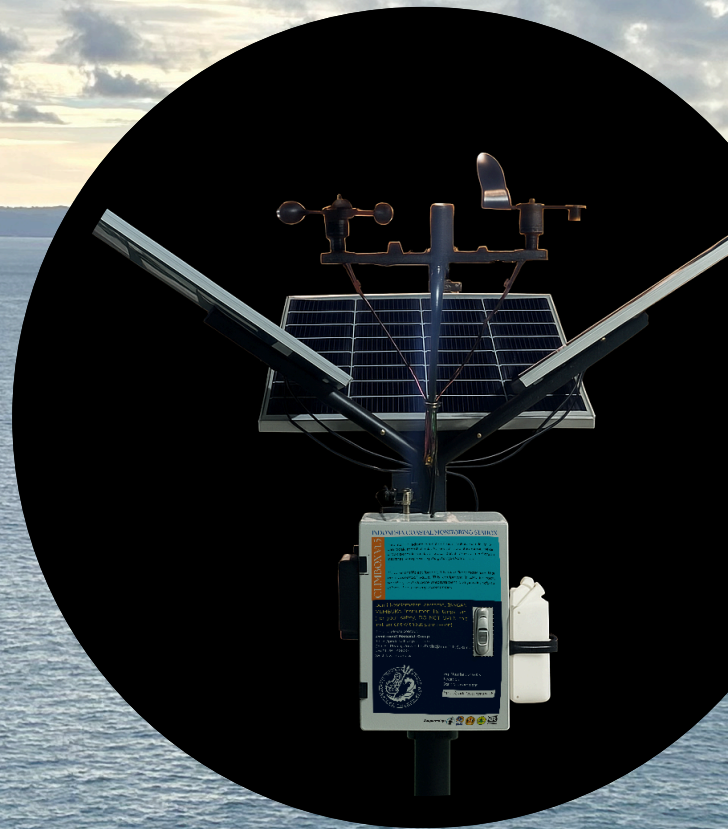
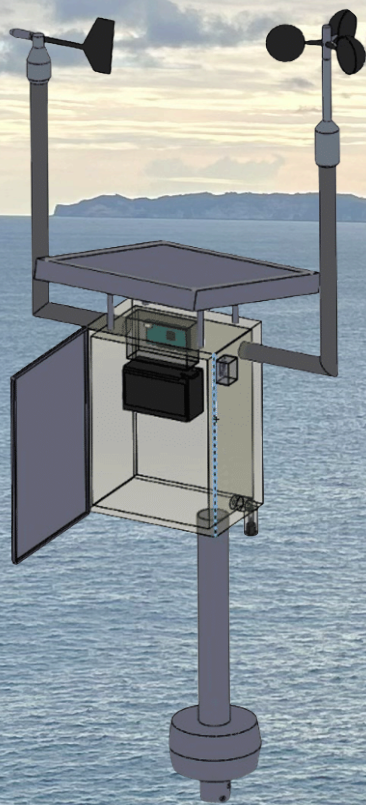


# Manual Book

# CLIMBOX V 1.5

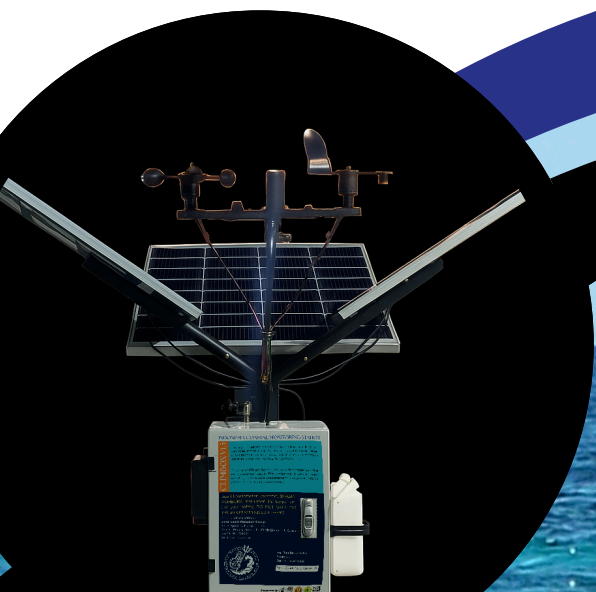


**BiMA**

# About Climbox

ClimBox V1.5 is an innovative scientific device designed to conduct integrated and continuous monitoring of weather and seawater quality. This device was developed through a collaboration between the Marine Science Department of Padjadjaran University, the Marine Science Department of Sultan Ageng Tirtayasa University, and QR Smart Device Pangandaran, with the aim of providing an efficient, automated, and integrated coastal environmental monitoring system. The main control system of ClimBox uses Arduino Mega as the data acquisition center from various environmental sensors with a data collection interval of one minute. All data obtained is recorded locally on an SD card and forwarded to ESP32, which functions as a data transmission module to Google Sheet via the internet.

In addition to local storage, ClimBox V1.5 is also equipped with a web-based visualization dashboard system that allows data to be displayed directly and in real time (<https://climbox-db.web.app>). Water quality measurements are taken periodically every hour, with an automatic pump mechanism that flows seawater to the sensor line for measurement. This activity is precisely regulated by a Real Time Clock (RTC) module and relay, which also regulates the automatic flushing process every six hours. This flushing process serves to keep the sensors clean from deposits and biofouling, so that measurement accuracy can be maintained over a long period of time. Meanwhile, weather condition parameter measurements are carried out continuously, providing comprehensive atmospheric data in very short time intervals. All collected weather and water quality data can be accessed through local storage or a cloud system, enabling more responsive marine environmental monitoring. The cloud-connected web dashboard makes it easy for users to analyze environmental change trends, monitor weather dynamics and water conditions in real time, and make quick and accurate decisions in response to potential environmental changes.



# Spesification

## APPLICATIONS

Climate change monitoring: detecting marine heatwaves, acidification, and hypoxia

Coastal management: flood risk, water quality assessment

Marine research: supporting open data and field campaigns

Community engagement: enabling citizen science & coastal education

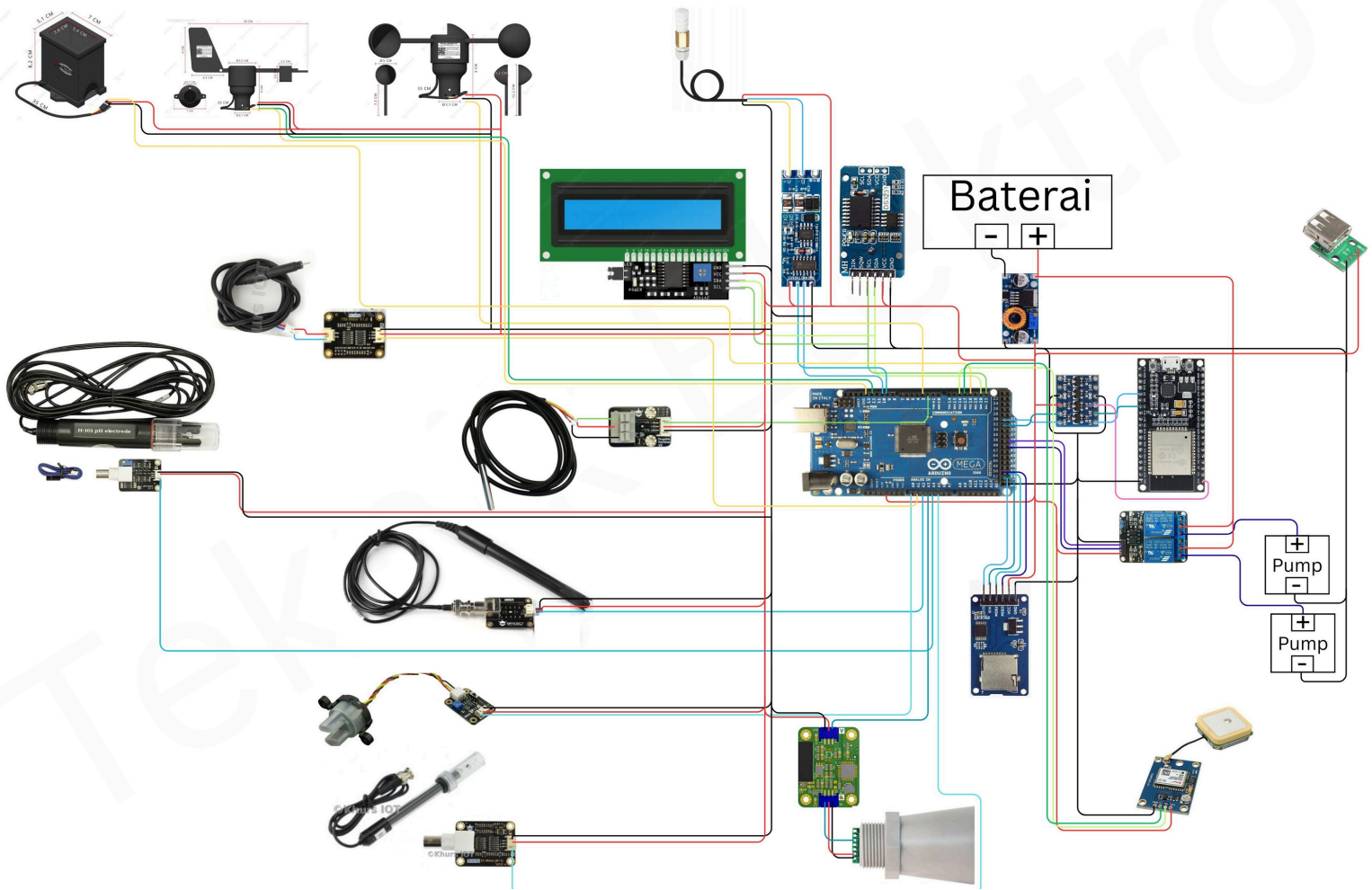
## PARAMETER

- pH
- Temperature (°C)
- Dissolved Oxygen (DO)
- Atmospheric Pressure (atm)
- Salinity (ppt)
- Turbidity (TSS)
- Wind Speed (m/s)
- Wind Direction
- Rainfall (mm)
- Humidity (%)

## DATA ACCESSIBILITY

- **PODC Portal** - free & open data access (<https://podc.fpik.unpad.ac.id/>)
- **Climbox Portal - Free & Open Data Acces** (<https://climbox-db.web.app>)
- **Onboard micro-SD** - local backup storage

# Wiring Installation





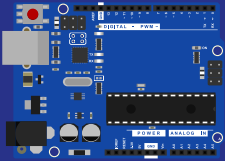
# Wiring Table

Arduino Pin Number	Pin Type	Connected components
2	Signal	Water Temperature
20	SDA	LCD
21	SCL	LCD
53	CS	Micro SD Card
52	SCK	Micro SD Card
51	MOSI	Micro SD Card
50	MOSI	Micro SD Card
39	IN1	Relay
41	IN2	Relay
17	TX	GPS
16	RX	GPS
12	Green	Wind direction sensor
13	Yellow	Wind direction sensor
18	Yellow	Rainfall sensor
3	Yellow	Wind Speed Sensor
30	HV1	Level Shifter
32	HV2	Level Shifter

# Wiring Table

Arduino Pin Number	Pin Type	Connected components
6	CLK	RTC
7	DATA	RTC
8	RST	RTC
A3	Analog Voltage Out	Ultrasound Sensor
A0	Data	TSS
A1	Data	TDS
A2	Data	Dissolved Oxygen
A4	Data	pH
A5	Data	Conductivity
9	TX	RS485 to TTL
10	RX	RS485 to TTL
33	36	Mode Button (Yellow)
34	37	Ok Button (Green)
35	35	Back Button (Red)
36	34	Up Button (Blue)
37	33	Down Button (White)

# Component



## Arduino Mega2560

Used as the main brain of the Climbox V1.5 system. This component reads analog/digital sensor signals, controls relays, and sends data to the ESP32 and SD Card.

- Features 54 I/O pins (15 PWM outputs)
- 16 analog inputs
- Features 4 UARTs (hardware serial ports)
- 16MHz crystal oscillator
- USB connection
- Power jack
- ISP header
- Reset button



## ESP 32

Used to send measurement data from sensors connected to Arduino to a server/cloud wirelessly.

- Operating voltage: 3.3V
- Input voltage: 7-12V (Vin)
- Digital IO Pin (DIO): 25
- Analog Input Pin (ADC): 6
- Analog Output Pin (DAC): 2
- UART: 3
- SPI: 2
- I2C: 3
- Flash Memory 4 MB
- SRAM: 520 KB
- Clock Speed: 240 Mhz
- Wi Fi : IEEE 802.11 b/g/n/e/i
- Mode supported: AP, STA, AP+STA
- CP2102 USB controller

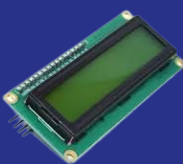
# Component



## SD Card Reader (MicroSD)

Functions as local storage and backup, storing all water quality (pH, DO, TDS, water temperature) and weather data (wind speed, rainfall, temperature/humidity) on a microSD card.

- Supports Micro SD cards and Micro SDHC cards (high-speed cards).
- Level conversion circuit board connects levels for 5V or 3.3V.
- Power supply is 4.5V to 5.5V, voltage regulator circuit board is 3.3V.
- 4 M2 screw holes for easy installation.



## Layar Display LCD (I2C LCD)

Direct field display. Displays real-time sensor results

- Display Type: 16x2 LCD (16 characters x 2 lines)
- Input Voltage: 5V DC (from power supply or USB)
- Character Size: 5mm x 8mm per character
- Backlight Color: Green
- Interface: I2C
- Module Dimensions: 80mm x 36mm x 15mm
- Display Size: 64.5 x 16mm

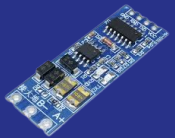
# Component



## DS3231 RTC

As a timestamp for data

- Dimensions: 38mm (length) \* 22mm (W) \* 14mm (height)
- Operating voltage: 3.3 - 5.5 V
- Clock chip: DS3231M



## RS485 TTL Converter

Used to allow all sensors in the Climbox to send data to the ESP32 components and SD card.

- Compatible with 3.3V and 5.0V power supplies.
- Compatible with 3.3V and 5.0V signals.
- About 0.8mm thick.
- RXD and TXD indicators.
- Supports multi-device communication with up to 128 devices.
- Equipped with a 120-ohm terminal resistor.

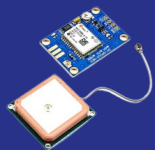


## USB Female

Used as an interface for an external power supply or direct communication to a PC during testing.

- Type: DIP 4Pin Micro
- Size: Standard
- Material: Metal, Electronic Parts
- Main Color: Silver Tone
- Net Weight: 5 grams

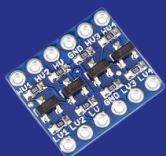
# Component



## GPS Connector Module

Used to store the geographic location of the measurement location.

- Standalone GPS receiver.
- Compatible with APM2 and APM2.5.
- EEPROM for data storage.
- LED to indicate GPS lock.
- Interface: RS232 TTL.
- Power: 3-5V, recommended 5V.
- Default baud rate: 9600bps.
- Antenna size: 25 x 25mm.
- Module size: 25 x 35mm.



## Level Shifter 4 Channel

Aligns voltage between devices (3.3V ↔ 5V). For example, an ESP32 (3.3V) communicating with a 5V sensor (pH, TDS).

- High Voltage: 5V
- Low Voltage: 3.3V
- GND for negative power
- 5V TTL input RXI, 3.3V TTL output RXO
- 3.3V TTL TXI input/output, 5V TTL TXO input/output, TXI and TXO are bilaterally switched
- Quantity: 5 Sets

# Component



## Relay 2 channel

Used to control two water pumps in the Climbox V1.5

- Opto-isolated inputs
- Maximum load: AC 250V/10A, DC 30V/10A
- Number of channels: 2
- Working voltage: 5V, active LOW
- LED indication for relay output status



## Wind Speed Sensor

Used to measure wind speed.

- Voltage 5v/3.3v.
- Hall effect sensor type.
- Rotation method uses bearings.
- Minimum measurable wind speed: 1.5 m/s, maximum: 30 m/s.
- Uses interrupt pin.
- Digital TTL output.
- Equipped with program application examples. The example code can be used for Arduino, NodeMCU ESP8266, Wemos, and ESP32 boards.

# Component

## Wind Direction Sensor



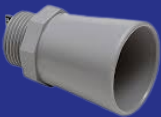
Used to measure wind direction.

- Voltage 5v/3.3v.
- Hall effect sensor type.
- Rotation method uses bearings.
- Minimum measurable wind speed: 1.5 m/s, maximum 30 m/s.
- Uses interrupt pin.
- Digital TTL output.
- Equipped with program application examples. The example code can be used for Arduino, NodeMCU ESP8266, Wemos, and ESP32 boards.

## Rain Gauge Sensor

Used to measure rainfall at sea/coastal levels.

- Working voltage: DC 3.3V/5V.
- Uses a magnetic sensor.
- Output: Pulse Digital TTL.
- Per tip measures 0.053 inches of rain or 1.346 mm of rain.



## Ultrasonic Sensor

Used to measure water levels (tidal waves)

- 1 cm resolution
- 10 Hz reading speed
- 42 kHz ultrasonic sensor measures distance to objects
- Operates at 3.0-5.5 V
- Low average current 3.4 mA

# Component



## Temp and Humid Sensor

Used to measure the temperature and humidity of the air around the device's installation location.

- Temperature Measurement Range:  $-30^{\circ}\text{C}$  to  $80^{\circ}\text{C}$
- Humidity Measurement Range: 0% to 100%RH
- Protection: IP44
- Waterproof
- Temperature:  $\pm 0.5^{\circ}\text{C}$  (resolution:  $0.1^{\circ}\text{C}$ ) / Humidity:  $\pm 5\%RH$  (resolution:  $0.1\%RH$ )
- Output: RS485 (MODBUS RTU Protocol)
- Power Consumption: 0.1W
- Voltage: DC5V to DC24V
- RS485 Communication Distance: Up to 800m
- Default Cable Length: 0.5m (Customizable)



## Total Suspended Solids (TSS) Sensor

Used to measure Total Suspended Solids (turbidity)

- Operating Voltage: 5V DC
- Operating Current: 40mA (MAX)
- Response Time: Insulation Resistance: 100M (Min)
- Output Method: Analog
- Analog output: 0-4.5V
- Digital Output: High/Low level signal (you can adjust the threshold value by adjusting the potentiometer)
- Operating Temperature:  $5^{\circ}\text{C}$ ~ $90^{\circ}\text{C}$
- Storage Temperature:  $-10^{\circ}\text{C}$ ~ $90^{\circ}\text{C}$
- Weight: 30g

# Component



## Total Dissolved Solid (TDS) Sensor

Used to measure dissolved salt & mineral levels

- Signal Transmitter Board
- Input Voltage: 3.3 ~ 5.5V
- Output Voltage: 0 ~ 2.3V
- Working Current: 3 ~ 6mA
- TDS Measurement Range: 0 ~ 1000ppm
- TDS Measurement Accuracy:  $\pm 10\%$  F.S. (25°C)
- Module Size: 42\*32mm
- Interface Module: PH2.0-3P
- Electrode Interface: XH2.54-2P



## pH Sensor

Used to measure the acidity/alkalinity of sea water

- Supply Voltage: 3.3~5.5V
- Output Voltage: 0~3.0V
- Probe Connector: BNC
- Signal Connector: PH2.0-3P
- Measurement Accuracy:  $\pm 0.1@25^{\circ}\text{C}$
- Dimensions: 42mm\*32mm/1.66\*1.26in
- Probe Type: Industrial Grade
- Detection Range: 0~14
- Temperature Range: 0~60°C
- Accuracy :  $\pm 0.1\text{pH}$  (25 °C)
- Response Time: <1min
- Probe Life: 7\*24hours >0.5 years (depending on the water quality)
- Cable Length: 500cm

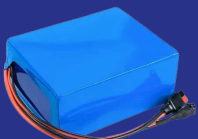
# Component



## Dissolved Oxygen (DO)

Used to measure dissolved oxygen levels

- Type: Galvanic Probe
- Detection Range: 0~20mg/L
- Response Time: Up to 98% full response, within 90 seconds (25°C)
- Pressure Range: 0~50PSI
- Electrode Service Life: 1 year (normal use)
- Maintenance Period: Membrane Cap Replacement Period: 1~2 months (in muddy water); 4~5 months - (in clean water)  
Filling Solution Replacement Period: Once every month
- Cable Length: 2 meters
- Probe Connector: BNC
- Signal Converter Board
- Operating Voltage: 3.3~5.5V
- Output Signal: 0~3.0V
- Cable Connector: BNC
- Signal Connector: Gravity Analog Interface (PH2.0-3P)
- Dimensions: 42mm \* 32mm



## Baterai

Used as a power source for the Climbox V1.5 Tool

- Battery capacity: 420 Wh, 21 cells
- Battery type: 21700
- RH

# Component



## Water Temperature Sensor

Water temperature sensor (generally DS18B20 waterproof)

- Range: -40-+80°C
- Supply: 12-24VDC
- Accuracy:  $\pm 0.5^\circ\text{C}$
- Response time: <1s
- Output Signal: 4-20mA, 0-5V, RS485
- Operating Temperature: -40°C-+80°C
- Housing material: 316L
- Probe weight(unpacked): 145g
- Ingress Protection: IP68
- Storage: 10-60°C@20%-90%RH



## Solar Charge Controller (SCC)

Regulates and controls the electric current from the solar panel to the battery to prevent overcharging and damage to the battery.

- Maximum PV Input Power: 12 V (1200 W), 24 V (2400 W), 36 V (3600 W), 48 V (4800 W)
- Body Material: Plastic
- Dimensions: 183 x 195 x 65 mm
- Other Current: 100 A
- Battery Support: Lithium and Lead Acid Batteries
- Maximum PV Voltage: 100 V

# Component



## Panel Surya 200 WP

Used as a charger when the battery for the tool runs out

- Model: MS100M-39// GH100M-39
- Rated Maximum Power (Pm): 100W
- Tolerance : 0 ~+/-5%
- Voltage at Pmax(Vmp) : 22.62V
- Current at Pmax (IMP) : 4.43A
- Open - Circuit Voltage (Voc) : 26.01V
- Short - Circuit Current (Isc): 4.64A
- Normal Operating Cell Temp (NOCT) 47+/- 2C
- Maximum System Voltage 1000 V DC
- Maximum Series Fuse Rating 10A
- Operating Temperature -40 to + 85C
- Application Class : Class
- Fire Safety Class: Class C
- Cell Technology: Mono-Si
- Weight : 5.78 K
- Dimensions (mm): 760 x 670 x 30 mm

# Component



## Modem wifi

Used as a signal provider for the ESP32 to send data to the website.

- Supports FDD-LTE/TD-LTE/UMTS/DC HSPA+/HSDPA/HSUPA/GSM/EDGE
- FDD-LTE cat4. Data service Peak Downlink Speed up to 500Mbps, Upload speed up to 50Mbps
- DC-HSPA+ Peak download speed up to 43.2Mbps
- HSPA+ downlink data service of up to 21.6 Mbit/s
- HSDPA data service of up to 14.4 Mbit/s
- HSUPA data service of up to 5.76 Mbit/s
- WCDMA data service of up to 384 kbit/s
- EDGE packet data service of up to DL 296 kbit/s, UL 236.8 kbit/s
- GPRS packet data service of up to 85.6 kbit/s
- LTE/UMTS/GSM Short Message Service (SMS)
- LTE: DL 2\*2 MIMO RNDIS
- WLAN 802.11b/g/n, 2.4GHz
- Wi-Fi AP, supports up to 10 Wi-Fi users
- Supports Firewall, UPnP, ALG and NAT function;
- Supports up to 8 wireless terminals
- Manage via Huawei Mobile WiFi App or browser
- standard USIM/SIM card interface

# Component



## Pompa Air

Used to draw seawater for measurement and freshwater for sensor flushing.

- Water Flow Rate: 6 Liters per Minute
- Thrust: 6 Bar (87 PSI)
- Suction Power: 1.5-2 Meters
- Voltage: DC 12 V
- Material: Pump Body: ABS Plastic
- Dimensions:
  - Pump Body: 14.8 x 9.5 x 5.5 cm
  - Water Hole Diameter: 10 mm (outer)
- Current: 3.5 A

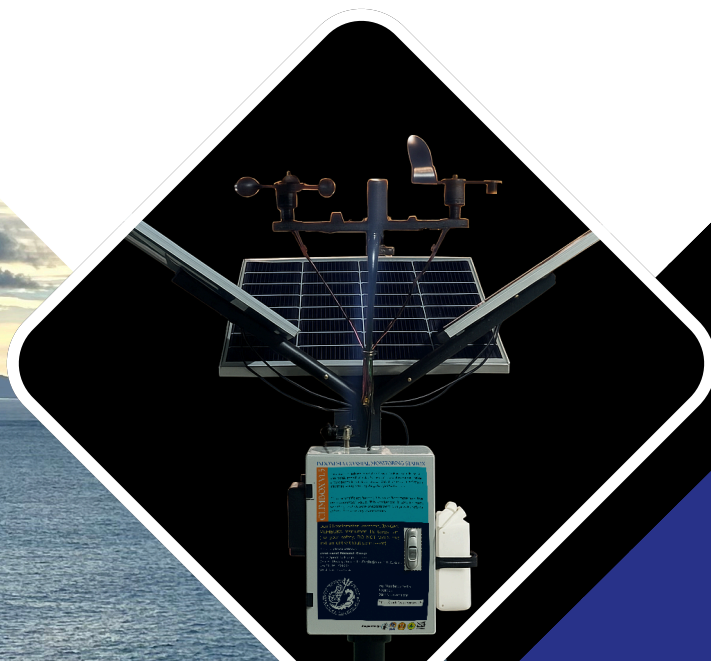
# How To Assembly

1. Install the support pole at the designated data collection site.
2. Attach the frame to the Climbox enclosure.
3. Mount the solar panel onto the pole and connect it to the battery.
4. Secure the Climbox unit onto the pole.
5. Install the atmospheric sensor pole on top of the Climbox box.
6. Fill the rinse water compartment inside the support pole.
7. Ensure all components are properly installed and firmly connected.
8. Turn on the battery via the SCC – the Climbox is now ready for operation.

# How To Use

The use of the Climbox V1.5 device begins with the preparation stage. Ensure that all components, such as sensors, solar panels, batteries, and Wi-Fi modems, are properly installed according to the available circuit schematic. Also check the cable connections of each sensor, such as the pH, DO, TDS, water temperature, wind direction and speed, and rainfall sensors, to ensure they are connected to the appropriate ports on the Arduino Mega2560 and ESP32 modules. Before turning on the device, make sure the battery is fully charged or that the solar panel is connected to provide power.

Once all components are ready, turn on the system by connecting the power source from the battery or power adapter to the main port. When the system is active, the indicator lights on the ESP32 module, Arduino, and each sensor will turn on as a sign that the device is working. Wait a few moments for all sensors to start reading data and for the ESP32 module to successfully connect to the Wi-Fi network. The measurement results can be monitored directly via the LCD screen (I2C LCD) which displays real-time data, such as pH value, TDS level, water temperature, and wind speed. The measurement data will be automatically stored on an SD card as a local backup, complete with a timestamp generated by the DS3231 RTC module. In addition, the ESP32 will send the data to a server or cloud wirelessly for remote monitoring purposes.

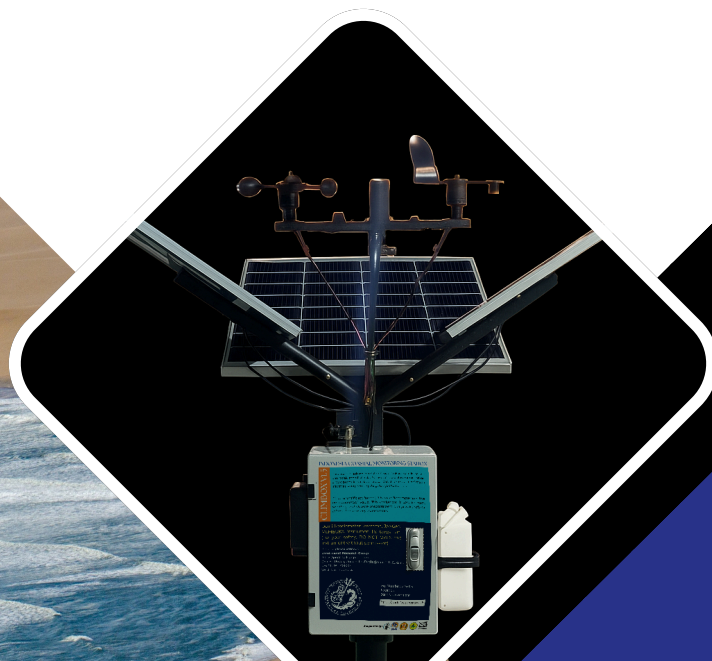


# How To Use

To ensure accurate measurement results, users need to calibrate the sensors regularly, especially the pH and DO sensors. The system is also equipped with a relay that controls two water pumps—one to take seawater samples for measurement and another to rinse the sensors with fresh water after use. Routine maintenance such as cleaning the sensors of dirt or algae is also necessary, especially for the DO, TSS, and water temperature sensors.

In terms of power storage, the solar charge controller (SCC) regulates the electric current from the solar panel to the battery to prevent overcharging. When the battery is full, the SCC will automatically stop the flow of power from the solar panel. For optimal results, the device should be placed in an open area so that the solar panel receives maximum light and the weather sensors can function properly.

In addition, the GPS module automatically records the geographical location of data collection, while the RTC provides a timestamp for each piece of recorded data. Thus, each measurement result can be tracked based on the time and location of collection. To retrieve data manually, users can remove the SD card and read it using a computer, or access the data online via a server/cloud website if the device is connected to a Wi-Fi network.



# Maintenance & Care

1. Install the support pole at the designated data collection site.
2. Attach the frame to the Climbox enclosure.
3. Mount the solar panel onto the pole and connect it to the battery.
4. Secure the Climbox unit onto the pole.
5. Install the atmospheric sensor pole on top of the Climbox box.
6. Fill the rinse water compartment inside the support pole.
7. Ensure all components are properly installed and firmly connected.
8. Turn on the battery via the SCC – the Climbox is now ready for operation.

# Safety Instructions & Warnings

This device is a scientific ocean and climate monitoring instrument. Unauthorized handling or tampering may cause damage to the equipment and risk of electric shock or contamination.

## Operating Safety

1. Do NOT open, disassemble, or modify any part of this instrument without authorization from KomitmenX Research Group.
2. Avoid exposure to direct impact, fire, or immersion in substances other than seawater.
3. Handle the device using proper safety gloves and avoid contact with internal electronic parts.
4. When transporting, ensure the instrument is powered off and secured to prevent damage.

## Environmental Notice

- This instrument contains sensitive sensors and batteries.
- Do not dispose of it in the sea or landfills.
- If found adrift or washed ashore, report immediately to:
- KomitmenX Research Group (<https://podc.fpik.unpad.ac.id>)

## Warning

For your safety and the integrity of research data:

**DO NOT OPEN, MOVE, OR REPAIR THIS INSTRUMENT WITHOUT PERMISSION**

# Contact Us



## More Information:



Visit Website  
<https://podc.fpik.unpad.ac.id>

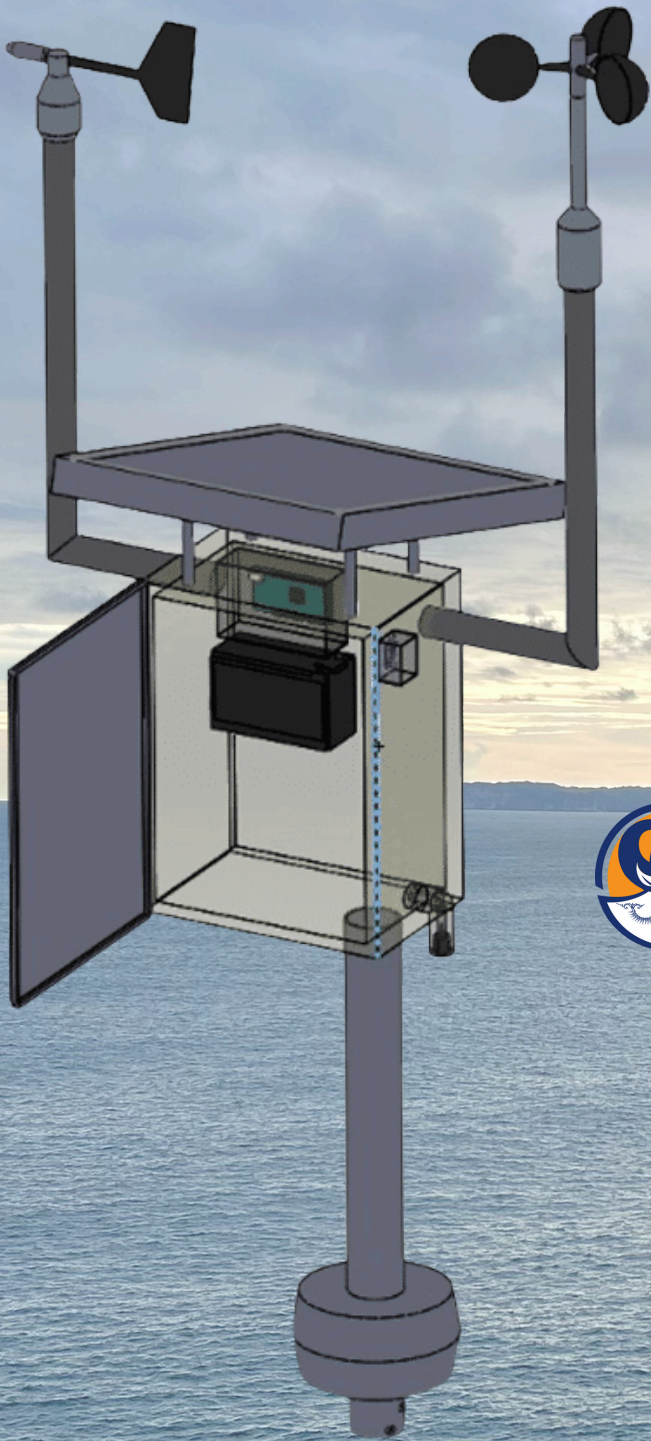
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21, Jawa Barat Indonesia.



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