IMPORTANT ADDITIONAL NOTES FROM THE 2013 SLOCUM GLIDER TRAINING COURSE

R. GERIN, E. MAURI, P. ZUPPELLI and S. KUCHLER

Approved by: ……

Dr. Paola Del Negro

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1. Introduction

The present report contains some important notions and fundamental tips to better interrogate/ communicate with a Slocum Glider, what is important to set in a mission and how to simulate a mission. Basically gives you some info on how the Slocum Glider software works. All this knowledge were assimilated at the Slocum Glider Training Course in Falmouth during 11-14 November 2013. The report has a schematic structure and it is divided in three parts: the class lessons, the laboratory/on the field lessons and a third paragraph on the Glider Terminal commands that includes common instructions. For a better comprehension of the report, the reading of the Slocum Manuals is highly recommended.

2. Class lessons

Important web resources:

- http://dmz.webbresearch.com/ (to authenticate)
- http://www.glider.webbresearch.com/;
- ftp://ftp.glider.webbresearch.com/glider/;
- ftp://ftp.glider.webbresearch.com/glider/windoze/production/src/doco/MANUAL/;
- http://twr-dockserver.webbresearch.com (to install and run the Glider Terminal, remember to use the latest version of Java).

The masterdata (file containing the list and description of all the parameters) can be found in:

- ftp://ftp.glider.webbresearch.com/glider/windoze/production/masterdata;
- http://marine.rutgers.edu/~kerfoot/slocum/masterdata/.

For a permanent modifications of the values of the parameters it is necessary to modify the autoexec.mi file that can be found in the config folder.

The dockserver should be protected by a firewall.

The Glider Terminal has the possibility to act from three different points of view: the glider perspective, the serial port prospective and the dockserver prospective. The point of view can be changed by selecting the desired button on the top right corner of the Glider Terminal.

In the Glider Terminal is it possible to activate a script that sends text messages to mobile phones (SMS) or e-mails in case of abort mission or surfacing (customizable).

f_xxxxx is a variable defined by the factory and used for example in autoexec.bat. It can be overwritten by another variable having the same name, but with a different prefix..

longterm.dat is a file that records all the variable (for exemple the battery voltage consumption on the long term use is here recorded). When the batteries are replaced, the variable relative to the battery MUST be reset.

sbdlist.dat is a file including the name of all the variables transmitted by the Glider in the *.sbd files.

The Glider filename code contains the Glider name, the date, the mission and the segment indication (see an example in Fig. 1)

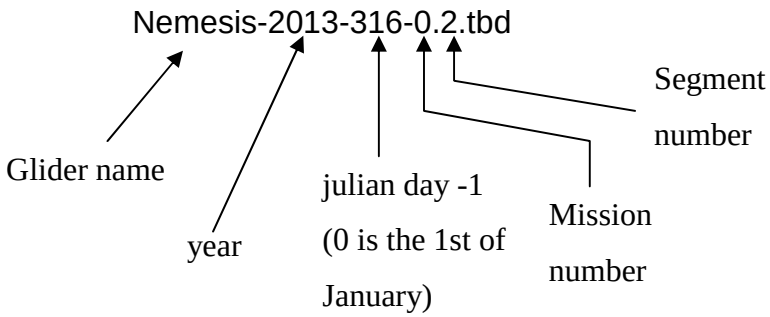

Fig. 1. Glider file name

The first time the Glider reaches the surface, it sends eight files, after the first surfacing only four files are sent. The four extra files contain the header of the regular files sent in the future transmissions. They are sent only once in order to avoid having the Glider at the surface transmitting redundant information.

glmpc terminal can be used to create the waypoint file (extreme care must be taken!!!).

The Data Visualizer is used to plot the parameters transmitted to the dockserver.

NEVER use the Glider in simulator mode and send it into a mission! The glider used in simulator mode is useful in the laboratory in order to understand the kind and quantity of data

generated during a mission. The Glider can be in simulator mode only if the simul.sim file is present in the Glider. The mission loadsim.mi has to be loaded by using the command:

loadmission loadsim.mi

(remember that the prompt displays a SIM indication).

Before running a mission, the simul.sim file MUST be removed from the Glider and the Glider MUST exit from the simulator mode by typing exit reset. Before the mission, a pre-mission checks must be performed by following the instructions in a dedicated excel file.

In the pocket simulator the files autoexec.mi and simul.sim must always be present, otherwise the pocket simulator cannot work.

A little tolerance in the pitch (visible in the m_pitch plot) avoid continuous adjustment of the pitch with a consequent battery depletion for a set c_pitch. Note that, a fluctuation of about 1° in the m_roll is absolutly regular, due to the battery displacement.

The Glider CPU cycle is 4 seconds.

In Glider Terminal you may want to use the esc button to scroll all down.

In lab_mode the bladder is completely empty and the values of the vacuum inside the glider must be 6.0 ± 0.2. Once in water, at surface (the bladder is fully inflated) the vacuum is about 8 (some variations due to the temperature can occur: lower temperature = higher vacuum). The glider will abort a mission if the vacuum is lower than 3 (4 in the masterdata) or higher than 12 (12 in the masterdata, but this value can be manually increased up to 14 in some cases). m_vacuum can increase because if the bladder has a small hole, at the surface the air the glider inflates is pulled out in the environment, while when the glider is underwater the bladder hole is silted due to the external pressure.

overdepth_sample_time must be equal or higher than 15, otherwise the glider experiences problems.

ABEND means Abort END.

BAW means Behaviour Argument When.

In a mission file, the line “behaviour abend” load all the abend behaviours of the masterdata, but if some behaviour are set below the “behaviour abend” line, the corresponding behaviour is overwriten for that mission. In the hierarchy of the Glider the first behaviour is the most important (that is why the behaviour abend is the first one in a mission file!).

"behaviour prepare to dive" must include:

- start when 0
- wait time 720

The mission files must be put on the dockserver in the "to glider" folder through a ftp transfer program like GMC, WINSCP or Filezilla. The files are automatically transferred to the glider if the dedicated script is active on the Glider Terminal. Once the files are on the Glider they are automatically moved to the sentlog folder of the dockserver. The files can also be manually transferred by using the command dockzr *.* -archive (the option –archive move the files in the sentlog folder at the end of the transmission).

When underwater, the Glider computes its position and if it reached a waypoint, the Glider changes the target waypoint. Eventually, the Glider can surface and, even if it recognize that it does not reached the waypoint due for example to a strong unpredicted underwater current, the Glider will head to the new target waypoint. This means that, in presence of strong variable current, the Glider can be very inaccurate and veers far from the set waypoints.

The Glider computes the mean water column current and apply a correction to its route in order to best navigate between the waypoints (Fig. 2). The point S is the first true surfacing, while the surfacing point as estimated by the dead reckoning algorithm is DR. The difference between these two points is due to the mean water column current (WCC) that causes the displacement during the underwater yos.

The mean WCC is unknown at this stage since the position of the point S is undefined. The Glider makes a first GPS fix at GPS1 and a second fix at GPS2. From those two points the Glider compute the current at the surface (SC) and by using the time can deduce the exact position of the S point and therefore can compute the mean water column current (WCC). The Glider remains at the surface for the transmission and it drifts (red track). To avoid erroneous current corrections, the heading adjustment is applied only when the Glider leaves the surface at point D (the position is computed again by using the time and SC).

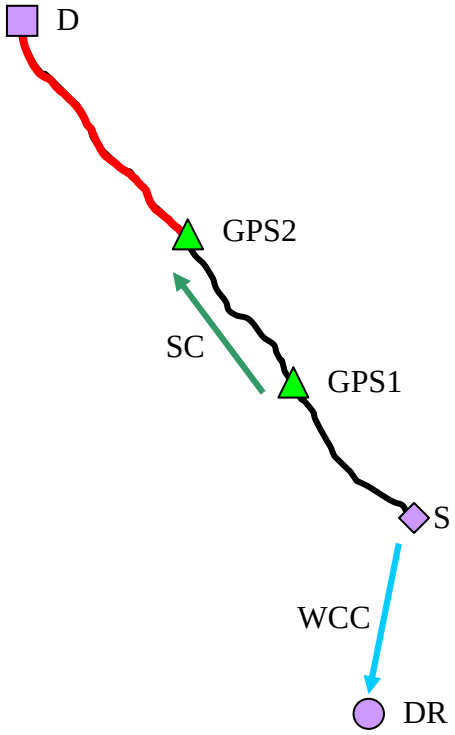

Fig. 2. The current correction is applied just before the Glider leaves the surface.

Care must be taken when operating a Glider in a strong adverse/favourable current areas because the current correction is based on the difference of vectors and in some cases can result in heading the Glider exactly in the opposite direction of the waypoint (see Fig. 3). In this case it is highly recommended to disable the current correction of the Glider.

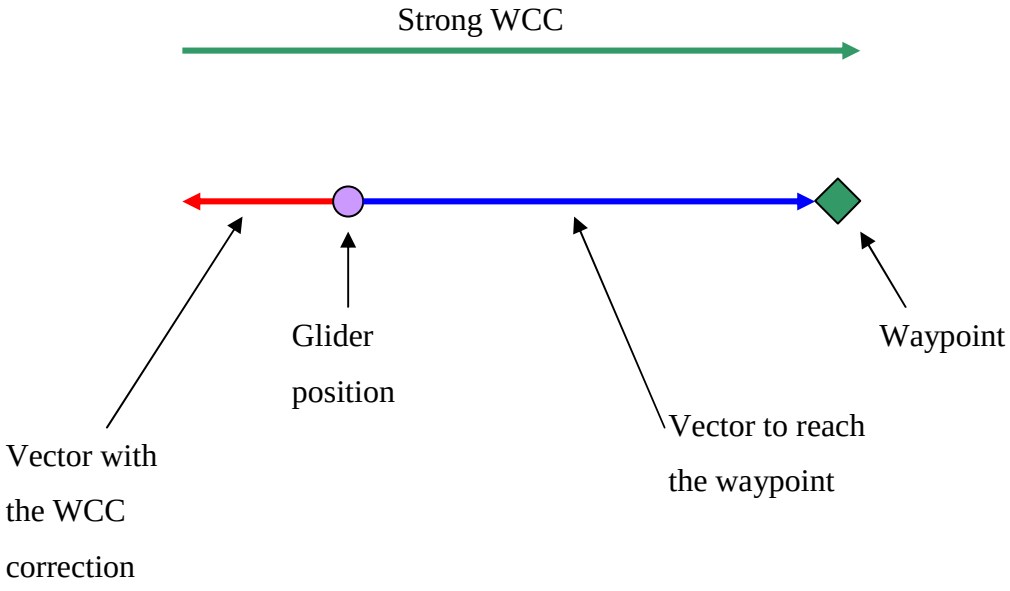

Fig. 3. Failure of the current correction.

The sampling parameters (time interval, depth range, when acquire the data (during the ascent/descent phase or both), …) of each sensor can be defined. Different files (sample_xx.ma) have to be recalled in the mission file. In that case the c_science_all_on_enable must be set 0.

One sensor can also be completely disabled by commenting the corresponding lines in the config/proglets.dat file.

The altimeter is important to set off and on when is needed. If the glider operates in 400 m all the time, the altimeter can set on after 300 m in order to save energy and potential false echoes at thermocline.

IMPORTANT: After 20000 yos the Glider should be sent to the factory for a check/maintenance.

The phone number (primary and/or secondary) can be changed by editing the autoexec.bat file (permanent change) or use the commands put c_iridium_phone_num and/or put c_iridium_phone_num_alt (temporary change).

3. Laboratory/on the field lessons

Fig. 4 represents the right way to weigh a glider in a tank. The knots can be used to adjust the pitch of the glider.

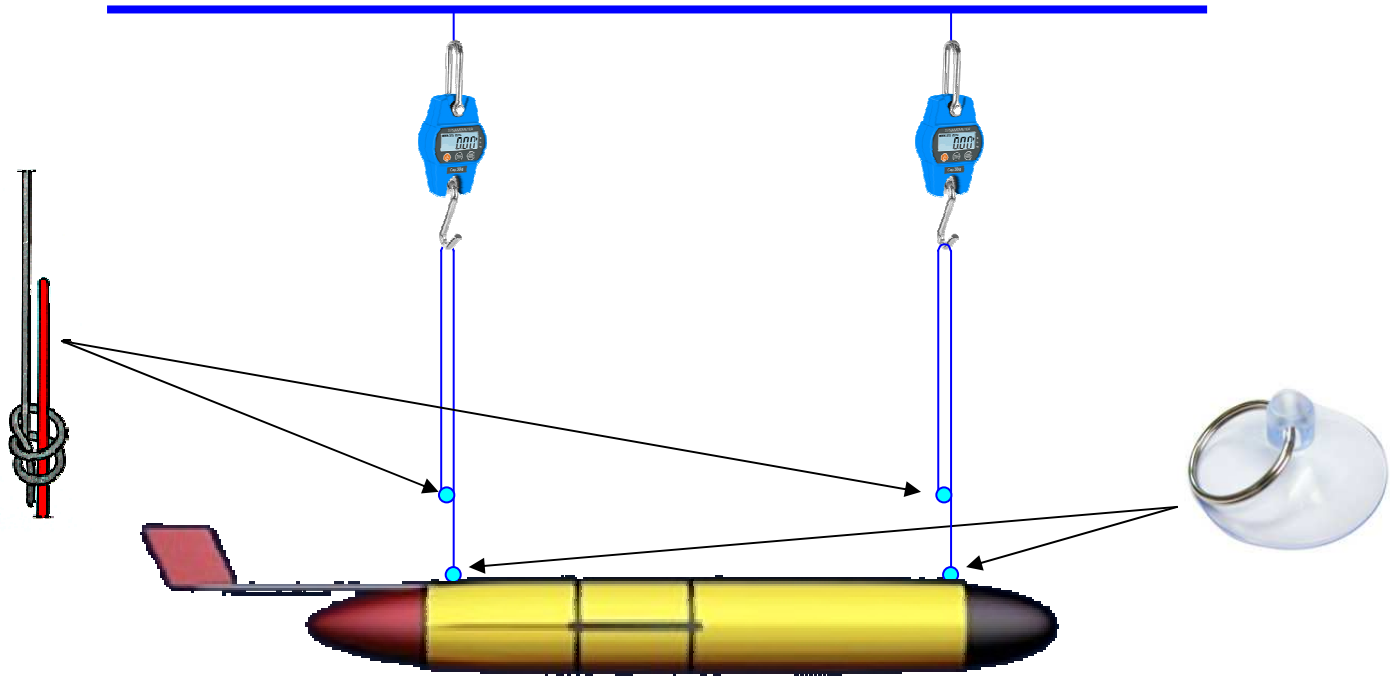

Fig. 4. How to correctly weigh a Glider in a tank.

Fig. 5 shows a simple tools useful to snatch the glider if it sink to the bottom of the tank.

Fig. 5. A grabber easily purchasable on the market.

The H-moment value (Fig. 6, distance between the center of buoyancy CB (that cannot be changed) and the center of mass CM) must be between 5 and 6 mm (4.5 to 6.5 is also ok);.

For the computation it is important to follow the instruction of the excel spreadsheet. In order to change the H-moment of 1 mm, about 400 grams from the bottom to the top of the Glider have to be moved. Higher H value correspond to higher stability. Higher stability causes large consumption of battery.

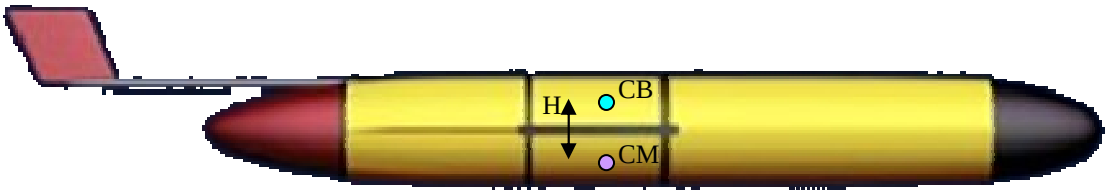

Fig. 6. H-moment of a Slocum Glider.

The total range of the pitch battery is 3 for a Glider equipped with the alkaline batteries and 1.8 for a Glider with the Lithium batteries.

The propeller absorption is from 3 (very low speed) to 30 (max speed) A per day.

4. Glider Terminal useful commands:

- XXX ? (corresponds to the help and provides the information about the command);
- use (gives the list of devices in use/out of order);
- use + gps (gives the status of the gps);
- report ++ m_depth (displays the depth; avoid to use this command during a mission, otherwise the screen will be overfilled by values and the other lines sent by the glider will be very difficult to catch);
- report clearall (stops to display the parameters on the screen);
- Ctrl W (gets the report about the warning recorded during a mission);
- Ctrl E (extends the surface period by 5 minutes);
- Ctrl F (forces the Glider to reload the mission files);
- Alt Q (used in the Glider Terminal to go back to previous command);
- exit pico (communicates directly to the Persistor);
- lab_mode on (enters in laboratory mode);
- ballast (puts the ballast and pitch pump to the zero position and empties the bladder);
- callback xx y (the glider will call you again via iridium after xx minutes calling the primary (0) or secondary (1) phone number (y=0, 1));
- IridCallback (automatic script; the Glider will call you again in 30 minutes (after the words “GPS location” are displayed on the Glider Terminal; this script can be used in the recovery procedure);
- u_use_ctd_depth_for_flying (to use the CTD pressure sensor instead of the navigation one);
- num_legs_to_run (manage the waypoints sequence; IMPORTANT the option -2);
- initial_wpt (-2 = the closest (it is computed considering the minimum distance between the Glider and the middle point of each couple of subsequent waypoints);

form 0 to N-1 = waypoint number (0 corresponds to the first waypoint, N is the number of waypoints));

- num_half_cycle_to_do (number of half yo, this must be always even);
- nth_yo_to_sample (to sample only every x yos);
- loadmission waterclr.mi (to reset the current data);
- max_wpt_distance (to help you if you typed wrong lat and lon);
- sequence mission1(5) mission2 (to load and execute 5 times the mission "mission1" and once "mission2");
- run xxx VS loadmission xxx (run xxx is used with files having a structure of a mission, while loadmission does not need files with such a struscture; i.e. run sci_on.mi cannot work);
- wiggle on (to test the rudder and the ballast/pitch pumps);
- ! [bang] (is used before commands when the Glider is in a mission, i.e. !dockzr *.*, !cd mafiles, …);
- dockzr (to transfer files from the dockserver to the Glider);
- zs (to transfer files from the Glider to the dockserver);
- !dockzr (as above but when the Glider is in a mission);
- !zs (as above but when the Glider is in a mission);
- m_coulomb_tot_ampere (used coulomb of the battery; max 720 for a new battery);
- leak and leak_forward (indicate if there is a leakage; about 0 means that there is water inside the Glider; 2.5 means that the Glider is dry, but if the value is fixed to 2.5, means that the cable of the sensor can be disconnected)

5. References

Slocum G2 Glider Operators Manual P/N 4343, Rev. B January 2012

Slocum G2 Glider Operators Training Guide Revised June 2012