Teledyne Webb Research Slocum Glider Training

With Ben Allsup &
Friends

TELEDYNE WEBB RESEARCH
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Welcome! Introductions ☺

- Coffee and breaks
- Training format
  - participate , get your hands dirty-ish
  - ask questions
  - make suggestion
- Safety!
  - Can you swim
    (don't)

*Lunch order!

menu

Brief History of Teledyne Webb Research

Doug Webb has a vision

Work hard,

Have fun,

Change the world

G1, G2 and Now G3

- This training will cover a “theory of operation” approach
- The training will largely applicable to each of our legacy models and the G3
- We will point out differences, advantages and where upgrades are possible or recommended
- Any G1 or G2 users present?
- Glider History lessons will be included ☺
  - “Glider wisdom”

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Support Philosophy & Structure

- "Triage"
- glidersupport@teledyne.com
  - Wide distribution list including support, service, sales, engineering, and executive personnel
  - Support ticketing system
  - Often will be answered during off-hours if subject is compelling enough and if personnel are available

- The "Batphone" (for first deployment "emergencies only")
  - (508) 524-8106
  - (855) 720-3915 (toll-free - US)

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Objective of Glider Training Class

A trainee should be comfortable configuring & preparing a glider for a qualification or test flight

We recommend starting slow and building a base of comfort and knowledge

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The Basics

- Glider components
- Glider flight fundamentals
- Glider communication
- Shore side software
- On-board glider software hierarchy

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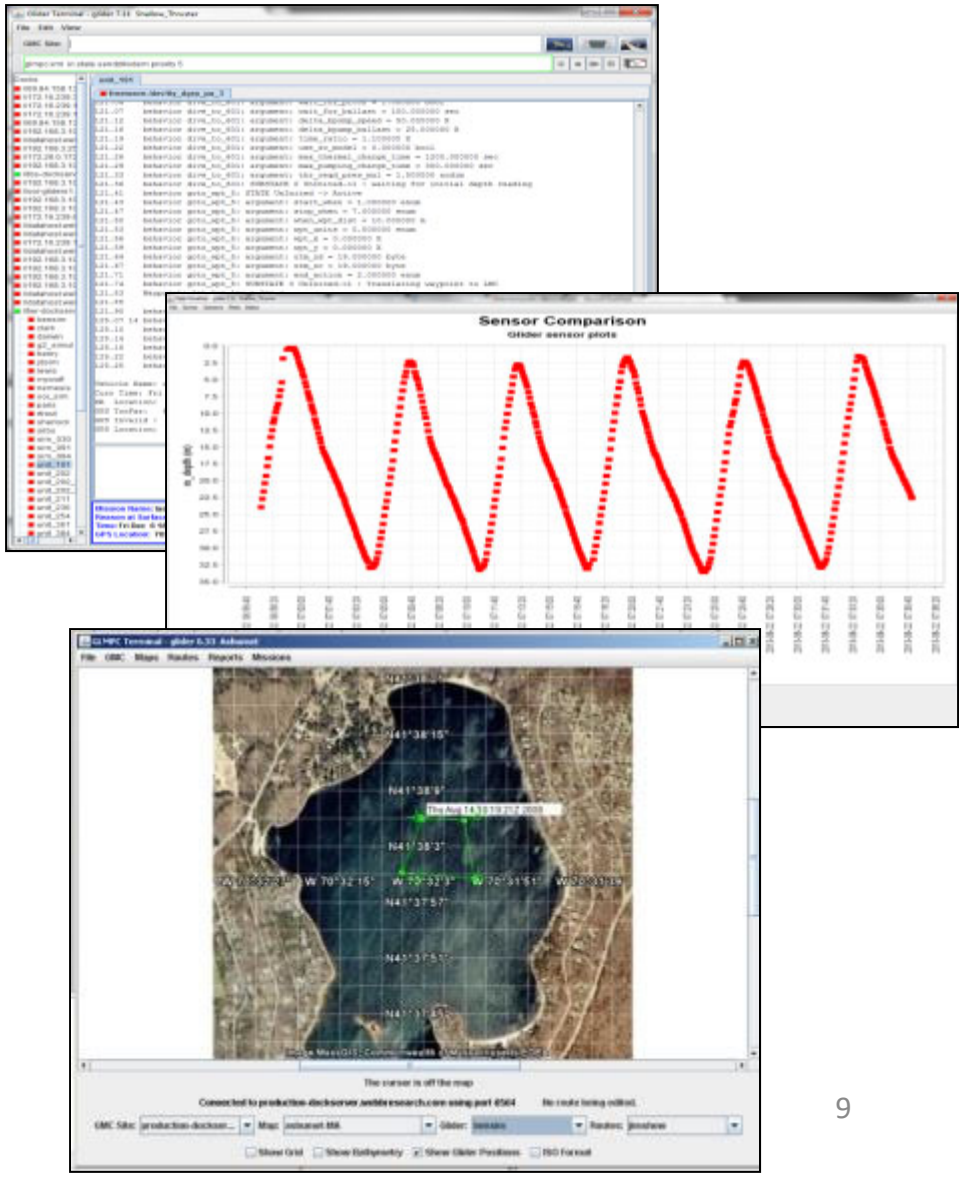
Day 1

- Classroom: Introduction to Dockserver, Glider Terminal, and Software
- Ballast Tank: Introduction to Glider Hardware

Day 1 & 2

- **Glider control & TWR tools**
  - Glider Terminal (glider communications)
  - Data Vis
  - SFMC
  - File transfer & Scripting
  - Simulation
  - Mission Planning
- **Preparation for Training Deployment**
  - Assembly & Disassembly
  - Battery install
  - Ballasting
  - Pre-mission Testing



Day 3 (or 4, depending on the weather)

Field Trip!

- Glider flight qualification training
- Operational use of TWR piloting tools

- Where do YOU test your gliders?

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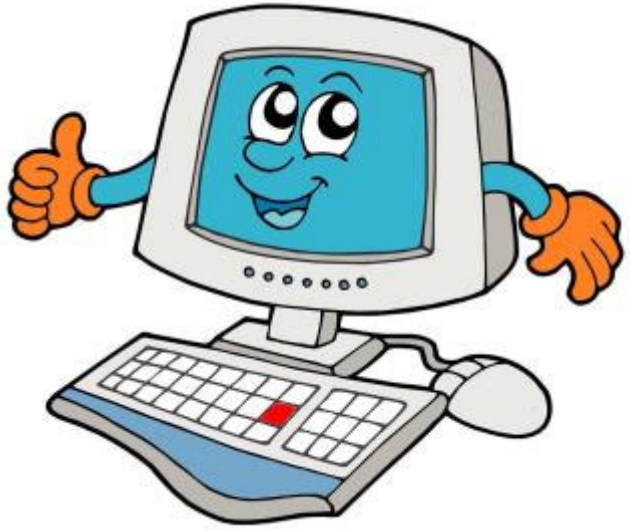
Day 4

- Glider Simulation
- Scripts
- Week in review
- Wrap-up & Open Discussion Q&A

The Datahost

- Most of the information we will discuss during training is available on the Datahost, our Glider User Forum: https://datahost.webbresearch.com
- On the forum, you will be able to access:
  - Posts from fellow users & TWR employees on the use of gliders
  - Manuals
  - Software Releases
  - Other Glider Resources
  - Client Tools/SFMC
- Register now!



TWR Forum

Slocum Glider support and ideas

Search... Search

Advanced search

Board index

User Control Panel (**0** new messages) • View your posts

FAQ Members Logout [bshaw]

It is currently March 12th, 2014, 1:00 pm

Last visit was: March 12th, 2014, 9:39 am

View unanswered posts • View unread posts • View new posts • View active topics

Mark forums read

GLIDERS	TOPICS	POSTS	LAST POST
FAQ Look here first.	45	110	by bshaw March 4th, 2014, 2:36 pm
Operation Things to do with a glider in a boat	37	103	by **admin** February 27th, 2014, 3:55 pm
Missions Mission development	31	91	by **admin** September 21st, 2013, 1:29 pm
lab testing	12	27	by Khalid August 30th, 2012, 12:56 pm
Suggestions	18	65	by Alan January 22nd, 2014, 10:48 am
Aborts	8	17	by bshaw January 14th, 2014, 11:49 am
NEWS!!! Teledyne Webb Research news and share stories of your programs accomplishments!	4	5	by arvindpereira November 29th, 2012, 12:57 am
Dockserver post all GMC questions here	36	104	by bshaw March 12th, 2014, 9:39 am
Resources Links to online glider resources	1	1	by **admin** February 17th, 2014, 7:11 am

WHO IS ONLINE

In total there is **1** user online :: 1 registered, 0 hidden and 0 guests (based on users active over the past 5 minutes)
Most users ever online was **13** on June 26th, 2012, 1:41 pm

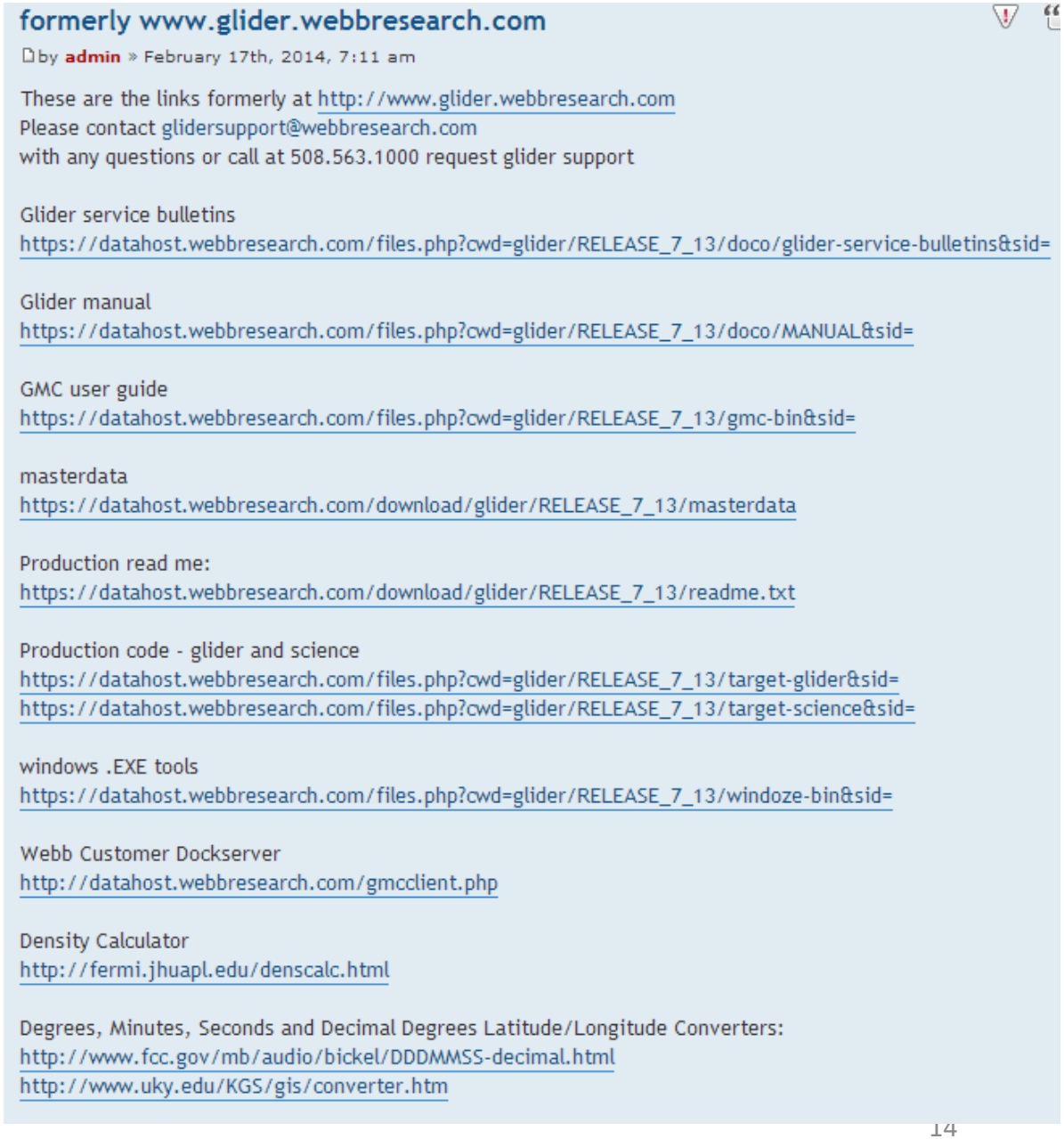
Registered users: bshaw
Legend: Administrators, Global moderators

Board index • Glider Resources • Client Tools

The team • Delete all board cookies • All times are UTC - 5 hours

Links & Resources

- Visit Glider Resources at the Datahost for helpful links & information



formerly www.glider.webbresearch.com

by **admin** » February 17th, 2014, 7:11 am

These are the links formerly at http://www.glider.webbresearch.com
Please contact glidersupport@webbresearch.com
with any questions or call at 508.563.1000 request glider support

Glider service bulletins
https://datahost.webbresearch.com/files.php?cwd=glider/RELEASE_7_13/doco/glider-service-bulletins&sid=

Glider manual
https://datahost.webbresearch.com/files.php?cwd=glider/RELEASE_7_13/doco/MANUAL&sid=

GMC user guide
https://datahost.webbresearch.com/files.php?cwd=glider/RELEASE_7_13/gmc-bin&sid=

masterdata
https://datahost.webbresearch.com/download/glider/RELEASE_7_13/masterdata

Production read me:
https://datahost.webbresearch.com/download/glider/RELEASE_7_13/readme.txt

Production code - glider and science
https://datahost.webbresearch.com/files.php?cwd=glider/RELEASE_7_13/target-glider&sid=
https://datahost.webbresearch.com/files.php?cwd=glider/RELEASE_7_13/target-science&sid=

windows .EXE tools
https://datahost.webbresearch.com/files.php?cwd=glider/RELEASE_7_13/windoze-bin&sid=

Webb Customer Dockserver
http://datahost.webbresearch.com/gmcclient.php

Density Calculator
http://fermi.jhuapl.edu/denscalc.html

Degrees, Minutes, Seconds and Decimal Degrees Latitude/Longitude Converters:
http://www.fcc.gov/mb/audio/bickel/DDDMMSS-decimal.html
http://www.uky.edu/KGS/gis/converter.htm

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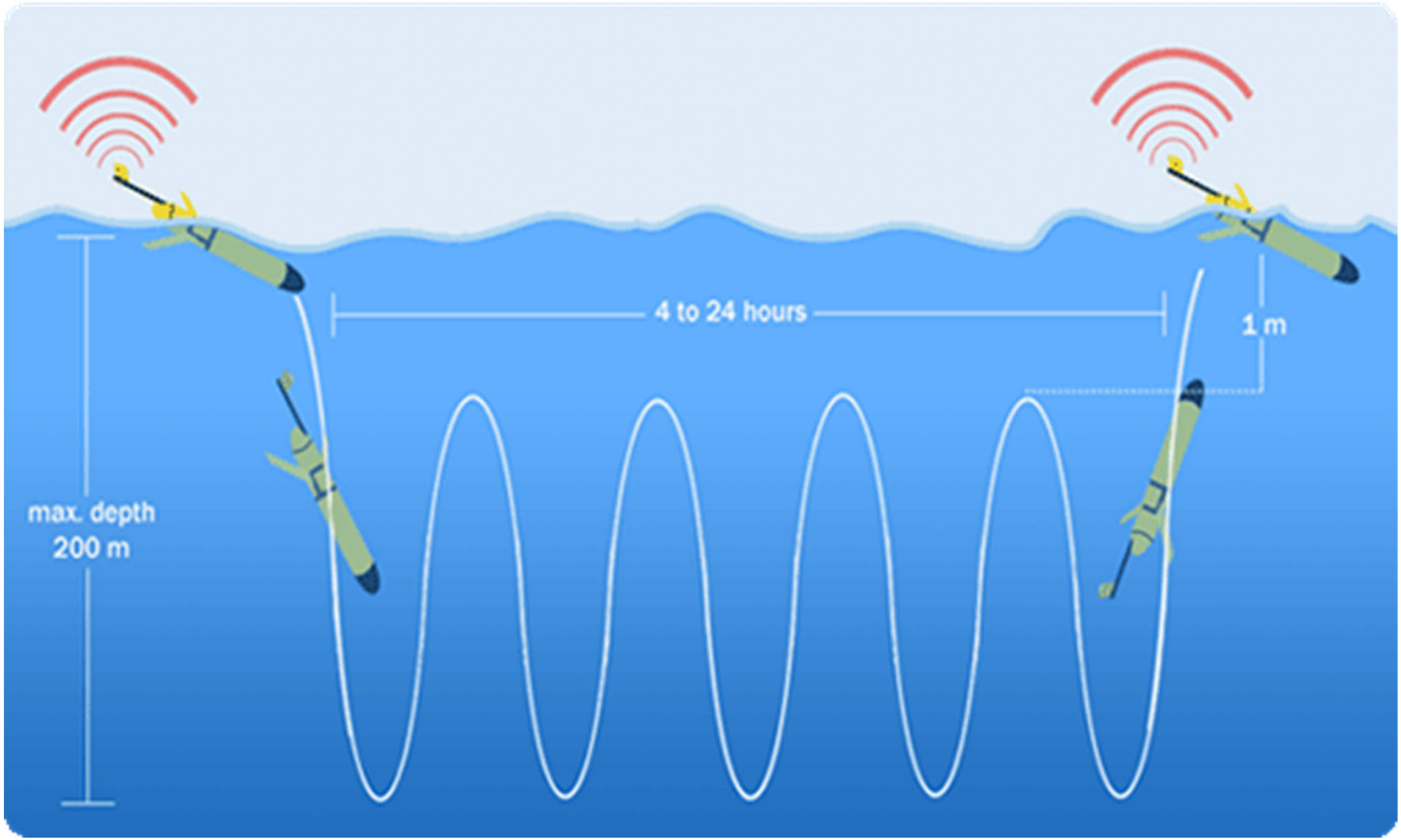
Glider Flight Fundamentals



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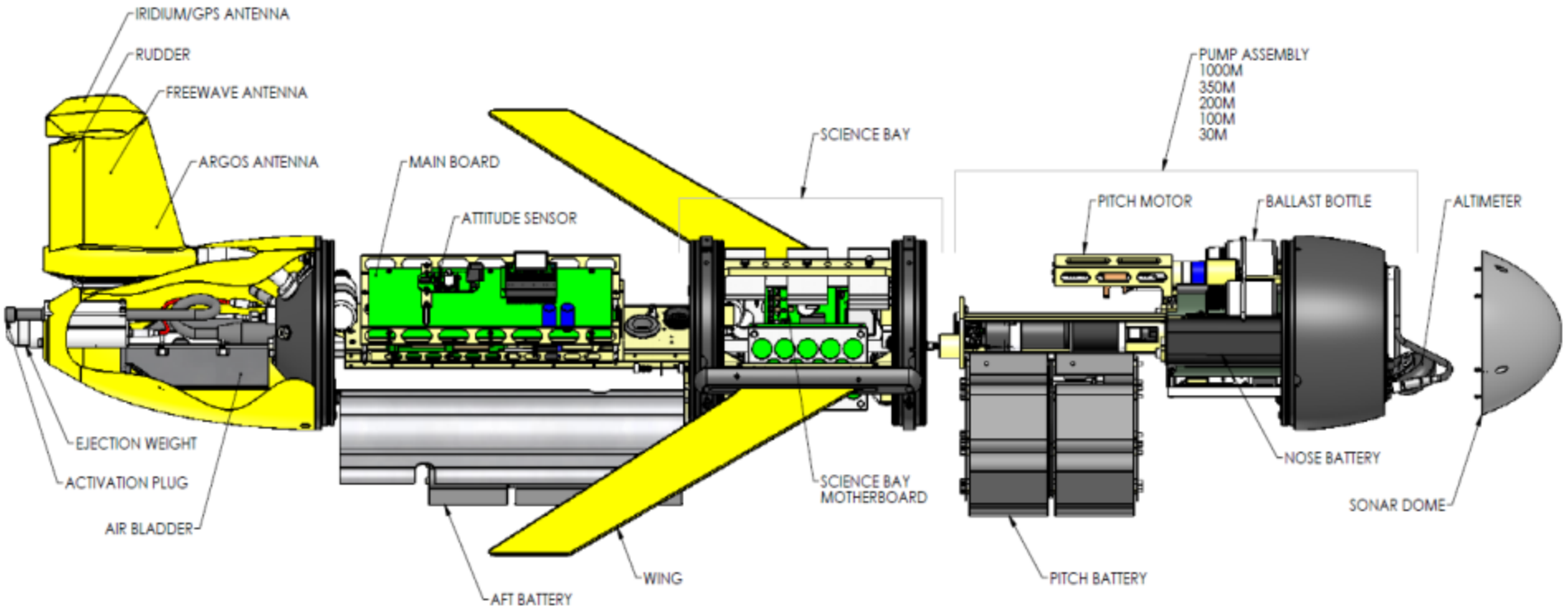
Glider Components

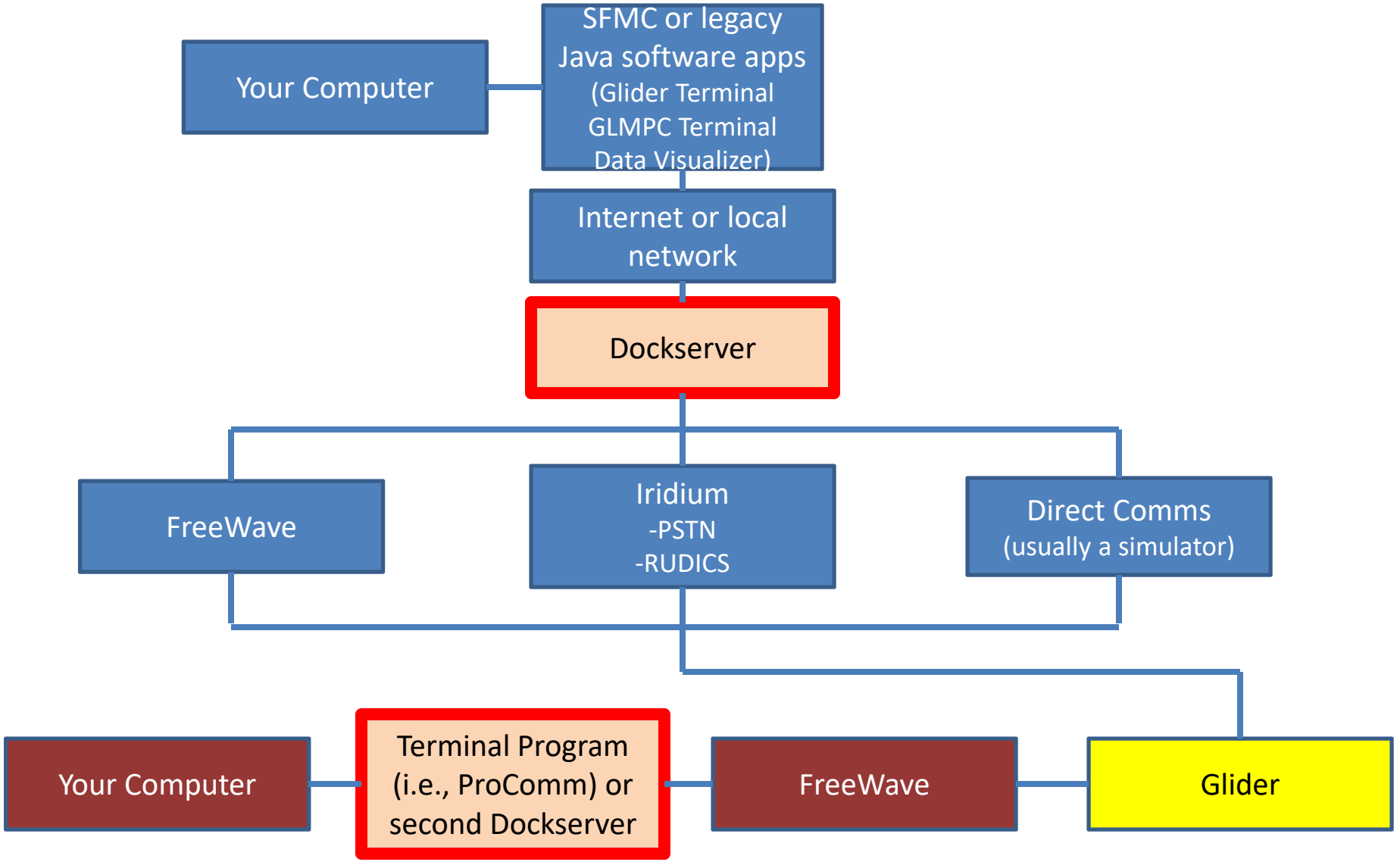


Remember:

O-ring care is essential!

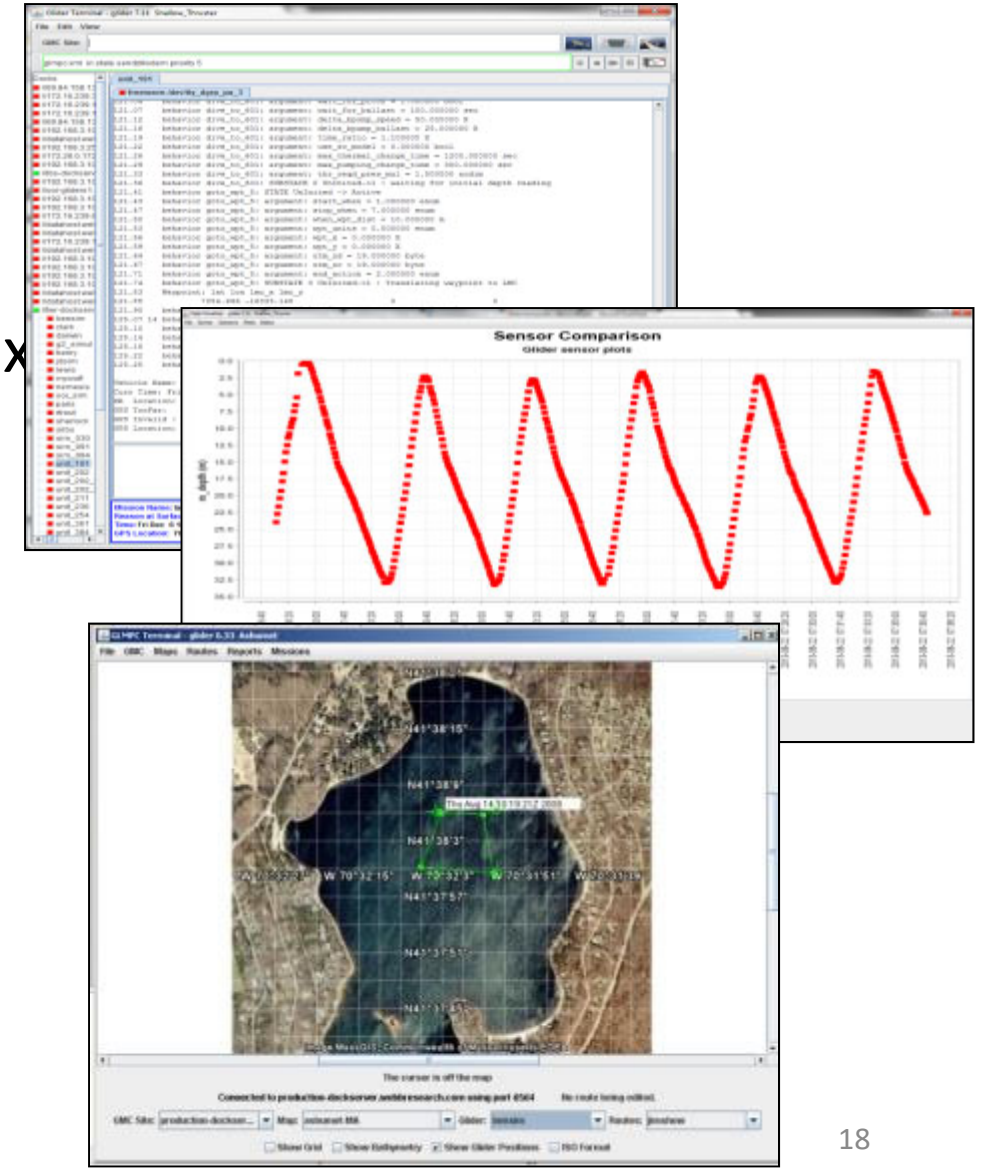
G2 and G3 hull o-rings are not identical

Glider Communication

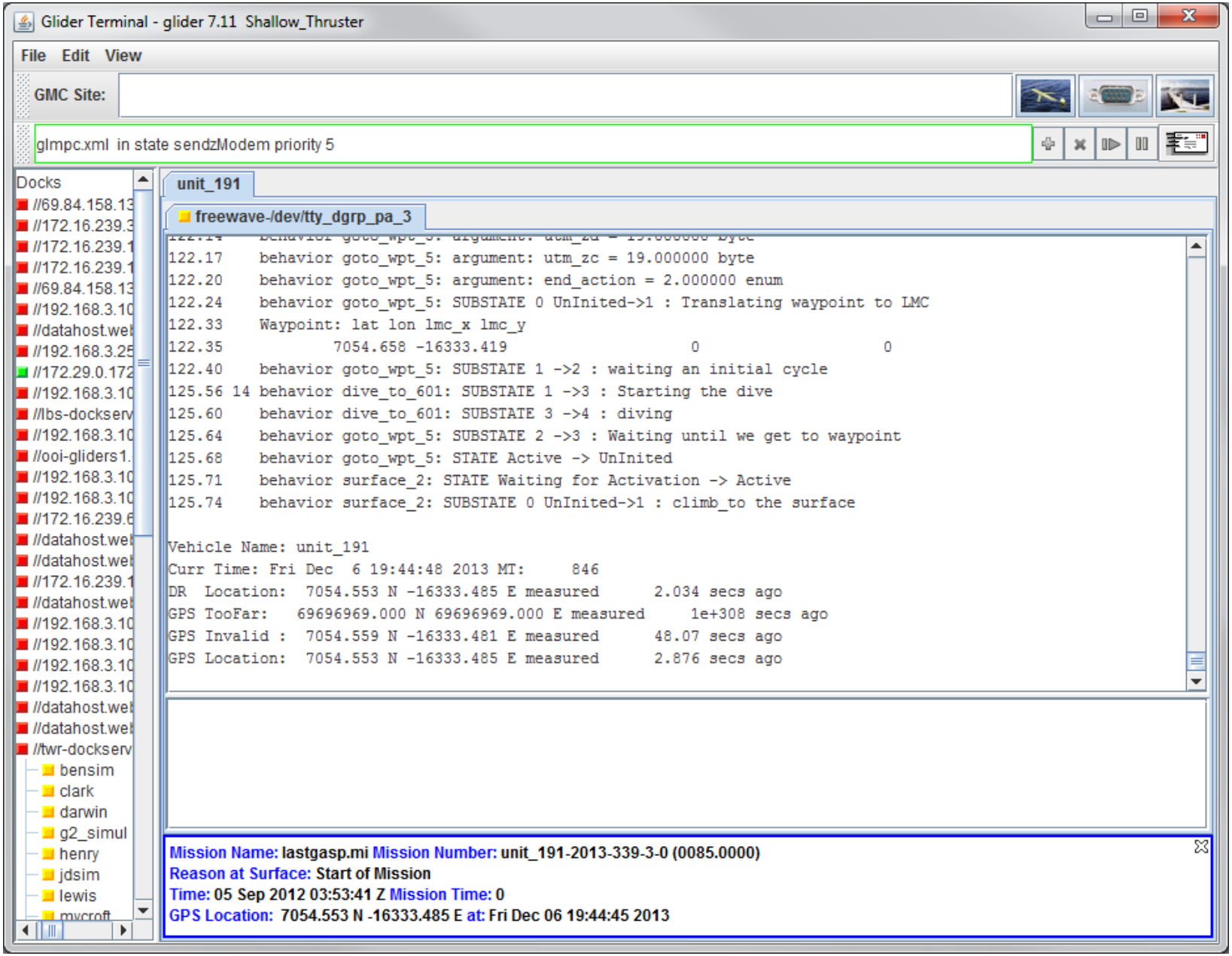


Shore-side Software

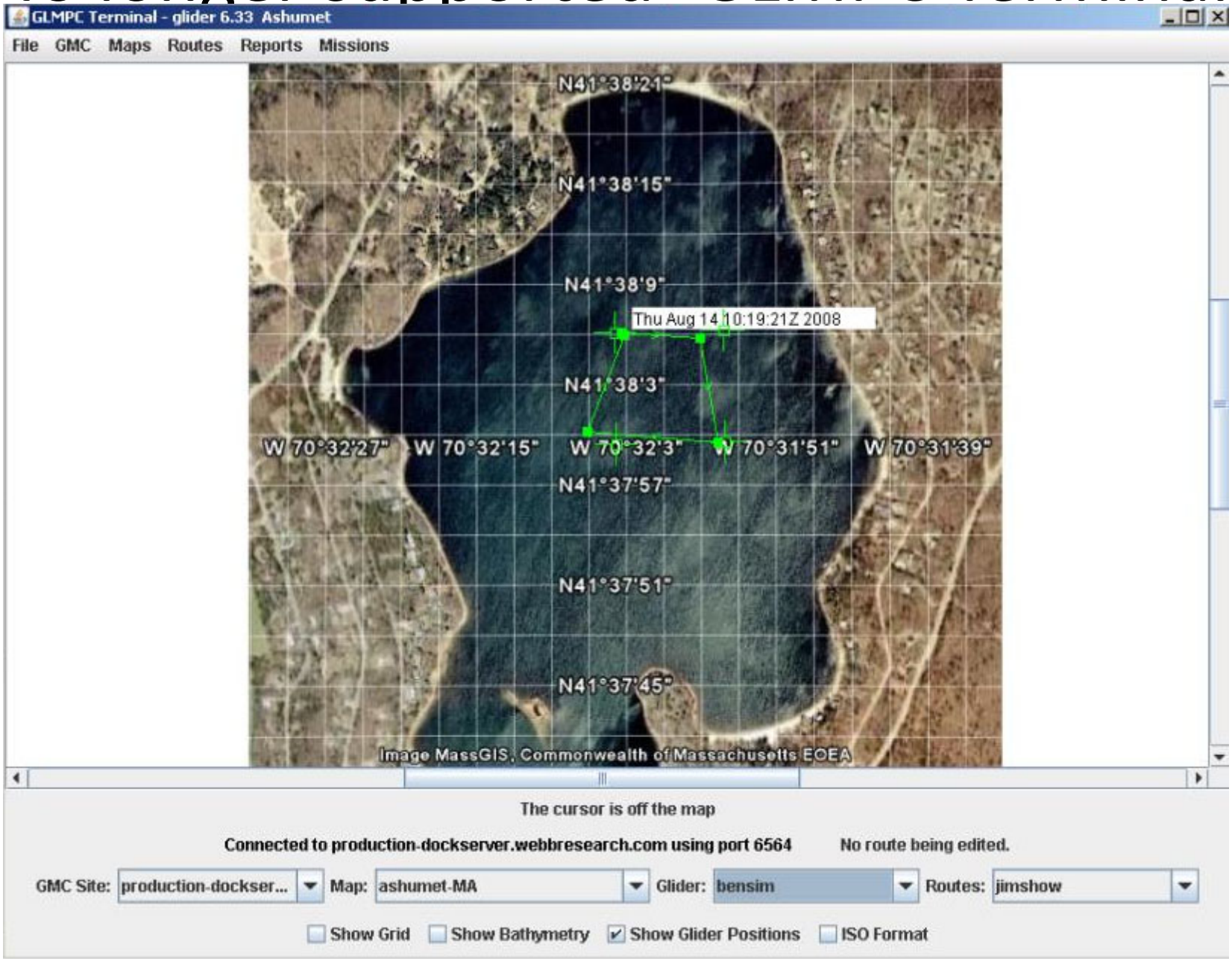
- Dockserver
  - Now hosting SFMC
  - Stand-alone, rack-mounted, or laptop Linux machine
- Glider Terminal
  - Text-based glider communication
- Data Visualizer
- FTP client – No longer needed with SFMC



Legacy Glider Terminal



No longer supported -GLMPC Terminal



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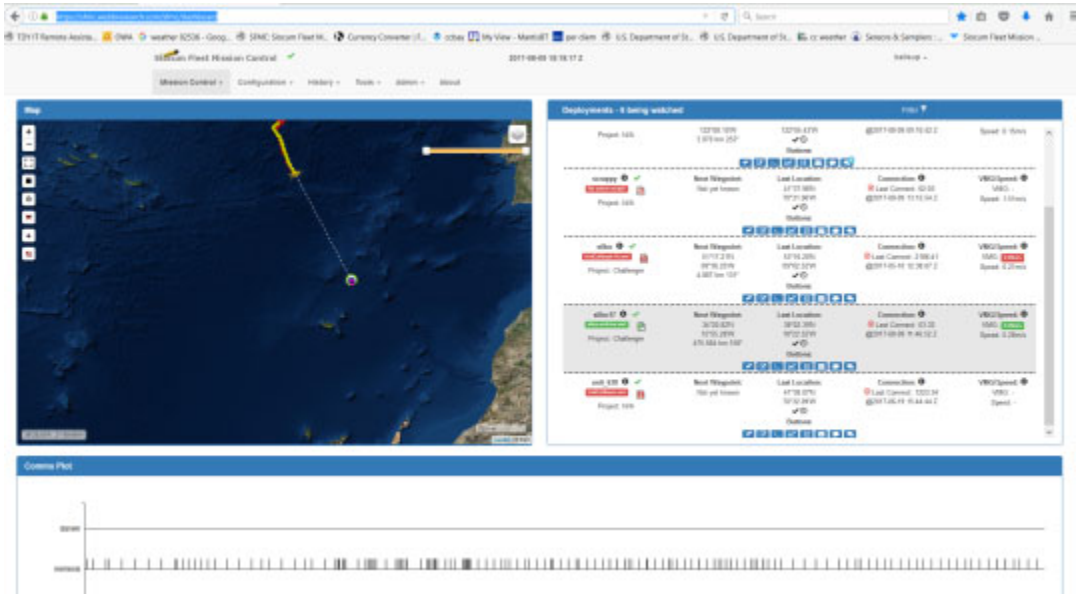
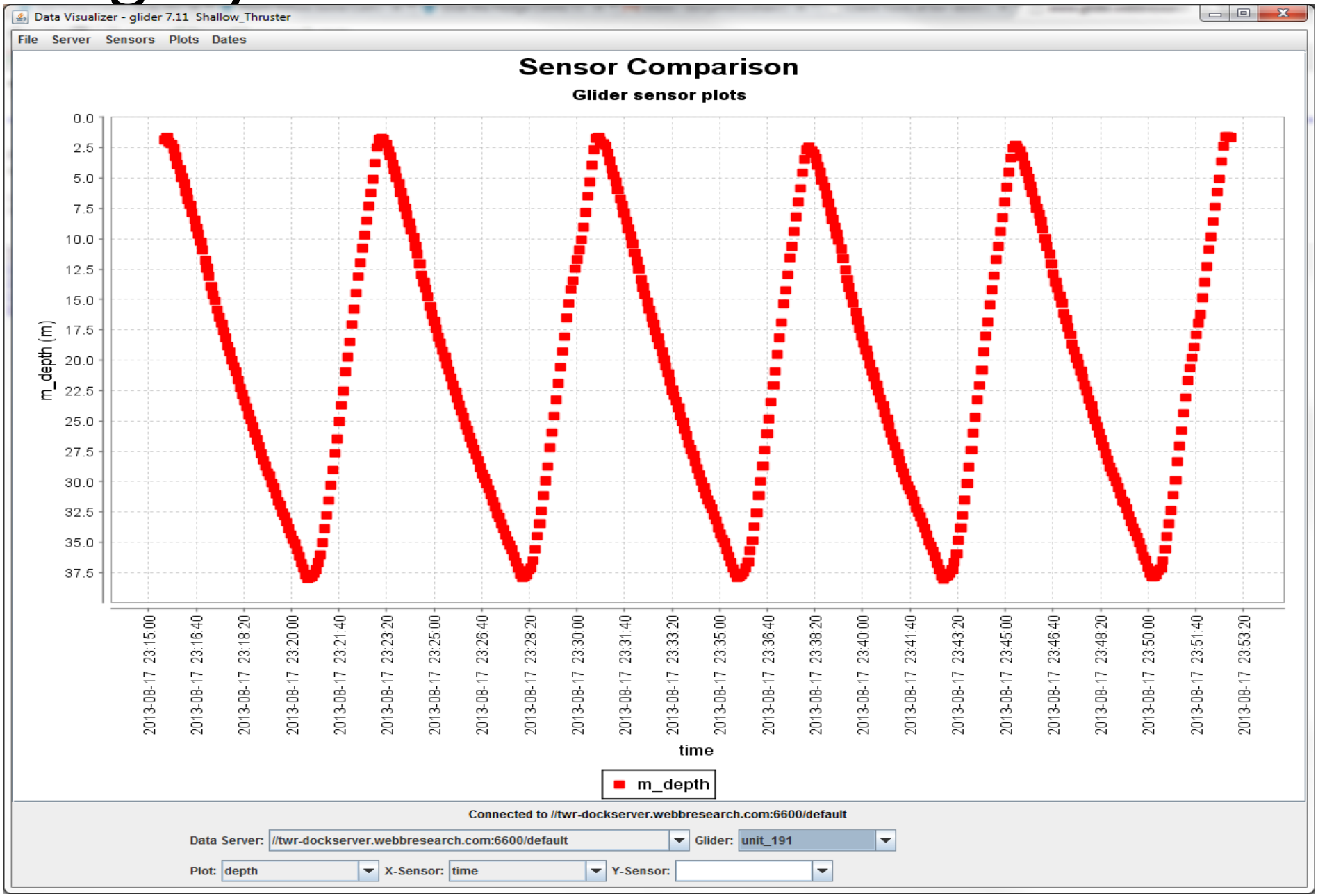
SFMC

- Slocum Fleet Mission Control
- https://sfmc.webbresearch.com/
- All glider piloting tools available in a single web based utility.
- Mobile support
- Manual



Legacy ->Data Visualizer



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Glider data and Dataserver

- Dataserver builds a PostgreSQL relational database from all incoming glider data on a Dockserver.
- Data extraction tools (Greater discussion Friday)

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Time for a Tour!

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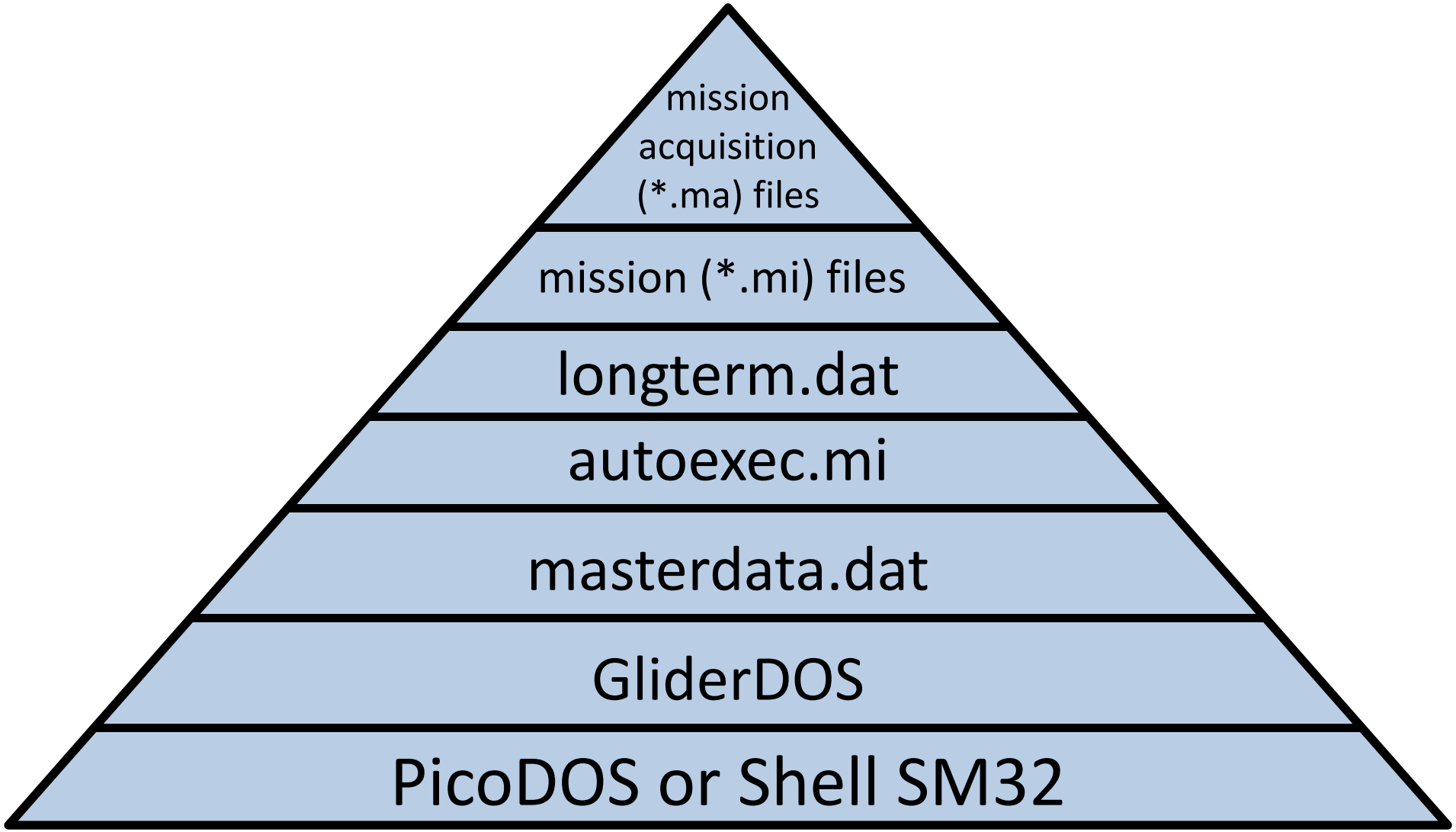
On-board Glider Software



Slocum's Hierarchy of ***Glider Software*** Needs

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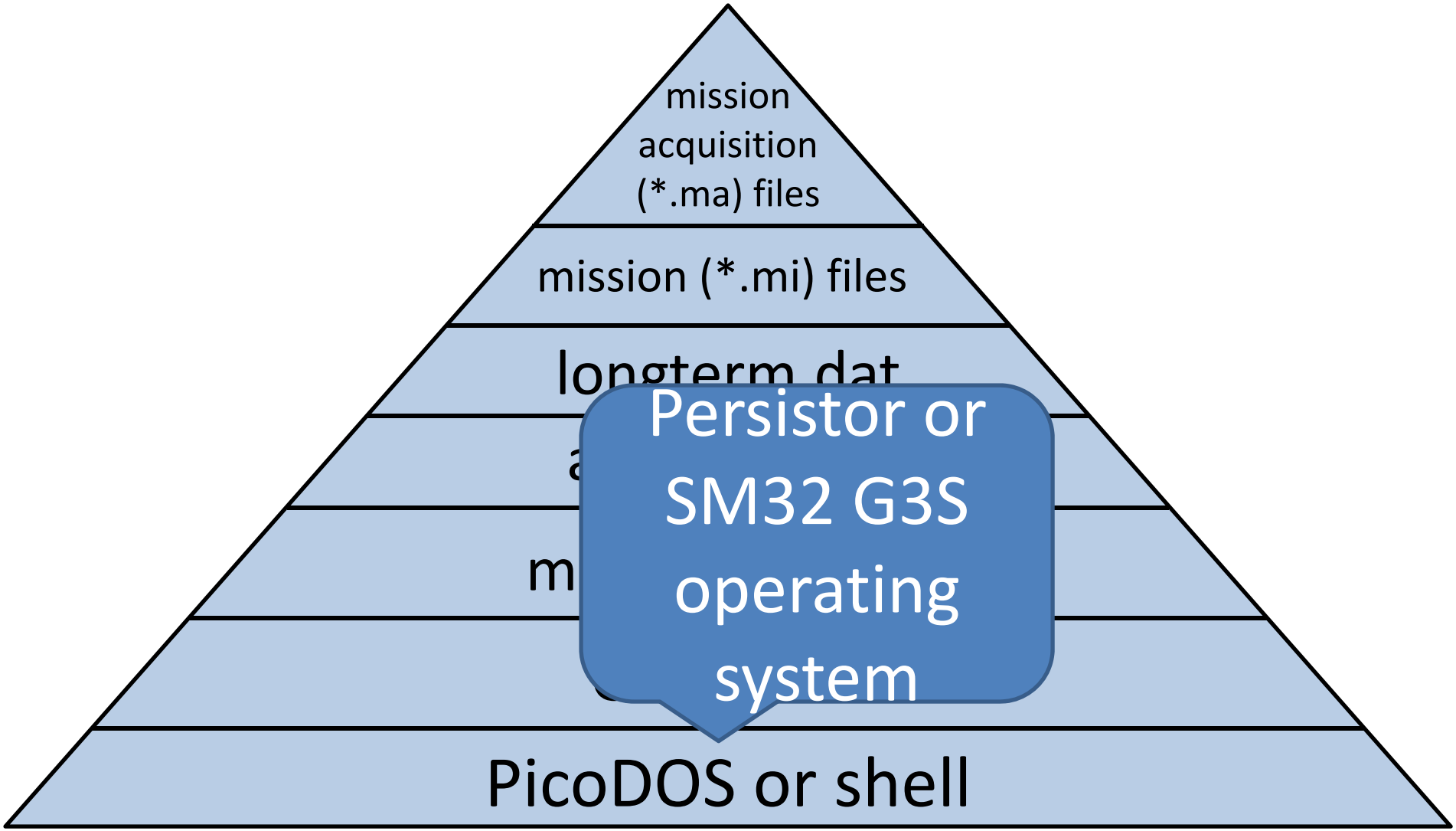
On-board Glider Software



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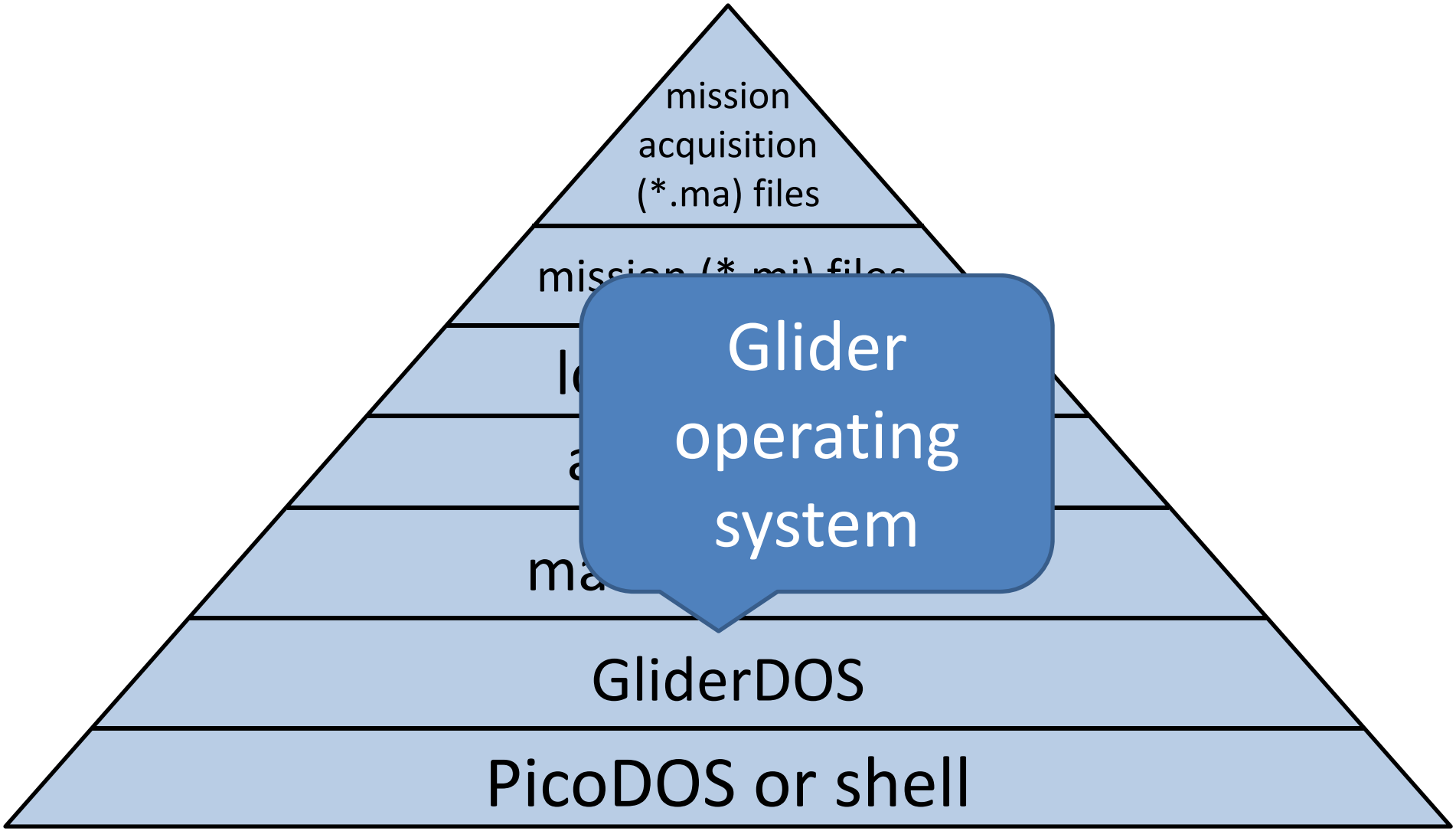
On-board Glider Software



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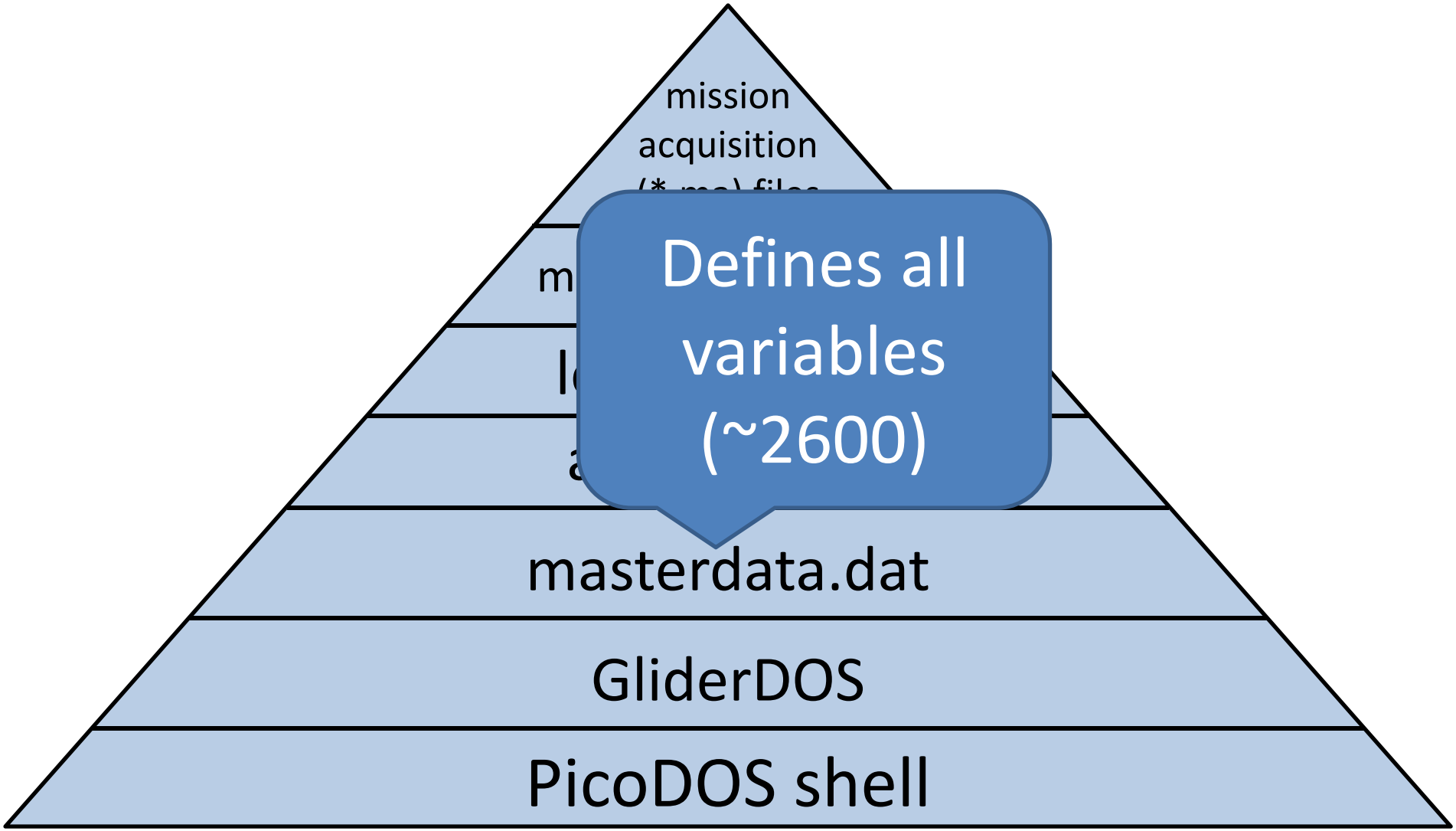
On-board Glider Software



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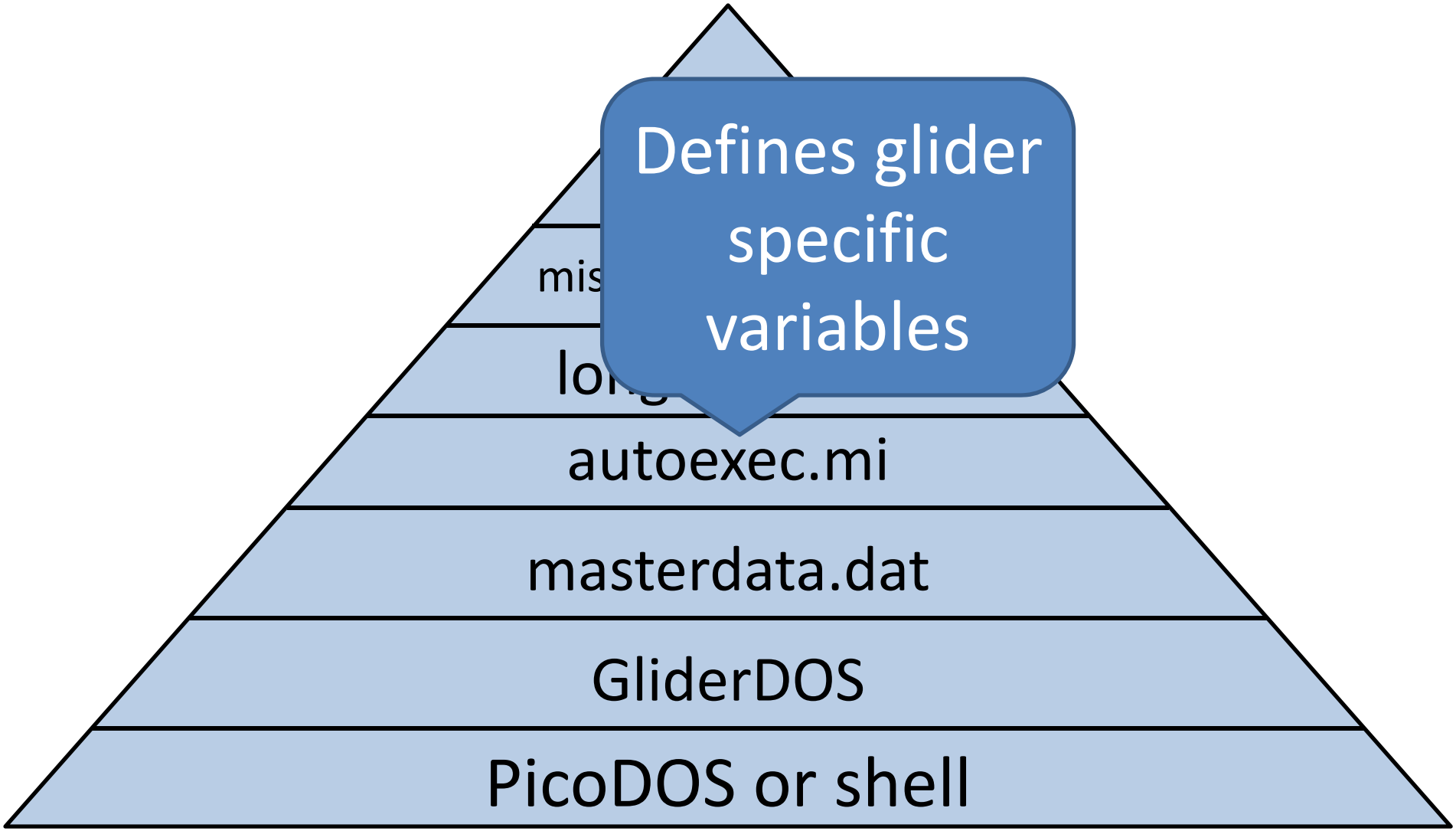
On-board Glider Software



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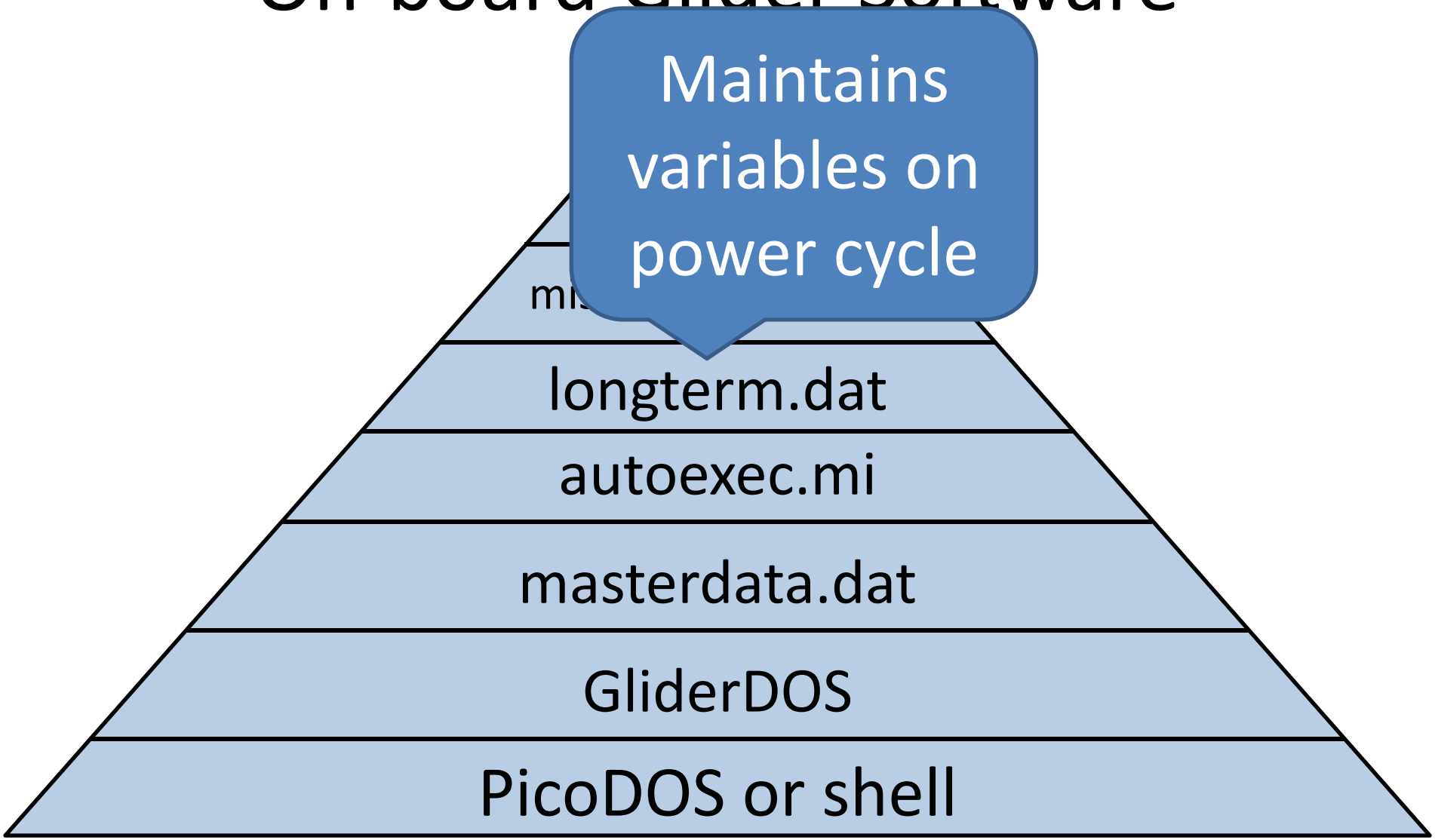
On-board Glider Software



Slocum's Hierarchy of ***Glider Software*** Needs

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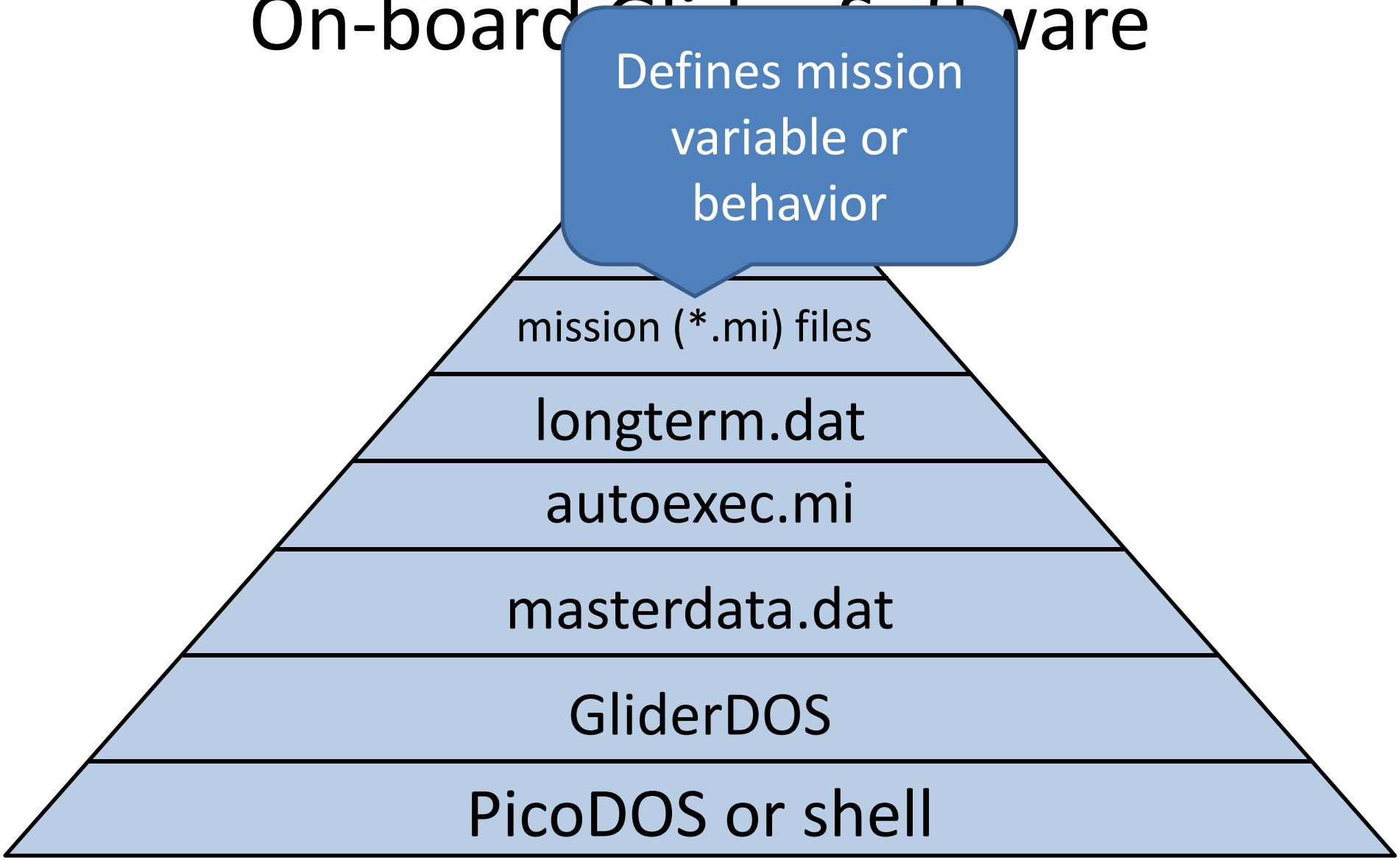
On-board Glider Software



Slocum's Hierarchy of ***Glider Software*** Needs

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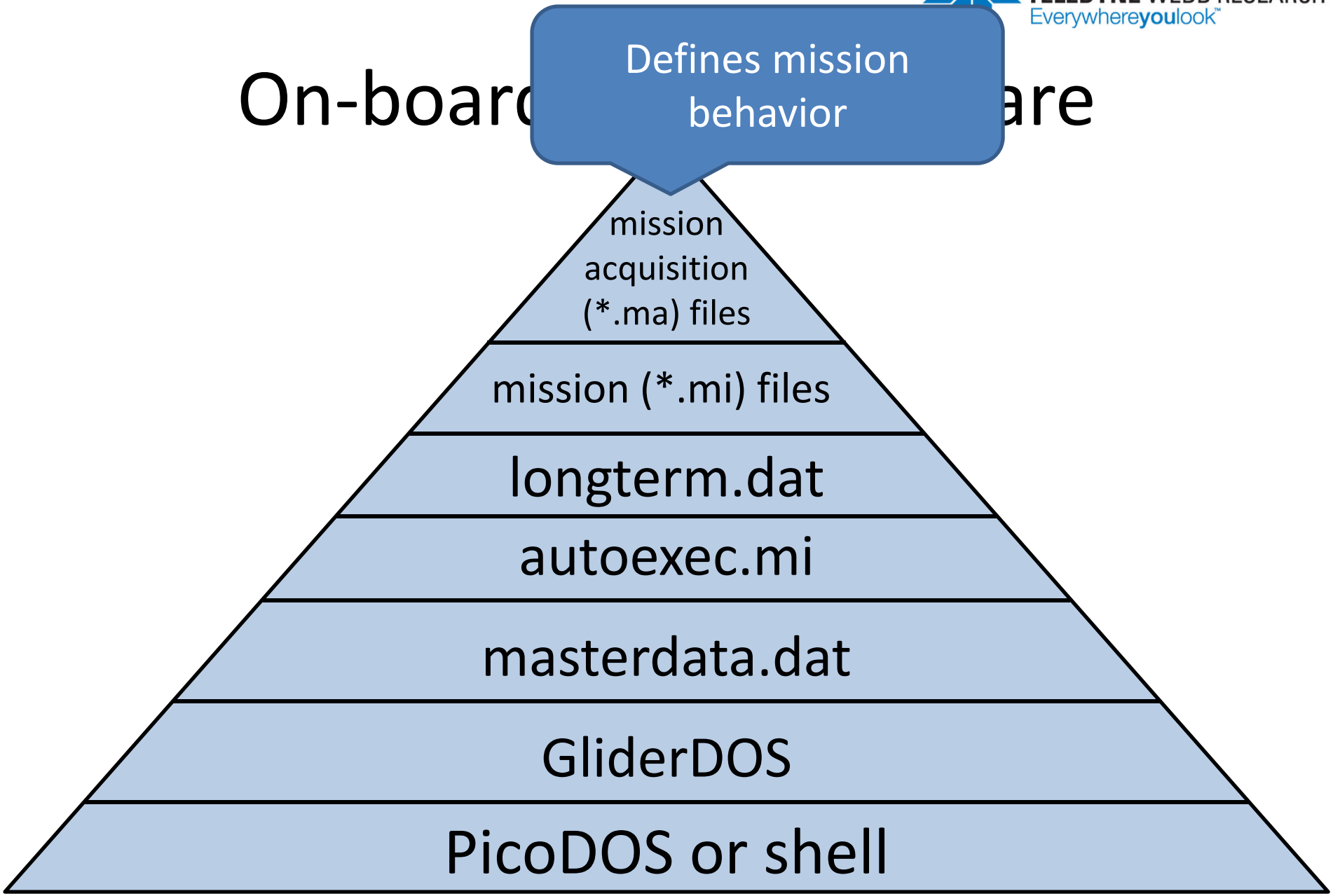

Slocum's Hierarchy of ***Glider Software*** Needs

Sensor Prefixes

Prefix	Significance
m_	Measured
c_	Commanded
u_	User-defined before run-time
f_	Set in factory
x_	Computed at run time (never set these values!)
s_	Simulated state variables
sci_	Science sensor

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Data Files

	Flight Side	Science Side
ALL data	*.DBD	*.EBD
Small data files	*.SBD	*.TBD
User-defined, custom	*.MBD	*.NBD
Log files	*.MLG	*.NLG

Logging on/off can create these 8 file types while in gliderdos or lab_mode

These log files are created at all times when mission is running (except when sending files or receiving files)

SBD and TBD are customized to send over iridium comms and sent by SFMC script

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Ascii header data

- dbd_label: DBD(dinkum_binary_data)file
- encoding_ver: 5
- num_ascii_tags: 14
- all_sensors: T
- the8x3_filename: 01320000
- full_filename: ifm14-2017-068-2-0
- filename_extension: dbd
- mission_name: stock.MI
- fileopen_time: Fri_Mar_10_06:41:42_2017
- total_num_sensors: 2000
- sensors_per_cycle: 2000
- state_bytes_per_cycle: 500
- sensor_list_crc: 868d75a7
- sensor_list_factored: 1

Key Glider Software Components

- Flight Persistor or SM32
  - glider.app or
  - Flight.gex
  - masterdata
  - autoexec.mi
  - longterm.dat
  - missions
  - ma files

------Clothesline---------

- Science Persistor or SM32
  - supersci.app or
  - Science.gex
  - proglets.dat

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Installed Devices

```
            name in ALLCAPS means CRITICAL device (* => SUPERCRITICAL)
                 [I Installed] [- Not_Installed]
                   [u In_use] [- Not_In_use] [X Out_of_Service]
            name       limits     stats (#total/#mission/#segment)
 0        simdrvr  -
 1    test_driver  -
 2          ARGOS* I u  -1  20   5  0
 3       WATCHDOG  I u  -1  -1  -1  0
 4        DEADMAN  I u  -1  20   5  0
 5        CONSOLE* I u  -1  20   5  0
 6            GPS  I u  -1  20   5  0
 7         pinger  -
 8       attitude  -
 9  attitude_tcm3  -
10   attitude_rev  I u   3  20   5  0 [   0   0  0] [   1   0  0] [   0   0  0]
11 ocean_pressure  I u   3  20   5  0
12         vacuum  I u   3  20   5  0
13        battery  I u   3  20   5  0
14lithium_battery  -
15       air_pump  I u   3  20   5  0
16    pitch_motor  I u   3  20   5  0
17  science_super  I u   3  20   5  0
18     roll_motor  -
19    fpitch_pump  -
20      fin_motor  -
21        digifin  I u   3  20   5  0
22      altimeter  I u   3  20   5  0
23            ctd  -
24        IRIDIUM* I u  -1  20   5  0 [   0   0  0] [   0   0  0] [   2   0  0]
25     leakdetect  I u   3  20   5  0
26       recovery  I u   3  20   5  0
27        coulomb  I u   3  20   5  0
28       veh_temp  I u   3  20   5  0
29  BUOYANCY_PUMP  I u   3  20   3  0
30THERMAL_ACC_PRE  -
31 THERMAL_ENGINE  -
32   THERMAL_PUMP  -
33         DE_PUMP  -
34    thruster_g1  -
35       thruster  I u   3  20   5  0
devices:(t/m/s) errs:   0/   0/   0 warn:   1/   0/   0 odd:   2/   0/   0
```

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 0         simdrvr  -
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 3         WATCHDOG  I u  -1  -1   -1  0
 4          DEADMAN  I u  -1  20    5  0
 5          CONSOLE* I u  -1  20    5  0
 6              GPS  I u  -1  20    5  0
 7           pinger  -
 8         attitude  -
 9   attitude_tcm3  -
10    attitude_rev  I u   3  20    5  0 [   0   0  0] [   1   0  0] [   0   0  0]
11  ocean_pressure  I u   3  20    5  0
12           vacuum  I u   3  20    5  0
13          battery  I u   3  20    5  0
14lithium_battery  -
15         air_pump  I u   3  20    5  0
16     pitch_motor  I u   3  20    5  0
17   science_super  I u   3  20    5  0
18      roll_motor  -
19     fpitch_pump  -
20       fin_motor  -
21          digifin  I u   3  20    5  0
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23              ctd  -
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29   BUOYANCY_PUMP  I u   3  20    3  0
30THERMAL_ACC_PRE  -
31 THERMAL_ENGINE  -
32    THERMAL_PUMP  -
33          DE_PUMP  -
34     thruster_g1  -
35         thruster  I u   3  20    5  0
devices:(t/m/s) errs:   0/   0/   0 warn:   1/   0/   0 odd:   2/   0/   0
```

Type `use` to see all devices installed in autoexec.mi

Installed Devices

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30THERMAL_ACC_PRE  -
31 THERMAL_ENGINE  -
32    THERMAL_PUMP  -
33          DE_PUMP  -
34     thruster_g1  -
35        thruster  I u   3  20   5  0
devices:(t/m/s) errs:   0/   0/   0 warn:   1/   0/   0 odd:   2/   0/   0
```

Type `use - sensor_name` to temporarily remove devices

Type `use + sensor_name` to reinstall devices that have been taken out of service

Type `use all` or `use none` to install or remove all devices

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Installed Devices

```
            name in ALLCAPS means CRITICAL device (* => SUPERCRITICAL)
                 [I Installed] [- Not_Installed]
                   [u In_use] [- Not_In_use] [X Out_of_Service]
             name        limits      stats (#total/#mission/#segment)
 0         simdrvr  -
 1     test_driver  -
 2           ARGOS* I u  -1  20    5  0
 3         WATCHDOG  I u  -1  -1   -1  0
 4          DEADMAN  I u  -1  20    5  0
 5          CONSOLE* I u  -1  20    5  0
 6              GPS  I u  -1  20    5  0
 7           pinger  -
 8         attitude  -
 9   attitude_tcm3  -
10    attitude_rev  I u   3  20    5  0 [   0   0  0] [   1   0  0] [   0   0  0]
11  ocean_pressure  I u   3  20    5  0
12           vacuum  I u   3  20    5  0
13          battery  I u   3  20    5  0
14 lithium_battery  -
15         air_pump  I u   3  20    5  0
16     pitch_motor  I u   3  20    5  0
17   science_super  I u   3  20    5  0
18      roll_motor  -
19     fpitch_pump  -
20       fin_motor  -
21          digifin  I u   3  20    5  0
22        altimeter  I u   3  20    5  0
23              ctd  -
24          IRIDIUM* I u  -1  20    5  0 [   0   0  0] [   0   0  0] [   2   0  0]
25      leakdetect  I u   3  20    5  0
26        recovery  I u   3  20    5  0
27          coulomb  I u   3  20    5  0
28         veh_temp  I u   3  20    5  0
29   BUOYANCY_PUMP  I u   3  20    3  0
30 THERMAL_ACC_PRE  -
31  THERMAL_ENGINE  -
32    THERMAL_PUMP  -
33          DE_PUMP  -
34     thruster_g1  -
35         thruster  I u   3  20    5  0
devices:(t/m/s) errs:   0/   0/   0 warn:   1/   0/   0 odd:   2/   0/   0
```

Total # of errors

# of errors in segment

# of errors in mission

Installed Devices

```
            name in ALLCAPS means CRITICAL device (* => SUPERCRITICAL)
                 [I Installed] [- Not_Installed]
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 4        DEADMAN  I u  -1  20   5  0
 5        CONSOLE* I u  -1  20   5  0
 6            GPS  I u  -1  20   5  0
 7         pinger  -
 8       attitude  -
 9  attitude_tcm3  -
10   attitude_rev  I u   3  20   5  0 [   0   0  0] [   1   0  0] [   0   0  0]
11 ocean_pressure  I u   3  20   5  0
12         vacuum  I u   3  20   5  0
13        battery  I u   3  20   5  0
14lithium_battery  -
15        air_pump  I u   3  20   5  0
16    pitch_motor  I u   3  20   5  0
17  science_super  I u   3  20   5  0
18     roll_motor  -
19    fpitch_pump  -
20      fin_motor  -
21        digifin  I u   3  20   5  0
22      altimeter  I u   3  20   5  0
23            ctd  -
24        IRIDIUM* I u  -1  20   5  0 [   0   0  0] [   0   0  0] [   2   0  0]
25     leakdetect  I u   3  20   5  0
26       recovery  I u   3  20   5  0
27        coulomb  I u   3  20   5  0
28       veh_temp  I u   3  20   5  0
29  BUOYANCY_PUMP  I u   3  20   3  0
30THERMAL_ACC_PRE  -
31 THERMAL_ENGINE  -
32   THERMAL_PUMP  -
33         DE_PUMP  -
34    thruster_g1  -
35       thruster  I u   3  20   5  0
devices:(t/m/s) errs:   0/   0/   0 warn:   1/   0/   0 odd:   2/   0/   0
```

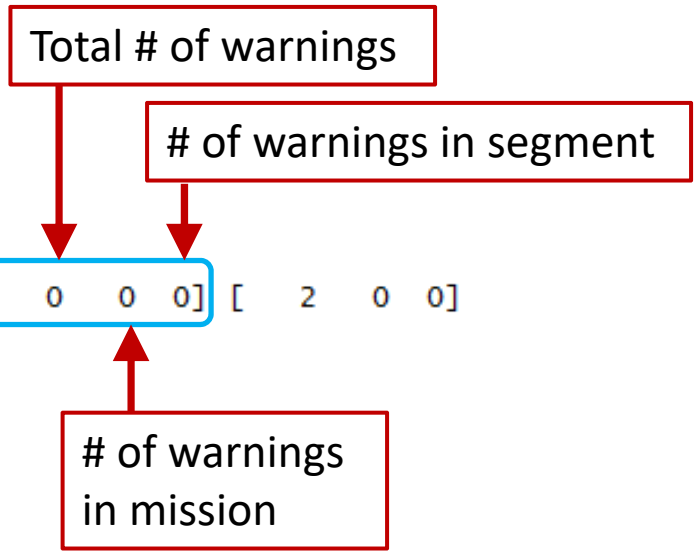

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Installed Devices

```
            name in ALLCAPS means CRITICAL device (* => SUPERCRITICAL)
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            name        limits      stats (#total/#mission/#segment)
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 1    test_driver  -
 2         ARGOS* I u  -1  20   5  0
 3       WATCHDOG  I u  -1  -1  -1  0
 4        DEADMAN  I u  -1  20   5  0
 5        CONSOLE* I u  -1  20   5  0
 6            GPS  I u  -1  20   5  0
 7         pinger  -
 8       attitude  -
 9  attitude_tcm3  -
10   attitude_rev  I u   3  20   5  0 [   0   0  0] [   1   0  0] [   0   0  0]
11 ocean_pressure  I u   3  20   5  0
12         vacuum  I u   3  20   5  0
13        battery  I u   3  20   5  0
14lithium_battery  -
15        air_pump  I u   3  20   5  0
16    pitch_motor  I u   3  20   5  0
17  science_super  I u   3  20   5  0
18     roll_motor  -
19    fpitch_pump  -
20      fin_motor  -
21        digifin  I u   3  20   5  0
22      altimeter  I u   3  20   5  0
23            ctd  -
24         IRIDIUM* I u  -1  20   5  0 [   0   0  0] [   0   0  0] [   2   0  0]
25     leakdetect  I u   3  20   5  0
26       recovery  I u   3  20   5  0
27        coulomb  I u   3  20   5  0
28       veh_temp  I u   3  20   5  0
29  BUOYANCY_PUMP  I u   3  20   3  0
30THERMAL_ACC_PRE  -
31 THERMAL_ENGINE  -
32   THERMAL_PUMP  -
33         DE_PUMP  -
34    thruster_g1  -
35       thruster  I u   3  20   5  0
devices:(t/m/s) errs:   0/   0/   0 warn:   1/   0/   0 odd:   2/   0/   0
```

Total # of oddities

# of oddities in segment

# of oddities in mission

Installed Devices

```
            name in ALLCAPS means CRITICAL device (* => SUPERCRITICAL)
                 [I Installed] [- Not_Installed]
                   [u In_use] [- Not_In_use] [X Out_of_Service]
            name       limits     stats (#total/#mission/#segment)
 0        simdrvr  -
 1    test_driver  -
 2          ARGOS* I u  -1  20   5  0
 3        WATCHDOG  I u  -1  -1  -1  0
 4        DEADMAN  I u  -1  20   5  0
 5        CONSOLE* I u  -1  20   5  0
 6            GPS  I u  -1  20   5  0
 7         pinger  -
 8       attitude  -
 9  attitude_tcm3  -
10   attitude_rev  I u   3  20   5  0 [   0   0  0] [   1   0  0] [   0   0  0]
11 ocean_pressure  I u   3  20   5  0
12         vacuum  I u   3  20   5  0
13        battery  I u   3  20   5  0
14lithium_battery  -
15       air_pump  I u   3  20   5  0
16    pitch_motor  I u   3  20   5  0
17  science_super  I u   3  20   5  0
18     roll_motor  -
19    fpitch_pump  -
20      fin_motor  -
21        digifin  I u   3  20   5  0
22      altimeter  I u   3  20   5  0
23            ctd  -
24        IRIDIUM* I u  -1  20   5  0 [   0   0  0] [   0   0  0] [   2   0  0]
25     leakdetect  I u   3  20   5  0
26       recovery  I u   3  20   5  0
27        coulomb  I u   3  20   5  0
28       veh_temp  I u   3  20   5  0
29  BUOYANCY_PUMP  I u   3  20   3  0
30THERMAL_ACC_PRE  -
31 THERMAL_ENGINE  -
32   THERMAL_PUMP  -
33         DE_PUMP  -
34    thruster_g1  -
35       thruster  I u   3  20   5  0
devices:(t/m/s) errs:   0/   0/   0 warn:   1/   0/   0 odd:   2/   0/   0
```

Can modify value of SETDEVLIMIT & SETNUMWARN to increase/decrease glider sensitivity

Testing Your New Glider

- Make sure to confirm the following:
  - FreeWave comms
  - Iridium comms
  - Wiggle (exercise all motors)
  - Science sensor output

Functional Checkout Procedure (4095-FCP)

- Personalize your glider!
  - Rename it
  - Add your phone numbers
  - Connect to your dockserver

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Common Glider Commands

- `help`
- `lab_mode`
- `wiggle`
- `use`
- `report ++`
- `get`
- `put`
- `longterm_put`
- `!` (bang)
- `consci`
- `whoru`
- `where`
- `zero_ocean_pressure`
- `dir`
- `run`
- `loadmission`
- `exit`
- `exit reset`

NOTE: List all available commands by typing `help`

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Glider DOs

- Secure it properly in crate with all three straps for shipping.
- Use fresh desiccants on each deployment upon opening.
- Monitor internal vacuum before launch (less vacuum indicates a leak; positive pressure may indicate dangerous gas accumulation).
- Simulate missions before launch.
- Test Iridium and Argos telemetry before launch.
- Burn off passivation in lithium primary batteries with a ~500m dive
- Deploy into wind

Glider DON'Ts

- Never power up a shallow glider without a vacuum.
- Never deploy a glider in simulation.
- Never deploy a glider in "boot pico or boot shell"
- Never exit to pico or shell during a deployment.
- Never power on a glider with more than 16.3 vDC from an external power supply.
- Never deploy a glider in lab_mode.
- Never perform the top of a yo below 30 meters (with 100 or 200 meter glider).
- Never secure the glider to the cart while over railing or in the water.

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Mission Commands

- `loadmission mission1.mi`
  - Sets glider sensor values found in mission1.mi
- `run mission2.mi`
  - Instructs glider to begin running mission2.mi
- `sequence mission3.mi mission4.mi mission5.mi`
  - Instructs glider to run mission3.mi. When mission3.mi completes glider will run mission4.mi, and when that finishes it will run mission5.mi

`Sequence mission6.mi(5)`

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Config Directory

- config.srf
  - Customize your surface dialog
- sbdlist.dat
  - Customize content of SBD file
- tbdlist.dat
  - Customize content of TBD file
- longterm.dat
  - Customize list of sensors that are stored whenever glider powers down

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config.srf

- Customize the surface dialog?

```
Vehicle Name: bensim
Curr Time: Fri Jul  6 20:05:02 2012 MT:      19
DR  Location:  3549.325 N -12204.651 E measured     19.808 secs ago
GPS TooFar:   69696969.000 N 69696969.000 E measured     1e+308 secs ago
GPS Invalid :  3549.325 N -12204.651 E measured      1.424 secs ago
GPS Location: 69696969.000 N 69696969.000 E measured     1e+308 secs ago
   sensor:c_wpt_lat(lat)=0                          1e+308 secs ago
   sensor:c_wpt_lon(lon)=0                          1e+308 secs ago
   sensor:m_battery(volts)=13.1215629514988          1.433 secs ago
   sensor:m_coulomb_amphr(amp-hrs)=0                1e+308 secs ago
   sensor:m_coulomb_amphr_total(amp-hrs)=0          20.004 secs ago
   sensor:m_final_water_vx(m/s)=0                   1e+308 secs ago
   sensor:m_final_water_vy(m/s)=0                   1e+308 secs ago
   sensor:m_iridium_signal_strength(nodim)=-1       1e+308 secs ago
   sensor:m_leakdetect_voltage(volts)=2.5            1.488 secs ago
   sensor:m_leakdetect_voltage_forward(volts)=-1      1.501 secs ago
   sensor:m_lithium_battery_relative_charge(%)=0     1e+308 secs ago
   sensor:m_tot_num_inflections(nodim)=22709        20.007 secs ago
   sensor:m_vacuum(inHg)=6.50223565323565            1.611 secs ago
   sensor:m_water_vx(m/s)=0                         1e+308 secs ago
   sensor:m_water_vy(m/s)=0                         1e+308 secs ago
   sensor:u_use_current_correction(nodim)=1         20.692 secs ago
   sensor:x_last_wpt_lat(lat)=3640.8665              19.96 secs ago
   sensor:x_last_wpt_lon(lon)=-12152.5347           19.964 secs ago
```

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sbdlist.dat

Customize content of SBD file

```
                c_battpos    600
                c_wpt_lat
                c_wpt_lon
                m_battpos    600
           m_de_oil_vol      600
                m_depth      600
                m_gps_lat
                m_gps_lon
                    m_lat    600
                    m_lon    600
                  m_pitch    600
               m_water_vx
               m_water_vy
m_present_secs_into_mission
            m_present_time
                  m_battpos  600
        m_coulomb_current    600
   m_coulomb_amphr_total     600
                m_speed      600
     x_low_power_status       300
```

Decimate sensors every x seconds

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tbdlist.dat

Customize content of TBD file

```
SCI_M_PRESENT_TIME
SCI_M_PRESENT_SECS_INTO_MISSION
SCI_WATER_COND                  30
SCI_WATER_TEMP                  30
SCI_WATER_PRESSURE              30
sci_c3sfl_chlorophyll           10
sci_c3sfl_phycoerythrin         10
sci_c3sfl_turbidity             10
sci_c3sfl_cdom                  10
```

Decimate sensors every x seconds

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longterm.dat

Oil bladders/bellaframs require replacement every 20,000 half cycles

Glider's "fuel gauge"

```
m_avg_climb_rate
m_avg_upward_inflection_time
★ m_tot_num_inflections
m_tot_horz_dist
m_lat
m_lon
m_tot_ballast_pumped_energy
m_battery
m_iridium_call_num
m_iridium_dialed_num
★ m_coulomb_amphr_total
s_water_depth_avg
s_water_depth_delta
s_water_depth_wavelength
f_ocean_pressure_min
m_avg_speed
x_last_wpt_lat
x_last_wpt_lon
x_de_avg_oil_vol_ierr_on_ascent
x_de_avg_oil_vol_ierr_on_descent
x_hover_ballast_shallow
x_hover_ballast_deep
x_hover_depth_shallow
x_hover_depth_deep
```

Customize list of sensors that are stored whenever glider powers down

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Mission Planning

Ballast & H-Moment

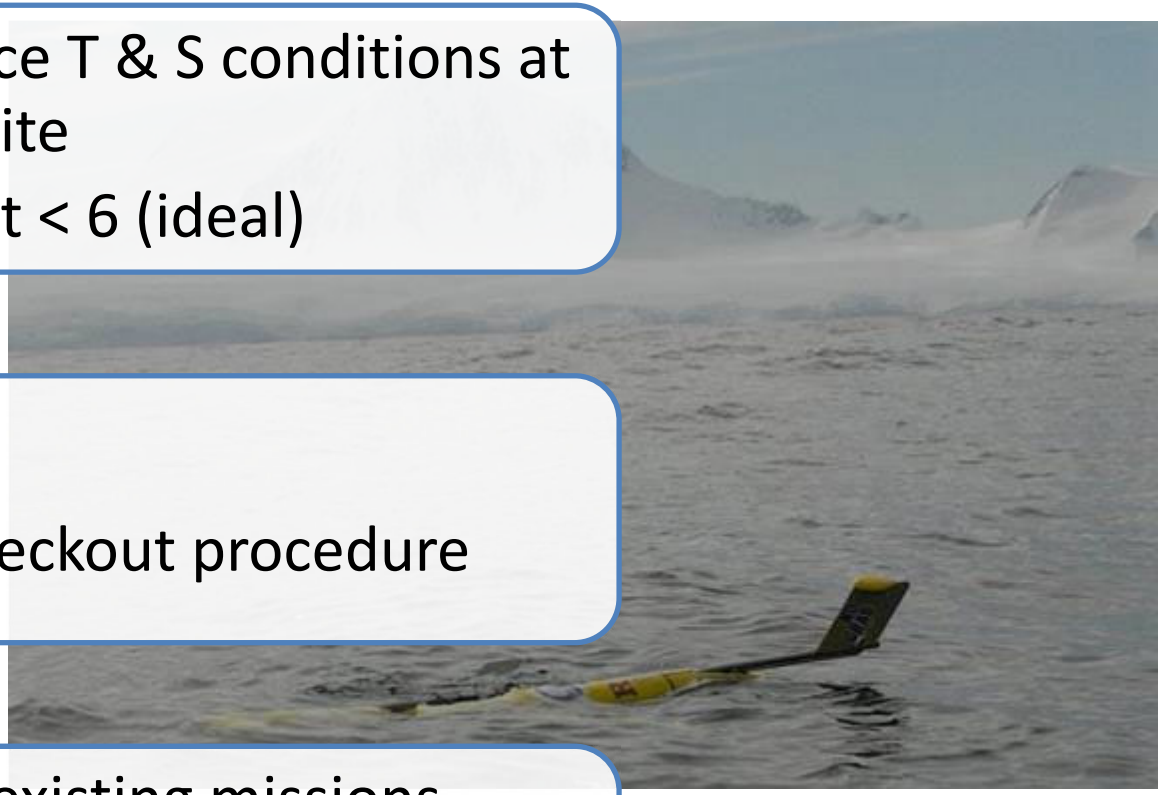
- Identify surface T & S conditions at deployment site
- 5 < H-moment < 6 (ideal)

Testing & Functional

- Vacuum test
- Functional checkout procedure

Simulate Missions

- Easy: modify existing missions
- Harder & riskier without experience: write your own



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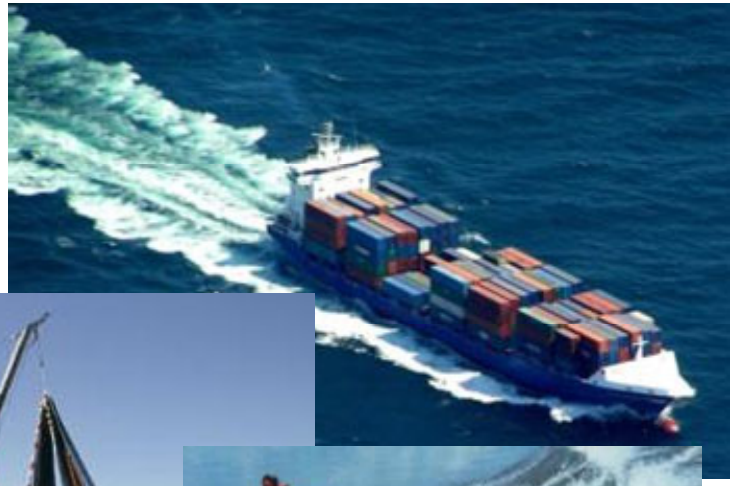
Water Space Management

- Consider the following when planning your deployment:
  - Tides
  - Shipping lanes
  - Recreational traffic
  - Fishing grounds
  - Bathymetry & sea floor characteristics



Altimeters

- The altimeter is downward looking
- Avoid flying close to bottom in dynamic terrain
- Altimeters use energy… Pilots might choose to turn off when not needed:
- sensor: u_alt_min_depth(m) 2.0 #how deep vehicle must be to use altitude

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Battery options

- Alkaline – number of batteries may vary depending on payload
- Lithium Primary – (3s (12v) and 4s (15v))Proper shipping certification needed for Hazardous goods
  - Requires enable circuit
- Rechargable – Available fall 2017, Proper shipping certification needed for Hazardous goods
  - New to G3 BMS board – suggested for all lithium batteries

Endurance

- Mission length
  - Power consumption
  - Calculation tool
- Sampling strategy
  - How frequently do you need science data?
- Do you need to use the altimeter?
  - Can be uninstalled in deep water
  - Remember not to overwrite altimeter settings in mission

Coulomb Counter

- The coulomb counter is the glider's "fuel tank"
- Important for lithium battery sets.
  - Lithium Primary 3s batteries have a nominal value of 720 amp-hrs
  - Lithium Primary 4s batteries have a nominal value of 460
  - Rechargeable – nominally 215
  - Gliders will begin aborting for low remaining energy when `m_coulomb_amphr_total` reaches 10% remaining)
  - zero this value when batteries are replaced:

    ```
    put m_coulomb_amphr_total 0
    ```

- User must set f_coulomb_battery_capacity for each battery type

Chart on next slide

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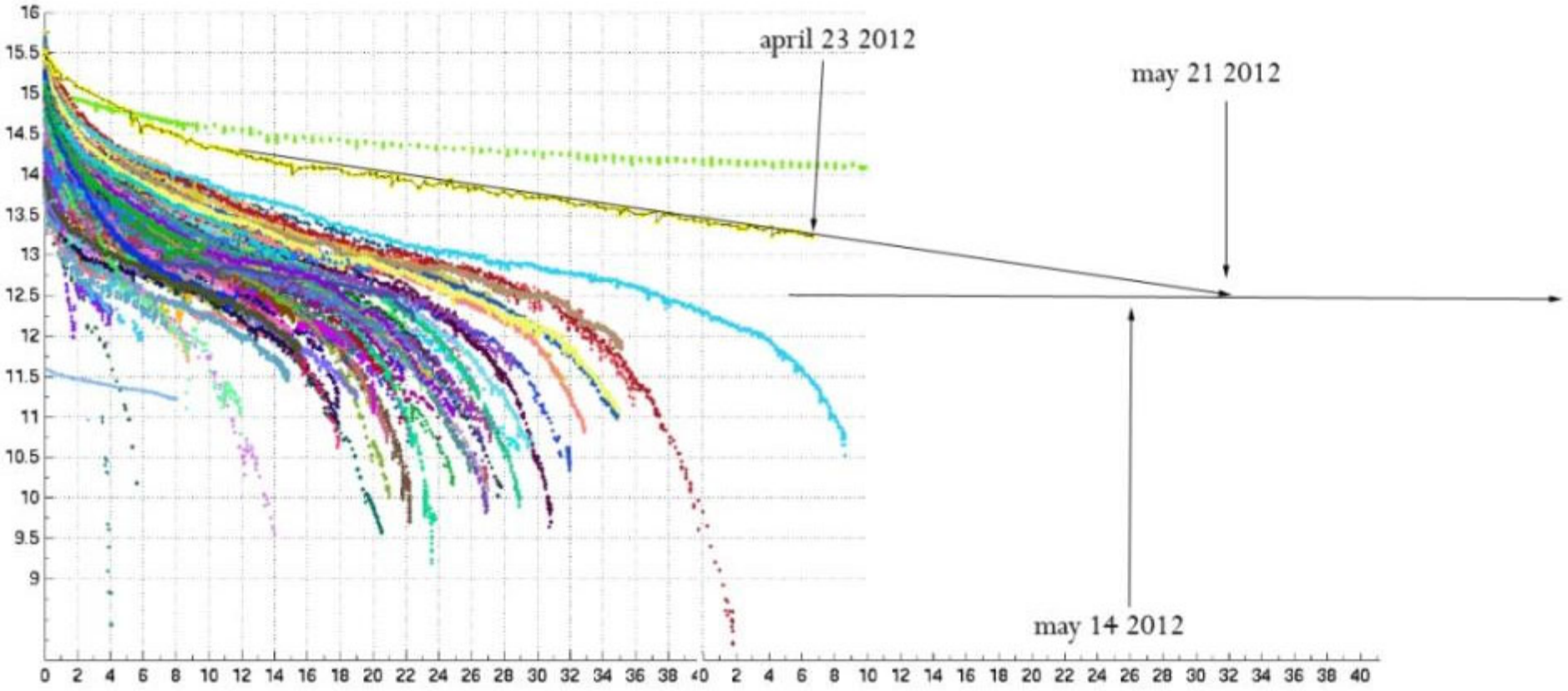
Battery capacitys

	Total Non-der-ated Amphrs (amphr	Total non-derated Watt Hours (WH)	Recommended f_coulomb_bat-tery_capacity	Recommended Undervolts (V)
Alkaline Standard Pack	168	2520	120	10
3S Primary Standard	780	8424	720	9.8
3S Primary Extended	1140	12312	1050	9.8
4S Primary Standard	600	8600	550	12
4S Primary Extended	870	12500	800	12
Lithium Rechargeable Standard	234.6	3300	215	12
Lithium Rechearеable Extended	326.4	4700	300	12

Alkaline Voltage Curve



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Compass Calibration

- Slocum glider compass calibration in a dedicated test stand.

- New G3 option:
  - Insitu compass cal
  - See mission attcal.mi in production release
  - See forum post or contact glidersupport for ultilty!

Crisis & Mission End Management

- Make sure you have answers to the following questions when it comes time to recover your glider:
  - Who?
  - When?
  - Where?
  - How?

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The Glider Aborted – Now What??

- Send the following commands to the glider:
  - `why?` (explains why glider aborted)
  - `use` (prints list of installed devices)
  - `where` (prints surface dialog to screen) (callback 2 0?)
- Download the relevant MLG (maybe the DBD)
- Increase time in GliderDOS so that glider doesn't sequence into `lastgasp.mi`
- Run callback 30 script
  - Remember: GPS & Iridium share the same antenna. Only one works at a time!

https://datahost.webbresearch.com/files.php?cwd=/glider/production/doco/how-it-works/abort-sequuences.txt

https://datahost.webbresearch.com/viewforum.php?f=7

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Dangers to the vehicle

- People – strangers and technicians
- Shipping (transporting)
- Predators (Remus Great White Shark video)
- Seals (green plug)
- Remora
- Low density surface layer (warm and fresh H20)
- Trucks

Glider deployment

- Small boat video

- The glider nose should always be pointed into the wind during cart deployment. The larger wind surface of the boat will push it over vehicle if deployed down wind.
- The tail is not a lifting point, but the glider can be manipulated onto the cart by hand

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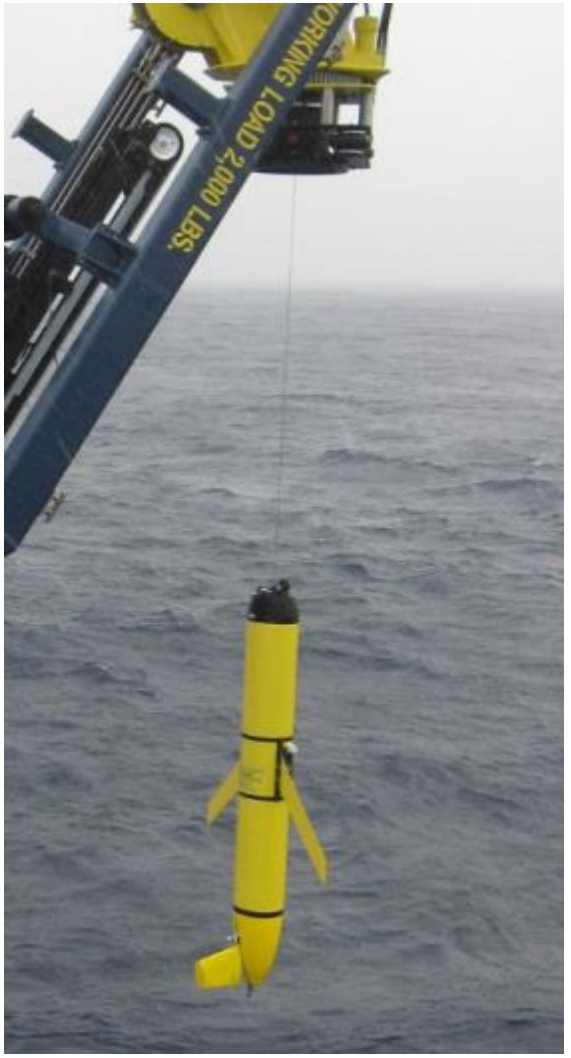
Recovery

- Small boat?
- Big boat?
- Strobe on?
- Recovery system?
- GPS format on recovery boat: is translation needed?
- ARGOS data?



Glider recovery

- Small boat video
- Approach from down wind
- Thruster blades are sharp (rubber band?)
- Let water drain from cowling
- Use leverage with cart on gunnel

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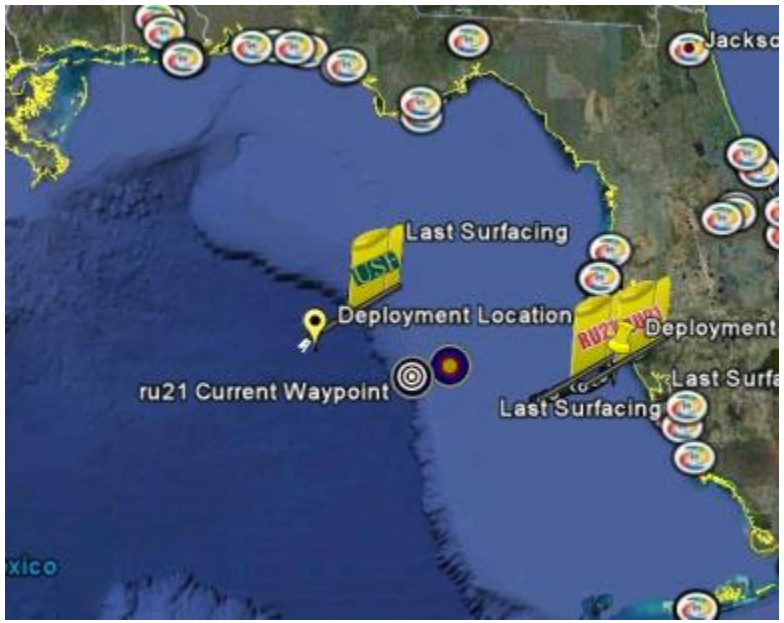
Mission Writing

- Start simple!
- Modify astock.mi
  - Default mission
  - flies around 4 points in Ashumet Pond
- You will likely need to adjust:
  - max_wpt_distance
  - Surface intervals
    - No comms timeout
    - Every x minutes
    - Surfacing at every waypoint

Modify Waypoints

- The goto_l10.ma file controls waypoints

```
<start:b_arg>
b_arg: num_legs_to_run(nodim) -1 # loop
b_arg: start_when(enum) 0 # BAW_IMMEDIATELY
b_arg: list_stop_when(enum) 7 # BAW_WHEN_WPT_DIST
b_arg: initial_wpt(enum) -2 # closest
b_arg: num_waypoints(nodim) 4
<end:b_arg>
<start:waypoints>
-7032.0640    4138.1060
-7031.9200    4138.1090
-7031.9170    4138.0000
-7032.0610    4137.9980
<end:waypoints>
```



Modify Dive Characteristics

- The yo14.ma file controls:
  - Dive to depth
    - must be less than max working depth
  - Climb to depth
    - must be shallower than 30m for piston-driven gliders
    - Inflecting at depths deeper than 30m will cause mission to abort (preventing damage to hardware)
    - Buoyancy drive and min speed.
  - Altitude
    - 6m off bottom for piston-driven gliders
    - 15m off bottom for oil-driven gliders

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Science Sensors

- The “clothesline”
  - Communication between the Flight & Science persistors
- Specify sampling scheme in sampleXX.ma files
  - state_to_sample (diving, climbing, hovering, on sfc)
  - intersample_time (# seconds between measurements)
  - nth_yo_to_sample (sample only n^{th} yo after 1^{st} yo)
  - intersample_depth (# meters between measurements)
  - min_depth
  - max_depth

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Shallow water operation

- Setshal.mi
- What is shallow?
- What type of engine/pump:
- **Deep pump**
- **Rating - min depth**
- 1000m = 30m?
- 350m =25m?

setshal.mi

- **Pistons pumps**
- 200 =15m?
- 100 =12m?
- 30/50 = 8m?

- ?stop pulling data?

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Scripts (autopilot)

- sfmc is TWR recommended
- sends all sbd and all tbd
- Dockzr all ma files
- Ctrl –F – ReRead Mafile
- Ctrl-W – Warning report
- Ctrl-R (dive!)

- (review script)

DBD format

- File naming convention
- Cache files
- Executables for conversion

- Zcancel will cancel the file transfer

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Simulation

- Three different types of simulator are available
  - Pocket Simulator (just a persistor, all electronics and motors are simulated)
  - Shoebox Simulator (persistor & mainboard, all motors are simulated; can be connected to a science board)
  - Full glider (all motors & electronics are used, some sensors simulated)

simul.sim

- simul.sim file controls the type of simulation
- This file must be placed in the flight config directory with the appropriate text:
  - no_electronics (pocket simulator)
  - just_electronics (shoebox simulator)
  - on_bench (full glider)

loadsim.mi

- Set your variables in this file (sensors with prefix “s_”)
- loadmission loadsim.mi

```
sensor: s_ini_lat(deg) 4138.1060                    # Ashumet pond
sensor: s_ini_lon(deg) -7032.0640                   # Ashumet pond


sensor: s_water_depth_avg(m)              200.0     #master data default is 30
sensor: s_water_depth_delta(m)              0.0
sensor: s_water_depth_wavelength(m)       100.0

sensor: s_wind_speed(m/s)       9.0                 # how fast the wind is blowing,
                                                    # 3.0 ==> 5.4 knots
sensor: s_wind_direction(rad) 0.0                   # Direction wind is blowing FROM

sensor: s_water_speed(m/s)       0.05               # Current speed,   0.5 ==> 1knot
sensor: s_water_direction(rad)  4.712               # direction current is going TO,
                                                    # toward the west
```

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Tips for Simulating

- You can modify autoexec.mi for simulation
  - Change the name? (unit_XXX_sim)
  - Uninstall iridium?
- For pocket simulators, set the time & date
- No comms surface will not get triggered if the glider maintains comms (you might need to unplug the Freewave)

Note Regarding Qualified Personnel

- Only trained and qualified personnel should operate and maintain the glider.
- Teledyne Webb Research conducts regular training sessions several times a year. Glider users should attend a training session and understand basic glider concepts and terminology.
- Contact glidersupport@teledyne.com for information regarding training sessions.
- Company policy is to fully support only properly trained individuals and groups.
- Only personnel who have attended a Teledyne Webb Research training session should use this document

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Advanced Training

- Come back to another session in a year or two as a refresher and bring your intermediary questions
  - 2-4 sessions a year – contact: ben.allsup@teledyne.com

- Watch for information about Advance sessions in forum and by email

  - 1 a year

Thank You!

- We would like to thank you for attending this training session and look forward to assisting you as you deploy your gliders!

- Glider Support Team (glidersupport@teledyne.com)

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