DEBRIEF analysis tool - Open Source and open to all

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Abstract

The UK Maritime Warfare Centre has developed a JAVA based software application for the analysis and debriefing of Maritime exercises (DEBRIEF). Uniquely, the 4th generation of DEBRIEF has been developed under an Open Source license, thereby allowing free and unrestricted access to the application and its source code through its web site at http://www.debrief.info.

This paper seeks to explain the rationale for MWC moving this application to Open Source status and highlight the benefits of this approach. A principal approach to the development of DEBRIEF has been the adoption of Open Standards, such XML and VPF. In addition to discussing the software issues associated with the development of DEBRIEF, a demonstration of its features will illustrate how the needs of modern Operational Analysis for Undersea Warfare are met.

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1 Introduction

The Maritime Warfare Centre is an organisation that is a focused centre of excellence for Maritime Warfare, which is responsible to UK Commander-in-Chief Fleet. It was formed as a "one-stop warfare shop" with the primary purpose of developing operational tactics and procedures to optimise the capability of the Fleet's platforms, sensors and weapon systems. In support of this, the Core Operational Analysis Group (COAG) utilises the application of scientific methods to solve military problems. Principle amongst the capabilities within the COAG is the development of software tools to facilitate the analysis of operational trials and exercises, in order to evaluate tactics and sensors. One such software tool is DEBRIEF, which has now gained wider use within the Maritime Warfare Centre amongst several warfare areas.

1.1 DEBRIEF History

DEBRIEF was originally produced by MWC in 1995 to act as a desktop viewer for results produced by the MWC's ASSET submarine simulator. It quickly became evident that real exercise data could also be viewed in the application, providing a more dynamic means of viewing data during analysis than could be provide by paper plots. The initial version of DEBRIEF was a 16-bit MS Windows C++ application, which was latter updated in late 1996 to 32 bits, in order to exploit the richer user interface components available for 32 bit Windows applications. It was at this stage that the application was demonstrated and subsequently issued under license to COMSUBDEVRON 12 of the US Navy. Over the next four years a number of fresh requirements had arisen, requirements that could not be economically met using the existing application architecture. Consequently the decision was made in 1999 to develop an updated version of DEBRIEF (DEBRIEF 2000), starting from a fresh-whiteboard and adopting a modern modular approach to allow incremental implementation.

2 Software Issues

Three policies were adopted when DEBRIEF was rebuilt from scratch in 1999. The programming language used would be Java™, Open Standards would be utilised where available and the software itself would be released as Open Source. The adoption of Java™ and Open Standards is discussed further here.

2.1 Java™

The initial versions of DEBRIEF were produced in the mid-late 1990's using the C++ language, selected because of its speed (essential for the low specification PC's provided to analysts at that time), and it's support for Object Oriented Programming (which provided both a modular architecture and low development times). By 1999 there were a large number of fresh requirements placed on DEBRIEF, a sufficient quantity that justified a complete redevelopment. This fresh version of DEBRIEF (DEBRIEF 2000) switched to using the Java™ language, thereby exploiting the follow advantages:

Version 1.2 of Java™ and successive releases provide a rich and growing API, with support for 2-D plotting, user properties, and more recently the wheel-mouse. Extensions to Java™ add support for 3-D plotting and media support (used for DEBRIEF's "record to video" function).

A wide range of tools is freely available which support Java™ development, significantly ANT [1] for automated builds and JUnit [2] for automated unit testing. The use of these tools has served to reduce cost whilst increasing quality. Automated builds and unit testing are essential with an Open Source application such as DEBRIEF, which may be updated and released to users several times per month.

Java™ is largely platform independent, and consequently may be used without change on both analysts' desktop PC's running Windows and tactical reconstruction workstations running varied flavours of Unix.

2.2 Open Standards

Where possible the development of DEBRIEF has endeavoured to adhere to and utilise Open Standards. Open Standards for file formats publish full details of the structure and syntax of the file format, allowing easy production of compliant data files. The utilisation of Open Standards by DEBRIEF has both provided access to a wealth of external data and facilitated easy adoption of DEBRIEF plot-files.

The **ASCII file format** [3] provides a great deal of flexibility in importing data into DEBRIEF. ASCII text files can be produced on all platforms, using all modern programming languages. The flat-file format used can quickly be exported from a spreadsheet when deployed on exercise, giving a fast turnaround for immediate quick-look analysis. Figure 1 shows a sample of the ASCII text file format used by DEBRIEF.

The **XMLfile format** [4] has the portability benefits of the ASCII file format, but adds the ability to store hierarchically structured data – essential for storing formatted DEBRIEF plots, whilst still remaining human-readable. XML files have a Document Type Definition (DTD [5]), a text file which defines the structure of the document. The DEBRIEF DTD (included in DEBRIEF download) allows external organisations to include DEBRIEF in their workflow, either producing XML files to be read by DEBRIEF, or finding other uses for the files produced by DEBRIEF. To illustrate the complex data structures possible within XML, Figure 2 demonstrates that a **`plot,`** contains a **`session,`** that in turn contains **`layers`** of data. The first **`layer`** is named *`Chart Features`*, and it is currently visible. The first feature within the *`Chart Features`* layer is a dark grey **`grid`** with a delta of 5 minutes. The second feature is a **`scale`**, and so on. Substantial cost savings have been achieved through the adoption of the XML file format, since Java™ already contains libraries to read and write data in this format. Similarly, projects wishing to re-use DEBRIEF plot-files achieve these cost savings.

The **Vector Product Format (VPF[1]) format** [5] is promoted by the US National Imagery and Mapping Agency (NIMA [7]). The VPF defines a structure of text and binary files which store vectored geographic data. A number of VPF libraries exist, the most well-known of which are the Vector Map (Vmap [8]) levels 0, 1, and 2, together with the Digital Nautical Chart (DNC [9]). By supporting the VPF format within DEBRIEF, users have gained the ability to plot multiple types of vectored library data. OpenMap [10] software components from BBN Technologies contain functionality to read and extract data from VPF libraries. The Open Source licensing of OpenMap has enabled DEBRIEF to integrate and freely distribute the OpenMap software – providing the VPF plotting functionality at low cost. A sample of VPF data displayed within DEBRIEF is shown in Figure 3.

3 Open Source

Although the implementation of Java™ and Open Standards has been important, arguably the most significant and innovative development in DEBRIEF has been the adoption of an Open Source licensing policy.

[1] VPF™ is a Registered Trademark of US National Imagery and Mapping Agency.

3.1 DEBRIEF Licensing

Previously, MWC had licensed the use of DEBRIEF to external organisations, where this was directly beneficial to MWC's interests. Distribution of the application in those instances was always on a free basis, subject to a disclaimer. Adoption of a more commercial oriented approach to distribution of the application was deliberately avoided as this would result in increased administrative overheads (particularly with regard to Quality Assurance issues) and raise the potential expectation of users that a higher level of support should be provided. In reviewing the licensing options for DEBRIEF 2000, MWC could see benefits in changing to the currently popular Open Source model.

3.2 Open Source Philosophy

> *The basic idea behind open source is very simple: When programmers can read, redistribute, and modify the source code for a piece of software, the software evolves. People improve it, people adapt it, people fix bugs. This can happen at a speed that, if one is used to the slow pace of conventional software development, seems astonishing. [11]*

Open Source licensing of software must meet a number of criteria, including:

- Free Redistribution – neither the compiled software nor its source code may be sold
- Source Code – source code for the application must be distributed in addition to the compiled version
- Derived Works – the license must allow modification of the source code, and the production of derived works

3.3 Benefits of Open Source

In summer 2000 the Maritime Warfare Centre, in line with it's commitment to be at the forefront of innovative practices, decided to switch the DEBRIEF application to Open Source status. In taking this bold and radical approach to the licensing of a defence software application, it is hoped that the following benefits may be realised:

- Organisations that are current users of DEBRIEF will have full access to the source code, allowing them to identify and correct bugs provided they have staff with the required programming skills. The licensing is such that these modifications should be again made public through the re-insertion into the central, online "code base".
- Organisations that are not currently using DEBRIEF will also have full access to the application and its source code. The ramifications of this wider usage are unclear at present, but correct management of the central "code base" by MWC will resolve quality control issues.
- Any organisation using DEBRIEF that identifies a bug/algorithmic problem is able to independently correct the problem and submit the corrected code back into the central "code base". In time, this will greatly increase the accuracy and reliability of the application. MWC may then freely utilise these improvements, only incurring the administrative overhead of "checking-in" code modified by third party organisations.
- The free, open source status of the application will allow a wider audience of commercial companies to bid for development contracts to maintain or extend DEBRIEF. This should provide for a more cost effect means of developing DEBRIEF further by providing a "level playing field" on which companies can bid, to ensure best value for money.
- The availability of DEBRIEF to other international users (in particular NATO countries) will provide an easy method of exchanging exercise data between nations, through the use of common file formats. This has the potential to increase efficiency and improve the level and quality of maritime analysis.
- The DEBRIEF application and it's supporting documentation will clearly describe its origins, thereby publicising and enforcing MWC's reputation as a centre of maritime tactical analysis.

3.4 DEBRIEF Online

DEBRIEF is available online at http://www.debrief.info. From this home page (Figure 4), you can access the latest news on DEBRIEF, request new features, report bugs, and download the most recent version. Additionally, a number of project support activities for DEBRIEF are hosted by an open source web-site known as SourceForge, which is used to

store the newest versions of DEBRIEF. The home page for DEBRIEF on SourceForge is at http://sourceforge.net/projects/debrief.

4 Fulfilling the needs of modern Operational Analysis for Undersea Warfare

DEBRIEF is very much a niche product, in an applications area overlooked by commercial organisations. The project management and software development approaches adopted have resulted in a rapidly maturing application capable of meeting a wide variety of analysis needs. Some of these needs are discussed below, together with how DEBRIEF has responded to them.

4.1 Flexibility

Cost constraints within government and defence domains mean that any software procured must be flexible enough to meet varied and changing requirements.

Modern tactics frequently involve collaborative working between a number of different assets: ships, submarines, helicopters and maritime patrol aircraft. To allow effective analysis, analytical tools must be capable of incorporating and displaying data from a plethora of platforms. DEBRIEF's ability to import ASCII text data enables it to read and display data from a wide variety of sources, as shown in Figure 5. Additionally, the human-readable nature of ASCII format files allows simple error checking of data to be conducted.

Increasingly analysis agencies and their analysts, must be multi-skilled and capable of conducting analysis in a number of areas of Undersea Warfare - from anti-submarine warfare to mine warfare, from new acoustic sensors to new communication bearers. An analysis tool that is flexible enough to perform a variety of analysis tasks in different warfare disciplines, will enable the analyst (and agency) to focus on a single tool. DEBRIEF's dynamic 2-D and 3-D views, time variable plots and customisable playback options ensure that the principle areas of maritime tactical development can be analysed. An example of a 3-D view is shown at Figure 6.

Frequently analysts needs to be deployed in-situ during an exercise, in order to conduct an initial Quick Look Analysis. In such circumstances, dedicated workstations and additional technical support is inappropriate – typically, all the analyst is allowed is a laptop. Whilst DEBRIEF does require a fair amount of processing power and memory, it's hardware requirements are easily met by modern laptops. Provided the analyst has a method of extracting positional data from onboard recorders into textual format and a spreadsheet by which to reformat it, then DEBRIEF will provide the means to support quick-look analysis in the field.

Modern Operation Analysis (OA) of Tactical Development exercises requires more than publication of a printed analysis report. PowerPoint-type presentations are frequently required during the analysis in addition to after its completion. Analysis reports are more and more frequently delivered online or via CD-ROM, giving searchable access to the content of the reports. DEBRIEF has met these needs by providing Record-to-video facilities, which allow a time-stepped portion of the exercise serial to be recorded directly to video for later inclusion in an online report or presentation

4.2 Quick turnaround

Reactive tasking to changing tactical problems and scenarios requires responsive tactical assessments. Analytical software must support rapid exercise analysis and short exercise-to-publication times.

The increasing rates of technological and political change mean that military tasking is often reactive and undertaken at short notice. Such circumstances frequently require significant reductions in the time available for the traditional operational analysis cycle (plan/exercise/analyse/publish). DEBRIEF is sufficiently flexible and simple enough to use, such that quick look analysis techniques in addition to higher level analysis functions can be supported.

4.3 Resource efficient

In today's budgetary constrained climate, analysis procedures and techniques must be cost effective and resource efficient. Consequently, analysis software should empower the analyst as much as possible, reducing the requirements for additional technical support staff.

DEBRIEF has been designed specifically with the "Analyst" in mind, to provide a one-stop analysis tool. The use of ASCII data as the prime input format for DEBRIEF has simplified the data processing requirements. With baseline knowledge of spreadsheets, the analyst has the ability to reformat textual data for input into DEBRIEF, thereby removing any reliance on sophisticated data processing or technical support staff.

The increase in functionality of DEBRIEF away from its original "Track Replay" ability has further empowered the analyst by the addition of analysis functions directly within DEBRIEF. The ability to display track, sensor, narrative, mapping data and time related parameters against an analysis tote (as displayed at Figure 7), further refines the analysis process ensuring greater efficiency. Whilst the ability to export analysis plots direct to word processing applications, further streamlines the report production process.

The inclusion of an online tutorial in DEBRIEF ensures that minimal training is required before being able to use DEBRIEF.

4.4 Collaborative analysis

With defence commitments increasing, the availability of maritime platforms to undertake naval exercises often decreases. International collaboration in exercises is frequently the most expedient method to ensure the availability of assets. However, analysis of these joint exercises, brings its own unique challenges. Analysis software should meet these challenges where possible.

Even in the days before DEBRIEF gained its Open Source status it was provided under license to external agencies to meet the needs of collaborative analysis. Use of DEBRIEF at collaborating agencies ensured uniformity in analysis techniques, as a well as providing a common styling of graphical output. The transition of DEBRIEF to Open Source status makes it available to a wider audience, without invoking any concerns over finance, ownership, IPR or support issues.

In addition to providing a coherent look and feel to joint reports, the Open Standard data formats supported by DEBRIEF (both ASCII & XML) has simplified the exchange and transfer of platform data between agencies. Ultimately, this has reduced the time and cost involved during the data reduction and reconstruction process following the exercise.

5 Conclusion

Through the adoption of Open Standards DEBRIEF has achieved developmental cost savings, and eased the cost of its integration into the analysis workflow. The continued pursuance of Open Standards within the Defence Industry can only improve software integration and interoperability, reduce time-to-market lengths, and overall provide improved software at lower cost.

Whilst the DEBRIEF venture would not appear to follow a sensible or profitable business model, the adoption of Open Source status for DEBRIEF has resulted in the Maritime Warfare Centre achieving improved software quality along with wider international recognition as a centre of Maritime Tactical Analysis. Accompanying this, PlanetMayo Ltd has been able to concentrate on providing an improved software product without the sales and marketing overheads associated with commercial ventures, remaining small, flexible, and profitable.

Above all, DEBRIEF's development has remained focused on the customer, the analyst, to ensure that the needs of modern operational analysis for Undersea Warfare are met.

6 References

[1] Apache Software Foundation, ANT, a Java based build tool. http://jakarta.apache.org/ant.

[2] JUnit, a regression testing framework written by Erich Gamma and Kent Beck, http://www.junit.org.

[3] American National Standards Institute, Standard X3.4 American Standard Code for Information Interchange, http://www.ansi.org/default.asp, 1968.

[4] Tim Bray et al, Extensible Markup Language (XML) 1.0 (Second Edition), http://www.w3.org/TR/REC-xml, October 2000.

[5] Tim Bray et al, Extensible Markup Language (XML) 1.0 (Second Edition), Section 2.8 titled *Prolog and Document Type Declaration*, http://www.w3.org/TR/REC-xml, October 2000.

[6] US Department of Defense, Interface Standard For Vector Product Format, http://164.214.2.59/publications/specs/printed/VPF/vpf.html, June 1996.

[7] US National Imagery and Mapping Agency, http://www.nima.mil.

[8] National Imagery and Mapping Agency, VECTOR SMART MAP (VMap) Level 0, http://164.214.2.59/publications/specs/printed/VMAP0/vmap0.html, February 1995.
[9] US Department of Defense, Digital Nautical Chart Performance Specification, http://164.214.2.59/dncpublic/index.htm, December 1997.
[10] OpenMap software, BBN Technologies, http://www.openmap.net
[11] Open Source Initiative, Organisation Home Page, http://www.opensource.org, 2001.

7 Author Biographies

Andy Evans is the Principal Submarine Analyst at the Maritime Warfare Centre and is the project officer for the development of DEBRIEF. He is a Submarine Warfare officer with over 20 years experience, including 8 years within the military Operational Analysis sector.

Ian Mayo is Director and Senior Software Engineer at PlanetMayo Ltd, based in Hampshire, England. His BSc and MPhil degrees were awarded from the University of Plymouth. Ian has produced software in support of naval command systems and tactical development for 10 years, and has been the software engineer responsible for DEBRIEF development for the last 6 years. He is currently supporting new DEBRIEF users across Europe, North America, Asia and Australia.

8 Figures

Figure 1 : Sample of ASCII data file (in REP format)

```
951212 050000.000 CARPET @C 12 11 10.63 N 11 41 52.37 W 269.7 2.0 0
951212 050100.000 CARPET @C 12 11 10.58 N 11 42 2.98 W 269.7 2.0 0
;NARRATIVE: 951212 095700.000 TOMATO SUSPECTED DETECTION OF RED
951212 050200.000 CARPET @C 12 11 10.51 N 11 42 14.81 W 269.9 2.0 0
951212 050300.000 CARPET @C 12 11 10.51 N 11 42 27.27 W 268.7 2.0 0
951212 050400.000 CARPET @C 12 11 10.28 N 11 42 40.33 W 270.6 2.0 0
```

Figure 2 : Sample of XML data file

```
<?xml version="1.0" encoding="UTF-8" ?>
<plot Created="Wed Dec 06 14:09:03 GMT+00:00 2000" Name="Debrief Plot">
  <session>
    <layers>
      <layer Name="Chart Features" Visible="TRUE">
        <grid Visible="TRUE" Delta="5.000">
          <colour Value="DARK_GREY" />
        </grid>
        <scale Visible="TRUE" Name="World Default" ScaleMax="10000" ScaleStep="5000"
          AutoMode="TRUE" Location="BottomLeft">
         <colour Value="GREY" />
        </scale>
      </layer>
```

Figure 3 : Sample of VPF data set

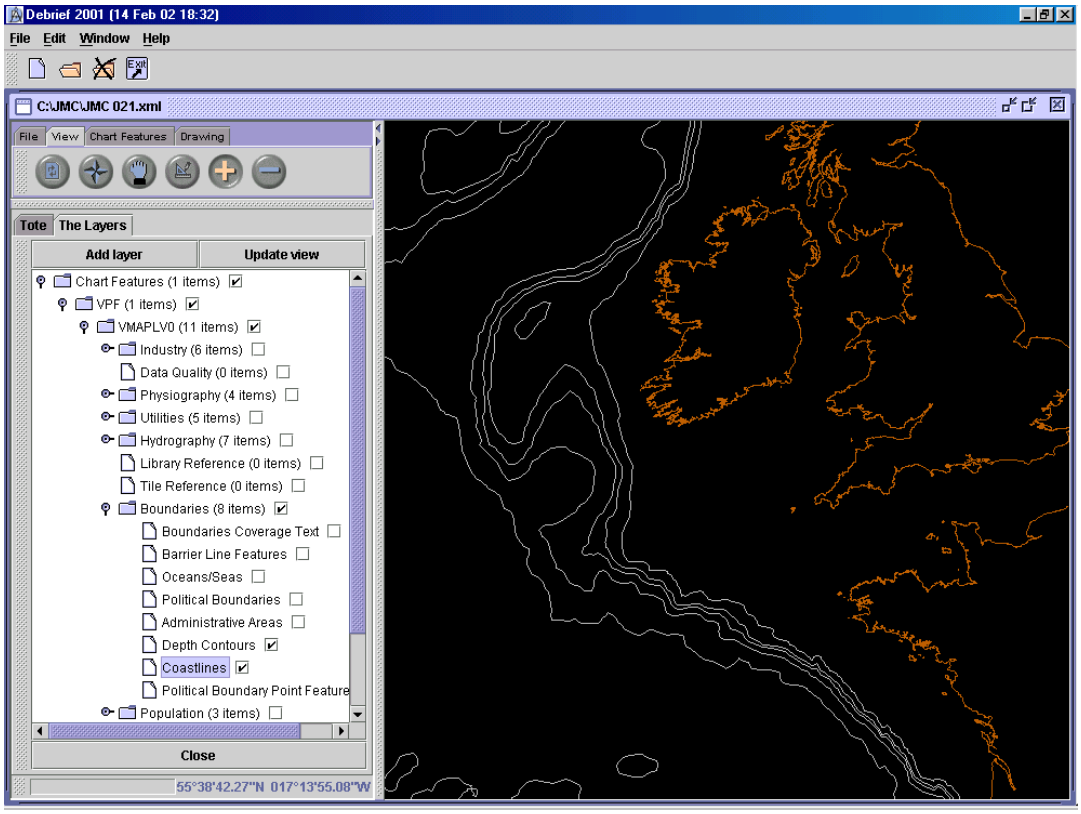

Figure 4 : DEBRIEF Home Page

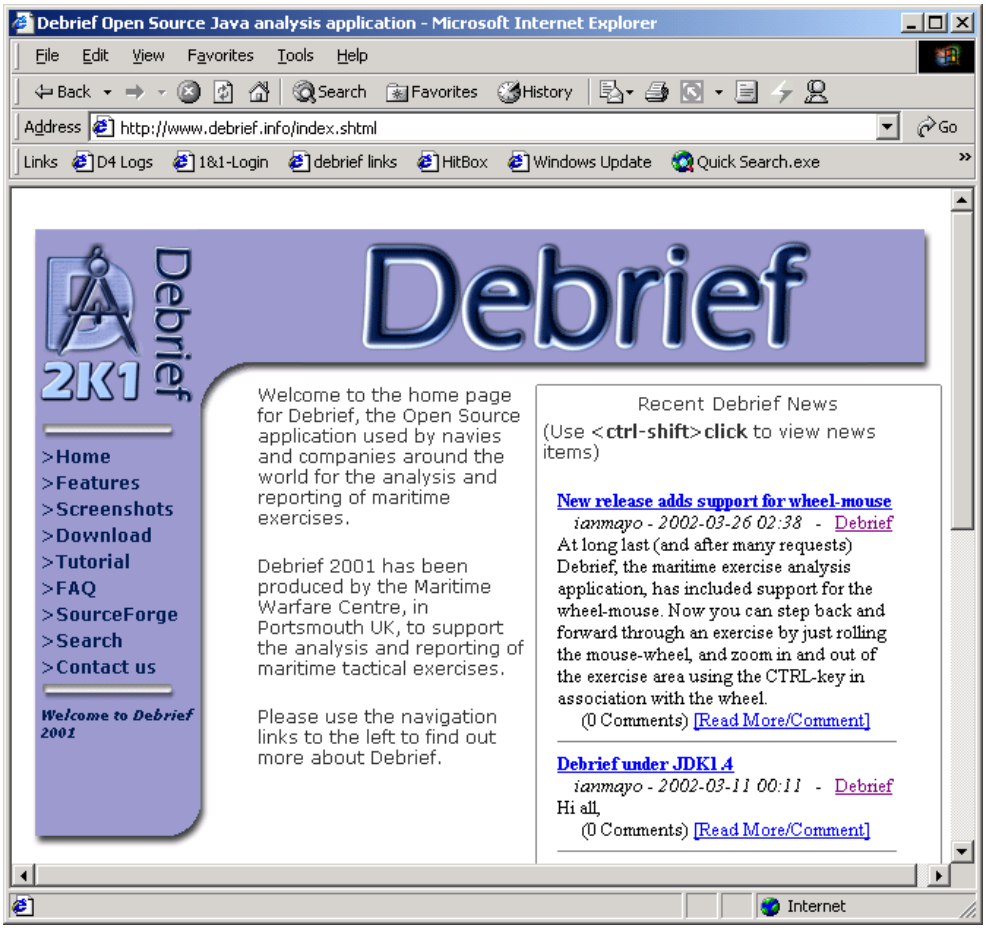

Figure 5 : Variety of data sources presented within DEBRIEF

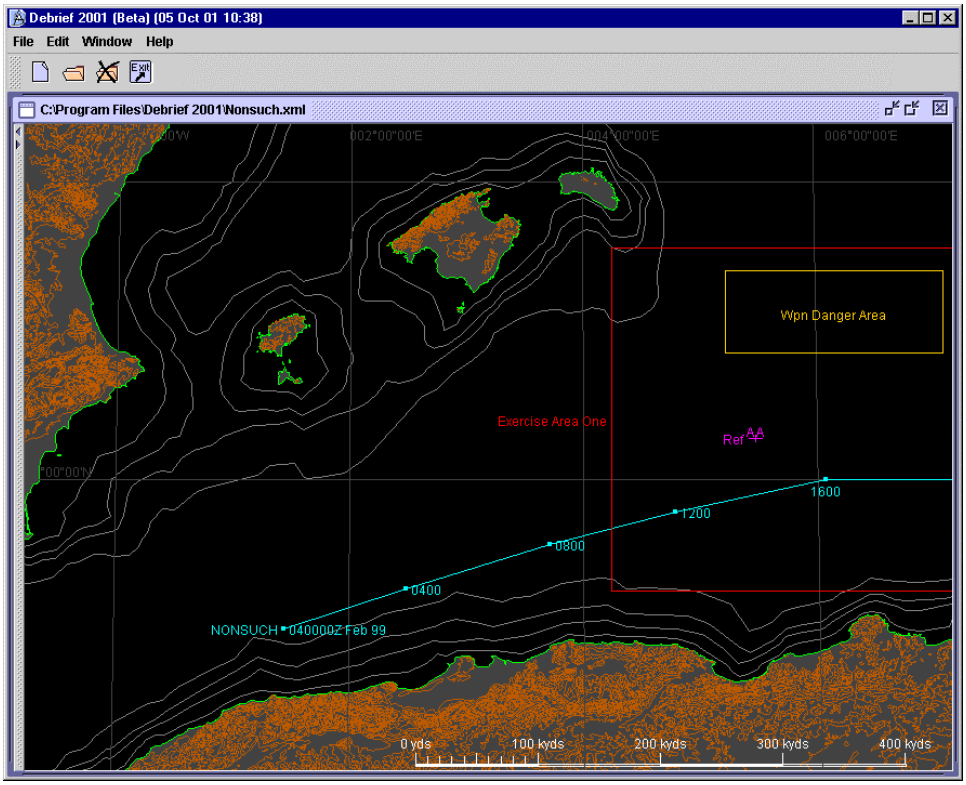

Figure 6 : 3D view of data

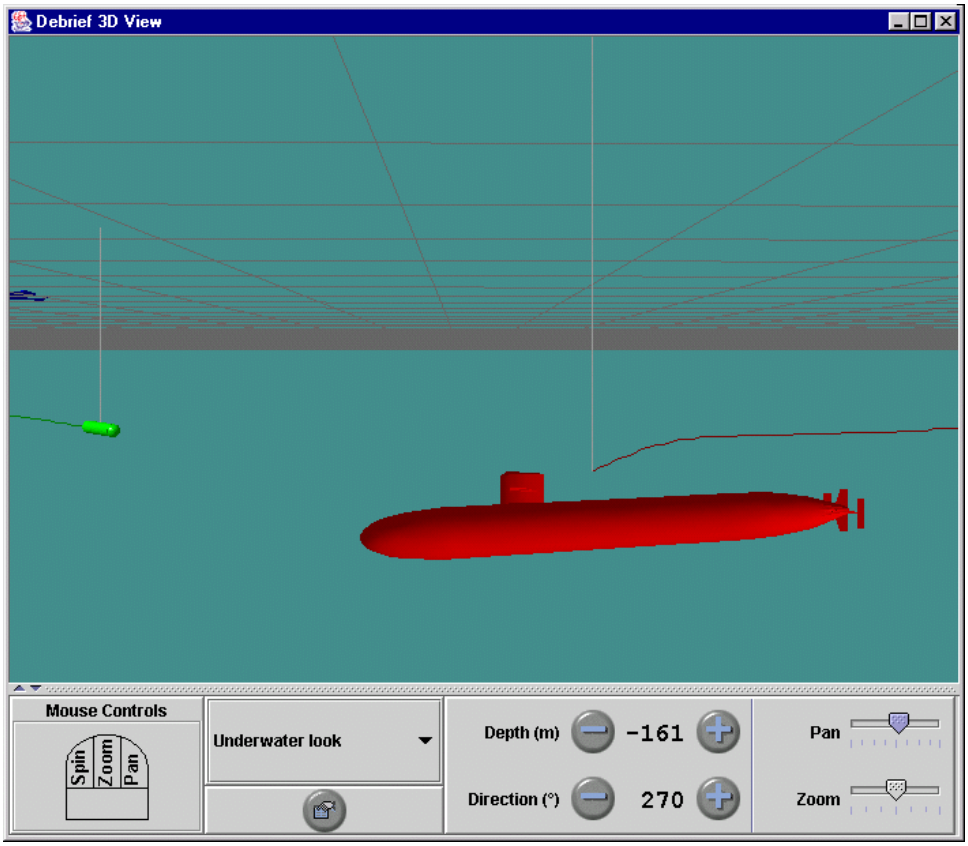

Figure 7 : Various DEBRIEF Analysis Windows