

CHAPTER 7

7. VISUALISATION AND DATA DELIVERY

Investigators / Institution

Jason Waring, Hiski Kippo and Irshad Nainar

CSIRO Marine and Atmospheric Research

7.1 Introduction

Recognising the importance of data archiving and data accessibility, SRFME has developed software tools that will allow WA marine managers, and the broader researcher community to interactively explore and visualise SRFME datasets and datasets from other projects. The four products that have been developed are:

- Argo website
- Aus-Connle website
- WebOLIVE
- Data Interrogation and Visualisation Environment

Data Management Functions

- To maintain the existing SRFME database and extend to support new types of observational and modelled datasets.
- To develop web tools to allow the Research Scientists to directly import data into the database.

The SRFME database can be found at:

SRFME-DB (<http://www.marine.csiro.au/datacentre/srfme>)

- This relational database contains a quality controlled observational and modelled dataset created as part of the SRFME project.

Argo website

The Argo website provides an interactive data explorer to display tracks and vertical profiles from over 100 Argo vertical profiling floats which have been deployed in the Indian and Southern Oceans (see Fig. 7.1).

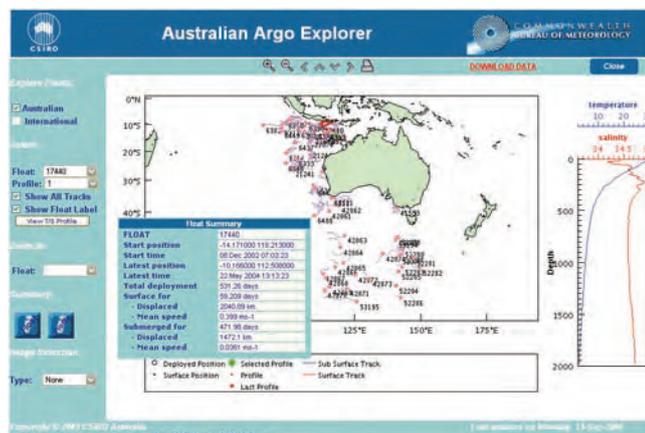


Fig. 7.1: The ARGO web explorer showing the drift tracks of over 100 floats.

The Argo website is located at <http://www.per.marine.csiro.au/argo>. It builds on a pre-existing website developed as part of the *Cooperative Ocean Observing Experiment (COOE)*. The Argo website was developed under a collaborative agreement with the Bureau of Meteorology.

Aus-Connle website

The *Australian Connectivity Interface (Aus-Connle)* is a web-based tool developed to allow environmental scientists and managers to investigate the large-scale patterns of spatial connectivity around Australia (see Figs 7.2 and 7.3). It provides the user with an estimate of the probability that any two regions are connected by ocean circulation over a specified dispersion period (10, or 20 days for monthly averaging or 30, 40, 60 or 80 days for quarterly averaging). It is expected to find applications in areas such as larval dispersion and recruitment studies, and the development of scenarios and risk assessments for contaminant dispersion.

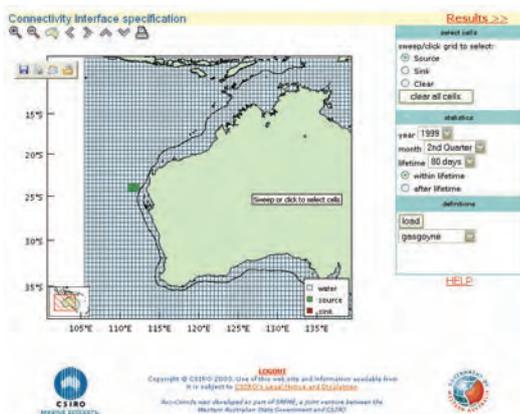


Fig. 7.2: Aus-Connle specification page – Selected source cells are shown in dark-green

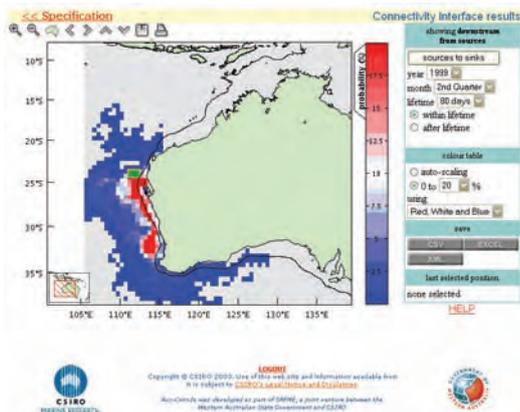


Fig. 7.3: Aus-Connle results page. Note the Leeuwin current.

The *Aus-Connle* website is located at <http://www.per.marine.csiro.au/aus-connle>. *Aus-Connle* builds on the *JEMS-Connle* website developed as part of the *North West Shelf Joint Environmental Management Study (NWSJEMS)*.

WebOLIVE

WebOLIVE is a web-based visualisation tool developed to allow users to explore gridded datasets (such as hydrodynamic model output and climatology atlases) using a standard web browser. Features include the ability to visualise selected variables for a given time and depth as coloured, contoured or vector maps, as well as interactively select a time-series and vertical profile for a specific location. Some controls are provided to permit refinement of the graphics (e.g. colour ranges and colour tables).

WebOLIVE has been integrated into the SRFME modelling website, allowing users to explore the CARS climatology and hydrodynamic model datasets (see Fig 7.4).

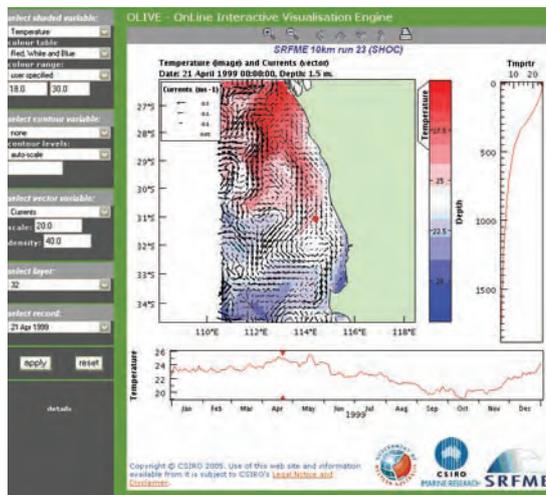


Fig. 7.4: Hydrodynamic model output displayed using WebOLIVE

Data Interrogation and Visualisation Environment (DIVE)

A large number of datasets have been accumulated within SRFME through field programs, remote sensing and numerical model runs. Not only are these datasets large in volume but they are also diverse in nature. They range from 1-dimensional point data (e.g. species biomass) to 4-dimensional time-varying volumetric datasets (e.g. model output).

These large diverse datasets are not easily understood without the aid of visualisation tools. A web enabled graphical tool would be the most effective means of delivering the data to our partners and collaborators.

The *Data Interrogation and Visualisation Environment (DIVE)* is a graphical tool to interactively explore and visualise these diverse datasets. It provides users with the ability to view and inter-compare datasets in space and time (e.g. Fig 7.5). DIVE supports the display of data as spatial maps, time-series plots and vertical profiles. The spatial data is represented as coloured maps, contoured plots, vector arrows, or as habitat maps (Fig 7.6).

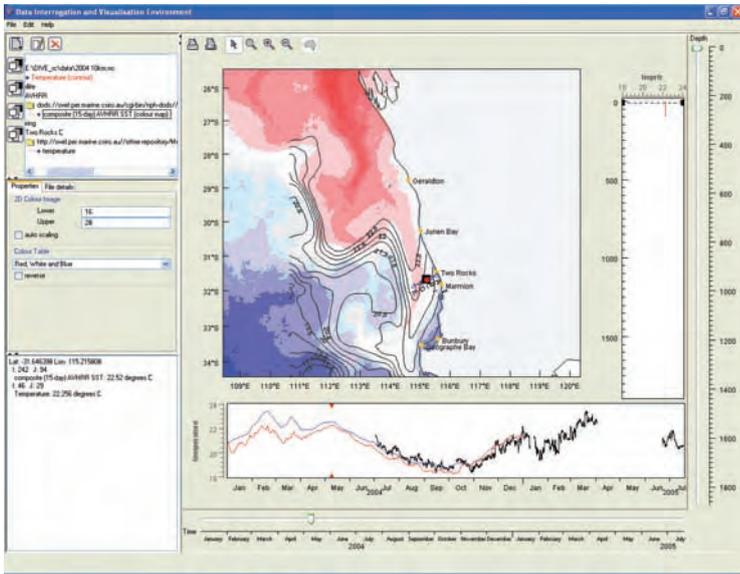


Fig. 7.5: Comparison of Remote Sensing, Hydrodynamic model output & data from moored instrument

DIVE has the capability to access datasets stored in the SRFME data repository. It allows for data residing remotely on the repository to be visualised and downloaded.

DIVE support the following file formats:

- NetCDF files that conform to commonly used formats within the oceanographic community such as COARDS, CF-1.0, etc.
- ASCII files conforming to the CMAR Column File Format (CFF). This format was designed specifically to capture observational datasets such as vertical profiles and time-series.
- ASCII files conforming to the CMAR Shape File Format (SFF). This format was designed to flexibly define geometric shapes.
- Shape files conforming to the ESRI shapefile format.

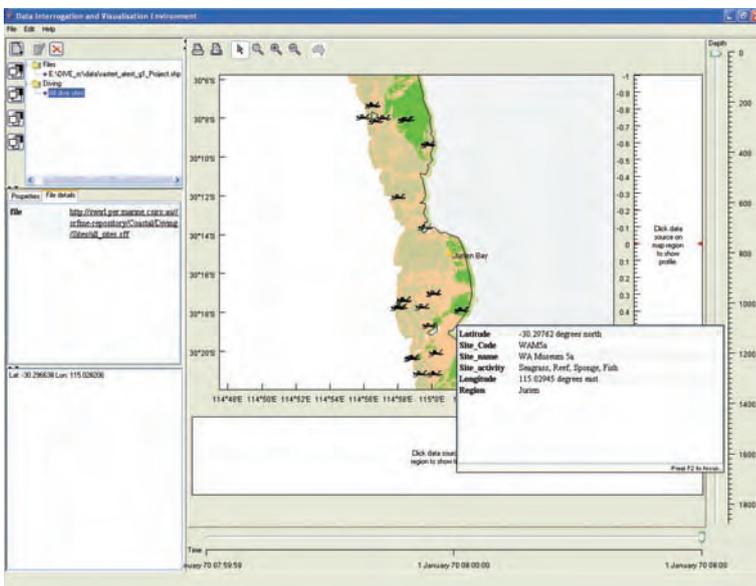


Fig. 7.6: Habitat map of Jurien bay with dive sites overlaid

DIVE supports the following types for data-streams:

- Model outputs
 - Hydrodynamic model
 - Biogeochemical model
 - Wave model
- Climatological datasets.
- Remote sensing data.
 - AVHRR datasets
 - SeaWIFS datasets
- Benthic habitat data.
- Underway time-series data (Fig 7.7).
- Temperature/salinity profile data (CTD casts) (Fig 7.7).
- Data measured by moored instruments.

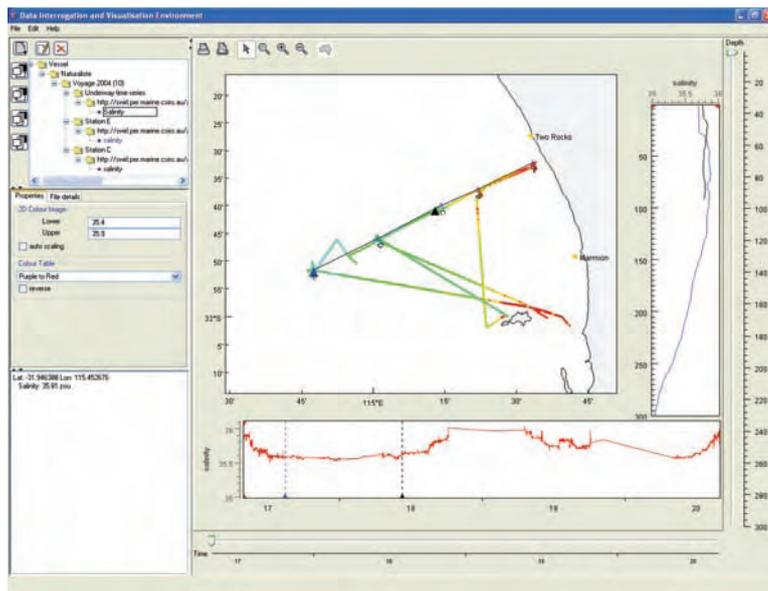


Fig. 7.7: Underway time-series & vertical profiles

DIVE provides a hierarchical view of the datasets in the SRFME data repository. The navigation model employed within DIVE allows the data to be accessed using different views (Fig 7.8). Currently DIVE supports three types of views:

- *Platform* view – This view lists the platforms used for data collection. Selecting a platform and navigating through its hierarchy displays the datasets associated with that platform.
- *Device* view - This view lists the devices and instruments used for the data collection. Selecting a device and navigating through its hierarchy displays the datasets associated with that device.
- *Data-stream* view - This view lists the different streams of data that has been collected. Selecting a data-stream and navigating through its hierarchy displays the datasets that conform to that stream.

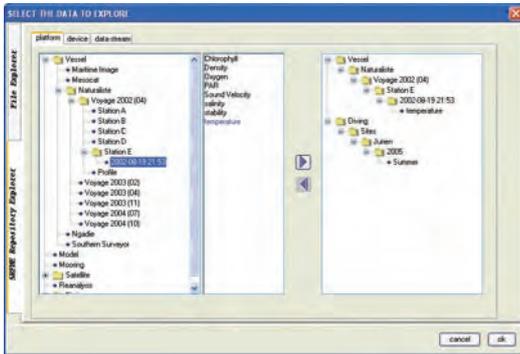


Fig. 7.8: Data Selection Dialog in DIVE

7.2 Data Repository

Data Management Overview

The SRFME program has generated data from a wide range of sources, disciplines and organizations that has resulted in the assembly of a multitude of data formats and data types.

To manage these data sets, a data repository was established that served as a central data distribution point and is supported by a repository web site (<http://www.marine.csiro.au/datacentre/srfme/>) and a publicly accessible metadata tool called MarLIN (<http://www.marine.csiro.au/marlin/>). MarLIN is linked to both the Australian Spatial Data Directory and Ocean Biogeographic Information System (OBIS). Both these external metadata search services provided international online access to SRFME metadata records. Metadata records are published in the public domain, while access to datasets in the data repository and the SRFME data repository web site are restricted to SRFME participants only.

Data Repository

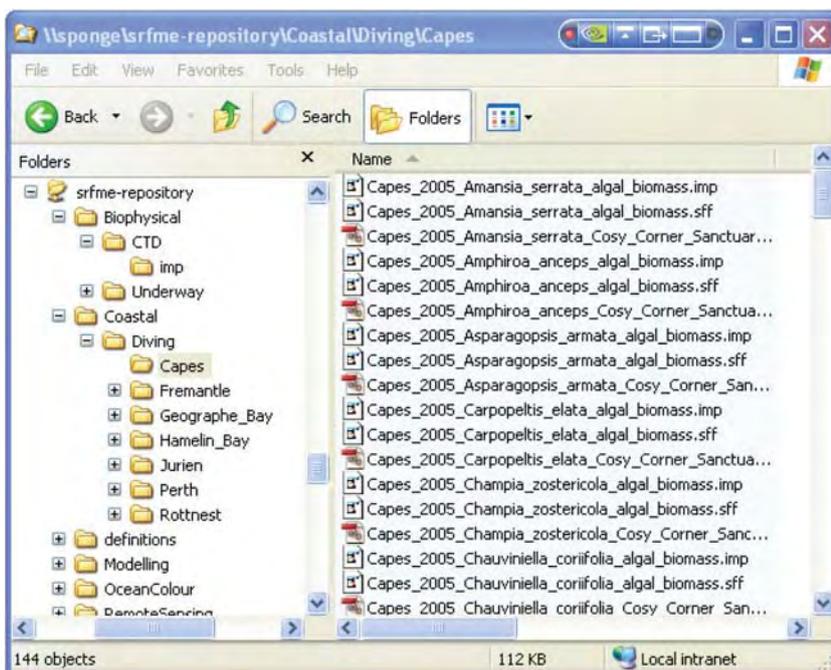


Fig 7.9 Data repository structure

The data repository is mounted on a CSIRO divisional computer with appropriate firewall restrictions to limit access to SRFME participants only. The repository consists of a directory structure that mirrors the major project components of the SRFME program.

To maintain the integrity of data, only data that has been quality assured by scientific staff is included in the repository. Quality standards are maintained by and are the responsibility of individual projects.

Data Repository Integration with DIVE

The DIVE visualization tool provides a flexible method of viewing data sets from three perspectives based on platform, device and data-stream. DIVE utilises a MySQL data base (SRFMEDB) to serve datasets from the SRFME data repository based on DIVE generated database queries. Data is then displayed appropriately as graphical layers based on the type of data.

Tools written in the Java programming language were developed to simultaneously validate and load standard data sets into SRFMEDB.

Figure 7.10 illustrates the main components that constitute the SRFME data management system.

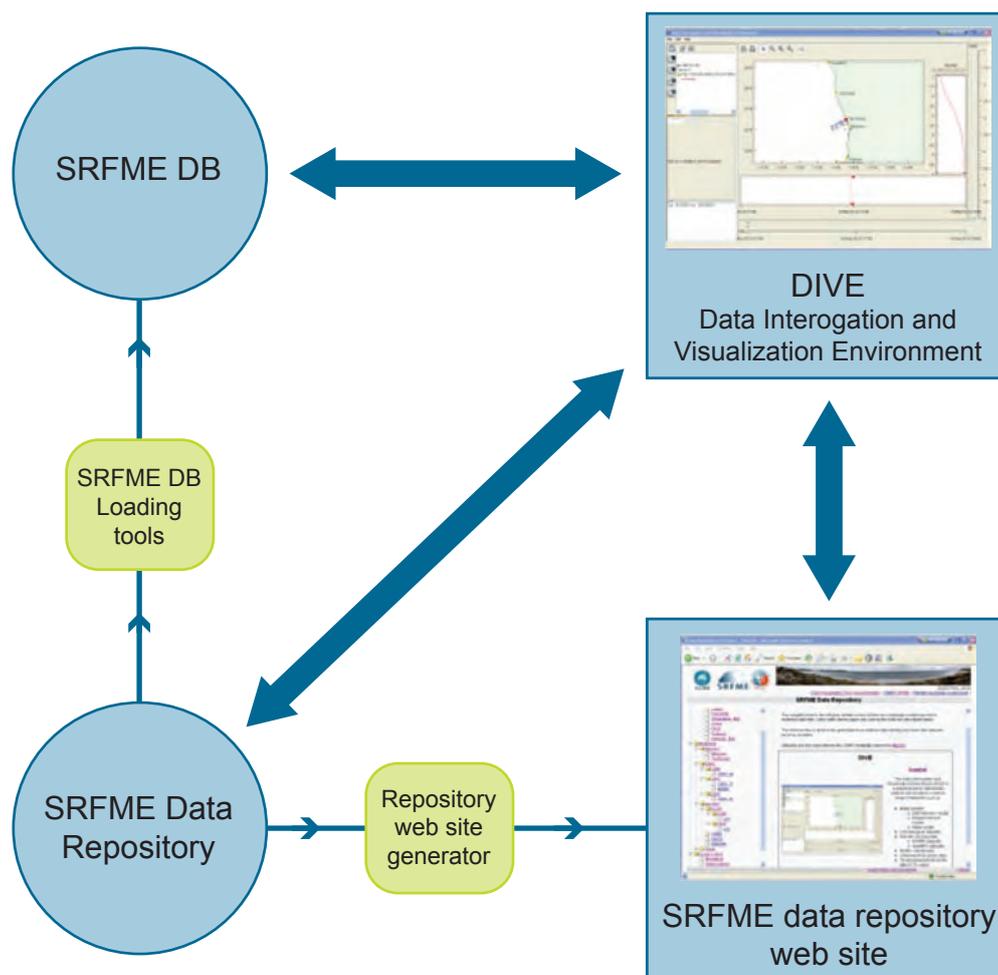


Fig 7.10 Data repository tools

To facilitate the operation of DIVE, data was converted to one of three standard formats as described in Table 7.1

Table 7.1 Standard file types used by DIVE

Data Type	Description	File extension
Column File Format (CFF)	A text based tabular file including a metadata header Ref: http://www.per.marine.csiro.au/srfme-repository_dev/docs/CMAR-CFF-v2.pdf	.cff
Network Common Data Format (NetCDF)	A machine-independent format for representing scientific data. Ref: http://www.unidata.ucar.edu/software/netcdf/docs/	.nc
Shape File Format (SFF)	Two-dimensional geo-referenced point, polyline, graph and grid geometric data as ASCII text http://www.per.marine.csiro.au/srfme-repository_dev/docs/CMAR-SFF-v3.doc	.sff

Data Repository Metadata

Metadata for datasets is located within each directory of the data repository, and is accessible via DIVE and from the Data Repository website.

A comprehensive metadata set is maintained within the SRFME Data Repository website (Fig. 7.11). This metadata set is ANZLIC compliant and is also registered within the CMAR metadata tool MarLIN (<http://www.marine.csiro.au/marlin>).

Through the use of the MarLIN metadata data base, SRFME metadata records are searchable through the Australian Spatial Data Directory (<http://asdd.ga.gov.au/>) and OBIS Australia (<http://www.obis.org.au/>). Access to SRFME metadata records is also possible through the international OBIS site (<http://www.iobis.org/>).



Fig 7.11 SRFME data repository web site showing metadata