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Wind directions at Leman & Wave directions at Buoy N3

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1 Introduction

This note describes a comparison of wave directions measured by the buoy N3 off Holderness (near 53.83°N 0.15°E) and wind directions measured by the UK Met. Office weather station at Leman (near 54.1°N 2.2°E). N3 records are half hourly from 14 October 1994 to 28 February 1995, the Leman data extends from 1983 to 1997; during the period of measuremen ts by N3, the Leman data were recorded at hourly intervals - but with some gaps, especially during January 1995.

2 General directional distributions

Figure 1 shows the directional distribution of waves from 6559 records obtained by N3. Figure 2 gives the distribution of wind direction at Leman from 25 000 records obtained between 1983 and 1997. The distribution of wave direction at N3 is far from uniform, with most waves coming from the south–southeast, with a secondary maximum from the north. Wind directions are more uniform, but with a maximum from the S-SW. (Note the peak at 340º-360° is because the program put 450 records with direction of 360° into this box.) But the direction of high winds is less uniform, as shown in Figure 3 which gives the distribution of winds > 30 knots.

3 Directions with high waves at N3

The directions of all waves at N3 was shown in Figure 1; the directional distribution of high waves is different, with the north replacing the south–southeast as the most frequent direction. Figure 4 shows the distribution of waves with $H_s > 3$ m; for $H_s > 4$ m, all waves were travelling from the north (between 300° and 10°).

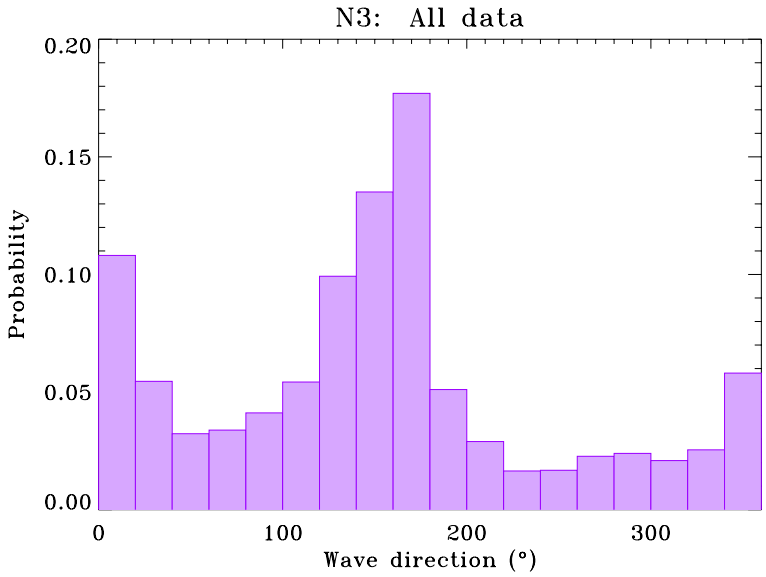

Figure 1: Directions of waves at N3, winter 1994–1995.

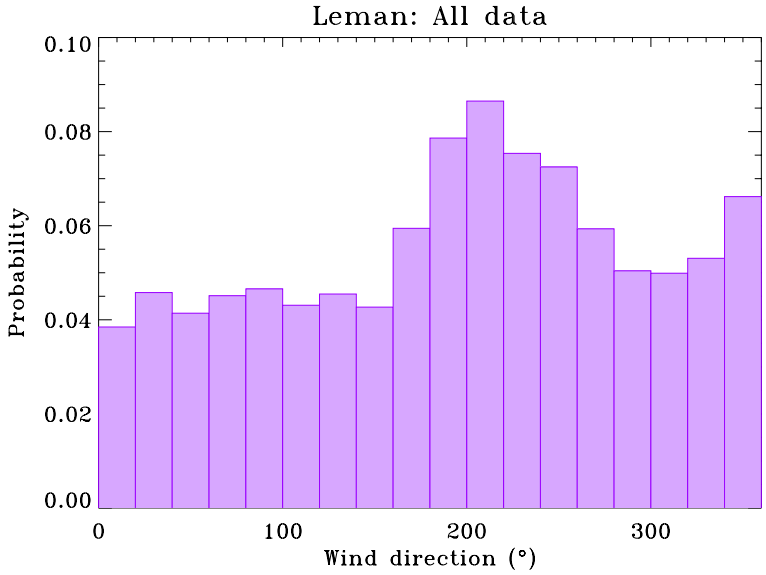

Figure 2: Directions of winds at Leman, 1983-1997.

4 Comparison of wind and wave directions

How good an estimate of wave direction at N3 is the wind direction at Leman? For high waves, as shown by Figure 5, the direction of the wind at Leman (within 1 hour of the buoy record) was almost always a good estimate of the wave direction at N3, although there appears to be a small bias. The mean difference (N3 direction - Leman direction) of the 282 records was 12.5°, the standard deviation was 40°, and the s.e.(mean difference) was 2.4° - so the mean difference of12.5° is statistically highly significant. The difference in N3 wave and Leman wind direction with lower wave heights was more often larger, – as shown in Figure 6 – but the mean difference of the 2707 records was -10.1°; the standard deviation was 66°, and s.e.(mean) was 1.3°.

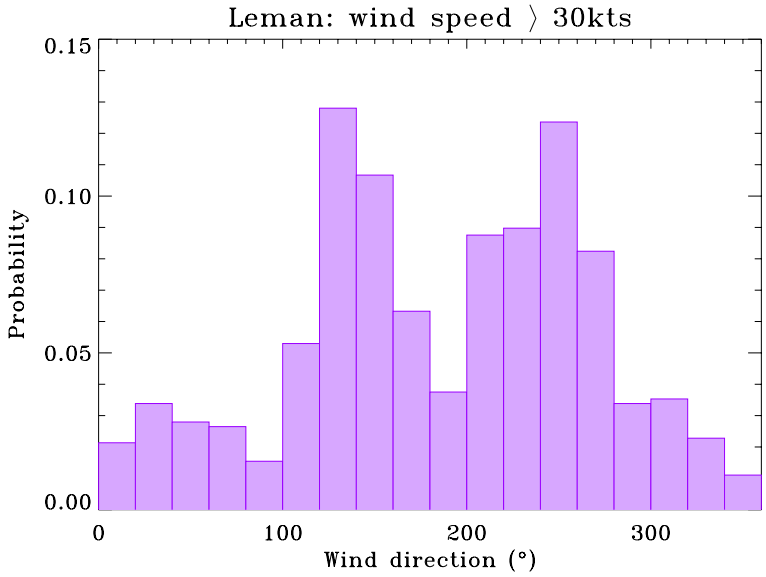

Figure 3: Directions of winds > 30 knots at Leman, 1983-1997.

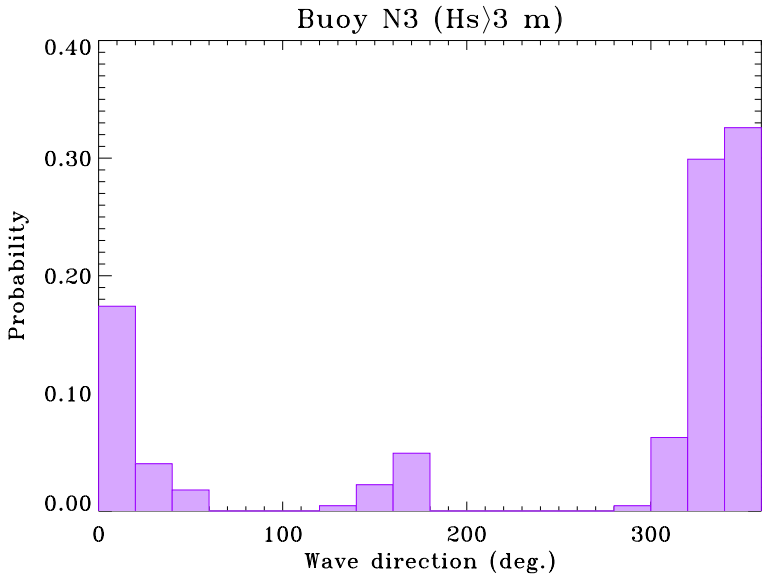

Figure 4: Wave directions at Buoy N3 when significant wave height was > 3 m.

5 Conclusions

Wave measurements at N3 for a few winter months indicate that wave directions are far from uniformly distributed, with all the high waves (significant wave height > 4 m) coming from the north.

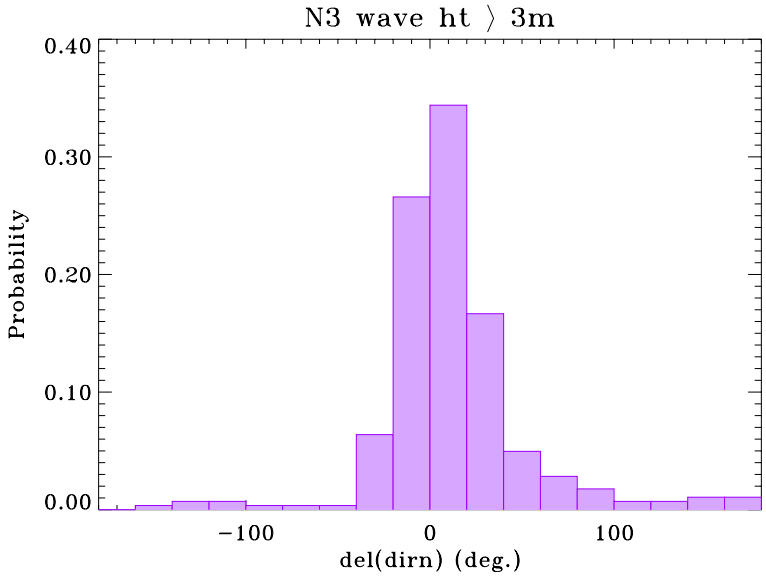

Figure 5: Distribution of wave direction at N3 minus wind direction at Leman, with N3 wave height, $H_s > 3\,\mathrm{m}$.

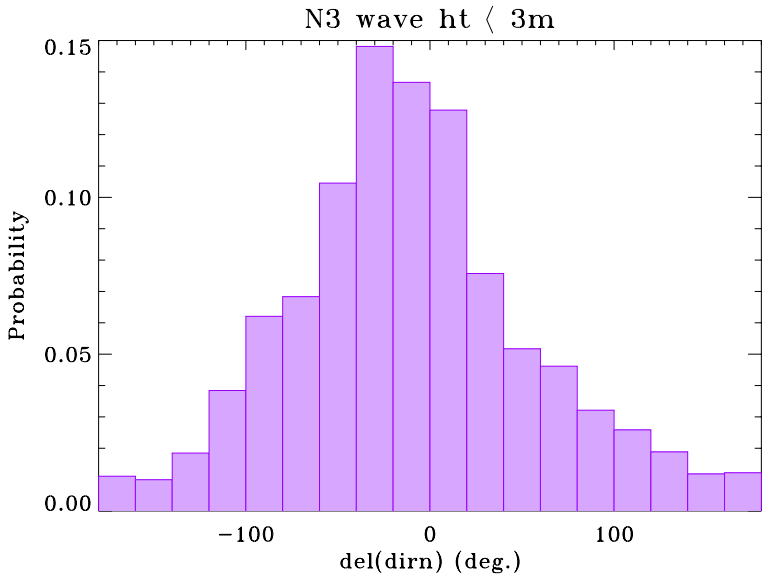

Figure 6: Distribution of wave direction at N3 minus wind direction at Leman, with N3 wave height, $H_s < 3\,\mathrm{m}$.

A comparison of wind directions at Leman during this winter a total of almost 3 000 records, showed little bias between wind and wave direction, suggesting that the wind direction at Leman can be used to produce a data set representative of wave direction at N3. There is some evidence of wave height related bias, indicating that 12° should be added to the wind direction if $H_s > 3\,\mathrm{m}$ and 10° should be subtracted if $H_s < 3\,\mathrm{m}$. But such a small correction (wind directions are only recorded to the nearest 10°) derived from only one winter seems neither worth applying nor investigating further.