St Gowan wave data.
Jericho Technical Report 04

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Introduction

Wave measurements from near the St. Gowan Light Vessel (near 51.5°N, 4.9°W) have been obtained from a Shipborne Wave Recorded fitted in the Light Vessel (data now held by the British Oceanography Data Centre), a buoy near the Light Vessel operated by the UK Met. Office, and from satellite radar altimeters: Geosat, ERS and TOPEX. Details of these data sets are described below, and a comparison of monthly mean wave heights estimated from these sources described.

BODC data from the St Gowan LV December 1976 - December 1983

These constitute quite a good data set of 3-hourly values, with an overall data return of 74%, varying from March (61%) to September (89%). There were no data from November 1979 - March 1980, August 1980, and February - April 1982, and gaps in other months.

Data specification gives -1.0 for missing values; in practice it is indicated by a 'P' or 'Q' placed after the value given as 0.0.

UK Met. Office buoy data from September 1992 to December 1997

Most of the 1992 wave heights were set to 0.0 as were all the 1993 data. There were no wave data for 1994 before 2 September, but after this date the data appear to be satisfactory, and from September 1994 to December 1997 there is a good data set of hourly values, achieving a return rate of 94%. The lowest return was March (74%), due mainly to March 1996 with only 45%.

Altimeter data, April 1985 to May 1998

Altimeter data within 50 km of St Gowan were extracted from the database of Geosat, ERS-1 and TOPEX data; these are at 1 second (6 - 7 km) intervals.

Figure 1 shows the location of the St Gowan Light Vessel and buoy (at 51.5°N, 4.9°W), a circle of 50 km radius about this position, and estimated tracks of TOPEX, repeated every ten days.. The '+' signs are the locations of the individual 1 Hz TOPEX footprints within this circle from September 1994 to December 1997.

Median values of wave height were calculated from these 1 Hz values for each transect of the 50 km circle when there were at least 5 validated values. From the entire data set, there were 215 median values.

Geosat: These data extend from April 1985 to December 1989, but Geosat was slow to acquire lock on the sea surface as it came off the land which resulted in a poor data return within the 50 km circle: only 89 individual validated values, making up 4.4% of the total number of altimeter records. There were only 6 median values from the entire Geosat data set;

2 in August 1985 and November 1985, and 1 in April 1985 and February 1986 (the tracks of the altimeter during its 17-day repeat after October 1986 were close to land, a few tracks during the earlier Geodetic Mission with a 168-day repeat were to the west of the Pembrokeshire peninsula).

ERS-1:These data cover the periods April 1992 - October 1993 and April 1994 - March 1995. There are 465 1 Hz values, making up 23% of the total 1 Hz data set.

TOPEX: TOPEX Ku-band data from October 1992 to May 1998 constitute the largest part of the data, 72.6%. This altimeter is in a 10-day repeat with wide spacing between the tracks, with two transect of the 50 km circle passing about 30 - 40 km from St Gowan; see Figure 1. The figure shows the gap in the data coverage as the altimeter NW to SE track leave the Welsh coast. Neither of the tracks is particularly close to St Gowan but, like St Gowan, both are exposed to the prevailing waves from the west-southwest.

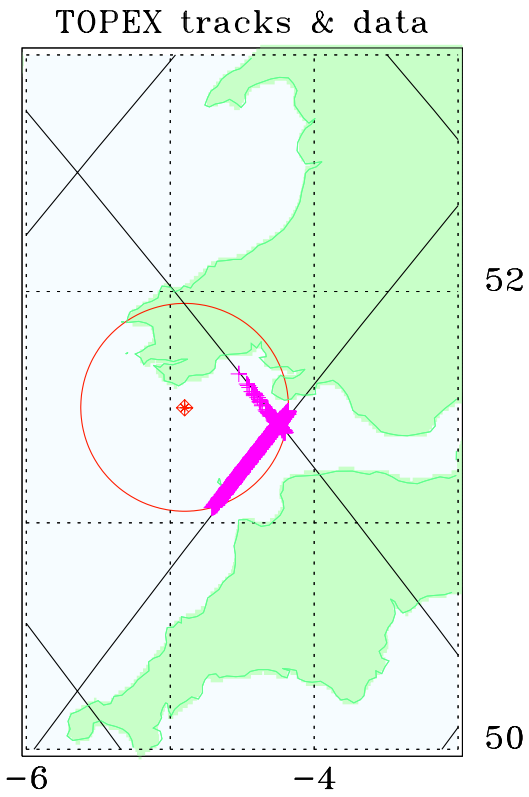

Figure 1

Comparison of altimeter and *in situ* estimates of monthly mean wave height

The altimeter and *in situ* data only coincide during the period September 1994 to December 1997. Monthly calendar mean wave heights from the two data sets are shown in Figure 2.

The agreement is clearly good, with a residual standard deviation about the principal component (the line plotted in the figure) of 0.086 m, and correlation coefficient of 0.98. The slope and intercept of the principal component are 0.91 (s.e.≈ 0.07) and 0.23 (s.e.≈ 0.11) respectively. The significant intercept might be due to calibration errors either in the buoy or the altimeter data, but could well be due to spatial variation in wave height across the 50 km circle. Figure 3 is a plot of calendar means from the 1976 - 1983 BODC data against the *in situ* 1994 - 1997 means, showing considerably more scatter than in Figure 2, with residual standard deviation of 0.18 m and correlation coefficient of 0.87, indicating that the altimeter data gives better estimates of monthly mean wave heights during its years of measurement than do *in situ* data from other years.

Figure 2

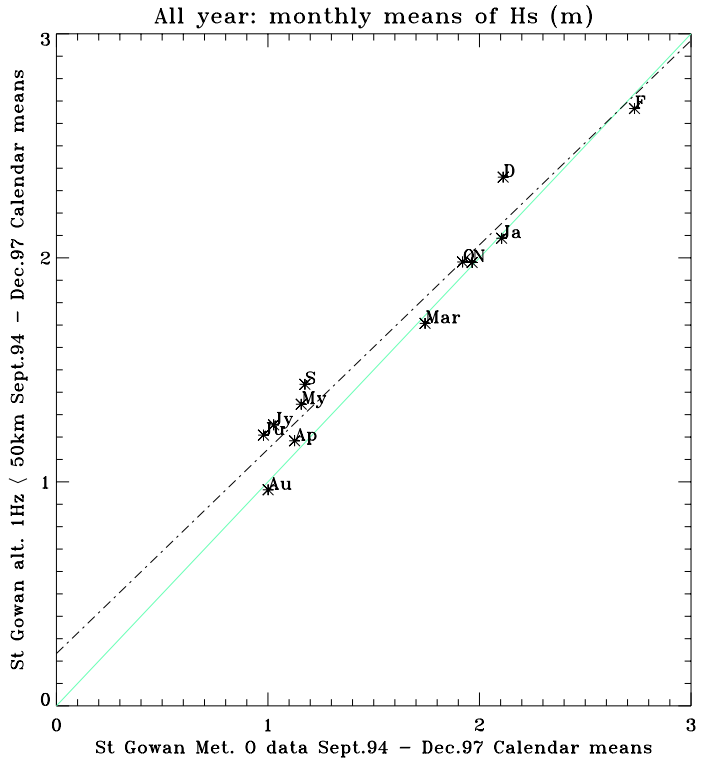

Figure 3

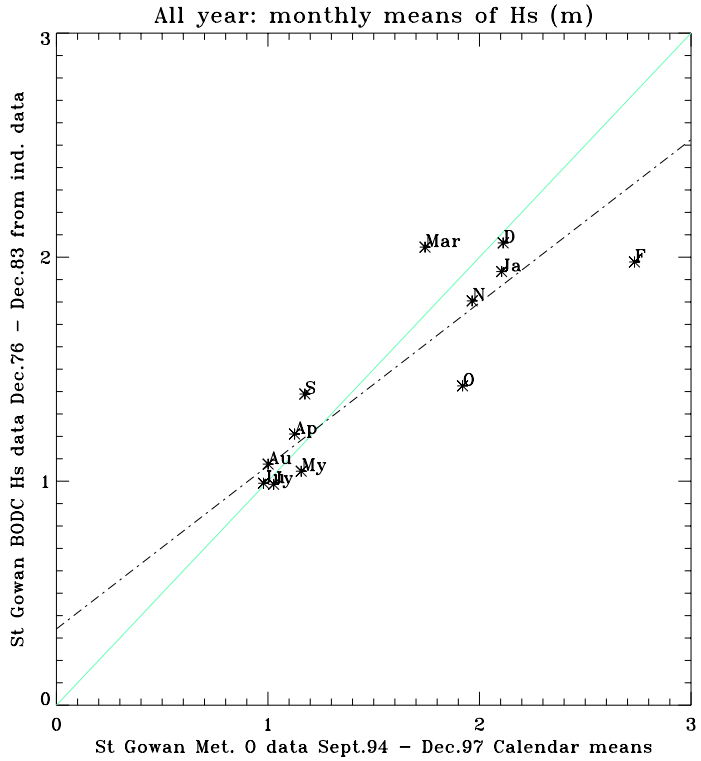

Figure 4 shows a plot of the forty individual monthly means, with residual standard deviation of 0.25 m, and correlation coefficient of 0.88. Similar comparisons but using the TOPEX transect median data were not so good, with a standard deviation of 0.35 m. This seems to because medians were only calculated if there were at least five 1 Hz values in the transect,

with the consequent loss of data. 19 of the 40 monthly means were derived from only 1 or 2 transect medians, and 33 of the 40 from 3 or fewer transects.

Nevertheless, the agreement between monthly mean wave heights from *in situ* and altimeter data appears to be surprisingly good, considering the small number of independent altimeter measurements. Table 1 gives the means for three individual months of March (the month with the lowest percentage of *in situ* buoy data). Note that the low mean value from the depleted Met. Office buoy data for March 1996 is reflected in the altimeter data.

Figure 4

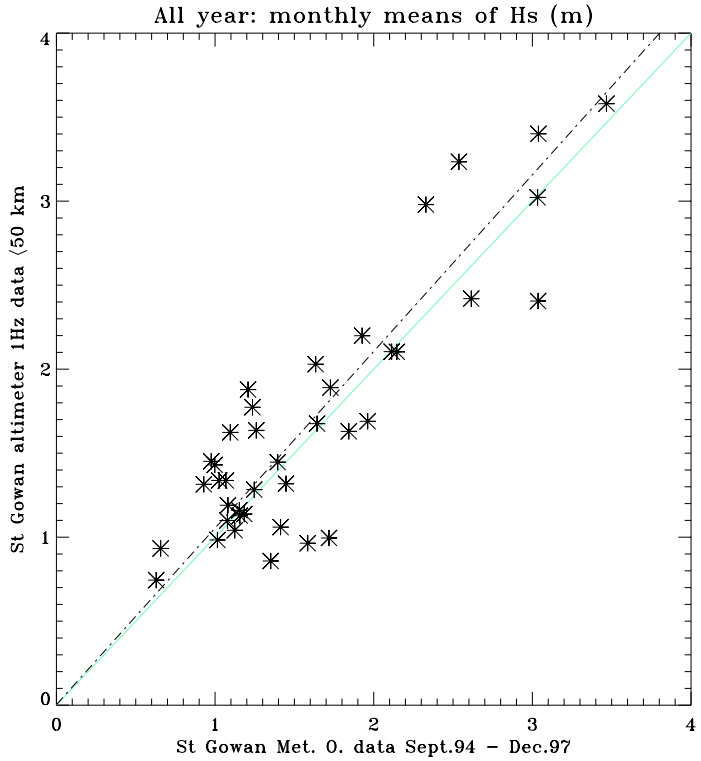

Table 1

	Nb of obs.	March 1995	Nb of obs.	March 1996	Nb of obs.	March 1997
Met.O. buoy data	581	2.1	335	1.1	733	1.7
alt 1 Hz data	29	2.1	27	1.1	27	1.9
alt medians	3	2.2	3	1.1	3	1.8

Conclusion

For this coastal site well exposed to the open ocean, the altimeter, in spite of its problems when operating close to land, gives good estimates of monthly calendar mean wave heights at the site. These altimeter estimates are considerably better than those obtained from nearby *in situ* measurements for different years; this suggests that the altimeter data are sufficiently accurate to indicate changes in the mean wave climate over a few years at this location.