



Procedure MEROP - AAs

GENERAL INFORMATION

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	Last edited on	14-10-2023

AAs PROCEDURES:

Software redeployment to be executed before the first run of the mission and as per request from the MSC:

- **G - SYSTEM RE-DEPLOYMENT**, deploy on the MEROP laptop the latest version of the teleoperation User Interface

To execute an experimental run:

- **A - SETUP MEROP HARDWARE**, prepare all hardware necessary for the run
- **B - START AND TEST THE TELEOPERATION SYSTEM**, turn ON the laptop, retrieve the ROIs files (from MSC server) and test the controllability of the SAMPLE rover (Mercator)
- **C - EXPERIMENT RUN**, start data recording and experiment execution (including think aloud)

After the experimental run:

- **D - END OF EXPERIMENT RUN**, stop all recordings and answer post-task questionnaire
- **E - EXPORT AND UPLOAD DATA FROM THE DAILY RUNS**, export daily data to an external SSD and upload the data to MSC (for the exploration cascade)
- **F - PACKING HARDWARE**, store safely all hardware

NOTES FOR AAs

- Traction glove is not used for experimental runs

REQUIREMENTS (FROM THE MSC SERVER):

You can collect files from the MSC data transfer server using the MEROP SSD (inside experiment case)

- Goals defined by the MSC for the run:
 - MEROP_ROIS.csv
 - MEROP_Paths.csv
- If UI redeployment is requested:
 - MEROP_UI_version_<X>.zip

SHORT EXPERIMENT DESCRIPTION AND GENERAL INSTRUCTIONS:

During the experiment run, the main goal of the AA is to contribute to the exploration cascade by identifying Points of Interest (POIs). For this, the AAs will receive, via the MSC data transfer computer, a file defining the Regions of Interest (ROIs) to explore, in green, and safe paths from the habitat to the ROIs, in blue. These will then be displayed in the MEROP interface (map and image augmentation) as illustrated in the Figure:

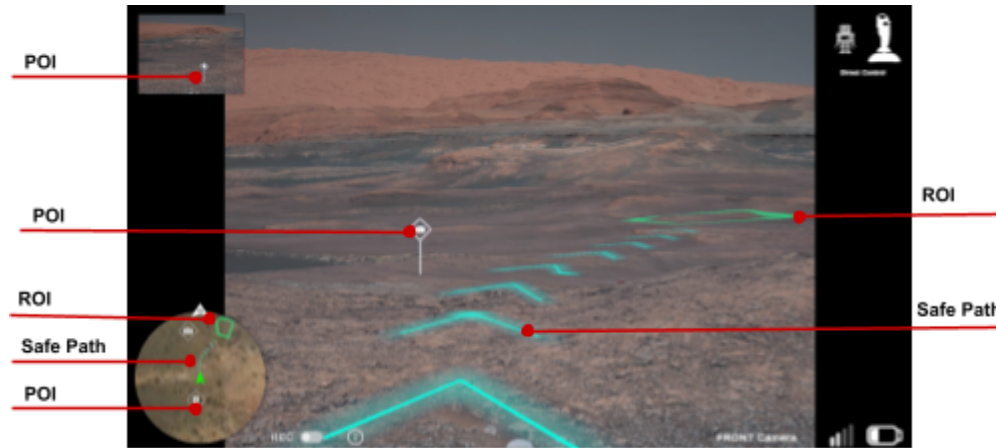


Fig. 1 GUI overview and expected outcome when the laptop is connected to the rover.

AAs should make geo-tagged annotations (POIs in the Figure above) that identify POIs for upcoming EVAs or other geological experiments. Additionally, these annotations will also serve a post-task debriefing purpose. Meaning that AAs can also use these to convey insights from the field to MSC through geo-tagged photos and/or text. For example, POI outside of the defined ROI, potentially dangerous areas, or anything else the AA finds relevant to report. These annotations are created using the illustrated radial menu:



Fig. 2. Annotation menu

At the end of the run, the AAs should export (zip) the generated annotations (GIS format), and upload them to the MSC data transfer server. The output of the experiment will be some similar to the following Figure:

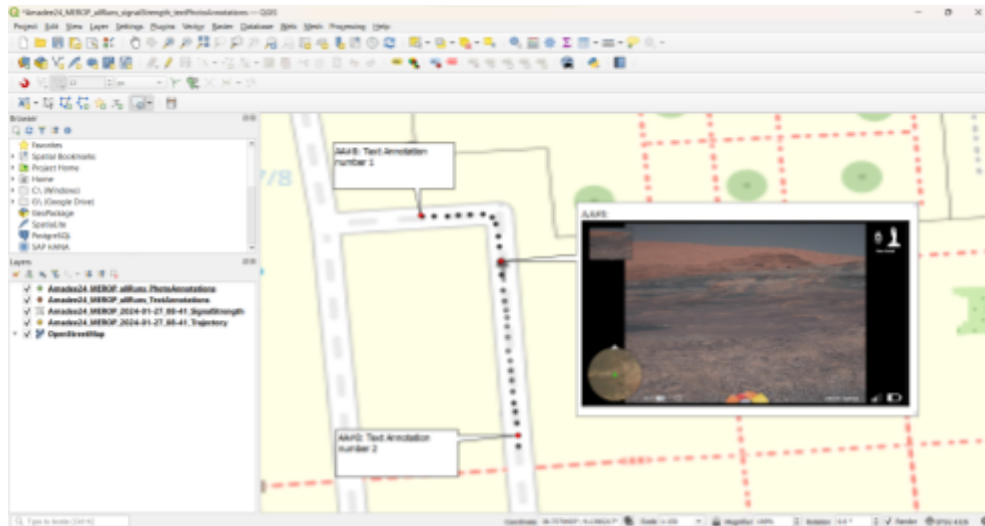


Fig. 3. QGIS project after run: expected output includes trajectory of the rover (points), signal strength (gradient of the points), text and image geotagged annotations.

AAs EXPERIMENT NUMBERS:

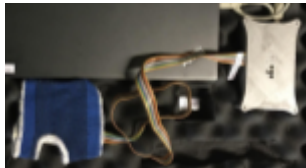
When asked for an AA number, use the standard numbering given to you by the MSC for all experiments. If this is not available, use the following numbering:

AA Name	Participant Number
Anika Mehlis	1
Robert Wild	2
Thomas Wijnen	3
Carmen Köhler	4
Simone Paternostro	5
Iñigo Muñoz	6

HARDWARE CHECKLIST

PeliCase Containing:

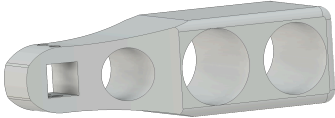


Laptop	
SSD + USB-C cable - use this one to store data (e.g. camera recordings) and transfer data from the MEROP laptop to the MSC server data transfer.	
3 power bricks - laptop, attitude device, and camera	
Joystick	
Attitude device	
1 Traction Glove	
Ethernet cable	

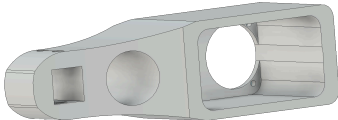
Video Camera



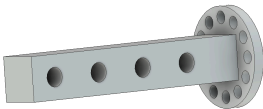
Replacement Motor Prong



Replacement Bearing Prong



Replacement Motor Axle

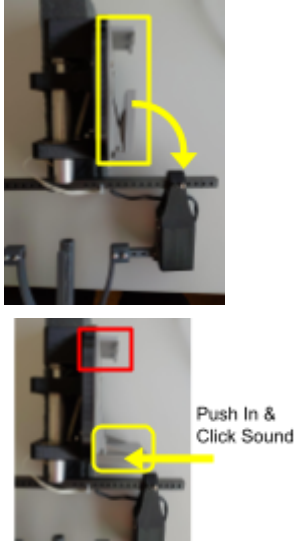


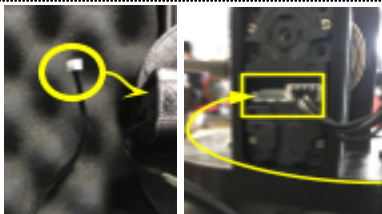
Procedures

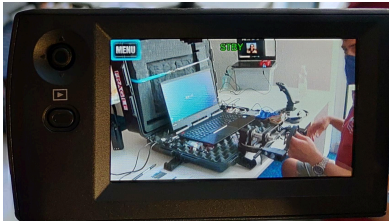
A - SETUP MEROP HARDWARE

Step	Action	NOTES	Duration	Check
A.1.	Request to the GOST team: "Prepare the SAMPLE rover (Mercator) for the MEROP run"	- GOST performs " A - SETUP SAMPLE SYSTEM FOR TELEOPERATION" procedures.		
A.2	Place the CASE on the table	CAUTION Pay attention to markings on the case indicating the "UP" and "DOWN" positioning. Once opened, the laptop inside the case should be in a horizontal position. 	2 s	
A.3.	Open case all 4 case latches: 1. press the buttons (red point in images) on latch 2. open the latch (yellow).	 <i>On the front-side of the case</i>  <i>On each side of the case</i> CAUTION Top lid will topple backwards slightly, but won't fall.	5 s	

A.4.	Get the two <i>BACK SUPPORT</i> pieces and place them on the back of the case (see pictures) (continues next page)		10 s	
A.5.	Open the lead of the case (see Figure)		2 s	
A.6.	Unhook the safety strap (red), and remove the equipment from the case: From “FOAM 2”: ☐ LAPTOP POWER BRICK ☐ ATTITUDE DEVICE POWER BRICK ☐ JOYSTICK Fom “FOAM 3”: ☐ ATTITUDE DEVICE ☐ VIDEO CAMERA		2 min	

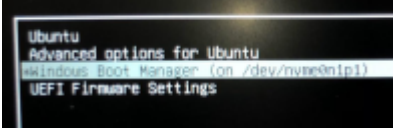
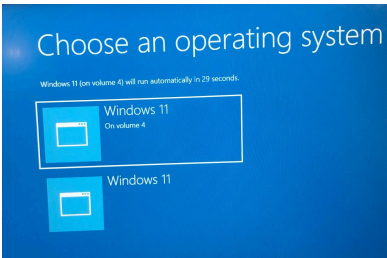
	☐ CAMERA POWER BRICK ☐ ETHERNET CABLE			
A.7.	Place "FOAM 1" and "FOAM 2" back in the case and close the safety strap		30 s	
A.8.	LAPTOP → ← LAPTOP POWER BRICK → ← Power Outlet		10 s	
A.9.	JOYSTICK → ← LAPTOP	Note: All USB connections have a number on the cable and on the corresponding laptop USB Port	5 s	
A.10.	Ops LAN → ← ETHERNET CABLE → ← LAPTOP	Note: If no OPS LAN port is available (i.e., ethernet port near the desk), you can use Wifi connection to operate the rover (connect to Polares Network)	15 s	
A.11	Open and lock (click sound) the support latch (yellow) of the ATTITUDE DEVICE	 Note: Afterwards, check if the latch is not loose.	5 s	
A.12.	ATTITUDE DEVICE → ← CASE - use the red sticker on the case as guide for attachment	 Note: When attaching the device make sure to first apply an	1 min	

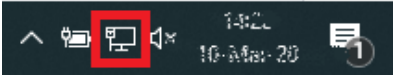
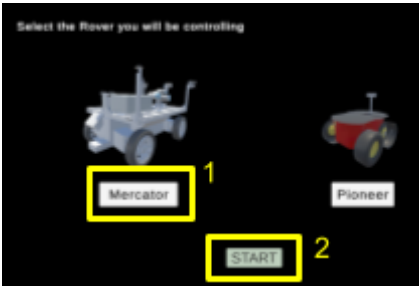
		<i>inwards force until the attachment goes inside the case, following it with a downwards force to ensure that the device is correctly mounted.</i> <i>To test stability apply a downwards force at the end of the shaft</i> CAUTION Ensure that the device outer part (green rectangle) is outside the table and can move freely without touching the table - manually rotate it to confirm		
A.13	COMMUNICATION CABLE → ← ATTITUDE DEVICE		5 s	
A.14	ATTITUDE DEVICE USB → ← LAPTOP		5 s	
A.15	ATTITUDE DEVICE POWER CABLE → ← ATTITUDE POWER BRICK → ← Power Outlet	Note: all device connections are numbered, e.g., female connector numbered “1” should be attached to a male connector numbered “1”	10 s	
A.16	Retrieve OeWF camera tripod assigned to this experiment.	NOTE: If a tripod is not available, skip all steps related the camera recording	2 min	
A.17	VIDEO CAMERA → ← Tripod		5s	

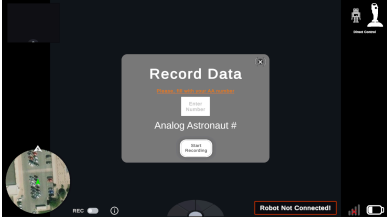
A.18	Position the Tripod to the back and left of the hardware setup (see the photo as example)		10s	
A.19	Electric Outlet → ← VIDEO CAMERA POWER BRICK → ← VIDEO CAMERA	 	30 s	
A.20	Open the Lens Cover (image)		5 s	
A.21	Open Camera Screen	 - it takes ~2 seconds to turn ON	5 s	
A.22	Adjust the video camera angle to get the full view of the equipment setup and a clear view of the laptop screen.	 Note: All elements of the operator control unit must be	10s	

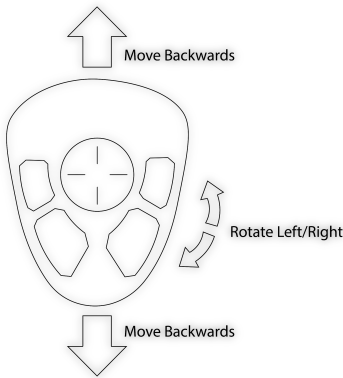
		visible (laptop screen, joystick, and if setup the attitude device).		
A.23	Go to "C - Set-Up Teleoperation System" procedure.			

B - START AND TEST THE TELEOPERATION SYSTEM

Step	Action	NOTES	Duration	Check
B.1.	✓ that "A - SETUP MEROP HARDWARE" was completed.			
B.2.	Request to the GOST team: "Prepare the SAMPLE rover (Mercator) for the MEROP run"	- GOST performs "A - SETUP SAMPLE SYSTEM FOR TELEOPERATION " procedures.	5 s	
B.3.	Turn ON the <i>LAPTOP</i> by <i>pressing the power button on the LAPTOP</i>		1 s	
B.4.	Select "Windows Boot Manager" on the operating system (OS) menu (see figure)	 Attention: there's a 5 second automatic selection of "Ubuntu", use the arrows and enter to select If the "Ubuntu" is automatically selected restart the Laptop and select "Windows Boot Manager" on the OS menu  - When shown this menu, press "Enter"	2 min	
B.5.	If asked, login as "Astronaut" user.		5 s	
B.6.	✓ that the laptop is connected to the charger - if not, redo step A.7.		5 s	

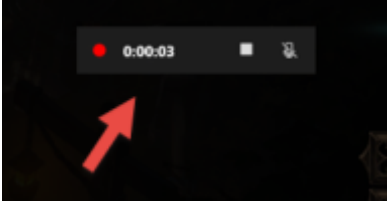
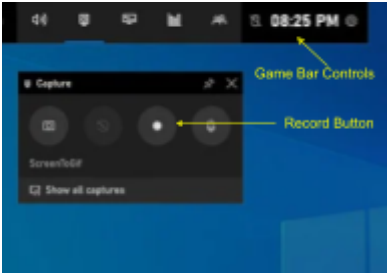
B.7.	✓ that LAN or Wi-Fi connection is active (see picture).		5 s	
B.8.	Collect the “MEROP_ROIs.csv” and “MEROP_Paths.csv” from MSC data server using SSD		2 min	
B.9	SSD → ← LAPTOP		5 s	
B.10	Copy the MEROP_ROI file to the laptop	File should be copied to folder “place_ROI_csv_here” in the Desktop If there’s any file already there, delete it before copying the new one	30 s	
B.11	Copy the MEROP_Path file to the laptop	File should be copied to folder “place_Road_csv_here” in the Desktop If there’s any file already there, delete it before copying the new one	30 s	
B.12	Wait for the GOSTs to inform you: “The rover is ready to start the experimental run.”		1-10 min	
B.13	Double click on the operator control application icon on the Desktop (see picture),		5 s	
B.14	Select the Mercator robot		5 s	
B.15	Wait for the rover camera feeds to appear (~30 sec) on the screen and the indicator on the bottom right to say the “rover is connected”.	Expected interface display when Disconnected :	15 s	

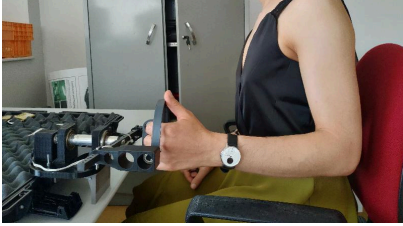
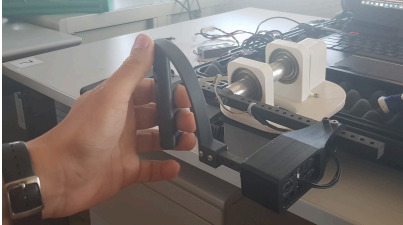
		 Expected interface display when Connected:  expected Map view:  - satellite image of the area - ROI - polygon in green - Safe Paths - series of arrows in blue		
B.16	Inform GOSTs: “AA is ready to start the MEROP experiment run”		5 s	
B.17	Wait for the GOSTs to inform you: “The rover is ready to start driving”		5 s	

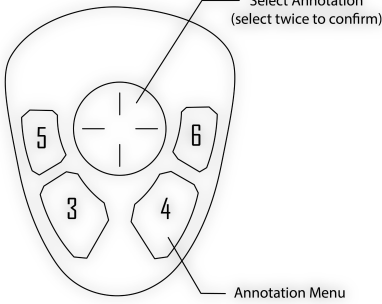
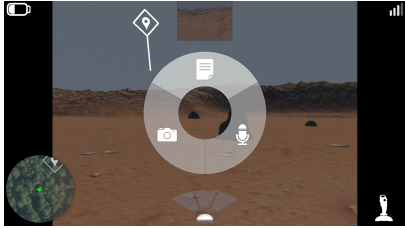
B.18	✓ that the joystick input is moving the rover	 1. You can do this by moving the joystick in any direction (while pressing the thumb or indicator button) and ✓ the corresponding visual feedback on the screen  2. If needed, the joystick mapping is available in the interface by clicking on the help button with the laptop's cursor	1 min	
B.19	↓ “T” key on the Keyboard to start verification of the haptic devices	CAUTION keep a safe distance from the Attitude Device; it will move abruptly	5 s	
B.20	✓ that the attitude device moves. - If the attitude device does not move: - ✓ the cable connections of the device: Steps A.13- A.15	If, after redoing the cable connections, the device does not move, continue the task and report this to the MSC	30 s	
B.21	Go to “C - Experiment Run” procedures			

C - EXPERIMENT RUN

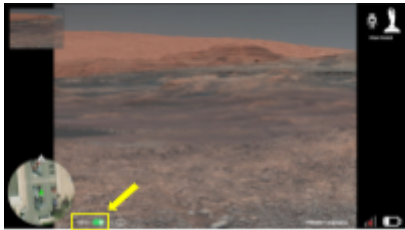
Step	Action	NOTES	Duration	Check
C.1.	✓ that “E - Set-Up Teleoperation System” procedure (steps E.1. to E.8.) was completed.			

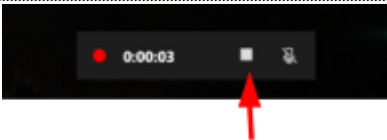
C.2.	↓ the camera's button (see picture) to initiate recording.		5 s	
C.3.	√ that red "REC" is displayed in the screen: - if "REC" is not displayed, repeat step F.3.		5 s	
C.4	Start screen and audio recording	Shortcut on the keyboard: 1. Windows logo key+Alt+R  If there is no confirmation of recording: 1. Press Windows logo key+G (displays the Xbox Game Bar controls.) 2. Select the screen record button  Note: - This step records the screen and audio of the out-loud reporting. - the "REC" button on the interface records the GIS layers, questionnaire and the onboard rover telemetry	1 min	

C.5.	Sit on the chair, adjust the chair height so to have your left arm in a relaxed and natural position when grabbing the attitude device (see picture).		15 s	
C.6.	On the participant number textbox, insert your AA number:		5 s	
C.7.	Press the "Start recording" button on the screen.		5 s	
C.8.	Say out loud the start time of the experiment run		5 s	
C.9.	Grab the joystick with your right hand.		5 s	
C.10.	Grab the attitude device with the left hand, while placing your index finger on the top hole		5 s	
		CAUTION To prevent injury, always perform a light grip over the attitude device, and the wrist should be relaxed and compliant with the motion of the device.		
C.11.	Start the exploration task and perform Think Aloud during the full run	Note: This is done concurrently with the task: report out loud any mental processes while performing actions or judging any situation. Think aloud method is a vocalization of the thoughts, related to high level decisions and actions taken during the task.		all duration of the experiment 20-45min

		HINT: Use the (i) button on the interface for help with the commands  		
C.12	After finishing the experiment go to 'D - End of Experiment Run' procedures.			

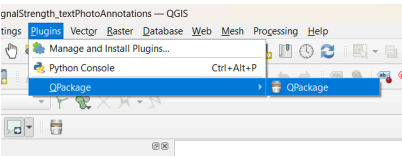
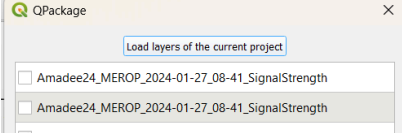
D - END OF EXPERIMENT RUN

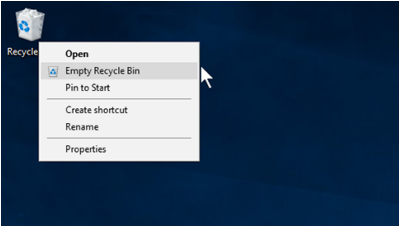
Step	Action	NOTES	Duration	Check
D.1.	Say out loud, to the camera the end time of the experiment run		5 s	
D.2	Inform GOSTs: "End of experimental run"		5 s	
D.3	Inform GOSTs: - if more MEROP runs are scheduled: - "Restart Experiment run" - if there's no more scheduled runs: - "End of MEROP Experiment runs"		5 s	
D.4.	Stop the onboard data recording: 1. ⬇ "Rec" toggle button (fig) 2. ⬇ "stop recording" (fig)		5 s	

				
D.5	↓ the camera's button (see picture) to stop recording.		5 s	
D.6	Answer the questionnaire displayed on the interface		5 min	
D.7	Stop the screen recording		5 s	
D.8	↓ "Q" button (keyboard) to close the teleoperation interface (see picture).	 If it doesn't work, use the shortcut: Alt+F4	1 s	
D.9	Report the end of the task to the MSC through the chat channel.		1 min	
D.10	If no other MEROP run is scheduled for today: Go to "E - Export and Save Data From the Run"			

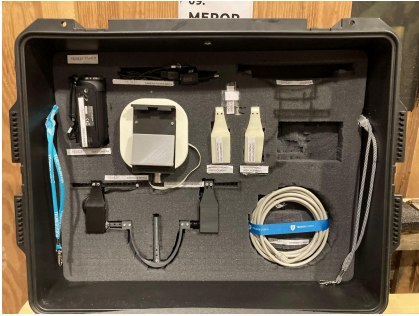
E - EXPORT AND UPLOAD DATA FROM THE DAILY RUNS

Step	Action	NOTES	Duration	Check
E.1	SSD → ← LAPTOP		5 s	
E.2	Go to the folder C:\AMADEE24\BaseGISFiles		30 s	
E.3	Open file (double-click):	This will open a QGIS application	30 s	

	"Amadee24_MEROP_allRuns_signalStrength_textPhotoAnnotations.qgs"			
E.4	↓ on the top Menu Plugins>QPackage>QPackage		30 s	
E.4	↓ 'Load layers of the current project'		5 s	
E.5	↓ 'Destination Folder' and save the data on the USB SSD (see notes for folder instructions)	If not available, create a new folder with the name "MSC_data" If available, inside "MSC_data" folder, create a new folder with the name: MEROP_GIS_PROJECT_<date>	1 min	
E.6	VIDEO CAMERA → ← LAPTOP		5 s	
E.7	Copy-Paste all recordings from the VIDEO CAMERA to the SSD (see notes for folder instructions)	Destination Folder in the SSD: "Video_data" (create new folder if it's not yet available)	5 min	
E.8	Delete all recordings in the VIDEO CAMERA		1 min	
E.9	Copy-Paste all screen recordings	Folder containing the screen recordings: Videos\Captures Destination Folder in the SSD: "Screen_data" (create new folder if it's not yet available)	5 min	
E.10	Delete all screen recordings from the laptop		2 min	
	Empty the "Recycle Bin"	Note: This step is crucial to ensure enough space in the laptop during experiment runs	1 min	

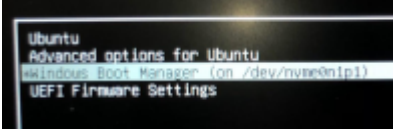
				
E.11	Shutdown the laptop		30 s	
E.12	SSD ← → LAPTOP		5 s	
E.13	CAMERA ← → LAPTOP		5 s	
E.14	Upload to the MSC server the contents saved in step E.5: MEROP_GIS_PROJECT_<date>		5 min	
E.15	Go to “F - PACKING HARDWARE”			

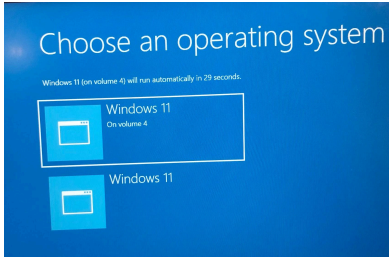
F - PACKING HARDWARE

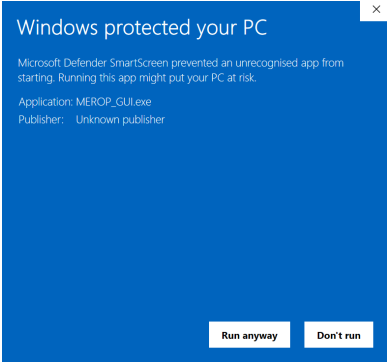
Step	Action	NOTES	Duration	Check
F.1	Unhook the safety strap (red), and place all equipment inside the case: On “FOAM 3”: ☐ ATTITUDE DEVICE ☐ VIDEO CAMERA ☐ CAMERA POWER BRICK ☐ ETHERNET CABLE On “FOAM 2”: ☐ LAPTOP POWER BRICK ☐ ATTITUDE DEVICE POWER BRICK ☐ JOYSTICK On the base: ☐ SSD ☐ TRACTION GLOVE ☐ 2x BACK SUPPORT	all equipment and respective placement spots are labelled FOAM 3 with all equipment:  FOAM 2 with all equipment: 	5 min	

Step	Action	NOTES	Duration	Check
		Base: 		
F.2	Close safety strap		10 s	
F.3.	Close the Case top	CAUTION Ensure that no cables are outside the case or in the edges or they will be damaged when closing the case.	5 s	

G - SYSTEM RE-DEPLOYMENT

Step	Action	NOTES	Duration	Check
G.1	Collect the latest version of the MEROP UI from the data server	The file naming will be specified by the MSC request, but should follow the naming logic: MEROP_UI_version_<X>.zip Use the MEROP SSD to transfer the zipped file from the server to the laptop	5 min	
G.2	SSD → ← LAPTOP		1 min	
G.3	Turn ON the laptop and login as Astronaut user	Select “Windows Boot Manager” on the operating system (OS) menu: 	2 min	

Step	Action	NOTES	Duration	Check
		Attention: there's a 5 second automatic selection of "Ubuntu", use the arrows and enter to select If the "Ubuntu" is automatically selected restart the Laptop and select "Windows Boot Manager" on the OS menu  - When shown this menu, press "Enter"		
G.4	Backup the previously deployed MEROP UI	Note: UI=User Interface 1. create a "Backups" folder in the SSD 2. move the "MEROP UI" folder from the Desktop the the "Backups" folder 3. Delete the "MEROP_GUI" icon from the Desktop	2 min	
G.5	Export the MEROP_UI_version_<X>.zip to the Desktop	1. right-click on MEROP_UI_version_<X>.zip 2. select "Extract all..." 3. chose Desktop as destination	5 min	
G.6	Create a MEROP UI shortcut	1. Open the "MEROP_UI_version_<X>" exported folder in the Desktop 2. open "MeropBuild" 3. right-click on MEROP_GUI 4. Select "Show more options" 5. Select "Create shortcut" 6. move the new shortcut to the Desktop 7. Rename the shortcut to "MEROP_GUI"	2 min	

Step	Action	NOTES	Duration	Check
G.7	Open the MEROP_GUI and enable security settings	1. Double click on MEROP_GUI icon Notes: Security warnings will pop up. Follow steps G.8 and G.9 to enable MEROP_GUI access to communicate with Mercator rover These warnings only appears one time, during the following runs with the same shortcut these warnings will not appear	5 min	
G.8	Disable windows security	If a security warning appears, select: 1. "More Options" 2. "Run anyway" 	10 s	
G.10	Close the MEROP_GUI	press "Q" on the keyboard If it doesn't work, use the shortcut: Alt+F4	30 s	