GAMIT/GLOBK Quick Start Guide

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1   Introduction

This Quick Start Guide provides basic instructions for first-time users getting started with GAMIT/GLOBK. We describe the download, compilation and test processes, beyond which we refer users to our main documents ("Introduction to GAMIT/GLOBK" and the more detailed reference manuals for GAMIT and GLOBK). This information is compiled through experience with first-time users of GAMIT/GLOBK from workshops and elsewhere. The "Prerequisites" section, below, provides details separated by the type of operating system (Linux, macOS and Windows). The rest of the compilation and testing process is common to all operating systems. Clickable web links to the many documents and software mentioned are embedded in this document for reference. Hover the cursor over any underlined text to click on the link.

2   Prerequisites

GAMIT/GLOBK requires a few other programs to be installed before compiling the source code and running the software to its full capacity. These prerequisites are also listed on our website at http://geoweb.mit.edu/gg/pre.php.

In addition to a basic Unix- or Linux-based operating system, there are four fundamental requirements for installing GAMIT/GLOBK on any system:

- a Fortran compiler;
- a C compiler;
- X11 libraries and headers, specifically:
    - an X11 library (libX11.a, libX11.so, libX11.dylib, libX11.la or libX11.dll.a); and
    - an X11 header file (Xlib.h).

Many operating systems will have some or all of these installed by default but others may not. Below are details about what to expect from our experience with various operating systems.

Once you have completed the steps described for your system, below, download the source code provided on our server, via FTP or secure HTTP, and install GAMIT/GLOBK. Further information is available in the "Downloading source code" section and on the main GAMIT/GLOBK web page.

2.1   Debian-based Linux

Debian-based Linux distributions include the common Ubuntu operating system. Install the prerequisite programs, including any dependencies and others that we have found to be missing in the core distribution but must be installed, i.e. (requires administrative privileges):

```
sudo apt install gfortran make libx11-dev csh tcsh bc curl
```

2.2   RPM-based Linux

RPM-based Linux distributions include Fedora, CentOS and openSUSE operating systems. Install the prerequisite programs, including any dependencies and others that we have found to be missing in the core distribution but must be installed, i.e. (requires administrative privileges):

```
sudo zypper install gcc-fortran libX11-devel csh tcsh ftp hostname
```

2.3   *macOS*

macOS (previously Mac OS X) requires the installation of Command Line Tools for Xcode, a Fortran compiler and XQuartz. The simplest way to install Command Line Tools for Xcode is to open a Terminal window and run:

```
xcode-select --install
```

This will download and install core command line programs, including a C compiler, and any dependencies. A Fortran compiler is not included but you may install gfortran from a standard installer (.dmg) file available from the GCC Wiki web page. Install the X Windows libraries and headers with XQuartz, which is available for download as a standard installer (.dmg) file.

2.4   *Windows*

Recent releases of Windows 10 and above may install and run the Windows Subsystem for Linux. See the Microsoft Docs installation guide for details. Once complete, install required packages following the instructions for Linux distributions, above, e.g. for Debian-based Linux if you install and use the Ubuntu or Debian package, or for RPM-based Linux if you install and use the openSUSE package.

Otherwise we recommend installing a virtual machine (e.g. VirtualBox or VMWare Workstation Player), which requires the installation of a regular Linux distribution (e.g. Ubuntu) to run via the virtual machine. GAMIT/GLOBK may then be installed and run on this virtual machine operating system, again following the instructions for the relevant Linux distribution, above.

Previously we had preferred to use Cygwin, which is a Linux emulator for Windows, for installing and running GAMIT/GLOBK. To install Cygwin, download and run setup-x86.exe (for 32-bit computers) or setup-x86_64.exe (64-bit) to begin installation. Generally, the defaults shown throughout the installation process are adequate and need not be changed. There are, however, specific packages which are required in addition to the default Cygwin packages that are installed. These are at least:

- Devel/gcc-fortran (allowing the required dependencies to be installed will ensure the GCC core packages are also installed, including a C compiler)
- Devel/make
- Math/bc
- Shells/tcsh
- X11/libX11-devel

(One may search for the appropriate packages from the Cygwin package search. Search for "libX11.*" and "Xlib.h" for the X11 libraries and header file, respectively, to find the appropriate package.) We also highly recommend installing the X11/xinit package and its dependencies. This will provide an X Windows environment from which one can open and use, for example, Emacs for creating or editing text files. This is important given the different end-of-line characters between Windows and other systems (Unix, Linux and macOS).

2.5   *Access to the CDDIS, EarthScope (formerly UNAVCO) and SOPAC global data centers*

Access to the CDDIS global data server via anonymous FTP was discontinued after 31 October 2020. CDDIS now needs to be accessed via authenticated secure HTTP or anonymous secure

FTP. Several of our scripts which download data for use during GNSS data processing have been updated to accommodate this change.

We recommend you register to use authenticated secure HTTP by creating a NASA Earthdata account at https://urs.earthdata.nasa.gov/. Then you must include this information in a ".netrc" file (note the dot at the beginning of the file name) in your home directory with the following line:

```
machine urs.earthdata.nasa.gov login <username> password <password>
```

where `<username>` is your Earthdata username and `<password>` is your Earthdata password (do not use quotation marks or brackets around your `<username>` or `<password>` in this line in .netrc). If you do not wish to create an Earthdata account, you may still access the CDDIS archive via anonymous secure FTP but this requires your system to have curl version ≥ 7.11.0 or wget version ≥ 1.18.

We also recommend adding a similar line in a .netrc file in your home directory to provide the CDDIS FTP server and the SOPAC server with the information they request:

```
machine gdc.cddis.eosdis.nasa.gov login anonymous password <email>
machine garner.ucsd.edu login anonymous password <email>
```

where `<email>` is your email address (again, without quotation marks or brackets around it).

We recommend installing the EarthScope Command Line Interface (CLI) to download data and products from EarthScope (formerly UNAVCO). You must have Python version 3.7 or above available on your operating system. We suggest installing the EarthScope CLI in a virtual environment in a hidden directory, e.g. ".earthscope-cli", in your home directory and adding $HOME/.earthscope-cli/bin to your PATH environment variable or linking the `es` program to a directory you already have in your PATH, e.g. "~/gg/com/", so GAMIT/GLOBK may run it, e.g.

```
mkdir .earthscope-cli
python3 -m venv .earthscope-cli
. .earthscope-cli/bin/activate
pip install earthscope-cli
ln -s ~/.earthscope-cli/bin/es ~/gg/com/es
```

See https://cddis.nasa.gov/Data_and_Derived_Products/CDDIS_Archive_Access.html (CDDIS), https://www.unavco.org/data/gps-gnss/file-server/file-server-access-examples.html (EarthScope, formerly UNAVCO) and http://garner.ucsd.edu/ (SOPAC) for more information.

3   Downloading source code

GAMIT/GLOBK requires a license to run, which is granted to an institution, not individuals; all current members of a licensed institution are permitted to run GAMIT/GLOBK. See http://geoweb.mit.edu/gg/license.php for more information.

Once you have obtained the license information, download *at least* the following files (10.71 is the current version) from our server, as described in the instructions received: com.10.71.tar.gz, gamit.10.71.tar.gz, help.10.71.tar.gz, kf.10.71.tar.gz, libraries.10.71.tar.gz, tables.10.71.tar.gz, test_install.10.71.tar.gz *and any incremental_updates.<YYYYMMDD>.tar.gz files*, where *<YYYYMMDD>* is the calendar date of the latest updates. You can use curl or wget from the command line, e.g. (all one line):

```
curl -k -R -O -u <username>:<password>
'<url>/source/{com,gamit,help,kf,libraries,tables,test_install}.10.71.tar.gz'
```

then (all one line):

```
curl -k -R -O -u <username>:<password>
<url>/source/incremental_updates.<YYYY><MM>01.tar.gz
```

or (all one line):

```
wget --no-check-certificate -N --user=<username> --password=<password>
<url>/source/{com,gamit,help,kf,libraries,tables,test_install}.10.71.tar.gz
<url>/source/incremental_updates.<YYYY><MM>01.tar.gz
```

where `<url>` must be replaced by our server address and directory, `<username>` by the username and `<password>` by the password provided in the instructions received, and `<YYYY>` and `<MM>` by the current (four-digit) year and (two-digit) month, respectively. You may also access the distribution via a web browser but you must use our https:// URL. Most browsers nowadays block FTP connections and you may therefore be prompted to open an alternative program, for example Finder on a Mac, if you enter the old ftp:// URL into a browser.

The incremental updates contain sometimes critical updates to source code and tables, and should be downloaded on at least a monthly basis. Failure to keep GAMIT/GLOBK updated will result in errors and other issues. Updates can be compiled in exactly the same way as described in the "Compilation" section, below.

Before downloading these files, we recommend choosing where you wish to install GAMIT/GLOBK by creating a main source directory. Examples include src/gg/10.71/ or gamit-globk/10.71/ in your home directory. In the following sections we refer to your chosen main directory as "*<source>*".

4 Compilation

We provide a script, "install_software", to compile GAMIT/GLOBK. You can download this file from the same server as the source code or extract it from the com.10.71.tar.gz file before running it, e.g. from your *<source>* directory:

```
tar xfzv com.10.71.tar.gz com/install_software
com/install_software
```

If you downloaded a copy of install_software directly from our server you will need to make it executable before running, e.g. from your *<source>* directory:

```
chmod +x install_software
```

Either way, read carefully the questions the script asks and provide the information it requires. If the X11 libraries and headers cannot be found automatically, you will need to stop the compilation and edit libraries/Makefile.config (in your *<source>* directory) before re-running install_software. Specifically, you will need to edit the "X11LIBPATH" and "X11INCPATH" lines near the top of the file; typical locations for the required files for common operating systems are provided, so you may only need to uncomment the relevant lines, e.g. for macOS:

```
X11LIBPATH /usr/X11/lib
X11INCPATH /usr/X11/include
```

Once the install_software script completes successfully, you will see instructions to set up environment variables to run GAMIT/GLOBK, which is the last step of the installation.

5 Additional software

There are several additional programs that users may find useful, if not necessary, to install before running GAMIT/GLOBK. The major addition is GMT, which is required for any

GAMIT/GLOBK scripts that produce plots, e.g. sh_plot_pos, sh_plotvel, etc. You can install GMT for Debian-based Linux distributions such as Ubuntu from the main repository, e.g.

```
sudo apt install gmt gmt-dcw gmt-gshhg
```

or from a community repository for RPM-based distributions such as openSUSE, e.g. (all one line):

```
sudo zypper ar -f
http://download.opensuse.org/repositories/home:/beyerle:/IAC/openSUSE_Le
ap_15.1/home:beyerle:IAC.repo
```

or (all one line):

```
sudo zypper ar -f
http://download.opensuse.org/repositories/home:/beyerle:/IAC/openSUSE_Le
ap_42.3/home:beyerle:IAC.repo
```

etc. depending on your distribution, then:

```
sudo zypper install GMT
```

Consult your operating system's software repository for information about how to install GMT.

GMT may be installed on macOS by simply downloading the standard installer (.dmg) file from their download web page, then adding the executable file to your PATH environment variable in your shell's startup file in the same way as for GAMIT/GLOBK, above, e.g. for sh/bash/zsh:

```
PATH="/Applications/GMT-6.3.0.app/Contents/Resources:$PATH"; export PATH
```

or for csh/tcsh:

```
setenv PATH "/Applications/GMT-6.3.0.app/Contents/Resources:$PATH"
```

6   Testing

Once you have successfully installed GAMIT/GLOBK (and GMT), you may now test the software using our "test_install" package, which you will have downloaded along with the source code. If you did not download it already, it is available along with the source code from our server and may be placed in the same main directory (*<source>*/).

In the *<source>*/test_install/ directory there is a README file which contains a detailed description and instructions for running a test. Read the file carefully and follow the instructions, after which you may check your results against the files provided in *<source>*/test_install/check_files/, which should be nearly identical. If they are, you have a fully functioning installation of GAMIT/GLOBK to start using for your own experiments.

7   Error and bug reporting

If you find and would like to report an error or bug, we suggest to start by inspecting your screen output. You may write this information to a log file (do *not* send a screenshot) at any time by adding a redirect to the end of your command line, e.g.

```
sh_gamit ... >& sh_gamit.log
```

or

```
sh_glred ... >& sh_glred.log
```

Once we have viewed and assessed this text file, we may then provide advice or follow up for more detailed information.