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THE OBSERVATIONS OF THE PERFORMANCE OF SMALL TONNAGE IN ICE, WINTER 2003

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The Observations of the Performance of Small Tonnage in Ice Winter 2003

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1 Abstract

The new engine power requirement of Finnish-Swedish ice class rules has been criticized to give too high power values for small ships. Therefore the Ship Laboratory of the Helsinki University of Technology observed the performance of the small tonnage in brash ice channels during winter 2003. The observation voyages were made on seven ships, one on each. Additionally the channel profile was measured in three locations so that the performance of the vessels could be evaluated. This report consists the description of the observation voyages and methods, the analysis of the results and conclusions of the performance of small tonnage in ice. The ships in this study are not identified but they are only designated as A, B, C, D, E, F and G.

2 Introduction

The power requirements of the new Finnish-Swedish ice rules were published in the beginning of October 2002 and came into force in 1 September 2003. The new power requirement seems to have the greatest effect on small ships of 2000-5000 dwt as compared with the old requirements (1985 rules). The ice class of existing vessels of this size may be lowered in ice classes IA and IA Super. Because of this it was decided to carry out a validation exercise where a set of small vessels are investigated. The owners of small vessels navigating in the Baltic in ice were sent a request to deliver the needed data for the calculations of the power requirement of the ice class according to the new rules. The request was sent to several ship owners and many of them answered but some did not deliver all data needed and finally the needed data of 18 ships was received.

Next step in this study was to observe the performance of some of these vessels when navigating in ice. Ships that had a high ratio between the power requirement according to the new rule and installed power were chosen for these observations. The number of the observed small ships was seven, six of which were navigating in the Gulf of Finland and one in Lake Mälaren in Sweden.

3 Ships and voyages

The ships selected for the study had a low ratio between the installed power and the new power requirement. Table 1 shows the 18 ships for which the power was calculated. The power requirement according to the new rule is symbolized with P_{2002} and according to the 1985 rule with P_{1985}.

Table 1. The calculations of the power requirement. The selected ships are marked and designated with letters.

Ship	L	B	T	D_P	Tonnage	Δ	α	ϕ_2	P_{inst}	**Ps, 2002** rule	**Ps, 1985** rule	F-S	D_P/T	P_{inst}/P_{2002}	P_{1985}/P_{2002}
	m	m	m	m	dwt	t	deg	deg	kW	kW	kW	Ice Class			
Ship 1	144.7	20.6	7.0	5.00	7226	16041	14	20	15600	5723	6466	IAS	0.71	2.73	1.13
Ship 2 (A)	90.9	16.5	5.2	3.05	3400	5583	30	44	2766	4791	3517	IAS	0.59	0.58	0.73
Ship 3	105.0	17.0	6.6	4.15	8145	10690	22	35	4120	3557	4323	IAS	0.63	1.16	1.22
Ship 4 (G)	85.0	12.5	5.3	2.60	3260	4537	30	47	1845	3101	1814	IA	0.49	0.60	0.59
Ship 5 (C)	78.8	12.6	5.4	2.70	2954	4204	29	61	1840	2899	1617	IA	0.50	0.63	0.56
Ship 6 (B)	78.9	12.5	5.3	2.80	3200	4018	34	90	1800	3399	1767	IA	0.53	0.53	0.52
Ship 7 (D)	80.2	12.5	5.0	2.40	3000	4042	36	64	1700	3642	1620	IA	0.48	0.47	0.44
Ship 8	85.0	14.4	5.9	3.20	4230	5712	30	52	2460	3051	1892	IA	0.54	0.81	0.62
Ship 9	102.4	15.9	5.9	3.80	5440	7624	25	30	2880	2305	2695	IA	0.65	1.25	1.17
Ship 10	80.8	12.5	5.4	2.90	3400	4500	31	30	1850	1817	1891	IA	0.54	1.02	1.04
Ship 11	76.3	13.5	5.0	2.60	2650	3951	30	40	2207	2694	1793	IA	0.52	0.82	0.67
Ship 12	89.7	13.6	5.7	3.20	4023	5356	30	40	2066	2359	2111	IA	0.56	0.88	0.90
Ship 13	87.0	13.6	5.7	3.20	4228	5461	31	36	2330	2271	2138	IA	0.56	1.03	0.94
Ship 14	79.1	12.5	5.4	2.85		4139	35	40	2040	2283	1798	IA	0.52	0.89	0.79
Ship 15	95.7	14.4	4.3	2.57	3036	4532	30	40	1999	2417	1249	IA	0.60	0.83	0.52
Ship 16	76.2	12.1	4.0	2.40	2120	3032	25	28	1249	1333	1144	IB	0.60	0.94	0.86
Ship 17	78.9	12.5	4.9	2.80		3710	34	40	1800	1514	1093	IB	0.57	1.19	0.72
Ship 18	78.9	12.5	5.2	2.80		3965	34	40	1650	1616	1230	IB	0.54	1.02	0.76

For the most of the vessels in Table 1 the ratio between the installed power and the new power requirement is close to one or higher. Five ships with this ratio close to 0.5 were chosen for the observations.

In addition to the five ships selected in Table 1 the performance of *Ship E* was observed during her voyage from Utö to Naantali and *Ship F* in Lake Mälaren from Södertälje to Västerås. The power requirement of these two vessels was not calculated in advance and the data needed for the calculations was collected from the ship during the voyage. The data of Ships E and F is presented in Table 2.

Table 2. Data of Ships E and F.

Ship	L	B	T	D_P	Tonnage	Δ	α	ϕ_2	P_{inst}	Ps, 2002 rule	Ps, 1985 rule	F-S	D_P/T	P_{inst}/P_{2002}	P_{1985}/P_{2002}
	m	m	m	m	dwt	t	deg	deg	kW	kW	kW	Ice Class			
Ship F	86.6	12.8	4.7	2.7	2896	4383	25	90	1975	3213	1861	IA	0.57	0.61	0.58
Ship E	92.4	13.6	6	2.96	4803	6483	32	70	2640	4165	2401	IA	0.49	0.63	0.58

The most ideal ice conditions for the observations would have been an old ice channel, one metre thick in the middle, which is the rule channel for ice class IA (and IA Super with 10 cm thick consolidated layer). The beginning of the winter was severe and the restrictions to navigation closed the Gulf of Bothnia from the IA vessels smaller than 4000 tdw in the end of January. Because of this most of the observations were made between Helsinki and Hamina in the Gulf of Finland. In the middle of February the ports east of Helsinki were restricted to vessels of ice class IA, smaller than 2000 dwt. Because of the hard ice conditions in the Gulf of Finland the archipelago fairway was opened and taken in use on February 2. Ice does not move in the archipelago fairway and the channel was very much navigated which made the observations easier to conduct. Four vessels out of seven were observed in this fairway, which made the comparison of the performance of these vessels easier although the observations in this route were made within one and a half months, between the 28th of January and the 13th of March.

The owners of the ships in this study represented four nationalities: two were Finnish, one Swedish, two German and two Dutch. The voyages and dates are presented in Table 3 and the routes are presented in Figures 1…3.

Table 3. The ships, voyages and dates in chronological order.

	Date	Ship	Year built	Tonnage [dwt]	Voyage
1	21.1.2003	A	1983	3400	Inkoo - Parainen
2	28.1.2003	B	2000	3200	Loviisa - Hamina
3	3.-5.2.2003	C	1982	2954	Rauma - Loviisa
4	12.2.2003	D	1991	3000	Kotka - Emäsalo
5	20.2.2003	E	1998	4803	Utö - Naantali
6	10.3.2003	F	1986	2896	Södertälje - Västerås
7	13.3.2003	G	1995	3260	Loviisa - Emäsalo

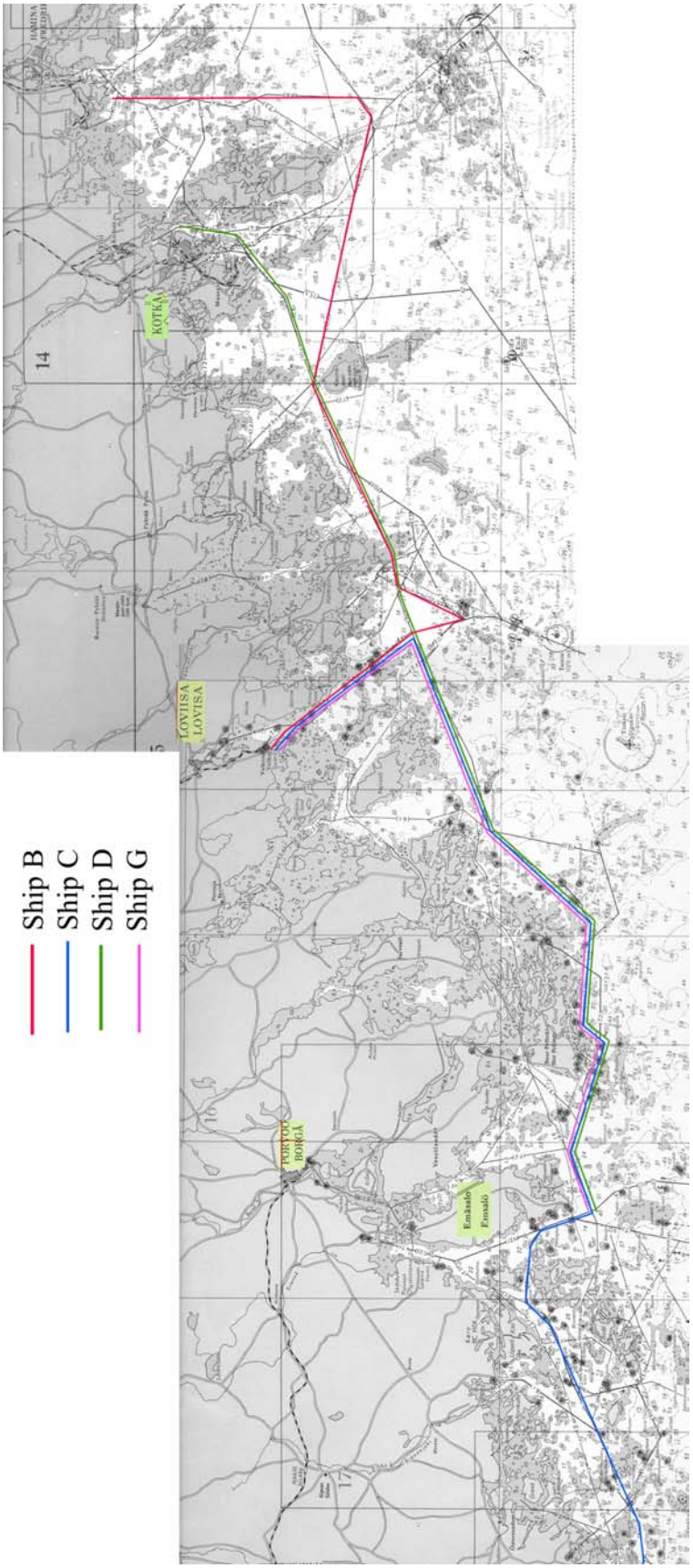


Figure 1. The routes of Ship C, *Ship B*, *Ship D* and *Ship G*.

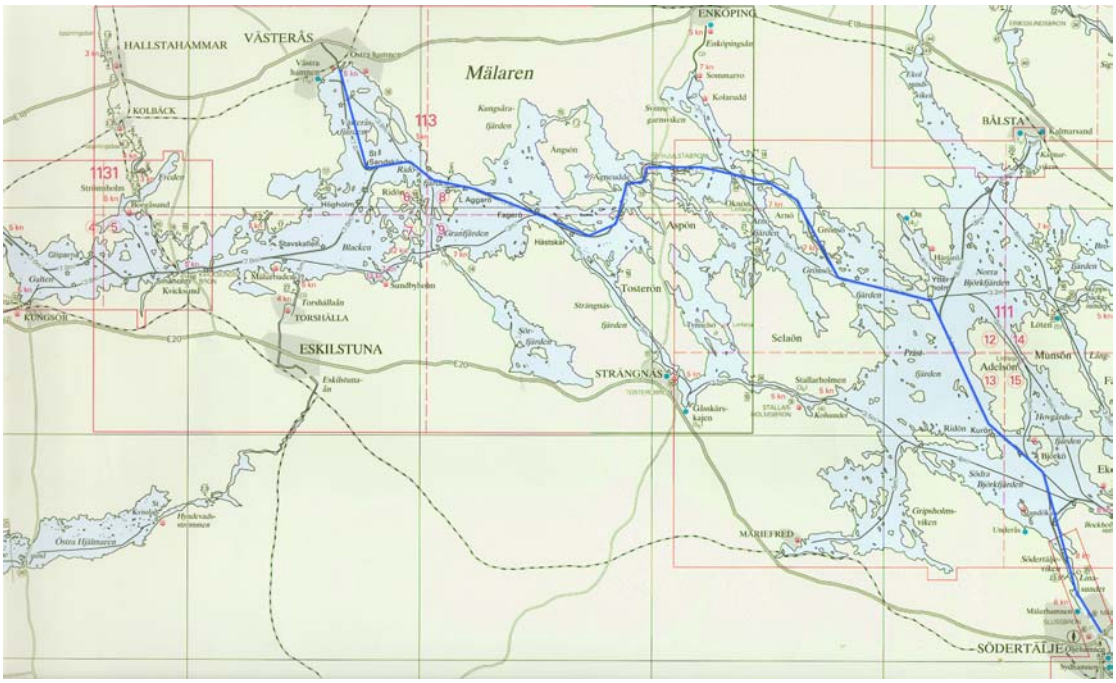


Figure 2. The route of *Ship F* in lake Mälaren from Södertälje to Västerås.

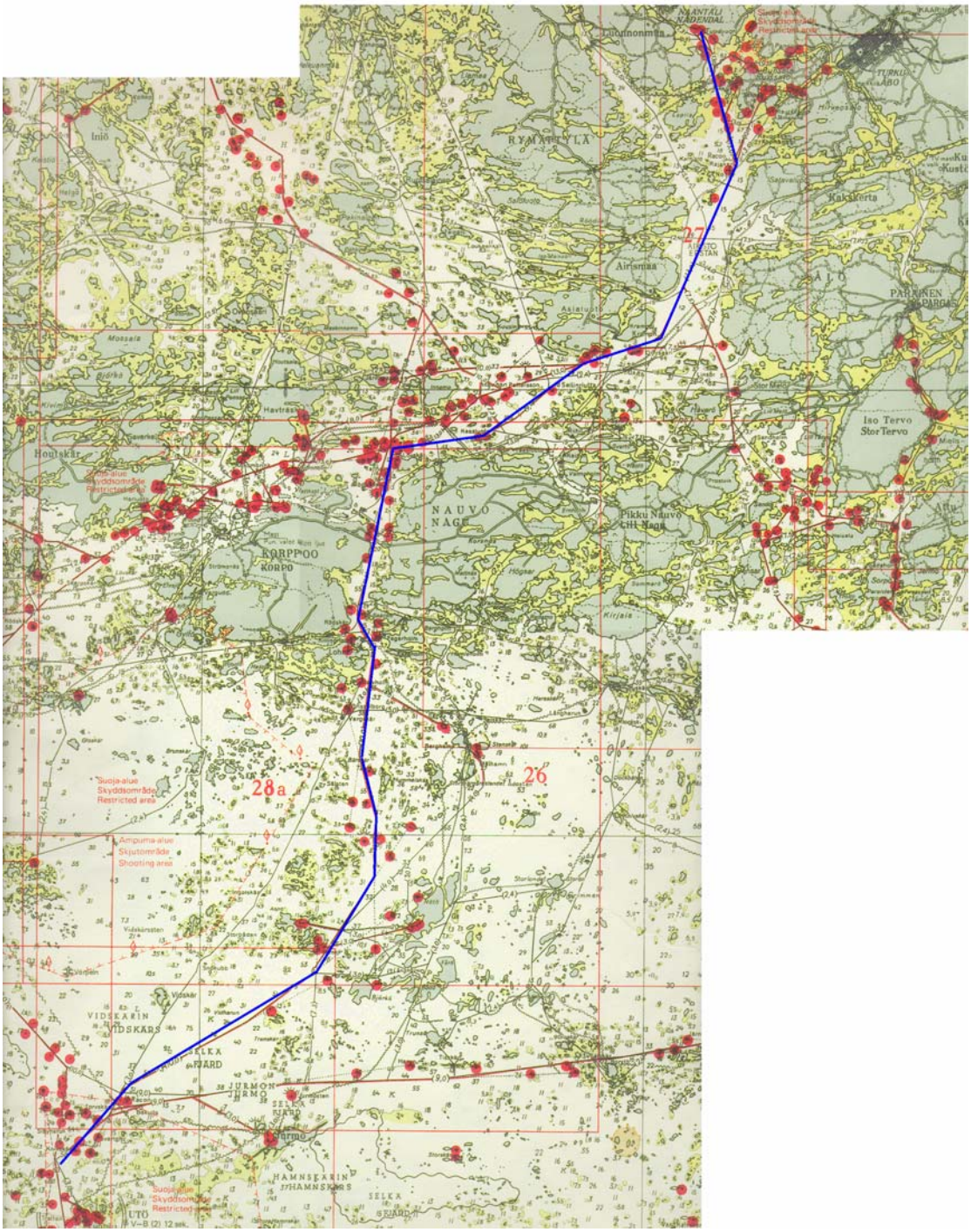


Figure 3. The route of *Ship E* from Utö to Naantali.

The observations were carried out so that the observer stayed onboard the vessel during the voyage. Date, time, position, speed and heading were recorded with a PC using a GPS navigator. The data collecting frequency was between one sample in two seconds and one sample in six seconds. During the observations the observer took notes using a form in which the ice conditions, power data and other observations were marked every second minute. The forms of all voyages are in Appendix 2.

4 Channel measurements and channel formation

4.1 Profile measurements

The channel profile was measured in four different locations: west of Emäsalo, close to the port of Loviisa, west of Ruissalo and south of Emäsalo. Figures 4…6 show the locations of the measuring areas. The dates of the voyages and channel profile measurements are shown in

Table 4.

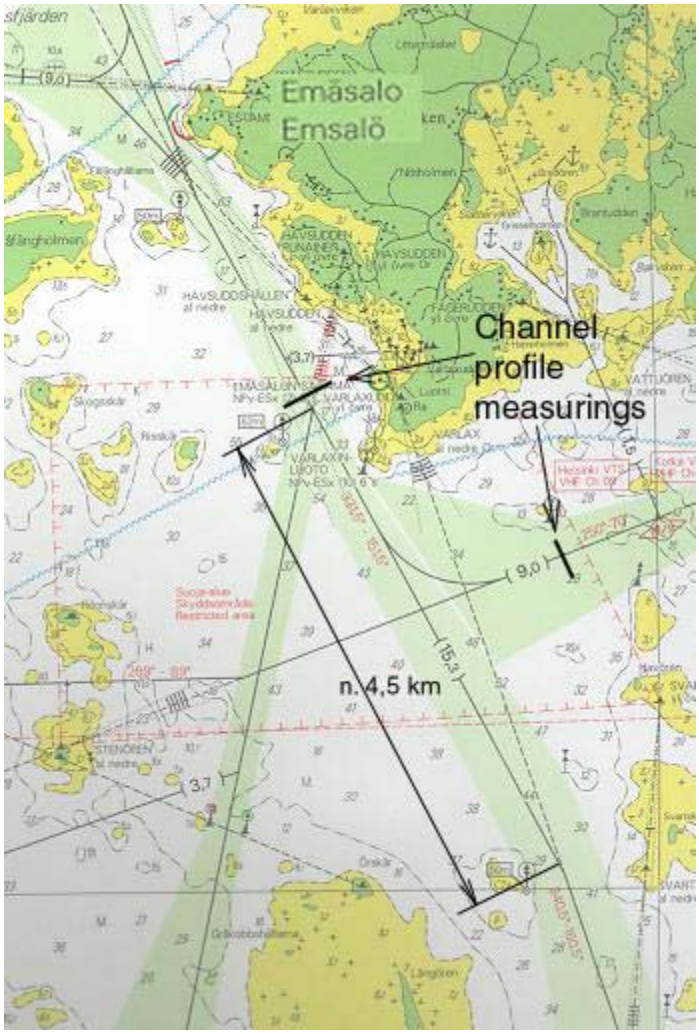


Figure 4. Channel profile measurings west and south of Emäsalo.

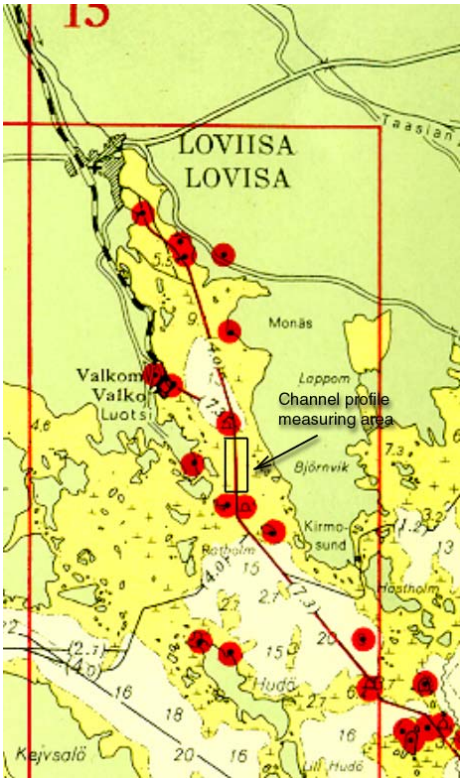


Figure 5. The channel profile measuring area in Loviisa.

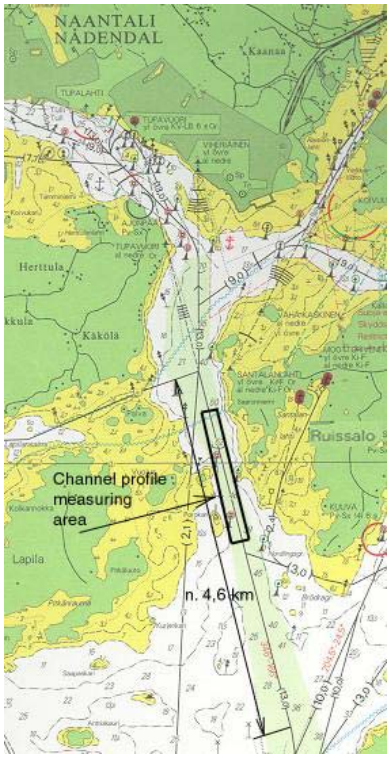


Figure 6. The channel profile measuring area west of Ruissalo.

Table 4. The dates of the voyages and channel measurings.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Friday
January	20	21 **Ship A**	22	23	24	25	26
	27	28 **Ship B**	29	30 **Channel 1 Emäsalo**	31	1	2
February	3 **Ship C**	4 **Ship C**	5 **Ship C**	6	7	8	9
	10	11 **Channel Loviisa**	12 **Ship D**	13	14	15	16
	17	18 **Channel Ruissalo**	19	20 **Ship E**	21	22	23
	24	25	26	27	28	1	2
March	3	4	5	6	7	8	9
	10 **Ship F**	11	12	13 **Ship G**	14	15	16
	17	18	19	20	21	22	23
	24	25	26 **Channel 2 Emäsalo**	27	28	29	30

The channel profiles were measured using a 50 mm drill with an engine. The first channel in Emäsalo and the channel in Ruissalo could not be measured over the whole channel because they were very much navigated and no pilot ladder was available. A

typical situation for channel cross-section measurements is shown in Figure 7 where the measurement team is waiting for a ship to pass the ice channel under measuring.

Figure 7. A ship interrupting the channel measurements west of Ruissalo.

4.1.1 Channel in Emäsalo 30.1.2003

One profile was defined of the channel leading out of Sköldvik oil terminal east of Emäsalo. When the archipelago fairway was opened to traffic the 2nd of February the small tonnage navigating to the eastern Gulf of Finland also used this measured part of the deep-water fairway. The channel was too light to be measured closer than 11 metres from central line. The channel was measured in the end of January and it was not very well formed yet. Using 2 degrees inclination angle between the closest measured point to central line and the central line the mid channel thickness was 0.20 m (Figure 8).

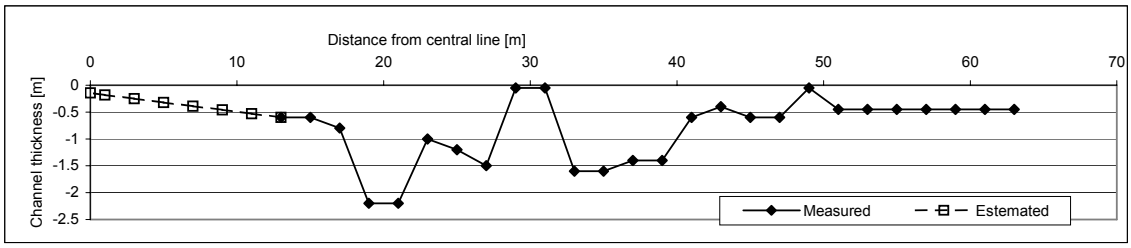


Figure 8. The profile of the channel west of Emäsalo 30.1.2003.

4.1.2 Channel in Loviisa 11.2.2003

Two profiles were defined of the channel leading to Loviisa. The distance between the profiles was 200 metres and the profiles were in relative terms of the same shape.

Both profiles could be measured over the whole channel because of an about 5 cm thick consolidated layer. The average mid channel thickness was 0.35 m. The profiles are given in Figure 9 and a photo of the channel in Figure 10.

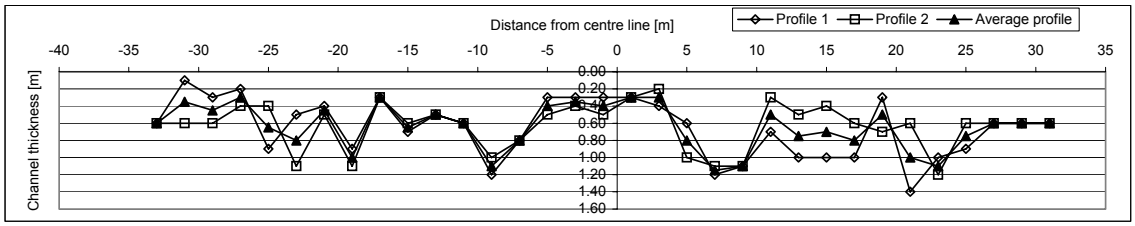


Figure 9. Channel profile and average profile in Loviisa 11.2.2003.

Figure 10. Loviisa channel 11.2.2003.

4.1.3 Channel in Ruissalo 18.2.2003

Four profiles were measured west of Ruissalo. This channel was a relatively much operated light channel and could therefore not be measured in the central line. Figure 11 shows the channel and Figure 12 the profiles.

Figure 11. Ruissalo channel 18.2.2003.

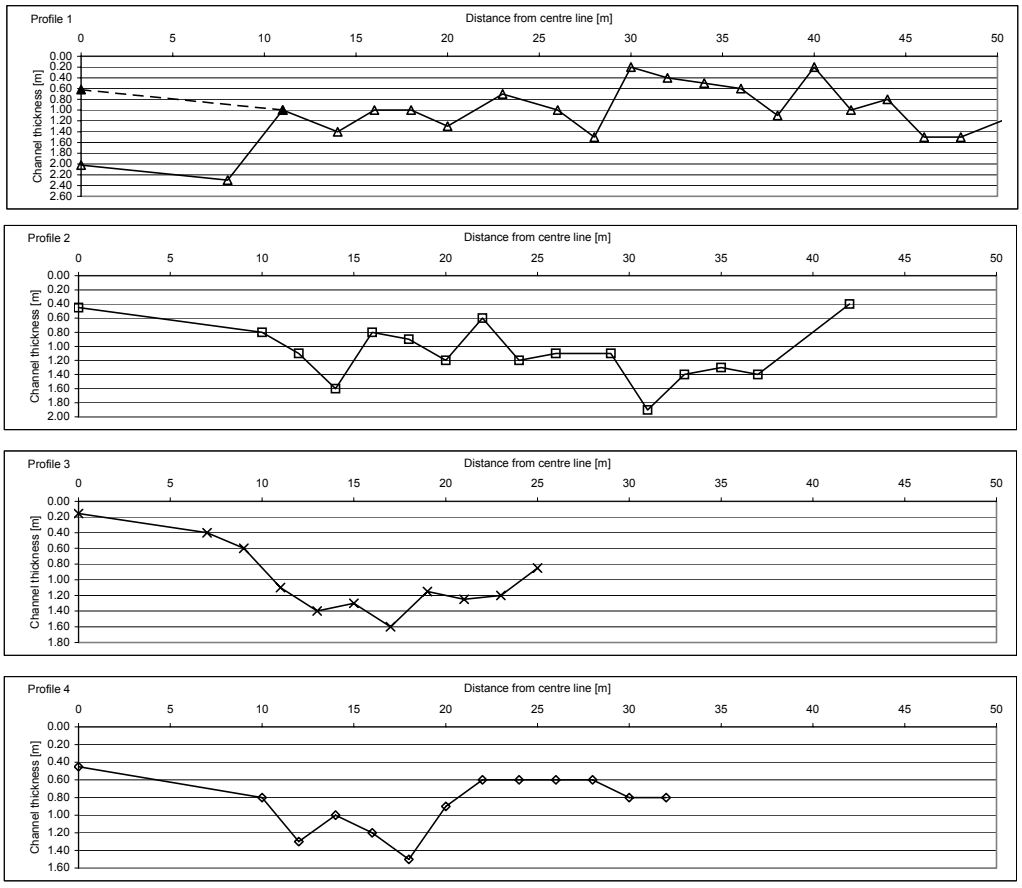


Figure 12. Four channel profiles measured west of Ruissalo 18.2.2003.

The mid channel thicknesses were estimated using again the two degrees slope angle between the measured thickness closest to the centre line. The visually estimated mid channel thickness was 0.50 m which profiles 2…4 support. The last measured thickness in profile 1 was 2.30 metres, which is the highest measured value. In this case there were probably ice floes one upon the other and if the mid channel thickness is estimated using the second last measured point the it would then be 0.62 metres which is close to the other mid channel thicknesses. The average mid channel thickness is thus 0.42 m.

4.1.4 Channels in Emäsalo 26.3.2003

The last channel profile measurements were made south of Emäsalo 26th of March. The channels of the deep fairway leading out of Sköldvik and the archipelago fairway eastwards (Figure 13) were measured. The mid channel thickness of the archipelago channel was 0.35 metres but if the cross sectional area of the channel from centre-line to 6.25 metres, that is about B/2 of the observed vessels, is converted to correspond to the cross section of the rule channel with the slope angle of two degrees the mid channel thickness is 0.60 metres shown in Figure 14 as a dashed line.

Figure 13. The channel of the archipelago fairway leading east from Emäsalo.

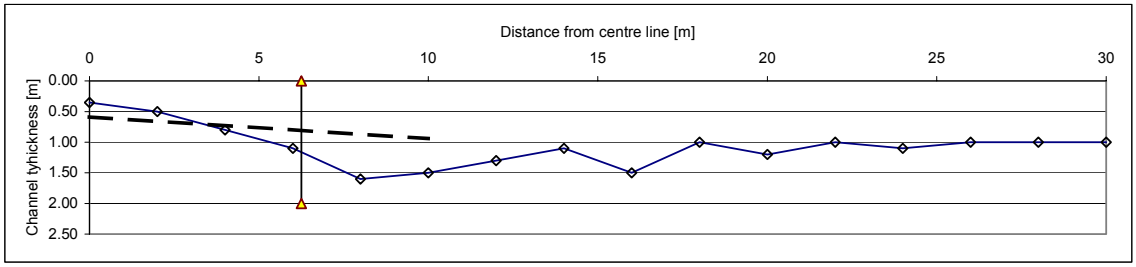


Figure 14. The channel profile of the archipelago fairway leading eastwards from Emäsalo measured the 26th of March 2003.

The channel of the deep-water fairway of Sköldvik oil terminal was measured in a location 2.7 km south of the first measured profile in the 30th of January 2003. These two measurements can be used to estimate the channel thickness formation during the period between the measuring dates. The dashed line shows the simplified channel profile with the slope angle of 2 degrees. The cross sectional area of the measured profile and simplified profile are the same from central line to 15 metres (Figure 15)

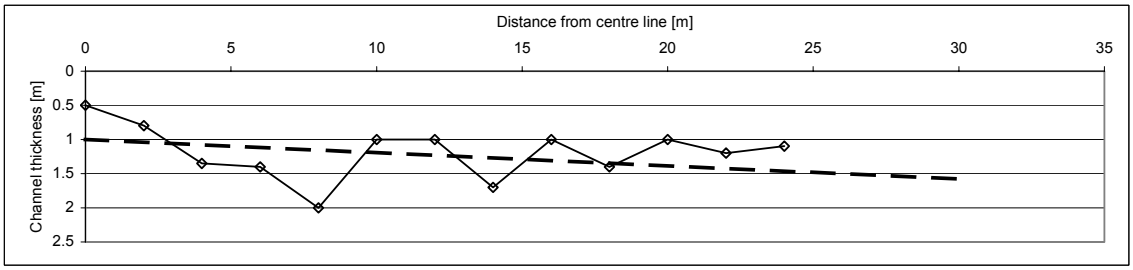


Figure 15. The channel profile of the deep-water fairway leading out of the Sköldvik oil terminal.

4.2 Ice channel formation

One ice channel was measured two times during the winter. It was the channel in the fairway leading out of the Sköldvik oil terminal. The channel was not measured exactly in the same location but the formation of the channel can anyway be estimated according to these two measurements. The channel was measured west of the pilot station of Emäsalo the 30th of January. At that time the channel was very light and the whole profile could not be defined. The estimated mid channel thickness is 0.15 m. The second time the channel was measured 1.5 NM southwards in the 26th of March and the whole profile could be defined. The mid channel thickness was 1.0 m.

When the cold sum in degree-days is calculated for the period between the two measurements and the mid channel thickness is assumed to be dependent on the square root of the cold sum, we can plot the mid channel thickness as a function of the date. Figure 16 shows the temperatures and the cold sum during the period between the measurements and Figure 17 shows the channel thickness as a function of the date.

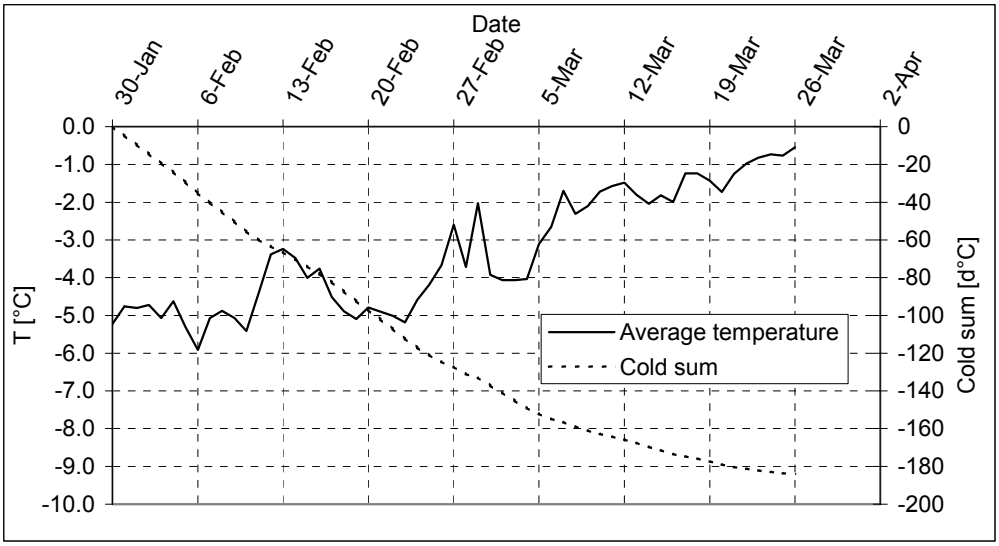


Figure 16. Average day temperature and relative cold sum for the period between the 30th of January and 26th of March 2003 in Isosaari.

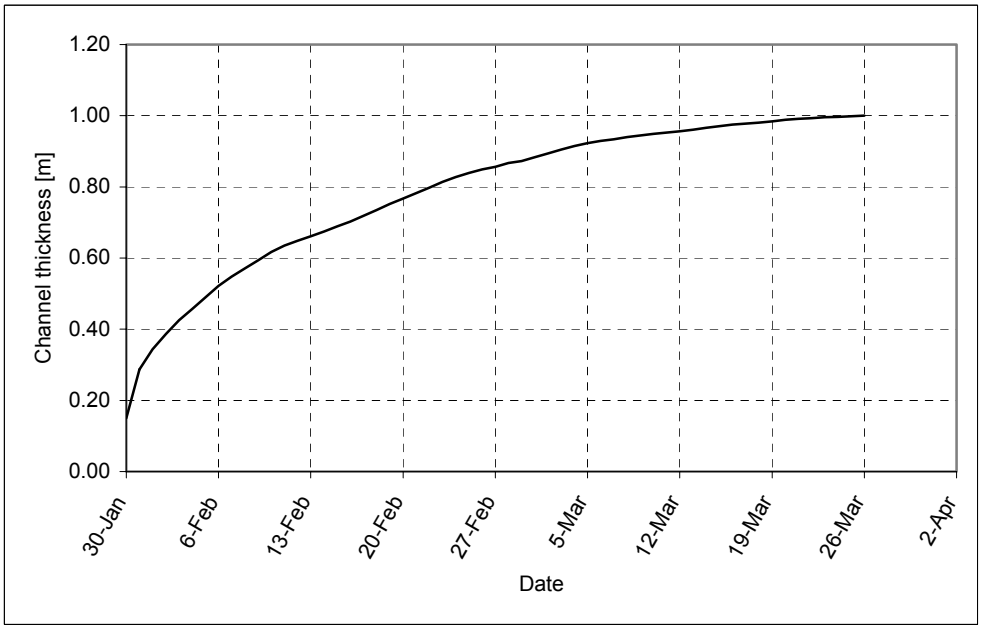


Figure 17. The estimated growth of mid-channel thickness as a function of date.

The profile of the channel of the archipelago fairway leading east from Emäsalo was measured the 26th of March and the mid channel thickness was 0.60 metres. If we assume that this channel formed equally to the Sköldvik channel, the thickness of this channel can be presented as a function of the dates (Figure 18).

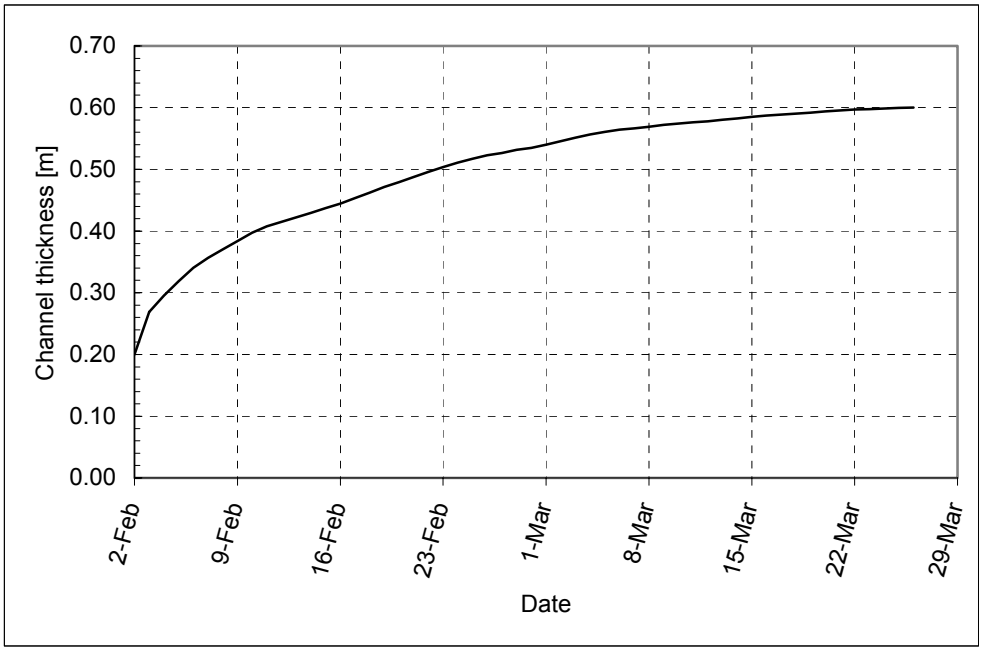


Figure 18. The estimated channel thickness of the archipelago fairway.

The archipelago fairway was opened to the traffic the 2nd of February and the ice thickness at the area was about 0.45 m so the mid channel thickness is assumed to have been 0.20 m at that time. Ship C passed the measuring point three days later and the mid channel thickness was already 0.32 m and *Ship G* passed the measuring point in the 13th of March, when the channel was about 0.58 m thick according to Figure 18.

The channel leading to Loviisa was navigated during the whole winter and it was measured the 11th of February and the average mid channel thickness was 0.35 m. The average daily temperature in Isosaari was continuously below zero degrees starting the 13th of December and the ice thickness out of Loviisa was 5-15 cm the 12th of December. Figure 19 shows the growth of the mid channel thickness starting from December 13.

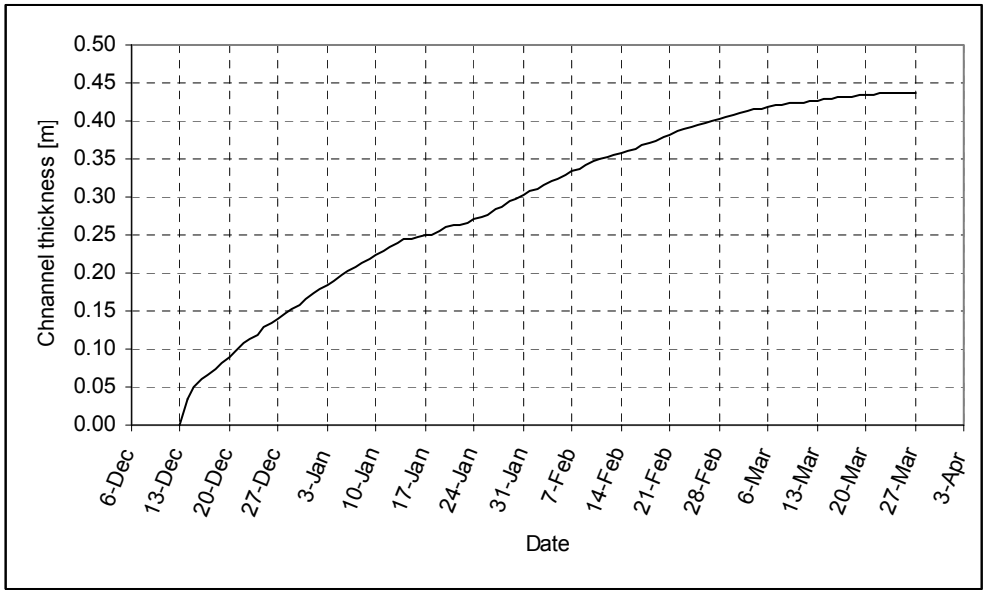


Figure 19. The mid channel thickness of the fairway leading to Loviisa.

The figures above are based on only a few measurements of the channel thickness and on the assumption that the channel thickness is proportional to the square root of cold sum. Because the channels could not be measured the same days as the voyages were made, some channel thicknesses had to be interpolated or extrapolated. The channel thicknesses used in the evaluation of the performance of the vessels in ice are presented in Table 5. The Emäsalo channel for Ship C was not the same channel than for the other ships but it was the Sköldvik channel west of Emäsalo and therefore the thickness is 0.15 m, which was defined in the 30th of January 2003.

Table 5. The estimated channel thicknesses during the voyages.

Ship	**Date**	**Channel**	**H_M**
Ship B	28.1.	Loviisa	29 cm
Ship C	5.2.	Emäsalo	25 cm
		Loviisa	32 cm
Ship E	20.2.	Ruissalo	42 cm
Ship G	13.3.	Emäsalo	58 cm
		Loviisa	43 cm

5 The voyages and evaluation of ships

The GPS data of each voyage was recorded using a PC and the observer took notes at the same time. Appendix 1 shows graphs for the speed, distance, latitude and longitude as a function of time together with the main actions during all voyages. The following evaluations are mainly based on these graphs.

5.1 Ship A

The voyage onboard *Ship A* was the first observation made in the 21st of January. *Ship A* is a 3400 dwt cement bulk carrier of ice class IA Super. *Ship A* was built in 1983 and her installed power is 2766 kW. According to the new rules the power should be 4791 kW for ice class IAS, 3650 kW for IA and 2468 kW for IC. Open water speed of *Ship A* is 13.7 knots.

The voyage of *Ship A* started from Kantvik (Kirkkonummi) in ballast. She navigated first about one hour in an old light ice channel before the open water leg that took about four hours. After that she navigated in an old light archipelago ice channel six hours and could sustain almost the open water speed. Her destination port was Parainen.

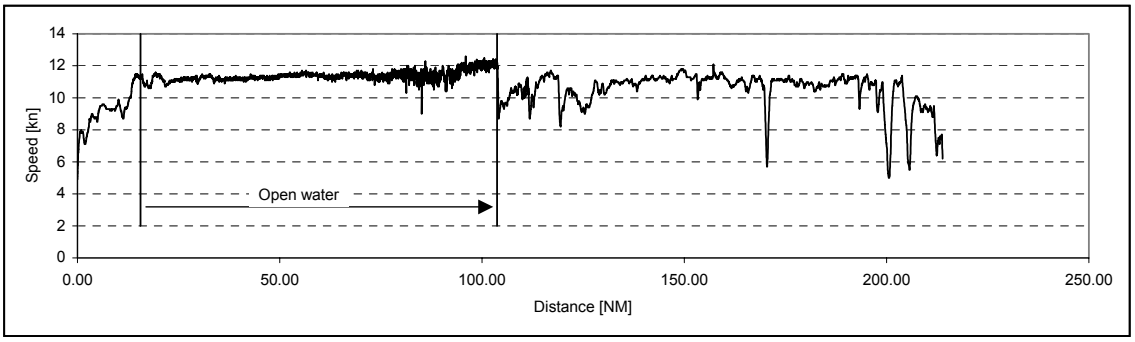


Figure 20. The speed of *Ship A* as a function of distance during her voyage from Inkoo to Parainen.

In the beginning of the voyage before the open water leg *Ship A* navigated in an old channel. The channel was relatively light because it was not very much navigated and the date was only the 26th of January. The speed during this leg was between six and ten knots. After the open water leg the vessel navigated in a very light ice channel where most of the slowing downs are because of some external reason. The ice channel was a very light quite newly broken channel with open water areas in the middle and a visual estimation from the bridge indicated that it did not have any actual side ridges. Since the ice class of the vessel is IA super, the vessel should have been able to sustain almost the open water speed of 13,7 knots in ice channels but she did not.

5.2 Ship B

Ship B is a quite new IA vessel of 3200 dwt with an installed power of 1800 kW. According to the new rules the power should be 3399 kW for ice class IA and 2244 kW for IB. Open water speed of *Ship B* is 12.2 knots.

The voyage of *Ship B* started in ballast from Loviisa (Valkom) and the destination was Hamina. The ice conditions were fairly difficult for her and she got stuck a few times during the voyage. However, icebreaker assistance was not needed since she got free when other vessels passed her. A part of the voyage was navigated in the same channel as *Ship C* and *Ship G* and another part in the same channel as *Ship D*.

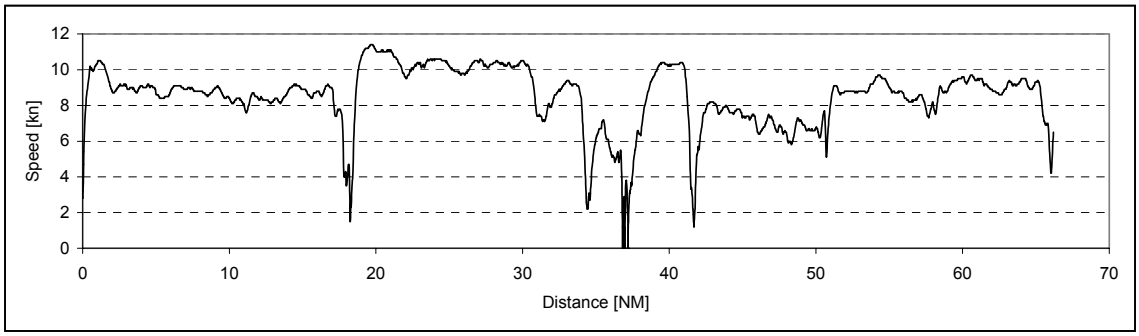


Figure 21. The speed of *Ship B* as a function of distance during her voyage from Loviisa to Hamina.

Ship B started the voyage well making a good time with the speed of 8…9 knots in a light ice channel. But when the ice channel got a little heavier or when the vessel turned or yielded to other ships the speed decreased dramatically. In some cases the speed dropped down to approximately two knots and several times down to five knots until she got stuck. After getting stuck she had to wait for 2 hours and 20 minutes to get free when another ship overtook her. The ice channel during the whole route should not have been very heavy and she still had difficulties in some locations, which indicates that she was close to her limits of capability in navigating in ice.

5.3 Ship C

Ship C is a 25 years old IA vessel of 2954 dwt dead weight. The installed power is 1840 kW and the power requirement is 2899 kW for ice class IA and 1939 for IB. The ship was ballast-laden and her open water ballast speed is 12 knots.

The voyage started from Rauma and before open water area, there was about an hour drive in quite a heavy old ice channel. The vessel met ice again south of Hanko but a little more difficult ice conditions started only a few hours later south of Inkoo. The ice conditions became very difficult and she got stuck among several other vessels and waited about four and a half hours for icebreaker Voima to assist her. The ice conditions were very difficult at the area because of the hard south -west wind. Voima towed *Ship C* about one and a half hours but she faced again difficulties south of Helsinki. From Helsinki to Loviisa she did not have difficulties in navigating in the old ice channel. She navigated between Emäsalo and Loviisa in the same ice channel as *Ship G* and *Ship D* and into the Port of Loviisa in the same ice channel as *Ship G* and *Ship B*.

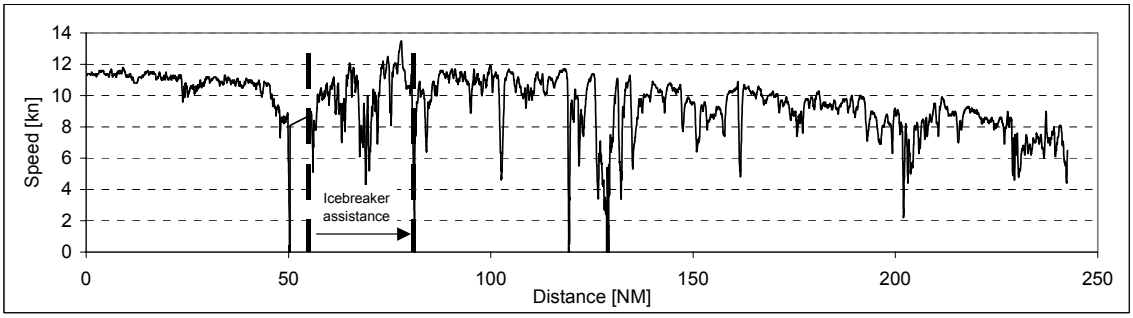


Figure 22. The speed of *Ship C* as a function of distance during her voyage between the position south of Hanko and Loviisa.

The difficulties before the archipelago fairway east of Helsinki are understandable because of the very heavy ice conditions where other more powerful ships also had difficulties. East of Helsinki the ice channel was light and she could keep up a speed of approximately ten knots. The archipelago fairway ice channel had been broken and taken into use only a few days earlier. So it could not have been very heavy in any locations and definitely not even close to one metre in the middle. Yet the speed dropped down to seven and even five knots when the ice channel got a little heavier. If the ice channel had been a little older she would probably have had difficulties to continuously keep up the speed of five knots.

5.4 Ship D

Ship D is a ten years old 3000 dwt ship of ice class IA. Installed power is 1700 kW and the new rules gives 3642 kW for ice class IA, 2427 kW for IB and 1463 kW for IC. Open water speed is 11 knots.

When *Ship D* left the port of Kotka she had difficulties in turning and she needed to be assisted by a tugboat. She navigated from Kotka to Emäsalo in an old ice channel and half of the voyage she was assisted by icebreaker Apu.

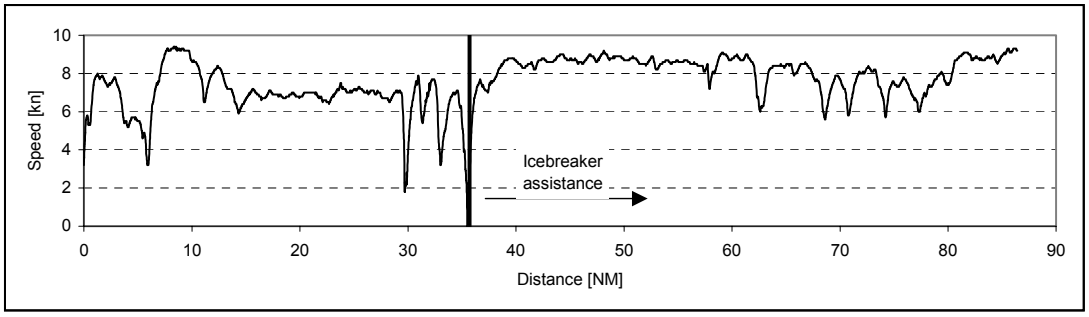


Figure 23. The speed of *Ship D* as a function of distance during her voyage from Kotka to Emäsalo.

In the beginning of the journey *Ship D* could occasionally keep up a speed of nine knots but the speed also dropped sometimes down to three knots. Again the channel was not very heavy and not close to the one metre thick rule channel. After a little more than two hours from Kotka the progression became quite difficult and in about half an hour she stopped to wait for icebreaker Apu that was coming from west. The

rest of the journey she was assisted by IB Apu but even then the speed decreased sometimes down to six knots without any obvious reason.

5.5 Ship E

Ship E is a little larger vessel than the others. It is a 4803 dwt IA vessel with the engine power of 2640 kW. According to the new rules she should have 4165 kW for ice class IA and 2800 kW for IB. Open water speed is 12 knots.

Ship E was coming into Naantali and the observations started north of Utö. The whole voyage was made in an ice old ice channel part of which was the fairway between Mariehamn and Turku. This ice channel was 100-150 metres wide and the vessel did not have any difficulties during the voyage. *Ship E* was in ballast during the voyage.

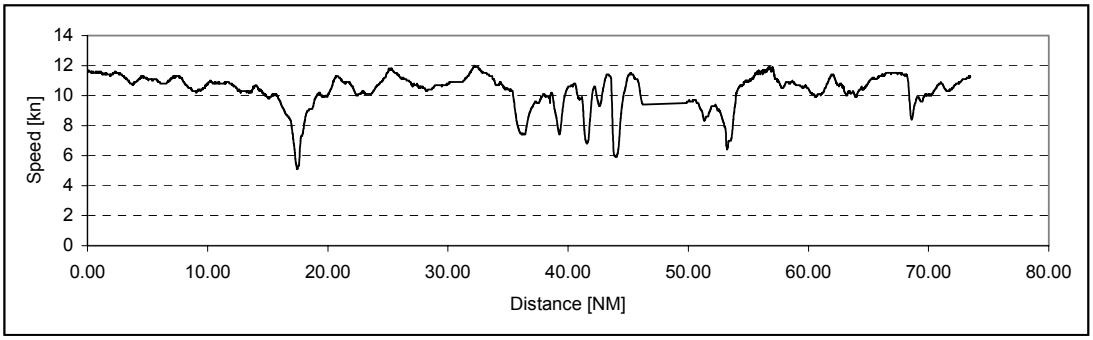


Figure 24. The speed of *Ship E* versus distance during her voyage from Utö to Naantali.

5.6 Ship F

Ship F is a 2896 dwt vessel who visits regularly Lake Mälaren in Sweden. Her installed power is 1975 kW and according the new rules the power should be 3213 for ice class IA and 2143 for IB. *Ship F* was originally designed to operate to Lake Vänern via the Trolhätte canal and to fit in the locks the bow was made quite blunt. Her open water speed is 12 knots.

The voyage of *Ship F* was made in Lake Mälaren starting from Södertälje. The voyage was made maybe a little too late because the melting of ice had already started. The whole voyage was made in an ice channel but there were large open areas especially closer to Västerås, which was the destination port. The ship did not have any difficulties during the voyage.

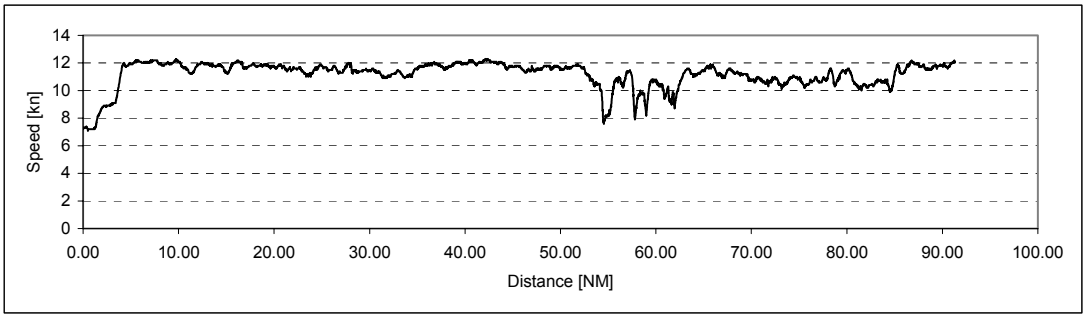


Figure 25. The speed of *Ship F* versus distance during her voyage from Södertälje to Västerås.

5.7 Ship G

The last observations were made on *Ship G* that is a 3240 dwt ship. The installed engine power is 1845 kW and it should be according to the new rules 3036 for ice class IA and 2053 for IB. Open water speed is 12.5 knots.

The voyage on *Ship G* was made in a much-operated old ice channel. The melting of ice had already started but the ice channel was still relatively hard to navigate. *Ship G* did not have major difficulties during the voyage, only in some positions where the channel turned or in the intersection of two channels the speed lowered a little.

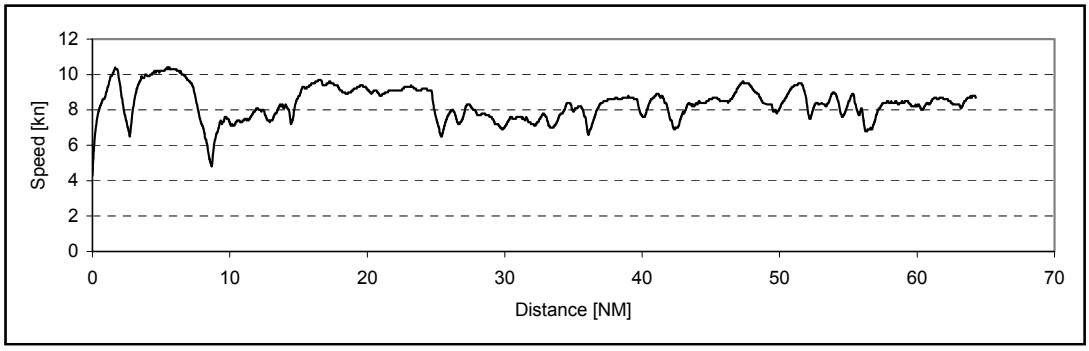


Figure 26. The speed of *Ship G* versus distance during her voyage from Loviisa to Emäsalo.

Ship G made the journey rather well being able to keep up the speed of eight, nine knots. The speed decreased below seven knots only because of some other reason e.g. when she met another ship. The journey was made in mid-March and the melting of ice had already started but the ice channel was still relatively heavy to navigate.

6 Comparison between ships that navigated in the same channels

Four ships: *Ship D*, *Ship B*, *Ship C* and *Ship G* used partly the same ice channels with each other. The ice channels have probably changed between the observations because the observation period was about one and a half months.

The ice channel leading to Loviisa was used by *Ship B* 28th of January, by *Ship C* a week later and by *Ship G* the 13th of March. The leg was only about 5 NM long and *Ship B* and *Ship G* did it almost in the same time but *Ship C* did a little slower (Figure 27). *Ship G* was coming out of Loviisa and she did not keep up full speed all the time because of some machines working on ice. Figure 28 shows the speed of the vessels during the leg.

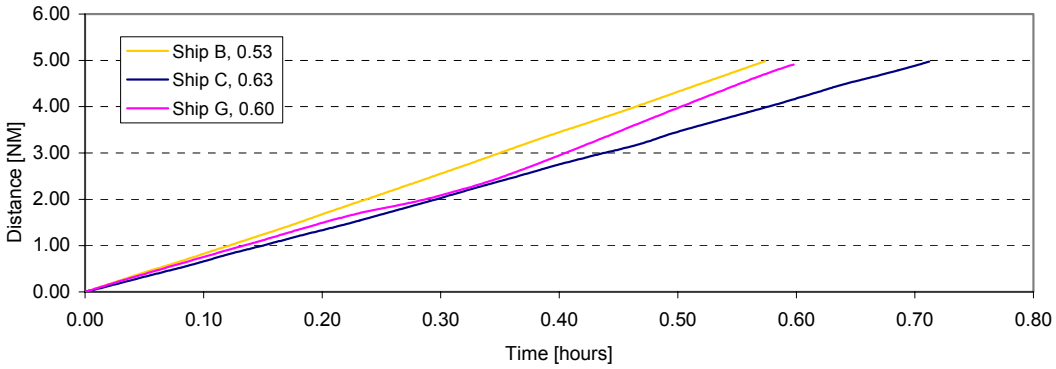


Figure 27. Distance versus time in the ice channel leading to Loviisa. The ratios between the installed power and the new power requirement are shown in the legend.

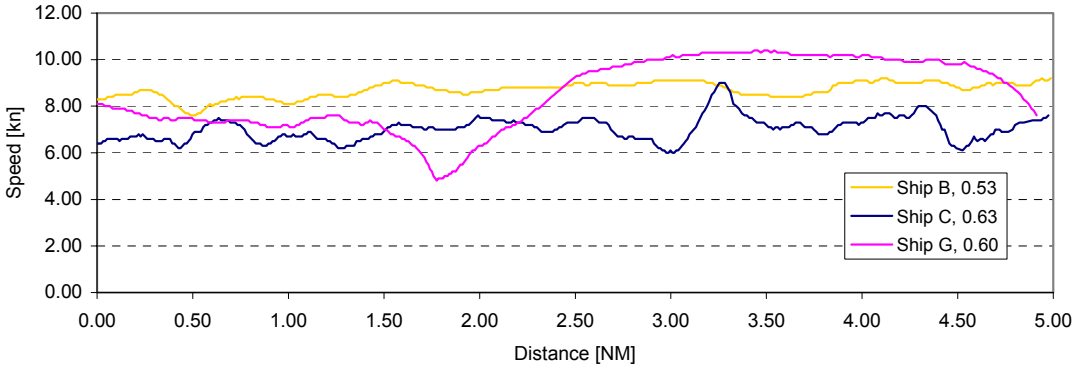


Figure 28. Speed versus distance in channel leading to Loviisa. The ratios between installed power and new power requirement are shown in the legend.

Ship B and *Ship C* used full power during this part of the voyage and *Ship B* did the leg one week earlier. The average speed of *Ship C* was 7.0 knots and *Ship B* 8.7 knots. *Ship B* seems to perform a little better in ice than *Ship C*, which can also be seen in the H-V –curve (Figure 33). *Ship G* used full power only for about 2.5 miles and her average speed was about 10 knots. *Ship G* did this part of the voyage about one and a half months later than *Ship B*, and so the channel must have been heavier which indicates that *Ship G* performs much better in ice than *Ship B* and *Ship C*.

Ship C, *Ship G* and *Ship D* used the same channel for 22 NM from the south of Loviisa to Emäsalo. The ships seem to be equally good in performing in the ice

channel (Figure 29). Figure 30 shows that there were some differences in speeds but all three vessels could keep the speed of about 8...9 knots.

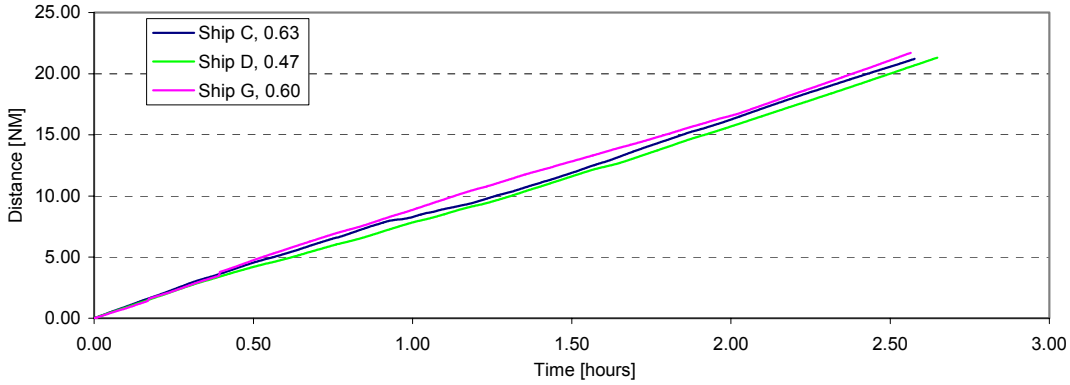


Figure 29. Distance versus time in the ice channel between Loviisa and Emäsalo. The ratios between the installed power and the new power requirement are shown in the legend.

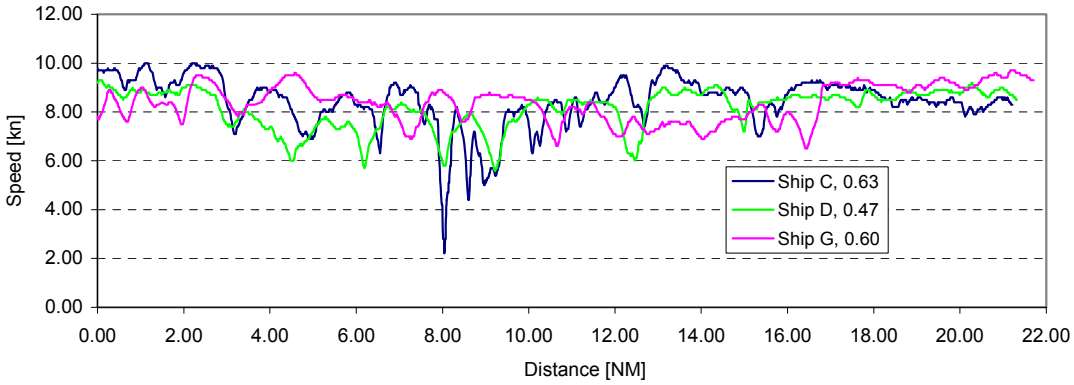


Figure 30. Speed versus distance in the ice channel between Loviisa and Emäsalo. The ratios between the installed power and the new power requirement are shown in the legend.

The average speeds during this leg were for *Ship C* 8.24 knots, for *Ship D* 8.06 knots and for *Ship G* 8.30 knots. The average speeds are almost the same for all ships but *Ship G* did the voyage one month after *Ship D* and one and a half months after *Ship C* and the ice channel must have been much thicker and heavier. The ice channel south of Emäsalo was 28 cm thick, 43 cm thick and 58 cm thick (Figure 18) when *Ship C*, *Ship D* and *Ship G* did their voyages respectively, which indicates that *Ship G* performs better in ice than *Ship D* and *Ship C*. *Ship D* seems to be a little better than *Ship C* although her ratio between the installed power and the new requirement is smaller than *Ship C*'s.

Ship D and *Ship B* used the same ice channel about 10 NM east of Loviisa. *Ship D* did the voyage about two weeks later than *Ship B*. Distance versus time and speed versus distance are presented in Figure 31 and Figure 32.

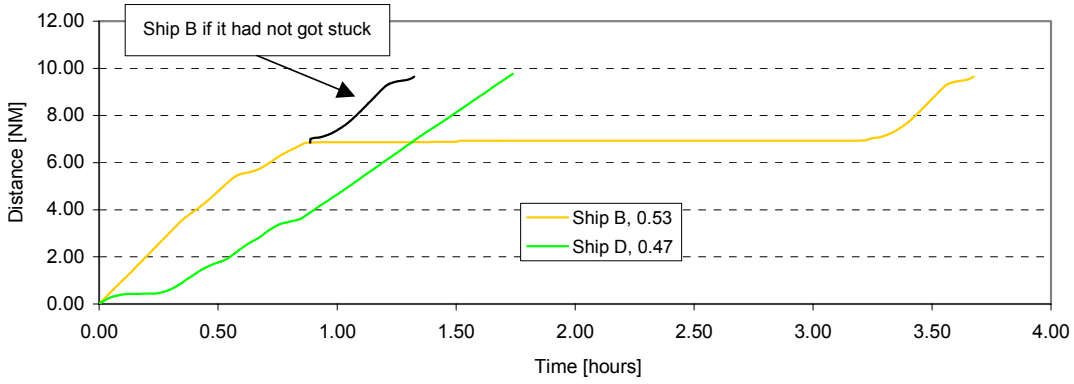


Figure 31. Distance versus time in the ice channel between Loviisa and Hamina. The ratios between the installed power and the new power requirement are shown in the legend.

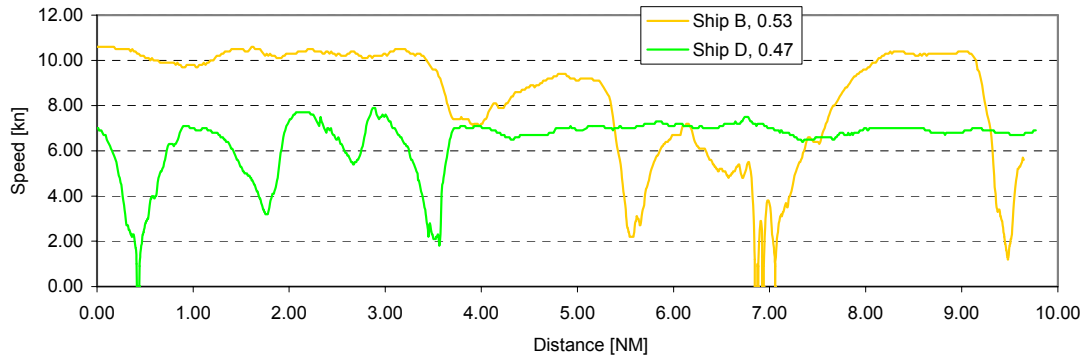


Figure 32. Speed versus distance in the ice channel between Loviisa and Hamina. The ratios between the installed power and the new power requirement are shown in the legend.

Ship B got stuck in ice and she had to wait about two and a half hours before a roro vessel passed her and she got loose. Figure 31 also shows that if *Ship B* had not got stuck she would have done the voyage in almost half an hour faster than *Ship D*. *Ship D* of course did the voyage two weeks later but this part of the voyage was only 10 miles long, which gives the average speed of 5.6 knots for *Ship D* and 4.0 knots for *Ship B* but if *Ship B* had not got stuck her average speed would have been 7.3 knots. It is difficult to evaluate the order of these two vessels but it looks like *Ship B* performed a little better in ice.

7 H-V –curves constructed from the available data

The channel profiles were measured a few times during the observation period. Some of the voyages were made approximately at the same time with the channel measurements but some thicknesses of channels had to be estimated with the help of the temperature data. The H-V –curves in Figure 33 are based on the measured and

estimated channel thicknesses presented in Chapter 4.2 and the open water speed. Error bars ±0.20 m was used for the channel thickness and ±0.50 knots for speed.

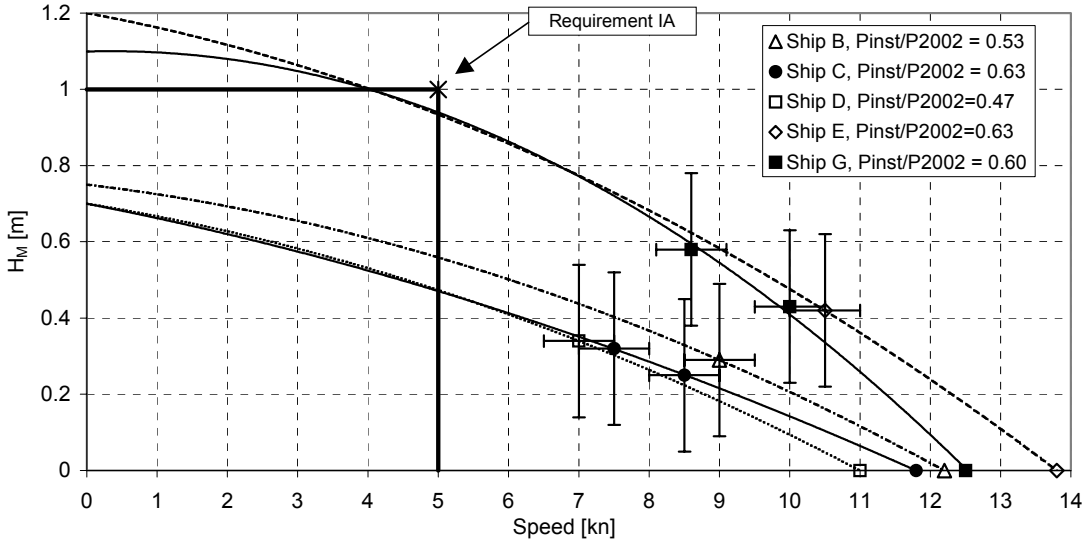


Figure 33. Estimated H-V -curves for five ships constructed using one or two speeds in an ice channel and the open water speed. The ratio between the installed and the required power for each ship is shown in the legend.

The H-V –curve of *Ship D* is also presented in Figure 33. The only ice channel measured in the route of *Ship D* was the Emäsalo ice channel, but an icebreaker assisted *Ship D* at that time and the data collecting was actually stopped just before the measured profile. However *Ship D* used the same route as *Ship B* and the H-V –curve was constructed as follows.

The speed of *Ship D* was 7.0 knots in February 12 and the speed of *Ship B* was about 10.0 knots in January 28 in location 60.371ºN, 26.708ºE. According to the H-V –curve of *Ship B* the channel thickness was approximately 0.20 m. This part of the ice channel is between Hamina and Kotka and so only ships navigating to Hamina use it. Therefore the ice channel can neither be compared to the measured one, much navigated part of the archipelago ice channel nor to the much less navigated Loviisa ice channel but the ice channel was probably something between these two. According to Figure 18 the thickness of the archipelago ice channel in the 12th of February was about 0.40 m and according to Figure 19 the Loviisa ice channel grew between the dates of the voyages of *Ship B* and *Ship D* about 7 cm, which gives the channel thickness of 0.27 m. The average of these two thicknesses, 0.34 m, was taken to the H-V –curve.

The H-V –curves of *Ship E* and *Ship G* go close to the IA rule point, 5 knots in one metre thick channel, but the H-V –curves of *Ship C* and *Ship B* are far from the rule requirement. *Ship E* is a much larger vessel than the others with deadweight of 4803 dwt, which may explain the large difference but *Ship G*, *Ship B* and *Ship C* are about the same size. One difference between these vessels is that *Ship B* and *Ship C* have CP-propellers but *Ship G* has an FP-propeller.

8 Conclusions

The new power requirements of Finnish-Swedish ice class rules were published in October 2002 and came into force 1 September 2003. The aim of this study is to clarify if the power requirement is too high for small vessels of about 3000 dwt. The evaluation of the small tonnage was carried out observing the performance of seven vessels of this size. All vessels observed were of ice class IA except one that was IA Super. This is because the restrictions to navigation closed the Gulf of Finland from ships IA smaller than 2000 dwt and lower ice classes in the middle of February. Also the Gulf of Bothnia was closed from small tonnage in the beginning of February.

Four ships out of these seven were observed in the Archipelago fairway east of Helsinki where the ice conditions were very good for the observations. One ship, *Ship A*, which has ice class IA Super was observed during her voyage from Kantvik to Parainen in January and the ice conditions at the area were not very difficult at that time. The performance observations of *Ship E* took place during her voyage from Utö to Naantali along the deep-water channel which was very wide, especially the part that is also used by the Sweden ferries. *Ship F* was observed in Lake Mälaren in Sweden in mid March, but melting of ice had already started and ice conditions were light and she had no difficulties during the voyage.

The four ships, *Ship B*, *Ship C*, *Ship D* and *Ship G* observed in the Gulf of Finland were all close to the smallest size and the lowest ice class that was allowed to navigate to the eastern ports of the Gulf of Finland. The archipelago channel was opened to traffic in the beginning of January, which helped the observations because the channel did not move and almost all vessels in this area used it. Although several ships used the channel daily, it never became one metre thick in the middle, on which the new power requirement is based for ice class IA. All four ships managed to navigate almost without icebreaker assistance or almost without getting stuck with a few exceptions. However the mid channel thickness was measured to be at maximum 60 centimetres and the vessels had even then difficulties in keeping up the speed of five knots during the whole voyage, thus it can be concluded that the vessels did not fulfil the engine power requirements for ice class IA.

The H-V –curve in channel could be constructed for five ships (Figure 33). According to this curve two ships, *Ship E* and *Ship G*, almost fulfilled the requirement for ice class IA, five knots in one metre thick channel, but three ships, *Ship C*, *Ship D* and *Ship B* were relatively far from the requirement. Some of these five ships made a part of their voyages in the same ice channel and could therefore be compared with each other. The comparisons supported the constructed H-V –curve especially in the case of *Ship D* which used the same fairway with *Ship C* between Loviisa and Emäsalo and with *Ship B* between Loviisa and Hamina. In both comparisons *Ship D* seemed to have performed a little worse than the two other ships. Therefore her H-V –curve is at most the same as *Ship C*'s or *Ship B*'s, which means that she does not fulfil the requirement.

Ship G was the only observed ship in the archipelago ice channel that almost fulfilled the requirement for ice class IA. *Ship G* and *Ship D* were loaded but *Ship B* and *Ship C* were in ballast. If the engine power requirement is calculated for the ballast draft the requirement is a little lower than for the loaded draft but usually vessels perform worse in ice in ballast. The prevailing draft can partly explain the lower level of H-V

–curves for *Ship B* and *Ship C* but the vessel must anyhow achieve the speed of 5 knots with all drafts.

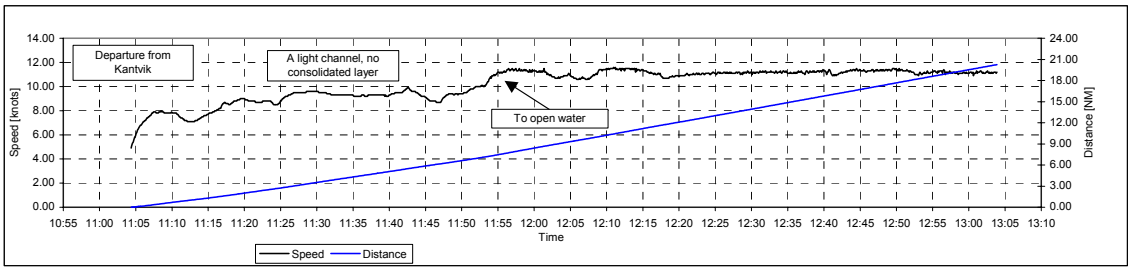
During the voyages of these seven vessels the restrictions to navigation barely allowed *Ship B*, *Ship C*, *Ship D* and *Ship G* to navigate in the area where the observations were made. During *Ship A*'s voyage even ships of ice class IC were allowed to navigate to Kantvik and Parainen and during *Ship E*'s voyage even ships of ice class II were allowed to navigate to Naantali. Mälaren also had no restrictions to navigation during *Ship F*'s voyage. The four ships that used the archipelago channel had difficulties during their voyage. One ship needed icebreaker assistance and another stayed a long time stuck in ice until another ship passed her and she got free. The speed of all four ships occasionally dropped under five knots or even lower, which may disturb other traffic especially in a narrow ice channel like the archipelago ice channel. This study is partly based on empirical methods and observations of the performance of the vessels but the speed of the vessels and some ice channel profiles were measured. Together with the observations, the measurements quite clearly prove that three vessels, *Ship C*, *Ship B* and *Ship D*, out of seven did not fulfil the requirements for ice class IA and two vessels, *Ship G* and *Ship E* almost fulfilled the engine power requirements. Because of the light ice conditions during the voyages of *Ship A* and *Ship F*, the performance of these two vessels is difficult to evaluate.

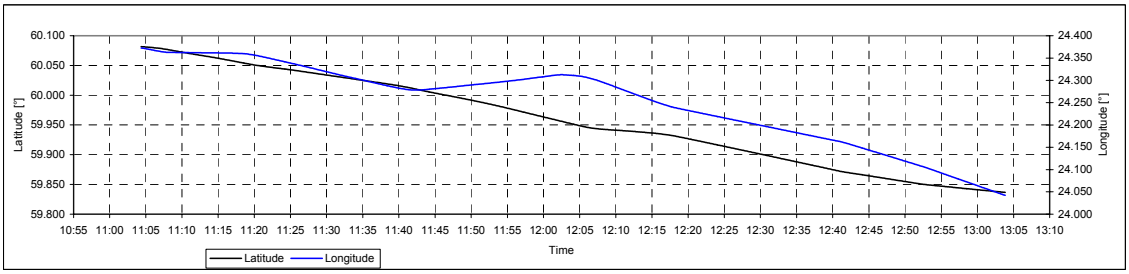
APPENDIX 1

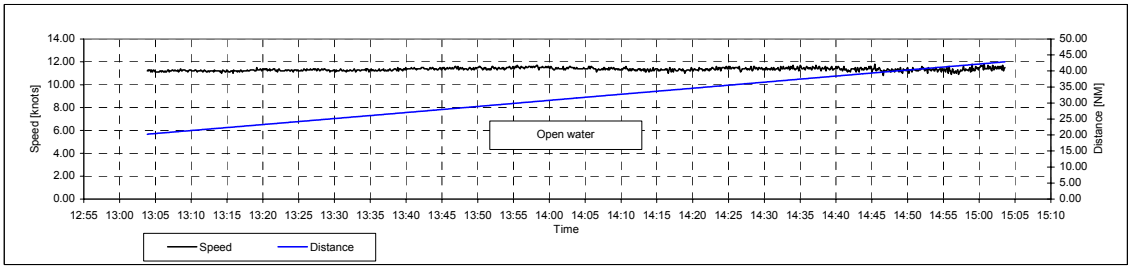
DISTANCE, SPEED AND LOCATION AS A FUNCTION OF TIME DURING THE VOYAGES

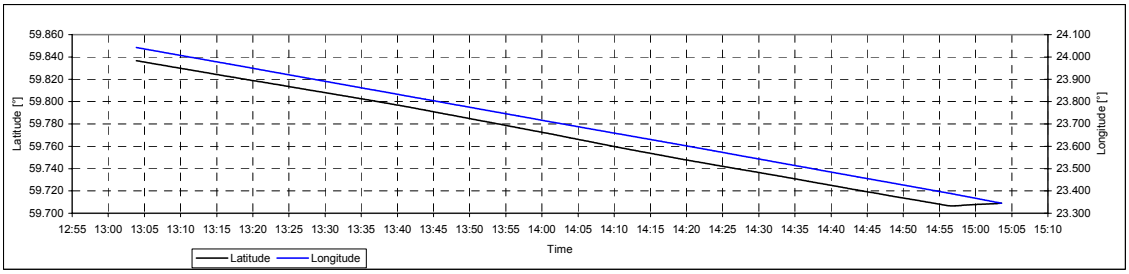
1. Ship A
2. Ship B
3. Ship C
4. Ship D
5. Ship E
6. Ship F
7. Ship G

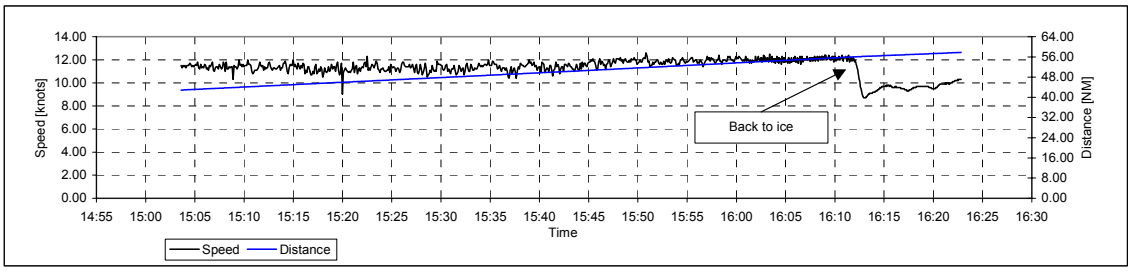
Ship A, 21.1.2003

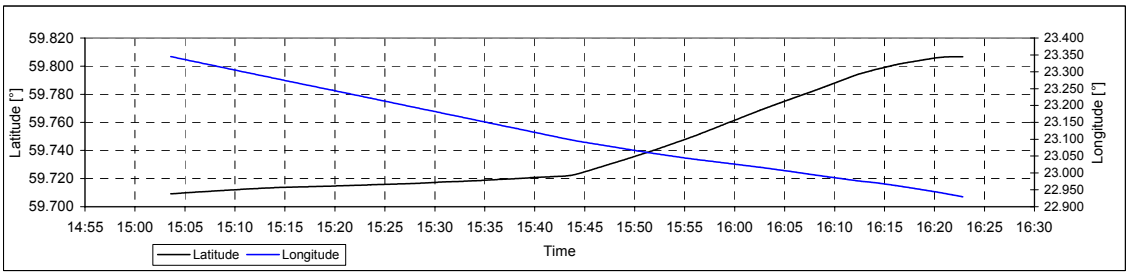


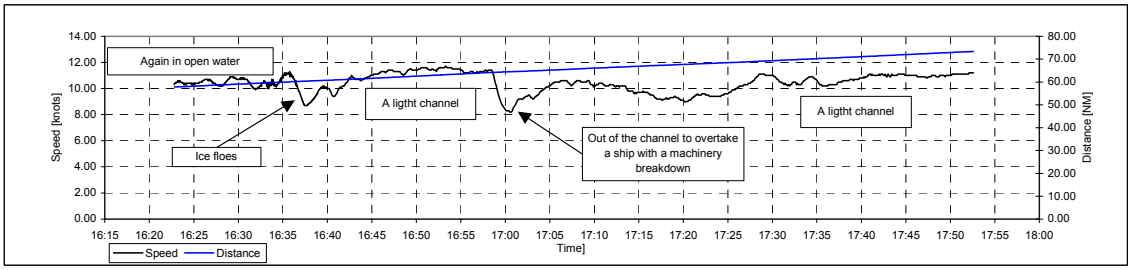


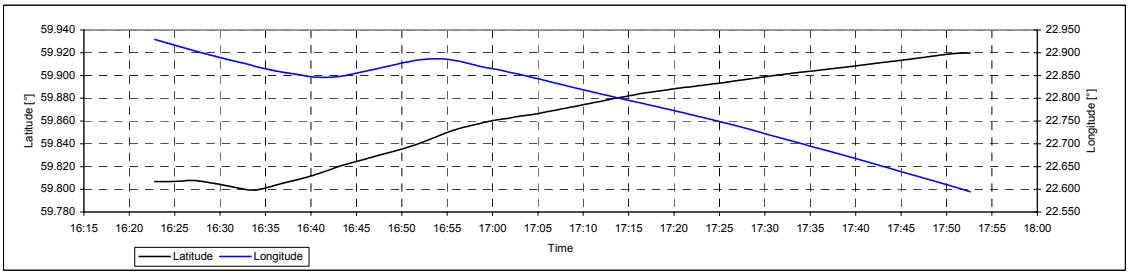


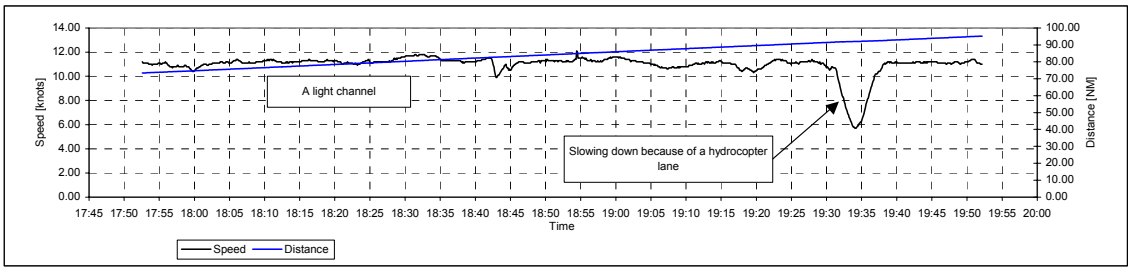


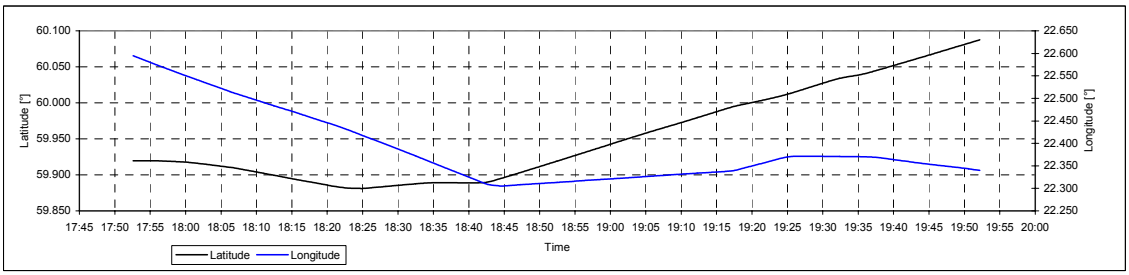

Speed [knots]
Distance [NM]
Time
Back to ice
Speed
Distance

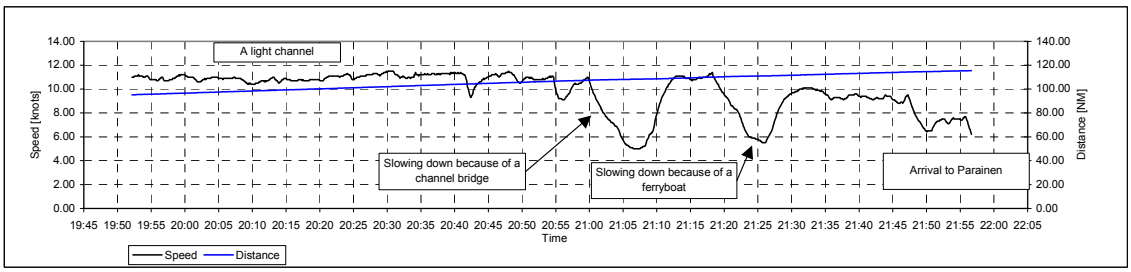

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

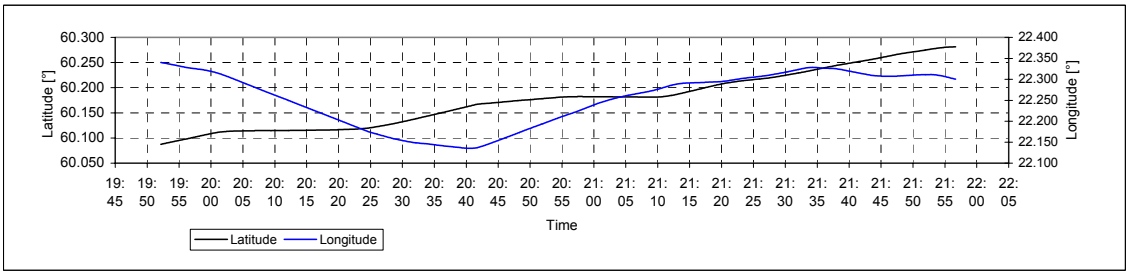

Speed [knots]
Distance [NM]
Time]
Again in open water
A ligtht channel
Ice floes
Out of the channel to overtake a ship with a machinery breakdown
A ligtht channel
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude

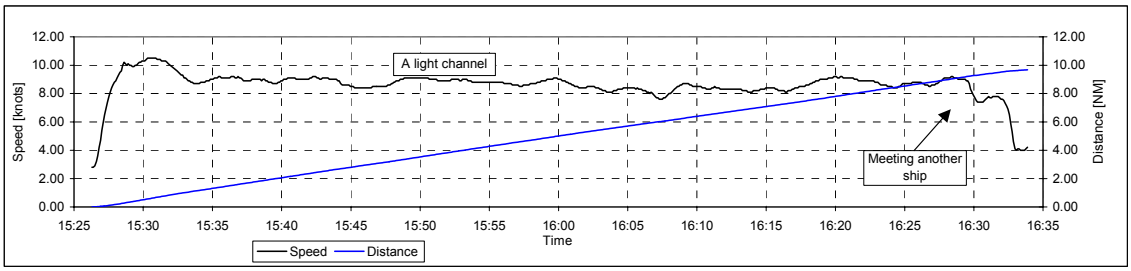


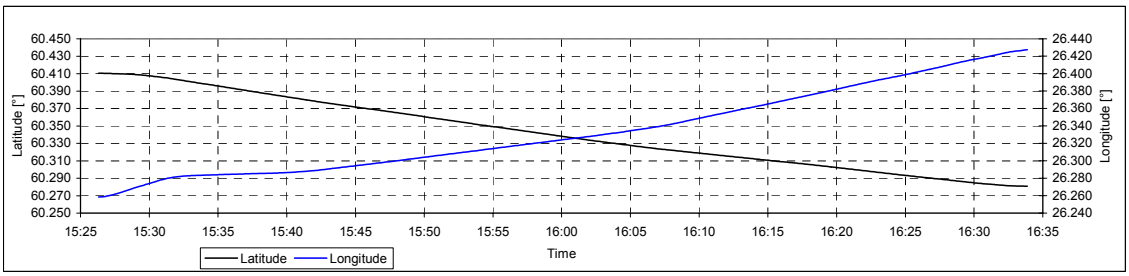


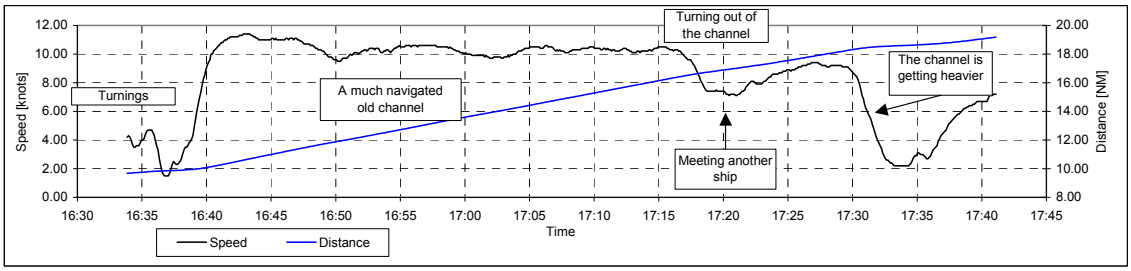


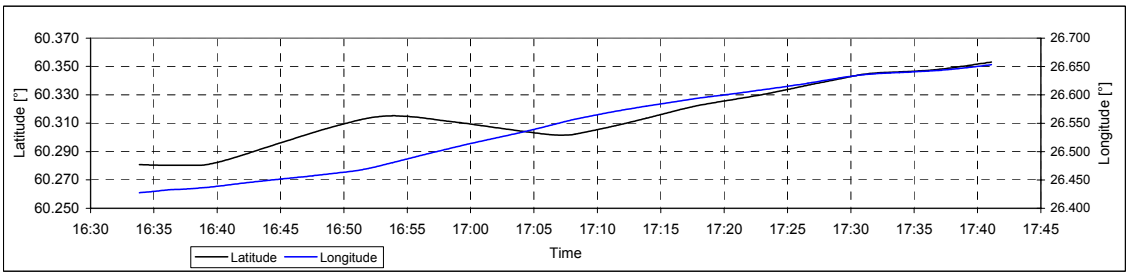


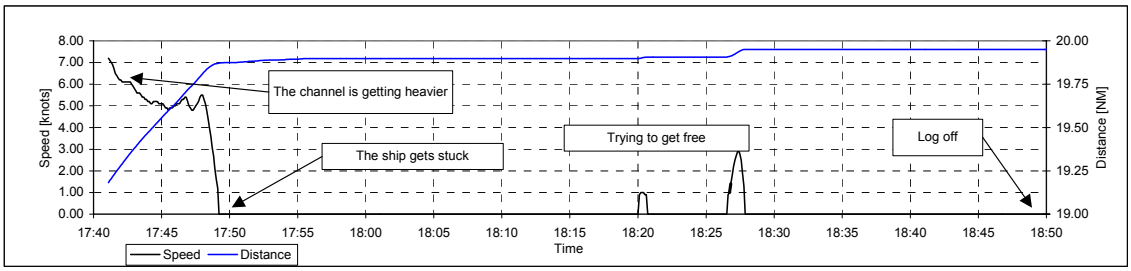
Ship B, 28.1.2003

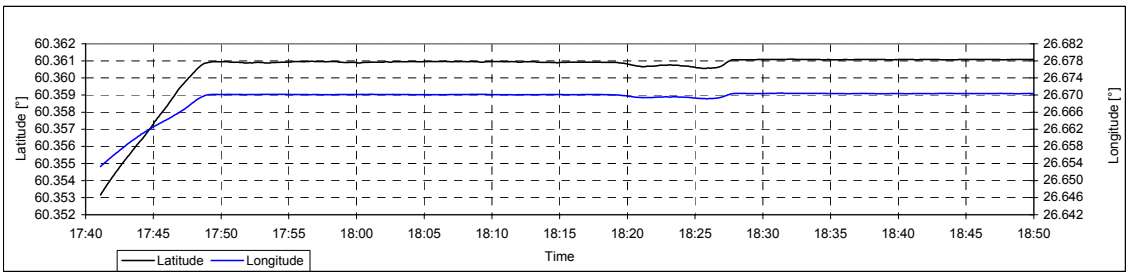

A light channel
Meeting another ship
Speed [knots]
Distance [NM]
Time
Speed
Distance

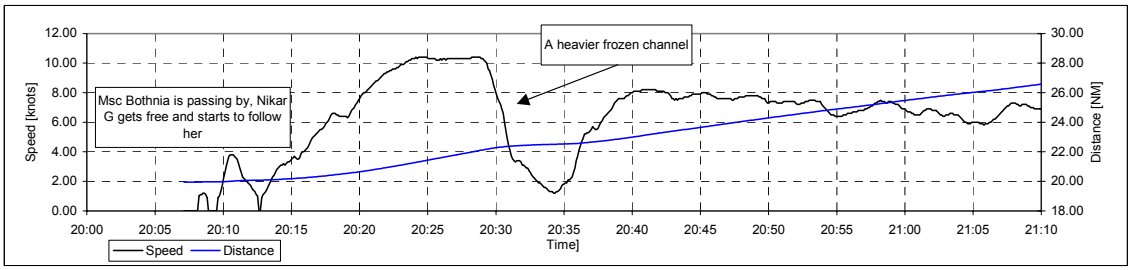

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

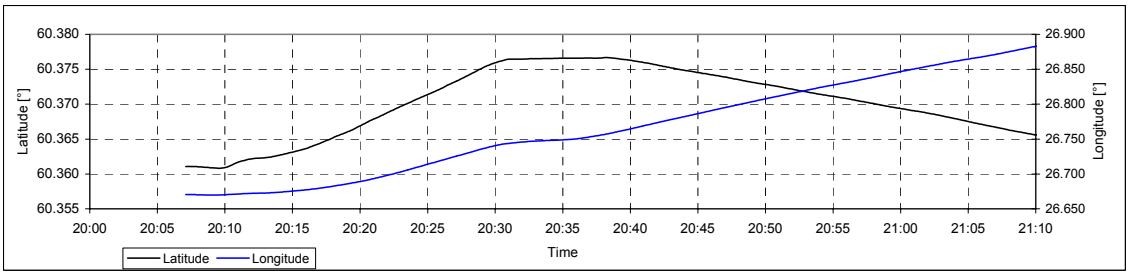

Turning out of the channel
The channel is getting heavier
Turnings
A much navigated old channel
Meeting another ship
Speed [knots]
Distance [NM]
Time
Speed
Distance

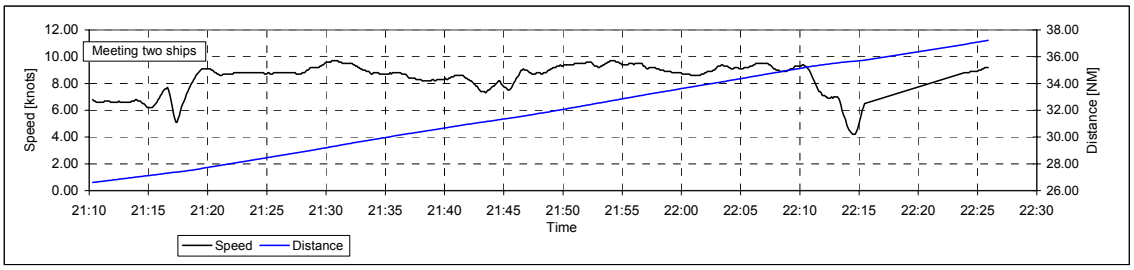

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

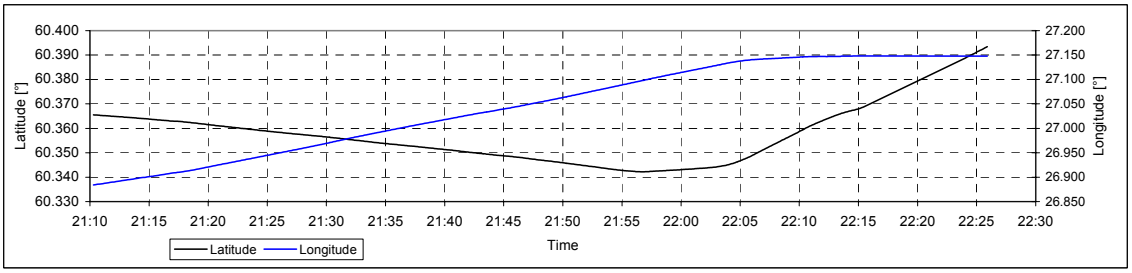

Speed [knots]
Distance [NM]
Time
The channel is getting heavier
The ship gets stuck
Trying to get free
Log off
Speed
Distance

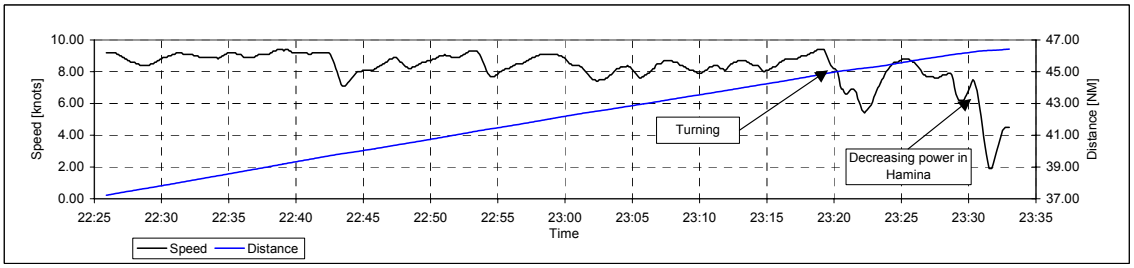

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

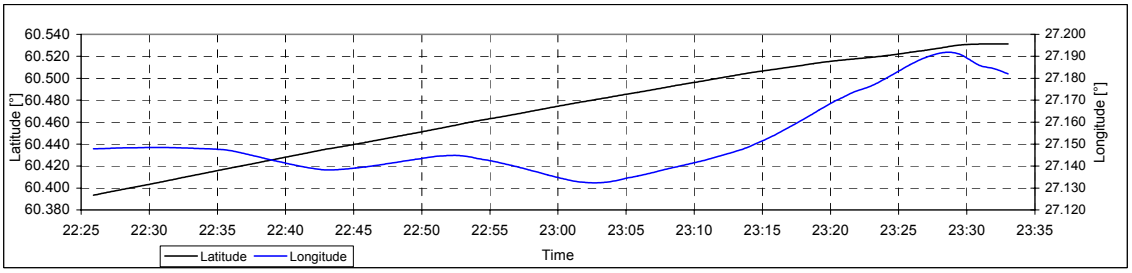

Speed [knots]
Distance [NM]
Time]
A heavier frozen channel
Msc Bothnia is passing by, Nikar G gets free and starts to follow her
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude

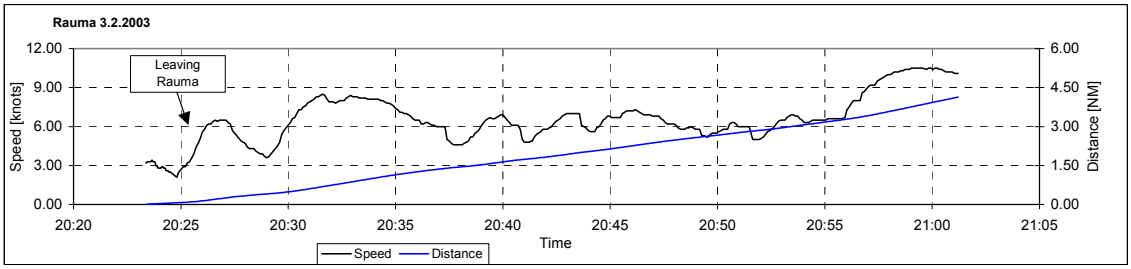

Meeting two ships
Speed [knots]
Distance [NM]
Time
Speed
Distance

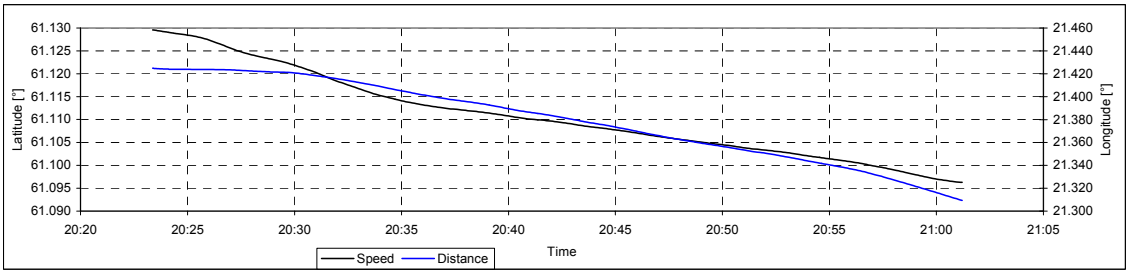

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

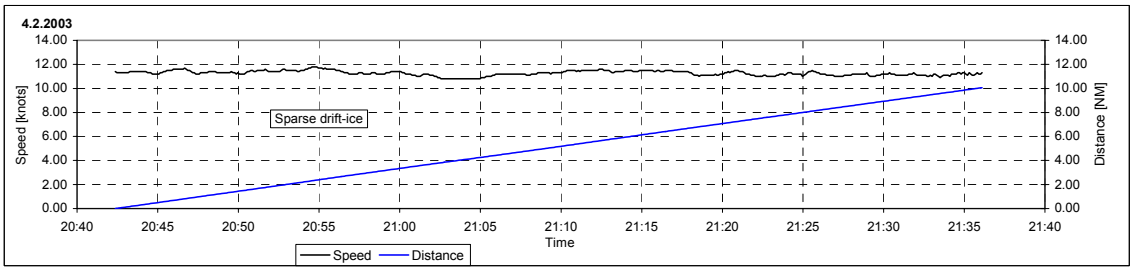

Speed [knots]
Distance [NM]
Turning
Decreasing power in Hamina
Time
Speed
Distance

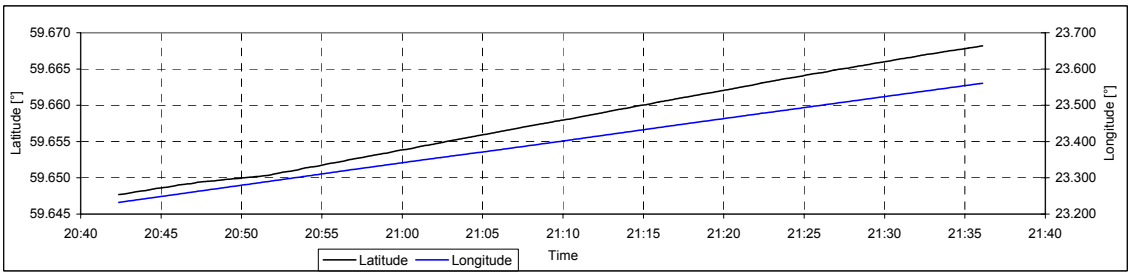

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

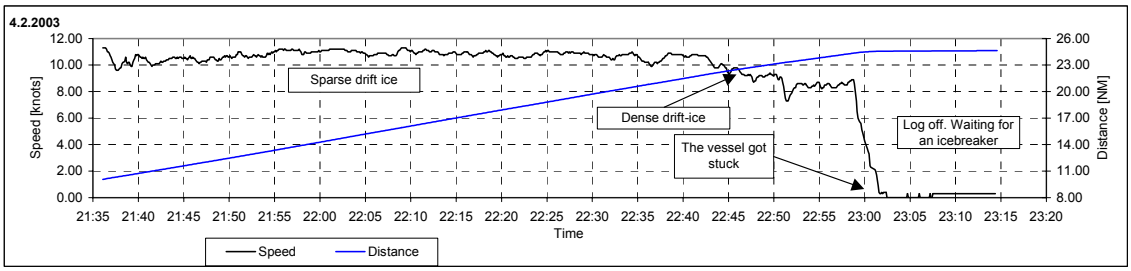
Ship C, 3.-5.2.2003

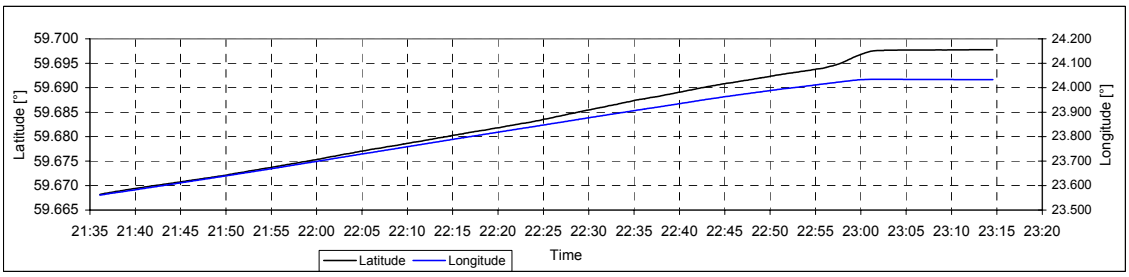


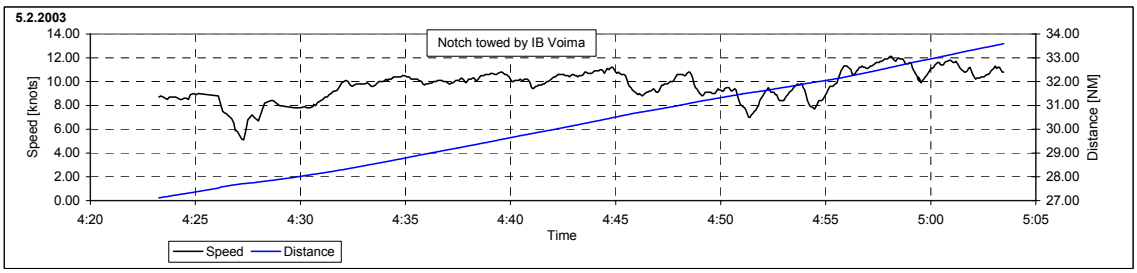


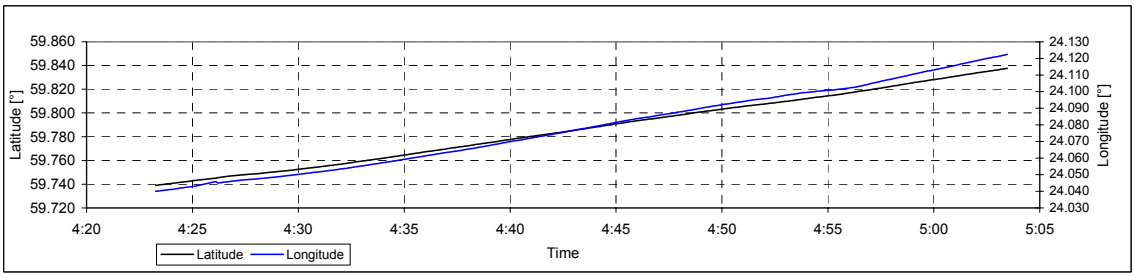


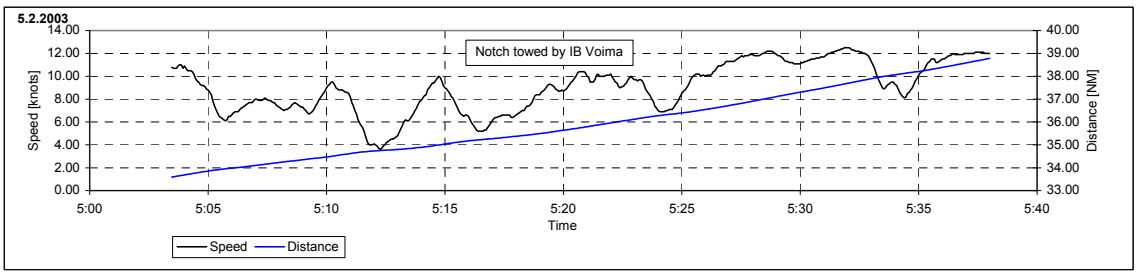


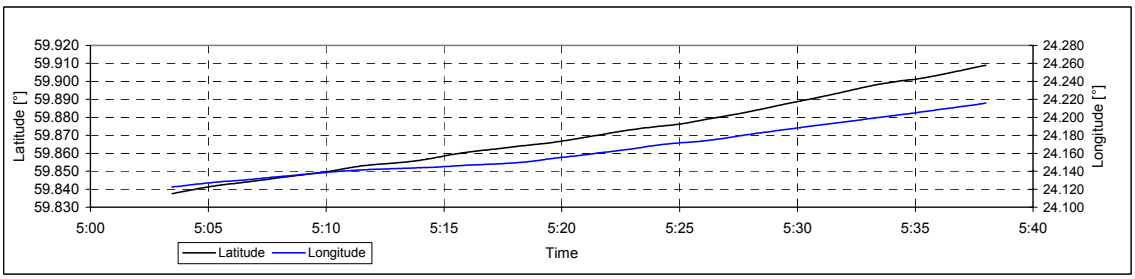

4.2.2003
Speed [knots]
Distance [NM]
Sparse drift ice
Dense drift-ice
The vessel got stuck
Log off. Waiting for an icebreaker
Time
Speed
Distance

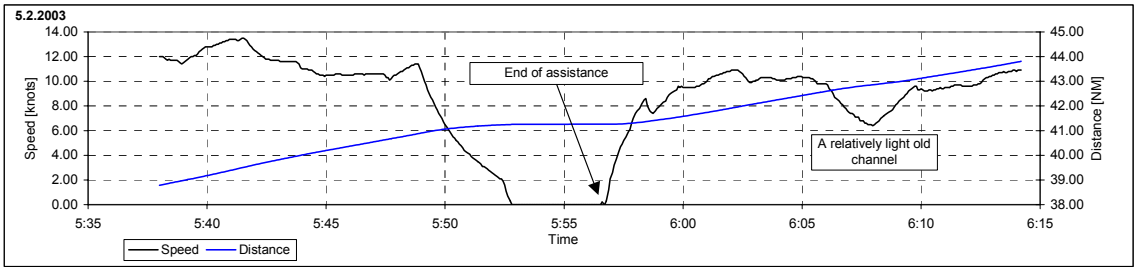

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

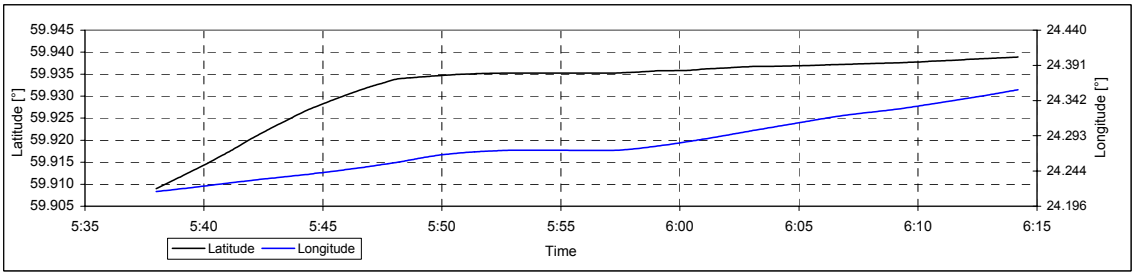

5.2.2003
Speed [knots]
Distance [NM]
Notch towed by IB Voima
Time
Speed
Distance

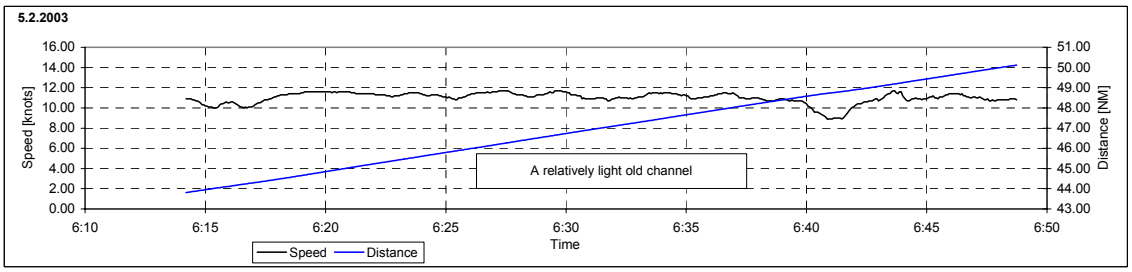

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

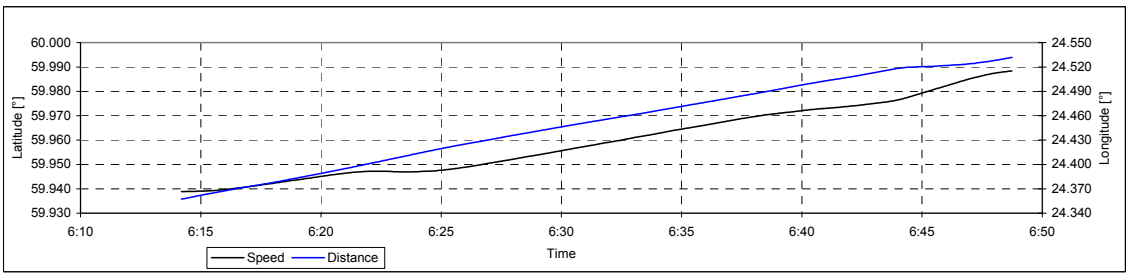

5.2.2003
Speed [knots]
Distance [NM]
Notch towed by IB Voima
Time
Speed
Distance

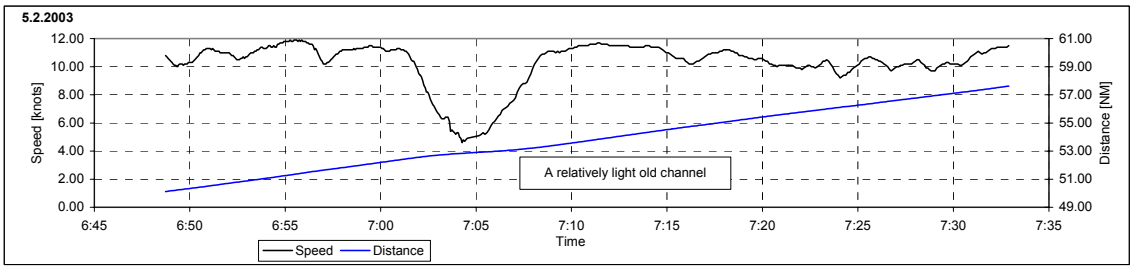

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

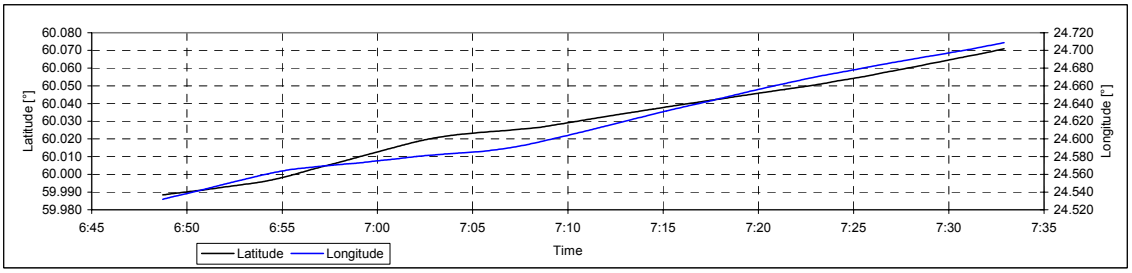

5.2.2003
Speed [knots]
Distance [NM]
End of assistance
A relatively light old channel
Time
Speed
Distance

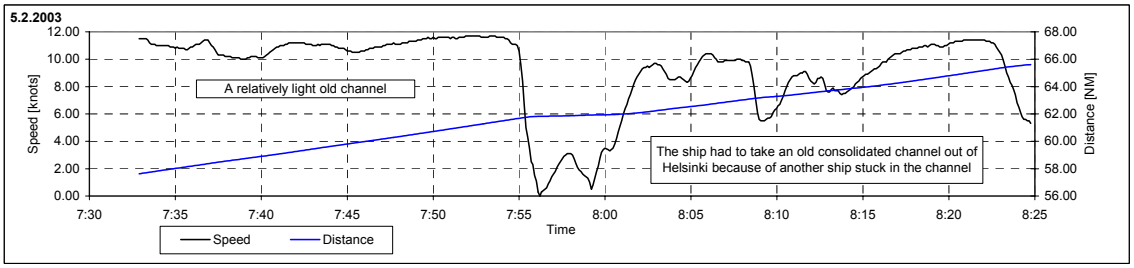

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

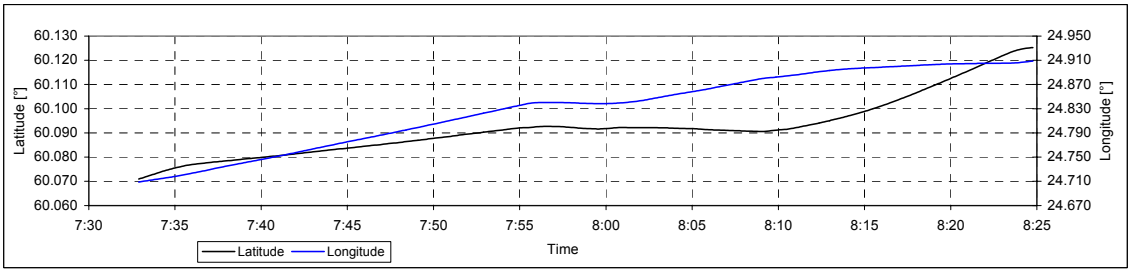

5.2.2003
Speed [knots]
Distance [NM]
A relatively light old channel
Time
Speed
Distance

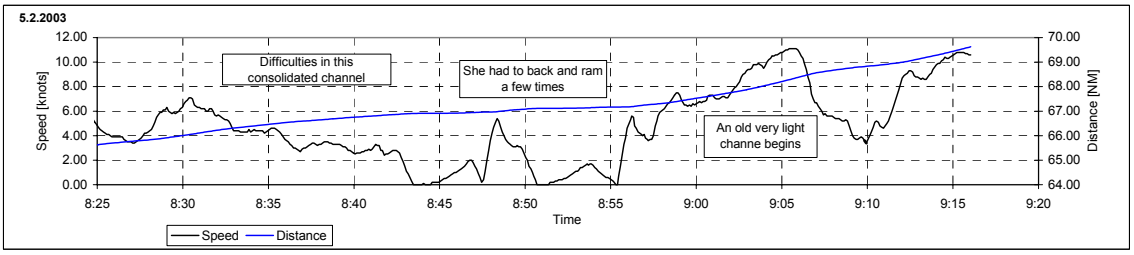

Latitude [°]
Longitude [°]
Time
Speed
Distance

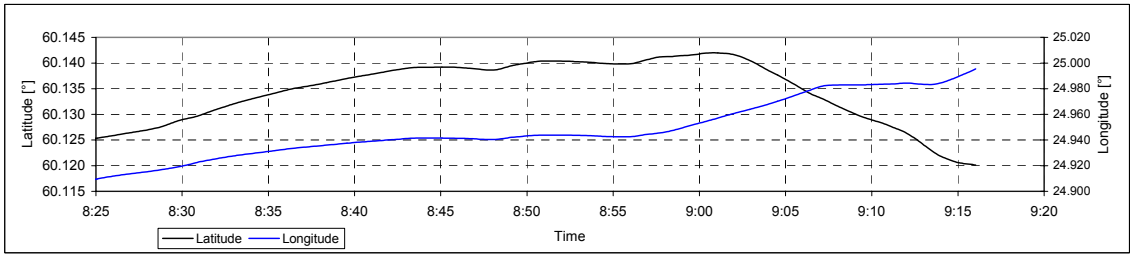

5.2.2003
Speed [knots]
Distance [NM]
A relatively light old channel
Speed
Distance
Time

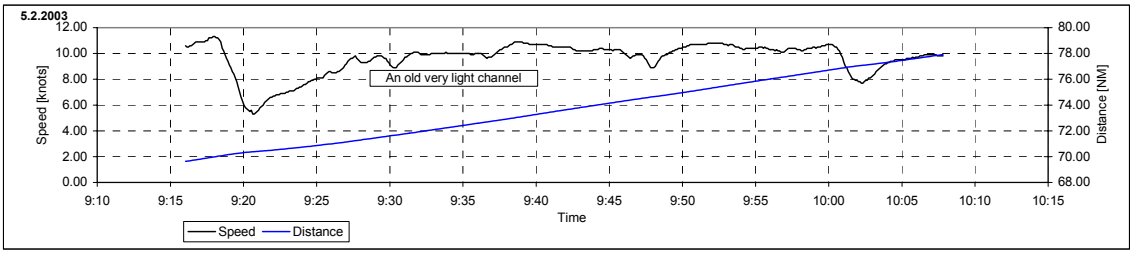

Latitude [°]
Longitude [°]
Latitude
Longitude
Time

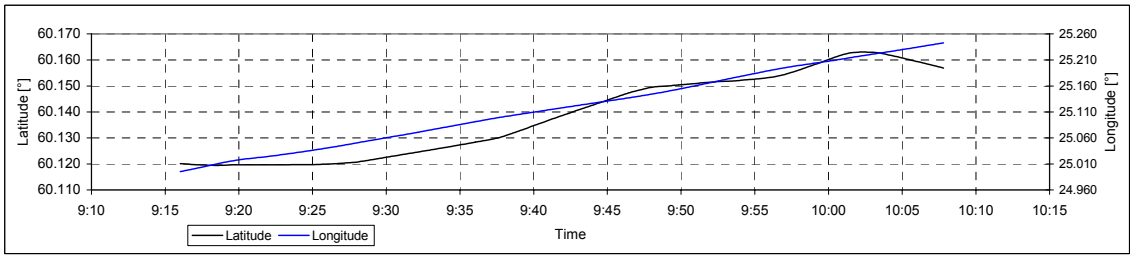

5.2.2003
Speed [knots]
Distance [NM]
A relatively light old channel
The ship had to take an old consolidated channel out of Helsinki because of another ship stuck in the channel
Speed
Distance
Time

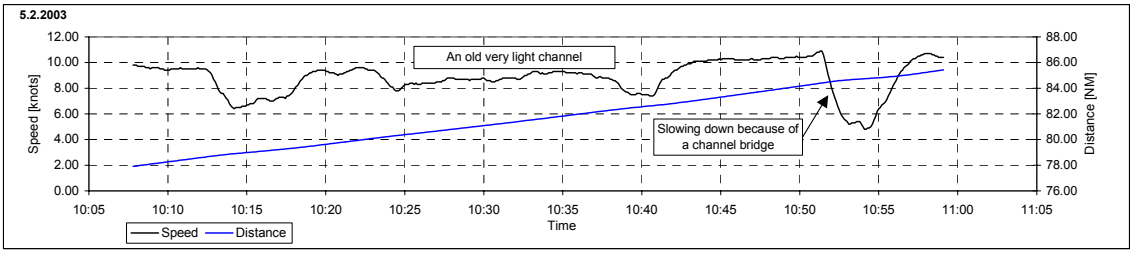

Latitude [°]
Longitude [°]
Latitude
Longitude
Time

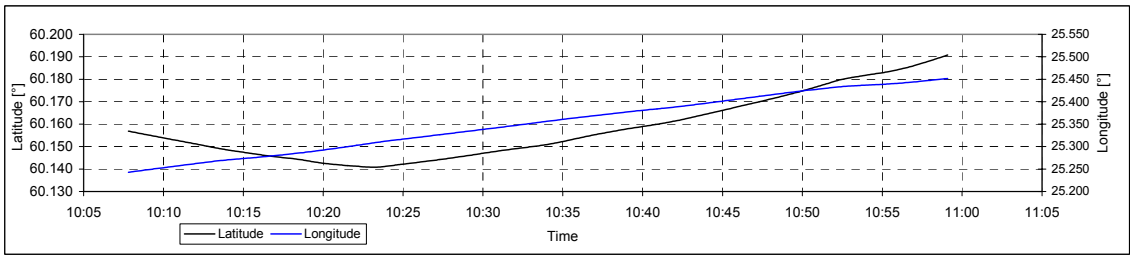

5.2.2003
Speed [knots]
Distance [NM]
Difficulties in this consolidated channel
She had to back and ram a few times
An old very light channe begins
Speed
Distance
Time

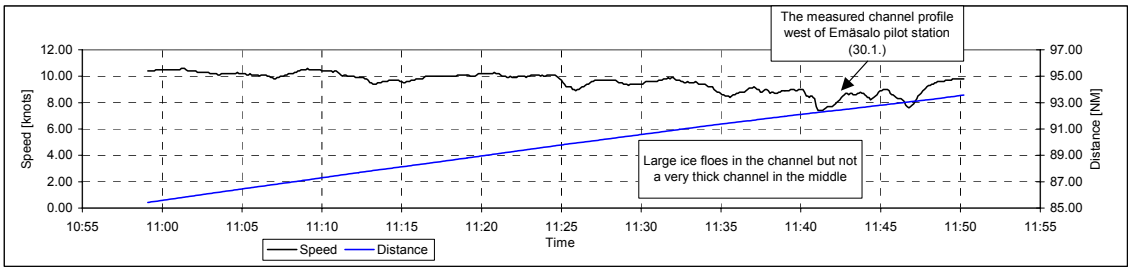

Latitude [°]
Longitude [°]
Latitude
Longitude
Time

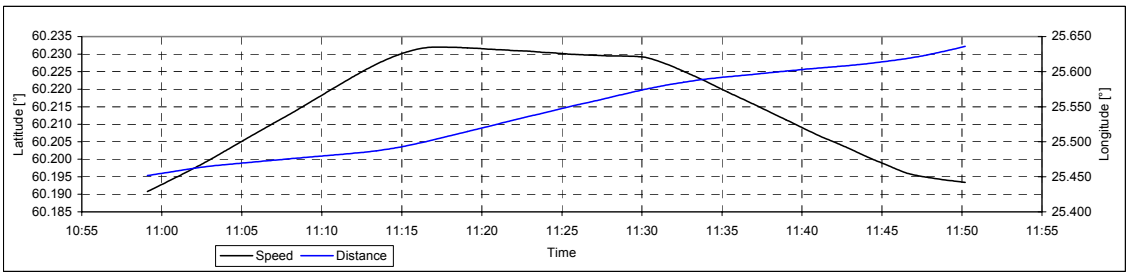

5.2.2003
Speed [knots]
Distance [NM]
An old very light channel
Time
Speed
Distance

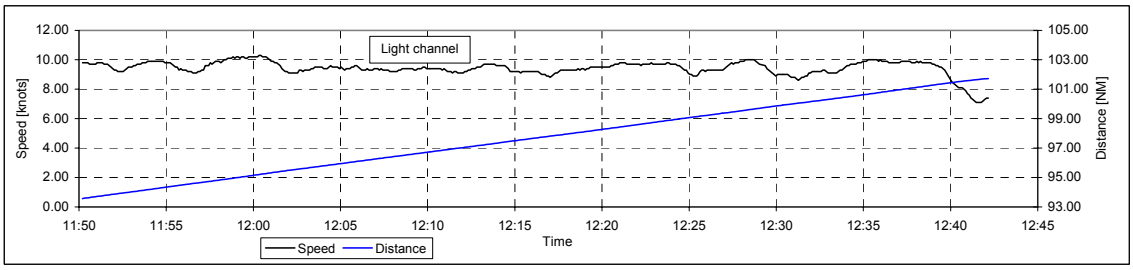

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

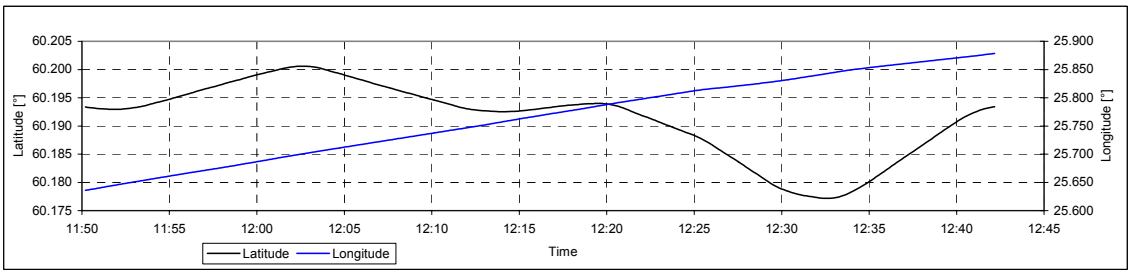

5.2.2003
Speed [knots]
Distance [NM]
An old very light channel
Slowing down because of a channel bridge
Time
Speed
Distance

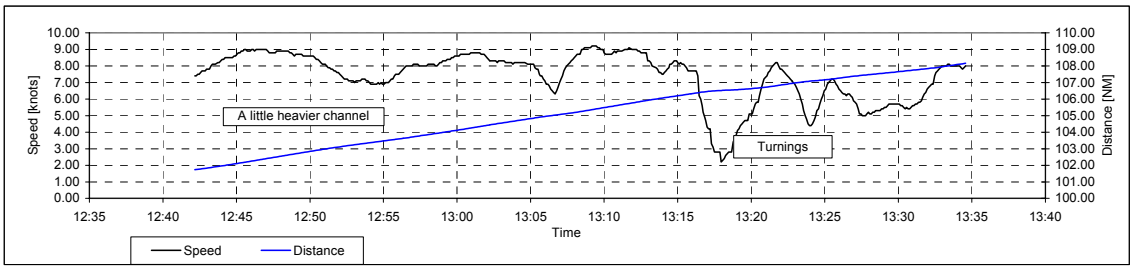

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

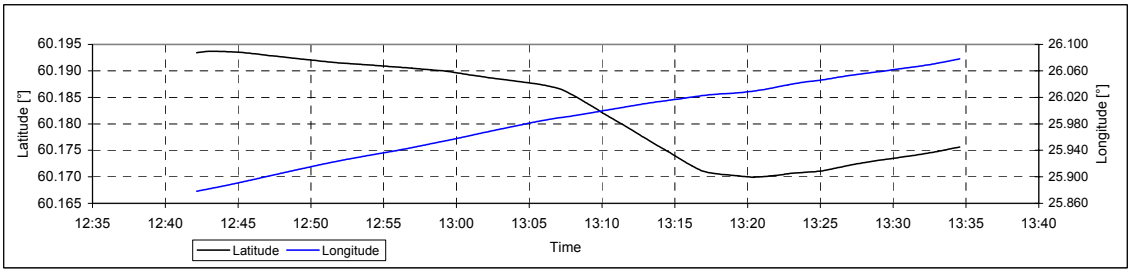

The measured channel profile west of Emäsalo pilot station (30.1.)
Large ice floes in the channel but not a very thick channel in the middle
Speed [knots]
Distance [NM]
Time
Speed
Distance

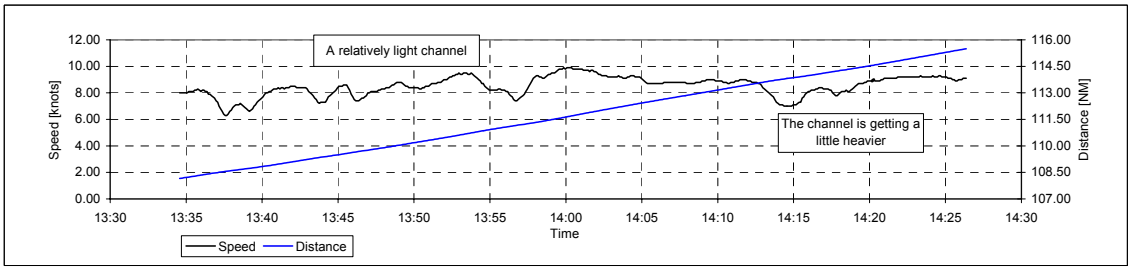

Latitude [°]
Longitude [°]
Time
Speed
Distance

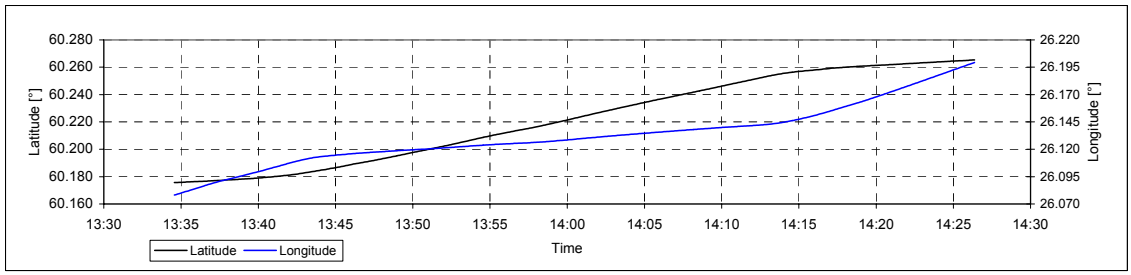

Light channel
Speed [knots]
Distance [NM]
Time
Speed
Distance

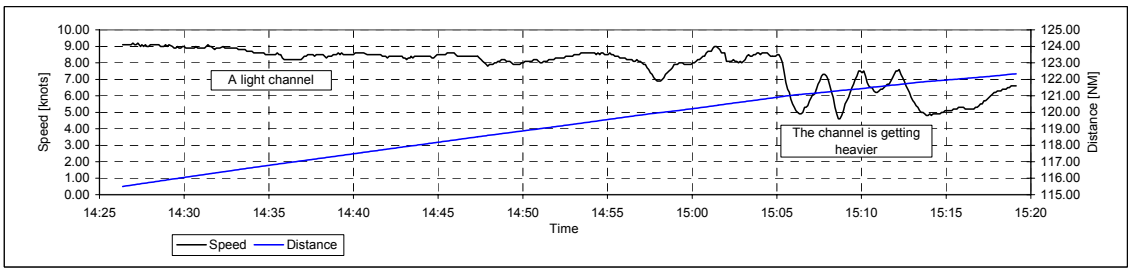

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

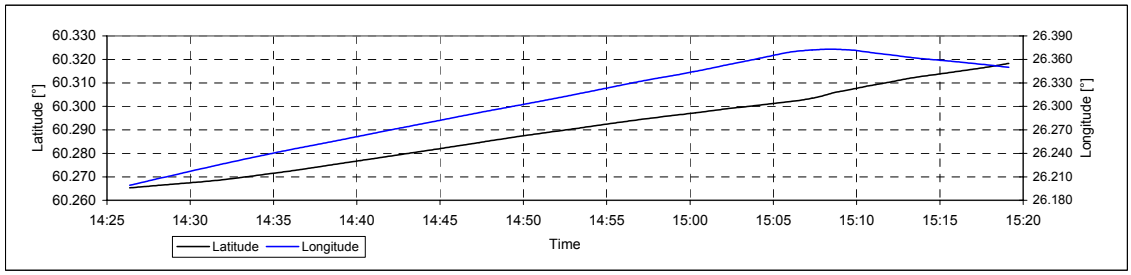

A little heavier channel
Turnings
Speed [knots]
Distance [NM]
Time
Speed
Distance

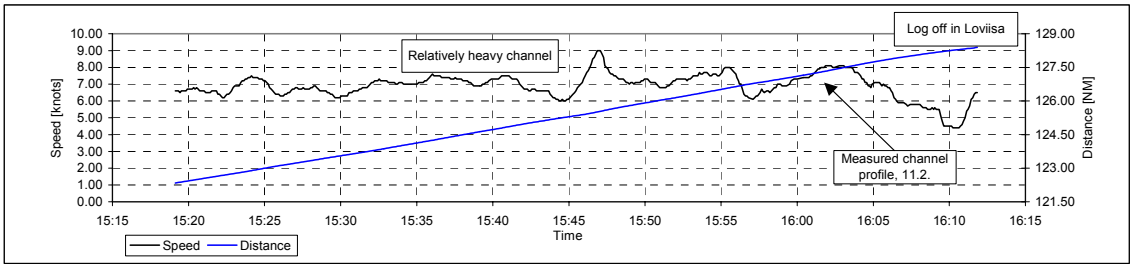

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

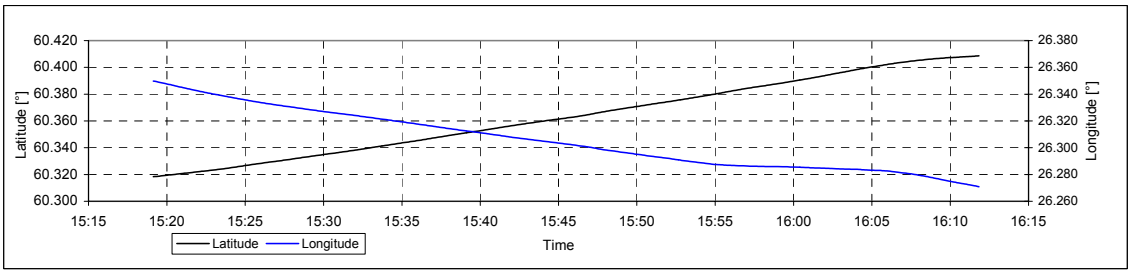

A relatively light channel
The channel is getting a little heavier
Speed [knots]
Distance [NM]
Time
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude

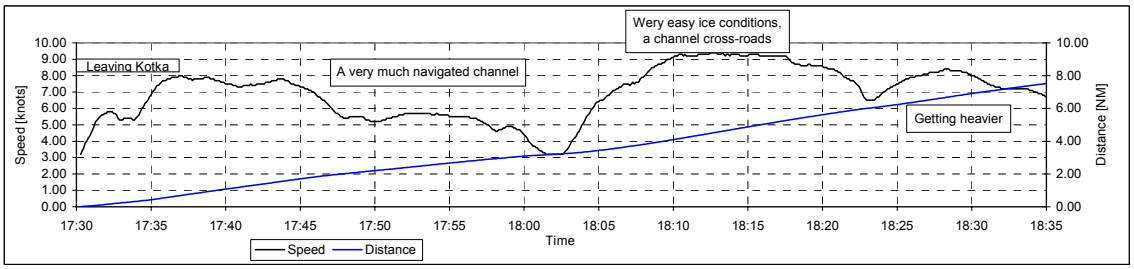

A light channel
The channel is getting heavier
Speed [knots]
Distance [NM]
Time
Speed
Distance

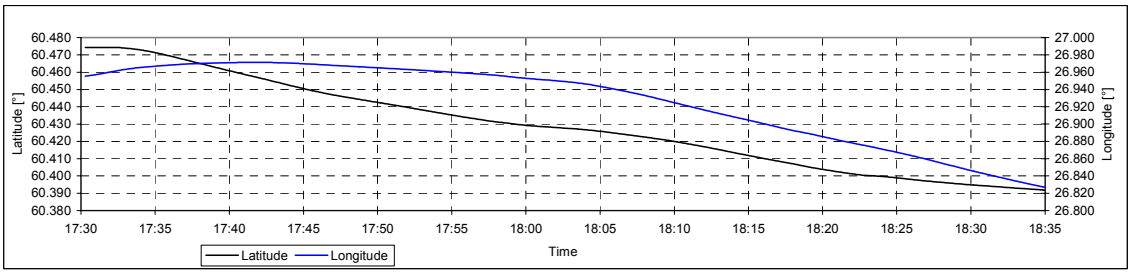

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

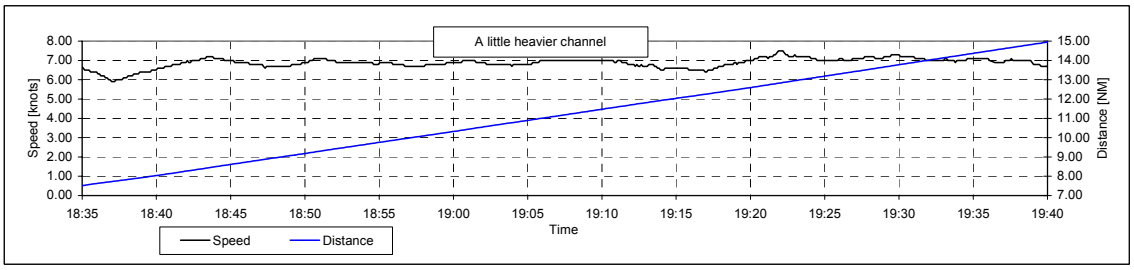

Log off in Loviisa
Relatively heavy channel
Measured channel profile, 11.2.
Speed [knots]
Distance [NM]
Time
Speed
Distance

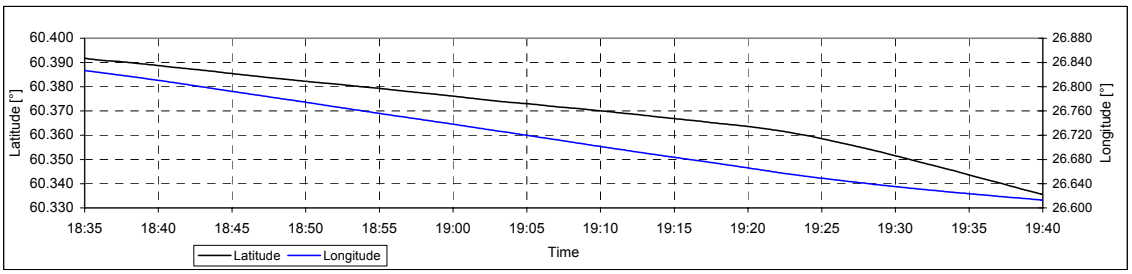

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

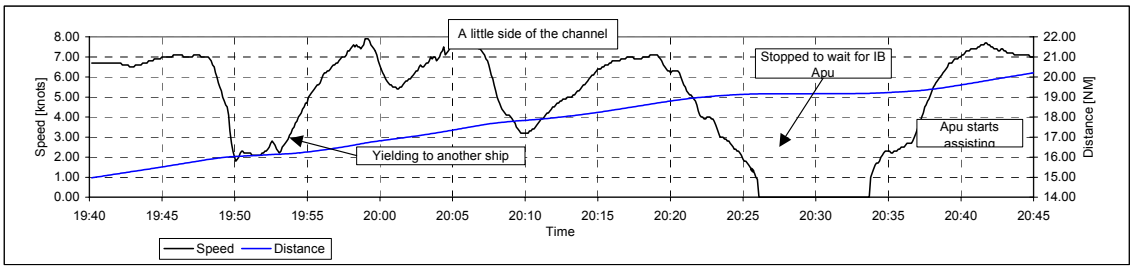
Ship D, 12.2.2003

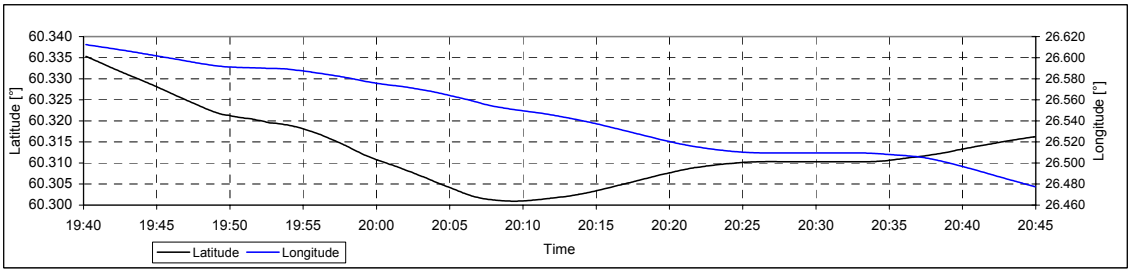


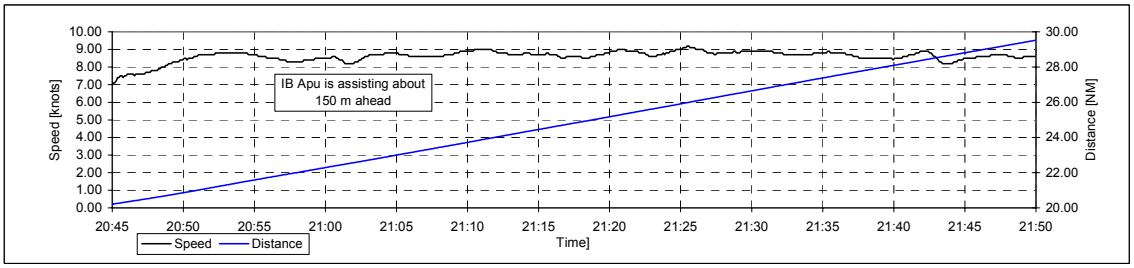


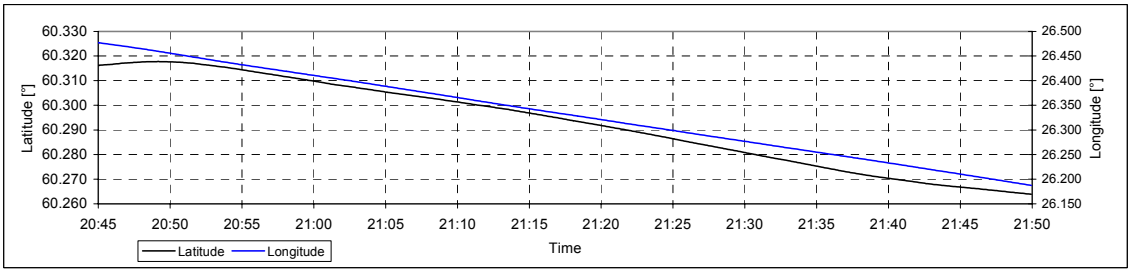


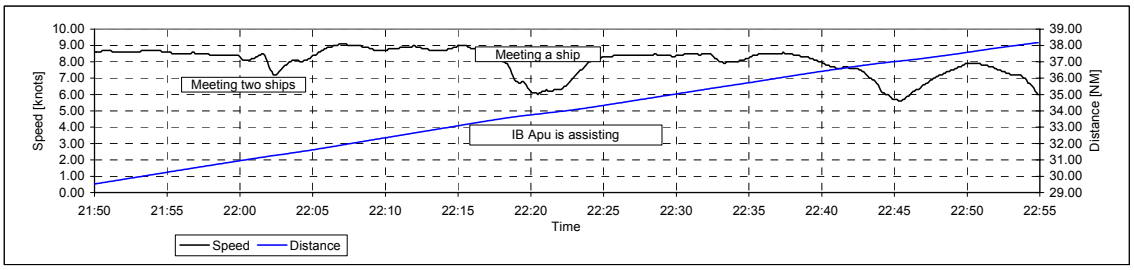


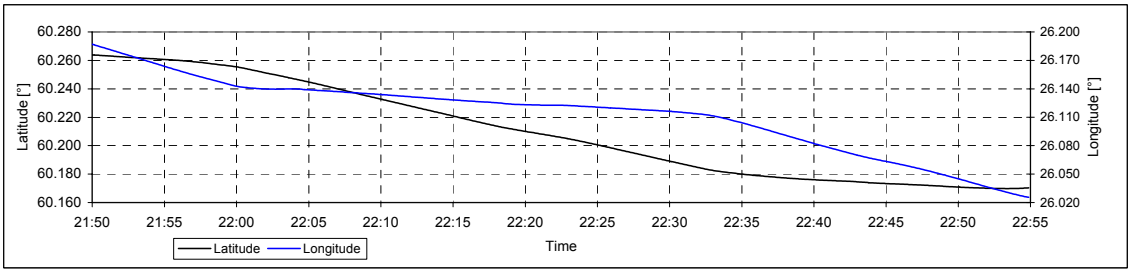

A little side of the channel
Stopped to wait for IB Apu
Yielding to another ship
Apu starts assisting
Speed [knots]
Distance [NM]
Time
Speed
Distance

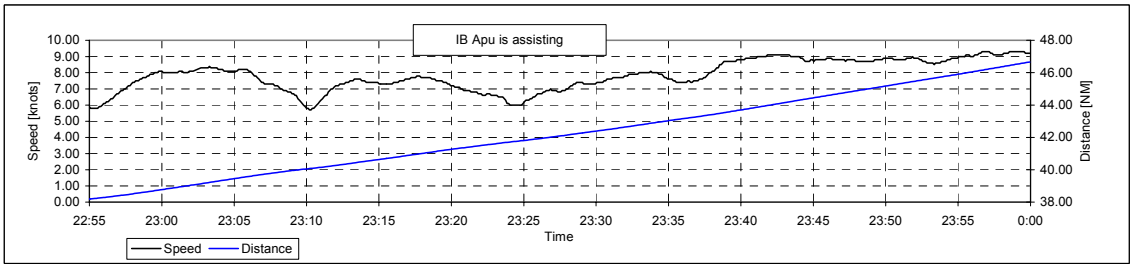

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

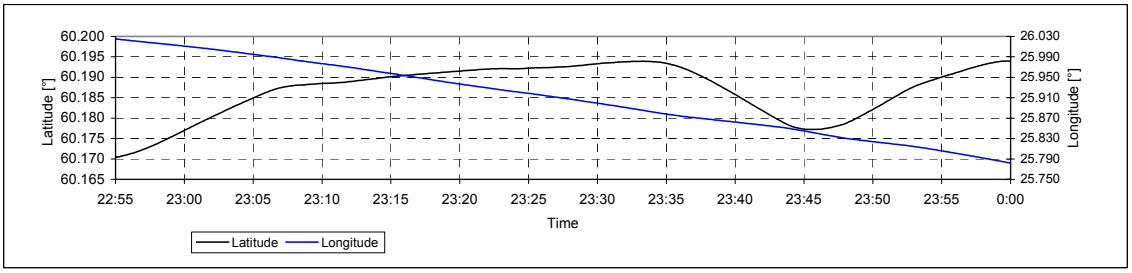

IB Apu is assisting about 150 m ahead
Speed [knots]
Distance [NM]
Time]
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude

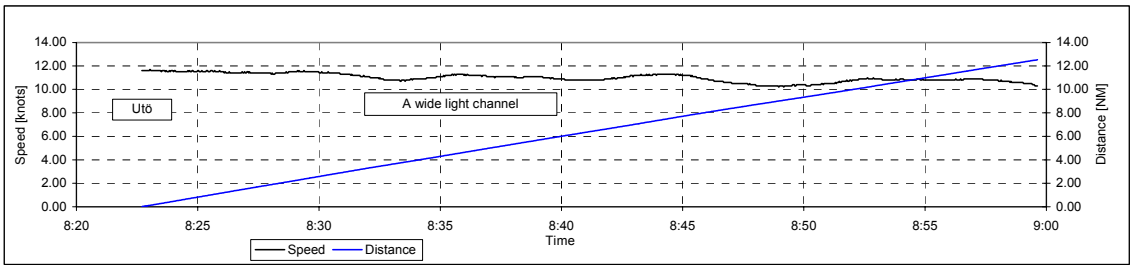

Meeting two ships
Meeting a ship
IB Apu is assisting
Speed [knots]
Distance [NM]
Time
Speed
Distance

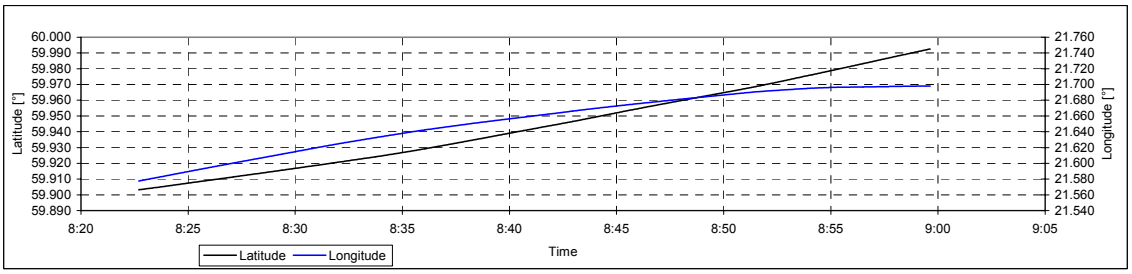

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

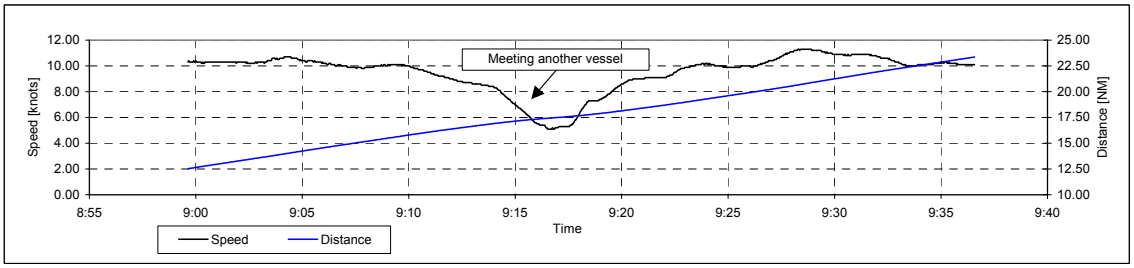

IB Apu is assisting
Speed [knots]
Distance [NM]
Time
Speed
Distance

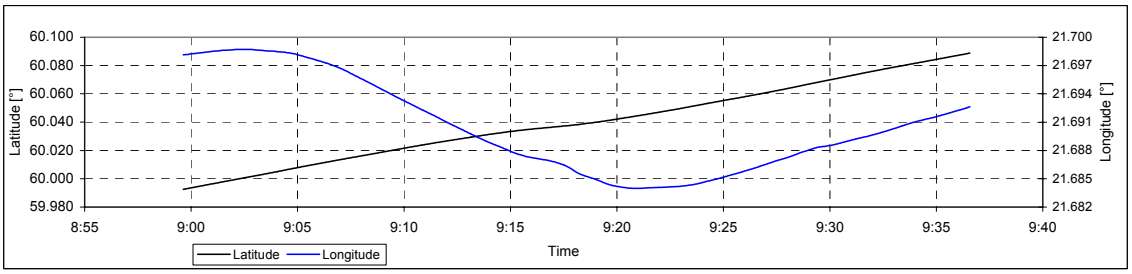

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

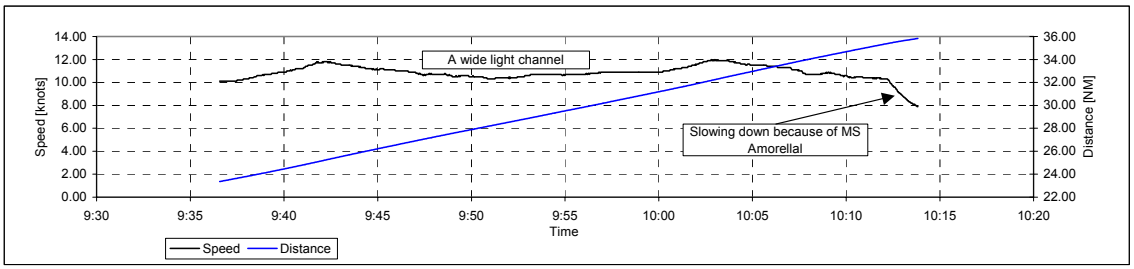
Ship E, 20.2.2003

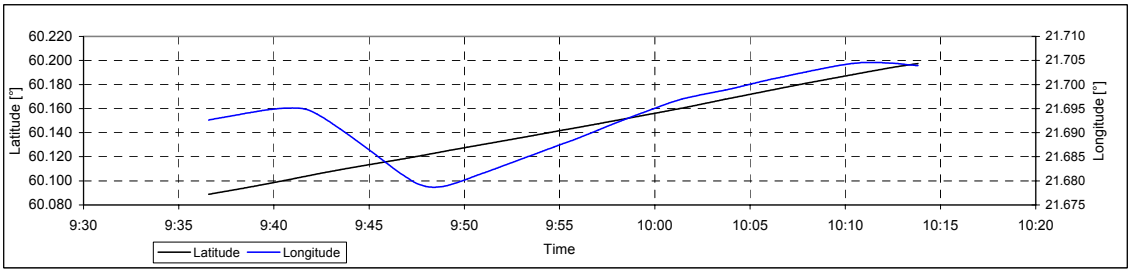


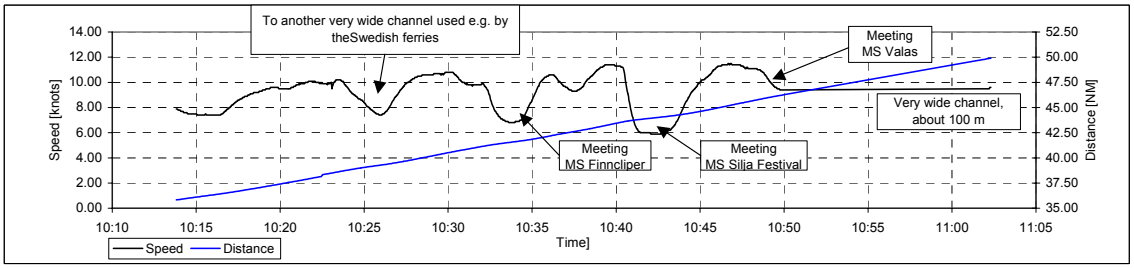


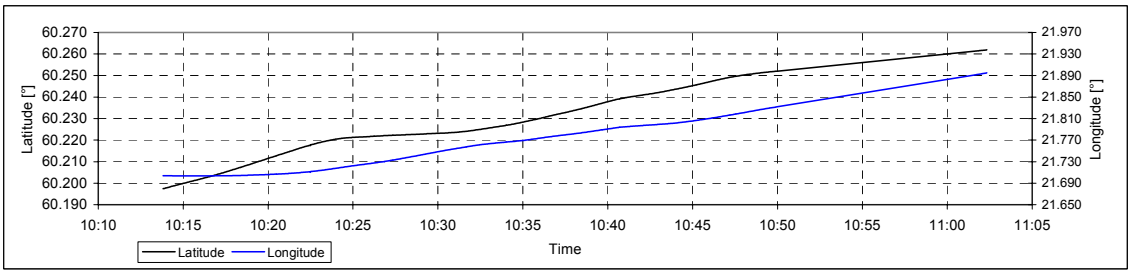


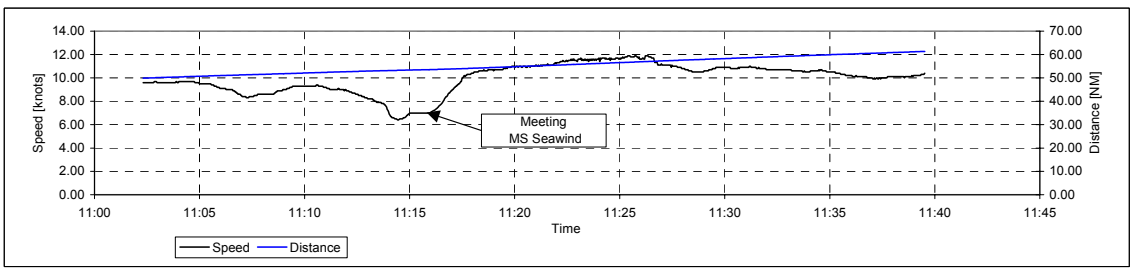


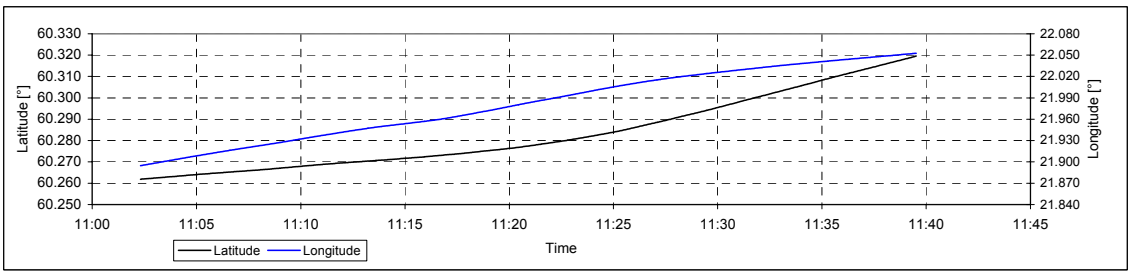

A wide light channel
Slowing down because of MS Amorellal
Speed [knots]
Distance [NM]
Time
Speed
Distance

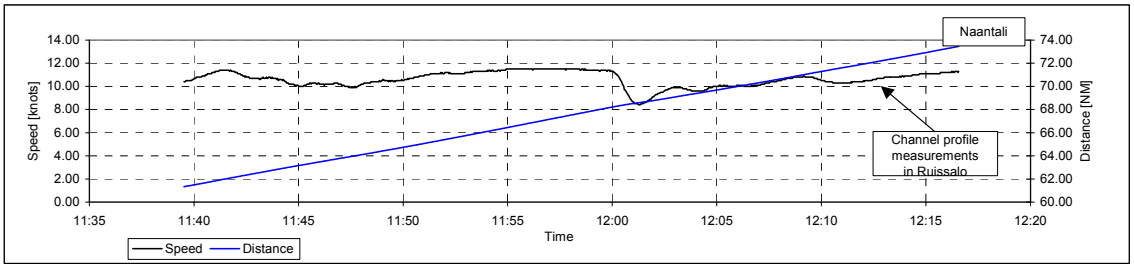

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

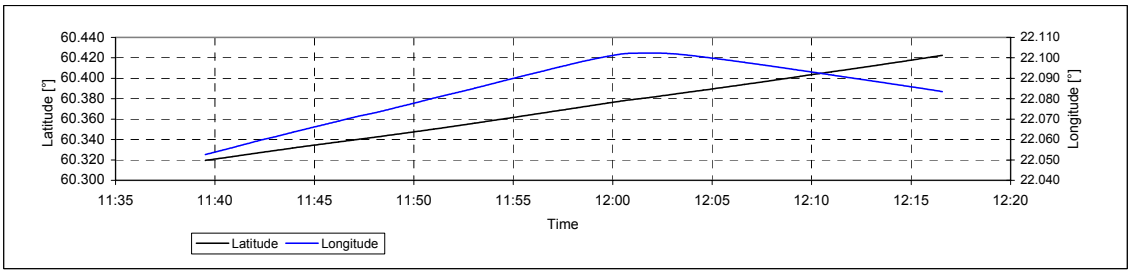

To another very wide channel used e.g. by theSwedish ferries
Meeting MS Valas
Very wide channel, about 100 m
Meeting MS Finncliper
Meeting MS Silia Festival
Speed [knots]
Distance [NM]
Time]
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude

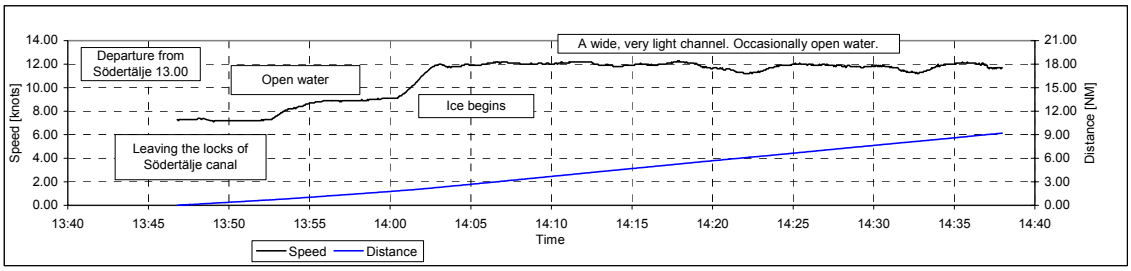

Meeting MS Seawind
Speed [knots]
Distance [NM]
Time
Speed
Distance

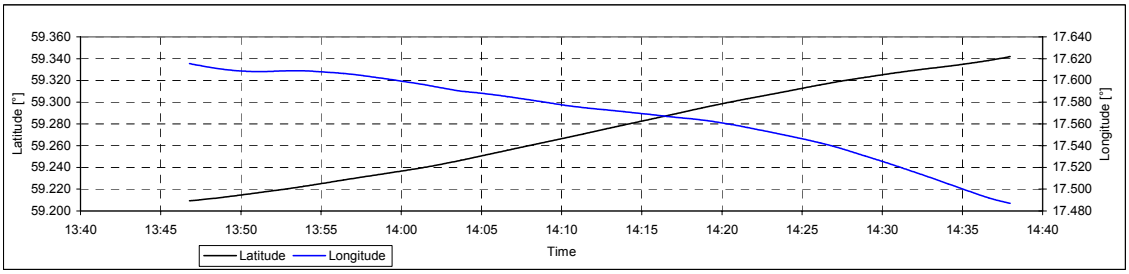

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

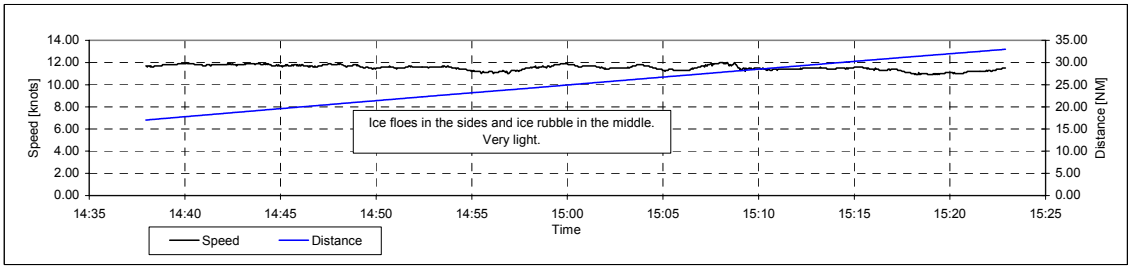

Naantali
Channel profile measurements in Ruissalo
Speed [knots]
Distance [NM]
Time
Speed
Distance
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
74.00
72.00
70.00
68.00
66.00
64.00
62.00
60.00
11:35
11:40
11:45
11:50
11:55
12:00
12:05
12:10
12:15
12:20

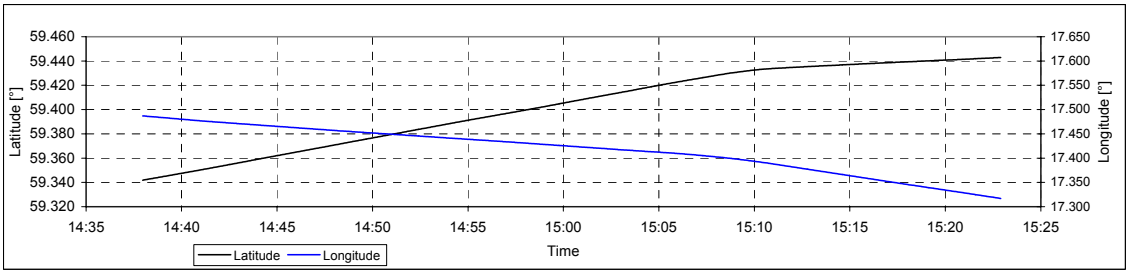

Latitude [°]
Longitude [°]
Time
Latitude
Longitude
60.440
60.420
60.400
60.380
60.360
60.340
60.320
60.300
22.110
22.100
22.090
22.080
22.070
22.060
22.050
22.040
11:35
11:40
11:45
11:50
11:55
12:00
12:05
12:10
12:15
12:20

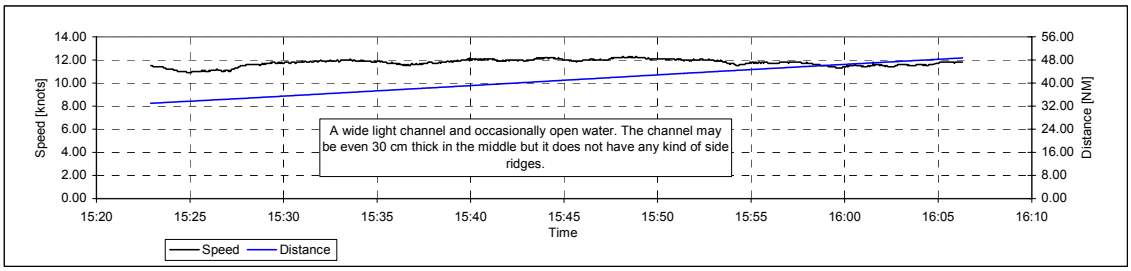
Ship F, 10.3.2003

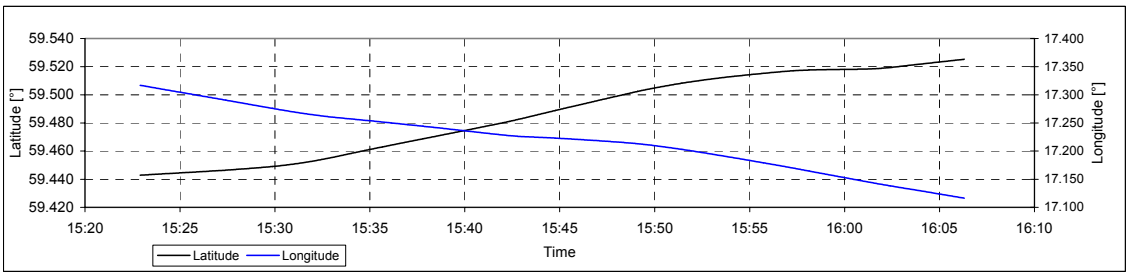


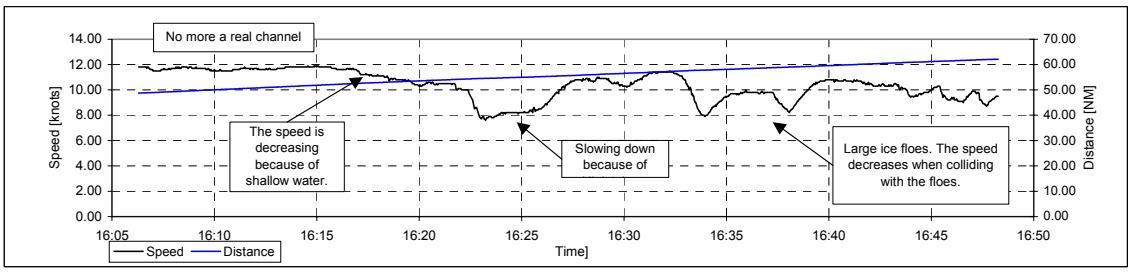


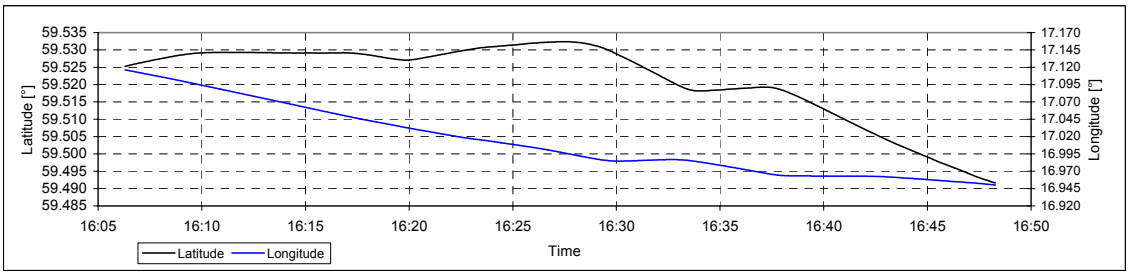


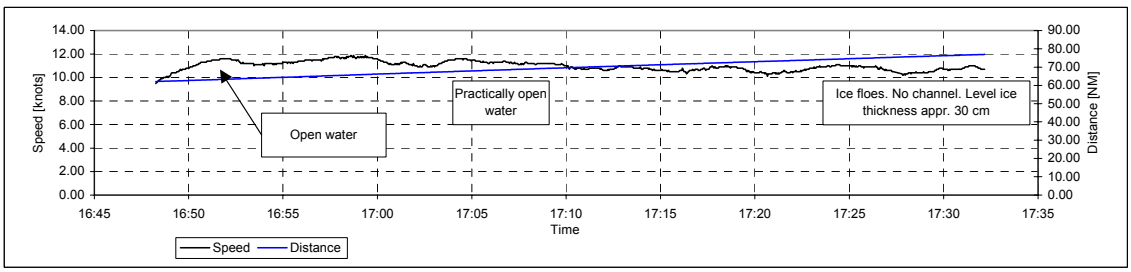


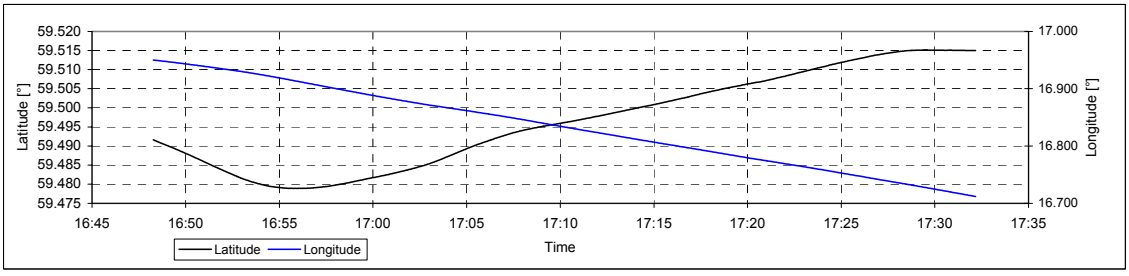

Speed [knots]
Distance [NM]
A wide light channel and occasionally open water. The channel may be even 30 cm thick in the middle but it does not have any kind of side ridges.
Time
Speed
Distance

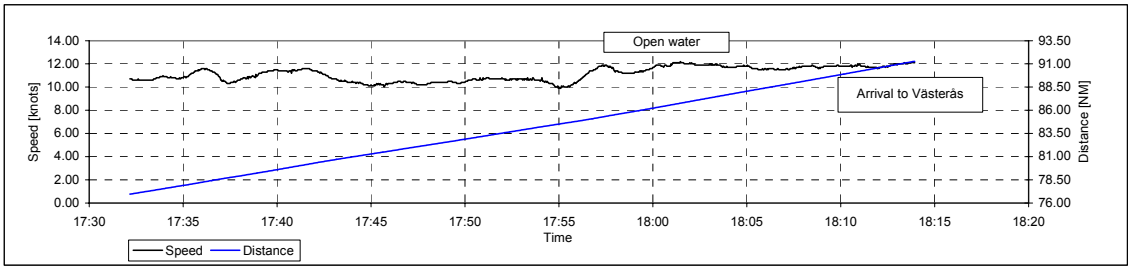

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

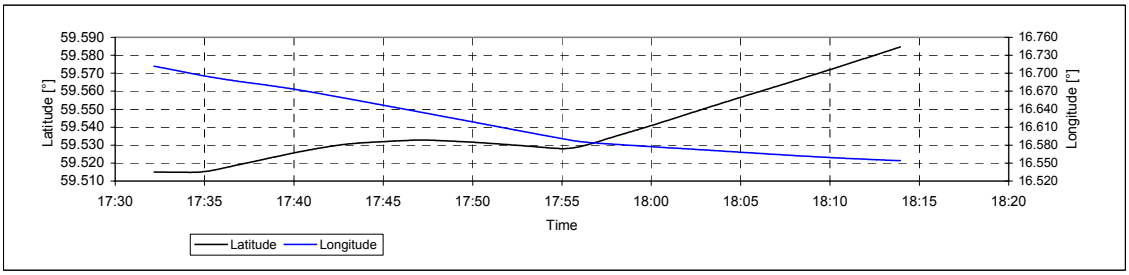

No more a real channel
The speed is decreasing because of shallow water.
Slowing down because of
Large ice floes. The speed decreases when colliding with the floes.
Speed [knots]
Distance [NM]
Time]
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude

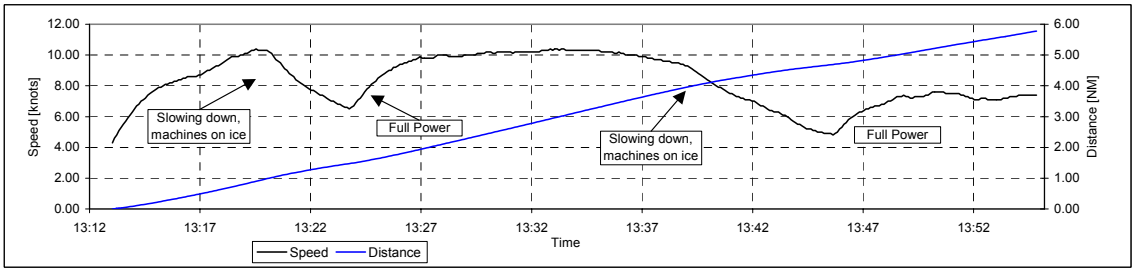

Open water
Practically open water
Ice floes. No channel. Level ice thickness appr. 30 cm
Speed [knots]
Distance [NM]
Time
Speed
Distance

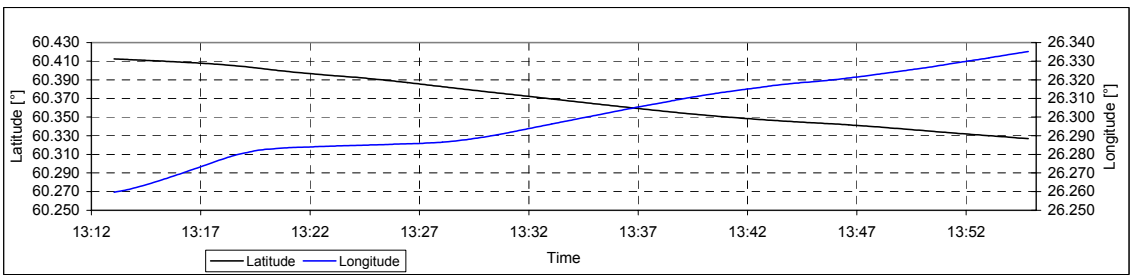

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

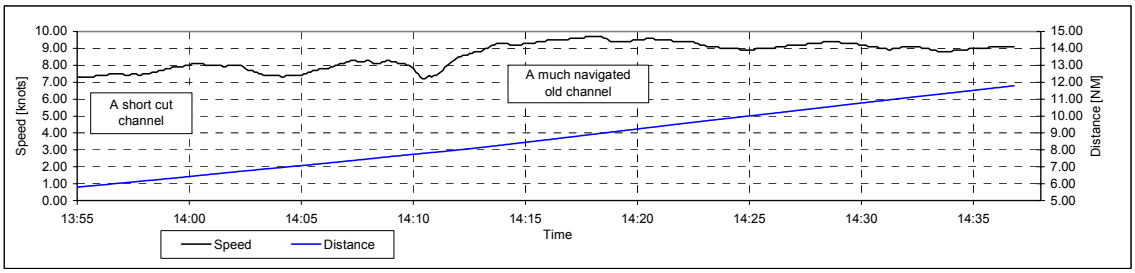


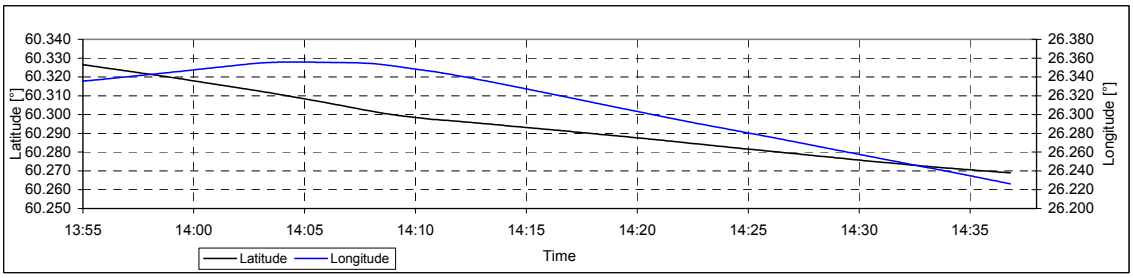


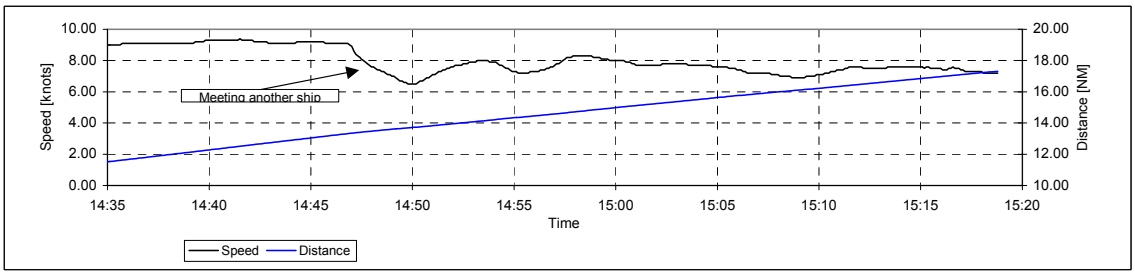
Ship G, 13.3.2003

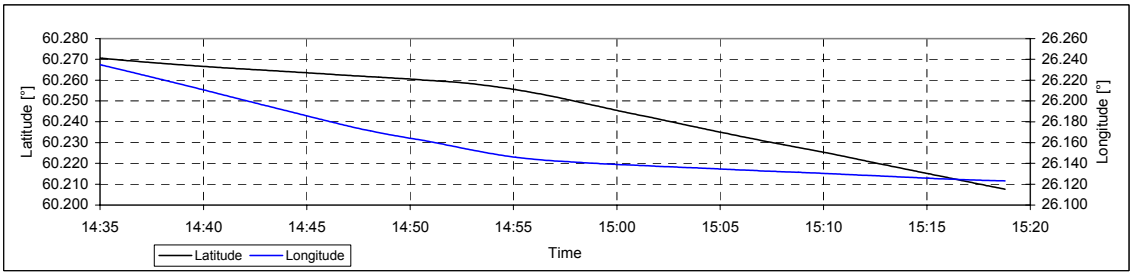


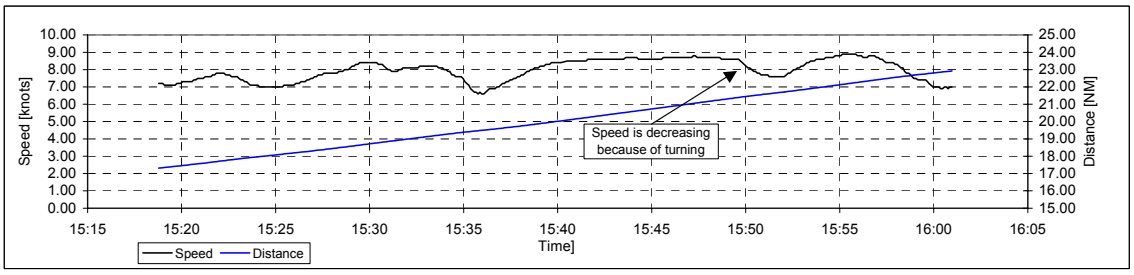


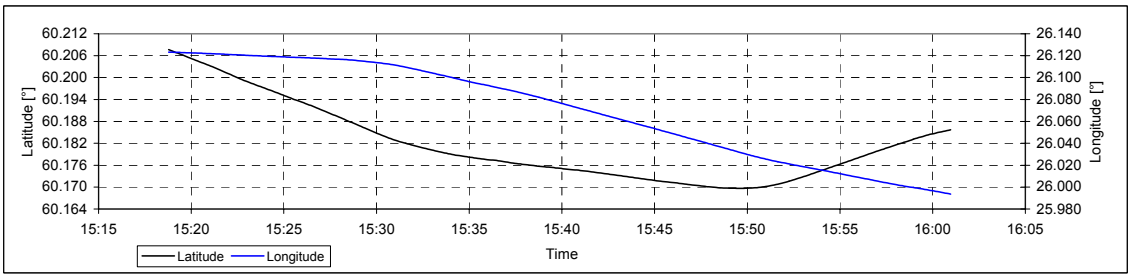

A short cut channel
A much navigated old channel
Speed [knots]
Distance [NM]
Time
Speed
Distance

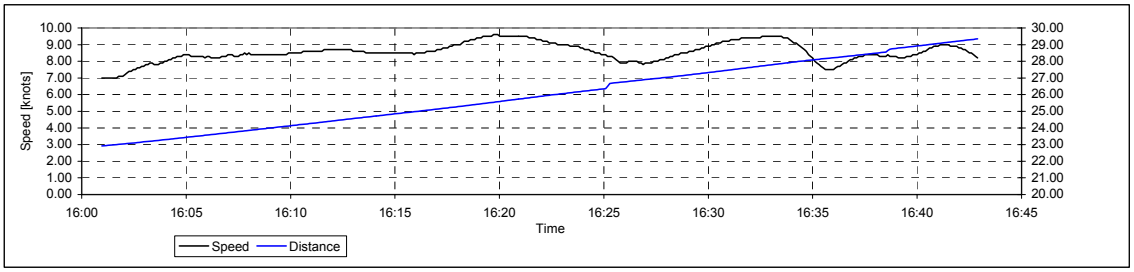

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

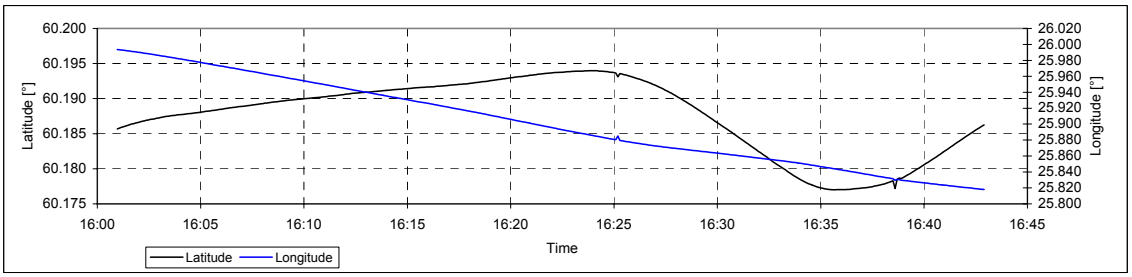

Meeting another ship
Speed [knots]
Distance [NM]
Time
Speed
Distance

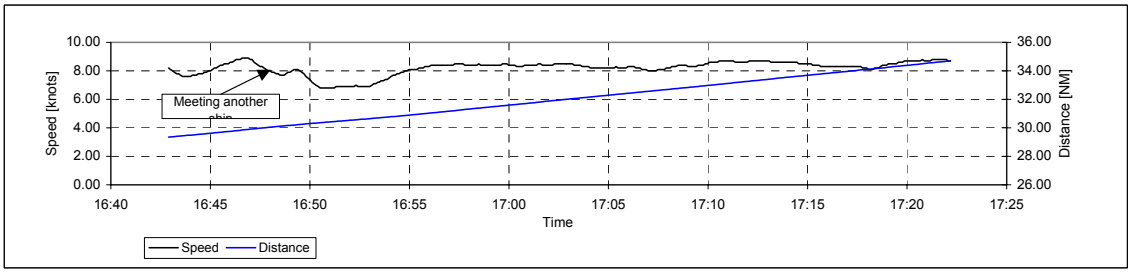

Latitude [°]
Longitude [°]
Time
Latitude
Longitude

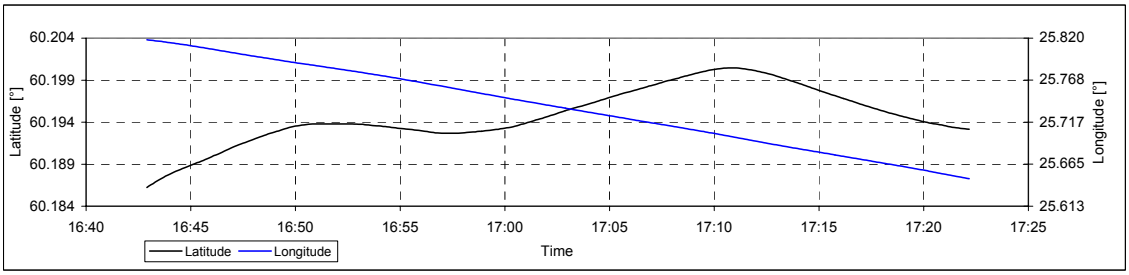

Speed is decreasing because of turning
Speed [knots]
Distance [NM]
Time]
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude


Speed [knots]
Distance [NM]
Time
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude


Speed [knots]
Distance [NM]
Meeting another
Time
Speed
Distance


Latitude [°]
Longitude [°]
Time
Latitude
Longitude

APPENDIX 2

THE OBSERVATION FORMS FILLED DURING THE VOYAGES

1. Ship A
2. Ship B
3. Ship C
4. Ship D
5. Ship E
6. Ship F
7. Ship G

Ship	Ship A																		
Date	21.-22.1.03																		
Voyage	Kantvik-Parainen																		
Time	11-12																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			Lähtö Kantvikista
4-6		60	210			40	10												Kevyehkö ränni
6-8																			Ei yhteenjäätynyttä kerrosta
8-10																			
10-12																			
12-14																			
14-16		75	210																
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30						40	8												
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42						50	8												
42-44																			
44-46																			
46-48												2		8	1				lauttoja
48-50																			
50-52																			
52-54																			
54-56																			jääraja, avovesi alkaa
56-58																			
58-60		0.725	215																Avovesi
		Air temperature		0															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship A																		
Date	21.-22.1.03																		
Voyage	Kantvik-Parainen																		
Time	16-17																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12		75	210											10	1				Aovedestä jäihin
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26														6					
26-28																			
28-30																			Avovesi
30-32																			
32-34																			
34-36		75	210											10	1				Yhteenjäätynyt lauttajää
36-38																			
38-40																			
40-42														6	1				Lauttajää
42-44						40	8												Kevyt ränni
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			Ulos rännistä, ohitettiin Sydgard
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship A																		
Date	21.-22.1.03																		
Voyage	Kantvik-Parainen																		
Time	17-18																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6						40	10												Takaisin ränniin
6-8																			
8-10																			
10-12							8												
12-14																			
14-16																			
16-18							10												
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship A																		
Date	21.-22.1.03																		
Voyage	Kantvik-Parainen																		
Time	18-19																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2		75	210			30	8												Vaihteleva vanha ränni
2-4																			Pimeyden takia vaikea arvioida
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship A																		
Date	21.-22.1.03																		
Voyage	Kantvik-Parainen																		
Time	19-20																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2		75	210			30	10												
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32		10	210			30	8												hydrokopterirata
32-34																			
34-36																			
36-38		70	210			30	8												
38-40																			
40-42		80	210			30	8												
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship A																		
Date	21.-22.1.03																		
Voyage	Kantvik-Parainen																		
Time	20-21																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			Ränni kevenee
44-46																			
46-48																			Kevyt vähän liikennöity ränni
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship A																		
Date	21.-22.1.03																		
Voyage	Kantvik-Parainen																		
Time	21-22																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2		30	210				8												Vähän liikennöity ränni
2-4																			
4-6																			
6-8																			
8-10		30	210																Railolossi
10-12																			
12-14		80	210																
14-16																			
16-18																			
18-20																			
20-22																			
22-24		0	210																Lossi
24-26		20	210																
26-28		45	210																
28-30		70	210																
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42		60	210																
42-44																			
44-46																			
46-48																			
48-50																			
50-52		40	210																
52-54		60																	
54-56																			
56-58																			Loppu
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship B		Huom:Ballastissa																
Date	28.1.2003		T=3.6m																
Voyage	Valko-Hamina		Pitch asetus 0.95																
Time	15-16																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			Huom! Laiva ballastissa T=3.6m
18-20																			Lähtö Valkomista 15.19
20-22																			
22-24																			13.26 Loggaus päälle
24-26																			
26-28		0.95	220	2			10	1											Kevyt tasainen ränni, pala 0…50c
28-30																			Jäät ei liiku, ei puristusta
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature			-8														
		Wind speed																	
		Wind direction																	
		Ice field speed		-															
		Ice field direction		-															
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship B																		
Date	28.1.2003																		
Voyage	Valko-Hamina																		
Time	16-17																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2		0.95	220	2			10	1											
2-4																			Käännös alkaa
4-6																			
6-8																			Käännös loppu
8-10																			
10-12																			
12-14																			Hieman raskaampi ränni
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			(Orrengrund pohjoispuolella)
28-30																			Käännös
30-32																			Kohtdataan Tomke 16.32
32-34																			
34-36		0.85																	Käänös bb, pitchin asetus sama
36-38		0.8																	
38-40																			Käännös loppu, juuri liikenn
40-42																			Ränni (Scheldeborg tuli juuri tästä)
42-44																			Leveä n. 150..200m paljon liikennöity ränni, pyöreät palat 20..30cm
44-46																			aaltoilevat keulan etusivuilla
46-48																			
48-50																			Käännös sb alkaa
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature		-8															
		Wind speed																	
		Wind direction																	
		Ice field speed		-															
		Ice field direction		-															
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship B																		
Date	28.1.2003																		
Voyage	Valko-Hamina																		
Time	17-18																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6				2			10	1											Kännös bb
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			Enemmän oikealle, vähän "ulos" rännistä, laiva tulossa vastaan
20-22																			Laiva bb
22-24																			Ei seurata sen ränniä
24-26																			Raskaampi ränni
26-28																			Pimeys alkaa haitata havannointia
28-30							10							10	1				Raskaampi ränni, lauttoja, ollaan ehkä kahden rännin välissä
30-32																			
32-34																			
34-36																			
36-38																			Ränni kevenee
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			Raskasta->nopeus nollaan, Täysi pakki
48-50			-0.85																Ei liiku
50-52			0.7																Tuuli painaa sivusta, ehkä pientä puristusta
52-54			-0.7																
54-56																			
56-58																			
58-60																			

		Air temperature		-5															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship B																		
Date	28.1.2003																		
Voyage	Valko-Hamina																		
Time	18-19																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			Edelleen kiinni
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			Pientä liikettä taaksepäin
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			Pientä liikettä eteenpäin
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			18.52 Loggaus stopattu
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship B																		
Date	28.1.2003																		
Voyage	Valko-Hamina																		
Time	19-20																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			Edelleen kiinni
2-4																			Laivan takana avovettä, mutta laidoista kiinni
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			

Air temperature	
Wind speed	
Wind direction	
Ice field speed	
Ice field direction	

	1	2	3	4	5	
Level ice	0-20	20-40	40-60	60-80	80-100	Ice thickness [cm]
Drift ice	0-10	10-30	30-100	100-300	over 300	Floe size [m]
Ridge field	0-0.5	0.5-1.0	1,0-1,5	1,5-2,0	2,0-2,5	Sail hight [m]
Compression	none	some	much			

Ship	Ship B																		
Date	28.1.2003																		
Voyage	Valko-Hamina																		
Time	20-21																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			Msc Botnia ajaa ohi 15m etäisyydeltä
10-12																			Liikkuu, seurataan Botniaa
12-14																			Raskas kohta, Botnialla tippuu
14-16																			n. 5 solmuun
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			Oikealle, vaihdetaan Haminan
30-32																			ränniin (Botnia menee Kotkaan)
32-34																			Raskaampi jäätynyt ränni
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			Kapeampi ränni, lauttoja 0-10m,
48-50																			ei samanlaista moskaa ja puuroa
50-52																			Taas puuroa ja moskaa, 200m leveä ränni
52-54																			Ränni kapenee
54-56																			
56-58																			
58-60																			
		Air temperature		-7															
		Wind speed		11 m/s															
		Wind direction		N															
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship B																		
Date	28.1.2003																		
Voyage	Valko-Hamina																		
Time	21-22																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2		0.9	220	2			10												
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			Narva ja Nyland tulee vastaan(kor
14-16																			Pyritään niiden ränniin
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			Pientä rännin etsiskelyä
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			Rännin kevyeen näköinen
56-58																			
58-60																			
		Air temperature			-7														
		Wind speed		11 m/s															
		Wind direction		N															
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship B																		
Date	28.1.2003																		
Voyage	Valko-Hamina																		
Time	22-23																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			GPS pois päältä, pieni epäjatkuvu
18-20																			(Paristot loppu, johto rikki)
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship B																		
Date	28.1.2003																		
Voyage	Valko-Hamina																		
Time	23-24																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4		0.9	220				10	1											
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			Lähestytään satamaa, Hiloniemi bb
18-20																			
20-22																			Ylitetään toinen ränni/risteyskohta
22-24																			
24-26																			
26-28																			Käännös bb
28-30																			
30-32		0.5																	Vähennetään tehoja
32-34																			23.33 Loggaus loppu
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			Keula ensimmäisen kerran laiturissa
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C																		
Date	3.2.2003																		
Voyage	Rauma-Loviisa																		
Time	20-21																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			Lähtö Raumalta
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			Mittaus
20-22																			
22-24																			
24-26																			
26-28																			
28-30						30													Vanhaa ränniä satamasta ulos,
30-32																			hinaajan avaama
32-34																			
34-36																			Rännissä saattaa olla konsolidoitunut kerros
36-38																			Rännin paksuutta vaikea arvioida,
38-40																			mutta se sulkeutuu vasta n. 100
40-42																			metrin päässä
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			Ränni jo niin kevyt, että
58-60																			lopetetaan mittaus
		Air temperature		-10															
		Wind speed		11															
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C		Ballastisyväys			keula		2,50												
Date	4.2.2003					Perä		3,60												
Voyage	Rauma-Loviisa																			
Time	20.30-22.50																			
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing		
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes	
20.30																			Ajojäätä, harvahkoa	
																			Harva ajojää alkoi n. klo 18.00	
21.00																			Edelleen harvaa ajojäätä	
22.50																			Tiheää ajojäätä peittoisuus 100 %	

Air temperature	
Wind speed	
Wind direction	
Ice field speed	
Ice field direction	

	1	2	3	4	5	
Level ice	0-20	20-40	40-60	60-80	80-100	Ice thickness [cm]
Drift ice	0-10	10-30	30-100	100-300	over 300	Floe size [m]
Ridge field	0-0.5	0.5-1.0	1,0-1,5	1,5-2,0	2,0-2,5	Sail hight [m]
Compression	none	some	much			

Ship	Ship C																		
Date	4.2.03																		
Voyage	Rauma-Loviisa																		
Time	23-00																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			Tiukkaa ahtojäätä
2-4																			Jumissa
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			Keskeytetään mittaus, odotetaan
14-16																			JM Voimaa
16-18																			Useita aluksia jumissa, vaikea
18-20																			tuulen pakkaama ahtojää
20-22																			Astoria, joka ohitti meidät jäi
22-24																			myös kiinni pari mailia edessä.
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C																		
Date	05.02.03																		
Voyage	Rauma-Loviisa																		
Time	0415-																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
04.15																1		H	H=haarukka, JM Voima
04.25																			GPS patterien vaihto
04.35																2		H	
04.40																1		H	
05.10																2		H	
5.30						40	10											H	
5.50						30	10											H	Hinaus päättyy
06.00						30	10												Kevyt ränni
6,45						##	10												Raskas, suhteellisen uusi ränni
8.00																			Mutka Helsingin kautta, koskalaiva
20-22																			rännissä väylällä. Välillä täysin umpeen
22-24																			jäätynyttä ränniä
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C																		
Date	5.2.02																		
Voyage	Rauma - Loviisa																		
Time	9-10																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2						40	10												Vanha ränni
2-4							8												
4-6						50													Erittäin kevyt ränni
6-8				15															Lauttajätä rännin vieressä
8-10																			
10-12						40	8												
12-14																			
14-16																			
16-18						80	7												
18-20																			
20-22						40	10												
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34						30	9												
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C																		
Date	5.2.02																		
Voyage	Rauma - Loviisa																		
Time	10-11																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2						30	9												
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			Railosilta, hidastus
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C																		
Date	5.2.02																		
Voyage	Rauma - Loviisa																		
Time	11-12																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			Rännissä suuria palasia, mutta
38-40																			keskeltä se ei ole kovin paksu.
40-42																			Kairauslinjan ylitys 11.43.15
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature		-13															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C																		
Date	5.2.02																		
Voyage	Rauma - Loviisa																		
Time	12-13																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			Emäsalon luotsiaseman eteläpuoli
2-4																			Vanhaa ränniä, ei kovin raskasta.
4-6																			Voi olla vaikea kairata keskeltä.
6-8																			
8-10																			
10-12																			
12-14																			
14-16						40	9												Ränni sulkeutuu n.100 m päässä
16-18																			
18-20																			
20-22																			
22-24						40	7												Kevyt ränni
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature		-13															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C																		
Date	5.2.02																		
Voyage	Rauma - Loviisa																		
Time	14-15																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	Compression	Piece size	c/10	Compression	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10						40	9												Hieman raskaampi ränni
10-12																			
12-14																			
14-16																			
16-18																			Näillä main olisi hyvä ränni kaira-
18-20																			ta, mutta pääsy voi olla vaikea
20-22																			V=8.8 kn
22-24																			
24-26						40	10												Ränni suht raskas, kuitenkin
26-28																			varmaan reilusti alle 1 m keskeltä
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			Ränni keventynyt
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship C																			
Date	5.2.02																			
Voyage	Rauma - Loviisa																			
Time	15-																			
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing		
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes	
15.30						40	10												Suhteellisen raskas ränni	
																			Ränni sulkeutuu ehkä 30-40 m	
																			päässä takana. Vaikea arvioida,	
																			onko lähellä 1m.	
15.57.10																			Hyvä paikka kairata, ileisesti	
																			pohjaa kairataan myös, V=6,3 kn	
16.00						100	10												Raskas ränni, isoja paloja	
16.12	Lopetetaan mittaus Valkon satamaan																			
22-24																				
24-26																				
26-28																				
28-30																				
30-32																				
32-34																				
34-36																				
36-38																				
38-40																				
40-42																				
42-44																				
44-46																				
46-48																				
48-50																				
50-52																				
52-54																				
54-56																				
56-58																				
58-60																				
		Air temperature																		
		Wind speed																		
		Wind direction																		
		Ice field speed																		
		Ice field direction																		
			1	2		3			4			5								
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]					
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]					
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]					
		Compression	none	some		much														

Ship	Ship D			Laiva puulastissa														
Date	12.2.2003			T=4.85														
Voyage	Kotka-Emäsalo			Avovesinopeus 10.3kn														
Time	17-18																	
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			Lähtö 17:08
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			Loggaus päälle
30-32		0.8		2			10	1											Ränni, Viikari tuli juri tästä
32-34		0.75																	10-30cm palloja
34-36																			Paljon liikennöity ränni
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48							10	2											Muuttuu raskaammaksi
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature		-1															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship D																	
Date	12.2.2003																	
Voyage	Kotka-Emäsalo																	
Time	18-19																	
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2							10	1											30-70cm paloja
2-4																			
4-6																			Risteysalue, ränni vasemmalle 90ast
6-8																			Mussalon satama oikealla, murrettua ja lauhdevettä tulee sieltä
8-10				1			9												Jäät paljon kevyempiä
10-12																			kunnon laine nousee sivulla
12-14																			
14-16																			satama-alue loppuu
16-18																			kevyttä vielä, 150m ennenkuin sulkeutuu takana
18-20																			
20-22				3			10	1											kapenee ja muuttuu raskaammaksi
22-24																			200 m leve (2 ränniä rinnan) ajetaan toista
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38				3			10												Raskaampi ränni
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship D																	
Date	12.2.2003																	
Voyage	Kotka-Emäsalo																	
Time	19-20																	
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			DAT 2 alkaa
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50				3			10												Laiva vastaan Holger konttilaiva
50-52																			Siirrytään aika jyrkällä käännöksellä
52-54																			sen ränniin, paksua tavaraa rännissä
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship D																		
Date	12.2.2003																		
Voyage	Kotka-Emäsalo																		
Time	20-21																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			Vähän rännin sivulla (luotsi luuli että laiva tulee vastaan(menikin Haminaan)
2-4																			GPs antennin siirto ulos
4-6																			
6-8																			Tullaan y-risteykseen
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			Tasaista ränniä
18-20																			
20-22																			JM Apu bb vastaan
22-24																			swan lake bb vastaan
24-26		0.4																	Pysytellään rännin sivussa ja odotellaan että Apu kääntyy ja tulee avustamaan
26-28																			Kokonaan seis
28-30																			
30-32																			
32-34																			Apu ajaa ohi
34-36																	x		Apu alkaa avustaa
36-38																	x		
38-40																	x		
40-42																	x		
42-44																	x		
44-46																	x		
46-48		0.8															x		Ajaa noin 150 m:n päässä
48-50																	x		
50-52																	x		
52-54																	x		
54-56																	x		
56-58																	x		
58-60																	x		
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship D																		
Date	12.2.2003																		
Voyage	Kotka-Emäsalo																		
Time	21-22																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																	x		JM Apu avustaa
2-4																	x		
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship D																	
Date	12.2.2003																	
Voyage	Kotka-Emäsalo																	
Time	22-23																	
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2				3													x		Kaksi laivaa vastaan , Apun perässä
2-4																	x		kiintojäähän, mutka vasempaan
4-6																	x		
6-8																	x		
8-10																	x		
10-12																	x		
12-14																	x		
14-16																	x		
16-18																	x		Ulos avun perässä rännistä, laiva tulee vastaan
18-20																	x		Apu 350 m:n päässä
20-22																	x		Pyritään takaisin ränniin
22-24																	x		
24-26																	x		
26-28																	x		
28-30																	x		Taas lyhyt väli
30-32																	x		
32-34																	x		
34-36																	x		
36-38																	x		
38-40																	x		
40-42																	x		
42-44																	x		
44-46																	x		
46-48																	x		
48-50																	x		
50-52																	x		
52-54																	x		
54-56																	x		
56-58																	x		
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship D																		
Date	12.2.2003																		
Voyage	Kotka-Emäsalo																		
Time	23-24																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2		0.8		3													x		JM Apu avustaa
2-4																	x		DAT 3 Alkaa
4-6																	x		
6-8																	x		
8-10																	x		
10-12																	x		
12-14																	x		
14-16																	x		
16-18																	x		
18-20																	x		
20-22																	x		
22-24																	x		
24-26																	x		
26-28																	x		
28-30																	x		
30-32																	x		
32-34																	x		
34-36																	x		Pellingin mutkat
36-38																	x		
38-40																	x		
40-42																	x		
42-44																	x		
44-46																	x		
46-48																	x		
48-50																	x		
50-52																	x		
52-54																	x		
54-56																	x		
56-58																	x		
58-60																	x		
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship D																		
Date	12.2.2003																		
Voyage	Kotka-Emäsalo																		
Time	24-01																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																	x		Apu avustaa
2-4																	x		
4-6																	x		
6-8																	x		
8-10																	x		
10-12																	x		
12-14																	x		
14-16																	x		
16-18																	x		
18-20																	x		
20-22																	x		
22-24																	x		
24-26																	x		Loggaus loppu
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship E																		
Date	20.3.2003																		
Voyage	Utö-Naantali																		
Time	8-9																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30						40	10												Leveä kevyt ränni
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46						20													
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship E																		
Date	20.3.2003																		
Voyage	Utö-Naantali																		
Time	9-10																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			Kohdattiin vastaantulevan
16-18																			laivan kanssa
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32						30	10												
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship E																		
Date	20.3.2003																		
Voyage	Utö-Naantali																		
Time	10-11																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12						20	10												Hidastetaan Viking Amorellan Takia
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			Tultiin suurempaan ränniin,
24-26																			vauhti tipahti hieman poskessa
26-28						20	10												Leveä paljon likennöity ränni
28-30																			
30-32																			Kohdattiin Finnclipper
32-34																			
34-36																			
36-38																			
38-40																			Kohdattiin Silja Festival
40-42						20	10												
42-44																			
44-46																			
46-48																			
48-50																			Kohdattiin Valas
50-52																			
52-54																			
54-56						20	10												Erittäin leveä paljon liikennöity
56-58																			ränni. Rännin leveys n. 6B
58-60																			=85- 100 m

		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship E																		
Date	20.3.2003																		
Voyage	Utö-Naantali																		
Time	11-12																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2						20	10												
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			Kohdattiin Seawind
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship E																		
Date	20.3.2003																		
Voyage	Utö-Naantali																		
Time	12-13																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2						20	10												
2-4																			
4-6																			Kairattu ränni
6-8																			
8-10																			Kairauslinja 3
10-12																			Kairauslinja 2
12-14																			Kairauslinja 1
14-16																			Kairauslinja 4
16-18																			Mittas lopetettu
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship F																		
Date	10.3.2003																		
Voyage	Södertälje-Västerås (Mälaren)																		
Time	13-14																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			Lähtö Södertäljestä
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			Sulussa
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			Ulos sulusta
36-38																			Avovettä
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature		0															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship F																		
Date	10.3.2003																		
Voyage	Södertälje-Västerås (Mälaren)																		
Time	14-15																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6												10		6	4				Jäät alkaa
6-8																			
8-10																			
10-12												20		8	4				
12-14																			
14-16																			
16-18												20		7	3				Ränni alkaa muodostua. Paljon
18-20																			liikennöity leveä ränni. Hyvin
20-22																			kevyt.
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			Ränni on hyvin kevyt Lauttajäätä
32-34																			reunoilla keskellä palakoko 30-40
34-36																			Avovettä
36-38																			
38-40						30	8												Ränni/lauttoja
40-42						20	7												
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship F																		
Date	10.3.2003																		
Voyage	Södertälje-Västerås (Mälaren)																		
Time	15-16																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2						30	8												Edelleen lauttoja reunal ja
2-4																			rännimassaa keskellä
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			Avovettä
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			Taas jäätä
34-36						30	6												Ei poskia, rännn aksuus ehkä
36-38																			30 cm ???
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship F																		
Date	10.3.2003																		
Voyage	Södertälje-Västerås (Mälaren)																		
Time	16-17																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2						20	5												Ränni enää oikeastaan kellvia
2-4																			jääpaloja ja lauttoja. Välillä
4-6																			avovesisaarekkeita.
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			Matalanveden vaikutuksesta
18-20																			vauhti vähän putosi
20-22																			
22-24																			Hidastettiin Hjulstabronin takia
24-26																			
26-28																			
28-30																			
30-32																			
32-34												20			4				
34-36																			
36-38																			
38-40						10	8					20		8	2				Yhdistetty lautta-rännijä.
40-42																			
42-44																			
44-46												20		8	4				
46-48																			
48-50												20		8	3				
50-52																			Avovettä
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed			20														
		Wind direction			235														
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship F																		
Date	10.3.2003																		
Voyage	Södertälje-Västerås (Mälaren)																		
Time	17-18																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Pitch	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			Edelleen käytännöllisesti katsoen
2-4																			avovettä
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			Ränni, joka on toisesta reunasta
16-18																			auki. Ajetiin lauttajäässä, kun vas-
18-20																			taan tuli kaksi laivaa.
20-22																			
22-24																			Ränni alkaa, huono ränni
24-26												30		8	3				Näillä main kävi jääryhmä 10.3.
26-28																			
28-30																			Ei enää ränniä. Epämääräistä
30-32												30		8	4				lauttajäätä (paksuus jääryhmältä)
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship G																	
Date	13.3.2003																	
Voyage	Valko-Emäsalo																	
Time	13-14																	
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Engine RPM	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			13.04 lähtö Valkomista
6-8																			
8-10																			
10-12																			
12-14		huom rpm																	13.13 loggaus päälle
14-16		790	170				9	1											Kevyt ränni
16-18																			Paloilla tilaa liikkua, yksi kerros
18-20																			Hiljennettiin (jäällä työkoneita)
20-22																			
22-24		850	180																Lisää tehoja
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			0-30 cm paloja
36-38							10	1											Muuttuu hieman raskaammaksi
38-40		700	150																Hiljennetään (jäällä työkoneita)
40-42																			
42-44																			
44-46		890	190				10	1											Lisää tehoja, paksumpi ränni, palat kerroksissa
46-48																			0-50 cm paloja, sulkeutuu nopeasti 30-40m
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			Vaihdettiin uudempaan ränniin
58-60																			isoja lauttoja 1-3m ei sohjoa
		Air temperature			2														
		Wind speed																	
		Wind direction																	
		Ice field speed		-															
		Ice field direction		-															
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship G																		
Date	13.3.2003																		
Voyage	Valko-Emäsalo																		
Time	14-15																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Engine RPM	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4		880	190																
4-6																			
6-8																			
8-10																			
10-12				50cm			10	1											Tullaan länteen menevälle rännille
12-14																			0-30cm pyöreitä palloja rännissä
14-16																			Leveä paljon liikennöity ränni
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			Christian Essberger vastaan
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature		.+6															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship G																		
Date	13.3.2003																		
Voyage	Valko-Emäsalo																		
Time	15-16																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Engine RPM	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2		875	190				10	1											0-30 cm palloja
2-4																			Raskaampi ränni
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			Vesikiven linja
38-40																			Yleensä Vesikiven linja raskain
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			Käännös oikealle
50-52																			tässä Kirsten kiinni tulomatkalla
52-54																			Käännöskohta paksun näköistä
54-56																			
56-58																			
58-60																			
		Air temperature		+6															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship G																		
Date	13.3.2003																		
Voyage	Valko-Emäsalo																		
Time	16-17																		
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Engine RPM	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10							10	1											0-30..50 cm paloja
10-12																			
12-14																			
14-16																			
16-18		900	195																
18-20		860	189																
20-22																			
22-24																			
24-26																			
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			Tiistedal tuli vastaan
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature		+7															
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													

Ship	Ship G																	
Date	13.3.2003																	
Voyage	Valko-Emäsalo																	
Time	17-18																	
	Propulsion			Level ice		Old channel			New channel			Drift ice				Ridge	Assist	Towing	
time	Power	Engine rpm	n [1/min]	t	t snow	Piece size	c/10	on	Piece size	c/10	on	t	t snow	c/10	Floe size	Sail hight			Notes
0-2																			
2-4																			
4-6																			
6-8																			
8-10																			
10-12																			
12-14																			
14-16																			
16-18																			
18-20																			
20-22																			
22-24																			1722 loggaus loppu
24-26																			Emäsalon kärjen E puolella
26-28																			
28-30																			
30-32																			
32-34																			
34-36																			
36-38																			
38-40																			
40-42																			
42-44																			
44-46																			
46-48																			
48-50																			
50-52																			
52-54																			
54-56																			
56-58																			
58-60																			
		Air temperature																	
		Wind speed																	
		Wind direction																	
		Ice field speed																	
		Ice field direction																	
			1	2		3			4			5							
		Level ice	0-20	20-40		40-60			60-80			80-100			Ice thickness [cm]				
		Drift ice	0-10	10-30		30-100			100-300			over 300			Floe size [m]				
		Ridge field	0-0.5	0.5-1.0		1,0-1,5			1,5-2,0			2,0-2,5			Sail hight [m]				
		Compression	none	some		much													