

Army Research Laboratory



**Mesoscale Model Data Preparation and Execution:
A New Method Utilizing the Internet**

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NOTICES

Disclaimers

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

Citation of manufacturers' or trade names does not constitute an official endorsement or approval of the use thereof.

Preface

For researchers using, but who are not extremely familiar with, the Battlescale Forecast Model (BFM), a longstanding problem existed with creating the required input files. Multiple scripts required editing, and C and FORTRAN code had to be edited and recompiled. The user needed to know exactly what code changes were required and the order of the processing. Only a small group of people were familiar with this time-consuming methodology. To remedy this situation, a web site was created which requires only a few user inputs per data type in order to transparently create the requisite BFM input files. Through this web site, which serves as a precursor to what will eventually be a "Model Execution and Evaluation Tool" (MEET), a user can now execute the mesoscale model Version 5 (MM5)* and automatically create Vis5d format files from the output.

NOTE: It was the author's intention to release this report September 2001; however, local security officials determined that the web site clearance process should take place first (and wisely so), thus this paper has been somewhat delayed in publication.

* MM5 was developed jointly by University Corporation for Atmospheric Research (UCAR) and Penn St. University.

Acknowledgments

The author acknowledges Dr. Brian Malloy of Clemson University for the original concept of using Perl for this web site, and Mr. Young Yee's efforts for involving Dr. Malloy as part of the visiting summer faculty program and for his encouragement. Dr. Teizi Henmi of U.S. Army Research Laboratory (ARL) provided the initial FORTRAN code, which converts the decoded Naval Research Laboratory Navy Operational Global Atmospheric Prediction System gridded binary (GRIB) files into a Battlescale Forecast Model readable format and was a very good beta tester. Thanks also to Dr. Pat Haines of ARL for showing the author how the original scripts, GRIB decoder, and FORTRAN code fit together.

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Executive Summary

Introduction

Battlescale Forecast Model (BFM) is typically run in two modes:

1. Operational. This mode is part of the Integrated Meteorological System (IMETS); large amounts of meteorological data are continually and automatically acquired, processed, and placed in an INFORMIX database. Users can then run the BFM over selected areas for data that is up to 24 hours old.
2. Research. A user will incorporate historical datasets not available on the IMETS. This mode was highly convoluted and time-consuming and could be simplified with some form of automation. Thus was born the concept of creating a web site where all the requisite BFM inputs could be acquired and processed. A model execute capability has been added to the web site as an initial step toward bringing to fruition the concept of a Model Execution and Evaluation Tool (MEET), a mesoscale model (version 5).

Overview

Creating input meteorological data files for the BFM was once a daunting task for the uninitiated researcher working on a case study or not familiar with IMETS. The user was required to know what data should be acquired and where to obtain it and the required C and FORTRAN code modifications and recompilations. Specifically, as part of the C gridded binary (GRIB) decoder, the user needed to indicate where the output decoded GRIB file should be placed. In the FORTRAN file, edits were required regarding central latitude and longitude, output file names, etc. Each of these code changes would be followed by recompilation; if the user mistyped anything, additional changes and recompilations had to be made. This entire process was very time-consuming and prone to errors.

To alleviate this problem, a web site was created which provides access to all BFM inputs, surface, upper-air, and large-scale initialization data a reformatting capability for all three types, and information on exactly what data should be acquired. The web site is built around Perl, a script language, which has excellent functionality for web applications.*

* When used in web applications, Perl is often referred to as Perl/Common Gateway Interface (CGI), because the Hyper Text Markup Language (HTML) code segments are tied to forms, and there are "action" functions which call up Perl modules. These modules can either modify data or create new HTML or can call native language code modules such as C, FORTRAN, etc. Therefore, the user is able to "talk" to the server from wherever they are running a browser; thus the term gateway.

Surface data is acquired from a Florida State University (FSU) Internet site. The user can obtain and upload to the server as many surface reports for a region as desired; these are then reformatted and placed into one file for BFM ingest. The concept is the same for the upper-air data (radiosonde observation [raob] reports), which come from a University of Wyoming Internet site. The large-scale initialization data is obtained from the Naval Research Laboratory Internet site by first accessing the Master Environmental Library (MEL) homepage. (We use Navy Operational Global Atmospheric Prediction System [NOGAPS].)

A detailed explanation of the various code segments comprising this web site is in the appendix of this report.

Conclusions

Using the web site to create the requisite meteorological inputs for BFM has significantly reduced the complexity of converting surface, upper-air, and large-scale initialization data to a format readable by BFM process by making the file reformatting transparent to the user. Use of the web site saves significant time for the BFM user and provides users who are not expert in the data requirements of BFM the ability to use the model.

A portion of the first phase of the MEET has been realized with the successful development of a user option to obtain the required data for and run Mesoscale Model (Version 5) MM5

1.0 Overview

1.1 Introduction

This report describes a new method for converting Naval Operational Global Atmospheric Prediction System (NOGAPS) data, upper air and surface report into the format required by the Battlescale Forecast Model (BFM). At Army Research Laboratory (ARL), Battlefield Environment Division (BED), the BFM is run in two different modes:

1. Operational. The Integrated Meteorological System (IMETS) continuously receives meteorological data, including NOGAPS, from various sources whereupon it is reformatted and placed in an INFORMIX database. Assuming the appropriate input data is present, a user can designate an area of interest and execute a BFM run. The INFORMIX database is continuously purging old meteorological data and inserting new meteorological data. Thus, this mode is suitable only for model runs using current data.
2. Research. This mode is applicable to the researcher who wants to execute the BFM using datasets that are more than 24 hours old. Prior to the development of this web tool, the researcher was required to:
 - a. Seek out various web sites for the applicable data inputs.
 - b. Modify shell scripts, as well as FORTRAN code.
 - c. Recompile the FORTRAN code.
 - d. Execute the FORTRAN code to reformat the data sets.
 - e. In the case of the NOGAPS output files, perform additional editing.

Therefore, this mode was very time-consuming and prone to error except for those who are experts. To address this problem, a web site has been created through which a researcher can obtain and reformat the requisite BFM inputs.

1.2 User Access Restriction

To limit web site access to authorized users, a login screen is displayed when the user first accesses the site, regardless of which page of the site the user tries to access. Figure 1 shows this login screen.

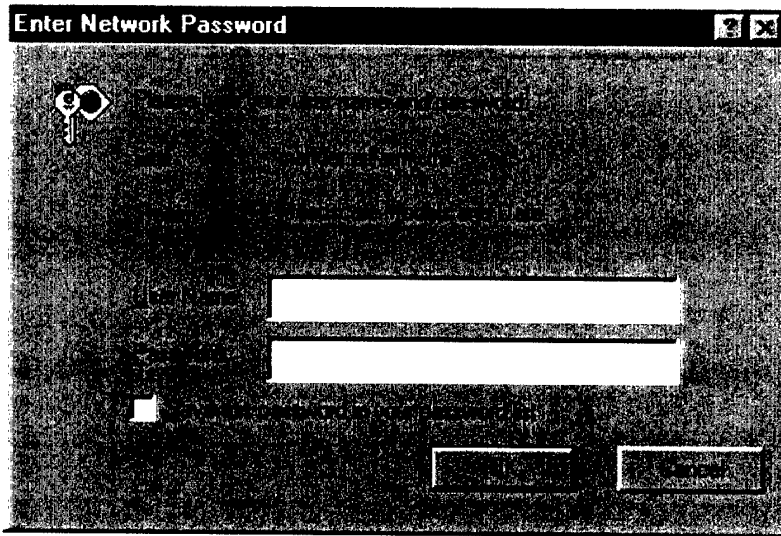


Figure 1. Web site user authentication form.

1.3 Home Page

After the user has successfully entered the required data, the front page of the site will be displayed (fig. 2). This page:

- briefly describes the options available
- provides links to the main page for this site as well as links to the Army Home Page and to the U.S. Army Research Laboratory Home Page
- provides a link to the security restrictions for this web site
- allows the user to easily bookmark the site

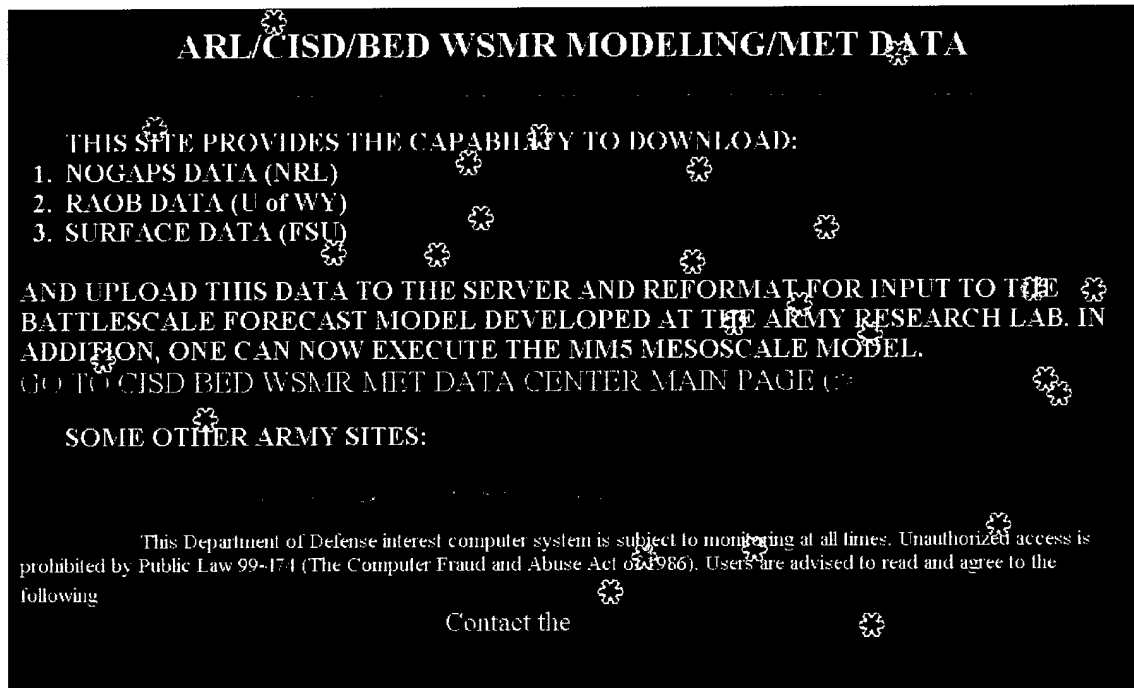


Figure 2. The front page of the web site.

1.4 Main Page – Data Acquisition, Processing, Help Pages, MM5 Execution

Linking to the main web page presents the user with five options:

1. download surface, upper-air, and Navy Operational Global Atmospheric Prediction System (NOGAPS) data
2. upload data (to the server)
3. reformat surface, upper-air, and NOGAPS data
4. access the Help area
 - a. information on the Battlescale Forecast Model (BFM) and
 - b. the difference in saving the data in Netscape and Internet Explorer (IE)
 - c. specific information on which NOGAPS data to download and
5. run the MM5 execute option (fig. 3)

ARL/BED WSMR MET DATA CENTER

Download/Request
*NOGAPS data (NRL)
*raob data (U of WY)
*surface met data (FSU)

FTP Pickup
*NOGAPS (NRL)

Upload to Server
*NOGAPS data file for BFM
*NOGAPS order message text
*NOGAPS file for MMS
*raob data file
*surface met data file

Reformat for BFM
*NOGAPS data file
*raob data file
*surface met data file

Help
*Battlescale Forecast Model (BFM)
*Which NOGAPS data to request for BFM?
*Which NOGAPS data to request for MMS?
*Requesting raob data
*Requesting surface met data

Run
** MMS **

This web page has been created to ease the processing required to create met inputs for the Battlescale Forecast Model used at Army Research Lab, Computational and Information Sciences Directorate Battlefield Environment Division, White Sands Missile Range, NM. From here, ARL researchers can obtain NOGAPS, raob, and surface met data, then reformat it for input to the Battlescale Forecast Model. As MMS will soon be another key mesoscale model researched here, its inputs and any preprocessing needed will also be made available through this site.

Download, reformat met data for BFM --- NOGAPS, raob, and surface met data

Please read the following **DISCLAIMER** regarding all external links available through this site.

Contact the **Webmaster**

NOTE: The user options are listed in the left hand frame.

Figure 3. Main Page.

The surface and upper-air data are in American Standard Code for Information Interchange (ASCII) format while the NOGAPS data are in Gridded Binary (GRIB) format. A user could obtain NOGAPS data from a site other than Naval Research Laboratory (NRL) Monterey, CA (such as the Naval Oceanographic Office) and still successfully process it through this web site because GRIB is a standard format. However, the surface data must be in “decoded METAR” format. While METAR is a standard format, the particular decode done at Florida State University (FSU) may not yield a standard format. Thus to use the surface meteorological data processing from this web site, the user is restricted to the FSU decoded METAR data. The same is true for the upper-air (or radiosonde observation [raob]) data. To successfully process upper air data through this web site, users should restrict themselves to using upper air data from the University of Wyoming web site since the decoders have been written to work on their specific format.

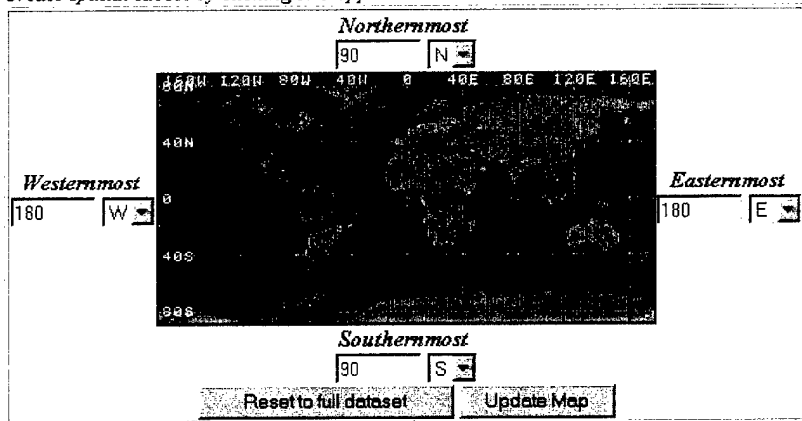
2.0 NOGAPS Data Preparation

To retrieve NOGAPS, the user first accesses the Master Environmental Library (MEL) web site and designates the type of data required. The user enters “NOGAPS” into a text box and selects Naval Research Laboratory, Monterey, CA as the site to search. The MEL then queries the user to select “current” data from the last 25 days or historical data.

* The METAR acronym roughly translates from the French as *Aviation Routine Weather Report*

After entering the desired selection, the user will be linked to the NRL site (fig. 4). (The order page is where the user inputs the beginning and ending model run times.) Shown in this figure is a NOGAPS model run time of September 24, 2001 with 1200 UT selected.

Create spatial subset by clicking two opposite corners.



DATE/TIME RANGE (GMT-YYYYMMDDhh.hh):

- SUBSCRIBE to data as it is produced (push to your delivery site).
- NOTIFY me via email every time the data is available (no data delivery).
- GET the data as a single request, specify a date range below.

	Begin time	End time
Dataset:	2001083100.00	2001092500.00
Request:	2001092412.00	2001092412.00

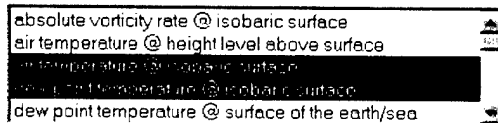
Figure 4. A portion of the NOGAPS order page from NRL Monterey, CA.

The first display is in a parameter list (fig. 5). For the BFM, the following are required:

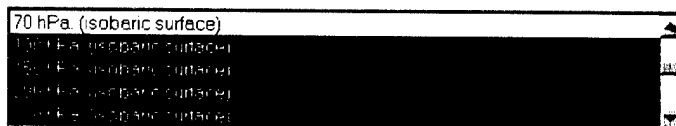
- air temperature
- dew point temperature
- geopotential height
- u- and v-components of the wind

PARAMETER :

This data set has more than one parameter. The parameters available are shown below with their associative level types. Select one or more parameter values

**LEVEL :**

This data set has more than one level type per parameter. Each parameter, however, is only available at certain levels. Check the chart of [Valid Parameter/Level/Forecast Combinations](#), and then select level values that are available

**FORECAST_TIME : (Tau (Hours since model analysis))**

This data set is available at various forecast times. Select all forecast times desired.



Figure 5. The parameter, level, and forecast time menus from the NRL Monterey, CA web site.

All are required at isobaric levels; the height levels should be selected at 100 to 1000 hPa. Next, three forecast times must be selected. Typically, the 0-, 12-, and 24-hour forecasts are selected; however, if the user wanted a longer forecast period, the 12-, 24-, and 36-hour forecasts can be selected. Once all of the options have been chosen, the user can either:

- wait for an email from NRL indicating the file is ready or
- use the file transfer protocol (FTP) pickup link (fig. 6)

If the user is obtaining recent data, FTP pickup is preferable, because the GRIB file will typically be ready in minutes.

ARL/BED WSMR MET DATA CENTER

FTP directory /receive/mel/pickup at ftp.nrlmry.navy.mil

Up to higher level directory

<p>Download/Request *NOGAPS data (NRL) *raob data (U of WY) *surface met data (FSU)</p> <p>FTP Pickup *NOGAPS (NRL)</p> <p>Upload to Server *NOGAPS data file for BFM *NOGAPS order message text *NOGAPS file for MMS *raob data file *surface met data file</p> <p>Reformat for BFM *NOGAPS data raob data *surface met data</p> <p>Help *Battlescale Forecast Model (BFM) *Which NOGAPS data to request for BFM? *Which NOGAPS data to request for MMS? *Requesting raob data *Requesting surface met data</p> <p>Run ** MMS **</p>	<p>11/27/2001 02:39PM 47,034 AFNATAFS1006900720.ASCII</p> <p>11/28/2001 02:43PM 47,034 AFNATAFS1006987344.ASCII</p> <p>11/29/2001 02:16PM 47,034 AFNATAFS1007072117.ASCII</p> <p>11/30/2001 12:07PM 47,034 AFNATAFS1007150778.ASCII</p> <p>11/27/2001 11:41AM 399,360 MEL_afva-20210-o.tar</p> <p>11/27/2001 11:50AM 3,205,120 MEL_afva-20211-o.tar</p> <p>11/28/2001 02:34PM 399,360 MEL_afva-20213-o.tar</p> <p>11/28/2001 02:53PM 3,696,640 MEL_afva-20214-o.tar</p> <p>11/28/2001 02:54PM 184,320 MEL_afva-20216-o.tar</p> <p>11/28/2001 06:06PM 6,717,440 MEL_afva-20217-o.tar</p> <p>11/28/2001 05:29PM 122,880 MEL_afva-20218-o.tar</p> <p>11/29/2001 02:33AM 10,240 MEL_afva-20219-o.tar</p> <p>11/29/2001 12:50PM 378,880 MEL_afva-20220-o.tar</p> <p>11/29/2001 01:16PM 3,717,120 MEL_afva-20221-o.tar</p> <p>11/29/2001 06:55AM Directory navo</p> <p>11/27/2001 05:34PM Directory nrlm-181720-o</p> <p>11/29/2001 10:26AM Directory nrlm-181721-o</p> <p>11/29/2001 03:43PM Directory nrlm-181722-o</p> <p>11/29/2001 11:06PM Directory nrlm-181723-o</p> <p>11/30/2001 03:13AM Directory nrlm-181724-o</p> <p>11/27/2001 10:07AM Directory nrlm-182537-o</p> <p>11/27/2001 11:22AM Directory nrlm-182544-o</p> <p>11/27/2001 11:35AM Directory nrlm-182545-o</p> <p>11/27/2001 08:49PM Directory nrlm-182577-o</p> <p>11/27/2001 08:49PM Directory nrlm-182578-o</p> <p>11/27/2001 08:51PM Directory nrlm-182581-o</p> <p>11/27/2001 08:50PM Directory nrlm-182583-o</p>
---	---

Figure 6. NOGAPS FTP pickup site at NRL.

Next, the user must upload the NOGAPS GRIB file to the server; a form is displayed when the “NOGAPS data file” link under “Upload to Server” is used (fig. 7). After completing the form, the user selects upload; a Perl script is activated which transfers the NOGAPS file from the local system to the server. The file is untarred (broken into individual files) and on the server.

File Uploading

Upload this NOGAPS file to the server

[Back to home page](#)

Figure 7. NOGAPS file upload.

Now the data can be converted into BFM format by clicking on “NOGAPS data file” under “Reformat for BFM”. Two forms are available for the user to input data: the “short form” (fig. 8) and the “long form” (fig. 9).

ARL/BED WSMR MET DATA CENTER

Download/Request
 *NOGAPS data (NRL)
 *raob data (11 of WY)
 *surface met data (FSU)
 FTP Pickup
 *NOGAPS (NRL)
 Upload to Server
 *NOGAPS data file
 for BFM
 *NOGAPS order
 message text
 *NOGAPS file for MMS
 *raob data file
 *surface met data file
 Reformat for BFM
 *NOGAPS data
 message text
 *NOGAPS file for MMS
 *raob data file
 *surface met data file
 Help
 *Battlescale Forecast
 Model (BFM)
 *Which NOGAPS data
 to request for BFM?
 *Which NOGAPS data
 to request for MMS?
 *Requesting raob data
 *Requesting surface met
 data
 Run
 ** MMS **

The NOGAPS Data Processing Program

central latitude (decimal degrees, (-) for Southern Hemisphere) (ex. -90.0)
 central longitude (decimal degrees, (-) for west longitudes) (ex. -180.0)
 grid spacing (in km)
 grid size

[Back to home page](#)

Figure 8. NOGAPS short form.

ARL/BED WSMR MET DATA CENTER

Download/Request
 *NOGAPS data (NRL)
 *raob data (11 of WY)
 *surface met data (FSU)
 FTP Pickup
 *NOGAPS (NRL)
 Upload to Server
 *NOGAPS data file
 for BFM
 *NOGAPS order
 message text
 *NOGAPS file for MMS
 *raob data file
 *surface met data file
 Reformat for BFM
 *NOGAPS data
 message text
 *NOGAPS file for MMS
 *raob data file
 *surface met data file
 Help
 *Battlescale Forecast
 Model (BFM)
 *Which NOGAPS data
 to request for BFM?
 *Which NOGAPS data
 to request for MMS?
 *Requesting raob data
 *Requesting surface met
 data
 Run
 ** MMS **

The NOGAPS Data Processing Program

Process ID
 central latitude (decimal degrees, (-) for Southern Hemisphere) (ex. -90.0)
 central longitude (decimal degrees, (-) for west longitudes) (ex. -180.0)
 grid spacing (in km)
 grid size
 1st output filename (format: ddMmmhhz.gsm, for ex. 12Aug12z.gsm)
 2nd output filename (ex. 13Aug00z.gsm)
 3rd output filename (ex. 13Aug12z.gsm)
 Enter time of NOGAPS model run (format: yyyyymmddhh, where hh is UTC time (00/12))
 # of hrs of forecast represented by 1st file

[Back to home page](#)

Figure 9. NOGAPS long form.

The short form is used when the user has saved the order text from NRL and uploaded it to the server. When the user orders NOGAPS data, there is a button to “see text of order”. This order text contains all the pertinent information including model run time(s) that have been selected. Therefore, the user will not need to input any time information;

it can be culled from the order text uploaded to the server (fig. 8). The user will input only information pertaining to the geometry of the BFM run. If the user; however, has not saved the order text and uploaded it to the server, additional input to the long form is required (fig. 9). Specifically, the user will have to input

- three output file names
- the model run time
- the number of forecast hours (If the analysis field is being used, select 0; if the initial NOGAPS file represents a 12 hour forecast, select 12.)

Also required on the long form are the:

- “Process ID”, a unique numeric identifier assigned by NRL to the NOGAPS request
- central latitude and longitude values of the area of interest
- grid spacing (kilometers) and the grid size (81x81 or 161x161)
- three output filenames for the three forecast periods

After completing and submitted the selected form (short or long), a Perl program:

1. concatenates each of the files representing a particular parameter at a particular isobaric level and forecast time, into one large file
2. initiates a GRIB decoder (a C-code version written by NRL contractor, SAIC) and converts the GRIB file into an ASCII file
3. initiates the FORTRAN code

This FORTRAN code converts the ASCII file, which contains the forecasted parameters for multiple atmospheric levels for the entire world, into a series of vertical profiles contained within the area of interest. The FORTRAN code then:

1. calculates the latitude and longitude values for the grid, designated by the user through the HTML form
2. calculates by interpolation the geopotential heights for the third and fifth vertical layers
3. chooses the NOGAPS grid points, which are located within the area of interest

The entire process takes approximately 1 minute (fig. 10), which is over an order of magnitude faster than when this transformation was done manually.

```

Download/Request
*NOGAPS data (NRL)
*raob data (U of WY)
*surface met data (FSM)
FTP Pickup
*NOGAPS URL
Upload to Server
*NOGAPS data file
for BFM
*NOGAPS order
message text
*NOGAPS file for MMS
*raob data file
*surface met data file
Reformat for BFM
NOGAPS URL
NOGAPS URL
NOGAPS URL
Help
*Eartlescale Forecast
Model (BFM)
*Which NOGAPS data
to request for BFM?
*Which NOGAPS data
to request for MMS?
*Requesting raob data
*Requesting surface met
data
Run
** MMS **

```

NOGAPS PROCESSING

Your inputs were

- [processid] = [108222]
- [latitude] = [32]
- [longitude] = [-106]
- [grdspace] = [10]
- [file1] = [16May00z.gsm]
- [file2] = [16May12z.gsm]
- [file3] = [17May00z.gsm]
- [date] = [1999051600]
- [grd-size] = [81x81]

<< GRIB file concatenation took: 4 wallclock secs (0.03 usr 0.04 sys + 0.75 cusr 3.32 csys = 4.14 CPU)>>

<< GRIB decoding took: 34 wallclock secs (0.00 usr 0.00 sys + 31.20 cusr 1.14 csys = 32.34 CPU)>>

<< NOGAPS file extraction took: 36 wallclock secs (0.00 usr 0.00 sys + 33.85 cusr 0.62 csys = 34.47 CPU)>>

Look for your output NOGAPS files in ~skirby/caambfm/nogaps/Nogaps/BFMDATA/1999051600/

Figure 10. Results for NOGAPS processing for BFM.

3.0 Upper-Air Data Preparation

When “raob data (University of WY)” is selected (fig. 3, left-hand menu), the user is linked to the Internet site as depicted in figure 11. From this site, the user can select a particular location such as EPZ, the raob taken at Santa Teresa, NM in close proximity to El Paso, TX. The raob format is shown in figure 12.

Region: Type of plot: Year: Month: From: To:

Click on the image to request a sounding at that location or enter the station number below

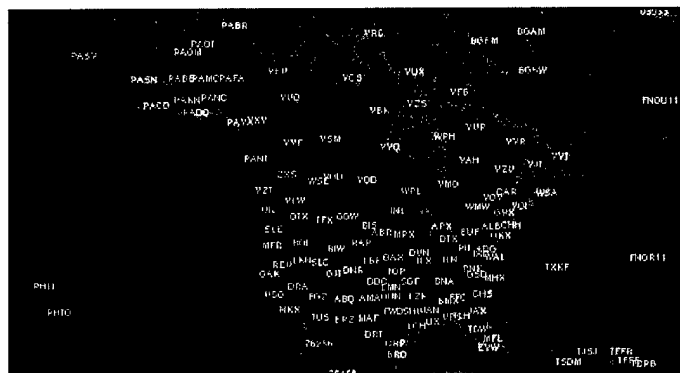


Figure 11. University of Wyoming upper-air data download Internet site.

72364 EPZ Santa Teresa Observations at 12Z 26 Sep 2001

PRES hPa	HGHT m	TEMP C	DUPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
1000.0	121									
925.0	807									
879.0	1252	14.6	2.6	44	5.28	105	6	298.6	314.5	299.5
859.0	1447	19.0	1.0	30	4.81	137	10	305.1	320.1	306.0
851.3	1524	19.0	0.1	28	4.56	150	12	305.9	320.2	306.8
850.0	1537	19.0	0.0	28	4.52	150	12	306.0	320.2	306.9
821.3	1829	17.2	-1.2	29	4.29	190	9	307.1	320.7	307.9
792.3	2134	15.3	-2.4	29	4.06	270	2	308.3	321.2	309.1
764.4	2438	13.4	-3.6	30	3.84	55	1	309.4	321.8	310.2
761.0	2476	13.2	-3.8	30	3.81	64	1	309.6	321.8	310.3
737.1	2743	12.5	-18.4	10	1.22	130	5	311.7	315.9	311.9
732.0	2802	12.4	-21.6	8	0.93	131	5	312.2	315.4	312.4
700.0	3174	9.6	-14.4	17	1.80	135	8	313.1	319.2	313.4
659.1	3658	6.2	-18.2	15	1.39	115	8	314.7	319.5	315.0
611.1	4267	2.0	-23.0	14	0.99	100	9	316.7	320.2	316.9
588.4	4572	-0.2	-25.4	13	0.83	100	12	317.6	320.6	317.8
566.5	4877	-2.3	-27.8	12	0.69	95	10	318.6	321.1	318.7
524.0	5505	-6.7	-32.7	11	0.47	51	6	320.5	322.2	320.6
500.0	5870	-7.5	-40.5	5	0.22	25	4	323.8	324.7	323.9
485.3	6096	-9.5	-41.0	6	0.22	0	7	324.1	325.0	324.2

Figure 12. EPZ raob for 26 September 2001.

After the raob data is displayed in the browser (Netscape or Internet Explorer [IE] it can be saved to the user's local system.* Whichever browser is used, the user must ensure that the file name suffix is ".txt;" otherwise, the Perl programs will not recognize the file.

* The method used to create a text file that can be saved to the user's local system is determined by which browser is being used, Netscape or IE. In Netscape, the user selects "File -> Save As" and then selects the "Plain Text" file type option. If IE is being used, the save as file type is "text file".

The user then selects Upload to Server, then the link called raob data. A form will be displayed (fig. 13) similar to the NOGAPS data file upload. From here, the user can browse their system for the saved file, load it, and then click on upload, which uploads the file to the server within seconds (fig. 14).

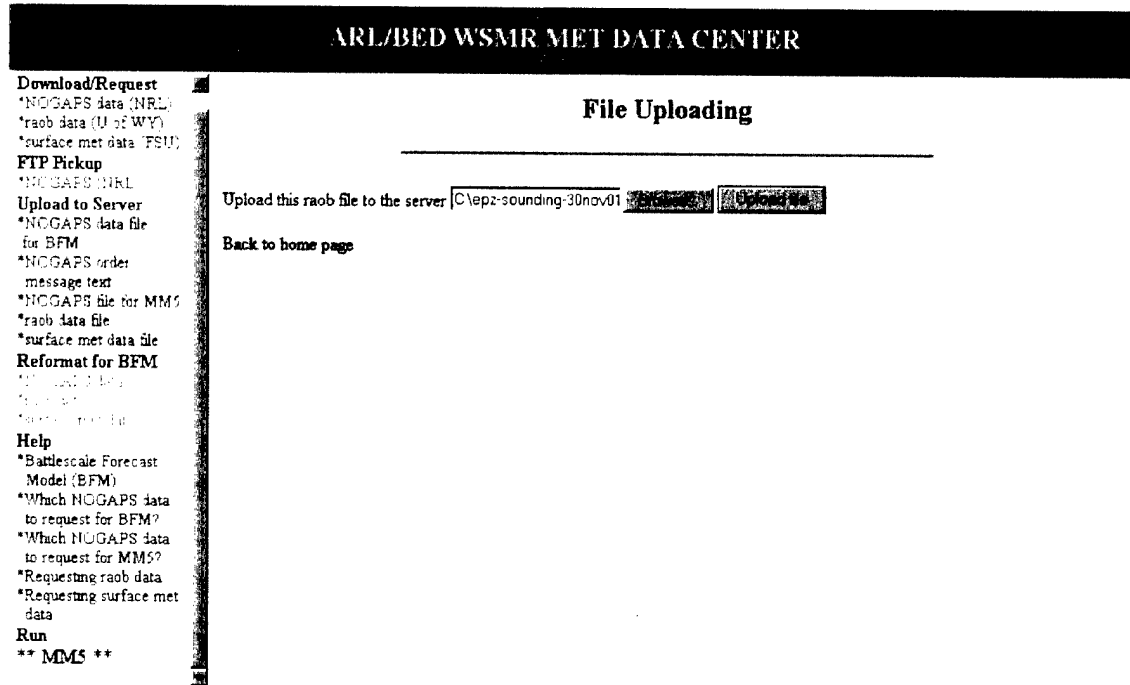


Figure 13. The raob upload form.

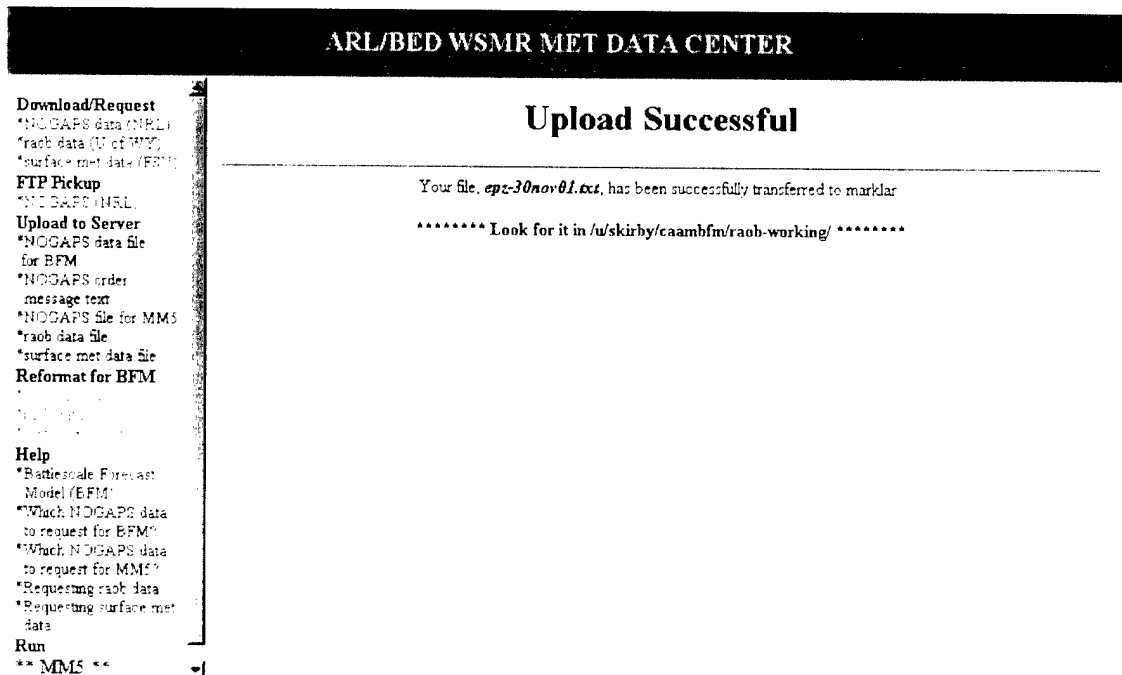


Figure 14. Results from a raob upload.

This process can be repeated any number of times; each selected raob will be sent to a "holding" area on the server. To reformat these raobs for BFM, the user will select Reformat for BFM, then the link raob data, which triggers a Perl program that calls C code. This C code parses through each of these text raobs and concatenates them into one file that is readable by the BFM. Prior to the creation of this web site, the user had to know where to deposit the raob files, and how to create the appropriate input file to a FORTRAN executable. Now, the problem has been reduced to uploading n number of raobs (all valid at the same time) and selecting "create uamet.d" in an HTML form (fig. 15).

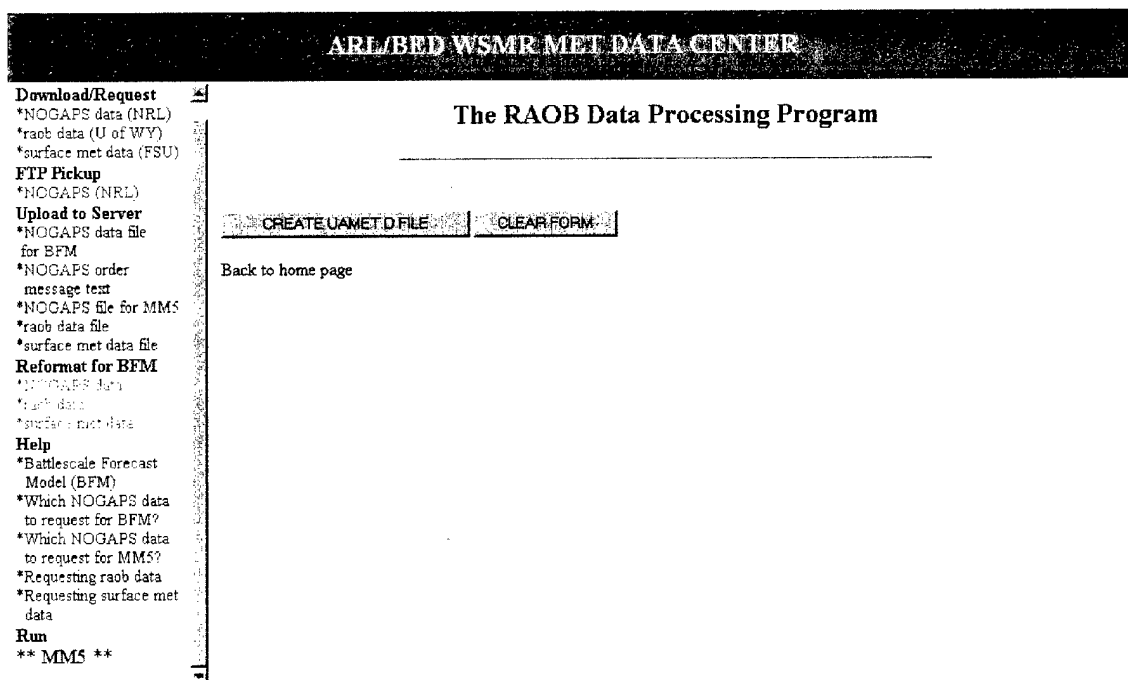


Figure 15. The raob processing form.

All of the relevant date/time information is extracted from the data files. Then, within seconds, the raob files are ready for BFM ingest (fig. 16).

```

Download/Request
*NOGAPS data (NRL)
*raob data (U of WY)
*surface met data (FSU)
FTP Pickup
*NOGAPS (NRL)
Upload to Server
*NOGAPS data file
for BFM
*NOGAPS order
message text
*NOGAPS file for MM5
*raob data file
*surface met data file
Reformat for BFM
*NOGAPS order
message text
*NOGAPS file for MM5
*raob data file
*surface met data file
Help
*Battle-scale Forecast
Model (BFM)
*Which NOGAPS data
to request for BFM?
*Which NOGAPS data
to request for MM5?
*Requesting raob data
*Requesting surface met
data
Run
** MM5 **

```

RAOB PROCESSING

Your job took: 1 wallclock secs (0.00 usr 0.00 sys + 0.03 cusr 0.10 csys = 0.13 CPU)

Look for your uamet.d file under --skirby/caambfm/processed-raob-data/(year)/(UT hour)

Figure 16. Results form for raob processing.

4.0 Surface Meteorological Data

Surface meteorological data are obtained from a FSU Internet site known as the “text weather utility” (fig. 17).

The user should select the bulletin type, “METAR decoded” (fig. 17); figure 18 is a sample display of this selection for the station, KELP (El Paso, TX). The METAR-decoded file is preferable to the non-decoded METAR file because the non-decoded METAR file contains a single line, which is a mix of both numbers and text codes and cannot be easily translated.

It is important to note that multiple hours of surface data can be requested; however, only one hour can be requested at a time. This restriction is necessary because the C function only reads the first line of data. Therefore, if a file contained observations for the last three hours, only the top line would be used, which is the three-hour-old data.

The same file-saving distinctions when using Netscape and IE for the raob data are also necessary when saving the METAR files: in Netscape the file can be saved as plain text, while in IE, the “text file” option must be used. For both browsers, the filename suffix must be “.txt”.

FSU METEOROLOGY

TEXT WEATHER UTILITY

This form makes use of the UNIDATA Weather program by Peter P. Neilley and the University Corporation for Atmospheric Research (UCAR) for the purpose of extracting weather information from the National Weather Service bulletins available on the Family of Services.

All data can be found in the [FSU Meteorology Data Archive](#).

Command: <bulletin type> <station identifier> [time]

Bulletin type: meter decoded

Station { TLH KTLH TAE KTAE } or State { @FL } Identifier
or SHOW to list available stations: kelp

Time: latest

Submit Reset

NOTE: Retrieving data further back than 24 hours can take up to a minute to process and display. Please be patient.

© Florida State University / Department of Meteorology, 2000
Send comments or problems to webmaster@met.fsu.edu

Figure 17. FSU "text weather utility".

Courtesy of

FSU METEOROLOGY

STN	TIME	VIS	PRESS	ALTR	THP	DEW	RH	DIR	SPD	GST	WEATHER	CLOUDS	REMARKS
KELP	1651	10	1016.6	30.19	22.0	-1.0	22	000	0	-99		CLR	A02 SLP166 TD2171006=

Florida State University / Department of Meteorology
Send comments or problems to webmaster@met.fsu.edu

Figure 18. Decoded METAR surface meteorological data for station KELP.

The same steps used for NOGAPS and raob data are used to select and upload the correct surface meteorological data file. The user will select Upload to Server, then the "surface met data file" link, and then browse their system for the file. As in the case of raobs, the user can upload any number of surface met data files (fig. 19), which will be sent to a "holding" directory, ready for processing (fig. 20). To reformat these files for BFM, the user will select Reformat for BFM, then the "surface met data" link.

ARL/BED WSMR MET DATA CENTER

Download/Request
*NOGAPS data (NRL)
*raob data (U.S. WFO)
*surface met data (FSU)
FTP Pickup
*NOGAPS (NRL)
Upload to Server
*NOGAPS data file
for BFM
*NOGAPS order
message text
*NOGAPS file for MMS
*raob data file
*surface met data file
Reformat for BFM
*NOGAPS file
*raob file
*surface met file
Help
*Battlescale Forecast
Model (BFM)
*Which NOGAPS data
to request for BFM?
*Which NOGAPS data
to request for MMS?
*Requesting raob data
*Requesting surface met
data
Run
** MMS **

File Uploading

Upload this surface met file to the server [C:\abq_12jan01_sfc.txt] [] []

[Back to home page](#)

Figure 19. Surface met file upload form.

ARL/BED WSMR MET DATA CENTER

Download/Request
*NOGAPS data (NRL)
*raob data (U.S. WFO)
*surface met data (FSU)
FTP Pickup
*NOGAPS (NRL)
Upload to Server
*NOGAPS data file
for BFM
*NOGAPS order
message text
*NOGAPS file for MMS
*raob data file
*surface met data file
Reformat for BFM
*NOGAPS file
*raob file
*surface met file
Help
*Battlescale Forecast
Model (BFM)
*Which NOGAPS data
to request for BFM?
*Which NOGAPS data
to request for MMS?
*Requesting raob data
*Requesting surface met
data
Run
** MMS **

Upload Successful

Your file, *abq_12jan01_sfc.txt*, has been successfully transferred to marklar

***** Look for it in /u/skirby/caambfm/sfc-working/ *****

Figure 20. Surface met file upload results form.

The form for reformatting surface met data (fig. 21) triggers a Perl program. (The year, month, and day are requested for this form because these parameters are not available within the data file.) The Perl program calls on C code that parses each of these files and then writes the reformatted data to one file. The reformatted data file is then ready for BFM ingest.

Download/Request
 *NOGAPS data (NRL)
 *raob data (U of WY)
 *surface met data (FSU)
FTP Pickup
 *NOGAPS (NRL)
Upload to Server
 *NOGAPS data file
 for BFM
 *NOGAPS order
 message text
 *NOGAPS file for MMS
 *raob data file
 *surface met data file
Reformat for BFM
 *NOGAPS data
 *raob data
 *surface met data
Help
 *Battlescale Forecast
 Model (BFM)
 *Which NOGAPS data
 to request for BFM?
 *Which NOGAPS data
 to request for MMS?
 *Requesting raob data
 *Requesting surface met
 data
Run
 ** MMS **

The Surface Met Data Processing Program

year of surface met data format: yyyy (ex: 2000)
 day and month of surface met data format: ddMmm (ex: 17Nov)

[Back to home page](#)

Figure 21. HTML form used to reformat decoded METAR surface meteorological data into BFM format.

After the form has been submitted, the surface met data file will be available; the location on the server will be shown on the results page (fig. 22).

Download/Request
 *NOGAPS data (NRL)
 *raob data (U of WY)
 *surface met data (FSU)
FTP Pickup
 *NOGAPS (NRL)
Upload to Server
 *NOGAPS data file
 for BFM
 *NOGAPS order
 message text
 *NOGAPS file for MMS
 *raob data file
 *surface met data file
Reformat for BFM
 *NOGAPS data
 *raob data
 *surface met data
Help
 *Battlescale Forecast
 Model (BFM)
 *Which NOGAPS data
 to request for BFM?
 *Which NOGAPS data
 to request for MMS?
 *Requesting raob data
 *Requesting surface met
 data
Run
 ** MMS **

SURFACE MET PROCESSING

Your inputs were:

- [year]=[2001]
- [day_month]=[12Jan]

Your job took: 0 wallclock secs (0.00 usr 0.00 sys + 0.02 cusr 0.08 csys = 0.10 CPU)

Look for your sfcmet.d file under ~skirby/caambfm/processed-sfc-data/2001/12Jan2001

Figure 22. Surface met file-processing results.

5.0 Help Section

A brief description of each of the web site's five "help" sections is presented below:

1. provides some background on the BFM, including its history and a brief description on the physical processes modeled
2. describes, for the user, exactly which parameters, height levels, and forecast cycles are required when ordering NOGAPS data for BFM
3. details the NOGAPS parameters that are required to run MM5
4. outlines the methods for saving the raob file (University of Wyoming Internet site) when a Netscape or an IE browser is used
5. describes the methods for saving the surface meteorological data (FSU Internet site) when a Netscape or an IE browser is used

6.0 MM5 Execution

The ability to execute mesoscale models, specifically mesoscale model (version 5) (MM5), through a web site is the most recent addition to this site and is a partial implementation of the first phase of the MEET.

Figure 23 shows the input form to run MM5. The user must enter the:

- job id which identifies the particular NOGAPS run that has been uploaded to the server and untarred
- central latitude/longitude identity of the domain
- number of nests
- model start and end times

When future revisions of this web site are made, other user inputs need to be added to this form, such as the terrain domain boundaries (currently set for the Utah area). However, for this initial testing phase, most of the input parameters have been “hardwired”, including the number of nests, which is set to five. Their sizes are:

- 35x41 grid points (81 km grid spacing)
- 49x52 (27 km resolution)
- 46x46 (9 km resolution)
- 43x43 (3 km resolution)
- 40x40 (1 km resolution)

ARL/BED WSMR MET DATA CENTER

Download/Request
 *NOGAPS data (NRL)
 *raob data (U of WY)
 *surface met data (FSU)

FTP Pickup
 *NOGAPS (NRL)

Upload to Server
 *NOGAPS data file for BFM
 *NOGAPS order message text
 *NOGAPS file for MMS
 *raob data file
 *surface met data file

Reformat for BFM
 *NOGAPS data
 *raob data
 *surface met data

Help
 *Battlescale Forecast Model (BFM)
 *Which NOGAPS data to request for BFM?
 *Which NOGAPS data to request for MMS?
 *Requesting raob data
 *Requesting surface met data

Run
 ** MMS **

MM5 Execution

Enter the MEL job id for the NOGAPS file

Enter the central latitude for AOI (decimal degrees, (-) for Southern Hemisphere) (ex. -90.0)

Enter the central longitude for AOI (decimal degrees, (-) for west longitudes) (ex. -180.0)

Enter the number of nested grids (1-5)

Enter the time interval of model input (sec)

Start Year

Select the month for model start

Select the day for model start

Select the hour for model start

End Year

Select the month for model end

Select the day for model end

Select the hour for model end

Figure 23. Inputs required to run MM5.

Figure 24 is the output from a MM5 run. The output presents the user's inputs, then a considerable amount of program output, which the user can observe during the model run. Finally, the timing results for each aspect of the MM5 run and the conversion to Vis5d format are provided (fig. 25).

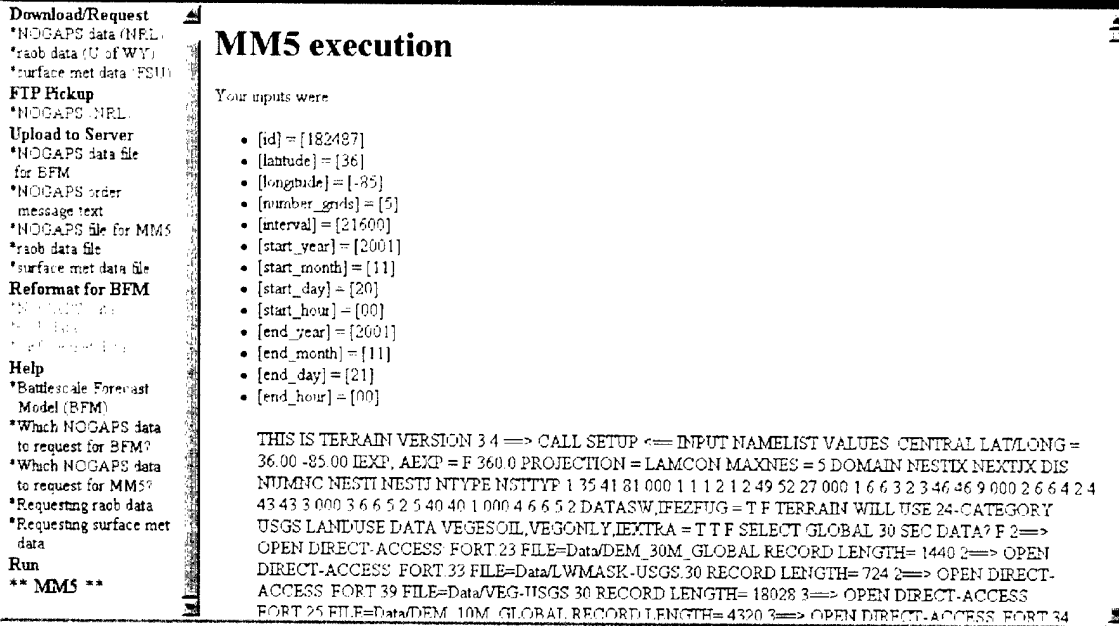


Figure 24. Top portion of the results screen after MM5 execution indicating user inputs.

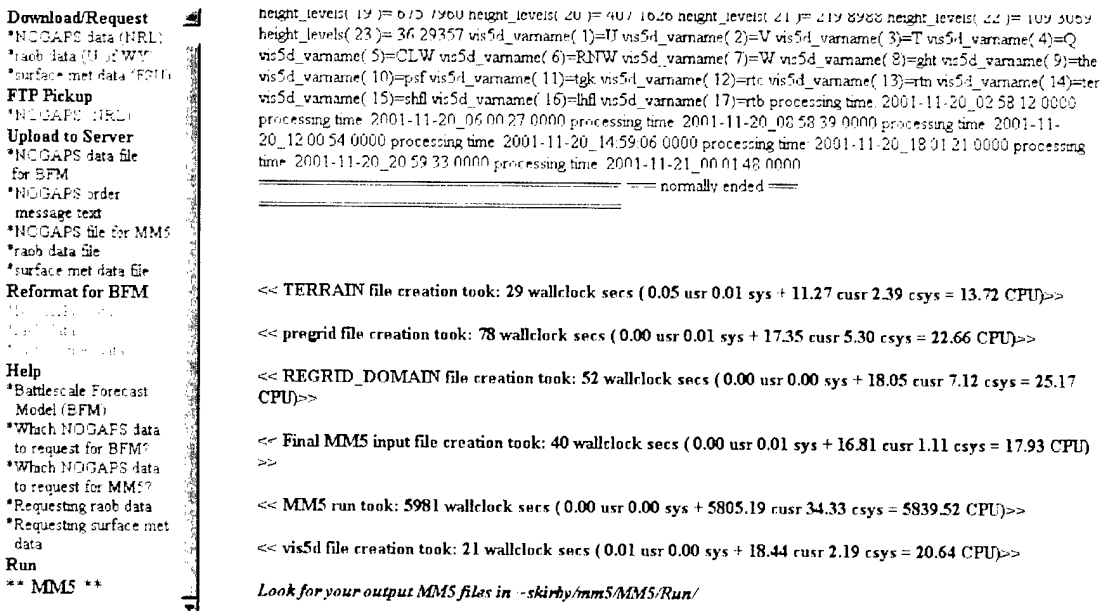


Figure 25. Bottom portion of MM5 execute form indicating timing results.

7.0 Applications of the Web-Based Meteorological Data Processing Tool

When preparing NOGAPS files for BFM research, ARL researcher, Dr. Teizi Henmi, utilized this web site. Using a Netscape browser (all of the author's development had been done in IE) proved quite beneficial as well. The author soon discovered that the data passed back from a form in a Netscape browser did not always match up what was passed back from a form in an IE browser, particularly when it came to certain symbols. Thus, his beta testing was extremely helpful.

Another ARL researcher, Mr. Terry Jameson, utilized this Internet site extensively for five field tests and a conference held at Yuma Proving Grounds, AZ for "Paradrop" testing where payloads are dropped by parachute. For this project, accurate wind prediction was required, thus BFM was employed.

8.0 Conclusions

The web site discussed in this report, which creates BFM-readable input files from various meteorological source data, considerably streamlines a very unwieldy, time-consuming process. The original process involved awkward shell script and C and FORTRAN code modifications, input file creation, and recompilations that were too convoluted and error-prone and was only known to a very small group of ARL personnel. Thus, this new web site really serves two purposes, it:

1. replaces the "old" way of processing data for BFM with a much faster and efficient method of
2. potentially enlarges the BFM user community by including new users who, though totally unfamiliar with BFM and its inputs, can endeavor to gather the appropriate data and run BFM

A MEET is being developed for various model outputs that will allow for the

- preparation of model inputs
- execution of models
- statistical analysis
- graphical display
- data basing

The MEET will be hosted on a tactical computer (now under construction) since all of the mesoscale models developed today take advantage of parallel processing computation. As shown in this report, MM5 can now be run through this web site. Much has been learned in development of the current web site; the knowledge gained will be useful as the MEET is constructed.

In addition to a statistical analysis capability, other enhancements are planned. They include, but are not limited to,:

- allowing for more than three NOGAPS files when preparing the data for BFM
- giving the user more than two grid sizes when preparing NOGAPS for BFM
- overcoming an unlikely but possible problem with concurrent users (Surface and upper-air data files are currently written to “generic” holding directories prior to processing and could be inadvertently overwritten by another user trying to process the same type of data.)
- developing a method whereby users can easily extract their processed data or model output
- adding other models besides MM5. (The WRF is currently being integrated, and another natural addition would be BFM.)
- providing feedback to users as to the quality of their input data. (For example, if too many levels of dew point data were missing, the user would be notified that a given model would not use this particular file.)
- for the MM5 execution, giving the user the capability to specify their domain.

Other parameter choices may be added depending on results from future testing.

Appendix

Code Description

The login form limits web site access to authorized users only. It is created due the presence of a ".htaccess" file and designates which users are authorized to use this web site. It in turn points to a "password" file, generated with a UNIX utility, containing the authorized username(s) and the encrypted password(s). The lead-in page to the web site links the user to the main page for data processing/MM5 execution as well as to the Army home page and the U.S. Army Research Laboratory home page.

The "main page" provides the user can access all of the functionality needed to obtain and process data and ask for help if needed. This page is composed of three frames the:

1. "top" which shows the site title (*top.html*)
2. the left frame which links to data manipulation, help, etc. (*content.html*)
3. the "main" frame which contains information about the site (*main.html*)

The key functionality flows from the left hand frame of the "main page", as it links to other HTML documents which in turn link to other HTML documents and call on Perl programs. Within the Download/Request section are three links to the:

1. Master Environmental Library web site which in turn links one to the NRL site,
2. University of Wyoming raob web site
3. FSU "text weather utility" where surface data is available

The next section, FTP Pickup, links the user to an NRL FTP server, then the NOGAPS data can be downloaded. Upload to Server consists of five parts:

1. BFM NOGAPS:links to *upload-nogaps-bfm.html* which presents a form asking for a file to upload. Selecting the Submit button calls the Perl program, *upload-nogaps-bfm.pl*, and transfers the NOGAPS data from the user's local system to a holding directory on the server.
2. BFM NOGAPS: order message text:links to *nogaps_order_msg_text.html*, which asks for a NOGAPS order message text file to upload. Submission of this information triggers a Perl program, *upload-nogaps-order-message-text.pl*, which transfers this text file to the server. The user will be required to input significantly fewer parameters in the BFM NOGAPS processing form, if the user is able to obtain and upload this file.
3. MM5 NOGAPS: links to *upload-nogaps-mm5.html* which presents a form asking for a file to upload. Selecting the Submit button calls the Perl program, *upload-nogaps-mm5.pl*, which transfers the NOGAPS data from the user's local system to a holding directory on the server.

4. raob Data: links to *raob.html* which produces a form requesting a raob filename to upload; submission of this form triggers the Perl program, *upload-raob.pl*, which transfers the raob file to a holding directory on the server.
5. Surface Data: links to *upload_sfc.html*; when the user selects a file with surface reports and submits the form, the Perl program, *upload-sfc.pl*, is activated which places the surface meteorological data onto the server.

The section, Reformat for BFM, consists of three sections:

1. NOGAPS: links the user to *nogaps_question.html* which presents a page asking the user whether they need the “short” form or the “long” form. Selection of “short” form links to *nogaps_process_short.html* which launches an HTML form. The user inputs the central latitude and longitude, grid size, and a grid resolution. Submission of this form initiates the Perl program, *morebasic_short_form.pl*, which does the file concatenation, creates the appropriate input files from the user inputs, calls a C program to perform the GRIB decoding, and then calls a FORTRAN program to do the sounding extraction as described earlier. If the user chooses this option, it is assumed they have already uploaded the NOGAPS order message text from which data and time information can be extracted.

- If the user chooses “long form”, a link to *nogaps_process_long.html* is established, and the user fills in the same information as in the short form plus three output filenames, NOGAPS-model run time, and whether the 0-hr analysis or the 12-hour forecast is selected. Once this form is submitted, the Perl program, *morebasic.pl*, generates the reformatted NOGAPS data. Regardless of which initial form is chosen (long or short), the FORTRAN program called up will be

- *read_nogaps_caam.f*, if the user selects grid size 81x81

- *read_nogaps_imets.f*, if the user selects grid size 161x161

(The *caam* refers to Computer-Assisted Artillery Meteorology. For artillery meteorology, a user is typically interested in smaller grid sizes.)

2. Raob data: links the user to *raob-process.html*, which allows the user to create the raob file. Submitting this form starts the Perl program, *raob-process.pl*, which calls a C program that takes all of the raobs in the holding directory on the server, reads in the relevant data, and creates an output file for BFM on the server.
3. Surface data: links the user to *sfc_process.html*, which provides a form requesting year, month, and day information. When this information is submitted, the Perl code, *surface.pl*, is triggered, which parses the surface met files on the server and reformats them into one BFM-readable file.

The Help area consists of five parts:

1. BFM: links to a static HTML page, *bfm.html*, showing BFM origins and a description of some of the mechanics of the 3-d objective analysis, the first part of a BFM run, and the BFM itself.

2. BFM NOGAPS: links to *nogaps_order-bfm.html*, which delineates precisely which parameters are required for BFM and which height levels plus what forecast cycles are needed.
3. MM5 NOGAPS: links to *nogaps_order-mm5.html*, and describes which parameters are required for MM5 and which height levels plus what forecast cycles are needed.
4. Raob data: links to *raob_order.html*, which provides instruction for saving the data depending on whether the user's browser is Netscape or IE.
5. Surface data: links to *sfc_order.html* which, as in item 3 above guide the user on how to save the surface data file with this again being dependent on the browser being used.

The last option is running the MM5. Selecting "Run" under the MM5 header, will display the form described by *mm5_execute.html*. When the user enters all the field data and submits the form, a Perl program, *mm5_execute.pl*, activates. The Perl program segments are as follows:

- a. echo user inputs
- b. verify no user inputs are missing
- c. get the appropriate NOGAPS files into a holding area directory
- d. move to the TERRAIN directory, create the *terrain.namelist* file and run *terrain.exe* to create TERRAIN.DOMAIN (nest number) files for each nest. (These files are created by horizontally interpolating latitude/longitude terrain elevation and land-use data onto the chosen mesoscale domain grids.)
- e. Move to the PREGRID directory, create the *pregrid.namelist* file, and run *pregrid_grib.exe*. This program reads start/end times from the namelist file and the desired time interval and then extracts the large-scale data as specified in the "Vtable" file pertinent to the model type (in this case, NOGAPS). Also, within the Perl code, the generically named NOGAPS files, GRIBFILE.AA, GRIBFILE.AB, etc., have to be symbolically linked to the "real" NOGAPS files.
- f. Move to the REGRIDDER directory, create the *namelist.input* file; run *regridder* executable. Regrid reads the pregrid output on pressure levels and interpolate the analyses from the native grid and map projection (in this case that of NOGAPS) to the grid and map projection the user has defined in the TERRAIN module.
- g. Move to the INTERPF directory, create the *namelist.input* file; run *interp* executable. Interpf takes the regrid output and generates model initial, lateral boundary condition, and a lower boundary condition.
- h. The "mmlif" file is created. (This is where the *mm5.exe* program gets all of its information such as domain dimensions, model forecast times, central latitude/longitude, nesting configuration, etc.) MM5 can now be run.

- i. The output MM5 files for each domain are converted to Vis5d format to enable visualization by that program. A utility called "tovis5d" made available through the MM5 Home Page at UCAR was used for this portion. The ability to view the resultant vis5d viewable files from the web site is to be implemented.

Acronyms

ARL	Army Research Laboratory
ASCII	American Standard Code for Information Interchange
BFM	Battlescale Forecast Model
CAAM	computer-assisted artillery meteorology
CGI	Common Gateway Interface
FTP	File Transfer Protocol
GRIB	Gridded Binary
HTML	HyperText Markup Language
IE	Internet Explorer
IMETS	Integrated Meteorological System
MEET	Model Execution and Evaluation Tool
MEL	Master Environmental Library
MM5	mesoscale model (version 5)
NOGAPS	Navy Operational Global Atmospheric Prediction System
NRL	Naval Research Laboratory
raob	radiosonde observation
WRF	Weather Research and Forecasting (model)

REPORT DOCUMENTATION PAGE

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14. ABSTRACT In order to streamline and simplify the methodologies required to obtain and process the requisite meteorological data for mesoscale meteorological models such as the Battlescale Forecast Model (BFM) and mesoscale model Version 5 (MM5), a new method utilizing the Internet and Perl/Common Gateway Interface has been developed. In order to execute a mesoscale model, one must first gather "large-scale initialization data", one example is the Naval Operational Global Atmospheric Prediction System (NOGAPS) data. In order to process this NOGAPS data, numerous shell scripts and FORTRAN code required editing and recompilation. Unless the user was quite familiar with the shell scripts and FORTRAN code, this process was very convoluted and time-consuming. The same was true utilizing mesoscale model Version 5 radiosonde observation roab and/or surface meteorological data as inputs to a model. To circumvent these problems, an Internet site, was created to provide a simple means to both access and process NOGAPS, roab, and surface data. The backbone of this Internet site is Perl, which is a powerful script language.					
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