# UDAS User Manual May 2022

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## **General Information**

The mobile UDAS used in MS 202 (Ocean Instrumentation) consists of the UDAS frame, sensors, tubing, a Pelican Case with interfacing cables (wiring), batteries for field work, and a Raspberry Pi. The sensors that are used with the UDAS frame are a GPS unit, Transmissometer (CSTAR, Sea Bird Scientific), Thermosalinograph (SBE45, Sea Bird Scientific), Nitrate Sensor (SUNA V2, Sea Bird Scientific), and a Fluorometer (C3, Turner Designs). All the sensors are stored in the warehouse on Tom Connolly’s Shelves in labeled wooden crates expect for the Fluorometer which is stored in a cardboard box. The UDAS frame, batteries and Pelican case are also stored in the warehouse along with two labeled Rubbermaid tubs containing tubing, hose clamps, and other spare parts for the UDAS system. The Raspberry Pi and GPS unit are stored in the Physical Oceanography Lab.

## **Setting up the Raspberry Pi**

Collect a Raspberry Pi and power adaptor from the Physical Oceanography Lab. These can be found in a box that is usually on the shelves on the south side of the lab (when entering the lab, the wall on your left).

1. Plug the Raspberry Pi into a power supply (in the lab use a wall outlet).
2. Connect the raspberry pi to a computer that has VNC viewer downloaded using an ethernet cable.
   1. Alternatively, download VNC viewer onto a laptop.
3. To use the Raspberry Pi open VNC Viewer and enter the eleven-digit number written on top of the Pi (this is the ethernet address, e.g. 169.254.51.201).
   1. When prompted, enter the username and password for the Pi.
      1. These are all written on the Pi’s.
      2. Typically, username = pi password = kelpforest
4. To turn on the WIFI click on the WIFI symbol in the upper right-hand corner (to the left of the Bluetooth symbol).
   1. Connect to Moss.
   2. \* Note: The Raspberry Pi’s do NOT support the two-factor authentication needed to log into Eduroam (must use Moss or Moss Guest).
   3. Click on the internet symbol (looks like a globe, between the Raspberry Pi and Folders icons) in the top left-hand corner.
   4. In the search bar enter “1.1.1.1” (no quotes).
   5. Scroll down and select “Advance Options” and “Continue to website”.
   6. This will take you to the log in screen.
   7. Enter your credentials.
      1. For Moss use your MLML username and password.
      2. For Moss Guest enter your email address.
   8. The Pi is now connected to the WIFI.
5. To connect the Pi to a computer using over WIFI first connect it to a computer using an ethernet cable as described above.
6. Next, click on the black box in the upper right-hand corner labeled “Va” (to the left of the Bluetooth icon.
   1. Write down the eight or nine-digit number that is displayed there (this number is now associated with the Raspberry Pi for this internet connection). All these numbers start with 10.37.16
      1. E.g., 10.37.16.243
7. Open VNC view on a different laptop.
8. Enter the eight- or nine-digit code beginning with 10.37.16
9. Enter the Pi’s username and password (typically pi and kelpforest).
10. You are now connected to the Raspberry Pi over WIFI. The ethernet cable can be unplugged at this time.

### **Downloading Code to the Raspberry Pi to run the UDAS**

1. Make sure the Raspberry Pi is connected to the internet using the steps above.
2. Open the web browser and navigate to <https://github.com/mlml-instrumentation-2022/udas-test>
3. Download the files “UDAS\_FCNS\_Module.py” and “UDAS\_Master\_Compilation.py”
   1. UDAS\_FCNS\_Module.py contains the functions needed to run all the sensors and the GPS
   2. UDAS\_Master\_Compilation.py calls the functions from UDAS\_FCNS\_Module.py and writes that data to a csv file. See “UDAS\_Master\_Compilation\_JM.py” for ideas as to what we pictured as the next steps. That code has not been tested and likely has bugs.
4. If any sensor needs to be tested individually at any point prior to, or during, set up, individual codes for each sensor can be found at <https://github.com/mlml-instrumentation-2022/udas-test>.

### **Assembling the UDAS**

1. GPS attachment.
   1. The GPS used in 2022 is soldered to wires which gets attached to the serial pins on the Raspberry Pi (see below photos).
      1. Note: The GPS needs troubleshooting. We were unable to acquire accurate data from this sensor in the field. For code to parse the GPS data and begin troubleshooting go to <https://github.com/mlml-instrumentation-2022/udas-test> and download “gps\_parse.py”.
      2. In the field it may be helpful to download a GPS tracking app on your phone as a backup in case the GPS sensor does not acquire data.

A whiteboard with writing on it

Description automatically generated with low confidence

*Figure 7: Schematic Drawing of the pins on the GPS*

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Description automatically generated

*Figure 8: Photo of the GPS attached to the Raspberry Pi*

1. Remove the sensors from their protective storage housing (Transmissometer, Thermosalinograph, Fluorometer, and SUNA).
   1. Attach the flow cells to the Transmissometer and SUNA
      1. These are stored in the cases alongside the sensors.
      2. For the Transmissometer, make sure to follow the directions for the orientation of the flow cell (printed on the flow cell).
      3. The SUNA flow cell comes in four pieces and can be tricky to align. The Easiest way to do this is pass a piece of wire through the middle hole that the water will pass through and then tighten the screws that hold the flow cell together. Remove the wire when done.
   2. The Thermosalinograph (TSG) attaches directly across from the white filter where water first enters the system. Carefully slide the screws through the UDAS frame and the TSG and tighten. Keep the intake port on the bottom and the outport on the top.
   3. The transmissometer attaches next to the TSG. Before attaching, make sure the flow cell is on the transmissometer (Step 1a). The power cord for this instrument will be on top when oriented properly.
   4. The fluorometer attaches to the corner of the frame next to the transmissometer. To attach, wrap two pieces of think black rubber around the fluorometer and tape in place. Then place hose clamps over the rubber tubbing and tighten to secure the fluorometer to the UDAS frame. Use stray pieces of tubing to fill the corner gap between the fluorometer and the UDAS so that the fluorometer is not jostling. The power cord for this instrument will be on top when oriented properly.
   5. Place the SUNA (with the flow cell already attached) on top of the UDAS (see photo below). Use zip ties to attach to the UDAS (there are extra-long zip ties in the shop which are perfect for this). The power cord for this instrument will be next to the fluorometer when oriented properly.
2. Tighten the bolts on top of the filters.
   1. During storage the bolts on top of the degasser are loosed and need to be tightened prior to usage.
3. Attach the tubing.
   1. All tubing is labeled with the sensors it connects to in the form “\_\_\_ to \_\_\_” (e.g. TSG to Transmissometer).
      1. In order, the water flows into the first filter (white), degasser, TSG, Transmissometer, SUNA, and then the fluorometer.
         1. For the fluorometer, the water should enter from the bottom and leave out the side (so that the flow cell can be filled, and the water not immediately run through due to gravity).
   2. The intake piece of tubing is not labeled but is easily identifiable by the wide diameter, and the weighted rectangular grate on one end.
      1. Attach a piece of hosing to the top of the degasser (second filter on the instrument when following the water path). This will prevent pressure buildup and bubble formation.
   3. Use hose clamps to attach all tubing to the nozzles on the filters and the instruments.
      1. Hose clamps can be found in the rubber bins with the hoses, in the Chem and Phys Oceanography Labs, and in the Shop.
   4. Take the assembled UDAS outside and run water through to test that there are no leaks. First, prime the system by filling the white filtration device with water. Then stick the intake pipe into a bucket filled with water. To power the UDAS outside, collect one of the 12 V batteries from the warehouse and attach the jumper cables on the UDAS to it.

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Figure 9: Photo of the fully assembled UDAS. The SUNA is on top. On the left-hand side from nearest to furthest are the TSG, Transmissometer, and Fluorometer.

### **Starting the UDAS**

1. To set up the UDAS on a Boston Whaler you will need some rope, and a grey weighted pole (found in the Chemical Oceanography Lab).
   1. Duct tape the intake hose to the grey pole from the Chemical Oceanography Lab and hang it on one of the cleats on the boat.
   2. Attach another piece of rope to the intake pipe/grey tube and tie that to the bow of the boat.
   3. This will prevent the intake pipe from coming out of the water while driving the boat on transects.
2. Connecting the sensors to power.
   1. Attach the sensors cords to their matching cords in the Pelican case.
   2. Plug the Raspberry Pi into the micro-USB that is connected to a battery inside the case.
   3. Find the cigarette lighter adaptor inside the case and plug that into the cigarette lighter on the boat to power the UDAS. You should here a fan turn on once the system is powered.

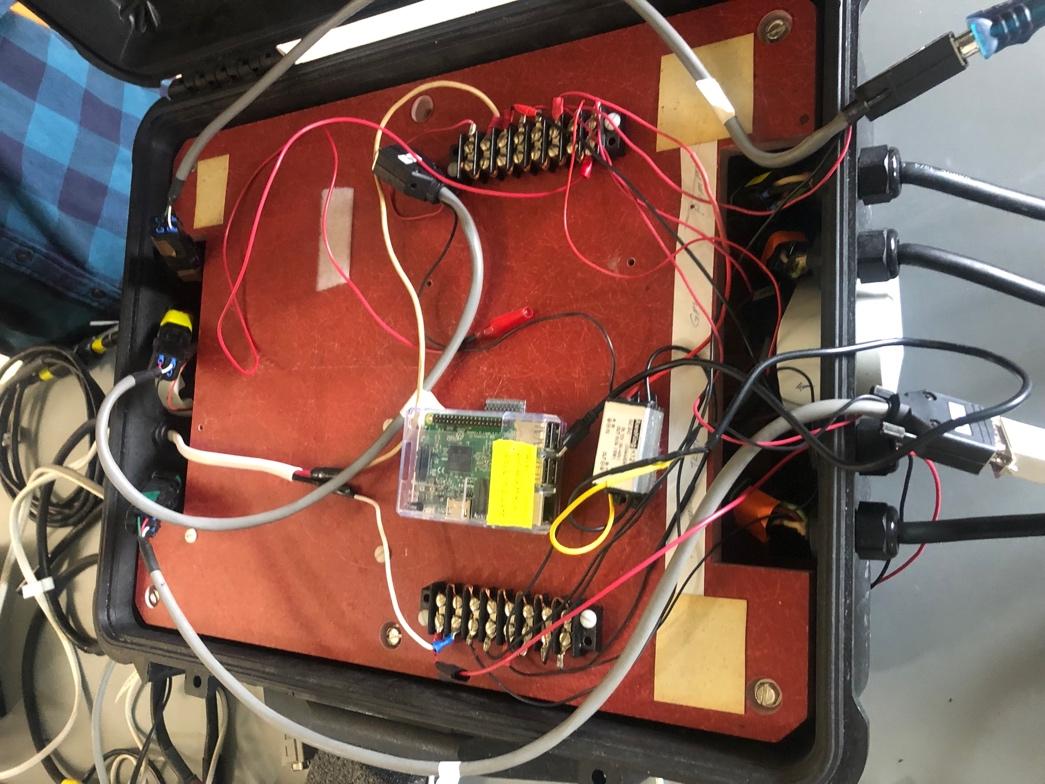


Figure 10: Inside of the pelican case with the Raspberry Pi.

1. To start data acquirement, plug in the sensors one at a time and modify the “UDAS\_Master\_Compilation.py” code so that the line of code defining the USB port occupied by the sensor is correct
   1. E.g. TSG\_port = /dev/tty/USB2
   2. To see what USB ports are being used open the terminal and type “ls/dev/ttyUSB\*”
      1. Do this after plugging in each sensor (one at a time)
      2. Typically, the USB port number starts at 0 for the first item plugged in and increases by one each time (i.e. the first sensor plugged in is plugged into /dev/tty/USB0, the second is /deb/tty/USB1 and so on)
   3. In the future, the code should be modified to have all these statements that need to be modified clustered together.
   4. Note: The GPS pin will always be the same and the code does not need to be modified for it.
2. Start the code.
3. Check to see that all sensors are reading out data. It is helpful to take a laptop into the field for this purpose (attach to the Raspberry Pi using an ethernet cable). If one or more sensors is not reading out data…
   1. Check to see if there is a connection problem along the wires or in the serial to USB adaptor.
   2. Unplug the sensors and re-plug.
   3. We found that some sensors were sensitive to either the USB port (Fluorometer) or the order in which they are plugged in (the TSG would not work when plugged in first/USB0).
   4. The SUNA has an extra piece that attaches to the USB to serial adaptor to flip the orientation of the pins. This is necessary to read data from the SUNA.
4. Prime the white filter and plug the pump into a 12 V battery.
5. You are ready to go into the field.

### **Retrieving Data from the Raspberry Pi and clean up**

1. When you are ready for the UDAS system to stop acquiring data stop the code.
   1. The data can be gotten off the Pi in two ways. First, you can connect the Pi to the internet and upload the data filed csv file to the class google drive. Alternatively, you can plug a flash drive into the Pi and copy the data file onto it.
2. To clean the UDAS system, run fresh water through it for a minimum of two minutes. When disassembling the UDAS for storage, check to see if there is mud in any of the sensors or filters. If so, rinse with freshwater and allow to dry before storing. Also, remove the flow cells from the SUNA and transmissometer prior to storage. For any additionally cleaning guidelines check out the individual sensor manuals.