APPENDIX A : *In Situ* Data

A.1 Introduction

A1.1 Requirement

The JERICHO project required *in situ* data from around the UK coastline (both nearshore and offshore) for the verification of altimeter data, and to aid in the setting up of shallow water wave models. This appendix gives an overview of the data sets available, and a description and brief analysis of those data that were used.

A1.2 Instrumentation

Commonly used instruments for measuring waves include surface-following Waverider buoys and bottom pressure recorders (possibly with high-frequency current meters for directional waves e.g. Wolf, 1997), wave staffs and arrays. In addition some Light Vessels have been fitted with instrumentation, allowing estimates of wave parameters to be automatically generated and transmitted to shore stations. This *in situ* instrumentation can be vulnerable to damage by the elements or by human interference and only gives measurements at a single location. The bottom pressure recorder is only useable in depths less than about 20m, or in much shallower depths in fetch-limited conditions since short waves are attenuated rapidly with depth. Recently satellite (altimeter and SAR) and other remote-sensing instruments such as HF and X-band radar have become available. These can record large volumes of data over a much larger spatial extent e.g. HF radar wave measurements can reach up to 20 km offshore from a coastal installation. An intercomparison of various wave-measuring devices was carried out at Holderness during the SCAWVEX project (Krogstad et al., 1999).

A1.3 Coastal Data

Hydraulics Research have recently produced a very useful catalogue of UK coastal wave data (Harford, 1998). From this catalogue it is clear that a large number of wind and wave data sets from around the UK coasts are potentially available. However, many of them are short term, resulting from instrumentation deployed for a specific project. Because of the expense in maintaining instrumentation in the seas for a long continuous period, few agencies can afford long term deployments.

A1.4 Offshore Data

JERICHO also required some offshore data for verification of altimeter data. However, there is no single archive centre for such data as oil companies tend to regard such information as proprietry and will usually commission a metocean specialist company to archive and quality control their data. An idea of the locations providing real time data to the met services can be gained from the US Florida State University web site (http://www.nws.fsu.edu/buoy/uk.html). Also the MAST III project SEANET produced a useful data base of wind and wave data sources in the North Sea region (http://www.minvenw.nl/projects/seanet/).

A.2 Data Sets Used In JERICHO

It was thus a significant task to identify data sets that were useful for the JERICHO project, from this apparent wealth of data. However, when further requirements are placed on the data of continuity for a period of 1 year or more which had to match the dates for which satellite altimeter wave data are available (1985-89, 1991 onwards), the number of useful data sets is drastically reduced. In the end, 23 data sets were selected and acquired, from 7 different sources, Table 1. Unfortunately, because the data were from different archives, data format, quality and resolution were not consistent, sometimes making it difficult to make direct comparisons between them. The formats are not fully described here, but are available from SOS on request. The seven data sources were:

The UK Meteorological Office
- 6 open ocean buoys (1-3, 5, 17 & 19 in Table1)
- 1 inshore buoy (8)
- 1 platform mounted automatic weather station (12b)
- 4 Light Vessels (4, 6, 9 & 10)

SeaData / Fugro Geos
- 7 data sets (owned by Shell, BP, and Phillips) platform mounted radars, lasers, wavestaffs, also wave buoys, (15, 16, 18, 20, 21, 22)

Rijkwaterstaat
- 2 sites with wave buoys off the Dutch coast (11, 14)

The British Oceanographic Data Centre
- 3 Light Vessels (4, 5, 6)
- 1 bottom pressure recorder (8)

The Environment Agency
- 1 buoy/tower data set (13)

Proudman Oceanographic Laboratory
- 1 set of 3 closely deployed buoys (23)

Southampton Oceanography Centre
- 1 short term buoy data set. (7)

These 23 data sets were selected because of their locations, covering a range of offshore, coastal and near shore sites to allow calibration/assessment of satellite data, to help in setting up shallow water wave models, and to provide time series for model input. A further use, developed during JERICHO, was to derive rules for transforming satellite altimeter wave height measurements from the nearest altimeter track to the shallow water model boundaries.

The data were all provided to the project team specifically for use within the JERICHO project, with the condition that they were not to be passed to third parties. Therefore readers with interest in specific data sets should contact the responsible agencies directly.

	Name	lat (N)	lon (E)	type	parameters	time res.	owner	go between	data at SOC	Depth (m)	No of files	Format	Comments
1	K3	53.5833	-15.55	UKMO OO buoy	Hs, Tz, U, dd	hourly	UKMO	UKMO	01/96-12/97	> 3000	1	UKMO ascii fixed width columns	
									12/91-12/97		yearly/monthly	UKMO report format	
2	K2	51.0167	-13.35	UKMO OO buoy	Hs, Tz, U, dd	hourly	UKMO	UKMO	01/96-12/97	~2000	1	UKMO ascii fixed width columns	
									12/91-12/97		yearly/monthly	UKMO report format	
3	K1	48.7167	-12.4333	UKMO OO buoy	Hs, Tz, U, dd	hourly	UKMO	UKMO	01/96-12/97	2000-2500	1	UKMO ascii fixed width columns	
									12/91-12/97		yearly/monthly	UKMO report format	
4	Seven Stones	50.063	-6.073	LV SBWR	Hs, Tz +	3 hourly	BODC	BODC	02/62-12/85	60	8	bodc request format	
				LV SBWR	Hs, Tz,U,dd	hourly	UKMO	UKMO	01/95-12/97		1	UKMO ascii fixed width columns	
5	St Gowan	51.5085	-4.9967	LV SBWR	Hs, Tz +	3 hourly	BODC	BODC	08/75-12/83		7	bodc request format	
		51.6167	-4.7333	UKMO OO Buoy	Hs, Tz, U, dd	hourly	UKMO	UKMO	09/92-12/97	49	1	UKMO ascii fixed width columns	
6	Channel LV	49.9067	-2.9167	LV SBWR	Hs, Tz +	3 hourly	BODC	BODC	09/79-12/85	65.8	4	bodc request format	
				LV SBWR	Hs, Tz, U, dd	hourly	UKMO	UKMO	06/89-12/97		1	UKMO ascii fixed width columns	
				LV SBWR					03/86-12/88		22 (30 days)	ascii	
7	SWALES	51.5	-4.75	waverider	Hs, Tz, U, dd	20 mins	SOC	SOC	10/93-01/94	40-50		pstar	
8	Lyme Bay	50.5	-2.8633	UKMO inshore	Hs, Tz,U,dd		UKMO	UKMO	07/83-12/97	10	1	UKMO ascii fixed width columns	
	(West Bex)	50.6702	-2.6667	Bot P sensor	1-D spectra	90 mins	BODC	BODC	11/83-04/88		71	bodc axf format	
9	Greenwich	50.24	0	LV SBWR	Hs, Tz,U,dd	hourly	UKMO	UKMO	07/93-12/97		1	UKMO ascii fixed width columns	
10	Sandettie	51.06	1.48	LV SBWR	Hs, Tz,U,dd	hourly	UKMO	UKMO	07/93-12/97		1	UKMO ascii fixed width columns	
11a	Ijmuiden	52.4631	4.5583	anemom	U	hourly	Rijkw'staat	Rijkw'staat	1981-96		1	Rw ascii (single parameter)	
11b	Ijmuiden sp	52.5583	4.0583	waverider	Hm0, Tm02	3hourly	Rijkw'staat	Rijkw'staat	1981 - 86		2	Rw ascii (single parameter)	
				WAVEC buoy	Hm0, Tm02	hourly	Rijkw'staat	Rijkw'staat	1987-96		2	Rw ascii (single parameter)	
12a	Leman	53.1	2.2	wavestaff/laser	Hs, Tz	hr-3hr	AMOCO	seadata	1972-93		3	seadata ascii fixed width	
		53.1	2.2	anemom	U, dd	hr-3hr	AMOCO	seadata	1972-93		3	seadata ascii fixed width	
12b	Leman AWS	53.06	2.12	AWS	Hs, Tz,U,dd	hourly	UKMO	UKMO	07/83-12/97			UKMO ascii fixed width columns	
13	BoyGrift	53.4917	0.3868	buoy	Hs, Hmax, Tz, Tpk	3 hourly	EA	EA	04/92-12/95		daily wave files	EA ascii	
		53.2903	0.3203	tower	U, dd	3 hourly	EA	EA	04/92-05/96		daily met files	EA ascii	
14	K13	53.2178	3.2203	anemom	U	hourly	Rijkw'staat	Rijkw'staat	1981-96		1	Rw ascii (single parameter)	
		53.2178	3.2203	waverider	Hm0, Tm02	3 hourly	Rijkw'staat	Rijkw'staat	1981-87		2	Rw ascii (single parameter)	
		53.2	3.2	WAVEC buoy	Hm0, Tm02	hourly	Rijkw'staat	Rijkw'staat	1987-96		2	Rw ascii (single parameter)	
15	W.Sole	53.7	1.15	wavestaff	Hs, Tz		BP	seadata	1972-90		3	seadata ascii fixed width	
				anemom	U, dd				1973-91		3	seadata ascii fixed width	
16	Villages	54.0333	0.1167	laser	Hs, Tz			seadata	1988-90		3	seadata ascii fixed width	
				anemom	U, dd				1988-90		3	seadata ascii fixed width	
17	K17	55.3333	2.3333	UKMO OO buoy	Hs, Tz, U, dd	hourly	UKMO	UKMO	01/96-12/97		1	UKMO ascii fixed width columns	
									07/95-12/97		yearly/monthly	UKMO report format	
18	Ekofisk	56.5472	3.2133	laser/buoy/radar	Hs, Tz		Philips	Seadata	1980-96		3	seadata ascii fixed width	buoy 1.2 nm W
		56.5472	3.2133	anemom(85m)	U, dd				1982-96		3	seadata ascii fixed width	
19	K16	57	0.45	UKMO OO buoy	Hs, Tz, U, dd	hourly	UKMO	UKMO	01/96-12/97		1	UKMO ascii fixed width columns	
									08/95-12/97		yearly/monthly	UKMO report format	
20	Forties	57.8	0.9	laser	Hs, Tz		BP	Seadata	1985-91		1	seadata ascii fixed width	
				waverider	Hs, Tz		BP	Seadata	1974-94		3	seadata ascii fixed width	
				wavestaff	Hs, Tz		BP	Seadata	1976-95		3	seadata ascii fixed width	
				anemom	U, dd		BP	Seadata	1974-95		3	seadata ascii fixed width	
21	Frigg	59.9	2.07	various	Hs, Tz		Philips	Seadata	1979-82				
				various	Hs,Tz, wave dirn		Philips	Seadata	1983-88				
				various,anemom	Hs,Tz,U, dd		Philips	Seadata	1992-98		3	seadata ascii fixed width	
22	N North Sea (N Corm	61.2	1.1	various	Hs, Tz, Wave Dn, U, dd		Shell	Seadata	1976-97		4	seadata ascii fixed width	
	,Brent, Statfjord)												
23	Holderness	53.93	0.0333	buoys	Hs, Tz, var spect.	30 mins	POL	POL	winter 94/95		3	POL ascii spectra summary info	
									winter 95/96		2	POL ascii spectra summary info	

Table 1: The *in situ* data used in JERICHO

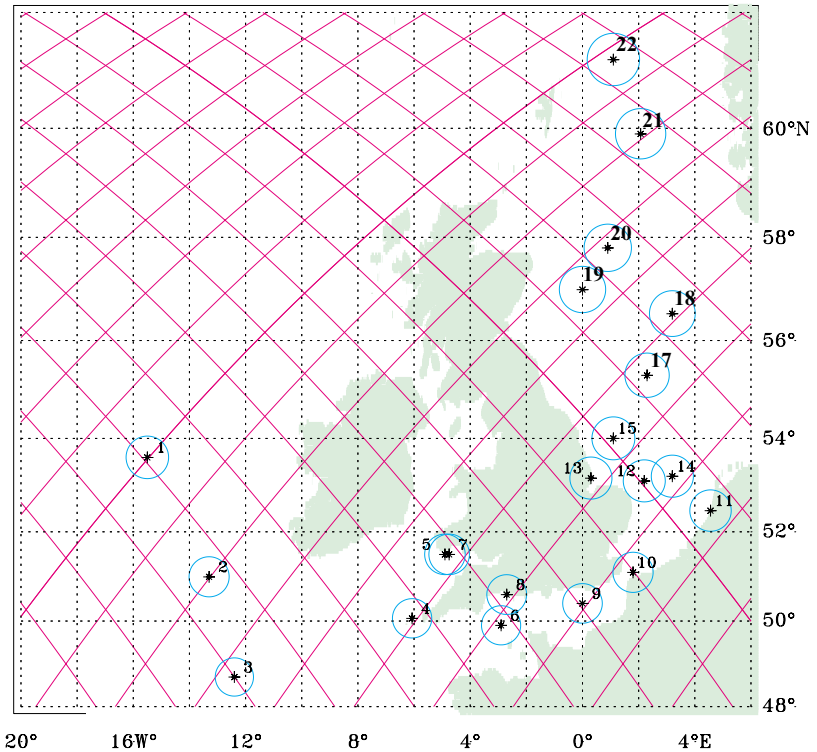

Figure 1 - Location of the JERICHO *in situ* data sets - the TOPEX 10 day repeat tracks are also shown.

A.3 Data Quality and Reliability

In fact, even with these carefully selected data sets, data quality problems were still experienced. Typically these problems were prolonged data drop outs, incorrectly set or unset default values. Also varying data resolution across data sets (e.g. from 0.1 to 0.5 m in significant wave height, 0.1 to 0.5 s in wave period, 0.1 ms^{-1} to 0.5 knots) caused problems when attempting to compare data from different sources. Specific problems are discussed in detail in individual JERICHO Technical Reports (JTR-01, JTR-02, JTR-04, JTR-05, JTR-14, JTR-19, JTR-20, JTR-25, JTR-30). In particular problems were experienced with UKMO derived data for the west coast and English Channel. Data provided by BODC, Fugro GEOS, Loginfo and Rijkwaterstaat, mostly from the North Sea, were found to be more useful to JERICHO.

A.4 Recommendations

Data Network and Deployment

Long time series are needed, at least 5 years and preferably 10 years to determine coastal wave statistics. For example the wave climate at Holderness could not be determined from 2 winters of data (Wolf, 1998), during one of which (coinciding with an El Ni o event), the normal pattern of SW prevailing winds which gives fetch-limited waves at Holderness and often bimodal mixed sea and swell spectra was reversed.

A limited network of offshore (20 km from shore) directional wave buoys would provide boundary conditions for fine-scale wave-transformation models and supplement the continuous satellite coverage. A set of coastal wave monitoring stations for model validation would also be very valuable, probably using bottom pressure recorders in less than 10m water depth. Occasional deployment of HF radar over a whole coastal cell would complete the picture

Data Archiving and Quality Control

The experience of JERICHO clearly demonstrated the importance of applying reliable and internally consistent quality control and archiving procedures. If care is not taken, the subsequent values of data sets can be reduced significantly. We suggest some simple guidelines:

1. Adopt a data format which allows data to be stored at the highest resolution compatible with the measurement accuracy.
2. Apply consistent procedures for setting default values in case of data drop-out or corruption.
3. Default values should be well outside the range of physically possible measured values.
4. Records with missing values should be included with default values set, to allow easier searching of files.
5. Data sets should be tested for continuity, drift and obvious errors before archival.

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Contacts for Wave Data

- British Oceanographic Data Centre

  British Oceanographic Data Centre,
  Proudman Oceanographic Laboratory,
  Bidston Observatory,
  Bidston Hill
  Prenton CH43 7RA,
  United Kingdom

  Tel: +44 151 653 8633
  Fax: +44 151 652 3950
  Email: bodcmail@ccms.ac.uk
  WWW (http://www.bodc.ac.uk/)

- Sea Data / Fugro-Geos

  Fugro GEOS UK
  Southampton Oceanography Centre
  Empress Dock
  Southampton
  SQ14 3ZH
  UK

  Phone: ++44 (0) 23 8059 6009
  Fax: ++44 (0) 23 8059 6509
  E-mail: seadata@geos.com
  WWW (http://www.geos.com)

- Rijkwaterstaat

  Ministry of Transport, Public works and Water Management
  National Institute for Coastal and Marine Management/RIKZ
  Central Office The Hague
  PO Box 20907
  2500 EX
  Den Haag
  The Netherlands

  Phone: +31 70 3114 311
  Fax: +31 70 3114 321

- UK Meteorological Office

  Marine Consultancy Service
  Marine Weather Group
  The Meteorological Office
  London Road
  Bracknell
  Berkshire RG12 2SZ