GAMIT/GLOBK In A Day*

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GAGE/SAGE Science Workshop
Pre-Workshop Course
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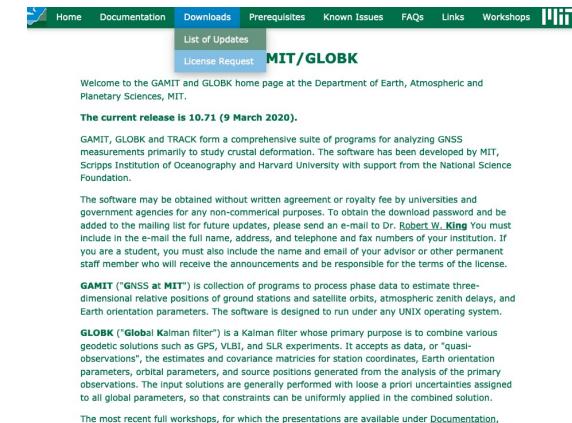
http://geoweb.mit.edu/gg/courses/202108_GAGE-SAGE/

Material from R. W. King, T. A. Herring, M. A. Floyd (MIT) and S. C. McClusky (now at ANU)

*Or two half-days in the world of virtual workshops

Installation

Apply for a license

http://geoweb.mit.edu/gg/

http://geoweb.mit.edu/gg/license.php

MIT

License form

Required Information

Desired Product for Download   Complete GAMIT/GLOBK Source Distribution ⬍

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Optional Information

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Installation and Useful Commands

Understand and install the prerequisites

http://geoweb.mit.edu/gg/pre.php

- A Fortran compiler (e.g. gfortran)
- A C compiler (e.g. gcc or clang)
- X11 libraries and header files
- Generic Mapping Tools (GMT)
- Linux:
- Mac:
  - Xcode or Command Line Tools for Xcode from the Apple Developer (for C compiler and command line programs in general for Terminal)
    - From Terminal: `xcode-select --install`
  - gfortran (e.g. https://gcc.gnu.org/wiki/GFortranBinaries#MacOS)
  - XQuartz (https://www.xquartz.org/)
- Windows:
  - Use Windows Subsystem for Linux (WSL) for Windows 10 and follow instructions for Linux
    - Ubuntu 16.04, Ubuntu 18.04, Debian 9, openSUSE 15.1 and openSUSE 43.1 Linux shells available for free
  - Use a virtual machine (e.g. https://www.vmware.com/ or https://www.virtualbox.org/), or Cygwin (https://www.cygwin.com/) for other versions of Windows

Read the notes

http://geoweb.mit.edu/gg/docs/GG_Quick_Start_Guide.pdf

- A brief guide to installation steps and prerequisites described here

ftp://chandler.mit.edu:

- /updates/README
  - General overview of the GAMIT/GLOBK software, including details of prerequisites and installation
- /updates/source/relnote.<NN.nn>
  - Specific details of the latest release (<NN.nn> is currently 10.71)

Preparation

- We recommend you separate tasks into three separate directories:
  - Source code directory   (to keep a local copy of the source code files; optional)
  - Installation directory   (to compile and install the source code)
  - Processing directory   (to process without overwriting files in the installation directory)

- Make a main installation directory of your choice on the command line
  - We *highly recommend* using a separate directory for each release of GAMIT; do *not* mix source code from different versions, e.g. ("maf" is the username)
    - On Mac, /Users/maf/Applications/gg/10.71/
    - On Linux, /home/maf/Programs/gg/10.71/

Source code directory

- Users may wish to keep a local copy of source code
    - As backup in case of problems during installation
    - If unable to reconnect to the source code repository (ftp://chandler.mit.edu)
- If you wish to do this, keep it separate from where you intend to install GAMIT/GLOBK, e.g.
    - ~/src/gg/10.71
    - ~/Applications/src/gg/10.71

Download source code

- Log in to ftp://chandler.mit.edu using the username and password provided with the license
- Download *at least* these required files
  - libraries.10.71.tar.gz   (common subroutines)
  - gamit.10.71.tar.gz   (GAMIT source code)
  - kf.10.71.tar.gz   (GLOBK source code)
  - com.10.71.tar.gz   (scripts to run the software from the command line)
  - tables.10.71.tar.gz   (metadata and other definitions and information)
  - help.10.71.tar.gz   (program help pages)
  - incremental_updates.*.tar.gz   (all updates to date for the current release version)
- Additional files (optional)
  - com_preGMT5.10.71.tar.gz   (scripts using syntax prior to GMT 5; no longer supported)
  - maps.10.71.tar.gz   (used with `sh_plotvel` and `velview`; not necessary for most users)
  - test_install.10.71.tar.gz   (instructions and output files for comparison to test installation)
  - relnote.10.71   (release notes for version 10.71)
- Copy these files into your main installation directory if downloaded to a source code directory

Compilation

- From the main installation directory

  - *Either* extract install_software from com.10.71.tar.gz and run it:
    ```
    tar xfzv com.10.71.tar.gz com/install_software
    com/install_software
    ```

  - *Or* download install_software from ftp://chandler.mit.edu, make it executable and run it:
    ```
    chmod +x install_software
    ./install_software
    ```

Compilation

- Read the output and answer the questions appropriately
- `install_software` will first extract the source code from all the tar-files
- You are then quite likely to need to stop the installation process to edit libraries/Makefile.config according to your operating system, e.g.
  - X11LIBPATH (path to libX11)
  - X11INCPATH (path to Xlib.h)
  - MAXSIT (maximum number of sites to process simultaneously; must be < 100)
  - MAXSAT (do not change)
  - MAXATM (maximum atmospheric estimates per session)
  - MAXEPC (maximum epochs per session, e.g. 24 hours at 30 s interval = 2880 measurement epochs)
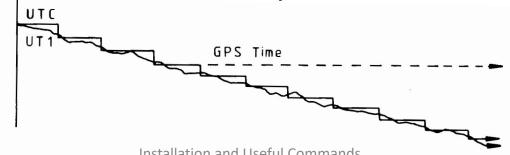 - OS block (usually no need to change)

Setting the environment

At the end of the installation you will see instructions such as:

```
Don't forget to set your : PATH to include /Users/maf/Applications/gg/10.71/com,
                                           /Users/maf/Applications/gg/10.71/gamit/bin and
                                           /Users/maf/Applications/gg/10.71/kf/bin;
                         : HELP_DIR environment variable in your shell profile; and
                         : INSTITUTE evnironment variable in your shell profile

For example, if using sh or bash ("echo $SHELL" = /bin/sh or /bin/bash),
add the following lines to ~/.bashrc (or ~/.bash_profile on Mac):

PATH="/Users/maf/Applications/gg/10.71/com:/Users/maf/Applications/gg/10.71/gamit/bin:/Use
rs/maf/Applications/gg/10.71/kf/bin:$PATH"; export PATH
HELP_DIR="/Users/maf/Applications/gg/10.71/help"; export HELP_DIR

Or, if using csh or tcsh ("echo $SHELL" = /bin/csh or /bin/tcsh),
add the following lines to ~/.cshrc:

setenv PATH
"/Users/maf/Applications/gg/10.71/com:/Users/maf/Applications/gg/10.71/gamit/bin:/Users/ma
f/Applications/gg/10.71/kf/bin:$PATH"
setenv HELP_DIR "/Users/maf/Applications/gg/10.71/help"
```

Updates!

- Incremental updates are made available on the first day of every month, so please check at least
  - Earth orientation parameters (pole.* and ut1.*; or sh_update_eop)
  - SVN-PRN translation tables (svnav.dat)
  - Differential code biases (dcb.dat)
  - Leap seconds (leap.sec)
  - Loading grids (ftp://everest.mit.edu/pub/GRIDS/)
- Example: 2016-12-31T23:59:60Z leap second

Additional software

- Generic Mapping Tools (GMT) (https://www.generic-mapping-tools.org/)
  - Required for plotting scripts to work
  - Scripts in com/ use GMT 5+
  - Prepend com_preGMT5/ to $PATH if using GMT 4
    - These scripts are no longer updated, so switch to GMT 5 or GMT 6!
- Tom's GGMatlab tools (http://geoweb.mit.edu/~tah/GGMatlab/)
  - tsview
  - velview

Useful commands

Redirection

- The output from one command may be written to a file... (this is useful for us to review if you have a problem or bug to report)
  - ">" to overwrite an existing file
  - ">>" to append to an existing file
  - `sort [file] > [sorted file]`
- ...or "piped" to another command, effectively forming the second command's input
  - "|"
  - `grep '^ .* P$' [file] | sort > [grep'd and sorted file]`

Shorthands

- Top-level ("root") directory = "/", e.g.
  - `cd /`
- Your home directory = "~" or "$HOME", e.g.
  - `ls ~`
- "Links" or "shortcuts" may be created, e.g.
  - `ln -s /home/user/gg/10.71 ~/gg`
- This creates a link in the user's home directory called "gg" that points to the directory /home/user/gg/10.71
  - Rather than "`cd /home/user/gg/10.71`", one can get to the same place simply with "`cd ~/gg`"
  - (This is used in GAMIT/GLOBK scripts and must remain in place!)

Checking processes and disk space

Processing sometimes fails, e.g. due to lack of available disk space, or stalls, e.g. due to a runaway process, which can be checked with the following:

- `du`
  - Disk usage: useful if you want to know how much space your (or others'!) directories are taking up
- `df`
  - Disk free space: useful if you want to know how much disk space is used and free
- `top`
  - Table Of Processes: useful if you want a real-time overview of processes that are running
- `ps`
  - List processes: useful if you want to see what processes are running and their process numbers, commands, etc.

What is a script?

- Scripts contain a series of commands written in one file and prepended by a "hash-bang"
  - `#!/bin/sh` for original Bourne Shell (usually the same as bash on modern systems)
  - `#!/bin/bash` for Bourne Again Shell
  - `#!/bin/csh` for C Shell (usually the same as tcsh on modern systems)
  - `#!/bin/tcsh` for TENEX C Shell
- The script may then be executed to run all of the commands in sequence as written
- Most scripts in GAMIT/GLOBK are written in csh or tcsh; many newer scripts are written in bash
  - Must have both csh and tcsh installed to run GAMIT/GLOBK scripts
  - bash usually installed by default on current Linux distributions

Script example

```
#!/bin/bash

printf 'The ISO date is: '

date +'%Y-%m-%dT%H:%M:%S%Z'

printf 'The mean of all numbers between 1 and 10 is: '

printf '1 10\n' | awk 'BEGIN {sum=0; n=0}; {for (i=$1; i<=$2; i++)
{sum=sum+i; n++}}; END {print sum/n}'

printf 'Goodbye!\n'
```

(Some lines above are wrapped, and be careful with power point converting – to en-dash and ' to a fancy quote)