



VISUALISING IN REAL-TIME

VISUALISING INFORMATION IN REAL-TIME HAS MANY BENEFITS. IT CAN REVEAL AREAS OF INTEREST QUICKER, SAVING TIME AND COST.

This article is a description of how GIS functionality is used within a Ship Information System (SIS), as carried out by the Danish Institute for Fisheries Research (DIFRES). This particular SIS application is the main system for accessing data collected by the research vessel Vædderen on its expedition around the world, i.e. the Galathea 3 expedition. In contrast to its predecessors, this SIS application has been equipped with a GIS mapping tool, which provides graphic and user-friendly access to the research data. This tool provides the ability to visualise 3D models relating to data collected as well as the position of their collection, allowing users to visually mine the collected data.

Usage – overview, access and data quality

The SIS application, specifically the data visualisation capabilities, gives the user a good overview of the recorded data, and can therefore be used to intuitively locate areas of interest for further analysis. At the same time it gives an easy access point to the recorded activities, so the exact time and place of a specific activity does not have to be remembered in order to search through the data. Furthermore the visualisation of dynamic data enables a high level of control to be asserted over the quality of data acquired. As data can be monitored in real-time, problems such as sensor malfunctions, activities being performed in the wrong/unintended location among others can be caught quickly and remedied. Since it is possible to use the SIS application both onboard the vessel and from land, the surveillance of the data quality can be done by other persons than the actual technicians on the vessel, and potentially by one specific person for a whole fleet of research vessels.

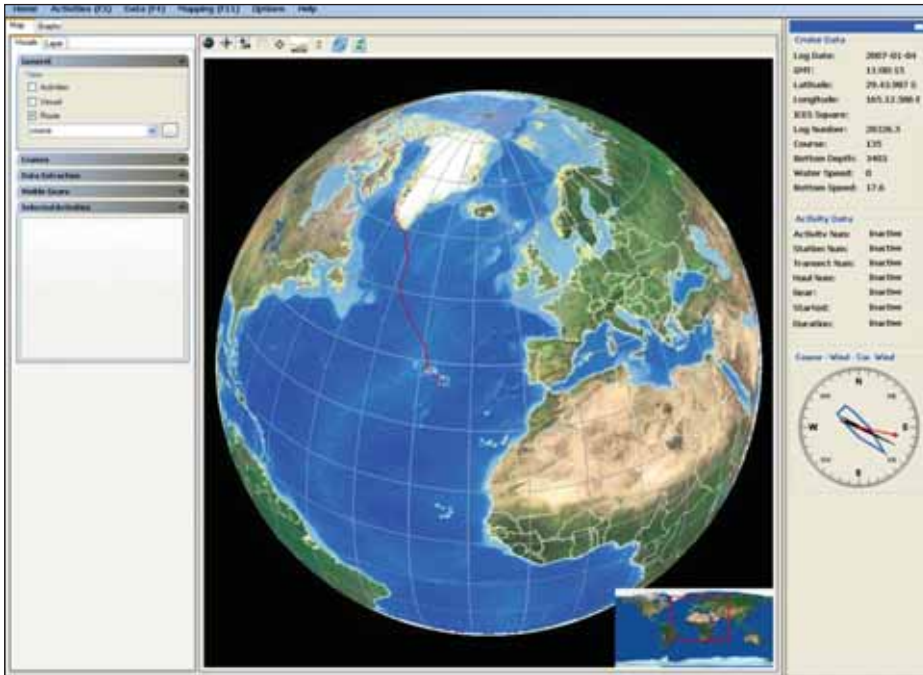


FIG. 1: SIS application mapping tool which offers possibilities for zooming, browsing and identifying data on a 3D globe.

Data acquisition and viewing

The SIS application for Galathea 3 was based on experience gained from two previous versions of similar systems. Using those applications as the basis for the functionality, the SIS application was created to monitor and visualise the data recorded during the expedition in real-time, as well as to give access to historical data.

As the vessel sails, navigation data (position, depth, speed, heading etc.) is continuously gathered in a database onboard, along with weather data (temperature, wind speed & direction). Furthermore, a water intake system at surface level samples a wide range of other parameters (salinity, conductivity, chlorophyll, water temperature etc), which is also uploaded to the database. In addition to this continuous data sampling, specific research activities are performed by lowering various instruments into the water at specific locations, e.g. the casting of a CTD probe, which measures the conductivity and temperature at different depths on its way to the bottom.

The SIS application gives access to the raw data recorded, either as data lists or 2D graphs, and is used by technicians and scientists to monitor the data gathered. To facilitate ease of use and to visualise where the vessel has sailed and carried out specific activities, a mapping tool was added to the application. This tool was created using the ESRI ArcGIS Engine 9.1, ArcGlobe control.

3D Mapping tool

Using OpenGL to extend the ArcGlobe control exposed from the ArcGIS Engine, it was possible to implement functionality to render the route that the expedition has sailed, as

well as a 3D model of the vessel to display its current position and direction and 3D models of the instruments used for activities that had been performed. The 3D activity models also allow interaction, i.e. by clicking upon them; additional information about the activity performed at that geographical point is displayed.

OpenGL is a graphic standard that is the premier environment for developing portable, interactive 2D and 3D graphics applications. OpenGL applications run within a continuous render loop so as a viewer moves, the scene rendered changes. This is the same principle that was used to provide the dynamic ability of the mapping tool. By automatically

monitoring the data being inserted into the database it is possible to retrieve navigation data updates that then allow for the position and direction of the vessel rendered to be updated in real-time. Activities are monitored and rendered in much the same way, and new activities are also rendered once they have been completed.

The 3D models used are defined in the format of ASCII Wavefront OBJ files. This type of file format is used to store and exchange 3D vector data and can be exported from popular graphic design applications such as Autodesk 3D Studio Max, which therefore allows for virtually any model required to be created and used within our mapping tool. In order to make the models more clearly visible without having to zoom very close to the globe with a risk of losing an overall perspective of location, the models are intentionally not rendered to scale.

The mapping tool has the ability to use either a global or scene view. The global view is useful for visualising an overview of where the vessel has sailed and where activities have been carried out. The scene view enables a closer inspection of the locations where activities have been performed, since GIS layers, such as e.g. bathymetry are also visualised. The 3D models give a quick reference to the type of activity performed (Figure 3A).

Custom functionality has been added to the mapping tool, so all of the activities can be selected by clicking upon them. When this is done, an overview of information about the activity is displayed (Figure 3B) and the graphs and raw data for that activity become available for viewing.

Present and future

The SIS application is designed in a way that

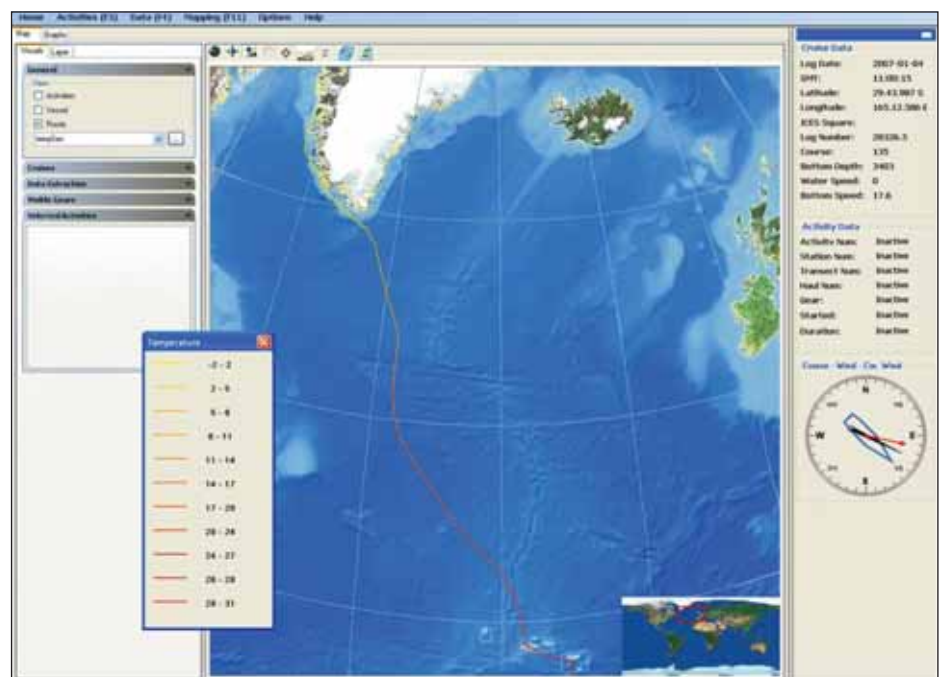


FIG. 2: Global view showing the water temperature along the vessel's route.

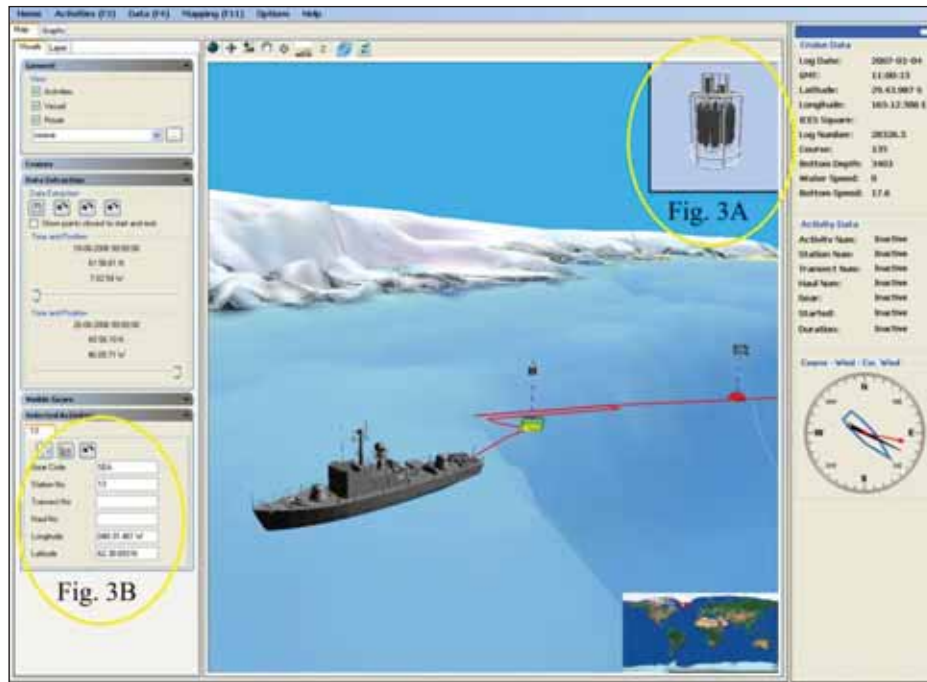


FIG. 3: The 3D models give a quick reference to the type of activity performed (3A) and overview of information about activity (3B).

allows it to be easily ported to other research vessels, either directly or by unplugging some of its modules and inserting others that are customised to facilitate the needs of a specific data collection. As described above, the system is currently in use on the Galathea 3 expedition. However, in the beginning of 2007 the application will be ported to the research vessel DANA, which is operated by DIFRES. There have also been expressions of interest from a number of other countries to

work with DIFRES in adapting the application, or the expertise gained from its creation, to fit the needs of their research vessels.

We are constantly working on improving the system by adding new features. One of the new things that we are currently working on is a planning/scheduling tool that makes use of the globe and the ability to show different activities. The idea is that the scientist can create a cruise plan by clicking on the globe and specifying what activity should



ABOUT DIFRES

Until recently, the Danish Institute for Fisheries Research was a research institution under the Danish Ministry of Food, Agriculture and Fisheries. On 1 January 2007, DIFRES merged with the Technical University of Denmark and four other Danish Government Research Institutes.

DIFRES performs fisheries research in order to advise the ministry, public authorities international organisations, the industry and trade of fisheries and other organisations.

THE GALATHEA 3 EXPEDITION

Galathea 3 is the largest Danish scientific expedition for more than 50 years. It is funded by the Danish government and a number of foundations, companies and individuals.

A total of 71 research projects are on board when the navy surveillance vessel Vaedderen ('The Ram') sails around the World from August 2006 until April 2007. The aim of Galathea 3 is to strengthen Danish research through the implementation of specific research projects onboard as well as by strengthening Danish relations with the international scientific search network.

More about the Galathea 3 expeditions can be read on the website www.galathea3.dk/uk

take place at that specific location. This plan can then be viewed and edited by other researchers or by technicians that have the practical knowledge of what is possible. In the end the plan can be printed out for approval and coordination with the vessel's captain.

The great intuitive usability of having a mapping tool in a data collection application such as SIS makes the application very applicable to a wide range of users and simplifies many different tasks for the researchers, such as data quality control and data mining.

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