# GPS FUNDAMENTALS

**Virtual training on the Pacific Islands Protected Area Portal (PIPAP) and Geographic Information Systems (GIS) for improved protected area planning and management in the Solomon Islands**

Bradley Eichelberger

October 19-23, 2020

SPREP
Secretariat of the Pacific Regional Environment Programme

BIOPAMA
From Knowledge to Action for a Protected Planet

IUCN

*This package/collection of training materials constitute an introductory, basic-level training to open source GIS software (QGIS) targeting technical-level government officers. The primary goal of the material is to provide participants with the tools to visualise, map, and collect spatial data for more effective planning and management of protected areas.*

*The materials include a series of presentations, video lectures and step-by-step instructions which were utilised in recent in-country technical trainings successfully carried out for two Pacific island countries, Samoa and Vanuatu and are planned to be used for further country trainings in the Pacific region.*

*The training materials were produced by the Secretariat of the Pacific Regional Environment Programme (SPREP) through assistance from the EU-ACP Biodiversity and Protected Areas Management (BIOPAMA) Programme (www.biopama.org). The contents of these materials are the sole responsibility of SPREP and can in no way be taken to reflect the views of the donors.*

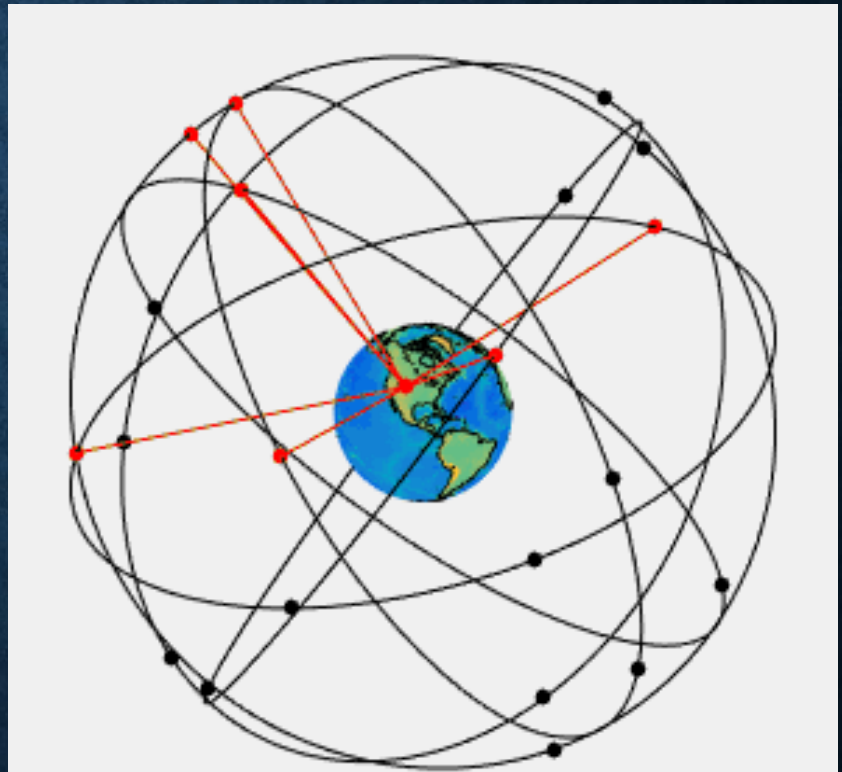
SPREP
Secretariat of the Pacific Regional Environment Programme

BIOPAMA
From Knowledge to Action for a Protected Planet

IUCN

# GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS)

- Series of 18-30 satellites that transmits time and location data through radio waves to a receiver
  - GPS (USA), GLONASS (Russian), Galileo (EU), Navic (India), BeiDou (China)
- At least 4 satellites required for geolocation
  - 3 possible if at sea level
- Currently, 24 satellites in operation for GPS
- Receiver picks up signal
  - More satellites = less error
  - Garmin units +/- 3 meters
  - Units with high receiver +/- few centimeters




Garmin GPS
+/- 3 meters


Phone
+/- 10 meters
Garmin GPS
+/- 3 meters

# AVERAGING

| Time | X | Y |
|---|---|---|

- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording

# AVERAGING

| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |

- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording

# AVERAGING

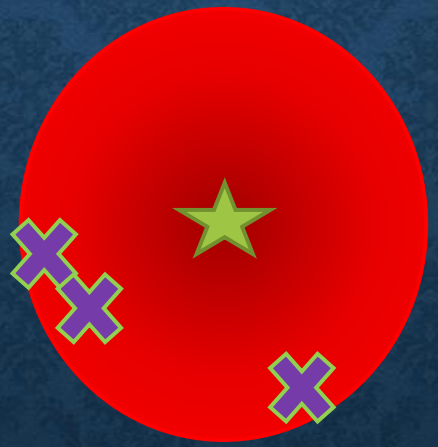
| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |

- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording

# AVERAGING

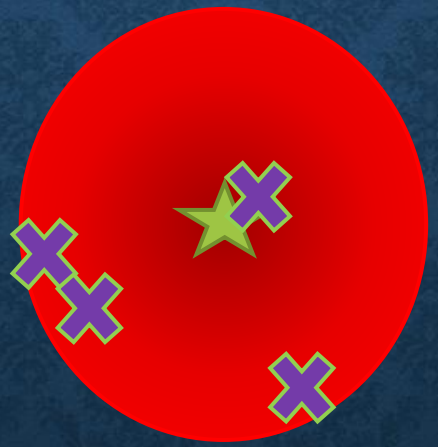
| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |

- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



# AVERAGING

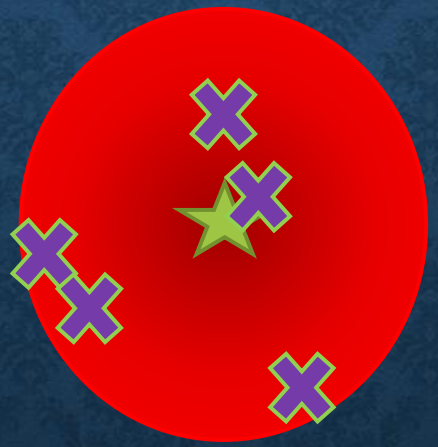
- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |

# AVERAGING

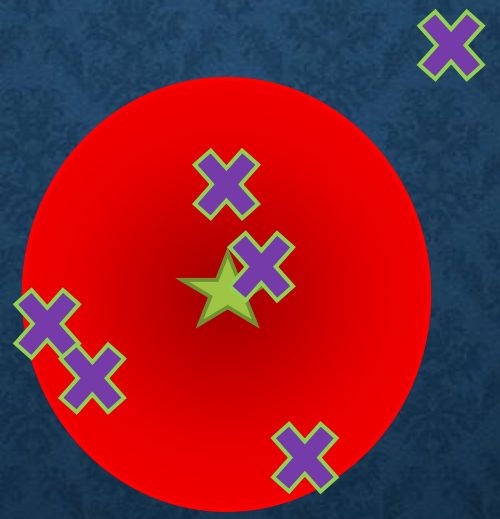
- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |

# AVERAGING

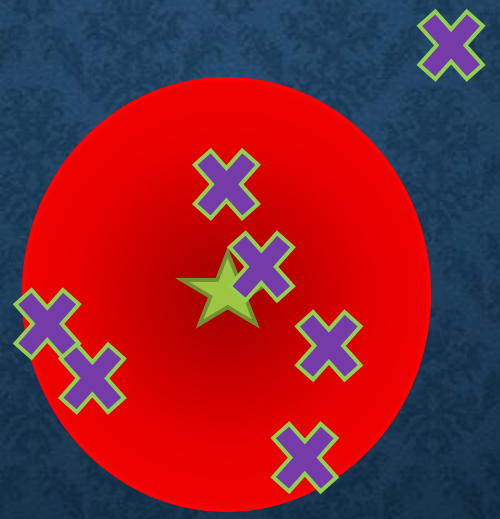
- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |
| 10:00:19 | 105.0 | 105.0 |

# AVERAGING

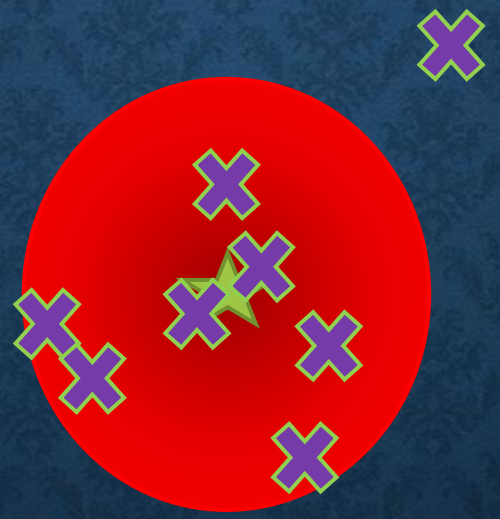
- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |
| 10:00:19 | 105.0 | 105.0 |
| 10:00:20 | 99.0 | 101.5 |

# AVERAGING

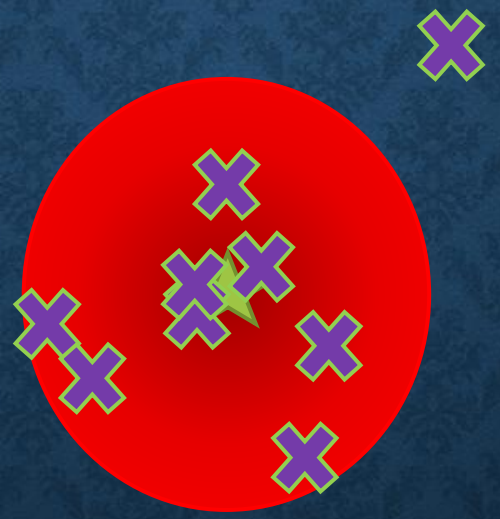
- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |
| 10:00:19 | 105.0 | 105.0 |
| 10:00:20 | 99.0 | 101.5 |
| 10:00:21 | 99.5 | 99.5 |

# AVERAGING

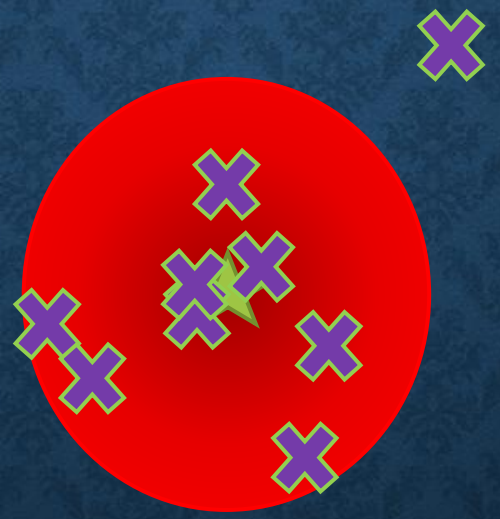
- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |
| 10:00:19 | 105.0 | 105.0 |
| 10:00:20 | 99.0 | 101.5 |
| 10:00:21 | 99.5 | 99.5 |
| 10:00:22 | 100.0 | 99.5 |

# AVERAGING

- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording

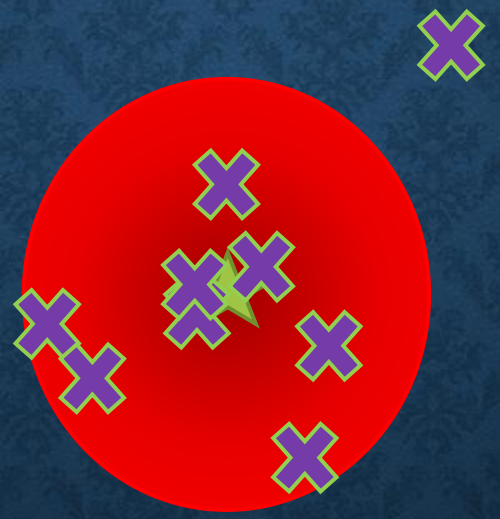


| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |
| 10:00:19 | 105.0 | 105.0 |
| 10:00:20 | 99.0 | 101.5 |
| 10:00:21 | 99.5 | 99.5 |
| 10:00:22 | 100.0 | 99.5 |

**HOW DO WE KNOW WHICH OF THESE IS THE CLOSEST?**

# AVERAGING

- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



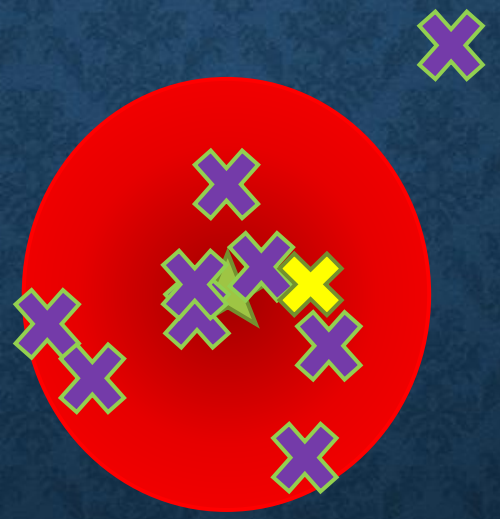
| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 97.5 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |
| 10:00:19 | 105.0 | 105.0 |
| 10:00:20 | 99.0 | 101.5 |
| 10:00:21 | 99.5 | 99.5 |
| 10:00:22 | 100.0 | 99.5 |

**HOW DO WE KNOW WHICH OF THESE IS THE CLOSEST?**

**WE DON'T KNOW**

# AVERAGING

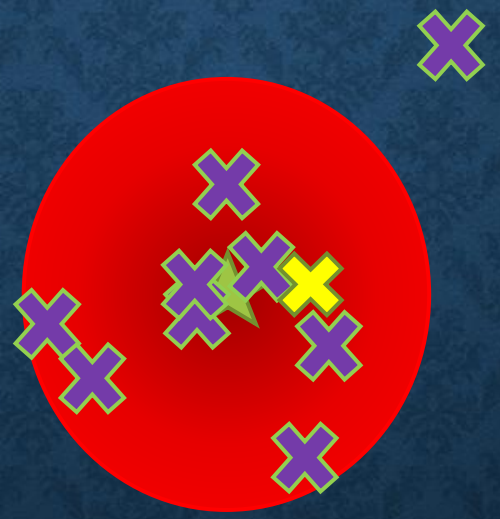
- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 111.0 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |
| 10:00:19 | 105.0 | 105.0 |
| 10:00:20 | 99.0 | 101.5 |
| 10:00:21 | 99.5 | 99.5 |
| 10:00:22 | 100.0 | 99.5 |
| Average | 101.4 | 100.3 |

# AVERAGING

- Error from bounce of trees, other structures, bad angles from satellites
- Star = Actual Location (100, 100)
- Red Circle = uncertainty +/- 3 meters
- Purple X's = GPS recording



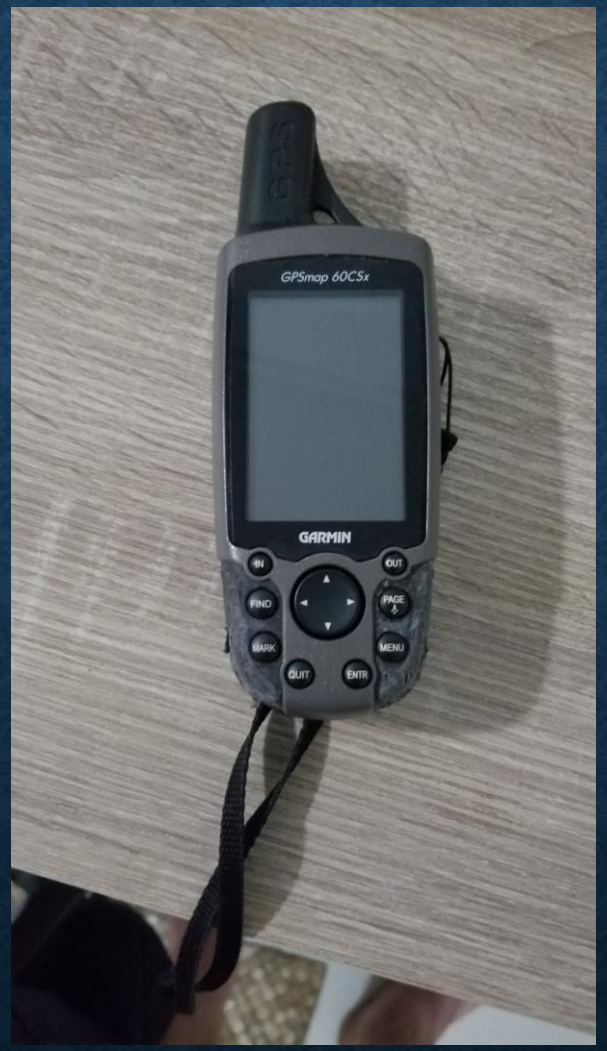
| Time | X | Y |
|---|---|---|
| 10:00:14 | 97.2 | 99.9 |
| 10:00:15 | 100.8 | 97.4 |
| 10:00:16 | 111.0 | 98.5 |
| 10:00:17 | 100.3 | 100.2 |
| 10:00:18 | 100.0 | 101.5 |
| 10:00:19 | 105.0 | 105.0 |
| 10:00:20 | 99.0 | 101.5 |
| 10:00:21 | 99.5 | 99.5 |
| 10:00:22 | 100.0 | 99.5 |
| Average | 101.4 | 100.3 |

**THE LONGER WE LET THE GPS AVERAGE POINTS, THE MORE POINTS ARE AVERAGED AND THE MORE POINTS WE AVERAGE THE LESS CHANCE OF ERROR!!!!**

# TODAY'S ASSIGNMENT

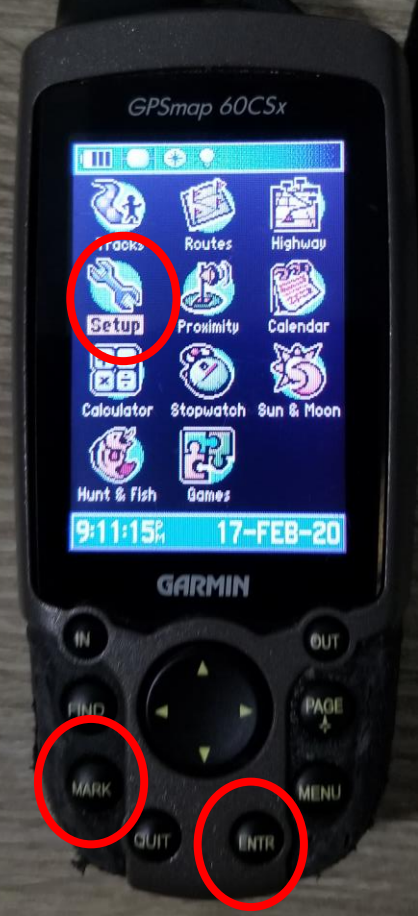
- Collect GPS data for the boundaries of a protected area or nearby building
- Record the GPS Coordinates from first point and then the averaged coordinates
- Log the averaged point as waypoints
- Name the waypoints after your first name
- Enter in the coordinates into a table
- Use Basecamp to export GPX file
- Import GPX file in QGIS
- Add the table coordinates into QGIS and turn them into points
- From the points, we are going to connect the points to draw a polygon
- Make a map of the protected area boundary
- Enter in the metadata for the new polygon shapefile

# GARMIN UNITS

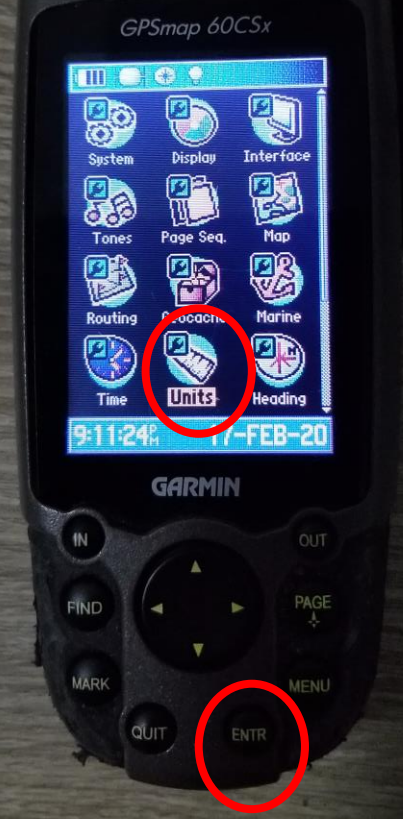


First We Need to
set the Coordinate System


Click Menu button
Then Select Setup
Then Enter

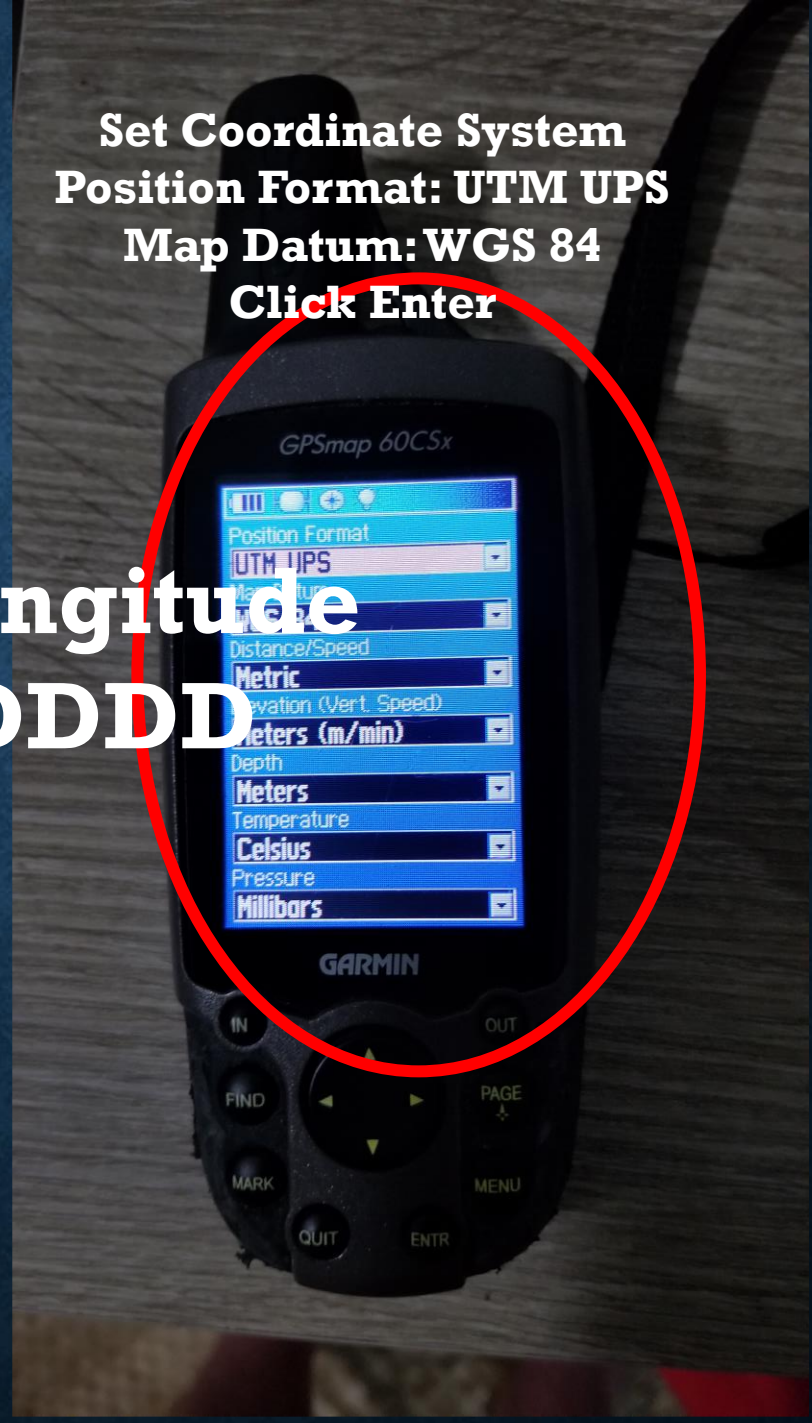



Select Units
And Click Enter

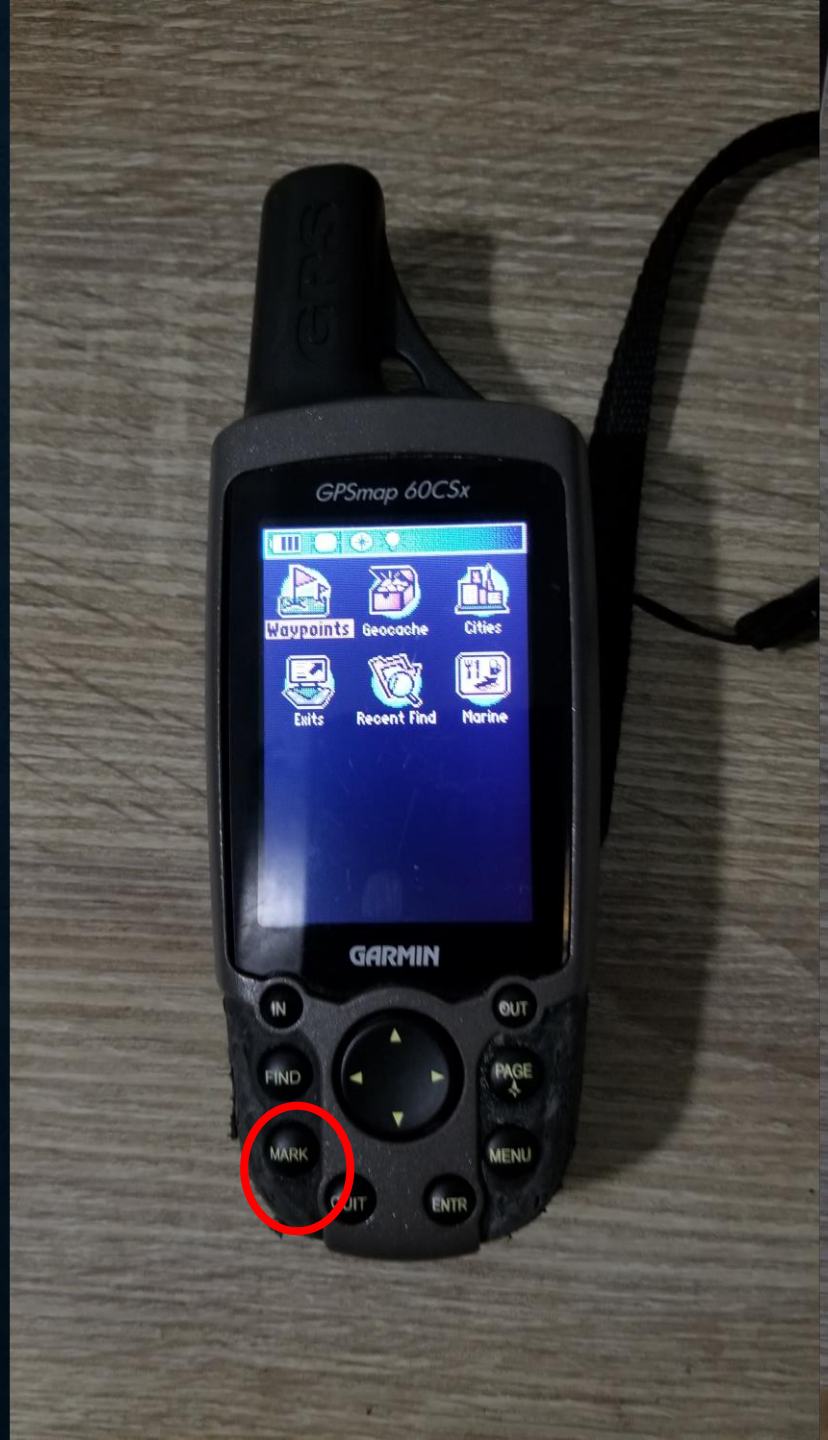


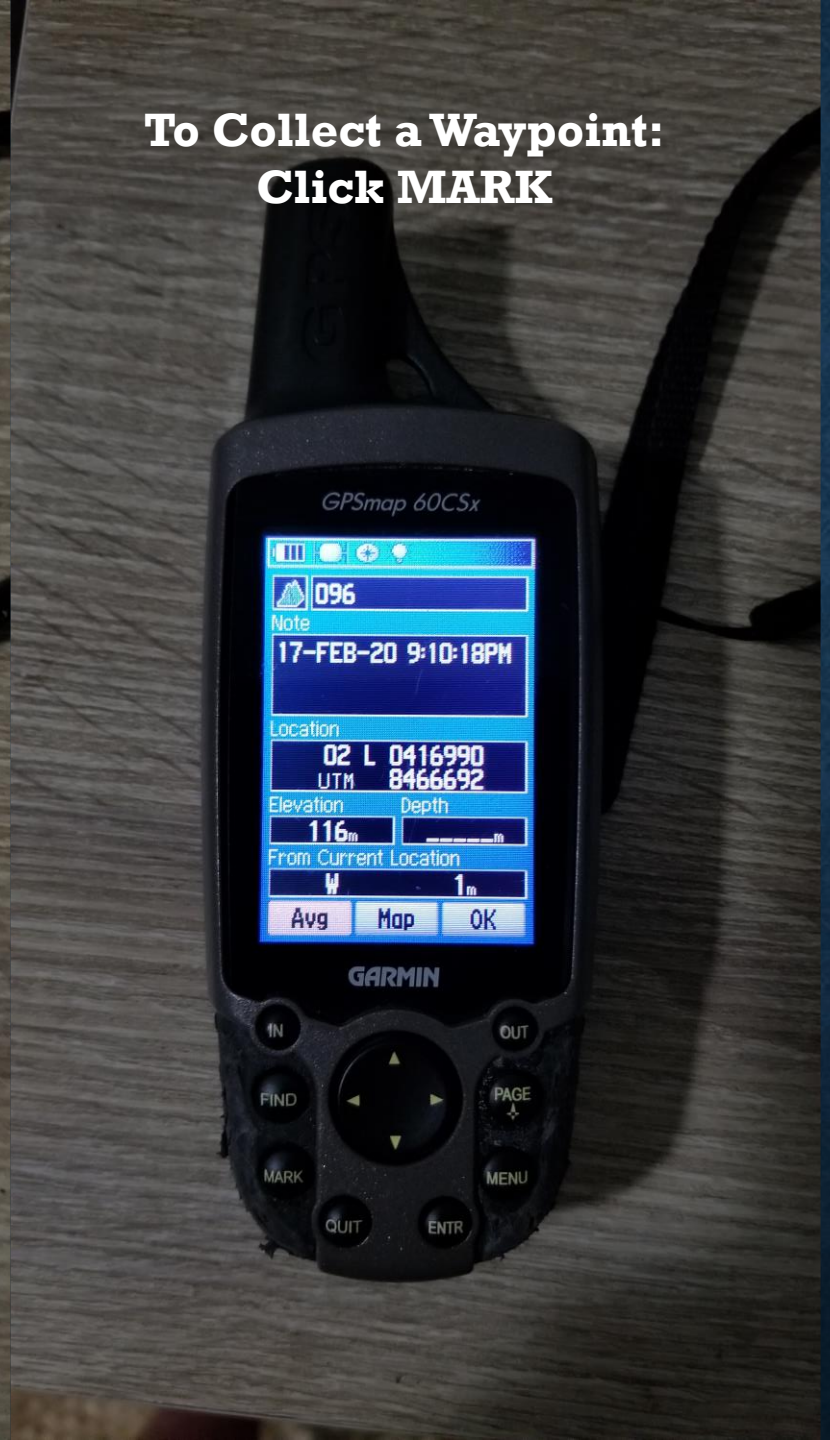

# Latitude/Longitude
# HDDD.DDDDD

**Set Coordinate System**
**Position Format: UTM UPS**
**Map Datum: WGS 84**
**Click Enter**



# To Collect a Waypoint:
# Click MARK

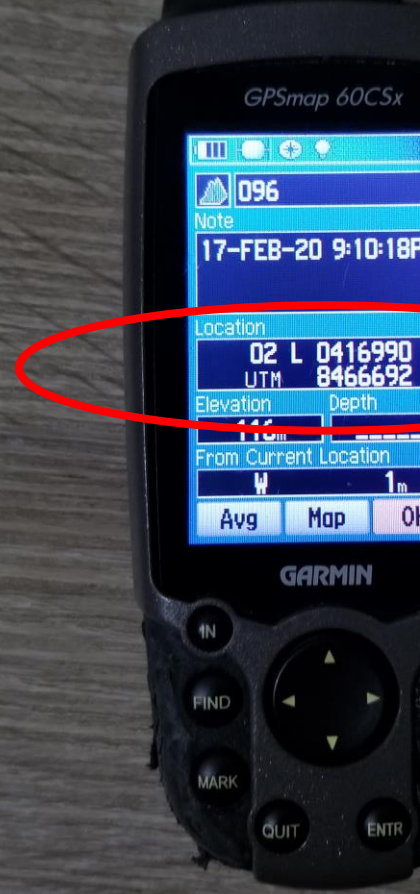


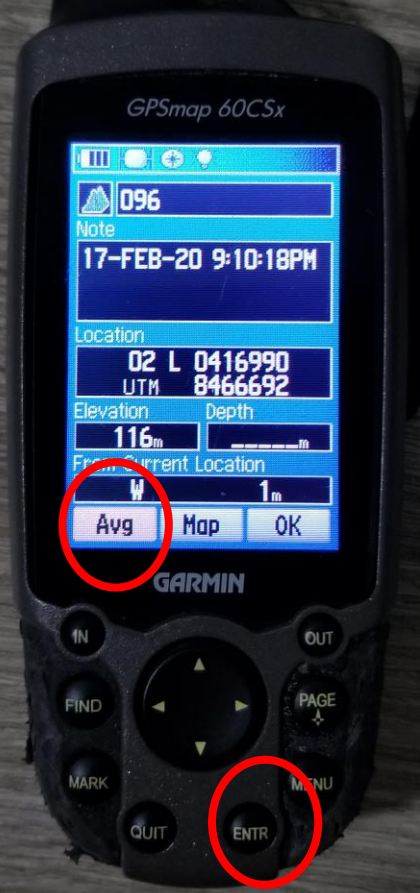
Use the Directional Pad
to go to the Name and
Click ENTER
to change name


Use the Directional Pad
to go to the Note and
Click ENTER
to add notes

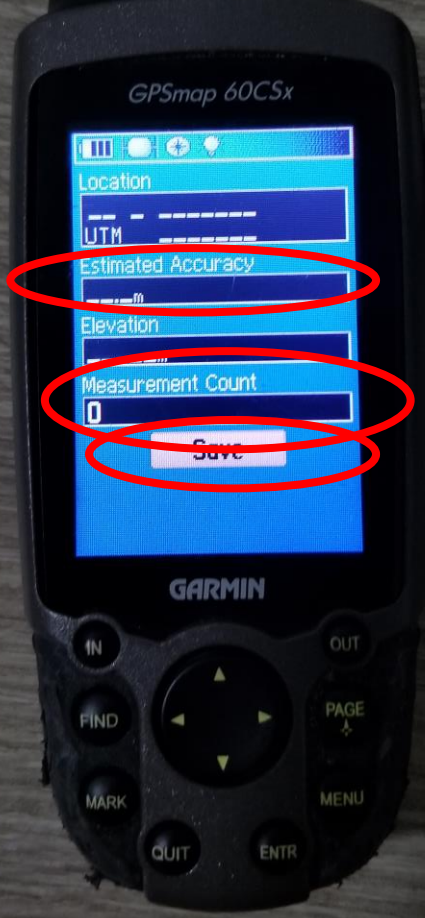

Coordinates WITHOUT
Averaging
Write the Name of Waypoint
And Unaveraged Coordinates down



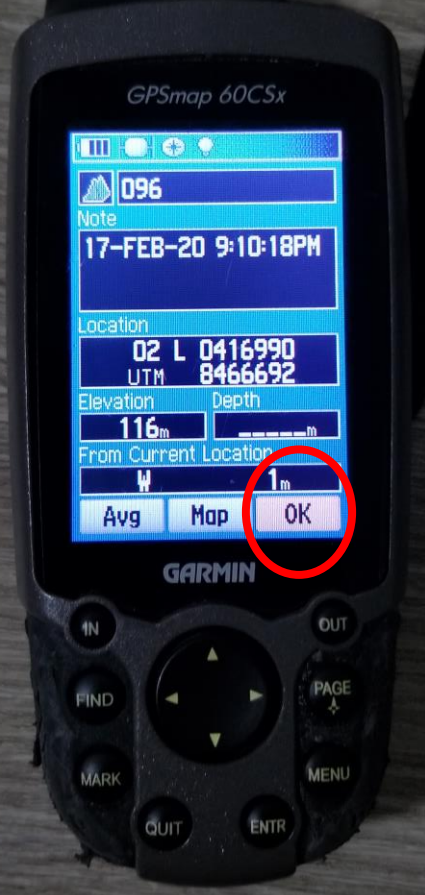
To AVERAGE, use
directional pad
to go to AVG
And click ENTR

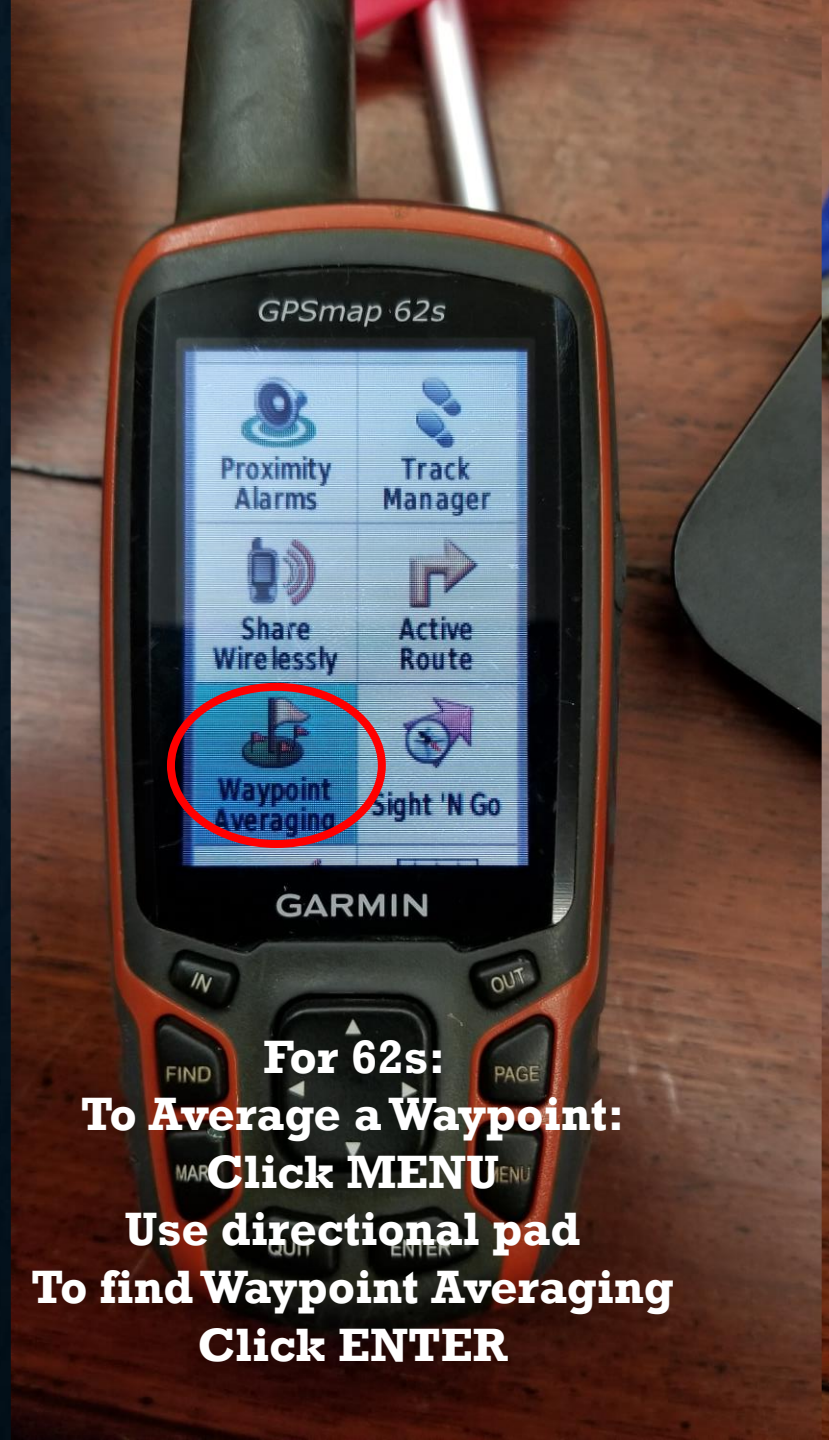



Wait for
measurement count
to get to 40
and observe estimated accuracy
when at 40 click Save

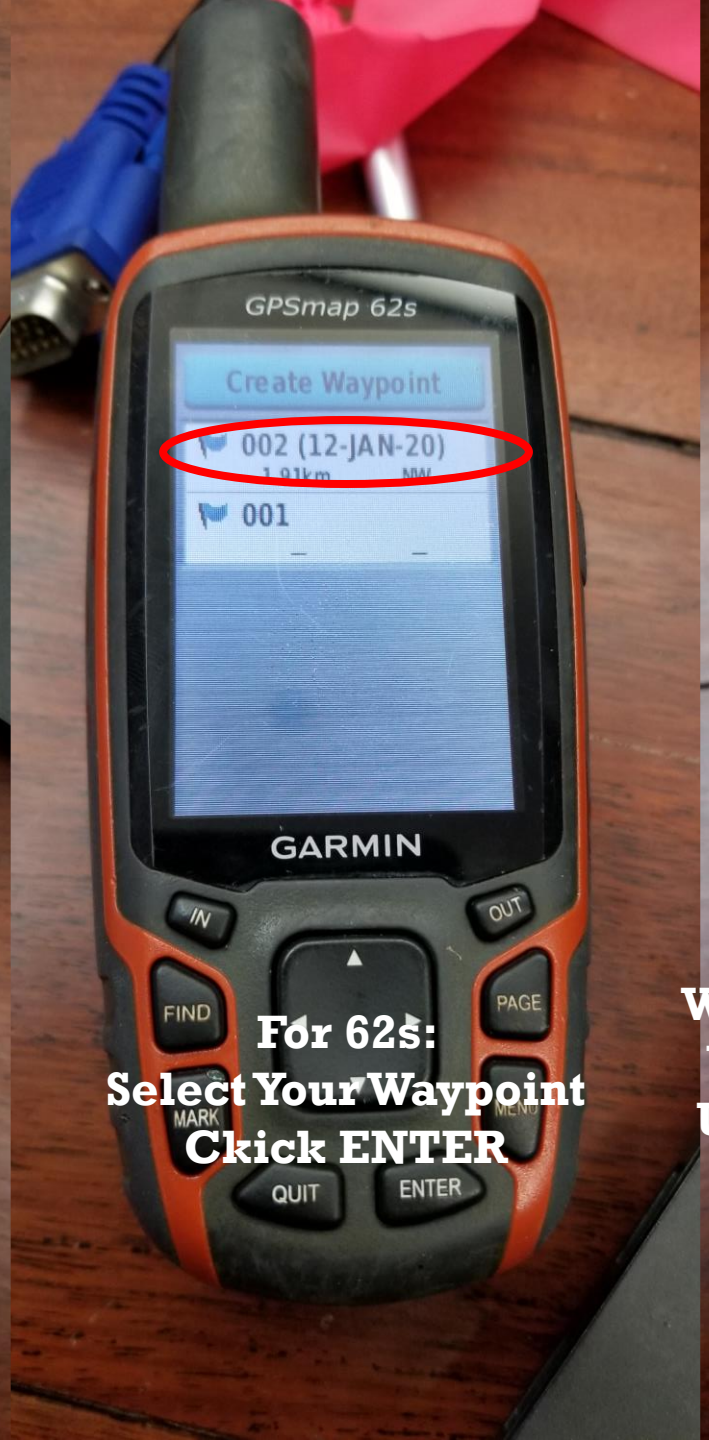



Coordinates will
be updated with
averaged coordinates
Write down the coordinates
Click OK to save waypoint

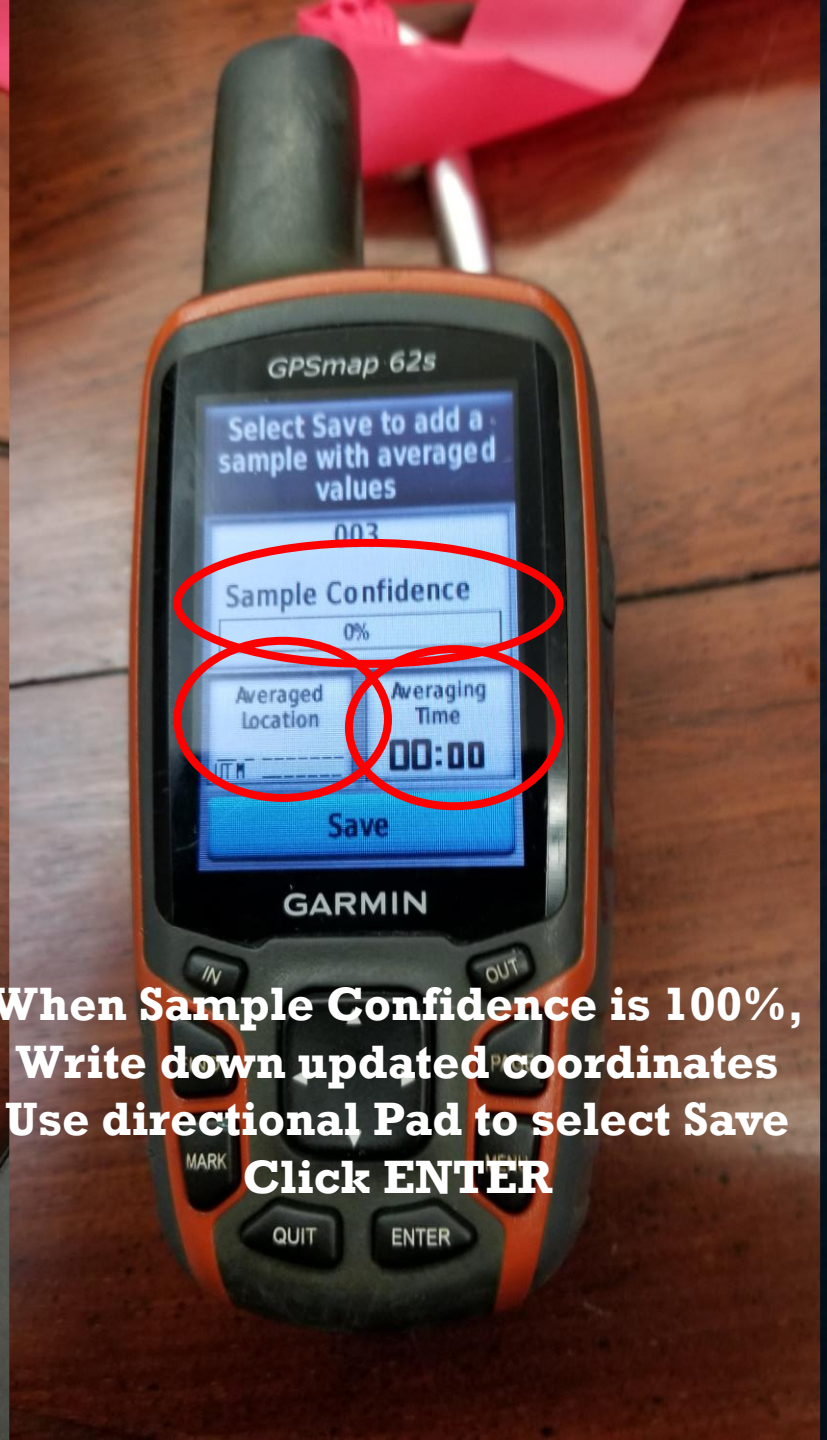





For 62s:
To Average a Waypoint:
Click MENU
Use directional pad
To find Waypoint Averaging
Click ENTER




For 62s:
Select Your Waypoint
Ckick ENTER




When Sample Confidence is 100%,
Write down updated coordinates
Use directional Pad to select Save
Click ENTER