves forward as the wave advances	0	$0.70 - 1.00$
2	Learner surfers able to successfully ride laterally along the crest of a wave.	70	$0.65 - 1.50$
3	Surfers that have developed the skill to generate speed by 'pumping' on the face of the wave.	60	$0.60 - 2.50$
4	Surfers beginning to initiate and execute standard surfing manoeuvres on occasion	55	$0.55 - 4.00$
5	Surfers able to execute standard manoeuvres consecutively on a single wave.	50	$0.50 +$
6	Surfers able to execute standard manoeuvres consecutively. Executes advanced manoeuvres on occasion.	40	$0.45 +$
7	Top amateur surfers able to consecutively execute advanced manoeuvres.	29	$0.40 +$
8	Professional surfers able to consecutively execute advanced manoeuvres.	27	$0.35 +$

Hutt, J.A., Black, K.P., & Mead, S.T. 2001. Classification of Surf Breaks in Relation to Surfing Skill. *Journal of Coastal Research*, 66–81. Special Issue.

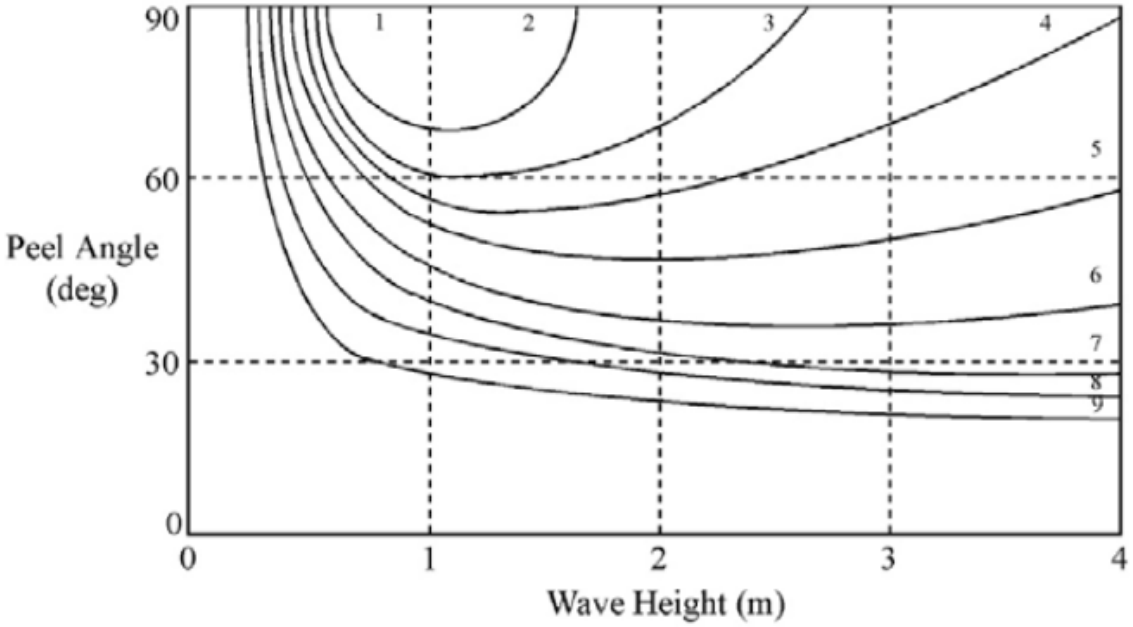


Figure 1: Peel angle as a function of wave height and surfer skill. The peel angle is on the *y*-axis, the wave height on the *x*-axes and the surfer skill is indicated by numbers in the graph.

The sand slug is modelled with a deep water wave height of 1.5m, a wave period of 10s and a SE wave direction, representing typical conditions for Cronulla. The surf rides and their wave heights and peel angles are determined with a numerical refraction diffraction computer model. The wave shape of the breaking waves is determined with a Smoothed Particle Hydrodynamics (SPH) computer model. The computer modelling showed that 4 different wave rides are developing. An A-frame centre peak shoreward of the sand slug and a smaller left and right, Southward and Northward of the centre peal. The modelling results are presented in the figure 2 until 5, showing wave rides and their wave heights, peel angles and wave shapes.

Centre peak left

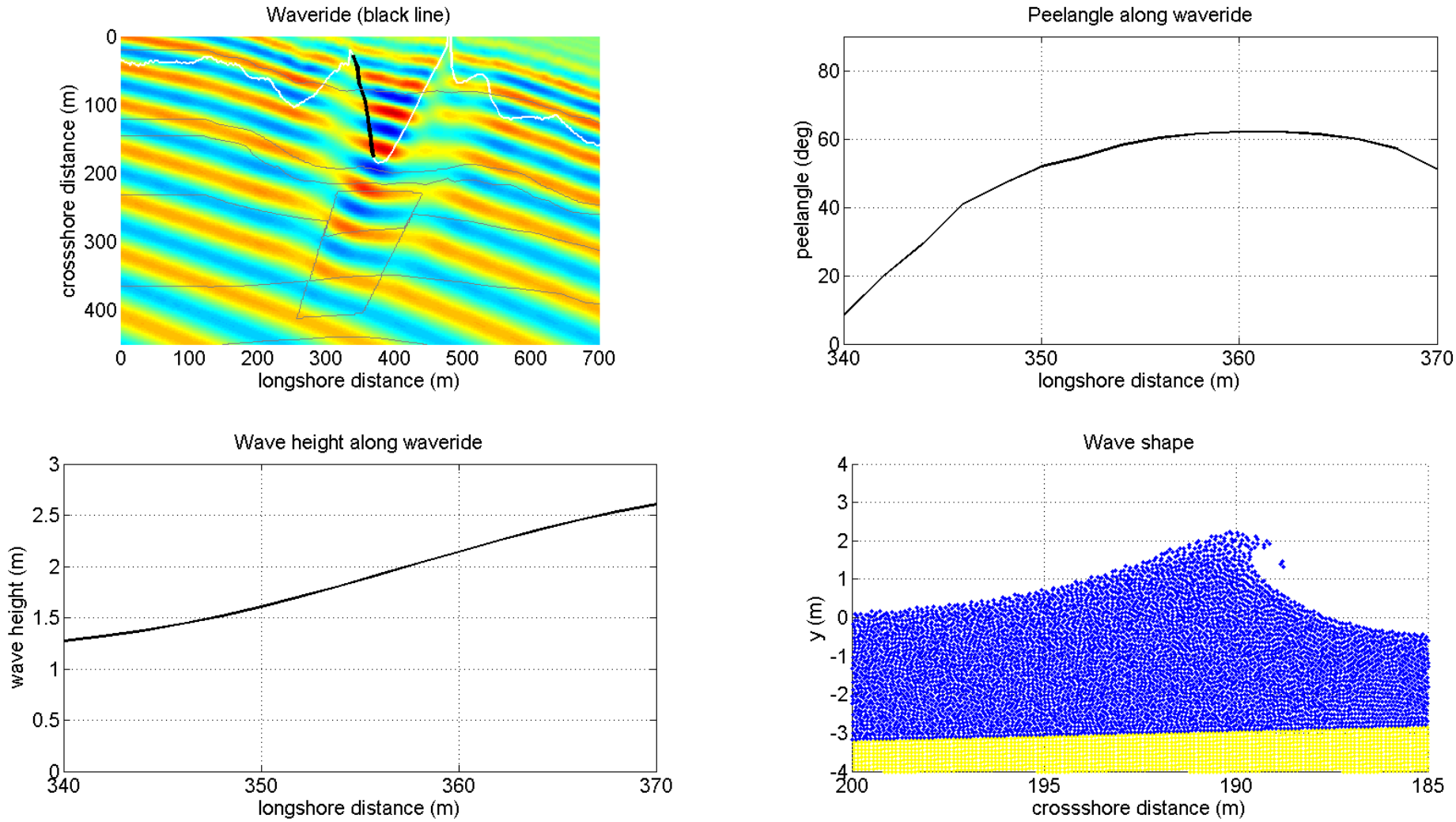


Figure 2: Modelling results for Centre peak left. *Upper left panel*, Waves travelling over sand slug, white line depicts the breaker line and the black line the wave ride. Grey lines depict depth contours and colours depict wave crests (red) and wave troughs (blue). *Upper right panel*, peel angle along wave ride. *Lower left panel*, wave height along wave ride. *Lower right panel*, wave shape at take off.

Centre peak right

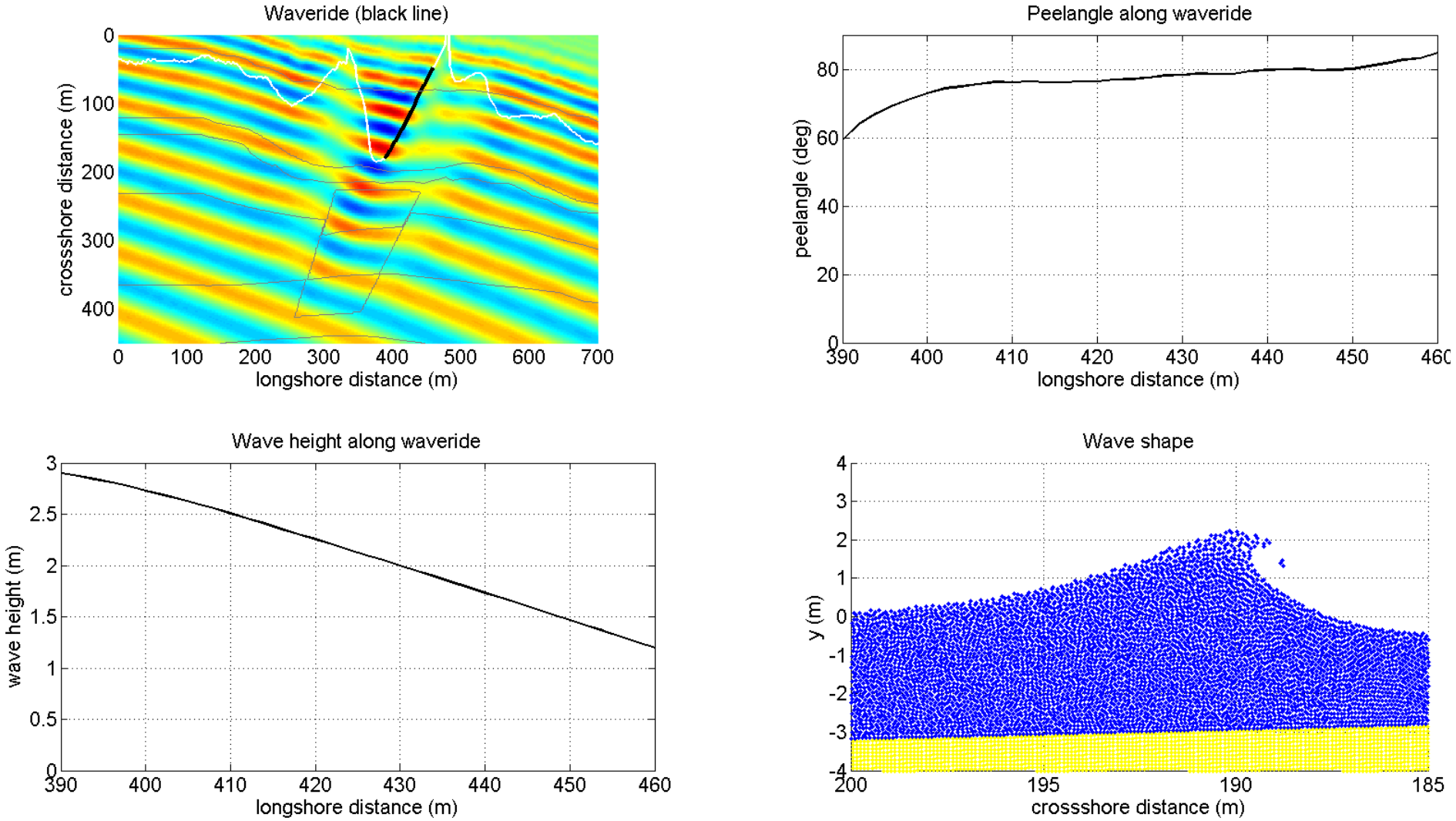


Figure 3: Modelling results for Centre peak right. *Upper left panel*, Waves travelling over sand slug, white line depicts the breaker line and the black line the wave ride. Grey lines depict depth contours and colours depict wave crests (red) and wave troughs (blue). *Upper right panel*, peel angle along wave ride. *Lower left panel*, wave height along wave ride. *Lower right panel*, wave shape at take off.

Northern peak

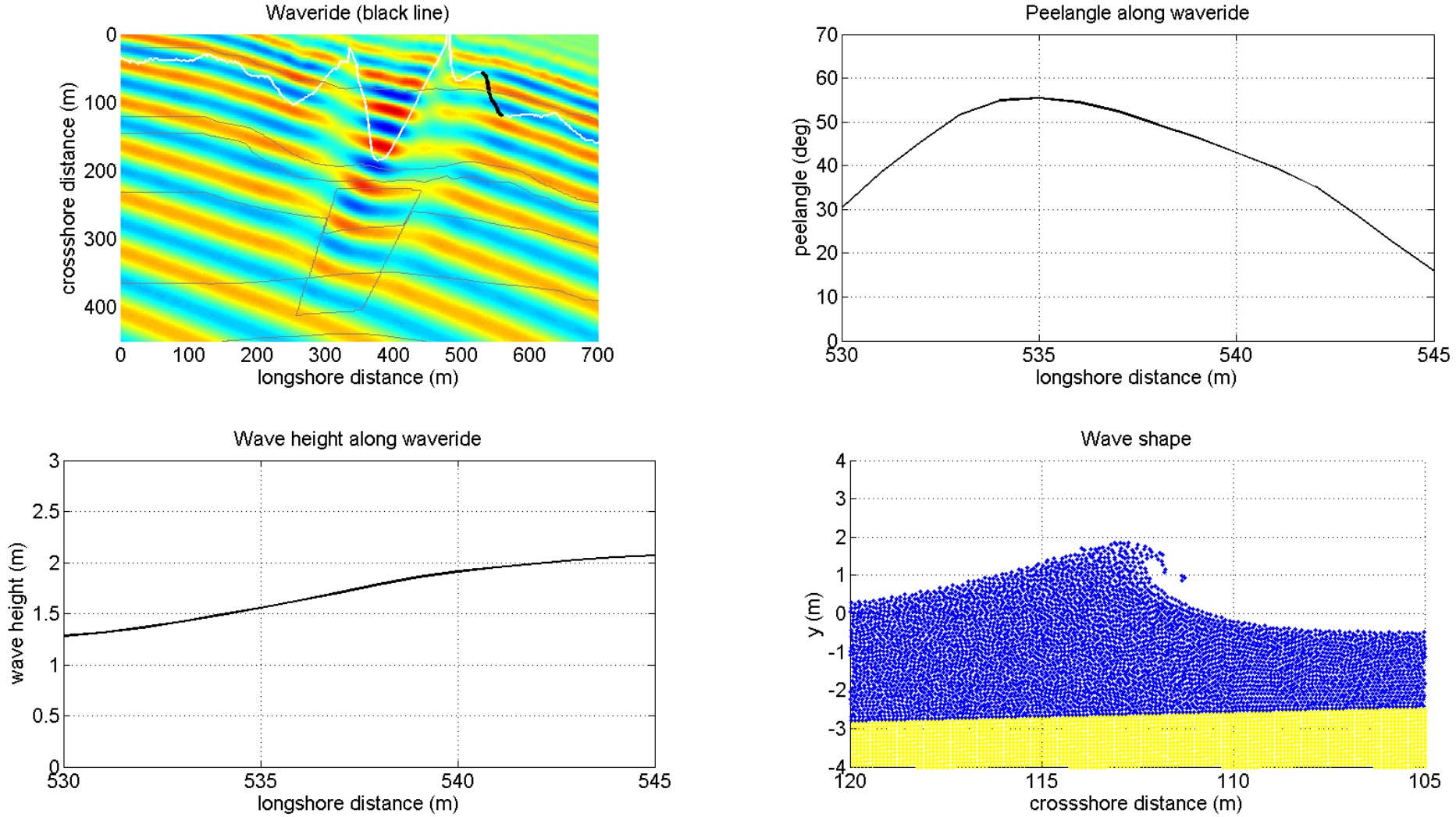


Figure 4: Modelling results for Northern peak. *Upper left panel*, Waves travelling over sand slug, white line depicts the breaker line and the black line the wave ride. Grey lines depict depth contours and colours depict wave crests (red) and wave troughs (blue). *Upper right panel*, peel angle along wave ride. *Lower left panel*, wave height along wave ride. *Lower right panel*, wave shape at take off.

Southern peak

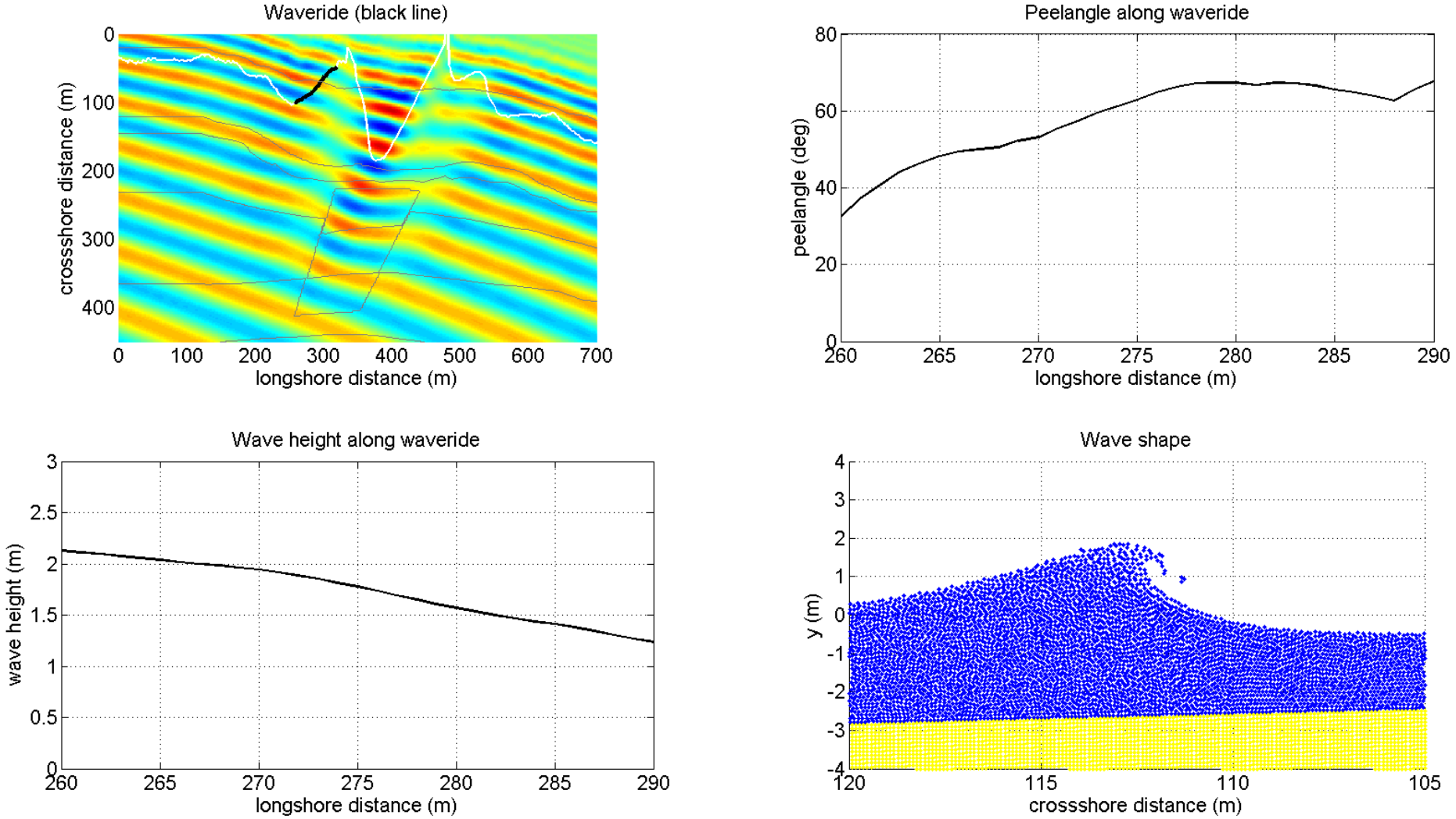


Figure 5: Modelling results for Southern peak. *Upper left panel*, Waves travelling over sand slug, white line depicts the breaker line and the black line the wave ride. Grey lines depict depth contours and colours depict wave crests (red) and wave troughs (blue). *Upper right panel*, peel angle along wave ride. *Lower left panel*, wave height along wave ride. *Lower right panel*, wave shape at take off.

Conclusions and recommendations

The modelling results show that different surfable wave rides are developing due to the construction of the sand slug. Whereas without sand slug the waves tend to close out. The initial peel angles are some what high (beginner waves), but as the sand slug will fade out due to morphological processes, the peel angles will increase over time resulting in faster wave rides (higher peel angles).

More research is needed to find an optimum for the sand slug design with respect to surfability parameters, the performance on different swells (wave periods, heights and directions) and lifespan of the sand slug.