COMKISS

Conveying Metocean Knowledge Improvements onto Shipping Safety

Executive Summary

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COMKISS Executive Summary

1 Overview

The costs to industry of inaccurate wind and wave information are high. Recent studies of insurance data indicated weather related losses of 2.5 billion Euro per annum[1]. In a single incident a container transport experienced damage to the value of 100 million Euro[2]. Operators are clear that they require better provision of sea state data than is presently available.

The aims of the COMKISS programme were twofold: To demonstrate to major segments of the marine industry the benefits that of satellite-derived information on sea surface winds and waves, and to test the potential added value of satellite data in new applications.

Three main offshore industry sectors were selected: ***ship design and certification*** the ***transportation of very large loads*** such as dock cranes and offshore platforms, and the operation of ***high speed craft***. What these segments have in common is the little use they have made of satellite data in the past. Where historical information on sea state has been required to evaluate ship or platform performance, then meteorological hindcasting was (and is) the favoured source. It is only very recently that an independent assessment made within the industry itself has concluded that statistics derived from satellite observations appear the more reliable[3]. Other commercial concerns are now more prepared to test their current method of operation against the satellite record and this is what is attempted in this project.

2 The Partnership

There were six partners in the COMKISS programme, with a strong end-user representation covering three sectors of the offshore marine industry. The two industrial partners, Dockwise and Bureau Veritas, guided the investigations in their areas of interest and adjudicated the results. A further unfunded partner, Corsica Ferries, co-operated on a voluntary basis allowing an analysis of High Speed Craft operations. There were four scientific partners: IFREMER, a large marine research organisation; The University of L nd, a university department specialising in the statistics of waves; Optimer, an engineering Metocean studies company; and Satellite Observing Systems, a leading EO value-added company specialising in providing satellite-derived marine information. Partner s responsibilities within the COMKISS project are given below:

- *Project Manager, Wave Statistics* — *University of L nd, Sweden,*
- *Project Co-ordinator, Wave climate data bases* — *Satellite Observing Systems, UK*
- *Science Partner, MetOcean Analyses* — *IFREMER (MetOcean Group), France*
- *Science Partner, MetOcean Analyses* — *OPTIMER, France*
- *End User Partner, Large load transportation* — *Dockwise, Belgium*
- *End User Partner, Ship Design / Certification* — *Bureau Veritas, France*
- *External End User, High Speed Passenger Ferries* — *Corsica Ferries, France*

3 Rationale, Objectives and Time Scale.

Within the general objective of demonstrating marine applications of satellite data to the offshore industry were 8 individual studies —aimed at testing the potential benefit, in terms of improvements to safety and economy, of specific applications of satellite data. These applications fell into two general categories: provision of ***Near Real Time*** data to operational offshore activities, and application of ***climatological databases*** for planning and design.

It might be expected that almost twelve years of continuous sea surface measurements from a succession of spacecraft would provide the reliable statistical record of conditions that is required for design planning. However, it is much less obvious that the few satellites currently operating

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[1] Based on shipping casualty data from the Institute of London Underwriters, and Lloyds Register of Shipping, 1987-97.

[2] Damage to he M/V APL China following an encounter with Typhoon Babs in the Pacific in November 1998.

[3] C. Cooper, 1997, A comparison of tow criteria derived from satellite and ship based observations, ASME 97.

can provide real-time updates on sea-state frequently enough throughout the day to assist in routine operations. COMKISS investigated the minimum requirements of the marine operations; for it should be possible, if there were sufficient interest, to introduce a fast-delivery mode on *all* wave measuring satellites operating now and in the future.

COMKISS began in August 1998 with the first application studies, analysing immediately available databases. Preparation of further databases continued to summer 1999, followed by trials of real time data. Analysis of databases, and development of statistical techniques, continued to spring 2000. Towards the end of the project, in spring/summer 2000, the end-users assessed the results of the COMKISS studies. These assessments were used to create a series of web based ***Demonstration Modules***, available at http://www.ifremer.fr/metocean/shipping.htm. In the final phase, the various findings were combined into recommendations for further work and to achieve greater exploitation of satellite data. The project closed in October 2000 at a COMKISS workshop, held as part of the International Association of Oil and Gas Producers (OGP) MetOcean Committee s Joint Industry Programme Week. At this meeting COMKISS results were presented to influential representatives of the offshore end-user community.

4 Highlights and Achievements

- **Fatigue and Failure**

The exact nature of the geographical and temporal distributions of sea state parameters is important when calculating the long term consequences of fatigue on a given route, or the possible propagation of critical structural weaknesses which may lead to failure under severe conditions. Techniques were developed to generate continuous, detailed, and route specific statistical databases from satellite data. These types of data bases are essential to enable more reliable calculations of important vessel response characteristics (see Figure 1).

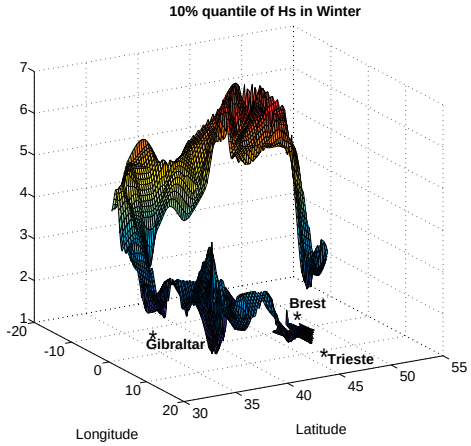

Figure 1. The 10% significant wave height (Hs) quantile for the Rotterdam to Trieste shipping route. The route starts at Rotterdam at the right hand side (52¡N, 4.5¡W), and finishes almost directly below, south of Trieste (at 45.5¡N ~10¡E) The section in the Bay of Biscay (Brest to Gibraltar) is clearly the roughest. The vertical scale and colour give Hs in m.

- **Theoretical bases**

Present techniques for calculating the response of vessels to sea conditions often make general assumptions about the statistical nature of the response distributions. These techniques play an important role in establishing design criteria for vessels. An important achievement of COMKISS was the development, using satellite data, of a more robust theoretical basis for such work.

- **Surface Currents**

Oceanographers have developed techniques to extract ocean surface current information from satellite measurements. Apart from a few specialist regional applications, these techniques have not yet been fully developed for commercial exploitation. Within COMKISS we investigated whether these satellite data could be exploited in more widespread applications to improve route selection and shorten voyage duration. It was shown that further work was necessary, but that the use of satellite data could help to reduce costs for end-users through reduction in, and improved predictability of, travel times.

- **Sea State Alarm**

Within COMKISS, Satellite Observing Systems developed and trialed the Sea State Alarm Service in which real-time satellite data were transmitted direct to offshore marine operations. Dockwise participated in the trial on a cable laying operation across the North Pacific, and the ship s officers reported increased confidence in assessing sea state conditions. (see Figure 2). Strong interest from specialist offshore operators indicate that a commercial application may be feasible, and future developments are planned.

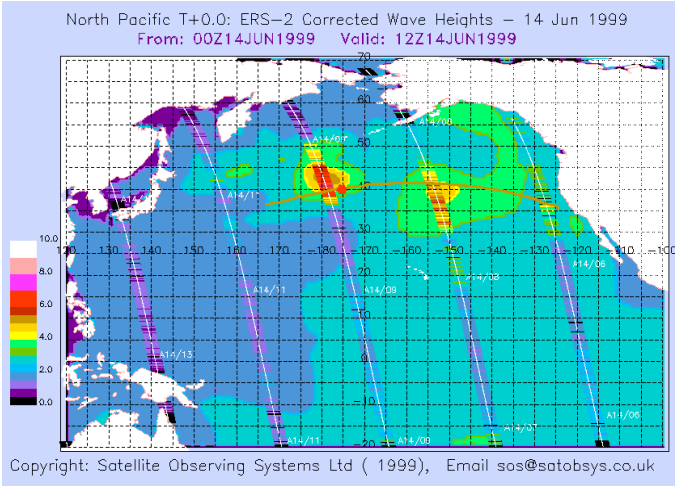

Figure 2. An example of data from the new Sea State Alarm Service tested within COMKISS.

- **Wave Climate Data Bases**

Wind and wave climate data bases are used for the design of ocean transport vessels and for pre-operational planning. It is perhaps surprising that many offshore operators still choose to use metocean climatologies based on visual observations. Using a software tool developed for the OGP, COMKISS compared climatologies derived from visual ship based observations, hindcast wind/wave models, and from satellite data (see Figure 3). Whilst the range of wave parameters available from satellite data is still limited, the satellite databases were shown to be consistent with the best of the alternative climatologies.

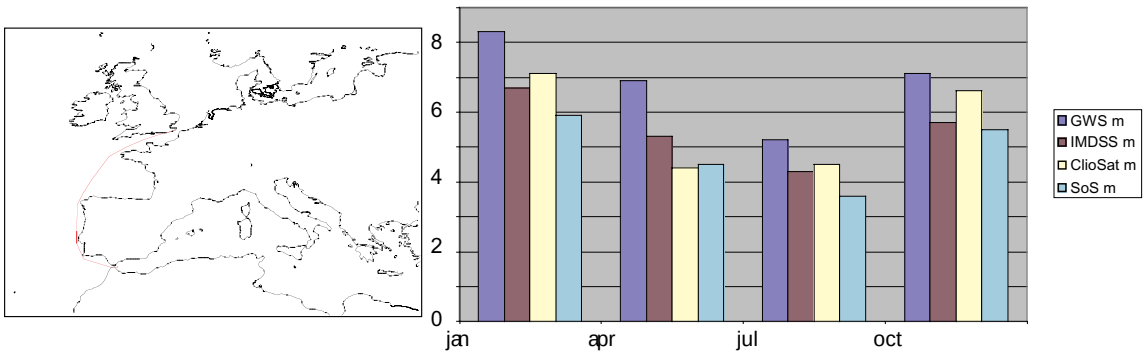

Figure 3. A comparison of 3 data bases over the Dover to Gibraltar Route, giving voyage Hs over four seasons. Cliosat and SOS are satellite data bases, IMDSS is a hindcast data base, GWS is derived from visual observations. These results demonstrate a clear inconsistency between the GWS and the other three.

- **High Speed Craft operation**

Corsica Ferries operates between Italy, France and Corsica. On several occasions during each summer season they find that some sailings, cancelled because of forecasts of severe weather conditions, actually could have taken place. On other occasions ferries already en route have been forced to turn back because they encounter bad weather that was not forecast. Each time the ferry company faces extra costs and passenger dissatisfaction. Accurate real time data could help to reduce the number of these events. COMKISS demonstrated that the present satellite provision of wave data was not sufficient and that higher frequency data coverage was required.

5 End User Evaluation - COMKISS Workshop

The evaluation of end-users was of central importance to COMKISS. COMKISS consulted the wider offshore community through the COMKISS/OGP workshop. To allow this workshop to take place within the COMKISS project time scale, the team requested, and was granted, a two month extension. General end user comments are summarised below:

End User Comments

- Satellite data are useful to the industry, **but** satellites by themselves do not solve any problems. Moreover, the satellite data, when they come out of the space agencies, still require significant effort before they can be used. It should be noted that space agencies should thus not expect funding support from industry for the launch of additional satellites.
- Oil industry buys metocean services from providers, they rarely develop them in-house, and projects will only be funded if they address a consensus based on risk assessment and safety criteria.
- Good presentation is essential to ensure that ships officers will make use of a service. The data can be of the highest quality, but if they are not presented in an accessible form, then they will not be used.
- Satellite data are already in wide use for climatological studies. The main barrier to acceptance is a lack of confidence in certain important wave parameters, currently available only from Synthetic Aperture Radar measurements (direction, frequency).
- A wide range of offshore operations would gain economic and safety benefits from improved real time provision of wave data. However, present satellite data coverage is too infrequent in time and space to offer a realistic operational service.

6 COMKISS Conclusions

COMKISS has demonstrated to segments of the offshore industry the benefit of marine satellite data in a range of operational applications. In some limited areas, the market is already well supplied with high quality products, in others there are fundamental limits in the ability of satellites to provide the required information. Generally speaking, improvements can be achieved in two ways.

- More satellite data. This requires higher sampling from satellites (e.g. from constellations of micro-satellites) and / or new instrumentation to measure new parameters.
- Better exploitation of existing data. This requires improvements to computer models, and / or improved assimilation techniques.

It seems likely that modifications to models can only achieve limited improvements. If models go to higher resolution, then they require reliable high resolution input. This in turn will be best provided by satellites. However, the initiation of new satellite missions requires significant initial investment that the offshore industry is not prepared to provide. For instance a constellation of 5 GANDER wave measuring micro satellites would cost roughly 50 million Euro[4], a new (mini) satellite to provide global directional wave spectra (SWIMSAT) is estimated to cost about 100 million Euro[5]. If these new satellites are to be launched, public money must be invested and so a public interest case must be made.

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[4] GANDER is a proposal from Satellite Observing Systems and Surrey Satellite Technolgy Ltd., UK, to build and launch a constellation of micorsatellites carrying wave measuring radar altimeters.

[5] Hauser et al, 2000, Draft SWIMSAT proposal for a European Space Agency Earth Explorer Opportunity mission

Suggested Further Work

Suggestions for further work were developed following end-user comments.

Climatological Applications

- Provide time-histories, and alternatives to Monte-Carlo simulations.
- Provide more reliable detailed spectral and directional information on sea states.
- Simplify access to satellite data, have formats suitable for industry applications

Near Real Time Applications

- Develop new merging techniques so that model nowcasts are consistent with observations.
- Improve temporal and spatial resolution of satellite measurements.
- Simplify and improve methods to make information available offshore.

7 Exploitation

Limited improvement to data provision is expected in the short term. During 2001 two new satellites operating altimeters will be launched (JASON and ENVISAT). ENVISAT will also carry a Synthetic Aperture Radar which will operate an ocean wave measuring mode. Both satellites will have near real time data capability and it is intended to carry out further trials of the Sea State Alarm service, and to develop new assimilation techniques which will provide better consistency between measured data and model predictions. Project planning is already under way for these activities, in the latter case through a proposal, named ***COMKIAS***, for which EUREKA status is being sought. COMKIAS will also develop and test an on-board advisory system which merges external met ocean predictions with on-board ship measurements.

A technical feasibility study for the ***GANDER*** project has demonstrated that a constellation of low cost micro-satellites could hosts wave measuring altimeters and so provide higher spatial and temporal coverage at a fraction of the cost of the large scientific missions (ENVISAT, JASON). The ***GAMBLE*** proposal, currently under evaluation at the EC, plans a network to make maximum advantage of the combination of such a constellation with the scientific satellites JASON and ENVISAT.

Direct exploitation of the COMKIAS project will take the form of distribution of copies of the Final Report and a CD with all project documentation. Presentations will be made at appropriate industry forums The COMKISS web site at http://www.maths.lth.se/matstat/staff/georg/comkiss/ will be maintained and feedback noted.

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