

TABLE OF CONTENTS

Table of Contents.	i
Acknowledgments	iv
A Reminder.	v
Copyright and Caveat Emptor	vi
 1. Prefaces	 1-1
1.1 Preface to version 3.1.	1-1
1.2 Preface to version 3.0.	1-3
1.3. Preface to version 2.1.	1-6
1.4. Preface to version 2.0.	1-6
2. Introduction.	2-1
3. GMT overview	3-1
4. General features	4-1
4.1 GMT defaults.	4-1
4.2 Command line arguments.	4-1
4.3 Standardized command line options	4-1
4.4 Command line history	4-2
4.5 Usage messages and error messages.	4-2
4.6 Standard input or file, header records	4-2
4.7 Verbose operation.	4-3
4.8 Output.	4-3
4.9 <i>PostScript</i> features	4-3
4.10 Landscape and Portrait orientation	4-3
4.11 Overlay and Continue modes.	4-4
4.12 Specifying pen attributes.	4-4
4.13 Specifying fill attributes	4-4
4.14 Creating color palette tables.	4-5
4.15 Character escape sequences.	4-6
4.16 Embedded grdf file format specifications.	4-7
4.17 Binary table i/o	4-8

5. GMT projections	5-1
5.1 Non-map Projections	5-1
5.1.1 Linear Projection with Cartesian Coordinates	5-1
5.1.2 Linear Projection with Polar (θ, r) Coordinates	5-4
5.2 Conic Projections	5-5
5.2.1 Albers Conic Equal-Area Projection.	5-5
5.2.2 Lambert Conic Conformal Projection	5-6
5.3 Azimuthal Projections	5-7
5.3.1 Lambert Azimuthal Equal-Area Projection.	5-7
5.3.2 Stereographic Conformal Projection	5-9
5.3.3 Orthographic Projection.	5-11
5.3.4 Azimuthal Equidistant Projection.	5-12
5.3.5 Azimuthal Gnomonic Projection	5-13
5.4 Cylindrical Projections.	5-14
5.4.1 Mercator Projection.	5-14
5.4.2 Transverse and Universal Transverse Mercator Projections	5-15
5.4.3 Oblique Mercator Projection	5-16
5.4.4 Cassini Cylindrical Projection.	5-17
5.4.5 Equidistant Cylindrical Projection	5-18
5.4.6 General Cylindrical Projections.	5-18
5.4.7 Miller Cylindrical Projections	5-19
5.5 Miscellaneous Projections.	5-21
5.5.1 Hammer Equal-Area Projection.	5-21
5.5.2 Mollweide Equal-Area Projection.	5-21
5.5.3 Winkel Tripel Projection	5-22
5.5.4 Robinson Projection	5-23
5.5.5 Eckert VI Projection	5-23
5.5.6 Sinusoidal Projection	5-24
6. Cookbook.	6-1
6.1 The making of contour maps.	6-1
6.2 Image presentations.	6-2
6.3 Spectral estimation and xy-plots	6-3
6.4 A 3-D perspective mesh plot	6-7
6.5 A 3-D illuminated surface in black and white	6-8
6.6 Plotting of histograms	6-8
6.7 A simple location map	6-9
6.8 A 3-D histogram.	6-10
6.9 Plotting time-series along track	6-10
6.10 A geographical bar graph	6-11
6.11 Making a 3-D RGB color cube	6-12
6.12 Optimal triangulation of data	6-15
6.13 Plotting of vector fields	6-16
6.14 Gridding of data and trend surfaces	6-17
6.15 Gridding, contouring, and masking of unconstrained areas	6-18
6.16 Gridding of data, continued	6-19
6.17 Images clipped by coastlines.	6-20

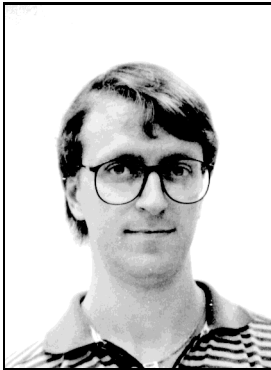
6.18 Volumes and spatial selections	6-21
6.19 Color patterns on maps	6-23
6.20 Custom map symbols	6-24
7. Mailing lists, updates, and bug reports	7-1
Appendix A: GMT supplemental programs	A-1
Appendix B: GMT file formats	B-1
Appendix C: How to make GMT Encapsulated <i>PostScript</i> Files.	C-1
Appendix D: Availability of GMT and related code.	D-1
Appendix E: Predefined 1-bit patterns in GMT	E-1
Appendix F: Chart of Octal Code for Characters	F-1
Appendix G: PostScript fonts used by GMT	G-1
Appendix H: Hints and known bugs concerning display of GMT PostScript	H-1
Appendix I: Color Space – The final frontier	I-1
Appendix J: Filtering of data in GMT.	J-1
Appendix K: The making of the GMT High-Resolution Coastline Database	K-1
Appendix L: GMT on non-UNIX platforms	L-1

ACKNOWLEDGMENTS

The Generic Mapping Tools (GMT) could not have been designed without the generous support of several people. We gratefully acknowledge A. B. Watts and W. F. Haxby for supporting our efforts on the original version 1.0 while we were their graduate students at Lamont–Doherty Earth Observatory. Doug Shearer and Roger Davis patiently answered many of our questions over e-mail. The subroutine *gaussj* was written and supplied by Bill Menke, L-DEO. Further development of versions 2.0 and 2.1 at SOEST would not have been possible without the support from the Hawaii Institute of Geophysics and School of Ocean and Earth Science and Technology Post-Doctoral Fellowship program to Paul Wessel. Walter H. F. Smith gratefully acknowledges the generous support of the C. H. and I. M. Green Foundation for Earth Sciences at the Institute of Geophysics and Planetary Physics, Scripps Institution of Oceanography, University of California at San Diego. GMT versions 3.0 and 3.1 owe their existence to grants EAR-93-02272 and OCE-95-29431 from the National Science Foundation, which we gratefully acknowledge.

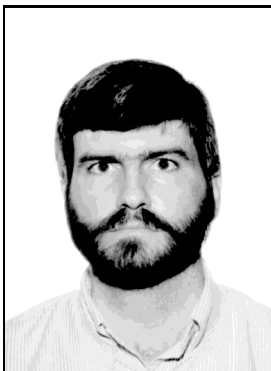
We would like to acknowledge the feedback we have received from many of the users of earlier versions. Many of these suggestions have been implemented, and the bug reports have been useful in providing more robust programs. Specifically, we would like to thank William Weibel, Ameet Raval, Manfred Brands, Angel Li, Andrew Macrae, John Lillibridge, Richard Signell, Michael Barck, and many others for advice on how to make GMT portable to DEC, SGI, HP, DEC Alpha, and NEXT workstations. John Lillibridge provided example 11. William Yip helped translate GMT to POSIX ANSI C and incorporate netCDF 3.

Honolulu, HI and Silver Spring, MD, November 1998



Dr. Pål (Paul) Wessel

Professor
Department of Geology and Geophysics
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa



Dr. Walter H. F. Smith

Geophysicist
Laboratory for Satellite Altimetry
National Oceanographic Data Center
National Oceanic and Atmospheric Administration

A REMINDER

If you feel it is appropriate, you may consider paying us back by citing our *EOS* articles on GMT (and perhaps also our Geophysics article on the GMT program surface) when you publish papers containing results or illustrations obtained using GMT. The *EOS* articles on GMT are

Wessel, P., and W. H. F. Smith, New, improved version of Generic Mapping Tools released, *EOS Trans. Amer. Geophys. U.*, vol. 79 (47), pp. 579, 1998.

Wessel, P., and W. H. F. Smith, New version of the Generic Mapping Tools released, *EOS Trans. Amer. Geophys. U.*, vol. 76 (33), pp. 329, 1995.

Wessel, P., and W. H. F. Smith, New version of the Generic Mapping Tools released, *EOS Trans. Amer. Geophys. U. electronic supplement*, http://www.agu.org/eos_elec/95154e.html, 1995.

Wessel, P., and W. H. F. Smith, Free software helps map and display data, *EOS Trans. Amer. Geophys. U.*, vol. 72 (41), pp. 441, 445-446, 1991.

The article in *Geophysics* on surface is

Smith, W. H. F., and P. Wessel, Gridding with continuous curvature splines in tension, *Geophysics*, vol. 55, pp. 293-305, 1990.

A few GMT users take the time to write us letters, telling us of the difference GMT is making in their work. We appreciate receiving these letters. On days when we wonder why we ever released GMT we pull these letters out and read them. Seriously, as financial support for GMT depends on how well we can "sell" the idea to funding agencies and our superiors, letter-writing is one area where GMT users can affect such decisions by supporting the GMT project.

COPYRIGHT AND CAVEAT EMPTOR!

Copyright © 1991–1998 by Paul Wessel and Walter H. F. Smith

The Generic Mapping Tools (GMT) is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation.

The GMT package is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details (<http://www.gnu.org/copyleft/gpl.html> or the file COPYING in the GMT directory).

Permission is granted to make and distribute verbatim copies of this manual provided that the copyright notice and these paragraphs are preserved on all copies. The GMT package may be included in a bundled distribution of software for which a reasonable fee may be charged.

The Generic Mapping Tools (GMT) does not come with any warranties, nor is it guaranteed to work on your computer. The user assumes full responsibility for the use of this system. In particular, the School of Ocean and Earth Science and Technology, the National Oceanic and Atmospheric Administration, the National Science Foundation, Paul Wessel, Walter H. F. Smith, or any other individuals involved in the design and maintenance of GMT are NOT responsible for any damage that may follow from correct or incorrect use of these programs.