

On the Accuracy of Wind Observations made on Board Finnish Light-Ships

By

EUGENIE LISITZIN

On board Finnish light-ships (Figure 1) observations on wind are made during the navigation period three times daily, usually at 7, 14 and 21 o'clock Finnish Standard time, simultaneously with current measurements in three different depths. The force of the wind is hereby estimated on the Beaufort scale. Concerning such observations the individual appreciation of the observer is, without doubt, of great, in some cases even of decisive importance. In order to consider at least to some degree the possible deviations in the estimation of the wind force by different observers, table 1 has been calculated. This table gives the mean wind force in the different years of the period 1921—40, and is based upon the observations made during the time June 1 to October 31. This space of time has been chosen mainly in order to get a period without greater omissions; on the other hand it is long enough to show the influence of the individual appreciation of the different observers. In this connection it may be mentioned that even a period as short as the named does not for some light-ships offer quite complete series. For instance at the light-ship Kemi (until the year 1932 called Plevna) the work was in twelve of the twenty years in question beginning later (the 4. to the 16. June)

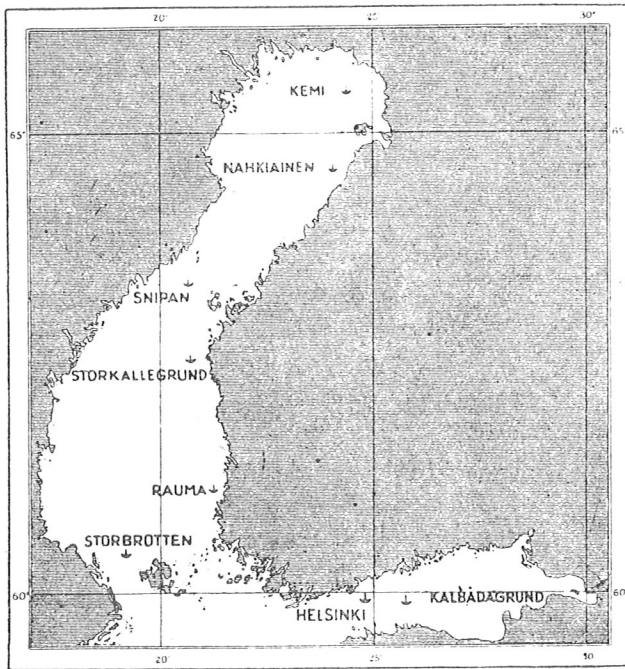


Figure 1. The positions of the Finnish light-ships

whereby this delay is caused by ice obstacles. On an average we may count that the named period was concerning Kemi about 6, concerning Nahkiainen about 5 days shorter than normal. Farther southwards the missing time becomes shorter still, namely for Snipan 4, for Storkallegrund 2 days and for Rauma (to the year 1932 Relanderinmatala) and Kalbådagrund only one day, while at Storbotten and Helsinki (until the year 1932 Åransgrund) there is practically no limitation of the observations because of ice obstacles. These omissions have thus no practical significance. Of greater importance are the lacking observations annotated at Storbotten. This light-ship, which in icepoor winters remains at its station the whole year, must, as a rule, interrupt the work in the summer for 10—20 days during which time the ship is repaired. This occurs usually in the latter

Table 1. Mean wind force (Beaufort) at the Finnish light-ships.

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	Mean	Diff.
Kemi	3.97	3.56	3.26	3.05	3.04	3.04	2.78	2.81	3.58	3.13	3.37	3.20	3.00	2.93	3.10	3.16	3.06	3.13	2.81	3.53	3.18	1.19
Nahkainen	3.35	2.67	2.41	2.59	2.37	2.96	2.67	3.02	3.38	3.14	3.86	3.66	3.27	3.00	2.92	3.41	2.62	2.85	2.95	3.50	3.03	1.49
Snipan	4.04	3.91	3.82	2.94	2.57	2.46	2.26	2.11	2.54	2.57	3.12	2.77	2.39	2.48	2.43	2.57	2.37	2.52	2.19	2.70	2.74	1.93
Storkallegrund	3.32	2.98	2.68	3.21	2.53	2.52	2.65	2.50	2.66	2.11	2.61	2.75	2.34	2.55	2.54	2.78	2.57	2.72	2.09	2.76	2.64	1.23
Rauma	3.16	2.58	3.05	2.33	2.50	2.10	2.60	2.72	3.24	2.80	3.12	2.99	2.54	2.48	2.96	2.91	2.87	2.97	2.48	3.03	2.77	1.14
Storbrotten ..	—	—	2.64	2.43	3.10	2.70	2.63	2.69	2.95	2.75	2.76	2.49	2.49	2.36	3.04	2.74	2.45	2.40	2.59	—	2.66	0.74
Helsinki	2.61	2.21	2.60	2.22	2.51	3.00	2.65	3.00	2.92	2.68	3.05	2.56	2.94	3.24	3.32	3.28	2.71	3.19	2.87	3.38	2.85	1.17
Kalbådegrund ..	2.83	2.30	2.89	2.38	2.14	2.23	2.50	2.53	2.68	2.88	2.67	2.51	2.66	2.71	2.86	3.07	2.51	2.56	2.58	3.05	2.63	0.93
Mean	3.33	2.89	2.92	2.64	2.60	2.63	2.59	2.67	2.99	2.76	3.07	2.87	2.70	2.72	2.90	2.99	2.64	2.79	2.57	3.14	2.82	0.76

half of June or in the beginning of July. The other light-ships were also sometimes forced to leave their stations for some reasons. In the cases where the omissions were more than a third of the research period the whole year has been left out of consideration. If the lacking time was 4—7 weeks, the mean value has been included in table 1, but the corresponding figure is printed in *italics*.

Before we begin a closer study of the results for the different light-ships, it must especially be pointed out that, as a matter of course, there exist considerable local deviations and that the wind force is subjected to great variations in different years. But also considering these factors the individual way of estimating the wind force appears quite distinctly in many cases. Especially obvious it is in the years where a new observer has begun the work as one may note a sharp change in the different values of frequencies as well as concerning the mean wind force. The wind observations at the light-ships, where the number of the observers has been great, may therefore not without further notice be compared with each other. A comparison of these values with the wind observations at the neighbouring stations allows us, however, to estimate the magnitude of the correction. For such a comparison the stations are most appropriate where one observer has been charged with the work during a prolonged time. We must, however, not forget that in the observation material, without doubt, there are cases where the wind force has been over- or underestimated during several years thus giving an uncorrect picture of the mean conditions.

Finally, it may be pointed out in this connection, that in spite of the fact that a definite person has generally been charged to make the observations, it often happens that in reality the work is carried out every now and then or, even during a longer time, by someone else. This may influence the wind observations to some degree but it is impossible to overlook the deviations arisen in this way and they have not been considered in the following.

In table 1 the change of the observer is indicated by a short vertical line between the mean values for two years. Already the means for the entire period show that there exist considerable deviations concerning the different light-ships. We notice immediately that while the three stations Storkallegrund, Storbrotten, and Kalbådagrund deviate from each other only a little, the light-ships Snipan, Rauma, and above all Helsinki, show considerably higher values. The two stations in the Bothnian Bay,

Kemi and Nahkiainen, form a special group. There the mean wind force is, on the average, higher than at any of the resting light-ships. At Kemi the same observer has been working during 15 years and the variations of the wind force are here during this time smaller than at any of the other stations. It is, however, probable that an overestimating of the wind force has taken place at Kemi although it is possible that at this light-ship, comparatively remote from shore, the wind force reaches higher values than at the other stations.

Nahkiainen forms an opposite to Kemi, as three different observers have been working there during the research period, 7, 5 and 8 years respectively. The difference between the wind force estimated by the first and second observer is striking. In the years 1922—27 the mean wind force was less than 3 B, in the year 1921 the value was certainly 3.35 B, but in this year the wind force in almost the whole area of the Gulf of Bothnia has been higher than in any of the other years during the research period. The mean value for the years 1921—27 is 2.71 B. In the following five years 1928—32 all yearly means exceed 3 B and the average for the entire period is 3.41 B. As such an increase of the wind force is not to be noted at the adjoining stations Kemi and Snipan the great difference is to be ascribed solely to the change of the observer. If we assume that the mean wind force at Nahkiainen is 3.0 B, we may count that the first of the named observers has, on an average, committed an underestimating of the wind force in 30 % of all the cases, the second one has overestimated 40 % of all the observations. A closer study of the frequencies of the different values for the wind force shows, however, that during the years 1921—27 no wind, as well as the wind forces 1—2 B have been annotated at Nahkiainen considerably more often than at Kemi. We can thus infer that the lower values of the wind force have been favoured at the expense of the higher ones. Concerning the observations in the years 1928—32 it may be mentioned that during this period the number of the cases with a wind force higher than 6 B has been at Nahkiainen 5 % greater than at Kemi. In the resting eight years 1933—40 such a tendency is not to be observed; on the contrary, the correspondance between the two light-ships in the Bothnian Bay is good although the variations of the mean wind force in the different years are at Nahkiainen greater than at Kemi.

At Snipan not less than five different persons made wind observations during the research period. The great variations of the mean values for

the wind force, comprising 1.93 B, are the natural consequence of this fact. If we determine the mean wind force for the working time of the different observers we get the following values:

1921—24	1925—30	1931—32	1933—35	1936—40
3.68 B	2.42 B	2.94 B	2.43 B	2.47 B

We notice that the average wind force was during the working time of the first and third observer higher than the mean value for the entire research period, while, concerning the second, fourth, and fifth observer, the state of things is the contrary. In the former cases we have probably an overestimating, in the latter an underestimating of the wind force. Finally, it may be noted that the mean wind force for 1940 is too high, as in this year the observations for June are lacking.

The following values may serve as an illustration for the overestimating of the wind force at Snipan in 1923. We find in per cents of all the cases how often no wind or weak wind (0—2 B), moderate wind (3—5 B) and strong wind (6—10 B) was observed during this year at Nahkiainen, Snipan and Storkallegrund.

	0—2 B	3—5 B	6—10 B
Nahkiainen	56.1 %	40.5 %	3.4 %
Snipan	28.2 %	50.9 %	20.9 %
Storkallegrund	58.3 %	31.9 %	9.8 %

The considerable difference between the values for wind force at Snipan on the one hand and at Nahkiainen and Storkallegrund on the other is obvious. The numerous occurrence of the strong wind causes the high mean value of the wind force at Snipan in 1923. In the two preceding years too, when the same observers have performed the work, the overestimating of the wind force at Snipan appears distinctly although in the year 1921 the difference is not nearly so large.

At Storkallegrund five different persons have made the observations, the last of them during a period of 11 years. In spite of the great number of the observers the variations of the mean wind force are at this lightship considerably lesser than at Snipan. The years 1921 and 1924 form an exception in this respect. In the former year the wind force was, as has been mentioned, high also at the other stations, whereas in the year 1924

the wind force at the other stations was low. We may therefore suppose that the high values at Storkallegrund are caused by an overestimating of the wind force. As the observer in question has been working only one year, we have once more an example for the fact that the individual estimating of the wind force influences the result to a high degree.

If we go over to Rauma we note that the number of observers at this light-ship has been four. The three former observers have been working during two, one, and three years respectively. The greater part of the observations, that is to say during the period of 14 years, has thus been made by the same person. As general conclusion it may be said that the first and the third observer have underestimated the wind force, the second has overestimated it, while the fourth has on the whole worked satisfactorily. The good agreement with the corresponding mean values for all stations is hereby striking.

Storbrotten has a special position among the light-ships. In spite of the fact that the number of the observers is six, the variations of the mean wind force are just at this station less than at the other light-ships. This depends, partly at least, upon the lacking of the observations for 1921, 1922 and 1940, where the wind force, on an average, has been high. Concerning the different years it may be said that an overestimating of the wind force has taken place in 1925. The same observer has, however, been working also in the year 1924 but in this case the result seems satisfactory.

Only the stations in the Gulf of Finland remain to be discussed. An overestimating of the wind force has, without doubt, taken place at Helsinki. This is certainly applicable only to the latter three of the five observers but as their working period contains 16 years these values are of decisive importance for the mean wind force. Not even the underestimating of the wind force which probably has been committed in the four first years can influence the result to a higher degree. This is illustrated by the following values representing the mean wind force for the working period of the different observers in comparison with the average wind force at Kalbådagrund for the same periods. As the observers have changed comparatively often at Kalbådagrund the work has here, during the three long periods been performed at least by two different persons:

	1921	1922—24	1925—35	1936—38	1939—40
Helsinki	2.61 B	2.34 B	2.90 B	3.06 B	3.12 B
Kalbådagrund ..	2.83 B	2.52 B	2.58 B	2.71 B	2.82 B

As for Helsinki we note a sharp change of the mean values between the second and the third period. Such a change does not appear at Kalbådagrund where the variations of the wind force are considerably less. The picture will be almost the same if we compute for Kalbådagrund the mean wind force for other periods, e.g. for the working time of the five different observers. Also in this case the variations are slight as for the rest the variations in the separate years too. They are at Kalbådagrund less than at all the other stations with complete observations, being only 0.93 B. An over- or underestimating of the wind force of greater importance cannot be observed at Kalbådagrund.

The correlation between the different stations and the entire area may also serve as a certain measure for the accuracy of the wind observations. We have:

Kemi	Nahkiainen	Snipan	Storkallegrund	Rauma	Helsinki	Kalbådagrund
0.85	0.64	0.61	0.44	0.89	0.22	0.59

As the research period contains 20 years we have a sure correlation as soon as the correlation factor reaches the value 0.59. The correspondence is best concerning Kemi and Rauma; it is just for the light-ships, where the same observer has been working during a prolonged time. We have further a sure correlation for Nahkiainen, Snipan, and Kalbådagrund. The result for Kalbådagrund is not surprising as the variations of the mean wind force have been slight at this station. At Nahkiainen and Snipan where the variations are large the different values deviate on the whole in the same direction as the mean wind force for the entire area. Concerning the remaining light-ships it is obvious that the correlation is problematic for Storkallegrund and quite unsatisfactory for Helsinki.