



NRL/FR/7440--04-10,030

Finland Air Force F/A-18 Moving-Map Composer (MMC) Version 3.4P, Software User's Manual

MAURA C. LOHRENZ
STEPHANIE A. MYRICK
MICHAEL E. TRENCHARD
MARLIN L. GENDRON
JESSICA L. WATKINS

*Mapping, Charting, and Geodesy Branch
Marine Geosciences Division*

April 9, 2004

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE				<i>Form Approved</i> <i>OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 09-04-2004		2. REPORT TYPE Formal		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Finland Air Force F/A-18 Moving-Map Composer (MMC) Version 3.4P, Software User's Manual				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Maura C. Lohrenz, Stephanie A. Myrick, Michael E. Trenchard, Marlin L. Gendron, and Jessica L. Watkins				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER 74-M008-02	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Research Laboratory Marine Geosciences Division Stennis Space Center, MS 39529-5004				8. PERFORMING ORGANIZATION REPORT NUMBER NRL/FR/7440--04-10,030	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) NAVAIR PMA-265				10. SPONSOR / MONITOR'S ACRONYM(S) NAVAIR	
				11. SPONSOR / MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT This report documents the Moving Map Composer (MMC) software system developed by scientists in NRL Code 7440.1. This is the third edition of the MMC User's Manual (the first and second editions are NRL/FR/7441--97-9677 and NRL/FR/7440--00-9983, respectively) and reflects changes that were implemented for the version 3.4P release of MMC.					
15. SUBJECT TERMS Moving Map Composer (MMC)					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UL	18. NUMBER OF PAGES 76	19a. NAME OF RESPONSIBLE PERSON Maura Lohrenz
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (include area code) 228-688-4611

CONTENTS

1. INTRODUCTION	1
2. SYSTEM CONFIGURATION.....	1
2.1 Hardware.....	1
2.2. Software	2
3. MMC GRAPHICAL USER INTERFACE	5
3.1 Starting MMC	5
3.2 Toolbars and Workspace Definitions.....	5
3.3 Top Menu Bar	12
4. COMMON MMC OPERATIONS	42
4.1 Loading and Selecting CDs in MMC.....	42
4.2 Process CAC	43
4.3 Archiving Data to CD	44
4.4 Logging CAC, Processed CAC (SCAC), and DTED CDs	45
4.5 Viewing Chart Data from a Processed CAC (SCAC) CD	46
4.6 Design, Build and Archive a New AODI and MPS-CDI.....	47
4.7 Add Data to an Existing Composition	50
4.8 Build an MPS CD with DTED and Processed CAC (SCAC) Data	51
ACKNOWLEDGMENTS	53
BIBLIOGRAPHY	53
APPENDIX A – FIAF MMC Components	57
APPENDIX B – Setting up the MMC Workstation	59
APPENDIX C – Installing a New Color Palette and Rebuild Composition	61
APPENDIX D – FiAF Map Data Format Interface.....	65
APPENDIX E – Glossary of Acronyms and Terms	67

TABLES

Table 1 – ID Numbers, System Names, and Locations of MMC Stations (as of 7/2002).....	6
Table B1 – FiAF MMC Device Listing at Boot Prompt	60
Table E1 – DTED Longitudinal Post Spacing (Level 1 vs Level 2)	69
Table E2 – TS Geographic Zones.....	70
Table E3 – Common Aeronautical Chart Series, Scales, and Display Ranges.....	71

FIGURES

Fig. 1 – FiAF MMC System hardware components	2
Fig. 2 – FiAF MMC System SCSI and GPIB connections	2
Fig. 3 – Primary MMC software functions	3
Fig. 4 – Building a user-defined AOD or MPS composition	3
Fig. 5 – Building a new AOD or MPS composition from a preexisting composition	4
Fig. 6 – Main MMC window	5
Fig. 7 – MMC title bar	6
Fig. 8 – Coverage definition buttons.....	7
Fig. 9 – Latitude/Longitude entry window	8
Fig. 10 – Zoom buttons	10
Fig. 11 – Zooming in with a stretch-box: (a) before zoom and (b) after zoom.....	11
Fig. 12 – File menu	13
Fig. 13 – Sample list of working compositions.....	14
Fig. 14 – Sample working composition displayed on MMC base map	14
Fig. 15 – Sample list of final compositions.....	15
Fig. 16 – Sample final compositions displayed on MMC base map	15
Fig. 17 – Edit menu	17
Fig. 18 – Overlays menu	18
Fig. 19 – MMC base map with (a) both WVS and political boundaries overlays ON (default), and (b) WVS overlay ON and political boundaries overlay OFF.....	18
Fig. 20 – MMC base map with latitude/longitude grid overlay ON	19

Fig. 21 – MMC base maps with user-defined polygons overlay (a) ON and (b) OFF	19
Fig. 22 – Available coverage (of data sources) overlays: (a) CAC only; (b) CAC (gray) abutting processed charts (tan); (c) CAC (gray) surrounding area with both processed charts and CAC (purple).	20
Fig. 23 – Coverages menu	20
Fig. 24 – Sample list of logged source coverages	21
Fig. 25 – Preferences menu	22
Fig. 26 – Composing preferences	23
Fig. 27 – CAC source data preferences	23
Fig. 28 – MPS source data preferences	23
Fig. 29 – View latitude/longitude preferences.....	24
Fig. 30 – Print preferences.....	25
Fig. 31 – Display preferences.....	26
Fig. 32 – Tools menu.....	26
Fig. 33 – AOD/MPS options menus (depends on image type set in Preferences): (a) AOD Options menu, and (b) MPS Options menu	27
Fig. 34 – Sample AOD summary listing	28
Fig. 35 – AOD recycle menu with file options.....	29
Fig. 36 – AOD recycle option	29
Fig. 37 – CDROM options menu.....	30
Fig. 38 – Archive to CDROM window	31
Fig. 39 – Media options.....	32
Fig. 40 – Data Processing menu	33
Fig. 41 – CD-ROM Site Window	34
Fig. 42 – GeoTIF Processing Window	36
Fig. 43 – Area of coverage verification dialog.....	37
Fig. 44 – GeoTIF Processing Window with Finalize button.....	38
Fig. 45 – System menu	39
Fig. 46 – Delete Processed Data option.....	39
Fig. 47 – System disk usage	40
Fig. 48 – Windows menu.....	40

Fig. 49 – Composition size with limits.....	41
Fig. 50 – Composition data size exceeds AOD limit: (a) JOG scale exceeds 260 MB; (b) individual JOG, TPC, and JNC scales are within 260 MB.....	41
Fig. 51 – AOD/MPS area status	42
Fig. 52 – Data sources display.....	42
Fig. 53 – MMC processing history log file	43
Fig. 54 – Print menu	43
Fig. 55 – CD-ROM Site Window: CD reader number 7 selected	45
Fig. 56 – CD-ROM Site Window: title listed for selected CD reader	45
Fig. 57 – Logging data sources: complete before building any compositions	48
Fig. 58 – MMC prompt to load CAC CD.....	49
Fig. C1 – Color palette warning message.....	61
Fig. C2 – New color palette caution summary	62
Fig. E1 – Sample MMC composition.....	67
Fig. E2 – Sample image (chart data)	68

FINLAND AIR FORCE F/A-18 MOVING-MAP COMPOSER (MMC) VERSION 3.4P SOFTWARE USERS' MANUAL

1. INTRODUCTION

This report documents the Moving-Map Composer (MMC) software system developed by scientists in NRL Code 7440.1. This is the third edition of the MMC Users' Manual (the first and second editions are NRL/FR/7441--97-9677 and NRL/FR/7440--00-9938, respectively) and reflects changes that were implemented for the version 3.4P release of MMC.

The MMC software is resident on the Finnish Air Force (FiAF) MMC System. MMC enables users to perform the following functions:

- ◆ Design and build Aircraft Optical Disk (AOD) images from user-specified Compressed Aeronautical Chart (CAC) and processed chart data;
- ◆ Write completed AOD images to militarized Write-Once Read-Many AODs;
- ◆ Evaluate failed AODs;
- ◆ Design and build Mission Planning System Compact Disk Images (MPS-CDIs) from user-specified CAC, processed chart, and DTED data;
- ◆ Write MPS-CDIs to Recordable Compact Disk (CD-R) for mission planning purposes;
- ◆ Process FiAF source geotiff files into a CAC-compatible format (when CAC is not available) and include them in an AOD image or MPS-CDI;
- ◆ Print final compositions, CAC images, checklists, and AOD summaries.

2. SYSTEM CONFIGURATION

2.1 Hardware

Figure 1 illustrates the FiAF MMC System hardware components and the data flow between each of these components. Figure 2 shows the Small Computer Standard Interface (SCSI) and General Purpose Interface Board (GPIB) connections for the FiAF MMC System workstation and peripherals. Appendix A defines each of these components in detail, and Appendix B describes how to set up the hardware.

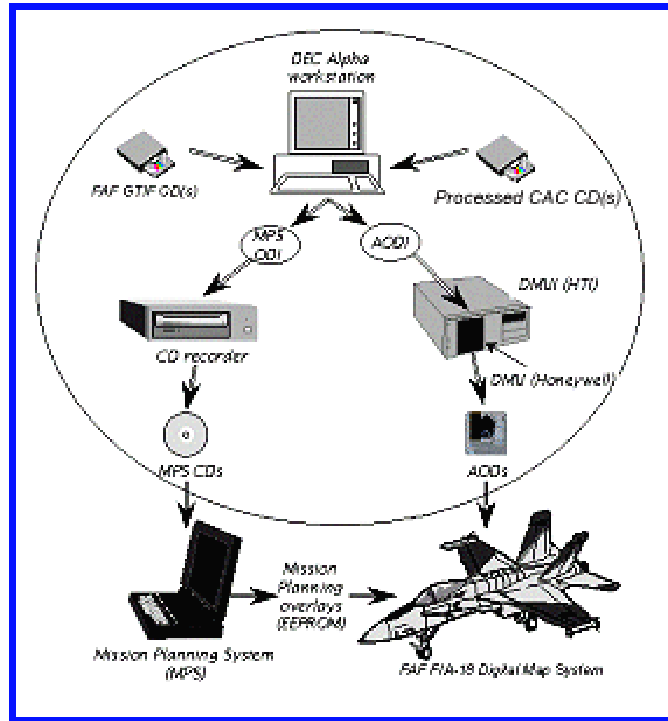


Fig. 1 – FiAF MMC System hardware components

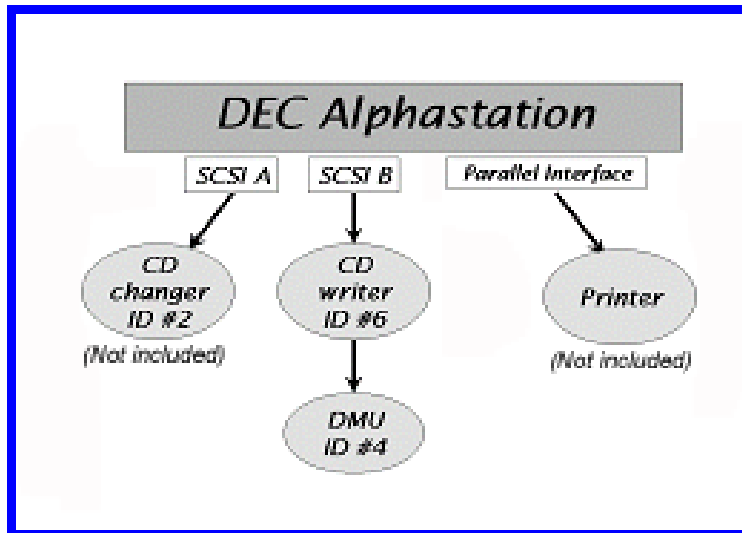


Fig. 2 – FiAF MMC System SCSI and GPIB connections

2.2. Software

Figure 3 is a simplified diagram of the principal MMC software operations: the MMC user inputs up to three primary data sources (CAC, DTED, and FiAF geotiff), from which MPS and AOD data are processed and archived.

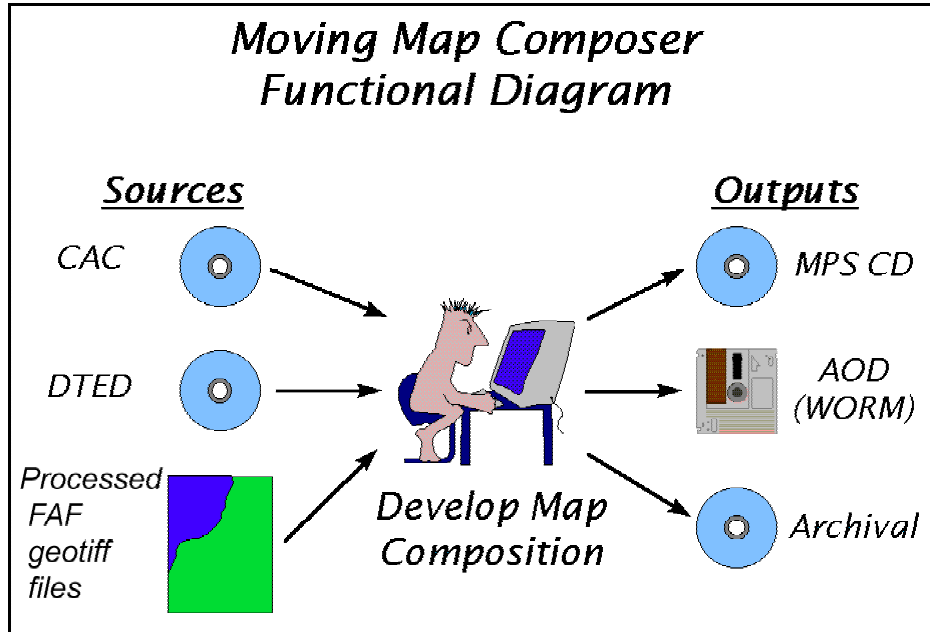


Fig. 3 – Primary MMC software functions

Figures 4 and 5 illustrate how to build an AOD or MPS composition, using two different methods (depending on available data). Figure 4 shows how to build a new, user-defined composition from “scratch,” while Fig. 5 shows how to build a new composition from a search for other preexisting compositions (when the user may or may not have all the source data available).

Functional Diagram: User-Defined Composition

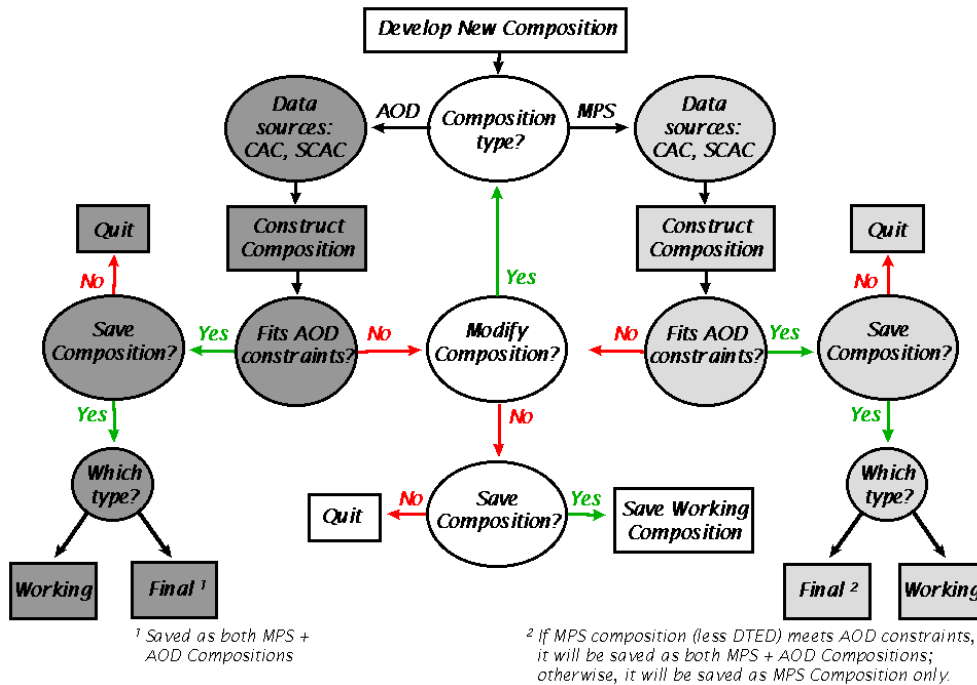


Fig. 4 – Building a user-defined AOD or MPS composition

Building a New Composition from Preexisting Composition(s) or Image(s)

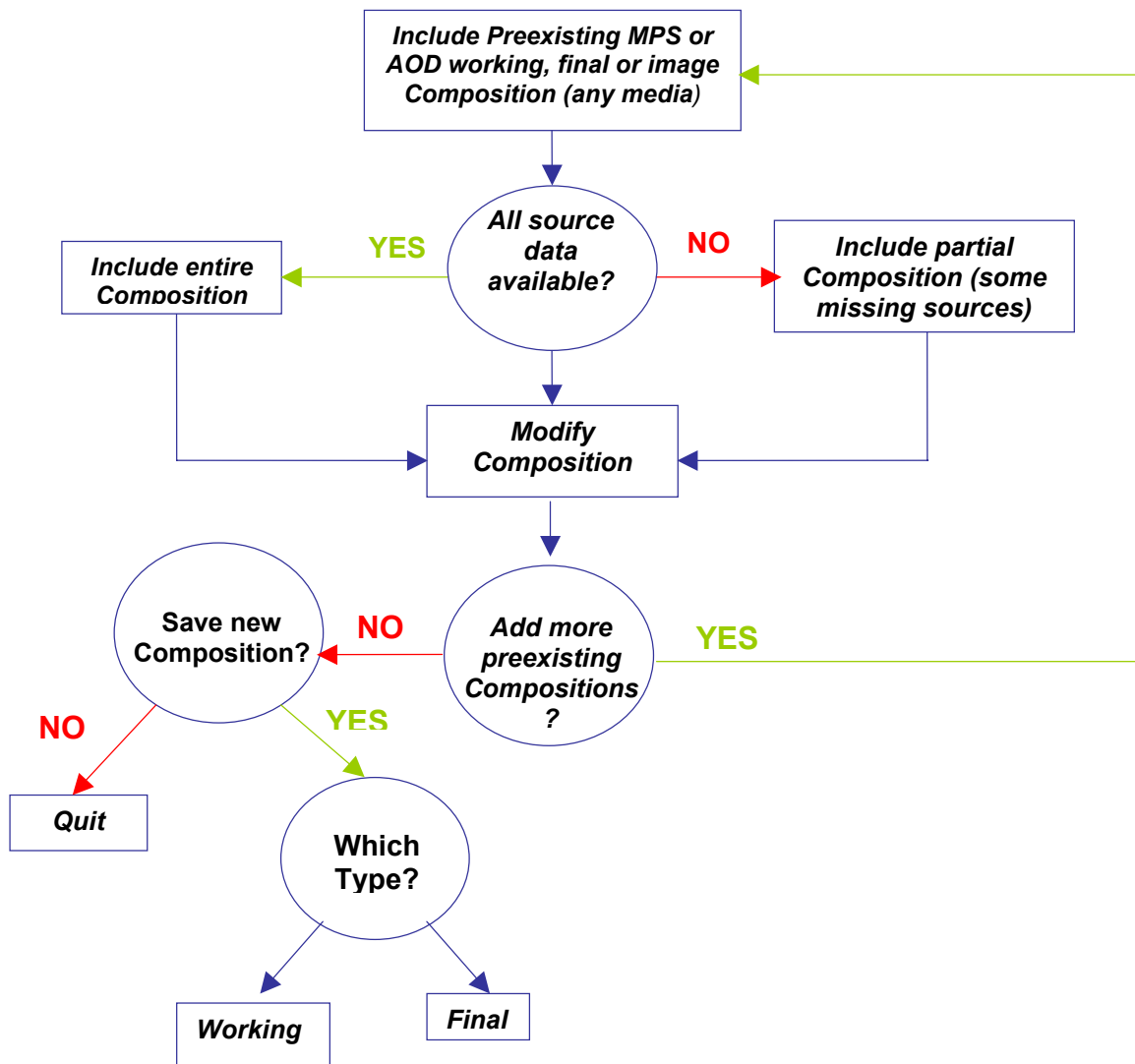


Fig. 5 – Building a new AOD or MPS composition from a preexisting composition

The next two sections provide more detailed information on the MMC software. Section 3 describes the MMC Graphical User Interface (GUI), including the world map workspace, tool bars, and all associated utilities. Section 4 provides step-by-step instructions on how to perform the most common MMC operations. This section was derived from a tutorial that NRL developed for the initial installation of the MMC workstation in China Lake, CA; Rota, Spain; and Aviano, Italy.

A glossary of terms and definitions is provided in Appendix C.

3. MMC GRAPHICAL USER INTERFACE

3.1 Starting MMC

MMC automatically starts after successful login to the MMC account. After several seconds, the main **MMC Window** appears (Fig. 6). Sections 3.2 and 3.3 provide detailed descriptions and illustrations of the various functions and utilities that MMC provides.

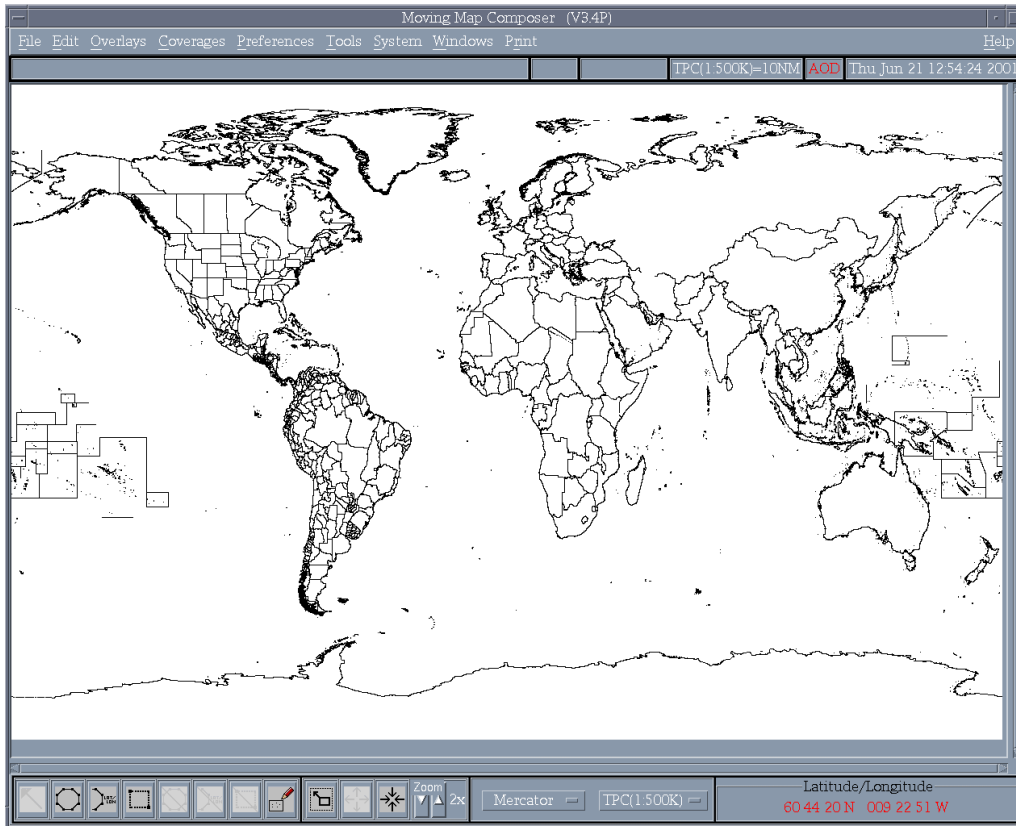


Fig. 6 – Main MMC window

3.2 Toolbars and Workspace Definitions

3.2.1 World-map Workspace

As shown in Fig. 6, the largest portion of the main **MMC Window** is a world base map on which to design AODI and MPS-CDI compositions. We recommend that the user zoom-in to an area of interest before designing a composition or adding overlays, to optimize performance (e.g., speed up the graphics). MMC provides vertical and horizontal scroll bars at the right side and bottom of the base map to allow the user to scroll through the area of interest if the computer screen is not large enough to display it in its entirety.

3.2.2 Title Information

MMC provides six blocks of information in a title bar (Fig. 7) just above the base map. The description that follows is keyed to the figure.

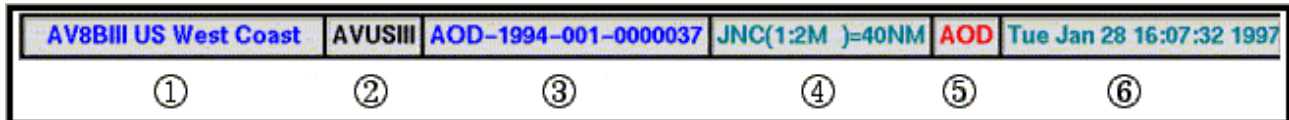


Fig. 7 – MMC title bar

1. A descriptive title for the AODI or MPS-CDI.
2. A unique filename (10 characters or less) for a final composition (this will also be used as a volume label when archiving to CD).
3. A unique library ID number for the AODI or MPS-CDI. This ID number uses the format *TTT-yyyy-vvv-Mcccccc*, where
 - ♦ *TTT* = the image type ('AOD' or 'MPS');
 - ♦ *yyyy* = the year the image was created;
 - ♦ *vvv* = the version number of the image (001 through 999);
 - ♦ *M* = the MMC System ID: a base-36 number (0-9, A-Z) that identifies which MMC system created the original template(s) for the composition. Up to 36 individual MMC systems can be identified by this ID, of which 11 have been assigned (Table 1).

Table 1 – ID Numbers, System Names, and Locations of MMC Stations (as of 7/2002)

<i>M</i>	<i>System Name</i>	<i>Location</i>
0	VOODOO	NRL, Stennis, MS (old NRL computer; no DMU)
1	MOE	NAWC-AD, China Lake, CA
2	LARRY	MCAS Cherry Point, NC
3	CURLY	NRL, Stennis, MS
4	SHEMP	MCAS Yuma, AZ
5	MAP005	Spain
6	MAP006	Spain
7	MAP007	Italy
8	MAP008	Hughes, Indianapolis, IN
Y	JED	NRL, Stennis, MS (F/A-18-owned)
Z	GRANNY	NRL, Stennis, MS (F/A-18-owned)
X	HARPO	NRL, Stennis, MS (FiAF F/A-18-owned)

- ♦ *cccccc* = a composition ID (000001 through 999999) unique for MMC system *M*. Two different MMC systems may create two different compositions with the same composition ID, but the MMC system ID (*M*, above) makes the image library number unique. This way, a user on one MMC system is not required to keep track of composition IDs on other MMC systems.

4. The chart series currently in use. To change the series, click on the *Chart Series / Map Scale* selection box (Section 3.2.6) in the lower-right corner of the **MMC Window**.
5. The type of image currently being created ('AOD' or 'MPS').
6. A clock displaying the current date and time. To reset, login to the SYSTEM account, then type **SET TIME=dd-mmm-yyyy:hh:mm:s.s** at the \$ prompt. For example: **SET TIME=20-JUL-1997:16:31:0.0** will set the clock to July 20, 1997, 4:31 pm. To verify the current date and time, type **SHOW TIME**. The system will print the current date and time. When finished, logout of the SYSTEM account and return to the MMC account.

3.2.3 Coverage Definition Buttons

The coverage definition buttons (Fig. 8) allow a user to define coverage areas in four ways: 1) using the mouse to pick points and define a polygon; 2) entering a series of lat/lon points to define a polygon; 3) using the mouse to draw a "rubber-band" box around a coverage; and 4) picking individual CAC segments. Note that when a button's icon is light gray, it is not currently available for use.

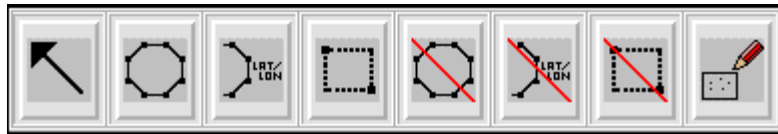


Fig. 8 – Coverage definition buttons

3.2.3.1 Select / Unselect Coverage Area



The Arrow button is deactivated until the user has defined at least one area of coverage (Section 3.2.3.2). When ready, click on this button, then click on the individual area(s) of coverage to be cut (or copied) and pasted between different chart series. Alternatively, to select or unselect ALL areas of coverage at one time, click on one of these *Edit* menu options: *Select All Coverages* or *Unselect All Coverages*. As a coverage is selected, it turns yellow.

3.2.3.2 Define an Area of Coverage

Use any combination of these three buttons to define an area or areas of map coverage for inclusion in an AOD image or MPS CD image template.



Use the *Define Coverage by Clicking Polygon Vertices* button to define an irregularly shaped area. Click on this button, and then click on a set of points on the world map with the left (first) mouse button. The points will define the vertices of a polygon, which in turn defines the coverage area. To close the polygon and fill the defined area with segments, double-click with the left mouse button.

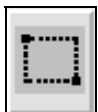


Use the *Define Coverage by Latitude/Longitude Coordinates* button to define an area bounded by specific latitude and longitude points. When a user clicks on this button, MMC pops up a **Latitude / Longitude Entry Window** (Fig. 9). Enter each geographic coordinate pair (latitude, longitude), indicating whether that coordinate crosses 180° longitude (relative to the previous

coordinate), then click on the *Next Entry* button. As each pair is entered, MMC will list it in the **Latitude/Longitude Entry Window**. The user can edit the entries as follows before accepting the coverage area:

- ◆ To delete a record, click on its entry in the list, and then click *Delete*.
- ◆ To edit a record, click on its entry in the list, click on *Edit*, and then edit the Latitude, Longitude, and Cross-180 entries in the top half of the window.
- ◆ To start over, click on *Clear all coordinates*.
- ◆ When all coordinates are listed correctly, click on *Accept Coordinates*. The main **MMC Window** will return, and the defined template will appear on the world map.
- ◆ To exit from the **Latitude/Longitude Entry Window** and not save the points as a template, click on *Cancel*. The main **MMC Window** will return.

Fig. 9 – Latitude/Longitude entry window

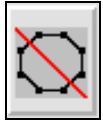


Use the *Define Coverage by a Stretch-Box* button to define a rectangular area of coverage using a “stretch-box.” Click on this button, and then click on the upper-left corner of the area to be defined with the left (first) mouse button. Hold the mouse button down and drag the resulting stretch-box to encompass the desired area. **Note:** the stretch-box only works from upper left

to lower right. As long as the mouse button is held down, the stretch-box will be adjustable. When the box is satisfactory, release the mouse button. Click once more (anywhere on the map) with the left mouse button to accept the coverage area and fill the box with segments.

3.2.3.3 Erase an Area of Coverage

These buttons are deactivated until the user has defined at least one area of coverage with one or more of the previous three buttons (Section 3.2.3.2). Use any combination of the following three buttons to erase areas of map coverage (i.e., remove coverage from an AOD image or MPS CD image template).



Use the *Erase Coverage by Clicking Polygon Vertices* button to erase an irregularly shaped area. Click on this button, then click a set of points on the world map with the left mouse button. The points will define a polygon enclosing the area to be erased. To close the polygon and erase the area, double-click with the left mouse button.



Use the *Erase Coverage By Latitude/Longitude Coordinates* button to erase an area bounded by specific latitude and longitude points. When the user clicks on this button, MMC pops up the **Latitude/Longitude Entry Window** (Fig. 9). Section 3.2.3.2 provides more details.



Use the *Erase Coverage by a Stretch-Box* button to erase a rectangular area of coverage. Click on this button, then click on the upper-left corner of the area to be erased with the left (first) mouse button. Hold the mouse button down and drag the resulting stretch-box to encompass the desired area. **Note: the stretch-box only works from upper left to lower right.** As long as the mouse button is held down, the stretch-box may be adjusted. As soon as the box is satisfactory, release the mouse button. Click once more on the map with the left mouse button to erase the enclosed area.

3.2.3.4 Set / Clear Individual Segments



Use the *Set/Clear* button to individually select segments to be added to — or deleted from — a template. In other words, this button acts as a toggle to select and deselect individual segments.

3.2.4 Zoom Buttons

The *Zoom* buttons (Fig. 10) allow a user to zoom into (or out from) an area of interest on the MMC base map. Zooming can be done via a “stretch box” or by selecting a zoom factor and then zooming in or out by that factor. Note that when a button’s icon is gray, it is not available for use. For instance, the *Zoom-out* button will be unavailable until the user has zoomed in.

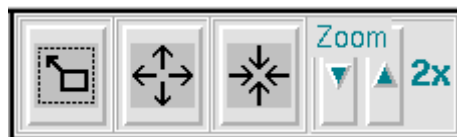


Fig. 10 – Zoom buttons

3.2.4.1 Zoom-in on a Stretch-Box

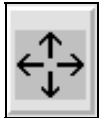


Use the *Zoom-in on a Stretch-Box* button to zoom to an area of interest with a “stretch-box.” Click on this button, then click on the upper-left corner of the area of interest with the left (first) mouse button. Hold the mouse button down and drag the resulting stretch-box to the lower-right corner of the area of interest. **Note: the stretch-box only works from upper left to lower right.**

Use the

As long as the mouse button is held down, the stretch-box may be adjusted. The box maintains a constant aspect ratio identical to that of the display screen. This ensures that the contents of the final stretch-box fit perfectly on the display. As soon as the box is satisfactory, release the mouse button, then click again with the left mouse button to perform the zoom (Fig. 11).

3.2.4.2 Zoom-out by a Specified Zoom Factor

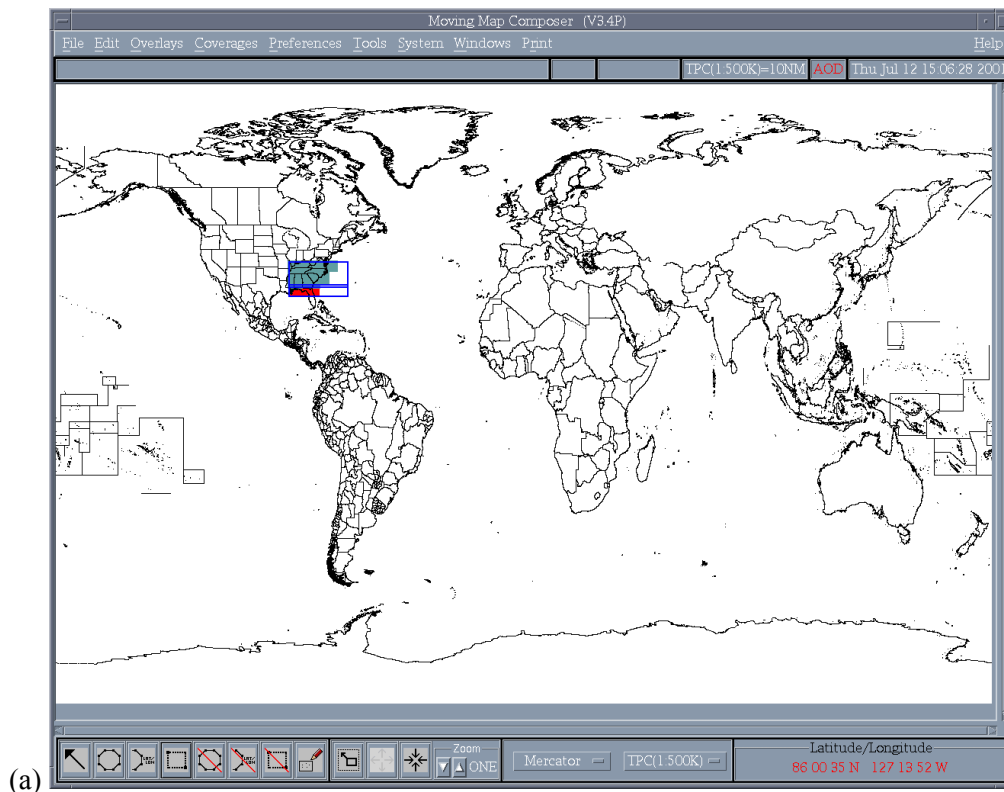


Use the *Zoom-out from a Point* button to zoom-out from the MMC base map. Click on this button, adjust the zoom factor (Section 3.2.4.4), then click on the map to zoom-out (the map will center on the selected point). **Note: the user cannot zoom out until he or she has zoomed in.** This button will appear light gray when it is unavailable.

3.2.4.3 Zoom-in by a Specified Zoom Factor



Use the *Zoom-in on a Point* button to zoom-in to the MMC base map. Click on this button, adjust the zoom factor, and then click on the map to zoom-in (the map will center on the selected point). This button will turn light gray when the maximum zoom-in has been reached.



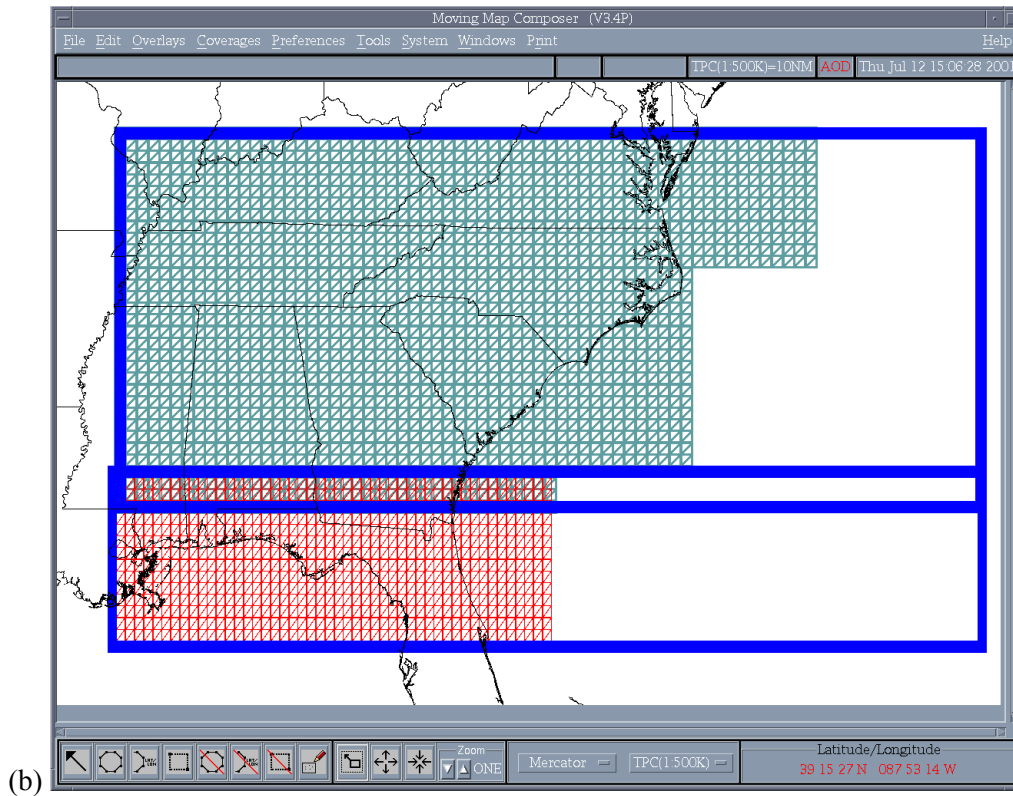


Fig. 11 – Zooming in with a stretch-box: (a) before zoom and (b) after zoom

3.2.4.4 Specify the Zoom Factor



Click on the arrows to change the *Zoom factor* (default = 2x). This value dictates how much to zoom-out or -in. For instance, with the *Zoom factor* set to 8, clicking on the *Zoom-in* button will zoom into the world map by 8:1. The maximum *Zoom factor* is 200.

Two special settings are available below factor 2: PAN and ONE. To pan (i.e., scroll) around the world map, set the *Zoom factor* to PAN, click on either the *Zoom-in* or *Zoom-out* button, then click on the map with the left mouse button. MMC will redraw the map centered on the point selected. For example, clicking on the left edge of the map will scroll to the left. To return to the original, unzoomed, world map, set the *Zoom factor* to ONE, click on either the *Zoom-in* or *Zoom-out* button, then click anywhere on the world map.

3.2.5 Map Projection Selection Box



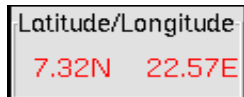
Choose a map projection from this drop-down list: *Mercator* [default], *North Polar*, or *South Polar*. Use *North Polar* to work with data in the North Polar TS zone (North Polar segments will be displayed in dark green); use *South Polar* to work with data in the South Polar zone (South Polar segments will be displayed in yellow); and use *Mercator* for all other work. **Note:** if the user tries to select individual segments in a polar TS zone, but the MMC base map is displayed in *Mercator*, the mouse pointer may appear to be “off” by 1 to 2 segments. Switch to the correct *Polar* projection to fix this problem. See Appendix C for more information on TS zones.

3.2.6 Chart Series and Scale Selection Box



Choose a chart series and associated scale from this drop-down list: *JNC (1:2M)*; *ONC (1:1M)*; *TPC (1:500k)* [default]; *JOG (1:250k)*; *TLM-100 (1:100k)*; *TLM-50 (1:50k)*; or *DTED*. Users can define coverages in one series and then switch to another series without losing what they've defined in the first. Users can also cut or copy coverages from one series and paste them into another (see *Edit* menu options *Cut*, *Copy*, and *Paste* in Section 3.3.2.2).

3.2.7 Cursor Position Box



This information box shows the current geographic position of the cursor on the MMC base map. Position is shown in decimal degrees of latitude and longitude or degrees, minutes, and seconds (depending on which is set in the *Preferences* menu, *View Latitude / Longitude* preferences, Section 3.3.5.3). Use this box to help find areas of interest.

3.3 Top Menu Bar

3.3.1 File

The *File* menu (Fig. 12) lets a user open a composition or image file, save a composition, and exit from MMC.

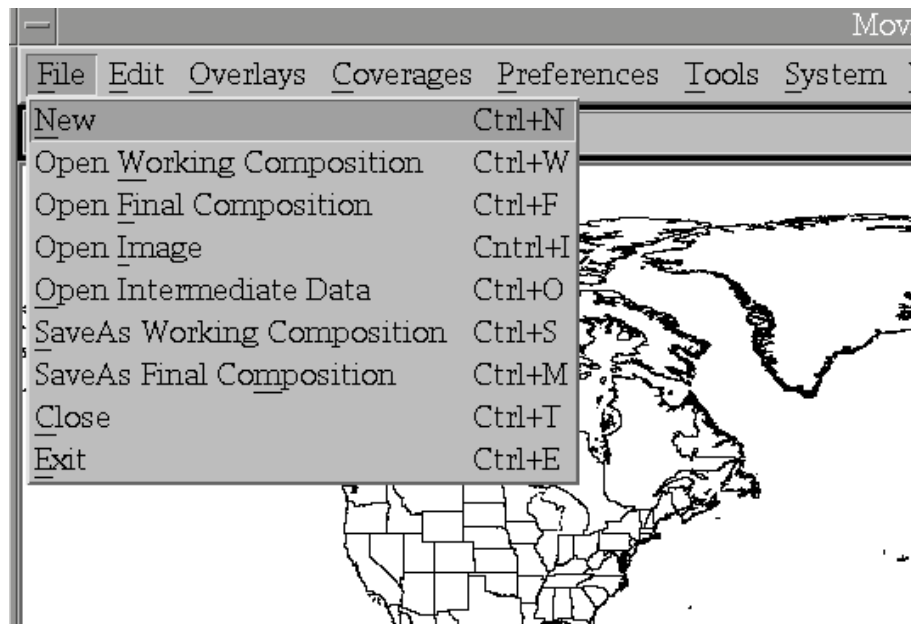


Fig. 12 – File menu

3.3.1.1 New (Ctrl+N)

This option opens a new file in preparation for building an AODI or MPS-CDI composition. Only open a new file to build a unique AODI or MPS-ODI. See the *Open* options (below) for alternatives to *New*. If a user was designing a composition and did not save it before selecting *New*, MMC will issue a warning message and the chance to save the work prior to starting a new file.

3.3.1.2 Open Working Composition (Ctrl+W)

This option opens a file containing a composition-in-progress for an AODI or MPS-CDI. Unlike a final composition, a working composition has no library number. In addition, MMC does not place any size restrictions on working files, so the user may build a large “master” composition as a working file, then break it into smaller compositions for final files. When the user selects *Open Working Composition*, MMC displays a list of working compositions from which to choose (Fig. 13). After choosing a composition, MMC returns to the base map and displays the selected composition (Fig. 14). At this point, the user can view the map data defined by the composition or modify the composition.



Fig. 13 – Sample list of working compositions

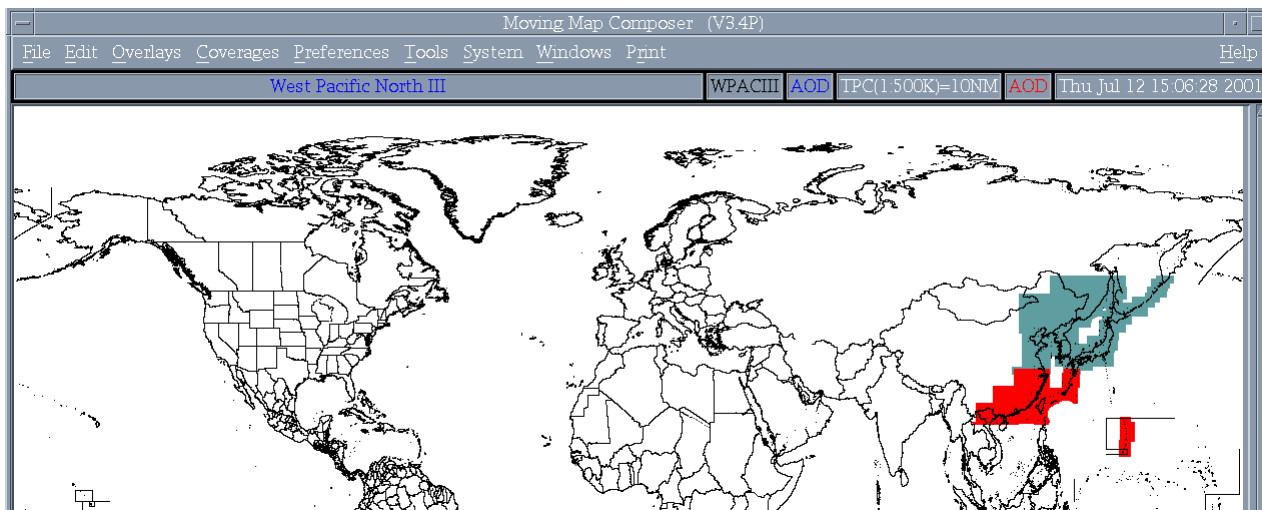


Fig. 14 – Sample working composition displayed on MMC base map

3.3.1.3 Open Final Composition (Ctrl+F)

This option opens an existing file containing a final AODI or MPS-CDI that has been assigned a library number. When a user selects *Open Final Composition*, MMC provides a list of current final compositions (Fig. 15) from which to choose. After the user chooses one, MMC returns to the base map and displays the selected composition (Fig. 16). At this point, the user can view map data defined by the composition or modify the composition and save it under a new name.

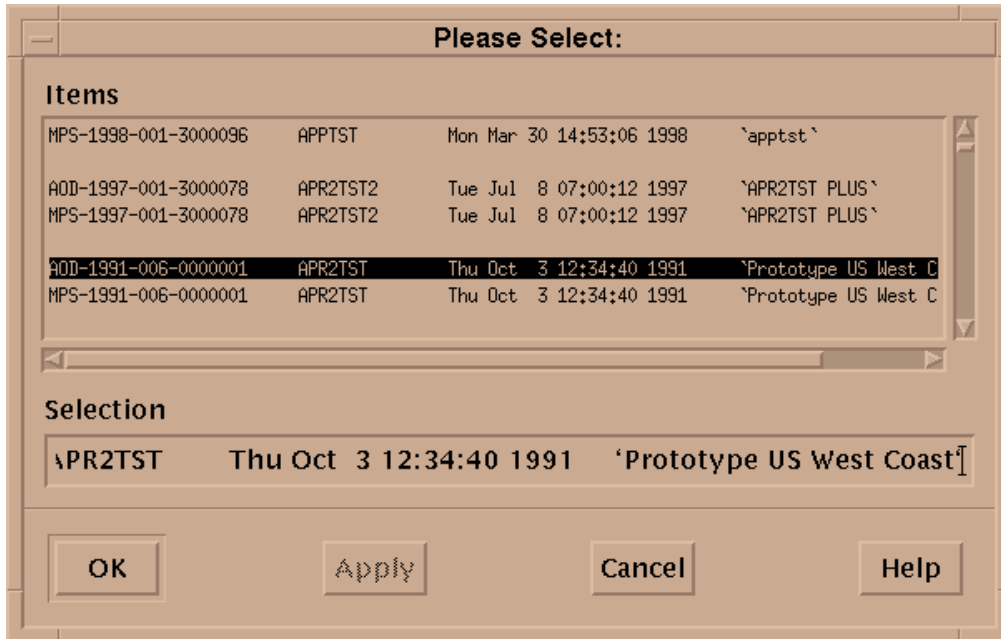


Fig. 15 – Sample list of final compositions

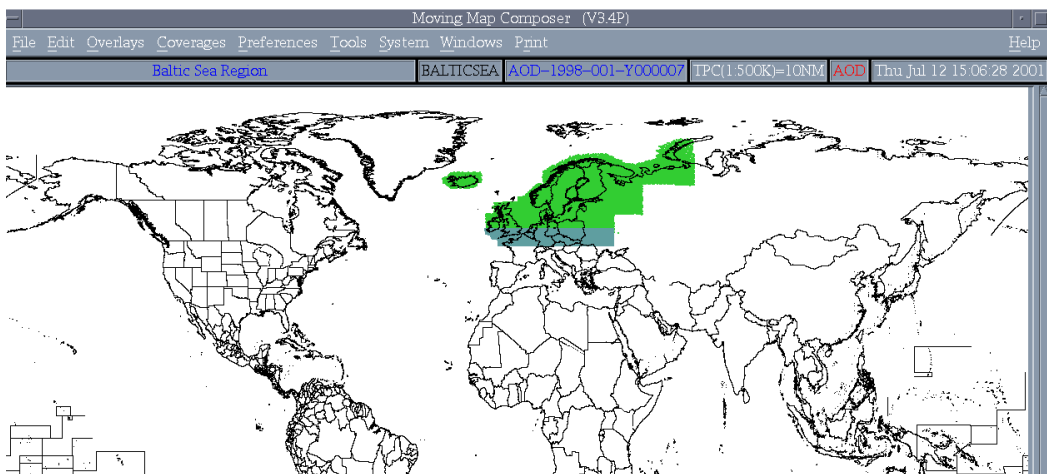


Fig. 16 – Sample final compositions displayed on MMC base map

3.3.1.4 Open Image (Ctrl+I)

This option opens an existing AOD or MPS image, builds a composition based on the image, and loads the composition into MMC for viewing and modification. After the user selects *Open Image*,

MMC queries with a selection box for the image type (AOD or MPS) and then the device type (CD, AOD, hard disk). If the user selects to open the image from CD, MMC will provide a graphical user interface (GUI) for selecting and mounting the necessary CD in an available drive. See Section 4.1 for more information about mounting CDs in MMC.

3.3.1.5 Open Intermediate Data (Ctrl+O)

This option opens intermediate (i.e., downsampled) data files for display and final processing into CAC.

3.3.1.6 Save As Working Composition (Ctrl+S)

This option saves the current composition as a working file, with no associated AOD / MPS-ODI library number. MMC does not place any size restrictions on working files, so the user may save a large “master” composition as a working file, then break it into smaller compositions for final files. MMC only keeps one version of each working filename; if the user tries to save a working file with a filename that already exists, MMC will ask if the user wants to overwrite the preexisting working file.

3.3.1.7 Save As Final Composition (Ctrl+M)

This option saves the current composition as a final file with a unique AOD or MPS-ODI library number. MMC restricts final compositions to the maximum size of the ODI type selected: AODI (260 MB) or MPS-ODI (600 MB). This size restriction is enforced prior to saving the final composition. If the user tries to save a file that is larger than these maximums, MMC will instruct the user to trim some data off of the image first. By default, MMC builds the composition for an MPS-ODI; the user must specify that the composition will ALSO be saved as an AODI file. MMC prompts the user for the final filename and description. Final filenames must be 10 characters or less, and can only contain alpha-numeric (e.g., no “_”, “-” etc.). Also, if the composition is too big to save to an AOD (i.e., over 260 MB), MMC will issue a warning message. If the user chooses to Fix the composition, MMC will display a message describing which scale(s) contain too much data, then give instructions on how to fix the composition before reattempting the save.

3.3.1.8 Close (Ctrl+T)

This option closes the current composition and refreshes the main **MMC Window**. If the user has made unsaved changes, MMC will issue a warning and provide an opportunity to save the work prior to closing.

3.3.1.9 Exit (Ctrl+E)

This option closes the current composition and exits from MMC. If the user has made unsaved changes, MMC will issue a warning and provide an opportunity to save the work prior to closing.

3.3.2 Edit

The *Edit* menu (Fig. 17) provides utilities to select coverages, cut (or copy) and paste coverages between scales, and undo or redo previous actions.

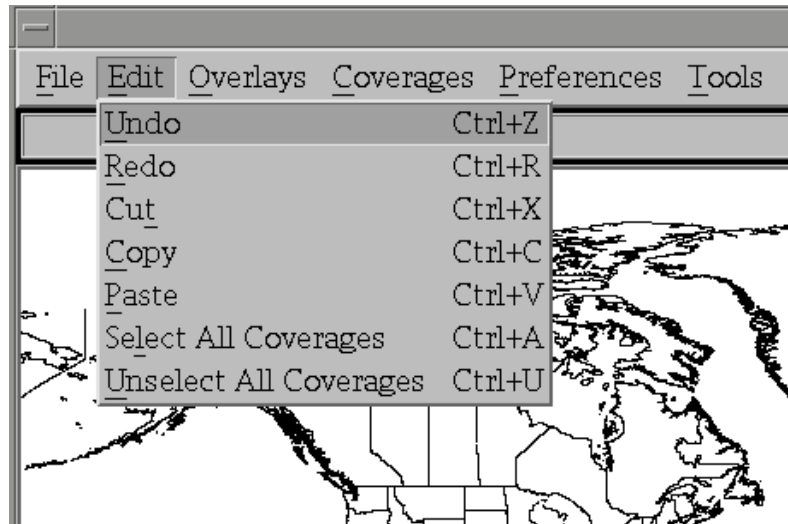


Fig. 17 – Edit menu

3.3.2.1 Undo (Ctrl+Z) / Redo (Ctrl+R)

Undo undoes the previous edit action (e.g., Cut). Redo repeats the previous action.

3.3.2.2 Cut (Ctrl+X) / Copy (Ctrl+C) / Paste (Ctrl+V)

To cut or copy one or more coverages from one scale to another, click on the Arrow button (Section 3.2.3.1), then click on each coverage area to be cut or copied (the selected coverages will turn yellow), then choose Cut or Copy. Alternatively, choose the Edit option's Select All Coverages (described below), then choose Cut or Copy. Warning: only the most recent Cut or Copy action stays in memory. If the user Cut one coverage, and then Cut or Copy another before pasting the first, the first coverage will be lost forever!

- ♦ Cut cuts the selected coverage from the current chart series and temporarily stores it in memory (to be pasted in another series, if desired).
- ♦ Copy makes a copy of the selected coverage and stores it in memory.
- ♦ Paste pastes the most recently cut or copied coverage from memory onto the current coverage.

3.3.2.3 Select All Coverages (Ctrl+A) / Unselect All Coverages (Ctrl+U)

Select All Coverages selects all available coverages from the current chart series (all coverages will turn yellow) for cutting or copying and pasting. Unselect All Coverages deselects selected coverages at the current map series.

3.3.3 Overlays

The Overlays menu (Fig. 18) includes options to refresh the display and overlay shorelines, political boundaries, latitude and longitude grid, user-defined coverage polygons, and available data coverages. Options are selected with a toggle button that turns red when chosen.

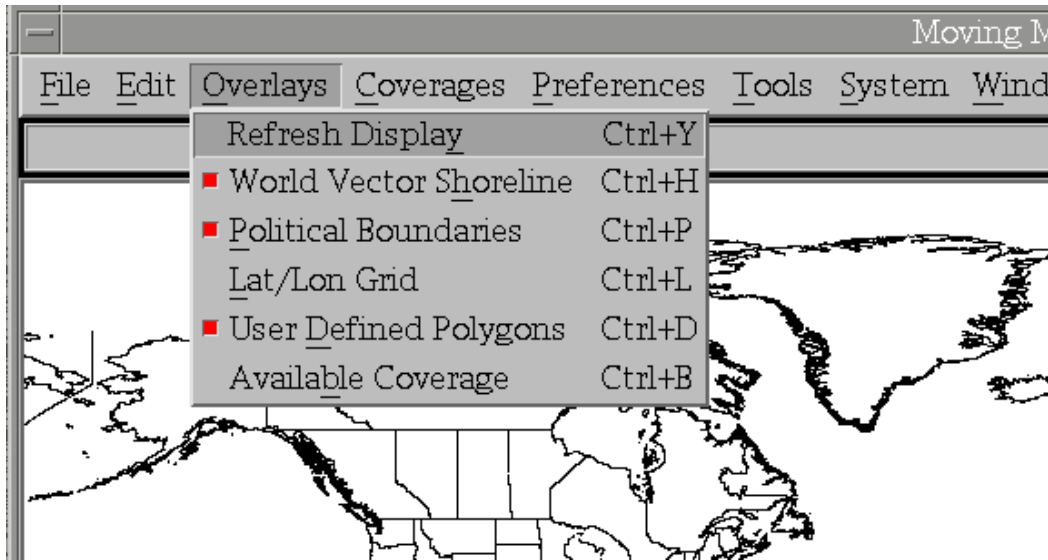


Fig. 18 – Overlays menu

3.3.3.1 Refresh Display

This option redraws the current map information in the **MMC Window**.

3.3.3.2 World Vector Shoreline (WVS)

WVS is the base map for MMC and a standard product from the National Imagery and Mapping Agency (NIMA). This overlay draws the shorelines of the world and is ON by default (Fig. 19(a)).

3.3.3.3 Political Boundaries

This overlay (ON by default) displays political boundaries between inland countries and states to provide a more robust base map (Fig. 19(a)). Figure 19(b) shows the *WVS* overlay ON and the *Political Boundaries* overlay OFF.



Fig. 19 – MMC base map with (a) both WVS and political boundaries overlays ON (default), and (b) WVS overlay ON and political boundaries overlay OFF

3.3.3.4 Lat / Lon Grid

This option displays a user-defined grid of latitude and longitude lines (OFF by default; see Fig. 19(a)). When the user turns this overlay ON, MMC will prompt for the grid spacing (default is 10° in latitude and longitude). Figure 20 shows the *Lat / Lon Grid* ON with a 20° grid.

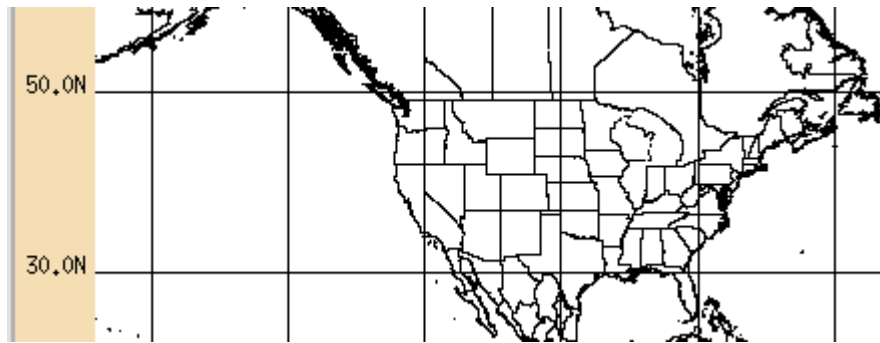


Fig. 20 – MMC base map with latitude/longitude grid overlay ON

3.3.3.5 User-Defined Polygons

This option outlines each coverage the user defines. These polygons are useful in selecting specific coverages for *Cut* and *Paste* operations. This overlay is ON by default (Fig. 21(a)). When it is OFF (Fig. 21(b)), adjacent coverages are not as easy to distinguish.



Fig. 21 – MMC base maps with user-defined polygons overlay (a) ON and (b) OFF

3.3.3.6 Available Coverage

This option displays all logged CAC coverage for the current map scale in light gray (Fig. 22(a)), all processed chart coverage for the current scale in tan (Fig. 22(b)), and areas that contain **both** CAC and processed chart data in purple (Fig. 22(c)). This overlay is OFF by default. **Note:** if the user is designing an MPS image and selects DTED from the *Chart series* selection box (Section 3.2.6), Available Coverage will reflect all logged DTED coverage.

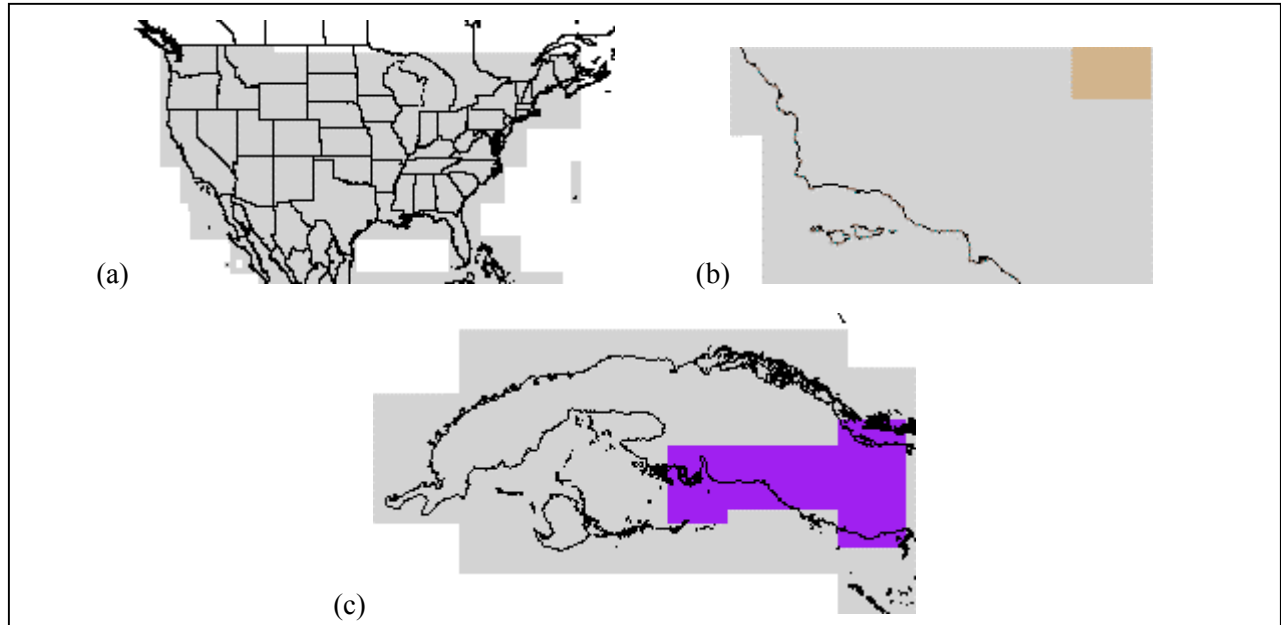


Fig. 22 – Available coverage (of data sources) overlays: (a) CAC only; (b) CAC (gray) abutting processed charts (tan); (c) CAC (gray) surrounding area with both processed charts and CAC (purple).

3.3.4 Coverages

The *Coverages* menu (Fig. 23) provides utilities to include one or more compositions, images, or processed data sets in a new composition.

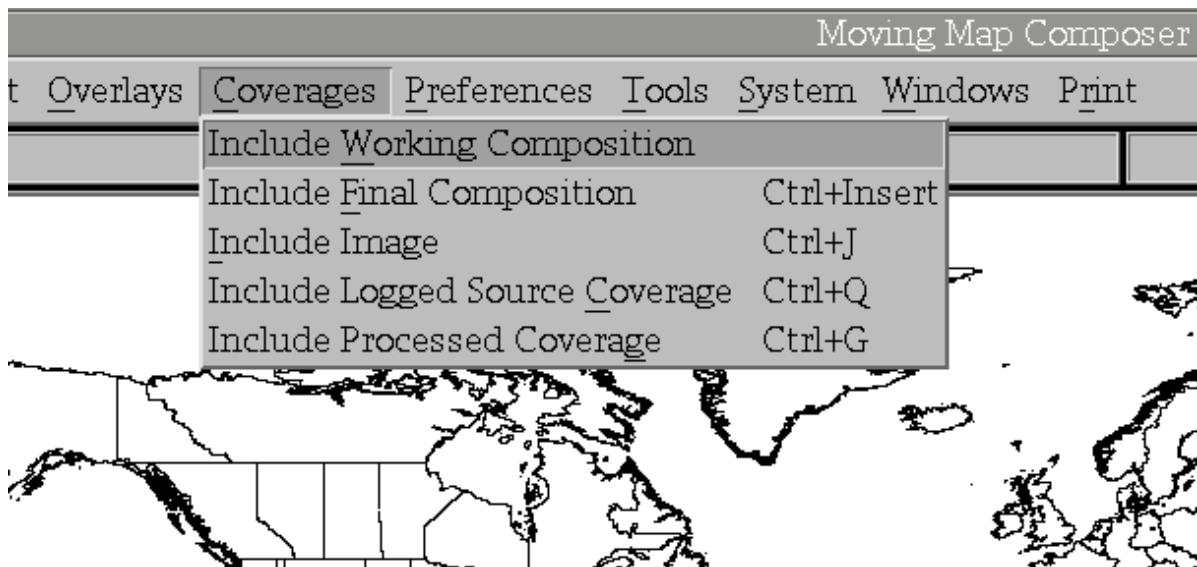


Fig. 23 – Coverages menu

3.3.4.1 Include Working Composition

This option retrieves a working composition for either an AODI or MPS-CDI. MMC will present a list of available compositions and prompt for which one to include. A modified working composition may be saved under the same name or a different name. If it is saved under the same name, the original will be deleted.

3.3.4.2 Include Final Composition

This option retrieves a final composition from the hard disk. MMC will present a list of available compositions and prompt for which one to include. Modifications to a final composition may only be saved under a new name.

3.3.4.3 Include Image

This option dynamically creates a temporary composition from a source image that can then be used to define a new composition (or supplement an existing one). This option will retrieve the composition of either an AOD or MPS image from the hard disk, a CD, or an AOD. If the user selects to open the image from CD, MMC will provide a GUI for mounting the CD in an MMC drive (see Section 4.1). Finally, MMC prompts for the source image filename.

3.3.4.4 Include Logged Source Coverage

This option builds a composition from a source coverage via a menu selection (Fig. 24). Valid source coverages are CAC and DTED CDs that have been logged into MMC. The menu selection box provides four columns of information for each entry: Info File name, CAC library number, date CAC was logged into MMC, and a geographic coverage description. CAC Info Files are named after the library number of their respective CAC CD. Note that some CAC CDs do not have an Info File (the first column lists 000000 instead of an Info File name, and the last column lists “No Info File Located” instead of a descriptive title). CAC CDs without Info Files do not have any geographic description associated with them.

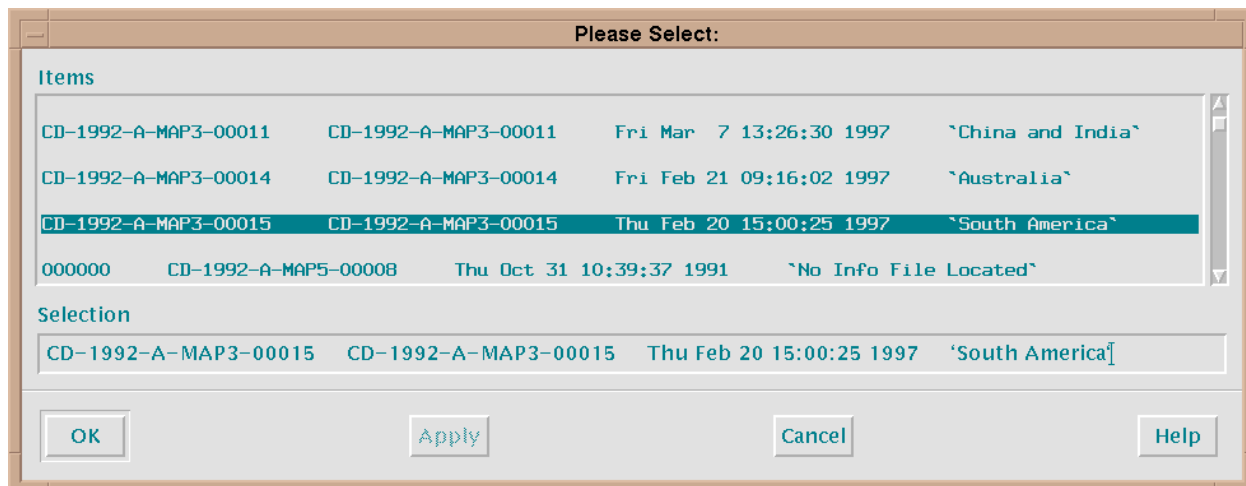


Fig. 24 – Sample list of logged source coverages

3.3.4.5 Include Processed Coverage

This option builds a composition from processed Finland Air Force geotiff coverage (i.e., geotiff map data that have been processed into CAC segments, then logged and stored on hard disk or CD). The menu selection box provides four columns of information for each entry: Info File name, Processed Coverage filename, date processed data were logged into MMC, and a brief description of the geographic coverage of the data.

3.3.5 Preferences

The *Preferences* menu (Fig. 25) allows the user to set certain preferences for the current MMC session, including whether to build an AOD or MPS composition, the primary source from which to view CAC data in the current image (e.g., from CAC CD or from processed data on the hard disk), the format in which to display latitude and longitude coordinates, and print options. Some menu options are selectable via toggle buttons that turn red when chosen.

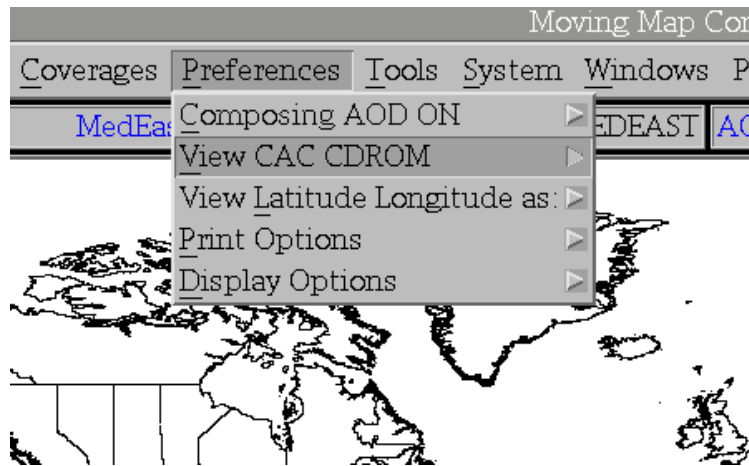


Fig. 25 – Preferences menu

3.3.5.1 Compose AOD / Compose MPS

This option sets the type of image to be built. This preference may be changed at any time during the creation of a map theater build. Note that restrictions on AOD images are more stringent than MPS images:

- ◆ When switched to *Composing AOD ON* (default), MMC will design a composition based on the restrictions of AOD images (e.g., MMC calculates the final image size, number of directories per scale and zone, and number of MB per directory). Note that MMC does not limit a user from exceeding AOD restrictions (although it will issue warnings) until saving a final composition.
- ◆ When switched to *Composing MPS ON* – by clicking on the *Compose MPS* option (Fig. 26) – MMC will compose an image based on the restrictions of MPS images (e.g., image size). A message box appears to confirm selection of this option. DTED data is only available under the *Compose MPS* preference.

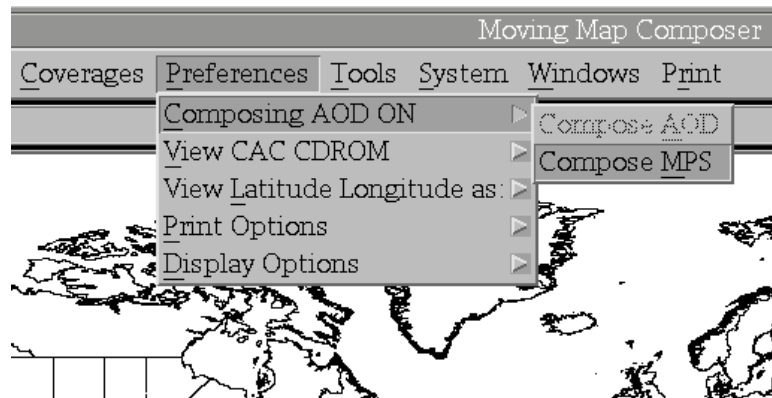


Fig. 26 – Composing preferences

3.3.5.2 View Chart Data Preferences

This option sets the source from which to view chart data. MMC tailors the menu options to accommodate the specific data source selected. Figure 27 reflects menu changes for a CAC data source selection, and Fig. 28 reflects menu changes for an MPS CD-ROM data source. Likewise, the menu is modified to reflect other selected data sources. Chart data may be viewed by selecting a coverage area with the arrow button, positioning the cursor in the area of interest, and pressing the right (third) mouse button. See Section 4.5 for more information on viewing chart data in MMC. Chart data will only be displayed for available CAC coverage in the source selected:

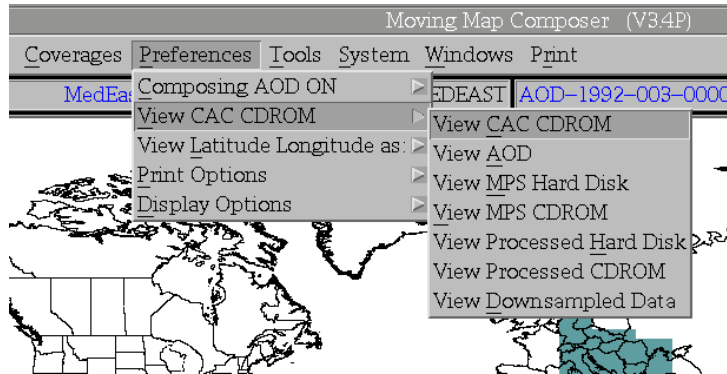


Fig. 27 – CAC source data preferences

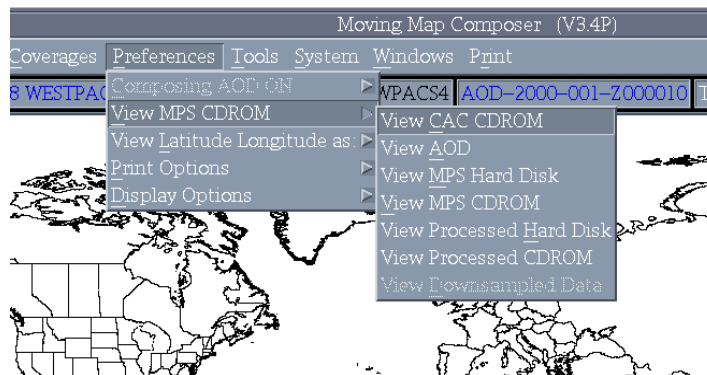


Fig. 28 – MPS source data preferences

- ◆ View CAC CDROM: (the default) sets the preference to view CAC data from a CAC CD (available from NIMA). When this preference is set, and the user clicks (with the third mouse button) on a segment to be viewed, MMC will issue a message telling the user to load the necessary CD. See Section 4.1 for more information on loading, selecting, and reading CDs.
- ◆ View AOD: view CAC data from an AOD mounted in the DMU. This option is not available until the user opens an AOD Image by clicking on *File*, then *Open Image*. This option is also not available if no DMU is attached to the system.
- ◆ View MPS Hard Disk: view map data from an MPS image stored on the hard disk.
- ◆ View MPS CDROM: view map data from an MPS image that has been logged and archived to CD. When this preference is set, and the user clicks on a segment to be viewed, MMC will notify the user to load the necessary CD. See Section 4.1 for more information on loading, selecting, and reading CDs.

- ◆ *View Processed Hard Disk*: view processed map data stored on the hard disk.
- ◆ *View Processed CDROM*: view processed map data that have been logged and archived to CD-ROM. When this preference is set, and the user clicks on a segment to be viewed, MMC will notify the user to load the necessary CD (Section 4.1).
- ◆ *View Downsampled data*: view downsampled (i.e., intermediate) map data stored on the hard disk.

3.3.5.3 View Latitude / Longitude Preferences

This option determines how MMC will display latitude and longitude coordinates: decimal degrees [default] or degrees, minutes, and seconds (Fig. 29). Latitude and longitude coordinates are used in the following MMC functions:

- ◆ the *Cursor Position* box in the lower-right corner of the main MMC display (Section 3.2.7); and
- ◆ to define or erase coverages by latitude and longitude.

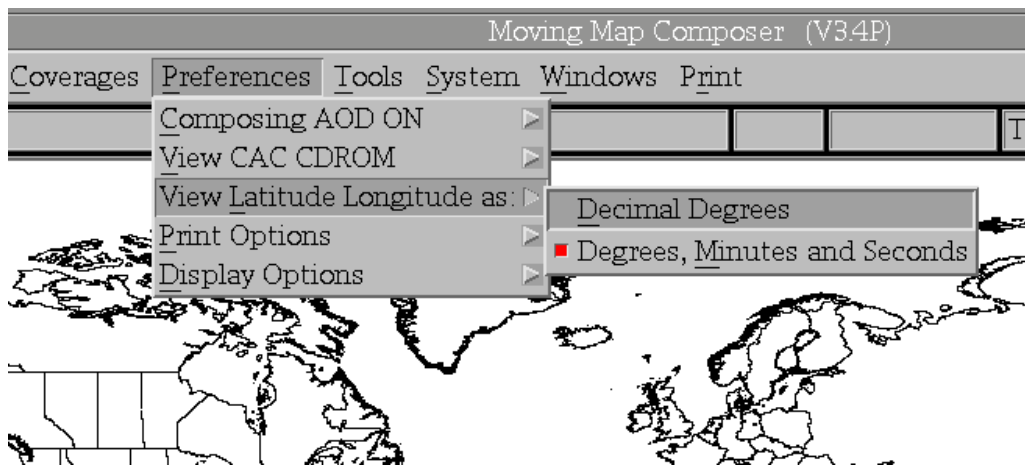


Fig. 29 – View latitude/longitude preferences

3.3.5.4 Print Options

This menu provides options for specifying the printer type and resolution (Fig. 30).

- ◆ *No Printer*: indicates a printer is not available for use. This is the default setting (upon first installing MMC 3.4P).
- ◆ *Text Only Printer*: indicates the available printer can only print text.
- ◆ *HP Text / Graphics Printer (300 dpi)*: indicates the available printer is a Hewlett Packard with 300 dpi resolution.
- ◆ *HP Text / Graphics Printer (600 dpi)*: indicates the available printer is a Hewlett Packard with 600 dpi resolution.
- ◆ *Seiko Color Printer*: indicates the available printer is a color Seiko such as those provided with the original AV-8B Map-Operator-Maintenance systems.

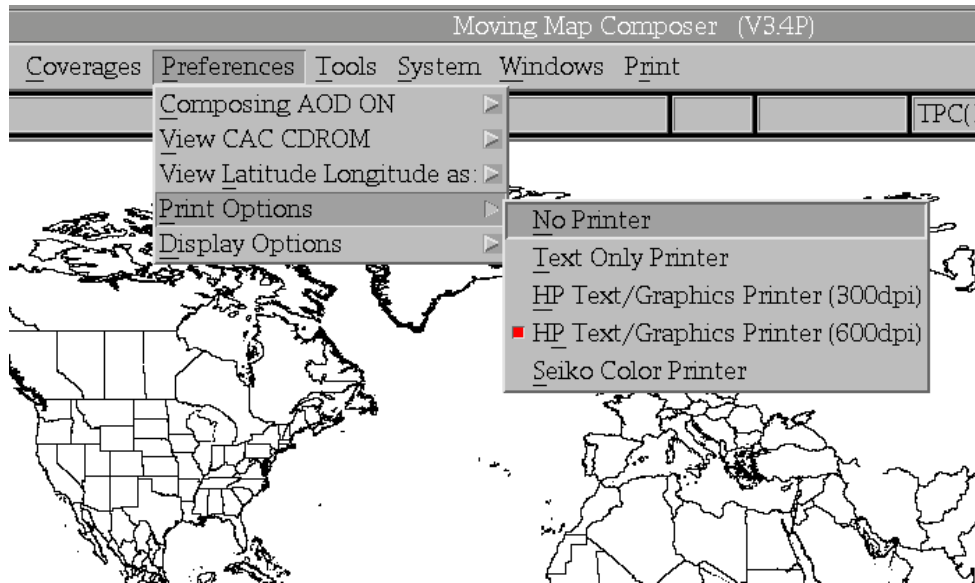


Fig. 30 – Print preferences

3.3.5.5 Display Options

This option sets the type of color map used for data display (Fig. 31).

Use Reduced Colormap: This option reduces the colormap of the processed map data for display within MMC without distorting the X-Windows-allocated colors. This option may degrade the display of the map data within MMC.

Use Virtual Colormap (Cockpit View): This option allows additional colors that are not normally required and is used in supporting cockpit views (true color). This option is the recommended setting for MMC.

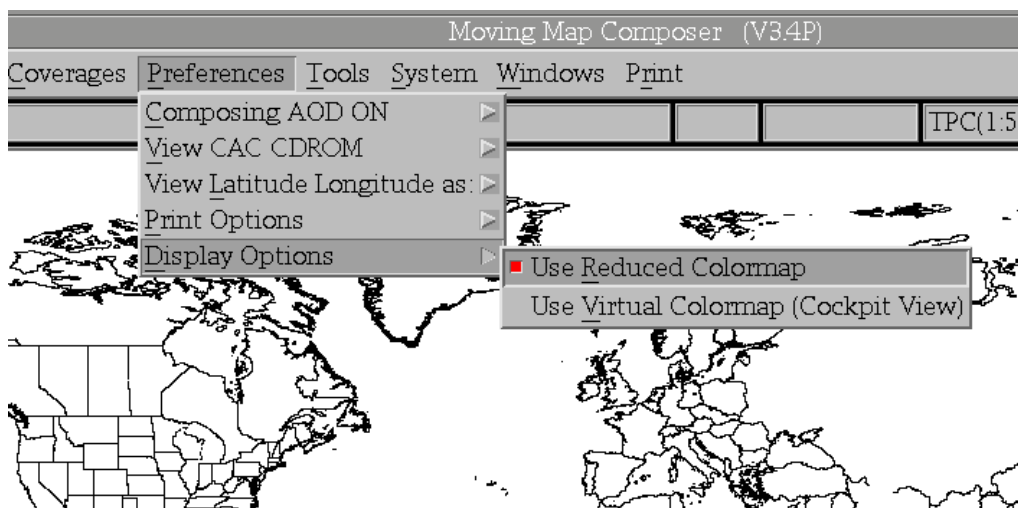


Fig. 31 – Display preferences

3.3.6 Tools

The *Tools* menu (Fig. 32) provides the user with many utilities, including processing map data, logging in new media (including CAC and DTED CDs), generating a summary of the current composition, building an AODI to hard disk or AOD, and archiving data (including processed data, AODIs, MPS-CDIs, and checklists) to CD.

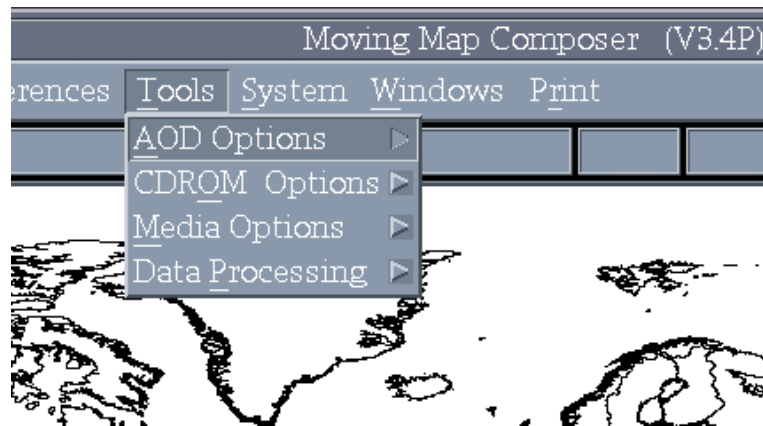


Fig. 32 – Tools menu

3.3.6.1 AOD (or MPS) Options

Depending on whether the user is composing an AOD image or MPS image (determined in the *Preferences* Menu, Section 3.3.5.1), the first item in the *Tools* menu will be either *AOD Options* or *MPS Options*. As shown in Fig. 33(a), there are five AOD options: *Generate AOD Summary*, *Build AOD Image*, *Generate Append Summary*, *Copy AOD Image to WORM*, and *AOD Recycle*. There is only one MPS option: *Build MPS Image* (Fig. 33(b)).

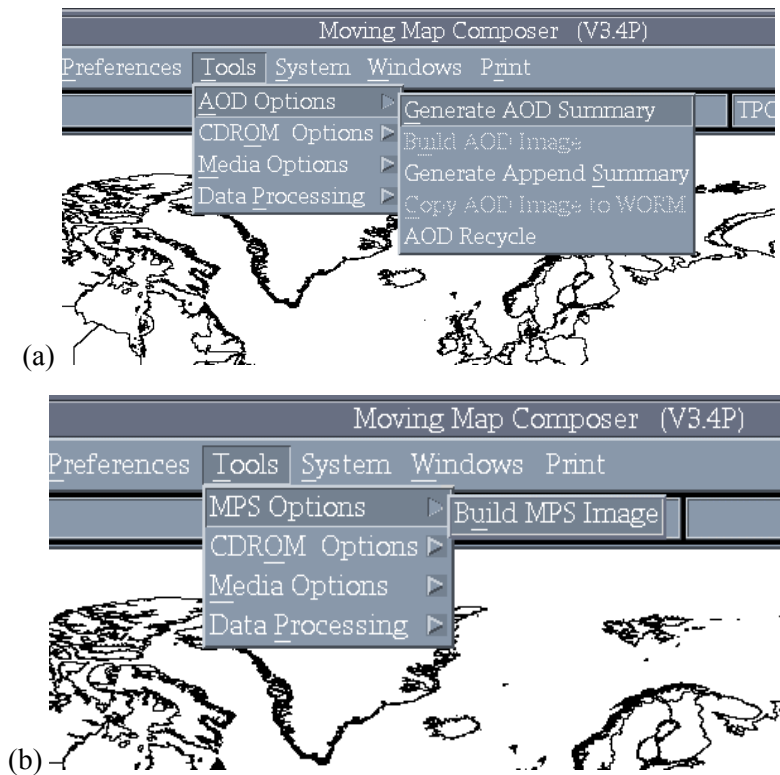


Fig. 33 – AOD/MPS options menus (depends on image type set in Preferences):
 (a) AOD Options menu, and (b) MPS Options menu

3.3.6.1.1 Generate AOD Summary — This option generates a printable summary of a previously built AOD (Fig. 34), including current status, date of summary, number of superdirectories used and remaining on the AOD, AOD size in bytes, and number of subdirectories written on the AOD. The summary also includes the names of the workstations used to create and write the AOD, AOD image composition and version numbers, and date written. A contents section includes additional subdirectory information, such as map scales and zones. The final coverage section provides the minimum and maximum latitude and longitude values – for each subdirectory – which together define the complete area of coverage.

3.3.6.1.2 Build AOD Image [or Build MPS Image] — This option builds a final image file from the user's AOD or MPS composition. Note: if the user has set the Compose AOD preference (Section 3.3.5.1), MMC will automatically build an MPS image first, then the AOD image. If the user has set the Compose MPS preference, MMC will only build the MPS image. The Build AOD [or MPS] Image option is not available until the user has opened a final composition (Section 3.3.1.3).

3.3.6.1.3 Generate Append Summary — This option generates a summary of any existing AOD composition, composition in development, or final AOD image (Fig. 34). For each zone, scale, and subdirectory in the composition or image file, Append Summary provides the minimum and maximum latitude and longitude, the number of CAC segments defined, and the number of sectors that would be used if the image were written to an AOD. The summary also gives the total number of bytes in the composition.


```

SUMMARY: Previously built ACOD Image
STATUS: GOOD **Correct ACOD Image**
TIME NOW: Thu Nov 12 13:30:39 1998
SUPERDIRS
# USED: 4 (Actual number used in ACOD)
# REMAINING: 12 (Actual number of superdirectories remaining)
ACOD SIZE: 217.39
# SUBDIRS: 2 (Image subdirectories cannot be modified)
ACOD ID:
Created by MMC station: V00000
Written by MMC station: JED
Composition Number: 1
Version: 6
Written on: 20 Oct 1998

CONTENTS: **Subdirectory Information**
**Note: Each zone for a given scale can only have a maximum
of 3 subdirectories**

Scale: JNC (1:2M )

|-----|
| Zone   | Zone   | ACOD | Subdirs | Subdir |
| Name   | Color  |      | Total   | Status |
|-----|
| Equatorial | Red   | 1    | 1      | GOOD  |
| North Temperate | Blue  | 1    | 1      | GOOD  |
|-----|

COVERAGE:

          33 13 37.8 N
          (33.2272)
          Row 35

          |-----|
          | SubDirectory 1 |
          |-----|
          | JNC          |
          | Equatorial   |
          | 30 segments  |
          | 1 Sectors     |
          |-----|
          | 93 47 22.1 W |
          | (-93.7895)  |
          | Column -99   |
          |-----|
          | 089 03 22.8 W |
          | (-89.0563)  |
          | Column -95   |
          |-----|

          27 41 32.3 N
          (27.6923)
          Row 30

          34 09 0.9 N
          (34.1502)
          Row 36

          |-----|
          | SubDirectory 2 |
          |-----|
          | JNC          |
          | North Temperate |
          | 20 segments  |
          | 1 Sectors     |
          |-----|
          | 93 33 9.5 W   |
          | (-93.5526)  |
          | Column -79   |
          |-----|
          | 088 49 13.5 W |
          | (-88.8204)  |
          | Column -76   |
          |-----|

          29 32 18.5 N
          (29.5385)
          Row 32
    
```

Fig. 34 – Sample AOD summary listing

3.3.6.1.4 *Copy AOD Image to WORM* — This option copies an AOD image from the MMC hard disk to an AOD on the DMU. Follow the directions given by MMC for this function. When a blank AOD is being used, MMC automatically begins the write procedure. If the AOD already contains data, it may either be recycled (i.e., all previous data are lost) and written with the new image or, the AOD can be appended (with no loss of existing data). If the AOD contains data from a failed write operation, MMC will offer to recycle it for use. Make sure an AOD is properly installed in the DMU, with the write-protect tab in the up (↑) position and that the DMU is turned on. **Recommendation:** label each AOD with the serial numbers of both the DMU and DMUI used to write the AOD. If there have been three write operations made to the AOD (i.e., the original write plus two appends), there should be three sets of DMU and DMUI serial numbers on the label (some may be duplicates).

3.3.6.1.5 *AOD Recycle* — This option allows remaining space on a previously used AOD to be used for new AOD images. **Note:** any preexisting images on the AOD are lost during the recycle operation, and one superdirectory will be lost. MMC invokes the **AOD Recycling Window** (Fig. 35).

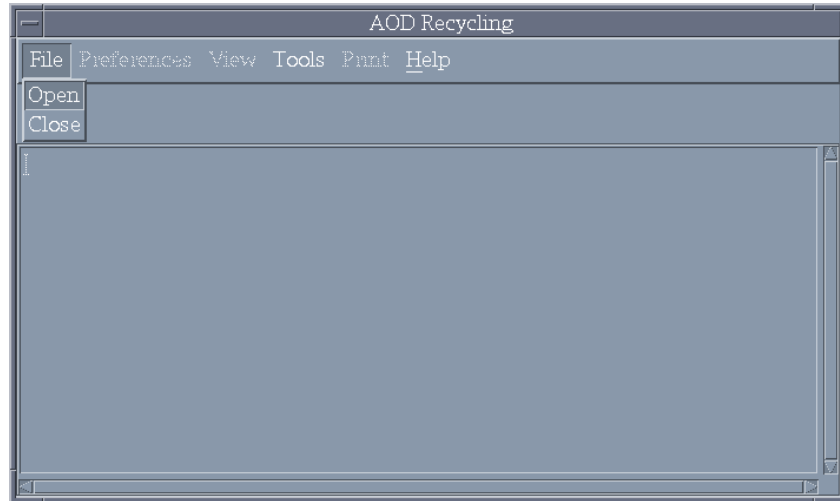


Fig. 35 – AOD recycle menu with file options

Click on the *File* menu option, then on *Open* to allow the DMU to open and read the AOD. MMC will then notify the user that the last sector written is being determined (and may take a few minutes to accomplish). Once completed, MMC displays the amount of remaining available space on the AOD and whether the open operation was successful. If the open was successful, the AOD may be recycled for further use.

To recycle an AOD, click on the **AOD Recycling Window** *Tools* menu, followed by the *Recycle* option (Fig. 36). Since all preexisting data will be lost, a confirmation window is provided. Click on *No* to cancel recycling or *Yes* to continue. When the *Yes* option is selected, the AOD will be recycled, which may take a few minutes to complete. Upon successful completion, a message will be displayed and the AOD is now available for use. To return to the main **MMC Window**, click on the *Close* option that is located under the *File* menu.

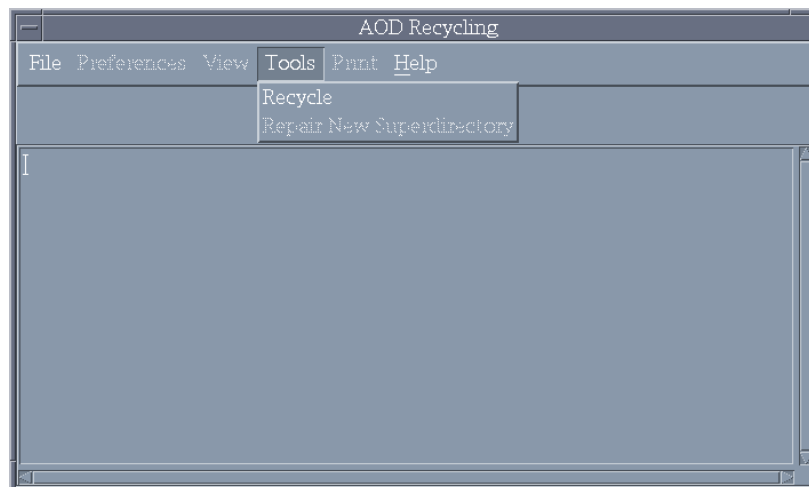


Fig. 36 – AOD recycle option

3.3.6.2 CDROM Options

These include archiving data to CD and restoring logged sources from CD (Fig. 37):

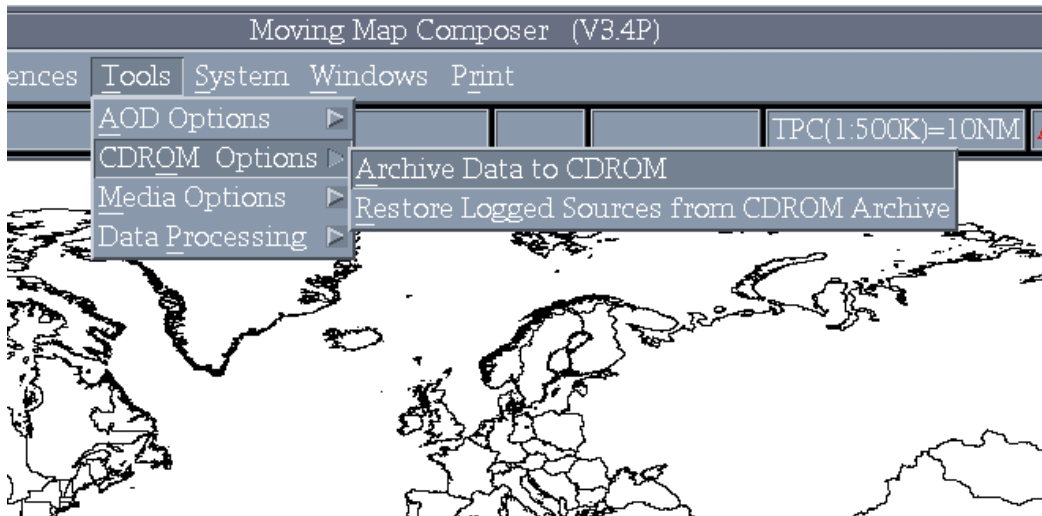


Fig. 37 – CDROM options menu

3.3.6.2.1 Archive Data To CDROM — This option will “Premaster” a set of data into a CD image and writes the data to a CD. The CD images conform to the International Standard Organization (ISO) 9660 standard for optical disk formats. When a user selects this option, MMC opens the **Archive To CDROM Window** (Fig. 38). Click on *PreMaster...* and select the data type to be archived: Processed CAC Data, AOD, MPS, CDROM, or Other Data. MMC will build an ISO 9660 Image from that data. If the user has built an ISO Image before, MMC will prompt the user to delete that file before building a new one. After premastering the data into an ISO Image, select *Cut...* to actually copy the data to a CD. When finished, select *Close* to return to the **MMC Window**. There are six data types that MMC can archive to CD:

- 1) **Processed CAC Data:** If the user is archiving processed data, MMC will pop-up a list of valid chart series to be archived (JNC, ONC, TPC, JOG, TLM-100, or TLM-50). Only one series of processed data may be archived to a single CD to maintain compatibility with the format and structure of CAC CDs. The only difference between CAC and processed CAC (SCAC) CDs is in the first field of their CD library numbers, *tt-yyyy-e-MAPs-fnnnn*, where:
 - tt** = type of data: ‘CD’ for CAC, or ‘SC’ for SCAC;
 - yyyy** = year (e.g., 1997);
 - e** = edition (A through Z);
 - ‘MAP’** = the characters “MAP”;
 - s** = scale (0 through 6; described in Appendix E.3);
 - f** = a unique integer identifying the CD mastering facility (e.g., 0 = 3M);
 - n**nnn = a unique ID number (0000 through 9999).

MMC recognizes both CAC and SCAC CDs as valid sources, but the library numbers must be different so that newly logged SCAC CDs will not erroneously replace previously logged CAC CDs, or vice versa. The ‘CD’ vs ‘SC’ at the start of the library number keeps the two data types distinct.

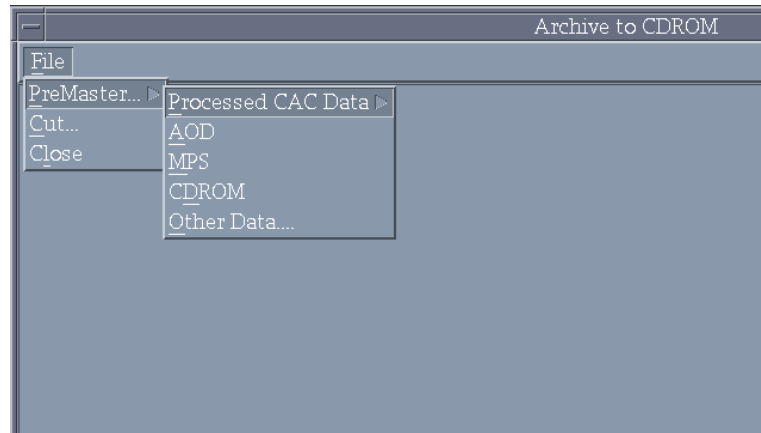


Fig. 38 – Archive to CDROM window

- 2) **AOD**: When archiving AOD data, MMC first checks whether there is a valid AOD Image on the hard disk. If not, MMC will not allow the user to Premaster. If there **is** a valid AOD Image, MMC will ask the user to verify the data to be archived. Select Yes to proceed (or Abort to cancel the operation).
- 3) **MPS**: When archiving MPS data, MMC first checks that there is a valid MPS Image on the hard disk. If not, MMC will not allow the user to Premaster. If there **is** a valid MPS Image, MMC will ask the user to verify the data to be archived. Select Yes to proceed (or Abort to cancel).
- 4) **CDROM**: Use this option to make a duplicate copy of any CD. MMC will display a verification message (answer Yes to proceed), then the **CD-ROM Site Window** (Fig. 41). Load the CD to be copied into the CD-ROM drive, select reader 7, then click on the Start Processing button at the bottom of the **CD-ROM Site Window**. See Section 4.1 for more information on loading, selecting, and reading CDs. MMC will take the user through the necessary steps to Premaster the data.
- 5) **Other Data**: Use this option to archive any other data on the MMC system. (It is particularly important to backup the *bitmaps directory* on a regular basis). MMC will display a verification message (select Yes to proceed) then a **File Selection Window** to help the user find the directory and file(s) to be included. After selecting the data files, MMC will guide the user through the necessary steps to Premaster the ISO Image.

3.3.6.2.2 Restore Logged Sources From CDROM Archive — Restores previously logged sources from CD. When the user selects this option, MMC displays an informational message about restoring data from CD (click on the Restore button to proceed). MMC will then display the **CD-ROM Site Window**. Click on the reader icon to select the CD to be read, then click on the Start Processing button at the bottom of the window. See Section 4.1 for more information on loading, selecting, and reading CDs.

3.3.6.3 Media Options

These include logging and unlogging media (e.g., CAC or DTED data from NIMA) in the MMC source databases (Fig. 39):

3.3.6.3.1 Log Media — This option logs new source data (CAC or DTED from NIMA) in the MMC source databases. While logging in a new CAC or DTED CD, MMC will build a bitmap of the source data that will be used to calculate and overlay available coverages (Section 3.3.3.6) and incorporate logged source data (Section 3.3.4.4) into an AODI or MPS-CDI. When the user selects Log Media, MMC displays the **CD-ROM Site Window**. After entering all the CDs to be logged, click on the Start Processing button at the bottom of the window. See Section 4.1 for more information on loading, selecting, and reading CDs.

Note: DO NOT eject any CDs until the “Logging Complete” message is displayed!

3.3.6.3.2 Unlog Media — This option removes references to source data from the MMC log file. This is done if a previously logged source is found to be bad (e.g., an unreadable CD). **Note: MMC will store multiple CAC CD versions, but not multiple DTED versions, because NIMA provides unique edition numbers for CAC CDs, but not for DTED CDs.**

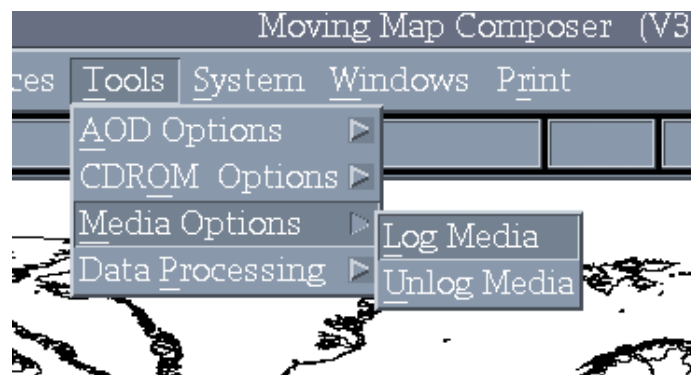


Fig. 39 – Media options

3.3.6.4 Data Processing

This selection provides options for processing FiAF geotiff data into CAC format (including all phases of compression) and deleting processed data from MMC (Fig. 40):

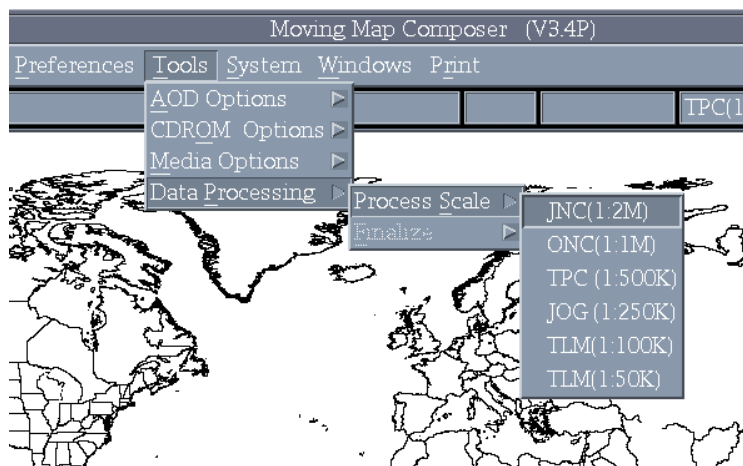


Fig. 40 – Data Processing menu

3.3.6.4.1 *Process Scale* — Select *Tools*, *Data Processing*, *Process Scale*, and then choose the appropriate chart scale for data to be processed from the list of supported scales. The **CD-ROM Site Window** (Fig. 41) appears. Insert the CD with data to be processed into the CD-ROM drive, and select reader 7 (the only reader available). Click on *Scan Readers*, and then *Start Processing*.

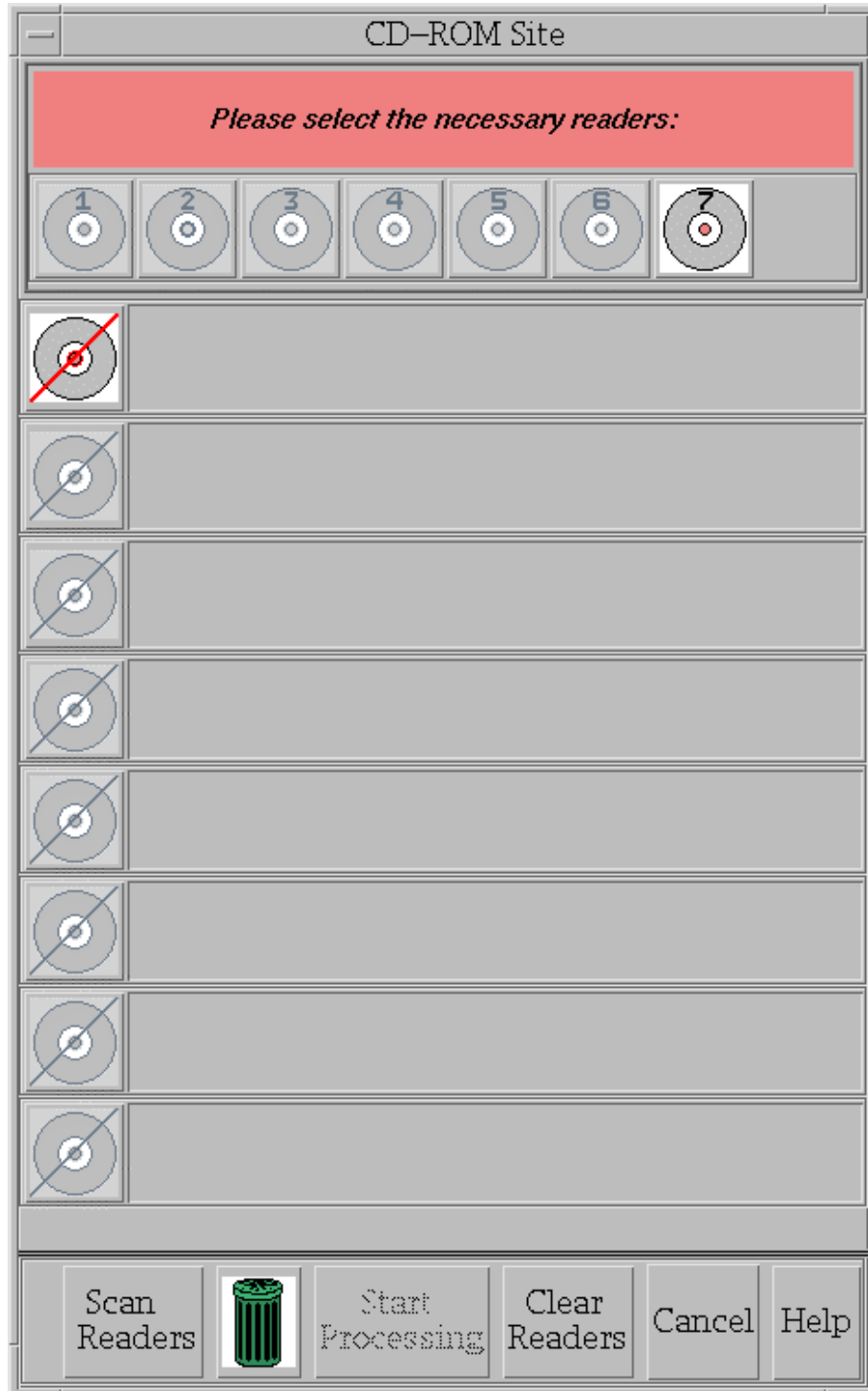


Fig. 41 – CD-ROM Site Window

If a color palette exists on the system that is different from the one needed for processing the selected data, then a dialog box will appear asking if you wish to build a new color palette. Click *Yes Build New Palette* to confirm and a **Summary Information** window will appear with important details and cautions about building color palettes. **Installing a new color palette renders all previously processed map data for the same scale obsolete and also renders all previous AOD Images and MPS Images obsolete. Read the information carefully.** The **Summary Information** window states:

A new color palette for this scale will be created using the color palette on file on the source CD-ROM.

CAUTIONS:

- All previously processed map data for this scale will be incompatible with the new color palette.
- MPS images containing previously processed map data for this scale will be incompatible with the new color palette.
- AODs containing previously processed map data for this scale cannot be appended with map data processed with the new color palette.
- An equivalent new color palette must be installed on the MPS system for compatibility with the new MPS images.

RECOMMENDATIONS:

- All previously processed map data for this scale should be re-processed with the new color palette.
- All previously processed map data and MPS images should be destroyed or marked OBSOLETE.
- Logged map data and map compositions from previously processed map data should be un-logged from MMC:
 - Select *Media Options* under the **Tools** menu.
 - Select *Unlog Media*.
 - Select *Source* to remove logged source map data or *User Defined* to remove map compositions.
 - Under *Source* select *CAC*, then choose *Processed CAC* and click on the selection to remove.
 - Under *Map Compositions*, select *Final*, then click on the selection to remove.
- AODs containing previously processed map data for this scale should be recycled prior to writing new map data at the same scale.
- If more than one scale will require a color palette change, re-process all scales with the new color palettes before creating new MPS images or AODs.

NOTE: CREATING A NEW COLOR PALETTE WILL PERMANENTLY RENDER ALL PREVIOUSLY PROCESSED MAP DATA FOR THIS SCALE OBSOLETE.

To continue with processing, click *I Agree* at the bottom of this window.

Once you agree to the previous information window, or if no conflicting color palette exists on the MMC system, then the **GeoTIF Processing Window** appears (Fig. 42).

If you are processing only one CD of data, it is recommended that you keep the **Finalize Automatically** box checked. When this option is on, the data will be finalized immediately after being

processed, but you will not be able to add any more data to that scale. To process additional data for that scale, archive the data and then delete the processed data for that scale from the hard drive. If you are processing data on more than one CD, uncheck the **Finalize Automatically** option; otherwise there may be problems with the edges of source data for each CD. Once data for those CDs have been processed, you may go back to the *Data Processing* menu and choose *Finalize* for the appropriate scale to manually finalize the data later. Be sure that all appropriate CDs have been processed before finalizing, because you will not be able to add more data for that scale once finalization is complete.

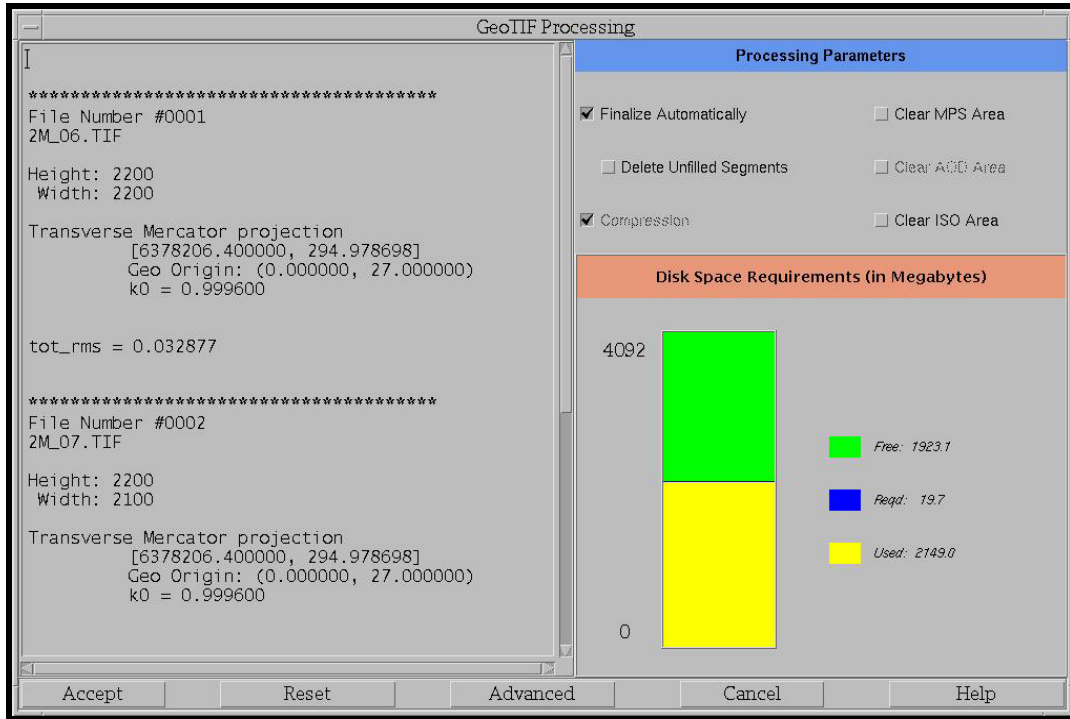


Fig. 42 – GeoTIF Processing Window

To accept the settings you have chosen, click *Accept* and processing will continue. MMC will display a template representation of the data zoomed into the area of coverage, with an overlay of a latitude and longitude reference grid. MMC will also display a message asking if the coverage is in the right area (Fig. 43). That is, is it in the right location and of the right size and shape? The user may have to move this message to the side if it obscures the template. If the template does not look right, click *No* to the message and determine the cause of the discrepancy. If the data look correct, click *Yes* and a *Processing* meter appears.

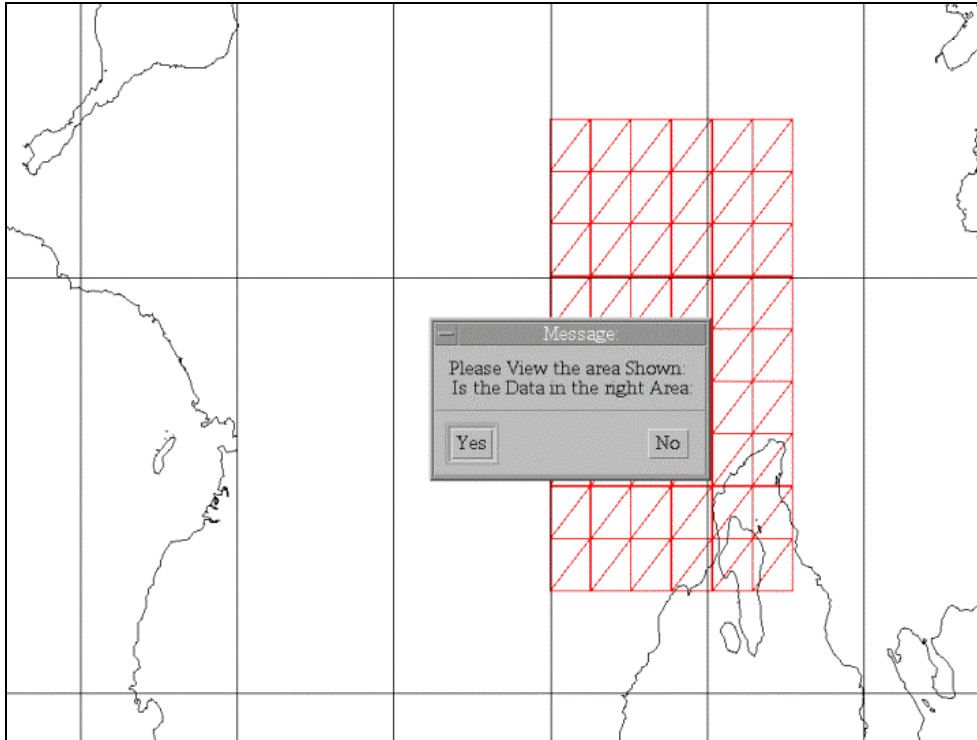


Fig. 43 – Area of coverage verification dialog

Wait for the processing to complete before attempting another task in MMC! This may take a long time depending on the size and scale of your data. When processing is complete, another dialog box appears stating that processed data have been added or removed at the current scale. Click *Acknowledge* to confirm. Another meter appears and after a few seconds a message appears announcing that processing is complete. Click *OK*.

At this point, if you selected to finalize the data automatically, MMC will return to the main **MMC Window**. If you unchecked the finalize option, you will now see another dialog that will ask if you wish to finalize now or continue processing data. Click *Finalize [scale]* to finalize the data. The [scale] shown depends on what data you just processed. MMC will again display a template representation of the data zoomed into the area of coverage, with an overlay of a latitude and longitude reference grid. The dialog “Is the data in the right area?” appears (Fig. 43). If the data look correct, click *Yes* to continue.

The **GeoTIF Processing Window** again appears; however, the options are slightly different (Fig. 44). The previous *Accept* button now reads *Finalize* and the advanced options are disabled. To finalize the data, click the *Finalize* button at the bottom left corner of the window. Wait for the *Compressing Data* meter to finish before attempting another task in MMC. This should not take as long as the previous *Processing* meter.

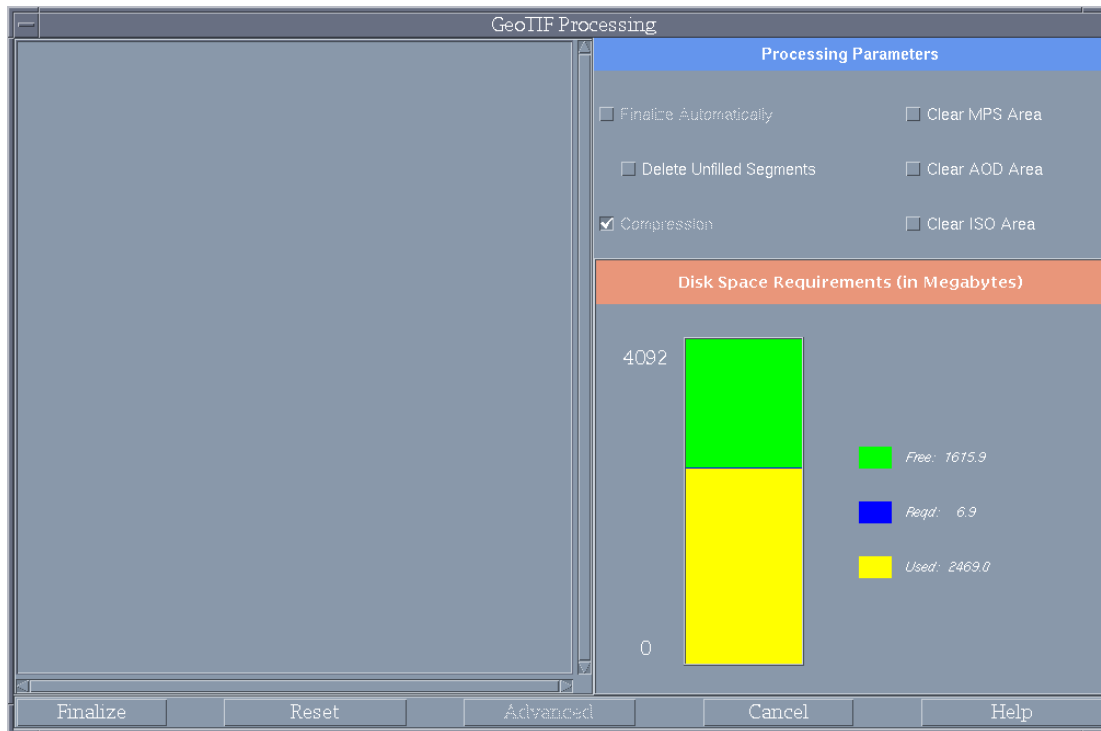


Fig. 44 – GeoTIF Processing Window with *Finalize* button

Once compression is done, a message will appear stating that the processed scale has been added or removed from the processing area. Click *Acknowledge* to confirm. After another short meter, a dialog appears stating that processing is complete. Click *OK*. MMC returns to the main MMC window.

3.3.6.4.2 Finalize — If the user does not finalize the processed data automatically or when prompted, the data can be finalized manually from the *Tools* → *Data Processing* menu. When the user selects *Finalize* from the menu, MMC will compress all the intermediate data into CAC files. A cascade menu for selecting the chart scale is provided. Click on the appropriate scale.

MMC will display a template representation of the data zoomed into the area of coverage, with an overlay of a latitude and longitude reference grid. MMC will also display a message asking if the coverage is in the right area (Fig. 43). That is, is it in the right location and of the right size and shape? If the template does not look right, click *No* to the message and determine the cause of the discrepancy. Otherwise, click *Yes* and MMC will invoke the **GeoTIF Processing Window** (Fig. 44). Click *Finalize* in the bottom left corner of the window to finalize the data. MMC will display a compression meter showing the percent complete. **Wait until compression has finished before attempting another task in MMC!**

Note: If MMC fails (e.g., due to a power failure or a system lock) while compressing data, simply restart MMC and click on *Tools*, *Data Processing*, and *Finalize* again.

When processing has completed, MMC will display a message saying that processed scale has been added or removed from the processing area. Click *Acknowledge*. After another short meter, a dialog appears stating that processing is complete. Click *OK*. MMC will return to the main MMC Window.

3.3.7 System

This menu (Fig. 45) includes options for maintaining system file resources including file deletion and disk space utilization:

- *Clear MPS Area*: Clears an MPS area on the hard disk.
- *Clear AOD Area*: Clears an AOD area on the hard disk.
- *Clear ISO Area*: Clears an ISO area on the hard disk.
- *Delete Processed Data*: Clears the defined area of CAC data coverage for the specified chart scale on the hard disk (Fig. 46).
- *Disk Usage*: Invokes the Disk Space Utilization Window (Fig. 47), which graphically depicts the percentages of used and available disk space.

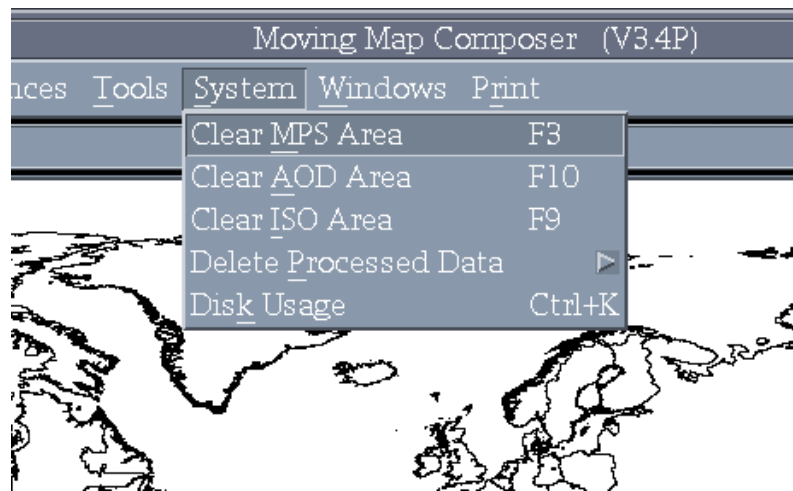


Fig. 45 – System menu

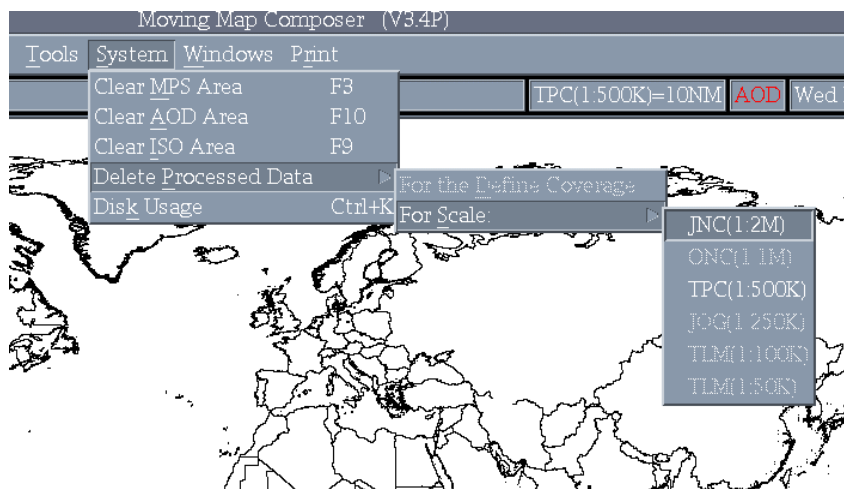


Fig. 46 – Delete Processed Data option

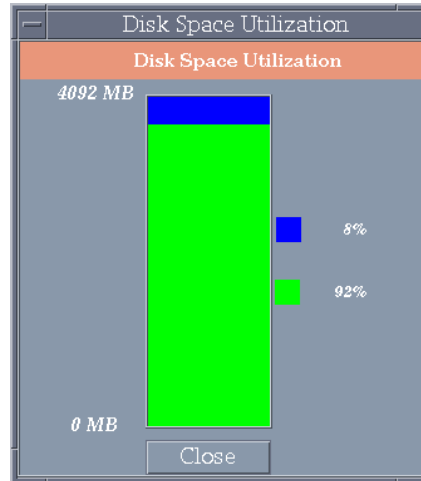


Fig. 47 – System disk usage

3.3.8 Windows

The *Windows* menu (Fig. 48) executes various MMC utilities in pop-up windows, including Composition Data Size, AOD/MPS Area Status, Data Sources Display, and History Display.

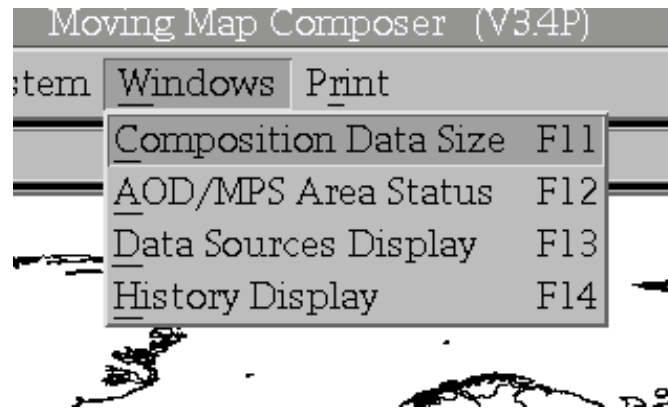


Fig. 48 – Windows menu

3.3.8.1 Composition Data Size

This window monitors how much disk space is used for each scale of chart data in a composition (Fig. 49). If one or more scales have too much data (calculated by the number of AOD sectors permitted per scale), the graph will turn red for that scale (Fig. 50(a)). If the size of the composition (for all the scales combined) is greater than 260 MB – i.e., too large to fit on an AOD – then the “Total” graphs will turn red. This can happen even if each individual scale of data is within the size limits of an AOD (Fig. 50(b)).

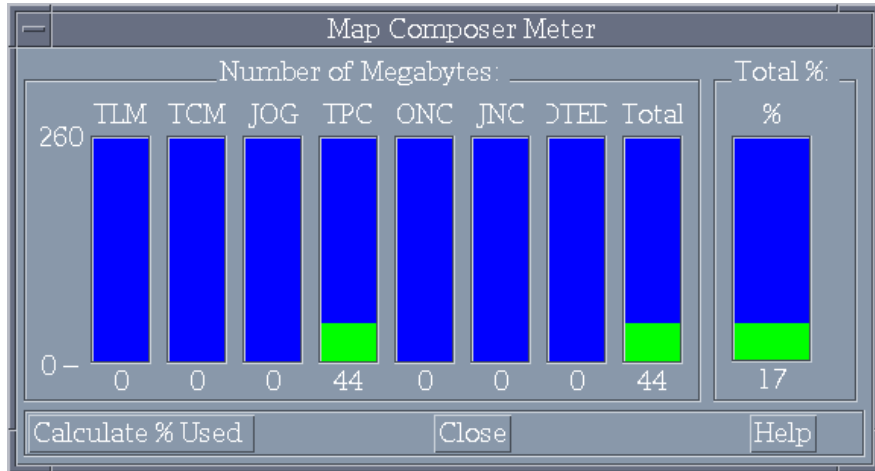


Fig. 49 – Composition size with limits

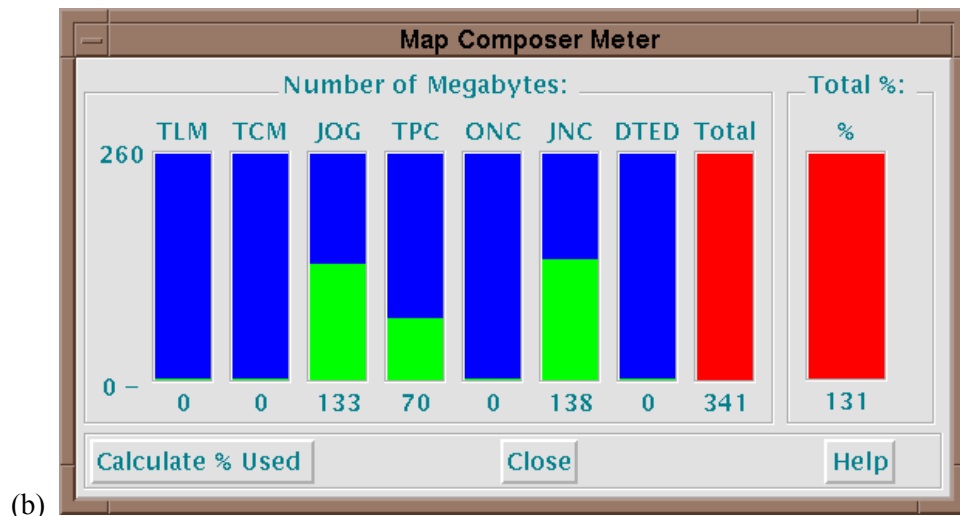
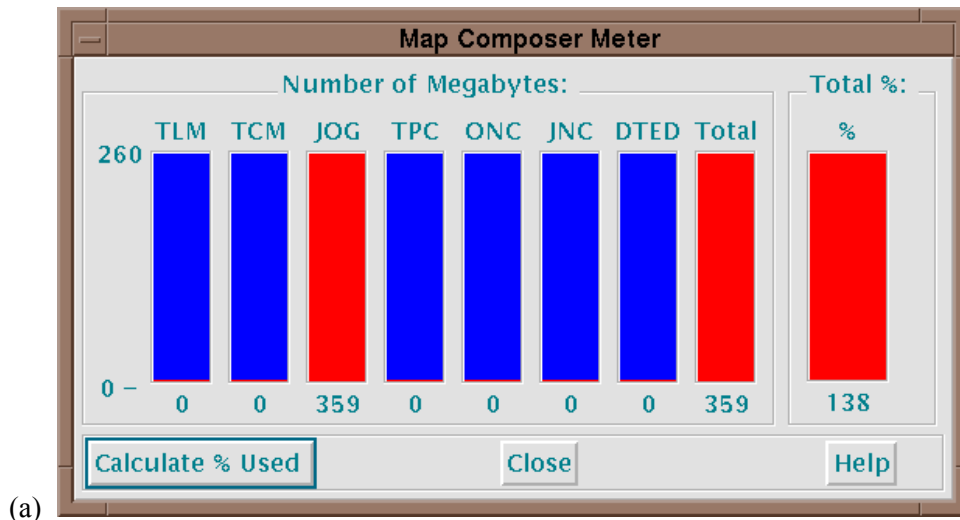


Fig. 50 – Composition data size exceeds AOD limit: (a) JOG scale exceeds 260 MB; (b) individual JOG, TPC, and JNC scales are within 260 MB, but total exceeds 260 MB

3.3.8.2 AOD / MPS Area Status

This option lists all AODIs and MPS Images currently stored on the MMC hard disk (Fig. 51). The list includes the descriptive title, library number, and build status for each image. Click on *Acknowledge* to erase this display and return to the main **MMC Window**.

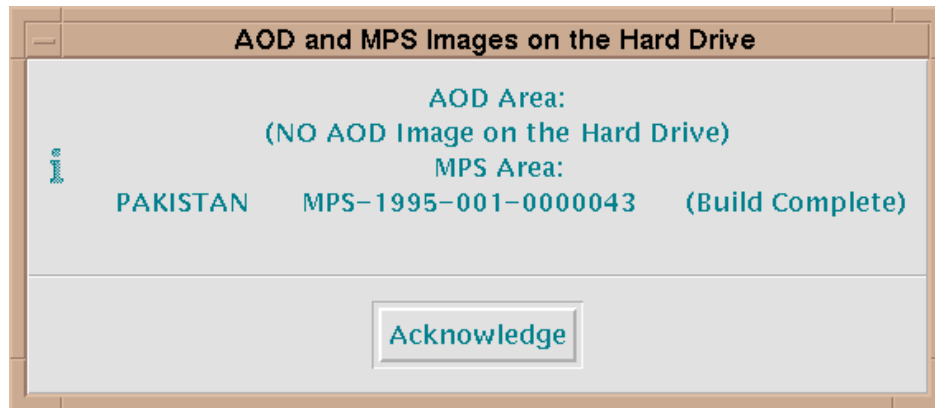


Fig. 51 – AOD/MPS area status

3.3.8.3 Data Sources Display

This option lists all logged data sources for the current composition, including DTED (for MPS compositions only), and CAC (Fig. 52). As the user defines new coverages, this display will reflect any new logged sources that are applicable.

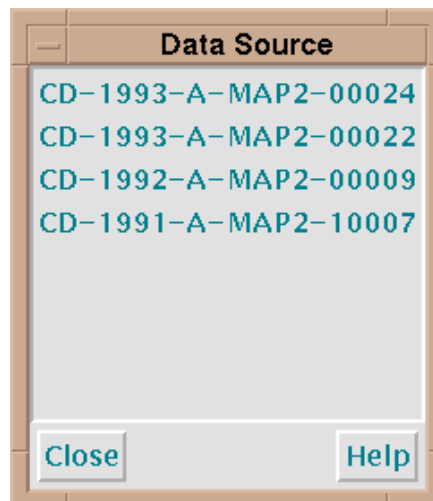


Fig. 52 – Data sources display

3.3.8.4 History Display

Clicking this option displays the MMC log file (Fig. 53), which includes all errors, warnings, and other messages issued by MMC. To print this log file, go to the MMC *Print* menu and click on *Print MMC Log File* (Section 3.3.9.3).

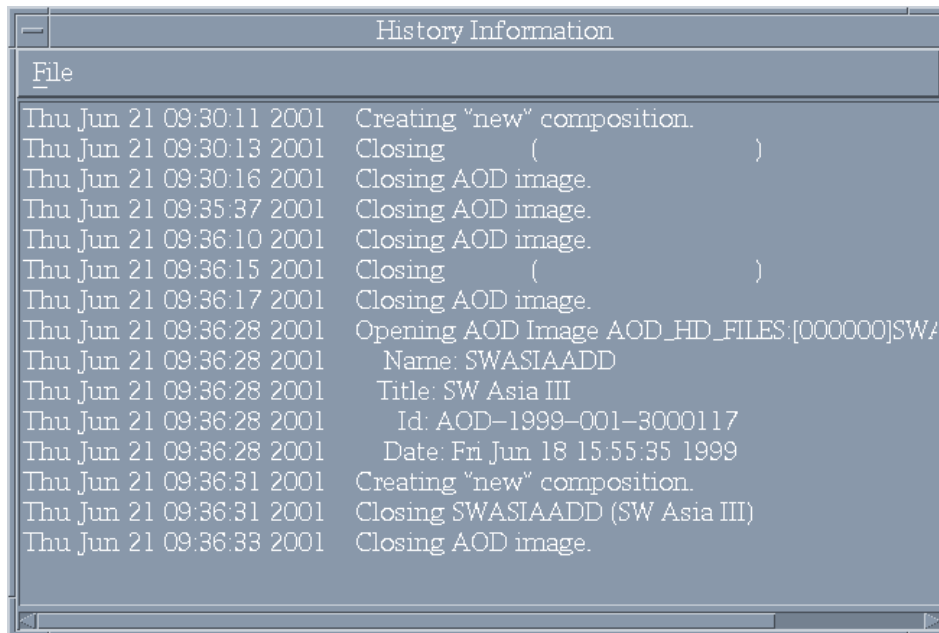


Fig. 53 – MMC processing history log file

3.3.9 Print

The *Print* menu (Fig. 54) provides three options: print the entire screen, print AOD audit files, and print the MMC log file.

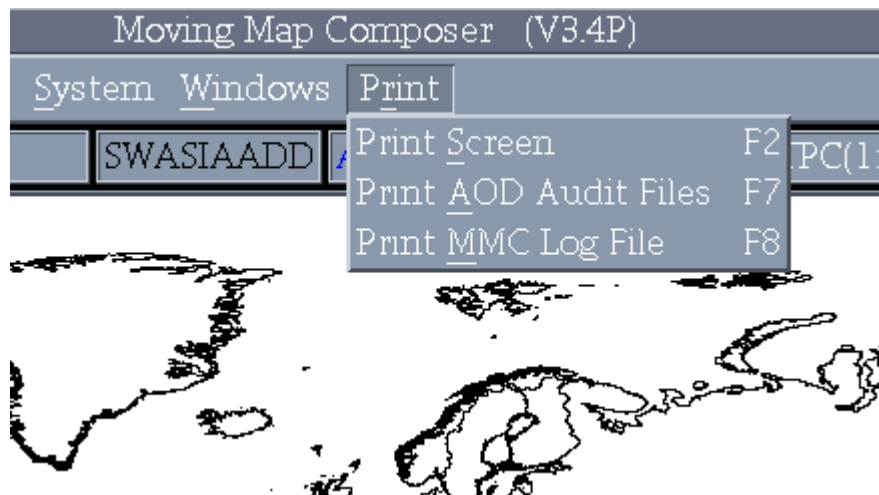


Fig. 54 – Print menu

3.3.9.1 Print Screen

This option prints the contents of the entire screen. A graphics printer (e.g., *HP-300*, *HP-600* or *Seiko printer*) must be connected and set via *Print Options* (Section 3.3.5.4) under the *Preferences* menu.

3.3.9.2 Print AOD Audit Files

This option prints the AOD Audit Files, which are created during AOD builds. After clicking on this option, MMC will prompt the user for AOD serial number and side. Only the audit file for that AOD and side will be printed. A text printer (e.g., *Text-Only Printer*, *HP-300*, or *HP-600*) must be connected and set via *Print Options*.

3.3.9.3 Print MMC Log File

This option prints the MMC log file. The user is advised to view this log file first – via the *History Display* (Section 3.3.8.4) under *Windows* – before printing. After printing, MMC will automatically purge the log file (i.e., clear all contents).

4. COMMON MMC OPERATIONS

4.1 Loading and Selecting CDs in MMC

MMC uses the CD changer (not included with FiAF system) and internal CD-ROM drive for a variety of operations, including archiving processed data and viewing chart data. The procedure for loading and selecting a CD is the same regardless of the application:

1. Load the required CD into the internal CD-ROM drive. With certain functions (for example, viewing CAC data from CD), MMC will specify which CD to load.
2. MMC will display the **CD-ROM Site Window** (Fig. 41), listing all seven CD slots; this includes six slots in the CD changer (CDROM1 through CDROM6), which are unavailable in the FiAF configuration and are colored gray, and the computer's internal CD drive (CDROM7).
3. Click (with left mouse button) on CD device number 7. As the user selects a device number, MMC will enter it in the list (Fig. 55).
4. Select *Scan Readers* (in the lower-left corner of the window); MMC will list the title of the CD on the selected reader (Fig. 56).
5. If the listed CD is not required, click (with middle mouse button) and drag that CD's number from the list to the Trash Can at the bottom of the window. The CD-ROM Site Window then again shows the readers as unselected (Fig. 41). You can also select Clear Readers to perform the same task. If several CDs were listed, all readers would be cleared, however.
6. When the required CD is listed, select Start Processing (at the bottom of the window).
7. Alternatively, select Clear Readers to start the process over, or Cancel to cancel the operation and return to MMC.



Fig. 55 – CD-ROM Site Window: CD reader number 7 selected



Fig. 56 – CD-ROM Site Window: title listed for selected CD reader

4.2 Process CAC

The *Data Processing* option is used to process FiAF geotiff map data and compress them into CAC files. MMC reads geotiff map files from CD and can only process one scale of geotiff data on any given CD. The volume label and directory structure for the geotiff map files are defined in Appendix D, Section 2. **MMC will not process FiAF map data that do not conform to the map data and directory structure formats listed in Appendix D, Section 2.**

1. Install CDROM containing source geotiff map files:
 - a) Insert the CD-ROM containing map data to be processed.
 - b) From the MMC main menu, click on *Tools*, then *Data Processing*.
 - c) Under *Process Scale*, select the appropriate scale.
 - d) From the **CD-ROM Site Window** (Fig. 41), select CD-ROM drive 7, and then click on *Scan Readers*.
 - e) Once the Volume ID of the CD-ROM is shown (FAF_GTIF), click *Start Processing*.
 - f) If the CD-ROM does not contain a palette file included with the source data, click *Yes* to use the system color palette. Otherwise, a message will appear asking if you want to install a new palette (Appendix D, Section 1 describes how to build a new color palette). Click *Yes Build New Palette* to continue and review the information message.

NOTE: Installing a new color palette renders all previously processed map data for the same scale obsolete and also renders all previous AOD Images and MPS Images obsolete. See *Data Processing* Section 3.3.6.4.1 for details.

2. Process the geotiff map files:
 - a) The **GeoTIF Processing Window** (Fig. 42) displays information about disk usage, processing options, and advanced processing options.
 - b) Review the **GeoTIF Processing Window** information, making sure that the **Finalize Automatically** option is checked, and click *Accept*.

Note: When *Finalize Automatically* is checked, MMC will not allow more data at the same map scale to be processed until these data have been archived and/or deleted from the

system. If more than one CD-ROM of map data at a given scale requires processing, do not select *Finalize Automatically* until the final CDROM is inserted.

- c) A bitmap of the map segments to be processed from this geotiff data is displayed (Fig. 43). Verify the approximate geographic extents of the map coverage shown and if correct, click Yes.
 - d) A processing meter appears near the bitmap coverage of the data to be processed. The bitmap displays map segments that have not been processed and compressed. The bitmap becomes smaller as more map segments are processed. Once processing is complete, click Acknowledge, and then click OK.
3. Review the processed map data (FiAF CAC) on the hard drive:
- a) From the main menu, click on Coverages, then Include Processed Coverage.
 - b) Select PROCESSED-HD-MAP_x in the dialog box and then click OK. **Note that *x* is an integer that indicates one of the following chart scales:**

<i>Integer</i>	<i>Chart Scale</i>
5	1:2M
4	1:1M
3	1:500K
2	1:250K
1	1:100K
0	1:50K

- c) On the toolbar (located at the bottom of the MMC window), use the Map Projection Selection Box button to change the map projection of the display from Mercator to North Polar and use



the Zoom-in on a Stretch-Box button that is located on the toolbar to zoom into the location of the map coverage.

Note: To provide accurate color fidelity of the map data, the MMC display must be set to Virtual Colors (via Preferences on the main MMC menu; see Section 3.3.5.5).

- d) Move the mouse to the location of the map coverage and click the right mouse button.
- e) In the **Map Coverage** window, view and scroll the FiAF CAC and verify its georeferenced accuracy and color fidelity (note that the mouse must be positioned inside the **Map Coverage** window to display accurate color fidelity in Virtual Colors mode).
- f) When finished viewing the map data, click on File, then Close in the **Map Coverage** window.

4.3 Archiving Data to CD

Archiving to CD is performed to preserve data and images that were created with MMC. See Section 3.3.6.2.1 for additional information on archiving data.

Perform the following steps to archive data to CD:

1. Click on Tools, CDROM Options, and then Archive Data to CDROM.
2. The **Archive to CDROM Window** will be displayed. From this window, click on File, PreMaster...., then Processed CAC Data and finally, the appropriate chart scale.

3. A message box appears when data from a previous archive operation exists. You are asked if it is acceptable to delete this data. Click Yes since this data (under normal operations) has already been copied to CD.
4. A message box appears to confirm this operation. Click Yes to proceed (or No to abort and return to the main MMC window).
5. A window is displayed to obtain a title for the archive. Enter a descriptive title – this title should also be used later to label the CD.
6. Wait until MMC finishes Premastering before continuing. A message box appears when it is complete.
7. Insert a blank CD label-side-up into the CD caddy, then load the caddy in the CD writer. Wait until the CD writer's green **Disc** light is ON (not blinking) before continuing.
8. Click on File (in the **Archive to CDROM Window**), then Cut.
9. **Wait until the CD writer has finished writing to the CD before continuing!** **Important:** even after MMC says the write is finished, wait until the CD writer's **Read** (green) and **Write** (red) lights stop blinking! (There is no other way for the CD writer to inform MMC that the write is finished.) The green **Disc** and **4x** lights will stay on.
10. Select Close from the **Archive to CDROM Window** to return to the **MMC Window**.
11. Again, be sure the CD writer's **Read** and **Write** lights have stopped blinking then, eject the CD from the CD writer.
12. Label the CD with an indelible pen. Include the date, AOD image library ID, and a descriptive title (from step 5, above).
13. A final message box appears advising the user to log and review the data that was just archived to CD. Further information may be obtained about logging a SCAC and deleting processed data through this message box.
14. Review the archived data from CD:
 - a) Load the AODI CD into the CD-ROM drive (Section 4.1).
 - b) MMC will display the **CD-ROM Site Window**; select reader 7. See Section 4.1 for more information on loading and selecting CDs in MMC.
 - c) Click on Scan Readers, followed by Start Processing.
 - d) In the main **MMC Window**, click on File, then Open Image (Ctrl-I). Follow the directions to open the AOD image file from CD.
 - e) View the CAC data in the AOD image by clicking on an area of interest with the right (third) mouse button (Section 4.5).

4.4 Logging CAC, Processed CAC (SCAC), and DTED CDs

Prior to building any AOD or MPS compositions, the user must first log all the necessary data sources. As a standard practice, NRL recommends that the user log in every available data source as it is received. Figure 57 is a data flow diagram that illustrates how to log data sources at various stages of MMC processing.

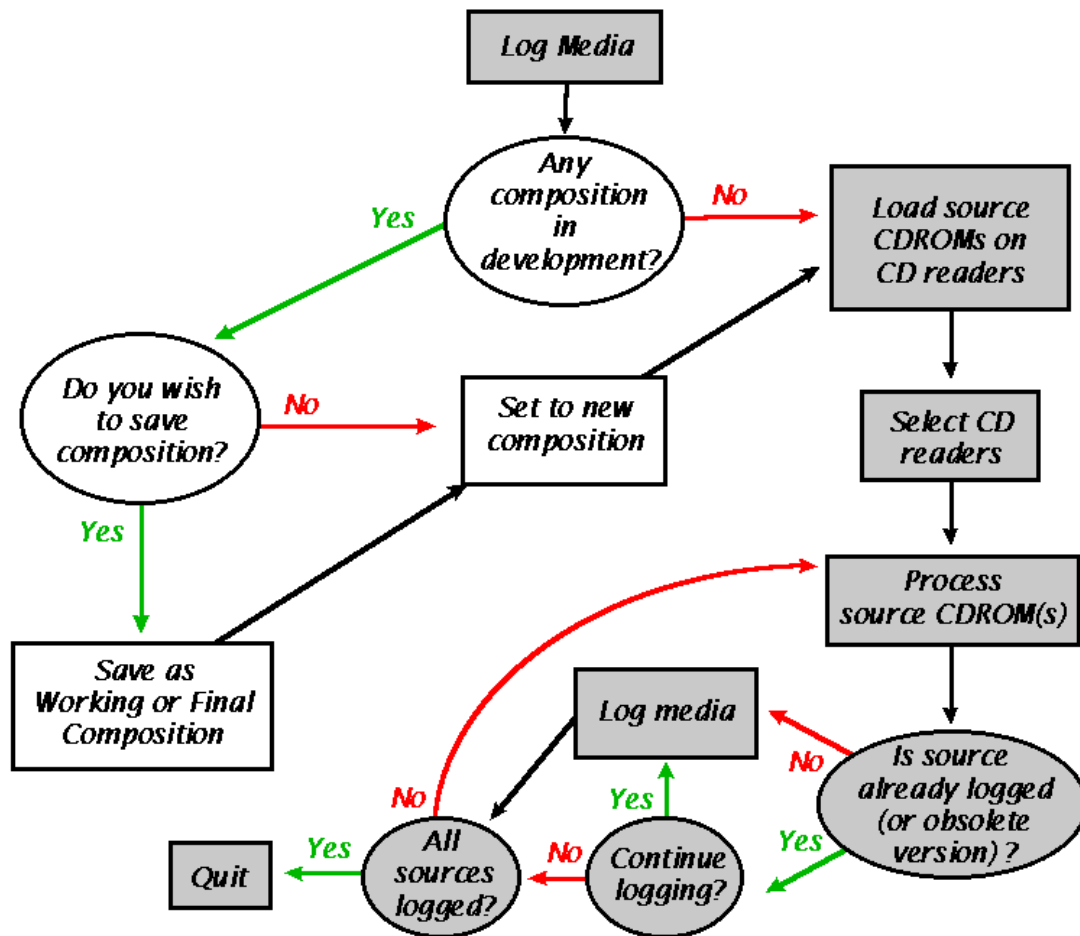


Fig. 57 – Logging data sources: complete before building any compositions

To log source data, perform the following steps:

- Insert the required CD(s) one at a time into the CD-ROM drive. **Note: load each CD facedown (label side up).**
- Click on *Tools*, then *Media Options*, then *Log Media*.
- MMC will open the **CD-ROM Site Window** (Fig. 41). Select the CD reader containing the CD to be logged (reader 7), click on *Scan Readers*, then *Start Processing*. MMC may prompt for a descriptive title for the CD (e.g., “Continental US at TPC scale”). Logging one CD takes about one minute. MMC verifies that the color palettes match. If a different palette is detected, an error message is displayed and the Log operation aborts.
- After the first CD is logged, repeat the process for any subsequent CDs. See Section 4.1 for more information about loading and selecting CDs in MMC.

4.5 Viewing Chart Data from a Processed CAC (SCAC) CD

This section lists the steps for viewing chart data from a processed CAC (also called SCAC) CD.

1. Log the desired SCAC CD into MMC, if not already done (Section 4.4).
2. From the main menu, click on Coverages, then Include Processed Coverage.
3. Select the title of the logged processed CD in the dialog box and then click OK.
4. MMC will prompt the user to load the appropriate SCAC CD (Fig. 58); load it into the CD-ROM drive (Section 4.1).
5. MMC will pop up the CD-ROM Site Window. In the FiAF configuration only the Alpha's internal CD drive (CDROM7) is available (the rest are unavailable and colored gray).
6. Click (with left mouse button) on CD device number 7.
7. Select Scan Readers (in the lower-left corner of the window); MMC will list the title of the CD on reader 7.
8. Click on Start Processing. MMC will display the coverage of the SCAC data.
9. Click inside the coverage area with the right (third) mouse button.
10. Note: To provide accurate color fidelity of the map data, the MMC display must be set to Virtual Colors (via Preferences on the main MMC menu and see Section 3.3.5.5).
11. To scroll around the image, position the cursor at the edge of the Map Coverage Window and click with the left mouse button. For example, to scroll up, position the cursor at the top edge of the Map Coverage Window and click. (When switching TS zones, there will be a pause while the new color palette loads).
12. From the Map Coverage Window (which displays the CAC data), click on File, and then Close to return to MMC.

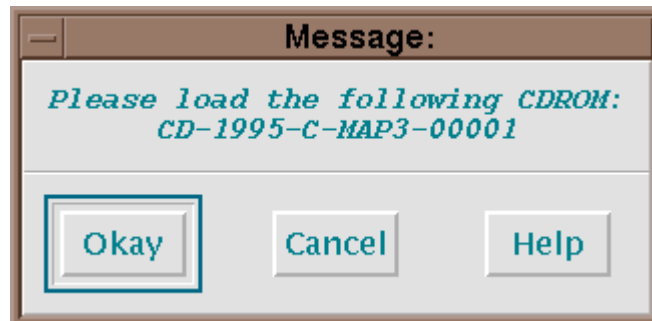



Fig. 58 – MMC prompt to load CAC CD

4.6 Design, Build, and Archive a New AODI and MPS-CDI

This section describes how to design, build, and archive a new AODI and MPS-CDI.

1. Display the existing logged coverage bitmap:
 - a) From the main menu, click on the File option, then *New*.
 - b) If the Build Type Mode (either *AOD* or *MPS*, just below menu bar on far right) is not set to *AOD*, change it by clicking on Preferences, then *Composing MPS ON*, then *Compose AOD*, and then click Yes.

- c) On the toolbar (located at the bottom of the MMC window), use the Chart Series and Scale Selection Box to set the map scale to the appropriate scale and the Map Projection Selection Box to set the appropriate map projection of the display.
 - d) From the main menu, click on *Overlays*, then *Available Coverage*.
 - e) If needed, use the Zoom-in on a Stretch-Box button  that is located on the toolbar to zoom.
 - f) MMC will display the coverage of all available sources at the selected scale.
2. Design a composition:
 - a) To include processed map coverage in a composition, click on *Coverages*, then *Include Processed Coverage*. Select the desired coverage to be included and click OK. This will add the coverage at the given chart scale to the current composition. Repeat this step for each scale to be included in this composition.
 - b) MMC will display your defined areas in colored boxes (the color reflects the TS zone of the data).
 - c) To check the size of the composition, from the main menu, click on *Windows*, and then *Composition Data Size Display* (Section 3.3.8.1) to see a meter showing how much space has been used.
 3. Save the composition:
 - a) Click on *File*, then *Save As Final Composition*.
 - b) Enter a filename and description when prompted.
 4. Reopen the same composition. (As a security measure, MMC requires that the user opens a final composition and not modify it prior to building the AODI):
 - a) Click on *File*, then *Open Final Composition*.
 - b) Scroll through the list and select the AOD composition (not the MPS composition) just created. MMC will display the coverage on the world map.
 5. Build the AODI and MPS images (MMC automatically builds both):
 - a) Click on *Tools*, then *AOD Options*, and then *Build AOD Image*.
 - b) MMC will display a *Data Sources Window* (Fig. 52) listing which data sources are needed.
 - c) MMC will also open the *CD-ROM Site Window*.
 - d) Load the first necessary CD into the CD-ROM drive. From the *CD-ROM Site Window*, select reader 7. Click on *Scan Readers*, then *Start Processing* (Section 4.1). Repeat this step for the rest of the needed sources. MMC will now build the AOD and MPS images.


NOTE: Installing a new color palette renders all previously processed map data for the same scale obsolete and also renders all previous AOD Images and MPS Images obsolete. Please see *Data Processing*, Section 3.3.6.4 for more details.

- e) Wait until MMC says the image build is complete before continuing with the next step.
6. Open the AOD image and review it:
 - a) Click on *File*, then *Open Image*. Follow the directions to open the new AOD image file from the hard disk.
 - b) View the CAC data in the AODI by clicking on an area of interest with the right (third) mouse button (Section 4.5).
 7. Archive the AODI to CD:
 - a) Click on *Tools*, *CDROM Options*, and *Archive Data to CDROM* (Section 3.3.6.2.1).
 - b) The **Archive to CDROM Window** will open. From this window, click on *File*, *PreMaster...*, then *AOD*.
 - c) A message box appears when data from a previous archive operation exists. You are asked if it is acceptable to delete this data. Click *Yes* since this data (under normal operations) has already been copied to CD.
 - d) A message box appears to confirm this operation. Click *Yes* to proceed (or *No* to abort and return to the main **MMC Window**).
 - e) A window appears to obtain a title for the archive. Enter a descriptive title – this title should also be used later to label the CD.
 - f) Wait until MMC finishes Premastering before continuing. A message box appears when it is complete.
 - g) Insert a blank CD label-side-up into the CD caddy, then load the caddy in the CD writer. Wait until the CD writer's green **Disc** light is ON (not blinking) before continuing.
 - h) Click on *File* (in the **Archive to CDROM Window**), then *Cut*.
 - i) **Wait until the CD writer has finished writing to the CD before continuing!** Important: even after MMC says the write is finished, wait until the CD writer's **Read** (green) and **Write** (red) lights stop blinking! (There is no other way for the CD writer to "tell" MMC that the write is finished.) The green **Disc** and **4x** lights will stay on.
 - j) Select *Close* from the **Archive to CDROM Window** to return to the **MMC Window**.
 - k) Again, be sure the CD writer's **Read** and **Write** lights have stopped blinking then, eject the CD from the CD writer.
 - l) Label the CD with an indelible pen. Include the date, AOD image library ID, and a descriptive title (from step e).
 8. Review the archived AODI from CD:
 - a) Load the AODI CD into the CD-ROM drive.
 - b) MMC will display the **CD-ROM Site Window** (Fig. 41), select reader 7. See Section 4.1 for more information on loading and selecting CDs in MMC.
 - c) Click on *Scan Readers*, followed by *Start Processing*.
 - d) In the main **MMC Window**, click on *File*, then *Open Image (Ctrl-I)*. Follow the directions to open the AOD image file from CD.
 - e) View the CAC data in the AOD image by clicking on an area of interest with the right (third) mouse button (Section 4.5).

9. Open the MPS image and review it:
 - d) Click on File, then Open Image (*Ctrl-I*). Follow the directions to open the MPS image file from the hard disk.
 - e) View the CAC data in the MPS image by clicking on an area of interest with the right (third) mouse button.
10. Archive the MPS image to CD: repeat step 7, substituting MPS for AOD in the Premaster... selection.
11. Review the archived MPS Image from CD: repeat step 8, substituting MPS for AOD in Open Image selection.

4.7 Add Data to an Existing Composition

This section describes how to add a new scale of data to an existing composition.

1. Click on the **File** menu and then click on New.
2. Log any new data sources required (see Section 4.4).
 - a) Use the Zoom-in on a Stretch-Box button  that is located on the toolbar to zoom into an area to show previously logged data sources.
 - b) Choose a new scale and geographic area for the data to be added.
 - c) Click on the Overlays menu, and Available Coverage. If necessary, zoom into an area of interest.
3. Open the final composition to be modified:
 - a) In MMC, click on Coverages, then Include Final Composition (*Ctrl-F*).
 - b) Scroll through the list of available compositions and select the desired AOD composition. MMC will display the templates for that composition on the world map.

Note: If FIAF CAC is not available for the open composition, the composition cannot be included (and an information message will be displayed).

4. Use the coverage definition buttons that are located in the lower-left corner of the main **MMC Window** (Section 3.2.3.2) to define additional template(s) for the new scale:


Tip: To define the same area in other scales where source data exists:

- Click on Edit, then Select All. The templates will turn yellow.
 - Click on Edit, then Copy (*Ctrl-C*).
- a) Change scales by clicking on the Chart Series / Map Scale selection box in the lower-right corner of the **MMC Window** and selecting the new scale. MMC will clear the world map of all current templates in preparation for defining templates in this new scale.
 - b) Click on Edit, then Paste (*Ctrl-V*). MMC will paste the previously selected templates into the new scale. Note that the size of the segment boxes will be different than they were in the previous scale, since segment size is scale-dependent. Also note that the new template will only include those segments that have been logged to date.

- c) If desired, modify these templates in the new scale by using one of the coverage definition buttons (Section 3.2.3).
- d) Use the *Composition Data Size Display* (Section 3.3.8.1) under the *Windows* menu option to monitor how much space has been used, and keep the composition within the limits of an AOD.
5. Review the map data at the new scale by clicking on the area of interest with the right (third) mouse button. From the **CD-ROM Site Window**, select the CD reader containing the source data, then click on *Scan Readers*, then *Start Processing*.
6. Save this work: click on *File*, then *Save As Final Composition*.
7. Reopen the new composition, build an AODI and MPS-CDI, review these images, and archive either or both to CD (see Section 4.3).

4.8 Build an MPS CD with DTED and Processed CAC (SCAC) Data

This section summarizes the procedure for building an MPS CD using DTED and Processed CAC (FiAF CAC) data. To use this section as a tutorial, use the samples given in brackets { }.

1. If necessary, log in any additional DTED CD(s) required, as described in Section 4.4.
2. Display the existing DTED coverage overlay:
 - a) Click on *File*, then *New*.
 - b) Click on *Preferences*, then *Composing AOD ON*, then *Compose MPS*.
 - c) Switch the data series to *DTED_1* using the *Chart Series / Map Scale* button in the lower-right corner of the main **MMC Window**.
 - d) Use the *Zoom-in on a Stretch-Box* button  that is located on the toolbar to zoom into the area of interest
 - e) Click on *Overlays*, then *Available Coverage*.
 - f) MMC will display the coverage of all existing, logged DTED CDs in the area of interest.
3. Design compositions using FiAF CAC and DTED data:
 - a) Define DTED area(s) of coverage using the coverage definition buttons that are located in the lower-left corner of the main **MMC Window** (Section 3.2.3.2).
 - b) MMC will display the defined DTED area(s) in colored boxes, where the color reflects the TS zone of the data, and each box represents a TS segment. For more information on TS zones and segments see Appendix E, Section 2.
 - c) Switch the data series to a new series {TPC (1:500k)} using the *Chart Series / Map Scale* button in the lower-right corner of the main **MMC Window**.
 - d) Click on *Overlays*, then *Available Coverage*. Available map data {all 1:500k data that is currently logged} will be displayed: CAC data in gray, processed data in tan, and a combination of CAC and processed data in purple.
 - e) Define map area(s) of coverage using the coverage definition buttons in the lower-left corner of the main **MMC Window** (Section 3.2.3.2).
 - f) To be sure the composition is not too large, click on *Windows*, then *Composition Data Size Display* to see a dynamic meter showing how much space has been used, and whether the image

has exceeded the limit for this scale of data. { **Note: to keep a tutorial short, try to keep each data coverage to around 5 to 10 MB in the meter; if either DTED or 1:500k is larger than 10 MB, trim the coverage using one of the Erase Coverage buttons at the bottom of the MMC Window. }**

2. Save this work: click on *File*, then *Save As Final Composition*.
3. Reopen this composition. (As a security measure, MMC requires that users open a final composition and don't modify it prior to building the MPS-CDI):
 - a) Click on *File*, then *Open Final Composition*.
 - b) Scroll through the list of available compositions and select the MPS composition just created. MMC will display the composition on the world map.
4. Build the MPS image:
 - a) Click on *Tools*, then *MPS Options*, then *Build MPS Image*.
 - b) MMC will open a **Data Sources Window** (Fig. 52) listing which data sources (FiAF CAC CDs) are needed.
 - c) MMC will also open the **CD-ROM Site Window** (Fig. 41).
 - d) Insert the first necessary FiAF CAC, or DTED CD (listed in the **Data Sources Window**) into the CD-ROM drive. Click on reader 7, then *Scan Readers*, check that the correct CD is loaded, and then click on *Start Processing*. Repeat for the rest of the CDs in the **Data Sources Window**. MMC will now build the MPS image. See Section 4.1 for more information on loading and selecting CDs in MMC.
5. Wait until MMC completes the MPS image build before continuing to the next step.
6. Open the MPS image and review it:
 - a) Click on *File*, then *Open Image (Ctrl-I)*. Follow the directions to open the MPS image file from the hard disk.
 - b) View the map data in the MPS image by clicking on an area of interest with the right (third) mouse button. See Section 4.5 for more information on viewing data.
7. Archive the MPS image to CD:
 - a) Click on *Tools*, then *CDROM Options*, then *Archive Data to CDROM*.
 - b) The **Archive to CDROM Window** will open. From this window, click on *File*, then *PreMaster*, then *MPS*. See Section 3.3.6.2 for more information on archiving MPS data to CD.
8. Review the archived MPS Image from CD:
 - a) Insert the MPS CD into the CD-ROM drive.
 - b) In the main **MMC Window**, click on *File*, then *Open Image (Ctrl-I)*. Follow the directions to open the MPS image file from CD.
 - c) View the map data in the MPS image by clicking on an area of interest with the right (third) mouse button. See Section 4.5 for more information on viewing chart data.

ACKNOWLEDGMENTS

This work was funded by the Naval Air Systems Command (NAVAIR) F/A-18 Finland program (Airtask A4112/089-2/725700000 and Technical Work Plan A4112-23). The authors thank Mr. Randall Powell and Mr. Andrew Guy for their support of this project. We also thank Mr. Timothy Woolverton (Project Manager for the Finnish Mission Data System) and Mr. Jarkko Kauppinen and Mr. Tuure Hakavouri (Finland Air Force Headquarters) for their support of this project.

BIBLIOGRAPHY

Lohrenz, M.C. and J.E. Ryan (1990). "The Navy Standard Compressed Aeronautical Chart." NOARL Report 8, Naval Research Laboratory, Stennis Space Center, MS.

Lohrenz, M.C., M.E. Trenchard, S.A. Myrick, P.B. Wischow, and L.M. Riedlinger (1993). "The Navy Tessellated Spheroid Map Projection System: a Comprehensive Definition." NRL/FR/7441-92-9408, Naval Research Laboratory, Stennis Space Center, MS.

National Imagery and Mapping Agency (1997). *Digitizing the Future*. WWW site: <http://164.214.2.59/publications/guides/df/df.html>.

Trenchard, M.E., M.C. Lohrenz, M.L. Gendron, and J.M. Mehaffey (1995). "Geographic Coverage Plots for F/A-18 and AV-8B Aircraft Optical Disks, Third Edition." NRL/MR/7441--95-7683, Naval Research Laboratory, Stennis Space Center, MS.

Appendix A

FiAF MMC COMPONENTS

Alphastation

The Central Processing Unit (CPU) for the FiAF MMC is an Alphastation (manufactured by Digital Equipment Corporation) with the following minimum configuration:

- ◆ 64 MB of parity memory
- ◆ 4.3 GB of disk space
- ◆ 1 high-resolution 17” color monitor
- ◆ 1 VMS-style keyboard
- ◆ 1.44 MB floppy diskette drive (SCSI)
- ◆ PCI-to-SCSI host bus adapter

At the time of the initial MMC purchase (FY96), each of these Alphastations cost about \$14,500 (GSA price) and came with a 1-year warranty.

AOD

An Aircraft Optical Disk (AOD) is a militarized Write-Once, Read-Many (WORM) Optical Disk that NRLSSC procures from Honeywell (part number 8509831) for \$1,230 each under contract #N00014-93-C-6016. A Japanese company developed specialized glass with a proprietary coating to be used for these AODs. However, this company stopped production of the glass components in 1993. Honeywell purchased a large quantity of glass to continue producing AODs for NAVAIR as a “last-time buy” agreement.

An AOD is two-sided and contains up to 260 MB of data per side. Current aircraft moving-map systems can only access one side of the AOD at a time; the aircraft must land before the pilot can flip the AOD to access the other side. The data is stored in the form of an AOD Image (AODI).

Data cannot be deleted or overwritten on an AOD, but old data can be “skipped” (i.e., ignored), and / or new data can be added to an AOD in the form of a new AODI. Up to 16 AODIs can be written to – and accessed from – an AOD, if the total space used by these images does not exceed 260 MB.

AODI

An Aircraft Optical Disk Image (AODI) is an exact replica of the information to be written to an AOD. Depending on a user’s choice, MMC will write an AODI to a file on the Alpha disk, archive it to recordable Compact Disk (CD-R), or copy it to an AOD via the DMU.

Digital Video Map Set

The FiAF Digital Video Map Set is comprised of a Digital Map Computer, Color Display, and Digital Memory Unit (DMU). Together, these components provide an in-flight, near-real-time, digital moving-map capability to the FiAF.

The Digital Map Computer and Display Computer combine the map data (built on MMC) with the mission data (built on MMC) and display the resulting image on a 4.5" x 4.5" color monitor in the aircraft. Once the mission is completed, the MMC operator can erase the DSU and reprogram it with new mission data without altering the base map on the AOD.

DMU and DMUI

The Digital Memory Unit (DMU) is used in the MMC workstation. The DMU (Honeywell part #8509830-002) is used exclusively for writing militarized AODs. It communicates with the Alphastation via a DMU Interface (DMUI, HTI part number DMUI-01), which translates between the Honeywell DMU's fiber-optic protocol and the computer's SCSI-I protocol. NRLSSC developed the OpenVMS-based driver on the Alphastation to communicate with the DMU via the DMUI.

MPS-CD

The Mission Planning System Compact Disk (MPS-CD) stores up to 650 MB of map data in the form of an MPS-CDI. The MPS-CD is the sole link between the MMC and MPS systems.

MPS-CDI

The Mission Planning System Compact Disk Image (MPS-CDI) contains CAC data, sometimes supplemented with DTED, of an area of interest for mission planning purposes. An MPS operator uses the MPS CDI map coverage to design and position mission overlays, such as threats, routes, targets, waypoints, etc., which are then stored on a DSU (Digital Storage Unit) and installed in the aircraft, along with the AOD (which stores the map coverage).

Appendix B

SETTING UP THE MMC WORKSTATION

The following procedure details how to set up the MMC workstation and connect all the peripherals:

- 1) **Unpack all equipment** from the boxes.
- 2) **Arrange equipment in workspace:**
 - ◆ Set DMUI on table;
 - ◆ Place CD writer on top of DMUI;
 - ◆ Place Alpha CPU on top of CD writer;
 - ◆ Place monitor, keyboard, and mouse next to stack of equipment.
- 3) **Plug peripherals into the back of the CPU:**
 - ◆ Monitor: Plug the monitor's video cable into the video port on the CPU (in the upper-right corner of the back of the CPU box: pictures of a monitor and sunglasses label this port).
 - ◆ Keyboard / Mouse: Plug the keyboard and mouse into their respective ports on the CPU (in the lower-center: pictures of a keyboard and a mouse label these ports).
 - ◆ CD writer: Plug the other Centronix - High Density SCSI cable into the external SCSI port on the CPU box (SCSI B, located between the monitor and the scanner connections). Plug the other end of this cable into the CD writer SCSI port labeled "host" (the right-most SCSI port, when viewing the CD writer from the back).
 - ◆ DMUI: Plug the Centronix - Centronix cable into the other SCSI port on the CD writer. Plug the other end of this cable into either of the DMUI SCSI ports. Plug a SCSI terminator into the remaining DMUI SCSI port.
- 4) **Power:**
 - ◆ Plug power cords into each peripheral (DMUI, CD writer, CPU, and monitor) then plug into unplugged power strip.
 - ◆ Check that all equipment is turned OFF at their individual power switches BEFORE plugging in power strip.
 - ◆ Plug in and turn on power strip.
 - ◆ Turn on the peripherals in the following order:
 - 1) DMUI (power switch on the back, then on the front of the box).
 - 2) CD writer and monitor.
 - 3) MMC System CPU.

5) Check device configuration and boot MMC System:

- ◆ Wait until the MMC System's >>> prompt is displayed.
- ◆ Check that the CD writer's red HDD light is off. If it is on, press the RESET button on the front of the CD writer (which will turn off the light), then, at the >>> prompt on the MMC System monitor, type *INIT*.
- ◆ When the >>> prompt returns on the MMC System monitor, wait 5 to 10 seconds, then type *SHOW DEVICE*. The MMC System should display a listing similar to that shown in Table B1.

Table B1 – FiAF MMC Device Listing at Boot Prompt

DEVICE ID	Device name	Description (not displayed)
DKA0	RZ29B	System disk
DKA100	RZ29B	MMC disk (Disk 1 of Volume Set)
DKA200	RZ29B	MMC disk (Disk 2 of Volume Set)
DKA400	RRD45	Internal CDROM drive
DVA0		Internal floppy disk drive
MKB400	YNGMINDS TURBO STUDIO	CD Writer
EWA0		Ethernet
PKA0	SCSI Bus ID 7	Internal SCSI Bus - A
PKB0	SCSI Bus ID 7	External SCSI Bus - B

- ◆ If this listing is incomplete or inaccurate: turn off the CPU, then turn off the power strip, then turn the power strip back on, and turn the CPU back on. Repeat the CD writer checks (and RESET if necessary), >>>*INIT* and >>>*SHOW DEVICE* commands. If the device listing is still inaccurate, repeat this power cycle one or two more times, then call Bob Murray at Raytheon, Indianapolis, IN.
- ◆ When the device listing is correct, type *B* (for boot) at the >>> prompt. It will take about 3 minutes to completely boot up the system.

6) Login:

Username: *MMC*

Password: *8675309*

Appendix C

INSTALLING A NEW COLOR PALETTE AND REBUILD COMPOSITION

There is no stand-alone program on MMC to install a color palette without processing additional map data. A new color palette can only be generated as part of processing new map data. A separate PC-based program named **MAKEPAL.EXE** is provided by NRL to convert a Finnish color palette text file into a binary color palette file (see Appendix D for Finnish color palette file format).

Color palettes *should remain static* since changing a color palette will require reprocessing of all previous map data at a given scale and render all archived AODI and MPS media obsolete. **This capability should be used sparingly.**

1. Load a new color palette:

- a. Install the CD-ROM containing a new color palette.
- b. From the MMC main menu, click on *Tools*, then *Data Processing*.
- c. Under *Process Scale*, select the appropriate scale.
- d. From the **CD-ROM Site Window**, select reader 7, click on *Scan Readers*.
- e. Once the Volume ID of the CD-ROM is shown, click *Start Processing*.

Note: A dialog box will appear that states: “A SCAC (Processed Compressed Aeronautical Chart) exists for this scale, but the processed data has NOT been deleted. The SCAC must be logged in and reviewed and the processed data must be DELETED off the hard drive for this scale before processing can continue”. You may click *Delete Processed Data Now*, or delete the processed map data from the main menu under the *System* option. The term SCAC is actually a misnomer from a previous version of MMC when processed map data were derived solely from scanned paper charts.

- f. If the CD-ROM contains a new color palette file, a warning dialog box appears (Fig. C1) stating that the color palette installed on the CD-ROM does not match the MMC system palette. Click on *Yes Build New Palette*.



Fig. C1 – Color palette warning message

- g. A **Summary Information** window (Fig. C2) is displayed that lists cautions and recommendations to consider before creating a new color palette (use the scroll bar to read *all* recommendations). **Please read this information carefully!** Click on *I AGREE* to proceed.

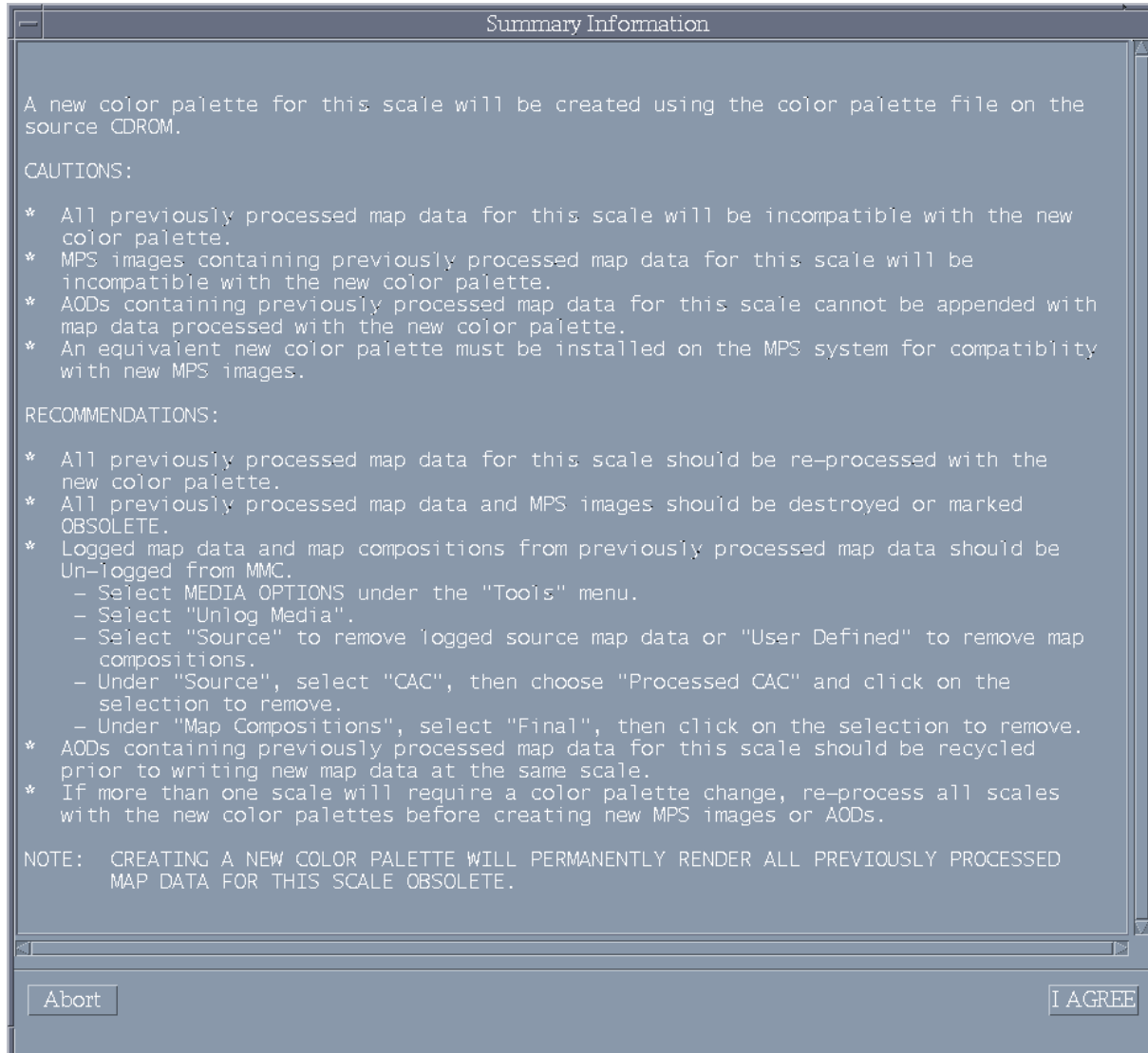


Fig. C2 – New color palette caution summary

- h. If logged map data sources exist for this map scale, a message will appear that states you must unlog these sources prior to continuing. To automatically unlog these sources, click Yes to the UNLOG sources message.

Note: Installing a new color palette renders all previously processed map data for the same scale obsolete and also renders all previous AOD Images and MPS Images obsolete. Any color palette changes made on MMC must also be made on the MPS system. A color palette with changes to only the last 16 entries (241-256) does NOT require reprocessing since only the first 240 color entries are used in map processing.

2. Process the geotiff map files

- a. The **GeoTIF Processing** window displays information about disk usage, processing options, and advanced options.
- b. Select the Advanced Options menu and click on the *Optimization* option. Now, click on the *Finalize Automatically* box to insert a check status.
- c. Review the **GeoTIF Processing Window** information, making sure that the *Finalize Automatically* option is “checked,” then click *Accept*.

Note: When *Finalize Automatically* is checked, MMC will not allow more data at the same map scale to be processed until these data have been archived and/or deleted from the system. If more than one CD-ROM of map data at a given scale requires processing, do not select *Finalize Automatically* until the final source CD-ROM has been processed.

- d. A bitmap of the map segments to be processed from this geotiff data is displayed. Verify the approximate geographic extents of the map coverage shown and if correct, click *Yes*.
- e. A processing meter appears near the bitmap coverage of the data to be processed. The bitmap displays map segments that have not been processed and compressed. The bitmap becomes smaller as more map segments are processed. Once processing is complete, click *Acknowledge*, and then click *Okay*.

3. Review the Processed map data (FiAF CAC) on the hard drive:

- a. From the main menu, click on *Coverages*, then *Include Processed Coverage*.
- b. Select *the* appropriate coverage file in the dialog box, and then click *OK*.
- c. On the toolbar (located at the bottom of the MMC window), change the map projection of the display from *Mercator to North Polar* and use the *Zoom-in on a Stretch-Box*



- button that is located on the toolbar to zoom into the location of the map coverage.
- d. Move the mouse to the location of the map coverage and click the right mouse button.
 - e. In the **Map Coverage** window, view and scroll the FiAF CAC and verify its georeferenced accuracy and color fidelity (note that the mouse must be positioned inside the **Map Coverage** window to display accurate color fidelity in *Virtual Colors* mode).

Note: To provide accurate color fidelity of the map data, the MMC display must be set to *Use Virtual Colors* (see MMC main menu under *Preferences*, then *Display Options*).

- f. When finished viewing the map data, click on *File*, then *Close* in the **Map Coverage** window.

Appendix D

FiAF MAP DATA FORMAT INTERFACE

DI. FiAF COLOR PALETTE FORMAT

NRL provides the FiAF with a PC-based utility program called **MAKEPAL.EXE**. This utility program will convert a Finnish text color palette file into a *palette.bin* file. The *palette.bin* file may be written in addition to the source geotiff files on a **FAF_GTIF** CD-ROM. The utility program is designed to be executed on a Windows NT operating system and will read a Finnish ASCII text color palette of the form:

```
#   R   G   B
---  ---  ---  ---
1 => 0   0   0
2 => 0  99  15
3 => 0 137 158
      .
      .
      .
```

The Finnish ASCII text palette is limited to a maximum of 256 colors with valid R,G,B values ranging from 0 to 255. The program will *only* read the first 240 color palette values because the first 240 colors are reserved for map data (the remaining 16 colors are reserved for mission planning overlays). If fewer than 240 colors are used for the map data, the remaining map data colors must be filled with zeros (i.e., “0 0 0”). If fewer than 240 colors exist, or an R, G, or B value is out of range, the **MAKEPAL.EXE** program will not execute correctly.

The geotiff producer is responsible for creating the *palette.bin* file and writing this file to the **FAF_GTIF** CD-ROM. The *palette.bin* file is the color palette that will be used by MMC to process the geotiff files on the **FAF_GTIF** CD-ROM. If the *palette.bin* file is exactly the same as the MMC system palette for the *map scale selected*, MMC will use the system color palette. If *any* difference is detected between the *palette.bin* and the MMC system palette for the map scale selected, then MMC will prompt the user to either install the new palette (which will then become the new system palette for that scale) or ignore the new palette and use the MMC system palette.

A *palette.bin* file is optional for a **FAF_GTIF** CD-ROM. If a *palette.bin* file does not exist on a **FAF_GTIF** CD-ROM, MMC will use the system color palette for that scale by default.

D2. FiAF GEOTIFF FILE FORMAT AND DIRECTORY STRUCTURE

1. MMC 3.4P supports geotiff files that conform to the geotiff format specification version 1.8.1 (see <http://www.remotesensing.org/geotiff/spec/geotiffhome.html> for a full definition). MMC has tested sample Finnish geotiff map data and will support both Model Transformation Tag and Model Pixel Scale / Model Tiepoint Tag geocoding. However, due to cost constraints, MMC cannot extensively test all possible geocoding and geokey combinations, but has successfully tested Finnish implementations used to date. MMC *only* supports the *Transverse Mercator* projection when the geotiff model type is *Projected*.
2. For MMC to identify and process source media, all FiAF geotiff CD-ROMs *must* have a volume identification of **FAF_GTIF**. Otherwise, MMC will *not* process the map data. The geotiff producer is responsible for providing the CD-ROM volume identification.
3. A FiAF geotiff CD-ROM may contain any number of geotiff files for a *single* map scale and one optional *palette.bin* file. All geotiff files must contain a *TIF* suffix (e.g., *ABCDEFGH.TIF*) and all files must reside in the root directory.

D3. FiAF DTED FORMAT

1. The FiAF DTED files must conform to the structure defined in Section 3.14 of MIL-PRF-89020A, Performance Specification Digital Terrain Elevation Data (April 1996).
2. MMC 3.4P will support *only* DTED level 1. DTED level 1 post (elevation) spacing is defined in Section 3.9 of the DTED military specification.
3. The directory structure *and* file naming convention of FiAF DTED must conform to the format defined in the DTED military specification, Section 3.14.2, *with the exception* that FiAF DTED is not required to have a gazetteer, a DMED file, text files, or the GAZETTE or TEXT directories.

For MMC to identify and process FiAF DTED, all FiAF DTED CD-ROMs *must* have a volume identification of **FAF_DTEDxxx** (where *xxx* is a unique number ranging from **500-999**). Otherwise, MMC will *not* process the data. The FiAF DTED producer is responsible for providing the CD-ROM volume identification.

Appendix E

GLOSSARY OF ACRONYMS AND TERMS

E1. PROCESSING TERMS

Composition (or template)

A composition is a user-defined geographic coverage area (or set of areas) saved as a series of bitmaps (Fig. E1). A composition includes a bitmap for each contiguous geographic area, within each TS zone, and at each map scale required to build the user's AOD image or MPS image. Each "bit" in the composition's bitmap(s) represents a single TS segment of CAC data (and/or DTED, if the user is designing an MPS image).

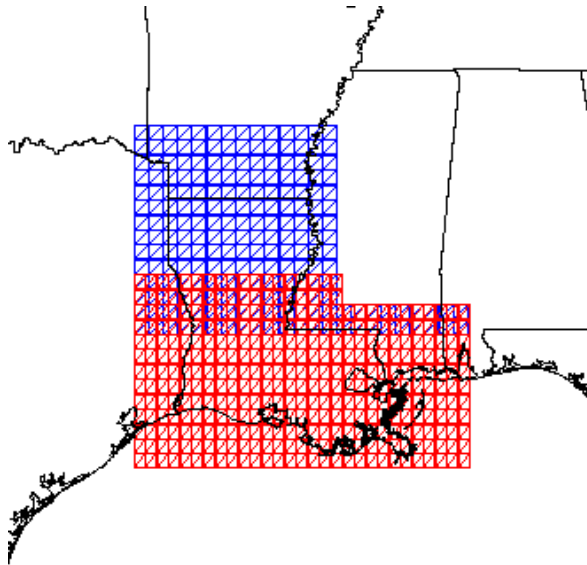


Fig. E1 – Sample MMC composition

Image

An image is the actual data set (including CAC data, processed map data, DTED, or some combination of these) to be copied to an AOD or MPS-CD. MMC constructs an image from a composition's bitmaps. Figure E2 illustrates a sample image comprised of CAC data.

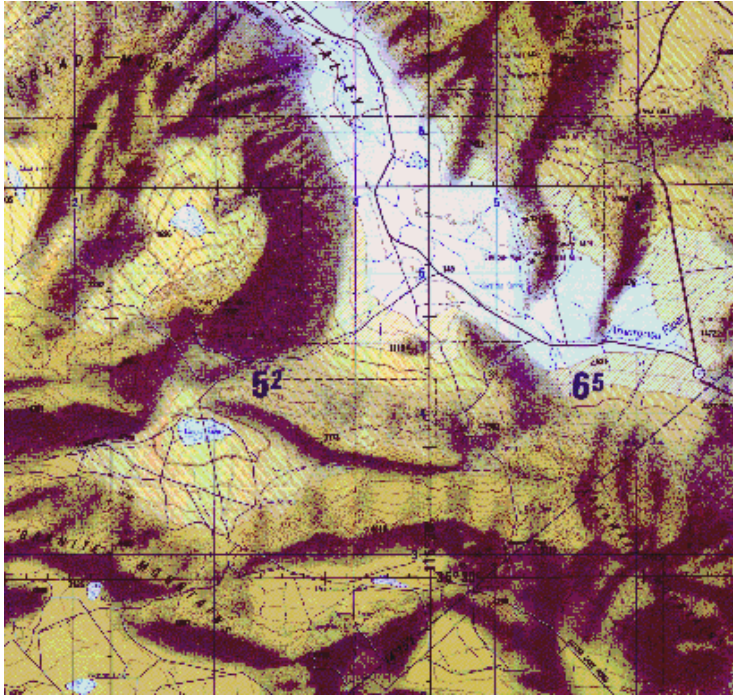


Fig. E2 – Sample image (chart data)

E2. DATA TYPES

ADRG

ARC (equal-Arc-second Raster Chart) Digitized Raster Graphics (ADRG) is a standard, digital, raster chart product produced and distributed on CD-ROM by NIMA. To produce ADRG, paper charts are scanned and transformed into the ARC system frame of reference. Data collected from a single chart / chart series and scale are maintained as a worldwide, seamless, database, in which each pixel is represented by a 24-bit RGB (Red, Green, and Blue) color value and exists at a distinct geographic location. All ADRG data have been adjusted to the World Geodetic System 1984 (WGS 84) horizontal datum. ADRG is the source data for both CAC and CADRG. For more details, refer to NIMA's Digitizing the Future report or website (NIMA 1997).

Compressed Aeronautical Chart (CAC)

The CAC database is a compressed (48:1) form of ADRG. CAC originally was produced by NRL and now is produced and distributed on CD-ROM by NIMA. CAC is the base map for current AV-8B and F/A-18 moving-map displays (future systems - e.g., the TAMMAC (Tactical Aircraft Moving Map Capability) Program - will use CADRG instead). CAC is organized into Tessellated Spheroid (TS) segments, as described in the TS definition (page 70).

To produce CAC, NIMA converts ADRG digital map images from the ARC system frame of reference into the TS projection using a neighborhood averaging function, which effectively reduces the resolution of the data from 256 pixels per inch (ppi) to 128 ppi for compatibility with current aircraft moving-map displays. The averaged data values are then color-compressed from 24 bits per pixel (full-color data) to 8 bits per pixel according to a predefined color palette. The data are also spatially compressed, a process that replaces every nonoverlapping group of 2 pixels \times 2 pixels in the data set with

a 1-byte codeword and creates a unique codebook for every 2" × 2" segment of data. The final data compression ratio for CAC is 48:1 over ADRG. Since most ADRG CD-ROMs are not filled to capacity, while most CAC CD-ROMs are filled, there may be over 65 ADRG CD-ROMs compressed onto a single CAC CD-ROM. See Lohrenz and Ryan (1990) for more details.

Compressed ADRG (CADRG)

Produced and distributed on CD-ROM by NIMA, CADRG was designed to be a jointly coordinated compression of ADRG to be used in any application requiring rapid display of a map image or manipulation of the image of a map in raster form. CADRG achieves a nominal compression of 55:1 over ADRG, excluding supplemental data such as color palettes and codebooks. CADRG is processed similarly to CAC, except that CADRG has a data density of 169 pixels per inch (CAC is 128 ppi) and CADRG maintains the ARC coordinate system of ADRG (CAC uses the TS projection system). CADRG will replace CAC as the standard raster chart data to be used in the TAMMAC cockpit moving-map systems. For more details, refer to NIMA's *Digitizing the Future* report or website (NIMA 1997).

Digital Terrain Elevation Data (DTED)

DTED is a uniform matrix of terrain elevation values that provides basic quantitative data for systems that require terrain elevation, slope, and/or gross surface roughness information. DTED is produced and distributed on CD-ROM by NIMA. DTED is available at two different resolutions:

- ◆ Level 1: Content is comparable to the contour information represented on a 1:250,000-scale chart. Latitudinal post spacing is 3 arc seconds (about 100 m); longitudinal post spacing varies by latitude (see Table E1).
- ◆ Level 2: Content is comparable to the contour information represented on a 1:50,000-scale chart. Latitudinal post spacing is 1 arc second (about 30 m); longitudinal post spacing varies by latitude (see Table E1).

Table E1 – DTED Longitudinal Post Spacing
(Level 1 vs Level 2)

Zone	Lat Bounds	Post Spacing (arc sec)	
		Level 1	Level 2
I	0° - 50° N/S	3	1
II	50° - 70° N/S	6	2
III	70° - 75° N/S	9	3
IV	75° - 80° N/S	12	4
V	80° - 90° N/S	18	6

For more information about DTED, refer to NIMA's *Digitizing the Future* publication or website (NIMA 1997).

Tessellated Spheroid (TS)

TS is the projection system used to store CAC data. TS was developed by Honeywell, Inc. as a structure for seamlessly storing and displaying global chart data on a cockpit moving-map display. TS stores CAC data in rectilinear segments, where one segment is characterized as follows:

- ◆ 2" × 2" section of scanned paper chart;

- ♦ 256 pixels × 256 pixels of raster data;
- ♦ a single file on the CAC distribution CD;
- ♦ smallest piece of data in MMC (drawn as a square bisected by a diagonal line).

TS organizes these segments into five geographic zones, as listed in Table E2. There is an overlap between zones (*not* reflected in Table E2), such that two rows of segments from each zone extend into the adjacent zone. This minimizes display “jumping” if a pilot is flying along a zone boundary. The amount of overlap in degrees of latitude is scale-dependent (since the size of a segment depends on the scale). For more information about the TS projection system, refer to Lohrenz et al. (1993).

Table E2 – TS Geographic Zones

<i>Zone ID</i>	<i>Zone name</i>	<i>N latitude bound</i>	<i>S latitude bound</i>
0	North Polar	90.00 deg N	51.69 deg N
1	North Temperate	51.69 deg N	31.38 deg N
2	Equatorial	31.38 deg N	31.38 deg S
3	South Temperate	31.38 deg S	51.69 deg S
4	South Polar	51.69 deg S	90.00 deg S

World Vector Shoreline (WVS)

WVS is the basemap for defining coverages for AOD images and MPS-CD images on the MMC workstation. WVS is a standard NIMA digital product consisting of the shorelines, international boundaries, and country names of the world. The uncompressed version of WVS averages 12 data points per nautical mile (nmi), approximately equivalent to the data density of a scanned 1:250,000 scale map. WVS conforms to the WGS 84 datum. Compressed and thinned versions of WVS are also available from NIMA. For more details, refer to NIMA’s *Digitizing the Future* (NIMA 1997).

E3. CHART SERIES, SCALES, and DISPLAY RANGES

Chart series and geographic scale typically refer to paper chart products: a Joint Operations Graphic (JOG) chart series is produced at a scale of 1:250,000, which means that 1” on the chart represents 250,000” on the ground. For aeronautical charts, larger scales (e.g., 1:50,000 and 1:100,000) provide more detailed map information for low altitude flying or approach and landing operations. Smaller scales (e.g., 1:2,000,000 and 1:5,000,000) are used for faster flying at high altitudes (e.g., cross-country flights).

The term map scale is not always appropriate for digital map products, since the actual scale may become distorted by zooming or subsampling the data. For digital charts, it may be more useful to refer to display range: e.g., the number of nautical miles from the top to the bottom of the screen on which the digital chart is displayed.

Table E3 is a list of the common aeronautical chart series, along with their geographic scales and normal (pre-zoom) display ranges. The table also indicates, for each chart series, if it is supported by current moving-map displays and if it will be supported under the new TAMMAC systems.

Table E3 – Common Aeronautical Chart Series, Scales, and Display Ranges

<i>Chart series</i>	<i>Scale</i> ^{*1}	<i>Display Range (nmi)</i> ^{*2}		<i>In current system?</i>	<i>In TAMMAC system?</i>
		<i>AV-8B</i>	<i>F/A-18</i>		
Global Navigation Chart (GNC)	1:5M	200	160	No	Yes
Jet Navigation Chart (JNC)	1:2M	100	80	Yes	Yes
Operational Navigation Chart (ONC)	1:1M	50	40	*3	Yes
Tactical Pilotage Chart (TPC)	1:500k	25	20	Yes	Yes
Joint Operational Graphics (JOG)	1:250k	13	10	Yes	Yes
Topographic Line Map-100 (TLM-100)	1:100k	5	4	Yes	Yes
Topographic Line Map-50 (TLM-50)	1:50k	3	2	No	Yes

*1 For map scales, M = million, k = thousand.

*2 AV-8B and F/A-18 use the same display but calculate range differently (Trenchard et al. 1995).

*3 The ONC series is not supported in current systems; instead, pilots can zoom into the JNC chart by 2:1 to simulate an ONC display range.

E4. AGENCIES AND COMPANIES

Defense Mapping Agency (DMA)

DMA has been reorganized and renamed to the National Imagery and Mapping Agency (NIMA). See description below.

Honeywell

As subcontractor to McDonnell Douglas, Honeywell manufactured and distributed most of the hardware components for the AV-8B and F/A-18 cockpit moving-map systems, including the DMU used by both the MMC System and the cockpit map computer. Honeywell also developed the TS projection system and CAC database format, specifications, and original compression software, which were later transitioned to NRL. NRL made significant modifications to the CAC compression software before transitioning it to NIMA in September 1995.

National Imagery and Mapping Agency (NIMA)

NIMA – formerly the Defense Mapping Agency (DMA) – produces and distributes the standard cartographic databases that support the cockpit moving-map, MAP-II, MPS-II, and MDS-II systems, including CAC, DTED, and WVS.

Naval Research Laboratory (NRL)

The NRL Mapping Sciences Section (Code 7440.1) developed the FiAF MMC workstation and Moving-Map Composers (MMC) software for the AV-8B Muxbus Data System. NRL Code 7440.1 is located at the Stennis Space Center, MS, which is on the Gulf of Mexico approximately 70 miles northeast of New Orleans, LA. The following are key NRL personnel in this effort:

- ◆ Project Team Leader: Maura Lohrenz
- ◆ Project Engineers: Marlin Gendron, Michelle Mehaffey, Stephanie Myrick, Michael Trenchard, Perry Wischow

REFERENCES

Lohrenz, M.C. and J.E. Ryan (1990). "The Navy Standard Compressed Aeronautical Chart." NOARL Report 8, Naval Research Laboratory, Stennis Space Center, MS.

Lohrenz, M.C., M.E. Trenchard, S.A. Myrick, P.B. Wischow, and L.M. Riedlinger (1993). "The Navy Tessellated Spheroid Map Projection System: a Comprehensive Definition." NRL/FR/7441-92-9408, Naval Research Laboratory, Stennis Space Center, MS.

National Imagery and Mapping Agency (1997). *Digitizing the Future*. WWW site: <http://164.214.2.59/publications/guides/df/df.html>.

Trenchard, M.E., M.C. Lohrenz, M.L. Gendron, and J.M. Mehaffey (1995). "Geographic Coverage Plots for F/A-18 and AV-8B Aircraft Optical Disks, Third Edition." NRL/MR/7441--95-7683, Naval Research Laboratory, Stennis Space Center, MS.