THE AFOSS INTERACTIVE DATA DISPLAY SYSTEM FOR OPERATIONAL AND EXPERIMENTAL USE

by

Anstein Foss,
Sigbjørn Grønås and Rebecca Rudsar
The Norwegian Meteorological Institute (DNMI)
P.O.box 43 - Blindern
0313 Oslo 3

1. INTRODUCTION

The AFOSS meteorological, interactive display system has been developed at DNMI by Anstein Foss to cover needs for graphical data display at the research department. The activity covers research and development in numerical weather prediction, oceanographic modelling, air pollution modelling and satellite information (Grønås, 1988), and AFOSS forms a vital part of the computational environment, Grønås et al. (1988). The system is also used for research by university groups in Bergen and Oslo.

Since it is a fast, fully interactive sytem, it is also used operationally by the forecasters. As a part of AFOSS all available NWP products from Norway, UK, US and ECMWF are reached from a one page menu. The total number of products amounts to several thousand when all derived parameters are included.

AFOSS is mainly used interactively on colour terminals to DNMI's main frame computer (IBM 9370). A PC-version exists for some of the modules. At DNMI this is used on PCs of the type IBM PS/2. Regularly, files with direct model output are transmitted to some customers, who use AFOSS PC-version graphics.

2. ELEMENTS AND STANDARDS IN AFOSS

AFOSS consists of computer programs, or elements, which display groups of meteorological information interactively. These elements are:

- 2D horizontal fields
- Cross-sections
- Observations in analysis and horizontal fields
- Meteograms
- Soundings from observations and prognoses

In addition, there exist two elements still in batch mode:

- Trajectories
- Observations

Standards used in AFOSS on the main frame are FORTRAN for programming, GDDM for graphics primitives, VM/CMS operative system and DNMI file structure (see section 3).

The PC version also uses FORTRAN, but GDT (IBM) for graphics primitives and DOS operating system.

For 2D horizontal fields, versions with GKS and PHIGS graphics exist.

3. DNMI FILE STRUCTURE

The DNMI file structure is being used operationally and in research. Two different kinds of files exist: files for all types of two-dimensional fields, called field-files, and files for observations, observation-files.

Both kinds have direct access and are arranged with a fixed record length. Words of 16 or 32 bits are used for storage. Information about the content of the file, including the record number for each field, is found in the first records of the file. In this list of content, each field in a field-file is identified by 16 parameters: Producer, grid number, year, month and day, time issued, record number, record length, data type, time parameter, vertical coordinate type, grid type, parameter, vertical coordinate, relative vertical coordinate, grid type, flag1, flag2. A header of 20 words is placed in front of each field. In addition to the information mentioned above, a more precise grid definition is found here.

Normally, there is one field-file connected to each analysis/-prediction cycle. Here products from the Norwegian model (analyses, initialized analyses, predicted dependent and diagnostic variables in pressure and sigma coordinates), UK models, ECMWF model and other models may be stored. Products from different grids, coordinates and map projections can be found on the same file.

Files containing observations have a similar structure, each observation type being stored on separate files.

Some utility programs are connected to the files. These are used to create a file, to read and write and to inspect the files.

4. STRUCTURE OF AFOSS

The interactive program of an element consists of data files, a file with coast-lines (when needed) and a Fortran program which reads a set-up file. This set-up file allows the user to define products and plotting specifications for each product. In addition, the layout of the menu and special commands concerning the style of the graphics are defined here.

The set-up file is a vital part of an AFOSS element. Without changing the Fortran program, new products can be added. Flexible arrangements to read needed parameters to form a new product are included. For 2D horizontal fields a product must be defined within the 13 different predefined types of maps: four different contour maps (fixed/variable contour steps, one or more colour-es), four wind maps (arrows with/without barbs, one colour/-coloured by values of a scalar), two direction maps, two types of cloud maps and a map which fills grid areas. At present, there is no map type which makes colours or shading between contours.

4.1 2D horizontal fields

The menu should be regarded as a shopping list for available products. A simple one-page menu is used. A black/white representation of the menu used operationally is shown in Figure 1, and the rest of this section explains how it might be used.

In this case the user can choose between model output during the last 24 hours from Norwegian models (LAM150 and LAM50), UK models, the US and the ECMWF model (Hemispheric area EC300.12 and Atlantic area EC.12). Altogether there are four different producers with 16 different model runs (upper left corner, Figure 1). In this version, all products are available as stereographic maps, however, there are several such maps present.

Some preset areas are given in Figure 1, upper right corner. Default is total area. Further down in the menu the different products are defined in four categories. First 23 different parameters in pressure coordinates, then similar parameters in sigma coordinates, then the surface parameters and lastly, the model parameter fields. The names are meant to be self-explanatory from the usual meaning of z, wind, T, TH (potential temperature), THE (equivalent TH), RH and Q. The letter S indicates a parameter in sigma coordinate. The number 2 behind a wind parameter means that every second grid-point is used. Combinations like TWIND and TADV mean wind coloured by temperature and temperature advection.

There are 22 different parameters characterized as surface parameters. Forecasts of precipitation, clouds at different levels and derived parameter like K-index belong to the surface parameters.

The menu includes information of preset steps in the contours, colours and time steps. The time step +0 gives initialized fields, +PAR are used for parameter fields and +STOP are used in case the model for some reason has stopped during the integration.

A command is written at the bottom of the page. A minimum command includes producer, parameter and time step. For fields in pressure and sigma coordinates, specification of the level must be added. Examples are:

LAM50.00 MSLP +24

EC.12 +120 500 Z

LAM150.18 TOPO +PAR

UKFIN.12 Z 1000 8. YELLOW   (contour interval 8 meters)

LAM150.12 MSLP 3H.PRECIP C.LOW C.MEDIUM C.HIGH +36

Time series (animation) are shown by extending the time parameter as in the following example:

UK.00 Z TMDZ 1000 500 +6 +48 /6   (maps every 6th hour)

Products from different producers can be plotted on the map of the first producer indicated:

UK.00 Z 1000 6H.PRECIP +24 LAM50.12 6H.PRECIP +36

Special options

There exist a number of special options which might be used with the ordinary commands and in addition, there are special commands to introduce special states, e.g introducing black and white plotting. The options give the user the possibility to control the style of the graphics, the contour steps, introduce smoothing etc. A addition/subtraction command is used to add or subtract fields. The following command gives the increase of wind between the two levels indicated:

LAM50.12 (WIND 700 - WIND 850) +24

The function keys are mainly used for zooming and to produce metafiles.

Similar menus are available for displaying fields operationally from the ocean wave model and the storm surge model.

4.2 Cross-sections

These are made in two steps. First all cross-sections are defined and the needed dependent variables are interpolated and stored on a file. Then the interactive plotting takes place. This element is so far mainly used in research.

4.3 Observations together with fields

This element is used to control analyses and background fields. A one page menu allows the user to plot observations together with fields from two different sets of fields. The observations plotted are wind, height, temperature and humidity. The two sets of fields might be background fields and analyses. The types of observations available are TEMP, PILOT, SYNOP, SHIP, BUOYS, AIREP and SATEM.

The plotted observations can be coloured according to preset limits. In this way the fit of the observations to the fields is clearly revealed.

4.4 Meteograms

There are two kinds of meteograms; those from the Norwegian models with time resolution of 3 hours and those from ECMWF with time resolution of 6 and 12 hours. In the set-up file geographical positions and station names are specified, and the user may choose interactively from these positions.

4.5 Soundings

Vertical soundings in skew T/ln p diagrams may be presented for TEMP, SATEM and model prognoses. In addition, the wind and the vertical velocity (for prognoses) are displayed. As for meteograms the positions are specified in the set-up file.

5. PLANS

All elements in AFOSS will in 1990 be implemented on a work station (probably Silicon Graphics), which will be developed for use in a central forecasting office. Standards here will be UNIX, PHIGS and probably X-WINDOWS. Another project at DNMI is the development of satellite images. This project will finish in 1990 and the satellite information will be available for the work station.

The programs for trajectories and general observation plotting are being further developed.

References:

Grønås, S., A. Foss, R. Rudsar, 1988: An Environment for Operational and Experimental Modelling. WMO PSMP Report Series No. 27, April 1988.

Grønås, S. 1988: Application of Limited Area NWP in Norway. WMO PSMP Report Series No. 27, April 1988.


```
Model:                                            Area:
 LAM50.00   LAM50.06   LAM50.12   LAM50.18       TOTAL  TOTAL.ROT  SOUTH  NORTH
                                                 NORWAY S-NORWAY  N-NORWAY  LAST
LAM150.00  LAM150.06  LAM150.12  LAM150.18       TOTAL  ATLANT  LAST
    UK.00   UKFIN.00      US.00      EC.12       TOTAL  ATLANT  LAST
    UK.12   UKFIN.12      US.12   EC300.12       TOTAL  ATLANT  LAST

Fields in P-levels:  ( 100 150 200 250 300 400 500 700 850 925 1000)
        Z  WIND  WIND2  T  THE  RH  TH  VORT  DIV  TMDZ  DZ  FF  UK.T  UK.TVIND
        TWIND  TWIND2  THEWIND  TADV  THEADV  GWIND  GWIND2  GVORT  AGWIND
Fields in sigma-levels:  ( 1 2 3 4 5 6 7 8 9 10 )
        TS  WINDS  WINDS2  THS  QS  RHS  THES  OMEGAS  VORTS  DIVS  FFS
        6H.DT  12H.DT  24H.DT  TWINDS  TWINDS2  THEWINDS  TADVS  THEADVS
Surface fields etc:
       MSLP  T2M  T2M.F  T2M.F2  WIND10M  3H.PRECIP  6H.PRECIP  12H.PRECIP  T0M
       FOG  C.LOW  C.MEDIUM  C.HIGH  TENDENCY  KINDEX  SHOWALTER  DUCTING  FF10
       RH2M  EC.12H.PRECIP  EC.6H.PRECIP  TOT.CLOUD
Parameter fields:
        TOPO ZNULL SST SNOW UKAREA ICE ICE+LAND SEA+ICE+LAND (Time = +PAR )

Time:   ANA +0 +3 +6 +9 +12 +15 +18 +21 +24 +27 +30 +33 +36 +39 +42 +45 +48 +54
        +60 +66 +72 +78 +84 +90 +96 +108 +120 +132 +144 +156 +168 +192 +216 +241
                                                                ( +PAR +STOP )
Contour step:    0.5 1. 2. 2.5 3. 4. 5. 8. 10. 20. 40. 50. 80.
Colours:         DARKBLUE RED PINK GREEN BLUE YELLOW WHITE

.......... Example: LAM50.00 WHOLE MSLP 6H.PRECIP +0 +42 /6 NOSTOP
.................. ( EXIT  DATE  PF-INFO  LIST ) ...... STOP / NOSTOP


LAM50.00 SOUTH WIND10M WHITE MSLP 6H.PRECIP +0 +42 /3 NOSTOP
```

Figure 1: Menu of AFOSS 2D graphics