



GAMIT/GLOBK example

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GPS Data Processing and Analysis with GAMIT/GLOBK and track

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

What did you do in the example?

1. Data preparation and experiment setup
 - Mostly done for you in the example
2. GAMIT (for surveys in 2000, 2002 and 2004)
 - Phase data processing
3. GLOBK (short-term for each survey)
 - Time series for several days of single survey
 - Combination of several days into one result for survey
4. GLOBK (long-term for entire experiment period)
 - Time series for many days or surveys over years
 - Combination of multiple days or surveys into velocities

Data preparation and experiment setup

sites.defaults

- In the example, the sites.defaults file has been created for you
- Normally you would create the sites.defaults file yourself
 - List any sites that you wish to use ultimately to stabilize your processed network, e.g. IGS sites with “ftprnx” flag
 - Think ahead to the last step!
 - More discussion in “Reference Frames” presentation tomorrow
 - Generally list “all_sites xstinfo”
 - This is important to avoid accidental overwriting of station.info by `sh_gamit` during processing

RINEX files

- In the example, RINEX files for “your” local site (only one, “7001”) have also been provided for you
- Normally you would create the RINEX files you wish to process yourself
 - If you are processing RINEX files available from public archives, you may not need to create your own RINEX files but you may need to download them
- Any RINEX files you wish to process must be placed in the `rinex/` directory, which you may also have to create, e.g.
`mkdir rinex`

sh_setup

- Run from your top-level experiment directory, e.g.
 - Survey name for survey processing (201709_NSFBay/, etc.)
 - Year for continuous processing (2016/, 2017/, etc.)
 - example/ for GAMIT/GLOBK example
- Creates a tables/ directory if necessary
- Links tables necessary for processing given year from ~/gg/tables/ to tables/ directory just created
- Check what is in tables/ directory just created, e.g.
`ls -l tables/`

process.defaults

- Adding your email address to process.defaults is not a necessary step but will define the email address to which you wish a summary to be sent at the end of processing
- You may not get an email sent unless your computer has a mail daemon running
 - This is usually not the case on personal laptops
 - However, the email contains the same content as the sh_gamit_<DDD>.summary file in the day directory/ies

sh_upd_stinfo

Run twice in the example from tables/ directory:

1. `sh_upd_stinfo -l sd`
Create `station.info` file with entries from primary `~/gg/tables/station.info` file for sites with “ftprnx” flag in `sites.defaults` (e.g. IGS sites)
 - This is usually a safe step although, as stated in the example, it is always important to check the resulting `station.info` file
2. `sh_upd_stinfo -files ../rinex/*.00o`
Add metadata from RINEX headers to `station.info` file
 - This is *not* recommended unless you are absolutely sure that the metadata in the RINEX headers is correct
 - It is still important to check the resulting `station.info` file
 - Usually this step is done manually by editing the `station.info` file for your sites

Are we ready to process?

- ✓ Required tables from `~/gg/tables/` linked to local `experiment tables/` directory
 - ✓ `process.defaults` edited as necessary
 - ✓ `sites.defaults` created and verified
 - ✓ `station.info` created and verified
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- We usually create and verify an “.apr”-file, which contains coordinates for all sites to be processed (necessary) and may be defined in `process.defaults`

GAMIT

sh_gamit

Run sh_gamit from top-level experiment directory with options:

- -expt scal
 - Experiment name (“scal” matches the site listings in sites.defaults, which enables you to have one sites.defaults file for multiple experiments but only process one of them)
- -d 2000 034 035 036
 - Days to process (necessary)
- -pres ELEV
 - Plot elevation-dependent plots of phase residuals
 - Not necessary but helpful for visualizing raw data and GAMIT processing quality
- -orbit IGSF
 - Define which orbit to use (IGSF is IGS Final orbits)
- -copt x k p
 - Not necessary because also may be defined in process.defaults (sh_gamit command line takes precedence)
- -dopts c ao
 - Not necessary because also may be defined in process.defaults (sh_gamit command line takes precedence)

What did `sh_gamit` do?

See each day's screen output (or log file if redirected)

- Series of checks to confirm that the necessary tables, EOPs (Earth orientation parameters) and orbits, are available
 - This includes updating the `.apr`-file for any sites that are missing, in this case site 7001
- Downloads RINEX files for sites given with “`ftprnx`” flag in `sites.defaults`
 - Servers to try defined by “`rinex_ftp_sites`” variable in `process.defaults`
- Creates a day directory in which to process and links necessary tables to day directory
- Creates X-files, which are GAMIT versions of RINEX files
- Runs `model`, `autc1n` and `solve`, and iterates once or twice
- Plots figures of phase residuals, if specified as `sh_gamit` option
- Repeats this sequence for each day in `sh_gamit` command

GLOBK (short-term)

sh_glred

Run twice in the example from your top-level experiment directory

1. `sh_glred -cmd`

- Copies templates of globk and glorg command files from `~/gg/tables/` to local experiment `gsoln/` directory
- You are then directed to edit the `gsoln/globk_comb.cmd` file
 - Comment loose EOP constraints
 - Uncomment tight EOP constraints
 - We do this because the aperture (size) of the network processed using `sh_gamit` is very small, so there is only a not much control on the orientation of the network
- You are also directed to edit the `gsoln/glorg_comb.cmd` file
 - We only estimate translation because we constrained the orientation of the network with tight constraints on the EOPs
 - We provide a list of stabilizing sites specifically for use in the example in `../..//tables/regional_stab_site`

sh_glred

2. With options:

- -s 2000 034 2000 036
 - Days to process (note different syntax from `sh_gamit`)
- -expt scal
 - Experiment name (“scal” matches the site listings in `sites.defaults`, which enables you to have one `sites.defaults` file for multiple experiments but only process one of them)
- -opt H G T
 - H: Convert ASCII h-files output from GAMIT to binary H-files for input to GLOBK using `htog1b`
 - G: Run globk
 - T: Read solution files output from GLOBK, and write and plot time series

What did `sh_glred` do?

- Makes the required directories, e.g. `glbf/` and `gsoln/`, in your top-level experiment directory
- Translates ASCII H-files output from GAMIT to binary H-files for input to GLOBK using `htoglb`
- Using the `globk_comb.cmd` and `glorg_comb.cmd` files you copied and edited in `gsoln/`, `glred` is run on each day to create the stabilized solution
 - Output files are `globk_scal_<YY><DDD>.org`
- Run `sh_plot_pos` on output “.org”-files to:
 - Output time series (“.pos”) files
 - Fit rate (or mean for time series less than one month long)
 - Plot residual time series

Repeat `sh_gamit` and `sh_glred`

- Now that you have processed a few days in 2000, you are directed to repeat the same data processing and experiment setup steps and run GAMIT and GLOBK for a few days in 2002 and 2004
- You then have a few days of processed data from three years over a total period of five years
- We can now proceed to long-term time series and velocity solutions

GLOBK (long-term)

Re-run `glred` for long-term time series

- Create a long-term solution directory, `vsoln/`, at the top-level experiment directory, e.g.

```
mkdir vsoln
```

- List the h-files from all years using `ls`, e.g.

```
ls ../????/glbf/h*glx > scal.gdl
```

- Run `glred` on all the h-files over the years

```
glred 6 globk_rep.prt globk_rep.log scal.gdl globk_long.cmd
```

- This step is not actually necessary because you already have `.org`-files for each day from running `sh_glred` in 2000, 2002 and 2004

Check and visualize the solution

- Check the stabilization of the time series, e.g.

```
grep 'POS STAT' globk_rep.org
```

or, if you did not re-run `glred`, because it is not necessary,

```
grep 'POS STAT' ../????/gsoln/globk_*.org
```

- Plot the long-term time series between the start of 2000 and the end of 2004, with the rate estimated and removed expect in the up component, e.g.

```
sh_plot_pos -f globk_rep.org -r -t RATE -t1 2000-001 -t2 2005-001 -u
```

or, if you did not re-run `glred`, because it is not necessary,

```
sh_plot_pos -f ../????/gsoln/globk_*.org -r -t RATE -t1 2000-001 -t2 2005-001 -u
```

- This step will produce time series (".pos"-files), residual time series (".res"-files) and plots of the residual time series ("*.ps"-files)

Run `globk` for velocities

- Run `globk` from the `vsoln/` directory, appending the “VEL” option to read lines in the command files that start with “VEL”, e.g.

```
globk 6 globk_vel.prt globk_vel.log scal.gdl globk_long.cmd VEL
```

Check and visualize the solution

- Check the stabilization of the positions and velocities, e.g.

```
grep 'POS STAT' globk_vel.org (for positions)
```

```
grep 'VEL STAT' globk_vel.org (for velocities)
```

- Plot the velocities in the area of southern California, e.g.

```
sh_plotvel -ps scal -f globk_vel.org -R240/246/32/35 -factor 0.5 -arrow_value 10 -page L
```

- This step will produce velocity files (".vel"-files) and plots of the velocities ("*.ps"-files)