FURTHER EXPERIMENTAL WASH WAVE MEASUREMENTS FOR HIGH SPEED DISPLACEMENT CATAMARAN FORMS IN SHALLOW WATER.

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CONTENTS

NOMENCLATURE

Fn or Fn_L	Froude Number, $\left[U/\sqrt{gL}\right]$
Fn_H	Depth Froude Number $\left[U/\sqrt{gH}\right]$
Rn	Reynolds Number, $\left[UL/\nu\right]$
U	Velocity [m s^{-1}]
W	Tank width [m]
H	Water depth [m]
L	Length on waterline[m]
A	Static wetted surface area [m^2]
B	Demihull maximum beam [m]
T	Demihull draught [m]
S	Separation between catamaran demihull centrelines [m]
∇	Volume of displacement [m^3]
Δ	Mass displacement in freshwater [kg]
C_B	Block coefficient
C_P	Prismatic coefficient
$L/\nabla^{1/3}$	Length : displacement ratio
R_T	Total resistance [N]
C_T	Coefficient of total resistance, $\left[R_T/\tfrac{1}{2}\rho AU^2\right]$
R_W	Wave resistance [N]
C_W	Coefficient of wave resistance, $\left[R_W/\tfrac{1}{2}\rho AU^2\right]$
R_{WP}	Wave pattern resistance [N]
C_{WP}	Coefficient of wave pattern resistance, $\left[R_{WP}/\tfrac{1}{2}\rho AU^2\right]$
C_F	Coefficient of frictional resistance, [ITTC-57 Correlation line]
C_R	Coefficient of residuary resistance
R	Resistance in general [N]
g	Acceleration due to gravity [9.80665 m s^{-2}]
ρ	Density of freshwater [1000 kg m^{-3}]
ν	Kinematic viscosity of freshwater [1.141×10^{-6} m^2 s^{-1} at 15°C]
t_v	Dynamic trim angle [°]
z_v	Dynamic sinkage (+ve downwards) [%T]

1 INTRODUCTION

Work on the resistance of high speed displacement catamarans has been ongoing over a number of years at the University of Southampton [1-4] in an effort to improve the understanding of their resistance components, seakeeping performance and to provide design and validation data.

This report describes a series of experiments carried out on a number of vessels in shallow water. The models were selected to investigate operational and design characteristics which might influence the wash waves. They form an extension to the systematic wash measurements reported in [5].

The models included a series of cylindrical bulbous bows, simulated blisters on the hull and trim changes. In addition to these a series of tests were carried out to investigate the influence of different propulsion devices on the wash waves, using guided self-propelled models fitted with propellers or waterjets.

The tests were carried out over a speed range of 1 m s^{-1} to 4 m s^{-1}. This corresponds to a length Froude Number Fn_L=0.25 to 1.0. All the towed models were tested at a water depth of 400mm (Fn_H=0.5 to 2.0). The self-propelled models were tested at water depths of 400mm and 200mm (Fn_H=0.71 to 2.9).

The work described forms part of a wider research programme, funded by EPSRC and industry and managed by Marinetech South Ltd over a two year period, which includes the development of theoretical methods for the prediction of the wash and wave resistance of catamarans. The theoretical work is the subject of a separate report [6].

2 DESCRIPTION OF MODELS

Details of the models used in this investigation are given in Table 1.

The models were constructed using an epoxy-foam sandwich skin. Models 5b and 5s are 1.6m in length.

It should be noted that Models 4b, 5b, 6b and 5s had already been used for calm water resistance tests and their results published in [7]. Some of the results for these models are used in the present report for comparison and discussion.

The models were of round bilge form with transom sterns, their bodyplans are presented in Figures 1a and 1b, and were derived from the NPL round bilge series [8] and the Series 64 round bilge series [9]. These hulls broadly represent the underwater form of a number of catamarans in service or currently under construction. The profiles of the series of four bulbs are presented in Figure 1c. The simulated blisters were approximately 100mm long and about 20mm thick and were situated at midships or just aft of the bow.

2.1 Towed models

The model towing force was in the horizontal direction. The towing point in all cases was situated at the longitudinal centre of gravity gravity and at a height of 1.5 times the draught above the baseline. No compensation was made for the vertical separation of the tow point and the propeller thrust line. The tow fitting allowed free movement in sinkage and trim whilst movements in surge, sway, roll and yaw were restrained. The models were fitted with turbulence stimulation comprising trip studs of 3.2mm diameter and 2.5mm height at a spacing of 25mm. The studs were situated 37.5mm aft of the stem. No underwater appendages were attached to the models. The weight of the towpost was 2.045 Kg.

2.2 Self propelled models

The model was tested as a catamaran in three configurations, narrow spacing with a separation to length ratio S/L=0.2, intermediate spacing S/L=0.3 and wide spacing S/L=0.4. The models were self-propelled by either two propellers or by four waterjets. The model ran in a set of guides attached to the carriage to maintain a straight course down the length of the tank. Details of the motors, waterjets and propellers are given in Appendix A.

3 FACILITIES AND TESTS

3.1 General

The model experiments were carried out in the GKN test tank on the Isle of Wight, which has the following principal particulars:

Length	:	200m
Breadth	:	4.6m
Tank Depth	:	1.7m
Maximum carriage speed:		$14 m\ s^{-1}$

In the current tests, water depths of 400mm and 200mm were used.

3.2 Wave pattern measurements

Extensive wave profile measurements were carried out to establish a wide database of wave characteristics in shallow water, which would be suitable for design and validation purposes. Such an extensive set of wave data would also facilitate the description of the near field wave pattern in three dimensions from the experimental results and facilitate the interpolation of the experimental data at various transverse positions.

The wave profiles were measured using resistance type wave probes coupled to wave probe monitors. The data were acquired and stored using laptop computers situated at the side of the tank adjacent to the main array of wave probes. The signals were acquired at a sampling rate of 100Hz. The acquisition program allowed a run time of up to 40 seconds to be used.

Three arrays of wave probes were used at three positions down the length of the tank. The main array of eight 300mm long wave probes was positioned approximately 62.5m down the tank from the model start position. The wave probes had transverse positions from the centreline of the tank relative to the model length of the following values Y/L=0.43, 0.55, 0.68, 0.80, 0.93, 1.03, 1.19 and 1.32.

Two arrays of four 600mm long wave probes were positioned either side of the main array. The first array was positioned approximately 41m from the models start position, the second array was positioned approximately 87m from the model start position. The wave probes had transverse positions relative to the model length of the following values Y/L=0.89, 1.02, 1.14 and 1.27.

3.3 Towed tests

The manned carriage is equipped with a dynamometer for measuring model total resistance together with various computer and instrumentation facilities for automated data acquisition. For these shallow water tests a Wolfson Unit MTIA dynamometer was used which was attached to an aluminium alloy frame situated under the main carriage.

Calm water total resistance, running trim, sinkage and wave pattern measurements were carried out for all of the towed tests. Trim (positive bow up) was measured by means of a potentiometer mounted on the tow fitting; accuracy of the measurement was within $\pm 0.05^{o}$. Sinkage (positive downwards) was measured by means of a potentiometer and a track on the towpost; accuracy of the measurement was within ±0.1mm.

3.4 Self-propelled tests

The tank has a manned carriage which is equipped with instrumentation to measure the speed of the carriage. The speed controller for the waterjets and propellers, together with a 60 Ah 12v battery and charger were also on the carriage to reduce the weight in the model. A set of aluminium guides was attached to an aluminium frame beneath the main carriage.

Wave pattern measurements were carried out for all of the models. Models were tested over a speed range from 1 m s^{-1} to 4 m s^{-1}. The propeller driven model achieved a top speed of 3.1m s^{-1} with the motors running with the maximum allowable voltage of 18v.

The model's trim and sinkage was determined from the movement of the two guideposts on the model relative to their initial position in the guides. Although a relatively simple method, it proved to be effective because of the large separation between the two posts of 740mm and the long run lengths.

$$t_v = \frac{T_A - T_F}{l_p} \qquad (1)$$

$$z_v = \frac{T_A + T_F}{2} \qquad (2)$$

4 DATA REDUCTION AND CORRECTIONS

4.1 Coefficients

All resistance data were reduced to coefficient form using fresh water density (ρ=1000 kg m^{-3}), static wetted surface area (A) and model speed (U):

$$\text{Resistance Coefficient} = \frac{\text{Resistance}}{\frac{1}{2}\rho A U^2} \qquad (3)$$

Corrections were applied as necessary to the measured data and these are described in the following sections:

4.2 Temperature correction

During the tests the water temperature varied from 18°C to 20°C. The total resistance measurements were corrected to the standard temperature of 15°C by modifying the frictional resistance component. The correction which has been applied is as follows:

$$C_{T_{15}} = C_{T_{test}} - C_{F_{test}} + C_{F_{15}} \qquad (4)$$

The correction should be slightly larger due to the form factor being greater than unity. However, the correction is in any case small and the above equation is considered to be sufficiently accurate.

4.3 Resistance due to turbulence studs

Turbulence studs were attached to all the towed models as described in Section 2. A detailed investigation of their influence on model drag was carried out, and is described in [10]. It was found that, whilst there was additional drag on the studs, this is to a certain extent negated by the laminar region upstream and the boundary layer momentum thickness increase down stream due to the studs.

4.4 Wetted Surface Area

Static wetted surface area was used to non-dimensionalise the resistance measurements. A detailed investigation into the use of running wetted surface area is described in [10]. The conclusions in [10] indicate that whilst the use of running wetted surface might provide a better understanding of the physical components of resistance, the use of static wetted area does not have a significant effect on model to ship extrapolation providing both model and full scale coefficients are based on static wetted surface area. Running wetted surface area is difficult to measure experimentally in a routine manner, and will not be available for a new design. From a practical viewpoint it is necessary to use the static wetted surface area, and it has therefore been applied in the current work.

5 PRESENTATION OF DATA

The wave profiles are presented in terms of wave height (mm) to a base of distance (m).

The basic presentation of the experimental resistance data is as follows:

$$C_T = C_F + C_R \tag{5}$$

The measured mean sinkage is presented as a percentage of the draught of the model, with positive sinkage being downwards. The measured mean trim is presented as an angle in degrees, with positive being bow up.

Figures 135 to 137 present the total resistance coefficients, trim and sinkage for the bulbous bow series. Also plotted are the results for Model 5b (without a bulb) and Model 5b in deep water.

Figures 138 to 140 present the total resistance coefficients, trim and sinkage for Model 5s catamaran S/L=0.2 with static trim applied. Also plotted are the results for zero trim and zero trim in deep water.

Figures 141 to 143 present the total resistance coefficients, trim and sinkage for Model 5s with plasticine blisters. The results for Model 5s in 400mm water depth and in deep water are also presented.

Figure 144 to 147 present the sinkage and trim for the self-propelled models in 400mm and 200mm water depths. Also plotted for comparison are the results of the towed tests in shallow water and towed tests in deep water.

6 DISCUSSION OF RESULTS

6.1 Wave profiles

The longitudinal wave cuts are presented in Figures 3 to 134 for a range of conditions at eight transverse positions from the centreline of the track of the model.

These profiles provide a wide range of data for input into propagation models, for assessing the effects of changing the hull parameters and for the validation of theoretical methods.

At a fundamental level, the wave profiles can be used to compare the wave heights for change in ship hull particulars, operating trim and method of propulsion.

The wave profiles with and without bulbs in shallow water can be compared, Figure 148, it is seen that these wave profiles are similar and that the waves produced by the model with no bulb have a slightly greater wave height.

The wave profiles for towed, propelled by propellers or waterjets, Figure 149, indicates that the method of propulsion tends to have little influence on the generated wave pattern.

It should be noted that in the trans-critical region solitary waves (solitons) were generated which moved ahead of the model, Figures 91 and 92. As it is likely that this phenomenon was amplified due to operation in a relatively narrow tank, discussion of the origin and behaviour of the solitary waves is not taken further in this report.

6.2 Total resistance

The total resistance C_T has been plotted against length Froude number Fn_L, for the towed models. The total resistance coefficient in shallow water has been compared with the deep water value $C_{T\infty}$. These deep water results were obtained from earlier tests as reported in [4 and 10] and recent tests of the bulb series in deep water.

6.2.1 Model 5b bulbous bows

Figure 135 presents the total resistance coefficient C_T for Model 5b catamaran S/L=0.2 with the four bulb series in water of 400mm depth. Also presented are the C_T values for the four bulb series in deep water, the C_T values for Model 5b (without a bulb) in shallow and deep water and the frictional resistance coefficient C_F for Model 5b with bulb 1.

In shallow water the bulbs appear to reduce the total resistance coefficient C_T compared with Model 5b with no bulb. In both deep and shallow water there is little difference between the bulbs except for bulb 1 which produces significantly higher C_T values at sub-crtical speeds, below Fn_L=0.5.

6.2.2 Model 5s catamaran trimmed conditions

Figure 138 presents the C_T value for Model 5s catamaran, with a separation to length ratio S/L=0.2 with a number of static trim angles imposed. Also plotted are the C_T values for 0^o static trim in shallow water, the deep water $C_{T\infty}$ and the C_F values.

The effect of applying static trim by the stern is to increase the total resistance coefficient. Applying static trim by the bow has little effect on the total resistance coefficient.

6.2.3 Model 5s monohull with plasticine blisters

Figure 141 presents the C_T values for Model 5s monohull with plasticine blisters at midships and at the bow. Also presented are the C_T values for the naked hull of Model 5s and Model 5s in deep water.

The use of blisters on the hull surface in the bow region increases C_T. The increase in C_T is most pronounced at sub-critical speeds. Positioning the blisters at midships has little effect on C_T.

6.3 Sinkage and trim

6.3.1 Model 5b bulbous bows

Figures 136 and 137 show the trim and sinkage for the bulbous bow series. The size of the bulb has little effect on the trim of the model. The trim produced by the bulbous bow models is similar to the Model 5b without bulbs. The size of the bulb appears to have some effect on the sinkage but only in the trans-critical region. The presence of the bulb increases the sinkage in the trans-critical region compared with Model 5b without a bulb.

6.3.2 Model 5s catamaran trimmed conditions

Figures 139 and 140 show the trim and sinkage for Model 5s catamaran with static trim applied. The angle of static trim applied shifts the level trim case by that angle. The shape of the curve remains the same. The sinkage shows similar trends to the trim.

6.3.3 Model 5s monohull with plasticine blisters

Figures 142 and 143 show the trim and sinkage results for Model 5s monohull with blisters. The use of blisters and their position on the hull has little effect on the trim. Sinkage is similarly unaffected by the use and positioning of the blisters.

6.3.4 Self-propelled models

Figures 144 and 145 show the trim angles for Model 5s catamarans in water depths of 400mm and 200mm. Plotted are the results for the self-propelled models, both waterjets and propellers, and the towed models. For comparison the deep water towed results have been plotted. In both shallow water depths the self-propelled models have similar trim angles. The trim of the self-propelled models is a little lower than the towed models in shallow water.

Figures 146 and 147 show the sinkage for Model 5s catamarans in water depths of 400mm and 200mm. Plotted are the results for the self-propelled models, both waterjets and propellers, and the towed models. For comparison the deep water towed results have been plotted. In water of depth 400mm the model propelled by propellers has the greatest sinkage. The waterjet propelled model and the towed model have similar sinkage values. In water of depth 200mm the results of the towed and propelled models are similar. For all cases at this depth the peak in the trans-critical region is not present.

7 CONCLUSIONS

7.1 The results of the experimental wash wave measurements extend the existing database for a systematic series of models travelling in shallow water to include design and operational considerations such as bulbs, blisters, trim angles and propulsion devices.

7.2 The data should prove useful for the validation of theoretical wash prediction methods and for input into wave propagation models.

7.3 The measured resistance, sinkage and trim further enhance the existing database for models operating in deep and shallow water.

7.4 In the main, at higher speeds well beyond critical, the shallow water results for resistance, sinkage and trim tend to settle at about the deep water values.

7.5 The method of propulsion, either propellers or waterjets tends to have little influence on the wave system generated.

ACKNOWLEDGEMENTS

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APPENDIX A

After initial trials in the GKN tank with radio controlled models, the level of interference prevented a steady speed from being obtained. The main tests were carried out using a modified servo centering unit connected directly to the speed controller instead of using a transmitter an receiver. This generated the pulse variation required by the speed controllers.

Propeller driven model

Motors (2)	:	Robbe Speed 700/18
Propeller diameter	:	50mm
Speed Controller	:	Robbe Navy 590
Supplied voltage	:	18v on carriage

Waterjet driven model

Motors (4)	:	Graupner speed 700 BB Turbo
Waterjets	:	Graupner 2345.1 (without buckets)
Impeller Diameter	:	29mm
Speed Contoller(2)	:	Robbe Navy 570
Supplied Voltage	:	12v on carriage

TABLES

Model	5b	5s
L [m]	1.6	1.6
B [m]	0.146	0.125
T[m]	0.073	0.063
∇ [m^3]	0.00667	0.00667
Δ [Kg]	6.67	6.67
$L/\nabla^{1/3}$	8.5	8.5
L/B	11.0	12.8
B/T	2.0	2.0
C_B	0.397	0.537
C_P	0.693	0.633
C_M	0.565	0.848
WSA [m^2]	0.276	0.261
LCB [%]	-6.4	-6.4

Table 1: Principal particulars for model 5s and basis model 5b.

	Bulb 1	Bulb 2	Bulb 3	Bulb 4
L_b [m]	0.021	0.046	0.071	0.101
Δ_b [Kg]	0.214	0.243	0.288	0.303
A_b [m^2]	0.044	0.051	0.054	0.055
$\varnothing_b$ [m]	0.05	0.05	0.05	0.05
LCB [%]	-4.6	-4.3	-3.9	-3.8
C_B	0.393	0.395	0.397	0.398
C_P	0.677	0.68	0.684	0.686

Table 2: Particulars of the four bulb series.

FIGURES

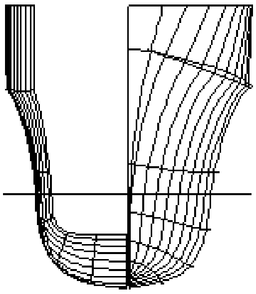


Figure 1a: Model 5s bodyplan

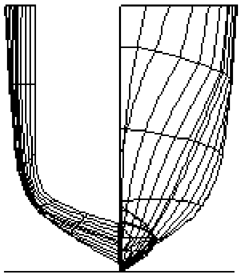


Figure 1b: Model 5b bulbous bow bodyplan

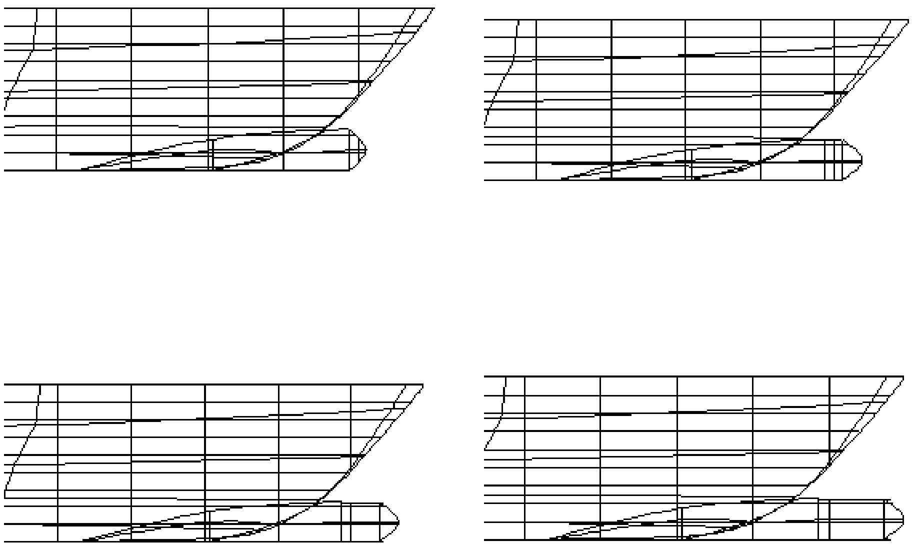


Figure 1c: Model 5b bulbous bow series.

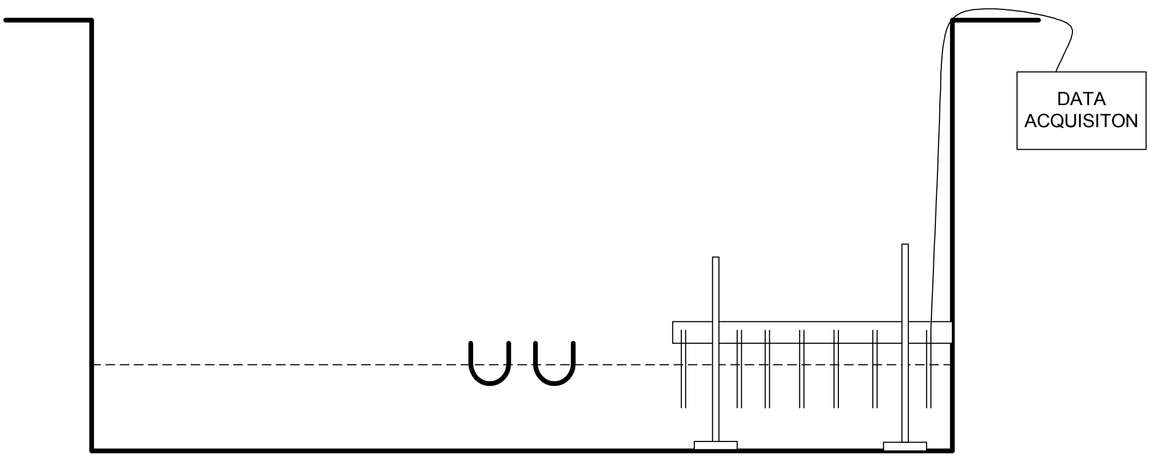


Figure 2a: Schematic of GKN-Westland tank (cross Section)

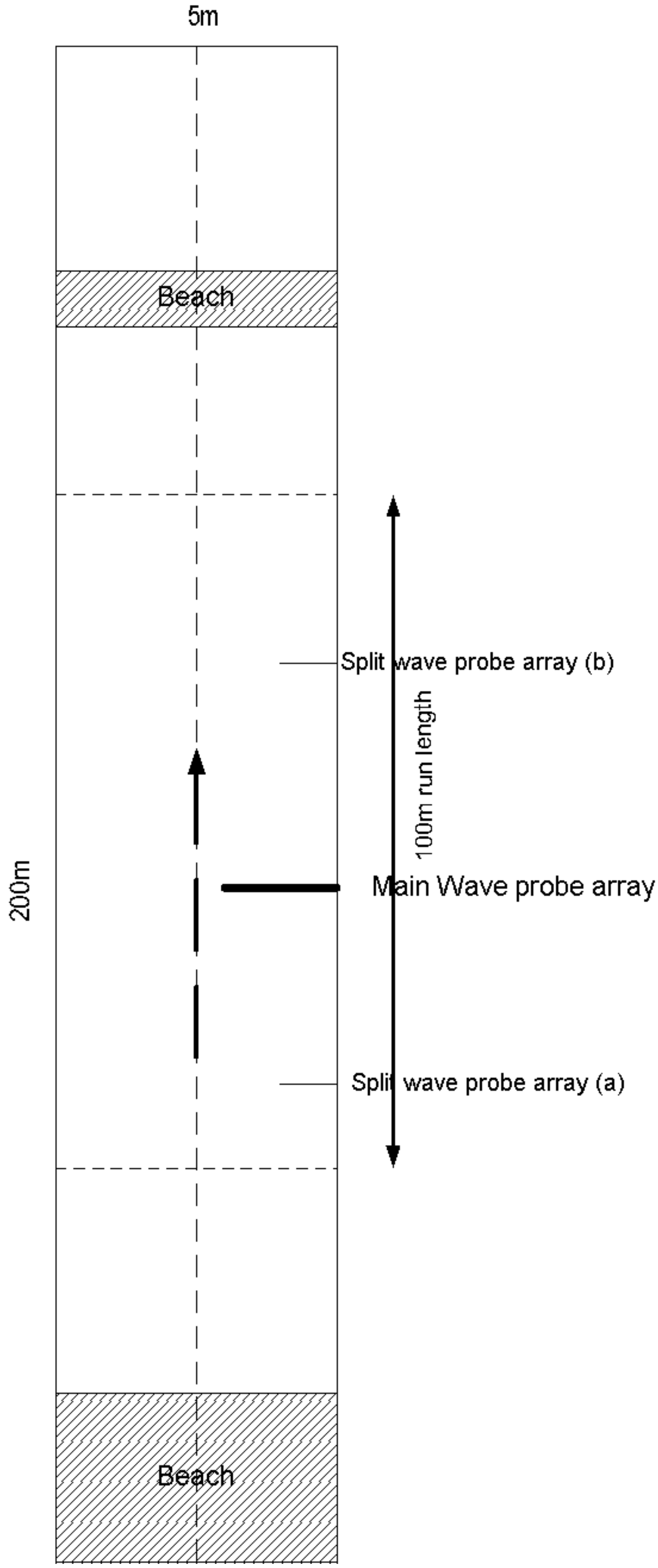


Figure 2b: Schematic of GKN tank.

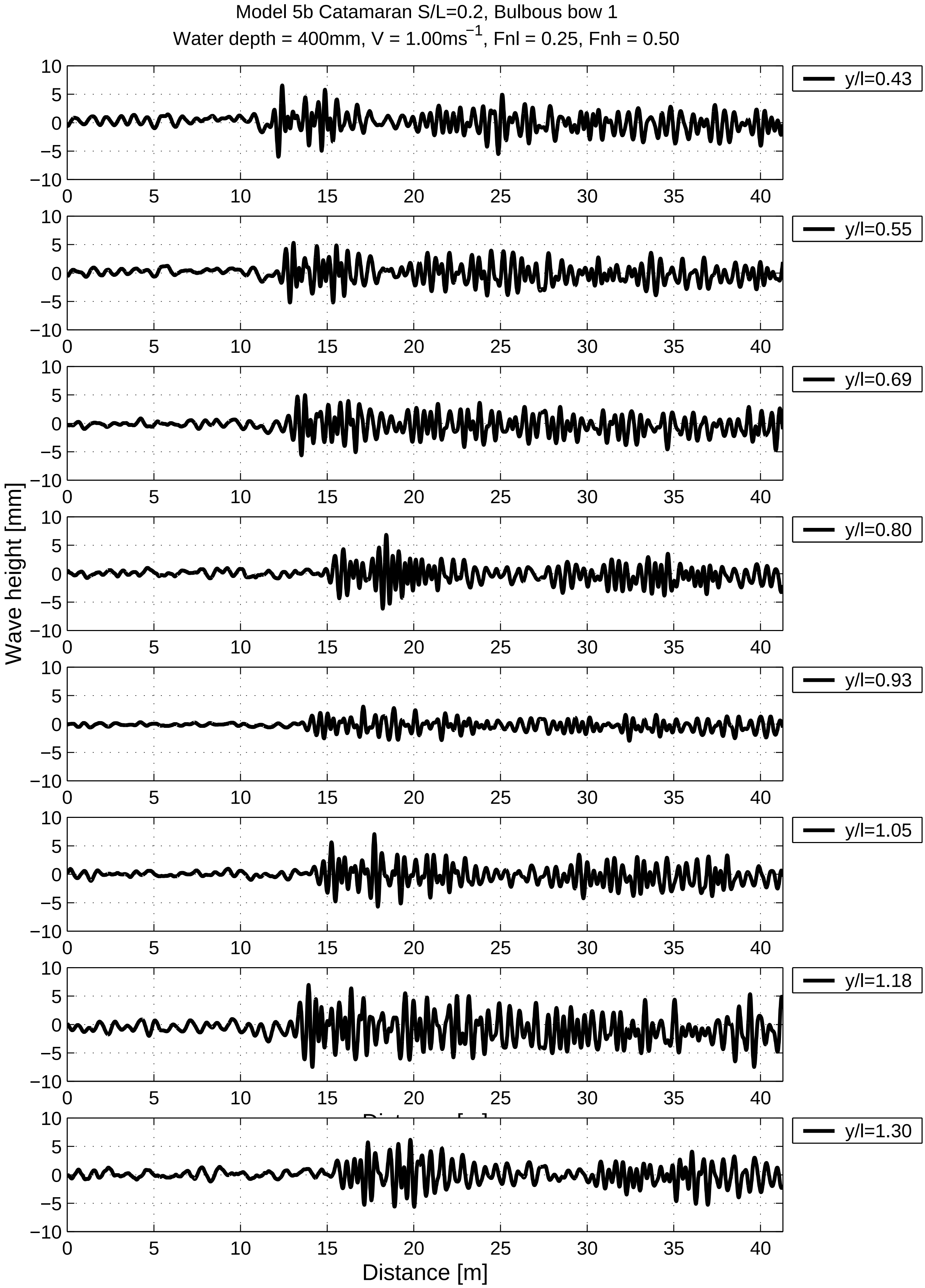

Model 5b Catamaran S/L=0.2, Bulbous bow 1
Water depth = 400mm, V = 1.00ms^{-1}, Fnl = 0.25, Fnh = 0.50
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 3

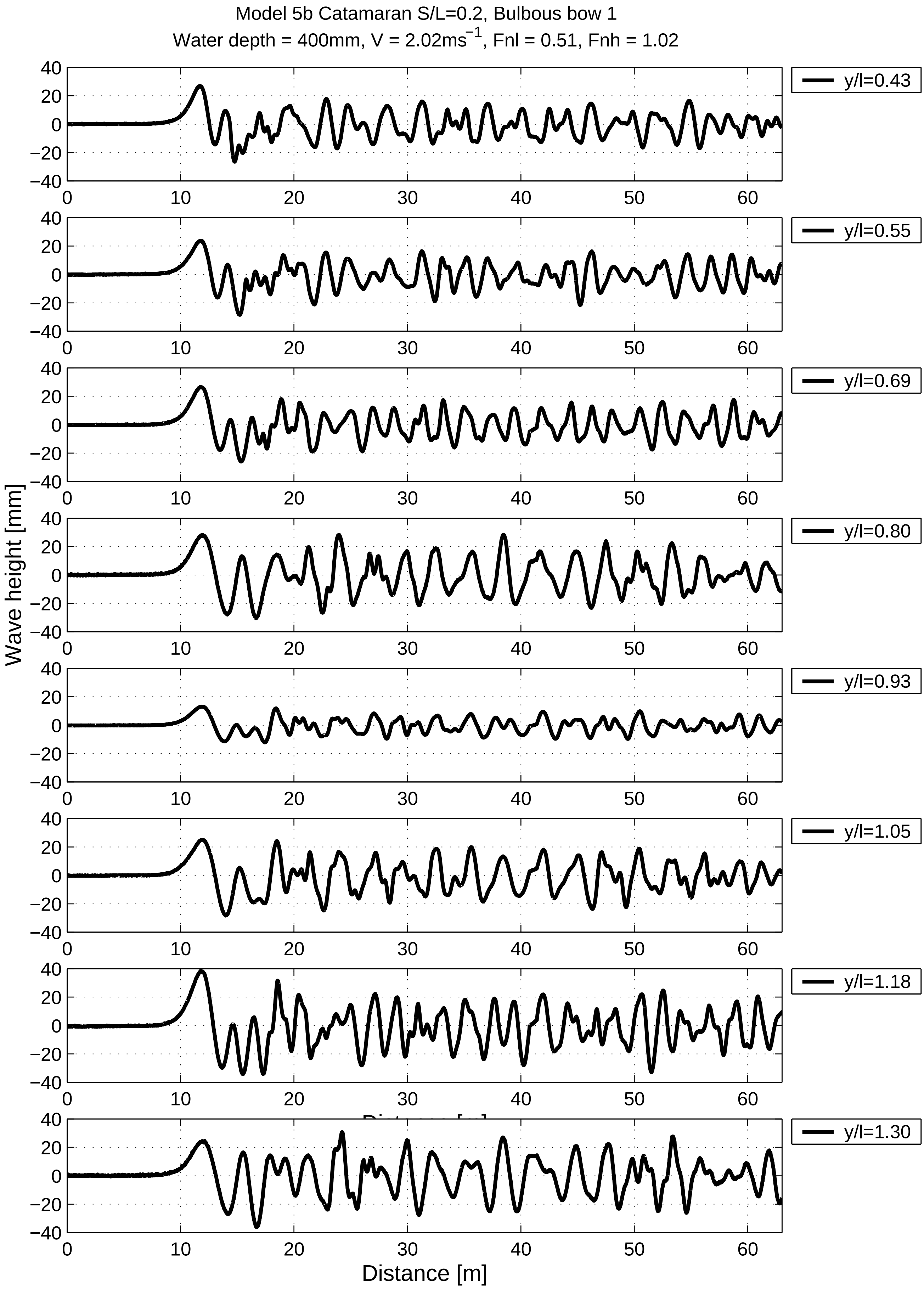

Model 5b Catamaran S/L=0.2, Bulbous bow 1
Water depth = 400mm, V = 2.02ms^{-1}, Fnl = 0.51, Fnh = 1.02
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 4

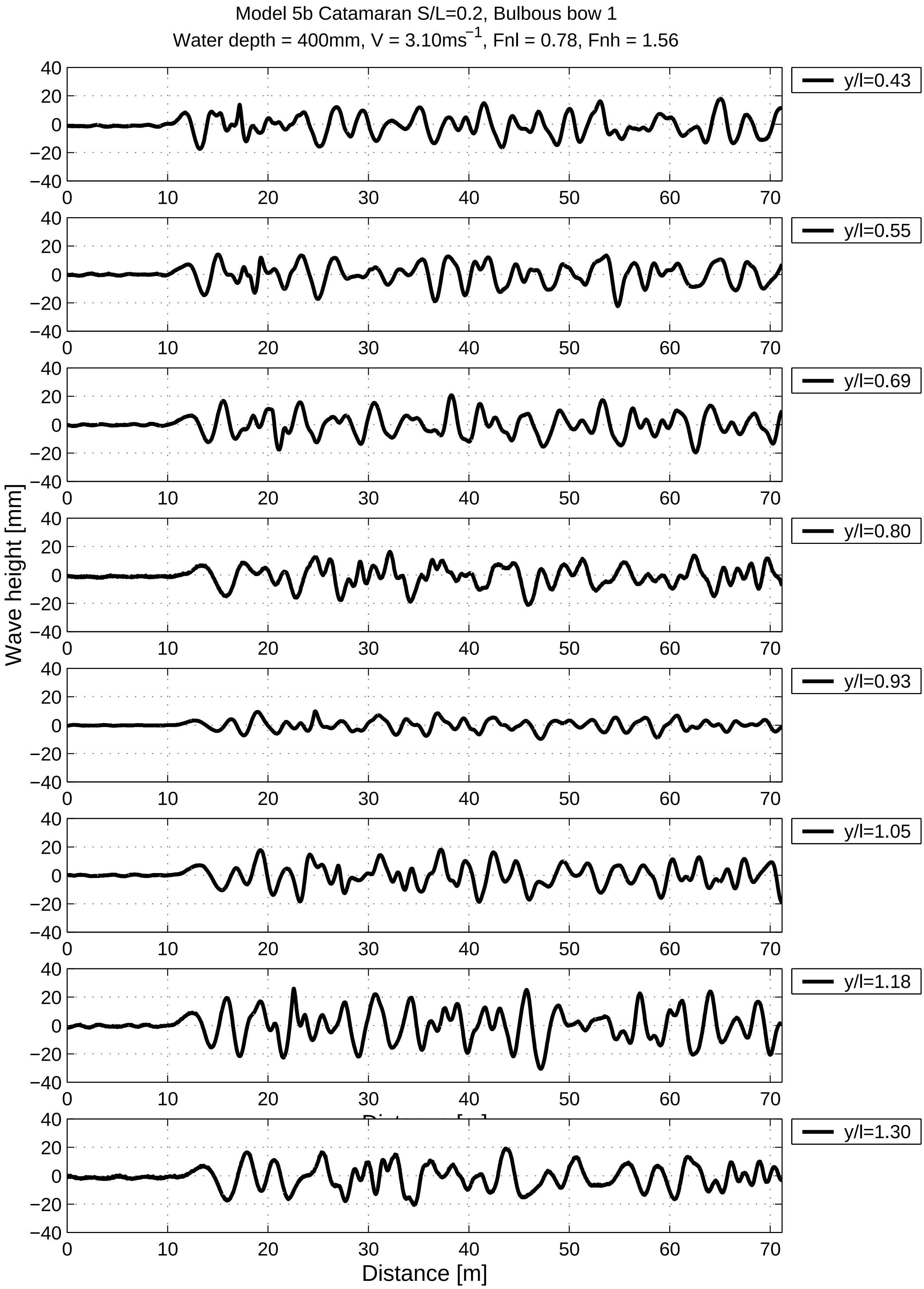

Model 5b Catamaran S/L=0.2, Bulbous bow 1
Water depth = 400mm, V = 3.10ms^{-1}, Fnl = 0.78, Fnh = 1.56
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 5

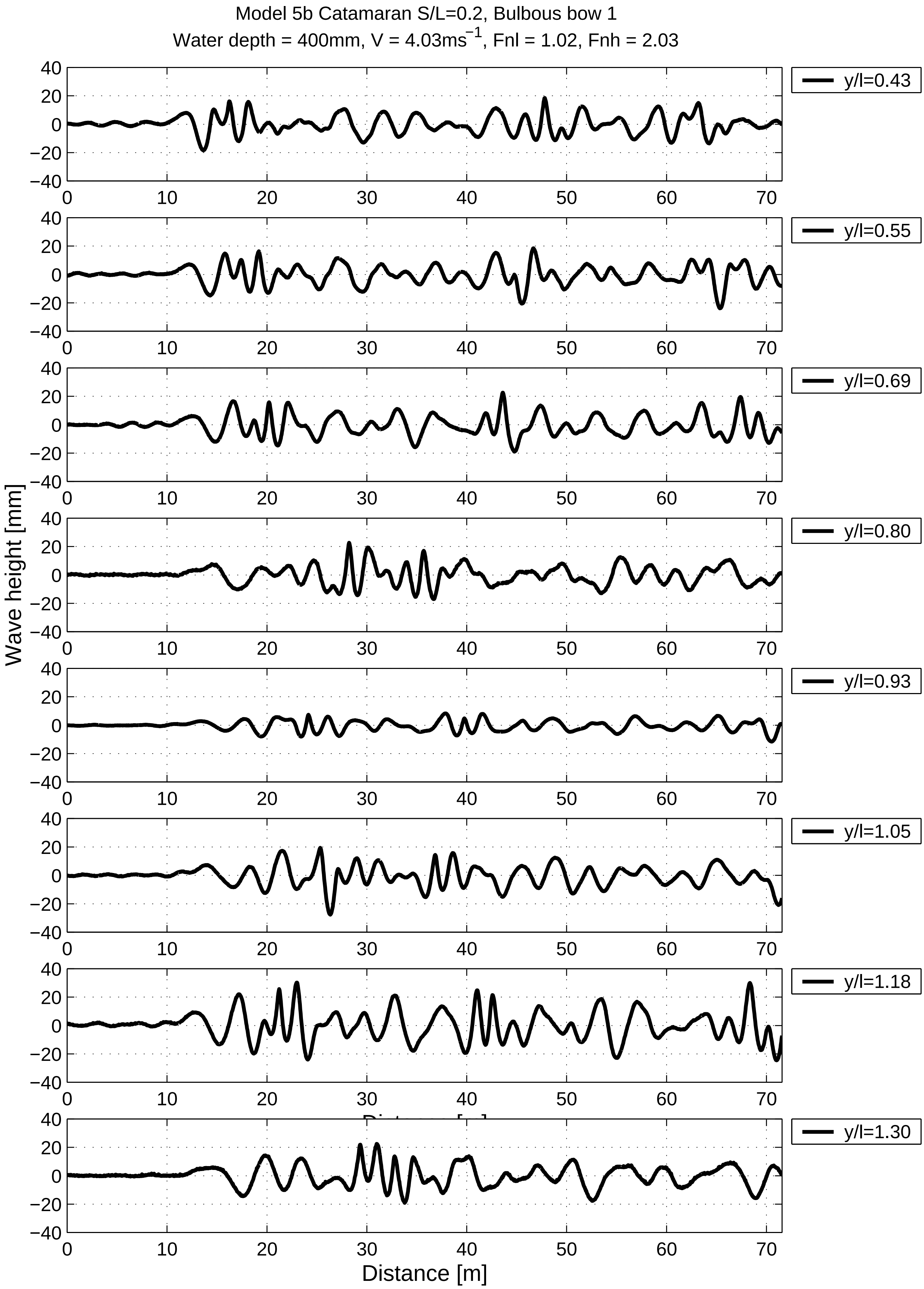
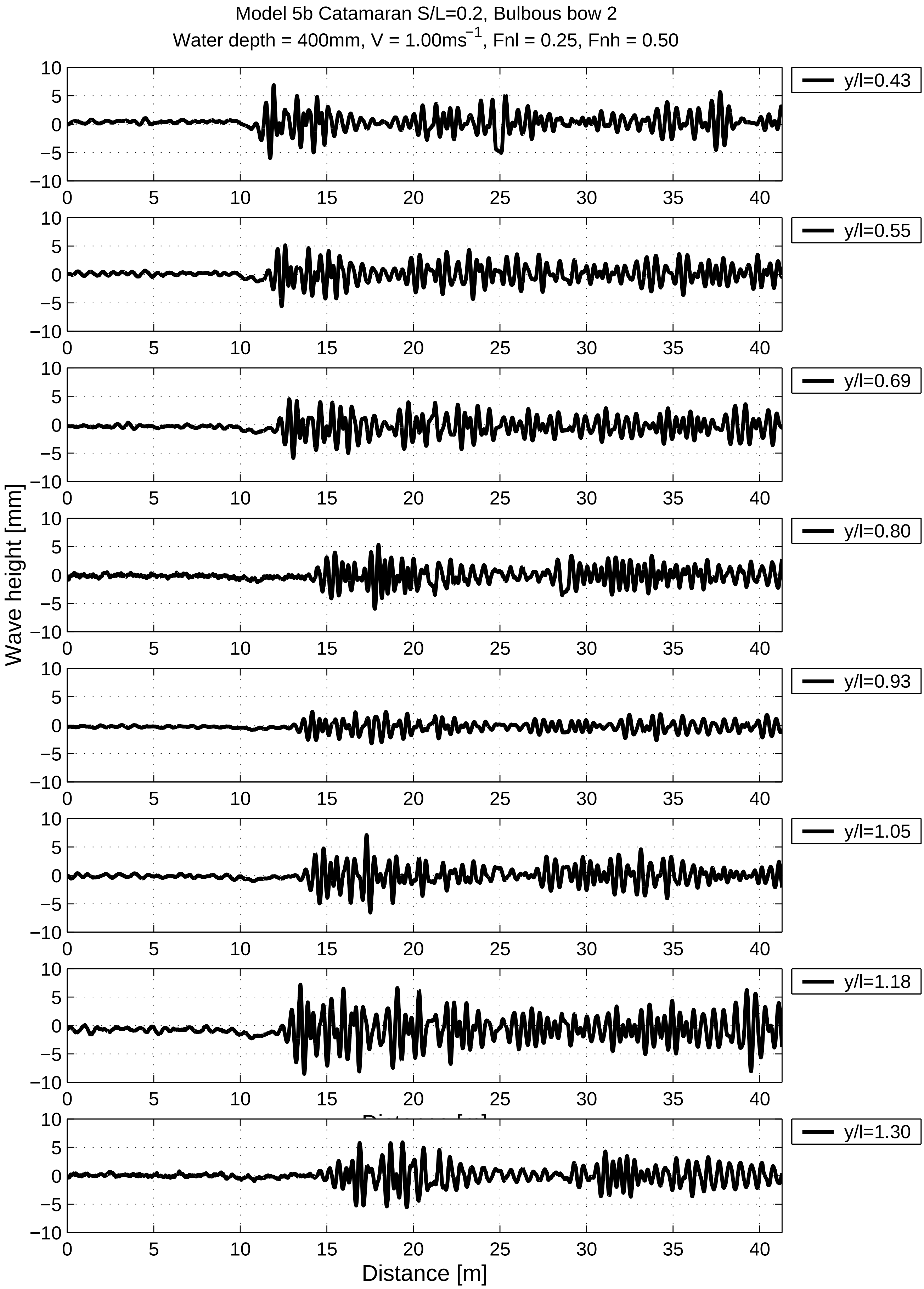

Model 5b Catamaran S/L=0.2, Bulbous bow 1
Water depth = 400mm, V = 4.03ms−1, Fnl = 1.02, Fnh = 2.03
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 6



Model 5b Catamaran S/L=0.2, Bulbous bow 2
Water depth = 400mm, V = 1.00ms^{-1}, Fnl = 0.25, Fnh = 0.50
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 7

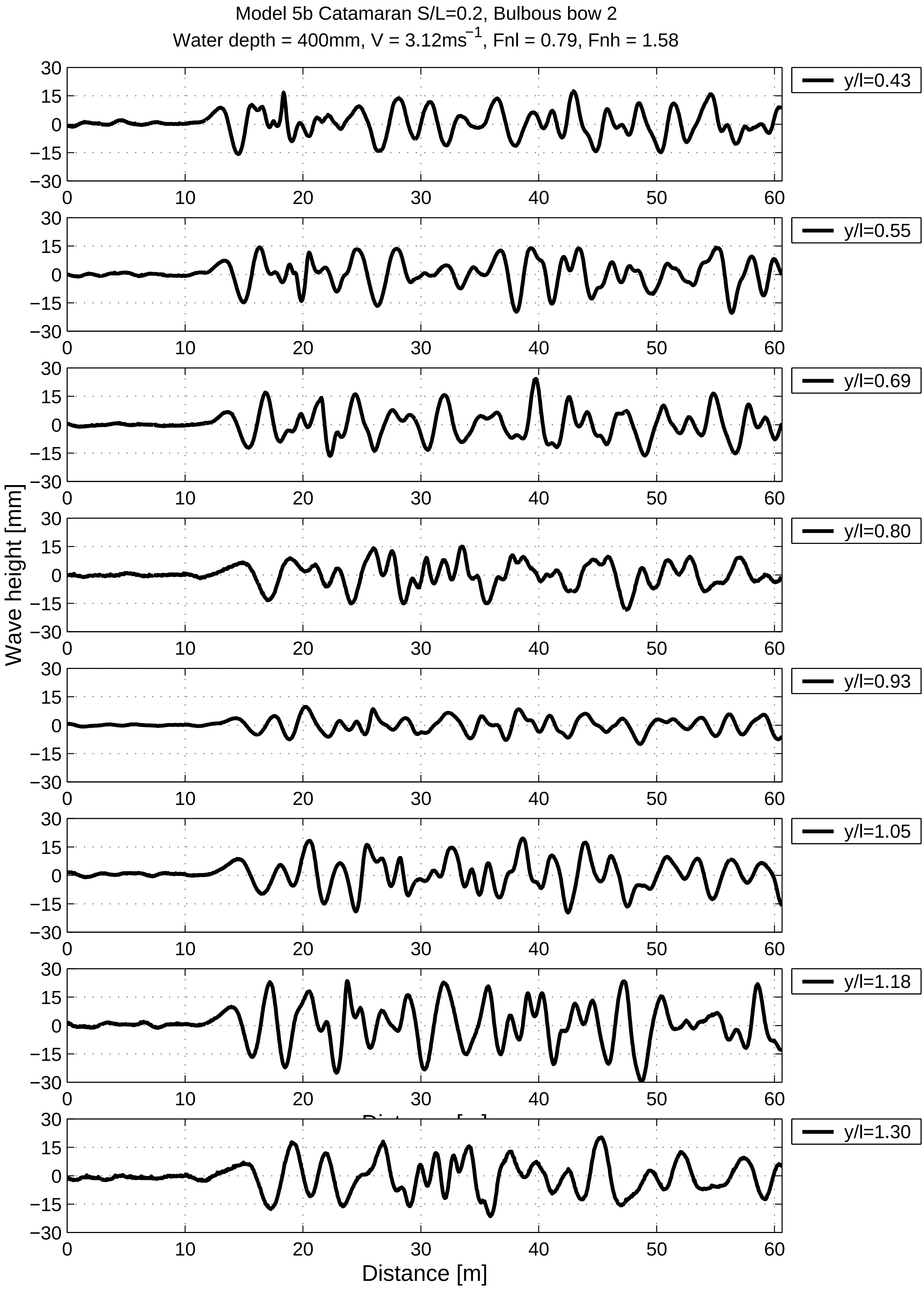

Model 5b Catamaran S/L=0.2, Bulbous bow 2
Water depth = 400mm, V = 3.12ms^{-1}, Fnl = 0.79, Fnh = 1.58
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 8

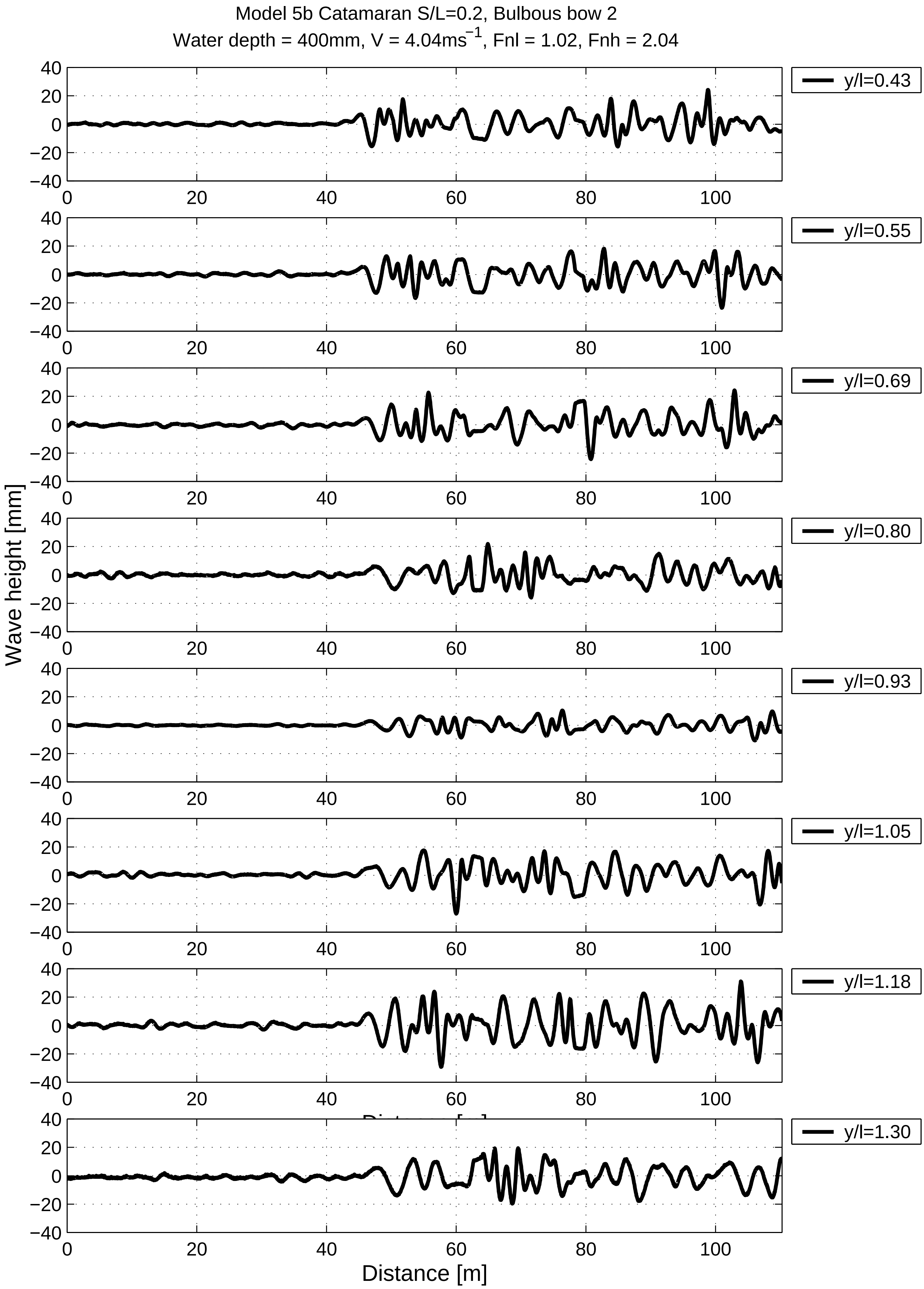
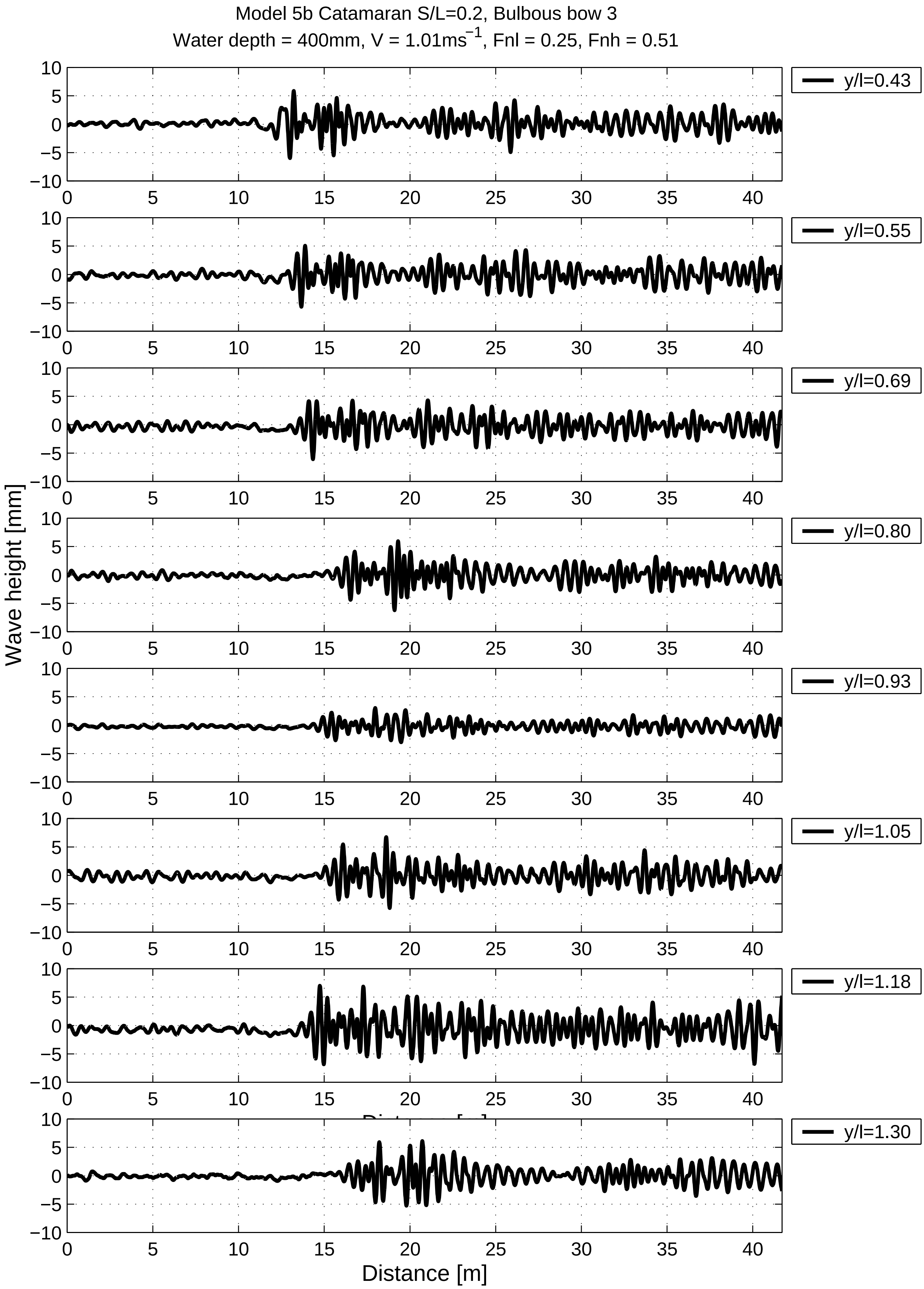

Model 5b Catamaran S/L=0.2, Bulbous bow 2
Water depth = 400mm, V = 4.04ms^{-1}, Fnl = 1.02, Fnh = 2.04
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 9



Model 5b Catamaran S/L=0.2, Bulbous bow 3
Water depth = 400mm, V = 1.01ms^{-1}, Fnl = 0.25, Fnh = 0.51
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 10

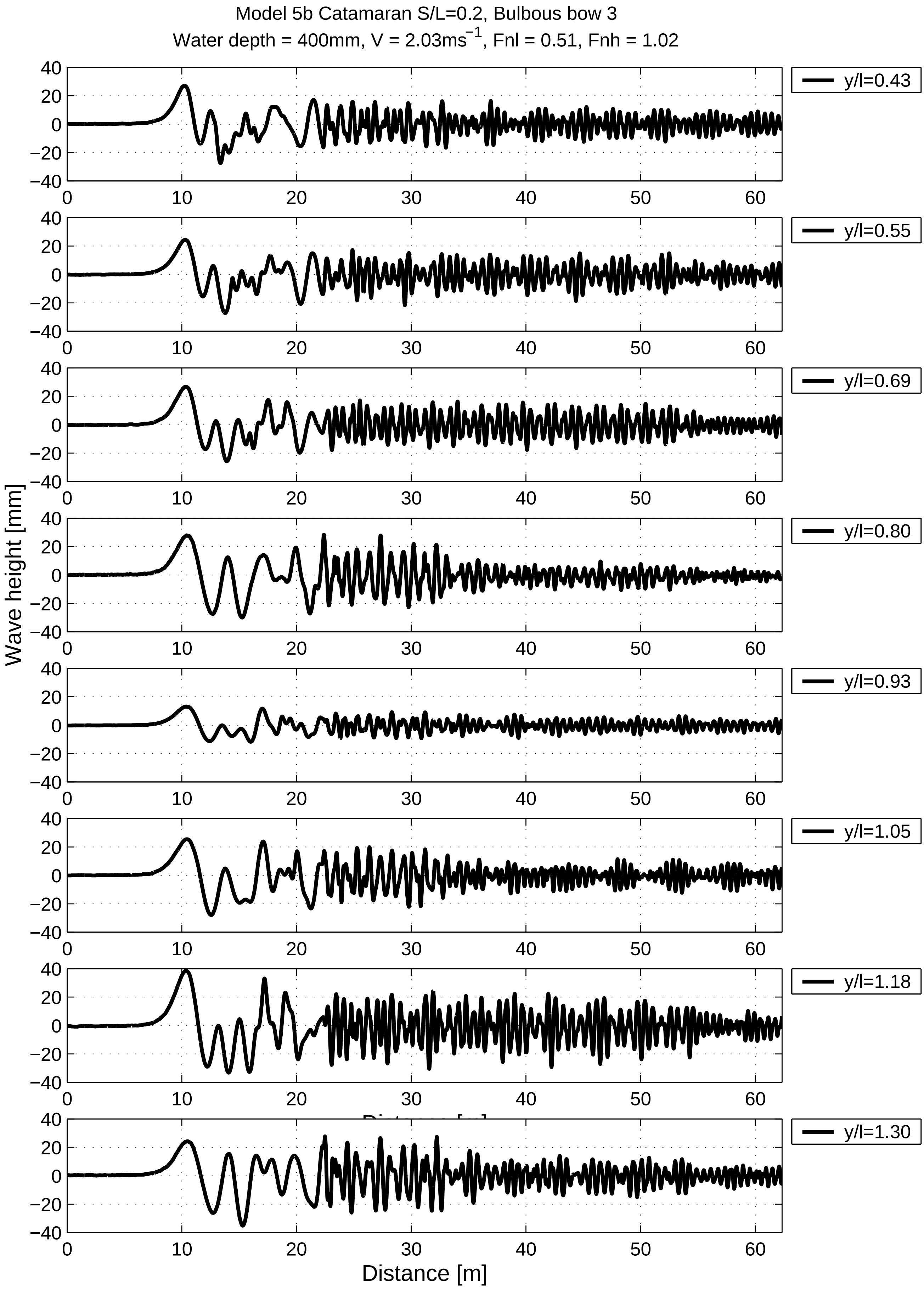

Model 5b Catamaran S/L=0.2, Bulbous bow 3
Water depth = 400mm, V = 2.03ms^{-1}, Fnl = 0.51, Fnh = 1.02
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 11

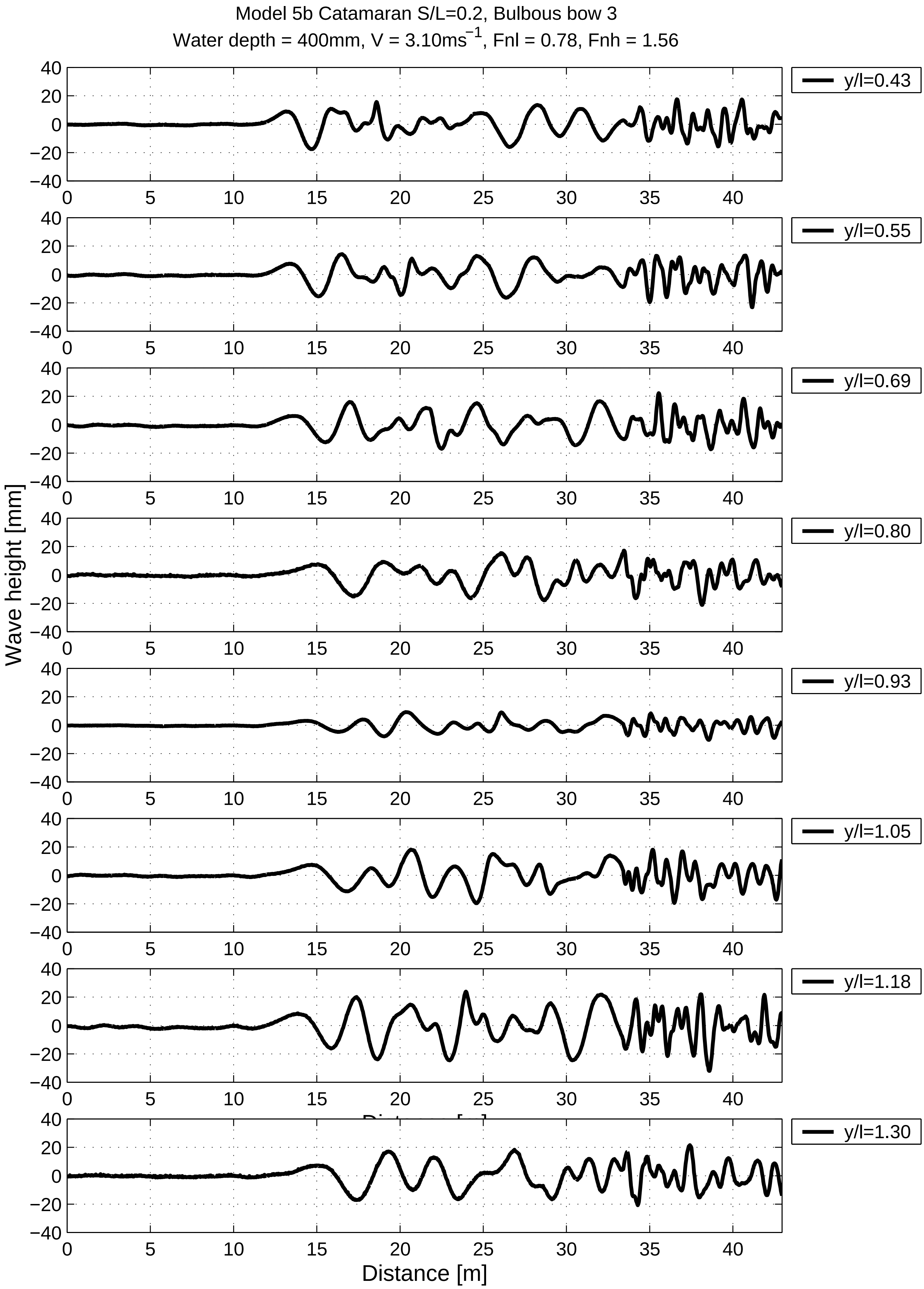
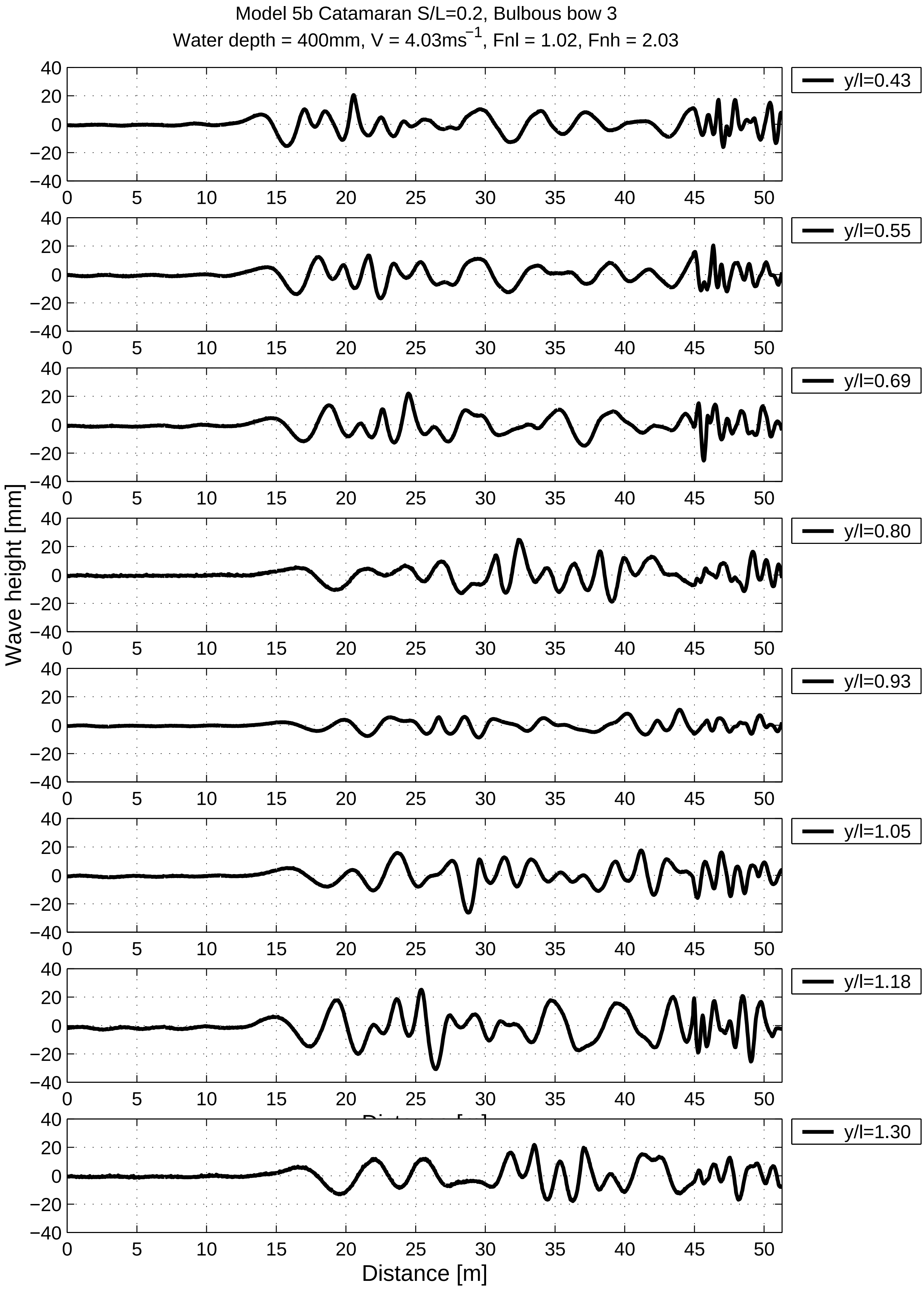

Model 5b Catamaran S/L=0.2, Bulbous bow 3
Water depth = 400mm, V = 3.10ms^{-1}, Fnl = 0.78, Fnh = 1.56
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 12



Model 5b Catamaran S/L=0.2, Bulbous bow 3
Water depth = 400mm, V = 4.03ms^{-1}, Fnl = 1.02, Fnh = 2.03
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 13

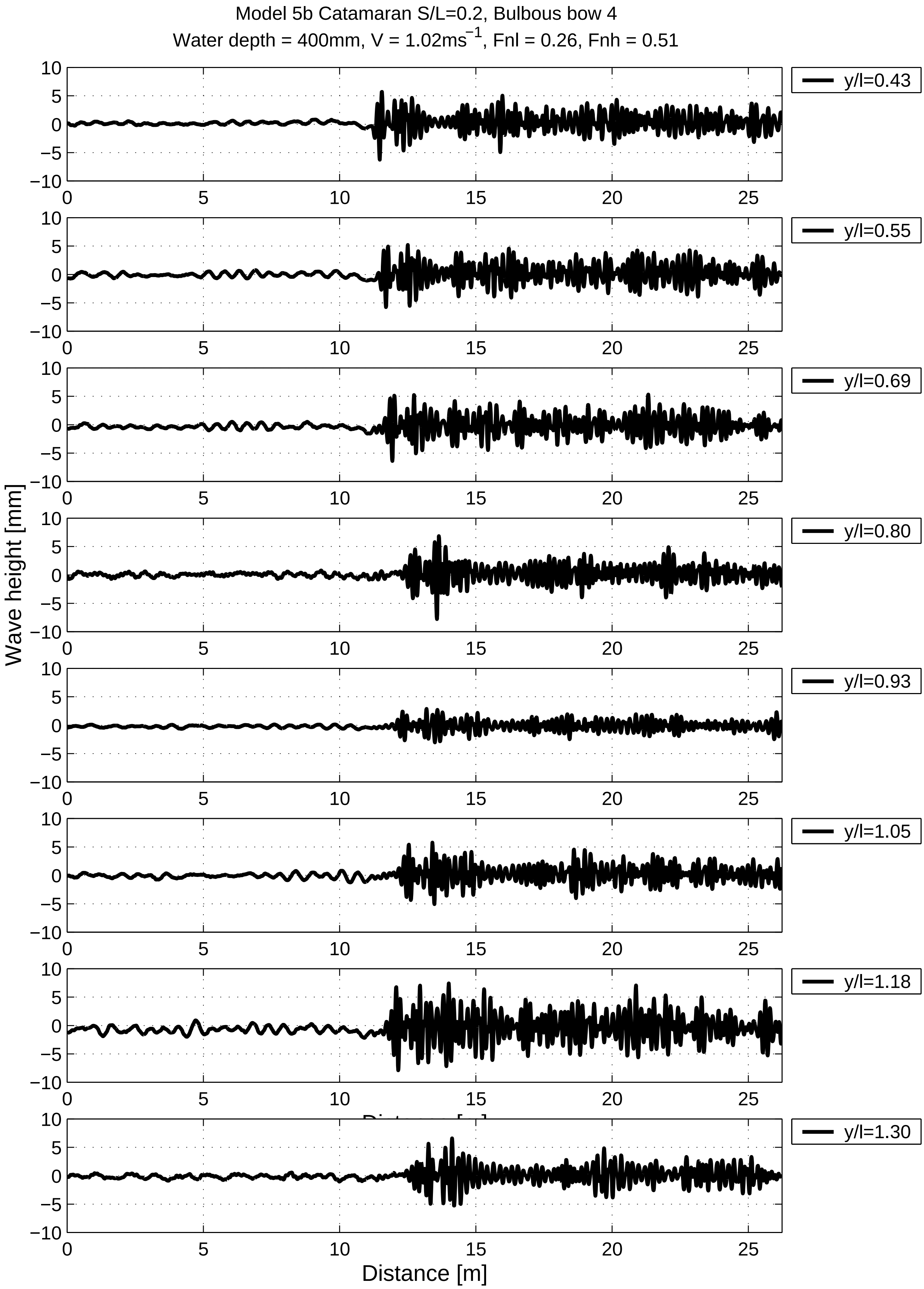

Model 5b Catamaran S/L=0.2, Bulbous bow 4
Water depth = 400mm, V = 1.02ms^−1, Fnl = 0.26, Fnh = 0.51
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 14

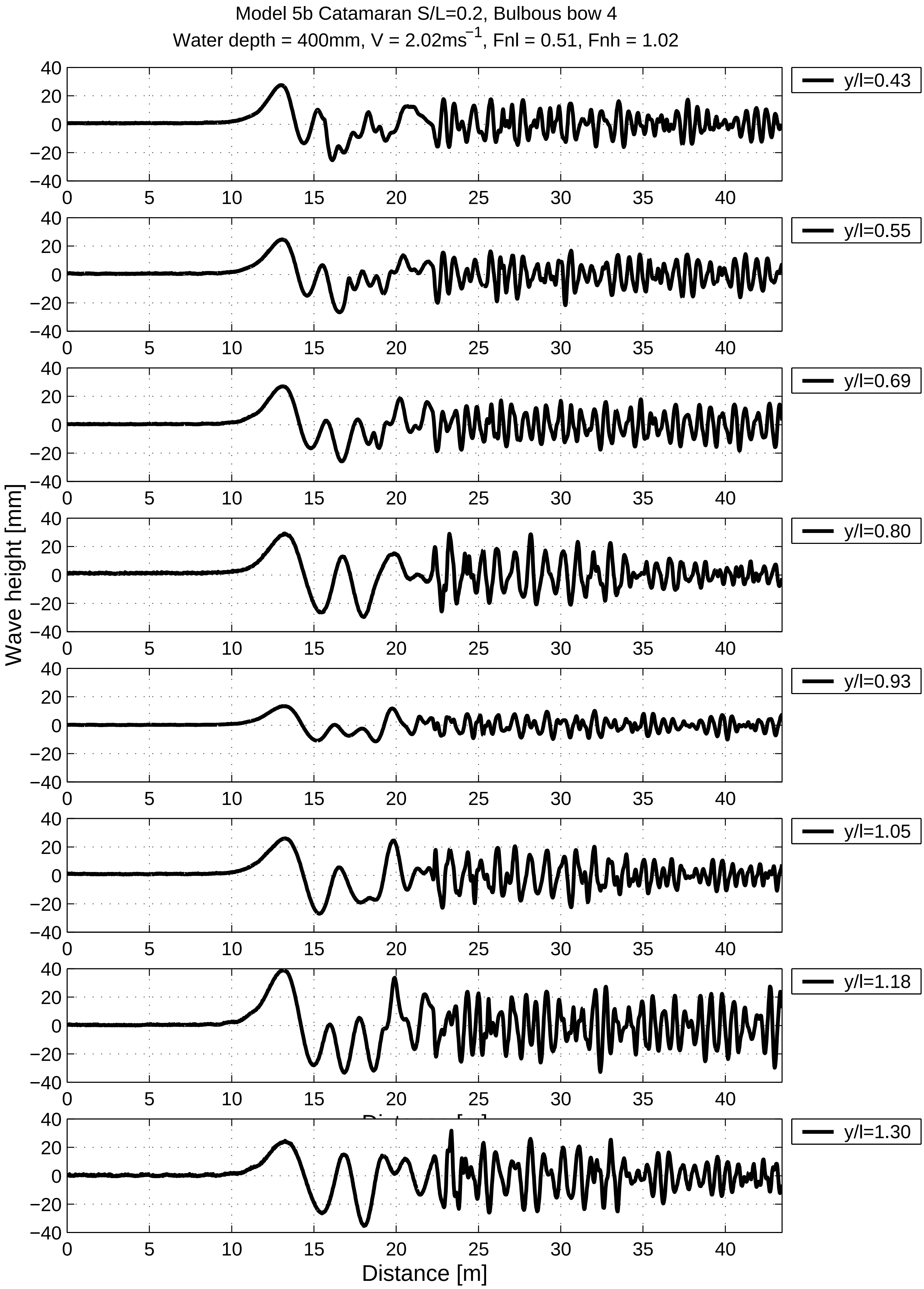
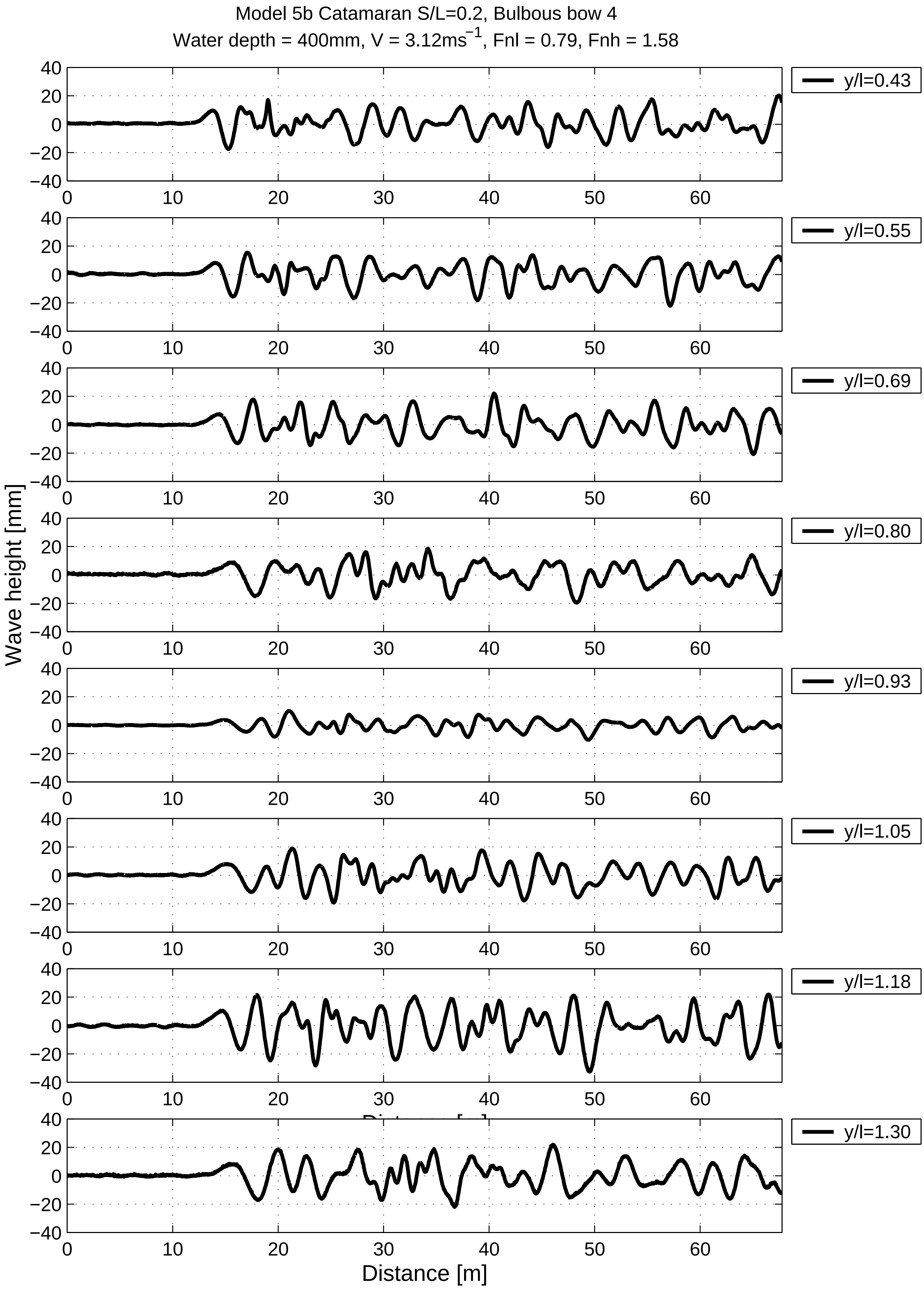

Model 5b Catamaran S/L=0.2, Bulbous bow 4
Water depth = 400mm, V = 2.02ms−1, Fnl = 0.51, Fnh = 1.02
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 15



Model 5b Catamaran S/L=0.2, Bulbous bow 4
Water depth = 400mm, V = 3.12ms^{-1}, Fnl = 0.79, Fnh = 1.58
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 16

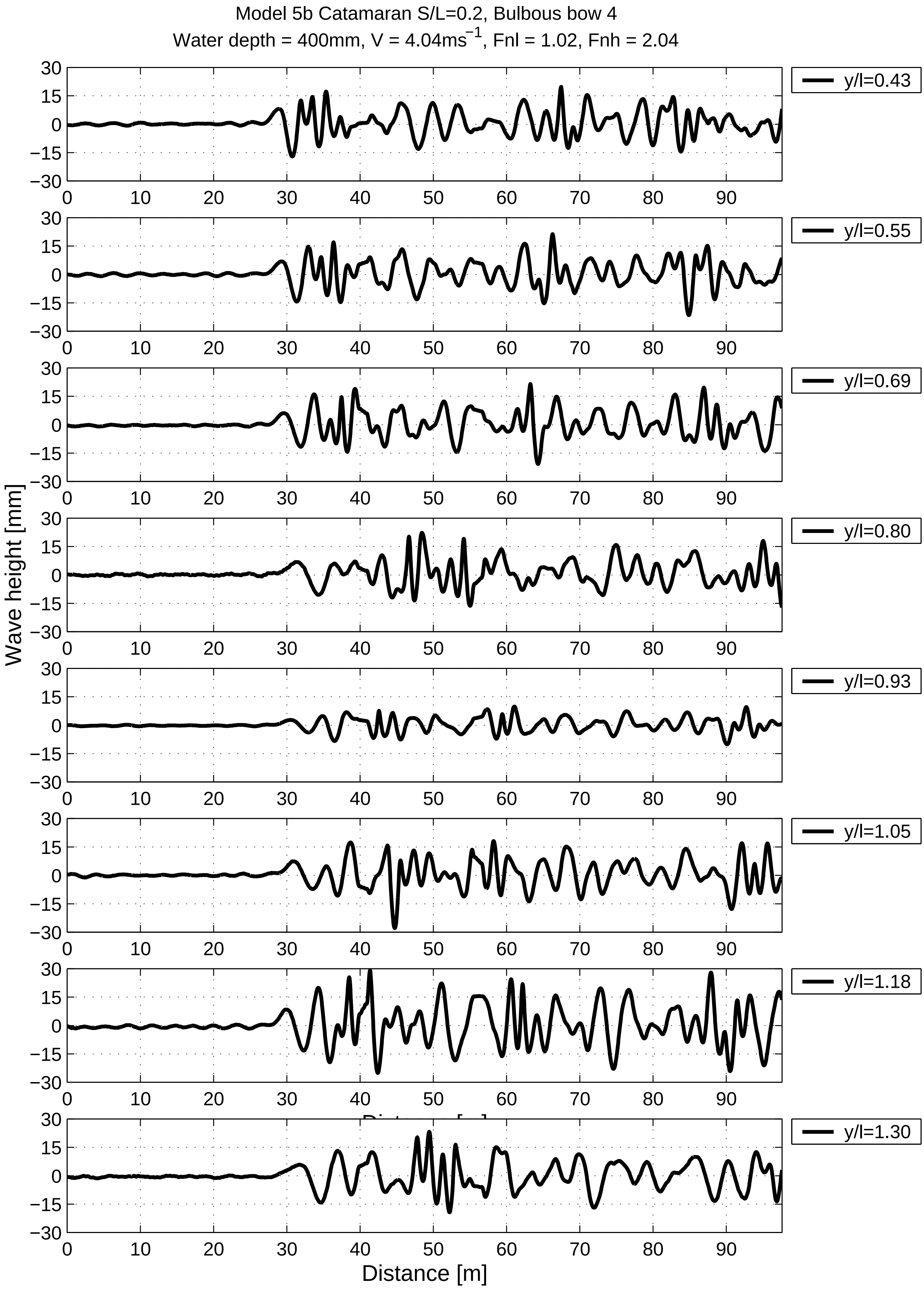
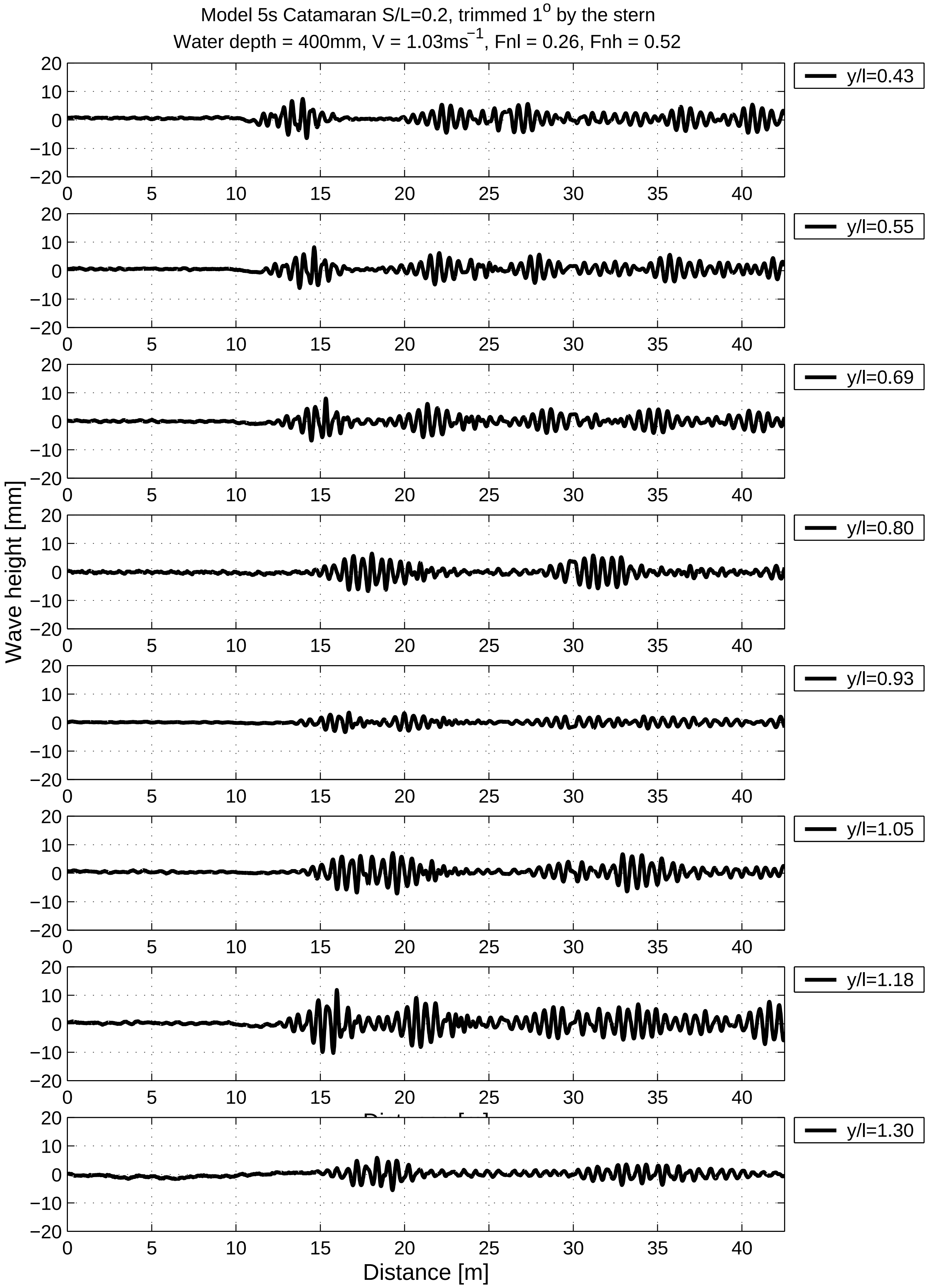

Model 5b Catamaran S/L=0.2, Bulbous bow 4
Water depth = 400mm, V = 4.04ms^{-1}, Fnl = 1.02, Fnh = 2.04
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 17



Model 5s Catamaran S/L=0.2, trimmed 1° by the stern
Water depth = 400mm, V = 1.03ms⁻¹, Fnl = 0.26, Fnh = 0.52
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 18

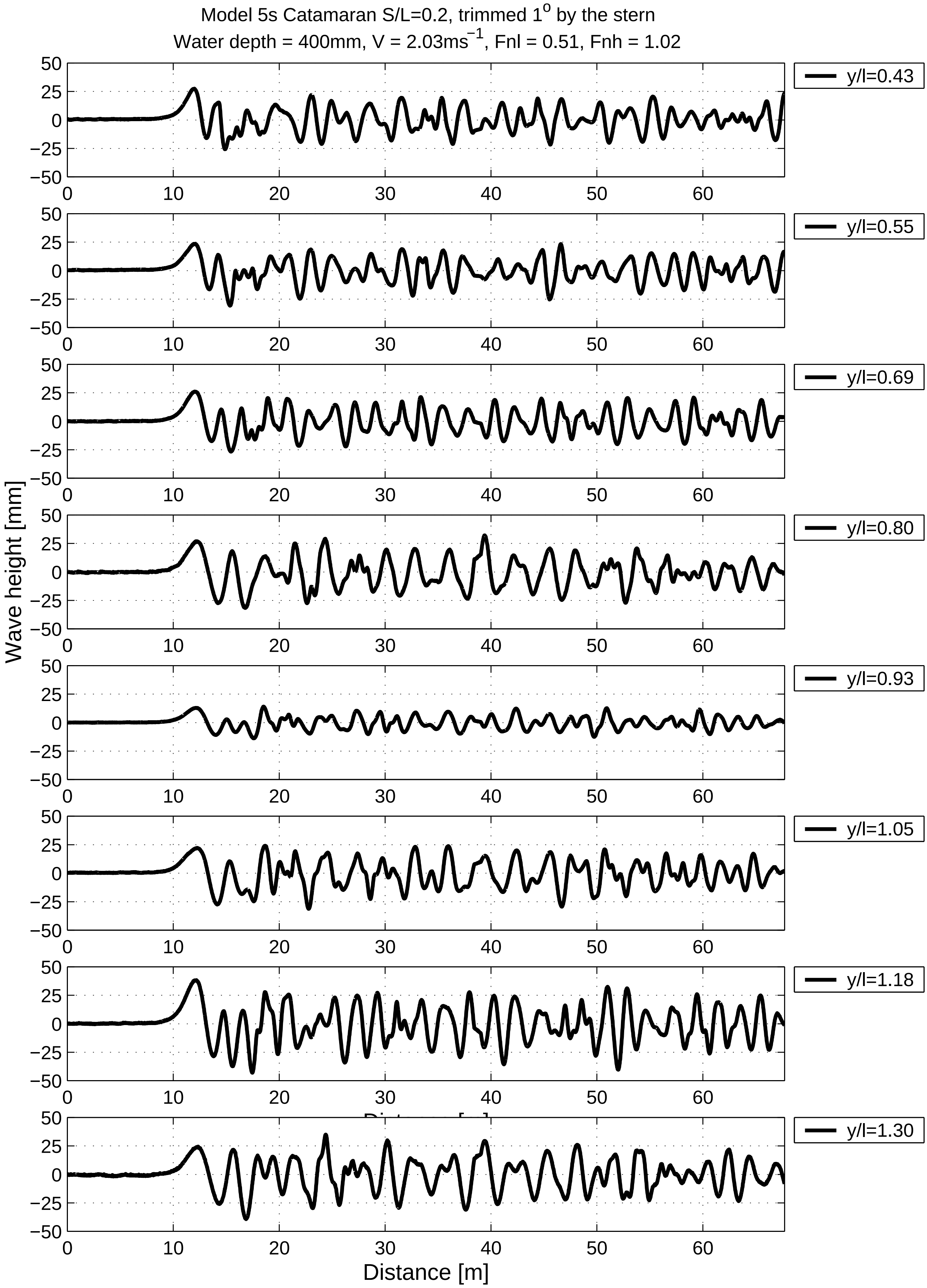
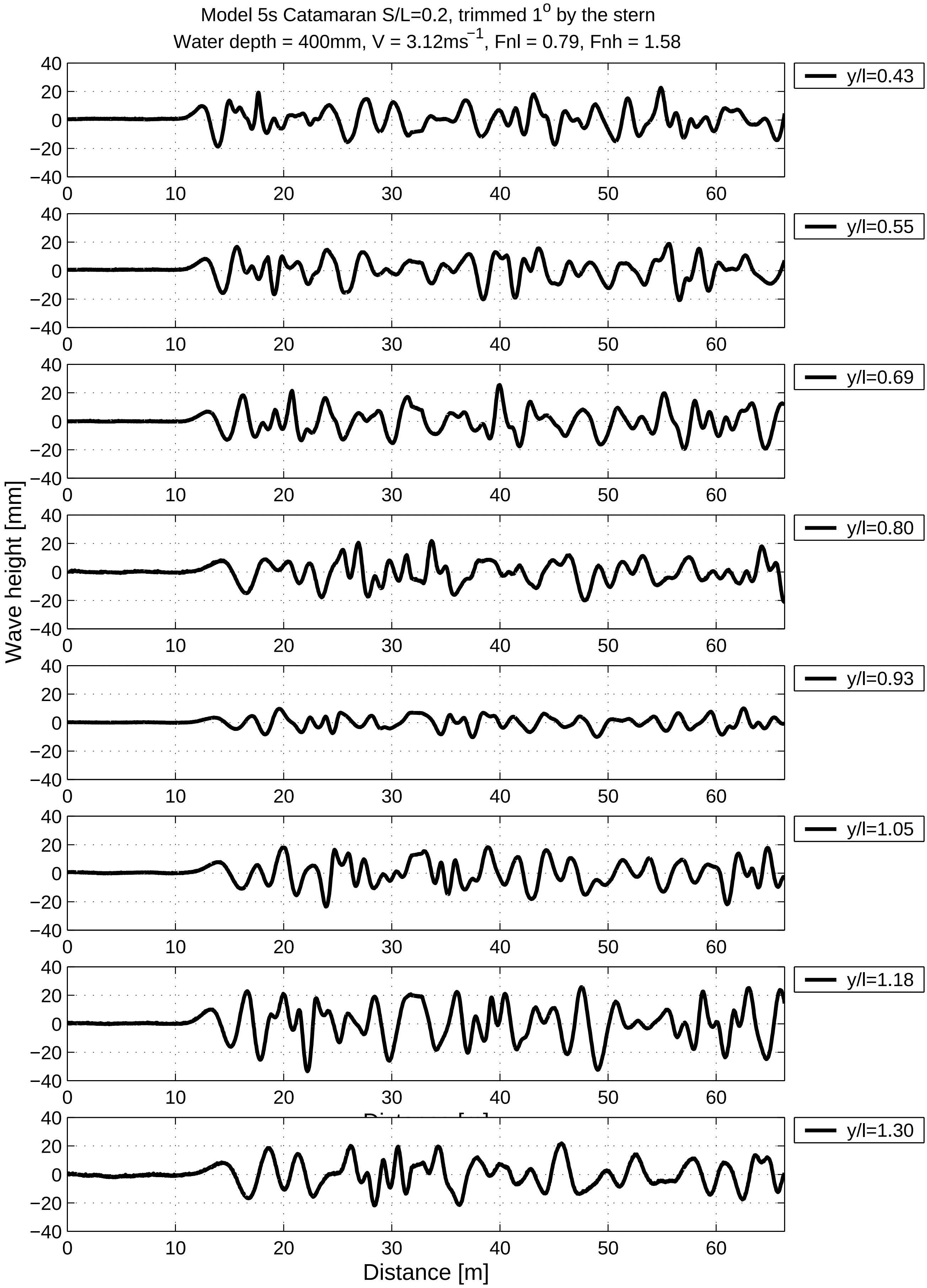
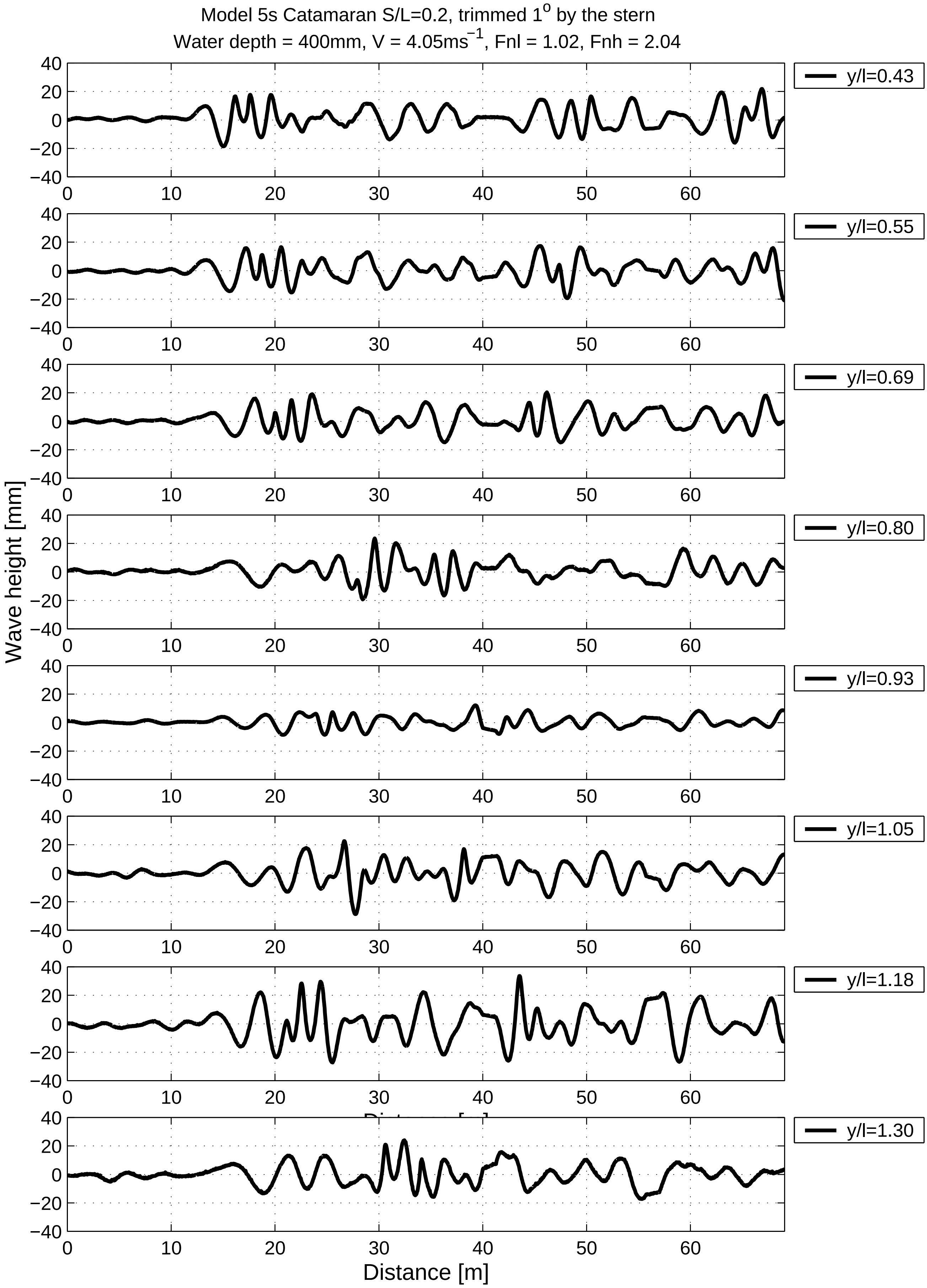

Model 5s Catamaran S/L=0.2, trimmed 1° by the stern
Water depth = 400mm, V = 2.03ms⁻¹, Fnl = 0.51, Fnh = 1.02
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 19



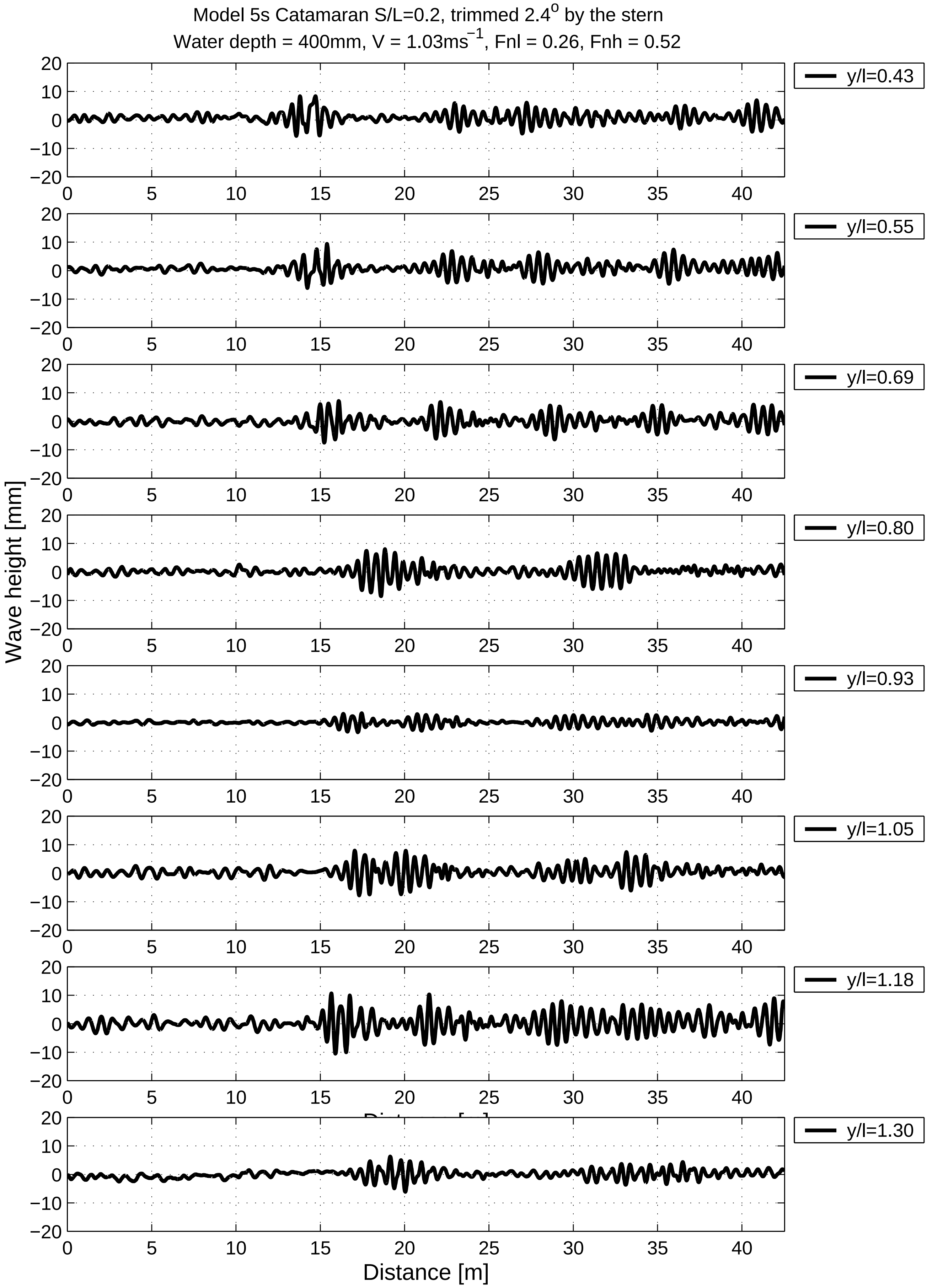
Model 5s Catamaran S/L=0.2, trimmed 1° by the stern
Water depth = 400mm, V = 3.12ms⁻¹, Fnl = 0.79, Fnh = 1.58
Wave height [mm]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Distance [m]

Figure 20



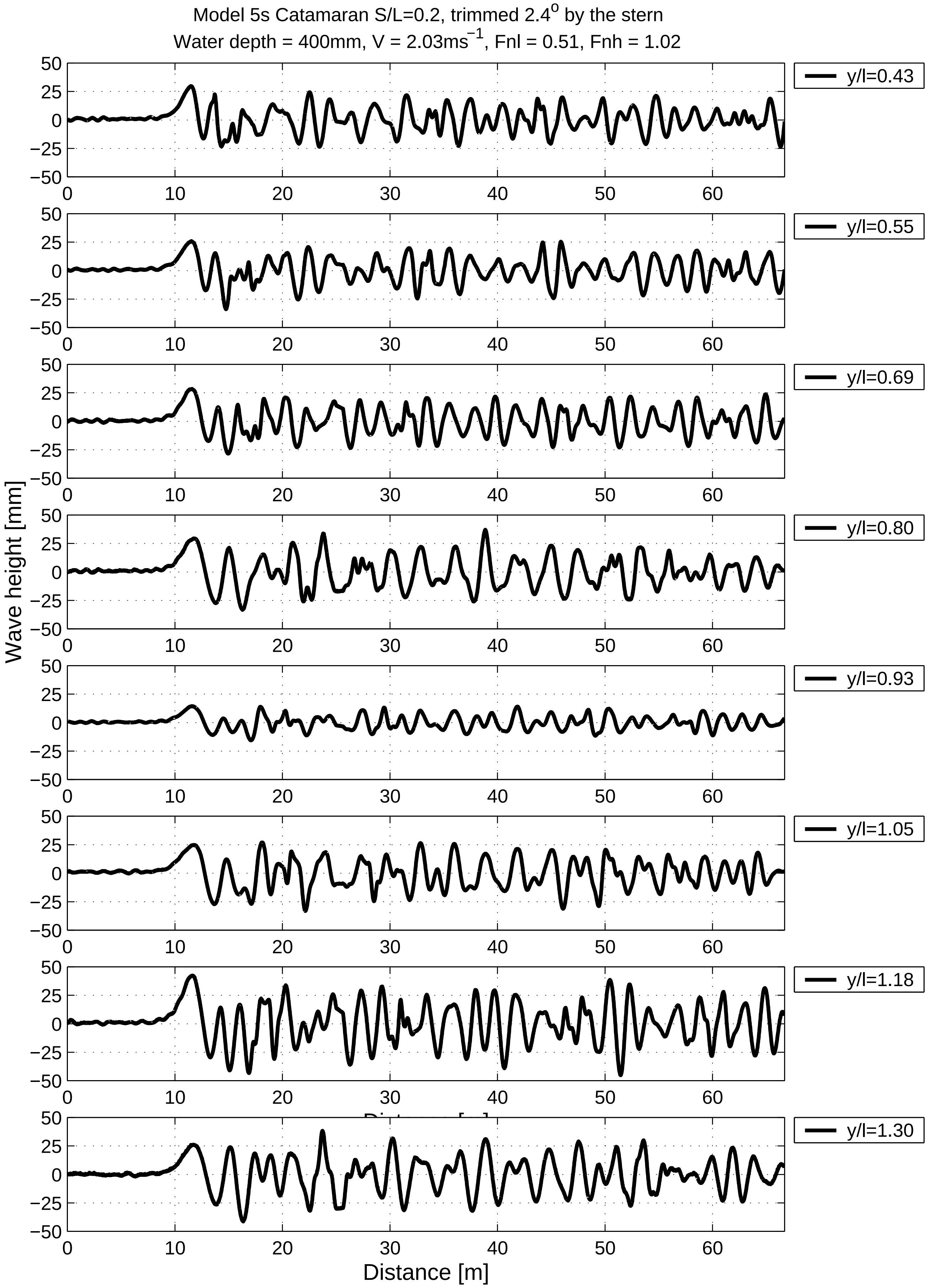
Model 5s Catamaran S/L=0.2, trimmed 1° by the stern
Water depth = 400mm, V = 4.05ms⁻¹, Fnl = 1.02, Fnh = 2.04
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 21



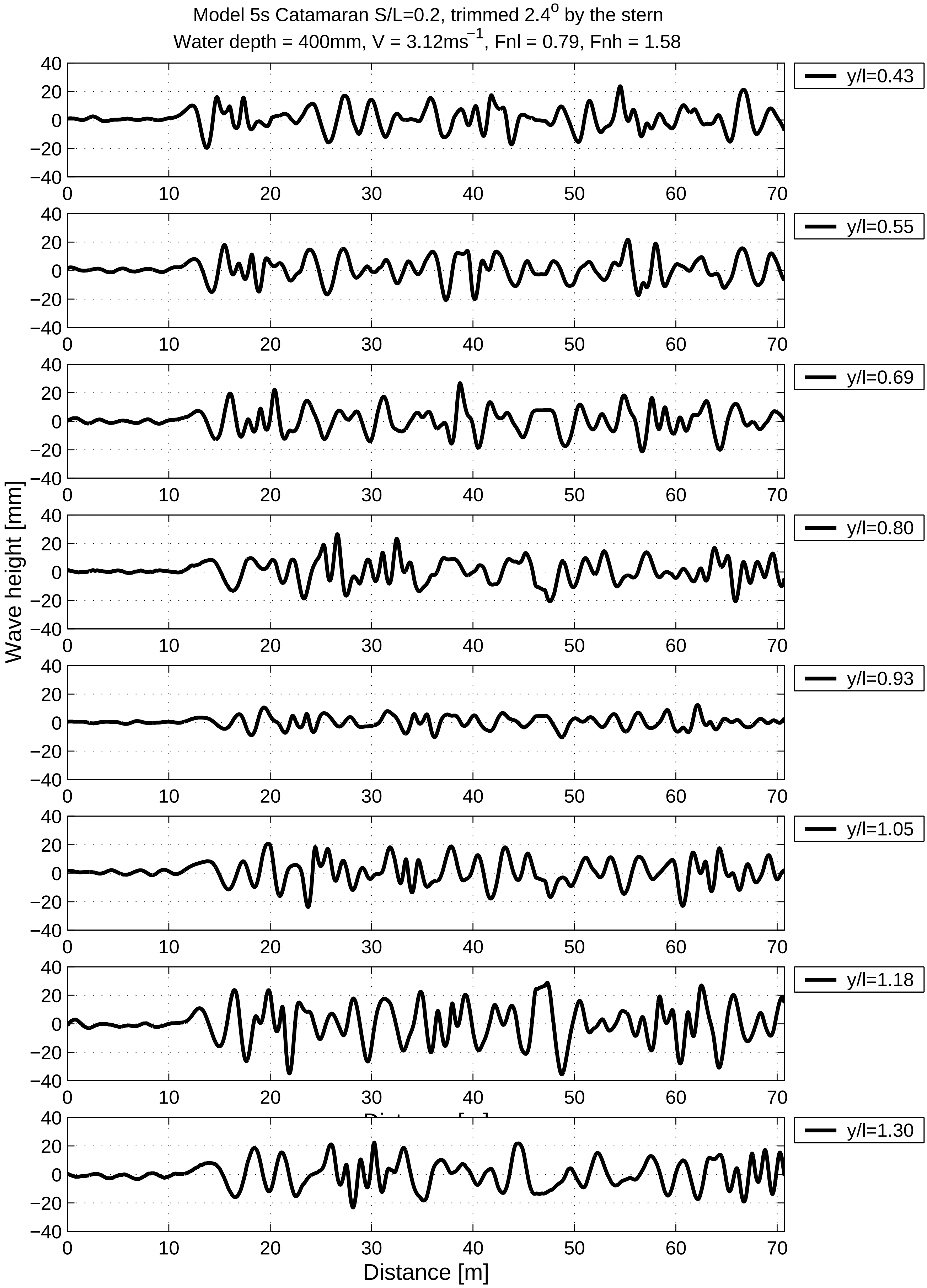
Model 5s Catamaran S/L=0.2, trimmed 2.4° by the stern
Water depth = 400mm, V = 1.03ms⁻¹, Fnl = 0.26, Fnh = 0.52
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 22



Model 5s Catamaran S/L=0.2, trimmed 2.4° by the stern
Water depth = 400mm, V = 2.03ms⁻¹, Fnl = 0.51, Fnh = 1.02
Wave height [mm]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Distance [m]

Figure 23



Model 5s Catamaran S/L=0.2, trimmed 2.4° by the stern
Water depth = 400mm, V = 3.12ms⁻¹, Fnl = 0.79, Fnh = 1.58
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 24

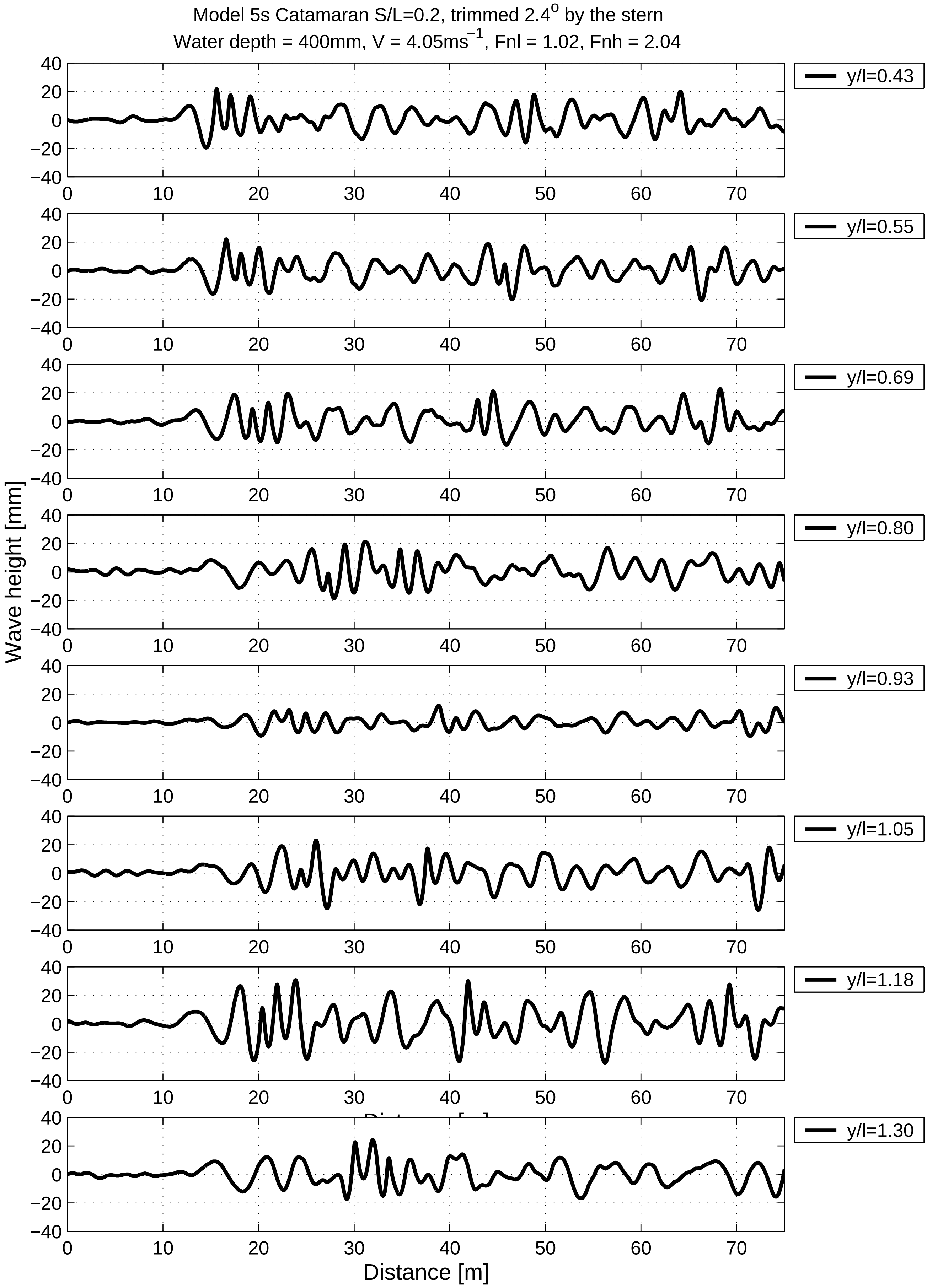

Model 5s Catamaran S/L=0.2, trimmed 2.4° by the stern
Water depth = 400mm, V = 4.05ms⁻¹, Fnl = 1.02, Fnh = 2.04
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 25

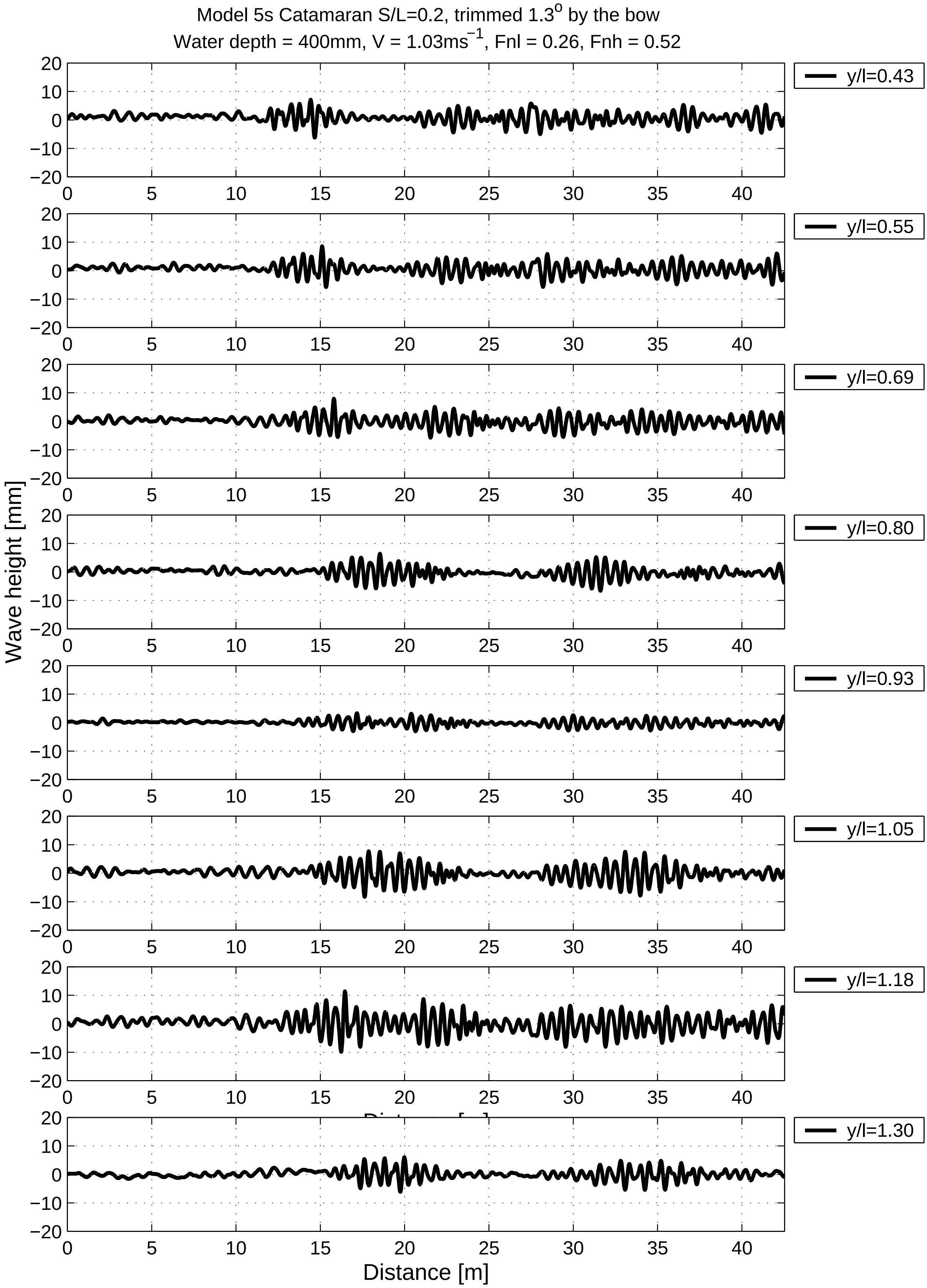

Model 5s Catamaran S/L=0.2, trimmed 1.3° by the bow
Water depth = 400mm, V = 1.03ms⁻¹, Fnl = 0.26, Fnh = 0.52
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
20
10
0
−10
−20
0
5
10
15
20
25
30
35
40

Figure 26

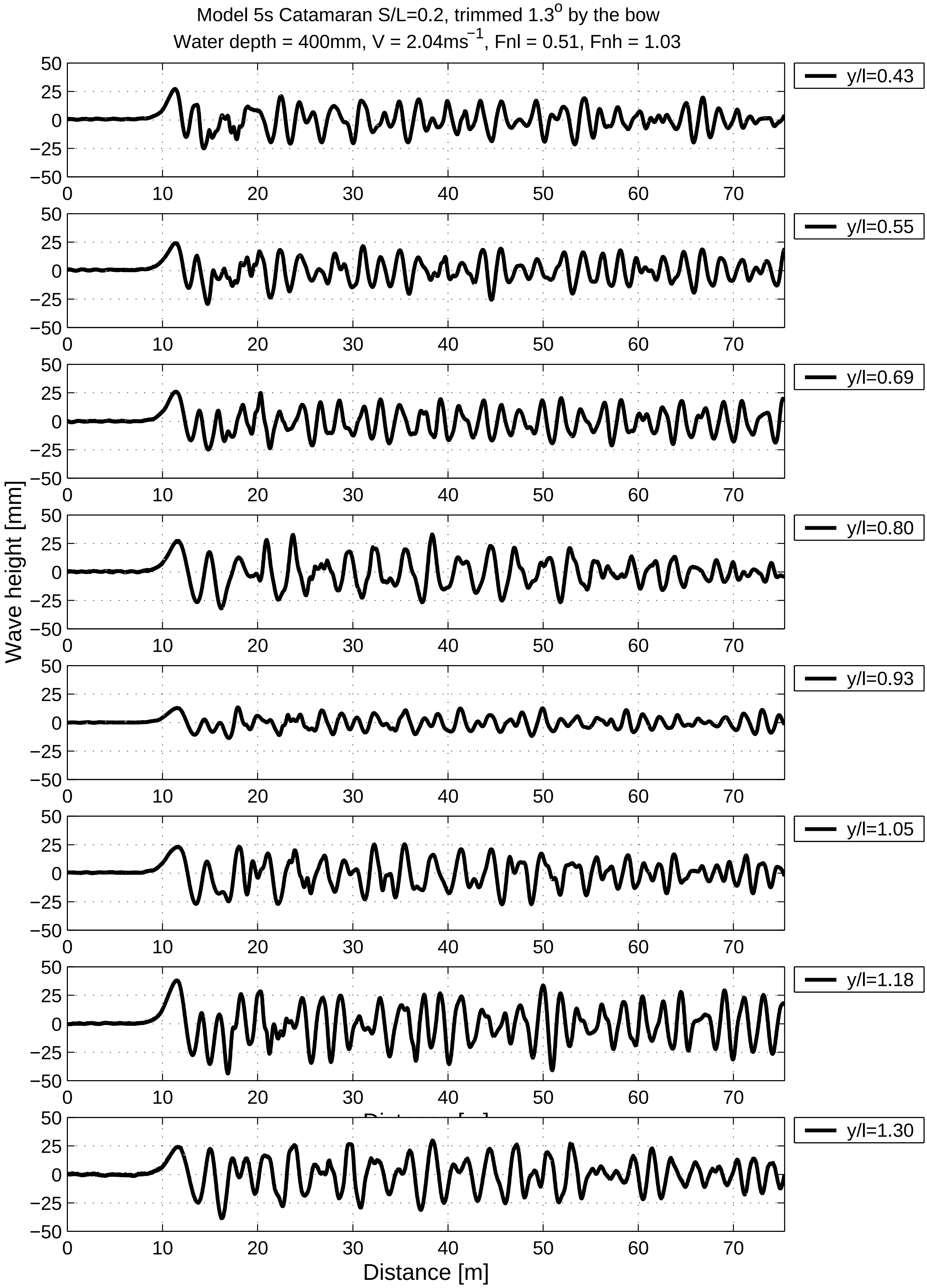
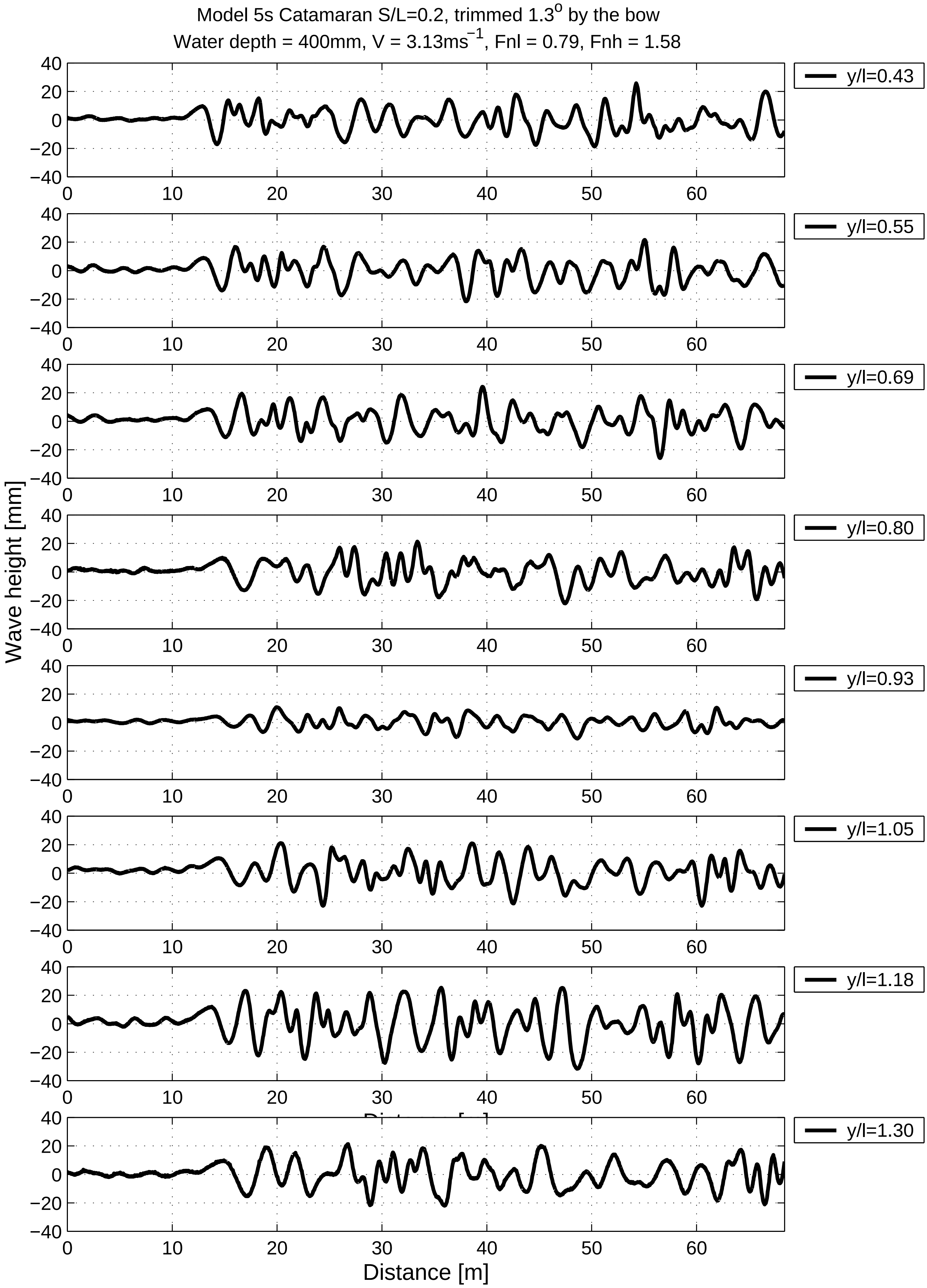
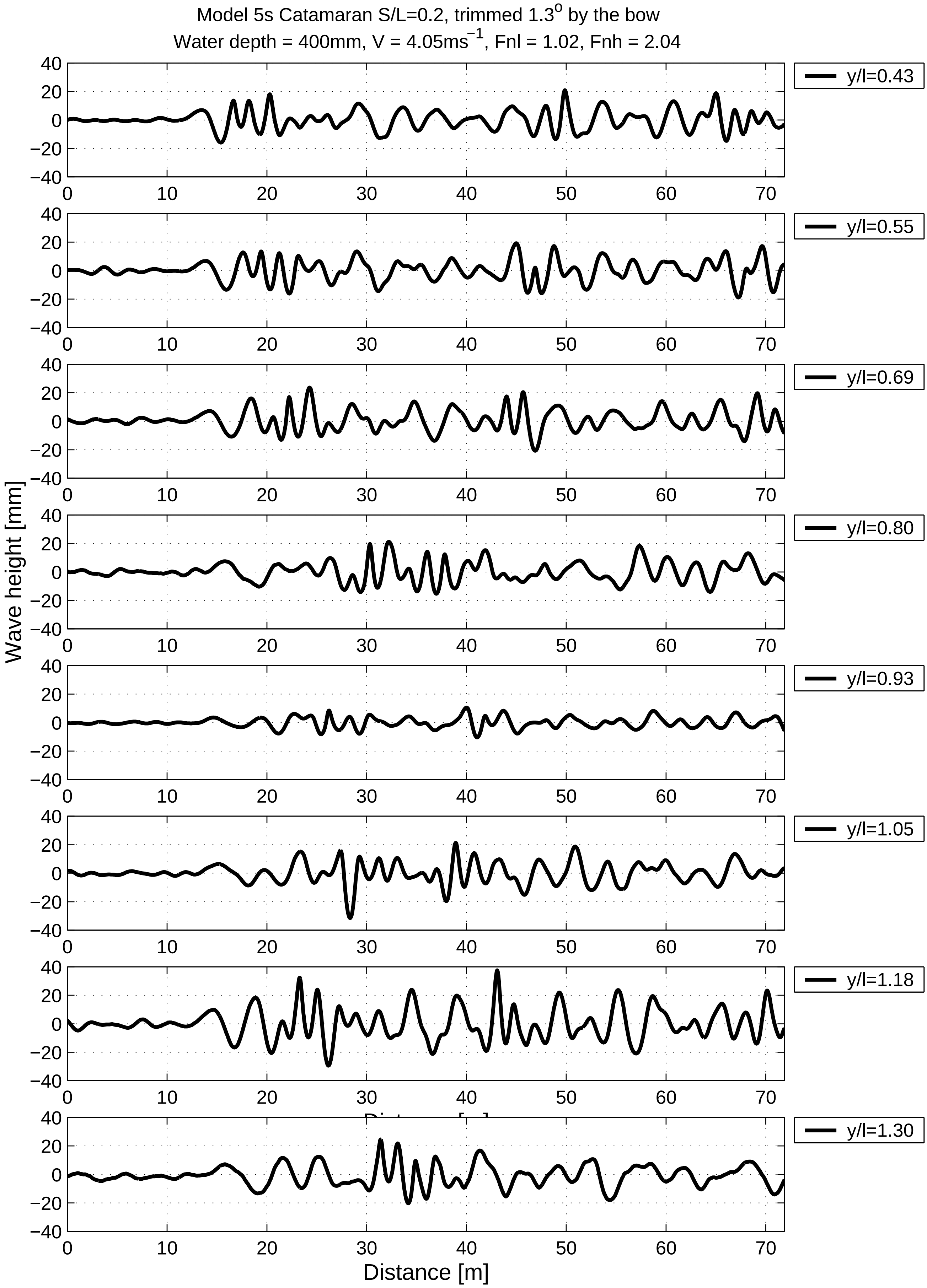

Model 5s Catamaran S/L=0.2, trimmed 1.3° by the bow
Water depth = 400mm, V = 2.04ms−1, Fnl = 0.51, Fnh = 1.03
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]
50
25
0
−25
−50
0
10
20
30
40
50
60
70

Figure 27



Model 5s Catamaran S/L=0.2, trimmed 1.3° by the bow
Water depth = 400mm, V = 3.13ms⁻¹, Fnl = 0.79, Fnh = 1.58
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 28



Model 5s Catamaran S/L=0.2, trimmed 1.3° by the bow
Water depth = 400mm, V = 4.05ms⁻¹, Fnl = 1.02, Fnh = 2.04
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 29

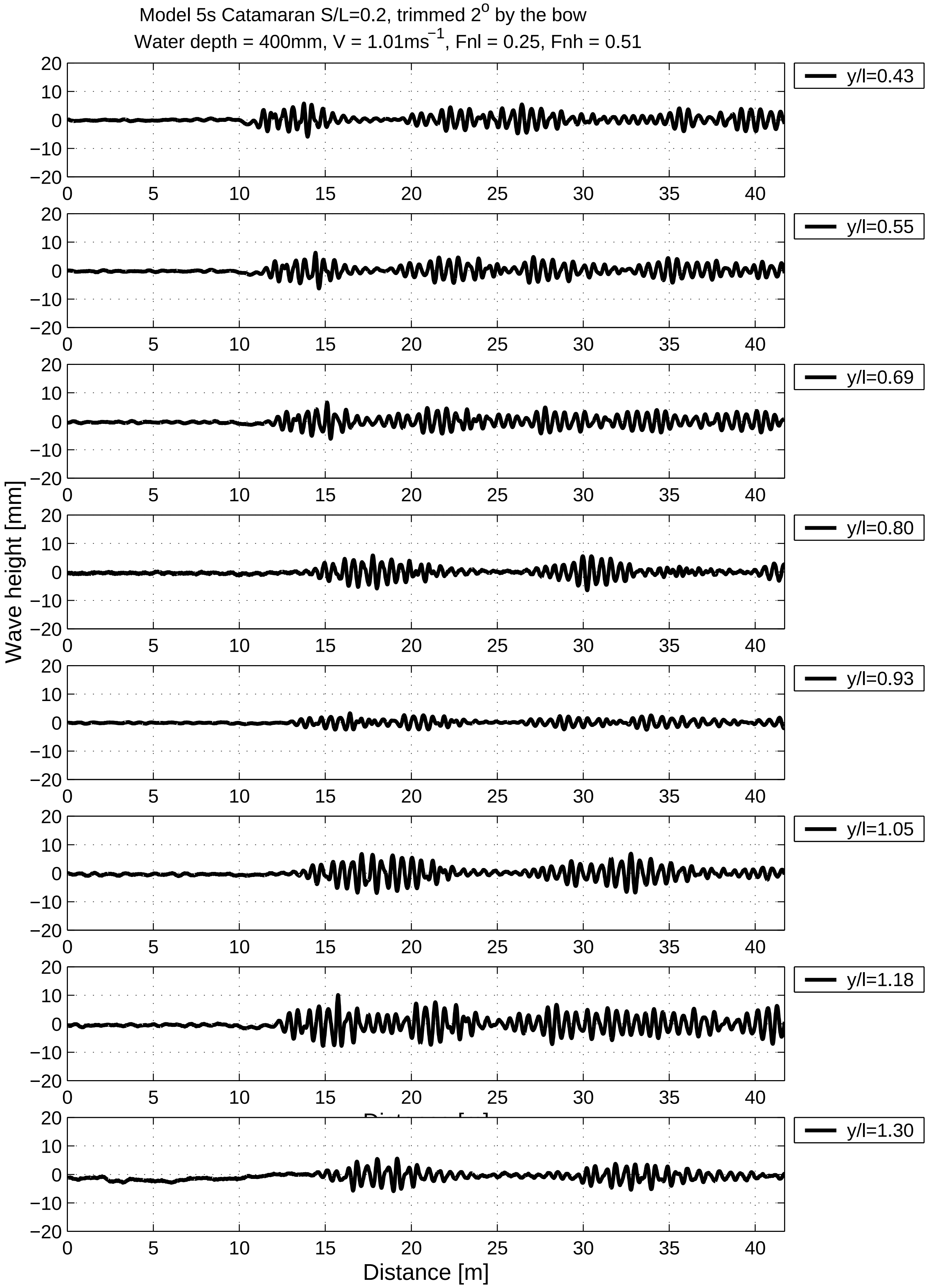
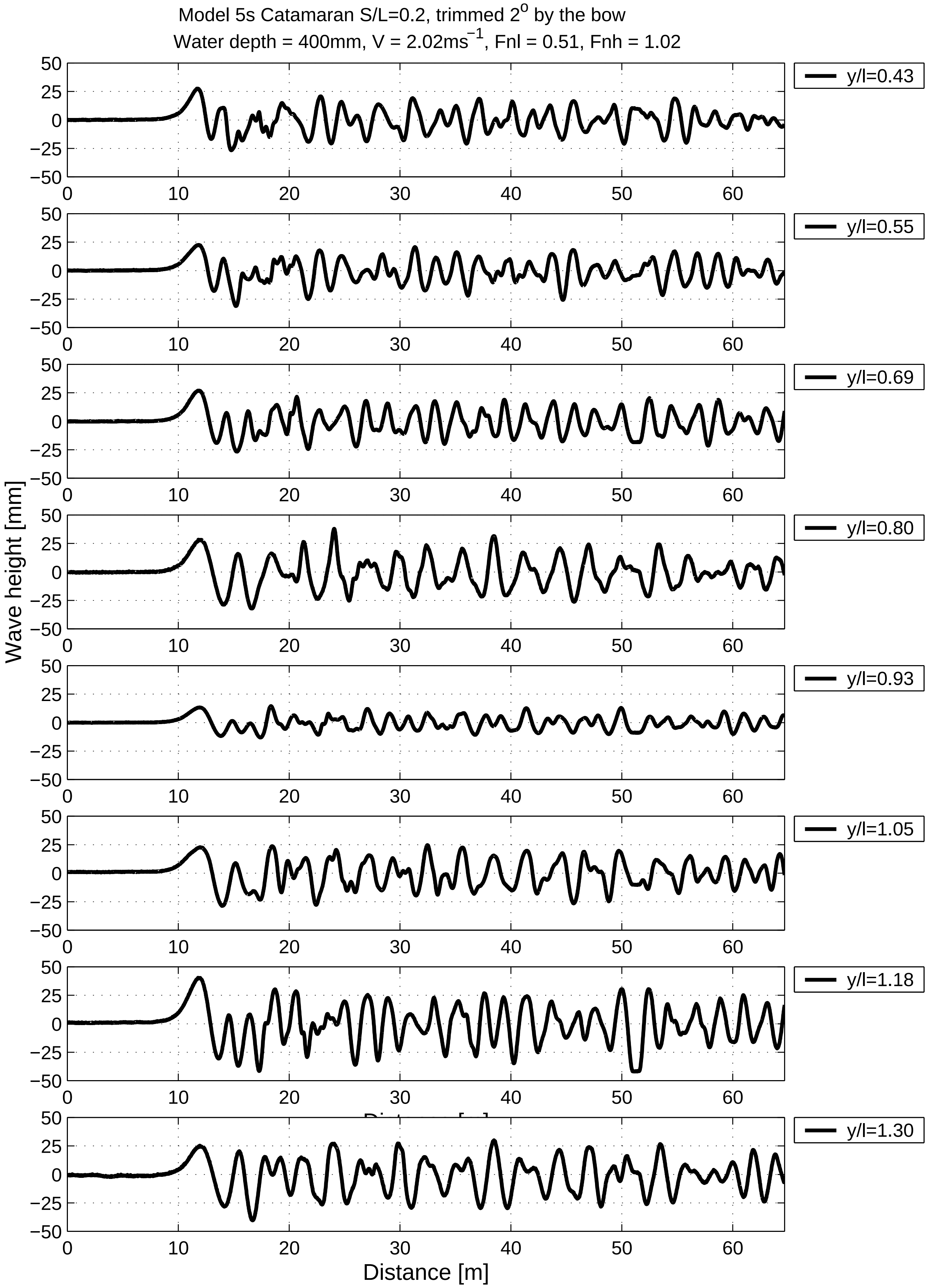
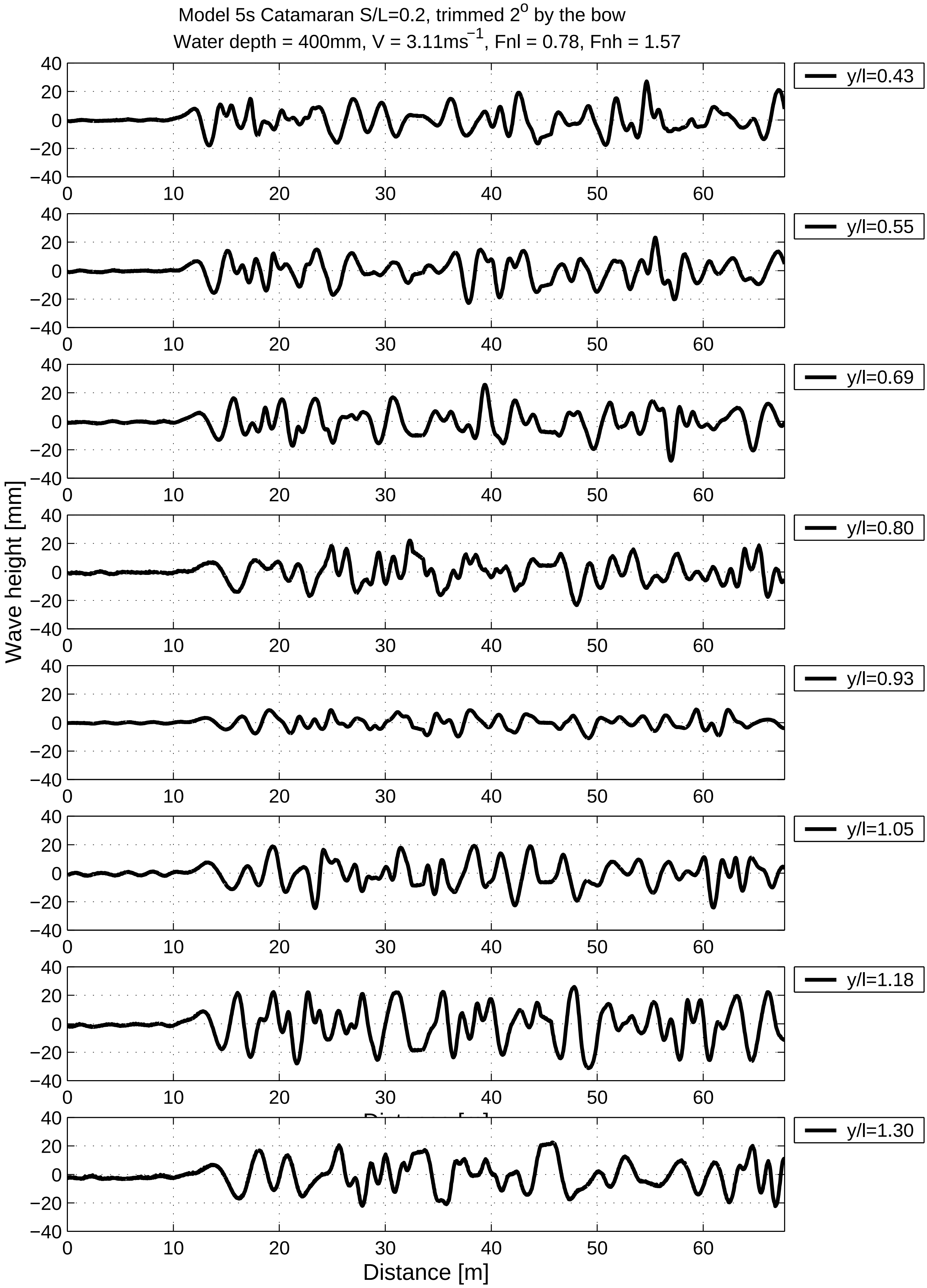

Model 5s Catamaran S/L=0.2, trimmed 2° by the bow
Water depth = 400mm, V = 1.01ms⁻¹, Fnl = 0.25, Fnh = 0.51
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 30



Model 5s Catamaran S/L=0.2, trimmed 2° by the bow
Water depth = 400mm, V = 2.02ms⁻¹, Fnl = 0.51, Fnh = 1.02
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 31



Model 5s Catamaran S/L=0.2, trimmed 2^{o} by the bow
Water depth = 400mm, V = 3.11ms^{-1}, Fnl = 0.78, Fnh = 1.57
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 32

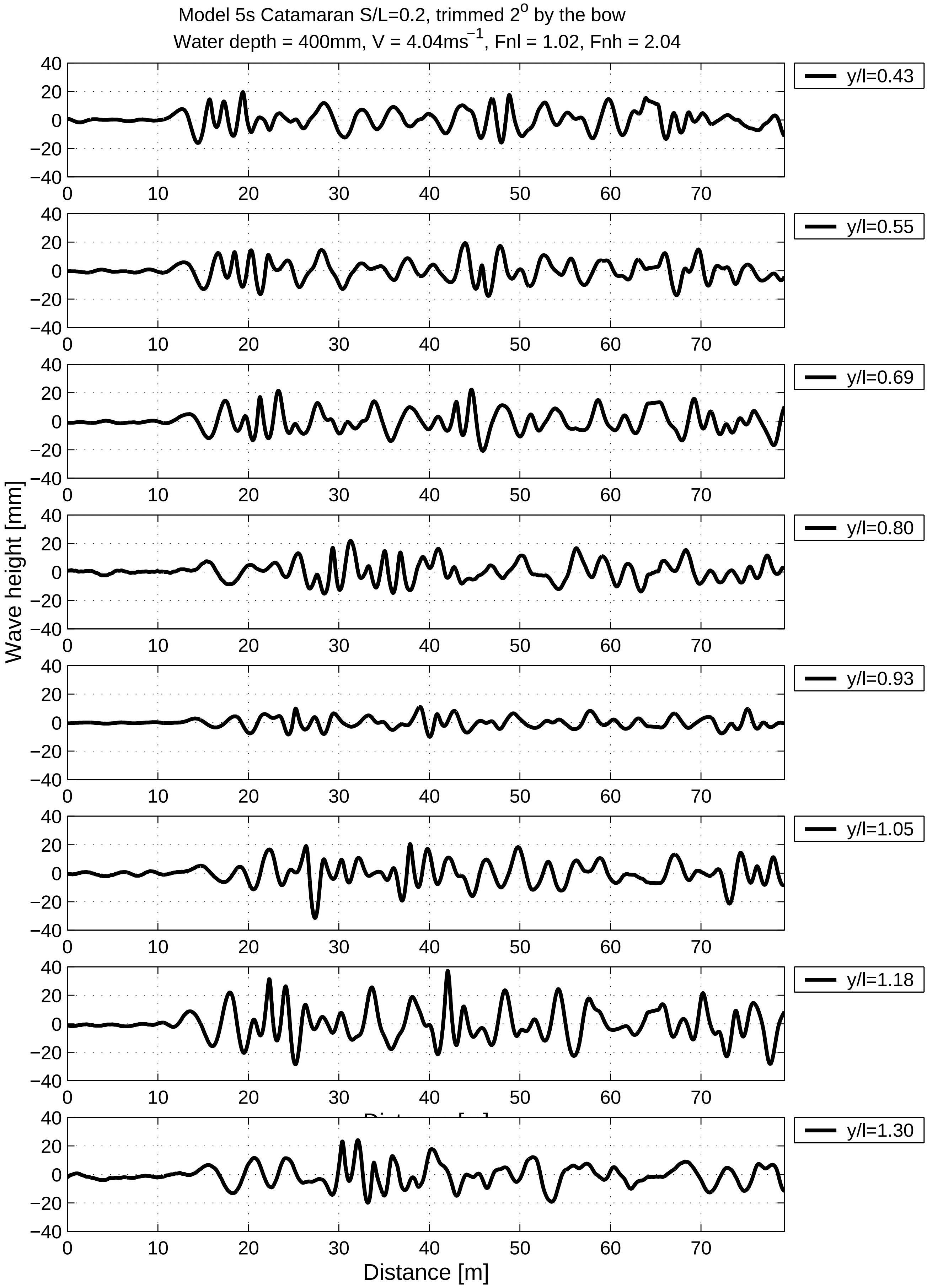

Model 5s Catamaran S/L=0.2, trimmed 2^{o} by the bow
Water depth = 400mm, V = 4.04ms^{-1}, Fnl = 1.02, Fnh = 2.04
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 33

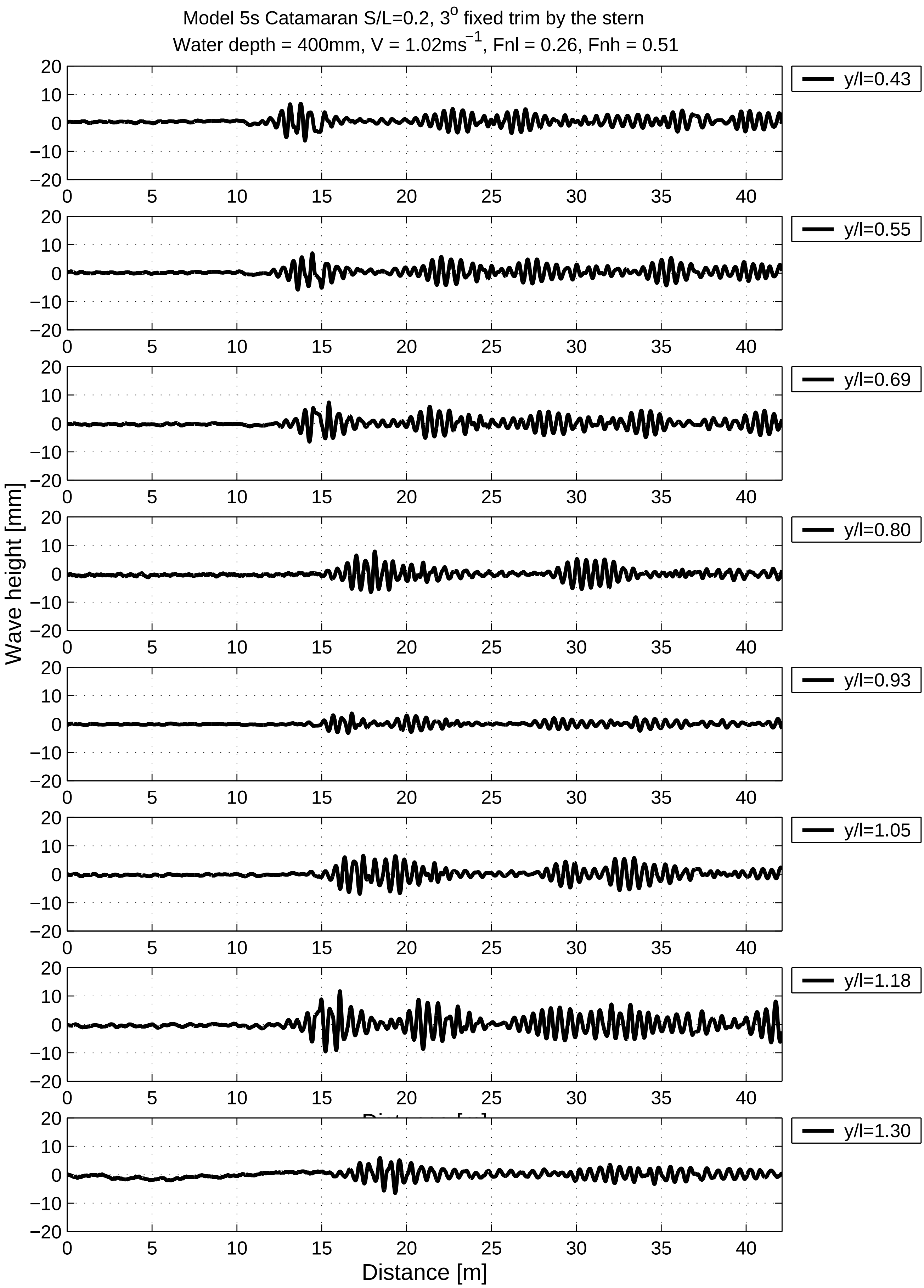

Model 5s Catamaran S/L=0.2, 3° fixed trim by the stern
Water depth = 400mm, V = 1.02ms⁻¹, Fnl = 0.26, Fnh = 0.51
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 34

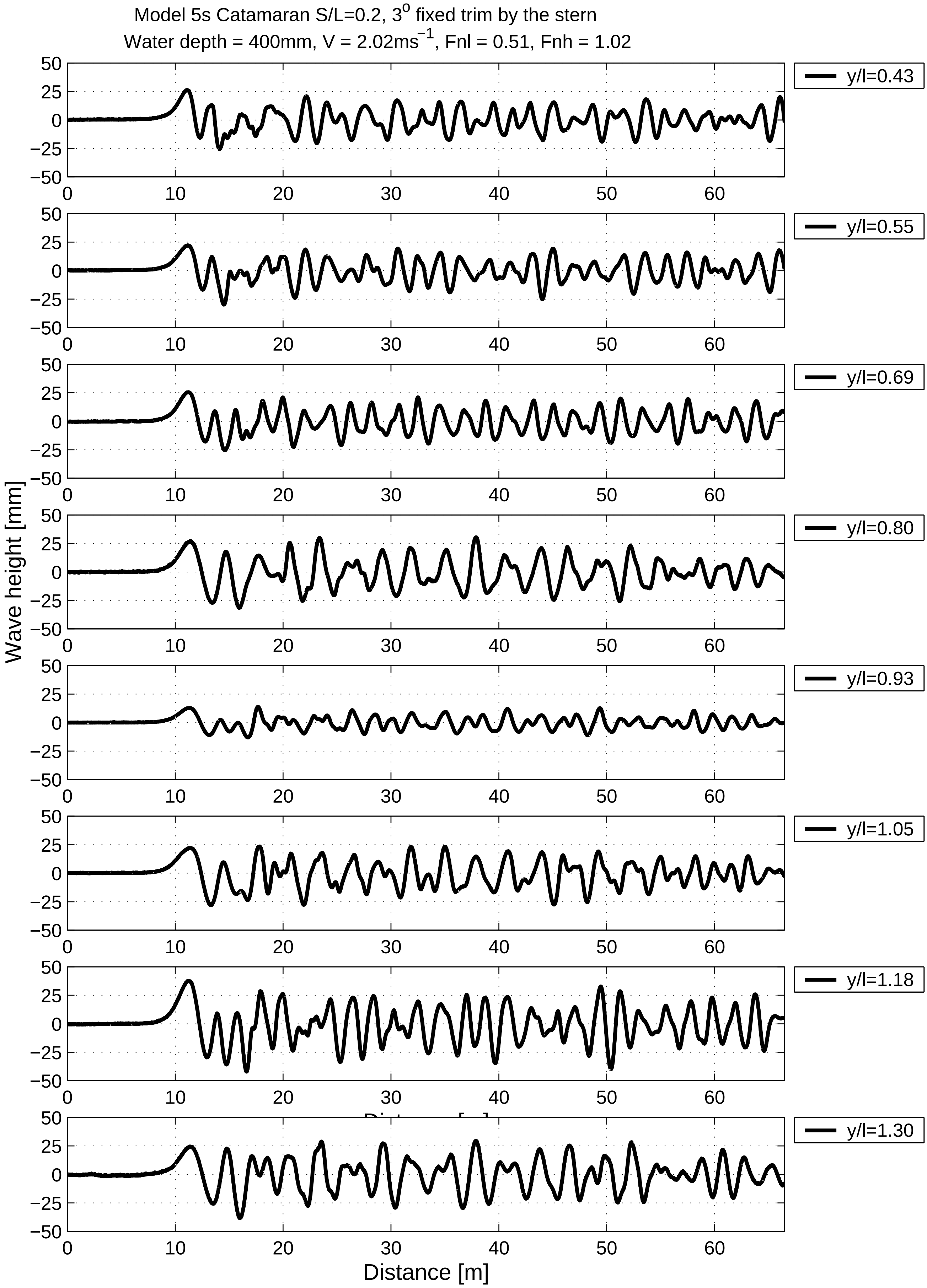
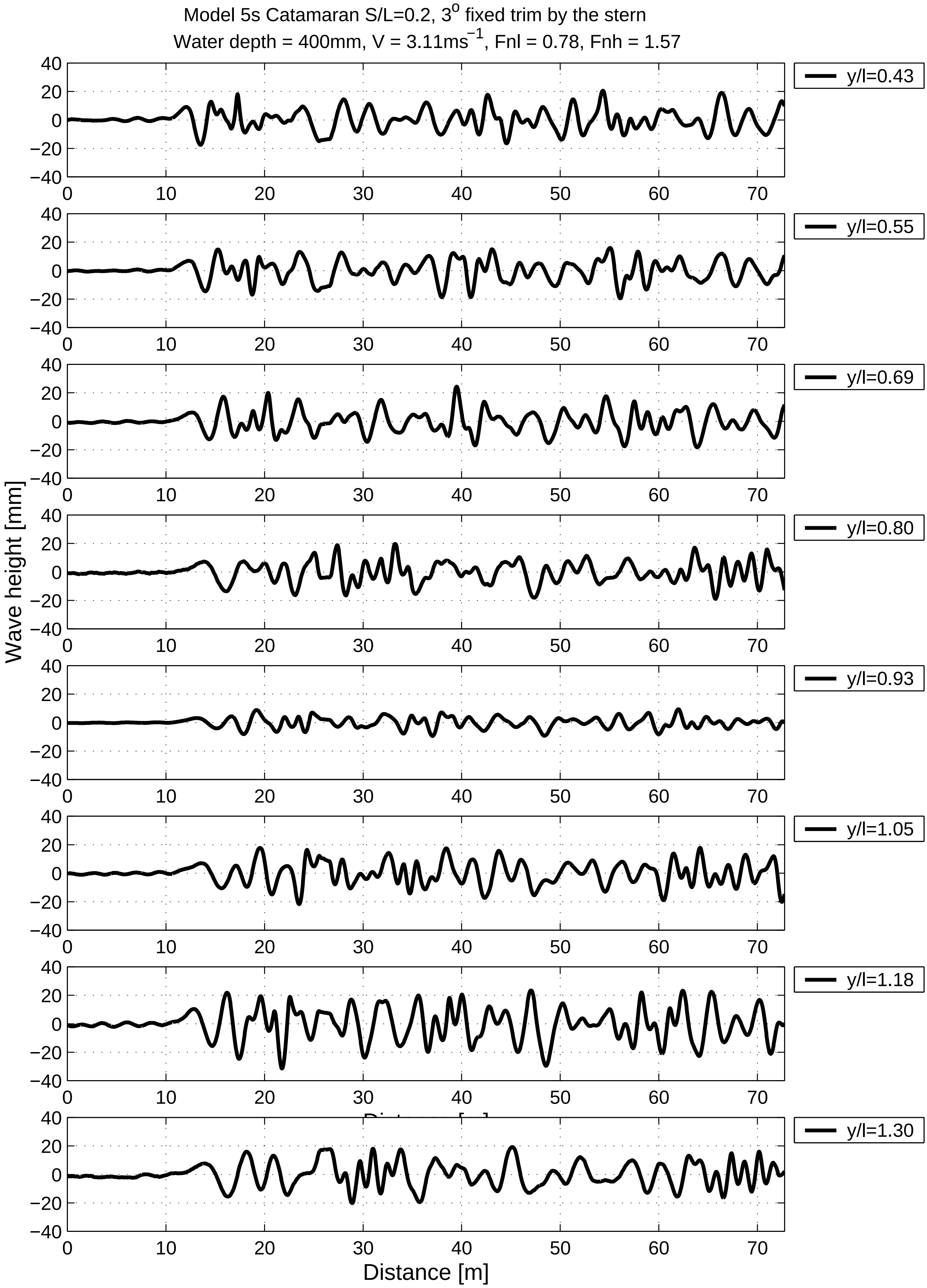

Model 5s Catamaran S/L=0.2, 3° fixed trim by the stern
Water depth = 400mm, V = 2.02ms⁻¹, Fnl = 0.51, Fnh = 1.02
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 35



Model 5s Catamaran S/L=0.2, 3° fixed trim by the stern
Water depth = 400mm, V = 3.11ms⁻¹, Fnl = 0.78, Fnh = 1.57
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
40
20
0
−20
−40
0
10
20
30
40
50
60
70

Figure 36

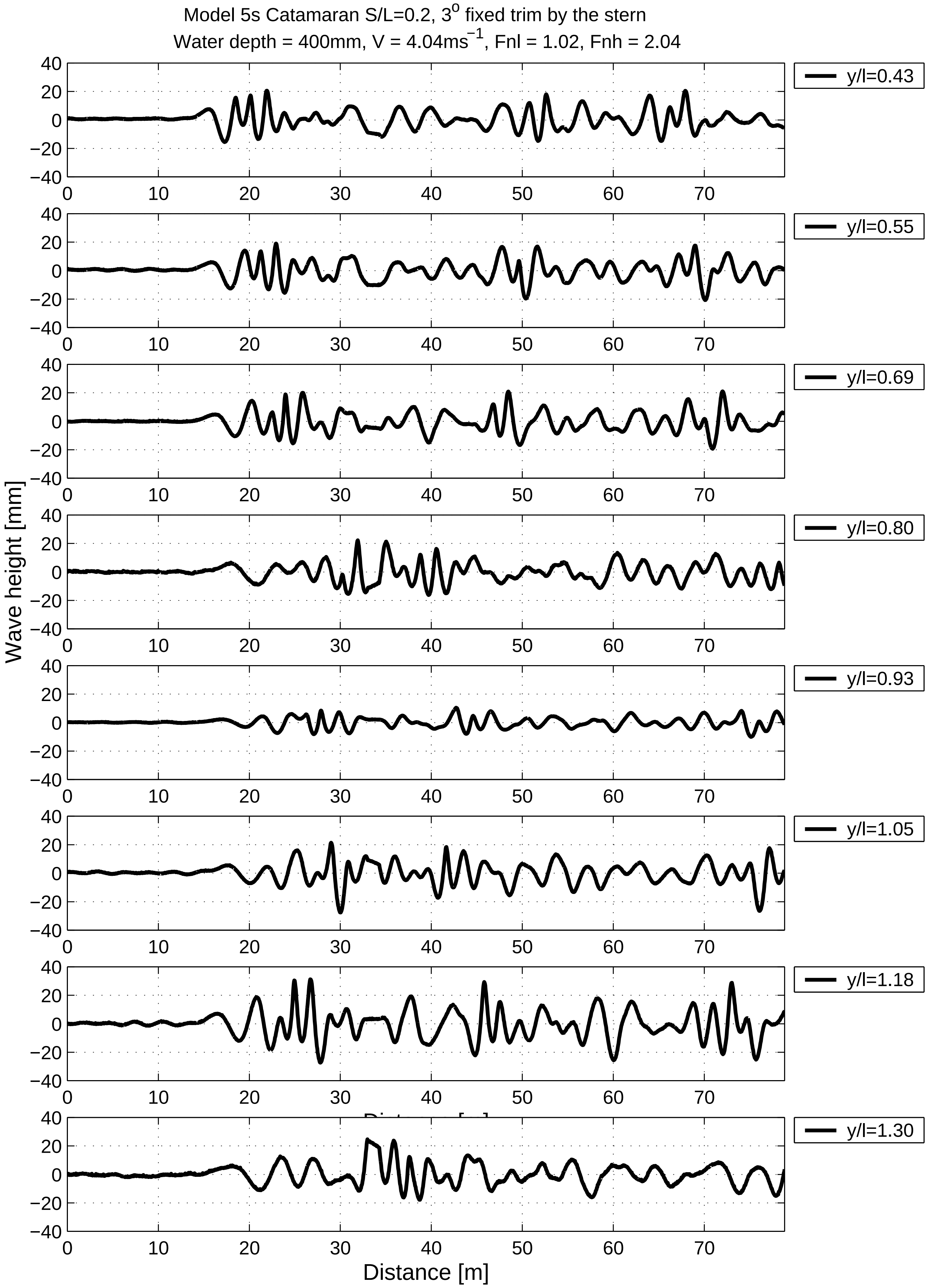
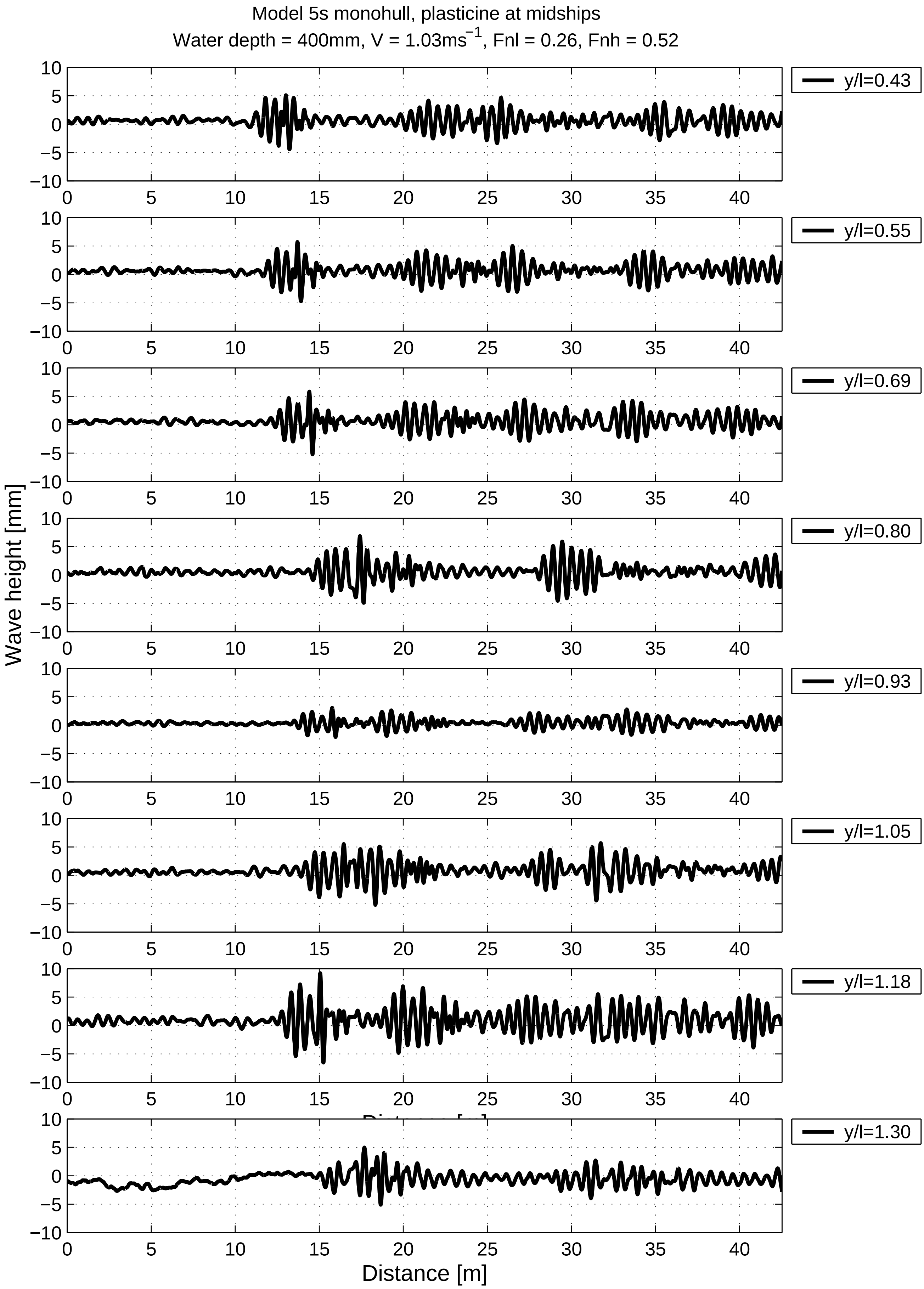

Model 5s Catamaran S/L=0.2, 3° fixed trim by the stern
Water depth = 400mm, V = 4.04ms⁻¹, Fnl = 1.02, Fnh = 2.04
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 37



Model 5s monohull, plasticine at midships
Water depth = 400mm, V = 1.03ms^{-1}, Fnl = 0.26, Fnh = 0.52
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 38

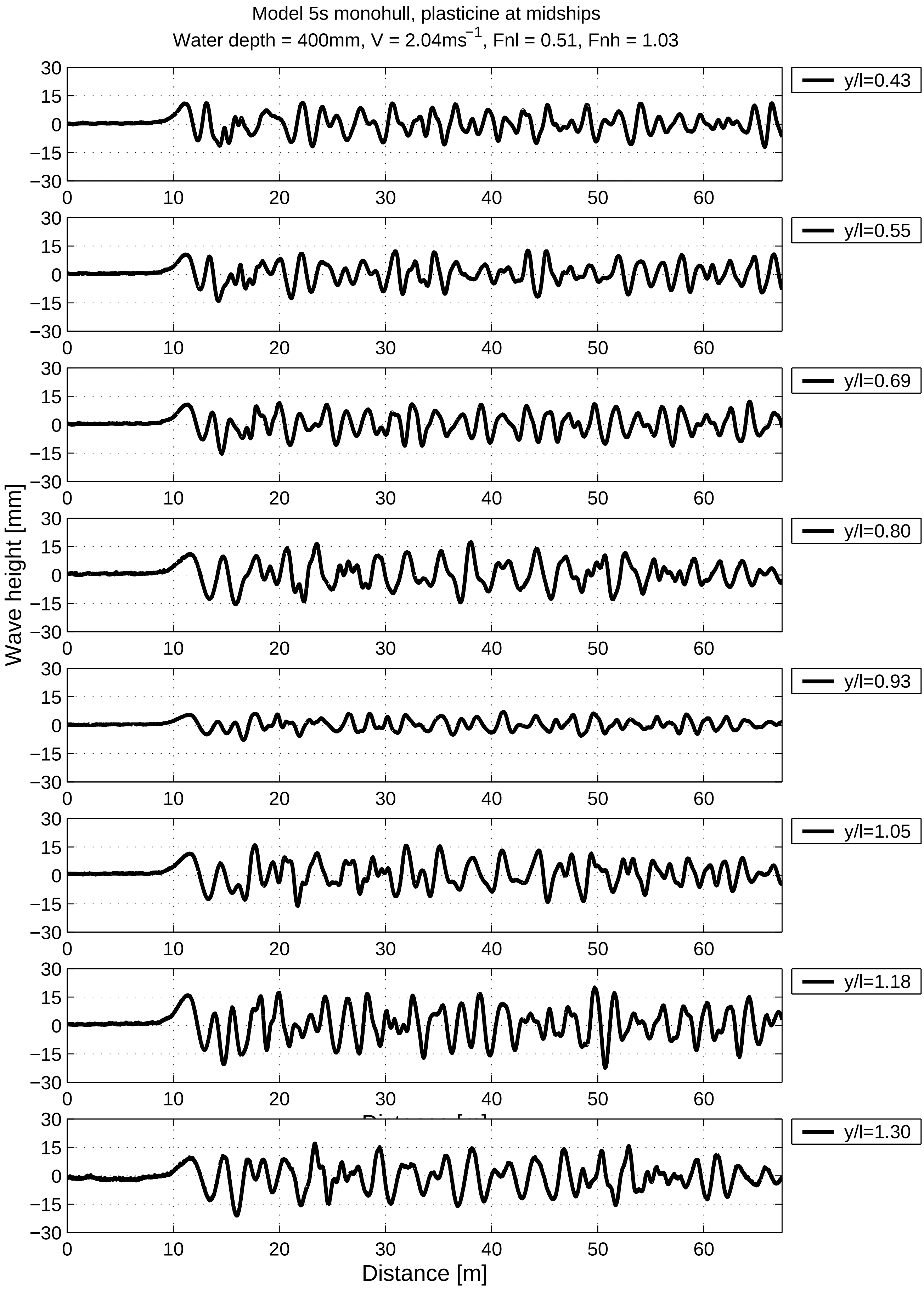
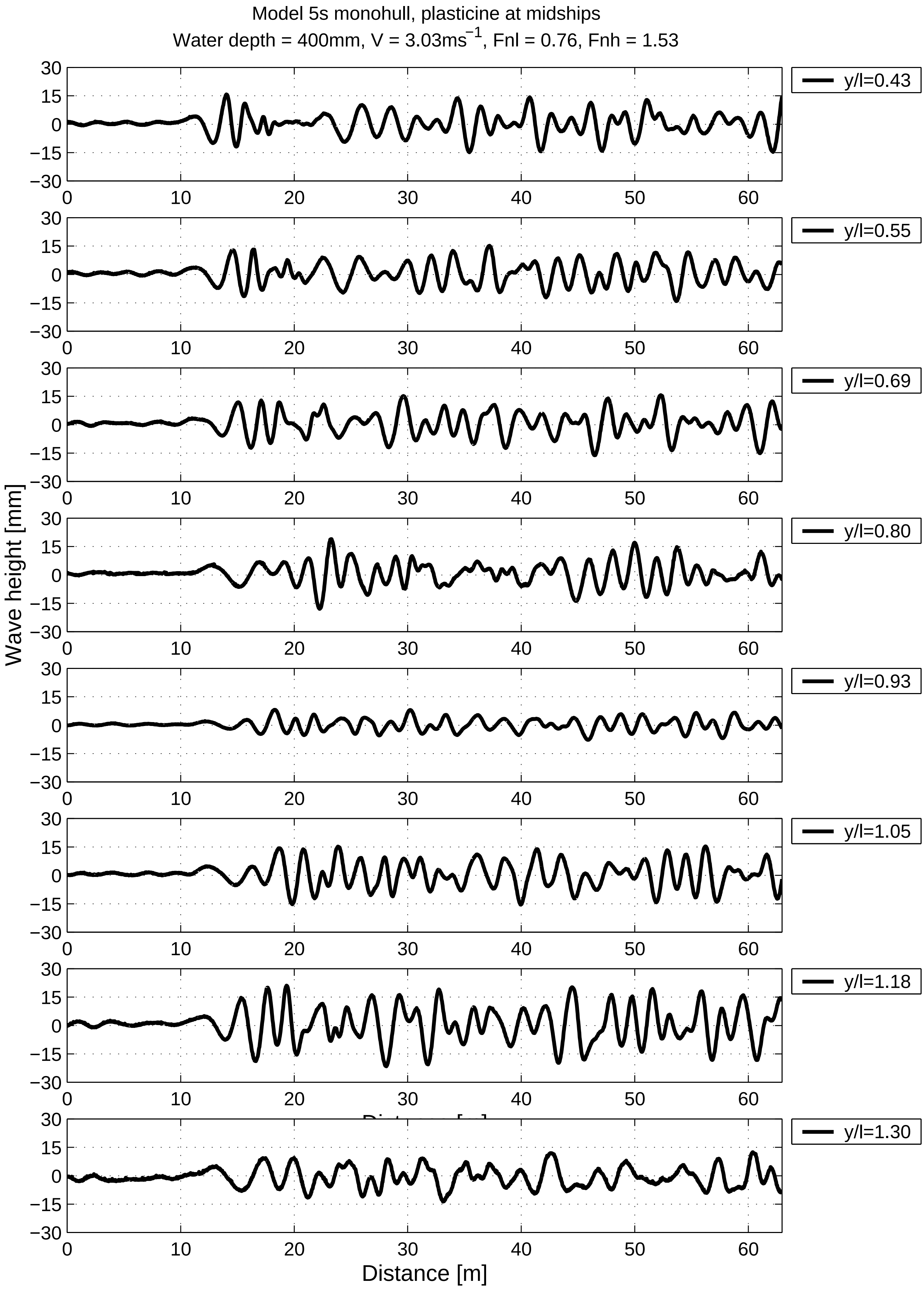
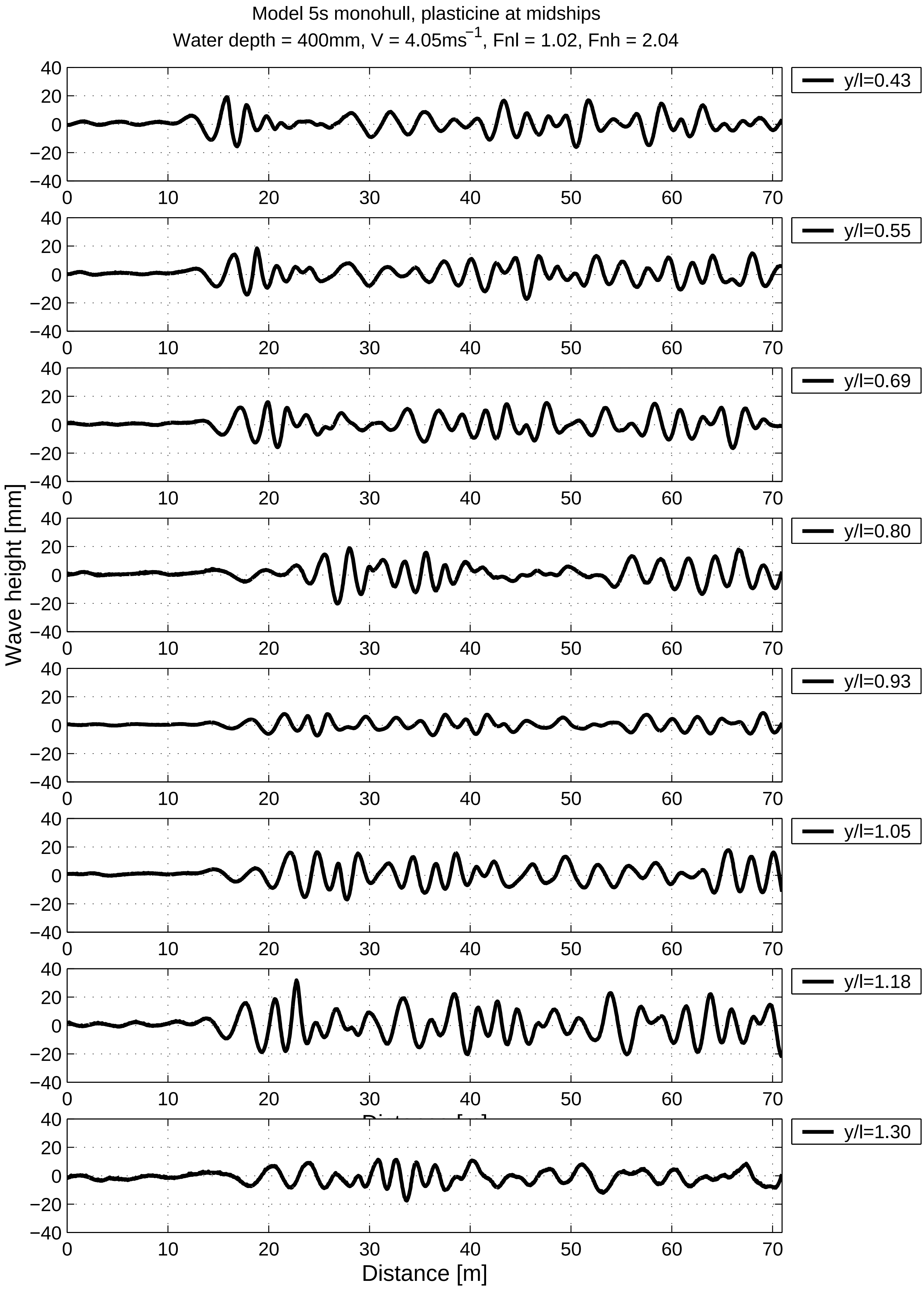

Model 5s monohull, plasticine at midships
Water depth = 400mm, V = 2.04ms^{-1}, Fnl = 0.51, Fnh = 1.03
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 39



Model 5s monohull, plasticine at midships
Water depth = 400mm, V = 3.03ms^{-1}, Fnl = 0.76, Fnh = 1.53
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 40



Model 5s monohull, plasticine at midships
Water depth = 400mm, V = 4.05ms^{-1}, Fnl = 1.02, Fnh = 2.04
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 41

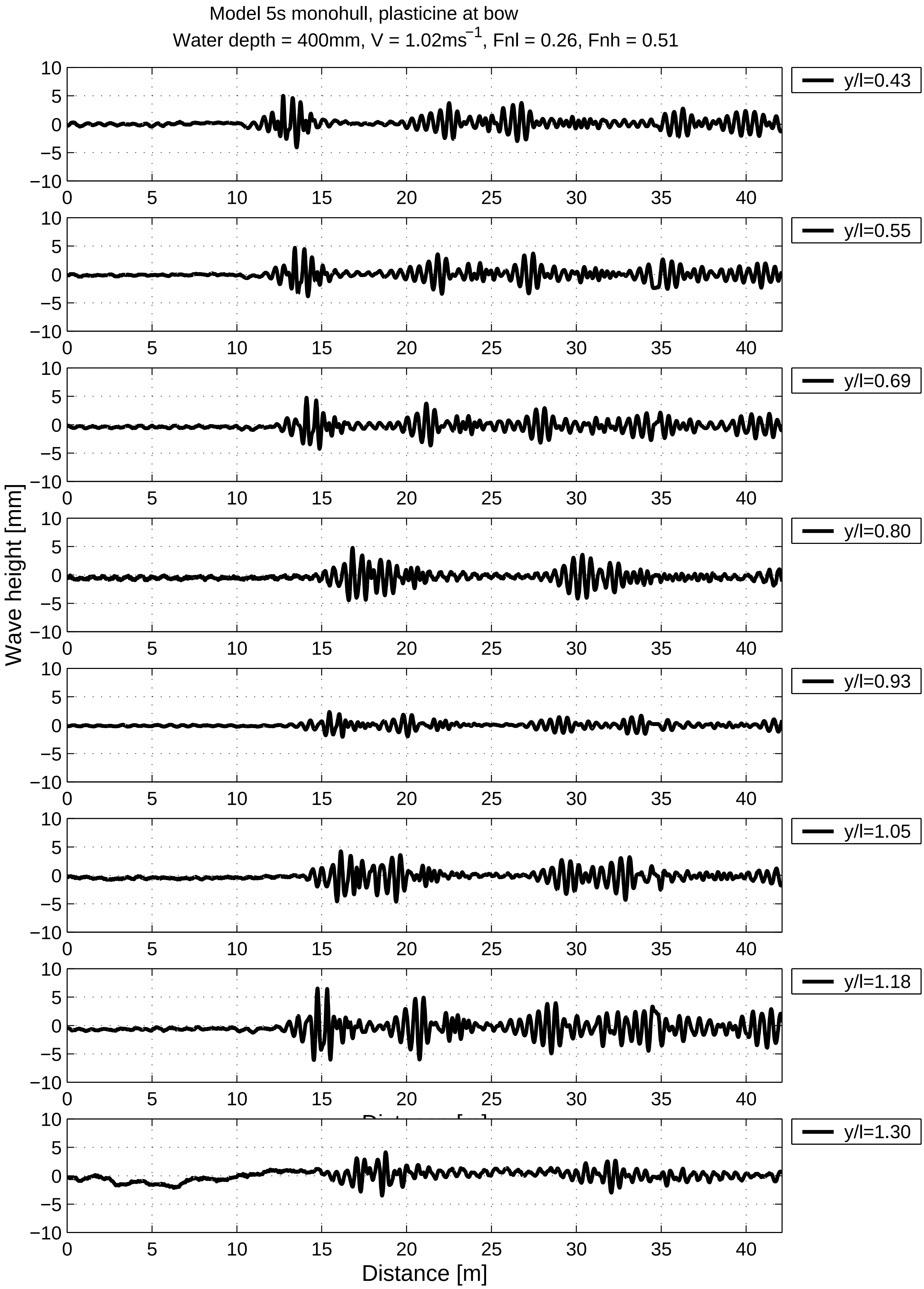
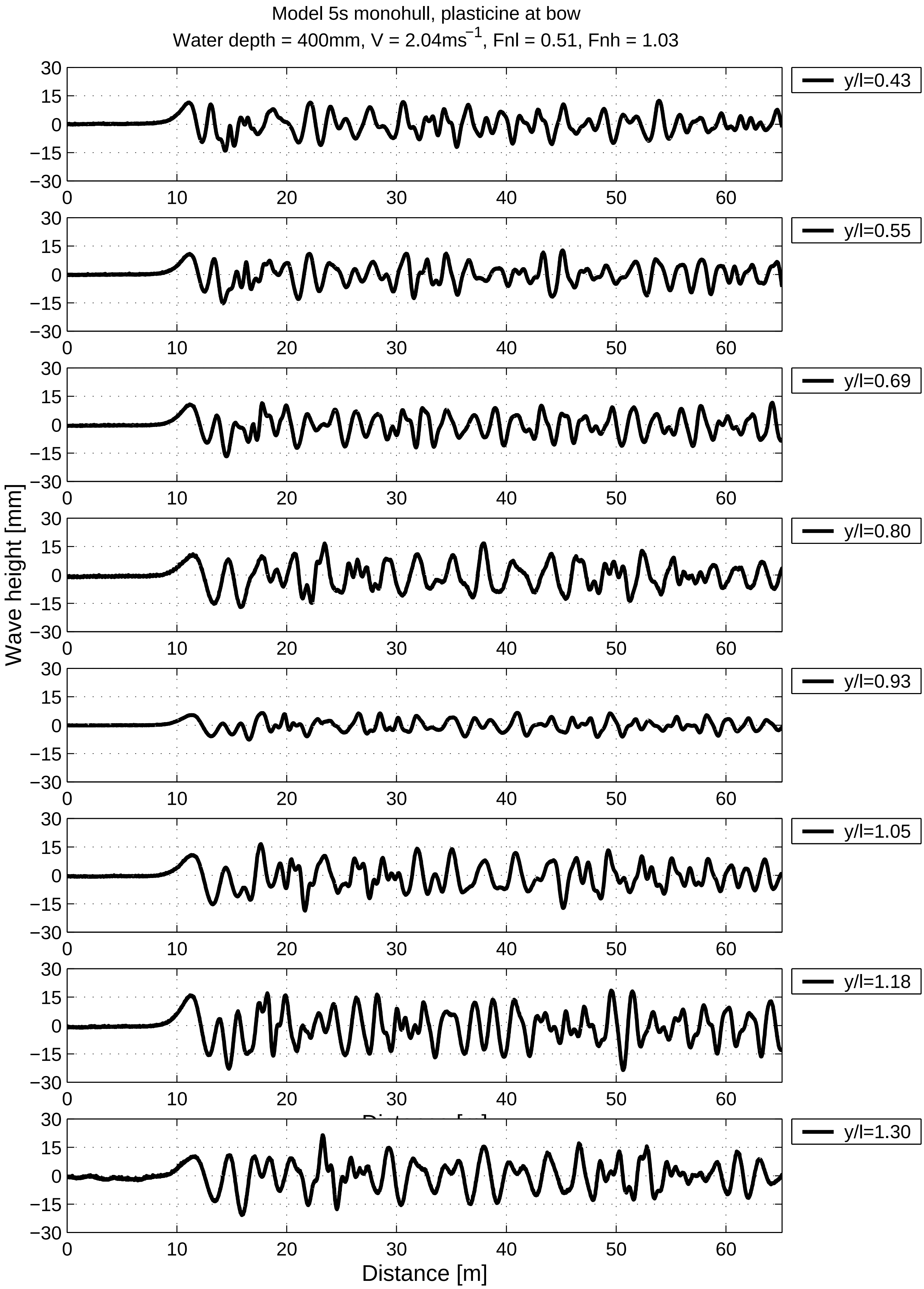

Model 5s monohull, plasticine at bow
Water depth = 400mm, V = 1.02ms^{-1}, Fnl = 0.26, Fnh = 0.51
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30

Figure 42


Model 5s monohull, plasticine at bow
Water depth = 400mm, V = 2.04ms^{-1}, Fnl = 0.51, Fnh = 1.03
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]
30
15
0
−15
−30
0
10
20
30
40
50
60
Figure 43

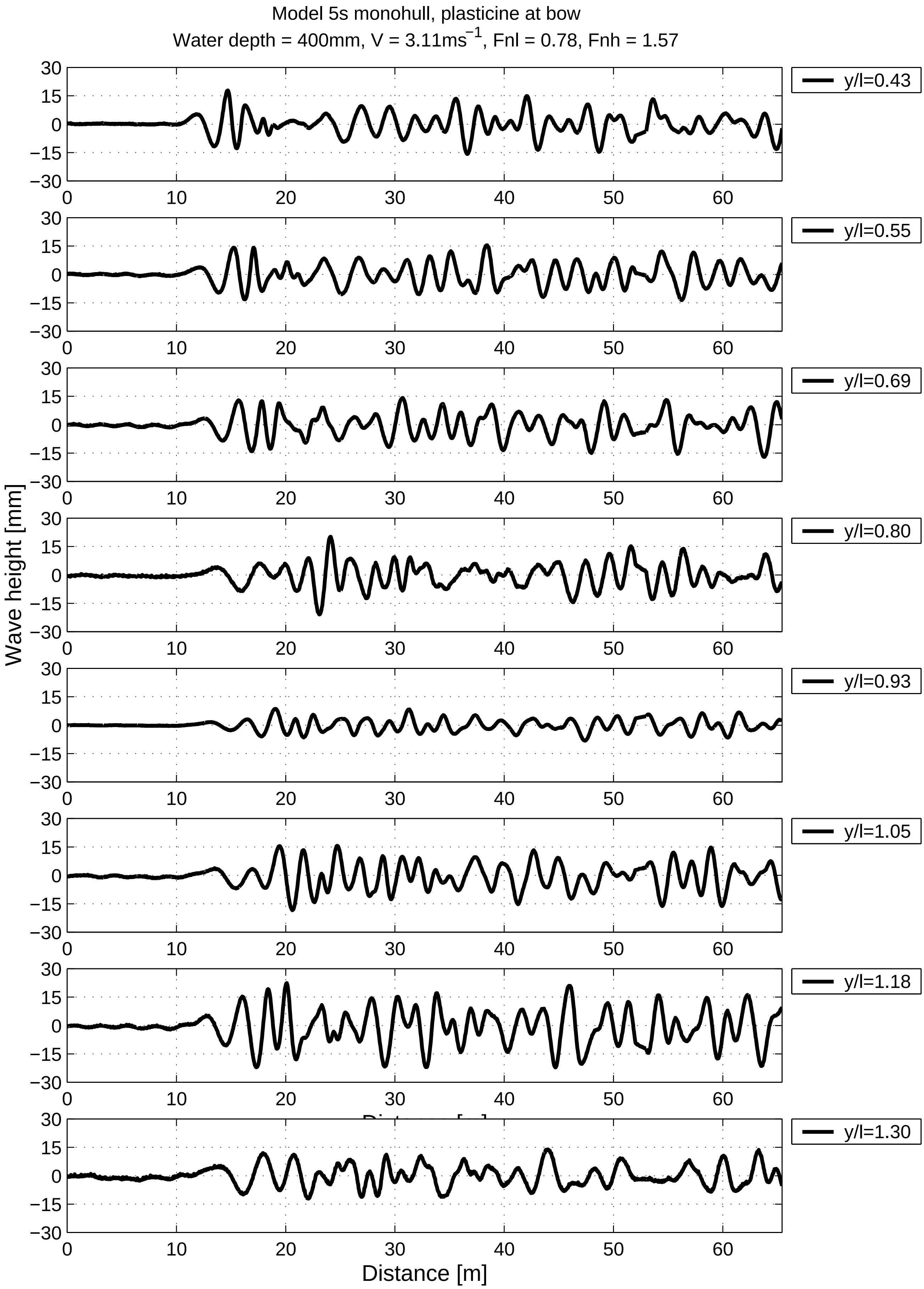
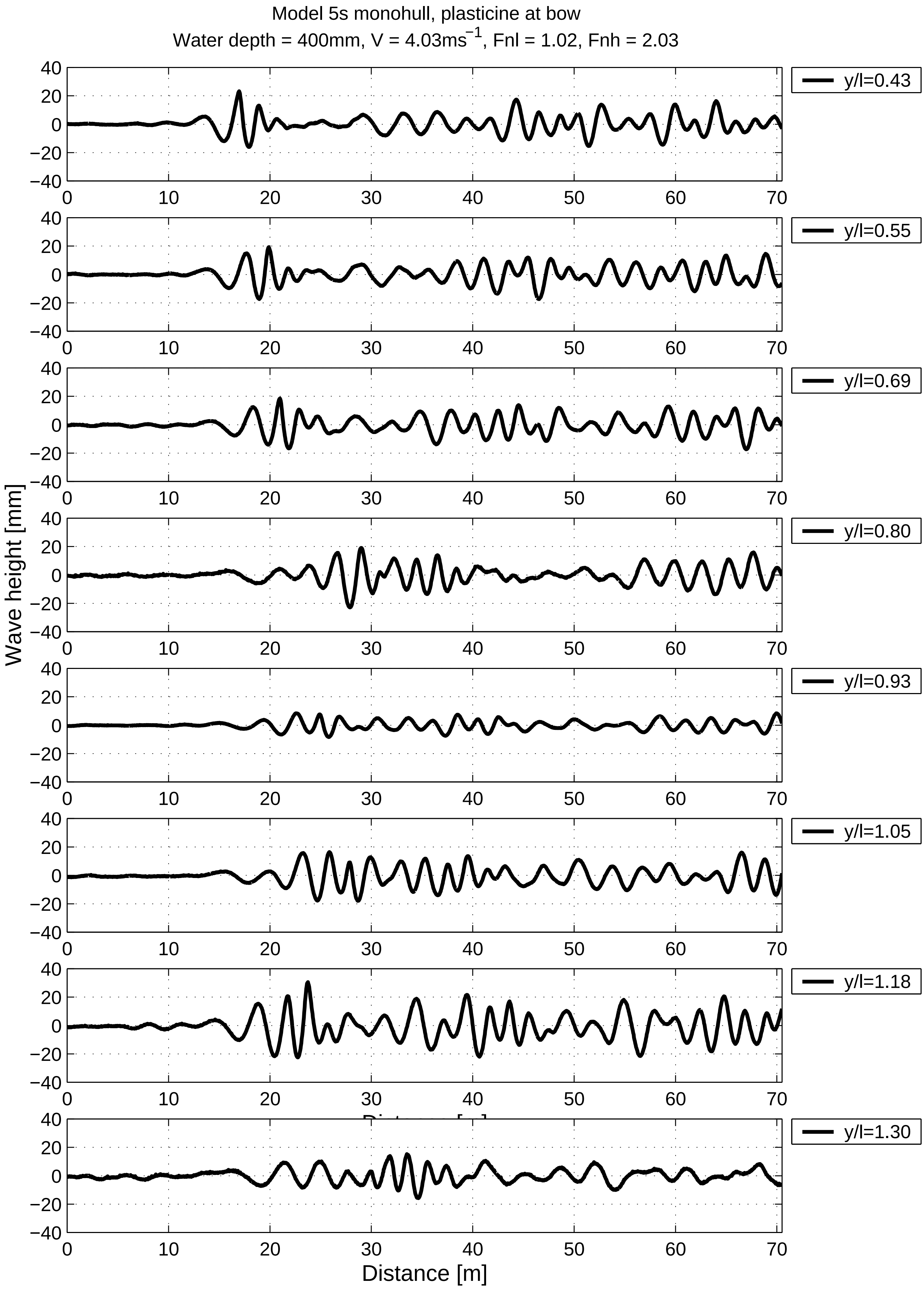
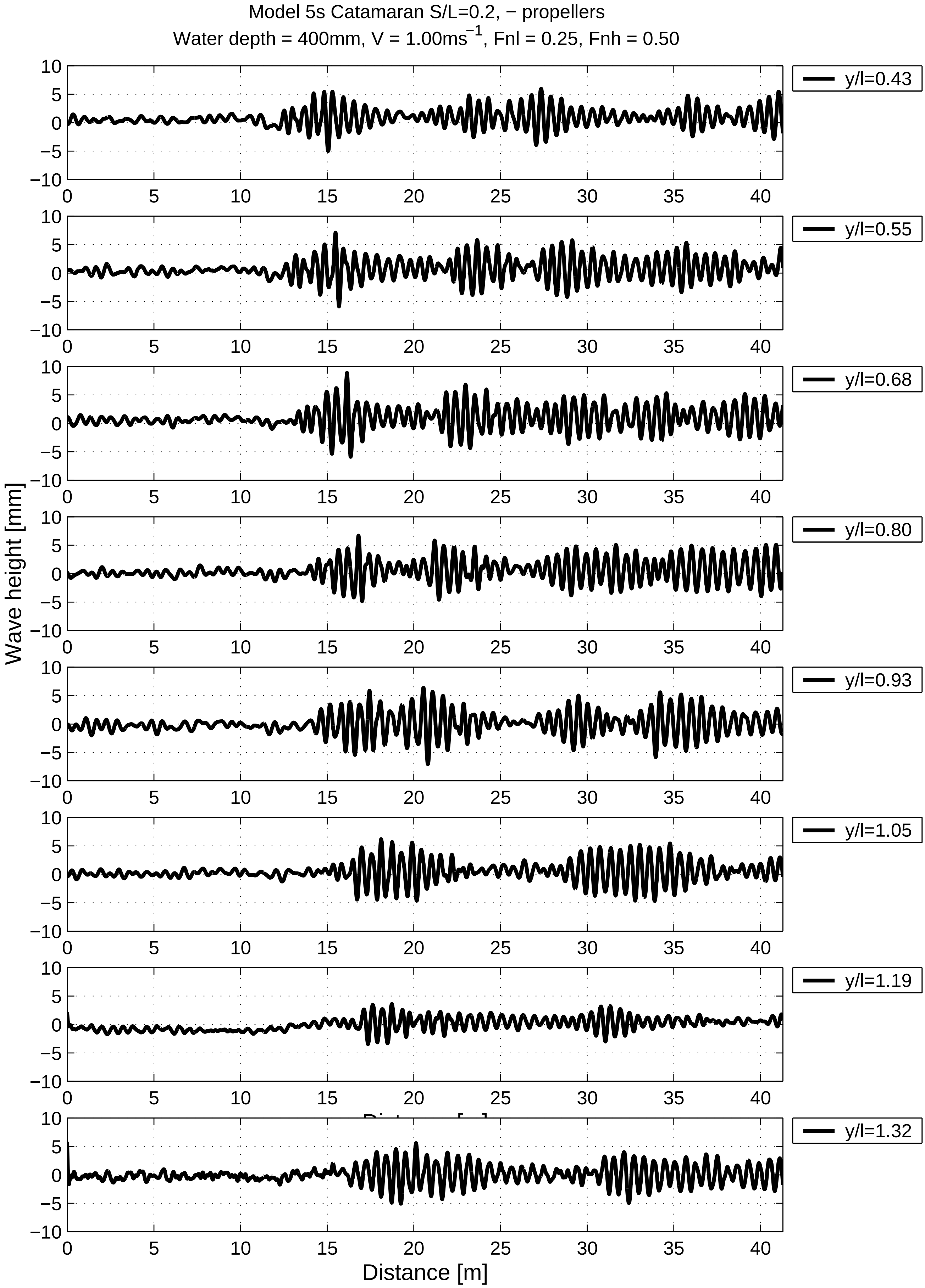

Model 5s monohull, plasticine at bow
Water depth = 400mm, V = 3.11ms^{-1}, Fnl = 0.78, Fnh = 1.57
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
30
15
0
−15
−30
0
10
20
30
40
50
60

Figure 44



Model 5s monohull, plasticine at bow
Water depth = 400mm, V = 4.03ms^{-1}, Fnl = 1.02, Fnh = 2.03
y/l=0.43
y/l=0.55
y/l=0.69
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.18
y/l=1.30
Wave height [mm]
Distance [m]

Figure 45



Model 5s Catamaran S/L=0.2, − propellers
Water depth = 400mm, V = 1.00ms^{-1}, Fnl = 0.25, Fnh = 0.50
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 46

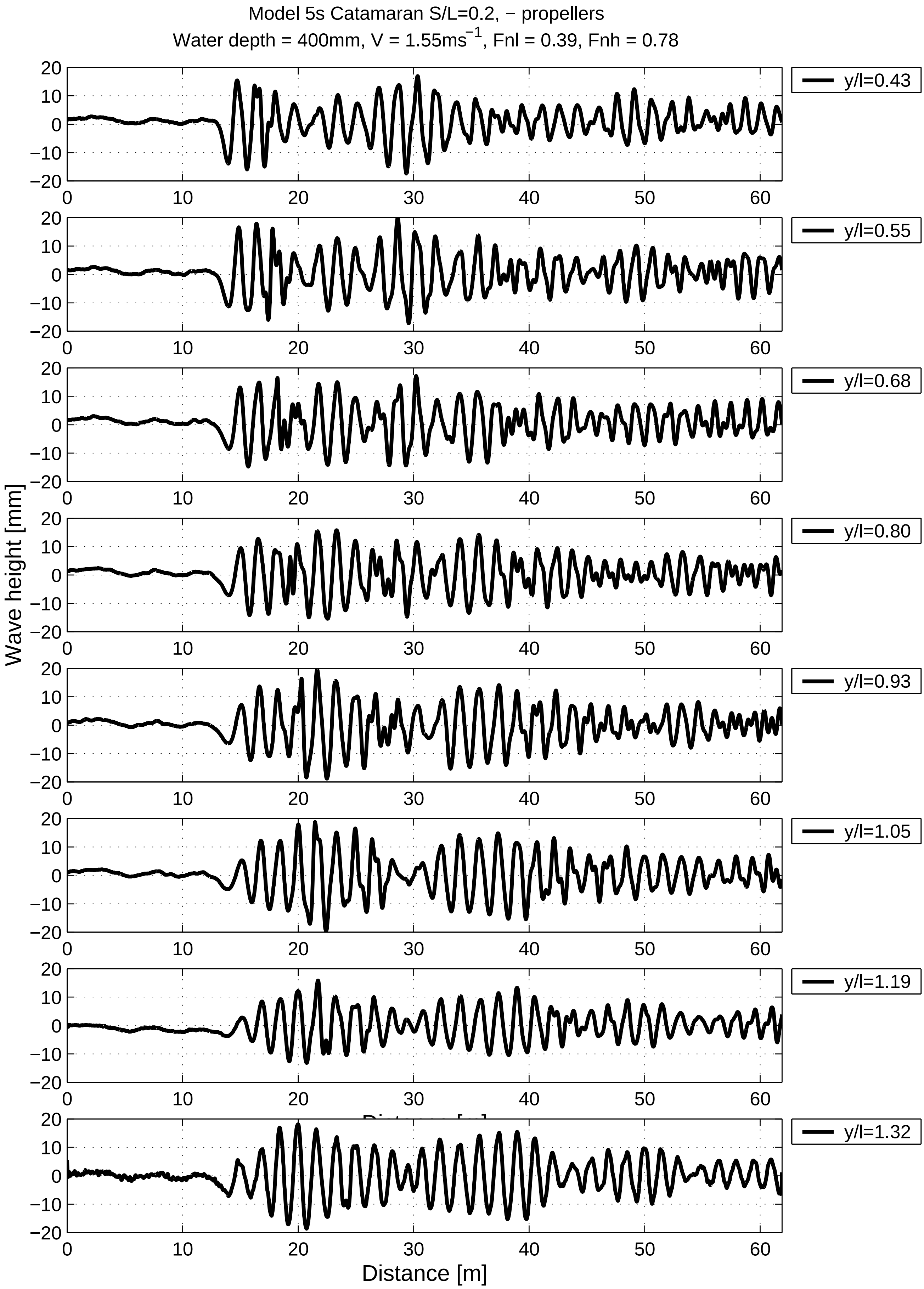

Model 5s Catamaran S/L=0.2, − propellers
Water depth = 400mm, V = 1.55ms−1, Fnl = 0.39, Fnh = 0.78
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 47

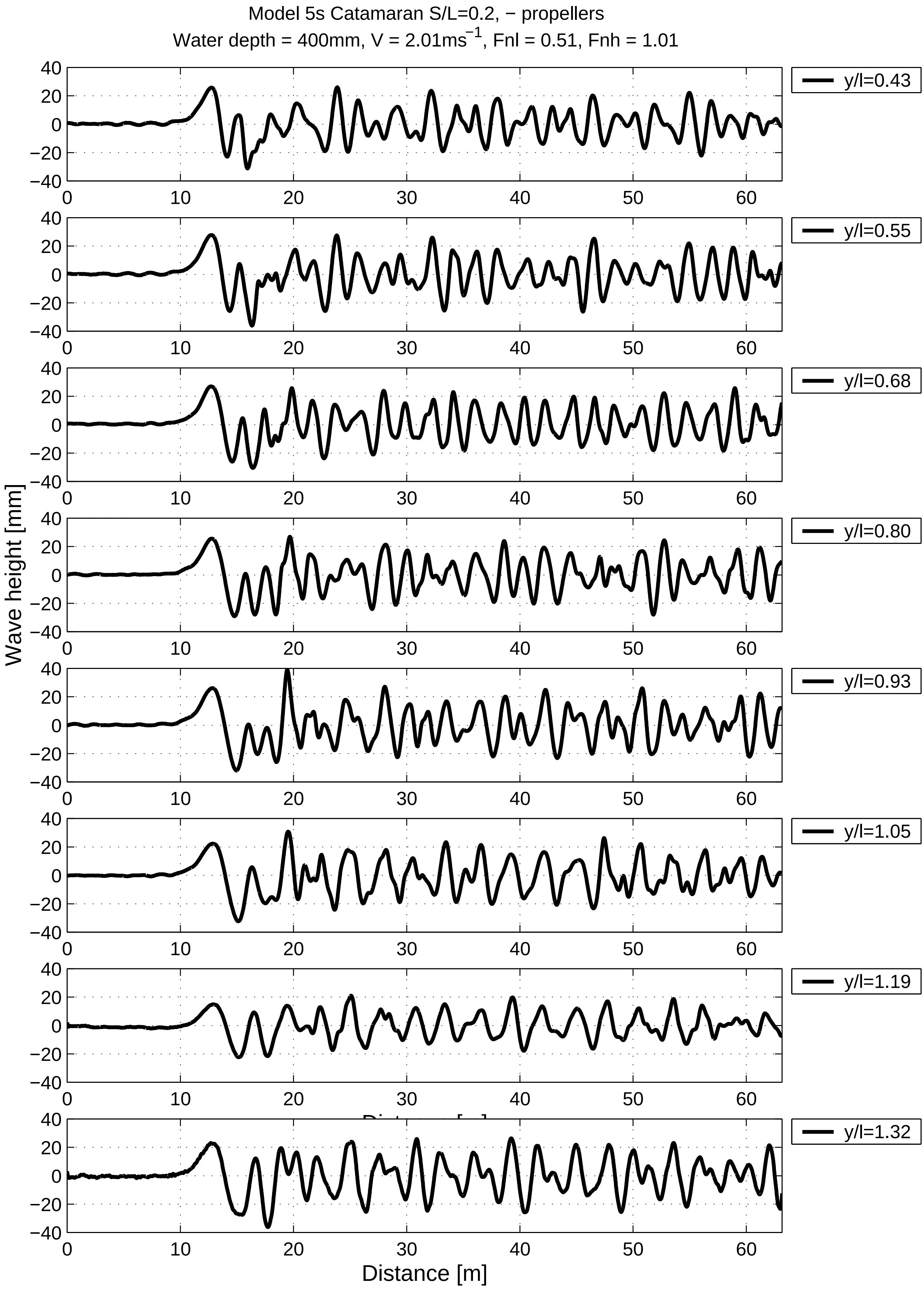
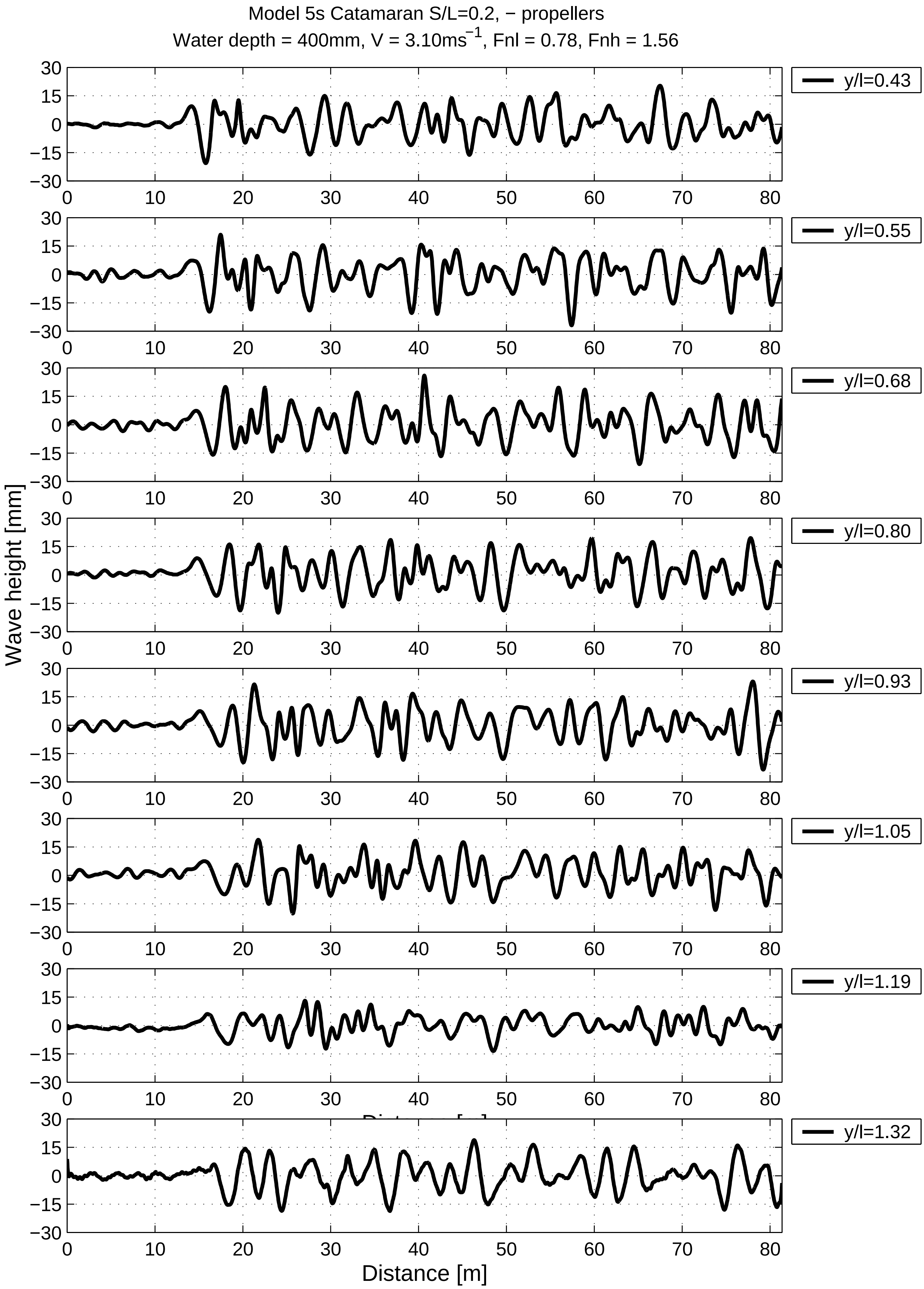

Model 5s Catamaran S/L=0.2, − propellers
Water depth = 400mm, V = 2.01ms^{-1}, Fnl = 0.51, Fnh = 1.01
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
40
20
0
−20
−40
0
10
20
30
40
50
60

Figure 48



Model 5s Catamaran S/L=0.2, − propellers
Water depth = 400mm, V = 3.10ms^{-1}, Fnl = 0.78, Fnh = 1.56
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 49

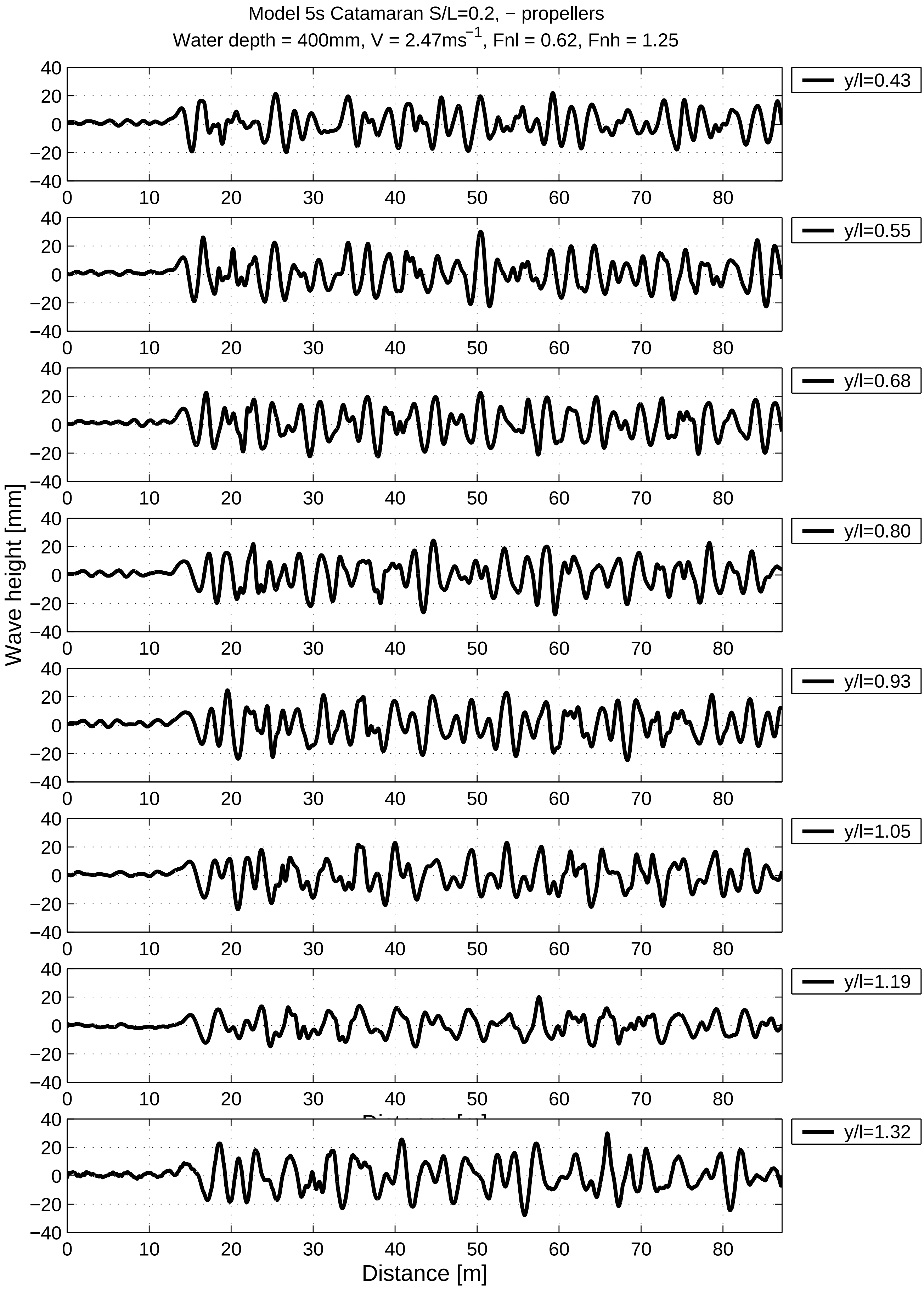

Model 5s Catamaran S/L=0.2, − propellers
Water depth = 400mm, V = 2.47ms−1, Fnl = 0.62, Fnh = 1.25
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 50

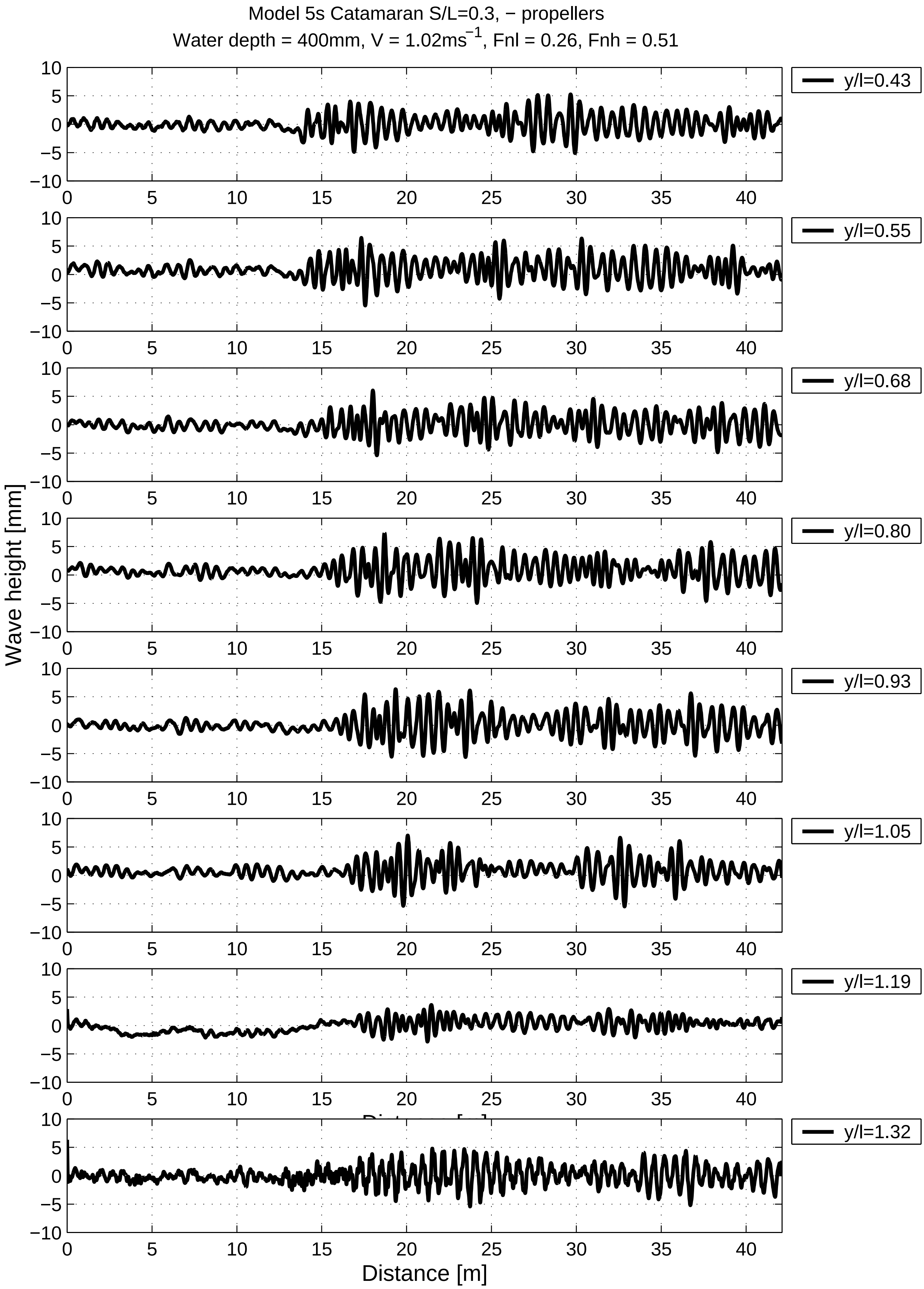

Model 5s Catamaran S/L=0.3, − propellers
Water depth = 400mm, V = 1.02ms^{-1}, Fnl = 0.26, Fnh = 0.51
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 51

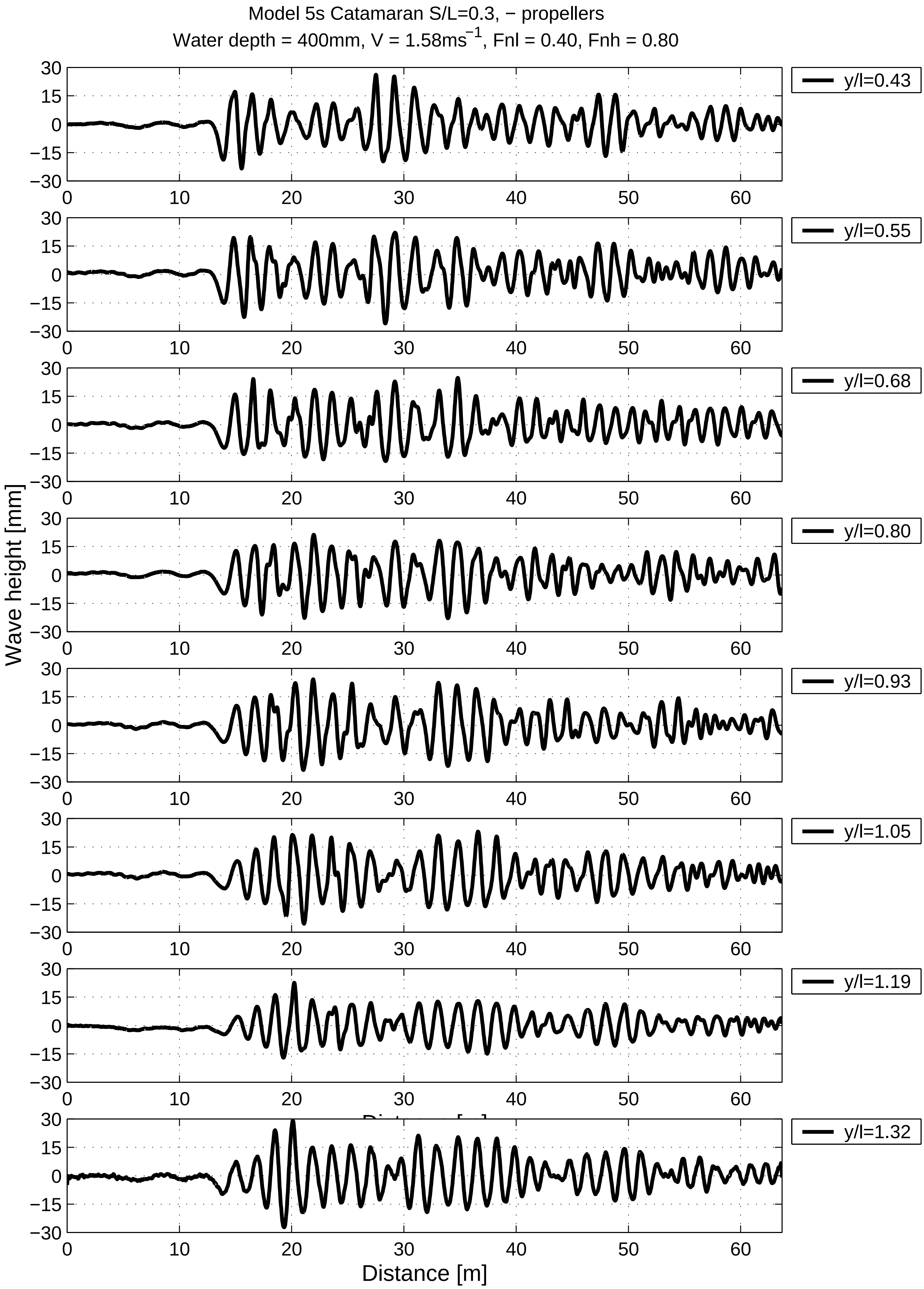

Model 5s Catamaran S/L=0.3, − propellers
Water depth = 400mm, V = 1.58ms−1, Fnl = 0.40, Fnh = 0.80
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 52

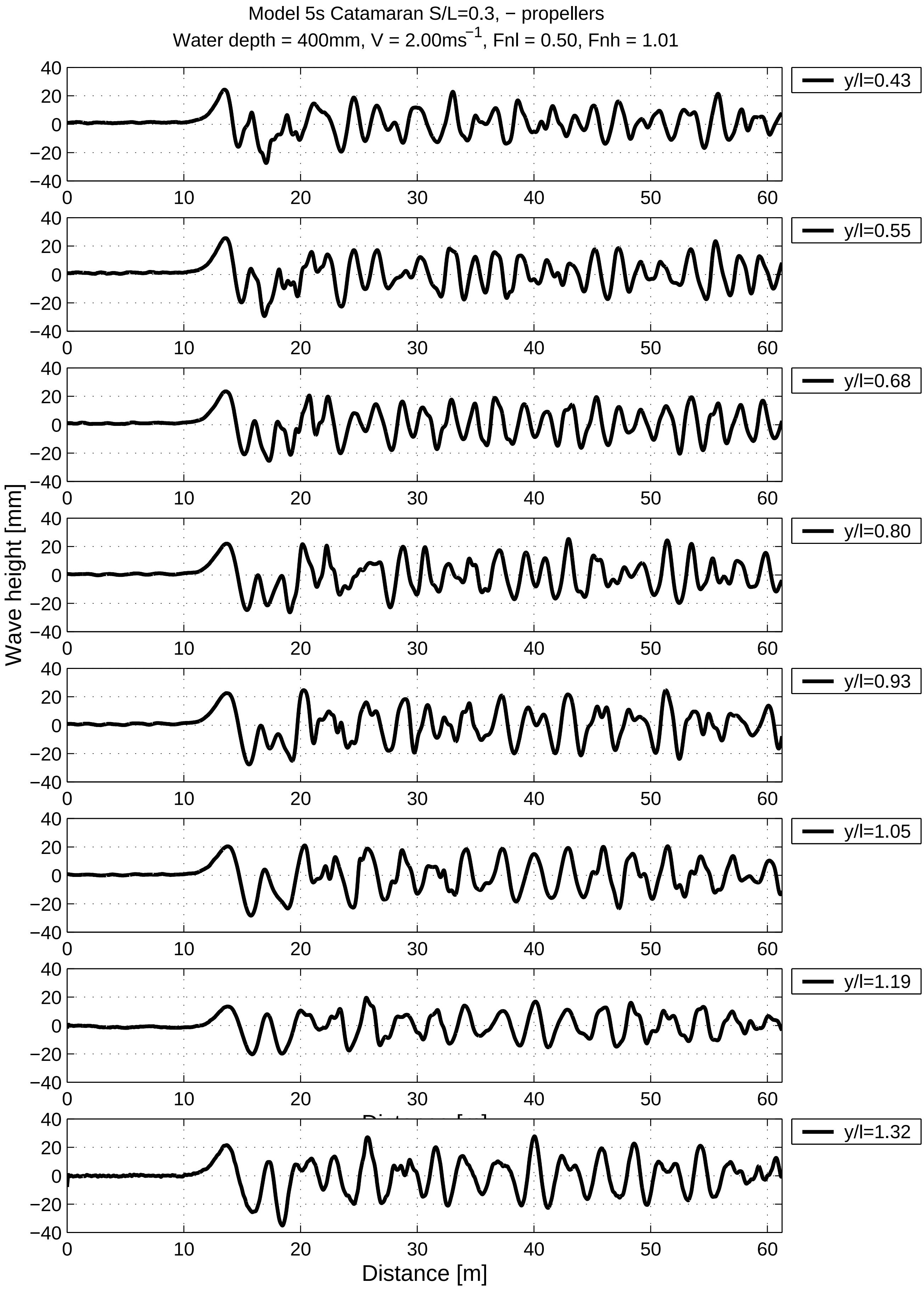
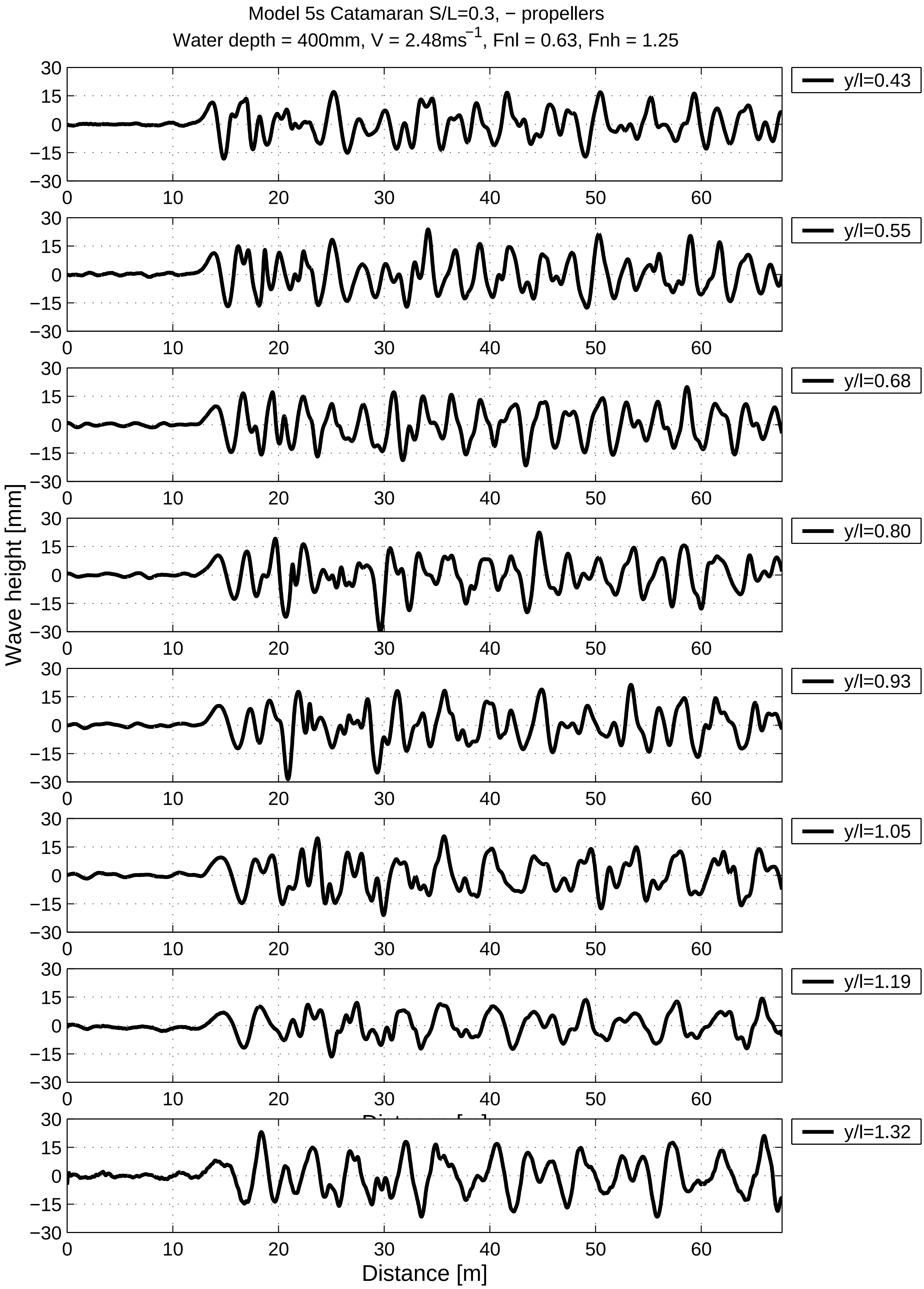
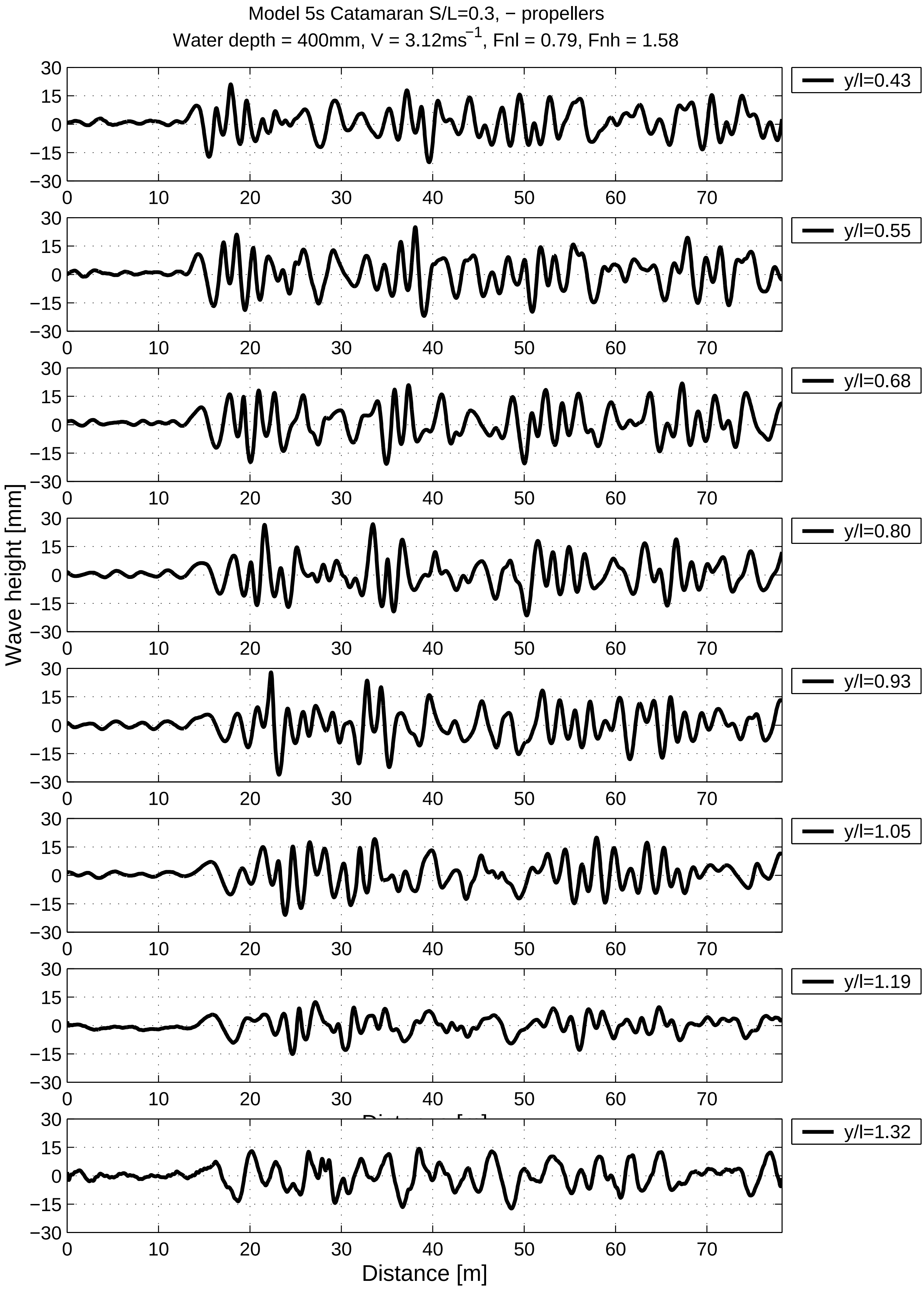

Model 5s Catamaran S/L=0.3, − propellers
Water depth = 400mm, V = 2.00ms^{-1}, Fnl = 0.50, Fnh = 1.01
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 53



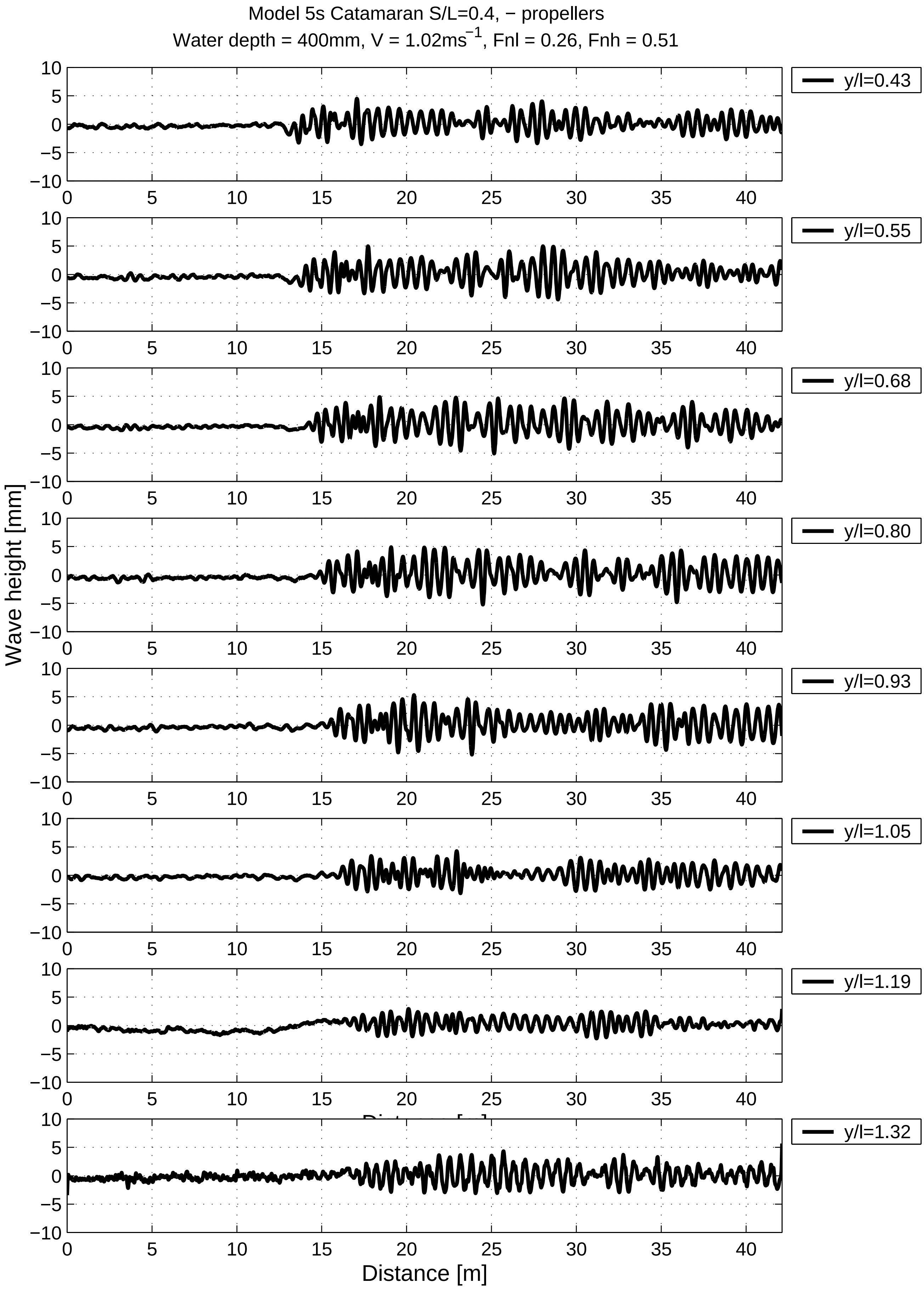
Model 5s Catamaran S/L=0.3, − propellers
Water depth = 400mm, V = 2.48ms^{-1}, Fnl = 0.63, Fnh = 1.25
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 54



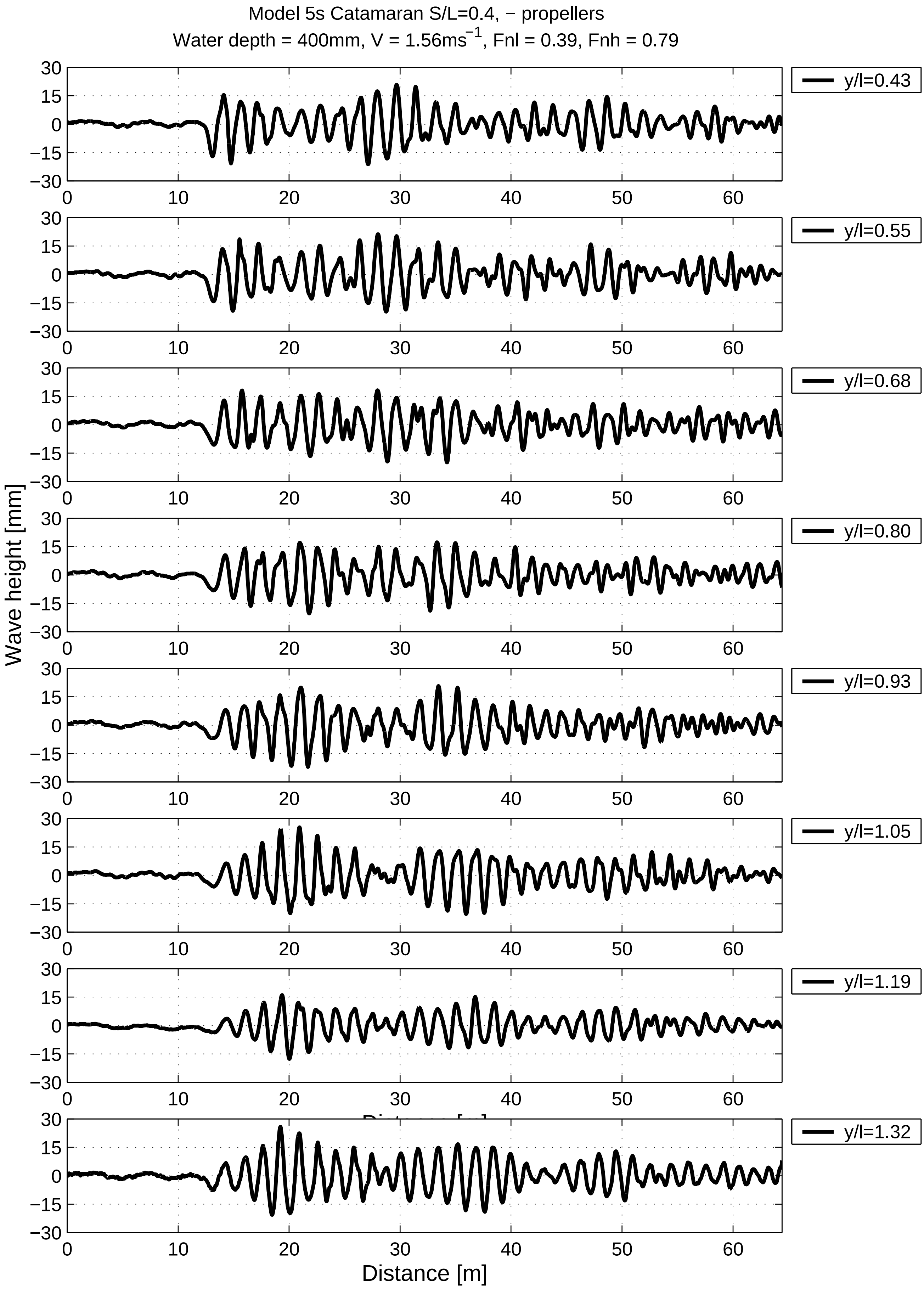
Model 5s Catamaran S/L=0.3, − propellers
Water depth = 400mm, V = 3.12ms^{-1}, Fnl = 0.79, Fnh = 1.58
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 55



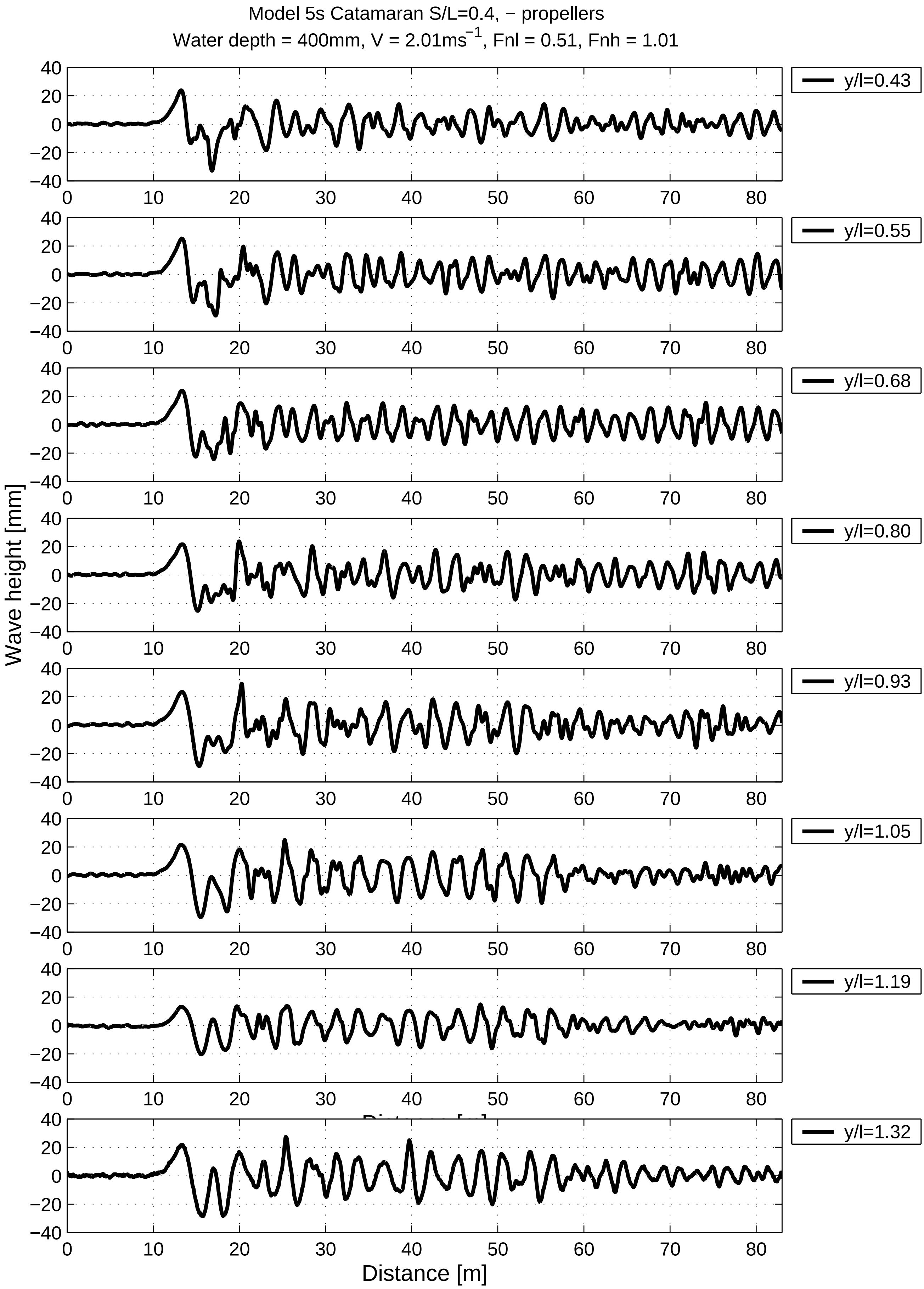
Model 5s Catamaran S/L=0.4, − propellers
Water depth = 400mm, V = 1.02ms^{-1}, Fnl = 0.26, Fnh = 0.51
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 56



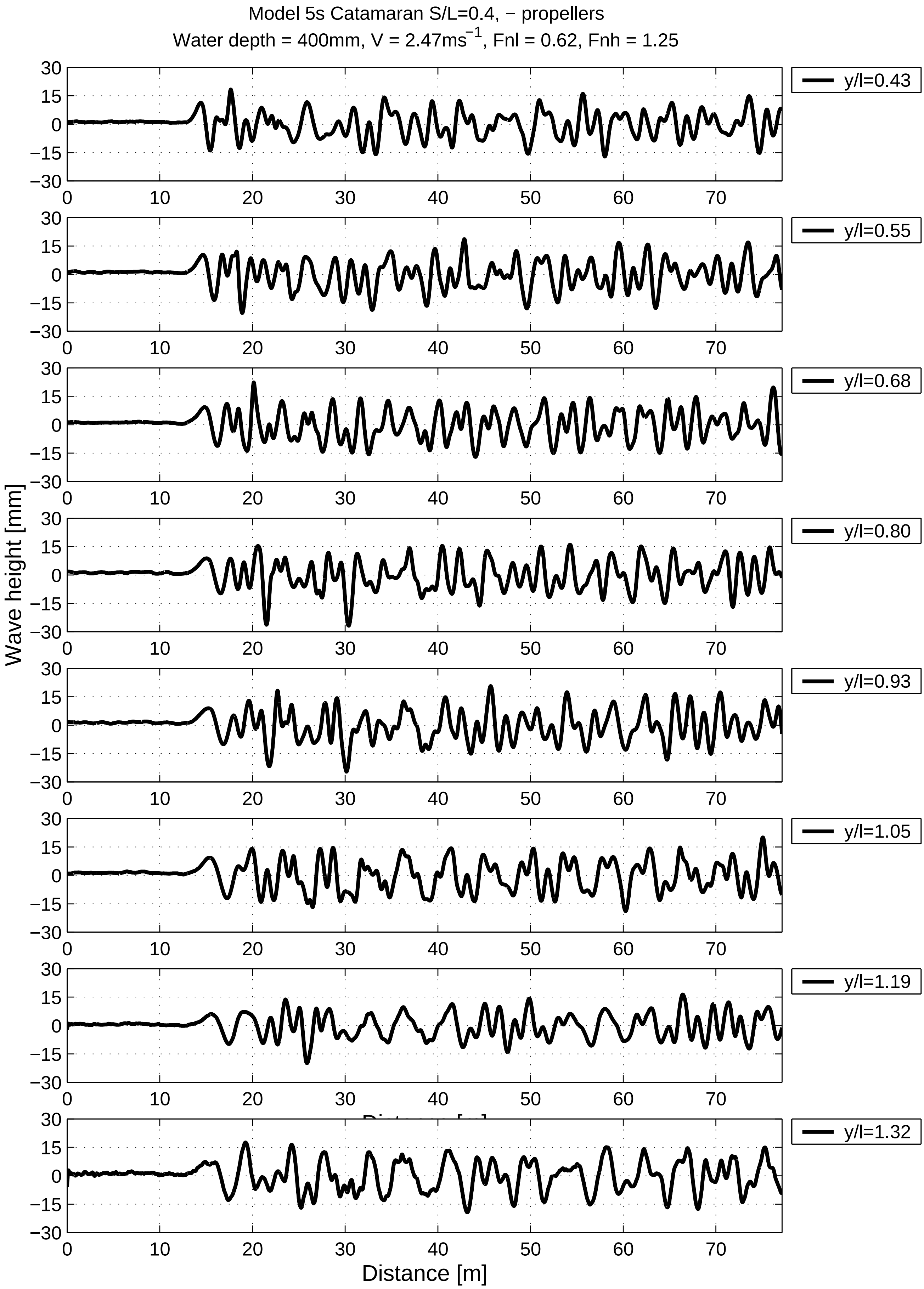
Model 5s Catamaran S/L=0.4, − propellers
Water depth = 400mm, V = 1.56ms^{-1}, Fnl = 0.39, Fnh = 0.79
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 57



Model 5s Catamaran S/L=0.4, − propellers
Water depth = 400mm, V = 2.01ms^{-1}, Fnl = 0.51, Fnh = 1.01
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 58



Model 5s Catamaran S/L=0.4, − propellers
Water depth = 400mm, V = 2.47ms−1, Fnl = 0.62, Fnh = 1.25
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 59

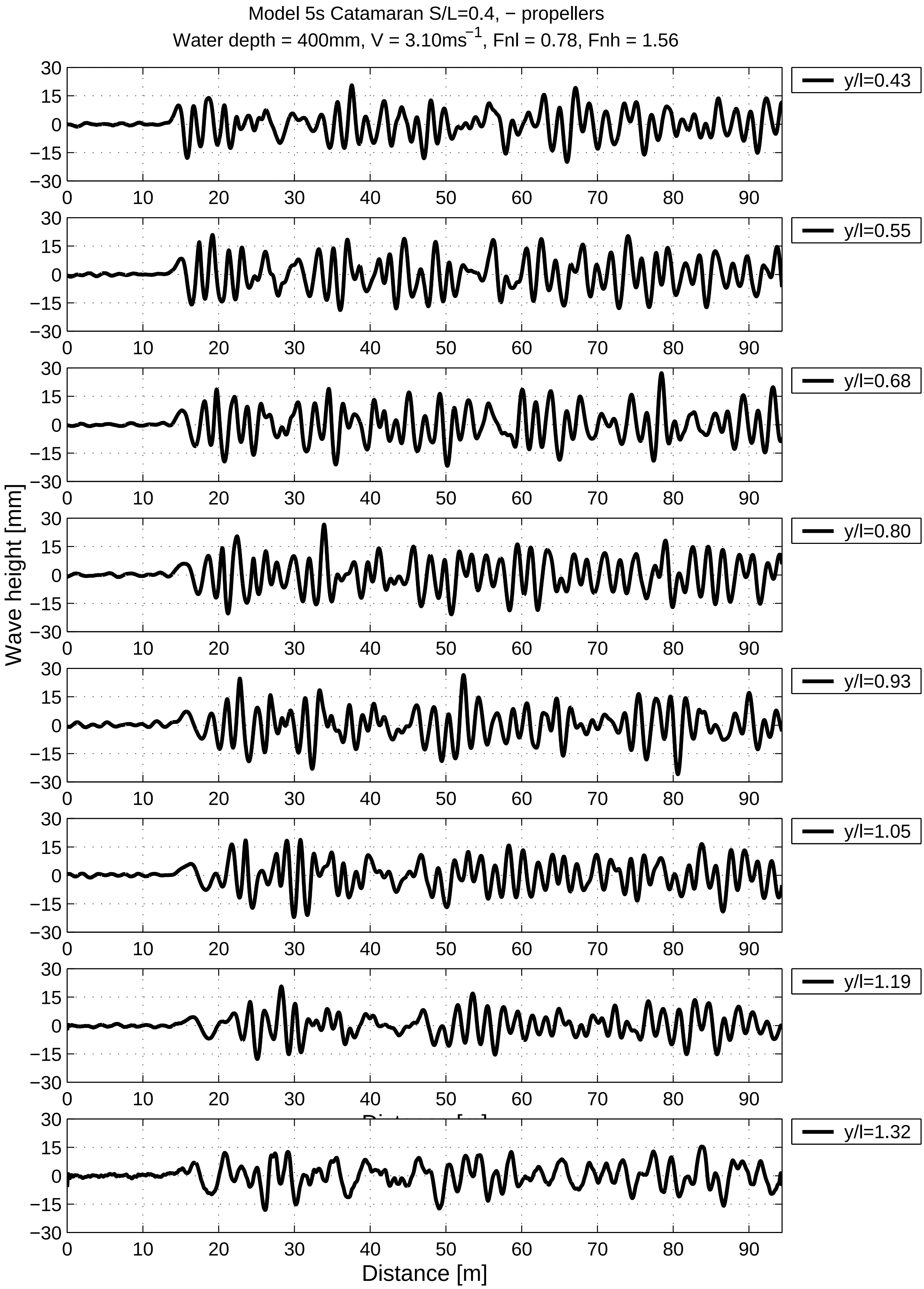

Model 5s Catamaran S/L=0.4, − propellers
Water depth = 400mm, V = 3.10ms^{-1}, Fnl = 0.78, Fnh = 1.56
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 60

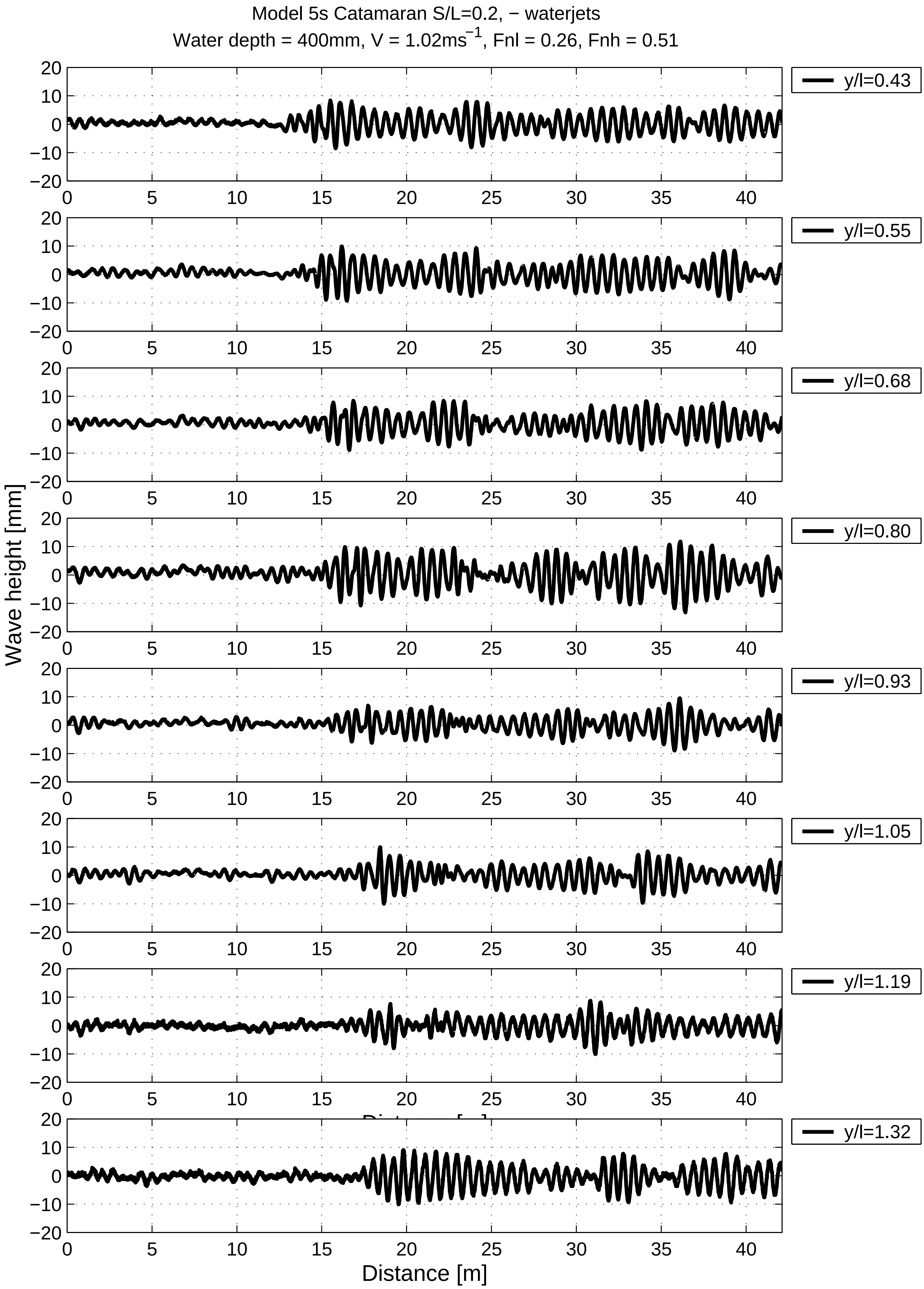

Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 400mm, V = 1.02ms−1, Fnl = 0.26, Fnh = 0.51
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 61

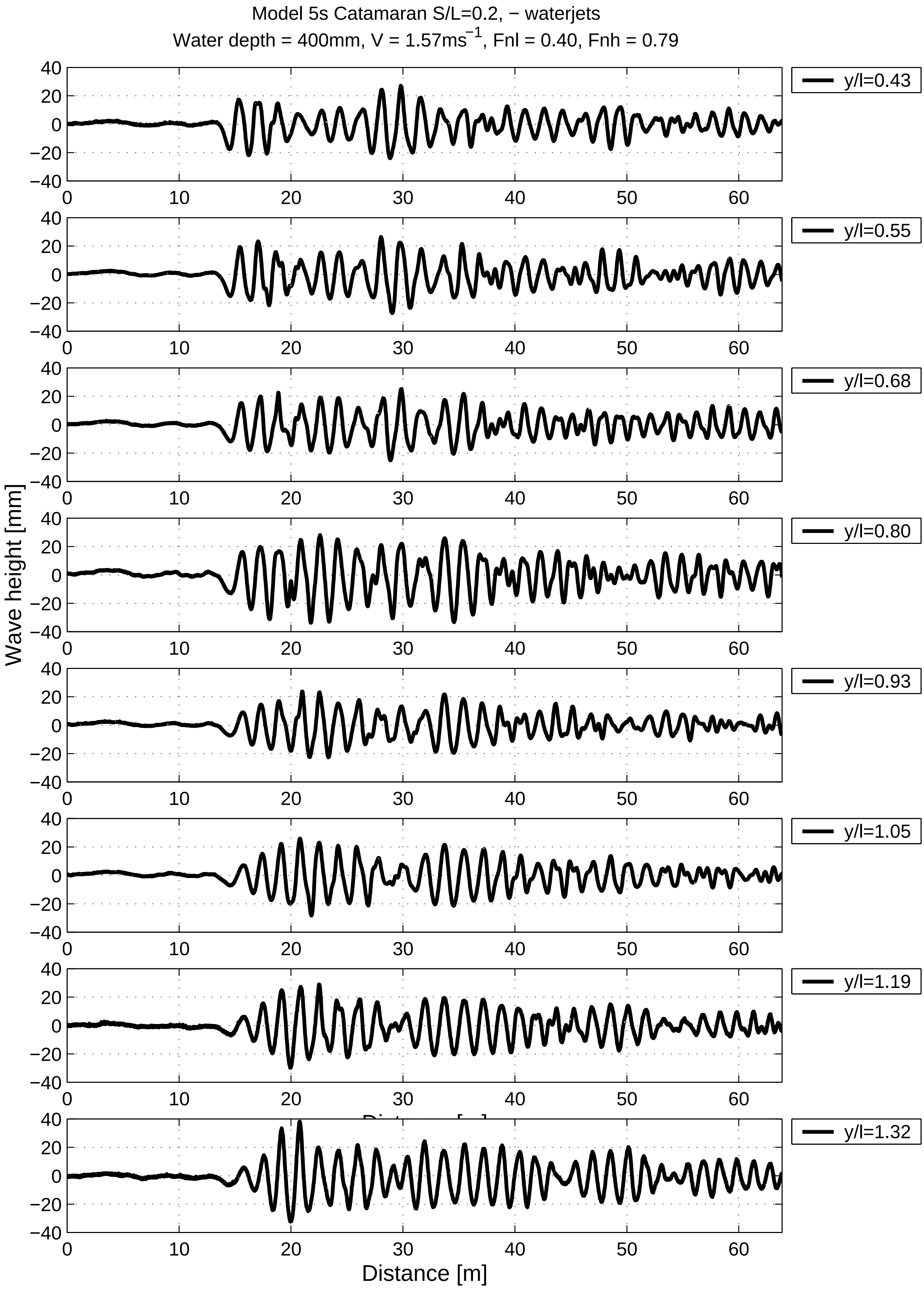
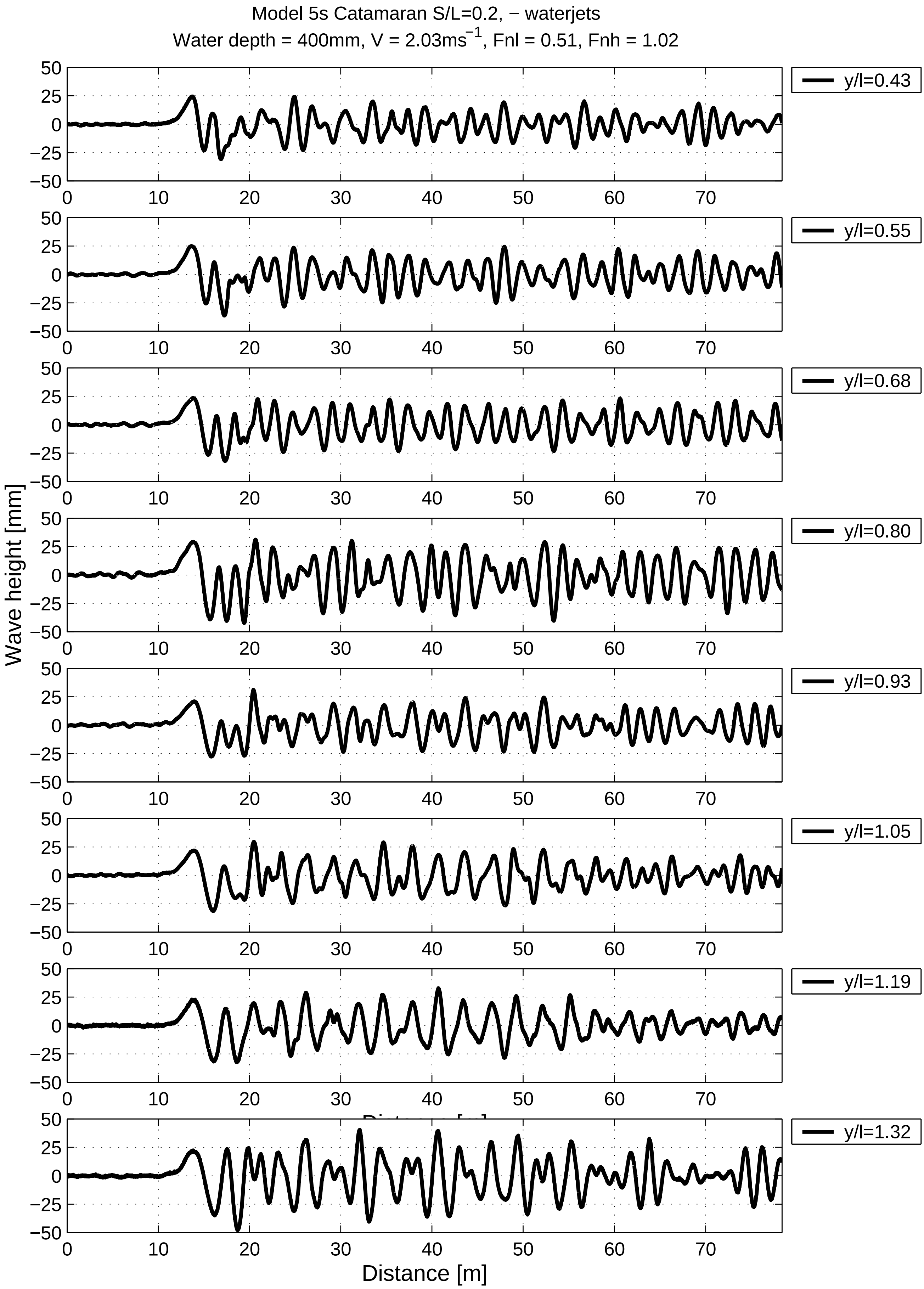
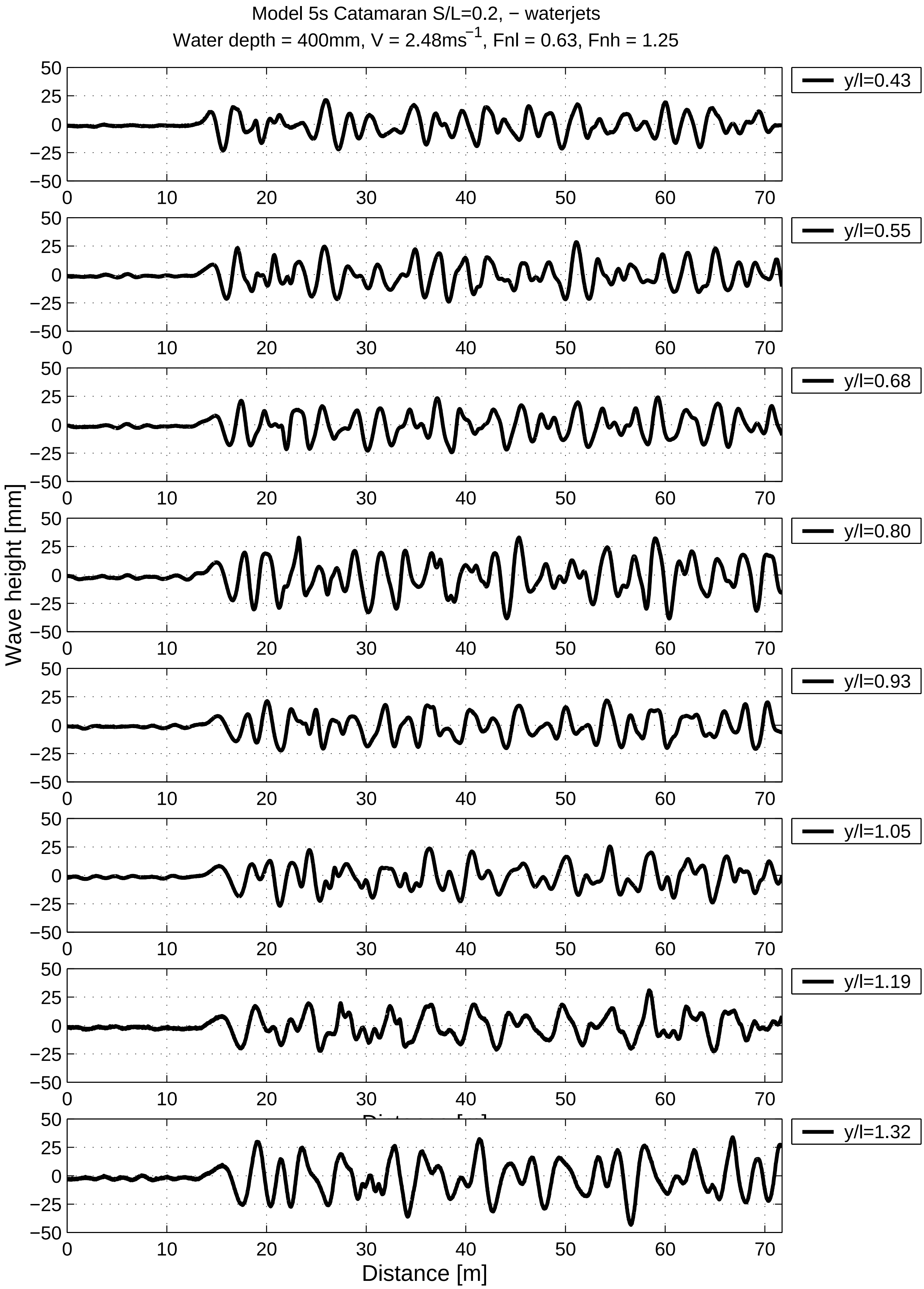

Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 400mm, V = 1.57ms^{-1}, Fnl = 0.40, Fnh = 0.79
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 62



Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 400mm, V = 2.03ms^{-1}, Fnl = 0.51, Fnh = 1.02
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 63



Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 400mm, V = 2.48ms^{-1}, Fnl = 0.63, Fnh = 1.25
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 64

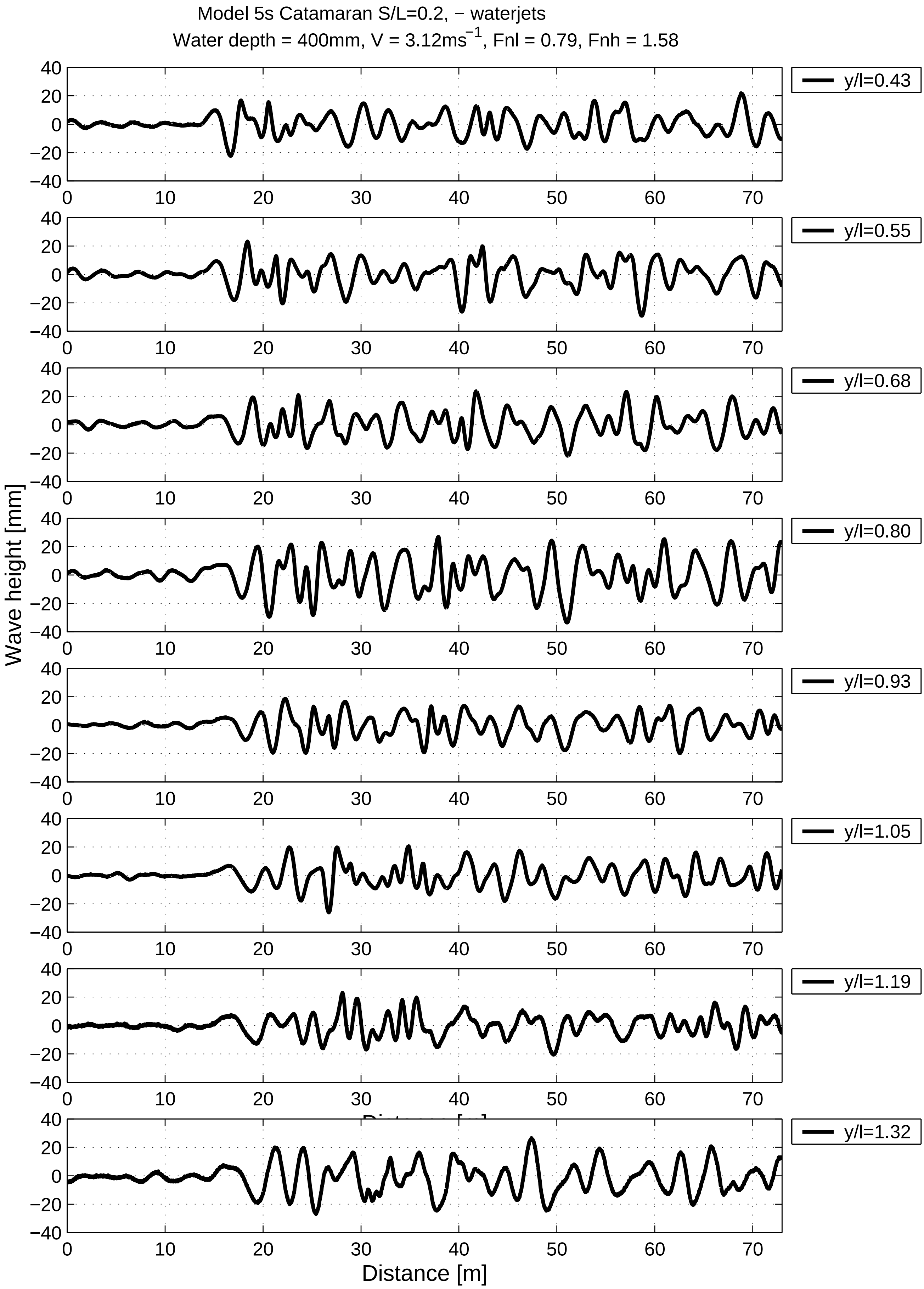
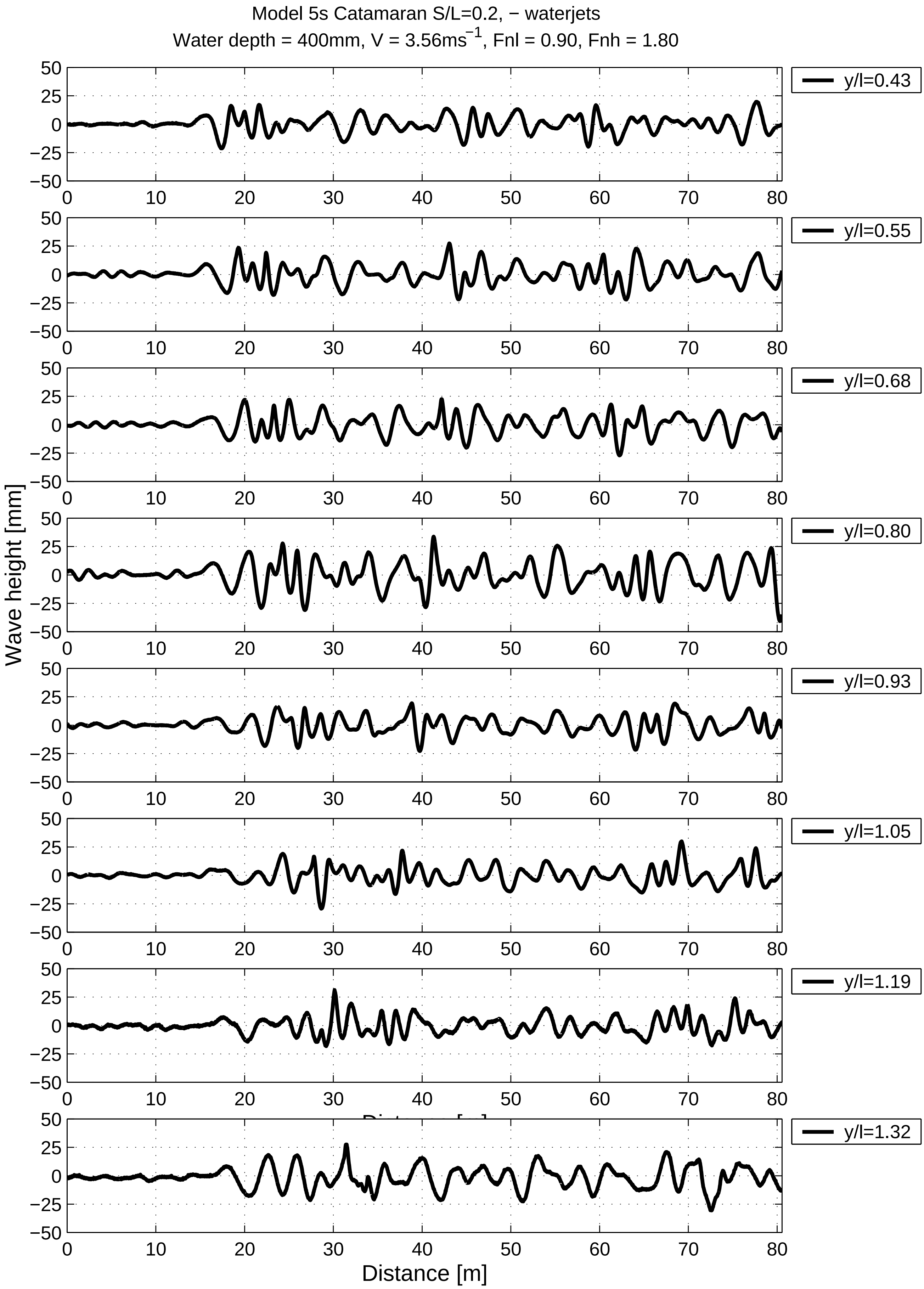
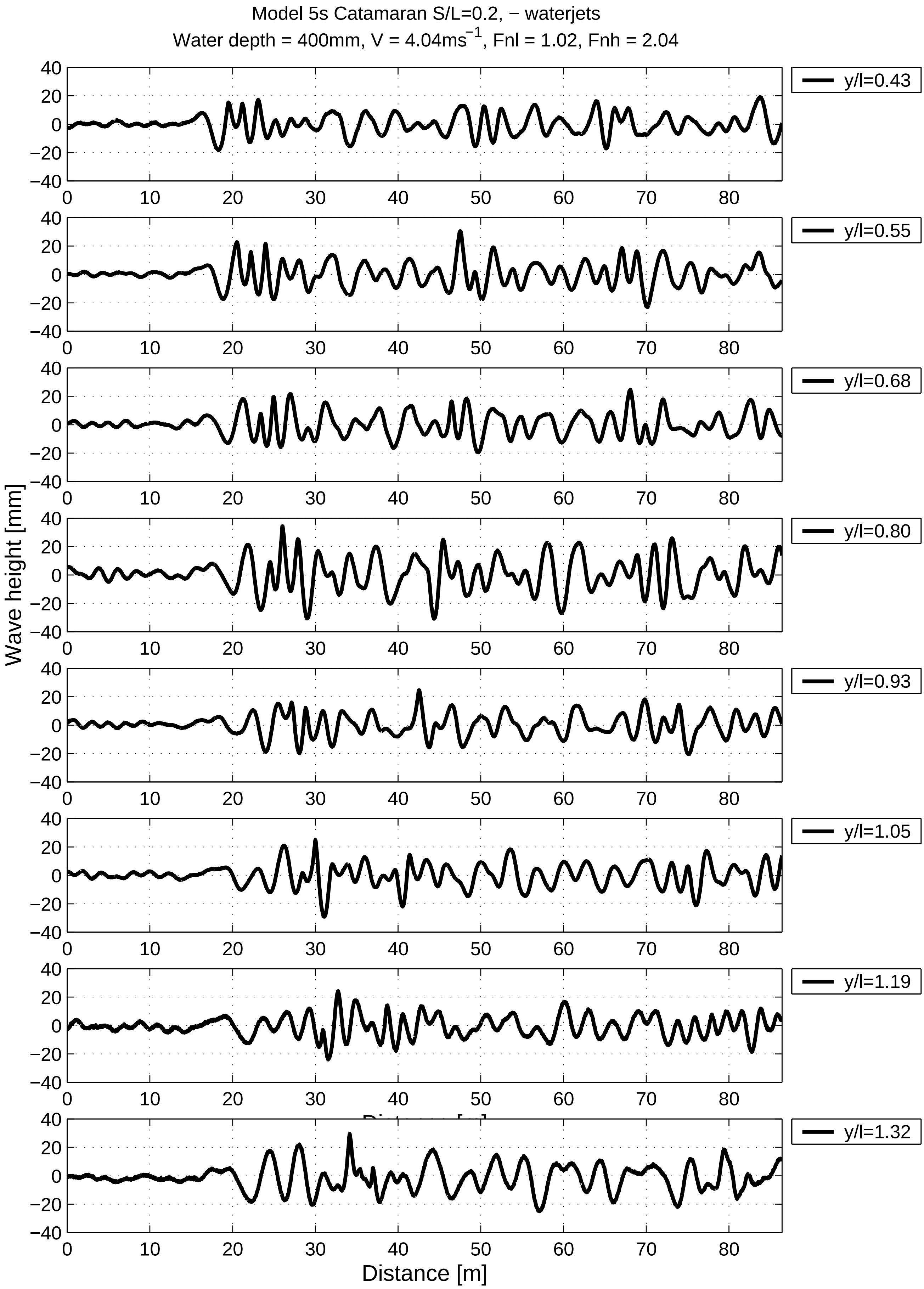

Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 400mm, V = 3.12ms^{-1}, Fnl = 0.79, Fnh = 1.58
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 65



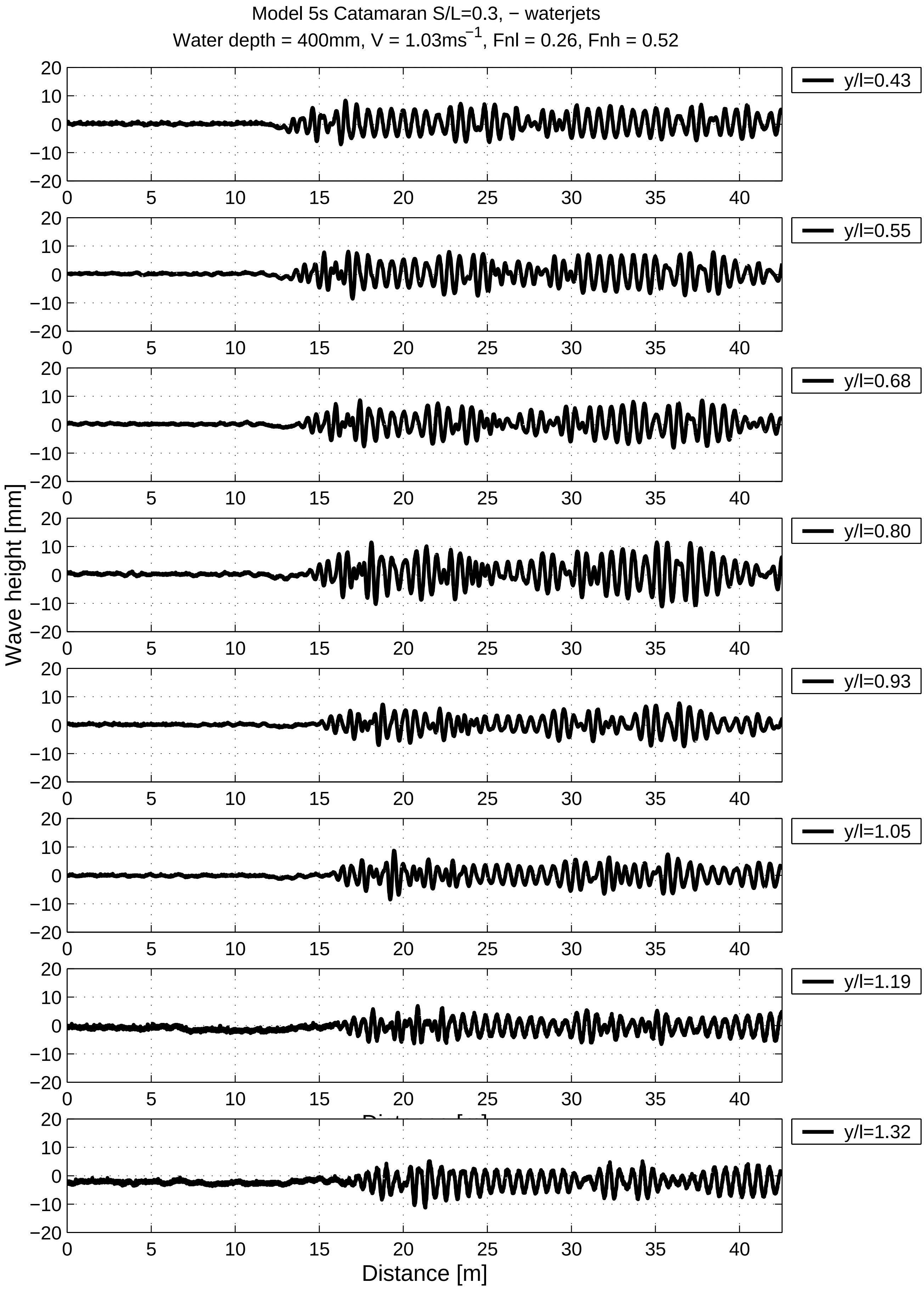
Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 400mm, V = 3.56ms−1, Fnl = 0.90, Fnh = 1.80
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 66



Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 400mm, V = 4.04ms^{-1}, Fnl = 1.02, Fnh = 2.04
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 67



Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 400mm, V = 1.03ms^−1, Fnl = 0.26, Fnh = 0.52
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 68

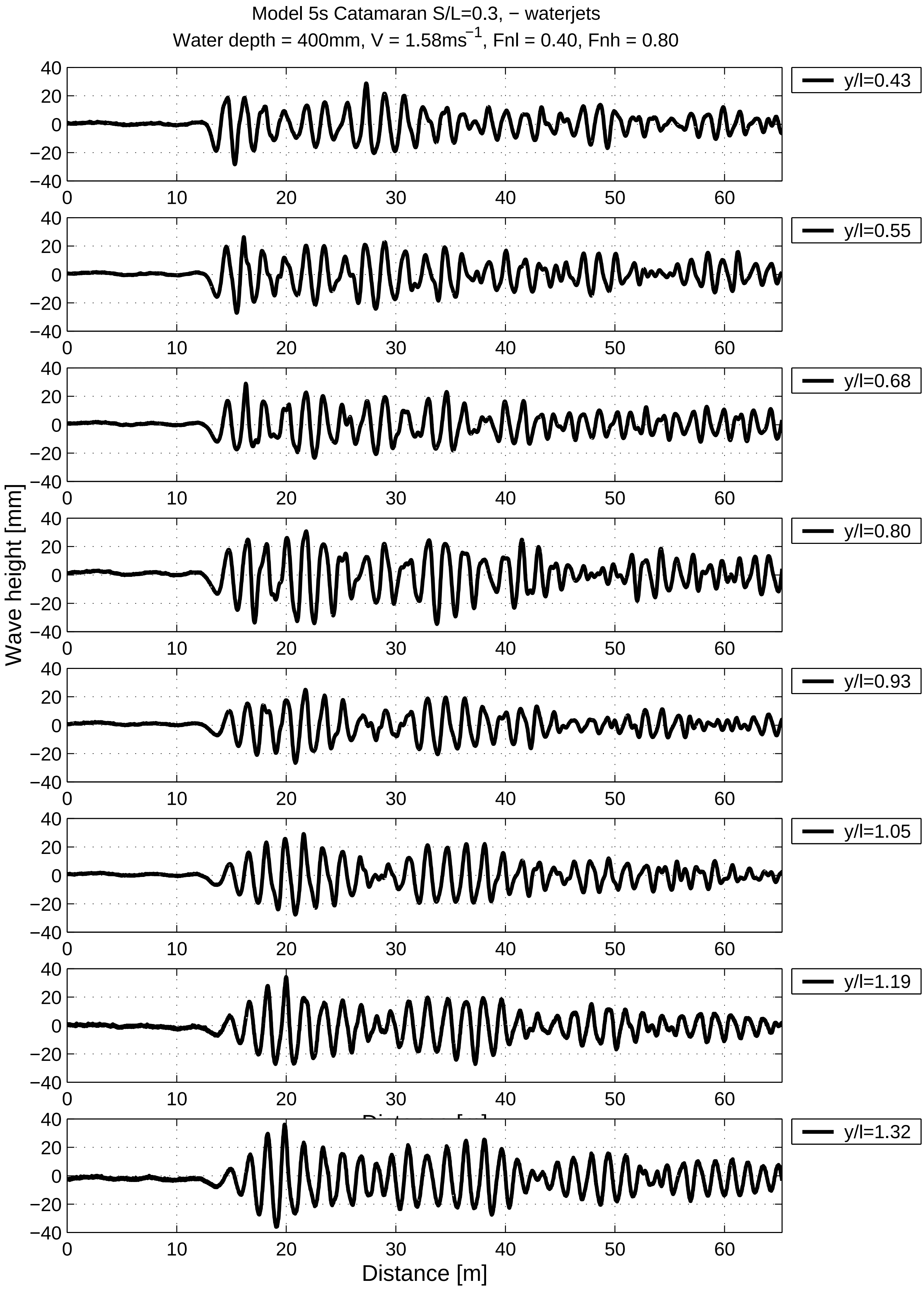

Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 400mm, V = 1.58ms^{-1}, Fnl = 0.40, Fnh = 0.80
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 69

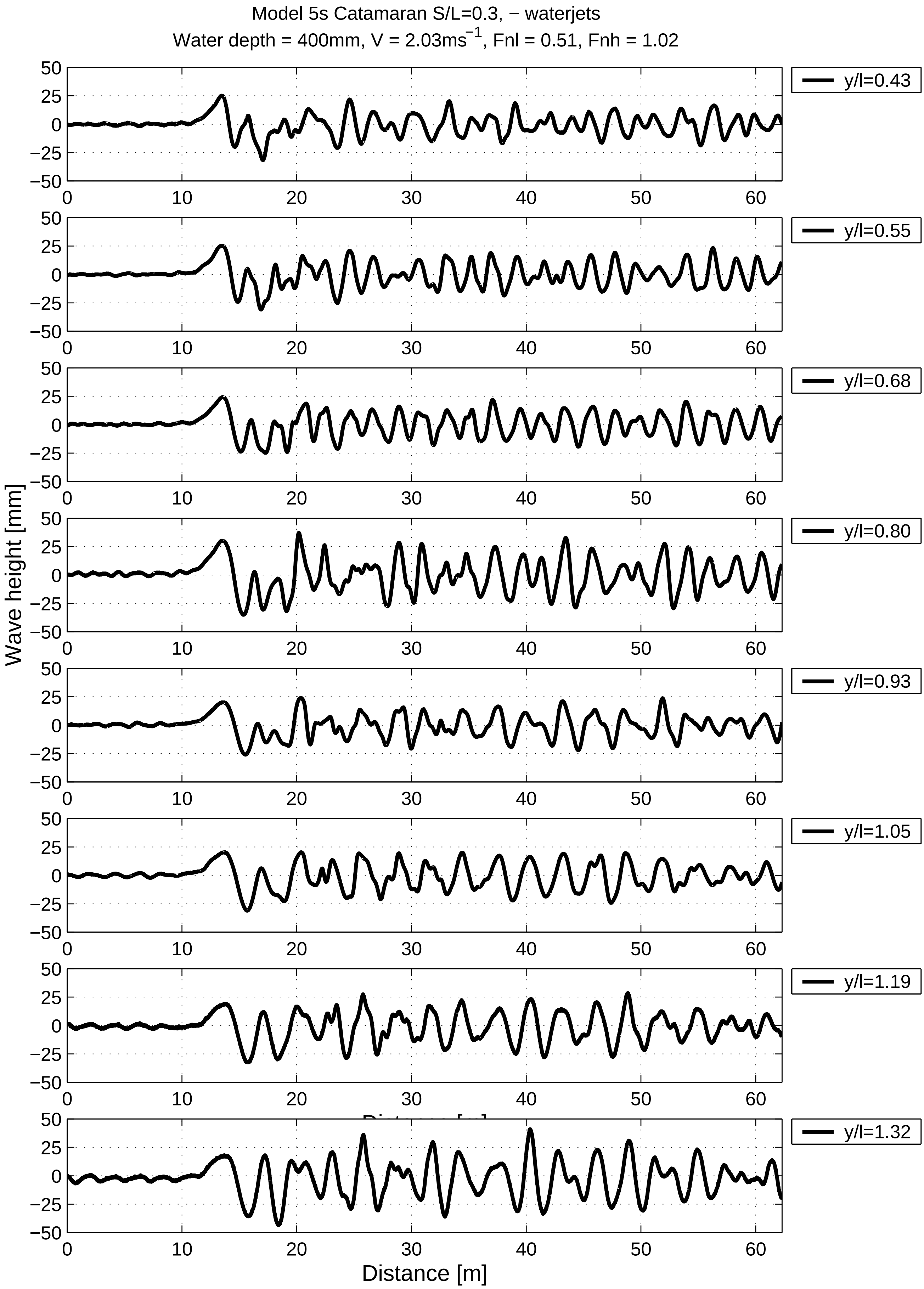

Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 400mm, V = 2.03ms−1, Fnl = 0.51, Fnh = 1.02
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]
50
25
0
−25
−50
0
10
20
30
40
50
60

Figure 70

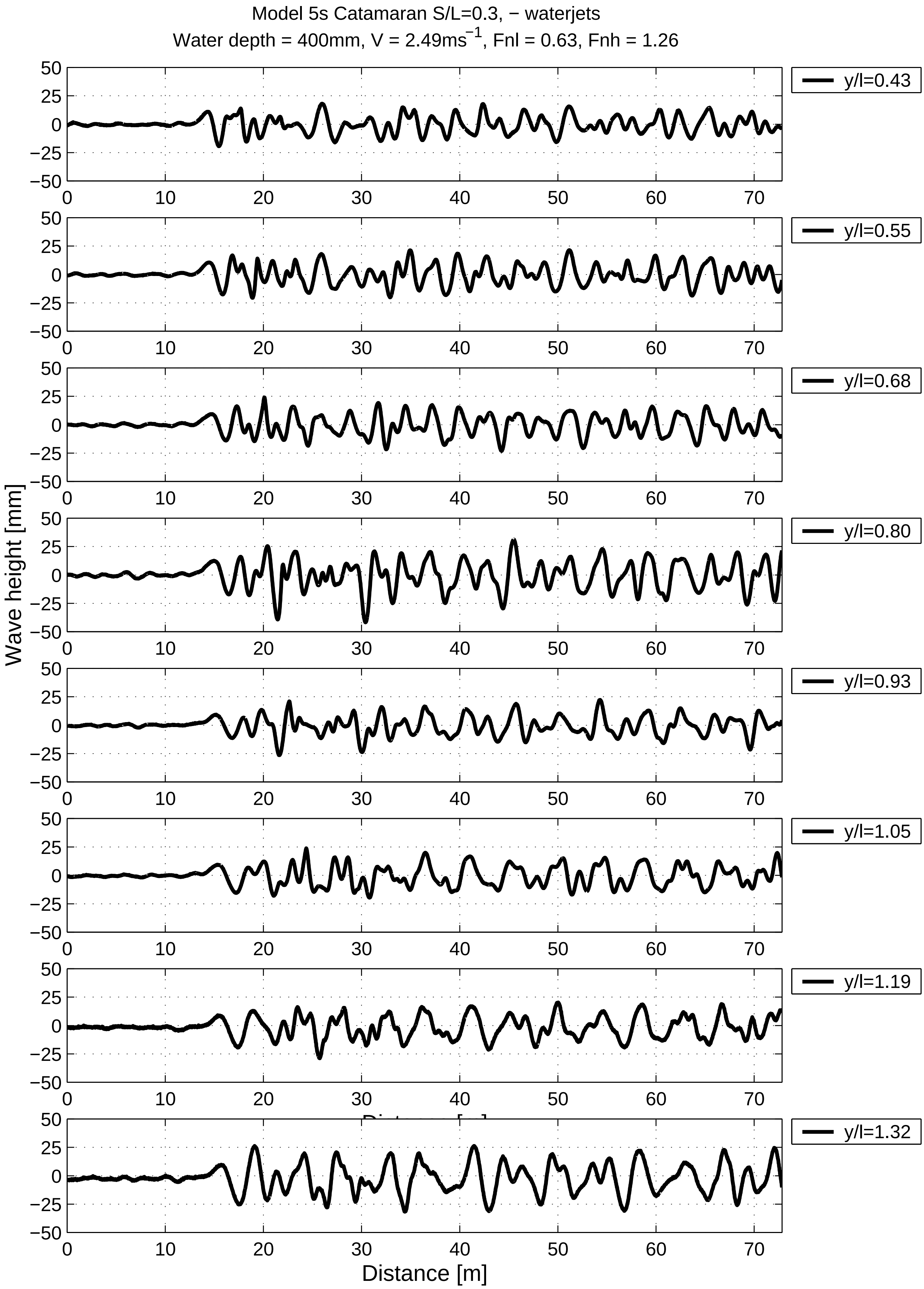

Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 400mm, V = 2.49ms−1, Fnl = 0.63, Fnh = 1.26
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 71

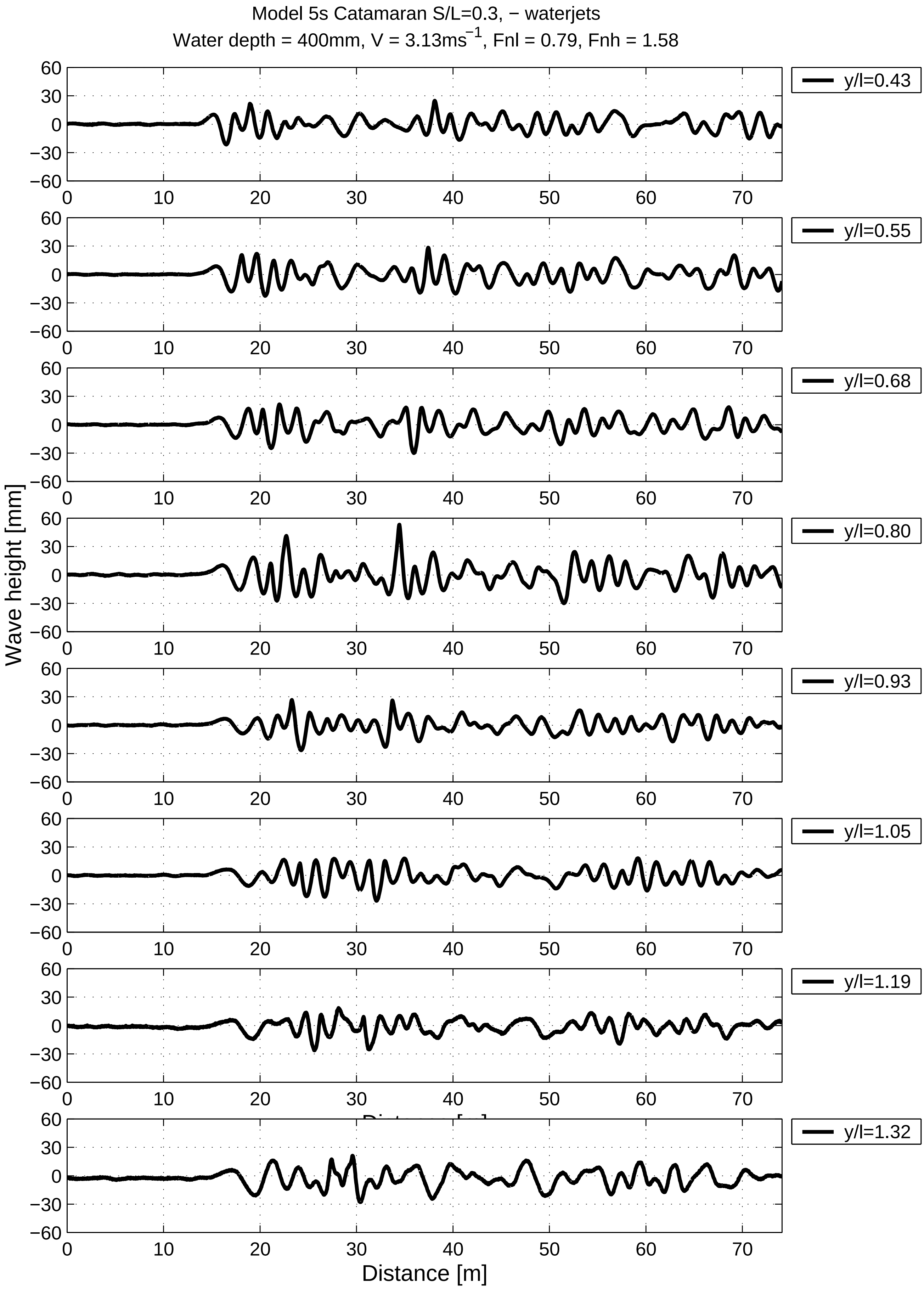
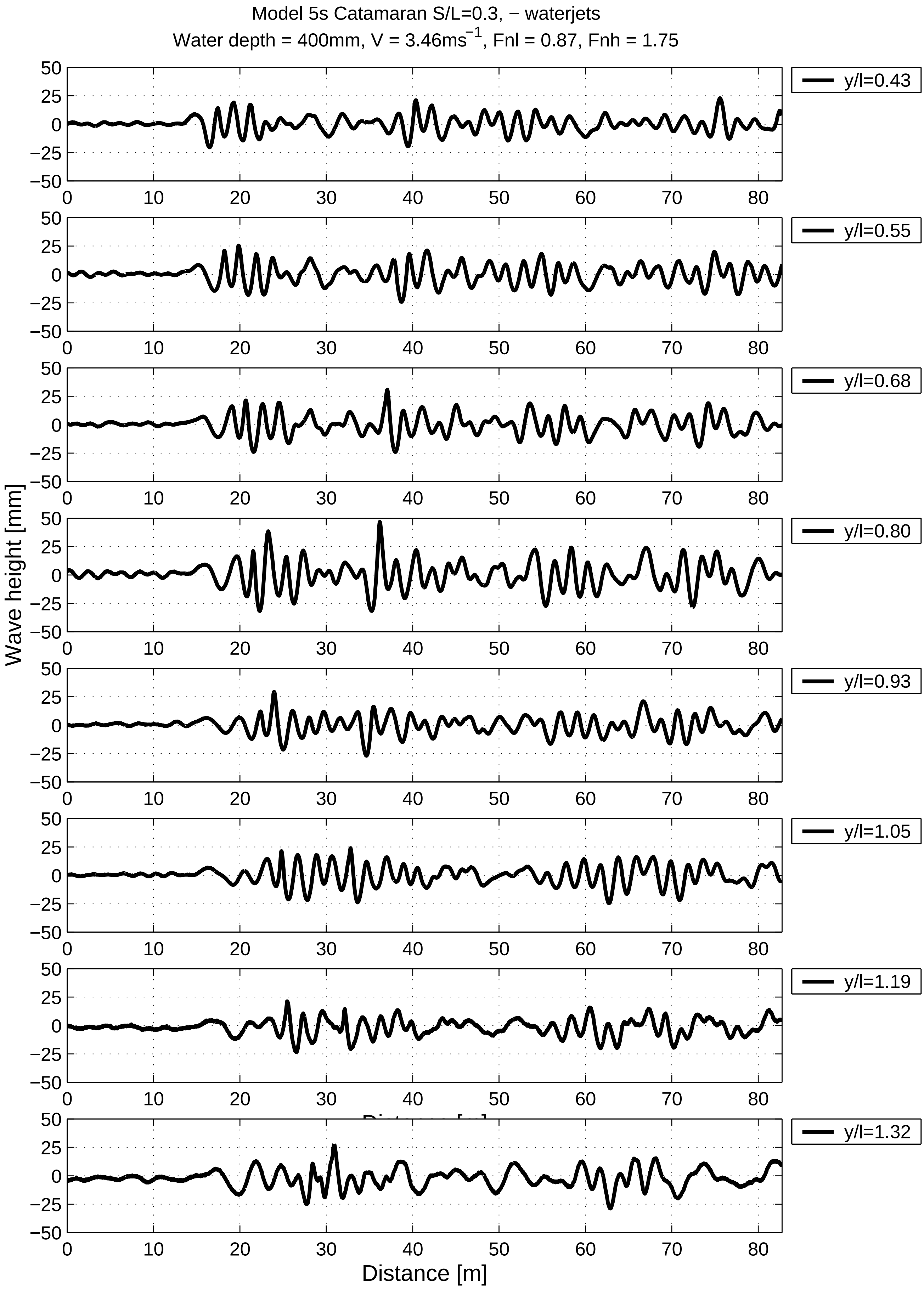
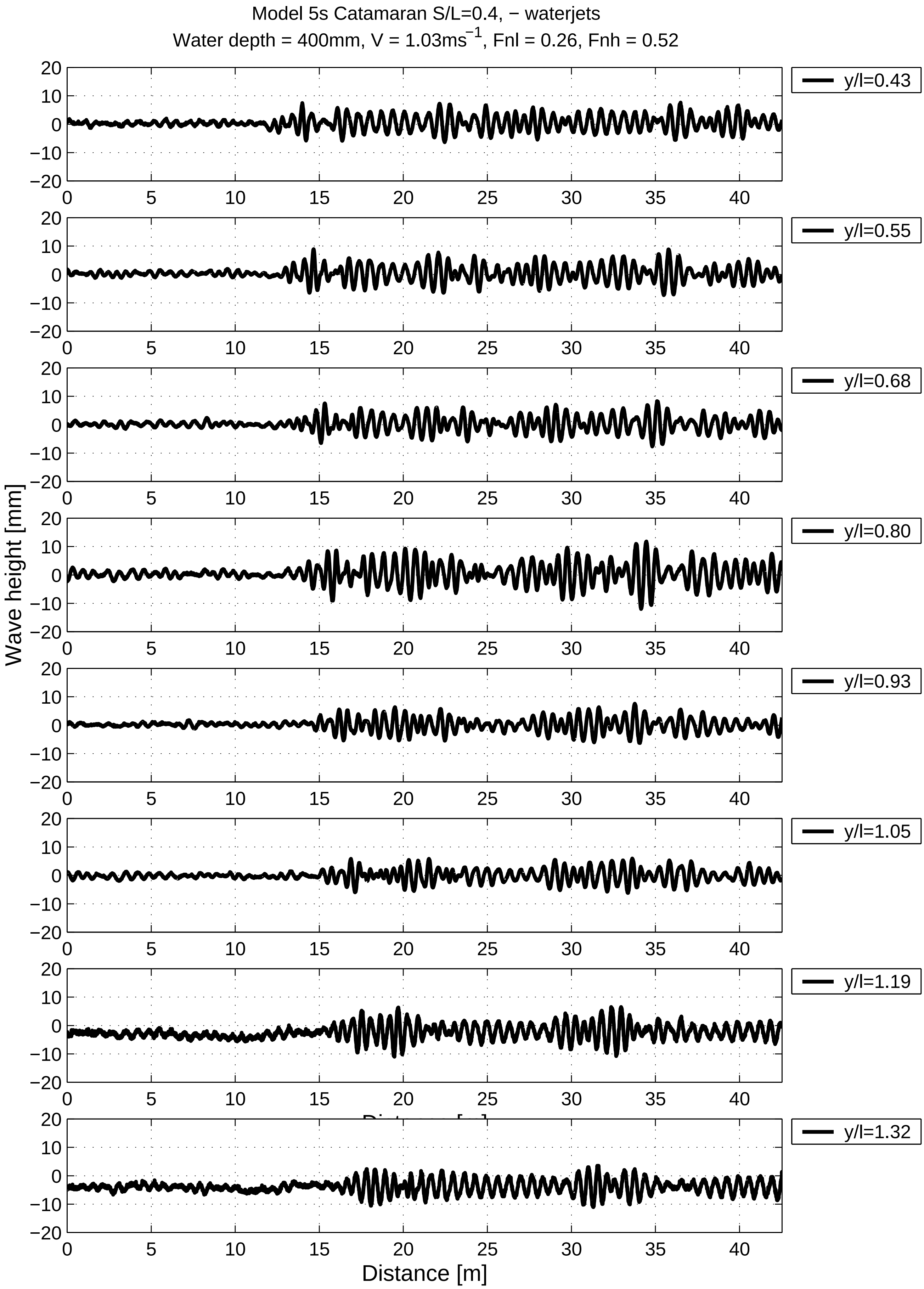

Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 400mm, V = 3.13ms^{-1}, Fnl = 0.79, Fnh = 1.58
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 72



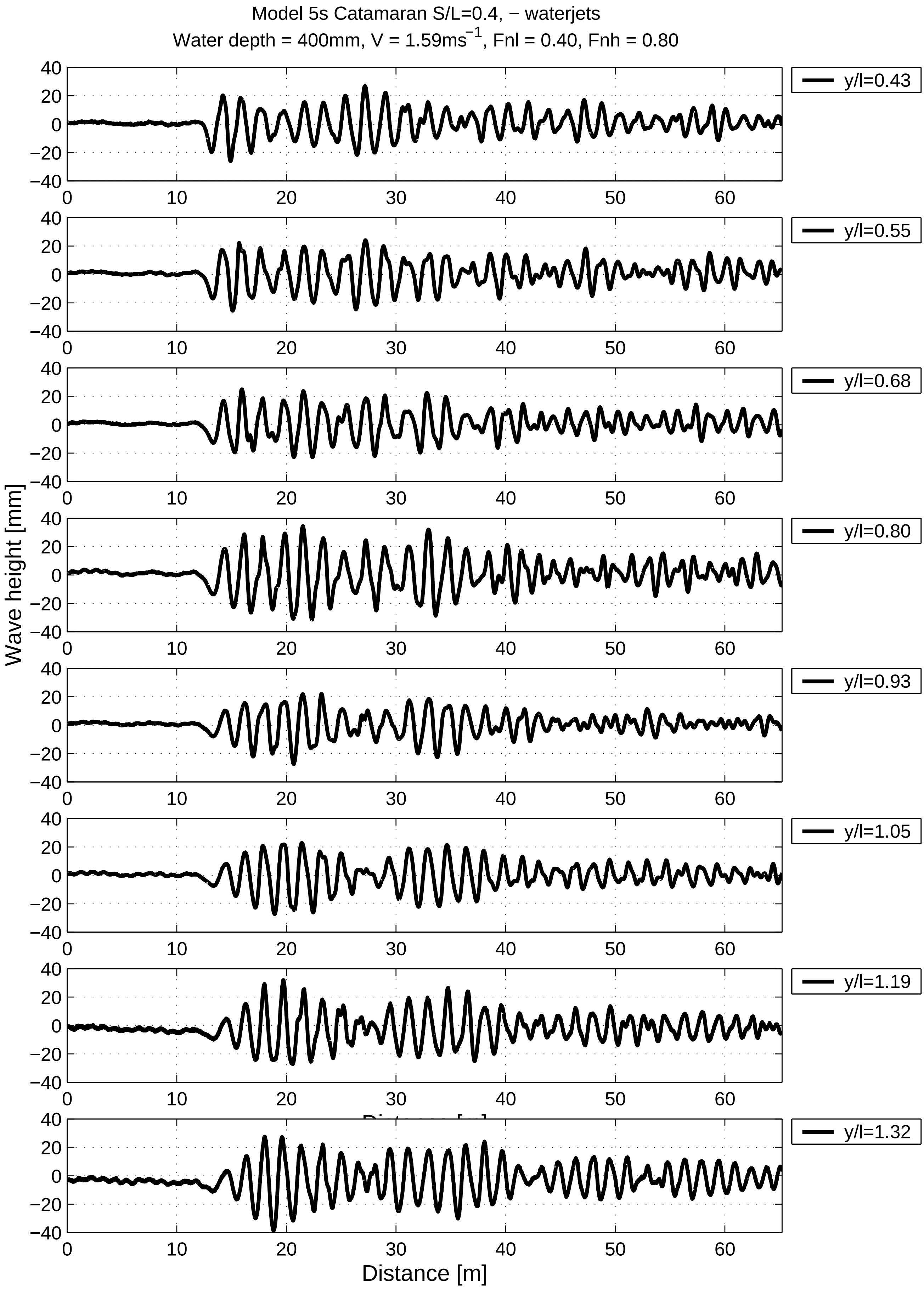
Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 400mm, V = 3.46ms^{-1}, Fnl = 0.87, Fnh = 1.75
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 73



Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 400mm, V = 1.03ms⁻¹, Fnl = 0.26, Fnh = 0.52
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 74


Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 400mm, V = 1.59ms^{-1}, Fnl = 0.40, Fnh = 0.80
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Figure 75

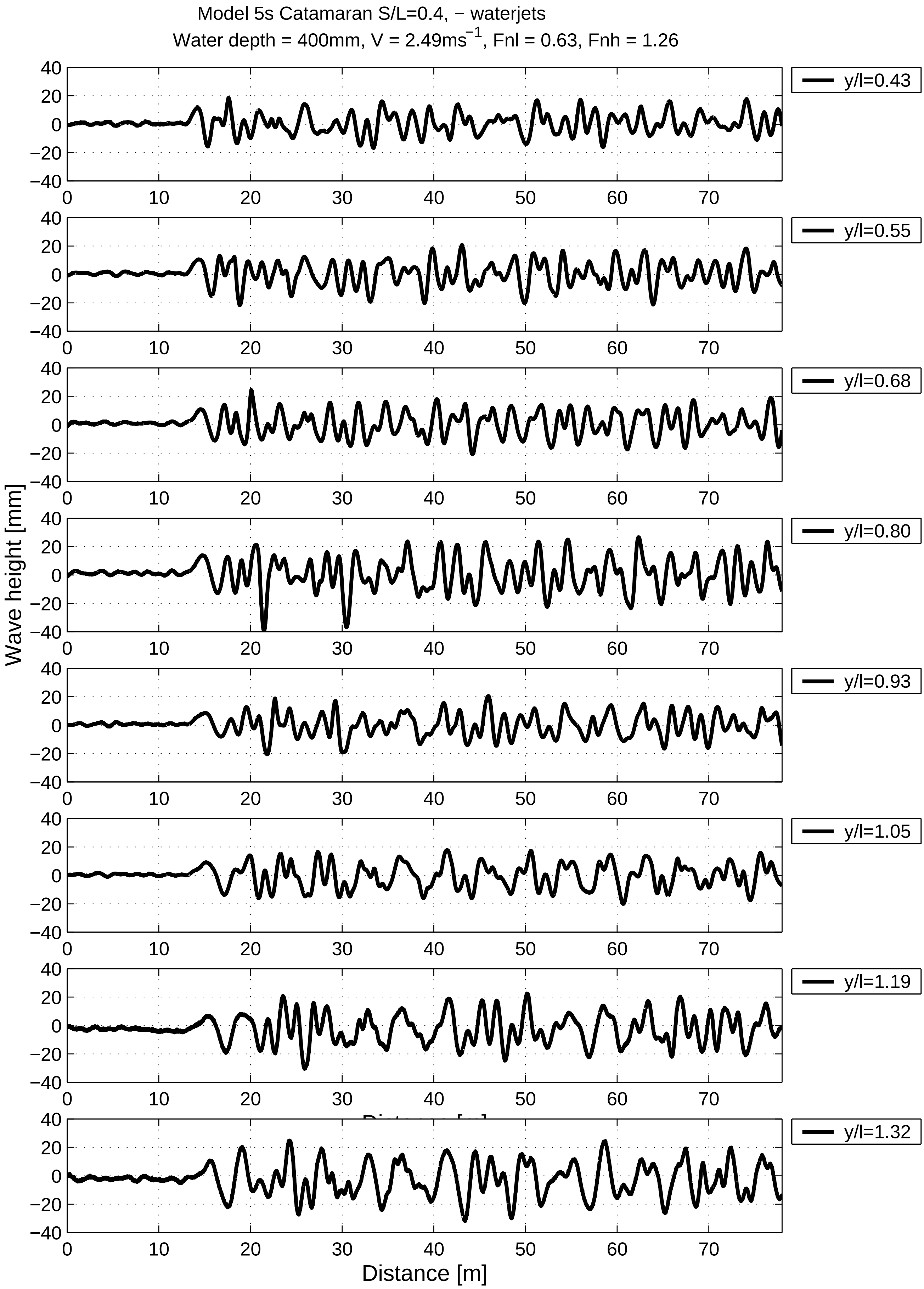
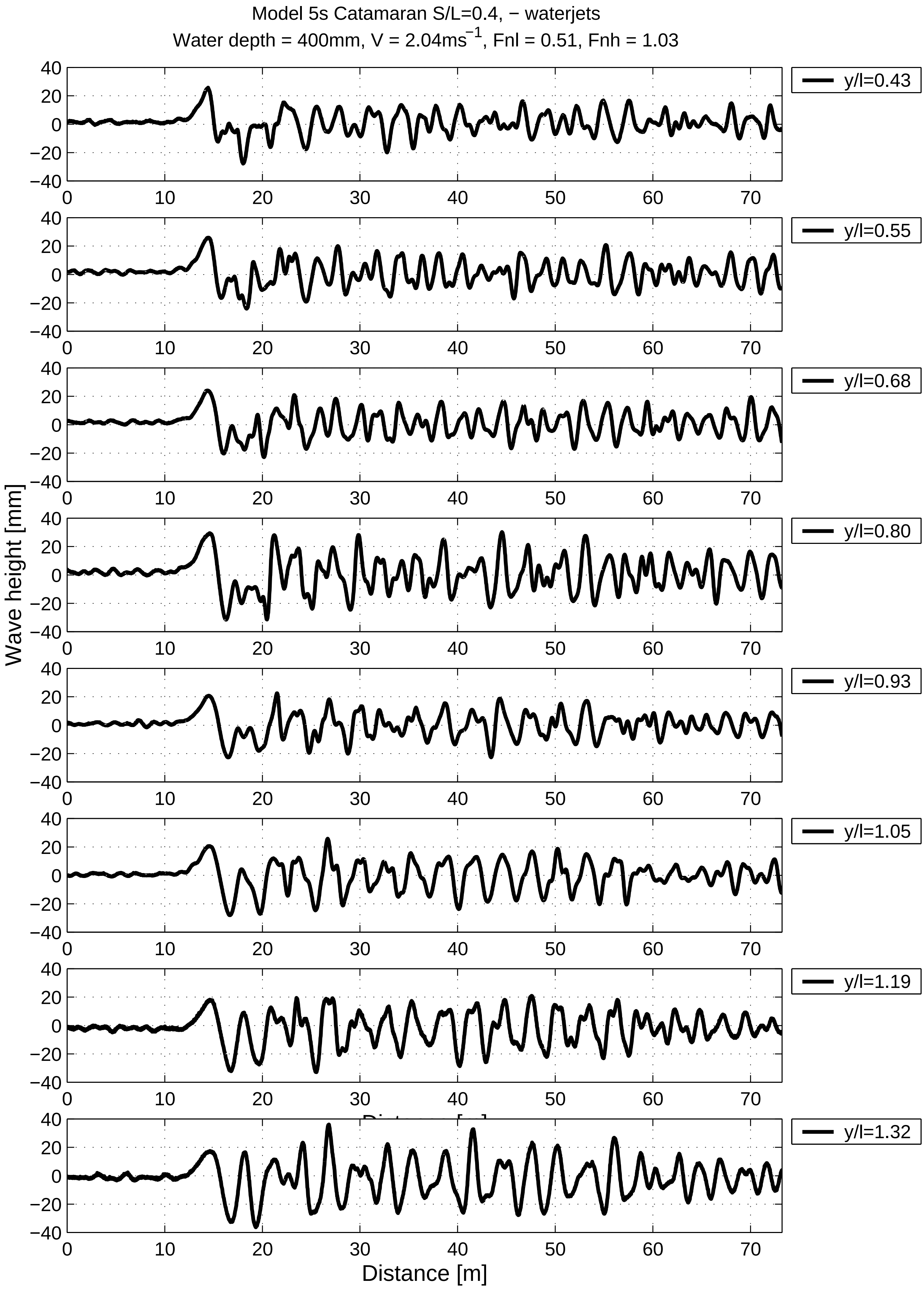
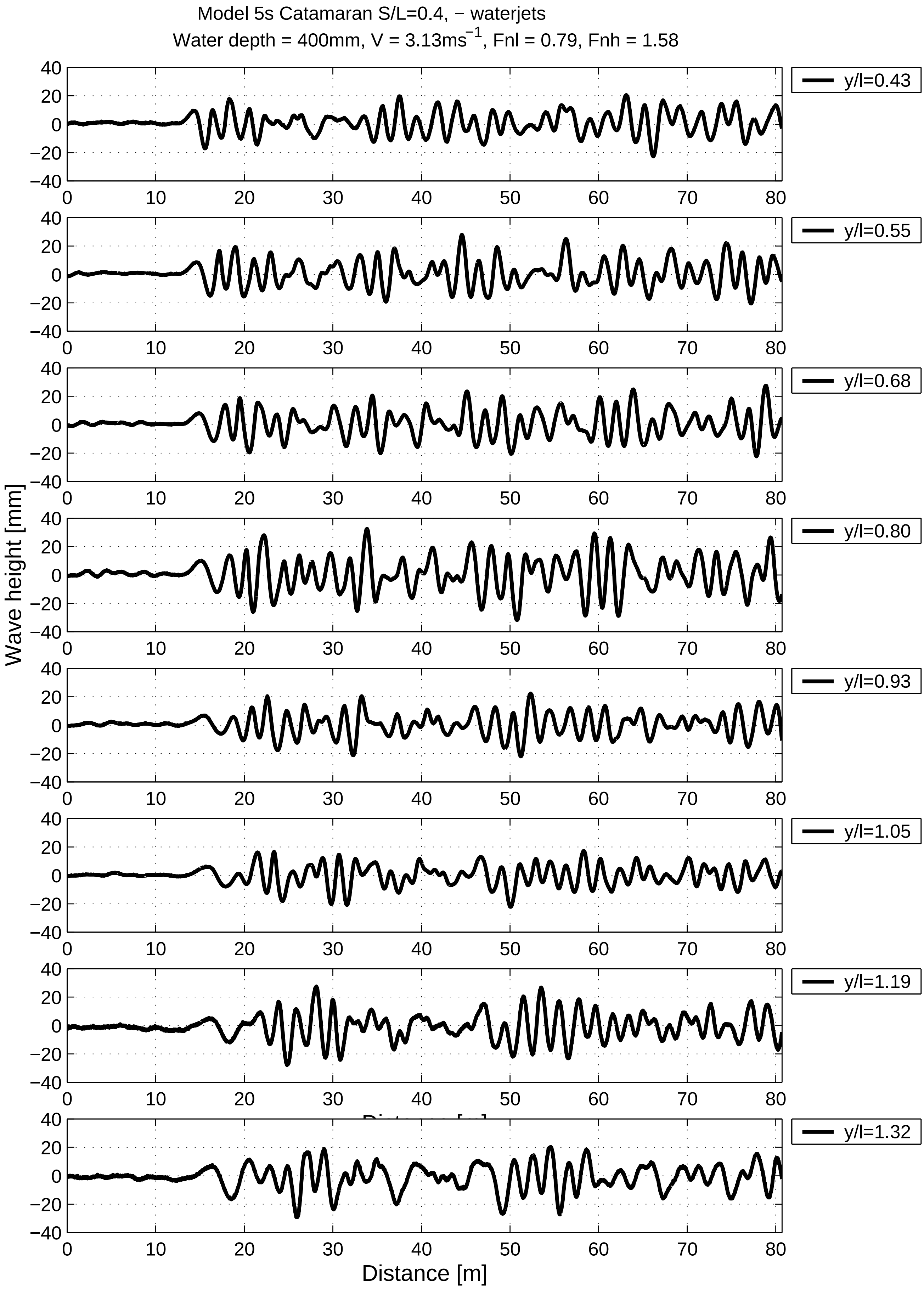

Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 400mm, V = 2.49ms−1, Fnl = 0.63, Fnh = 1.26
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 76



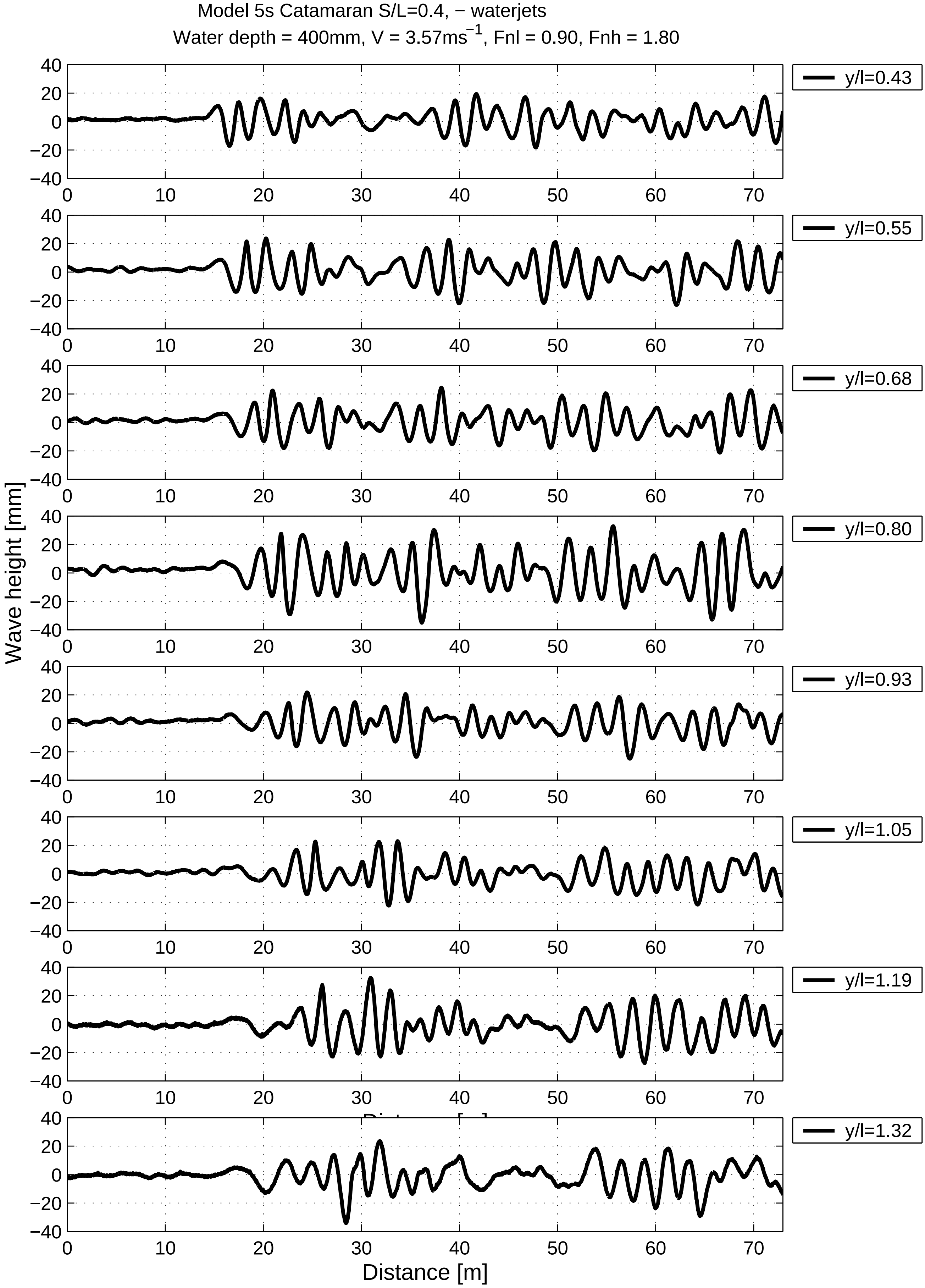
Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 400mm, V = 2.04ms−1, Fnl = 0.51, Fnh = 1.03
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 77



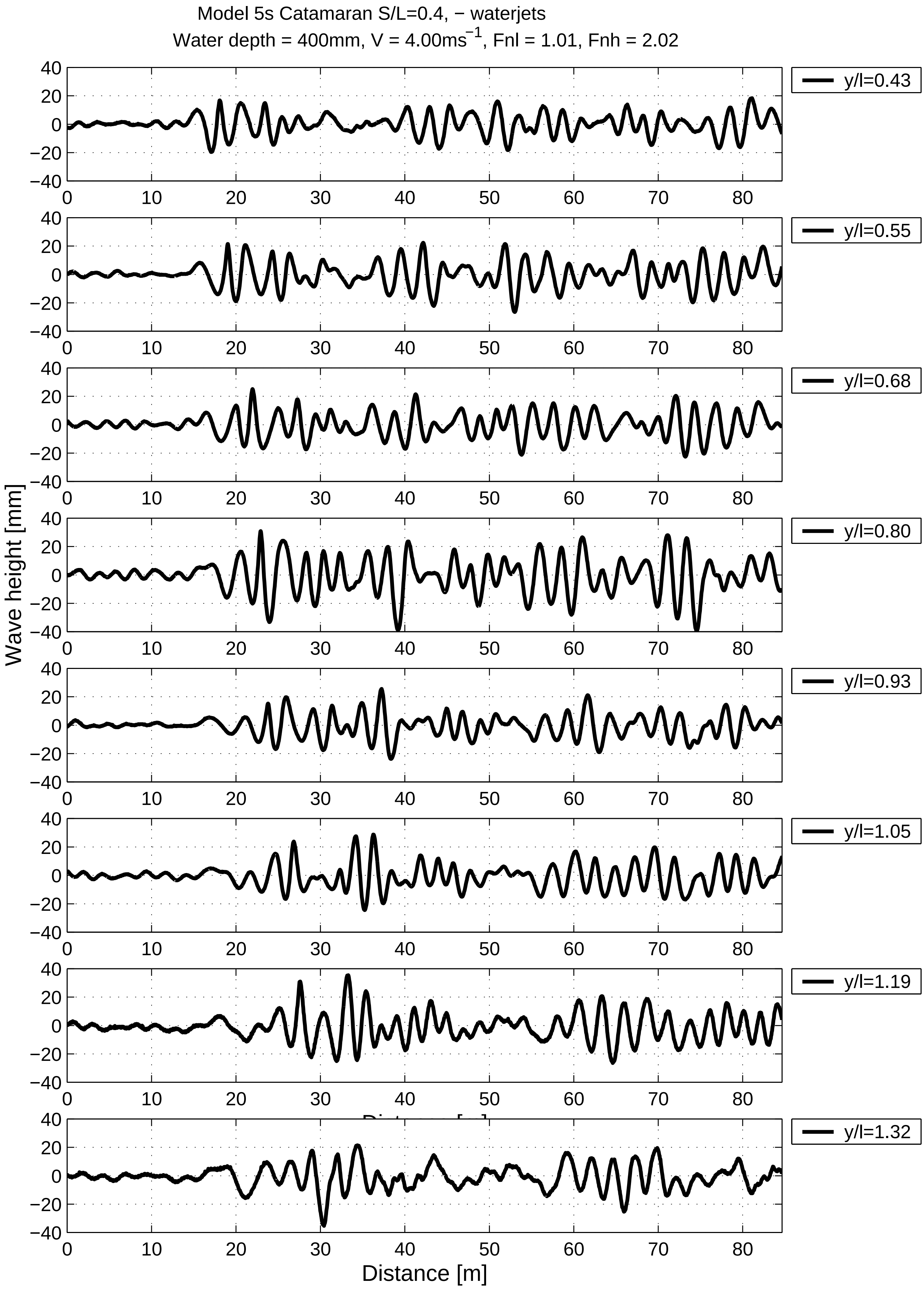
Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 400mm, V = 3.13ms−1, Fnl = 0.79, Fnh = 1.58
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 78



Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 400mm, V = 3.57ms^{-1}, Fnl = 0.90, Fnh = 1.80
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 79



Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 400mm, V = 4.00ms^{-1}, Fnl = 1.01, Fnh = 2.02
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 80

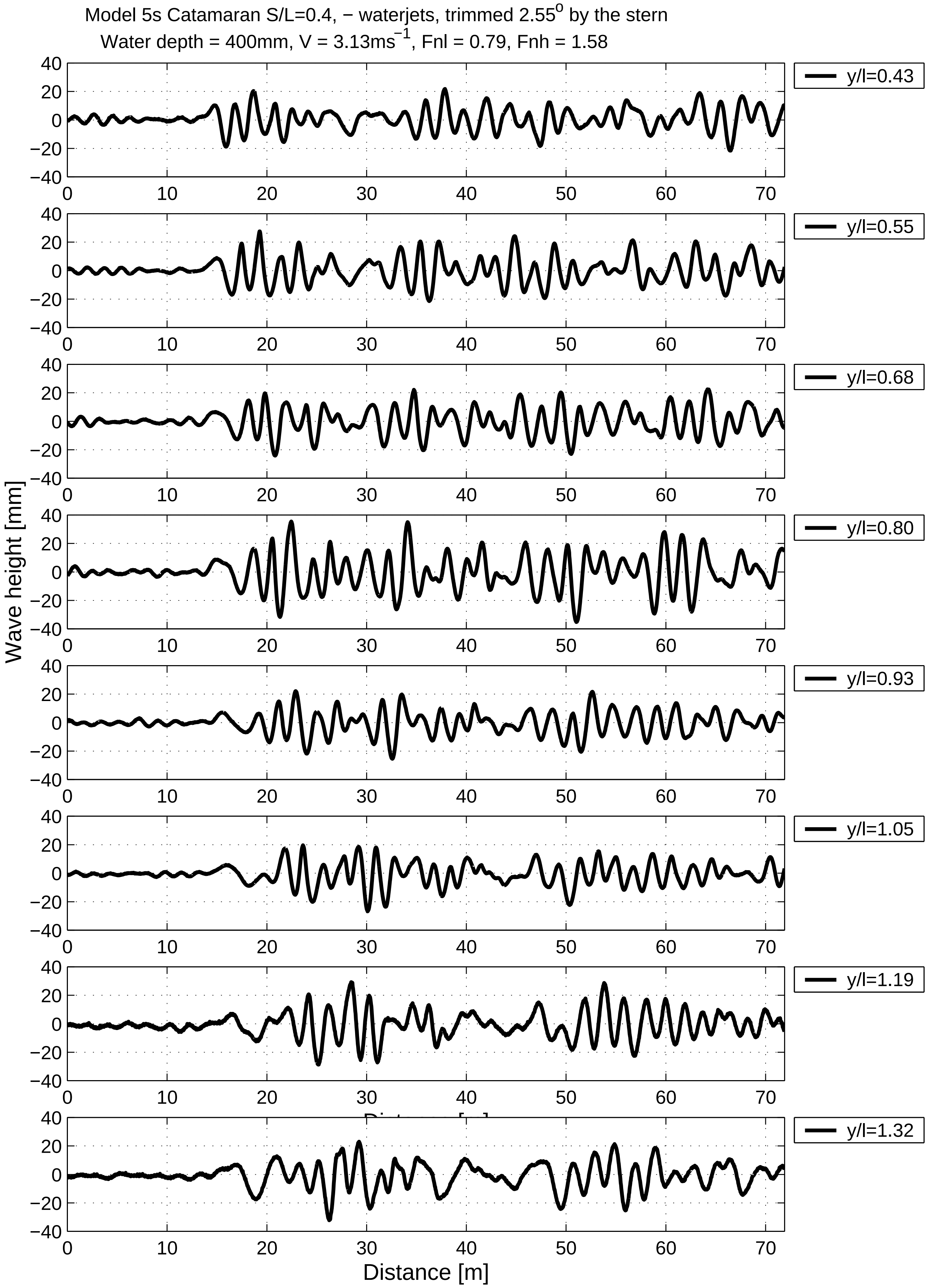

Model 5s Catamaran S/L=0.4, − waterjets, trimmed 2.55° by the stern
Water depth = 400mm, V = 3.13ms⁻¹, Fnl = 0.79, Fnh = 1.58
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 81

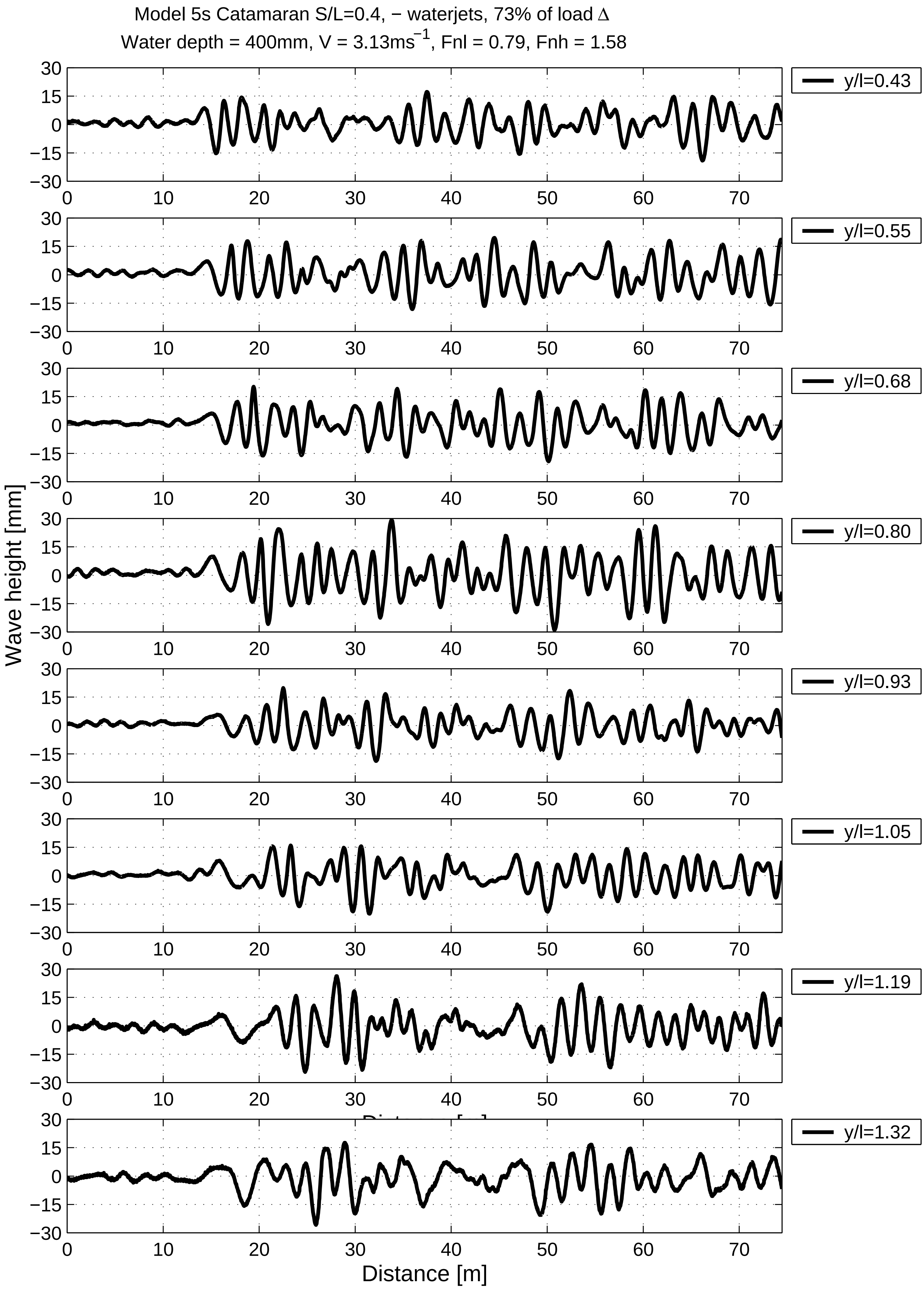
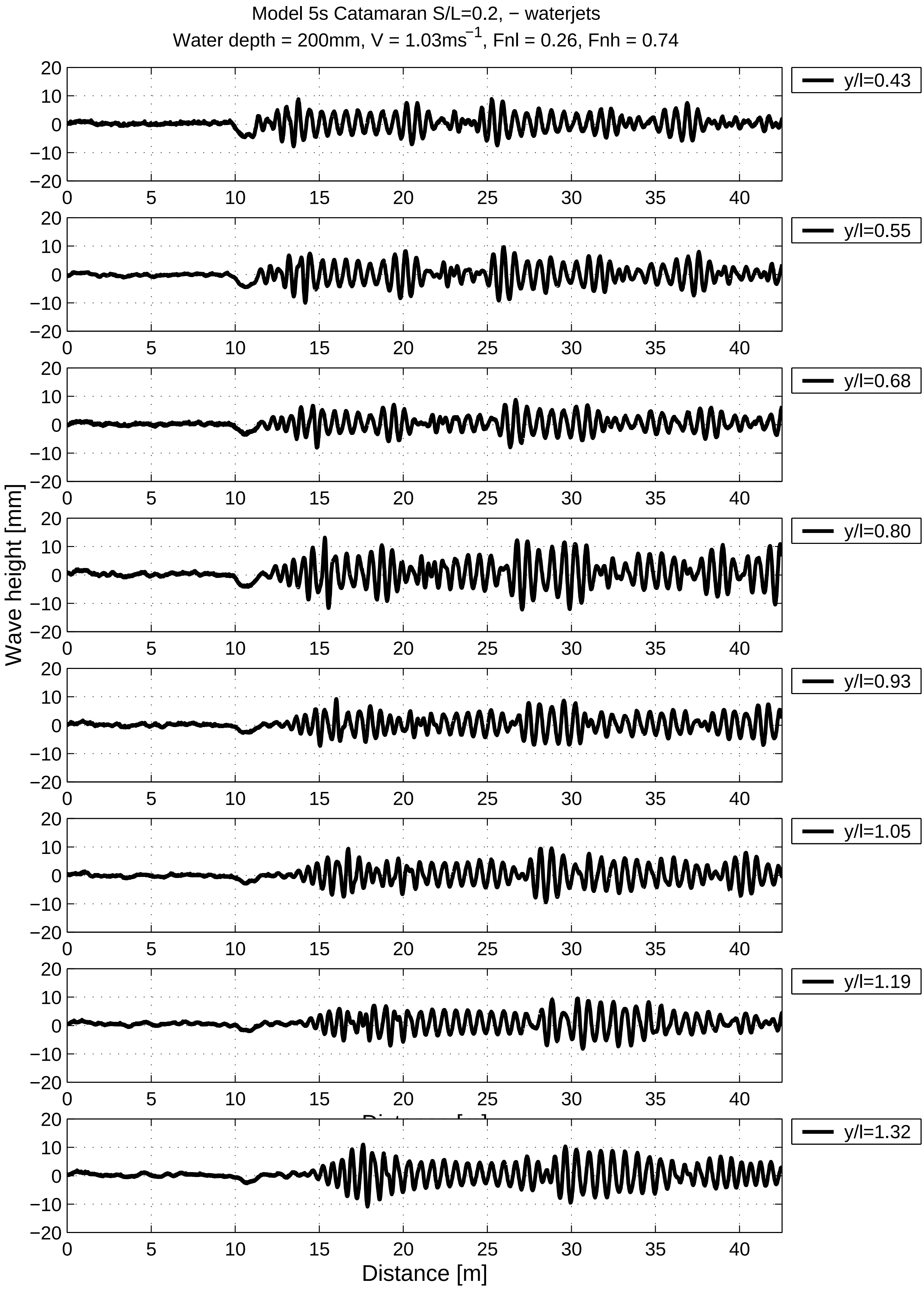

Model 5s Catamaran S/L=0.4, − waterjets, 73% of load Δ
Water depth = 400mm, V = 3.13ms−1, Fnl = 0.79, Fnh = 1.58
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 82



Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 200mm, V = 1.03ms^{-1}, Fnl = 0.26, Fnh = 0.74
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 83

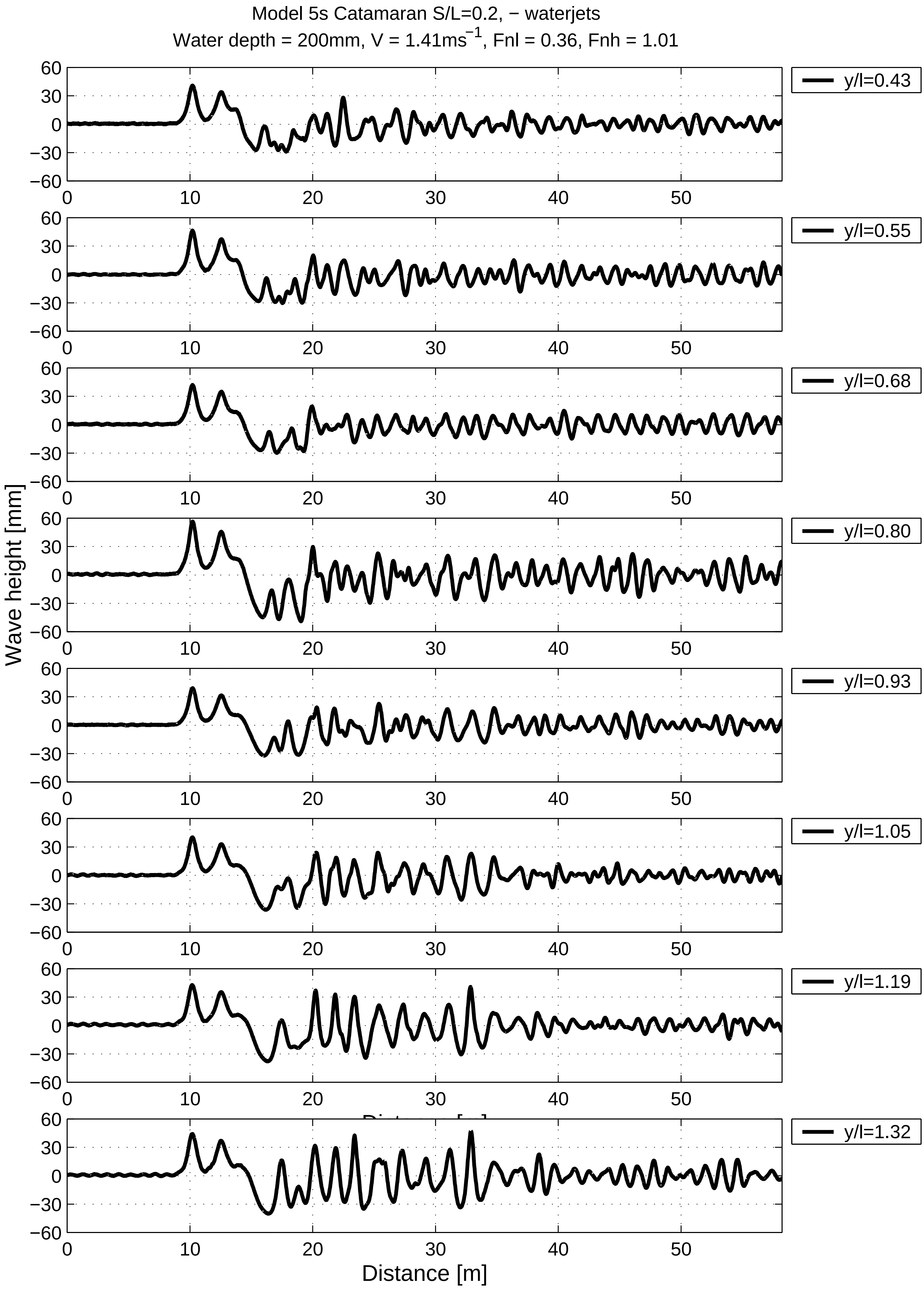
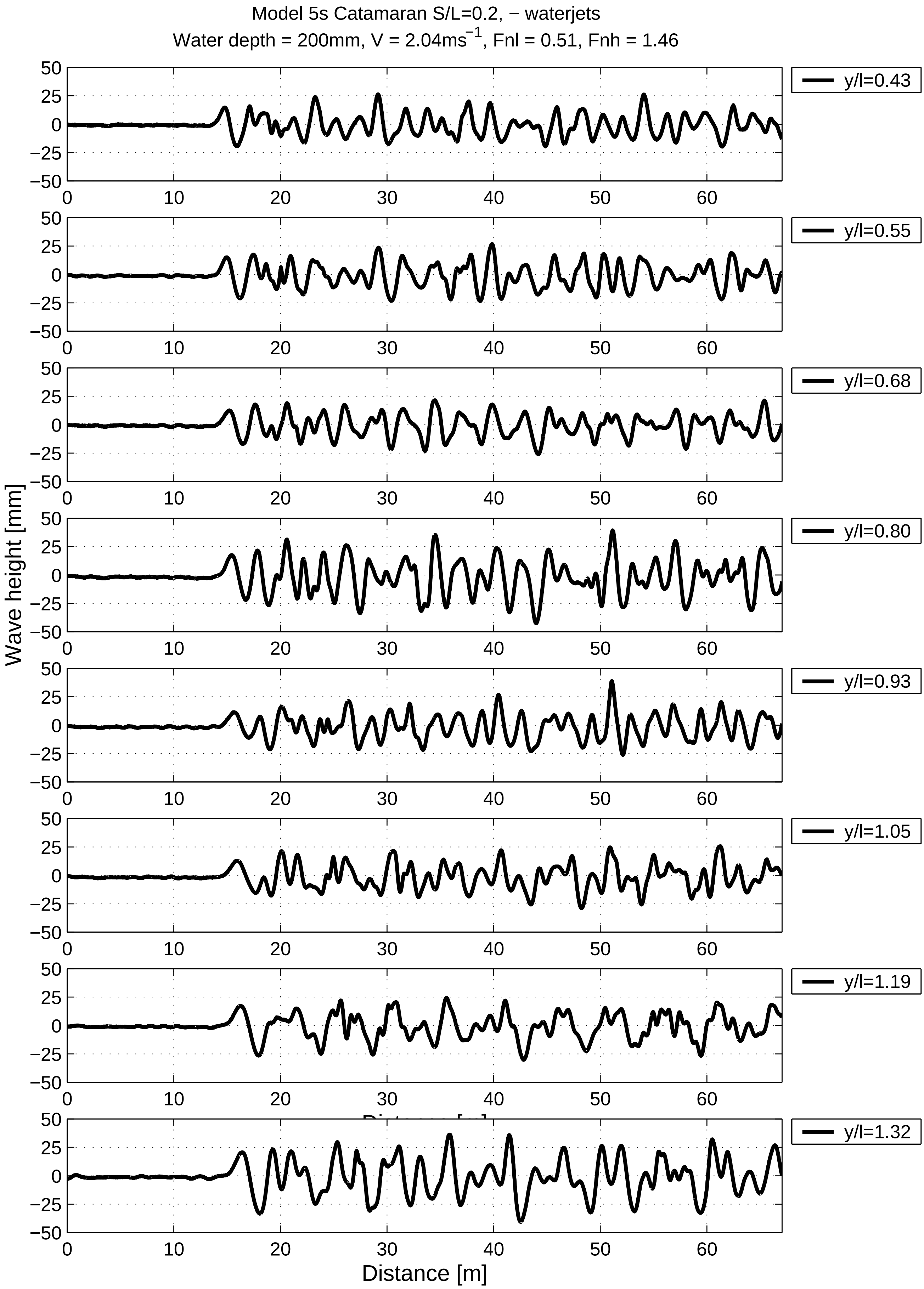

Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 200mm, V = 1.41ms^{-1}, Fnl = 0.36, Fnh = 1.01
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]
60
30
0
−30
−60
0
10
20
30
40
50

Figure 84



Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 200mm, V = 2.04ms−1, Fnl = 0.51, Fnh = 1.46
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 85

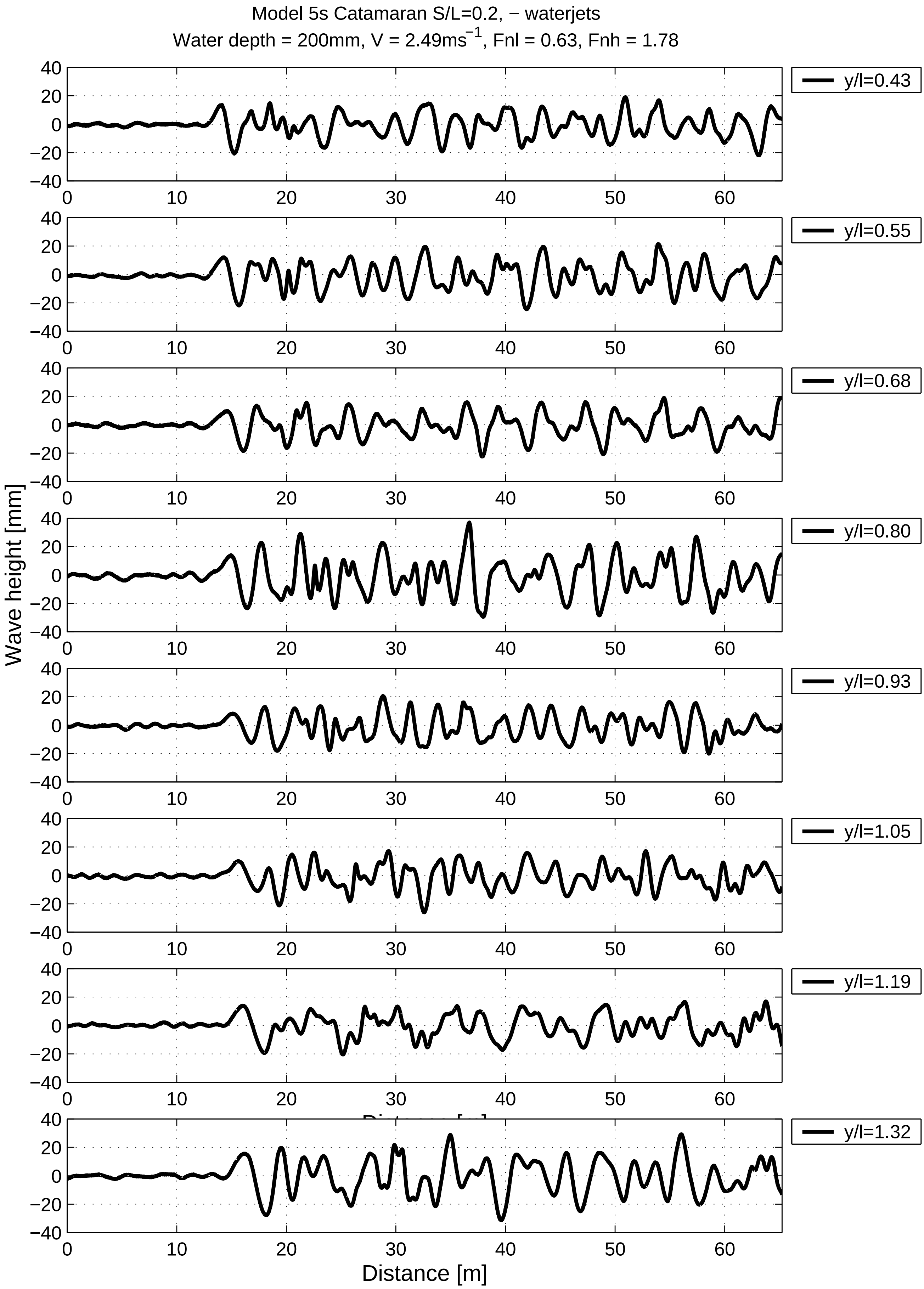
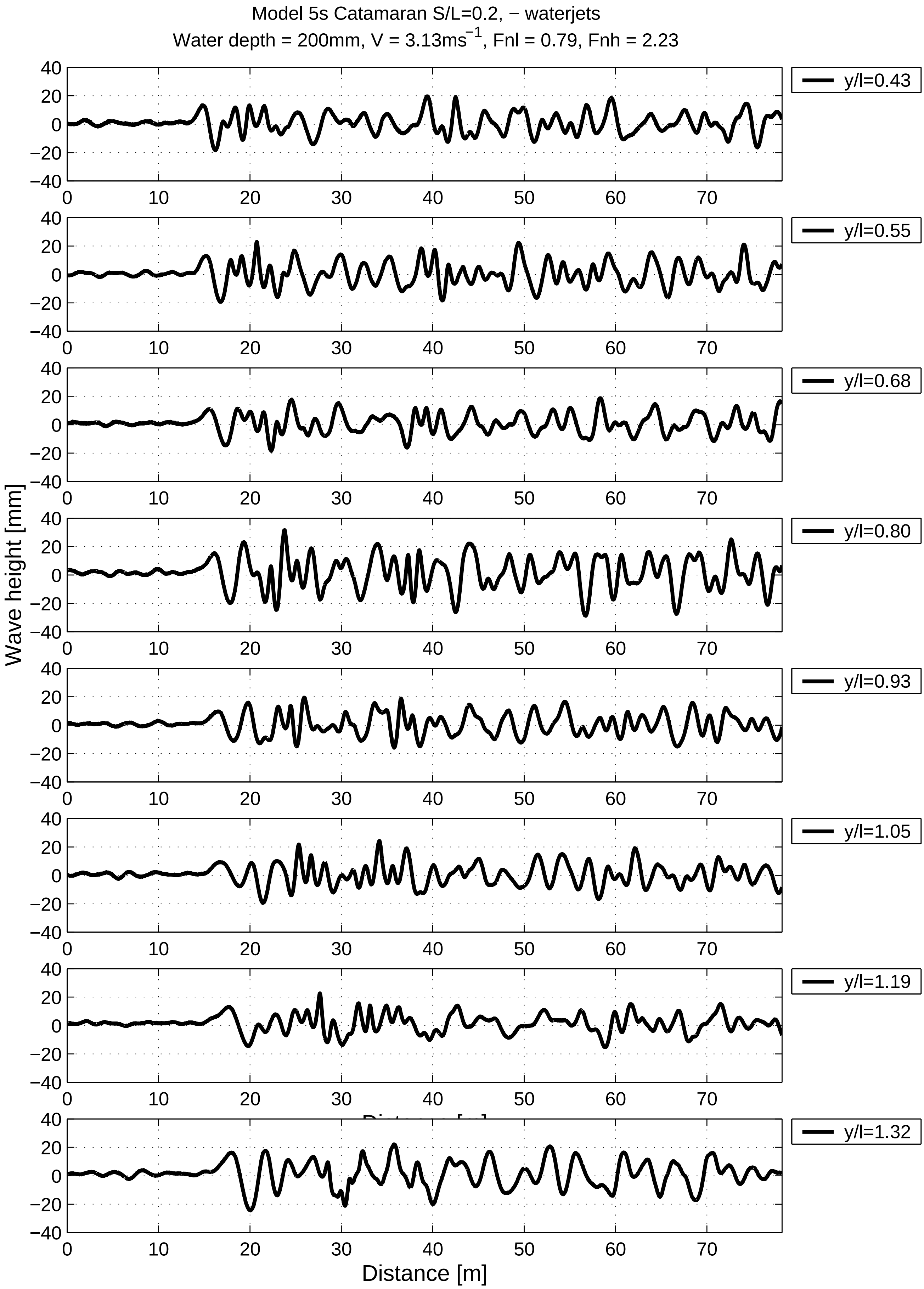

Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 200mm, V = 2.49ms^{-1}, Fnl = 0.63, Fnh = 1.78
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 86



Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 200mm, V = 3.13ms^{-1}, Fnl = 0.79, Fnh = 2.23
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 87

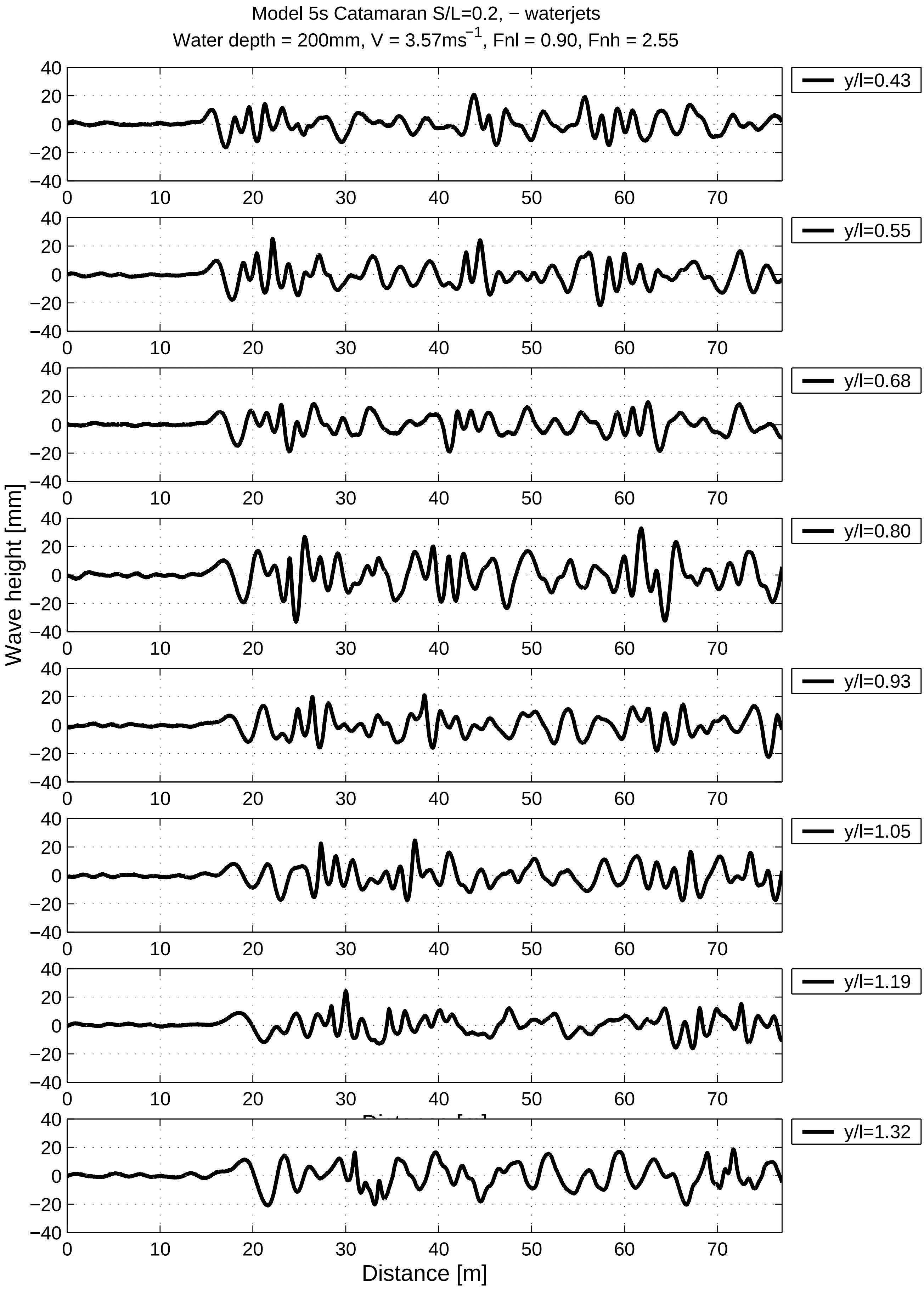
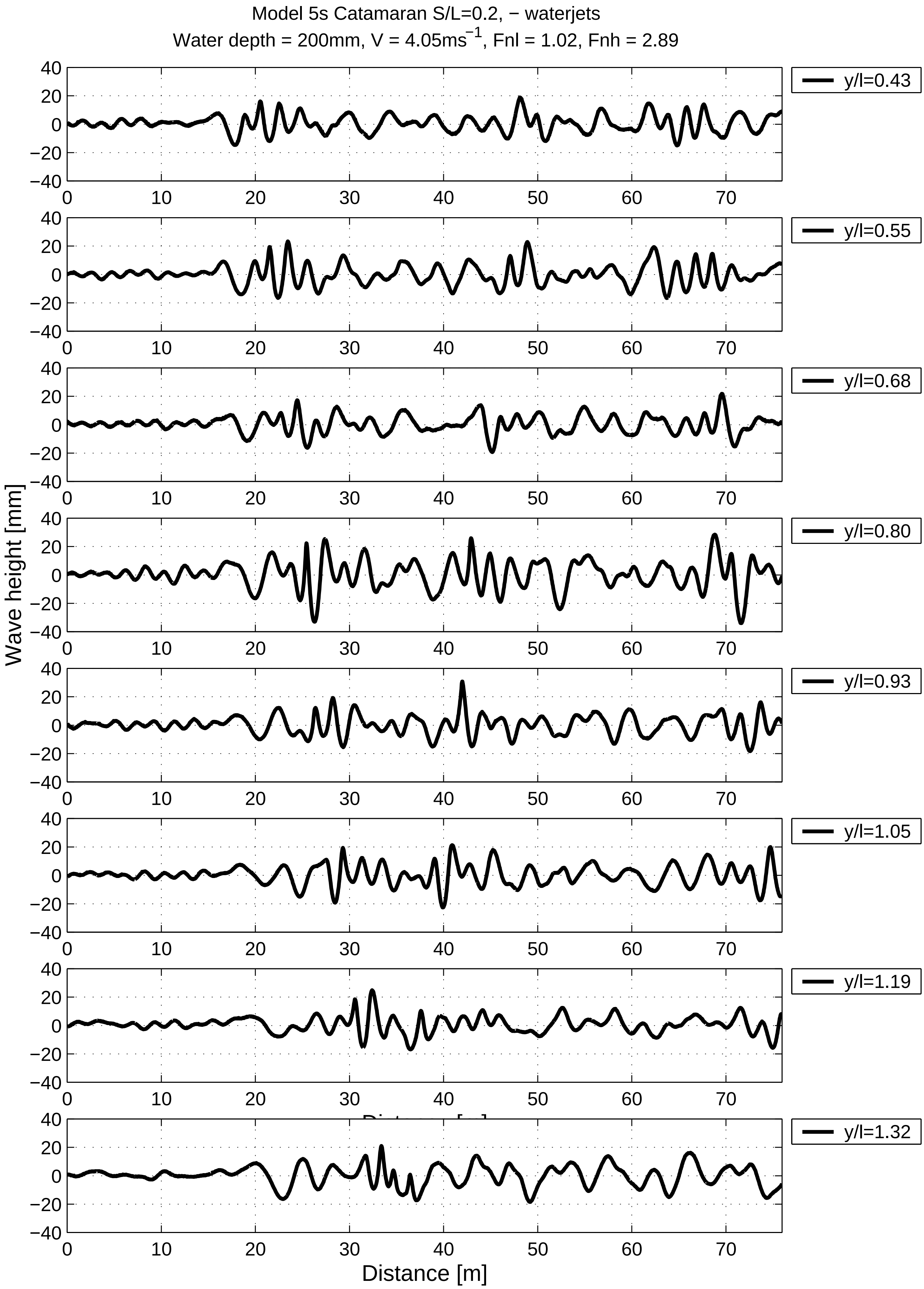
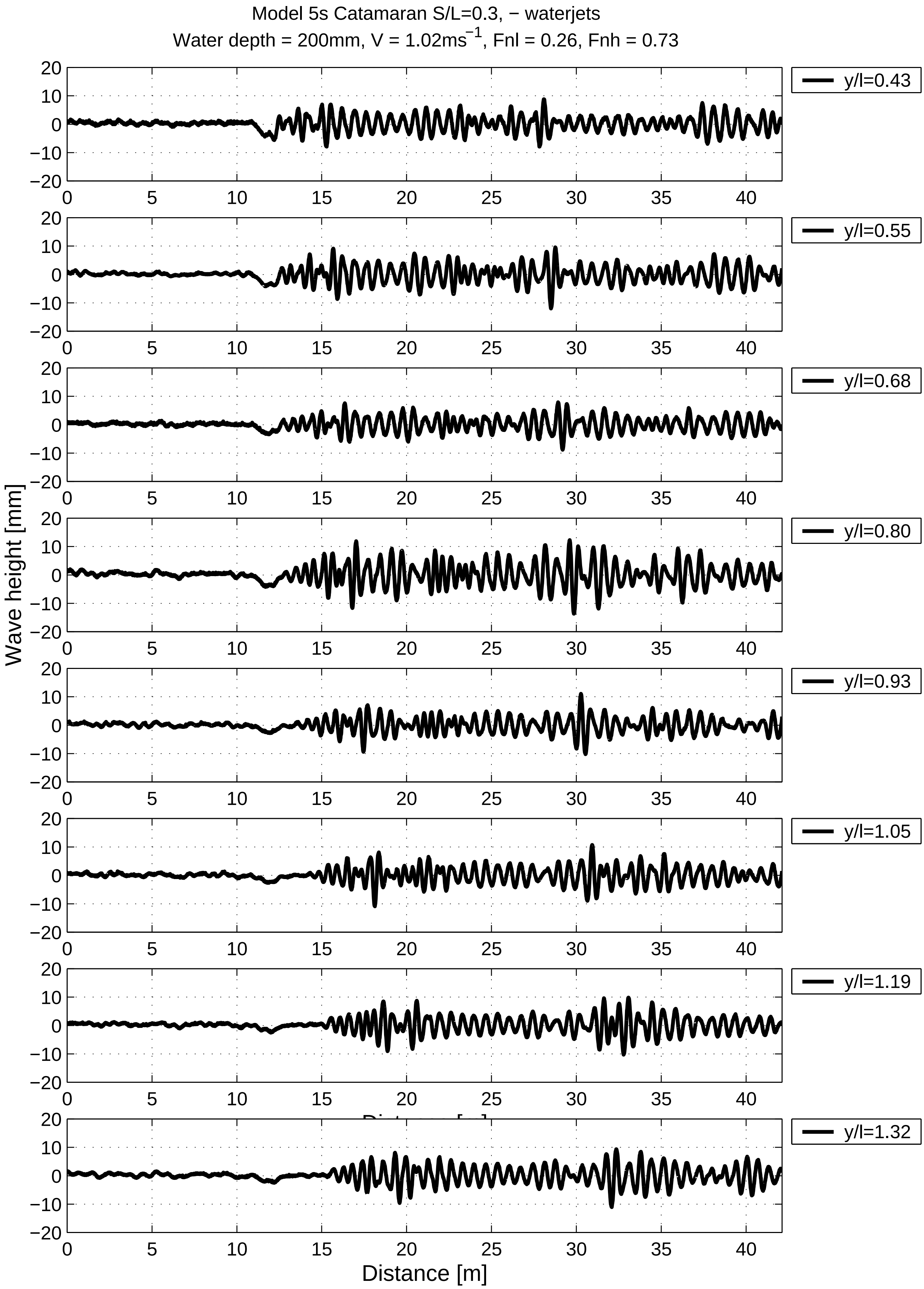

Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 200mm, V = 3.57ms−1, Fnl = 0.90, Fnh = 2.55
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 88



Model 5s Catamaran S/L=0.2, − waterjets
Water depth = 200mm, V = 4.05ms^{-1}, Fnl = 1.02, Fnh = 2.89
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 89



Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 200mm, V = 1.02ms−1, Fnl = 0.26, Fnh = 0.73
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 90

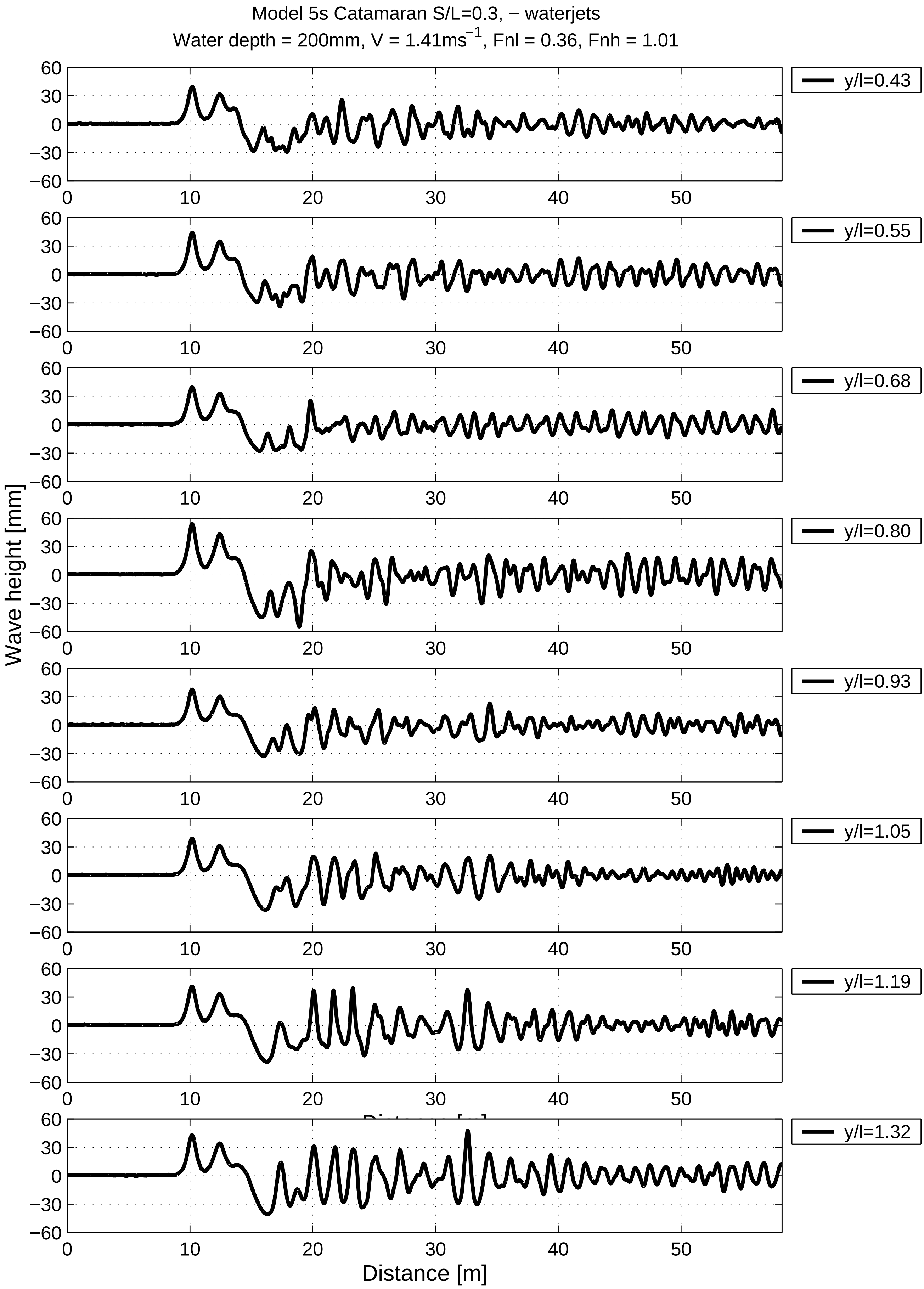
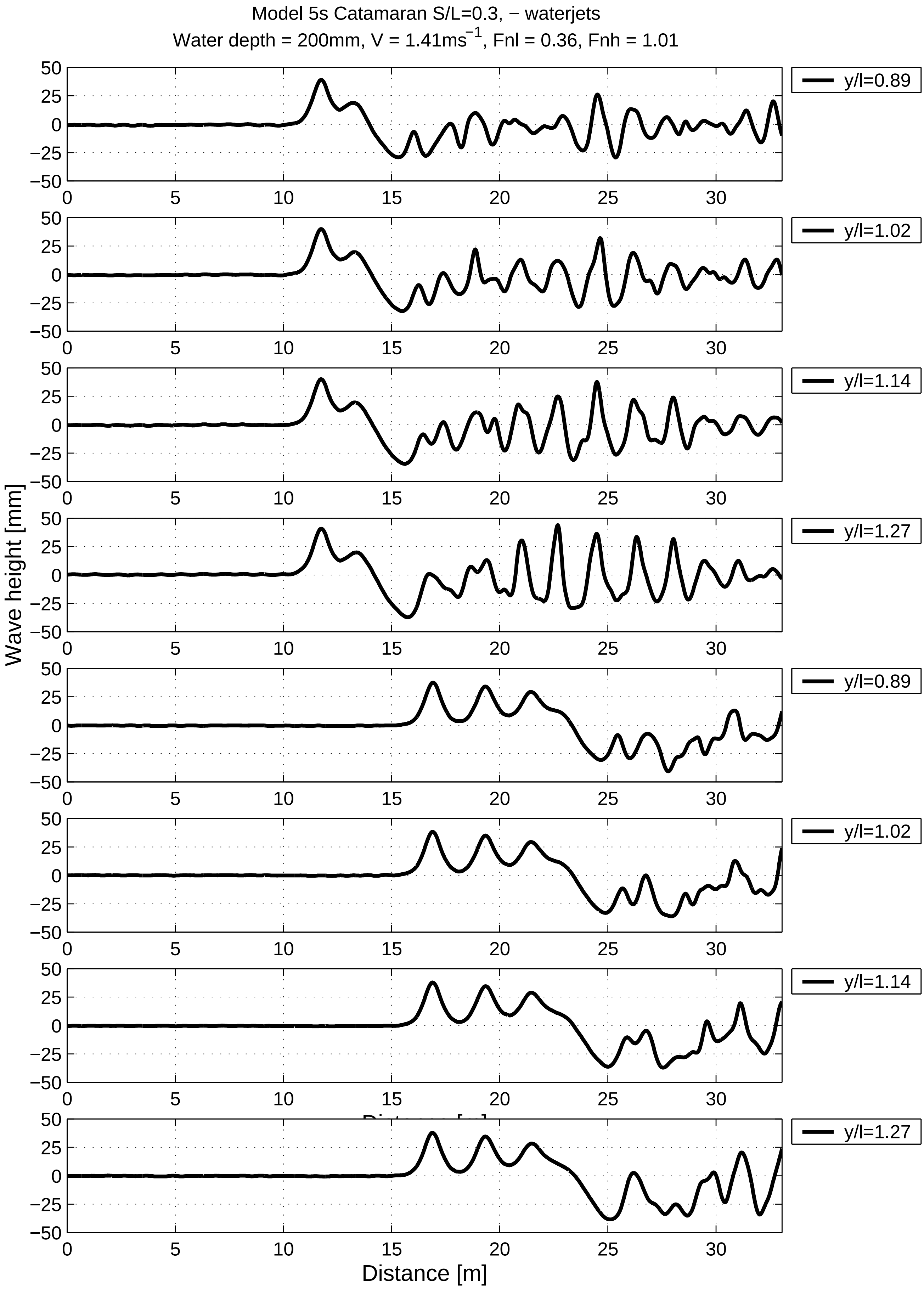

Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 200mm, V = 1.41ms^{-1}, Fnl = 0.36, Fnh = 1.01
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]
60
30
0
−30
−60
0
10
20
30
40
50

Figure 91



Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 200mm, V = 1.41ms−1, Fnl = 0.36, Fnh = 1.01
y/l=0.89
y/l=1.02
y/l=1.14
y/l=1.27
y/l=0.89
y/l=1.02
y/l=1.14
y/l=1.27
Wave height [mm]
Distance [m]

Figure 92

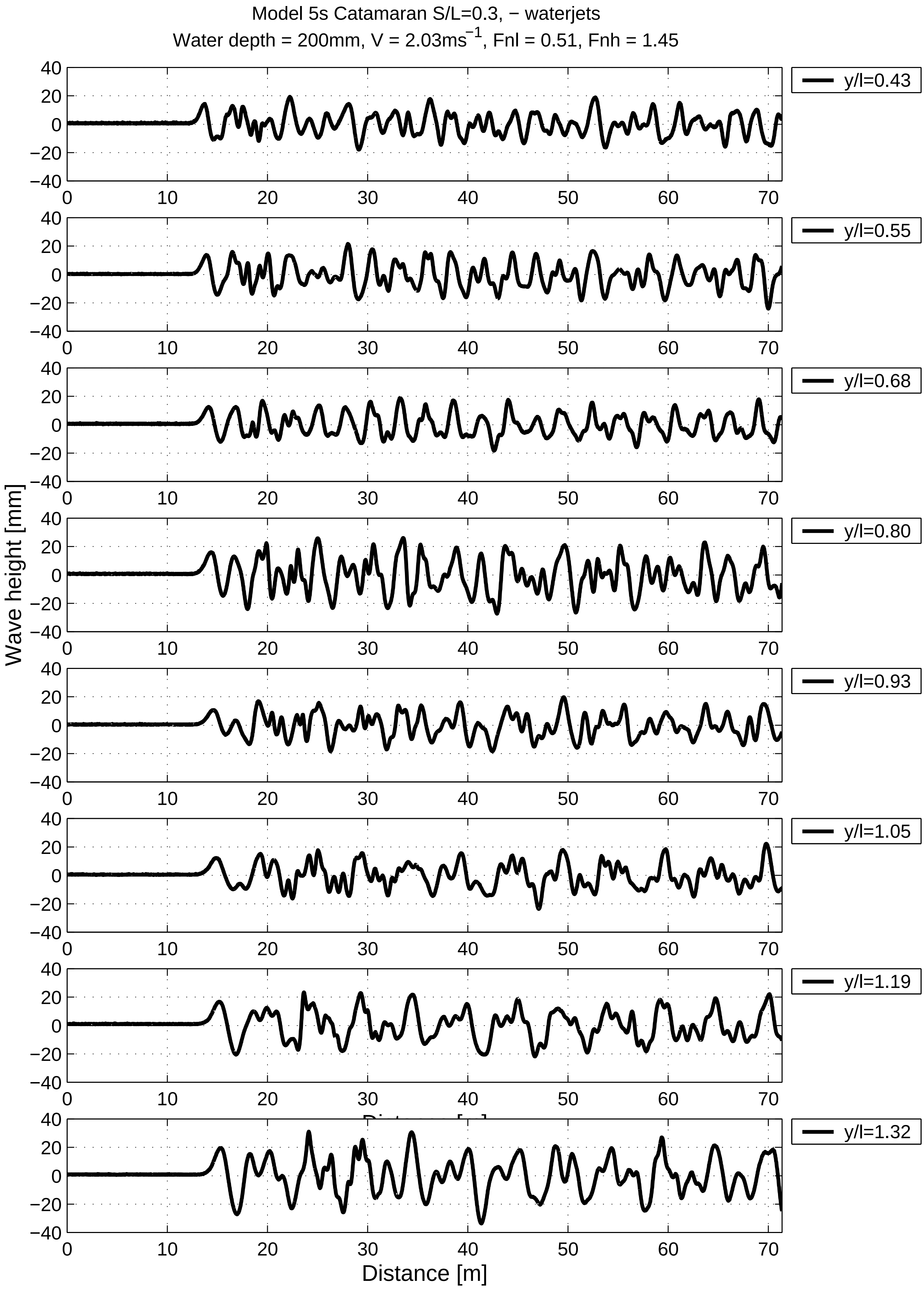
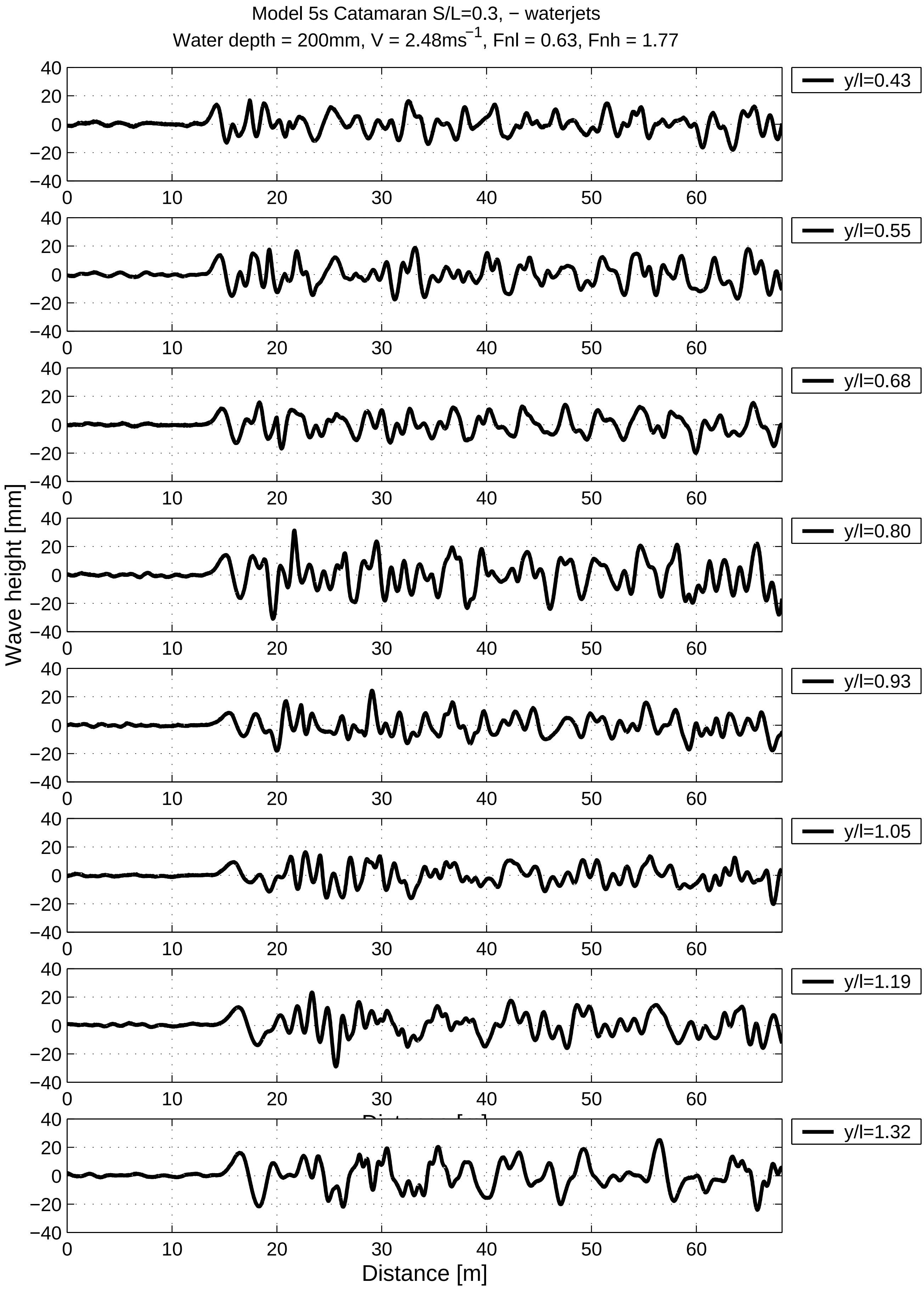

Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 200mm, V = 2.03ms^{-1}, Fnl = 0.51, Fnh = 1.45
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 93



Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 200mm, V = 2.48ms−1, Fnl = 0.63, Fnh = 1.77
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 94

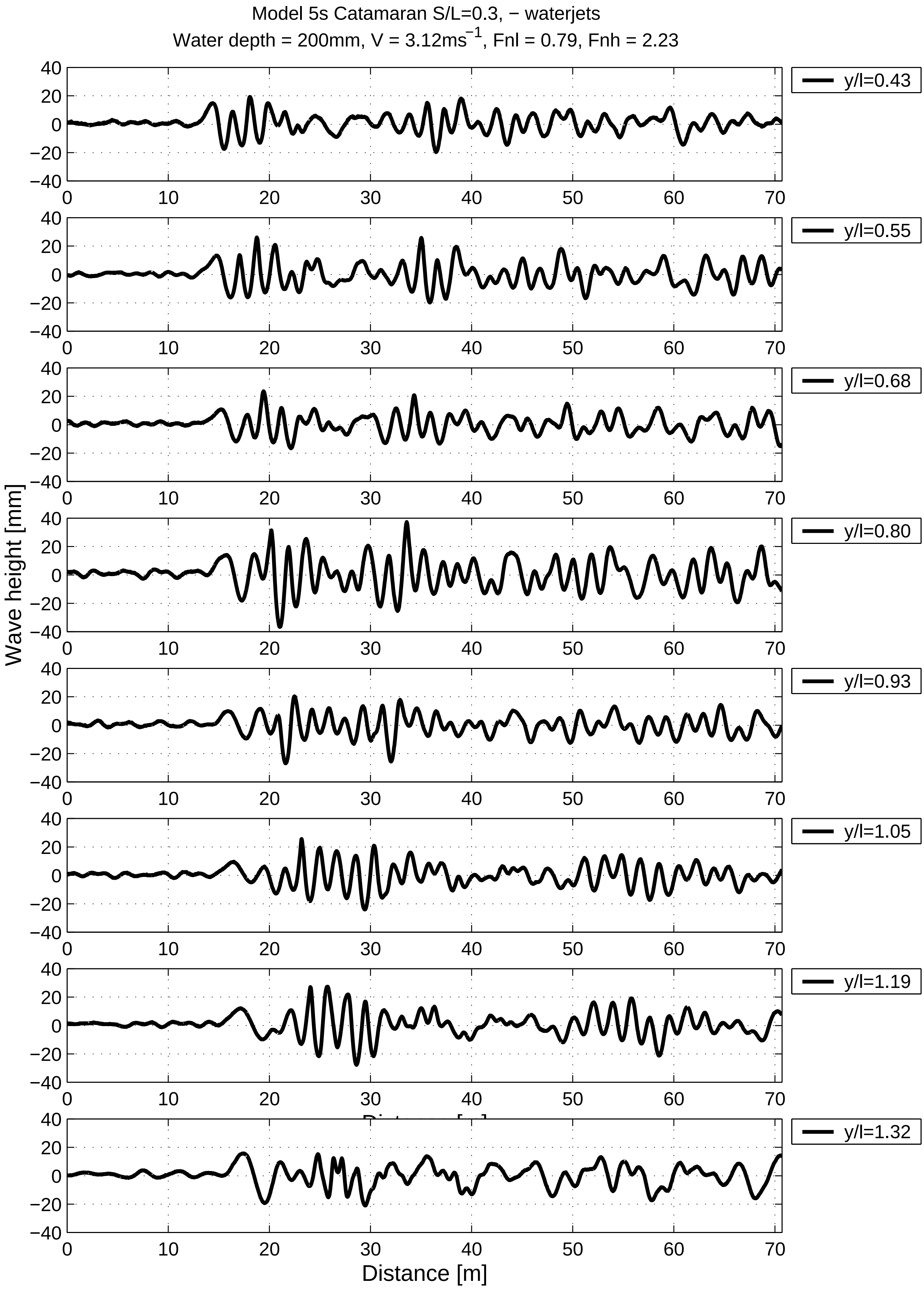
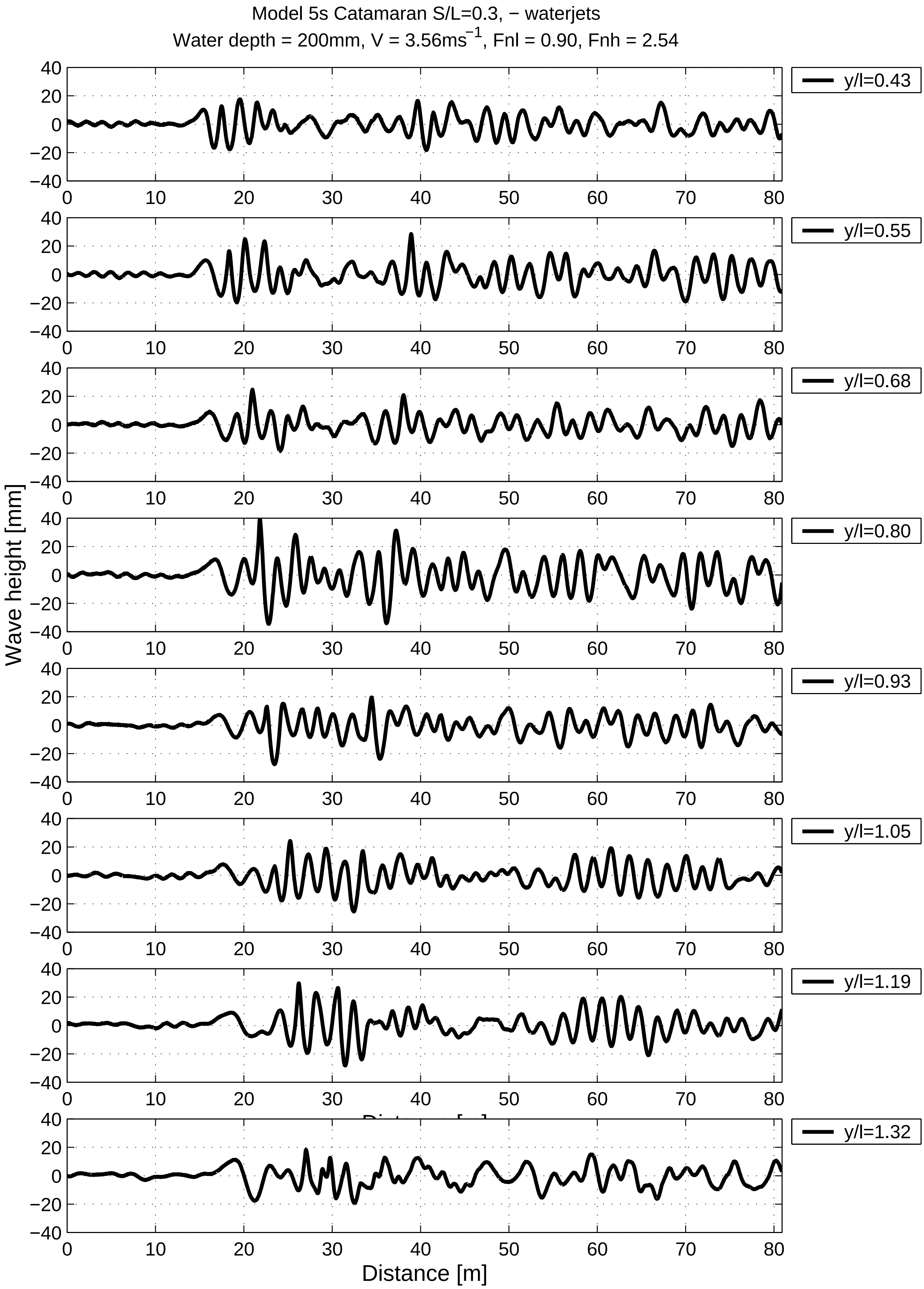

Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 200mm, V = 3.12ms−1, Fnl = 0.79, Fnh = 2.23
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 95



Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 200mm, V = 3.56ms^{-1}, Fnl = 0.90, Fnh = 2.54
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 96

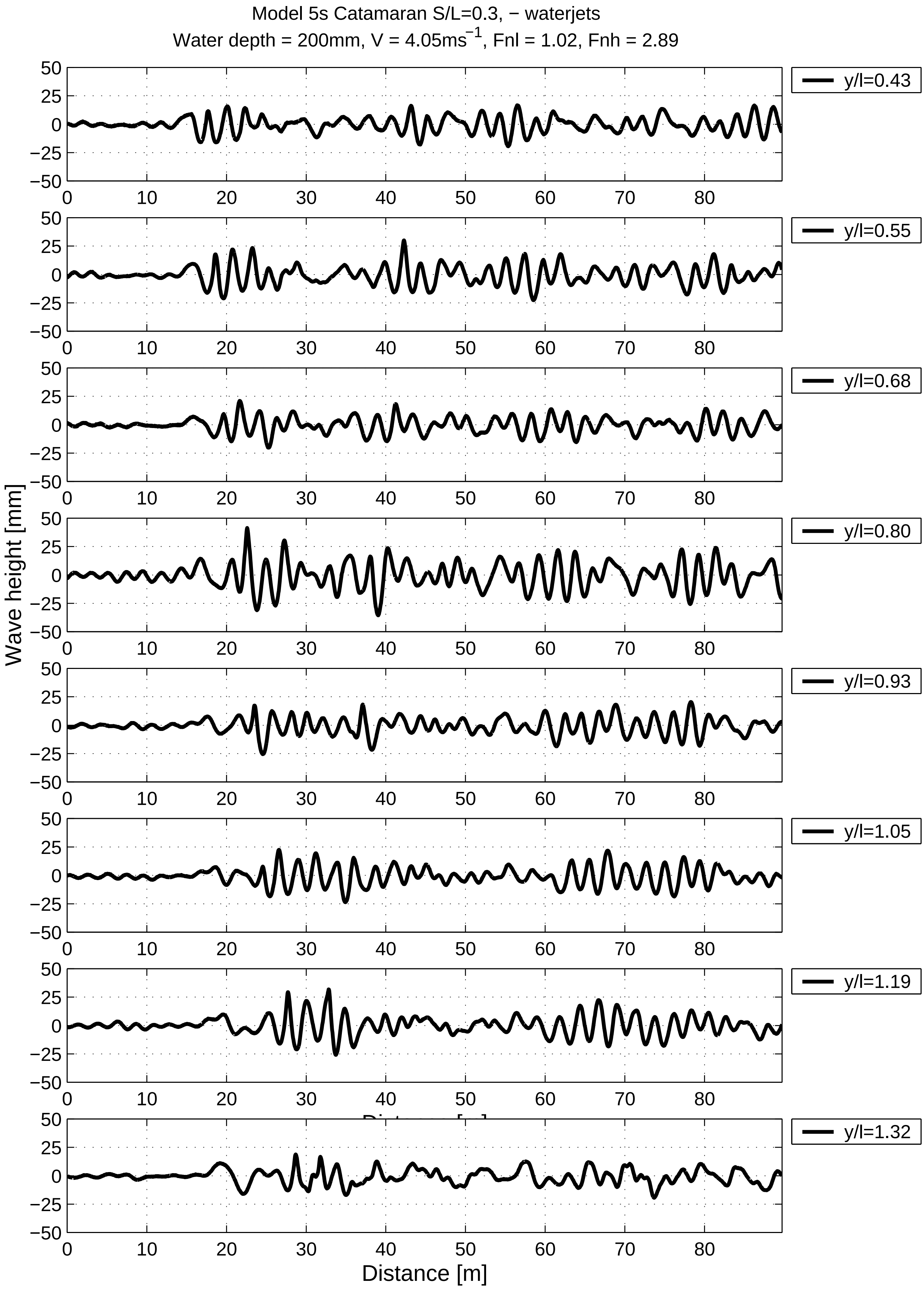

Model 5s Catamaran S/L=0.3, − waterjets
Water depth = 200mm, V = 4.05ms^{-1}, Fnl = 1.02, Fnh = 2.89
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 97

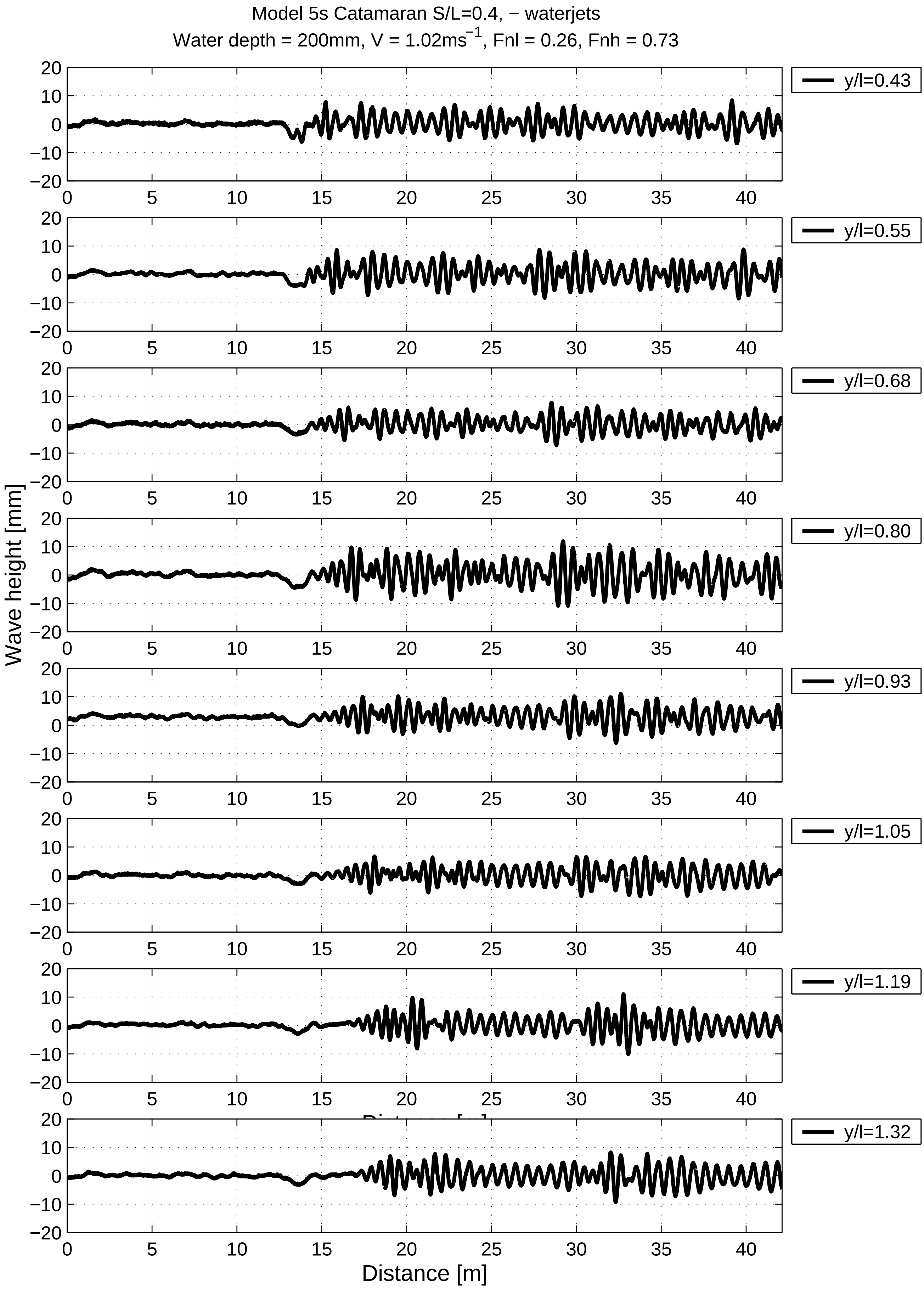

Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 200mm, V = 1.02ms^−1, Fnl = 0.26, Fnh = 0.73
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 98

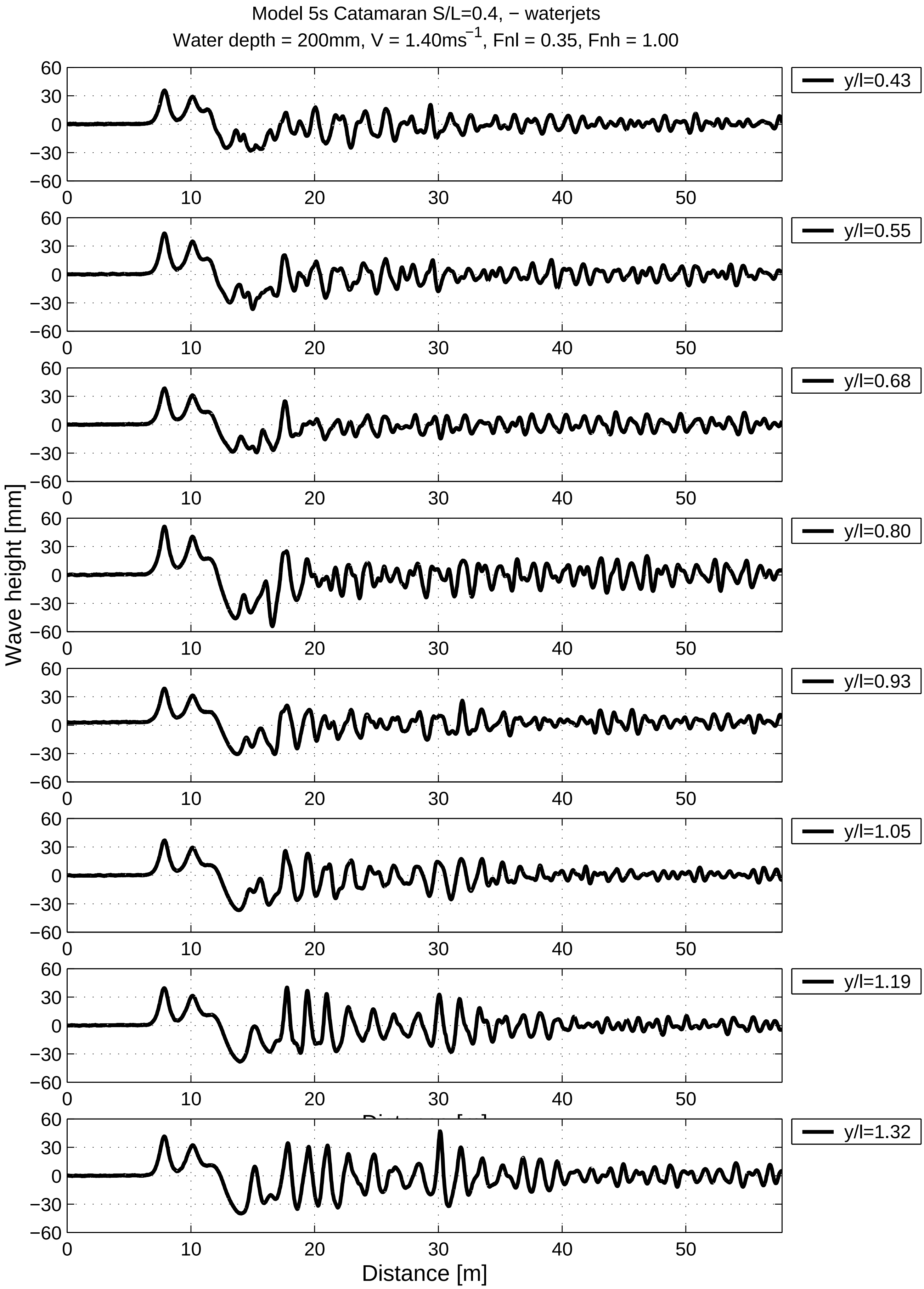
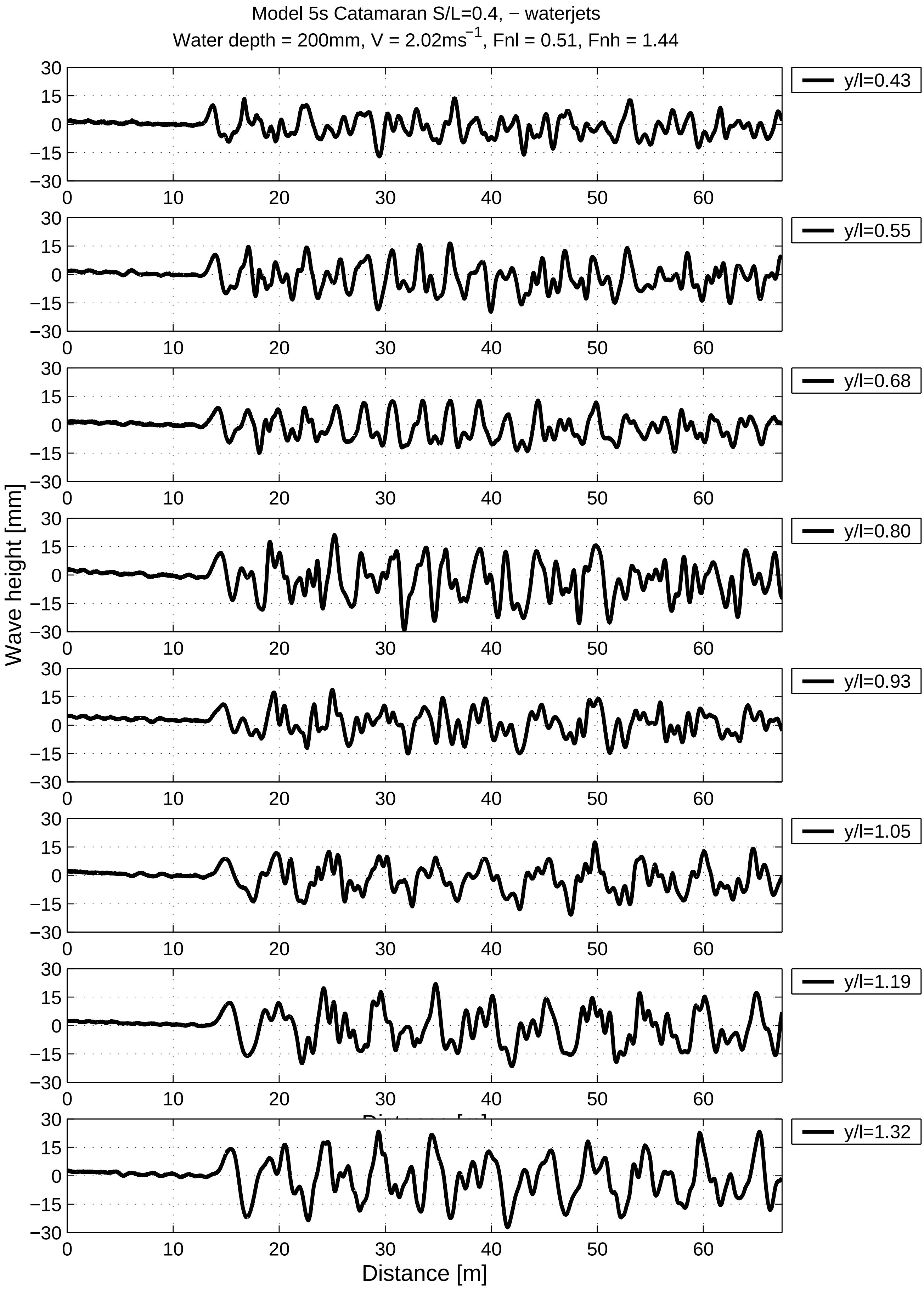
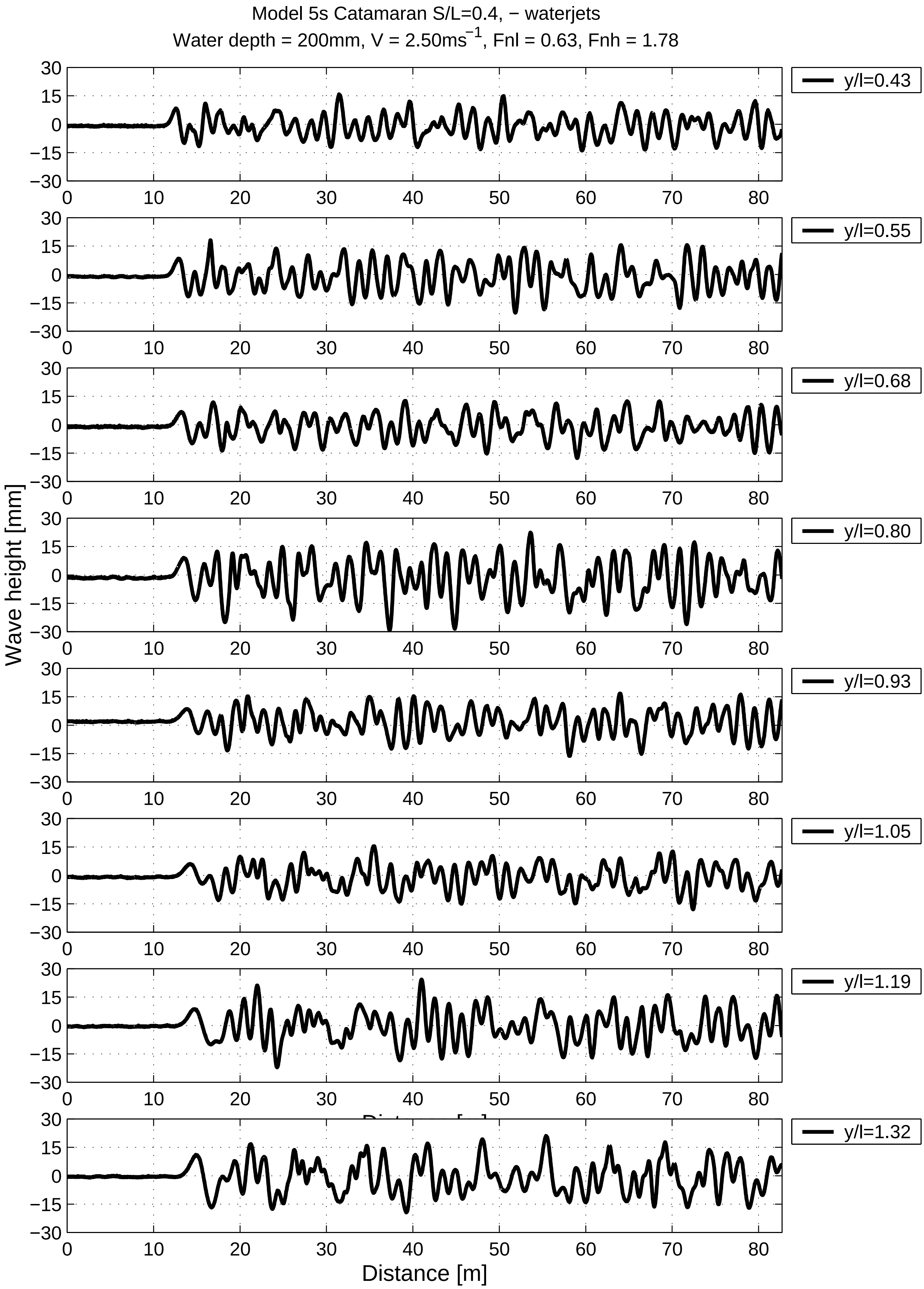

Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 200mm, V = 1.40ms−1, Fnl = 0.35, Fnh = 1.00
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]
60
30
0
−30
−60
0
10
20
30
40
50

Figure 99



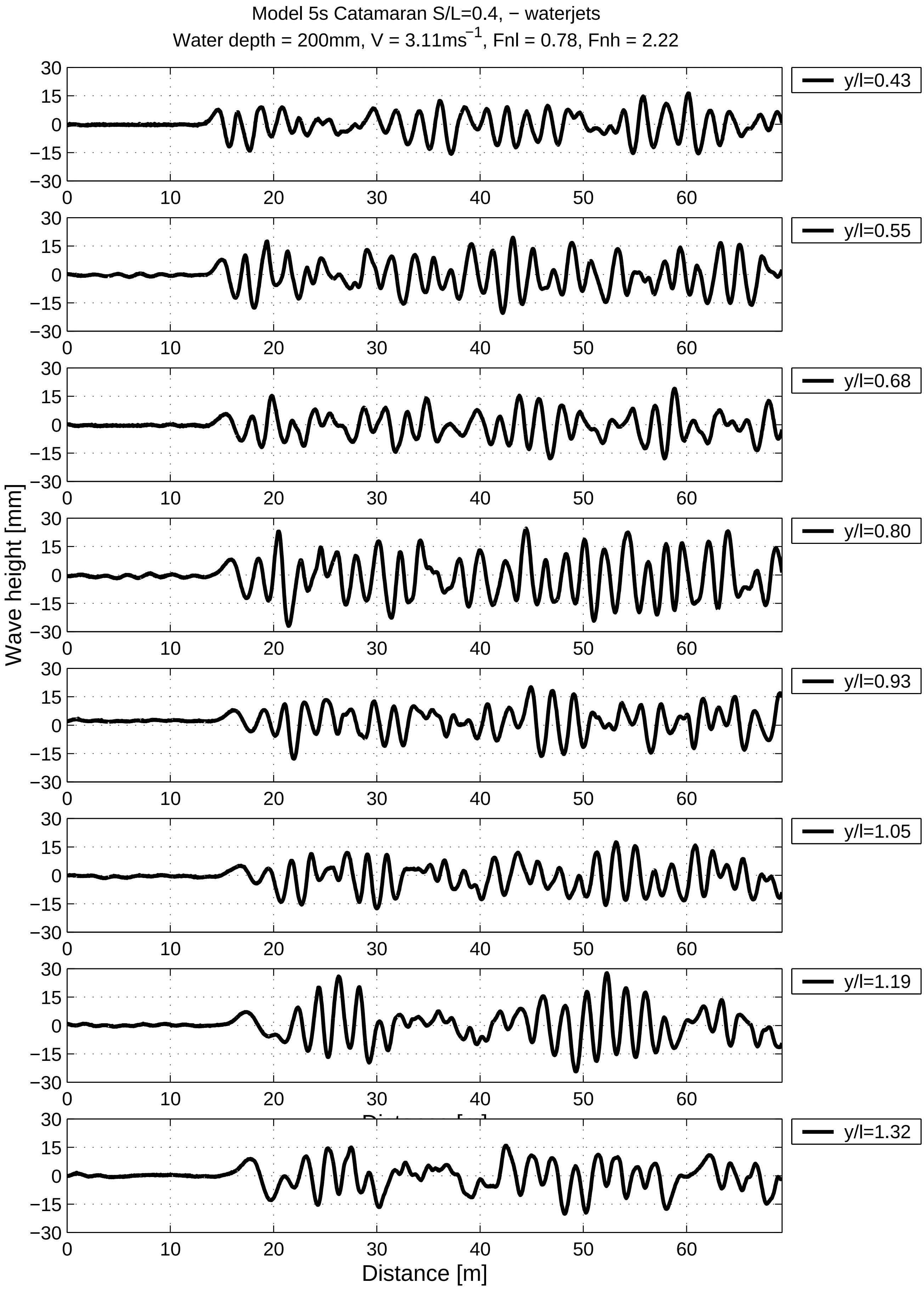
Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 200mm, V = 2.02ms^{-1}, Fnl = 0.51, Fnh = 1.44
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 100



Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 200mm, V = 2.50ms−1, Fnl = 0.63, Fnh = 1.78
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]
30
15
0
−15
−30
0
10
20
30
40
50
60
70
80

Figure 101



Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 200mm, V = 3.11ms^{-1}, Fnl = 0.78, Fnh = 2.22
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 102

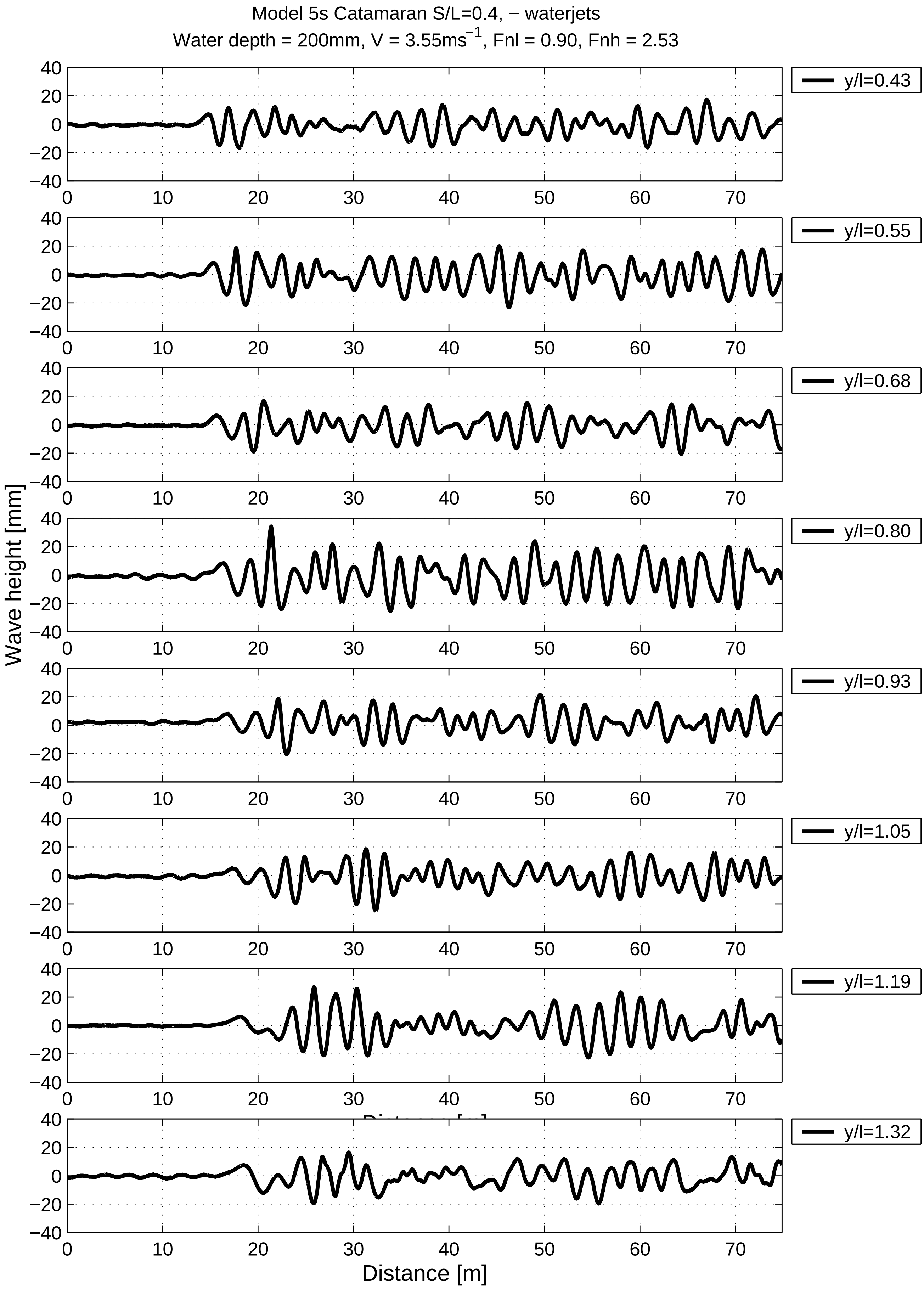
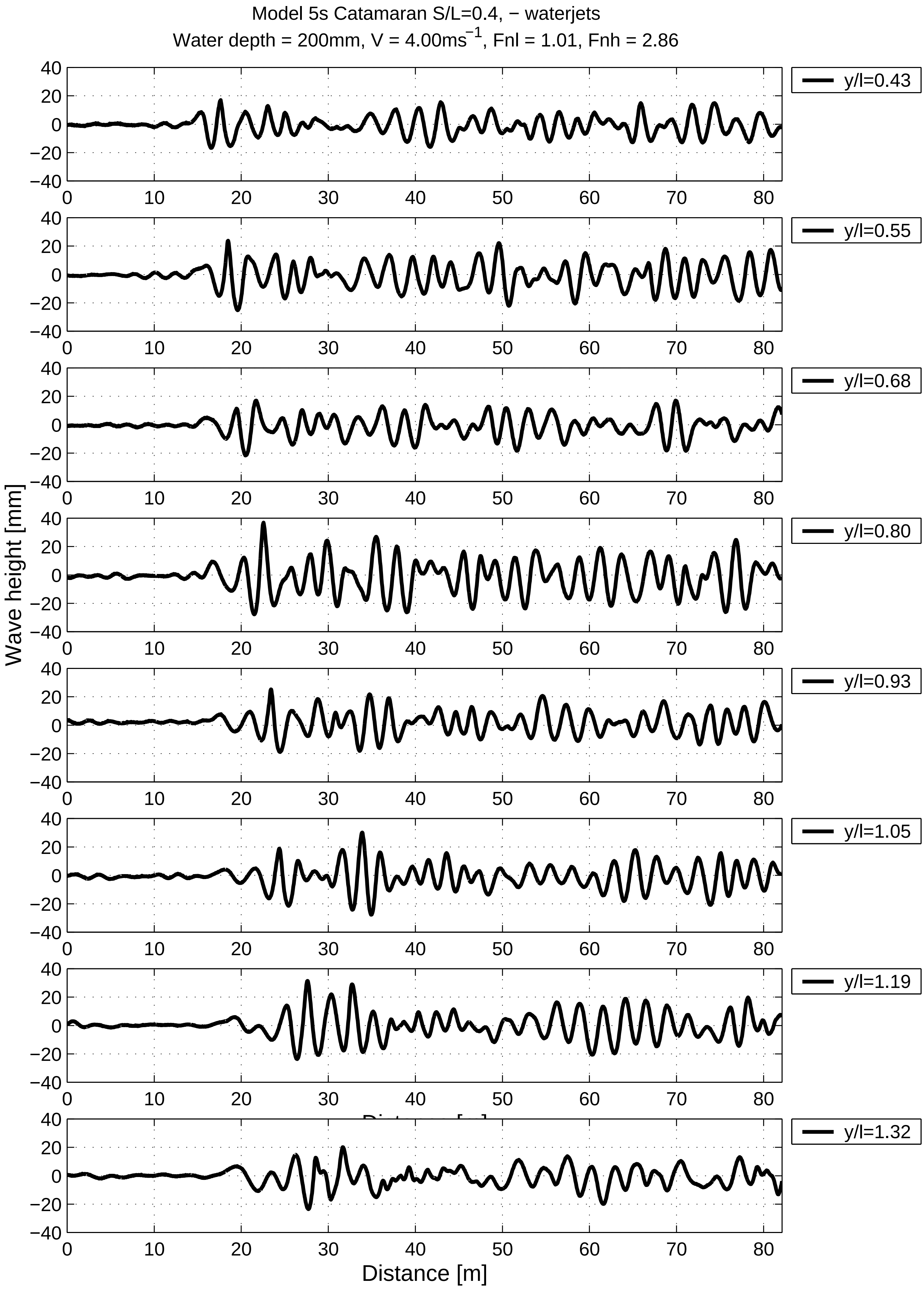

Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 200mm, V = 3.55ms−1, Fnl = 0.90, Fnh = 2.53
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 103



Model 5s Catamaran S/L=0.4, − waterjets
Water depth = 200mm, V = 4.00ms^−1, Fnl = 1.01, Fnh = 2.86
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 104

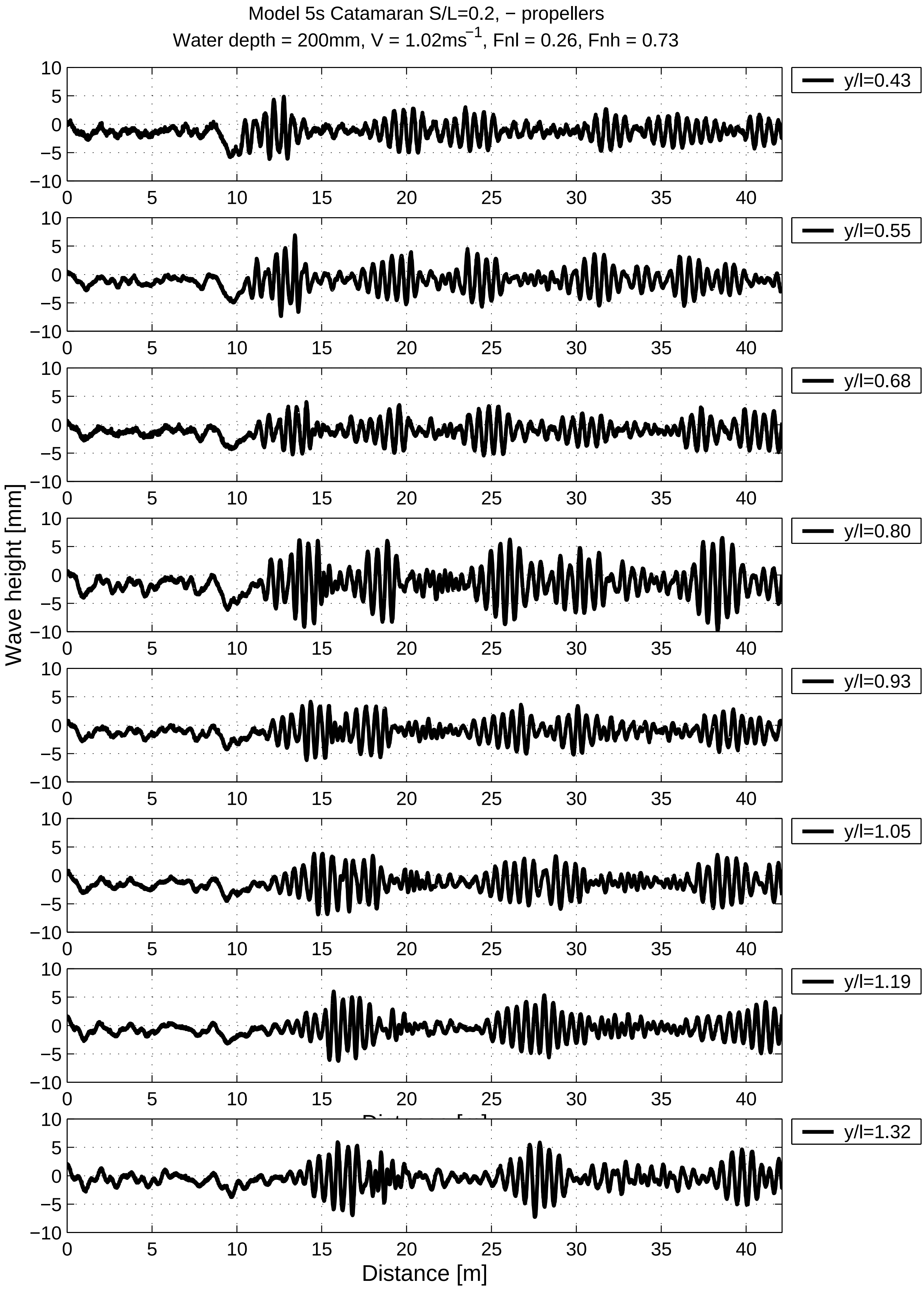

Model 5s Catamaran S/L=0.2, − propellers
Water depth = 200mm, V = 1.02ms^{-1}, Fnl = 0.26, Fnh = 0.73
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 105

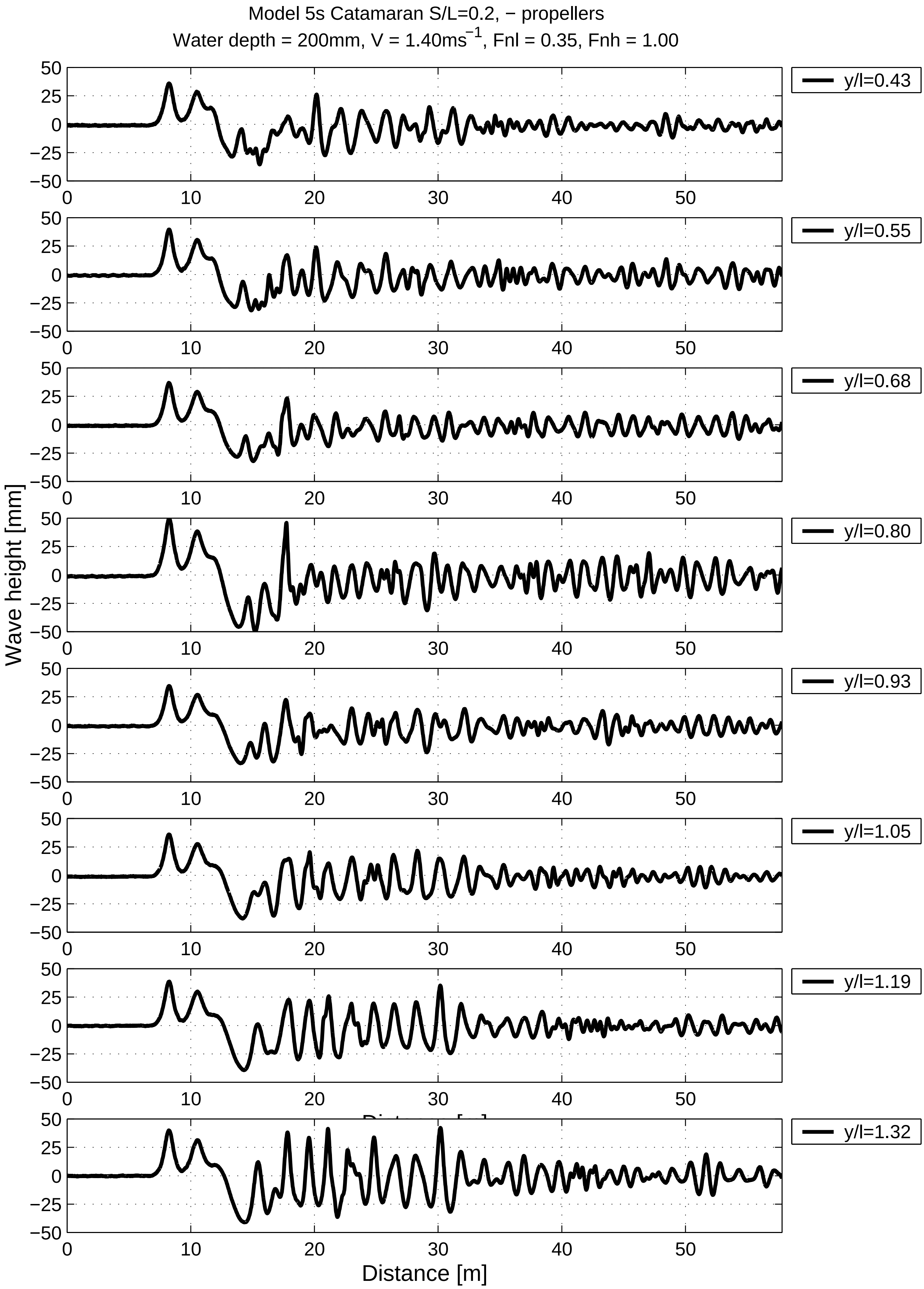
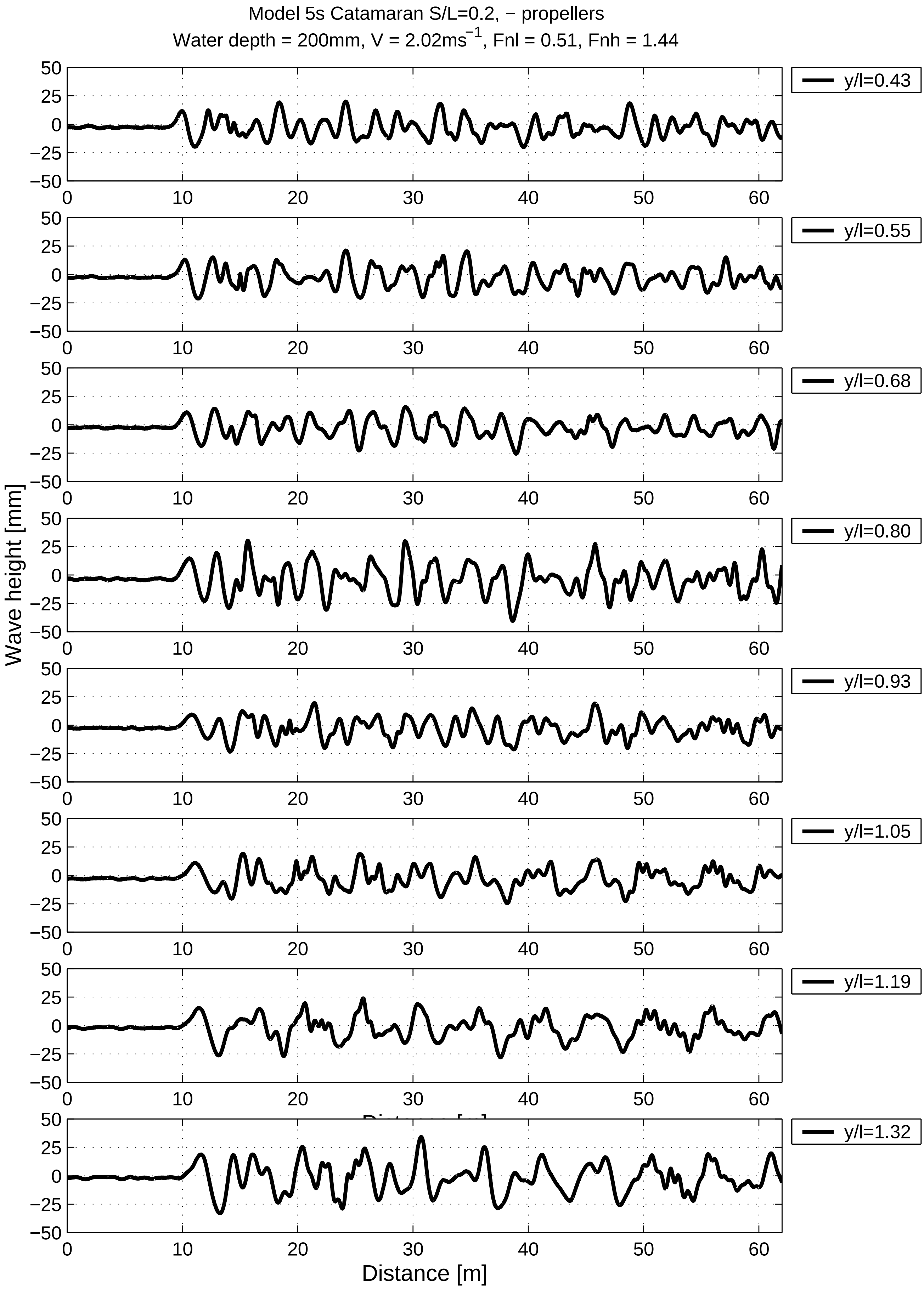

Model 5s Catamaran S/L=0.2, − propellers
Water depth = 200mm, V = 1.40ms⁻¹, Fnl = 0.35, Fnh = 1.00
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 106



Model 5s Catamaran S/L=0.2, − propellers
Water depth = 200mm, V = 2.02ms^{-1}, Fnl = 0.51, Fnh = 1.44
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 107

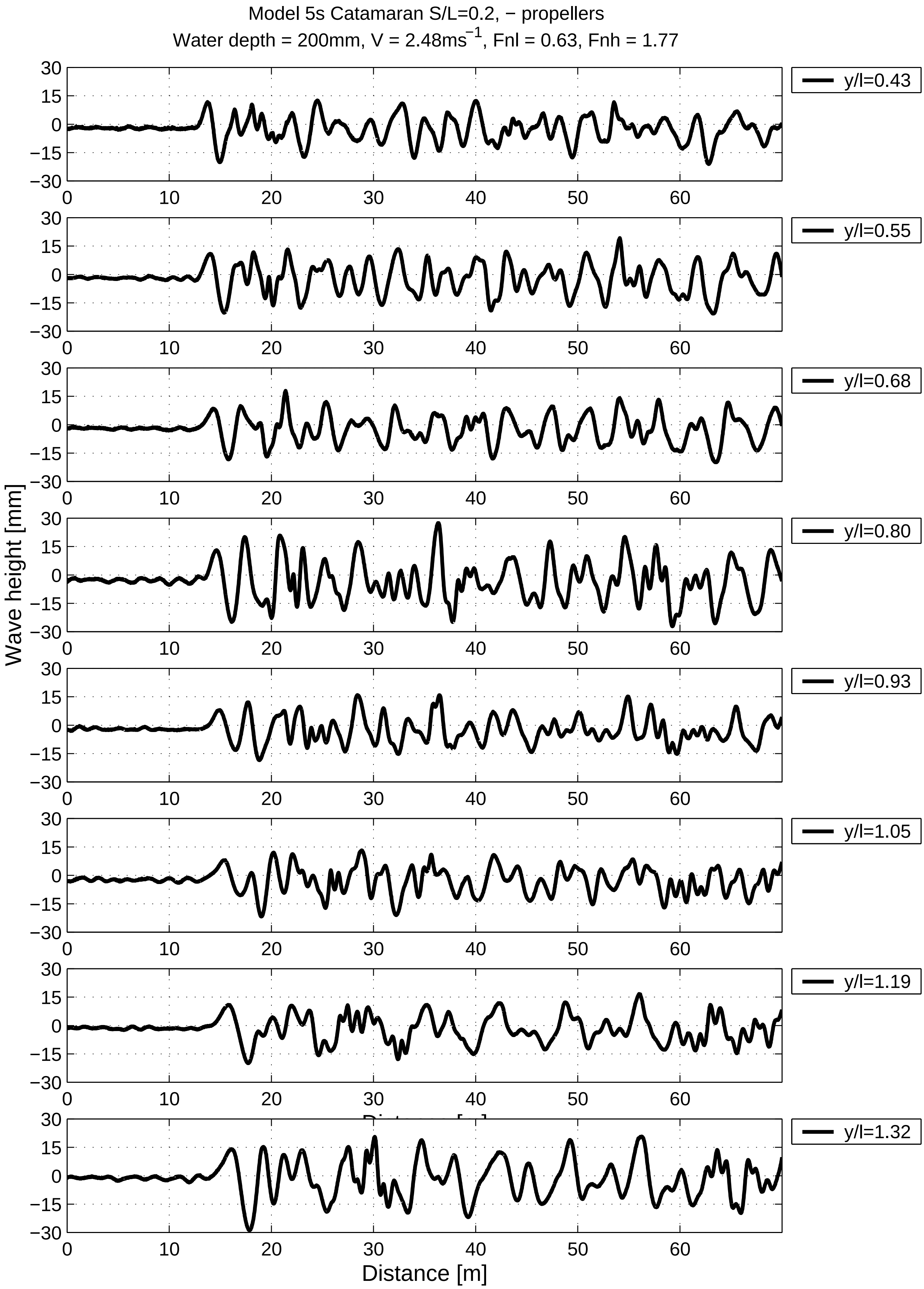
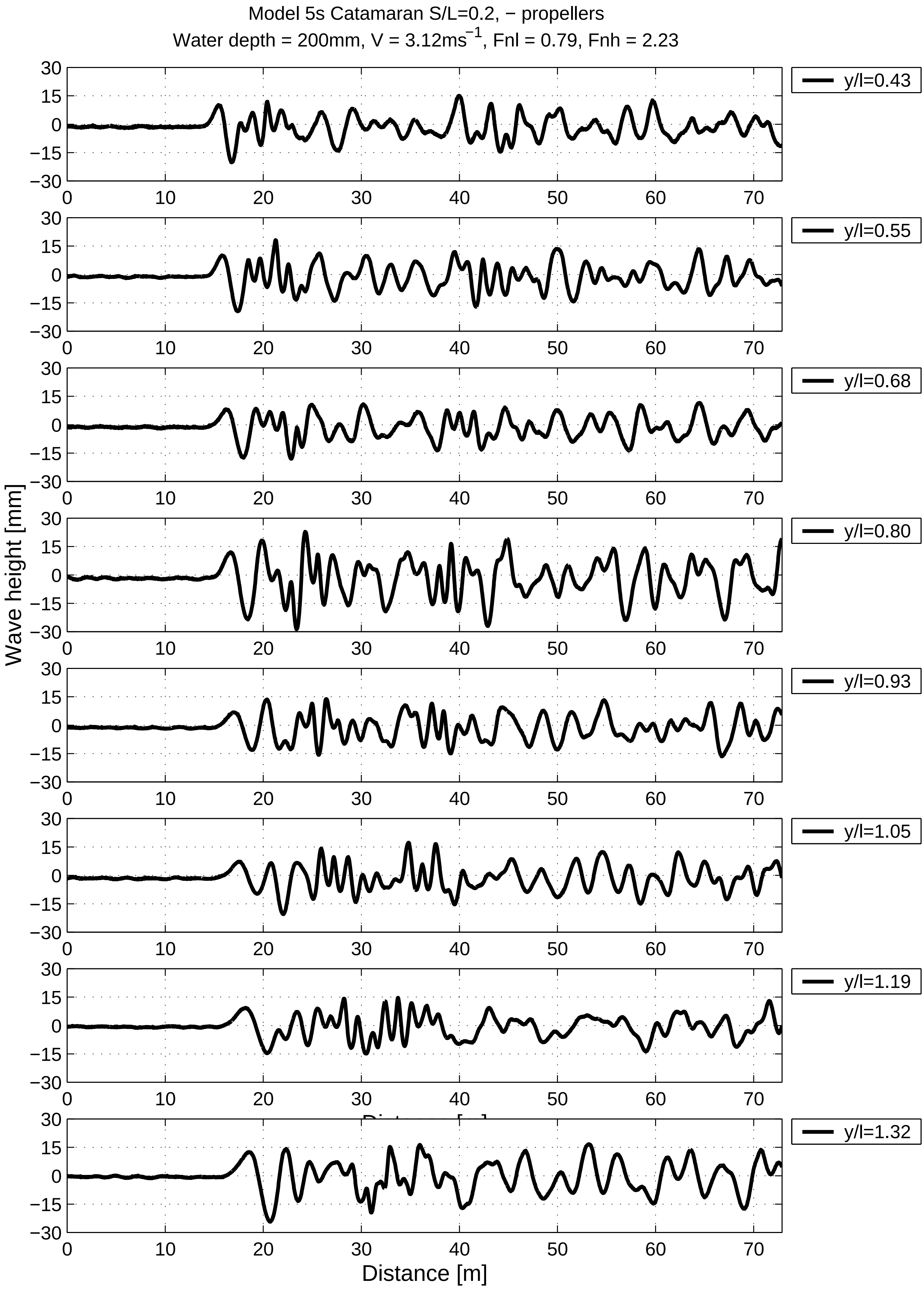
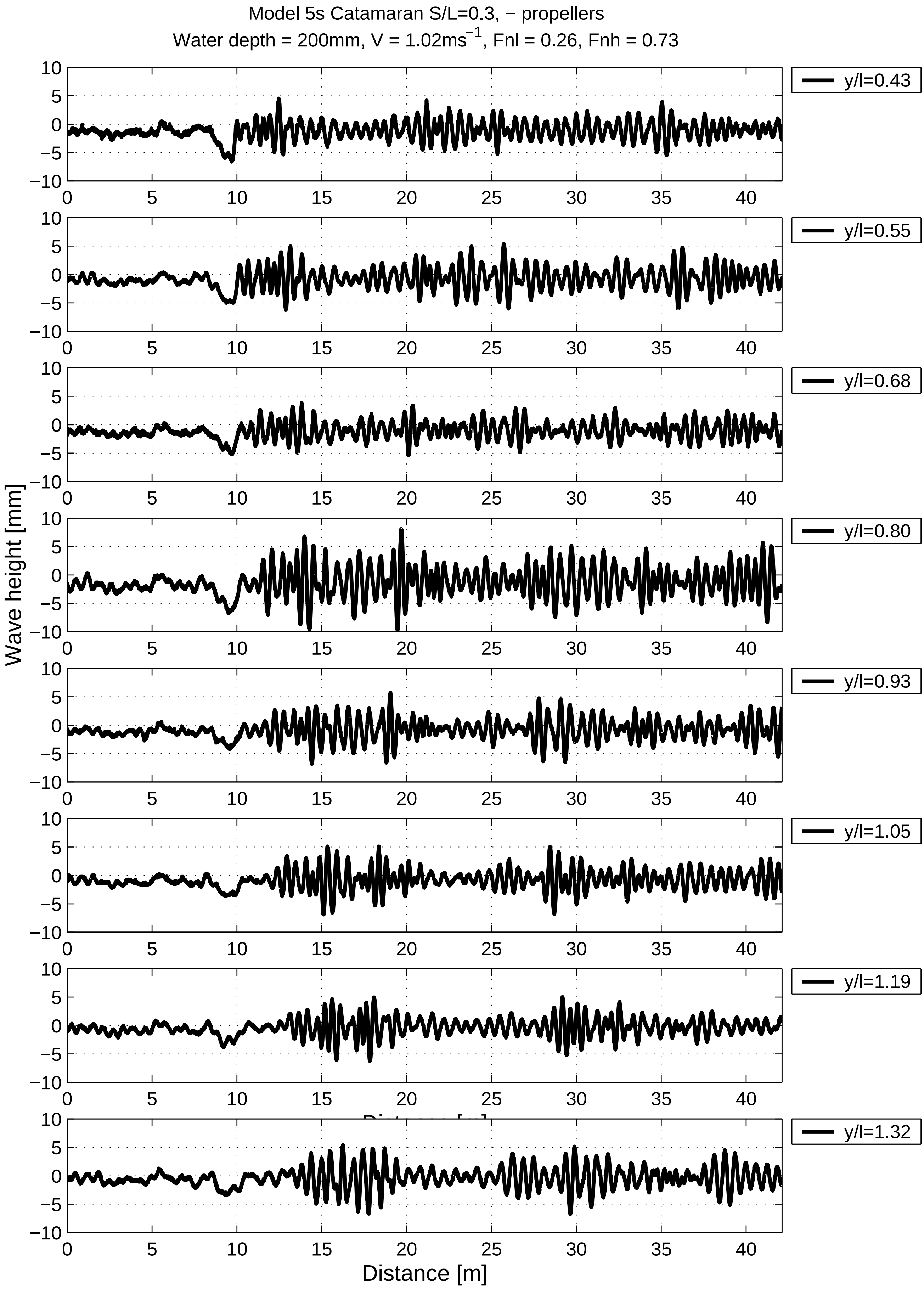

Model 5s Catamaran S/L=0.2, − propellers
Water depth = 200mm, V = 2.48ms^{-1}, Fnl = 0.63, Fnh = 1.77
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

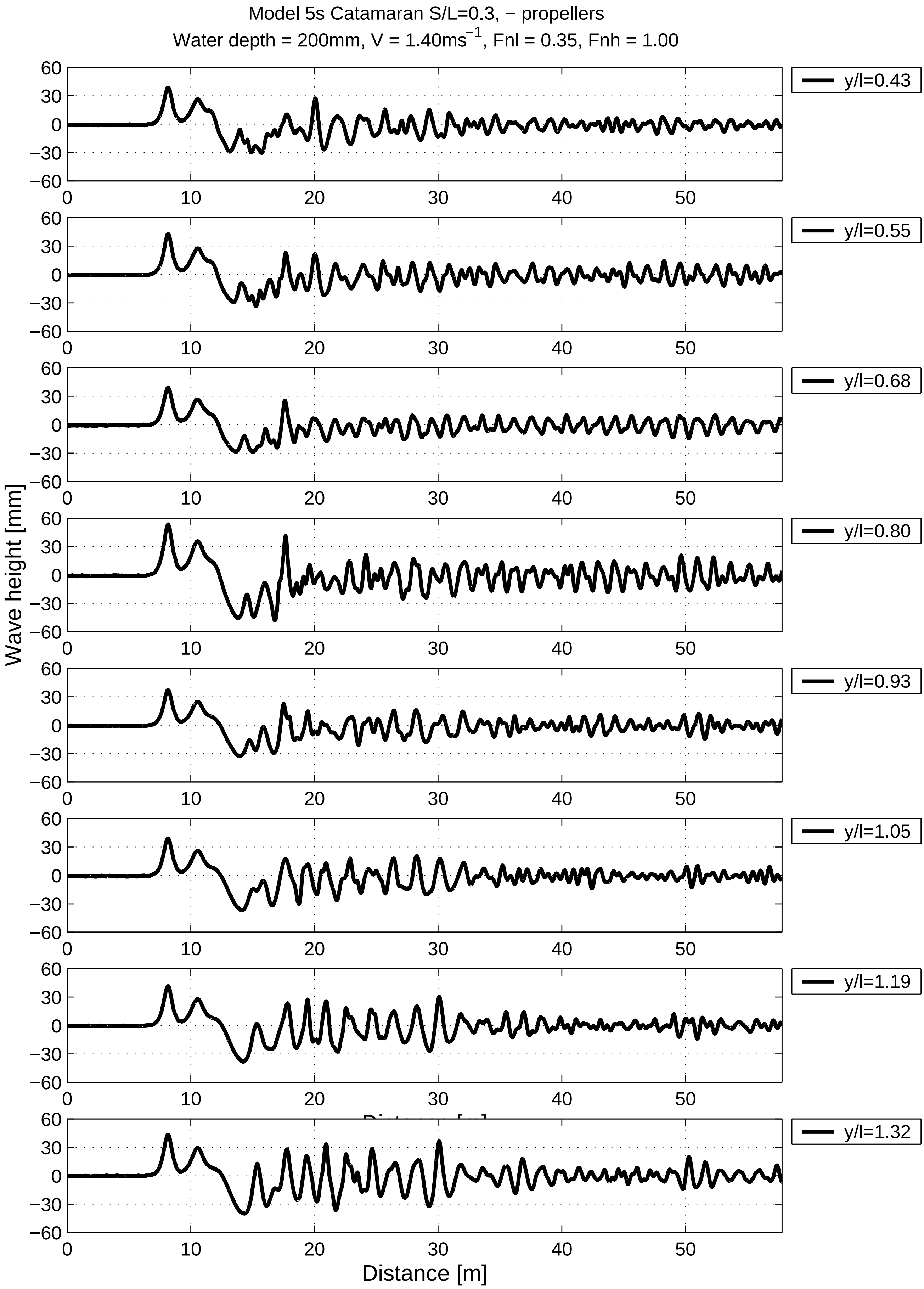
Figure 108


Model 5s Catamaran S/L=0.2, − propellers
Water depth = 200mm, V = 3.12ms−1, Fnl = 0.79, Fnh = 2.23
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]
Figure 109



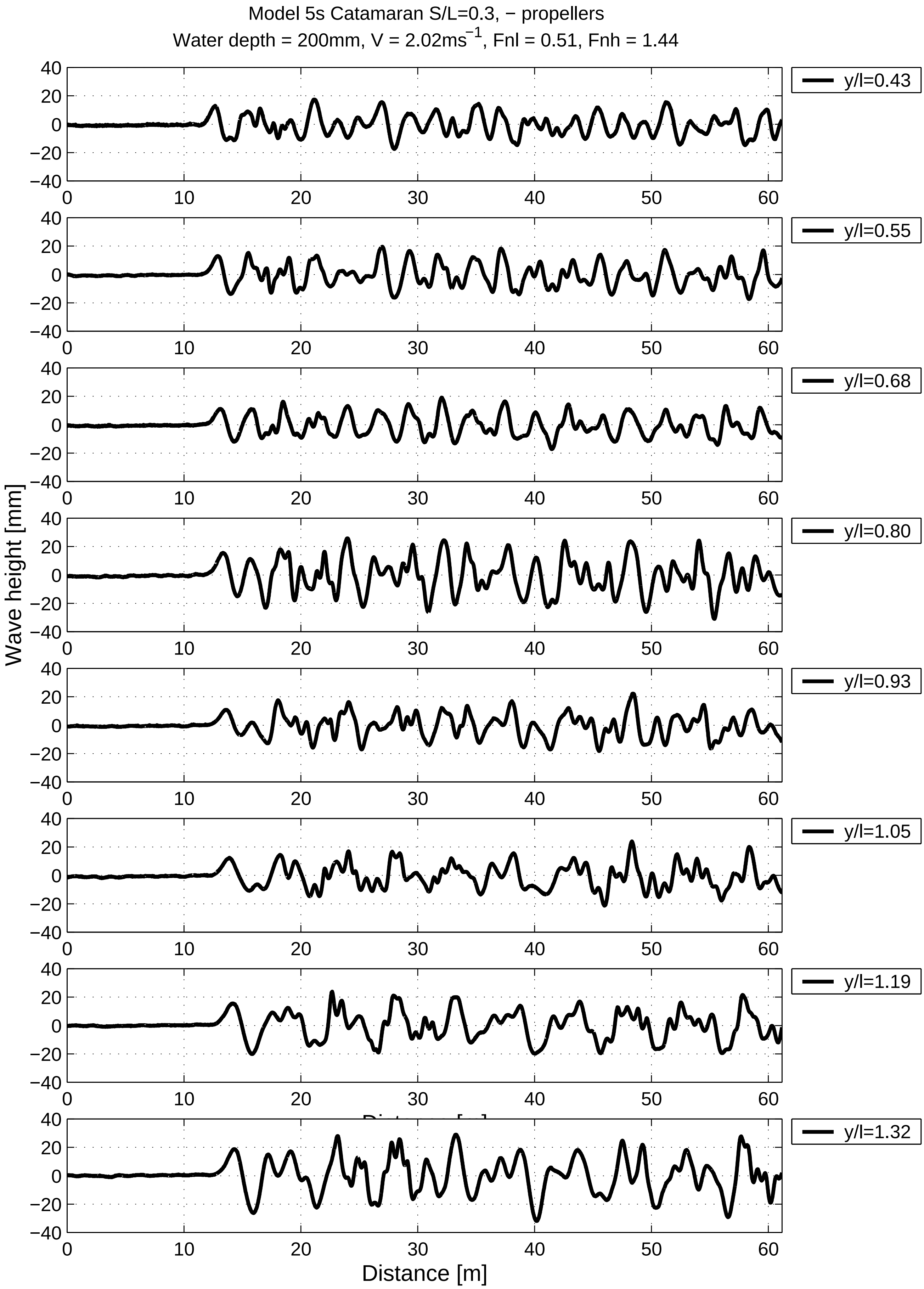
Model 5s Catamaran S/L=0.3, − propellers
Water depth = 200mm, V = 1.02ms⁻¹, Fnl = 0.26, Fnh = 0.73
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 110



Model 5s Catamaran S/L=0.3, − propellers
Water depth = 200mm, V = 1.40ms^{-1}, Fnl = 0.35, Fnh = 1.00
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 111



Model 5s Catamaran S/L=0.3, − propellers
Water depth = 200mm, V = 2.02ms^{-1}, Fnl = 0.51, Fnh = 1.44
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 112

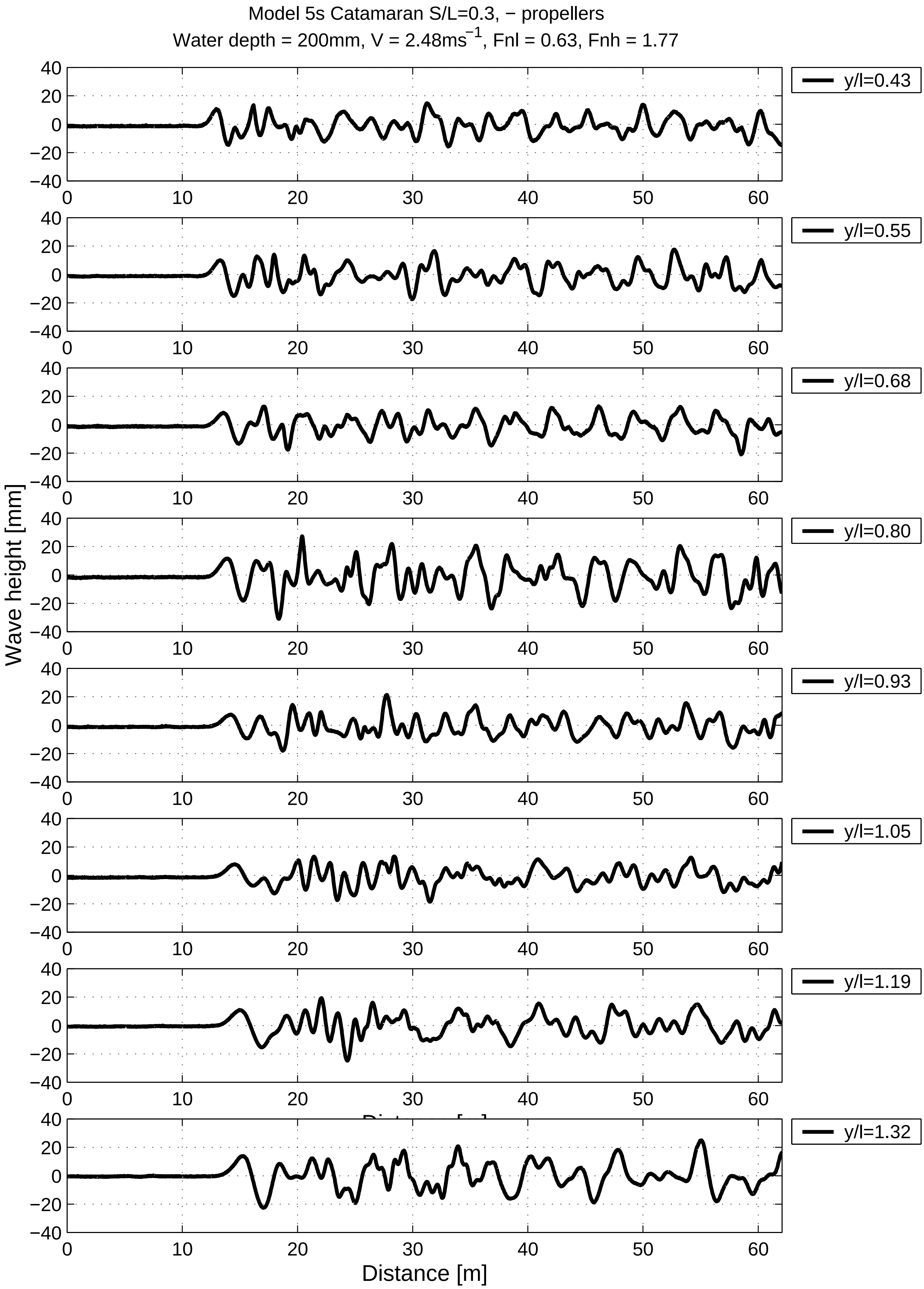
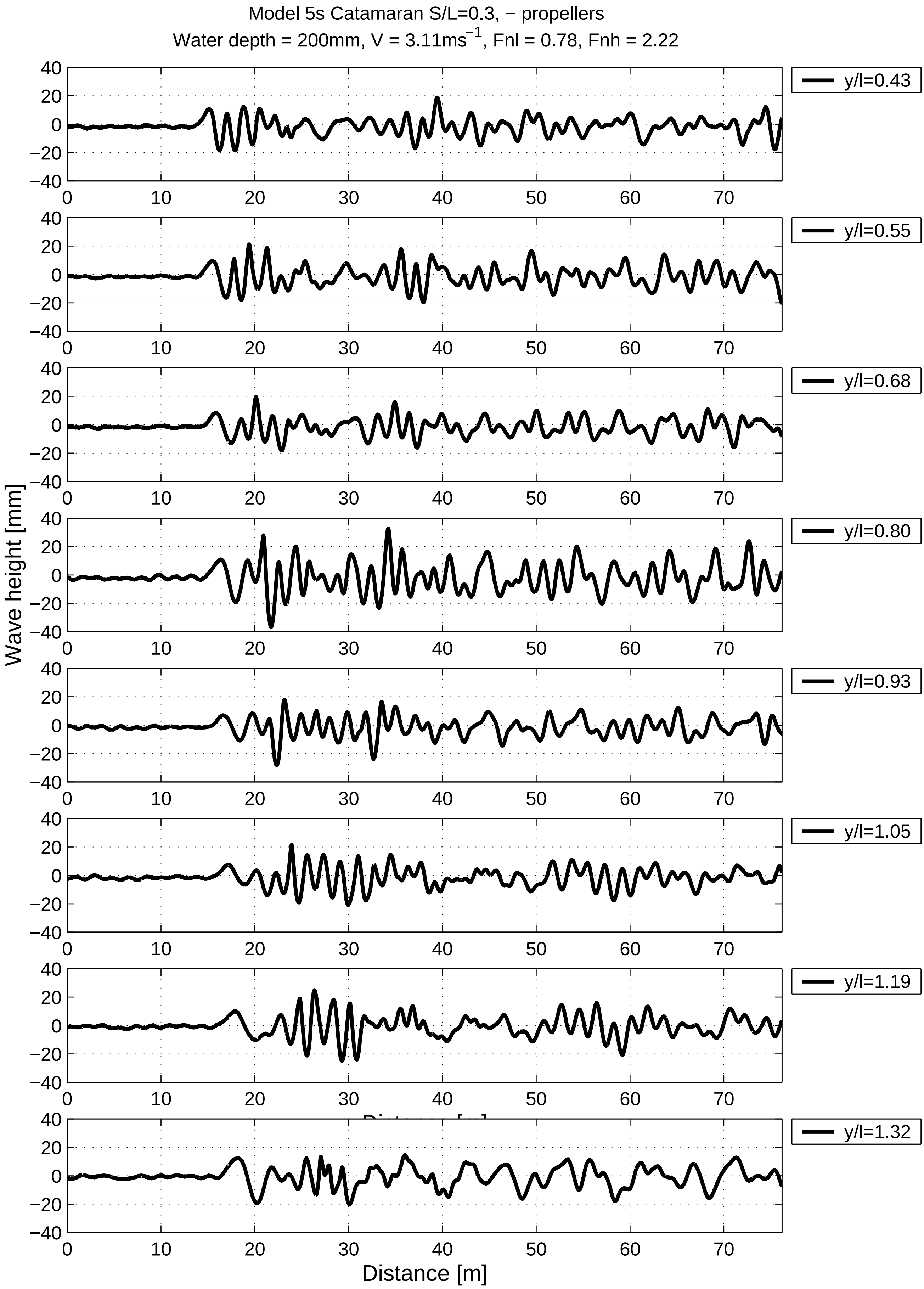

Model 5s Catamaran S/L=0.3, − propellers
Water depth = 200mm, V = 2.48ms^{-1}, Fnl = 0.63, Fnh = 1.77
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
40
20
0
−20
−40
0
10
20
30
40
50
60

Figure 113



Model 5s Catamaran S/L=0.3, − propellers
Water depth = 200mm, V = 3.11ms−1, Fnl = 0.78, Fnh = 2.22
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 114

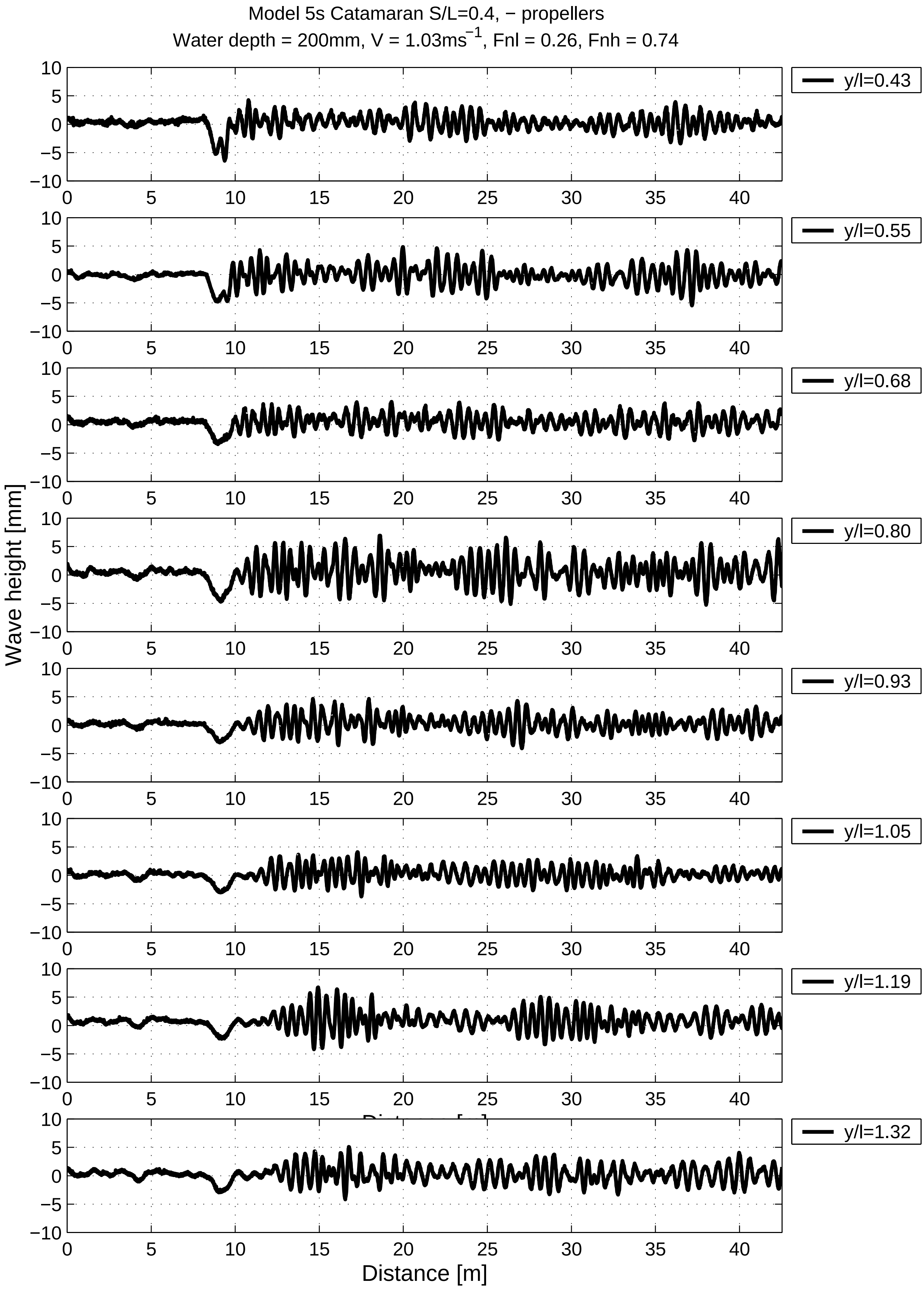

Model 5s Catamaran S/L=0.4, − propellers
Water depth = 200mm, V = 1.03ms^{-1}, Fnl = 0.26, Fnh = 0.74
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 115

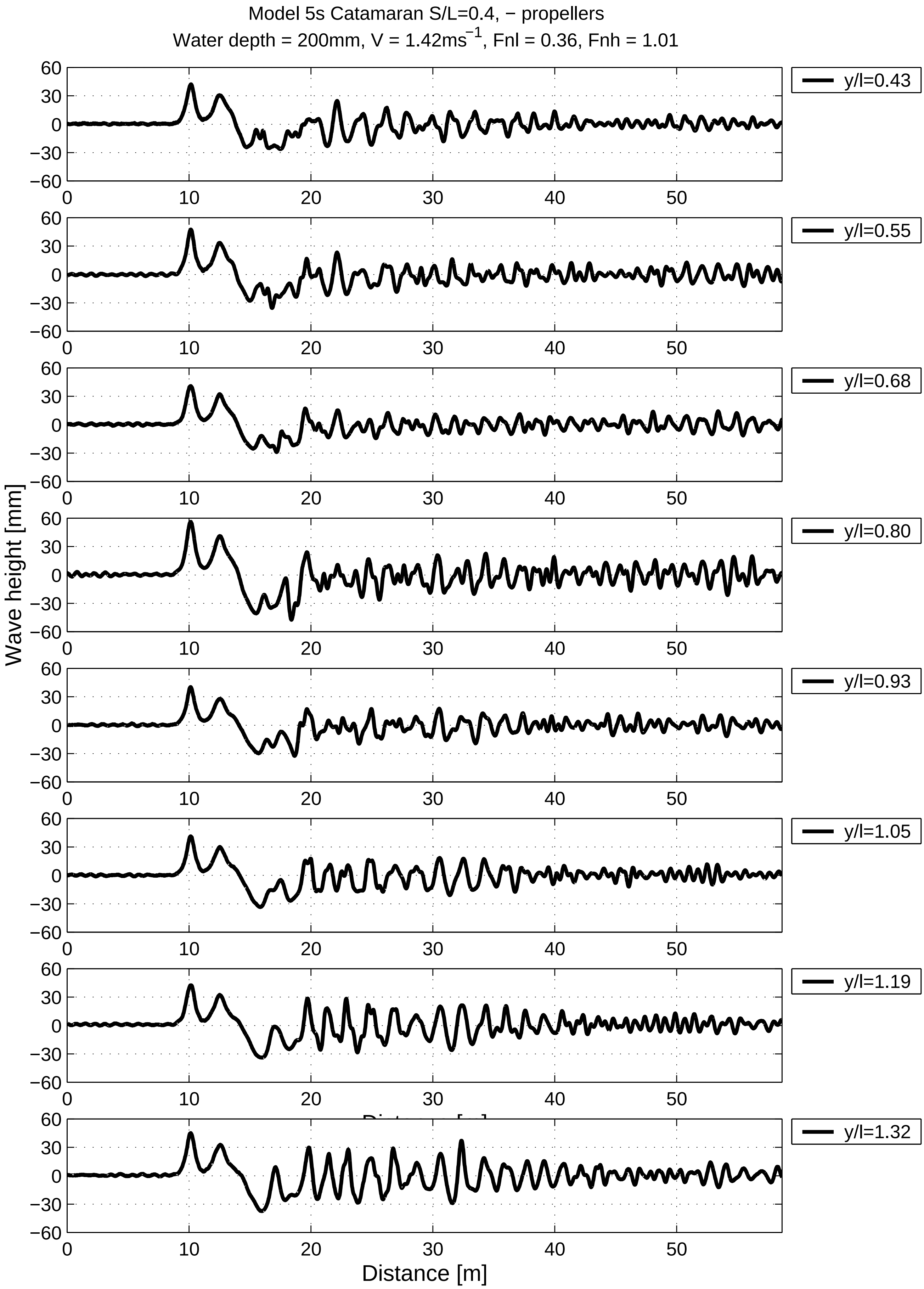

Model 5s Catamaran S/L=0.4, − propellers
Water depth = 200mm, V = 1.42ms^{-1}, Fnl = 0.36, Fnh = 1.01
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 116

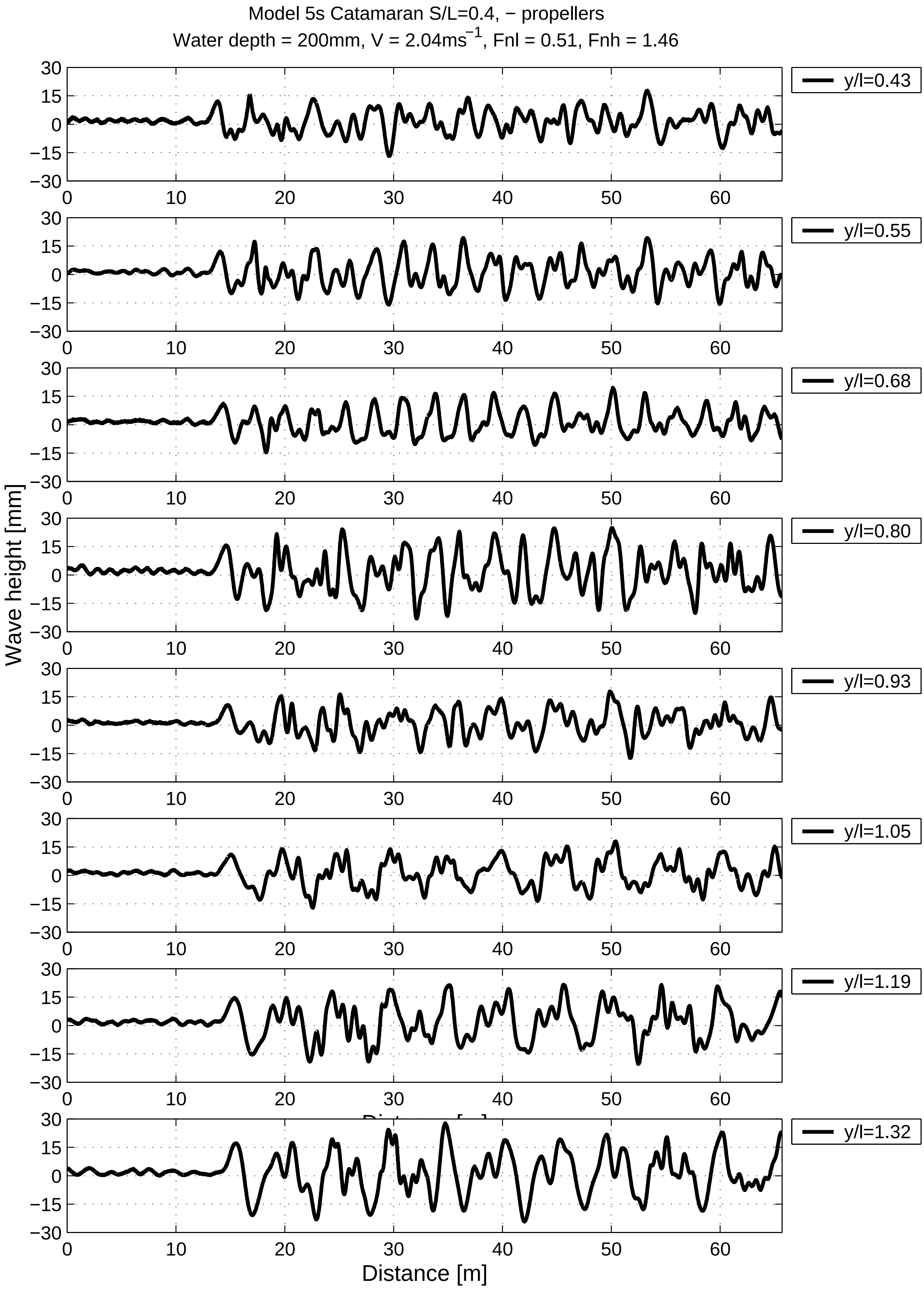
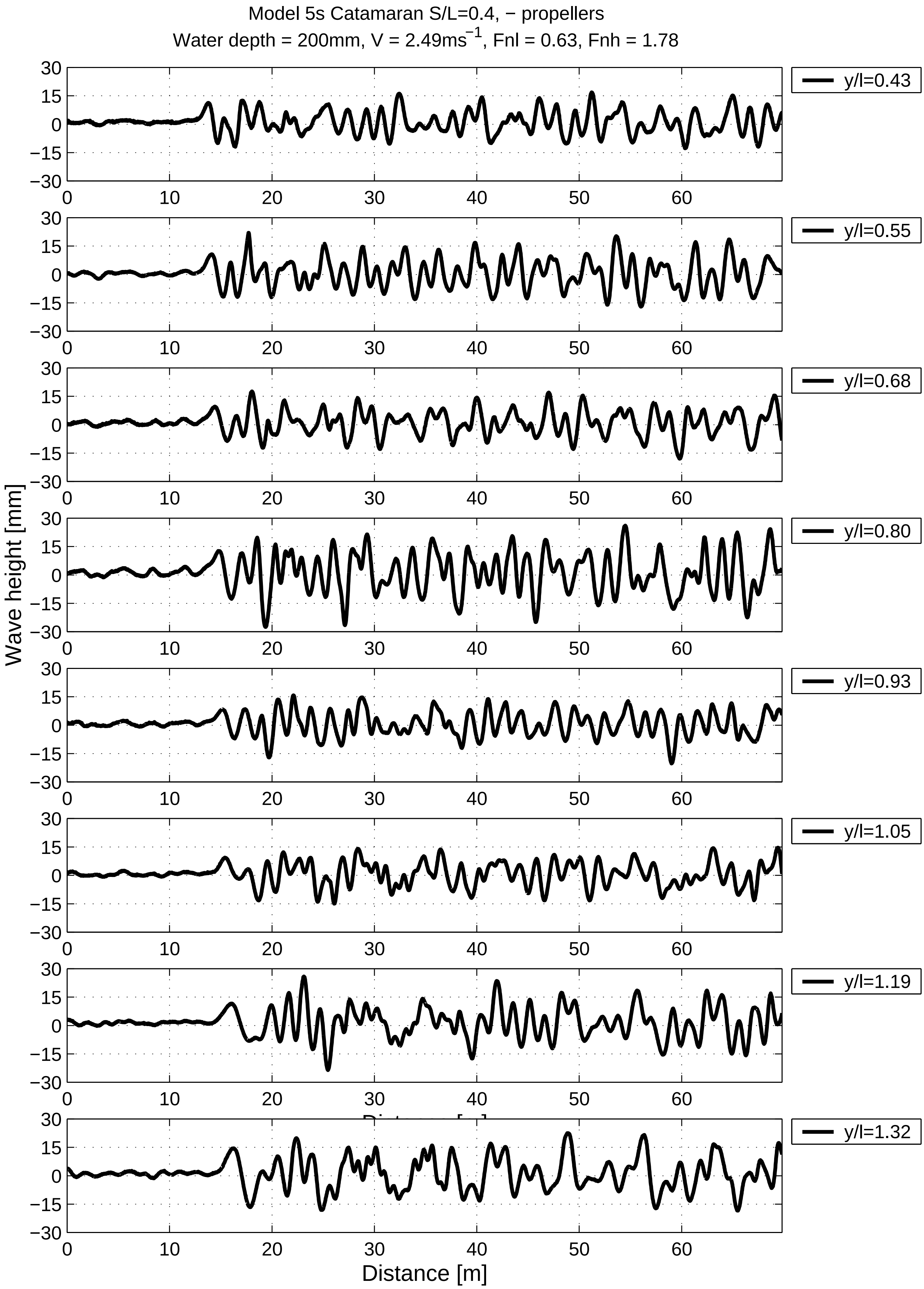
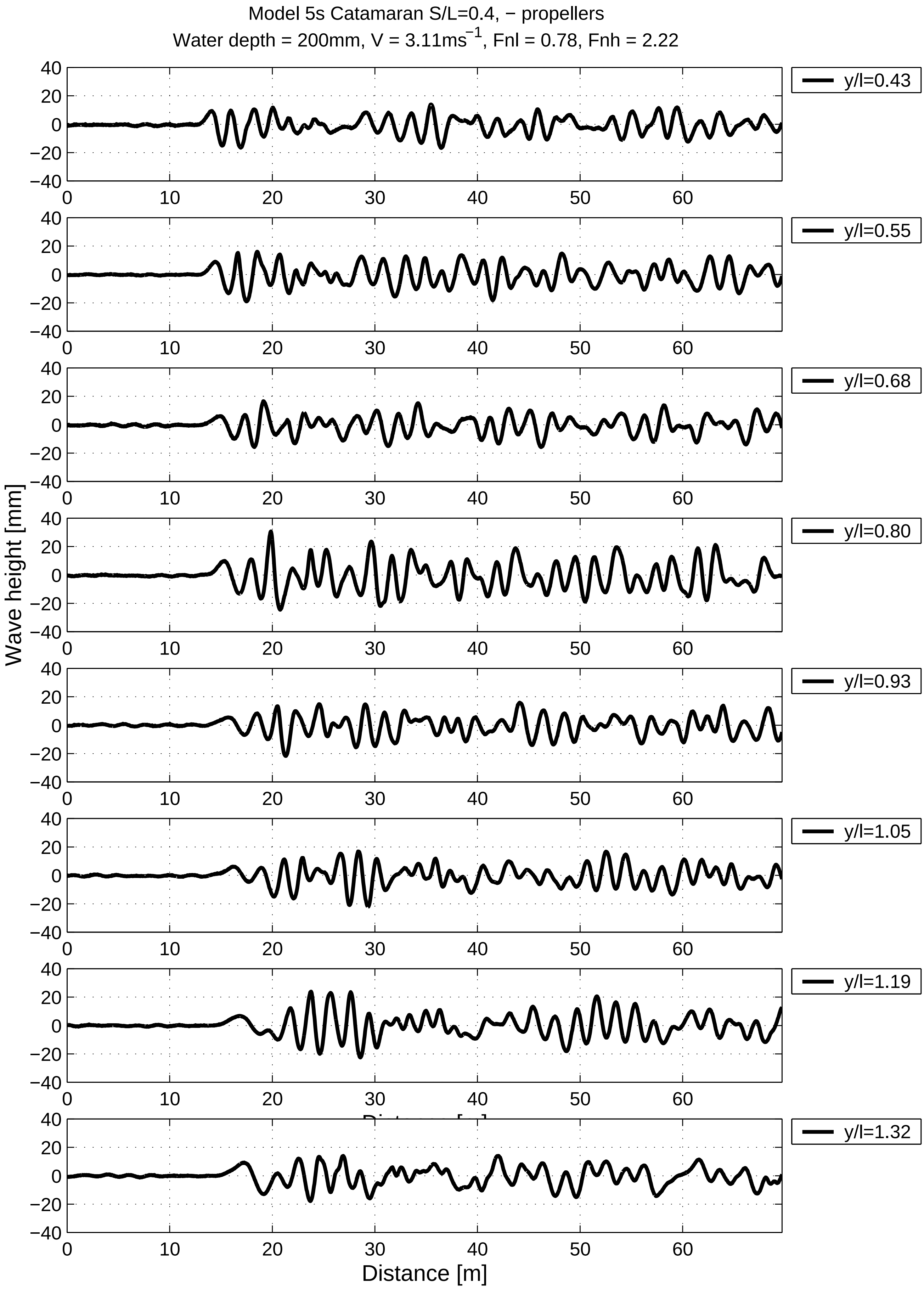

Model 5s Catamaran S/L=0.4, − propellers
Water depth = 200mm, V = 2.04ms−1, Fnl = 0.51, Fnh = 1.46
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 117



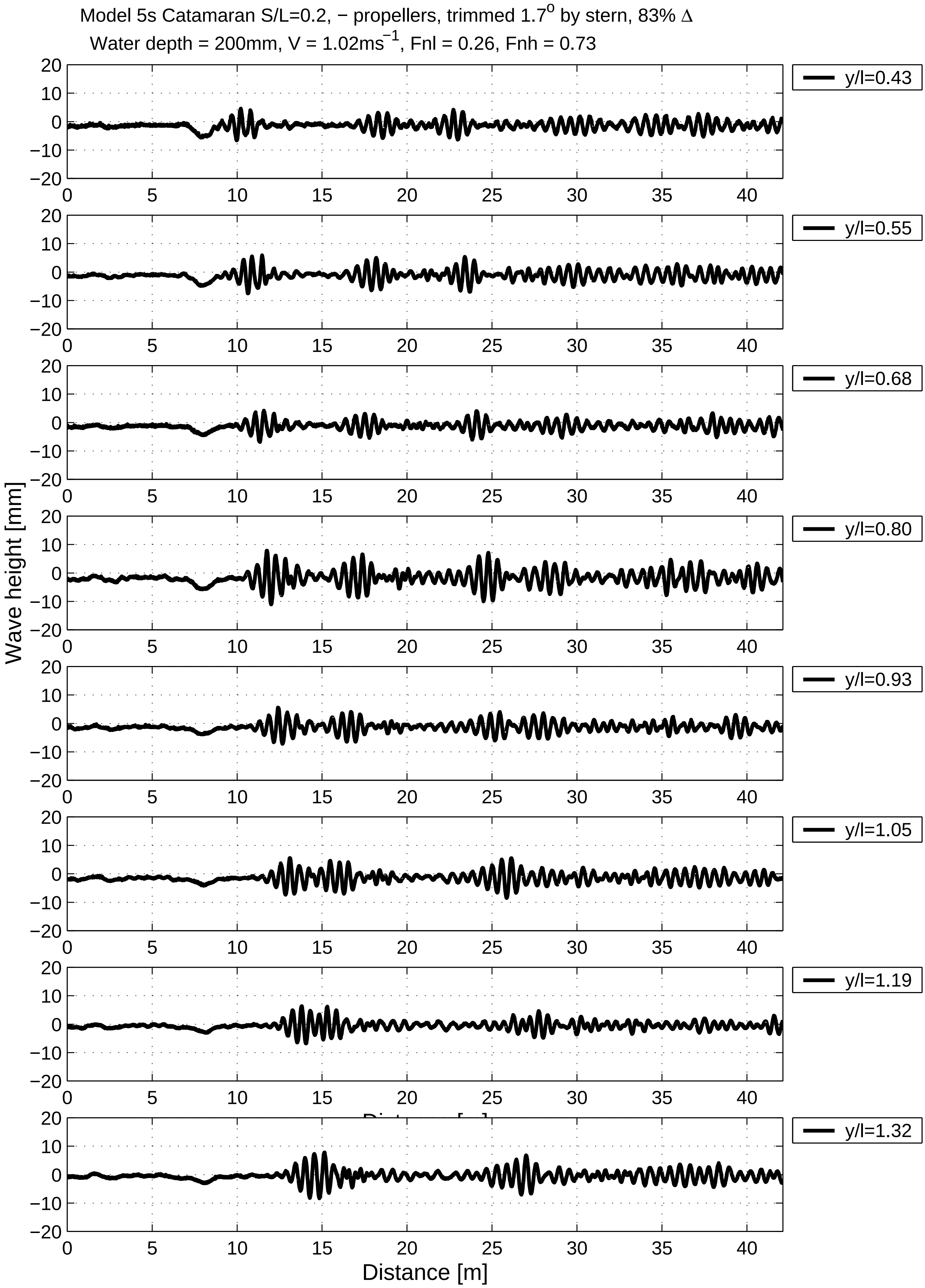
Model 5s Catamaran S/L=0.4, − propellers
Water depth = 200mm, V = 2.49ms−1, Fnl = 0.63, Fnh = 1.78
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 118



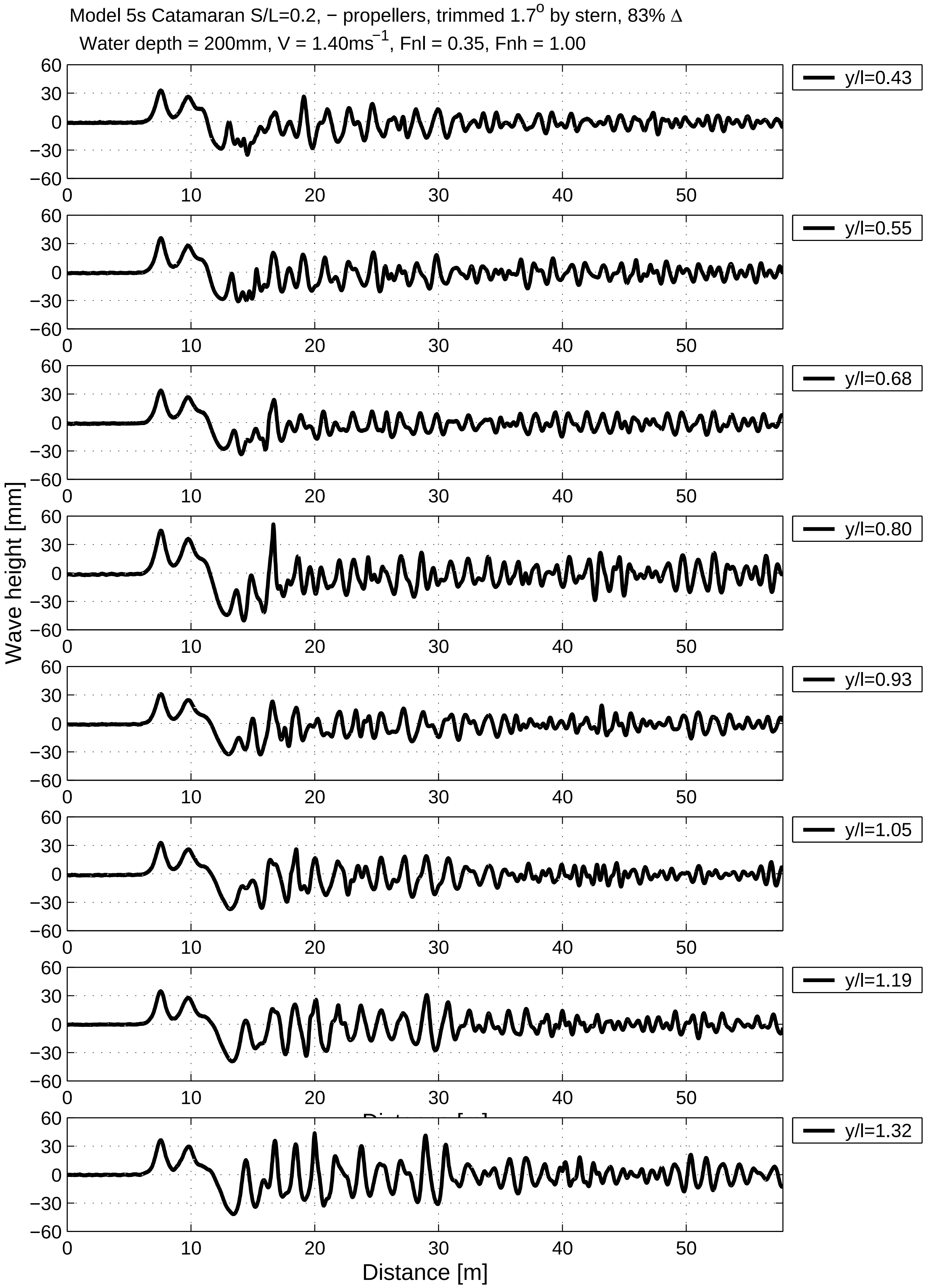
Model 5s Catamaran S/L=0.4, − propellers
Water depth = 200mm, V = 3.11ms^{-1}, Fnl = 0.78, Fnh = 2.22
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 119



Model 5s Catamaran S/L=0.2, − propellers, trimmed 1.7° by stern, 83% Δ
Water depth = 200mm, V = 1.02ms⁻¹, Fnl = 0.26, Fnh = 0.73
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 120



Model 5s Catamaran S/L=0.2, − propellers, trimmed 1.7° by stern, 83% Δ
Water depth = 200mm, V = 1.40ms⁻¹, Fnl = 0.35, Fnh = 1.00
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 121

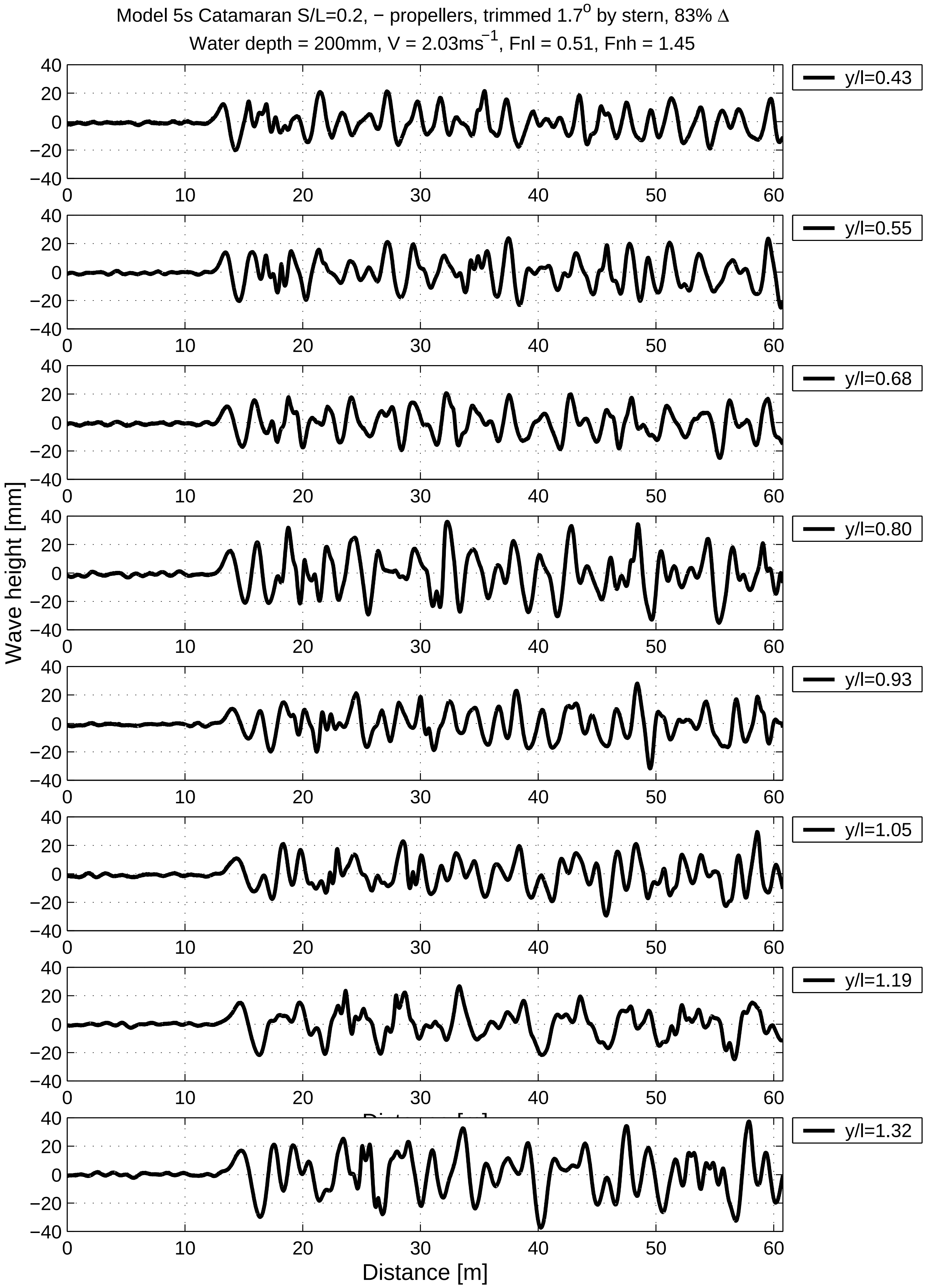

Model 5s Catamaran S/L=0.2, − propellers, trimmed 1.7° by stern, 83% Δ
Water depth = 200mm, V = 2.03ms⁻¹, Fnl = 0.51, Fnh = 1.45
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 122

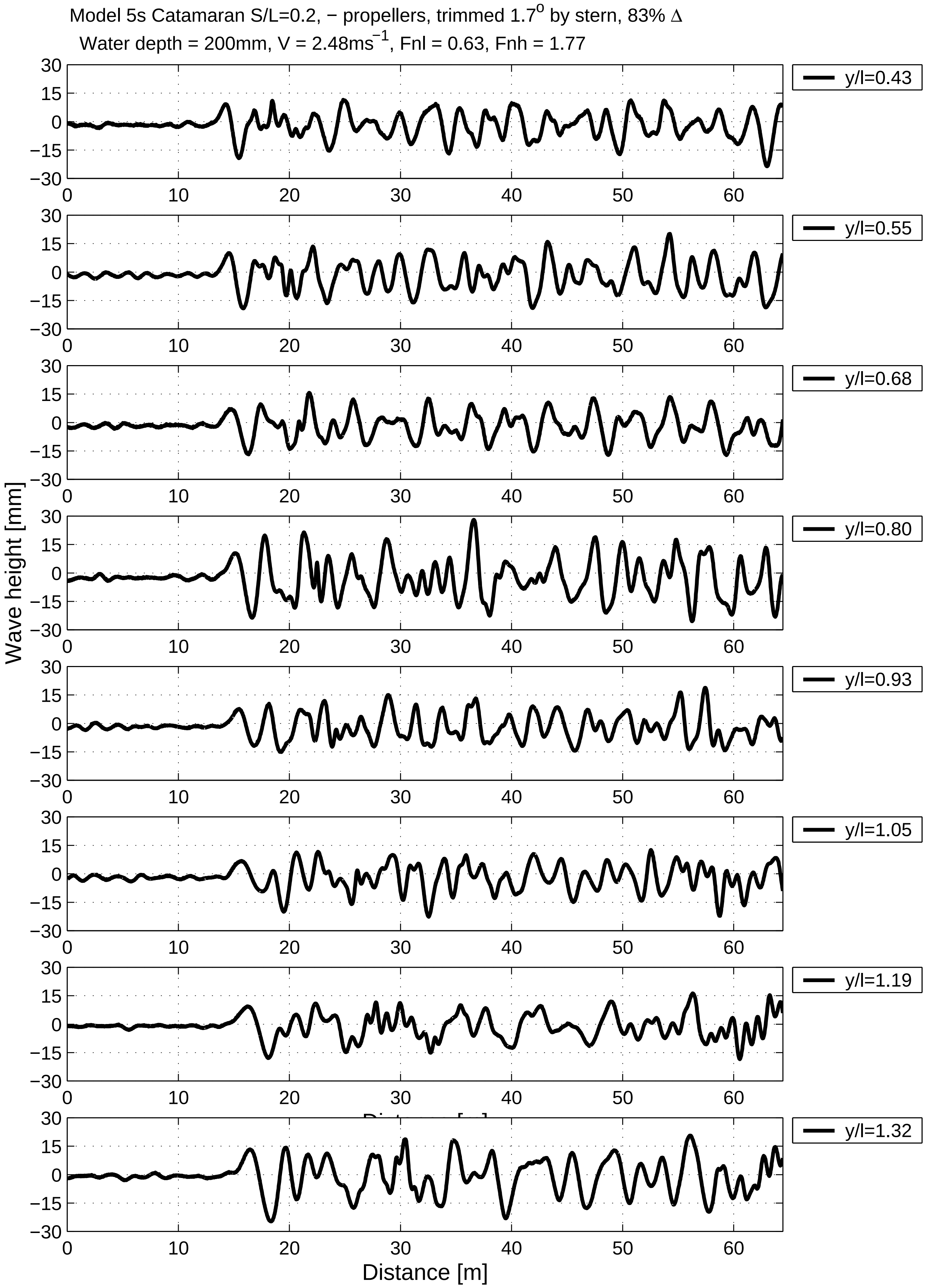

Model 5s Catamaran S/L=0.2, − propellers, trimmed 1.7° by stern, 83% Δ
Water depth = 200mm, V = 2.48ms⁻¹, Fnl = 0.63, Fnh = 1.77
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 123

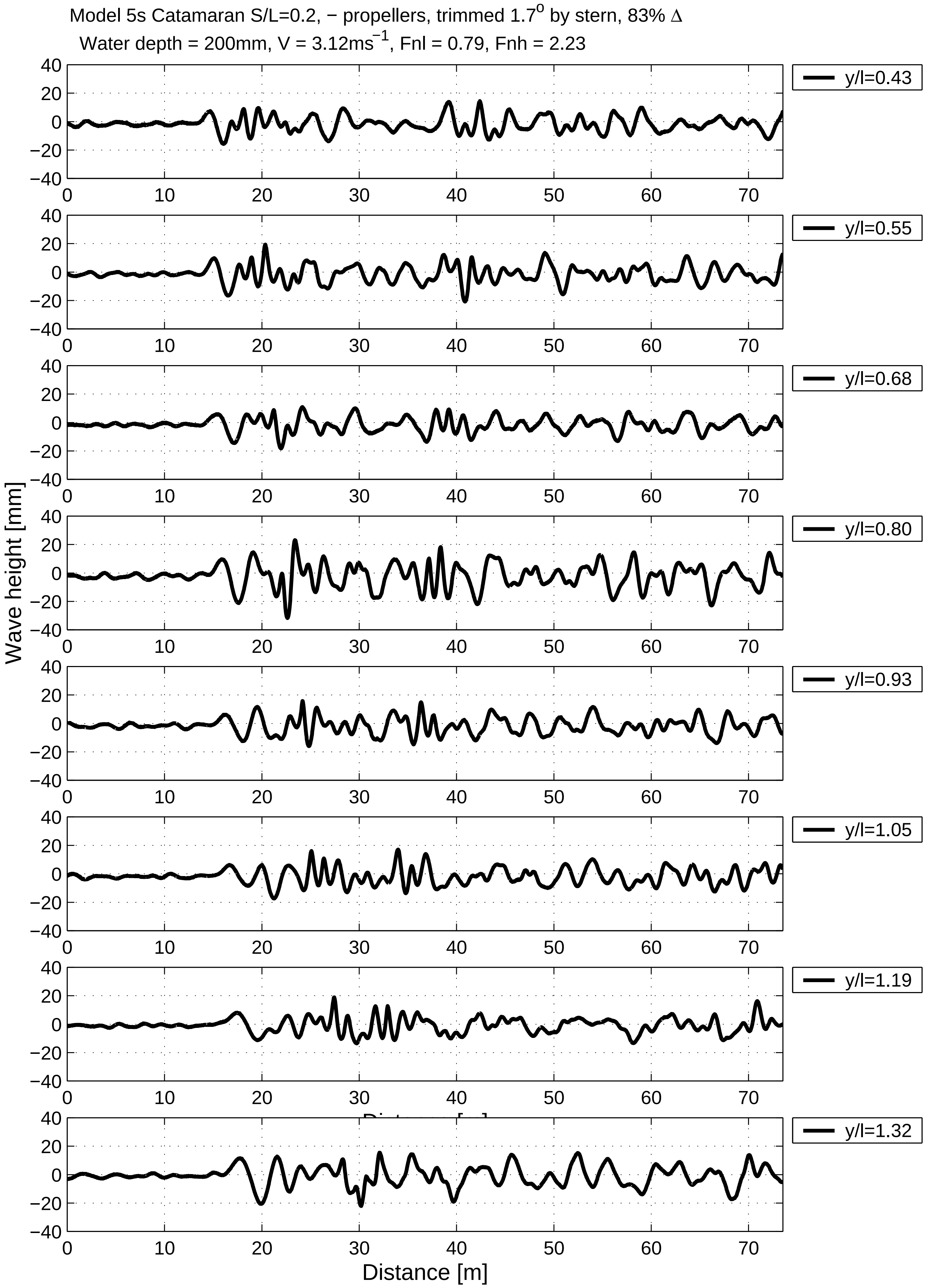
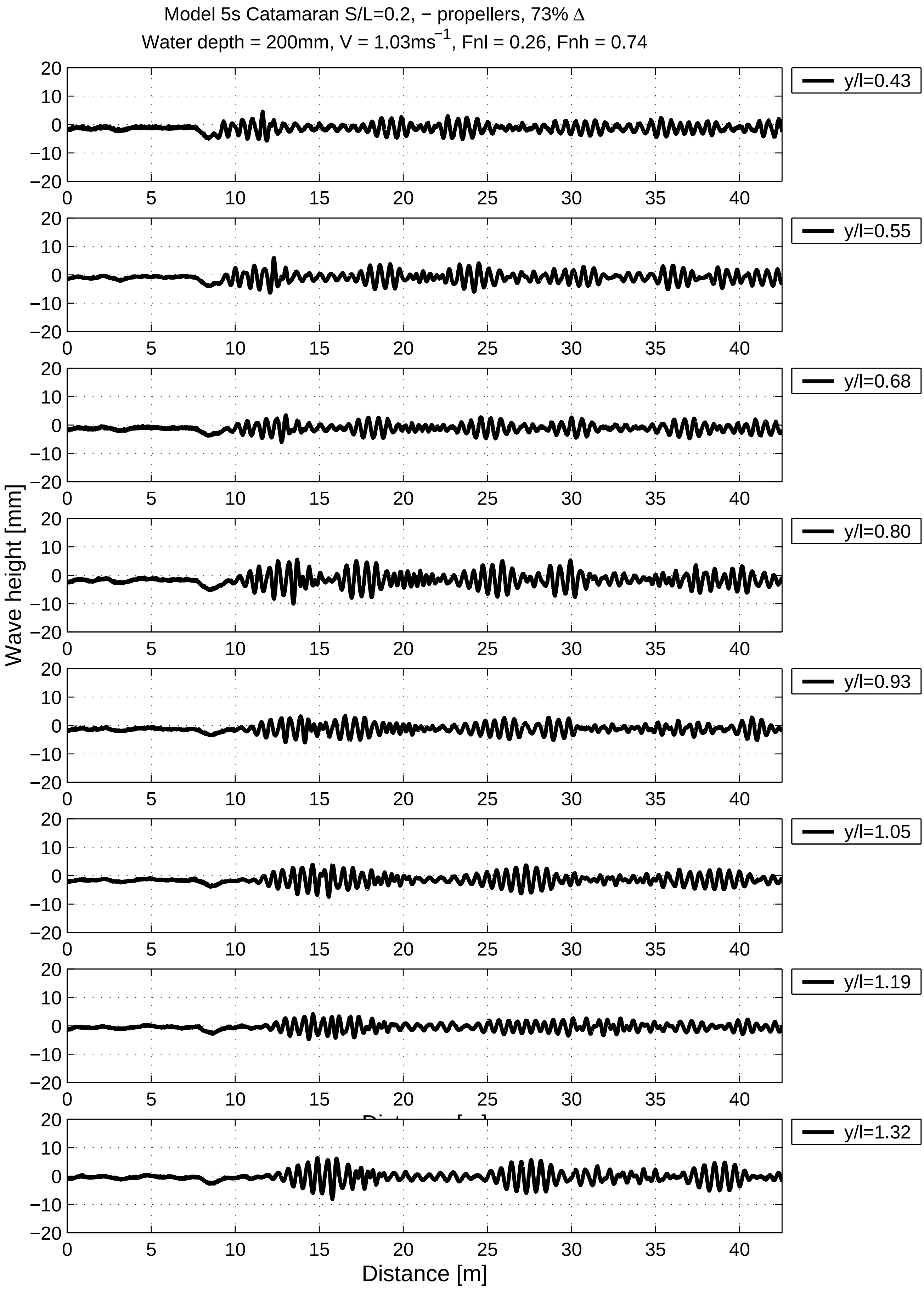
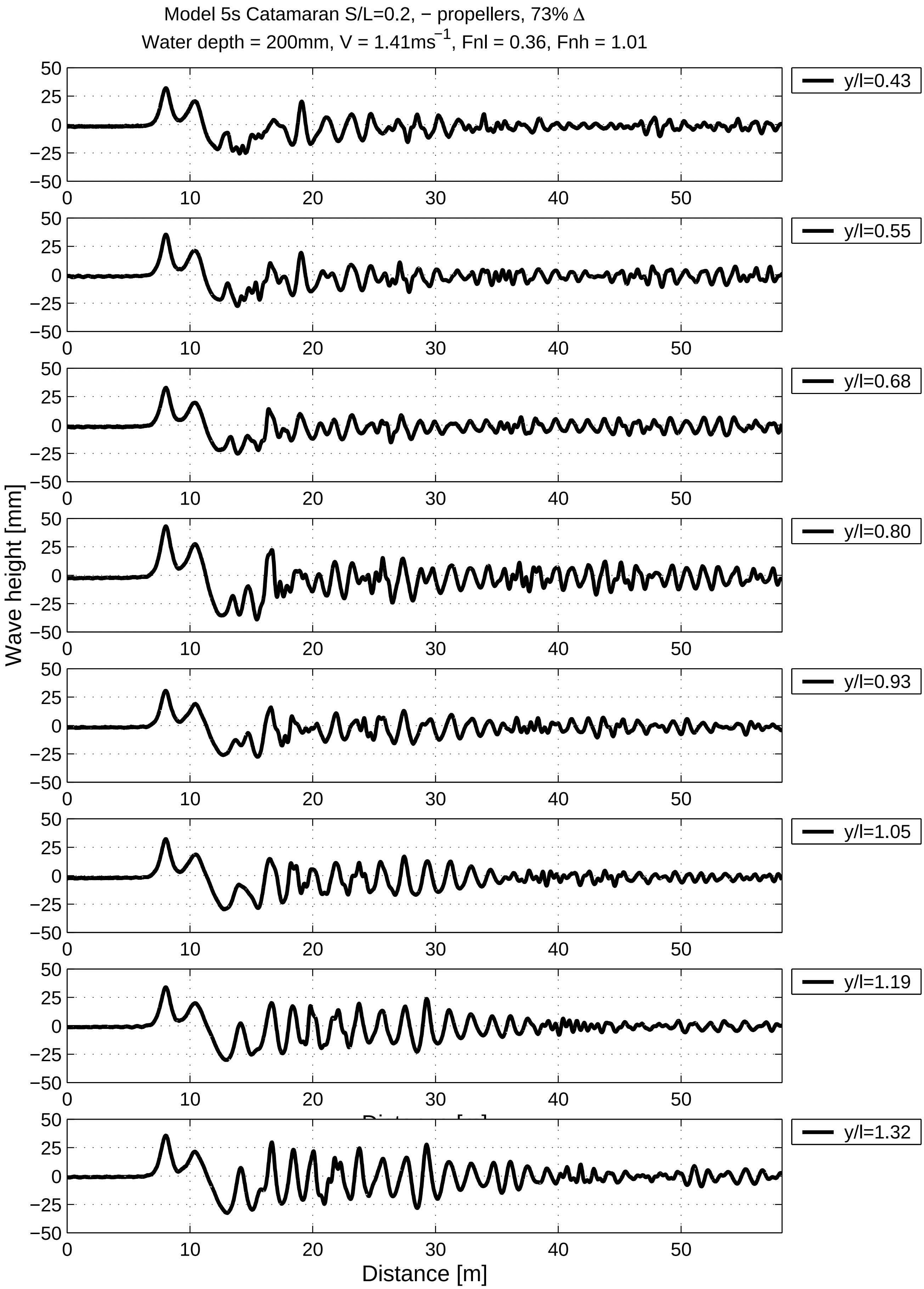

Model 5s Catamaran S/L=0.2, − propellers, trimmed 1.7° by stern, 83% Δ
Water depth = 200mm, V = 3.12ms⁻¹, Fnl = 0.79, Fnh = 2.23
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 124



Model 5s Catamaran S/L=0.2, − propellers, 73% Δ
Water depth = 200mm, V = 1.03ms^{-1}, Fnl = 0.26, Fnh = 0.74
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 125



Model 5s Catamaran S/L=0.2, − propellers, 73% Δ
Water depth = 200mm, V = 1.41ms−1, Fnl = 0.36, Fnh = 1.01
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 126

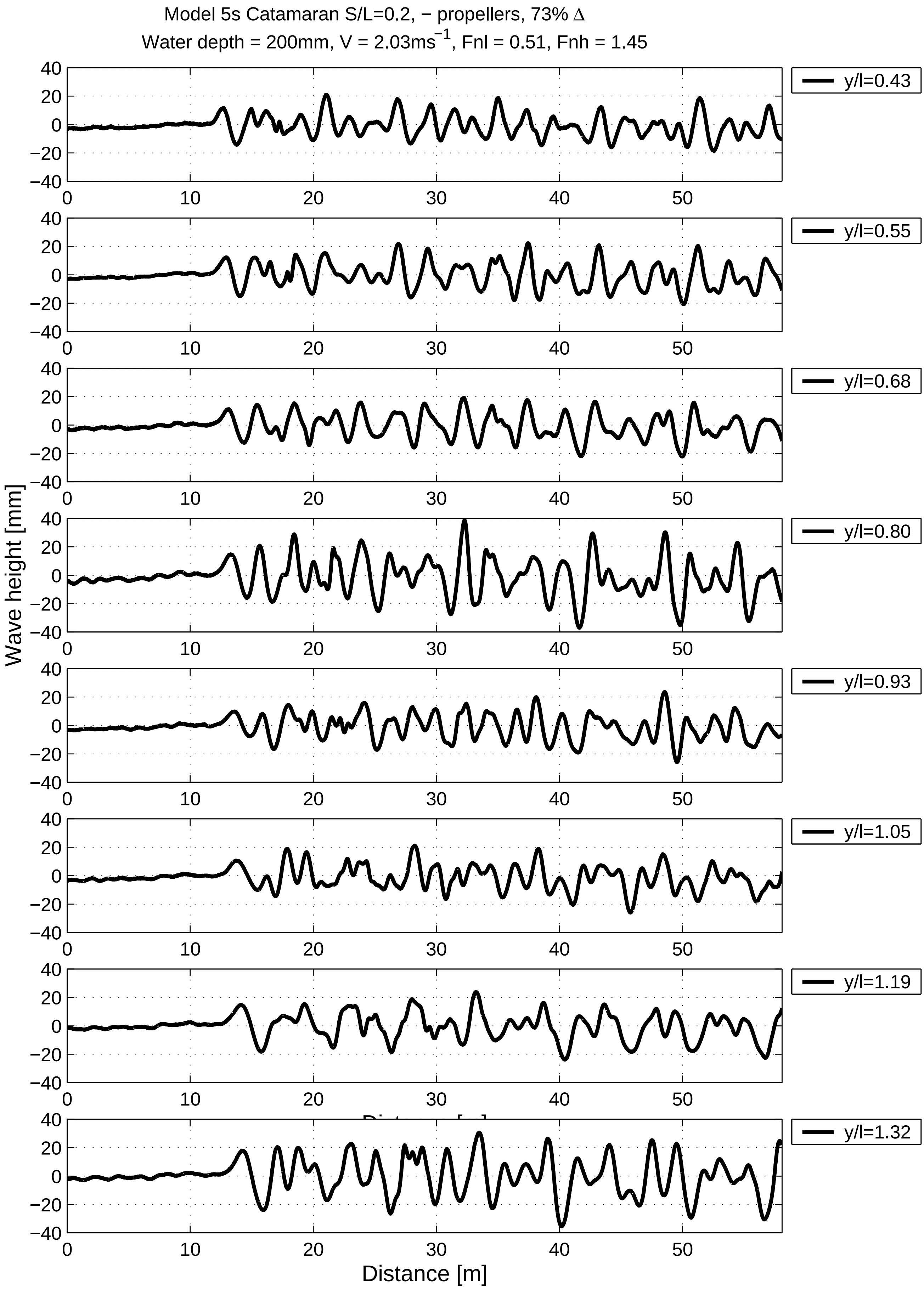

Model 5s Catamaran S/L=0.2, − propellers, 73% Δ
Water depth = 200mm, V = 2.03ms−1, Fnl = 0.51, Fnh = 1.45
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 127

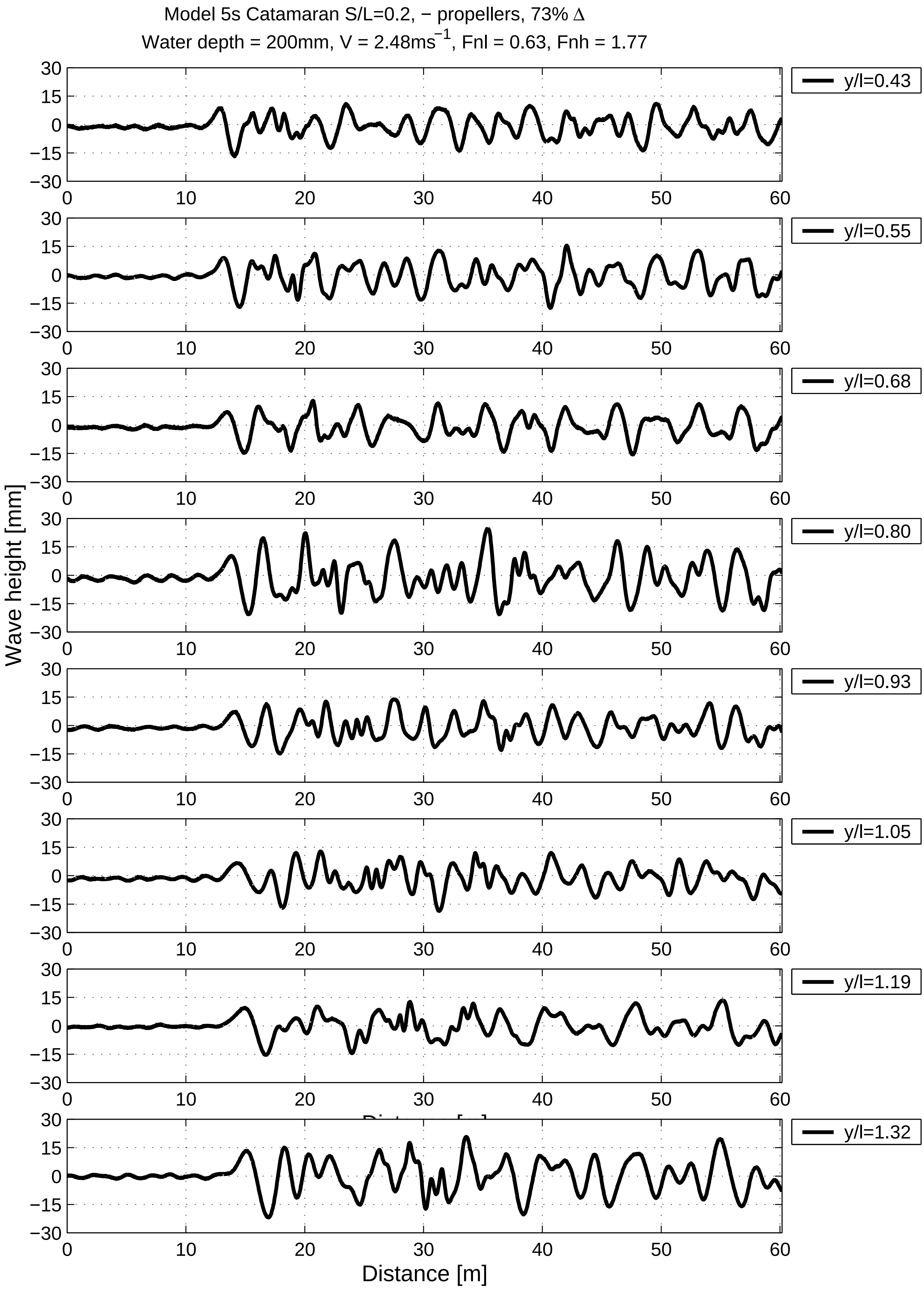
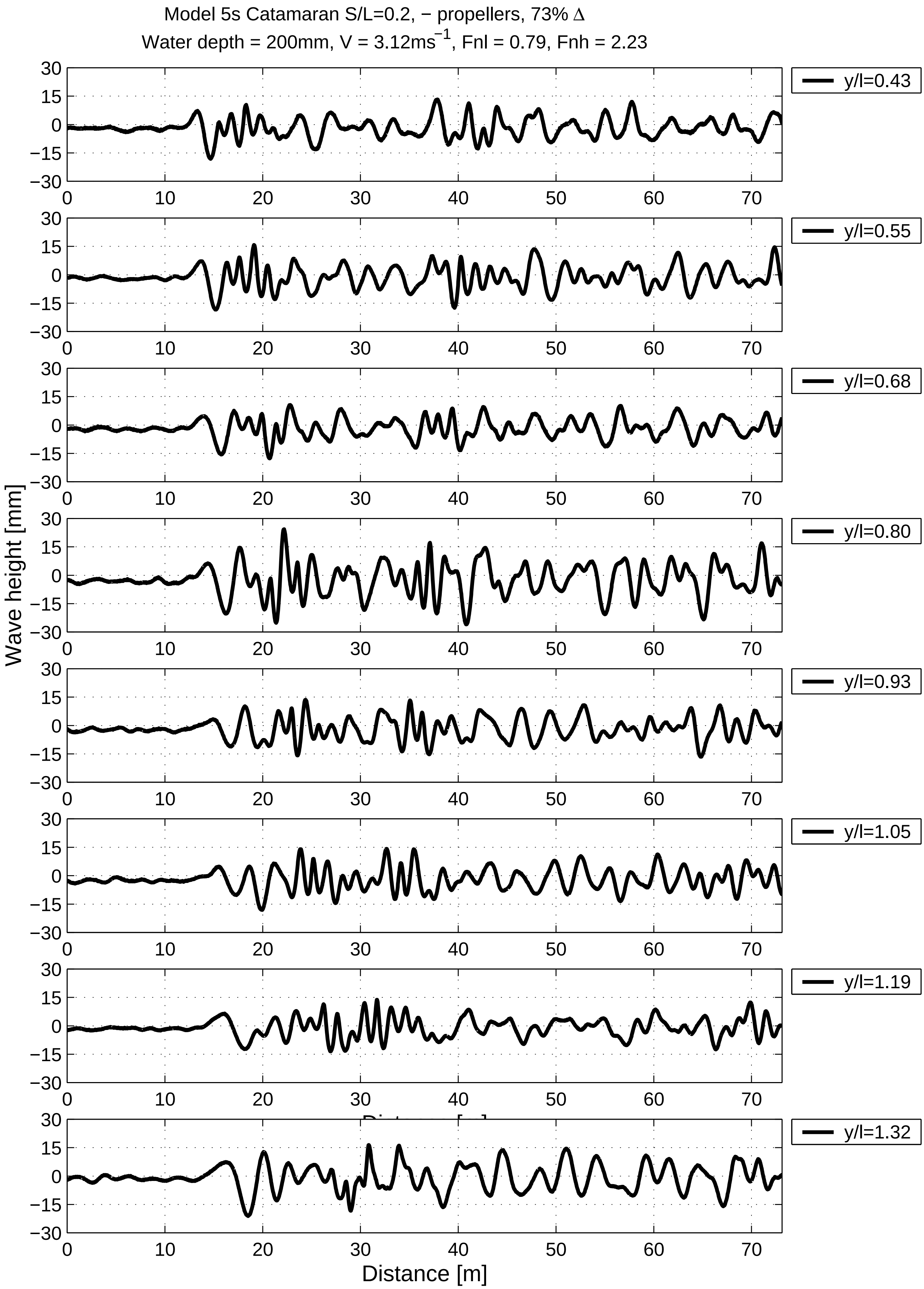

Model 5s Catamaran S/L=0.2, − propellers, 73% Δ
Water depth = 200mm, V = 2.48ms−1, Fnl = 0.63, Fnh = 1.77
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 128



Model 5s Catamaran S/L=0.2, − propellers, 73% Δ
Water depth = 200mm, V = 3.12ms−1, Fnl = 0.79, Fnh = 2.23
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 129

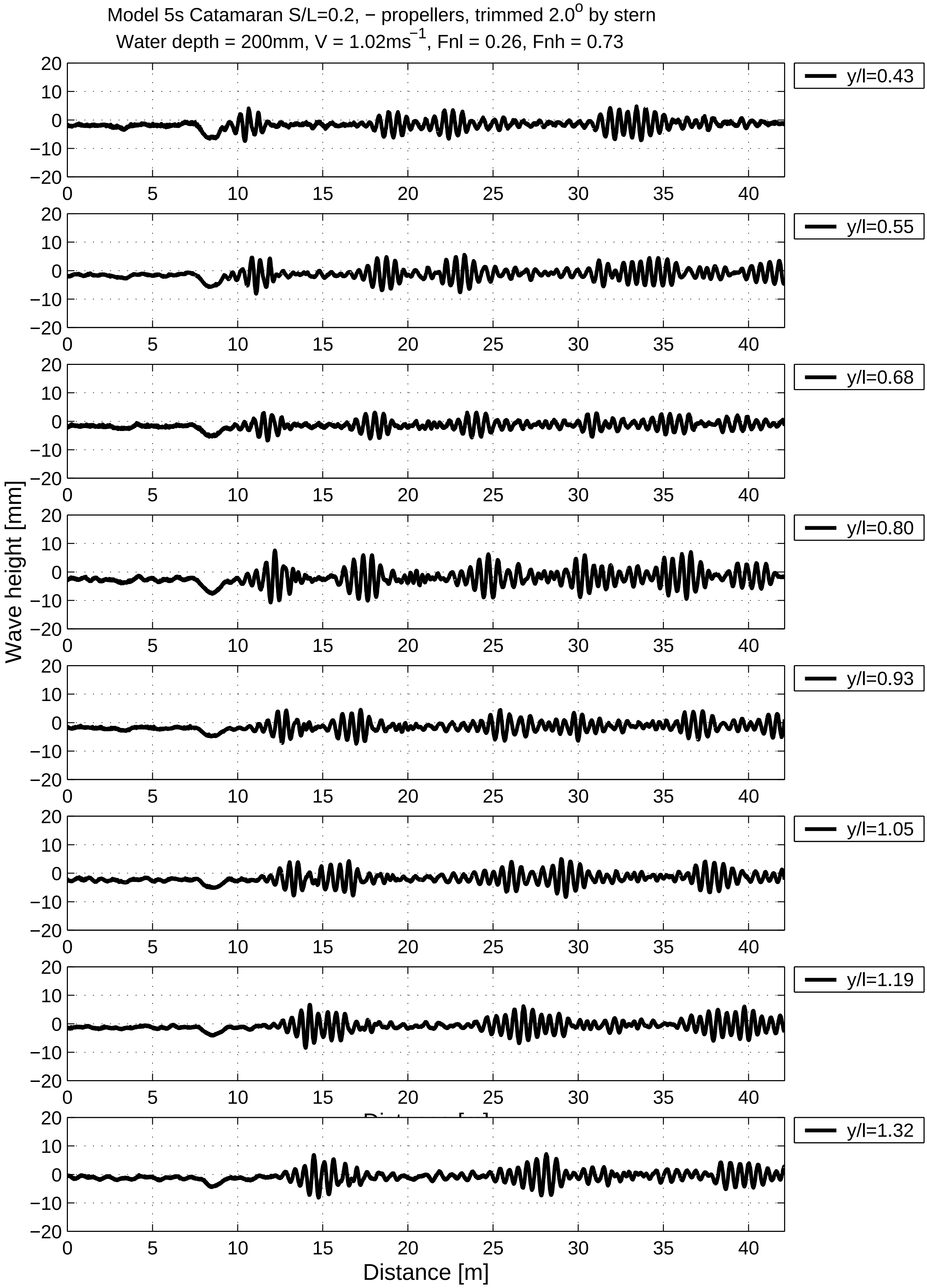
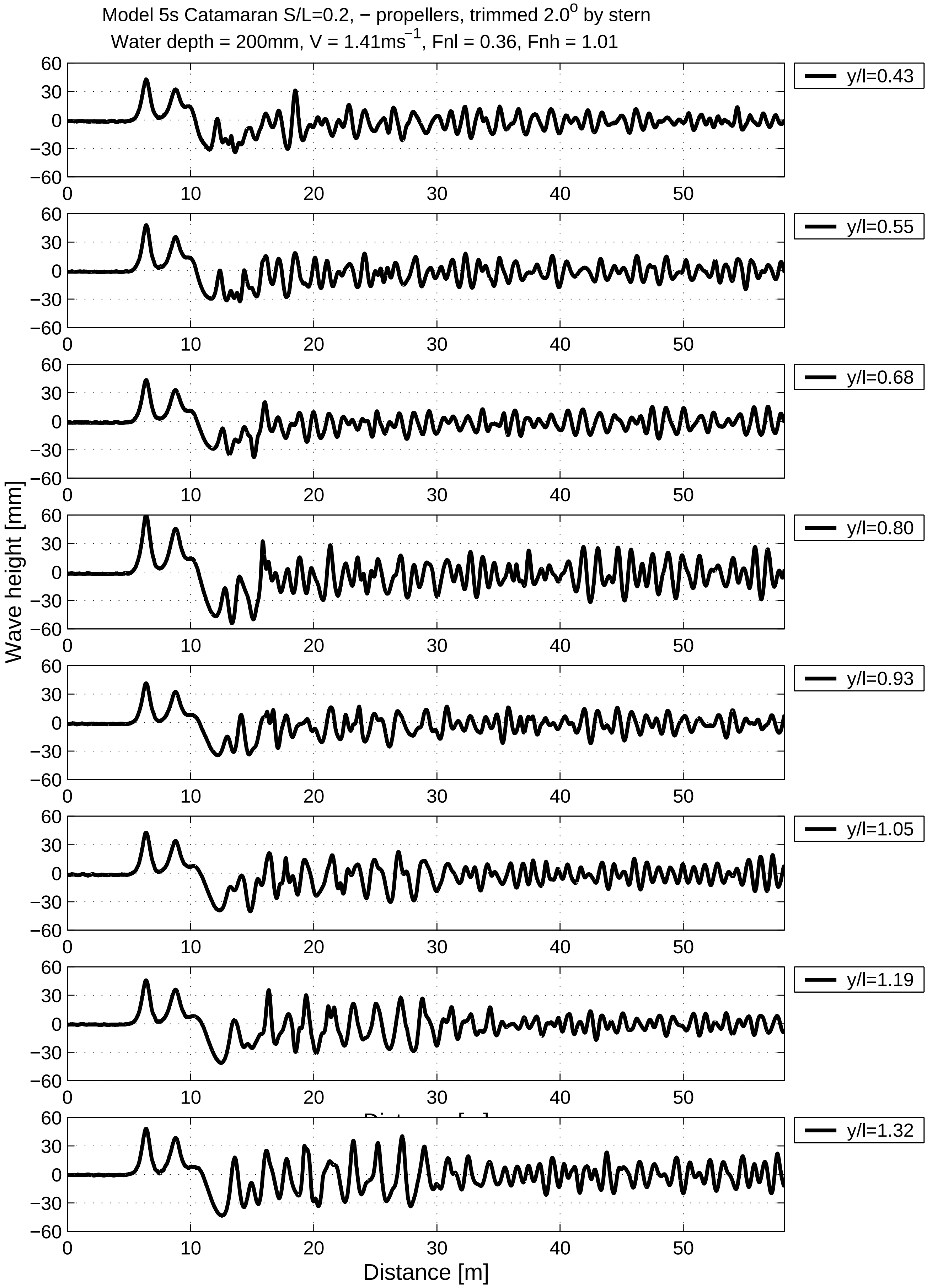

Model 5s Catamaran S/L=0.2, − propellers, trimmed 2.0° by stern
Water depth = 200mm, V = 1.02ms⁻¹, Fnl = 0.26, Fnh = 0.73
Wave height [mm]
Distance [m]
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32

Figure 130



Model 5s Catamaran S/L=0.2, − propellers, trimmed 2.0° by stern
Water depth = 200mm, V = 1.41ms⁻¹, Fnl = 0.36, Fnh = 1.01
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 131

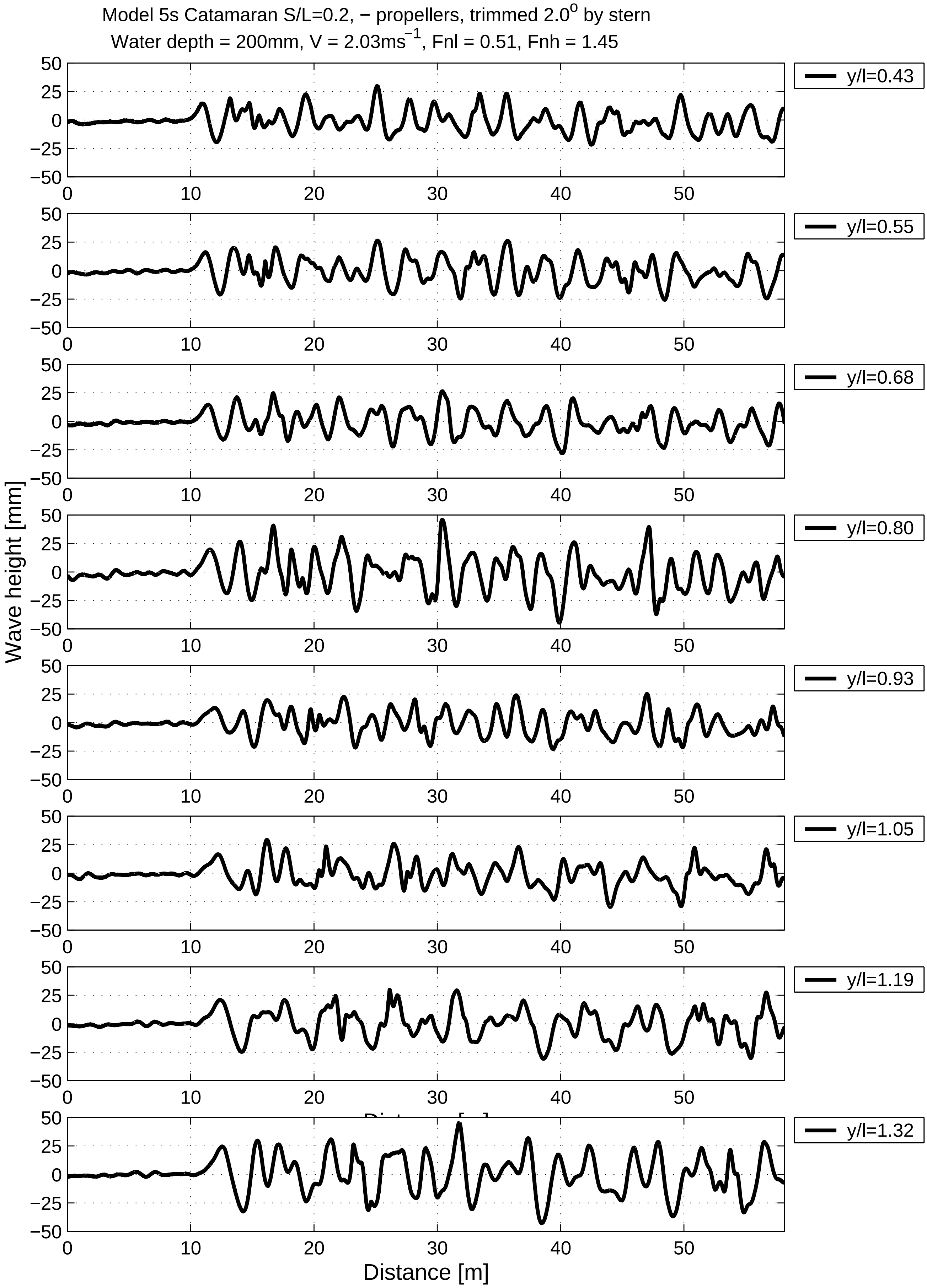
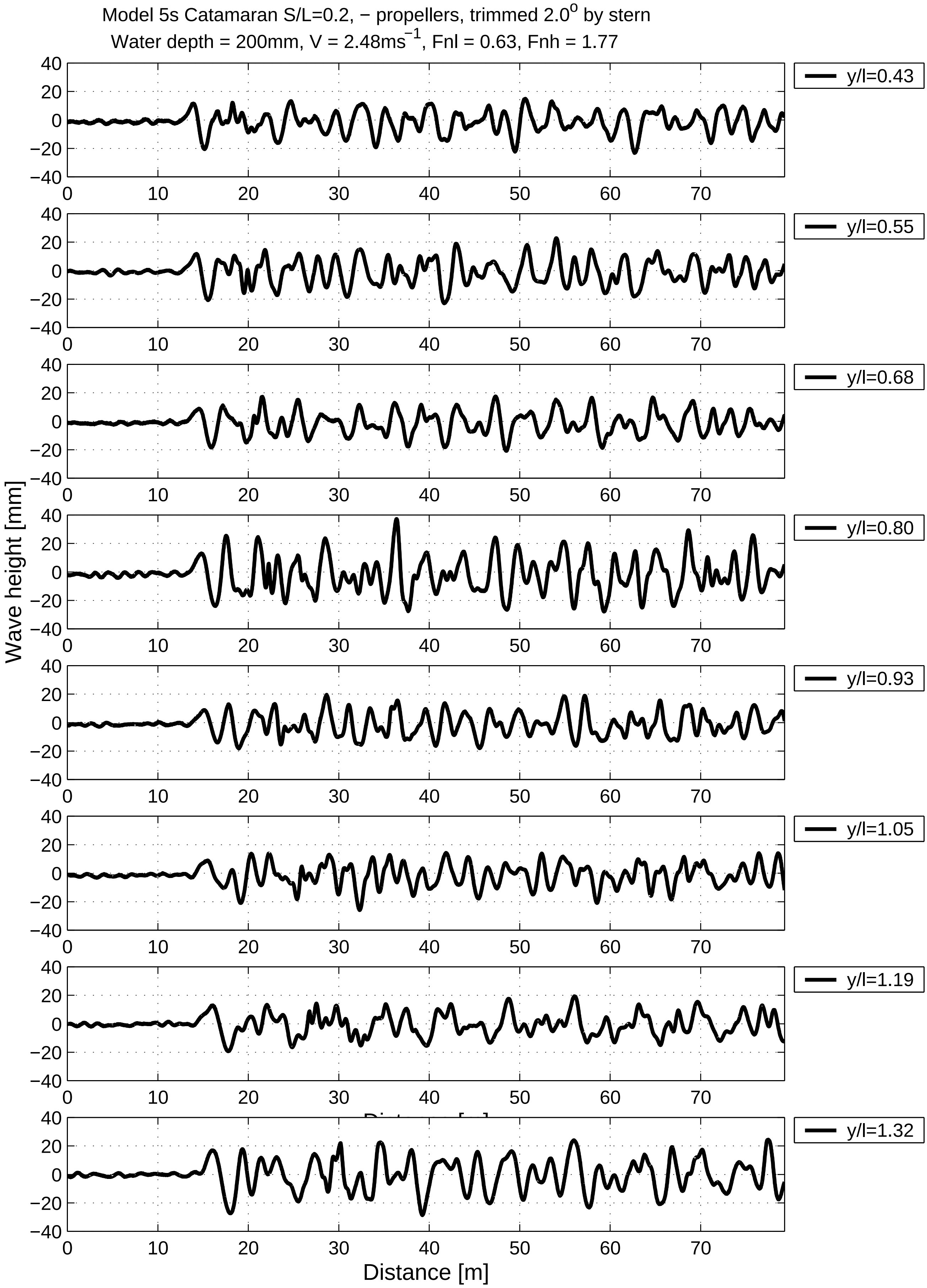
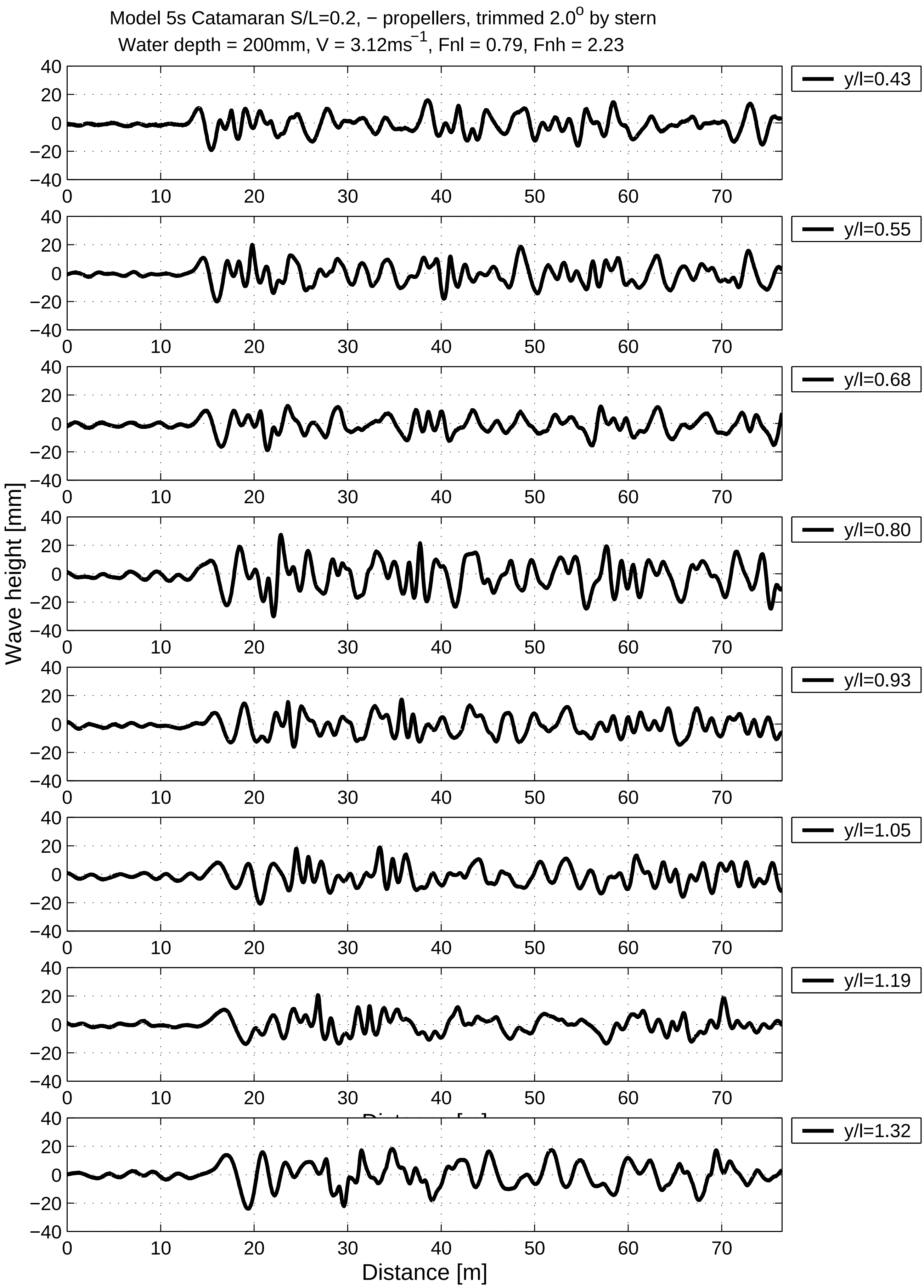

Model 5s Catamaran S/L=0.2, − propellers, trimmed 2.0° by stern
Water depth = 200mm, V = 2.03ms⁻¹, Fnl = 0.51, Fnh = 1.45
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 132



Model 5s Catamaran S/L=0.2, − propellers, trimmed 2.0^o by stern
Water depth = 200mm, V = 2.48ms^{-1}, Fnl = 0.63, Fnh = 1.77
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 133



Model 5s Catamaran S/L=0.2, − propellers, trimmed 2.0° by stern
Water depth = 200mm, V = 3.12ms⁻¹, Fnl = 0.79, Fnh = 2.23
y/l=0.43
y/l=0.55
y/l=0.68
y/l=0.80
y/l=0.93
y/l=1.05
y/l=1.19
y/l=1.32
Wave height [mm]
Distance [m]

Figure 134

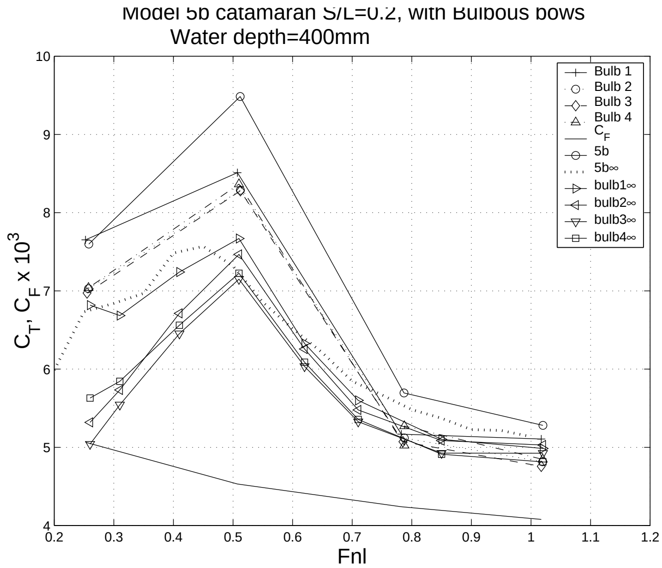


Figure 135

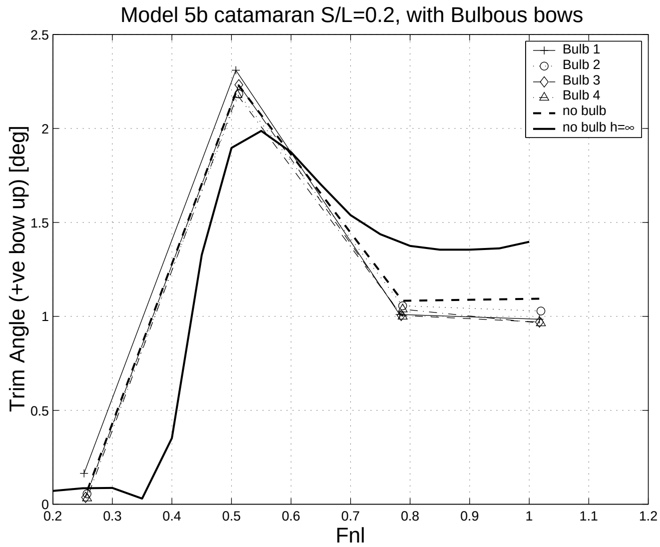


Figure 136

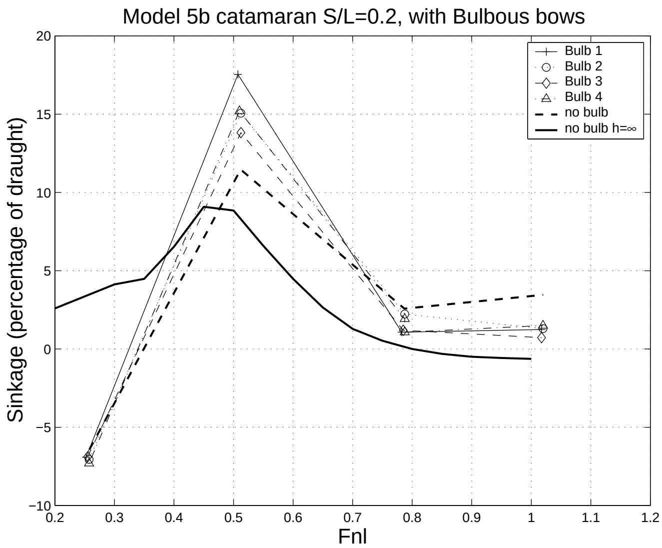


Figure 137

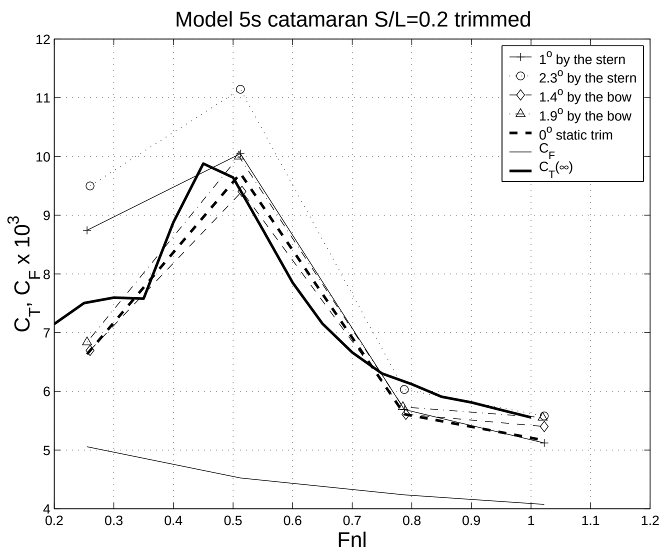


Figure 138

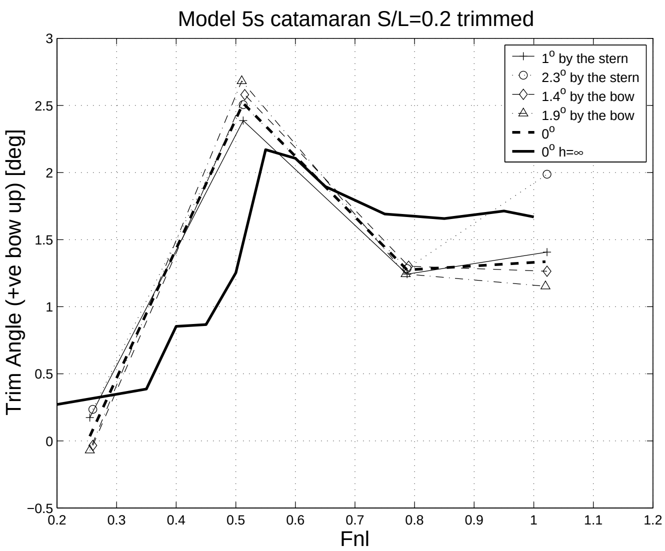


Figure 139

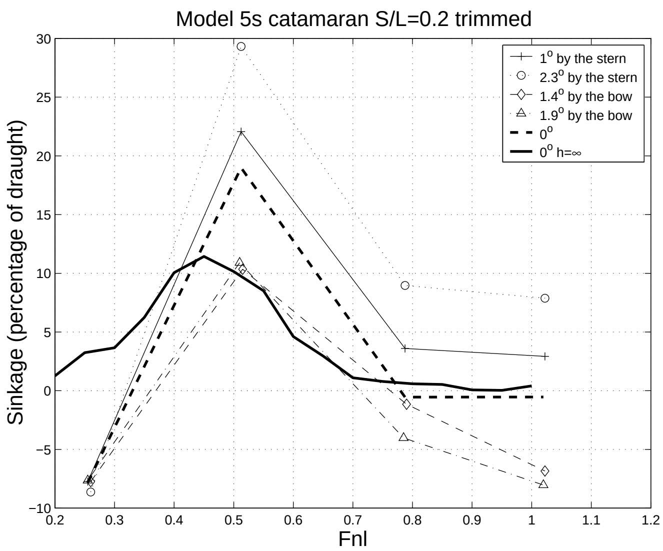


Figure 140

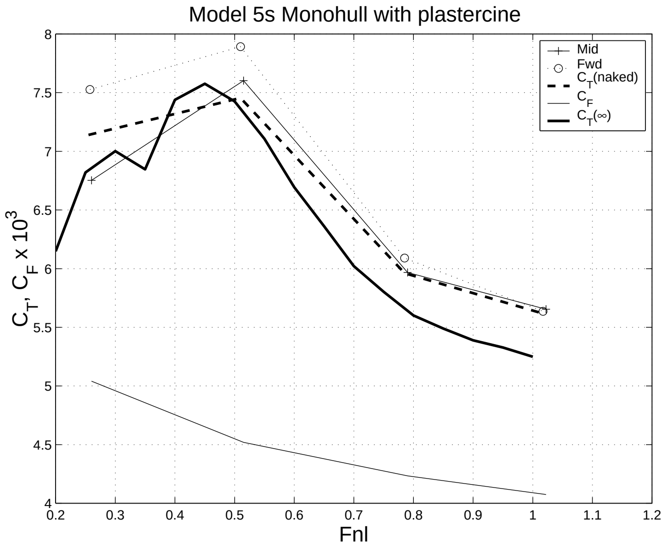


Figure 141

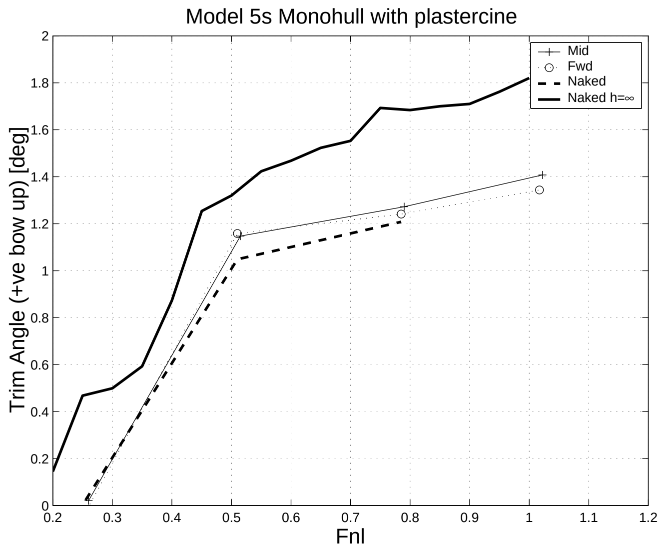


Figure 142

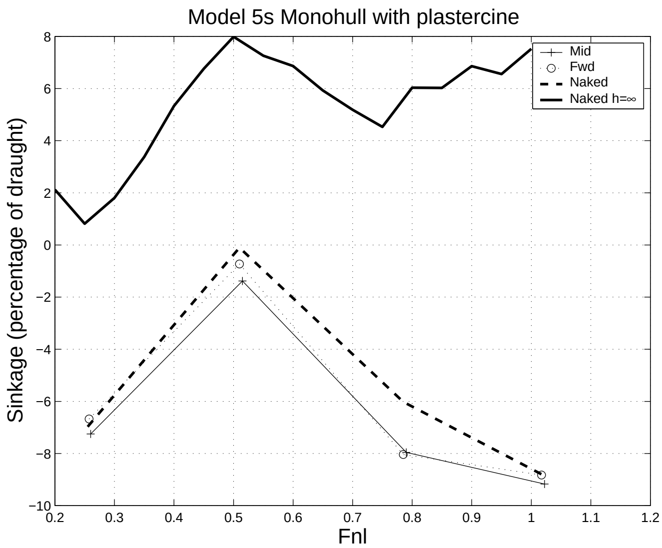


Figure 143

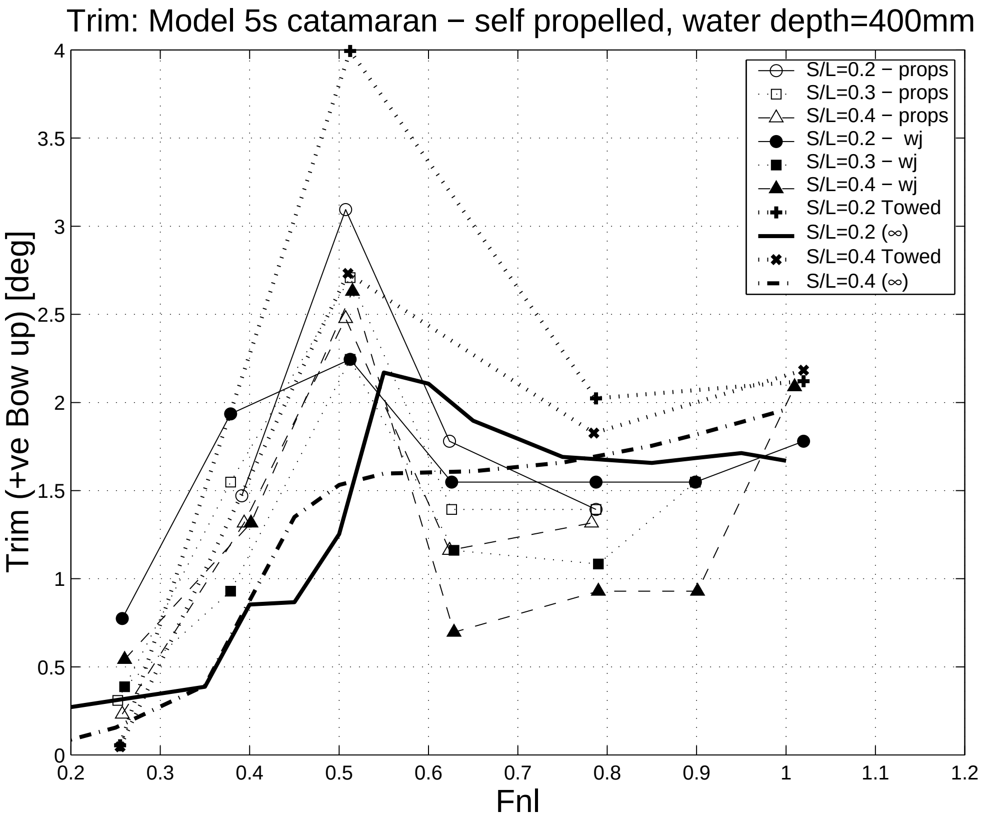


Figure 144

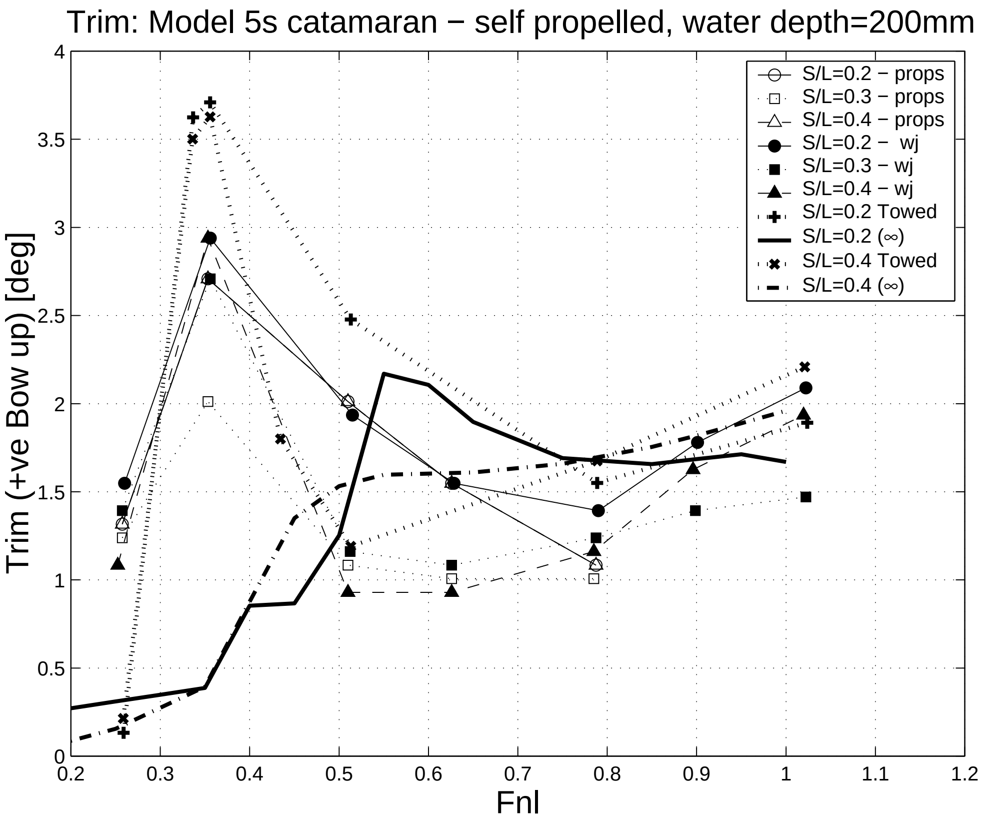


Figure 145

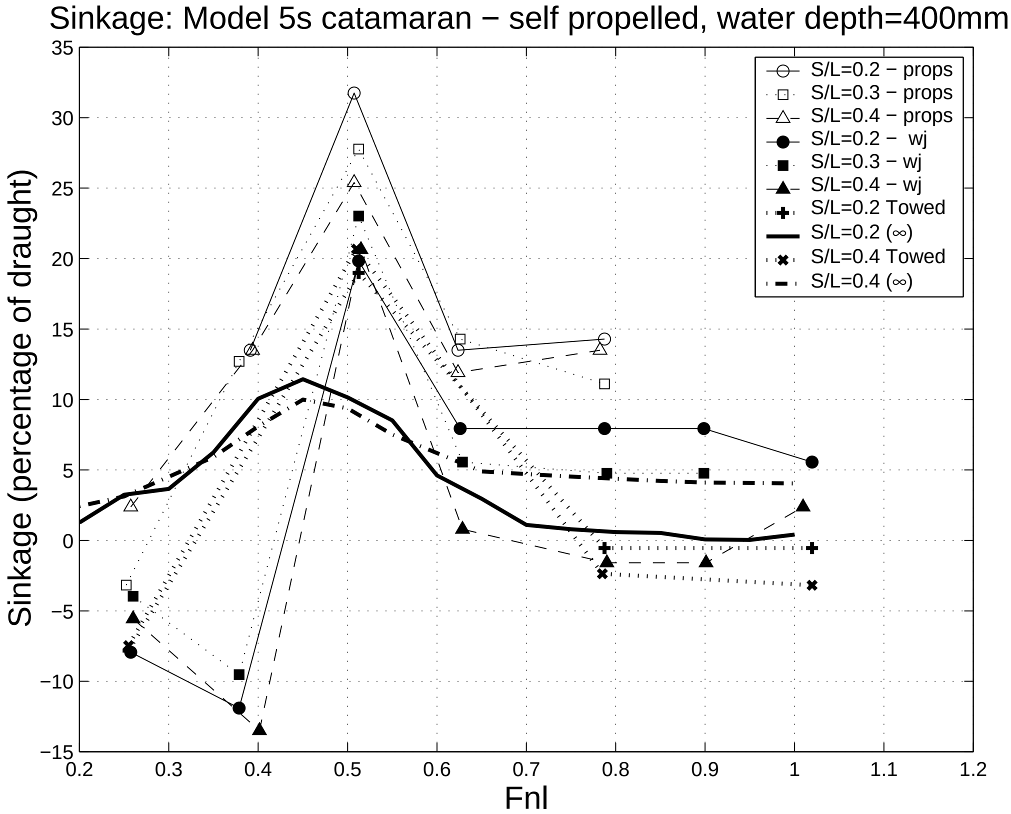


Figure 146

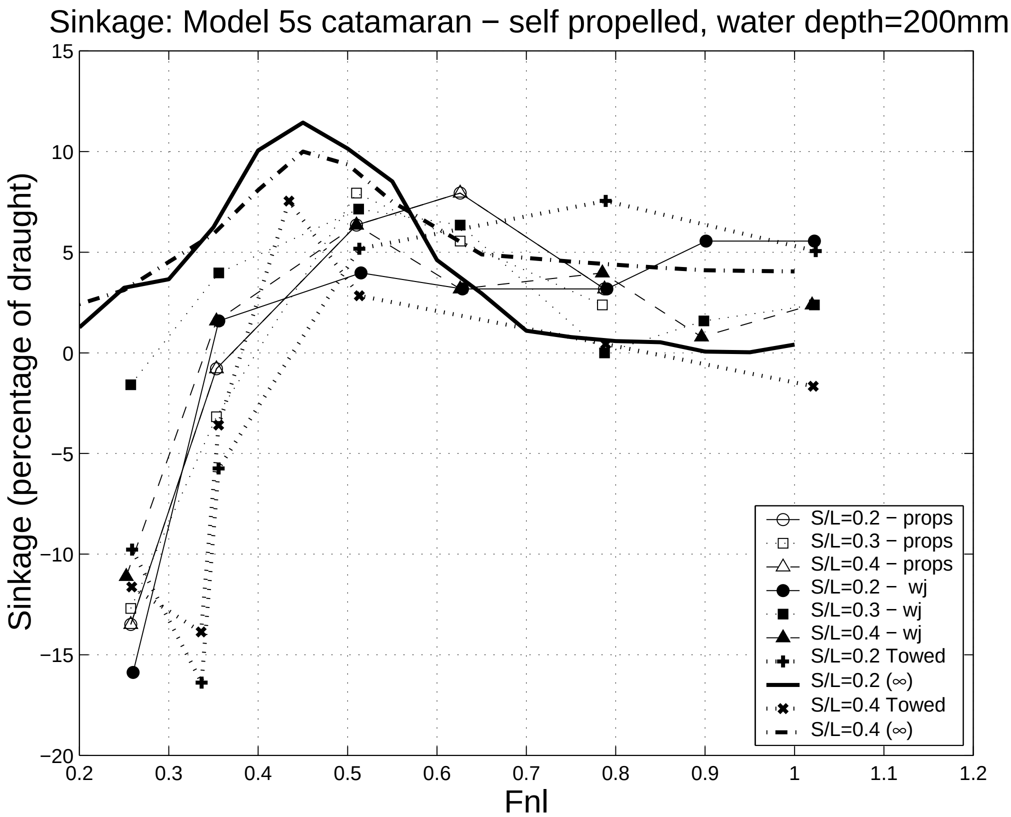


Figure 147

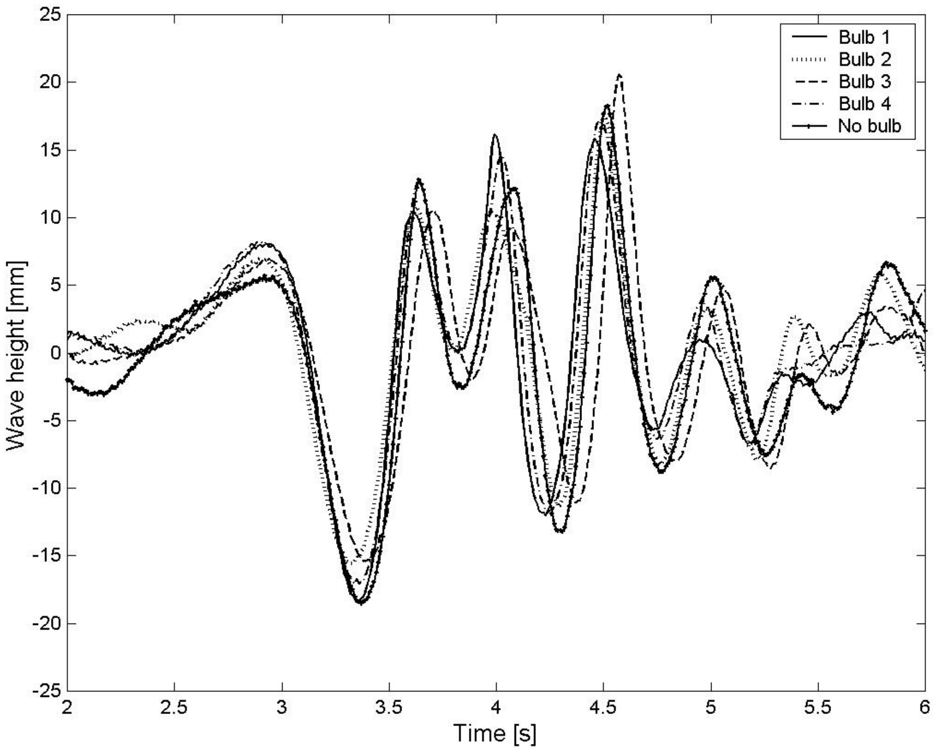


Figure 148: Comparison of wave cuts for Model 5b catamaran S/L=0.2 with and without bulbs. ($V=4.0m\ s^{-1}$, H=400mm, $Fn_L=1.00$, $Fn_H=2.01$).

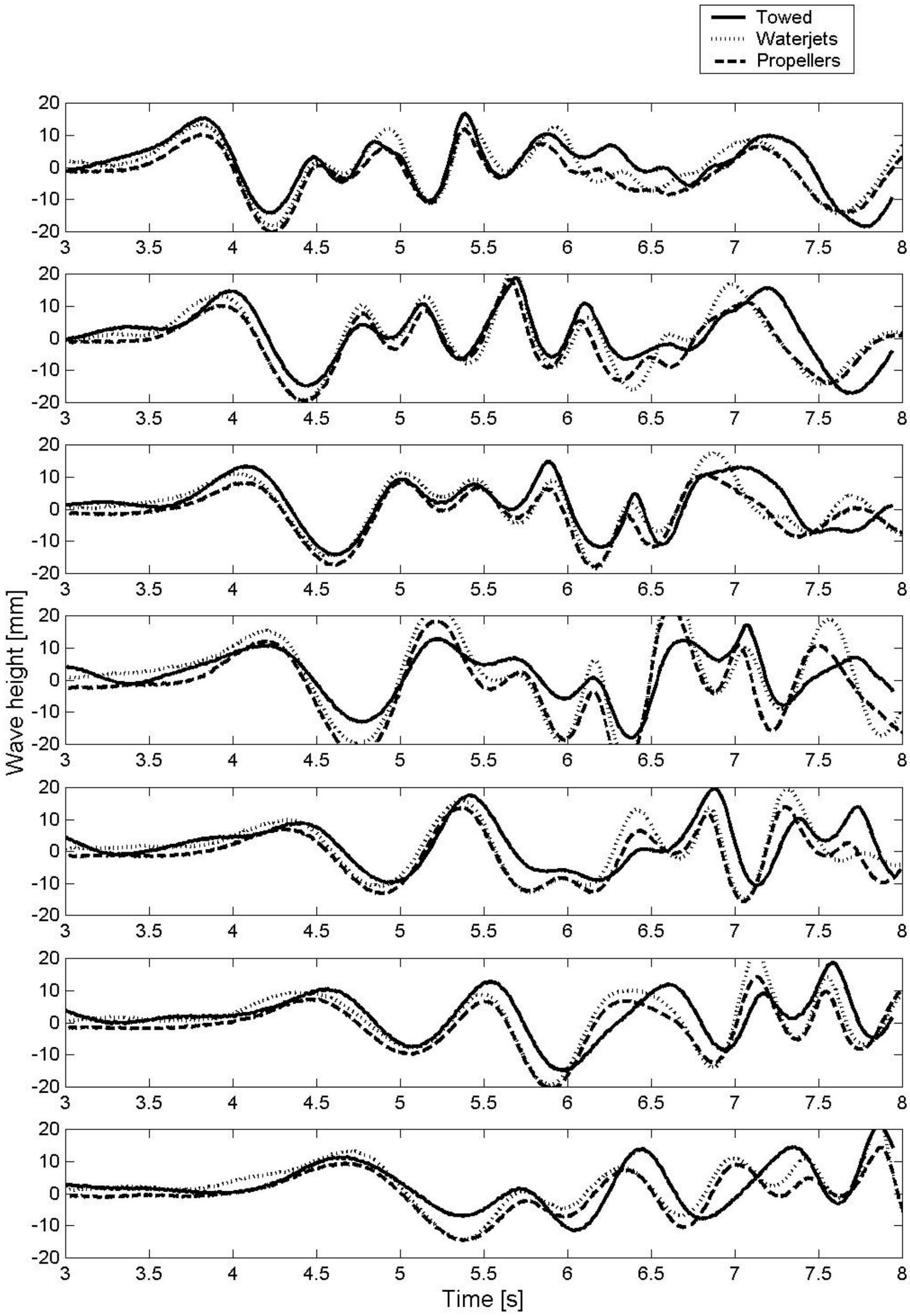


Figure 149: Comparison of wave cuts produced by towed and self-propelled models. (Model 5s catamaran S/L=0.2, H=200mm, V=3.1m s^{-1}, Fn_L=0.78, Fn_H=2.21)