Review of incidents resulting in loss of containers

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Review of incidents resulting in loss of containers

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CONTENTS PAGE

1 INTRODUCTION

This report is part of phase 1 of the TopTier Joint industry project and contains the incident review. It lists 44 incidents from which information was available. It only contains incidents in which it is believed that ship motions contributed to the loss and/or damage of containers. It is difficult to judge if this list gives a representative overview of the incidents, however it still gives a unified and structured overview useful for the next phases in the project.

Chapter 2 provides a reading guide containing the main sources, estimates made and some definitions and notations. Chapter 3 contains the classification of the incidents including an overview and derived statistics. Chapter 4 contains the description of the individual incidents.

2 READING GUIDE

2.1 Definitions and notation

The below table provides the applied definitions and notations used in this report.

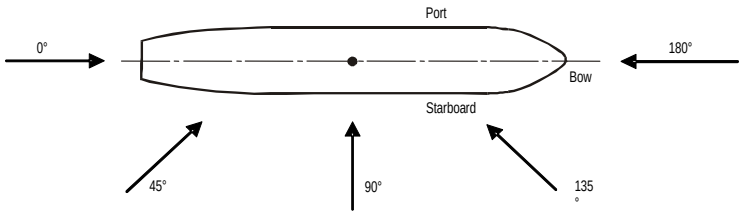
Table 2-1: Definitions and notation

Quantity	Symbol	Unit
Length over all	L_{OA}	m
Beam	B	m
Transverse metacentric height	GM	m
Mass radius of inertia around x-axis	k_{xx}	m
Added mass radius of inertia around x-axis	a_{xx}	m
Roll natural period	$T\phi$	s
Significant wave height	H_s	M
Peak wave period	T_p	S
Wave encounter period	T_e	s
Wave length	λ	m
Effective wave length	λ_{eff}	m
Wave heading (ship fixed)	μ	deg

The co-ordinate system and related sign conventions follow the ITTC standards. The wave heading (μ) of the vessel is given in a ship co-ordinate system; it is defined as the angle between the direction of wave propagation and the direction of the vessel's bow. The following sign convention for the wave heading applies:

Table 2-2: Ship wave heading convention

180 deg	Head seas
135 deg / 215 deg	Bow-quartering seas over starboard / portside
90 deg / 270 deg	Beam seas over starboard / portside
45 deg / 315 deg	Stern-quartering seas over starboard / portside
0 deg	Following seas



2.2 Estimation of rolling period

The natural period of roll is given by the following formula:

$$T_\phi = 2\pi\sqrt{\frac{k_{xx}^{\ 2} + a_{xx}^{\ 2}}{g \cdot GM}}$$

In which:

T_ϕ = natural period in [s]
k_{xx} = mass radius of inertia around x-axis in [m]
a_{xx} = added mass radius of inertia around x-axis in [m]
g = acceleration due to gravity in [m/s^2]
GM = transverse metacentric height including free surface correction in [m]

In some cases the GM is given, but in 21 of the 44 incidents, it has been estimated. Table 2-3 shows the applied GM values, which are based on information provided by the ship operators. Typical values are estimated for long voyages (like Asia – Europe and Asia – USA and vice versa) and for coastal voyages (like inter-Asia or inter-Europe). Due to congestion in Long Beach (USA), container vessels were fully loaded in 2020 and 2021. This resulted in lower GM values for Pacific Eastbound (from Asia to USA) in this period. In addition to the typical GM values, also lower and higher estimates are given. It is not claimed that these are the extreme values but they reflect the typical range.

Table 2-3: Applied GM values if not available

GM [m]	Long voyages	Pacific Eastbound 2020-2021	Coastal voyages
Typical	2.0	1.5	3.0
Low	1.2	1.0	1.2
High	4.0	2.5	8.0

Next to the GM values also the mass radius of inertia around x-axis (roll inertia) and roll added mass is needed in the estimation of the rolling period. Table 2-4 shows the applied values of k_{xx} which are based on experience, research (Grin et al, 2016[1]) and measurement data on the CMA-CGM Rigoletto (9400 TEU container vessel). The roll added mass (a_{xx}) depends on the vessel shape, motion response and water depth. To keep it simple, it is here estimated at 0.18B (from experience) and its variation is assumed to be including in the variation of the k_{xx}.

As these estimations have significant effect on the estimation of the roll period it is recommended to get better estimates of k_{xx} and a_{xx} in next phases of the project.

Table 2-4: Applied k_{xx} and a_{xx}

	k_{xx}/B [-]	**a_{xx}/B [-]**
Typical	0.39	0.18
Low	0.29	0.18
High	0.49	0.18

[1] Grin et al, *'On the prediction of weight distribution and its effect on seakeeping'*, PRADS 2016.

2.3 Estimation of speed

In 10% of the incidents the speed is not available. In that case a typical speed is assumed of around 15 kn in 5 m waves. This increases to around 18 kn in lower waves and reducing to around 12 kn in higher waves.

2.4 Estimation of wave conditions, wave encounter period and wave length

On basis of the estimated track (combination of time, latitude and longitude), wind and wave conditions are estimated from ECMWF ERA-5 hindcast data. This public available dataset is from the European Centre of Medium Range Weather Forecasts in the UK. It has a spatial resolution of 0.5 x 0.5 deg (approximately 30 x 30 nm) and a time step of 1 h. The applied dataset contains the wave spectral parameters of windsea and swell (H_s, T_1 and μ). The mean wave period (T_1) has been converted to peak wave period (T_p) by using a factor 1.198 (this is valid for Jonswap type wave spectra).

In the next step, the wave direction has been translated from earth fixed (coming from with respect to the North) to ship fixed (coming from with respect to the bow). Thereafter the wave encounter period is calculated with:

$$T_e = \frac{g \cdot T_p^2}{g \cdot T_p - 2\pi \cdot V_s \cdot \cos(\mu)}$$

In which:

T_e = wave encounter period in [s]
T_p = peak wave period in [s]
g = acceleration due to gravity in [m/s^2]
Vs = vessel speed in [m/s]
μ = ship fixed wave heading [rad]

The effective wave length is based on a deep water wave length approximation and calculated by:

$$\lambda_{eff} = \frac{1.56 \cdot T_p^2}{|\cos(\mu)|}$$

Note that throughout this report λ_{eff} is referred to as λ.

From this the ratio between the roll natural period and the encounter period (T_ϕ/T_e) and ratio between the wave length and vessel length (λ/Loa) are calculated. These 2 ratios give, together with wave direction, a rough guess on expected seakeeping behaviour. Note that 'limits' are to be refined in later stages of the project.

Table 2-5: Rough estimate of ship motions

	T_ϕ/T_e	λ/Loa	μ
Parametric roll in (close to) head seas	$1.8<T_\phi/T_e<2.2$	$0.5<\lambda/Loa\leq 2$	$150<\mu\leq 180$
Parametric roll in (close to) following seas	$1.8<T_\phi/T_e<2.2$	$0.5<\lambda/Loa\leq 2$	$0<\mu\leq 30$
Resonant roll	$0.9<T_\phi/T_e<1.1$	-	$0<\mu\leq 90$
Head and bow quartering	-	$0.7<\lambda/Loa\leq 1.3$	$90<\mu\leq 180$

Note that resonant roll is sometimes referred to as synchronous roll. Vertical plane motions denote heave and pitch motions and the accompanying vertical accelerations, risk on slamming and shipping green water

2.5 Sources and confidence level

The main sources in this report are:

1. Incident reports from flag states:
   - UK: MAIB
   - Australia: ATSB
   - Germany: BSU
   - Netherlands: DSB
   - France: Beamer
   - Denmark: DMAIB
2. Operators within the TopTier JIP
3. Cargolaw.com (until 2012)
4. Fleetmon.com (from 2015)
5. Gcaptian.com (from 2018)
6. Pandr-marine.com (from 2020)

Besides above sources, local news sites have been used. The first and second sources are considered reliable, whereas remaining sources have varying reliability. In more recent years the later three sources also provide maps with tracks from AIS data, which improves the estimates on position although some uncertainties remain. If we want to further improve track information, AIS data need to be purchased from one of the many suppliers who has access to historic AIS data retrieved from satellites.

As mentioned before the track is coupled to ECMWF ERA-5 hindcast data. As long as the track is retrieved from maps from above mentioned sources, there is no need to spend effort on validating and refining the weather data.

The next main source of uncertainty is on the loading condition. In 50% of the incidents, GM is not available (as well as the draught). In all cases the roll inertia is not accurately known. Finally hull lines are not known either. Although some assumptions can be made, it is not recommended to reproduce the ship motions be means of seakeeping calculations. There are too many uncertainties from both the wave conditions as well as the ship conditions.

The description of the damage is mainly based on photos. Although much more detail is available for the incidents which were investigated by the flag states, it is chosen to keep the damage description fairly general. For further details the investigation reports are a good basis.

3 CLASSIFICATION OF INCIDENTS

3.1 Incident overview

Table 3-1shows the incident list. It contains 57 incident from which 44 are included in this report. The grey fields denote the incidents not reported including the reason for not including it. The ID refers to the paragraph number in Chapter 4 and the number of containers refer to the (estimated) number of affected containers (damaged + lost).

Table 3-1: Incident list (grey lines not included in report)

ID	Ship name	Date	Containers	Remark (only when not included in the report)
1	APL China	Oct 1998	1406	
2	P&O Nedlloyd Barcelona	Jan 2000	51	
3	OOCL America	Jan 2000	567	
4	Ville D'Orion	Mar 2001	69	
5	Dutch Navigator	Apr 2001	9	
-	Lykes Liberator	Feb 2002	60	Lost 30 containers at the France coast, ship has superstructure at the bow
6	Andinet	Dec 2003	0	
-	CSAV Shenzhen	Sep 2004	72	Stern bay collapse in Pacific (only 1 photo but no further information)
7	Xin Qing Dao	Oct 2004	60	
-	Spaarnedijk	Jan 2005	5	Approx 5 damaged containers, unknown number lost (no public information)
-	Bunga Raya Satu	Dec 2005	8	9 Damaged containers containing windmill blades (no public information)
8	P&O Nedlloyd Genoa	Jan 2006	59	
9	P&O Nedlloyd Mondriaan	Feb 2006	108	
10	CMA CGM Otello	Feb 2006	70	
11	CMA CGM Verdi	Feb 2006	140	
12	Jeppesen Maersk	Nov 2006	50	
-	MSC Napoli	Jan 2007	0	Structural failure in English Channel, some containers lost after beaching the vessel
13	Annabella	Feb 2007	7	
14	Ital Florida	Jun 2007	130	
-	NYK Antares	Nov 2007	50	Stern bay collapse on the North Sea (Except 1 photo no further information)
15	CMA CGM Dahlia	Feb 2008	80	
-	Chicago Express	Sep 2008	0	Crew member died due to heavy rolling
-	Herm IJmuiden	Jan 2009	11	Lost 11 empty containers on the North Sea
16	Pacific Adventurer	Mar 2009	33	
17	YM Taichung	Apr 2009	40	
-	NAVI Baltic	Oct 2009	9	Lost 9 containers on the North Sea
-	CMV CCNI Guayas	Sep 2009	0	Crew member died due to heavy rolling
18	Bai Chay Bridge	Jun 2012	168	
-	MOL Comfort	Jun 2013	4382	Lost all containers after structural failure in the Indian Ocean
19	Svendborg Maersk	Feb 2014	767	
20	Wehr Singapore	Nov 2015	6	
-	Red Cedar	Jan 2017	15	Lost 15 containers on the North Sea
21	Maersk Merete	Feb 2017	128	
22	Ever Smart	Oct 2017	153	
23	CMA CGM Washington	Jan 2018	222	
24	Maersk Shanghai	Mar 2018	73	
25	YM Efficiency	May 2018	143	
-	MOL Maneuver	Jan 2019	0	Stern bay collapse (except for facebook video no further information)
26	MSC Zoe	Jan 2019	875	
27	Helsinki Bridge	Feb 2019	100	
28	OOCL Rauma	Feb 2020	7	
29	APL England	May 2020	113	
30	MSC Palak	Jul 2020	22	
31	UNI Florida	Jul 2020	65	
32	ONE Aquila	Oct 2020	180	
33	Seroja Lima	Nov 2020	117	
34	ONE Apus	Nov 2020	2756	
35	Evergreen Liberal	Dec 2020	66	
36	Maersk Essen	Jan 2021	750	
37	MSC Aries	Jan 2021	43	
38	UNI Popular	Jan 2021	14	
39	Maersk Eindhoven	Feb 2021	325	
40	MED Denizli	Feb 2021	21	
41	Baltic Tern	Apr 2021	7	
42	Ever Liven	Jun 2021	15	
43	Thalassa Tyhi	Jul 2021	64	
44	ZIM Kingston	Oct 2021	134	

3.2 Incident statistics

This section contains a number of statistics based on the information listed in the incident list and present report. In 44 incidents in total 9824 containers were lost or damaged. This is 223 containers per incident on average. It is important to note that a few major incidents increased the average significantly. This is illustrated in Figure 3-1 in which the size of the vessel is shown together with the magnitude of the incident (colour and size of the circle). In six incidents more than 5% of the FEU (or 2.5% of the TEU) capacity was lost or damaged.

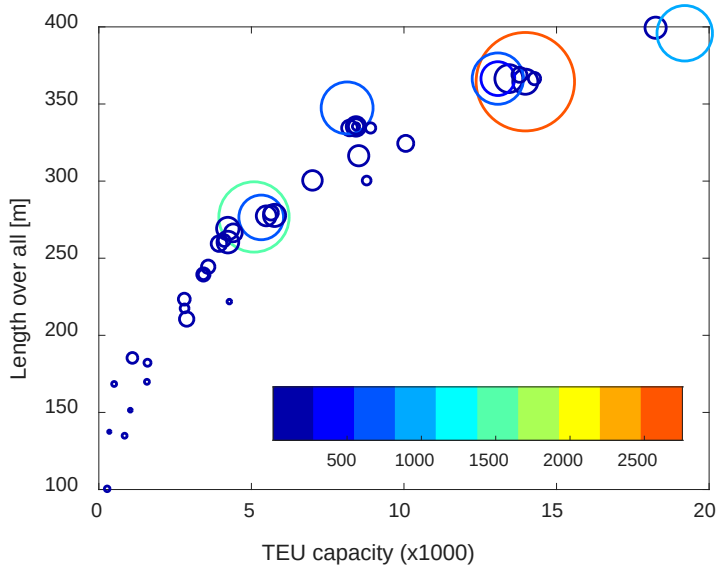


Figure 3-1: Size of ship and incident magnitude

Figure 3-2 shows the incident location. It shows the magnitude of the incident (size of the circle) together with the significant wave height (colours) at the time of the incident. It shows that the largest incidents (in terms of lost/damaged containers) happened on the Pacific and along the European coast. On the other hand most of the incidents happened close to the coast.

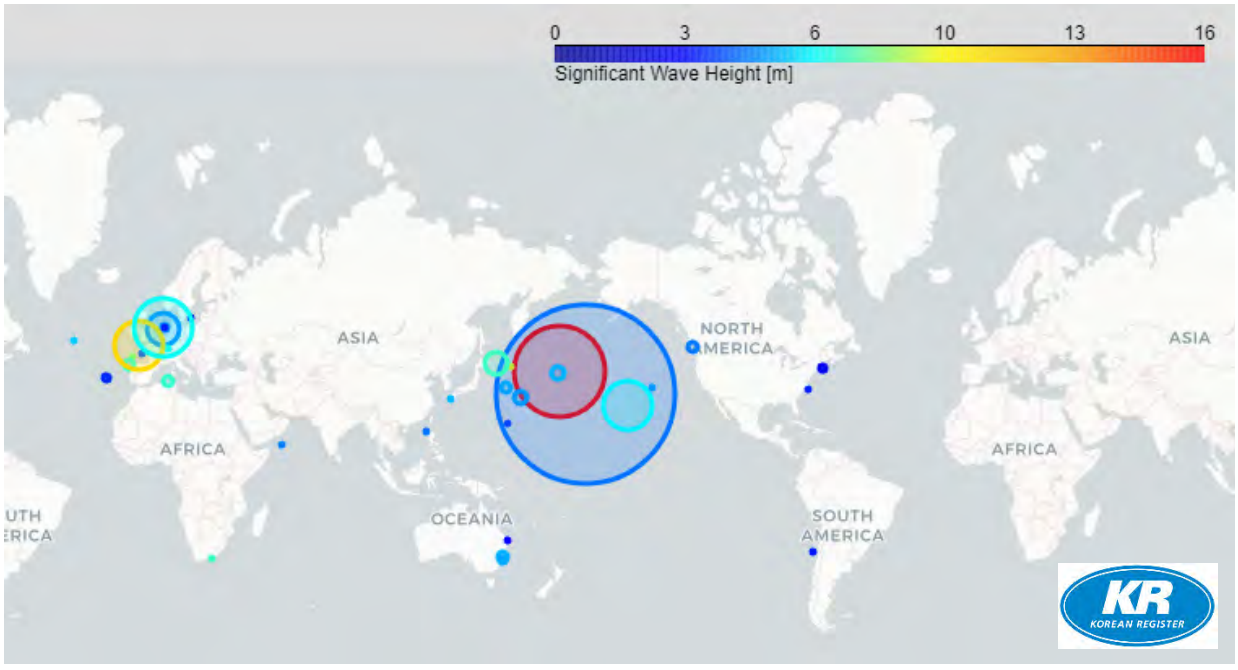


Figure 3-2: Incident location (courtesy Korean Register)

Figure 3-3 shows that the incidents are almost equally distributed along the day and night. However it has to be noted that in 25% of the incidents time was too uncertain to class it. The distributions on Operator, Class and Shipyard seem to follow their respective market share.
Figure 3-4 shows a selection of histograms in which it is shown that the wave height is typically 5.3 m (median value) and transverse stability typically 1.7 m (this is excluding the incidents in which the GM is estimated). Note that in both cases the spreading is large. The histograms of speed and ship fixed wave direction are almost uniformly distributed with no typical value.

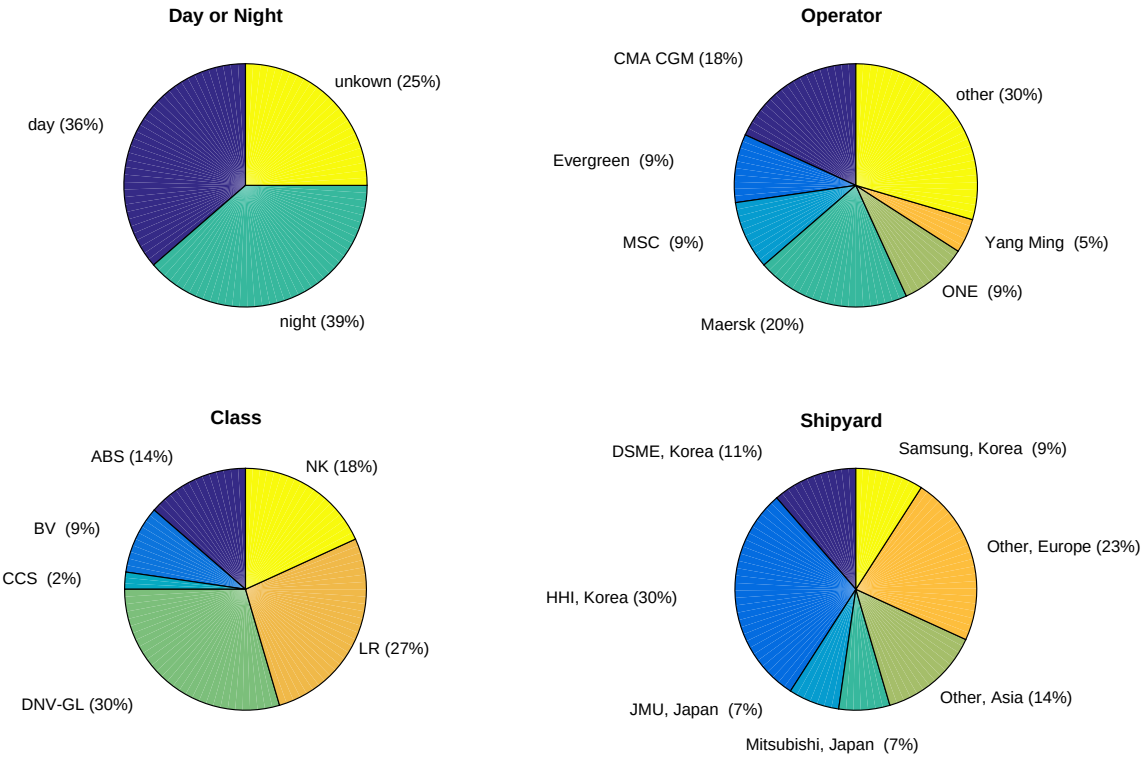


Figure 3-3: Selection of Pie charts

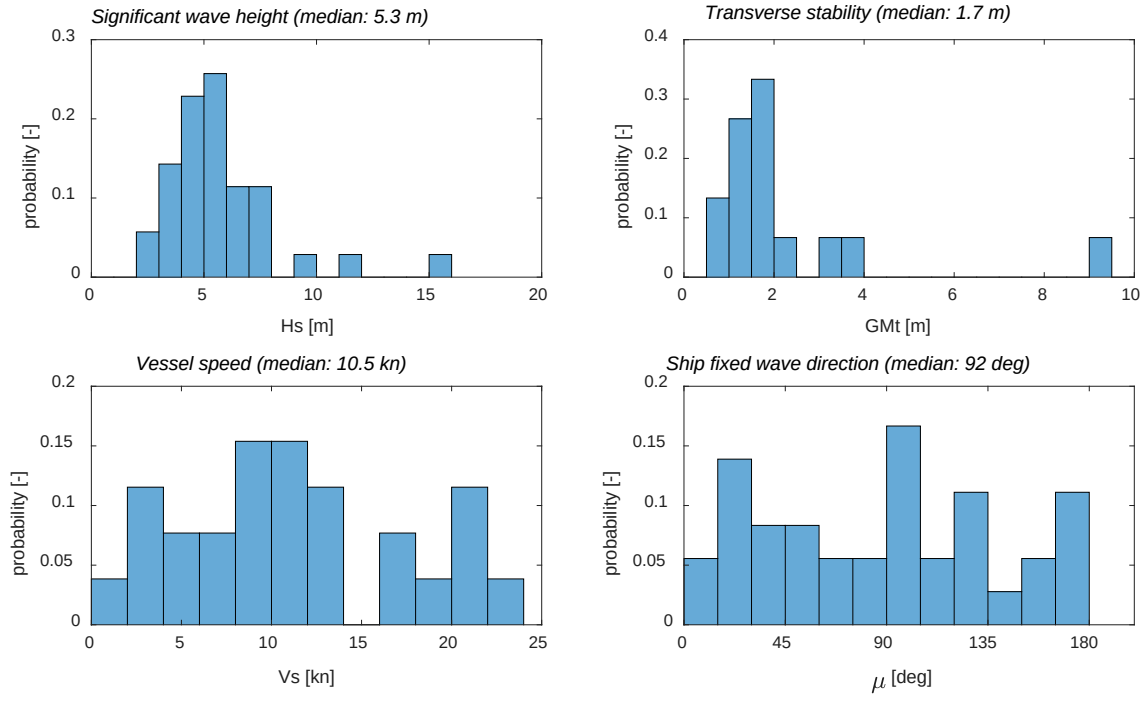


Figure 3-4: Selection of histograms

3.3 Classification of incident

Table 3-2 shows the classification matrix. This matrix is an attempt to summarise and classify the incident conditions and damage. The rows classify the damage and the columns the seakeeping behaviour. The classification of seakeeping behaviour is in-line with the rough estimate of ship motions in Table 2-1. In the matrix the numbers show the section number of the incident. E.g. in the top left corner it states; 5, 6 and 42 which refer to section 4.5 (Dutch Navigator, 2001), section 4.6 (Andinet, 2003) and section 4.42 (Ever Liven, 2021).

Table 3-2: Classification matrix (values refer to paragraph number of incident)

	Resonant roll	Parametric roll (stern)	Parametric roll (bow)	Head & bow quartering	Unknown	Total (#)
(Partial) stack collapse	5,6,42			28,38,41	13,40	8
Single (stern) bay collapse	7,17,27,35	32	8	2,21,22,43	4,12,14,18,31	15
Multiple stern bay collapse	10,11		25		15	4
Multiple bay collapse	16,26,44	23,34,36,39	1,19,29		3	11
Unknown	9		30	20,37	24,33	6
Total (#)	13	5	6	9	11	44

Damage classification

(Partial) stack collapse	Incidents in which 1 or a few stacks partially or completely collapsed. Typically resulting in damage or loss of a limited number of containers
Single (stern) bay collapse	Partial or complete collapse of 1 bay. In all, except 1 incident (P&O Nedlloyd Barcelona, 2000) it concerned the stern bay.
Multiple stern bay collapse	Partial or complete collapse of 2 or 3 bays at the stern.
Multiple bay collapse	Partial or complete collapse of multiple bays along the ship in most incidents resulting in a damage or loss of many containers
Unknown	If photos are absent it is not possible to classify the damage

Seakeeping classification

Resonant roll	Resonant (synchronous) roll is occurring in stern quartering or beam seas when the rolling period is close to the encounter period of the waves.
Parametric roll (stern)	Parametric roll in (close to) following seas could happen when the rolling period is twice the encounter period, the roll damping is low and the stability variations large (see section 2.4)
Parametric roll (bow)	Parametric roll in (close to) head seas could happen when the rolling period is twice the encounter period, the roll damping is low and the stability variations large (see section 2.4)
Head & bow quartering	In head and bow quartering seas the motions in the vertical plane are largest, resulting in vertical accelerations, risk on shipping green water and bow flare slamming. In bow quartering some rolling may occur as well.
Unknown	If ship position and/or timing is unknown, it is not possible to get the wave conditions and thereby impossible to make a first estimate on the ship motions.

Note that above classification of damage and seakeeping are on a high level and does not provide details. For instance, the damage classification does not elaborate on the state of lashing material and containers, if containers were stowed according the cargo securing manual, occurrence of stack resonance etc. For the incidents that are investigated by flag states, more details can be found in the incident reports. Regarding seakeeping, typically multiple issues may have contributed to the incident. It is for instance believed that hull girder vibrations (vertical, transverse and torsional) contributed to many of the incidents. These vibrations could come from various sources; like slamming at the stern or bow, propeller vibrations and maybe springing (continuous excitation of one of the global bending modes). In especially bow and stern quartering seas also steering might introduce some (additional) roll. And at low GM values, stability loss is potentially possible in high waves from the stern. Temporary loss of propulsion power could result in loss of control. In some of the incidents loss of engine power was reported but it seems that in these cases the engine was restarted in time to prevent a free drifting ship. Finally the effect of wind might have contributed as well.

Table 3-2 shows that a single stern bay failure occurred most frequently: in 15 of the 44 described incidents. The seakeeping behaviour that might have caused these failures is variable (and unknown for 5 incidents). Multiple bay collapse is the second most damage, here the seakeeping behaviour seems mainly roll related i.e. resonant roll or parametric roll.

Table 3-3 shows the classification matrix again, but instead of the number of incidents, the total number of lost or damaged containers is shown. Here it is clearly visible that most of the containers are lost or damaged in multiple bay collapses, likely caused by parametric roll in 65% of the affected containers (41% in following seas in 23% in head seas).

Table 3-3: Classification matrix (values refer to the total number of lost or damaged containers)

	Resonant roll	Parametric roll (stern)	Parametric roll (bow)	Head & bow quartering	Unknown	Total (#)
(Partial) stack collapse	27	-	-	28	11	66
Single (stern) bay collapse	196	180	59	352	261	1048
Multiple stern bay collapse	210	-	143	-	40	393
Multiple bay collapse	1042	4053	2286	-	567	7948
Unknown	108	-	22	49	190	369
	1583	4233	2510	429	1069	9824

4 INCIDENT REPORTS

4.1 APL China, 1998

4.1.1 Summary

Note that in the same storm also MOL Alligator Strength, Ever Union and the APL President Adams lost or damaged containers.

Table 4-1: Summary of info

General info

IMO	9074389
Name	APL China
Year of build	1995
TEU capacity	5,108
Loa	276.3 m
B	40.0 m

Incident info

date & time	26 Oct 1998 17:00 UTC
Speed	Approx. 7 kn
Position	40.87° N / 176.60° E *Pacific, eastbound*
wave heading	Approx. 180 deg *Kaohsiung, Taiwan to Seattle, USA*
hindcast waves	Hs = 15.9 m
draught	12.34 m
transverse stability	2 m
Rolling period	25.7 s
affected/damaged/lost containers	1406/1000/406

Figure 4-1: Damage overview photo

4.1.2 Incident conditions

The below track has been taken from France et al. (2001).

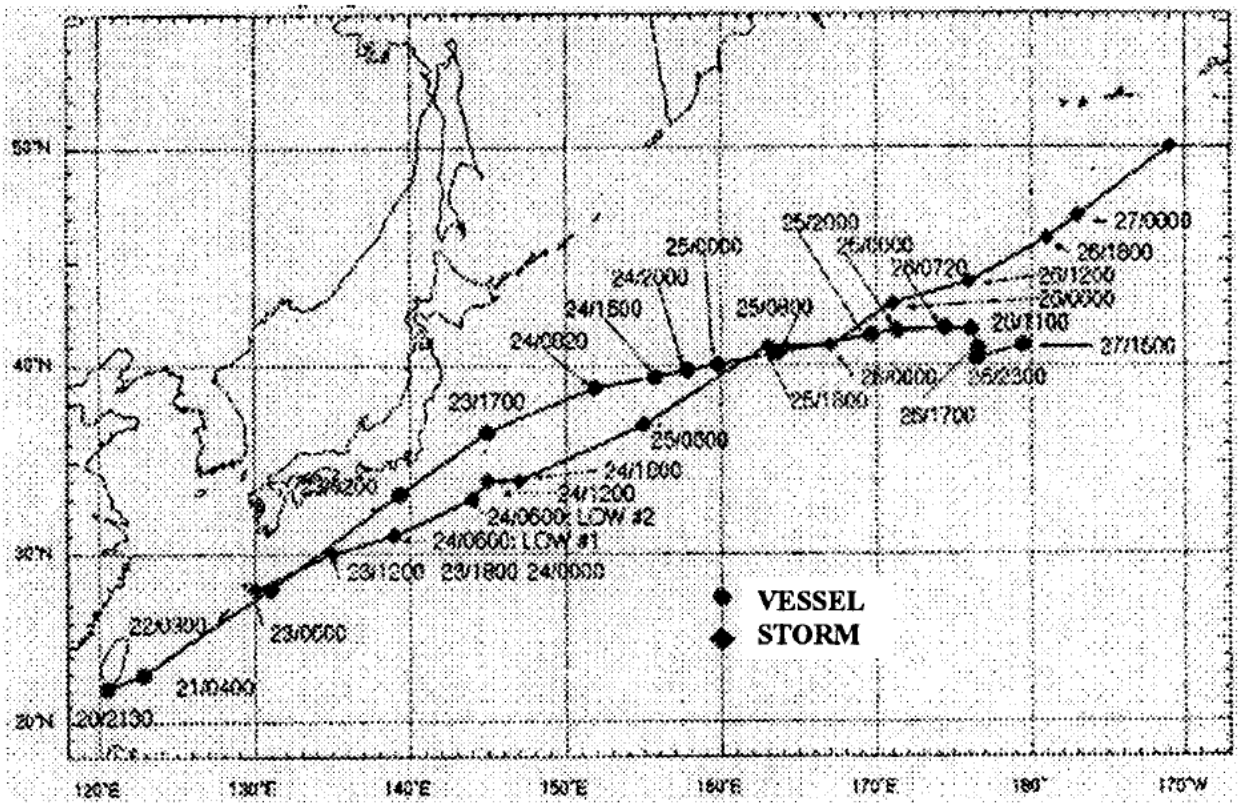


Figure 4-2: Approximate ship position (France et al., 2001)

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-2: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	15.1	17.6	346	1.8	1.2	1.3	1.5
Swell	1.2	16.5	051	2.8	1.3	1.4	1.7
Windsea	15.1	17.7	343	1.8	1.2	1.3	1.5

The ship fixed wave direction deviates considerably from the publication, where a head seas condition has been stated. Due to the rapidly changing weather conditions and the significant course change, our estimate could be wrong in this case. Note that the wave height and wave period are close to the estimation provided in the publication.

Assuming that the vessel was indeed sailing in head waves the Tϕ/Te is indeed close to 2, so parametric roll in head seas is likely. This is in-line with the conclusion in the publication.

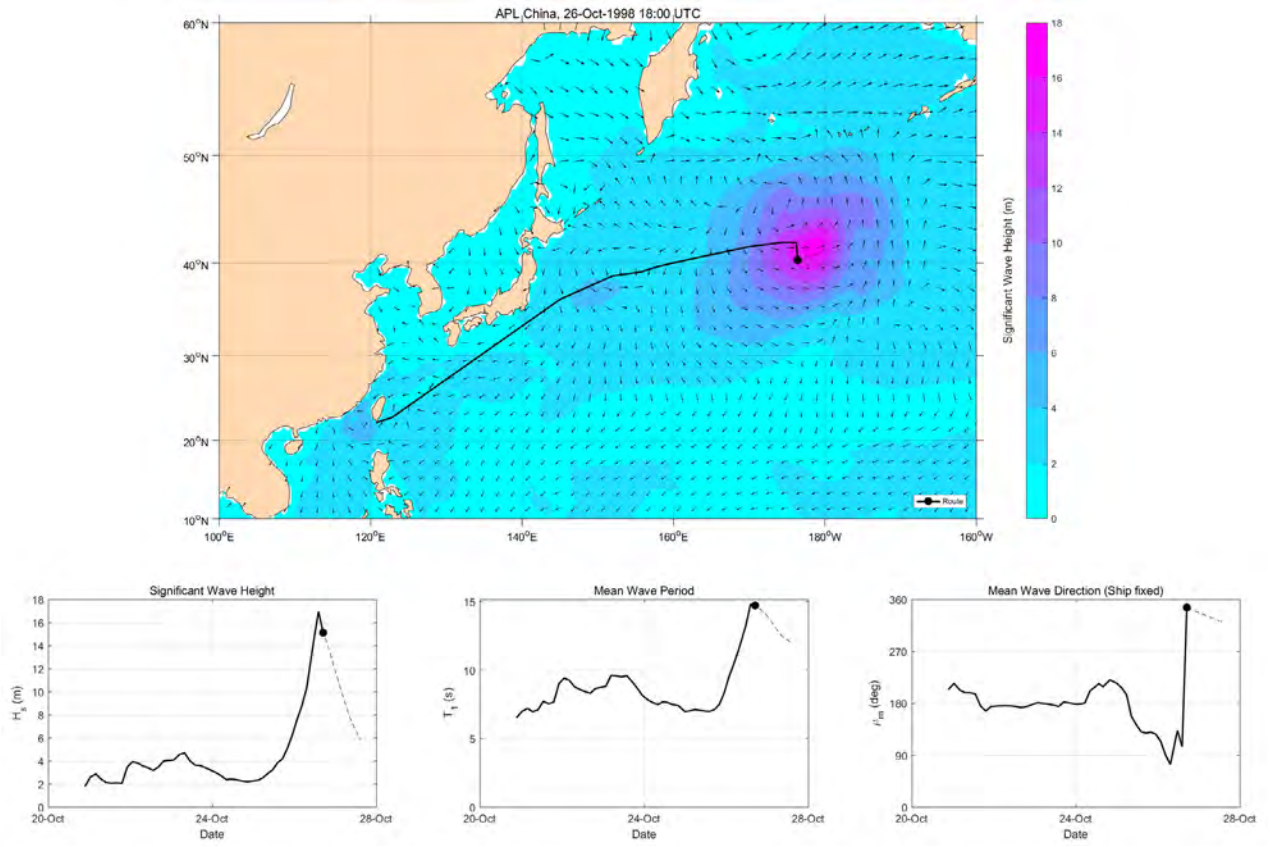


Figure 4-3: Wave hindcast (source ECMWF ERA5)

4.1.3 Description of damage

Large scale collapse. 7 out of 16 bays (partially) collapsed.

Figure 4-4: Location of damage

4.1.4 Other photos

Figure 4-5: Selection of other incident photos

4.1.5 Sources

- http://www.cargolaw.com/1998nightmare.html
- https://traderiskguaranty.com/trgpeak/apl-china-shipping-loss/
- France N.W. at all, *"An Investigation of Head-Sea Parametric Rolling and its Influence on Container Lashing Systems"*, SNAME 2001

4.2 P&O Nedlloyd Barcelona, 2000

4.2.1 Summary

Table 4-3: Summary of info

General info

IMO	9147112
Name	P&O Nedlloyd Barcelona
Year of build	1997
TEU capacity	3,607
Loa	244 m
B	32 m

Incident info

date & time	Somewhere between 1997-2002
Speed	Unknown
Position	Unknown
Heading	Head seas (from photos) *To Busan, South Korea*
hindcast waves	Unknown
Draught	Unknown
transverse stability	Unknown
Rolling period	Unknown
affected/damaged/lost containers	Approx. 51/40/11 (rough count from photos)

Figure 4-6: Damage overview photo

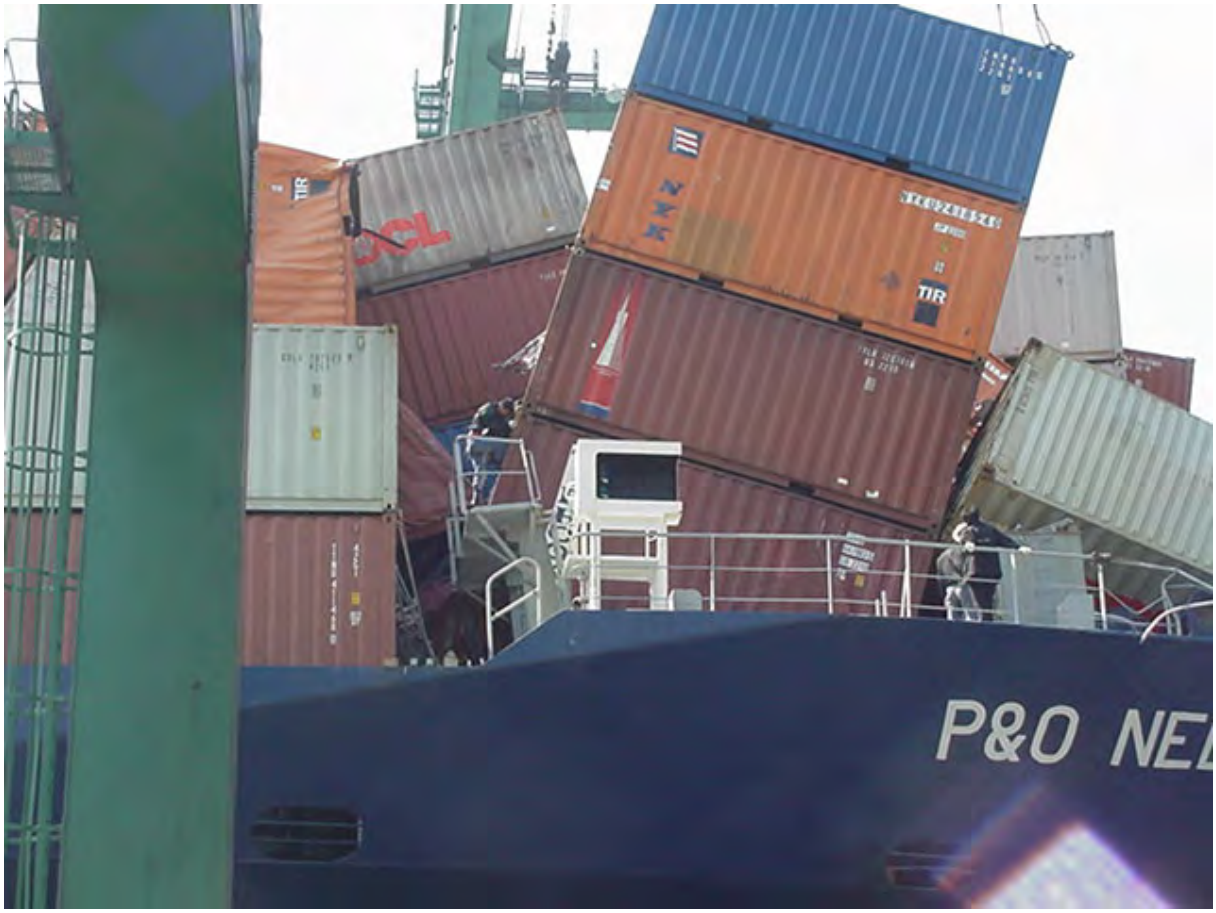
4.2.2 Incident conditions

Unknown.

4.2.3 Description of damage

Most forward bay of containers is collapsed / damaged due to shipping of green water.

4.2.4 Other photos


TIR
NYK
TIR
P&O


TRLU 181753 8
45R1


OOCL
P&O Nedlloyd

Figure 4-7: Selection of other incident photos

4.2.5 Sources

- https://www.flickr.com/photos/22545798@N04/albums/72157603855774478/with/2244381475/
- http://www.cargolaw.com/2005nightmare_backhaul.html
- http://rss.investordata.co.za/mobile/article.php?id=196813&feed=132&cat=&is_cat

4.3 OOCL America, 2000

4.3.1 Summary

Table 4-4: Summary of info

General info	
IMO	9102291
Name	OOCL America
Year of build	1995
TEU capacity	5,344
Loa	276.0
B	40.0
Incident info	
date & time	29 Jan 2000 05:00 UTC
speed	16 kn (estimation as per chapter 2)
position	41° 49’ N / 147° 53’ E *Pacific, westbound*
heading	Approx. 250 deg *Long Beach, USA to Kaohsiung, Taiwan*
hindcast waves	Unknown
draught	Unknown
transverse stability	2 m (Long Voyage, estimation as per chapter 2)
Rolling period	24.4 s (Long Voyage, estimation as per chapter 2)
affected/damaged/lost containers	567/350/217

Figure 4-8: Damage overview photo

4.3.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-5: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	1.1	6.7	109	0.8	4.5	2.5	7.2
Swell	1.0	7.5	103	1.2	3.8	2.1	6.0
Windsea	0.5	3.5	125	0.4	13.1	7.1	20.9

With a total wave height of only 1.1 m, it is unlikely that the incident happened at the position and time mentioned in Cargolaw.

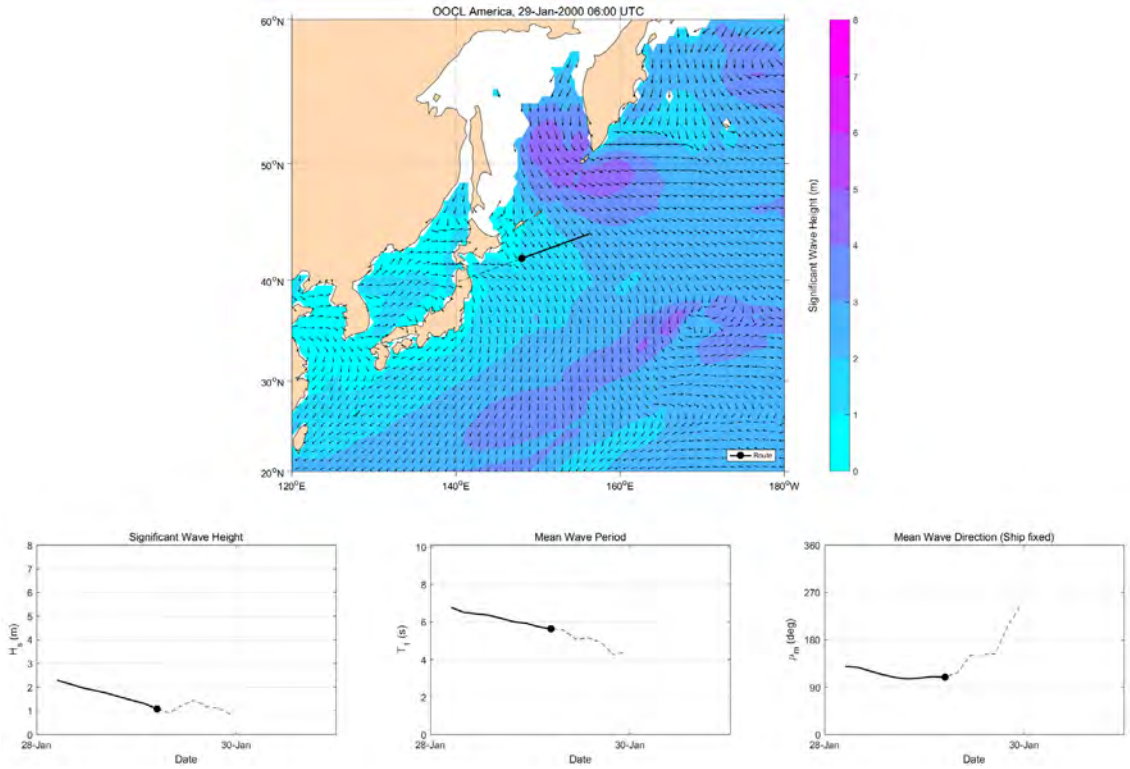


Figure 4-9: Wave hindcast (source ECMWF ERA-5)

4.3.3 Description of damage

Collapse of 4 bays (3 bays at the stern and 1 bay forward of the bridge).

Figure 4-10: Location of damage

4.3.4 Other photos

Figure 4-11: Selection of other incident photos

4.3.5 Sources

- http://www.cargolaw.com/2000nightmare_1_oocl_ameri.html

4.4 Ville D'Orion, 2001

4.4.1 Summary

Table 4-6: Summary of info

General info

IMO	9125619
Name	Ville D'Orion
Year of build	1997
TEU capacity	3,961
Loa	259.0
B	32.0

Incident info

date & time	24 Mar 2001
speed	Unknown
position	Pacific
heading	Eastbound *To Los Angeles, USA*
hindcast waves	Unknown
draught	Unknown
transverse stability	Unknown
rolling period	Unknown
affected/damaged/lost containers	69/69/0

Figure 4-12: Damage overview photo

4.4.2 Incident conditions

Not possible.

4.4.3 Description of damage

Collapse of 1 bay at the stern.

Figure 4-13: Location of damage

4.4.4 Other photos

Figure 4-14: Selection of other incident photos

4.4.5 Sources

- http://www.cargolaw.com/2001nightmare_orion.html

4.5 Dutch Navigator, 2001

4.5.1 Summary

Table 4-7: Summary of info

General info	
IMO	9173290
Name	Dutch Navigator
Year of build	1998
TEU capacity	297
Loa	100.0
B	13.0
Incident info	
date & time	26 Apr 2001, time of event unknown
speed	9 kn while at reduced speed throughout the day
position	Approx. 47° N / 004° W (estimated noon position) *French Coast*
heading	142 deg (estimated from route) *Bilbao, Spain to Avonmouth, England*
hindcast waves	Hs = 4.4 m
draught	Unknown
transverse stability	0.67 m
rolling period	13.7 s (based on estimated roll inertia)
affected/damaged/lost containers	9/9/0

Figure 4-15: Damage overview photo

4.5.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-8: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.4	10.4	262	12.5	1.4	1.0	1.7
Swell	2.0	12.6	276	17.4	1.1	0.8	1.3
Windsea	3.9	9.9	260	9.5	1.5	1.1	1.8

Given the close to beam on wave conditions, wave period close to the estimated roll natural period, resonant roll in beam seas is likely.

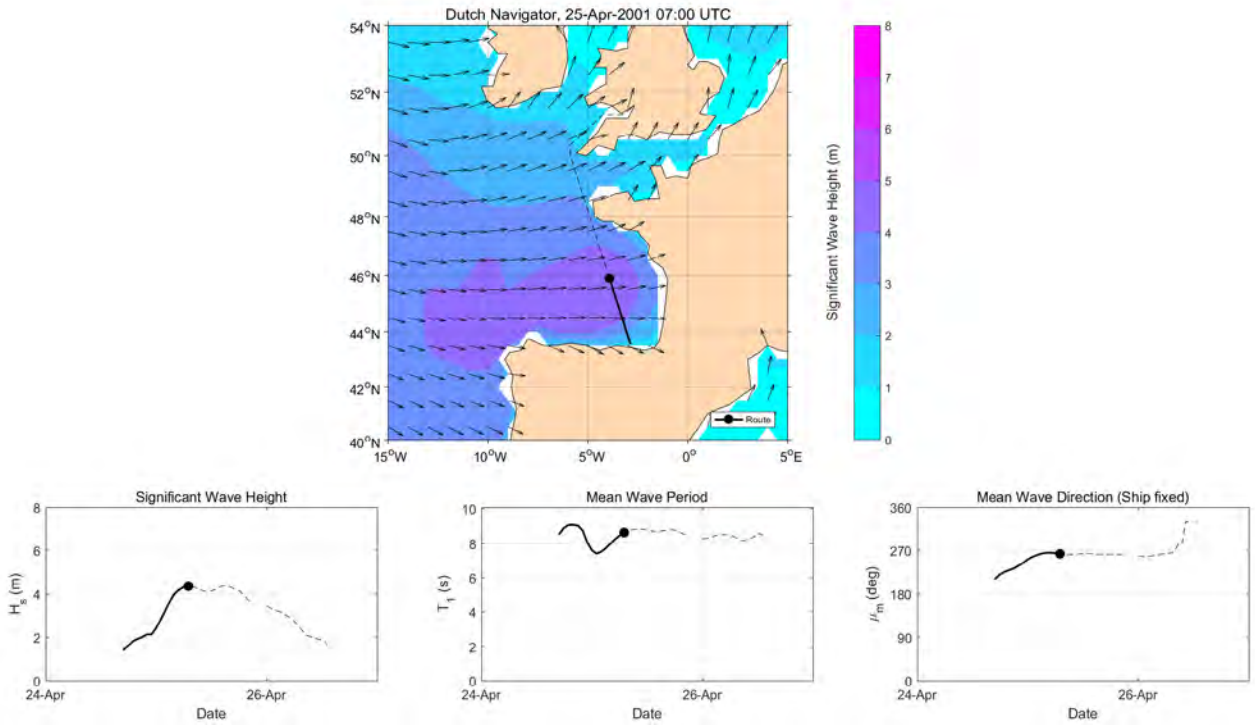


Figure 4-16: Wave hindcast (source ECMWF ERA5)

4.5.3 Description of damage

Single stack collapse in the cargo hold (at the bow). Together with the Annabella incident in 2017 (see section 4.13). These are the only cases in which it was reported that containers were damaged in the cargo hold.

Figure 4-17: Location of damage

4.5.4 Other photos

Figure 4-18: Selection of other incident photos

4.5.5 Sources

- MAIB report, *"Report on the investigation of shift of cargo containers involving dangerous good on the Dutch Navigator"*, Report No 37/2002, Nov 2002

4.6 Andinet, 2003

4.6.1 Summary

Table 4-9: Summary of info

General info

IMO	8318544
Name	Andinet
Year of build	1985
TEU capacity	367
Loa	137.0
B	23.0

Incident info

date & time	21 Dec 2003 15:04 UTC
speed	15 kn (estimation as per chapter 2)
position	Approx. 53.4° N / 004.7° W *Netherlands Coast (near Vlieland)*
heading	028 to 070 deg *Antwerp, Belgium to Bremen, Germany*
hindcast waves	Hs = 4.9 m
draught	Unknown
transverse stability	3 m (coastal voyage, estimation as per chapter 2)
roll period	11.5 s (coastal voyage, estimation as per chapter 2)
affected/damaged/lost containers	3/0/3

Figure 4-19: Overview photo (no damage photos available)

4.6.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-10: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.9	11.1	277	11.8	1.0	0.5	1.9
Swell	2.3	13.0	253	4.8	1.0	0.5	1.9
Windsea	4.3	10.5	283	6.4	1.0	0.5	1.9

Based on the above wave conditions, resonant roll in beam seas is likely.

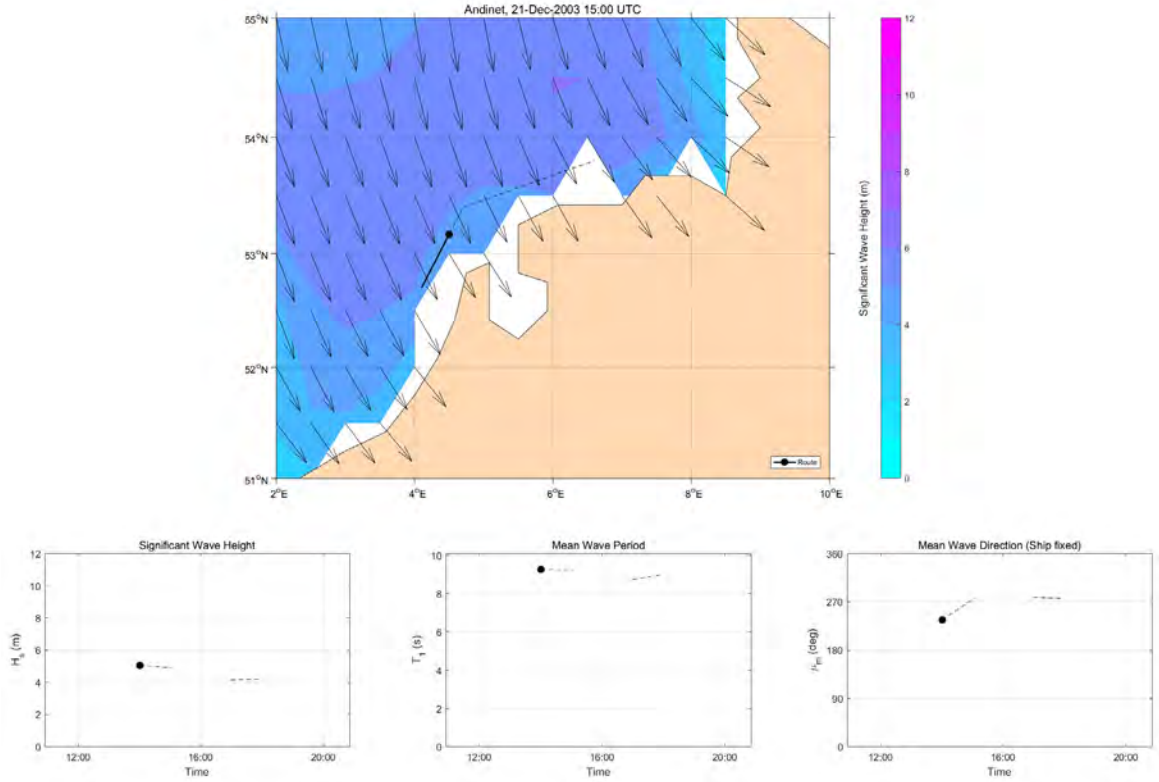


Figure 4-20: Wave hindcast (source ECMWF ERA5)

4.6.3 Description of damage

Not possible.

4.6.4 Other photos

No photos available.

4.6.5 Sources

- https://www.bnnvara.nl/vroegevogels/artikelen/surfers-rouwen-om-vervuiling-noordzee-door-andinet
- https://www.trouw.nl/nieuws/vaten-met-giftige-stoffen-nog-zoek~bcad0dd5/
- https://www.standaard.be/cnt/nflh31122003_002
- Rechtbank Amsterdam, *"Rb. Amsterdam, 17-01-2008, nr. 13-085262-04"*, 17 jan 2008

4.7 Xin Qing Dao

4.7.1 Summary

Table 4-11: Summary of info

General info

IMO	9270452
Name	Xin Qing Dao
Year of build	2003
TEU capacity	5,668
Loa	279.0
B	40.0

Incident info

date & time	Approx. 27 Oct 2004 04:00 *Time estimated based on 'night of'*
speed	Approx. 18 kn (estimation as per chapter 2)
position	Approx. 48° N / 007° E *185 km west of Point of Raz*
heading	Approx. 030 deg *Malta to Felixstowe, England*
hindcast waves	Hs = 6.6 m
draught	Unknown
transverse stability	3 m (coastal voyage, estimation as per chapter 2)
roll period	19.9 s (coastal voyage, estimation as per chapter 2)
affected/damaged/lost containers	60/29/31

Figure 4-21: Damage overview photo

4.7.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-12: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	6.6	12.0	013	0.8	0.9	0.4	1.7
Swell	2.5	14.7	342	0.8	0.8	0.4	1.6
Windsea	6.1	11.5	017	0.8	0.9	0.4	1.7

In these close to following seas conditions it could be parametric roll, although with the assumed GM value of 3 m, the Tϕ/Te ratio is considerably below 2. Therefore resonant roll is slightly more likely.

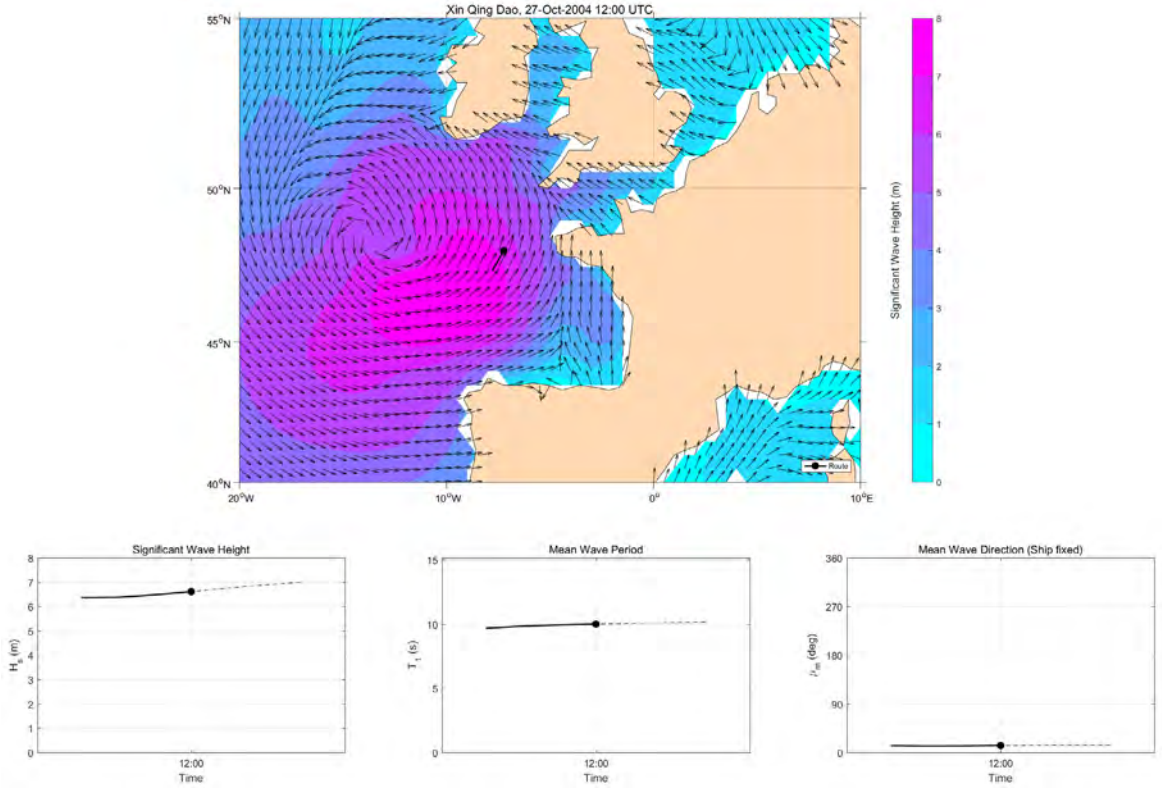


Figure 4-22: Wave hindcast (source ECMWF ERA5)

4.7.3 Description of damage

Collapse of 1 bay at the stern.

Figure 4-23: Location of damage

4.7.4 Other photos

Figure 4-24: Selection of other incident photos

4.7.5 Sources

- http://www.cargolaw.com/2004nightmare_unstacked.html

4.8 P&O Nedlloyd Genoa, 2006

4.8.1 Summary

Table 4-13: Summary of info

General info	
IMO	9168219
Name	P&O Nedlloyd Genoa
Year of build	1998
TEU capacity	2,902
Loa	210.1
B	32.2
Incident info	
date & time	27 Jan 2006 19:18 UTC
speed	5 kn
position	50° 15’ N / 034° 02’ W *Atlantic, westbound*
heading	180 deg *Le Havre, France to Newark, USA*
hindcast waves	Hs = 5.7 m
draught	Unknown
transverse stability	1.13 m
roll period	26.1 s (based on estimated roll inertia)
affected/damaged/lost containers	59/32/27

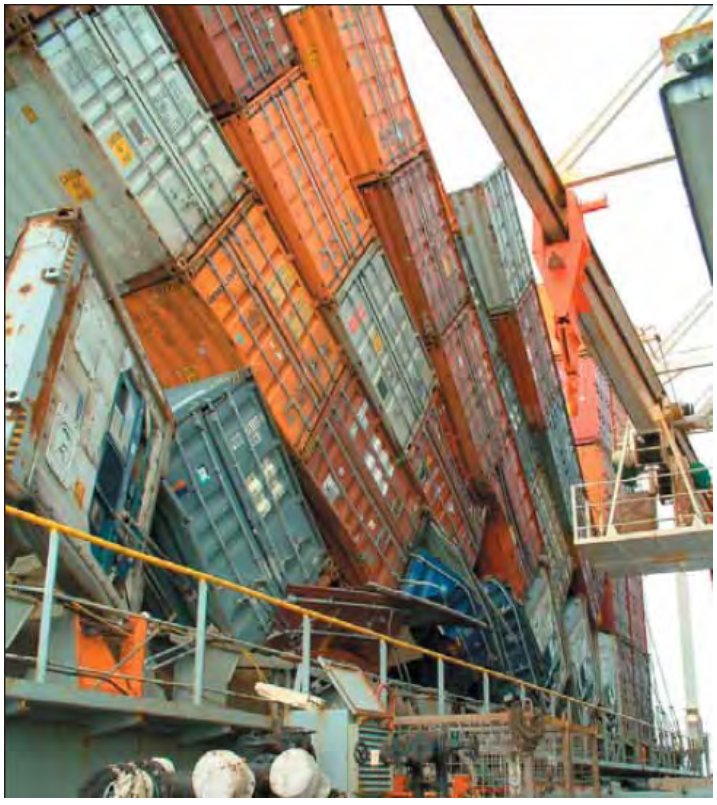


Figure 4-25: Damage overview photo

4.8.2 Incident conditions

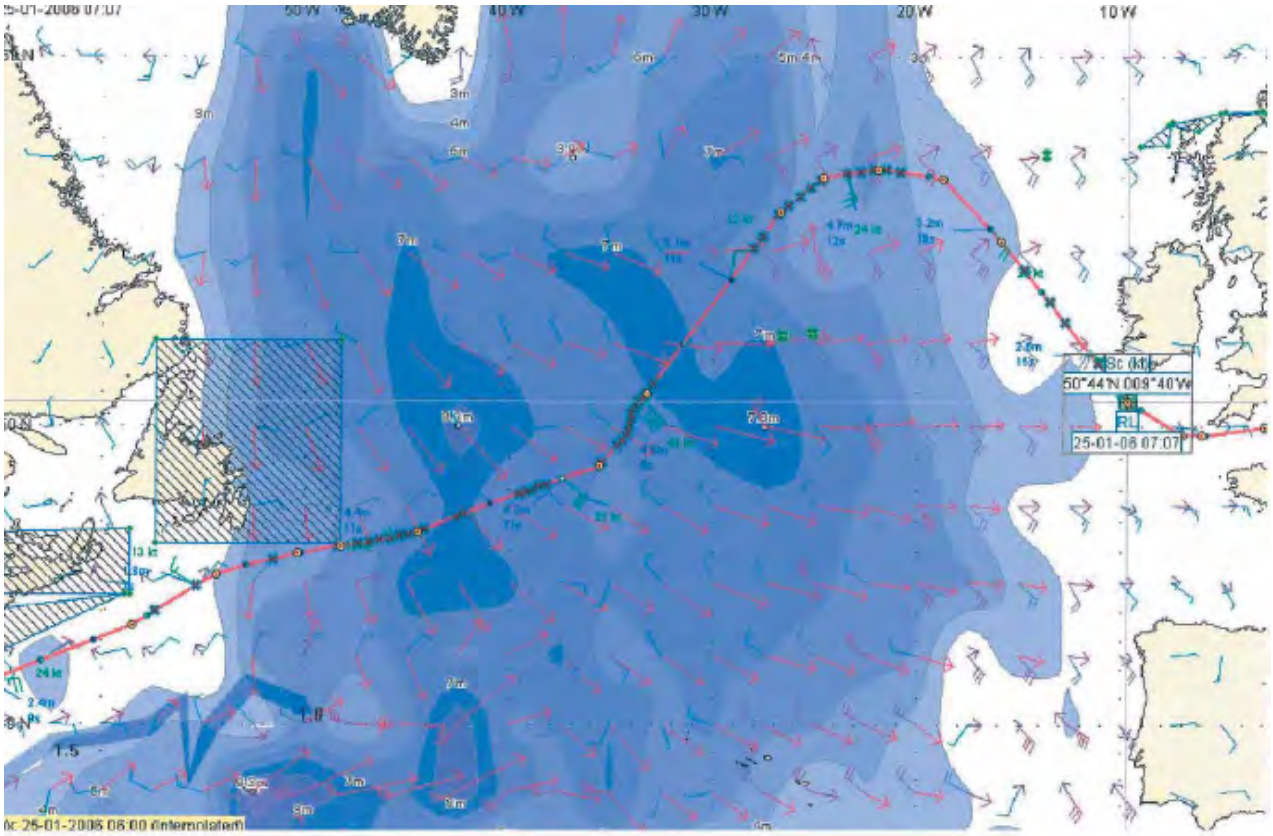


Figure 4-26: Ship position, local time (source MAIB report)

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-14: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	5.7	11.8	190	1.0	2.5	1.9	3.8
Swell	3.4	12.6	192	1.1	2.3	1.8	3.5
Windsea	3.4	8.1	184	1.0	3.9	3.0	5.8

Given the (close to) head seas condition, λ/L and Tϕ/Te ratio, parametric roll in head seas seems most likely.

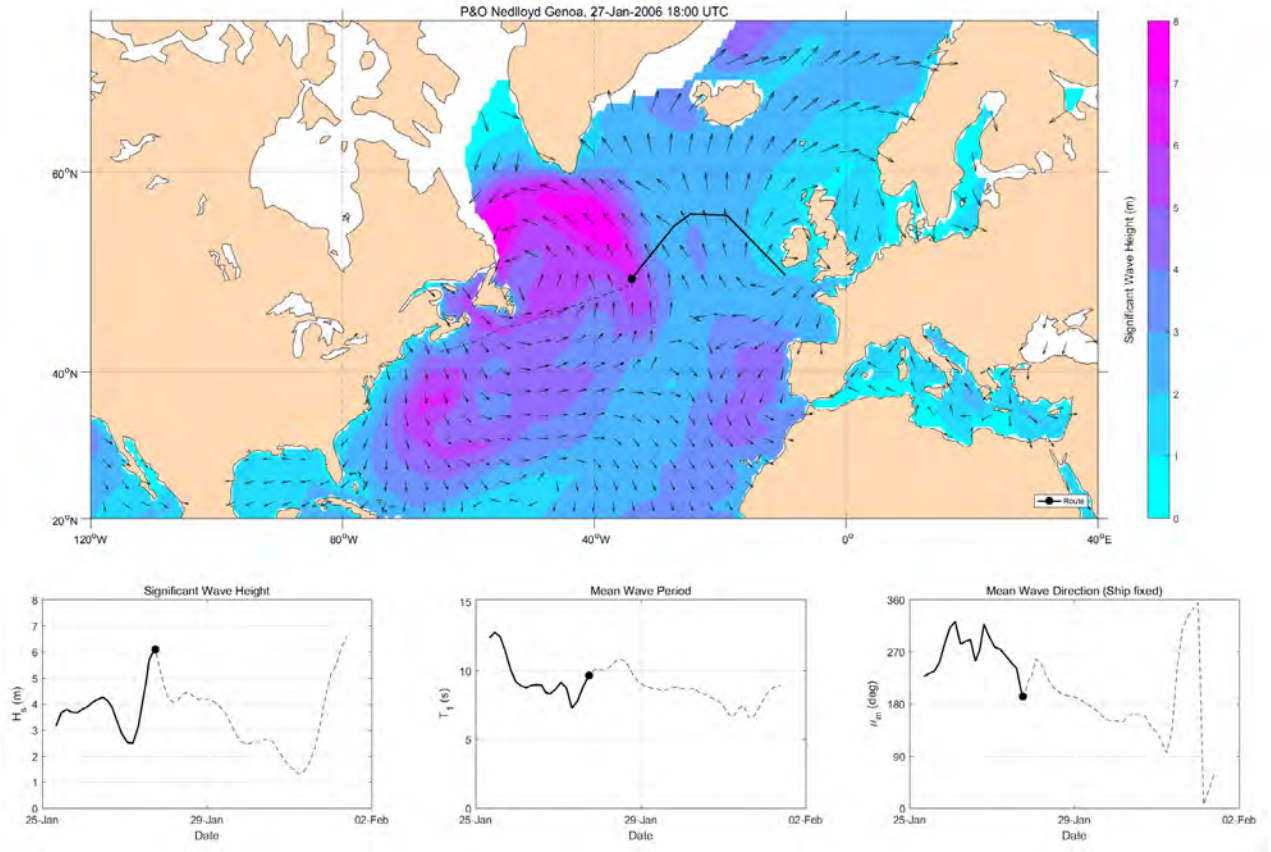


Figure 4-27: Wave hindcast (source ECMWF ERA5)

4.8.3 Description of damage

1 bay in front of the superstructure.

Figure 4-28: Location of damage

4.8.4 Other photos

No other incident photos.

4.8.5 Sources

- MAIB report, *"Report on the investigation of the loss of cargo containers overboard from P&O Nedlloyd Genoa"*, Report No 20/2006, Aug 2006

4.9 P&O Nedlloyd Mondriaan, 2006

4.9.1 Summary

Table 4-15: Summary of info

General info

IMO	9289922
Name	P&O Nedlloyd Mondriaan
Year of build	2004
TEU capacity	8,450
Loa	335.0 m
B	42.8 m

Incident info

date & time	1st incident: 9 Feb 2006 17:05 UTC 2nd incident: 19 Feb 2006 *(same storm as CMA CGM Verdi and Otello)**
speed	15 kn (estimation as per chapter 2)
position	1st incident: Approx. 54° N / 006° E *Dutch coast (15 km off Terschelling)* 2nd incident: Bay of Biscay
heading	Estimated at 072 deg from TSS *Southampton, England to Hamburg, Germany*
hindcast waves	Hs = 4.6 m (1st incident)
draught	Unknown
transverse stability	3 m (coastal voyage, estimation as per chapter 2)
roll period	21.3 s (coastal voyage, estimation as per chapter 2)
affected/damaged/lost containers	1st incident: 58/0/58 2nd incident: 50/0/50

** No information for this ship's second incident. This chapter covers the first.*

Figure 4-29: Overview photo (no damage photos available)

4.9.2 Incident conditions

Based on estimated position and time, course and speed of the first incident, the following wave conditions have been estimated:

Table 4-16: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.6	10.7	285	4.9	1.8	0.8	3.5
Swell	1.7	13.1	258	1.5	1.4	0.6	2.6
Windsea	4.2	10.3	289	7.9	1.9	0.9	3.8

Based on the above wave conditions, resonant roll in beam seas is likely.

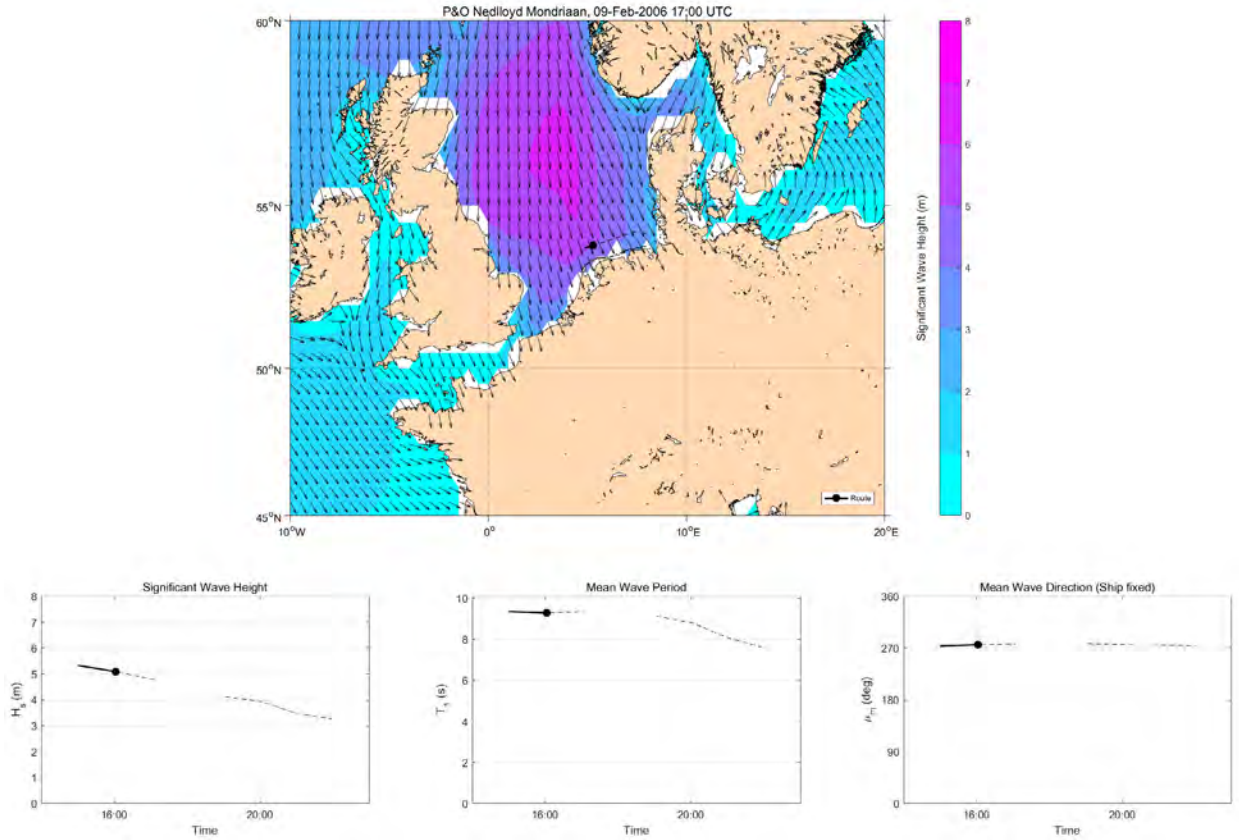


Figure 4-30: Wave hindcast (source ECMWF ERA5)

4.9.3 Description of damage

Not possible.

4.9.4 Other photos

No photos available.

4.9.5 Sources

- https://wwz.cedre.fr/en/Resources/Spills/Spills/P-O-Nedlloyd-Mondriaan
- https://www.youtube.com/watch?v=p4VWtLVKQcE
- https://www.wolfstad.com/2006/02/beachcombing-for-corned-beef-shoes-and-hammers/

4.10 CMA CGM Otello, 2006

4.10.1 Summary

Table 4-17: Summary of info.

General info

IMO	9299628
Name	CMA CGM Otello
Year of build	2005
TEU capacity	8,238
Loa	334.0 m
B	42.8 m

Incident info

date & time	17 Feb 2006 06:25 UTC (same storm as P&O Nedlloyd Mondriaan and CMA CGM Verdi)
speed	Approx. 23 kn
position	45° 29' N / 008° 07' W *French Coast*
heading	027 deg *Port Kelang, Malaysia to Le Havre, France*
hindcast waves	Hs = 7.8 m
draught	Unknown
transverse stability	2 m (long voyage, estimation as per chapter 2)
roll period	24.4 s (long voyage, estimation as per chapter 2)
affected/damaged/lost containers	70/20/50

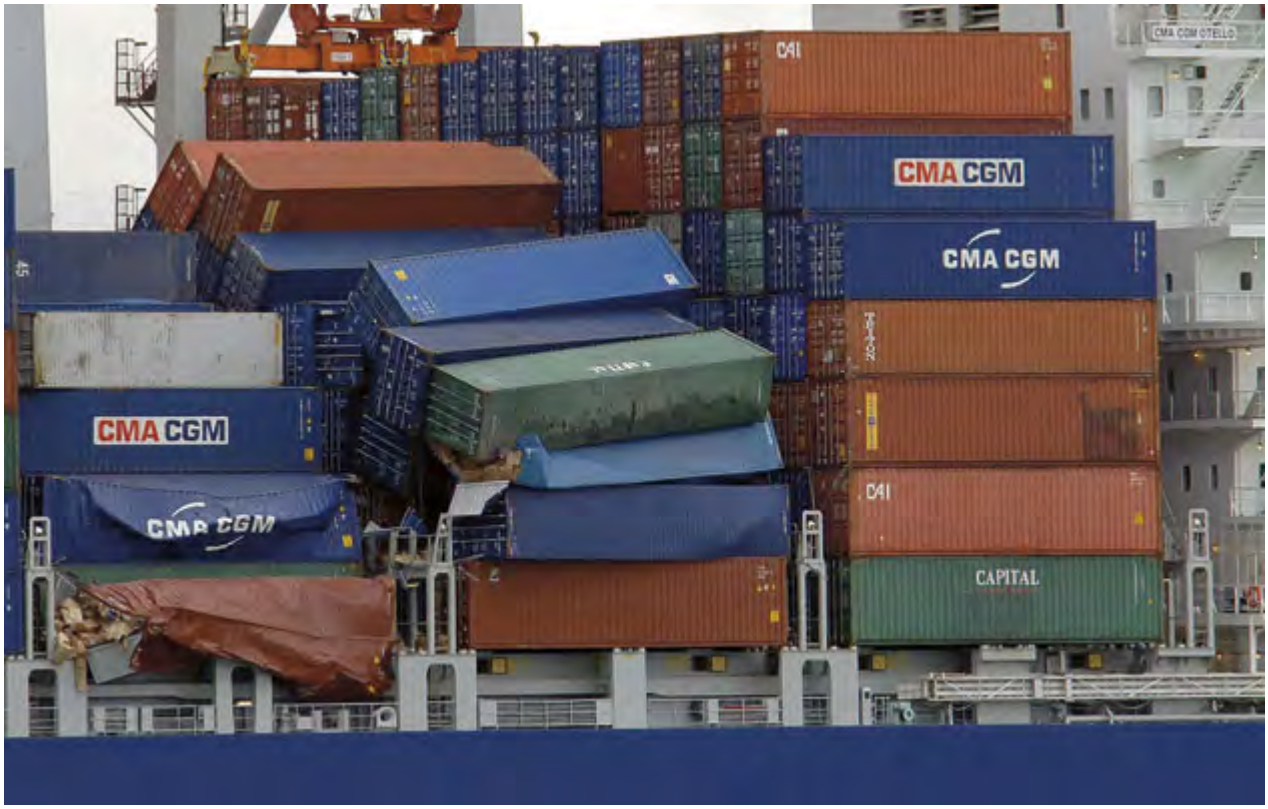


Figure 4-31: Damage overview photo

4.10.2 Incident conditions

Based on estimated position and time, course and speed from Beamer investigation report, the following wave conditions have been estimated:

Table 4-18: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	7.8	15.8	276	14.7	1.5	0.8	2.3
Swell	6.7	17.8	266	20.5	1.4	0.8	2.2
Windsea	3.9	9.9	305	2.5	1.4	0.7	2.2

Based on the above wave conditions, resonant roll in beam seas is likely.

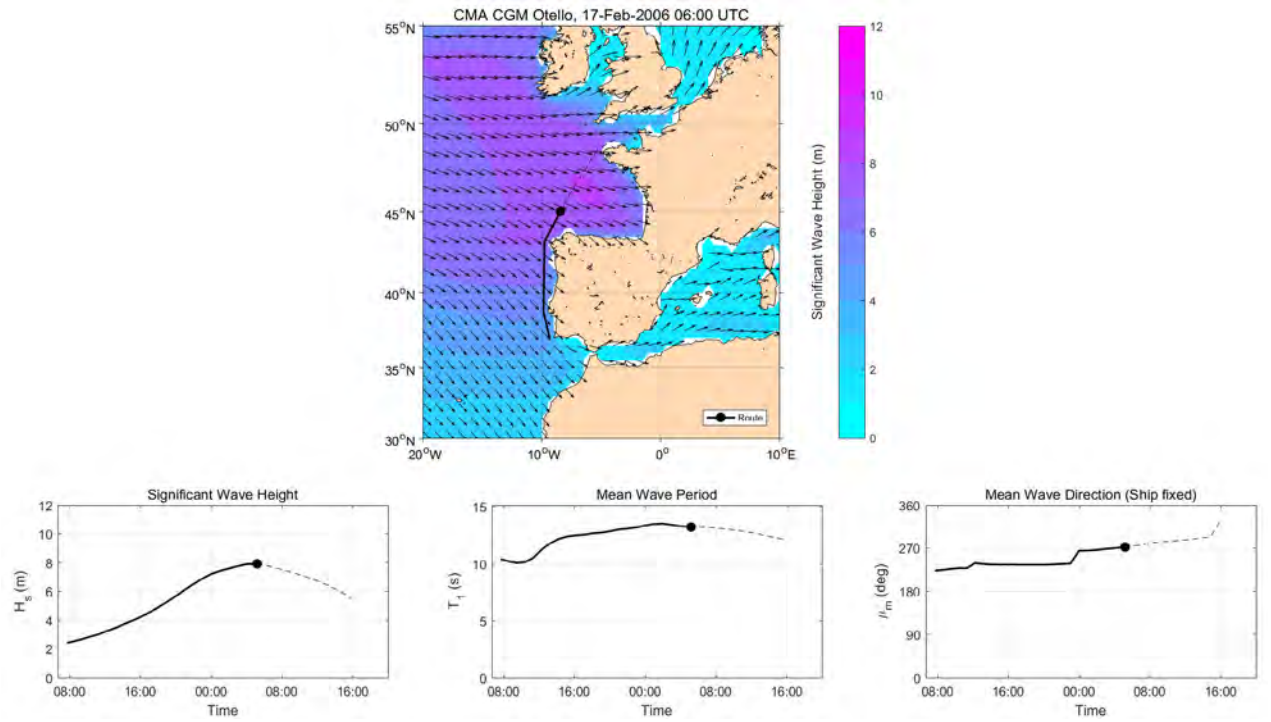


Figure 4-32: Wave hindcast (source ECMWF ERA5)

4.10.3 Description of damage

Collapse of 2 stacks at the stern

Figure 4-33: Location of damage

4.10.4 Other photos

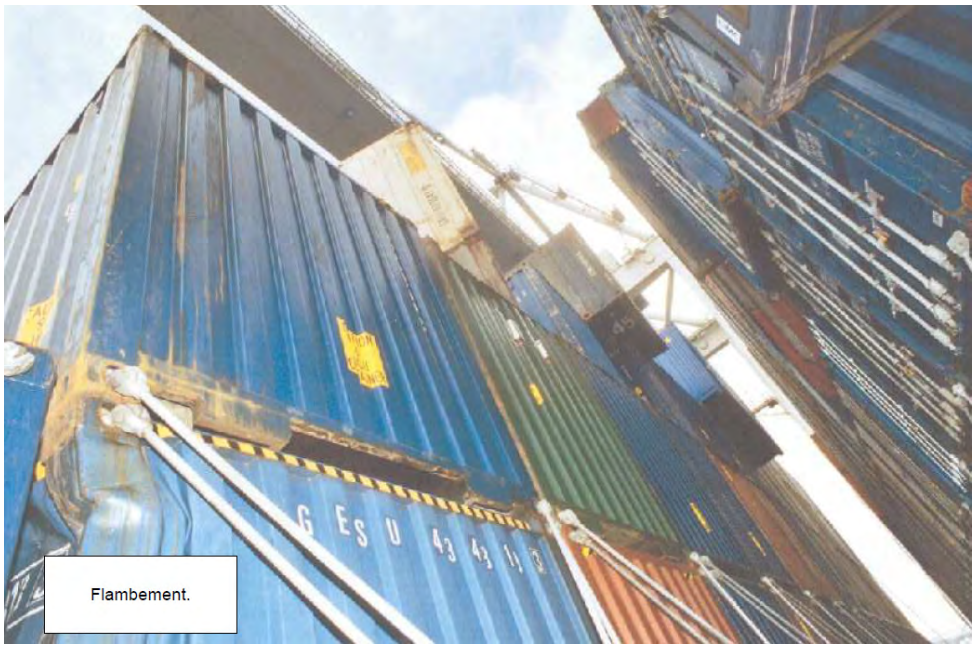


Figure 4-34: Selection of other incident photos

4.10.5 Sources

- Beamer, "*Report on the technical inquiry into the CMA CGM OTELLO*", 2008

4.11 CMA CGM Verdi, 2006

4.11.1 Summary

Table 4-19: Summary of info

General info

IMO	9280653
Name	CMA CGM Verdi
Year of build	2004
TEU capacity	5,782
Loa	277.3 m
B	40.0 m

Incident info

date & time	18 Feb 2006 (same storm as P&O Nedlloyd Mondriaan and CMA CGM Otello)
speed	13 kn (estimation as per chapter 2)
position	43.00° N / 009.75° W *Near Cape Finisterre, Spain*
heading	Approx. 000 deg *To Southampton, England*
hindcast waves	Hs = 6.9 m
draught	Unknown
transverse stability	2 m (long voyage, estimation as per chapter 2)
roll period	24.4 s (long voyage, estimation as per chapter 2)
affected/damaged/lost containers	140/55/85

Figure 4-35: Damage overview photo

4.11.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-20: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	6.9	13.8	251	3.3	1.9	1.1	3.1
Swell	4.9	16.4	231	1.7	1.7	0.9	2.8
Windsea	4.9	11.1	269	89.3	2.2	1.2	3.5

Based on the above wave conditions, resonant roll in (close to) beam seas is likely.

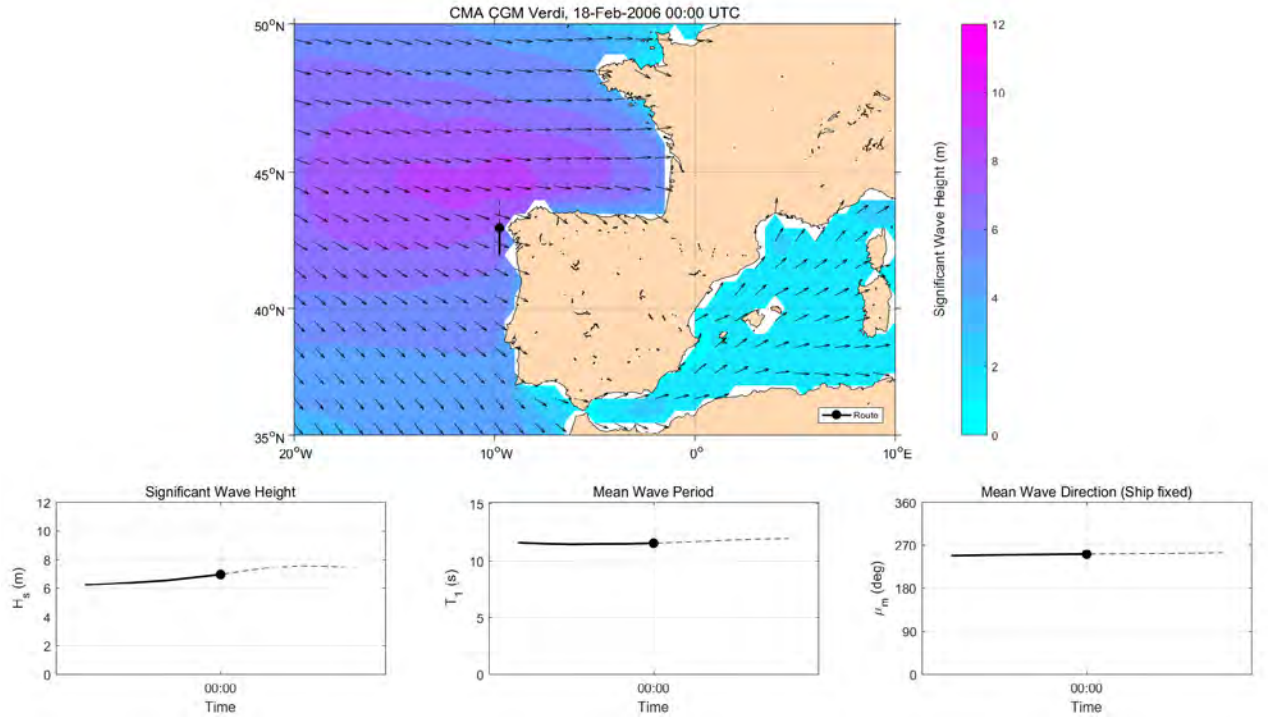


Figure 4-36: Wave hindcast (source ECMWF ERA5)

4.11.3 Description of damage

Multiple stack collapse at 3 bays aft of the wheelhouse.

Figure 4-37: Location of damage

4.11.4 Other photos

No photos available.

4.11.5 Sources

- https://wwz.cedre.fr/en/Resources/Spills/Spills/CMA-CGM-Verdi
- https://forums.ybw.com/index.php?threads/more-containers-in-the-sea-with-some-statistics-at-last.81591/ (quoting Lloyd's List)
- https://www.dailyecho.co.uk/news/5642560.dangling-on-the-edge/

4.12 Jeppesen Maersk, 2006

4.12.1 Summary

Table 4-21: Summary of info

General info

IMO	9215165
Name	Jeppesen Maersk
Year of build	2001
TEU capacity	2833
Loa	217.0
B	32.0

Incident info

date & time	Before 25 Nov 2006 (arrival port)
speed	Unknown
position	Approx. 250 miles North of Tenerife
heading	Felixstowe, England to Kingston, Jamaica
hindcast waves	Unknown
draught	Unknown
transverse stability	Unknown
roll period	Unknown
affected/damaged/lost containers	50/10/12

Figure 4-38: Damage overview photo

4.12.2 Incident conditions

Not possible.

4.12.3 Description of damage

Collapse of 1 bay at the stern.

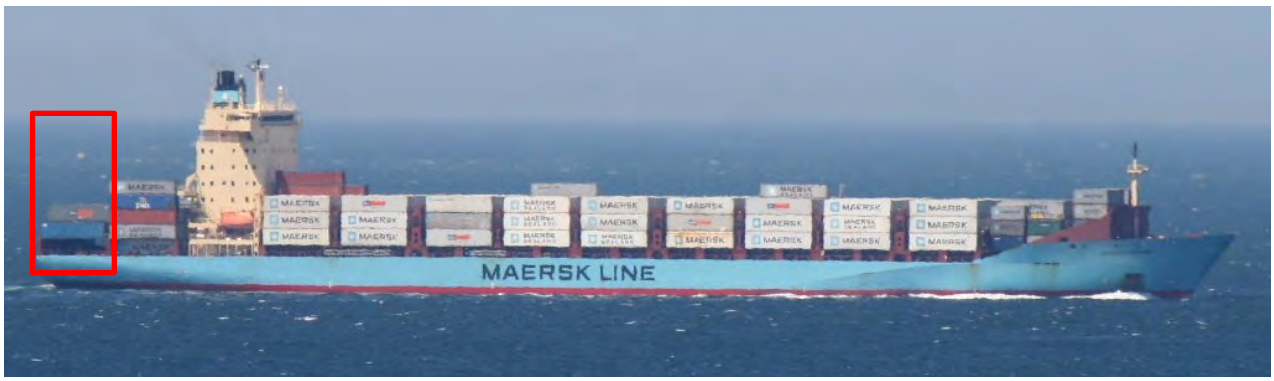


Figure 4-39: Location of damage

4.12.4 Other photos

Figure 4-40: Selection of other incident photos

4.12.5 Sources

- http://www.cargolaw.com/2008nightmare_jeppesen.html

4.13 Annabella, 2007

4.13.1 Summary

Table 4-22: Summary of info

General info	
IMO	8919788
Name	Annabella
Year of build	1991
TEU capacity	868
Loa	134.0
B	22.0
Incident info	
date & time	25 Feb 2007 18:50 UTC, course & speed altered
speed	12 kn, reduced from estimated 18+ kn before
position	Approx. 56° N / 017° E *Baltic Sea*
heading	From 060 deg to 017 deg to pass west of Gotland
hindcast waves	Hs = 2.4 m
draught	Unknown
transverse stability	1.68 m
roll period	14.6 s (based on estimate roll inertia)
affected/damaged/lost containers	7/7/0

Figure 4-41: Overview photo (no damage overview photo available)

4.13.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-23: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	2.4	7.5	063	1.4	1.5	1.1	1.8
Swell	1.0	8.9	089	36.0	1.6	1.3	2.0
Windsea	2.2	7.2	058	1.2	1.4	1.1	1.8

Based on the above wave conditions, resonant roll is less likely (although the vessel is sailing in close to beam seas). As one stack collapsed in the cargo hold, vertical motions due to heave in beam seas or pitch in bow quartering seas are the most likely contributors.

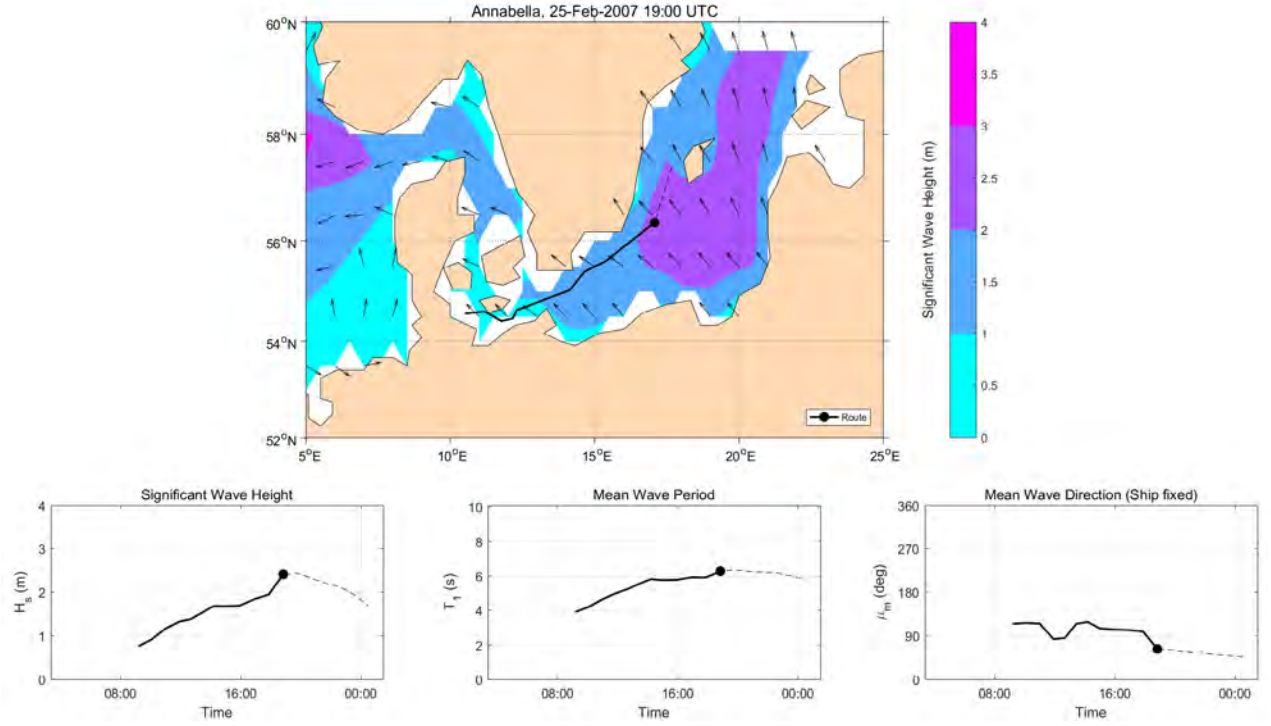


Figure 4-42: Wave hindcast (source ECMWF ERA5)

4.13.3 Description of damage

One stack collapsed around amidships at the centreline.

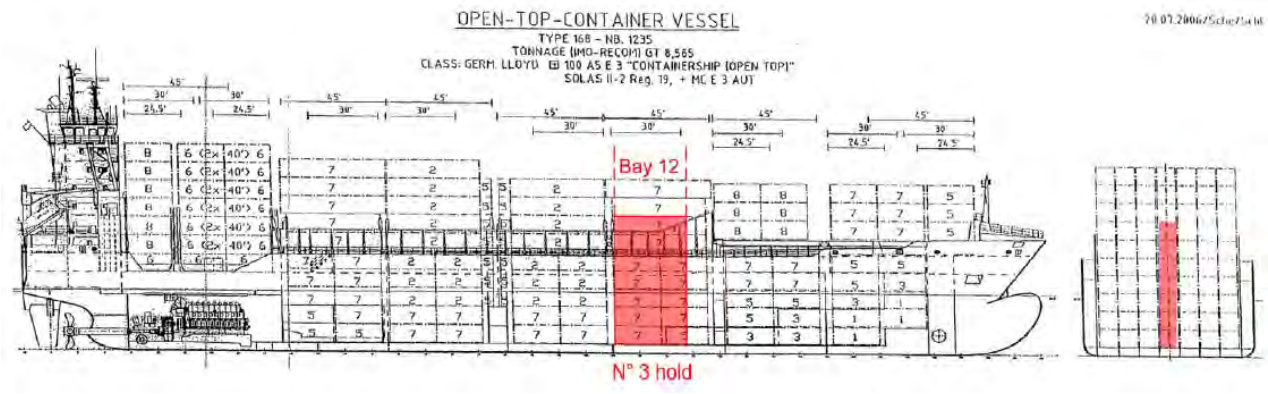


Figure 4-43: Location of damage

4.13.4 Other photos

Figure 4-44: Selection of other incident photos

4.13.5 Sources

- MAIB report, *"Report on the investigation of the collapse of cargo containers on Annabella"*, Report No 21/2007, Sep 2007

4.14 Ital Florida, 2007

4.14.1 Summary

See also UNI Florida incident in 2020.

Table 4-24: Summary of info

General info

IMO	9308039
Name	GFS Perfect UNI Florida (2015) ITAL Florida (2007)
Year of build	2007
TEU capacity	3,450
Loa	239.0
B	32.0

Incident info

date & time	16-19 June 2007 (exact date and time unknown)
speed	16 kn (according to Cargolaw)
position	Arabian Sea/Indian Ocean (exact position unknown)
heading	Unknown
hindcast waves	7-10 m waves (according to Cargolaw)
draught	Unknown
transverse stability	Unknown
roll period	Unknown
affected/damaged/lost containers	130/40/10 (rough count from photo)

Figure 4-45: Damage overview photo

4.14.2 Incident conditions

Not possible.

4.14.3 Description of damage

Stack collapse of 2 bays at the stern.

Figure 4-46: Location of damage

4.14.4 Other photos

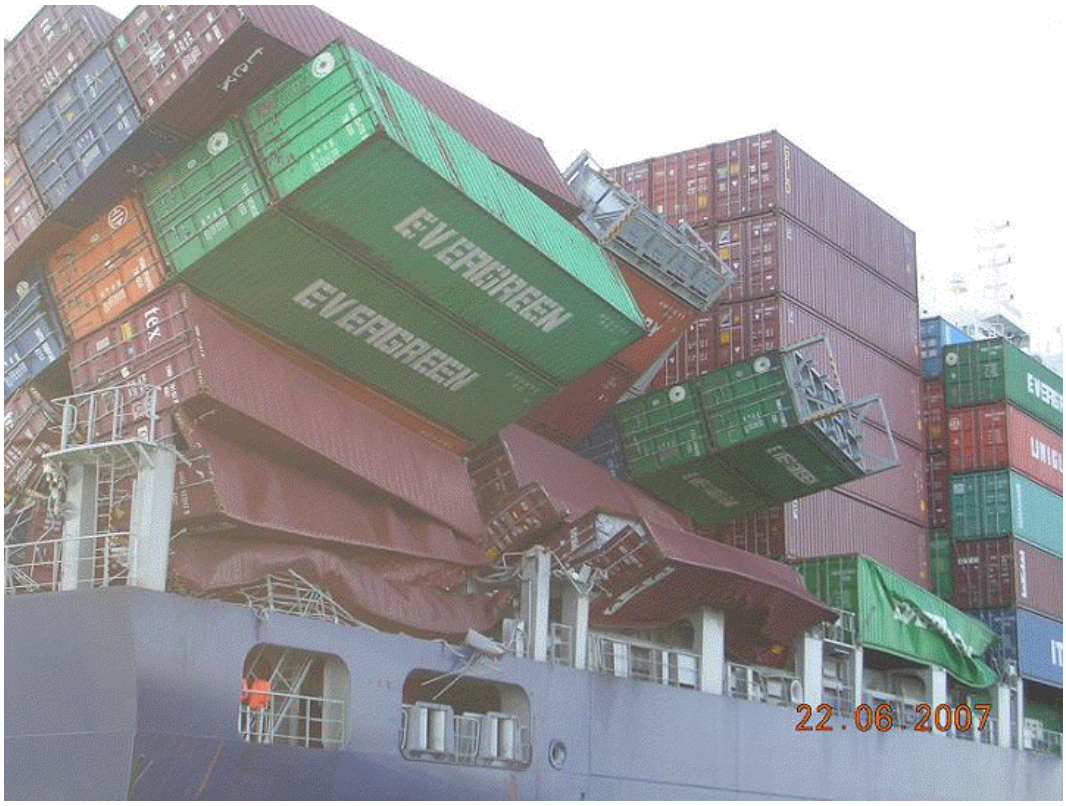


Figure 4-47: Selection of other incident photos

4.14.5 Sources

- http://www.cargolaw.com/2007nightmare_ital.florida.html
- https://www.fleetmon.com/vessels/gfs-perfect_9308039_31727/photos/2608801/

4.15 CMA CGM Dahlia, 2008

4.15.1 Summary

Table 4-25: Summary of info

General info	
IMO	9314959
Name	CMA CGM Dahlia
Year of build	2006
TEU capacity	2,824
Loa	223.0
B	30.0
Incident info	
date & time	10 Feb 2008 (arrival in port on 21 Feb 2008)
speed	Unknown
position	Pacific, Eastbound
heading	To Manzanillo, Mexico
hindcast waves	Unknown
draught	Unknown
transverse stability	Unknown
roll period	Unknown
affected/damaged/lost containers	80/20/20

Figure 4-48: Damage overview photo

4.15.2 Incident conditions

Not possible.

4.15.3 Description of damage

Partial collapse of 2 bays at the stern.

Figure 4-49: Location of damage

4.15.4 Other photos

Figure 4-50: Selection of other incident photos

4.15.5 Sources

- https://traderiskguaranty.com/trgpeak/protect-cargo-m-v-cma-cgm-dahlia/
- http://www.cargolaw.com/2008nightmare_cma_dahlia.html

4.16 Pacific Adventurer, 2009

4.16.1 Summary

Table 4-26: Summary of info

General info

IMO	9003847
Name	Pacific Adventurer
Year of build	1991
TEU capacity	1,123
Loa	184.9 m
B	27.6 m

Incident info

date & time	10 Mar 2009 17:12 UTC *(11 Mar 2009 03:12 LT)*
speed	Approx. 8 kn
position	27.1° S / 154.2° E *Australian Coast*
heading	319 deg *Newcastle, Australia to Brisbane, Australia*
hindcast waves	Hs = 3.1 m
draught	Ta/Tf = 8.04/7.74 m
transverse stability	GM_{fluid} = 3.4 m (FSC = 1.0 m)
roll period	10 s according incident report (12.9 s more likely)
affected/damaged/lost containers	33/2/31

Figure 4-51: Damage overview photo

4.16.2 Incident conditions

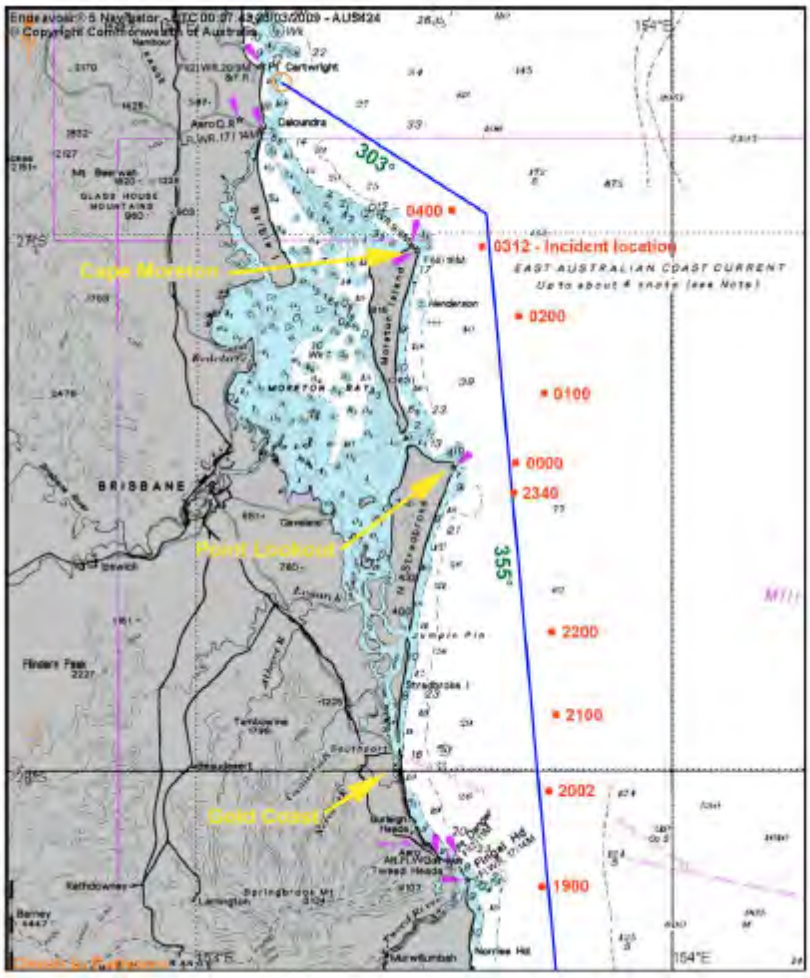


Figure 4-52: Ship position, local time (source ATSB report)

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-27: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	3.1	8.8	045	0.9	1.2	0.9	1.5
Swell	1.5	11.0	084	6.0	1.1	0.9	1.4
Windsea	2.7	8.1	035	0.8	1.2	1.0	1.5

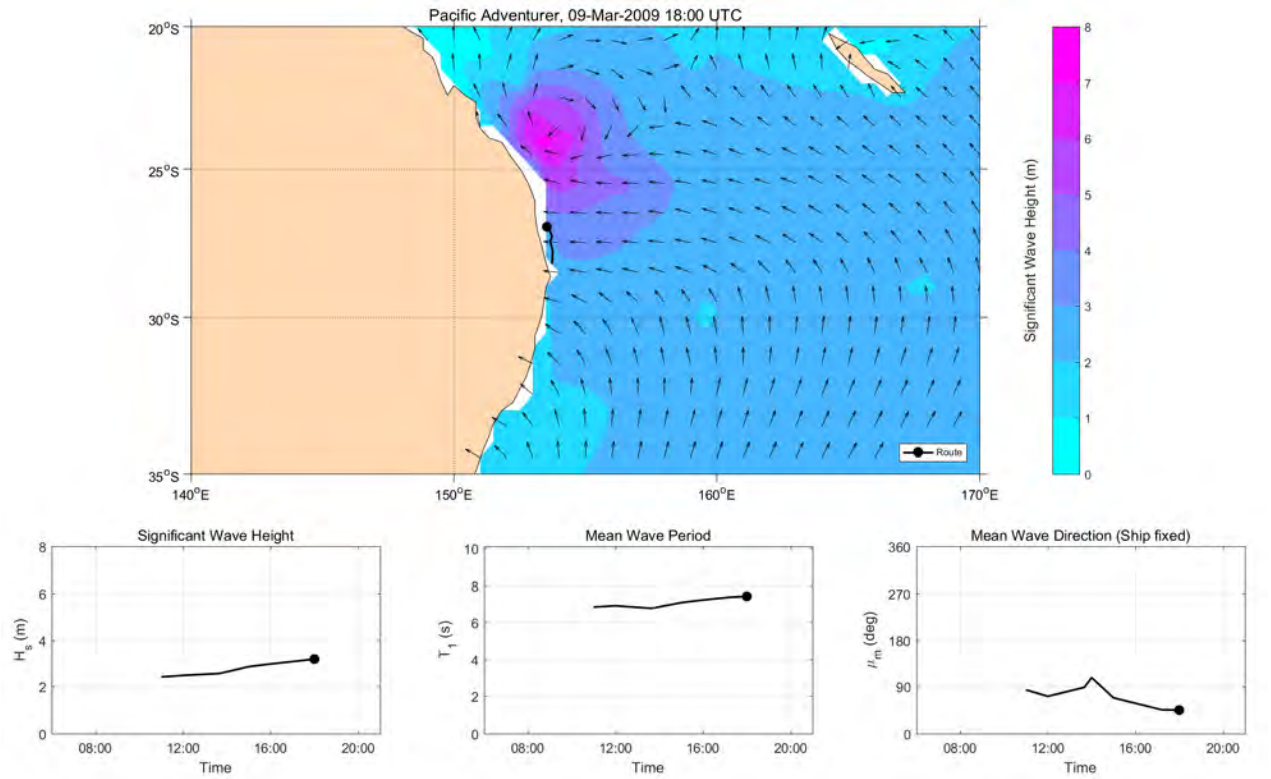


Figure 4-53: Wave hindcast (source ECMWF ERA5)

The provided GM_{solid} was 4.4 m and including a free surface correction (FSC) of 1.0 m, the GM_{fluid} was 3.4 m. In the incident report a rolling period of 10 s was mentioned but that would give an estimated kxx of only 0.3B which seems too low for the containerships. Probably the rolling period was somewhere between 9.5 and 12.5 s (assuming a solid GM and a small kxx or on the other side a fluid GM and a large kxx).

In the hours before the incident violent rolling was reported with up to 35 deg angles to one side.

The vessel was sailing in beam seas and with the given peak period of 9 s and the estimated rolling period this was close to resonant roll.

4.16.3 Description of damage

All 31 deck containers in bay 25 were lost and 2 containers were damaged (located at the most forward bay). The lost containers in bay 25 protruded the ship's hull and caused a significant oil spill.

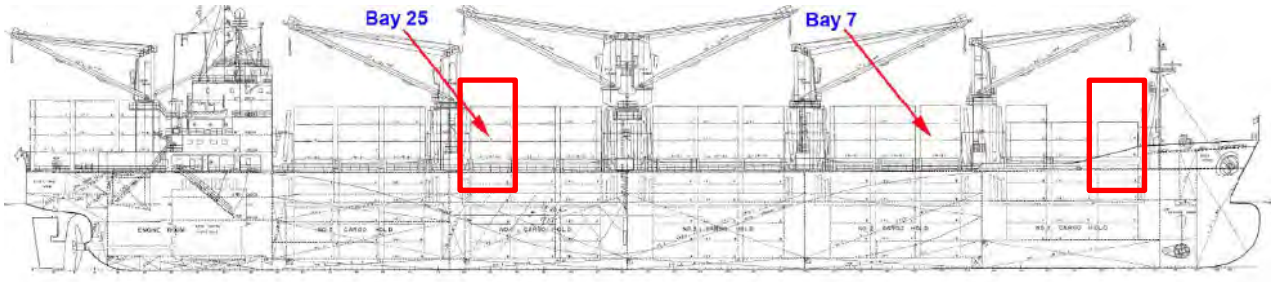


Figure 4-54: Location of damage

4.16.4 Other photos

Figure 4-55: Selection of other incident photos

4.16.5 Sources

- ATSB TRANSPORT SAFETY REPORT Marine Occurrence Investigation No. 263 MO-2009-002, *"Independent investigation into the loss of containers from the Hong Kong registered container ship Pacific Adventurer"*, 2011
- https://www.brisbanetimes.com.au/national/queensland/oil-spill-ship-owners-to-plead-guilty-20110930-1l1ai.html

4.17 YM Taichung, 2009

4.17.1 Summary

Table 4-28: Summary of info

General info

IMO	9280811
Name	YM Taichung
Year of build	2004
TEU capacity	4,132
Loa	261.0 m
B	32.0 m

Incident info

date & time	5 Apr 2009
speed	15 kn (estimation as per chapter 2)
position	Approx. 35° N / 144° W *1,000 NM west of San Francisco*
heading	Assumed at 090 deg *To Long Beach, USA*
hindcast waves	Hs = 5.2 m
draught	Unknown
transverse stability	2 m (long voyage, estimation as per chapter 2)
roll period	19.5 s (long voyage, estimation as per chapter 2)
affected/damaged/lost containers	40/26/14

Figure 4-56: Damage overview photo

4.17.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-29: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	5.2	13.1	316	1.4	1.1	0.6	1.7
Swell	4.2	15.4	321	1.3	0.9	0.5	1.5
Windsea	3.0	8.8	306	1.8	1.5	0.8	2.4

From the wave conditions and estimated rolling period, resonant roll in stern quartering seas seems most likely.

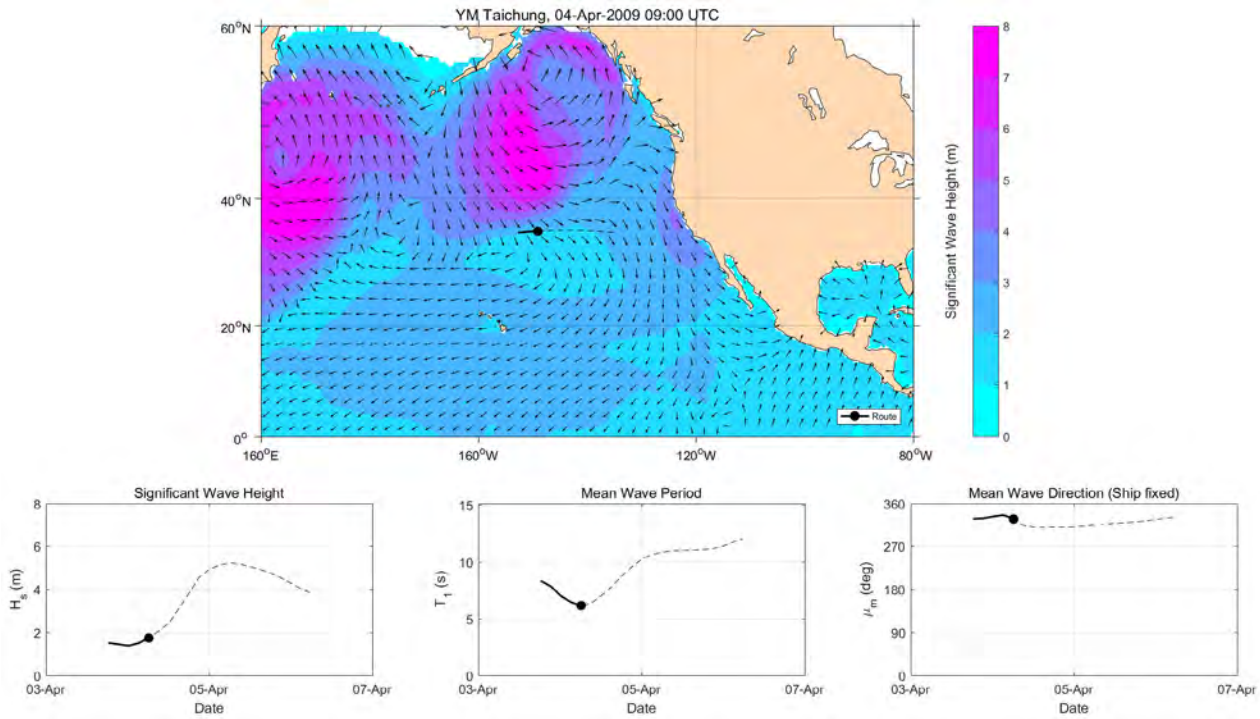


Figure 4-57: Wave hindcast (source ECMWF ERA5)

4.17.3 Description of damage

Partial stack collapse at the stern.

Figure 4-58: Location of damage

4.17.4 Other photos

Figure 4-59: Selection of other incident photos

4.17.5 Sources

- http://www.cargolaw.com/2000nightmare_singleonly14.html#Taichung-Tumble

4.18 Bai Chay Bridge, 2012

4.18.1 Summary

Table 4-30: Summary of info

General info

IMO	9463346
Name	Bai Chay Bridge
Year of build	2011
TEU capacity	4,430
Loa	266.0
B	36.0

Incident info

date & time	Before 23 Jun 2012 (arrival date Hong Kong)
speed	Unknown
position	East of Japan (exact location unknown)
heading	Pacific, westbound
hindcast waves	Unknown (Typhoon Guchol)
draught	Unknown
transverse stability	Unknown
roll period	Unknown
affected/damaged/lost containers	168/60/30 (rough count from photos)

Figure 4-60: Damage overview photo

4.18.2 Incident conditions

Not possible.

4.18.3 Description of damage

Stack collapse of 1 complete bay at the stern and one complete bay, 3 or 4 bays before the wheelhouse (this is not clearly visible on the incident photos).

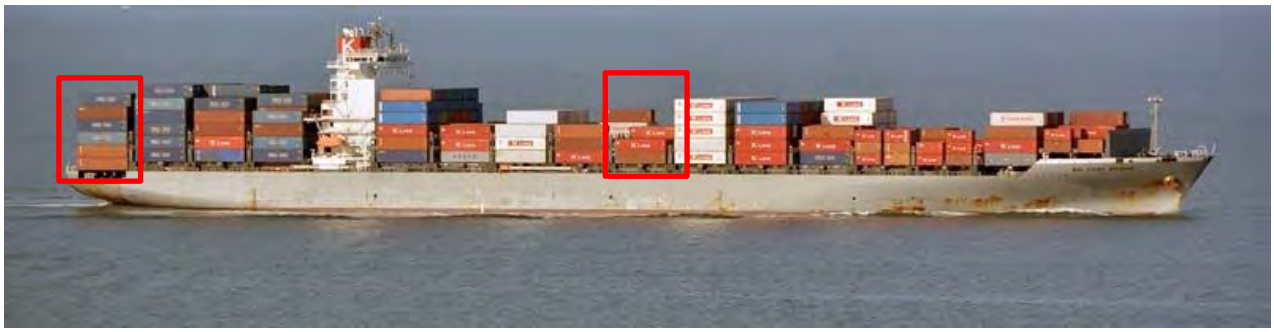


Figure 4-61: Location of damage

4.18.4 Other photos


K LINE


K LINE

Figure 4-62: Selection of other incident photos

4.18.5 Sources

- http://www.cargolaw.com/2012nightmare_bai_chay_bri.html

4.19 Svendborg Maersk, 2014

4.19.1 Summary

Table 4-31: Summary of info

General info

IMO	9146467
Name	Svendborg Maersk
Year of build	1998
TEU capacity	8,160
Loa	347.0
B	42.8

Incident info

date & time	(1) 14 Feb 2014 15:43 UTC (2) 14 Feb 2014 19:13 UTC
speed	Approx. 3 kn
position	(1) 48° 42.4' N / 005° 58.5' W (2) 48° 32.3' N / 006° 08.1' W *French Coast*
heading	210 deg *Rotterdam, Netherlands to Colombo, Sri Lanka*
hindcast waves	Hs = 11.0 m
draught	Ta/Tf = 13.2/13.4 m
transverse stability	1.75 m
roll period	27.9 s (based on an estimated roll inertia)
affected/damaged/lost containers	767/250/517

Figure 4-63: Damage overview photo

4.19.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated (taken at time of second incident; conditions were worse there than at the first):

Table 4-32: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	11.0	14.7	165	1.0	2.1	1.6	2.6
Swell	1.6	13.2	218	1.2	2.3	1.8	2.8
Windsea	10.8	14.7	163	1.0	2.1	1.6	2.6

Based on the above wave conditions, the vessel was sailing in close to head seas conditions. With an estimated GM of around 4 m the Tϕ/Te is fairly close to 2, so parametric roll in head seas is likely. This was also the conclusion in the DMAIB report.

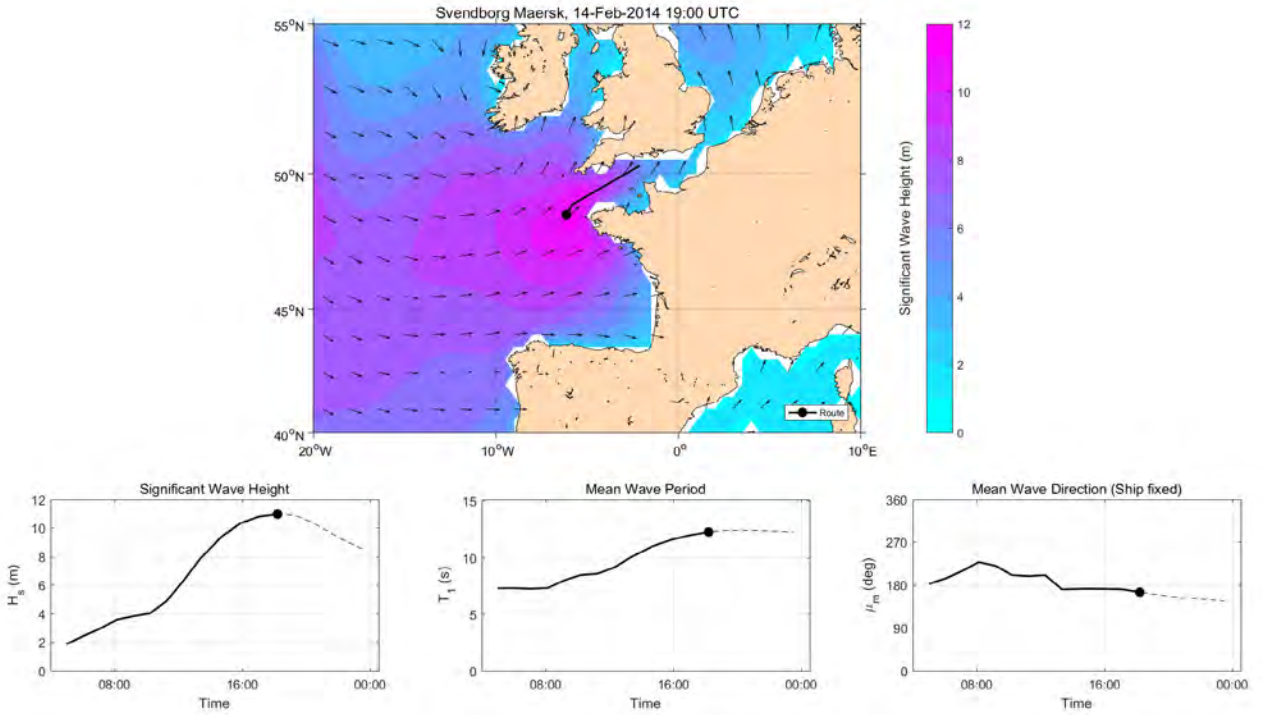


Figure 4-64: Wave hindcast (source ECMWF ERA5)

4.19.3 Description of damage

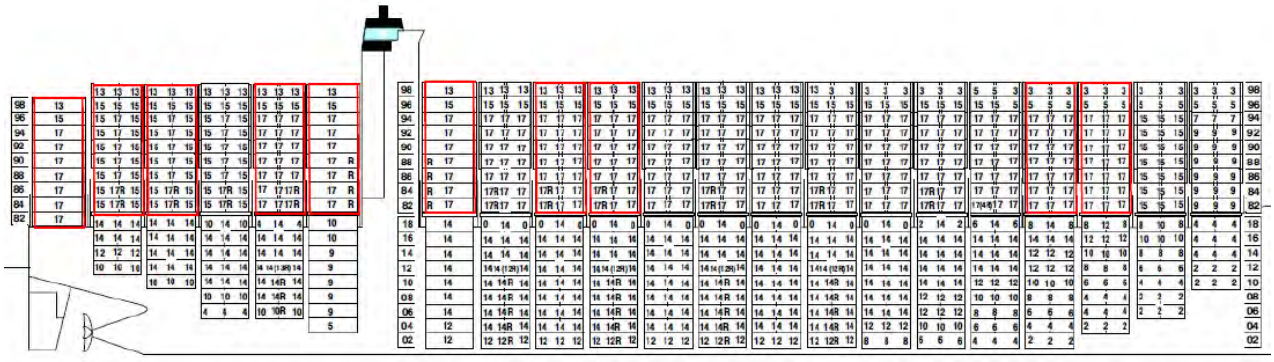


Figure 4-65: Location of damage

4.19.4 Other photos

Figure 4-66: Selection of other incident photos

4.19.5 Sources

- DMAIB, Marine accident report, “Svendborg Maersk Heavy weather damage on 14 Feb 2014”, Sep 2014
- https://malagamaritima.blogspot.com/2014/02/el-portacontenedores-svendborg-maersk.html

4.20 Wehr Singapore, 2015

4.20.1 Summary

Table 4-33: Summary of info

General info

IMO	9256224
Name	Wehr Singapore
Year of build	2004
TEU capacity	4,300
Loa	221.4
B	32.29

Incident info

date & time	25 Nov 2015 01:00 UTC
speed	12 kn (estimation as per chapter 2)
position	42° 32’ N / 155° 43’ E *310 nm east of Kuril Archipelago* *North Pacific, westbound*
heading	Estimated at 230 deg from destination *Balboa, Panama to Busan, South Korea*
hindcast waves	Hs = 9.4 m
draught	Unknown
transverse stability	2 m (long voyage, estimation as per chapter 2)
roll period	19.7 s (long voyage, estimation as per chapter 2)
affected/damaged/lost containers	6/0/6

Figure 4-67: Overview photo (no damage photos available)

4.20.2 Incident conditions

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-34: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	9.4	13.0	135	1.7	1.8	1.0	2.9
Swell	1.8	13.3	290	3.5	1.3	0.7	2.1
Windsea	9.3	12.9	134	1.7	1.8	1.0	2.9

In these bow quartering seas conditions, resonant roll and parametric roll seems unlikely. Combined first order ship motions (heave, pitch, and roll) and/or slamming induced vibrations are the most likely contributors. However due to the rapidly changing weather conditions, the result it quite sensitive to position and time of the incident.

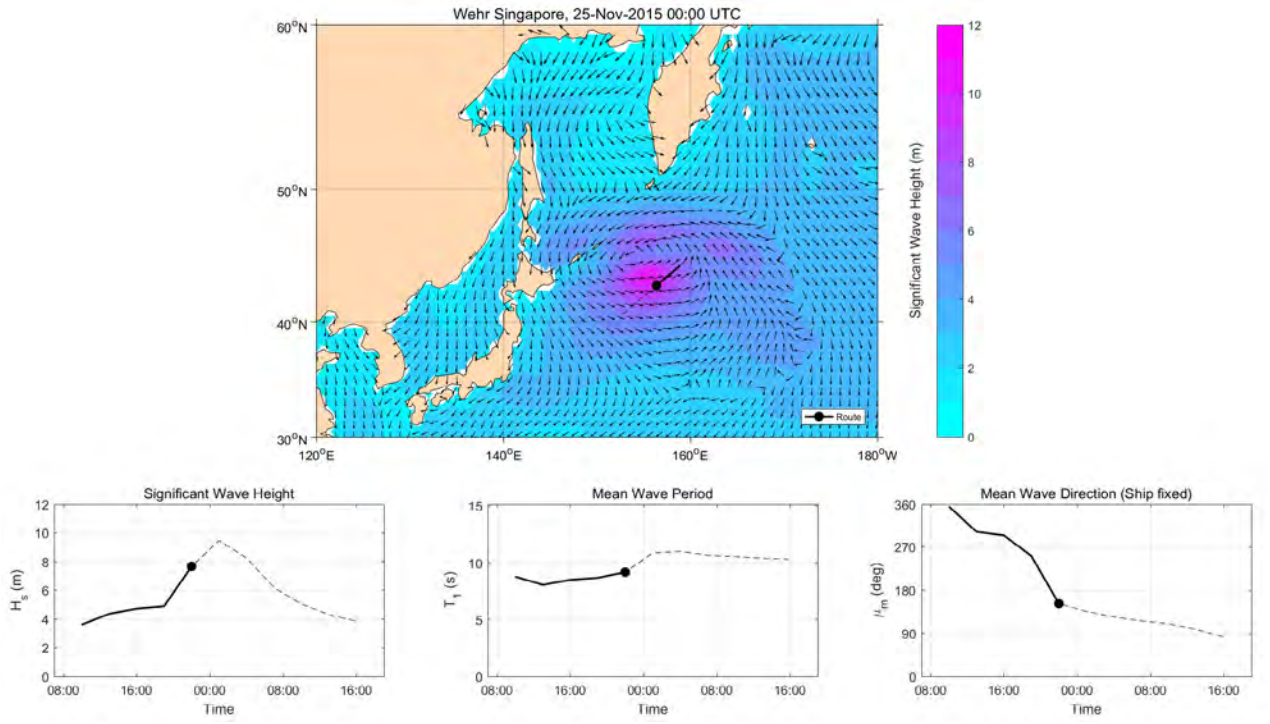


Figure 4-68: Wave hindcast (source ECMWF ERA5)

4.20.3 Description of damage

Not possible.

4.20.4 Other photos

No photos available.

4.20.5 Sources

- https://www.fleetmon.com/maritime-news/2015/10363/wehr-singapore-under-way-again-containers-loss/

4.21 Maersk Merete, 2017

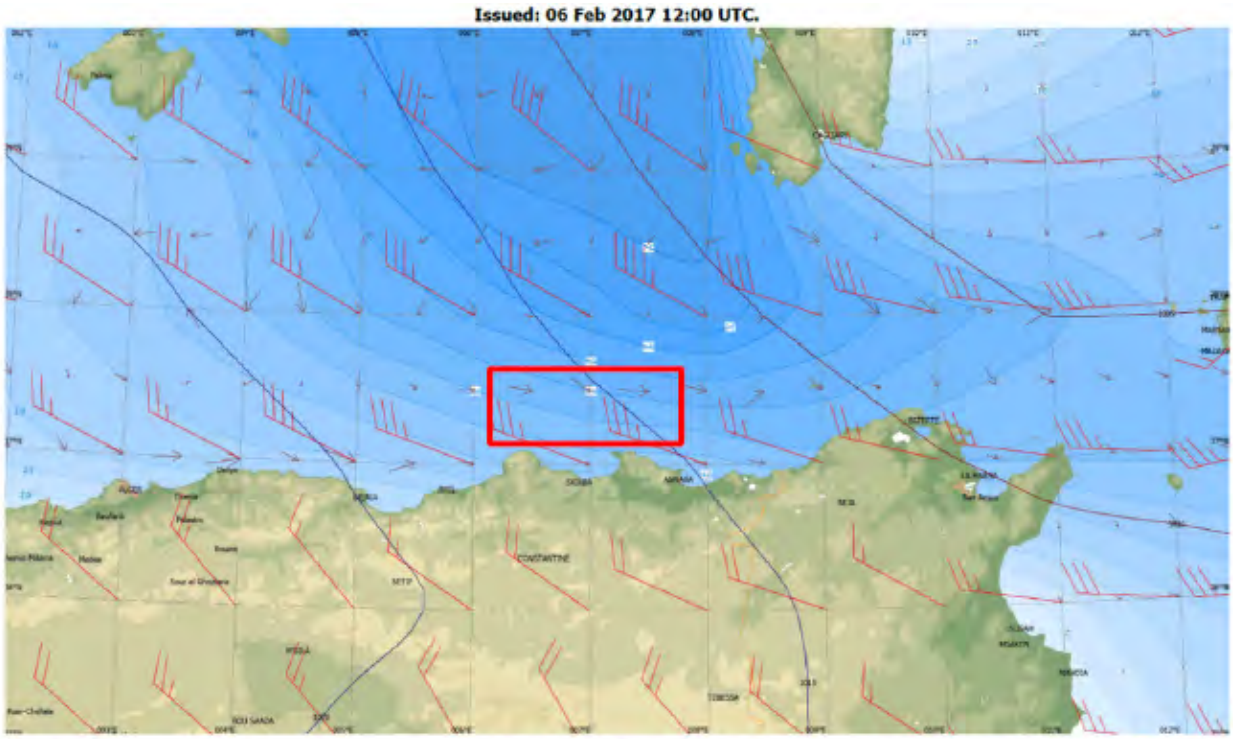
4.21.1 Summary

Table 4-35: Summary of info

General info	
IMO	9632064
Name	Maersk Merete
Year of build	2014
TEU capacity	18,270
Loa	399.0
B	59.0
Incident info	
date & time	Approx. 6 Feb 2017 16:00 UTC
speed	15 kn (estimation as per chapter 2)
position	38° N / 007° E *Mediterranean, North of Skikda, Algeria*
heading	Approx. 270 deg *Suez, Egypt (Tanjung Pelepas) to Algeciras, Spain*
hindcast waves	Hs = 7.0 m
draught	Unknown
transverse stability	1.9 m
roll period	36.9 s (based on estimated roll inertia)
affected/damaged/lost containers	128/85/43

Figure 4-69: Damage overview photo

4.21.2 Incident conditions



Weather forecast by SPOS. The area marked in red was where the vessel passed between 14:00 hrs and 20:00 hrs on 6 February 2017. In that area, the weather forecast remained 35 knots, equalling wind force 8 Bft.

Based on estimated position and time, course and speed, the following wave conditions have been estimated:

Table 4-36: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	7.0	12.3	125	1.0	3.7	2.8	4.6
Swell	2.8	15.1	092	19.1	2.5	1.9	3.1
Windsea	6.4	11.7	131	0.9	4.0	3.1	4.9

In these bow quartering seas conditions, resonant roll and parametric roll seems unlikely. Combined first order ship motions (heave, pitch, and roll) and/or slamming induced vibrations are the most likely contributors.

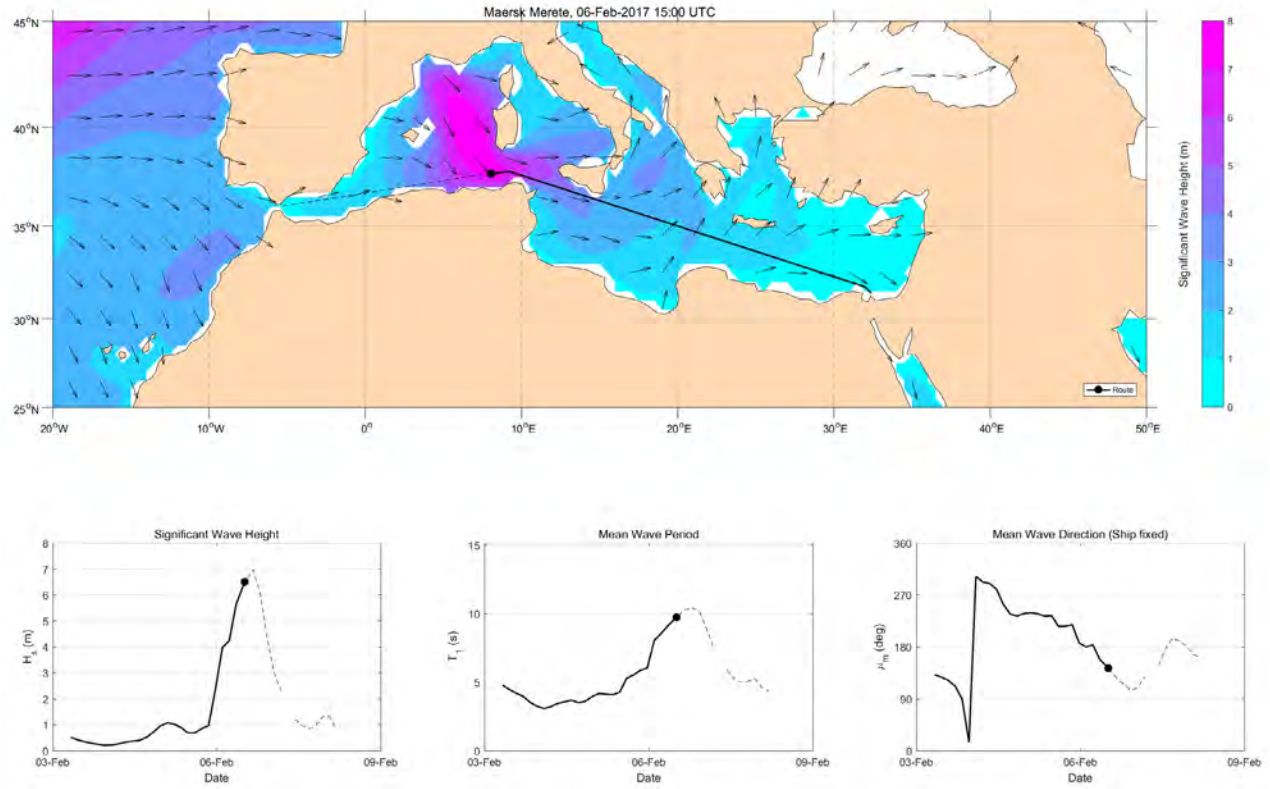


Figure 4-70: Wave hindcast (source ECMWF ERA5)

4.21.3 Description of damage

1 bay at the stern.

Figure 4-71: Location of damage

4.21.4 Other photos

Figure 4-72: Selection of other incident photos

4.21.5 Sources

- https://www.maritimeherald.com/2017/boxship-merete-maersk-lost-43-container-in-mediterranean/
- https://mobile.twitter.com/gibdan1/status/829727509725982724?lang=da
- https://www.fleetmon.com/maritime-news/2017/17159/merete-maersk-lost-43-containers-16-them-drifting/

4.22 Ever Smart, 2017

4.22.1 Summary

Table 4-37: Summary of info

General info

IMO	9300403
Name	Ever Smart
Year of build	2006
TEU capacity	7,024
Loa	300.0
B	42.9

Incident info

date & time	29 Oct 2017 15:00-17:00 UTC *(local time 30 Oct 2017 'early hours morning')*
speed	17 kn
position	35°N / 153°E *700 miles east of Japan, North Pacific Ocean*
heading	082 deg *Taipei, Taiwan to Los Angeles, USA*
hindcast waves	Hs = 4.5 m
draught	13.9 m observed (13.57 m from loading computer)
transverse stability	0.95 m
roll period	38 s (based on estimated roll inertia)
affected/damaged/lost containers	153/34/75

Figure 4-73: Damage overview photo

4.22.2 Incident conditions

According to the MAIB report:

On 29 October 2017, the UK registered container ship Ever Smart suffered a container stow collapse while on passage between Taipei, Taiwan and Los Angeles, USA. The master had changed the ship's passage plan to avoid severe weather caused by a developing depression east of Japan. The ship continued in heavy seas; rolling 10º to 12º and pitching heavily with frequent bow flare slamming.

From the position and time in the MAIB report, the following wave conditions have been estimated:

Table 4-38: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.5	8.9	107	1.4	5.0	3.9	6.2
Swell	1.3	10.9	207	0.5	5.1	3.9	6.3
Windsea	4.3	8.7	103	1.9	5.0	3.8	6.1

As wave directions conditions changed rapidly in this storm a more beam or stern quartering seas condition would also have been possible. But present heading (beam to bow quartering seas) seems to be more or less in line with the reported ship behaviour.

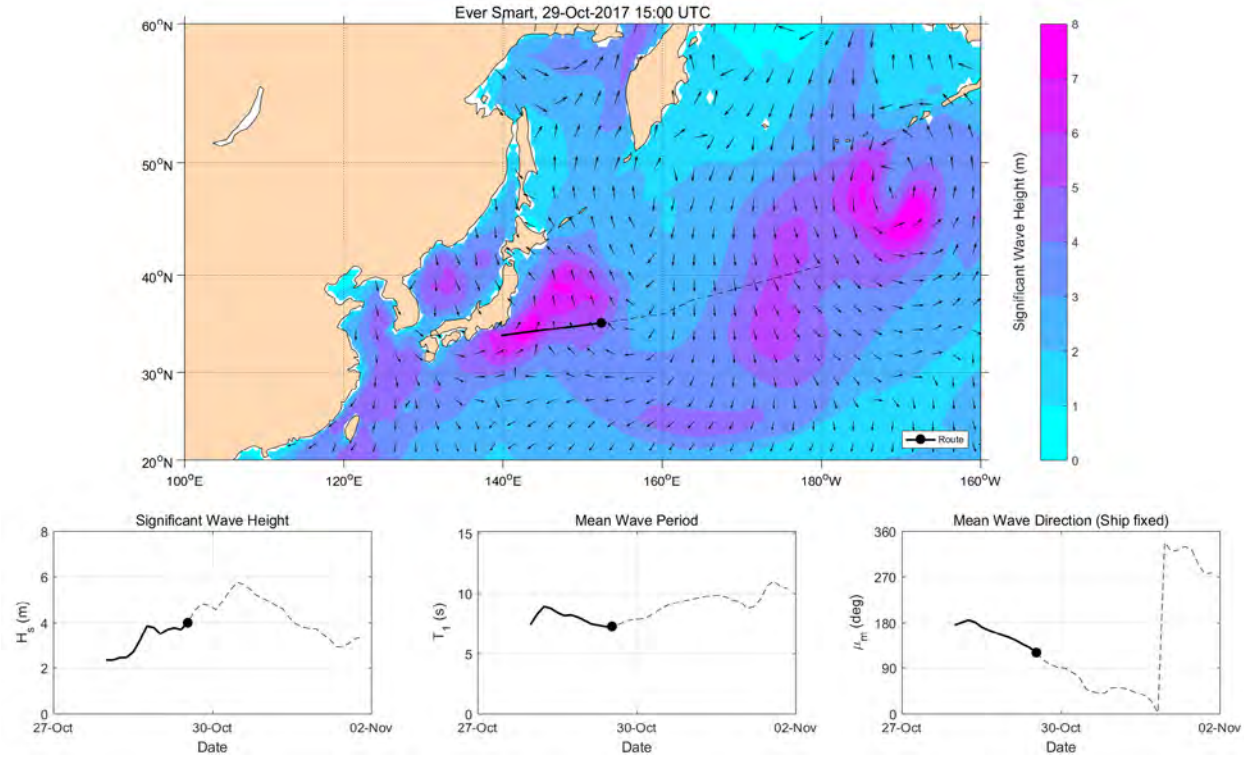


Figure 4-74: Wave hindcast (source ECMWF ERA5)

4.22.3 Description of damage

Stack collapse of 1 bay at the stern.

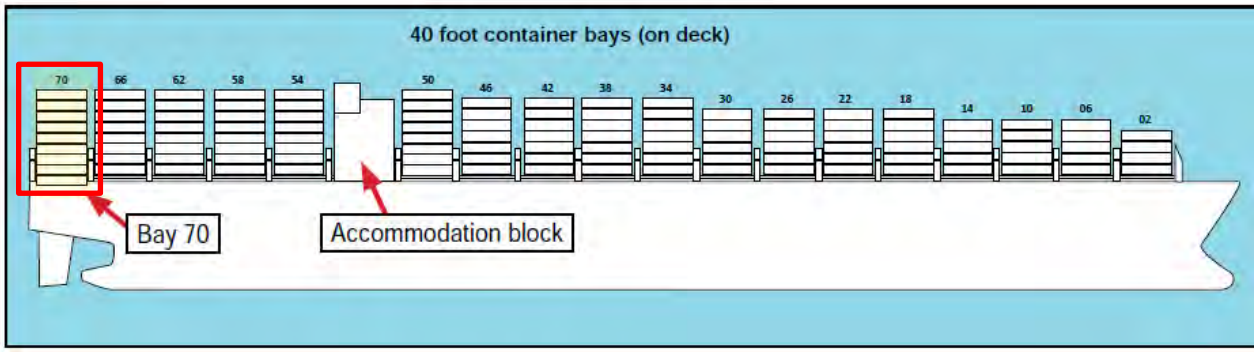


Figure 4-75: Location of damage

The MAIB investigation concluded that:

- *The loss of the containers most likely occurred during a period of heavy pitching and hull vibration in the early morning of 30 October.*
- *A combination of factors resulted in a loss of integrity for the whole deck cargo bay; in particular, the containers were not stowed or secured in accordance with the cargo securing manual.*
- *The container lashings might not have been secured correctly.*

4.22.4 Other photos

Figure 4-76: Selection of other incident photos

4.22.5 Sources

- MAIB Accident report No 14/2020 “Report on the investigation of the loss of 42 containers from the container ship Ever Smart”, July 2020

4.23 CMA CGM Washington, 2018

4.23.1 Summary

Table 4-39: Summary of info

General info

IMO	9780847
Name	CMA CGM Washington
Year of build	2017
TEU capacity	13,460
Loa	366.0 m
B	48.0 m

Incident info

date & time	19 Jan 2018 14:27 UTC *(20 Jan 2018 01:27 LT)*
speed	Approx. 21 kn (19 Jan 16:54)
position	32° 09.3’ N / 159° 17.7’ E *Pacific*
heading	082 deg *Eastbound*
hindcast waves	Hs = 5.2 m
draught	13.32 m
transverse stability	1.28 m
roll period	40 s
affected/damaged/lost containers	222/85/137

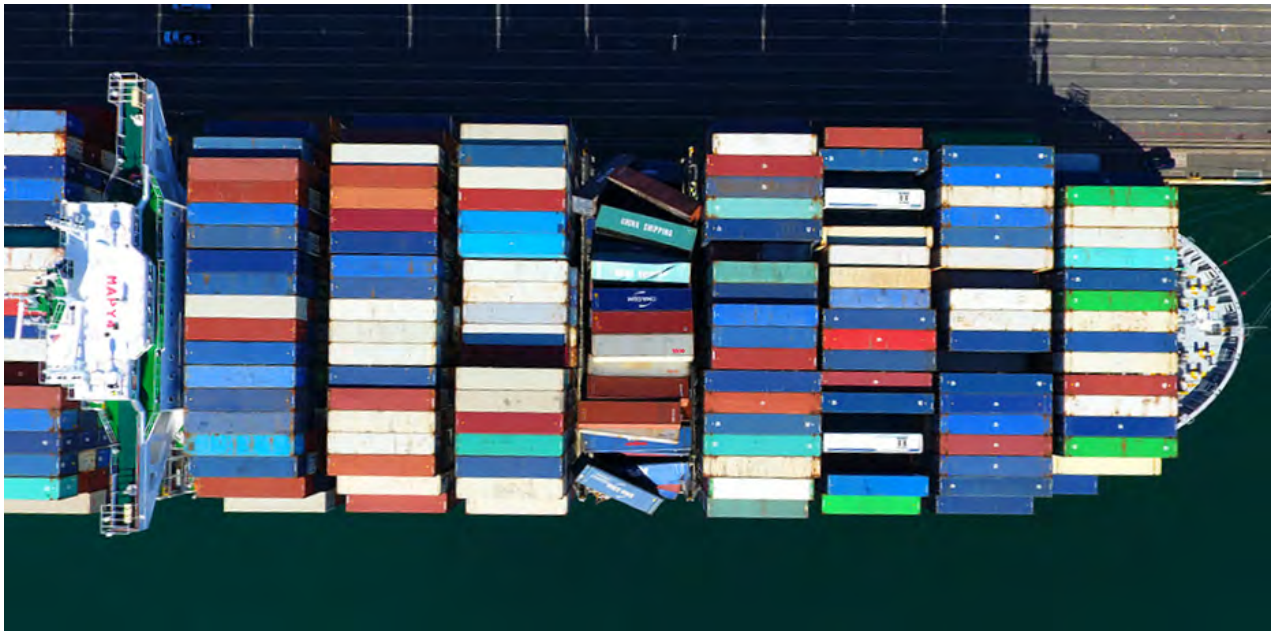


Figure 4-77: Damage overview photo

4.23.2 Incident conditions

Following the Octopus-Onboard screen dumps in the MAIB report, the wave conditions were as follows:

	Hs [m]	Tp [s]	μ [deg]
Swell	4.8	16.8	311
Wind sea	2.1	9.1	321

This compares fairly well with the ERA5 estimate below:

Table 4-40: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-]		
					Typical	Low	High
Total	5.2	13.8	316	1.1	1.7	1.3	2.1
Swell	4.7	15.0	312	1.2	1.7	1.3	2.1
Windsea	2.0	7.3	336	0.9	0.7	0.5	0.9

Given the heading and T_ϕ/ T_e ratio, parametric roll in (close to) following seas is most likely, although resonant roll could be possible as well (requires a higher GM than the taken 1.28 m and a lower k_{xx}).

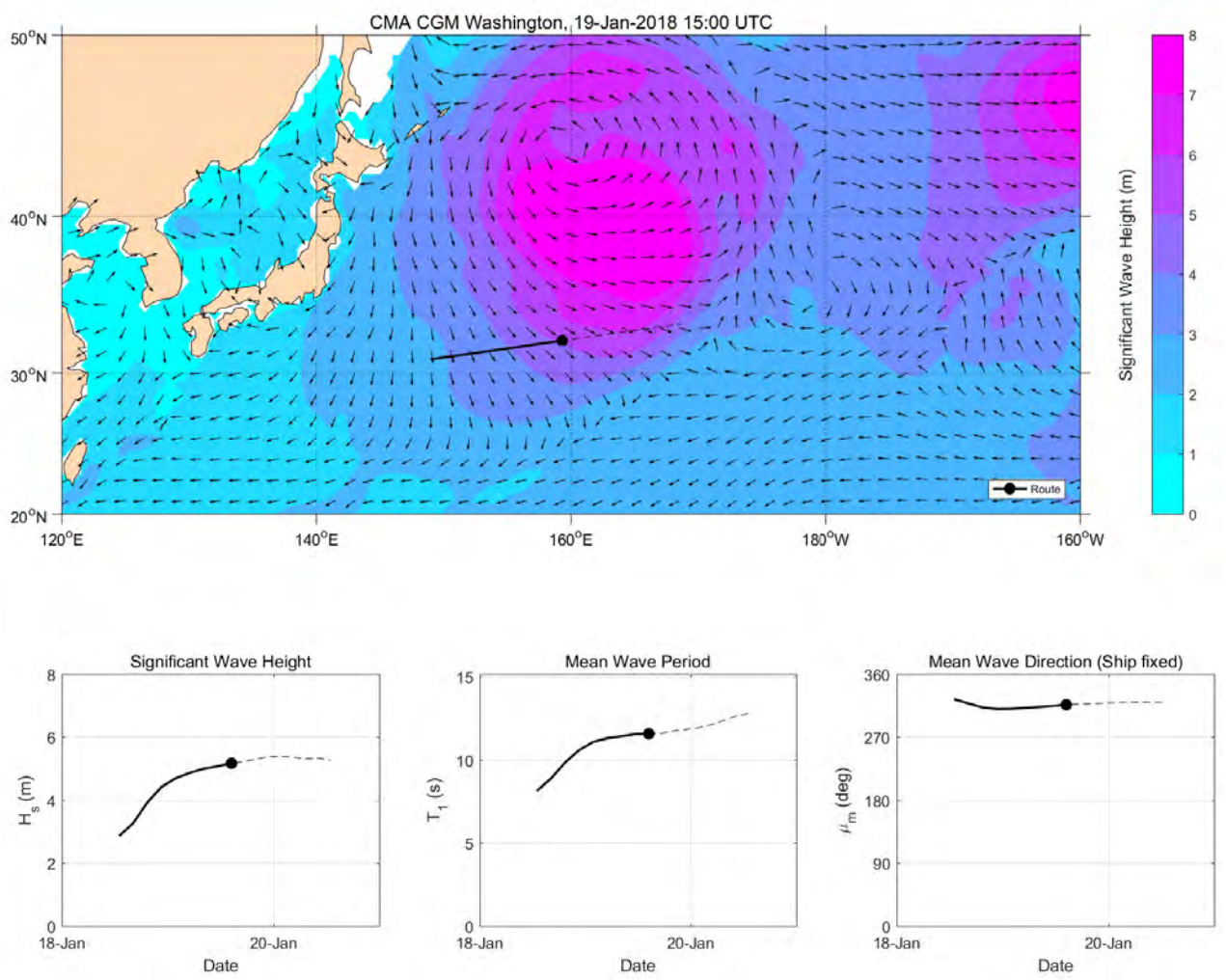


Figure 4-78: Wave hindcast (source ECMWF ERA5)

4.23.3 Description of damage

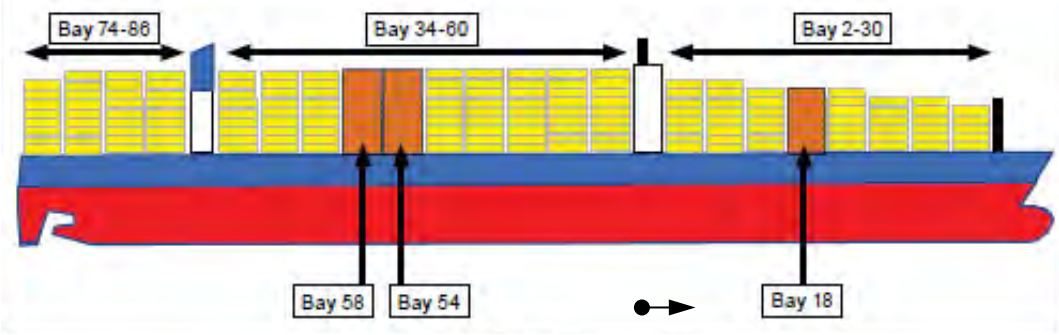
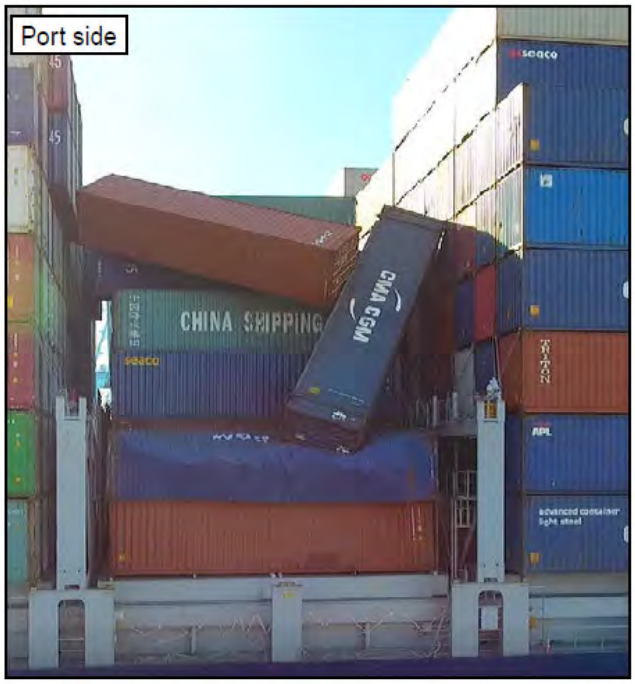
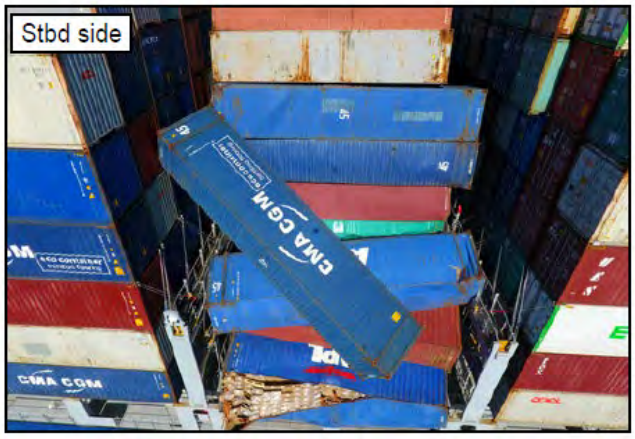
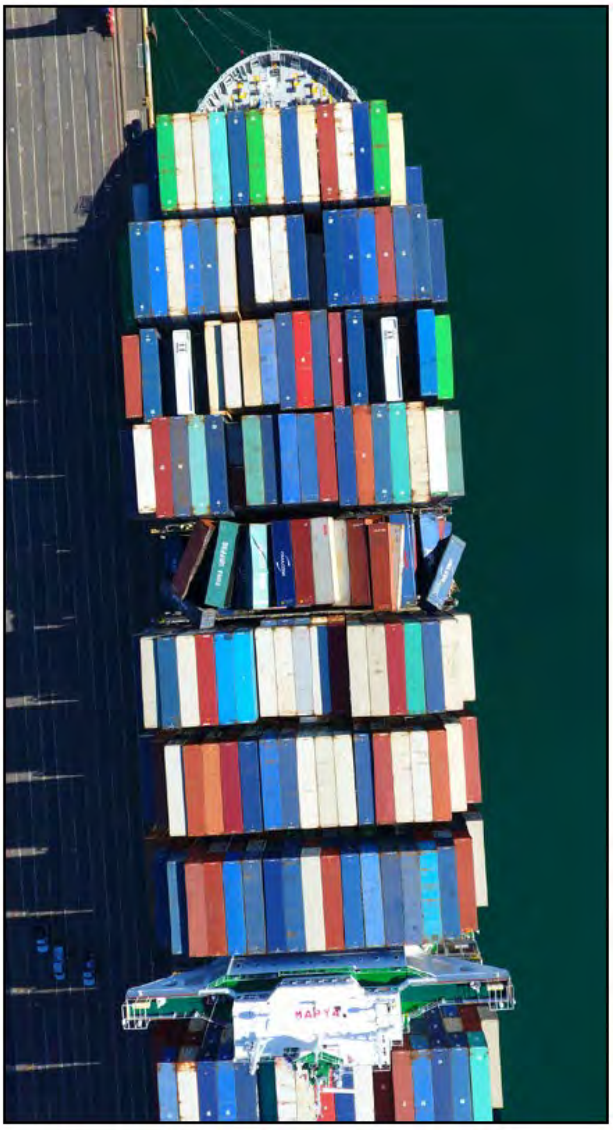


Figure 4-79: Location of damage

4.23.4 Other photos








Port side
OOCL
APL


Stbd side
Intermodal

Figure 4-80: Selection of other incident photos

4.23.5 Sources

- MAIB report 2/2020, “Report on the investigation into the loss of 137 containers from the container ship CMA CGM G. Washington”, Jan 2020

4.24 Maersk Shanghai, 2018

4.24.1 Summary

Table 4-41: Summary of info

General info

IMO	9725158
Name	Maersk Shanghai
Year of build	2016
TEU capacity	10,081
Loa	324.0 m
B	48.0 m

Incident info

date & time	3 Mar 2018 15:15 UTC
speed	15 kn (estimation as per chapter 2)
position	35°N / 076°W *About 17 miles off the coast of Oregon*
heading	227 deg estimated based on assumed route *Norfolk, Virginia to Charleston, South Carolina*
hindcast waves	Hs = 3.6 m
draught	Unknown
transverse stability	0.8 m
Roll period	47.5 s (based on estimated roll inertia)
affected/damaged/lost containers	73/0/73 (73 lost or collapsed)

Figure 4-81: Side view (no damage photos available)

4.24.2 Incident conditions

The 324-meter cargo ship Maersk Shanghai was underway from Norfolk, Virginia to Charleston, South Carolina when the crew contacted the Coast Guard late Saturday night to report that they had lost 70 to 73 cargo containers due to high winds and heavy seas approximately 17 miles off Oregon Inlet, North Carolina, according to a Coast Guard report on the incident.

Statement Maersk:
We can confirm that on March 3th at 20:15 EST the vessel Maersk Shanghai, reported between 70 – 73 containers collapsed and/or were lost overboard due to poor weather at sea when in route to Charleston, South Carolina.

From above statements, the following wave conditions were estimated:

Table 4-42: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	3.6	9.2	057	0.7	3.7	2.8	4.5
Swell	1.6	14.5	012	0.4	2.2	1.7	2.7
Windsea	3.3	7.9	066	1.0	4.5	3.5	5.5

Based on the above conditions and an estimated speed of 15 kn, the wave encounter period is approximately 17 s. With the provided GM the rolling period would be around 48 s (varying between 36 to 58 s depending on kxx). Given the heading and T_ϕ/ T_e ratio, both resonant roll as well as parametric roll seem unlikely.

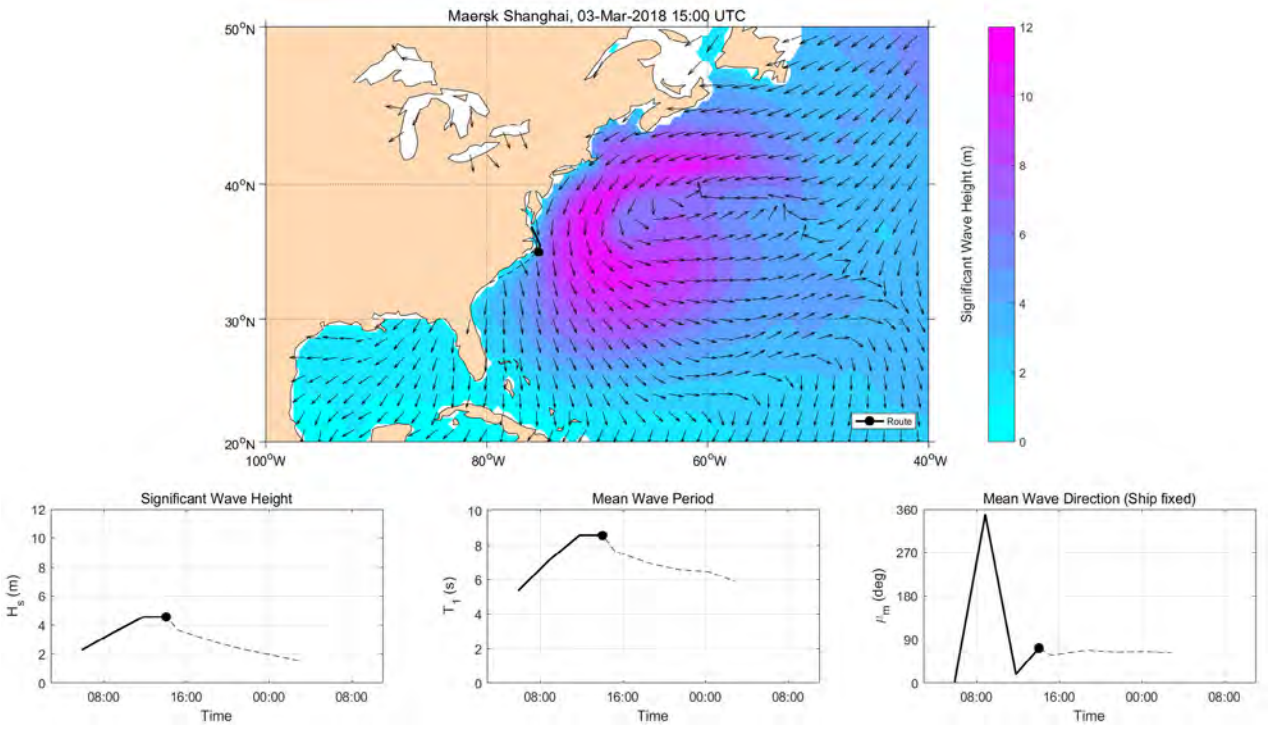


Figure 4-82: Wave hindcast (source ECMWF ERA5)

4.24.3 Description of damage

Not possible.

4.24.4 Other photos

No photos available.

4.24.5 Sources

- https://gcaptain.com/containership-loses-about-70-containers-overboard-off-us-east-coast/
- https://moovafrica.com/news/maersk-ship-loses-dozens-of-containers-off-n-c-coast/
- https://www.maritime-executive.com/article/maersk-shanghai-container-containing-acid-yet-to-be-found

4.25 YM Efficiency, 2018

4.25.1 Summary

Table 4-43: Summary of info

General info

IMO	9353280
Name	YM Efficiency
Year of build	2009
TEU capacity	4,250
Loa	268.8 m
B	32.2 m

Incident info

date & time	31 May 2018 14:35 UTC
speed	3-4 kn
position	33.0° S / 152.1° E *Australian Coast*
heading	210 deg prior to incident; 000 deg after
hindcast waves	Hs = 4.8 m
draught	Ta/Tf = 12.5/10.5 m
transverse stability	1.09 m (arrival)
roll period	20.1 s
affected/damaged/lost containers	143/62/81

Figure 4-83: Damage overview photo

4.25.2 Incident conditions

The second mate reverted to manual steering before switching back to autopilot at about 0013 on 1 June with a set heading of 210°. The ship continued to make comfortable progress (little rolling or pitching) in the prevailing conditions at a speed of about 3 to 4 knots. Shortly after 0034, in a position about 16 miles east-south-east of Newcastle, the ship experienced a period of sudden rolling for between 60 and 90 seconds. During this period, the ship rolled quickly and heavily at least three times… …According to the master and second mate, the rolling reached angles of up to 30º to port and starboard… …The second mate reported hearing loud noises on deck and suspected that there had been some container damage. He turned on the ship's deck lights and observed that a number of containers had been damaged and possibly lost overboard from the bays aft of the accommodation.

Based on the weather conditions at the time of the accident and YM Efficiency's heading, it is almost certain that the ship was in head seas at a speed of about 3 knots. Calculations using recorded wave data and, the ship's heading and speed data, provided a probable calculated wave length of between 229 m and 262 m (the ship's length between perpendiculars was 256.5 m). The probable wave encounter period was calculated to be 11–12 s. When compared to the ship's calculated roll period of about 20 s, the wave encounter period does not appear to satisfy the related condition required for parametric rolling. While calculations show that some criteria required for parametric rolling may have been satisfied, there was insufficient evidence to conclude that parametric rolling was a contributing factor.

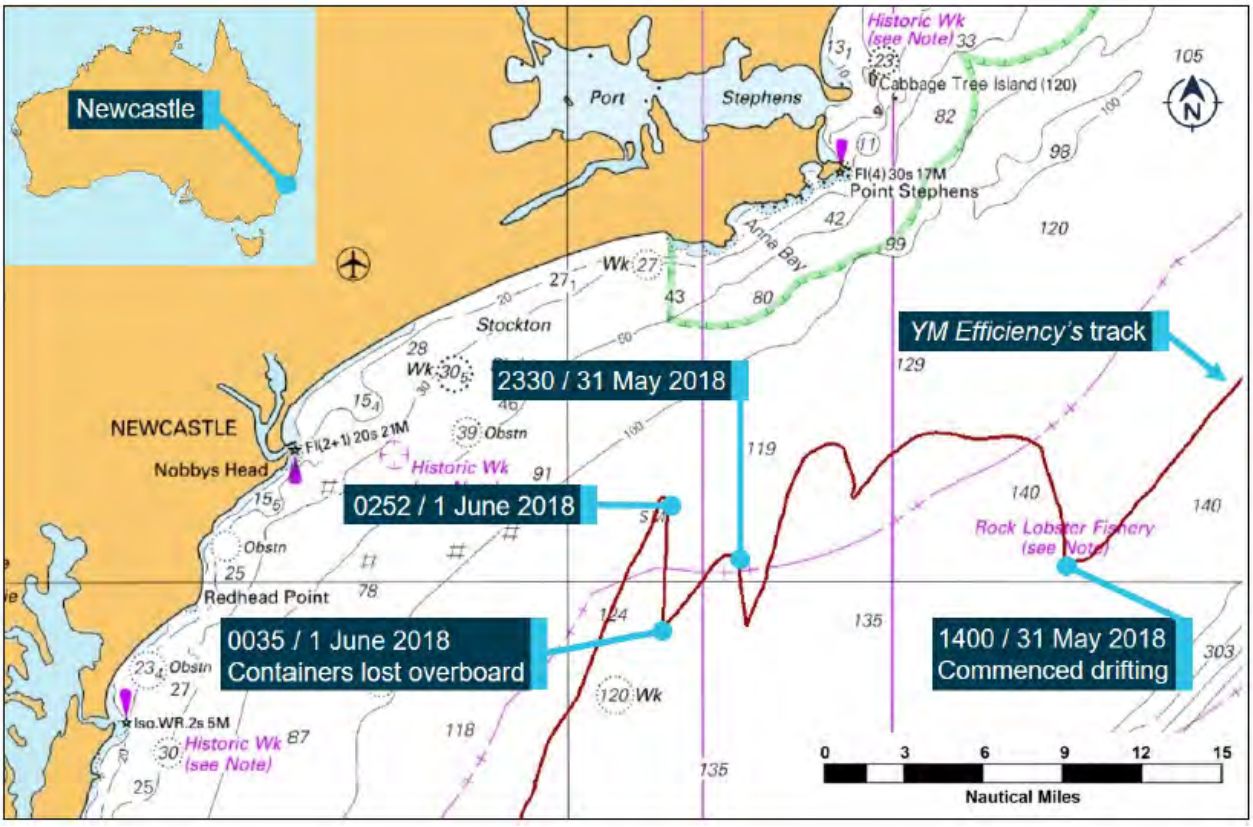


Figure 4-84: Ship position (source AMSA report)

From the AMSA report, the following wave conditions have been estimated:

Table 4-44: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	5.5	11.6	193	0.8	2.5	2.0	3.1
Swell	1.8	14.3	215	1.0	2.0	1.5	2.5
Windsea	5.1	11.1	191	0.8	2.7	2.1	3.3

The reported heading and wave period is close to the one estimated from Wave Watch 3. But quite a bit lower than the ones mentioned in the incident report. From the GM of 1.09 m, estimated kxx/B of 0.39 and estimated roll added mass (axx/B=0.04), the wave encounter period is estimated at 26.6 s. This is considerably higher than the AMSA estimate of 20 s.

Given the close to head seas condition and the T_ϕ/ T_e ratio of around 2, parametric roll in head seas is the most likely cause (and seems to match with the crew statement *…experienced a period of sudden rolling for between 60 and 90 seconds…*).

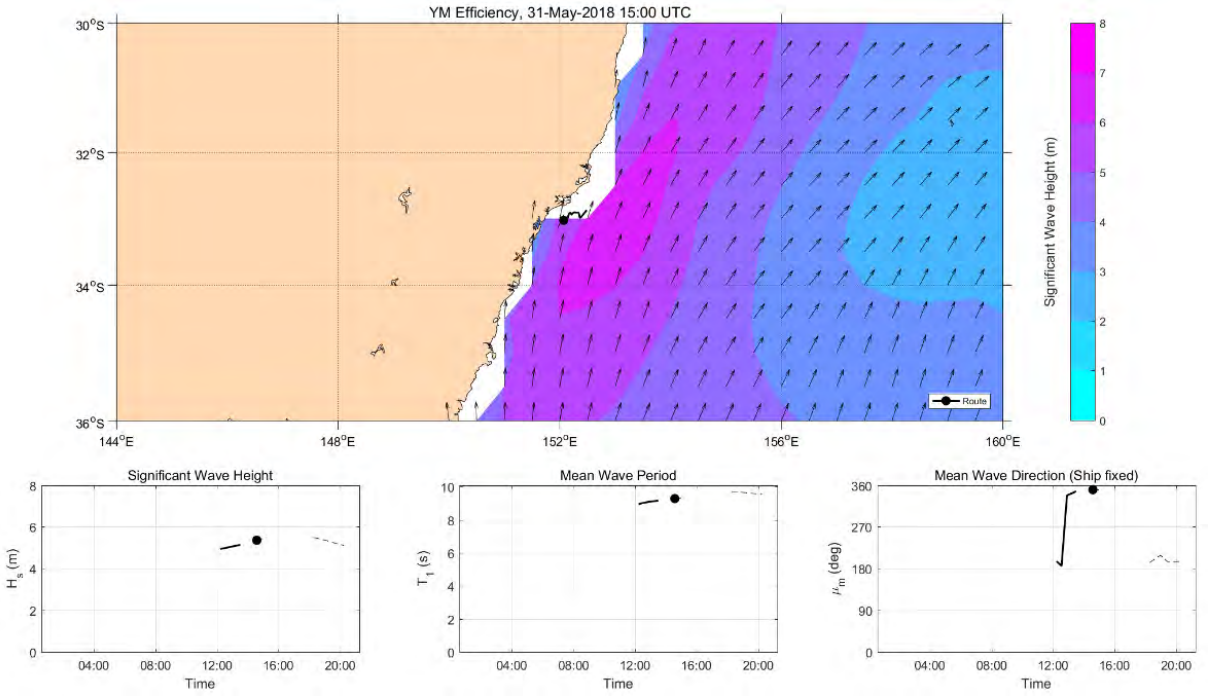


Figure 4-85: Wave hindcast (source ECMWF ERA5)

4.25.3 Description of damage

Stack collapse of 2 bays at the stern (directly aft of the superstructure).

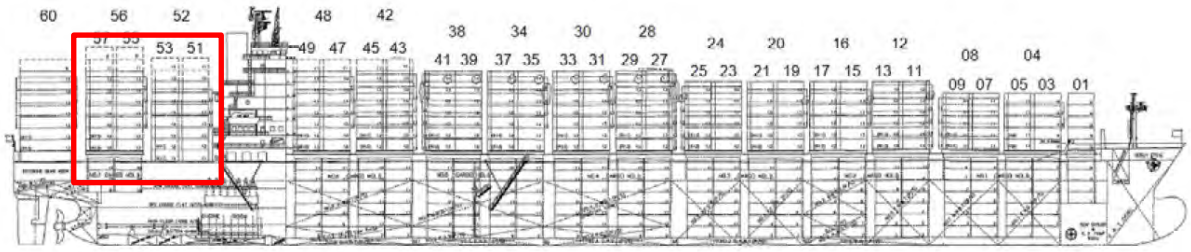


Figure 4-86: Location of damage

4.25.4 Other photos

Figure 4-87: Selection of other incident photos

4.25.5 Sources

- ATSB Transport Safety Report, “Loss of containers overboard from YM Efficiency”, 13 Feb 2020

4.26 MSC Zoe, 2019

4.26.1 Summary

Table 4-45: Summary of info

General info

IMO	9703318
Name	MSC Zoe
Year of build	2015
TEU capacity	19,224
Loa	395.4 m
B	59.0 m

Incident info

date & time	1 Jan 2019 19:00 UTC – 2 Jan 2019 0:00 UTC
speed	9 kn
position	53.6° N / 005.15° E *Netherlands Coast, North of Terschelling*
heading	065 deg
hindcast waves	Hs = 5.2 to 6.5 m (source: Deltaris)
draught	Ta/Tf = 12.47/12.03 m
transverse stability	10.23 m (FSC = 1.22 m)
Roll period	15.7 s
affected/damaged/lost containers	875/533/342 (No of damaged estimated)

Figure 4-88: Damage overview photo

4.26.2 Incident conditions

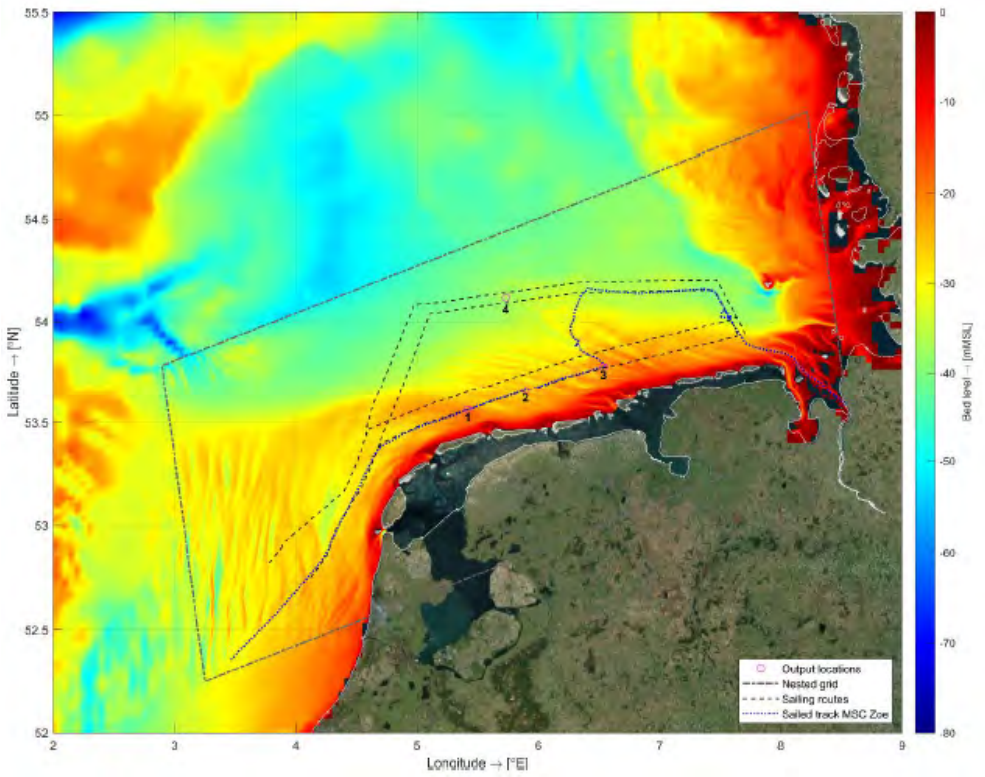


Table 4.1 Information on the considered main output locations along the sailed track of the MSC Zoe.

Loc. ID + *Time*	Longitude [°E]	Latitude [°N]	Bed level [mMSL]
1: *1-1-19 20:00 (20:10)*	5.420370	53.563703	-20.93
2: *1-1-19 22:00 (22:01)*	5.895292	53.660787	-26.52
3: *2-1-19 00:00 (00:30)*	6.538329	53.779176	-21.67
4: *2-1-19 00:00 (00:00)*	5.731791	54.117485	-37.37

Table 5.3 Wave parameters at the four considered output locations derived from the computed 2D wave spectra by SWAN for the respective selected moments in time.

Loc. ID + *Time*	H_s [m]	H_{max} [m]	h_{cr} [m]	h_p [m]	T_p [s]	$T_{m0,1}$ [s]	$T_{m0,2}$ [s]	$T_{m-1,0}$ [s]	L_p [m]	MWD [°N]	σ [°] (m [-])	γ [-]
1: *1-1-19 20:00*	5.23	9.59	6.48	3.11	11.77	9.07	8.36	10.20	153	340	20.93 (5.2)	1.15
2: *1-1-19 22:00*	5.66	10.50	6.74	3.76	12.10	9.40	8.69	10.51	172	336	22.55 (5.2)	1.40
3: *2-1-19 00:00*	6.46	11.53	8.25	3.28	12.43	10.03	9.33	11.08	164	333	23.77 (4.6)	1.67
4: *2-1-19 00:00*	6.37	11.84	7.09	4.75	12.25	9.54	8.86	10.57	196	336	23.48 (4.7)	1.53

Given the wave conditions and rolling period, close to resonant roll in beam seas is most likely. This is also what the report mention, possibly in combination of green water and bottom contact.

4.26.3 Description of damage

Major stack collapse of 5 out of the 24 bays.

Figure 4-89: Location of damage

4.26.4 Other photos

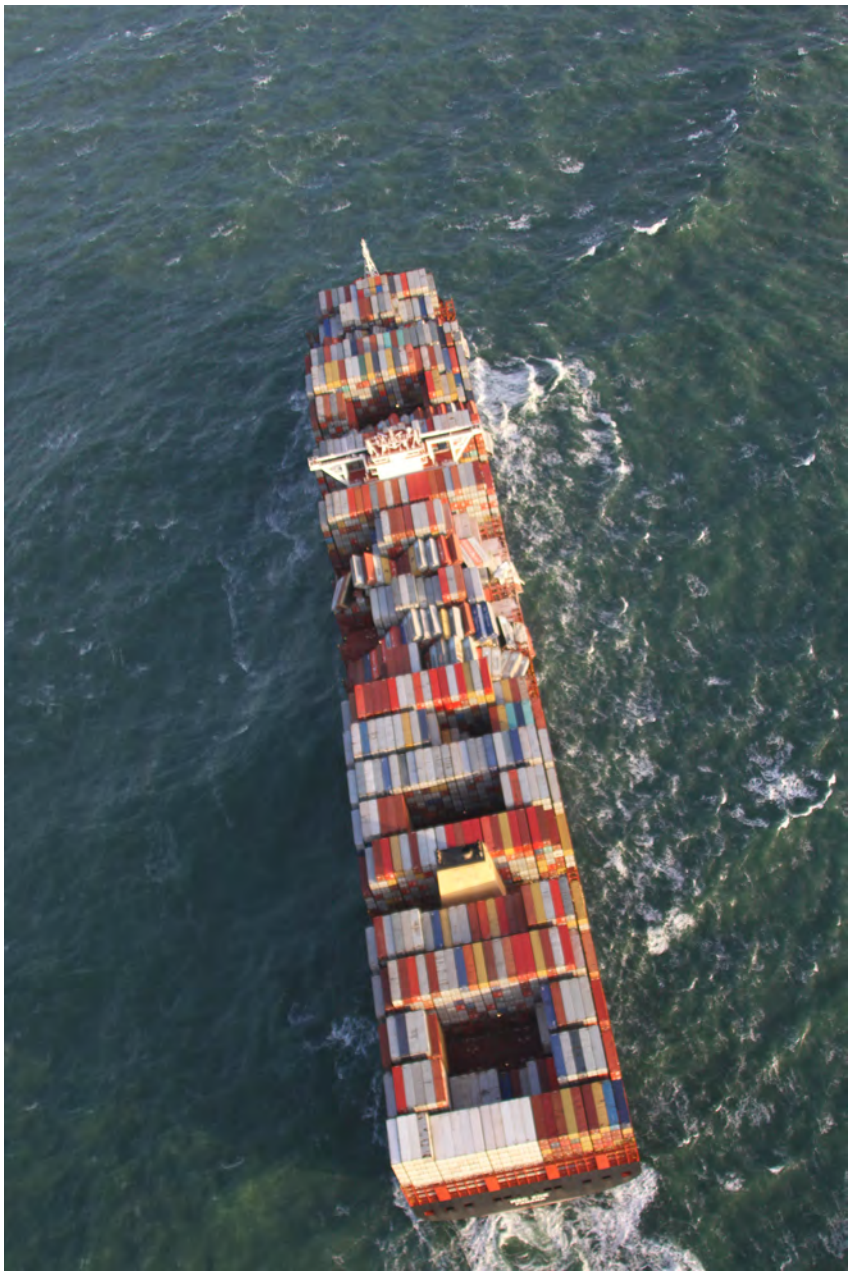


Figure 4-90: Selection of other incident photos

4.26.5 Sources

- https://www.kustwacht.nl/dossiers/msczoe
- Joint investigation report Panama Maritime Authority, Dutch Safety Board and Bundesstelle fur Seeunfalluntersuchung, *"Loss of containers overboard from MSC ZOE 1-2 Jan 2019",* 25 Jun 2020 https://www.bsu-bund.de/EN/Publications/Unfallberichte/_functions/unfallberichte_table_2020.html?nn=1351146

4.27 Helsinki Bridge, 2019

4.27.1 Summary

Table 4-46: Summary of info

General info

IMO	9588081
Name	Helsinki Bridge
Year of build	2012
TEU capacity	8,930
Loa	334.0
B	45.0

Incident info

date & time	27 Feb 2019, time unknown
speed	18 kn (estimation as per chapter 2)
position	42° N / 070° W *US East Coast*
Heading	Between 180 to 240 deg *Boston, USA to Wilmington, USA*
hindcast waves	Hs = 2.5 m
draught	Unknown
transverse stability	3 m (coastal voyage, estimation as per chapter 2)
roll period	22.4 s (coastal voyage, estimation as per chapter 2)
affected/damaged/lost containers	100/20/10

Figure 4-91: Damage overview photo

4.27.2 Incident conditions

Based on above info, the following weather conditions has been estimated:

Table 4-47: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	2.5	6.9	054	0.4	1.6	0.7	3.1
Swell	0.3	7.3	038	0.3	1.1	0.5	2.1
Windsea	2.5	6.9	054	0.4	1.6	0.7	3.1

Based on these stern quartering seas conditions and given the estimated rolling period of 22 s (based on a GM of 3 m), resonant roll in stern quartering seas seems most likely.

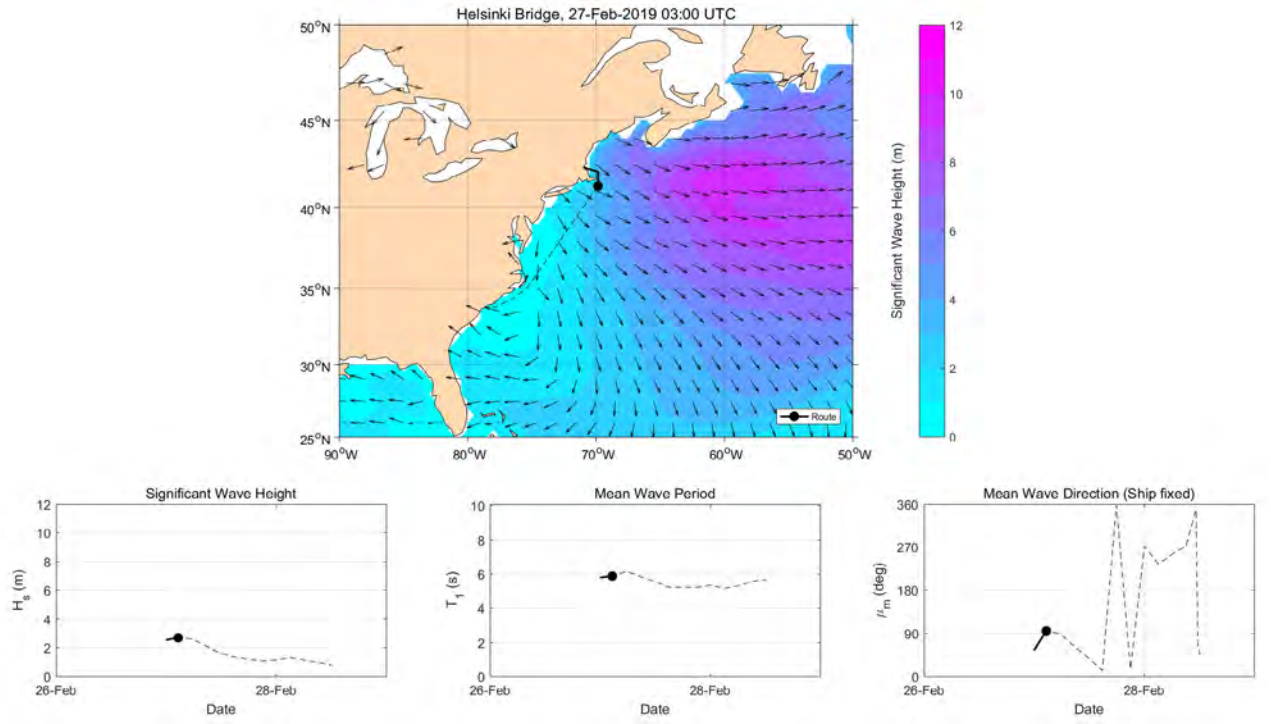


Figure 4-92: Wave hindcast (source ECMWF ERA5)

4.27.3 Description of damage

Figure 4-93: Location of damage

4.27.4 Other photos

Figure 4-94: Selection of other incident photos

4.27.5 Sources

- https://www.fleetmon.com/maritime-news/2019/25425/container-ship-containers-collapse-loss-eastern-us/

4.28 OOCL Rauma, 2020

4.28.1 Summary

Table 4-48: Summary of info

General info

IMO	9462794
Name	OOCL Rauma
Year of build	2009
TEU capacity	525
Loa	168.0 m
B	27.0 m

Incident info

date & time	11 Feb 2020 around 14:30 UTC (5 containers lost) & 12 Feb 2020 around 01:00 UTC (2 containers lost)
speed	15 kn (estimation as per chapter 2) prior to first incident; then dropped to 2 kn
position	53.8° N / 005.4° E *Dutch Coast (25 NM North of Ameland Island)*
heading	274 deg between first and second incident *Kotka, Finland to Rotterdam, Netherlands*
hindcast waves	Hs = 5.6 m
draught	Unknown
transverse stability	3 m (coastal voyage, estimation as per chapter 2)
roll period	13.4 s (coastal voyage, estimation as per chapter 2)
affected/damaged/lost containers	0/0/7

Figure 4-95: Damage overview photo

4.28.2 Incident conditions

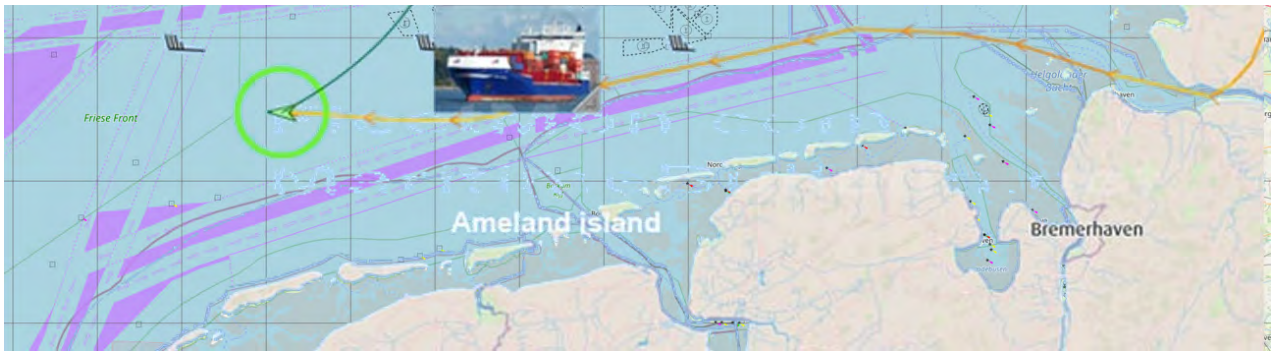


Figure 4-96: Approximate ship position at 15:30 (source fleetmon.com)

Table 4-49: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	5.6	10.4	180	1.0	1.4	0.7	2.7
Swell	1.1	12.0	139	1.2	1.2	0.6	2.4
Windsea	5.5	10.3	181	1.0	1.4	0.7	2.7

In these head seas conditions, large pitch/heave motions possibly in combination with shipping green water seem the most likely contributors.

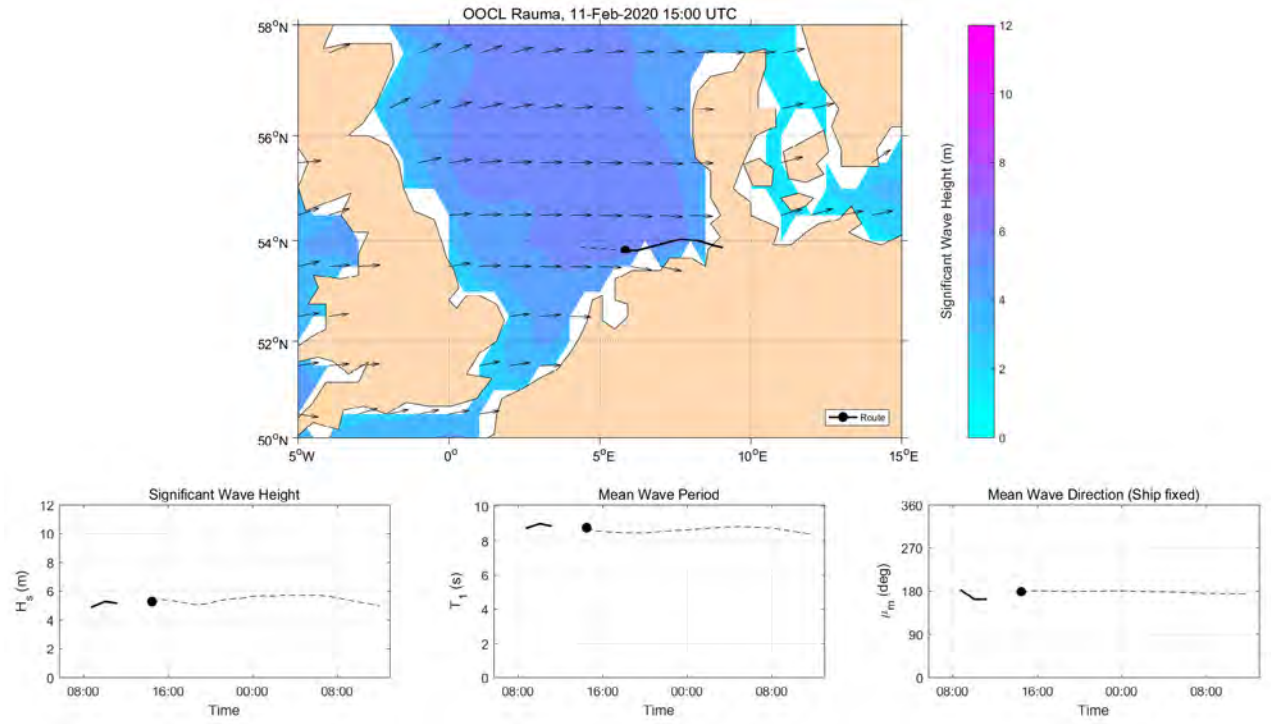


Figure 4-97: Wave hindcast (source ECMWF ERA5)

4.28.3 Description of damage

Partial stack collapse in 2 bays.

Figure 4-98: Location of damage

According to the lawsuit it was a combination of:

Heavy weather / maximum stack weight exceeded.

4.28.4 Other photos

Figure 4-99: Selection of other incident photos

4.28.5 Sources

- https://swzmaritime.nl/news/2020/02/17/investigation-into-container-vessel-oocl-rauma-losing-containers/
- https://www.omropfryslan.nl/nieuws/938699-schip-blijft-voorlopig-liggen-boven-terschelling-containers-nog-niet-gevonden
- https://www.fleetmon.com/maritime-news/2020/28761/dutch-container-ship-lost-containers-troubled-dutc/
- Tuchtcollege Voor De Scheepvaart, *"Uitspraak Van Het Tuchtcollege Voor De Scheepvaart Van 16 Juli 2021 (Nr. 11 Van 2021) In De Zaak 2020.V12-OOCL Rauma"*, 16 Jul 2021

4.29 APL England, 2020

4.29.1 Summary

Second incident also in Australia in 2016

Table 4-50: Summary of info

General info

IMO	9218650
Name	ZIM Haifa (present name) APL England
Year of build	2001
TEU capacity	5,510
Loa	277.0
B	40.0

Incident info

date & time	23 May 2020 16:15 UTC
speed	7 kn
position	34.37° S / 151.91° E *Australian Coast*
heading	185 deg
hindcast waves	Hs = 5.3 m
draught	Ta/Tf = 13.32/11.44 m
transverse stability	3 m (coastal voyage, estimation as per chapter 2)
roll period	19.9 s (coastal voyage, estimation as per chapter 2)
affected/damaged/lost containers	113/63/50

Figure 4-100: Damage overview photo

4.29.2 Incident conditions

From the incident report:

At 0215 EST (Eastern Standard Time, UTC+10) on 24 May, when about 40 NM east of Sydney, the ship underwent a series of heavy rolls… …The heavy rolling dissipated while the ship continued to pitch noticeably. At about 0230, the master changed course more southerly to 195° and maintained a ship speed of about 7 knots…

Based on the above and positions in the incident report the following weather conditions are found:

Table 4-51: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	5.3	11.2	164	0.7	2.1	1.0	4.1
Swell	2.3	13.4	199	0.7	1.7	0.8	3.4
Windsea	4.7	10.7	161	0.8	2.3	1.1	4.4

Based on the above conditions and a speed of 7 kn, the wave encounter period is approximately 8 s. As the transverse stability (GM) is not provided in the incident report, it is difficult to estimate the rolling period. A very rough guess would around 20 s (assuming a GM of 3 m and typical roll inertia) but it could vary between less than 10 s and above 38 s. Given the heading (head seas), low speed and T_ϕ/ T_e ratio, parametric roll in head seas is likely.

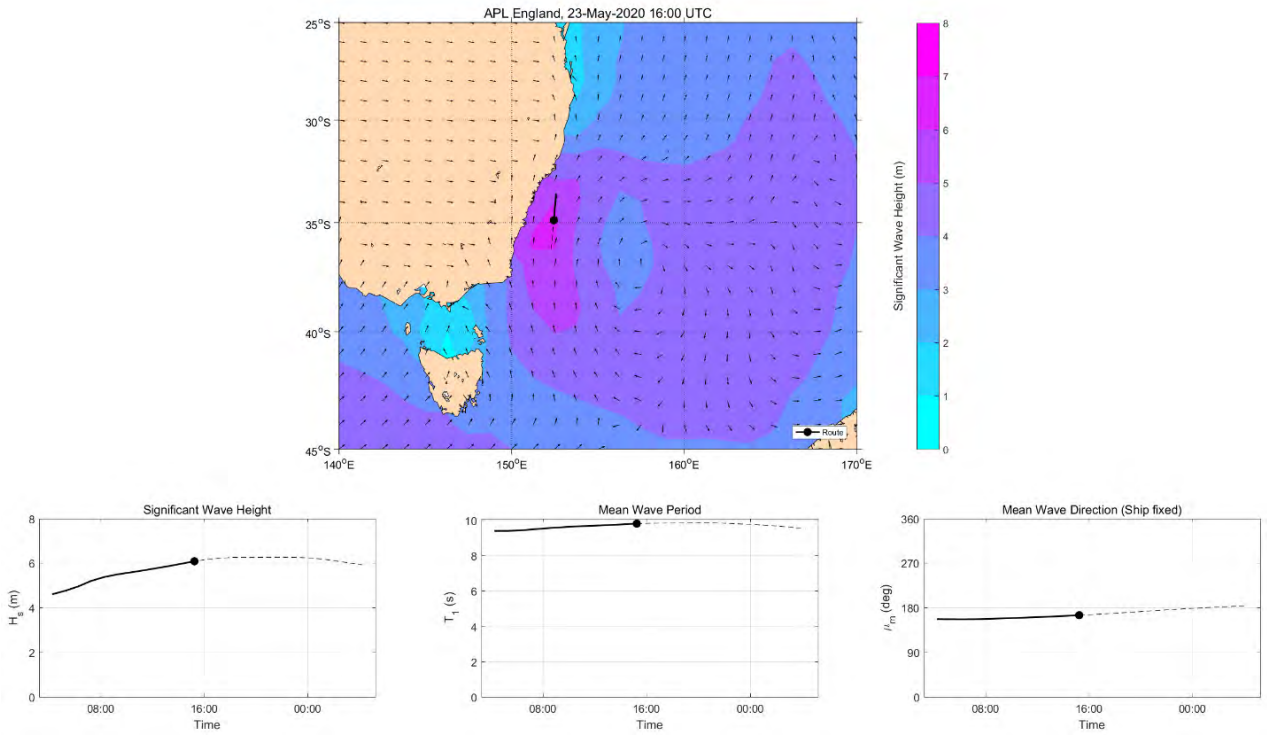


Figure 4-101: Wave hindcast (source ECMWF ERA5)

4.29.3 Description of damage

Complete stack collapse of 3 top layers at the stern (lashing bridge up to the 5th layer). In addition partial stack collapse (3 or 4 rows at SB), 4 bays before the wheelhouse.

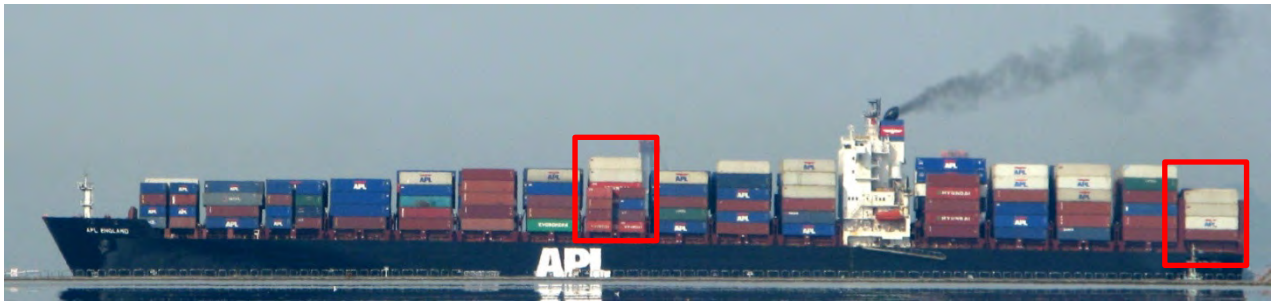


Figure 4-102: Location of damage

4.29.4 Other photos

Figure 4-103: Selection of other incident photos

4.29.5 Sources

- ATSB Transport Safety Report, “Loss of containers overboard involving APL England”, Preliminary, 28 October 2020
- https://www.abc.net.au/news/2020-05-30/shipmaster-of-apn-england-charged-over-container-spill/12304214

4.30 MSC Palak, 2020

4.30.1 Summary

Table 4-52: Summary of info

General info

IMO	9735206
Name	MSC Palak
Year of build	2016
TEU capacity	8,800
Loa	299.9 m
B	48.3 m

Incident info

date & time	14 Jul 2020 21:37 UTC
speed	0 kn (at anchor)
position	33.86° S / 025.68° E
heading	Unknown
hindcast waves	Hs = 7.1 m
draught	Unknown
transverse stability	3 m (coastal voyage, estimation as per chapter 2) *During interrupted unloading*
roll period	24.1 s (coastal voyage, estimation as per chapter 2)
affected/damaged/lost containers	22/0/22

Figure 4-104: Overview photo (no damage photos available)

4.30.2 Incident conditions

Following the information from internet the vessel left port Ngqura (near Port Elizabeth) because of the expected heavy swell and anchored outside. Based on this information it is assumed that the vessel was aligned with the wind and wind sea direction.

Table 4-53: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	7.1	14.7	190	1.1	1.6	0.8	3.2
Swell	1.5	17.7	209	1.3	1.4	0.6	2.7
Windsea	6.3	11.2	180	1.1	2.2	1.0	4.2

From the above information and estimated rolling period of 24 s (based on a GM of 3 m), parametric roll in head seas seems likely.

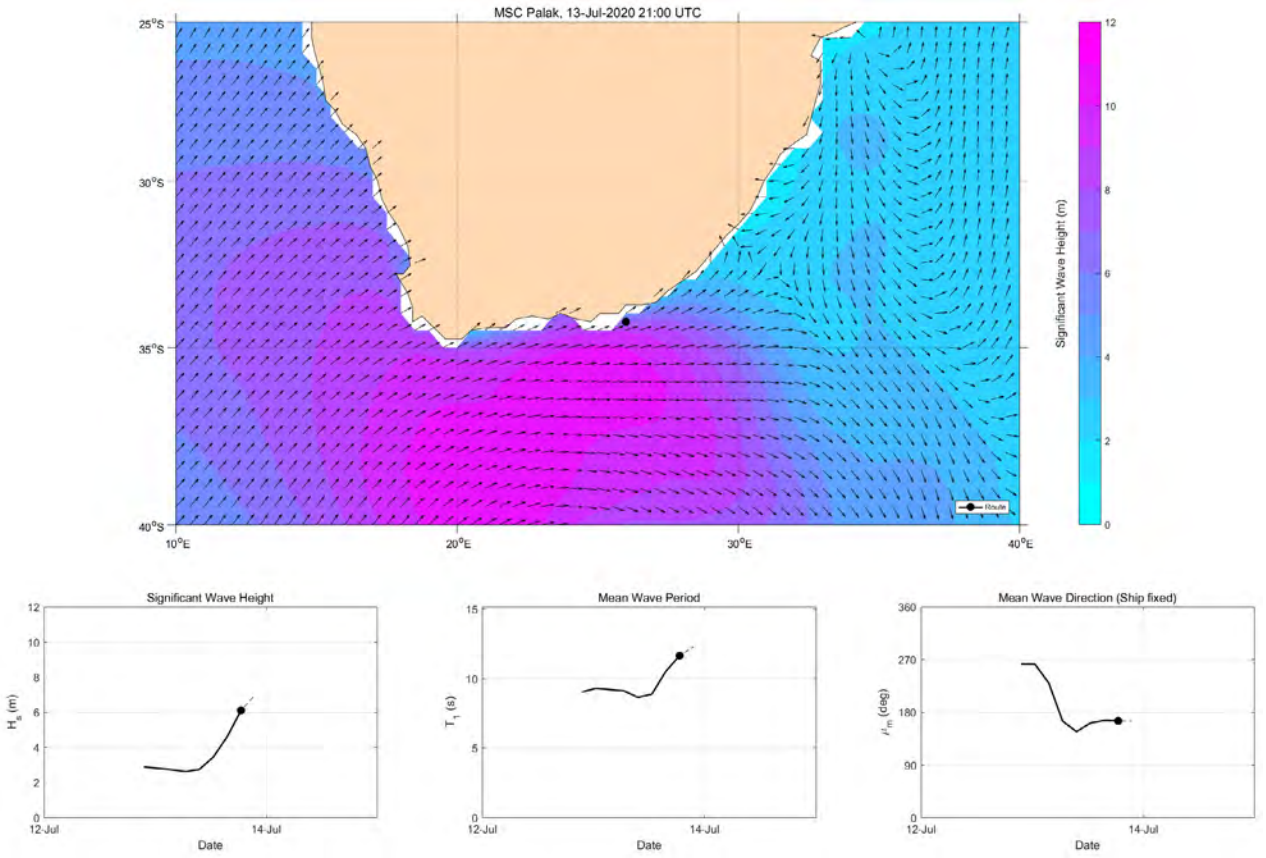


Figure 4-105: Wave hindcast (source ECMWF ERA5)

4.30.3 Description of damage

22 containers lost while at anchor riding out a storm. The exact stow position of lost containers is not reported.

4.30.4 Other photos

No photos available.

4.30.5 Sources

- https://blog.samsa.org.za/tag/msc-palak/
- https://www.fleetmon.com/maritime-news/2020/30277/msc-container-ship-lost-containers-rough-weather-l/
- https://africaports.co.za/2020/07/20/africa-ports-ships-maritime-news-20-july-2020/

4.31 UNI Florida, 2020

4.31.1 Summary

See also Ital Florida incident in 2007.

Table 4-54: Summary of info

General info

IMO	9308039
Name	GFS Perfect UNI Florida (2015) ITAL Florida (2007)
Year of build	2007
TEU capacity	3,450
Loa	239.0
B	32.0

Incident info

date & time	Before 27 Jul 2020 (arrival port Jabel Ali, Dubai)
speed	Unknown
position	Arabian Sea
heading	Saudi Arabia (unknown departure port) to Dubai
hindcast waves	Unknown
draught	Unknown
transverse stability	Unknown
roll period	Unknown
affected/damaged/lost containers	65/20/10 (rough count from photo)

Figure 4-106: Damage overview photo

4.31.2 Incident conditions

As the departure port is unknown it is also unknown if the vessel went from the Red Sea to the Persian Gulf (for instance when it departed from Jeddah) or that it stayed in the Persian Gulf (e.g departure from Damman port). In both cases the wave conditions are relatively mild.

4.31.3 Description of damage

Stack collapse of 1 bay at the stern.

Figure 4-107: Location of damage

4.31.4 Other photos

Figure 4-108: Selection of other incident photos

4.31.5 Sources

- https://www.fleetmon.com/maritime-news/2020/30449/containers-collapsed-board-container-ship-uae/
- https://www.marineinsight.com/shipping-news/watch-vessel-uni-florida-arrives-in-uae-with-toppled-containers/
- https://www.facebook.com/ologdubai/photos/pcb.1639820626180874/1639820576180879/?type=3&theater

4.32 ONE Aquila, 2020

4.32.1 Summary

Table 4-55: Summary of info

General info	
IMO	9806043
Name	ONE Aquila
Year of build	2018
TEU capacity	14,000
Loa	364.0 m
B	51.0 m
Incident info	
date & time	Approx. 29 Oct 2020 14:21 UTC
speed	Approx. 11.6 kn
position	Approx. 40.5° N / 176° E Pacific, eastbound
heading	Approx. 085 deg *Hong Kong to Long Beach, USA*
reported weather	Hs = 5.6 m
draught	Unknown
transverse stability	2 m (long voyage, estimation as per chapter 2)
roll period	31.1 s (long voyage, estimation as per chapter 2)
affected/damaged/lost containers	Approx. 180/80/100 (100+ reported & photo count)

Figure 4-109: Damage overview photo

4.32.2 Incident conditions

From the plot below, position, speed and time of incident has been estimated.

Figure 4-110: Approximate ship position (source fleetmon.com)

Based on above info, the following weather conditions has been estimated:

Table 4-56: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	5.6	12.7	015	0.7	1.7	0.9	2.8
Swell	4.8	14.2	021	0.7	1.6	0.9	2.6
Windsea	3.0	8.8	001	0.7	2.0	1.1	3.2

At a speed of 11.6 kn this results in a wave encounter period of approximately 16.7 s. As the loading condition is unknown it is difficult to estimate the rolling period. A very rough guess would around 31 s (assuming a GM of 2 m and typical roll inertia) but it could vary between less than 17 s and above 48 s. Therefore it is could be both parametric or resonant roll, but parametric roll seems slightly more likely.

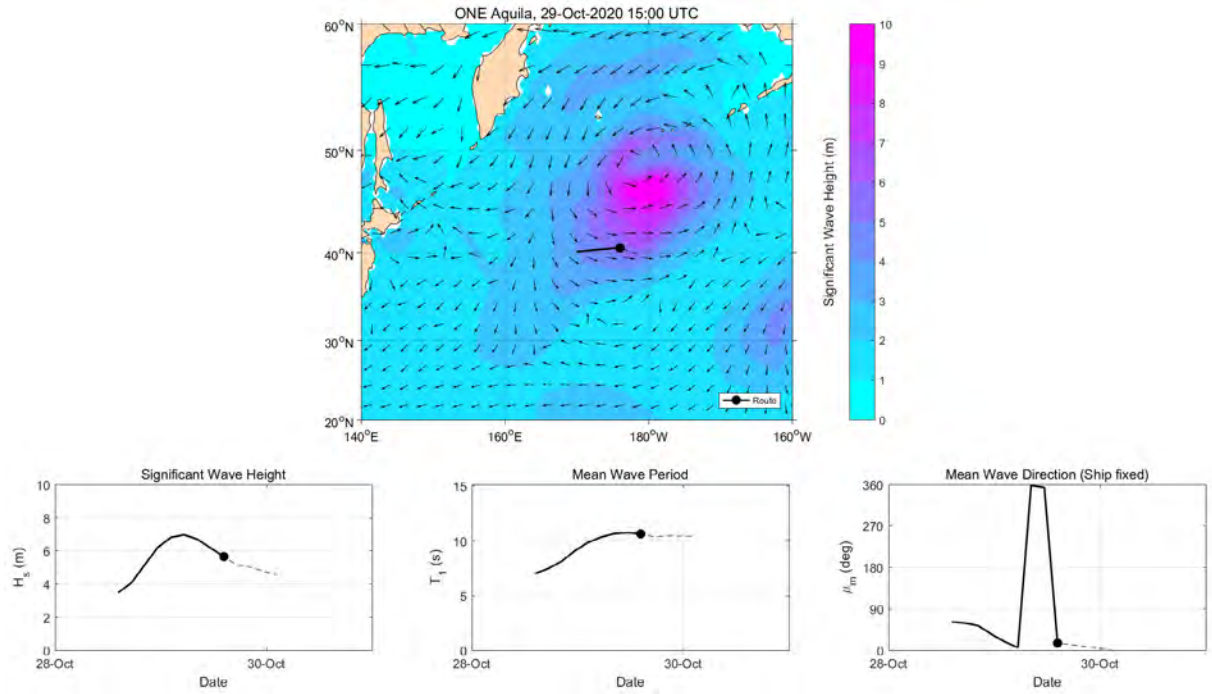


Figure 4-111: Wave hindcast (source ECMWF ERA5)

4.32.3 Description of damage

Stack collapse of 1 bay at the stern.

Figure 4-112: Location of damage

4.32.4 Other photos

Figure 4-113: Selection of other incident photos

4.32.5 Sources

- http://www.maritimebulletin.net/2020/11/04/one-mega-container-ship-lost-at-least-100-containers-in-the-pacific-update/
- https://www.fleetmon.com/maritime-news/2020/31505/one-mega-container-ship-lost-least-100-containers-/
- https://westseattleblog.com/2020/11/seen-off-west-seattle-cargo-ship-headed/

4.33 Seroja Lima, 2020

4.33.1 Summary

Table 4-57: Summary of info

General info

IMO	9567661
Name	Seroja Lima
Year of build	2011
TEU capacity	8,540
Loa	316.0
B	46.0

Incident info

date & time	19 Nov 2020 22:00 UTC (possibly 20 Nov 2020 morning)
speed	18.5 kn (on 19 Nov 2020)
position	Approx. 38° 40' N / 019° 30' W *Atlantic, westbound*
heading	285 deg *Suez, Egypt to New York, USA*
hindcast waves	Hs = 3.7 m
draught	Unknown
transverse stability	2 m (long voyage, estimation as per chapter 2)
roll period	28.1 s (long voyage, estimation as per chapter 2)
affected/damaged/lost containers	117/90/27

Figure 4-114: Overview phot (no damage overview photos available)

4.33.2 Incident conditions

From the plot below, position, speed and time of incident has been estimated.

Figure 4-115: Approximate ship position (source fleetmon.com)

Based on above info, the following weather conditions have been estimated:

Table 4-58: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	3.7	10.6	071	1.7	2.1	1.2	3.4
Swell	3.2	11.9	083	4.7	2.2	1.2	3.5
Windsea	1.9	7.1	042	0.7	1.4	0.8	2.3

From the wave conditions (around beam seas and a Tϕ/Te of over 2), resonant roll and parametric roll are both not very likely.

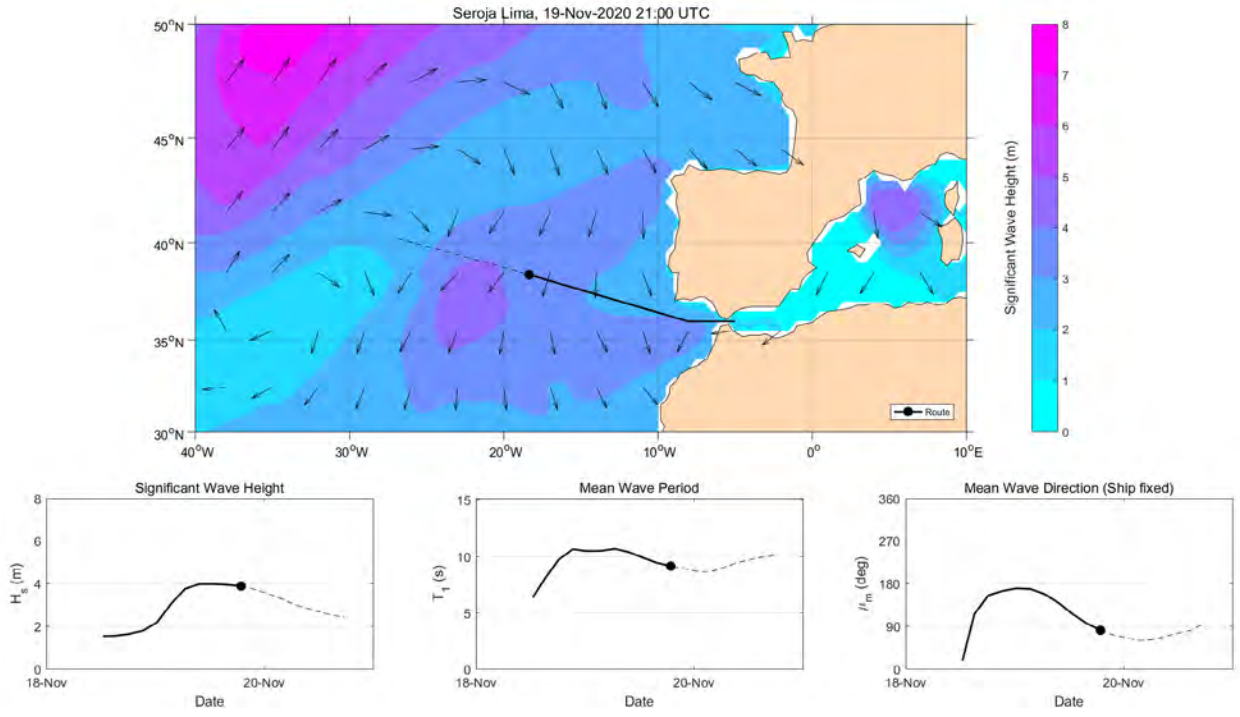


Table 4-59: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

4.33.3 Description of damage

Not possible.

4.33.4 Other photos

No other photos.

4.33.5 Sources

- https://www.fleetmon.com/maritime-news/2020/31785/post-panamax-container-ship-lost-least-27-containe/
- https://container-news.com/msc-cargo-lost-in-maersk-boxship-stack-collapse-incident/
- https://www.wkwebster.com/casualty-details/156/seroja-lima

4.34 ONE Apus, 2020

4.34.1 Summary

Table 4-60: Summary of info

General info	
IMO	9806079
Name	ONE Apus
Year of build	2019
TEU capacity	14,000
Loa	364.0 m
B	51.0 m
Incident info	
date & time	30 Nov 2020 13:15 UTC
speed	13.1 kn
position	33.25° N / 172.6° W *Pacific*
heading	Approx. 100 deg *Eastbound*
hindcast waves	Hs = 4.6 m
draught	Unknown
transverse stability	1.5 m (Pacific eastbound, estimation as per chapter 2)
roll period	35.9 s (Pacific eastbound, estimation as per chapter 2)
affected/damaged/lost containers	2756/940/1816

Figure 4-116: Damage overview photo

4.34.2 Incident conditions

From the plot below, position, speed and time of incident has been estimated.

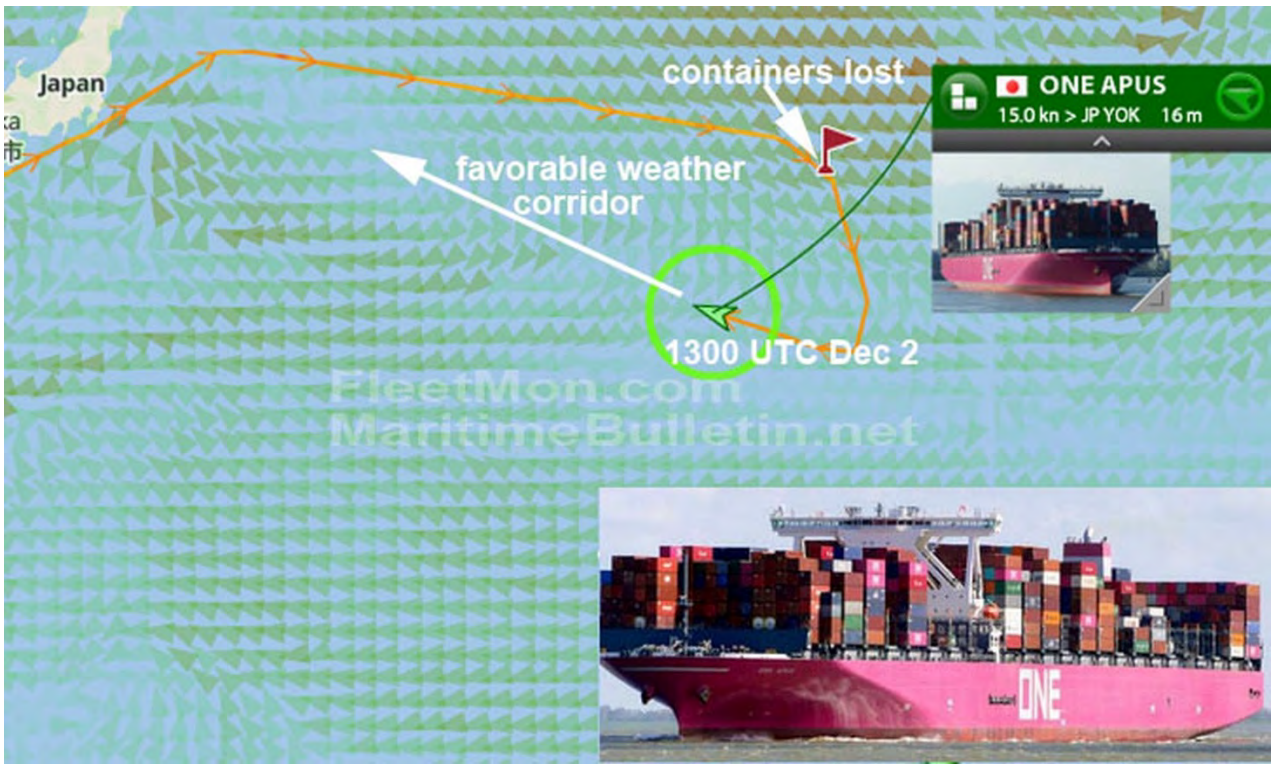


Figure 4-117: Approximate ship position (source maritimebulletin.net)

Based on above info, the following weather conditions has been estimated:

Table 4-61: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.6	14.9	020	1.0	1.8	1.2	2.6
Swell	4.6	15.1	020	1.0	1.7	1.2	2.6
Windsea	0.5	4.0	011	1.0	0.6	-0.4	-0.9

As the loading condition is unknown it is difficult to estimate the rolling period. A very rough guess would around 36 s (assuming a GM of 1.5 m and typical roll inertia) but it could vary between roughly 24 s and above 50 s. Based on the wave direction and T_ϕ/ T_e ratio, parametric roll in following seas seems most likely.

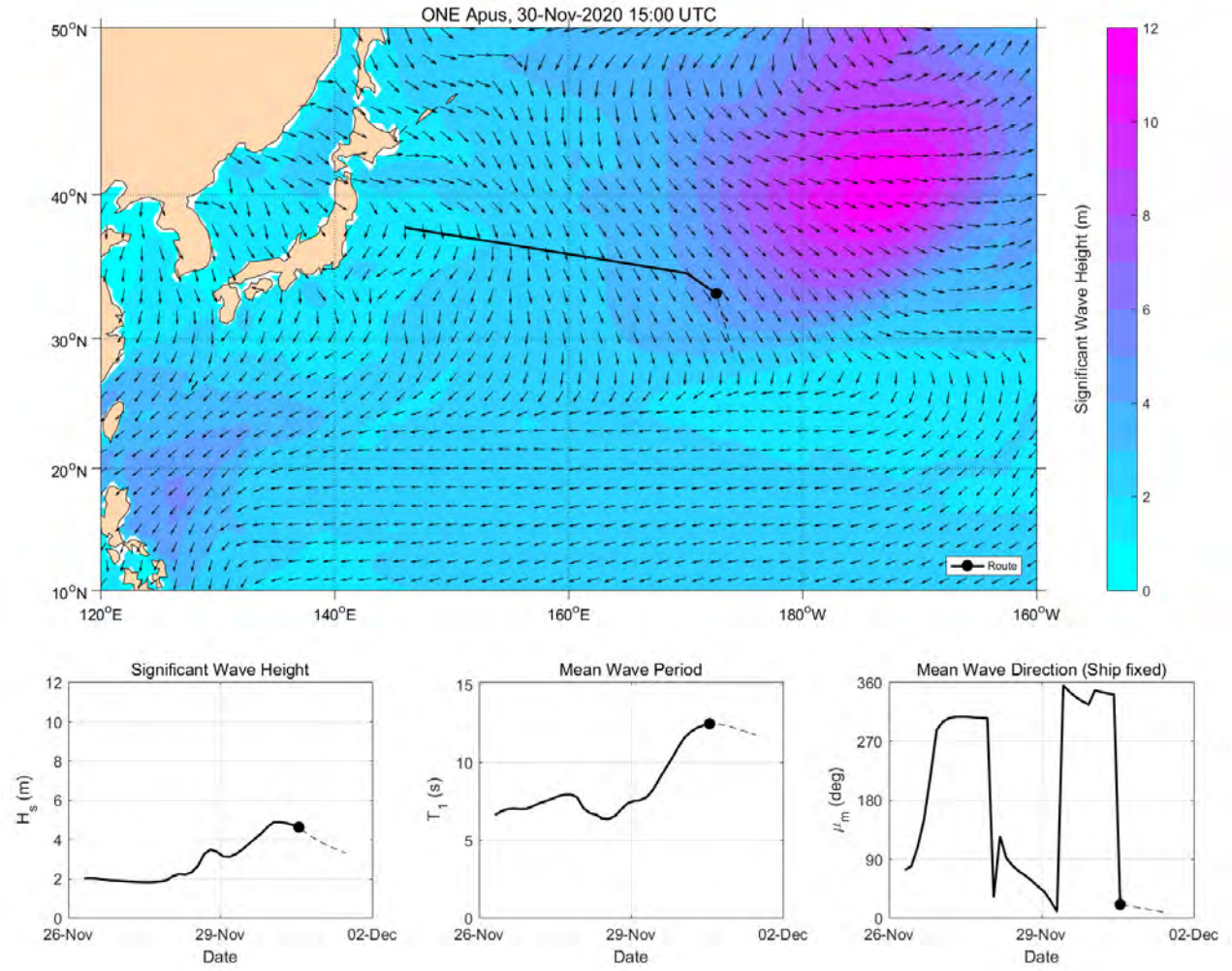


Figure 4-118: Wave hindcast (source ECMWF ERA5)

4.34.3 Description of damage

18 Of the bays collapsed. From which 16 completely and 2 partially.

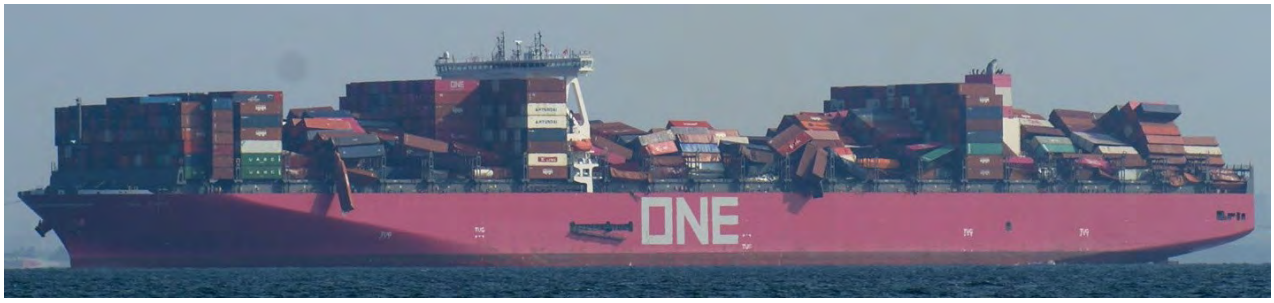


Figure 4-119: Location of damage

4.34.4 Other photos

Figure 4-120: Selection of other incident photos

4.34.5 Sources

- https://youtu.be/kSpesP7-6vo
- https://gcaptain.com/drone-footage-gives-new-view-of-one-apus-damage/
- https://gcaptain.com/one-apus-discharges-in-long-beach-after-last-years-epic-cargo-loss/
- http://www.maritimebulletin.net/2020/11/30/ultra-large-container-ship-lost-some-50-containers-in-north-pacific/

4.35 Ever Liberal, 2020

4.35.1 Summary

Table 4-62: Summary of info

General info

IMO	9604160
Name	Ever Liberal
Year of build	2014
TEU capacity	8,452
Loa	335.0
B	46.0

Incident info

date & time	30 Dec 2020 02:30 UTC
speed	23.4 kn
position	31° 21.6’ N / 129° 32.3’ E *Japanese Coast*
heading	144 deg *Busan, Korea to Los Angeles, USA*
hindcast waves	Hs = 5.5 m
draught	Ta/Tf = 12.6/12.6 m
transverse stability	1.4 m
roll period	33.2 s (based on estimated roll inertia)
affected/damaged/lost containers	66/30/36

Figure 4-121: Damage overview photo

4.35.2 Incident conditions

Statement as received from Evergreen:
Ship was sailing from PUS on Dec/30,0118hrs, via Osumi Kaikyo for Los Angeles. At the time NNW wind 30-45kts, very rough sea and swell, ship was rolling mod'ly about 10 degree to both side, On Dec.30th 1126LT at position 31-21.6N, 129-32.3E, before entering Osumi Kaikyo. Suddenly ship was rolling to 15 degree about two times, duty officer heard one 'PONG" sound, he found some containers collapsed and fell to sea on ship starboard side, I reported to DP immediately, in the meantime, I adjusted ship course to 190-200, reduced ship speed to 60 rpm to keep ship in stable situation and less ship's rolling within 5 degrees.

From above statement and the plot below, position, speed and time of incident are established.

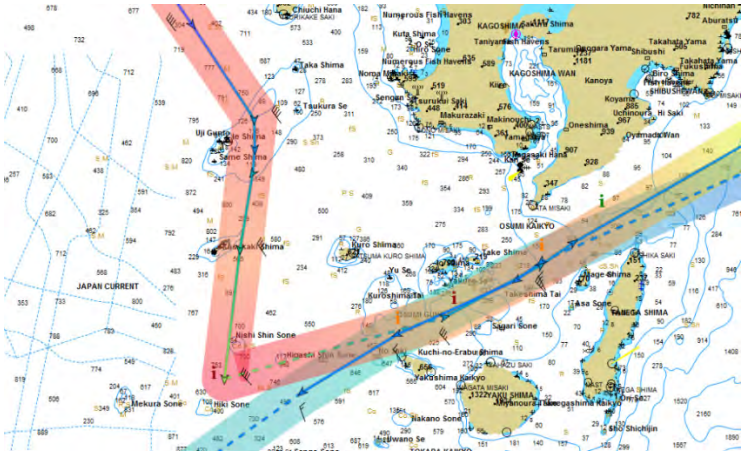


Figure 4-122: Approximate ship position (source pandr-marine.com)

Based on above info, the following weather conditions has been estimated (note that this is lower than the 6-7 m waves pandr-marine.com estimated):

Table 4-63: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs	Tp	μ	λ/L	Tϕ/Te [-]		
	[m]	[s]	[deg]	[-]	Typical	Low	High
Total	5.5	10.8	025	0.6	1.1	0.8	1.3
Swell	1.2	12.2	055	0.9	1.7	1.3	2.1
Windsea	5.4	10.7	024	0.6	1.1	0.8	1.3

At a speed of 23.4 kn this results in a wave encounter period of approximately 31 s. The rolling period is estimated at 33 s (assuming a typical kxx). Therefore resonant roll seems likely.

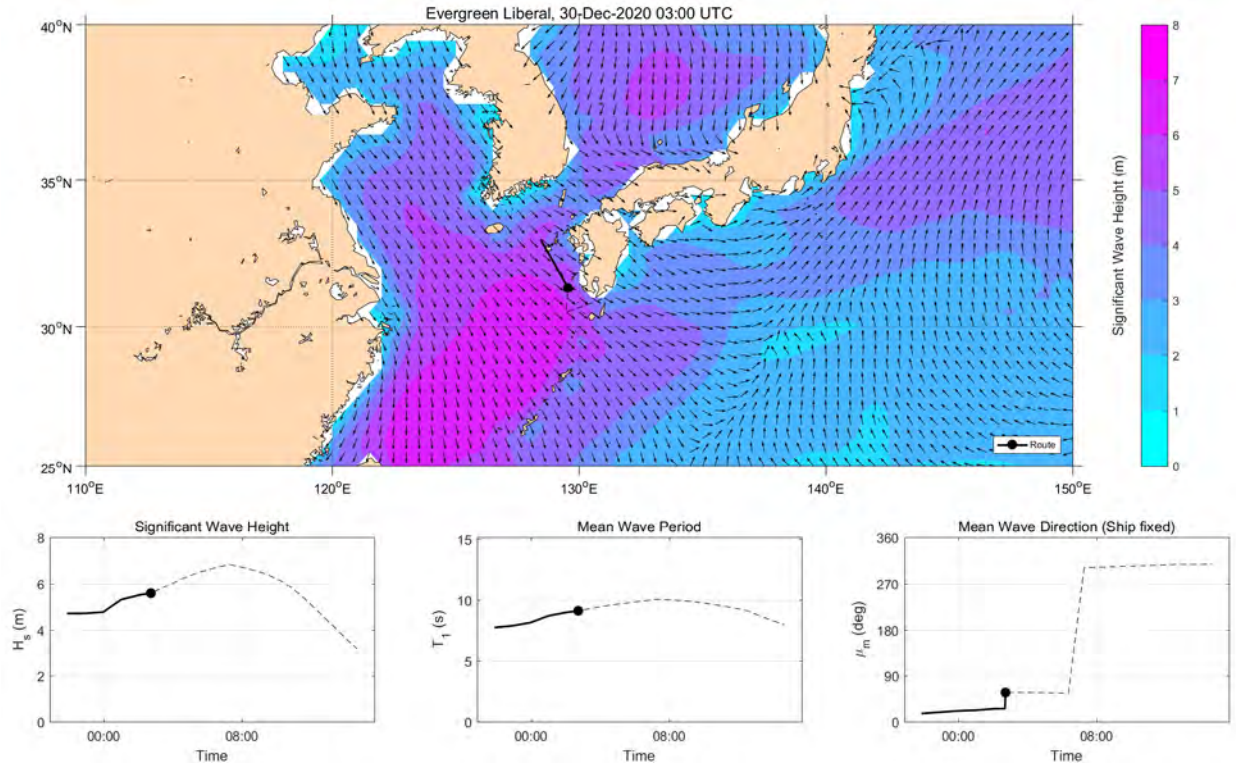


Figure 4-123: Wave hindcast (source ECMWF ERA5)

4.35.3 Description of damage

Stack collapse 2 bays behind the bridge

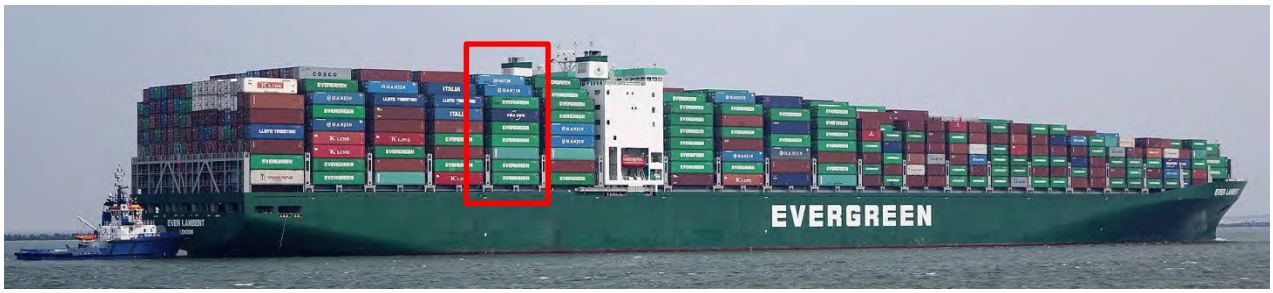


Figure 4-124: Location of damage

Statement as received from Evergreen:

Observation Report by Operation Personnel

EVER LIBERAL was fully complied with CSM, all securing and lashing was arranged accordingly. Although we found two mix-used of twistlocks with different makers in BAY62&BAY74, those containers were still secured properly without damage in their original cell position. It could therefore be concluded that containers didn't get any damage or insecurity issue during transportation because of mix-used twistlocks. We did have survey at scene personally when vessel berthed in Taipei, and found total 10 of baselocks which were unlocked, improperly locked, broken of handling bar, or even didn't sit properly into corner casting in BAY58 to BAY78. Nevertheless, those containers were still keep safely onboard without any damage. Therefore, based on the result of survey at scene, we could infer the incident of loss containers at sea was not direct relevant to lashing force issues. To sum up all above and reviewing together with BAY62's bay plan, we suspected that incident of loss containers were resulted by fallen containers which were loaded in BAY62 ROW02/01/03/05/07/09, and might coming from weak points in the bay plan. The reason of fallen for those containers were unknown, but we guessed the problem was coming from below reasons,

a. FAT failure
b. Containers in poor condition
c. Cargo contents secured improperly

Survey Report
Lashing materials were inspected at bay no. 62 and found part of lashing bars were bent heavily, turnbuckles were parted, some twistlocks were broken and pin of shackles were missing. We noted most containers collapsed or fell into water from 6 tiers because the containers were secured by twistlocks only without lashing or bridge fitting applied on containers. Furthermore, we found a few different twistlocks applied on the containers. Deck officer revealed to us that such different twistlocks were possibly fitted by stevedores ashore during loading operation.

According to our above findings, we are of the view that the above noted collapse of containers stowed on board the vessel might have been attributed to insufficient strength of securing materials (twistlock) without lashing, resulted in the securing materials were parted due to sudden jerk during rolling at sea when encountered heavy weather and containers collapsed on deck or fell into water during the voyage. We further suspected that the different twistlocks applied on the containers might have also been one of the reasons resulting in containers collapsed.

4.35.4 Other photos

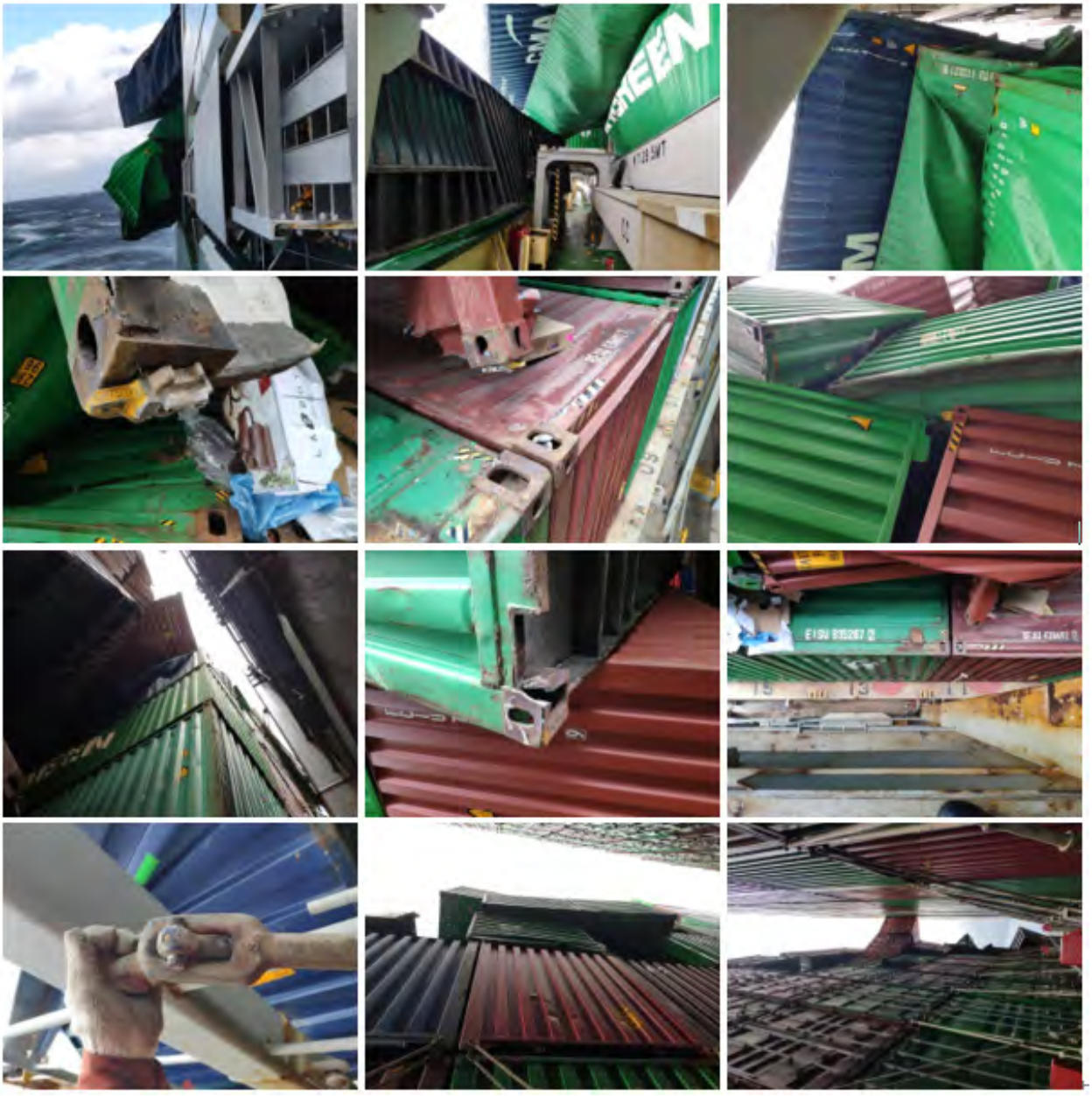


Figure 4-125: Selection of other incident photos

4.35.5 Sources

- https://www.offshore-energy.biz/evergreen-boxship-loses-36-containers-in-bad-weather/
- https://gcaptain.com/evergreen-ship-loses-36-containers-off-japan/
- https://www.pandr-marine.com/ever-liberal-collapse-containers-30th-dec-2020/108/
- Info received from Evergreen

4.36 Maersk Essen, 2021

4.36.1 Summary

Table 4-64: Summary of info

General info	
IMO	9456783
Name	Maersk Essen
Year of build	2010
TEU capacity	13,100
Loa	366.0 m
B	48.0 m
Incident info	
date & time	16 Jan 2021 19:21 UTC
speed	Approx. 10 kn
position	Approx. 29° N 154° W *Pacific, eastbound*
Heading	Approx. 095-135 deg *Xiamen, China to Los Angeles, USA*
hindcast waves	Hs = 6.2 m
draught	Unknown
transverse stability	1.5 m (Pacific eastbound, estimation as per chapter 2)
roll period	33.8 s (Pacific eastbound, estimation as per chapter 2)
affected/damaged/lost containers	750/0/750

Figure 4-126: Damage overview photo

4.36.2 Incident conditions

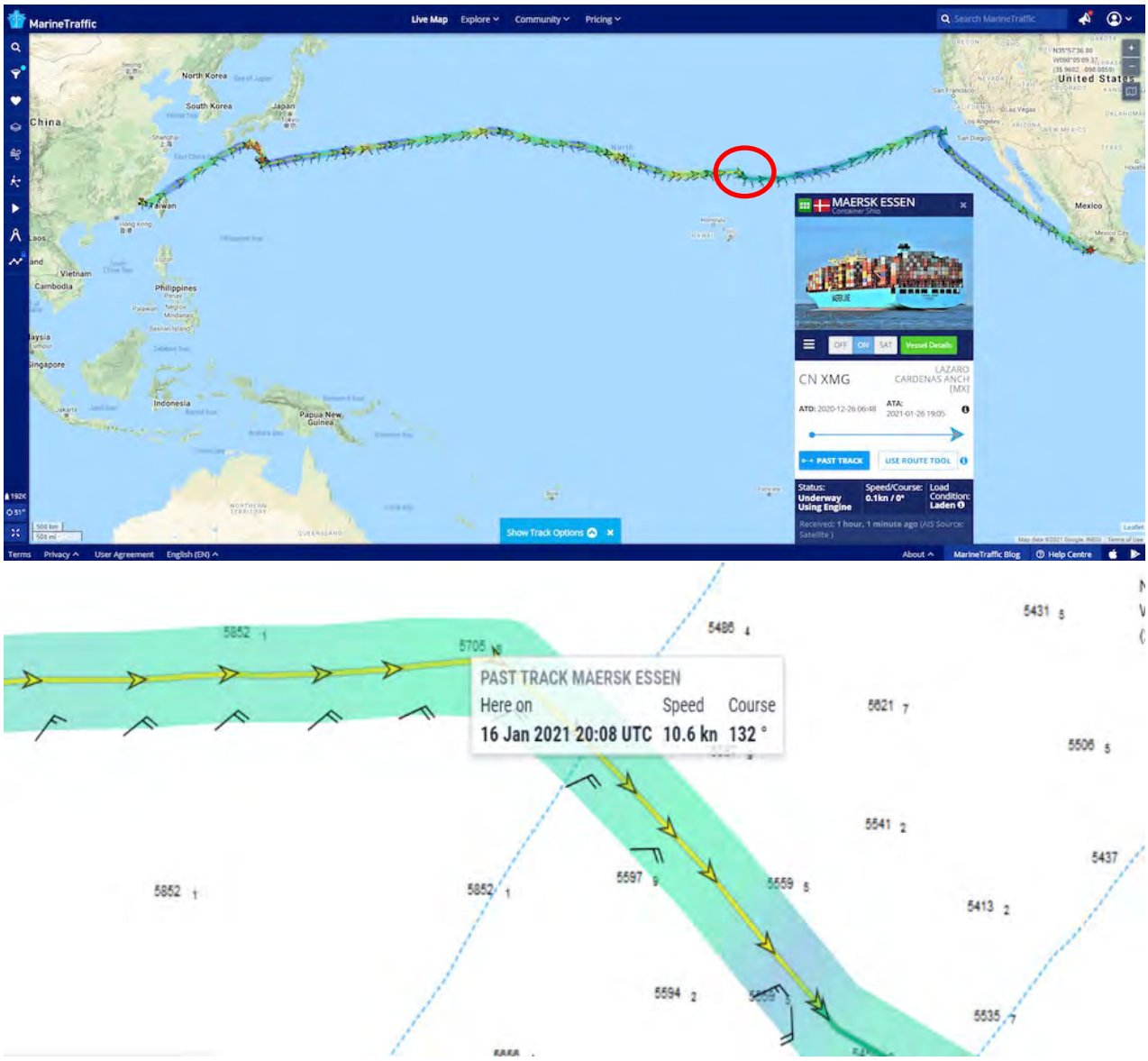


Figure 4-127: Approximate ship position (source MarineTraffic.com & www.pandr-marine.com)

From the above information the following wave conditions are estimated:

Table 4-65: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	6.2	18.3	356	1.4	1.5	1.0	2.3
Swell	6.1	18.8	357	1.4	1.5	1.0	2.2
Windsea	1.2	5.6	203	1.6	9.4	6.2	14.1

As the loading condition is unknown it is difficult to estimate the rolling period. A very rough guess would around 34 s (assuming a GM of 1.5 m and typical roll inertia) but it could vary between less than 23 s and above 50 s. Based on the wave direction and T_ϕ/ T_e ratio, parametric roll and resonant roll are both possible. But given the following seas conditions, parametric roll in following seas is more likely.

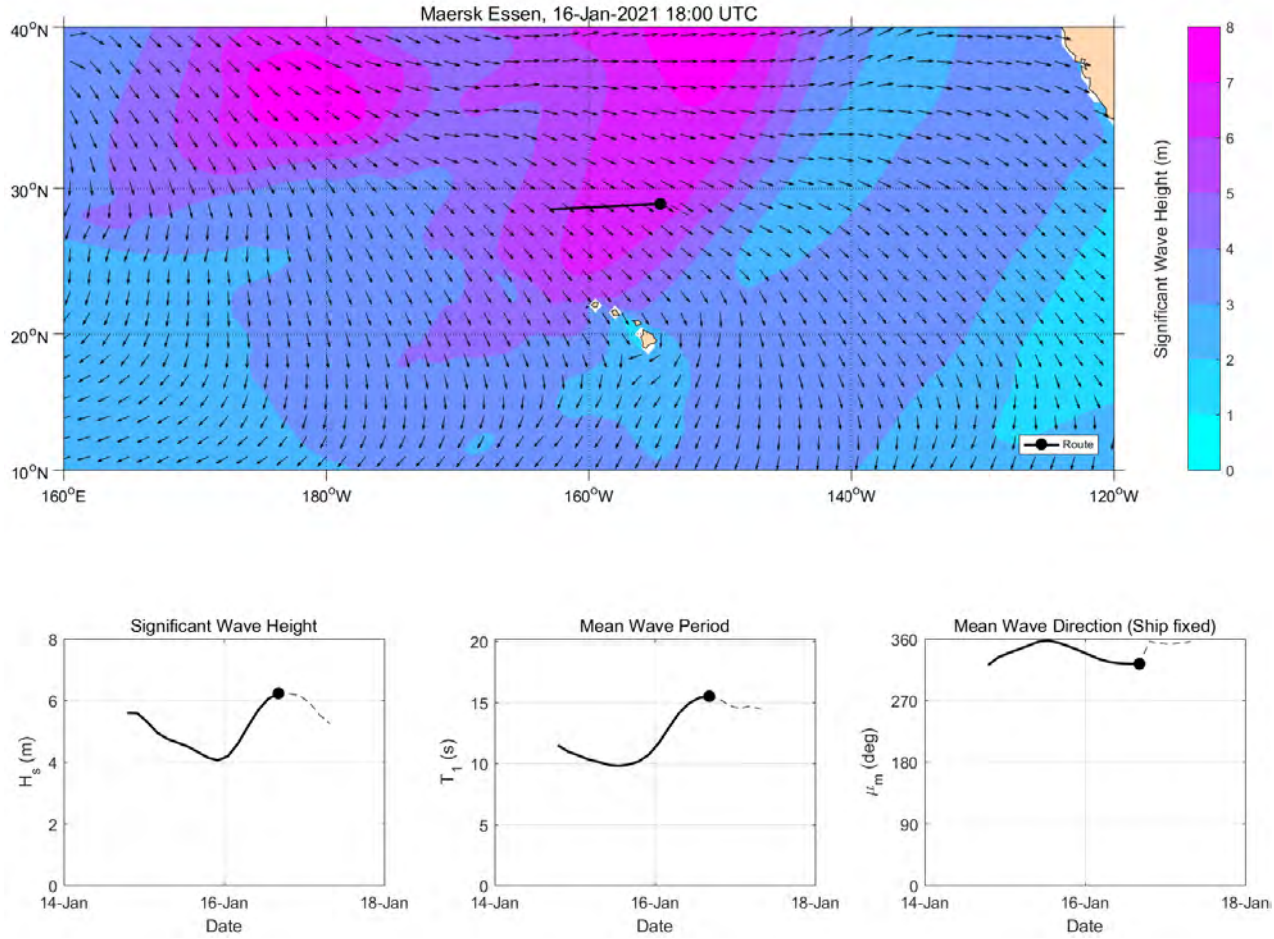


Figure 4-128: Wave hindcast (source ECMWF ERA5)

4.36.3 Description of damage

Multiple stack collapse bay 4, 9, 9 and 10.

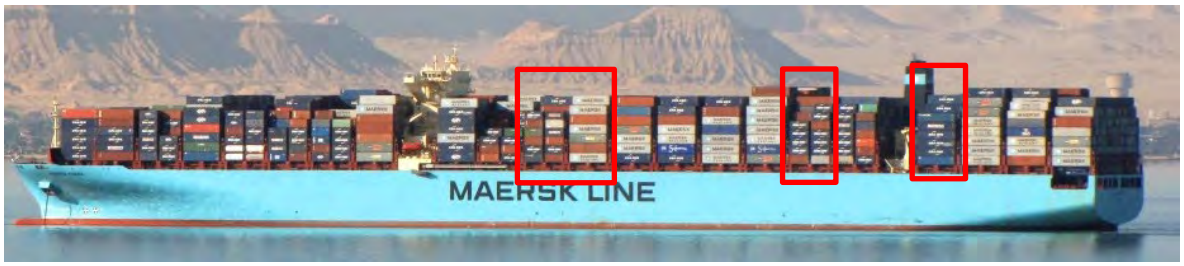


Figure 4-129: Location of damage

4.36.4 Other photos

Figure 4-130: Selection of other incident photos

4.36.5 Sources

- https://dmaib.com/reports/2021/maersk-essen-loss-of-cargo-on-16-january-2021-ongoing-investigation/
- https://www.pandr-marine.com/maersk-essen-collapse-container-16th-jan-2021/117/
- https://www.maritime-executive.com/article/maersk-boxship-loses-750-containers-overboard-in-north-pacific

4.37 MSC Aries, 2021

4.37.1 Summary

Table 4-66: Summary of info

General info

IMO	9857169
Name	MSC Aries
Year of build	2020
TEU capacity	14,300
Loa	366.0
B	51.0

Incident info

date & time	26 Jan 2021 06:16 UTC
speed	21.6 kn
position	22° 06’ N / 154° 01’ W *Pacific, westbound*
heading	274 deg *Long Beach, USA to Ningbo, China*
hindcast waves	Hs = 4.1 m
draught	Unknown
transverse stability	2 m (long voyage, estimation as per chapter 2)
roll period	31.1 s (long voyage, estimation as per chapter 2)
affected/damaged/lost containers	43/0/43

Figure 4-131: MSC Aries (no incident photos available)

4.37.2 Incident conditions

From the plots below, position, speed and time of incident has been estimated.

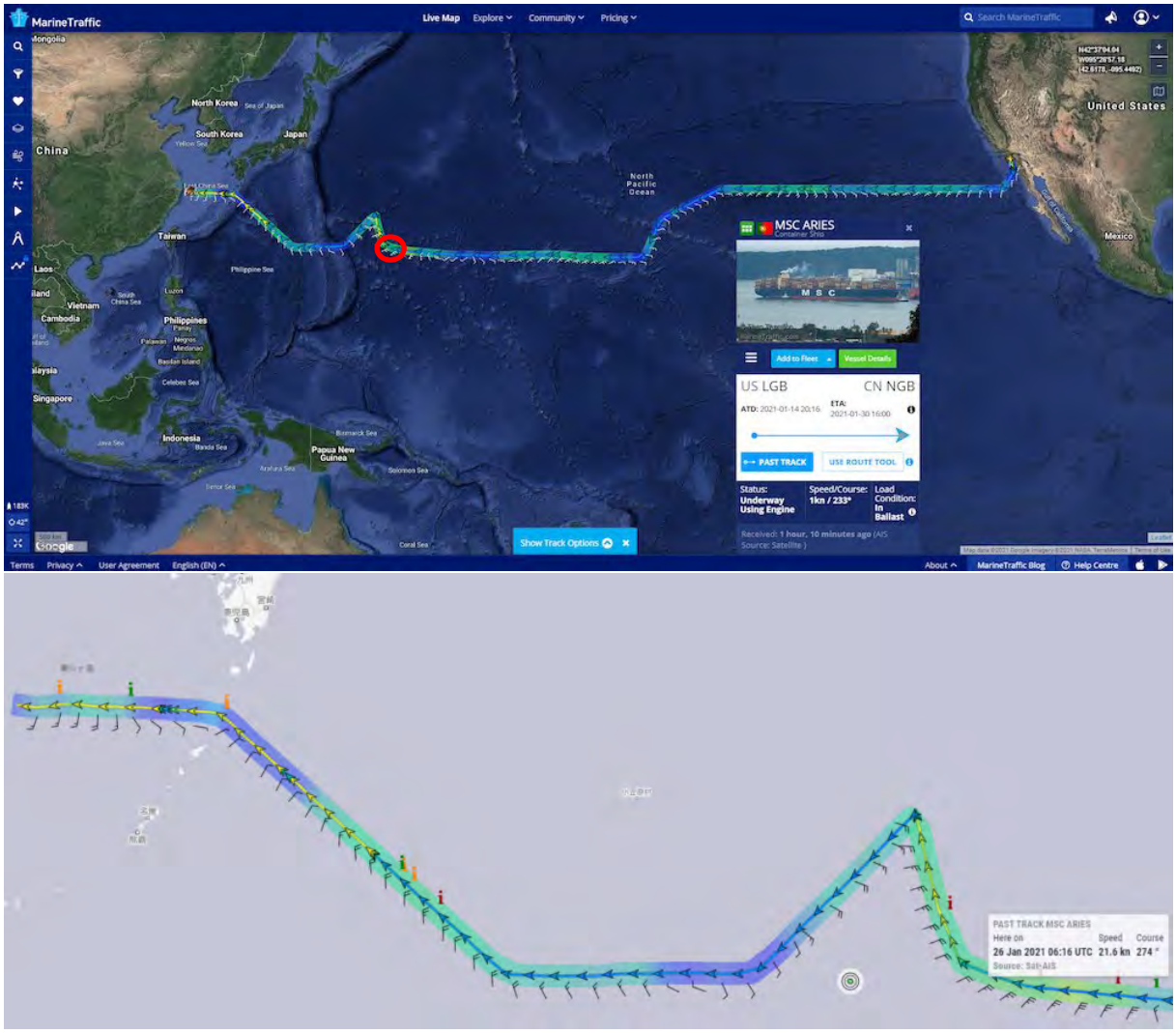


Figure 4-132: Approximate ship position (sources fleetmon.com & pandr-marine.com)

Based on above info, the following weather conditions has been estimated:

Table 4-67: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.1	11.2	134	0.8	4.0	2.2	6.4
Swell	3.2	13.1	149	0.6	3.5	1.9	5.5
Windsea	2.6	8.1	112	1.4	5.1	2.8	8.1

As the loading condition is unknown it is difficult to estimate the rolling period. A very rough guess would around 31 s (assuming a GM of 2 m and typical roll inertia) but it could vary between less than 17 s and up to around 50 s. Based on the wave direction and T_ϕ/ T_e ratio, parametric roll and resonant roll are both unlikely.

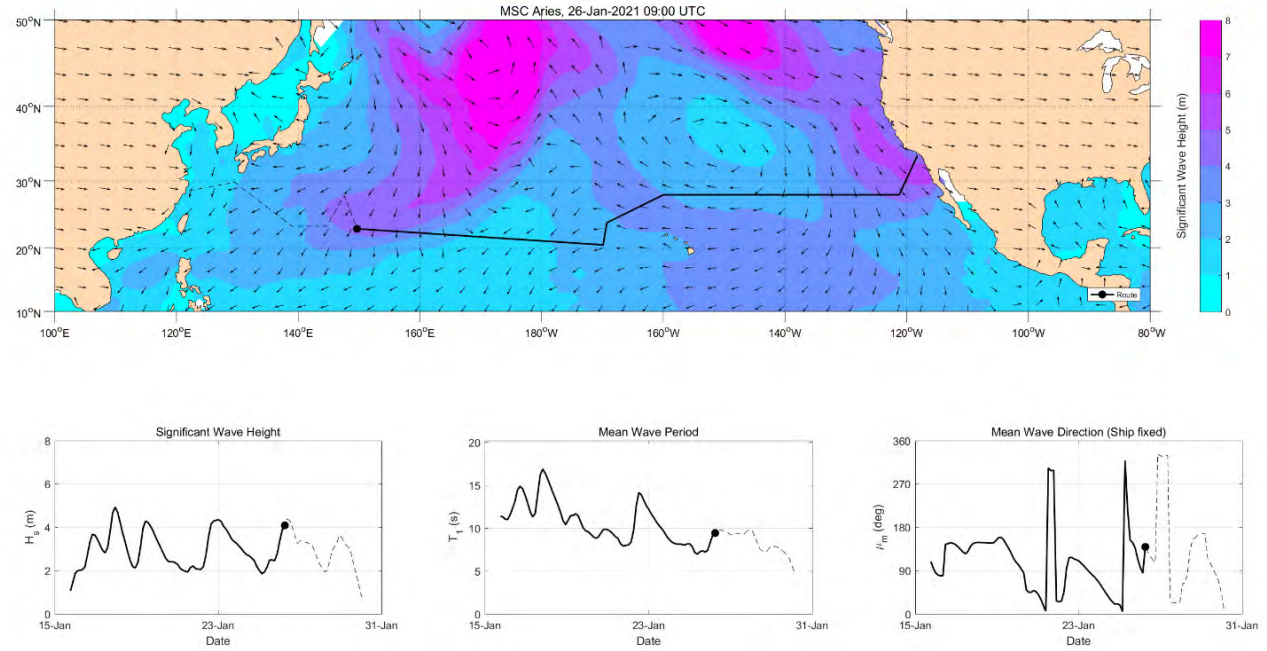


Figure 4-133: Wave hindcast (source ECMWF ERA5)

4.37.3 Description of damage

Not possible.

4.37.4 Other photos

No photos available.

4.37.5 Sources

- https://fleetmon.com/maritime-news/2021/32541/mega-container-ship-mass-containers-loss-north-pac/
- https://www.pandr-marine.com/msc-aries-collaspe-containers-27th-jan-2021/129/
- https://splash247.com/msc-latest-liner-to-suffer-box-spill-in-the-pacific/

4.38 UNI Popular, 2021

4.38.1 Summary

Table 4-68: Summary of info

General info

IMO	9202209
Name	UNI Popular
Year of build	2000
TEU capacity	1,618
Loa	181.8 m
B	28.0 m

Incident info

date & time	29 Jan 2021 19:00 UTC
speed	10-12 kn
position	18° 39.5' N 119° 03.1' E *South China Sea*
heading	000 deg *Davao, Philippines to Hong Kong, China*
hindcast waves	Hs = 4.6 m
draught	Ta/Tf = 6.84/5.03m
transverse stability	3.7 m
roll period	12.5 s (based on estimated roll inertia)
affected/damaged/lost containers	14/12/2

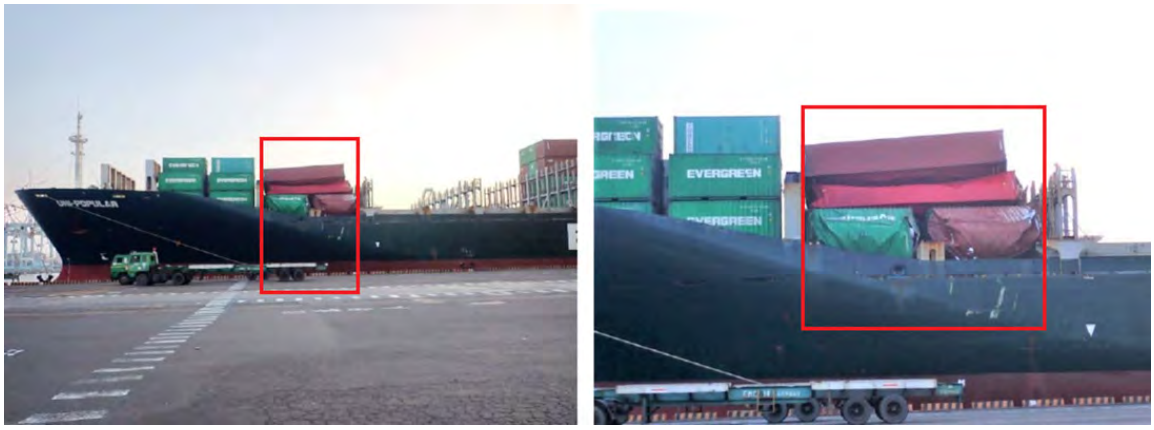


Figure 4-134: Damage overview photo

4.38.2 Incident conditions

Based on above info, the following wave conditions have been estimated:

Table 4-69: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.6	10.2	124	1.6	1.5	1.1	1.8
Swell	1.4	11.3	163	0.9	1.4	1.1	1.8
Windsea	4.4	10.1	122	1.7	1.5	1.1	1.8

Based on the above conditions and a speed of 11 kn, the wave encounter period is approximately 8 s. The estimated rolling period is around 12.5 s (range approx. 10 s to 15 s depending on k_{xx}). Given the heading, combined motions in bow quartering seas are most likely.

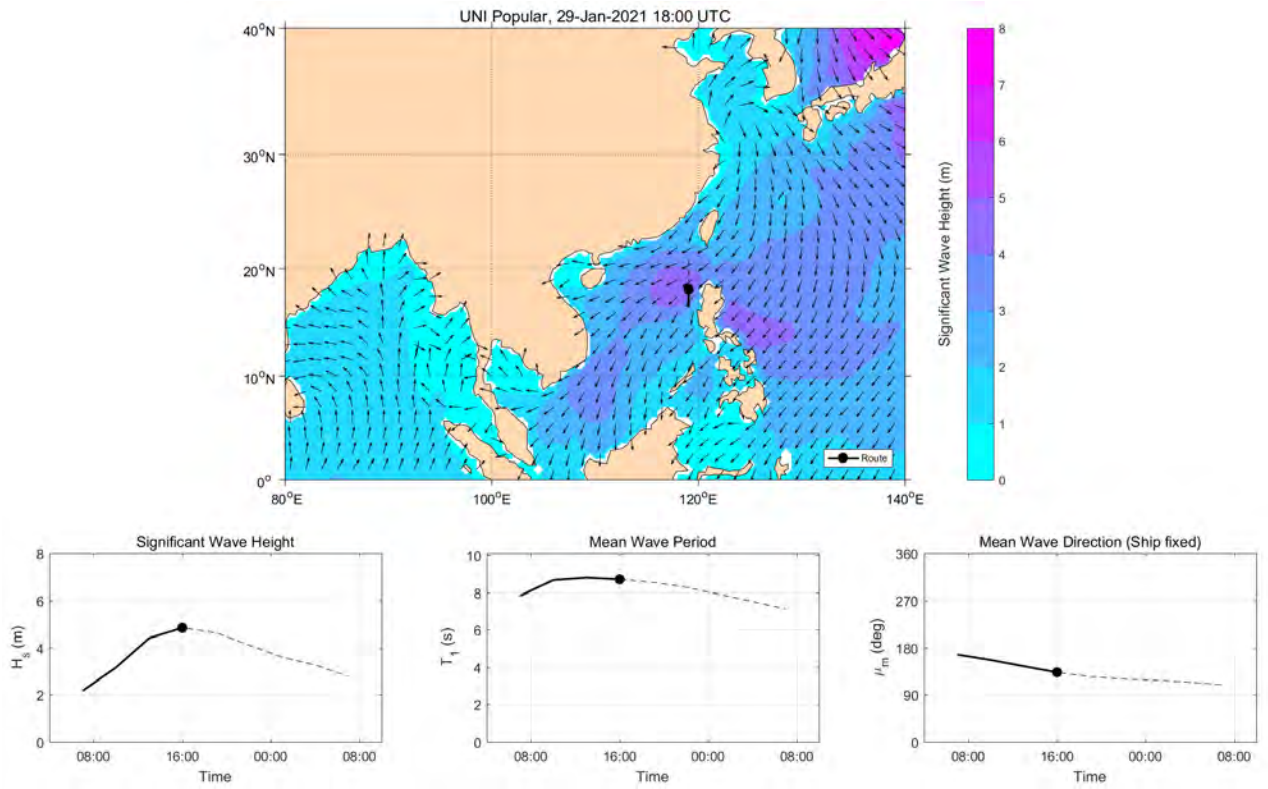


Figure 4-135: Wave hindcast (source ECMWF ERA5)

4.38.3 Description of damage

Partial collapse of 3 stacks in fairly empty bay.

Figure 4-136: Location of damage

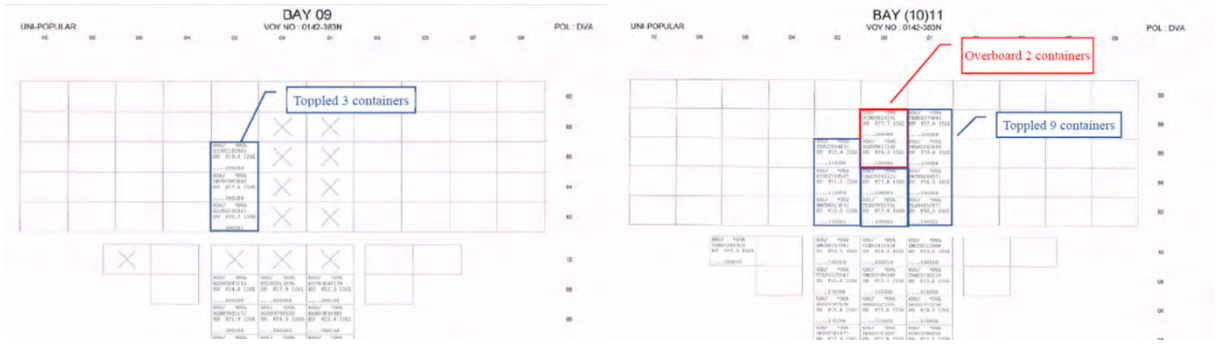


Figure 4-137: Location of damage (detail)

4.38.4 Other photos

Figure 4-138: Selection of other incident photos

4.38.5 Sources

- Info received from Evergreen

4.39 Maersk Eindhoven, 2021

4.39.1 Summary

Table 4-70: Summary of info

General info

IMO	9456771
Name	Maersk Eindhoven
Year of build	2010
TEU capacity	13,100
Loa	366.0 m
B	48.0 m

Incident info

date & time	16 Feb 2021 22:44 UTC
speed	11.4 kn
position	43° 39.8’ N 149° 02.7’ E *Pacific, eastbound*
heading	063 deg *Xiamen, China to Los Angeles, USA*
hindcast waves	Hs = 7.1 m
draught	Unknown
transverse stability	1.5 m (Pacific eastbound, estimation as per chapter 2)
roll period	33.8 s (Pacific eastbound, estimation as per chapter 2)
affected/damaged/lost containers	325/65/260

Figure 4-139: Damage overview photo

4.39.2 Incident conditions

From the plots below, position, speed and time of incident has been estimated.

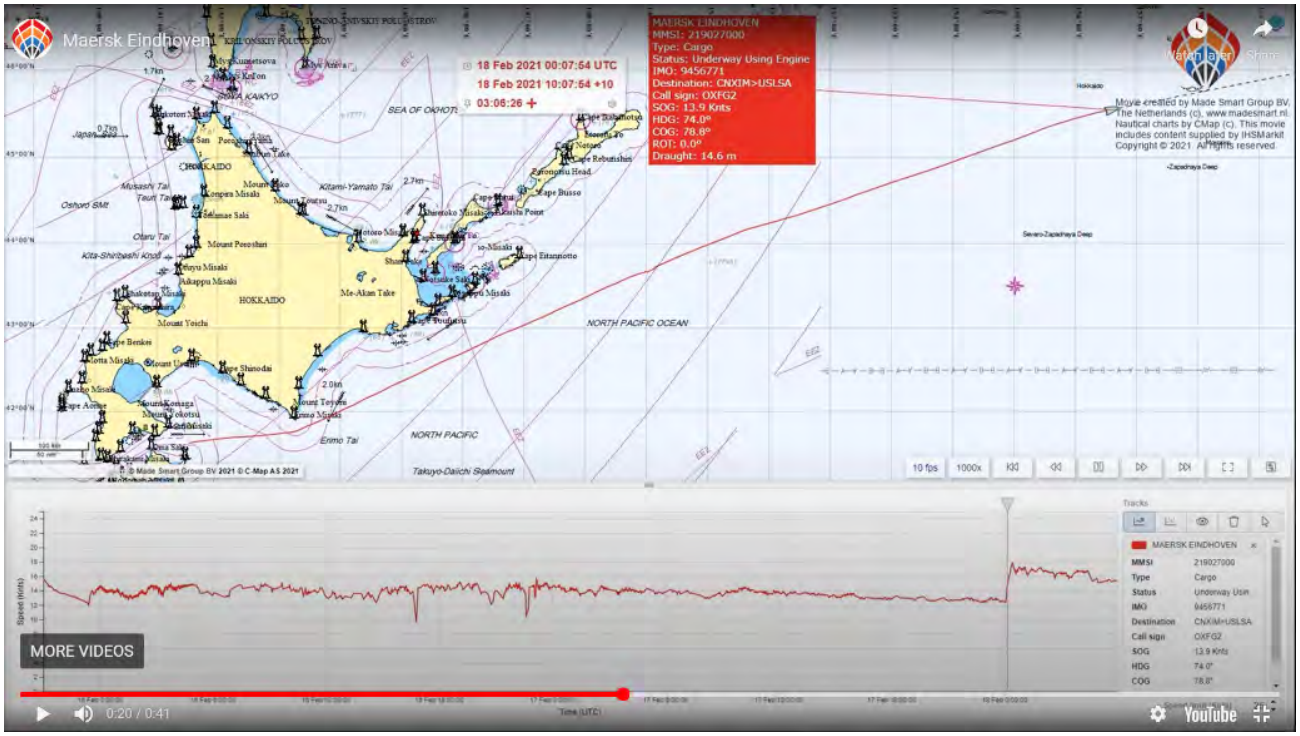


Figure 4-140: Approximate ship position (source youtube.com / Made Smart)

Based on above info, the following weather conditions has been estimated:

Table 4-71: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs	Tp	μ	λ/L	Tϕ/Te [-]		
	[m]	[s]	[deg]	[-]	Typical	Low	High
Total	7.1	13.2	022	0.8	1.9	1.3	2.8
Swell	3.6	15.4	050	1.2	1.9	1.2	2.8
Windsea	6.0	12.3	013	0.8	1.9	1.3	2.9

In this almost following seas condition the wave encounter period is around 17.5 s when sailing at 11.4 kn. As in the statement it is mentioned that there was a 3-4 minute engine failure the speed was possibly somewhat lower (and thereby also the wave encounter period).

As the loading condition is unknown it is difficult to estimate the rolling period. A very rough guess would be around 34 s (assuming a GM of 1.5 m and typical roll inertia) but it could vary between less than 23 s and above 50 s. Based on the wave direction, speed and T_ϕ/ T_e ratio, it is could be both parametric roll or resonant roll, but parametric roll in (close to) following seas seems slightly more likely.

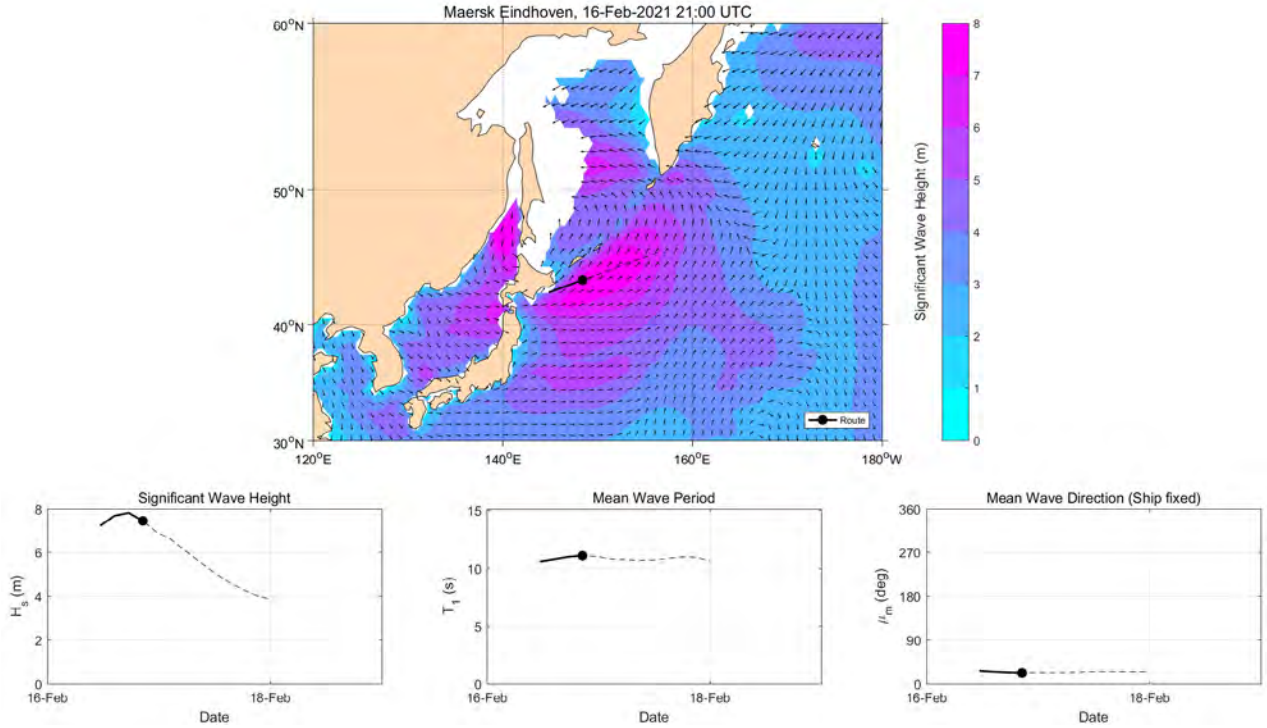


Figure 4-141: Wave hindcast (source ECMWF ERA5)

4.39.3 Description of damage

Collapse of 3 bays along the length of the ship.

Figure 4-142: Location of damage

4.39.4 Other photos

No other photos available.

4.39.5 Sources

- https://www.marineinsight.com/shipping-news/maersk-cargo-ship-losses-260-containers-in-pacific/
- https://shipsandports.com.ng/maersk-engine-oil-pressure-triggered-eindhoven-loss-of-propulsion/
- https://www.youtube.com/watch?v=7yuw1MqyVOs
- https://www.pandr-marine.com/maersk-eindhoven-collapsed-containers-17th-feb-2021/150/

4.40 MED Denizli, 2021

4.40.1 Summary

Table 4-72: Summary of info

General info

IMO	9106493
Name	MED Denizli
Year of build	1996
TEU capacity	1,055
Loa	151.0 m
B	24.0 m

Incident info

date & time	Before 18 Feb 2021 13:00 (arrival port)
speed	Unknown
position	Eastern Mediterranean Sea
heading	Unknown
hindcast waves	Unknown
draught	Unknown
transverse stability	Unknown
roll period	Unknown
affected/damaged/lost containers	21/4/0 (at least 21 affected, number of lost not mentioned)

Figure 4-143: Damage overview photo

4.40.2 Incident conditions

Not possible.

4.40.3 Description of damage

Multiple containers collapsed (possible lost) on fairly empty deck.

4.40.4 Other photos

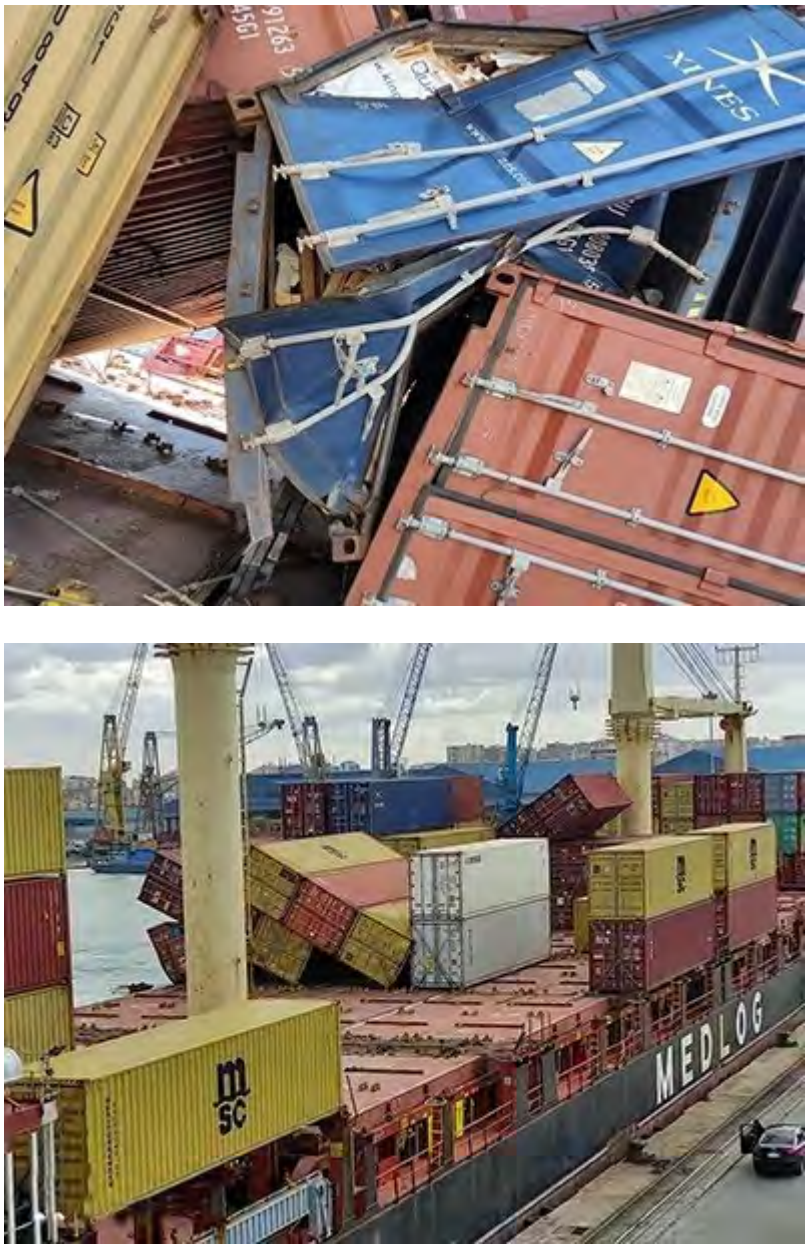


Figure 4-144: Selection of other incident photos

4.40.5 Sources

- https://alexcont.com/en/med-denizli-.html

4.41 Baltic Tern, 2021

4.41.1 Summary

Table 4-73: Summary of info

General info

IMO	9313199
Name	Baltic Tern
Year of build	2005
TEU capacity	1,600
Loa	169.4
B	27.2

Incident info

date & time	7 Apr 2021 09:45 UTC
speed	3.1 kn
position	53.7° N / 005.7° W *Netherlands Coast*
heading	255 deg *St. Petersburg, Russia to Rotterdam, Netherlands*
hindcast waves	Hs = 3.6 m
draught	Unknown
transverse stability	3 m (coastal voyage, estimation as per chapter 2)
roll period	13.5 s (coastal voyage, estimation as per chapter 2)
affected/damaged/lost containers	7/2/5

Figure 4-145: Damage overview photo

4.41.2 Incident conditions

Based on above info, the following weather conditions has been estimated:

Table 4-74: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	3.6	11.2	110	3.4	1.2	0.6	2.4
Swell	2.4	14.5	105	4.3	0.9	0.4	1.8
Windsea	2.7	8.6	113	3.0	1.6	0.8	3.2

Resonant roll in close to beam seas conditions seems most likely.

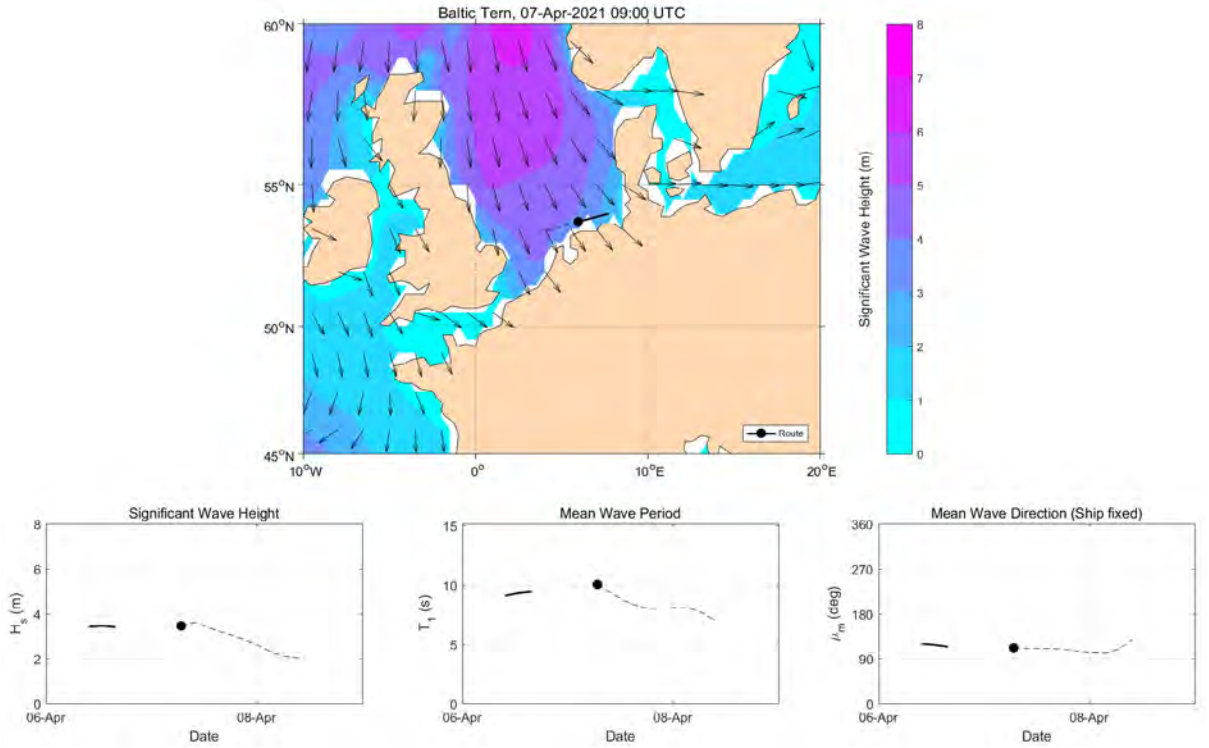


Figure 4-146: Wave hindcast (source ECMWF ERA5)

4.41.3 Description of damage

Partial stack collapse in 1 bay at the bow.

Figure 4-147: Location of damage

4.41.4 Other photos

Figure 4-148: Selection of other incident photos

4.41.5 Sources

- https://www.fleetmon.com/maritime-news/2021/33277/container-ship-lost-containers-north-sea-netherlan/
- https://swzmaritime.nl/news/2021/04/13/investigation-into-containers-lost-overboard-by-baltic-tern/

4.42 Ever Liven, 2021

4.42.1 Summary

Table 4-75: Summary of info

General info	
IMO	9595527
Name	Ever Liven
Year of build	2013
TEU capacity	8,452
Loa	335.0 m
B	45.8 m
Incident info	
date & time	9 Jun 2021 13:05 UTC
speed	21 kn
position	31° 36.7’ S 073° 29.9’ W *South Pacific*
heading	322 deg *Westbound*
hindcast waves	Hs = 3.5 m
draught	Ta/Tf = 11.3/11.3 m
transverse stability	2 m (long voyage, estimation as per chapter 2)
roll period	27.9 s (long voyage, estimation as per chapter 2)
affected/damaged/lost containers	15/6/9

Figure 4-149: Damage overview photo

4.42.2 Incident conditions

Statement as received from Evergreen:

0200LT to 0700LT	*Wind force 4 grades from North and SW swell 2 meters height*
0700LT to 0900LT	*Swell direction was from the ship's port beam and ship started rolling moderately. Maximum list is 9 degree.*
0905LT	*Suddenly a heavy swell occurred and ship rolled seriously to 19 degree. There was found 6 containers collapsed on the center of the hatch cover and saw some containers fell overboard at starboard side.*
0906LT	*Master changed course to 270 degree immediately to avoid more rolling on the ship.*
0907LT	*Master broadcasted the situation to all crew and asked Chief Officer to go to the scene for checking.*
0910LT	*Chief Officer found six containers collapsed on the center of hatch cover and lost nine containers at BAY54.*

Based on the information supplied by Evergreen, the following wave conditions have been estimated:

Table 4-76: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	3.5	16.9	268	41.8	1.7	0.9	2.7
Swell	3.5	16.9	268	42.7	1.7	0.9	2.7
Windsea	0.1	2.4	185	1.3	44.0	23.9	70.0

Based on the estimated rolling period of 28 s (based on an estimated GM of 2 m), resonant roll in beam seas is unlikely. However the GM is estimated, and with high estimate of 4 m (and a low estimate of kxx), resonant roll could be well possible.

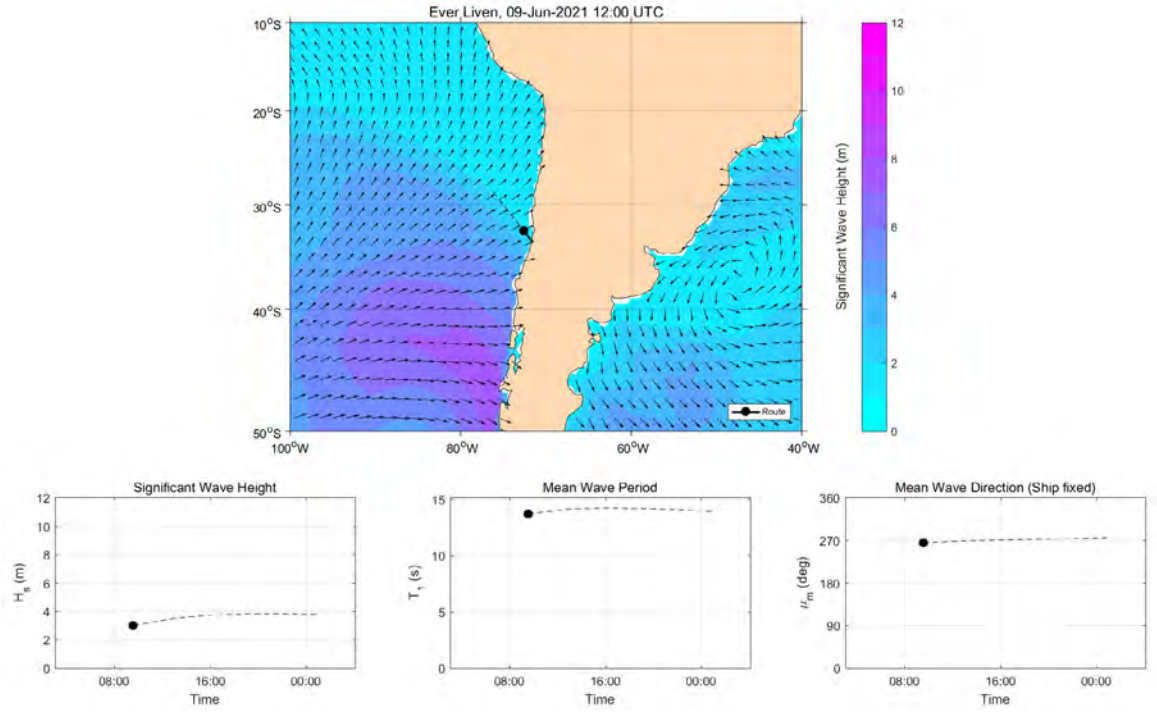


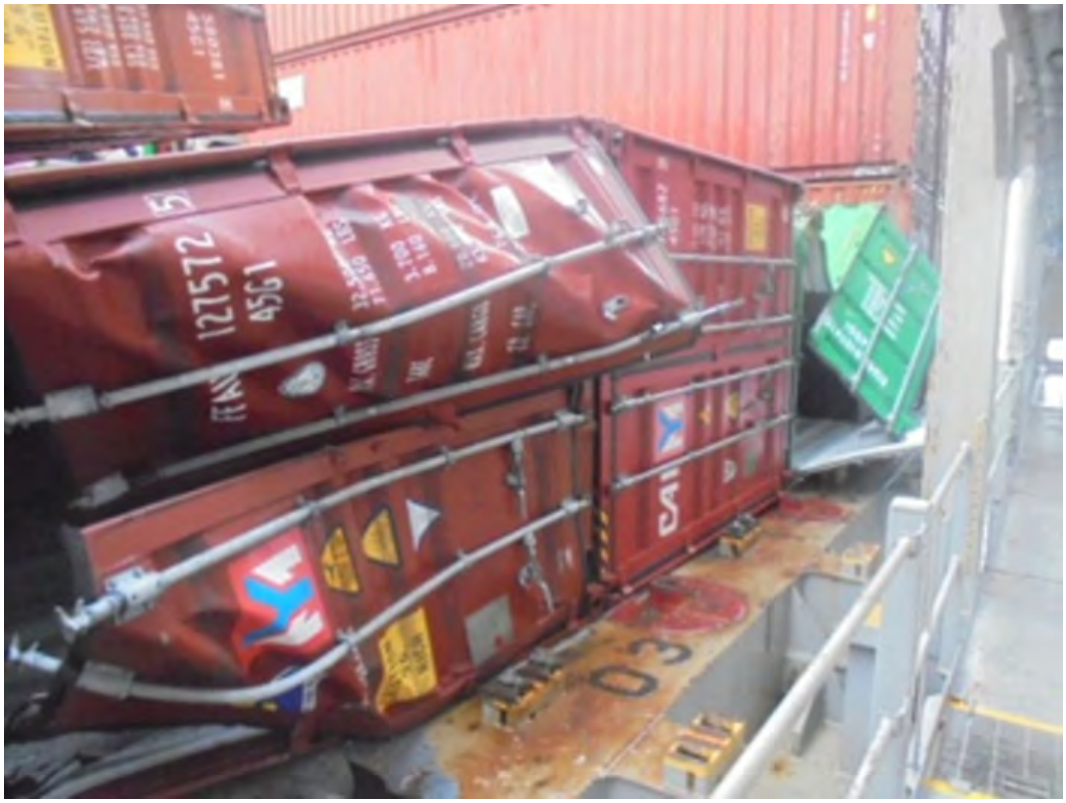
Figure 4-150: Wave hindcast (source ECMWF ERA5)

4.42.3 Description of damage

Partial collapse of a few stacks within 1 bay.

Figure 4-151: Location of damage

4.42.4 Other photos



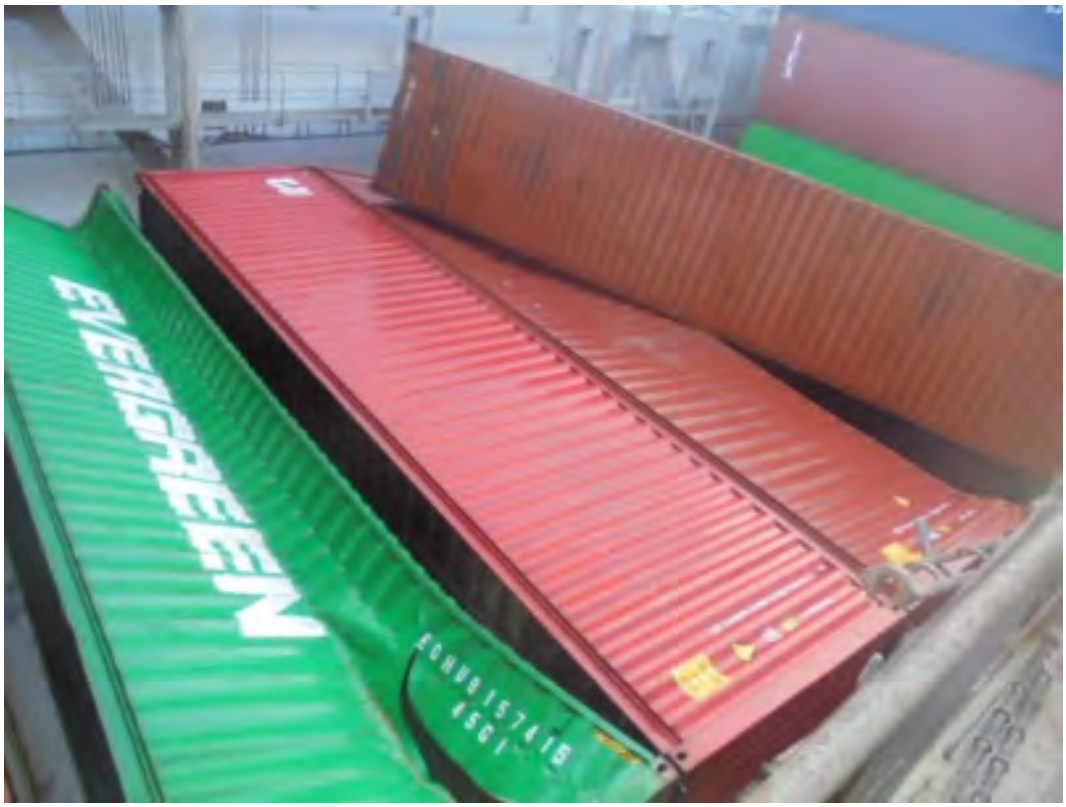


Figure 4-152: Selection of other incident photos

4.42.5 Sources

- Info received from Evergreen

4.43 Thalassa Tyhi, 2021

4.43.1 Summary

Table 4-77: Summary of info

General info	
IMO	9667162
Name	Thalassa Tyhi
Year of build	2014
TEU capacity	13,808
Loa	368.5 m
B	51.0 m
Incident info	
date & time	14 Jul 2021 04:02 UTC
speed	9.6 kn
position	13° 11.6’ N 055° 58.01’ E *Arabian Sea*
heading	270 deg
hindcast waves	Hs = 4.8 m
draught	Ta/Tf = 16.33/16.33 m
transverse stability	1.56 m
roll period	27.6 s (based on estimated roll inertia)
affected/damaged/lost containers	64/42/22

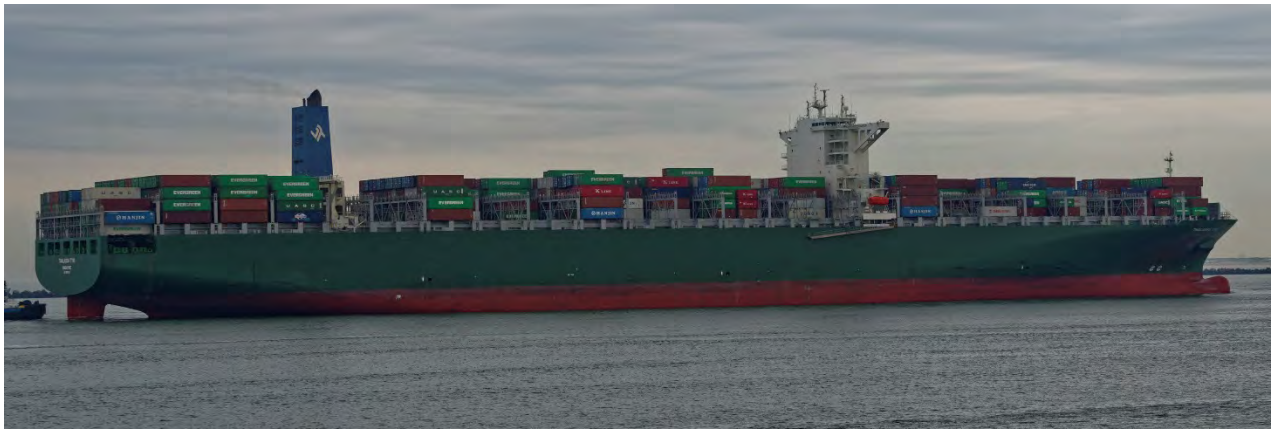


Figure 4-153: Side view of Thalassa Tyhi (no incident overview photo available)

4.43.2 Incident conditions

Master reported winds of 45-47 knots, wind sea waves of 5-5.5 meters and swells of 4-5 meters on July 13th and 14th noon reports. According to WNI analysis, she encountered average winds of 27-32 knots (Gust 41-48 knots) and significant waves of 4.8-5.8 meters from13th noon to 14th noon. Satellite Wind Analysis data (The Advanced Scatterometer; ASCAT) shows wind of about 30-35 knots near the vessel around 14th 04UTC

Based on the information supplied by Evergreen, the following wave conditions have been estimated:

Table 4-78: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.8	10.9	240	1.3	2.9	2.2	3.6
Swell	2.0	13.1	273	13.4	2.1	1.6	2.6
Windsea	4.4	10.4	234	1.1	3.1	2.4	3.9

ERA-5 estimates are on the low side when compared to the WNI analysis and estimate from the master. Slightly more south, ERA-5 predicts somewhat higher waves (between 5 and 6 m), which is closer to the estimates.

Given the wave direction and Tϕ/Te ratio, parametric roll and resonant roll seems unlikely. Combined motions in bow quartering seas, possibly in combination with bow flare slamming and hull girder vibrations are more likely.

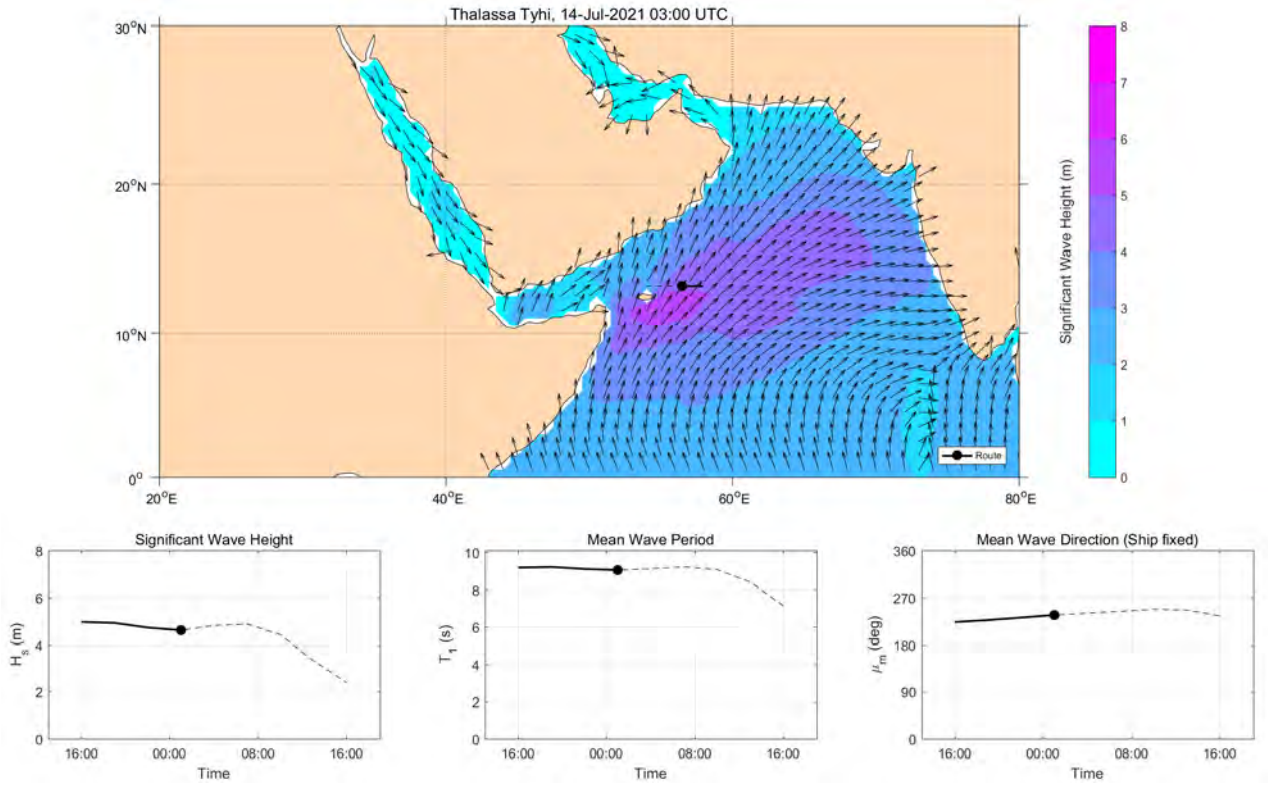


Figure 4-154: Wave hindcast (source ECMWF ERA5)

4.43.3 Description of damage

Partial collapse of containers in multiple bays. Most severe damage and lost containers at the stern.

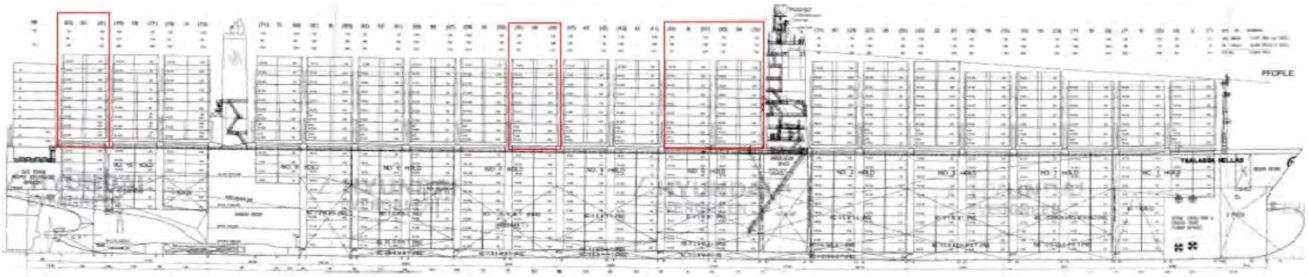


Figure 4-155: Location of damage

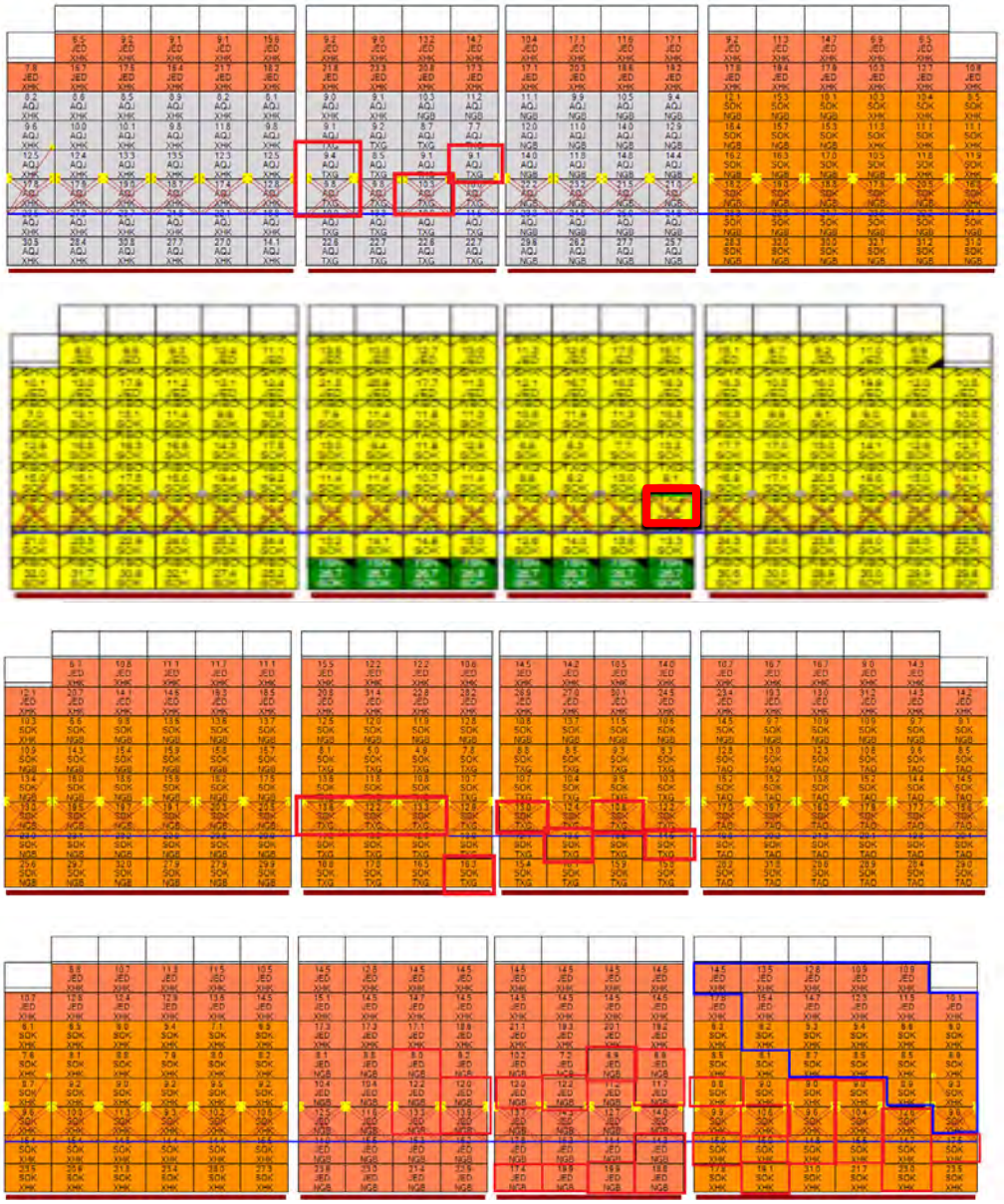


Figure 4-156: Location of damage (bay 34,37,50 and 82 respectively)

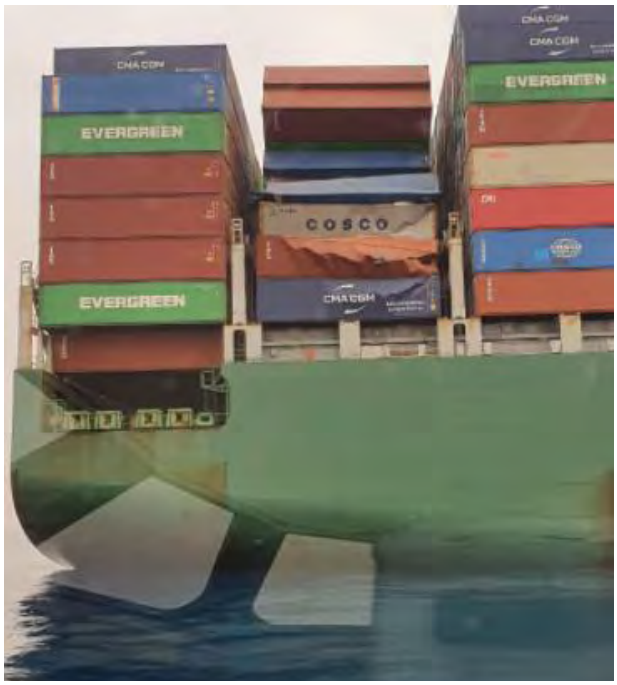
Statements as received from Evergreen:

The container's forward inboard bottom twist lock was in open position and the container base was not resting completely on the lock. Surveyor unable to comment if the container was completely landed during loading with lock left in open position or it moved upward due to heavy weather. The fact that lock did not break may be an indication that it was not locked properly. The aft inboard twist lock was found almost at half position i.e. not fully closed. This row (No.19) had lost five containers overboard and wonder if this was the start of problem. The apparent condition of the lashing gear onboard was good.

Comment from Surveyor:

- *We are unable to comment exactly what could have happened during voyage that caused the damages/losses.*
- *We would send a request to owners through charterers to provide us the documents and information to investigate the incident.*
- *The damages/loss have occurred only to the bays situated aft of the accommodation block. Overwhelming majority of the damaged containers was stowed on the starboard side of the midship (rows 01 to 19). Except Bay No.82, all the containers have damages to the forward side. Most of the damaged containers have suffered damages to their permanent member like posts (mostly forward right posts).*
- *Even the lost containers from Bay 82 were also from the odd rows.*
- *At this stage, the damages of containers due to movement of cargo does not seem likely as some of the cargo that is visible consists of soft items like blankets/bags etc.*
- *From the pattern of damages/losses, the focus should be on the possibility of vessel encountering "Parametric Rolling" that might have exposed her to heavy stress at starboard quarter. If such situation was allowed to continue for some time, this could have resulted in failure of lashing/securing material and resultant damages.*

4.43.4 Other photos



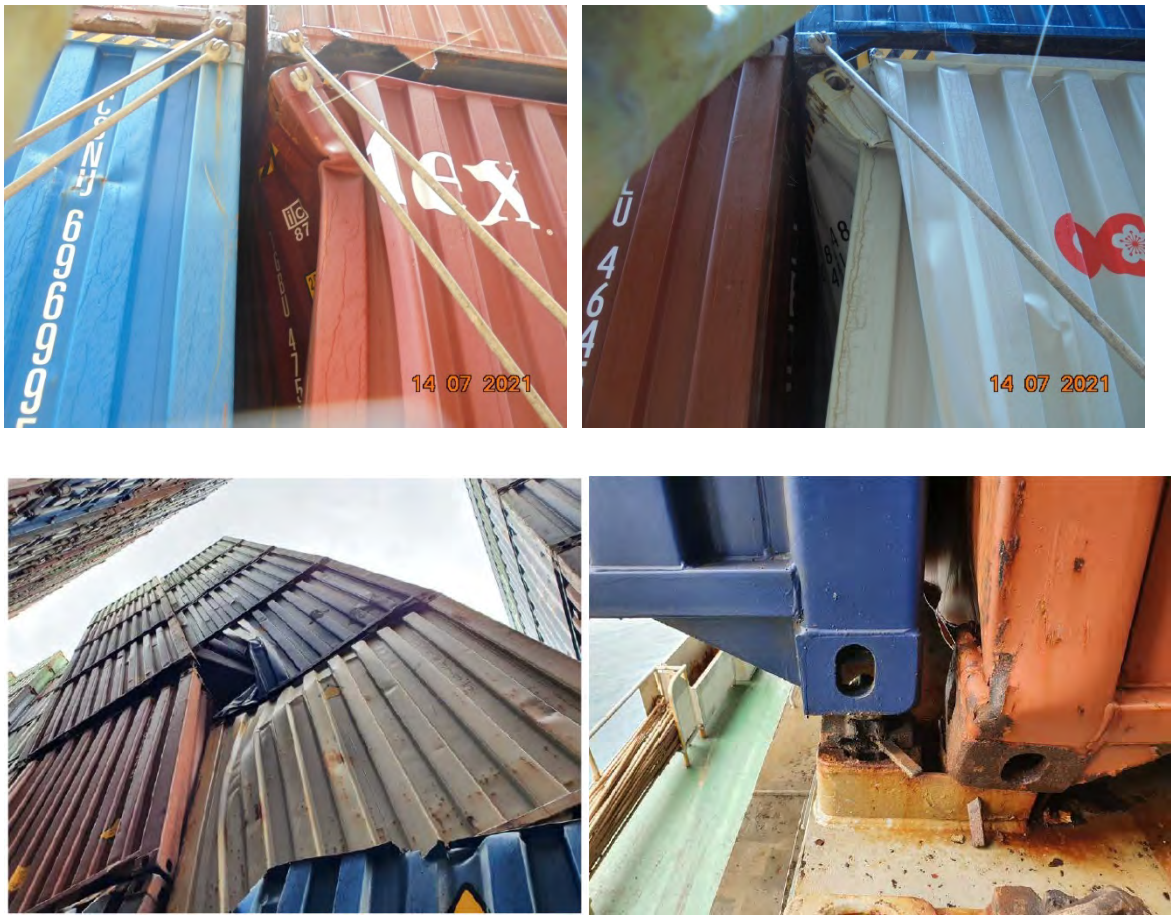


Figure 4-157: Selection of other incident photos

4.43.5 Sources

- Info received from Evergreen

4.44 ZIM Kingston, 2021

4.44.1 Summary

Table 4-79: Summary of info

General info

IMO	9389693
Name	ZIM Kingston
Year of build	2008
TEU capacity	4,253
Loa	260.0
B	32.0

Incident info

date & time	Approx. 22 Oct 2021 10:00 UTC (afternoon local time)
speed	12 kn (estimation as per chapter 2)
position	Approx. 48° 20' N 125° 40' W *Pacific, eastbound*
Heading	077 deg, then 000 deg *Busan, South Korea to Vancouver, Canada*
hindcast waves	Hs = 4.7 m
draught	Unknown
transverse stability	1.5 m (Pacific eastbound, estimation as per chapter 2)
roll period	22.5 s (Pacific eastbound, estimation as per chapter 2)
affected/damaged/lost containers	134/94/40 (damaged rough count from photo)

Figure 4-158: Damage overview photo

4.44.2 Incident conditions

From the plots below, position, speed and time of incident has been estimated.

Figure 4-159: Approximate ship position (source Fleetmon)

Based on above info, the following weather conditions has been estimated:

Table 4-80: Estimated wave conditions based on ECMWF ERA5 (ship fixed heading)

	Hs [m]	Tp [s]	μ [deg]	λ/L [-]	Tϕ/Te [-] Typical	Low	High
Total	4.7	13.5	321	1.4	1.3	0.9	2.0
Swell	4.7	13.5	321	1.4	1.3	0.9	1.9
Windsea	0.3	3.2	309	1.7	1.6	1.0	2.4

Given above wave conditions resonant roll in stern quartering seas seems likely.

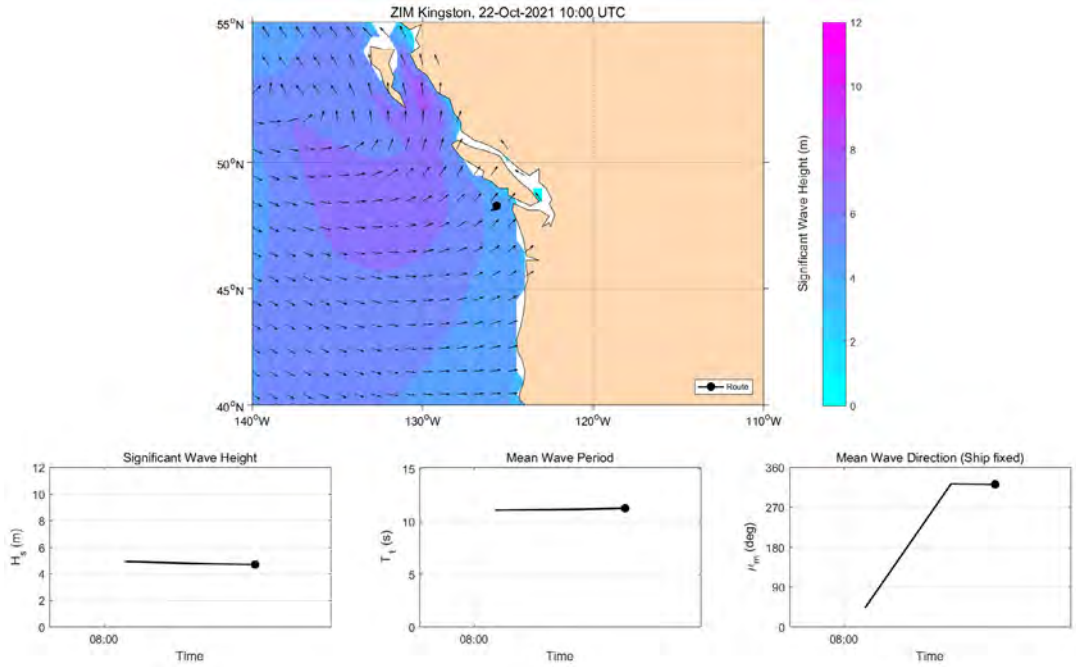


Figure 4-160: Wave hindcast (source ECMWF ERA5)

4.44.3 Description of damage

Collapse of 3 bays (complete collapse at most forward bay, partial collapse of bays at around the amidships and stern).

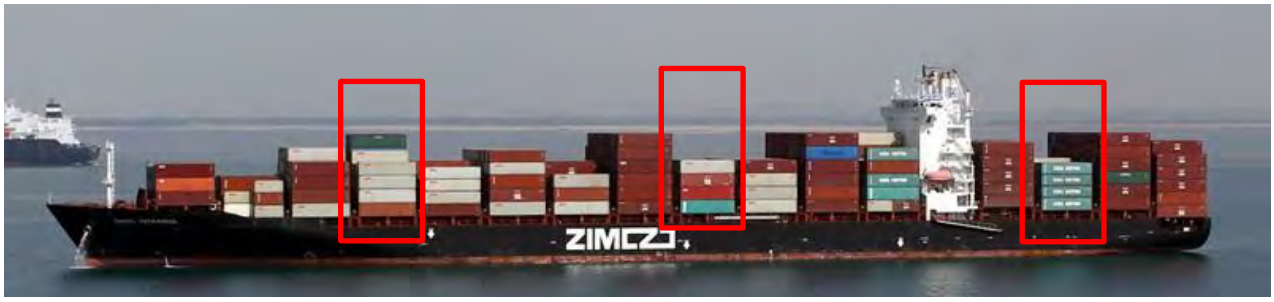


Figure 4-161: Location of damage

4.44.4 Other photos

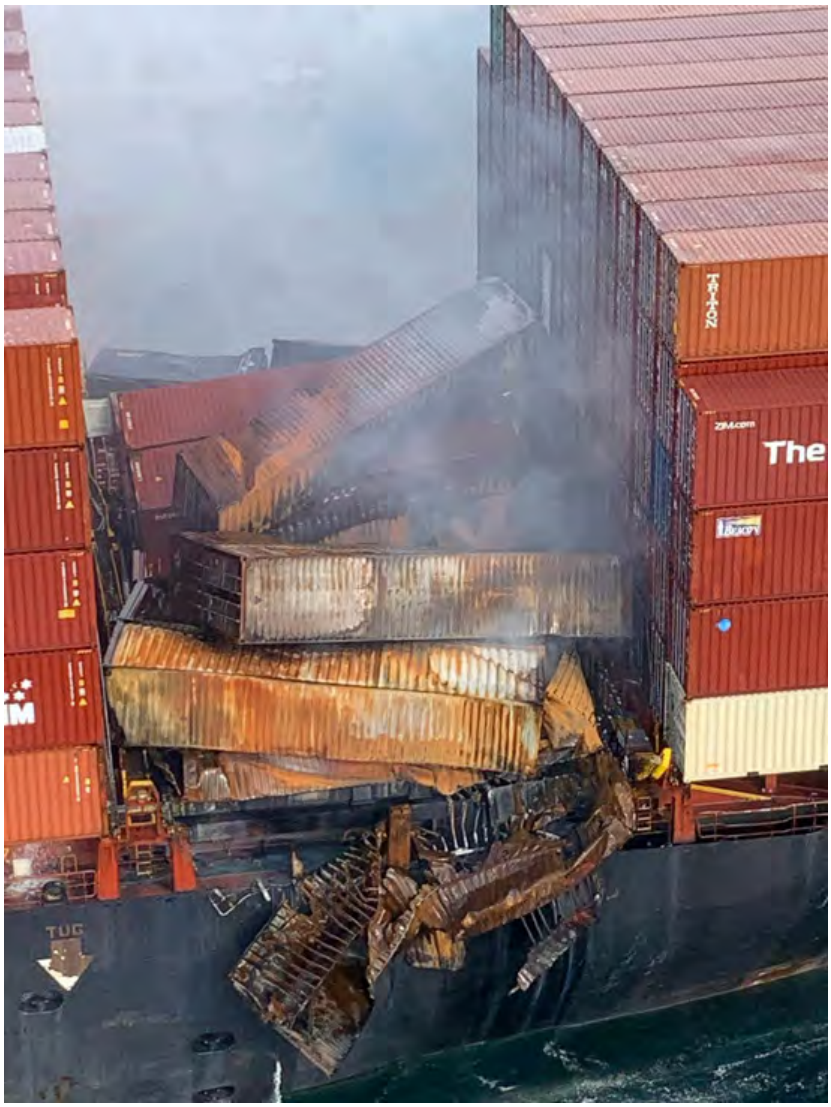


Figure 4-162: Selection of other incident photos

4.44.5 Sources

- https://www.fleetmon.com/maritime-news/2021/35913/zim-kingston-fire-after-containers-loss-and-collap/
- https://www.offshore-energy.biz/zim-kingston-catches-fire-loses-40-containers-in-rough-seas/
- https://swzmaritime.nl/news/2021/10/25/canadian-coast-guard-reports-fire-on-container-ship-zim-kingston-has-been-stabilised/
- https://twitter.com/USCGPacificNW/status/1452316980506238985

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