7.3 AUSTRALIAN MARINE FORECASTING SYSTEM

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1. INTRODUCTION

This paper briefly describes how the Australian Integrated Forecasting System (AIFS) rationalised the forecasting process by bringing multiple systems together onto the one platform. Included is a look at the main components utilised in the Australian Marine Forecast System for improving the combination of people with machines to "get it right". These include visualisation, graphical editing, automatic text generation, graphics preparation and verification.

2 BACKGROUND

The Australian Integrated Forecast System (AIFS, Kelly and Gigliotti, 1997) brought together a large number of meteorological forecast systems onto a common platform. This resulted in a more efficient and effective process for creating and disseminating weather forecast products. It is now installed in some 26 operational sites in Australia, as well as the Fiji Meteorological Service, and a modified version in the Malaysian Meteorological Service. AIFS is a combination of packages for viewing data and NWP, managing databases and the preparation and distribution of messages. It runs on a Unix X-Windows platform and is written in C, a scientific visualisation language IDL, and uses McIDAS (Suomi et al., 1983) for visualisation and processing of satellite imagery, and NWP data.

Plans for the next generation system are known as "AIFS 2" where the focus is more on streamlining and enhancing forecast operations. A key objective is to produce forecasts in digital form, based on digital guidance data from the NWP models, then modified by the operational forecaster using graphical editing techniques. This digital forecast is then stored in a Forecast Database (FDB), allowing graphical and textual forecast products to be derived automatically and semi-automatically, as well as linking to a systematic verification system.

The visualisation and processing components of AIFS 2 are being developed using the Java programming language, using the VisAD (Hibbard, 1997) (Hibbard, VISAD Home Page) system as the integrated data model, providing navigation and projection facilities, as well as advanced visualisation facilities.

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3 OVERVIEW OF AMFS

Already, many graphical products are being created directly within AIFS from NWP and the forecast and observation databases. However, there has not been a component in AIFS for producing graphical products that incorporate forecaster editing, or the automatic generation of text products.

The Australian Marine Forecast System (AMFS) (Thomas et. al., 1999) allows forecasters to graphically modify model guidance, stores the results in a "digital forecast database", and then prepares text and graphical coastal waters products from information in the database. Model wind fields are interpolated to a single wind barb for each 6-hour time step for each of the coastal sections. Any number of model guidance fields may be loaded, and the forecaster can dynamically choose which model to use as the basis for any given forecast time. The graphical editor consists of 2 panels, where the top panel is the synoptic representation of the data, while the bottom panel is a time series view of the forecast winds and swells for a specifically selected location. The guidance data is presented as a background field of wind directions and speeds, as well as swell directions and heights. Nominated forecast points are interpolated from the guidance data and are displayed as wind barbs or as swell arrows. Both barbs and arrows may be manipulated by clicking and dragging the end of the barb/arrow. Temporal and spatial smoothing of adjustments can be achieved by user adjustment of slider bars to indicate the extent of the smoothing in space and time.

Following adjustment of the guidance data at the nominated points, either a graphical forecast product or a textual forecast product may be previewed and/or sent to the AIFS Communications System for despatch/transmission, and also stored in the Forecast Database. The verification procedure then occurs on a daily basis, comparing the forecast digital data to nearby representative observations.

The AMFS was chosen as one of the first AIFS 2 applications because:

- initial requirements are relatively well known since the Tasmania/Antarctica Region experience with "WindMap", developed by one of the authors (John Bally) while working as an operational forecaster in the Tasmanian Regional Forecasting Centre;
- the graphical editor requirements are relatively simple in the first instance since they are 2D and the domain is fixed;
- text generation for coastal waters has been identified as one of the easier forms of text

generation because of simple syntax and small vocabulary; and

- it trials key components planned for AIFS 2, namely the graphical editor, the forecast database, and the verification module.

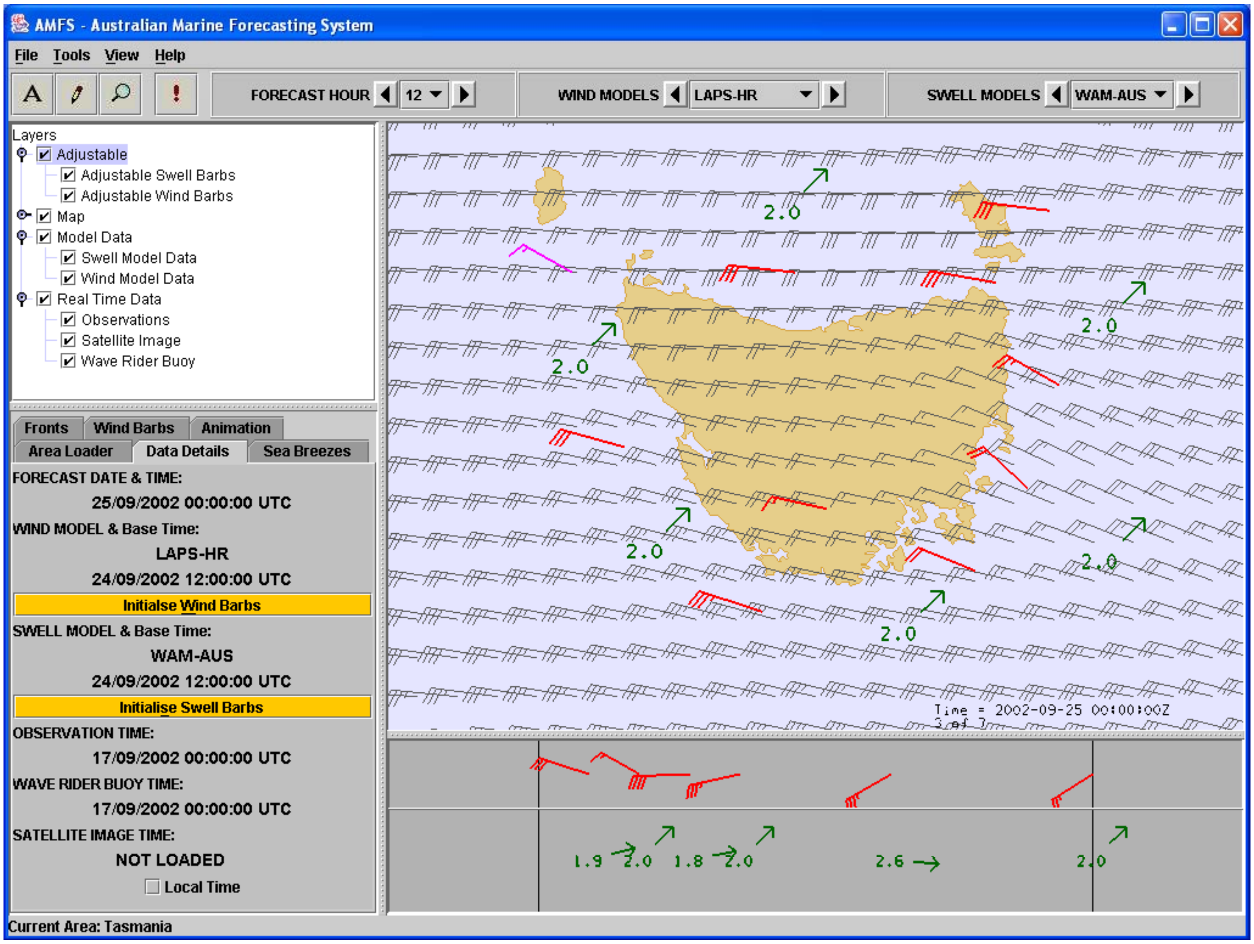

Figure 1. AMFS Display of the +12 hour forecast showing NWP guidance field (black wind barbs), modifiable wind barbs (red) at key locations, and
modifiable swell arrows (green). At the bottom of the screen is a meteogram type display of the modifiable wind barbs for a particular location (the pink wind barb in the geographical display).

A coastal waters forecast product analysis was undertaken to establish the information content of the current coastal waters forecast service. AMFS was designed to at least maintain the level of detail in the service, while introducing production efficiencies and new presentations of the forecast. The analysis of 572 coastal waters forecasts from all Australian states showed that :

- almost all (85%) of forecasts were for the whole of a coastal waters district. This gives them, on average, a spatial resolution of about 250km. Only 5% of forecasts contained direction and speed information specific to less than 3/4 of a forecast district (less than about 200km); and
- Only 6% of forecasts contained information for time periods of less than 6 hours.

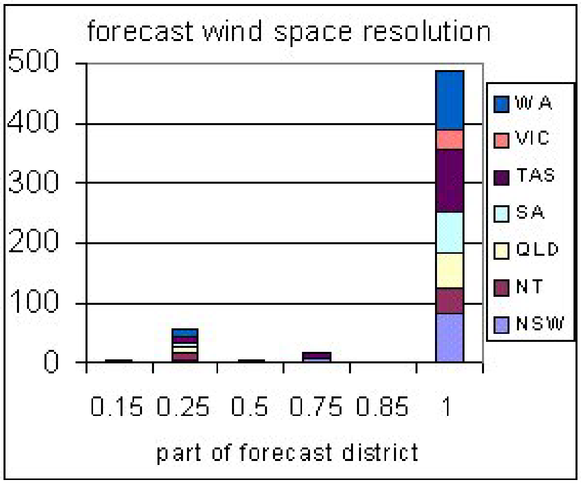

Figure 2 Spatial resolution of Australian Coastal Waters forecasts.

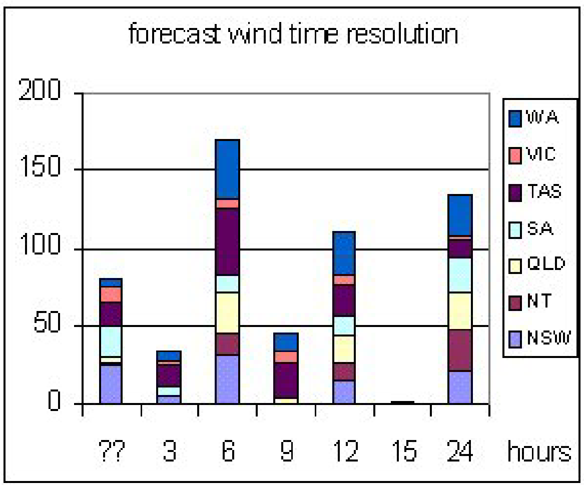

Figure 3 Temporal resolution of Australian Coastal Waters forecasts.

The decision to use just one wind barb per coastal waters district and a six hour timestep was based on level of detail measured in the existing manually prepared coastal waters forecasts.

4 PROJECT DEVELOPMENT STRATEGY

A component-based approach has been adopted to allow the Bureau to source key elements of the system from other agencies and organisations. For instance, the advanced meteorological visualisation component, VisAD, is being sourced from the University of Wisconsin (UoW). The basis for the graphical editor component of AMFS is contained in the Java class visad.bom.CollectiveBarbManipulation, which is freely available as part of the VisAD package. The automatic text generation module has been developed by the Environmental Computing and Visualisation (Skierski, EC and V home page), based on the natural language generator package as described by Elhadad. So the true reference should be to and is currently implemented in the Lisp programming language. The ATG output is yet to undergo extensive evaluation, and a decision on whether to more tightly integrate the ATG (e.g. by a port to Java) has been deferred pending the evaluation phase.

5 CURRENT STATUS AND LESSONS LEARNT

The development of AMFS is nearing the operational deployment stage in the Tasmanian Regional Office of the Bureau of Meteorology, and a demonstration version has been installed in the South Australian Regional Office. The project began during 1999, and so has taken some 3 years to reach the stage of first operational deployment. As this project was based on a working prototype (windmap), initial project expectations were for a rapid integration into AIFS 2 were high.

Looking back on this work, the following lessons are worth mentioning:

- forecasters, like many professionals, aim to improve on their current performance, and so they often describe desirable enhancements as being of critical importance, and required now;
- the services analysis should have been performed earlier in the project, and used more strongly to differentiate between these desired enhancements and those that are really necessary for the project to succeed;
- aim to reproduce the functionality of any existing (non-integrated) system before adding further features (delays in the development process have occurred through trying to do too much in “Version 1”);

These points are of some importance, as any effort to integrate an existing system is seen as an opportunity to provide major functionality enhancements to the existing system, overlooking the fact that “integrating a software package can cost as much as two dollars for every dollar spent acquiring it” (Thomasma, 2002). The approach of focusing on exactly what is needed for the “next release”, and deferring detailed study of longer term requirements is well handled by the eXtreme Programming (eXtreme Programming FAQ) methodology. AMFS and other AIFS 2 projects are now placing more emphasis on such an approach to provide more rapid convergence and a sharper focus in the development effort. A significant benefit of the integrated system is the production of verification information on a daily basis. Forecast wind speeds and directions are compared with representative observations for all time steps in the forecast period.

6 SUMMARY

AIFS has come a long way in meeting its aim of freeing forecasters from tedious product preparation work so they can concentrate more on the meteorology. However, forecasters are asking for AIFS 2 to go further and generate worded forecasts from NWP, which they can then edit and use to prepare other products. AMFS is one of the first AIFS 2 applications to apply this approach, and consideration will be given to extending this approach to aviation and general weather forecasting within AIFS.

7 ACKNOWLEDGMENTS

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