Meteo Mini Meteostation 2.0
by Makers for Makers

TOC

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Introduction

Do you think about making your own home weather station? We have prepared a complete kit for you, including a radiation shield, box, shield holder, fasteners and our Meteo Mini development board, which you can easily program using the Arduino IDE.

We have written about the Meteo Mini on our GitHub. Briefly we can remind the board.

It contains the ESP-C3-12F (ESP32-C3-MINI from version 3.5) module based on the ESP32-C3 Wi-Fi chip, and is equipped with a connector for connecting I2C sensors. The weather station is powered by a LiPol battery, which is connected via a connector on the motherboard. For even greater simplicity of connection, the board is ready to accommodate the internal DALLAS DS18B20 temperature sensor and our popular µŠup connector for easy connection of other I2C bus sensors.
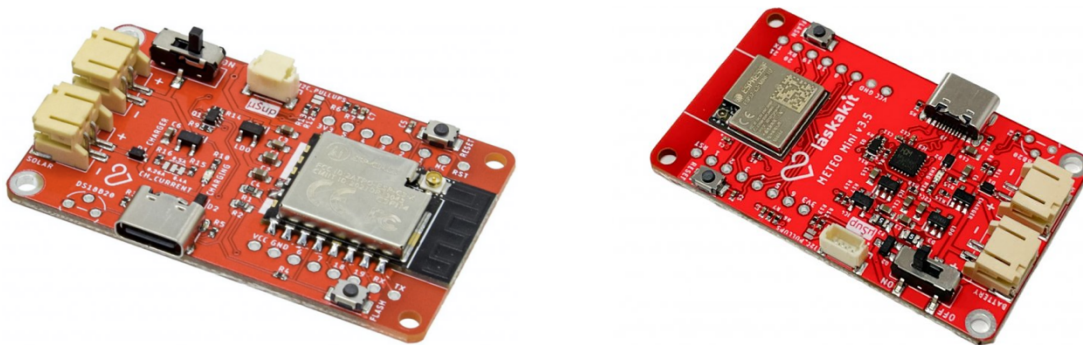
The board also has an integrated battery charger so the battery can be charged from the USB-C connector or a solar panel with a nominal voltage of 5-6V. There is also a connector for this on the motherboard. There is also a voltage divider on the board which is connected to the battery and its output is connected to the ADC input of the microcontroller. The status of the battery will thus be under constant surveillance.

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Parts for assembly

Depending on whether you have an integrated or external Wi-Fi antenna, the contents of the package vary.

- 1 pc - LaskaKit Meteo Mini (either PCB antenna for integrated antenna or IPEX for external)
- 1 pc - Sensor LaskaKit BME280 pressure, temperature and humidity sensor
- 1 pc - GeB LiPol Battery 603048 900mAh 3.7V JST-PH 2.0
- 1 pc - Solar panel 5V 4W with wall mount
- 1 pc - JQ-118 USB-C to JST-PH-2 2mm 10cm Power Cable
- 1 pc - μŠup, STEMMA QT, Qwiic JST-SH 4-pin cable - 10cm
- 1 pc - Cover for weather station sensors, 70x145mm, plastic
- 1 pc - Antenna 5dBi 19cm 2.4G white + Pigtail (in case of external antenna)
- 1 pc - Radiation shield
- 6 pcs - Screw M2.2x5 (for attaching the sensor and board to the box)
- 1 pcs - Screw M3.5x12 (optional attachment of the solarium to the radiation shield)
- 4 pcs - Screw M2.2x16 (attaching the top cover of the box)
- 2 pcs - Screw M3x20 (attaching the box with holder to the radiation shield)
- 3 pcs - Zip ties 3,6x300 mm black

For the final assembly, you will still need the designed printed parts prepared especially for this project. You can buy them ready-made or, if you have the option, print them yourself.

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Required tools

- Phillips screwdriver.
- Pliers (for cutting the zip ties).
- Computer with Arduino IDE to upload the program to the development board.
- LaskaKit CH9102 Programmer USB-C, microUSB, UART (or CH39102) to upload the program to the development board. (Only for boards before version 3.5)
- Wi-Fi device to connect to the flashed development board to set up the Wi-Fi network to which the weather station should connect (e.g. mobile phone).
- If you want to mount the solar panel on the radiation shield, then you will still need tools to drill a hole to attach it through and into which the M3.5x12 screw will go. For more information on this option, see "Connecting to the radiation shield and solar panel".

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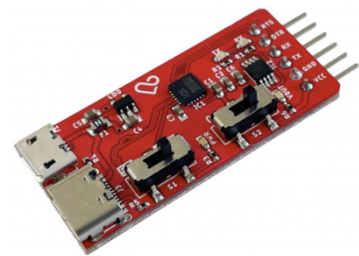
Assembly

Before the actual assembly, it is necessary to first connect and program the development board with the sensor. The connection is simple thanks to the µŠup connectors and can be done without soldering.
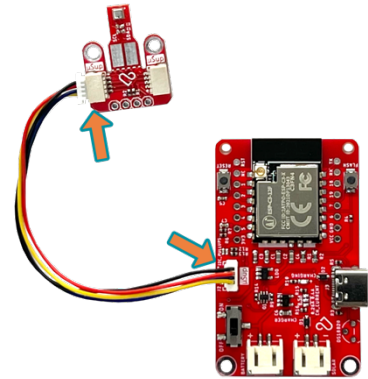
1) Take the µŠup JST-PH-4 10 cm jumper cable and connect the BME280 sensor from the left connector to the board to the µŠup connector. You don't need much force to plug it in, the connector has a lock so it's hard to plug it in the wrong way. You can use either connector on the BME280, but the left one is preferable for better cable management.

2) The next step will be to flash the motherboard, which comes without the software loaded. So we will need to plug the LáskaKit programmer into the board.

3) (Only for boards before version 3.5) Make sure the programmer is switched to 3.3V! (switch VCC OUT to ON if necessary)

4) (Only for boards before version 3.5) Plug the programmer into the development board. RTS to RTS, +3V3 to VCC (DTR to DTR, TX to RX, RX to TX):
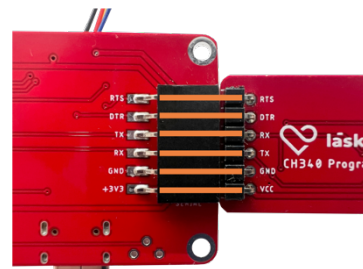
5) After setting the correct voltage on the programmer and connecting it to the board, don't forget to put the switch on the Meteo mini development board in the **ON** position to turn it on:

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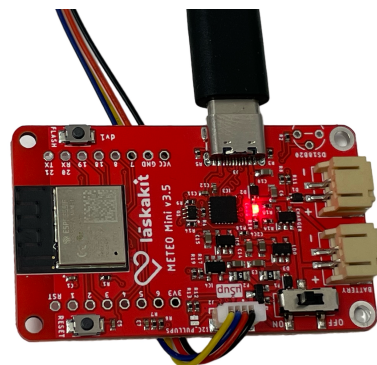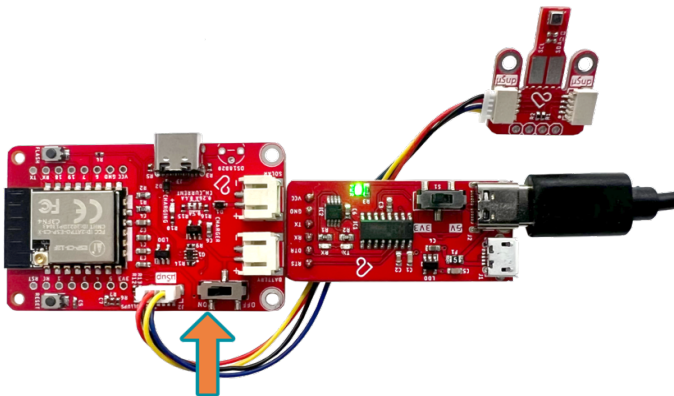
6) Connect the USB converter to your computer with a USB cable. If you don't have it working yet, install the necessary drivers. Follow the instructions for the specific converter. For the converter we recommend, and also for board from version v3.5 you will find links to the drivers and installation instructions on our web. To ensure proper voltage levels, switch the slide switch on the board to the 3V3 position. Any additional details are on our board page here: LaskaKit Meteo Mini PCB antenna.

7) On our repository page with the code for the weather station, download the source file of the program, open it in the Arduino IDE, edit the value for the domain where to send the measurements and upload the program to the board. We will discuss how to do this more:

If you don't have the Arduino IDE installed, you can download and install it from the official website here.

Our project repository can be found at: https://github.com/LaskaKit/Weather_Station_Mini/

In the "SW" directory there are files with source code. To make working with the files easier, you can download our entire current repository as a ZIP file and open it on your computer so you have everything at your fingertips:
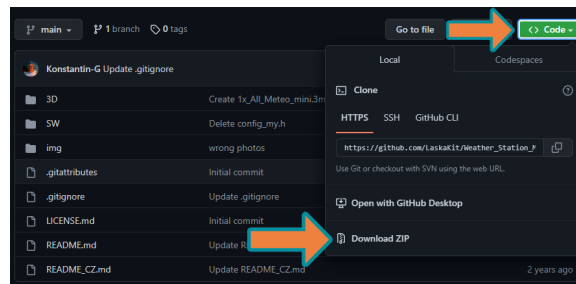

We'll continue our tutorial with an example for TMEP.cz, and for that we just need a single file. Of course you can modify the example for another service or your own server. From our repository page, download the source file of the program in the "SW/TMEP" directory and open it in the Arduino IDE.

If you have never worked with ESP modules, in this case ESP32, you will need to install support for these boards. You can read how to do it here. Simply put: in the menu under "File" - "Preferences" you will need to put a link to "Additional boards manager URLs":

https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json

And to confirm. Then, after installing the other boards (which happens immediately after confirmation), you can select the "ESP32-C3 Dev Module" board. Select the port on which you have installed the programming converter (in Windows you can find out e.g. from the "Device Manager", but typically you will only see one in the IDE).

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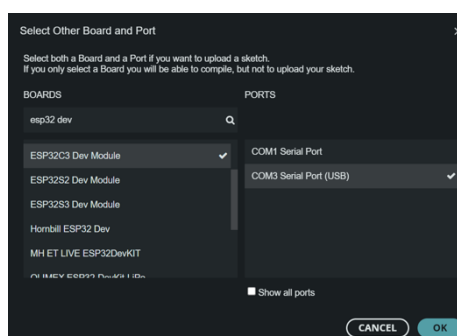
The next thing needed to successfully upload the software to the board is to install the BME280 sensor library, the WifiManager library (by tzapu) and the ESP32AnalogRead library. In our project for BME280 we use the library from Adafruit - https://github.com/adafruit/Adafruit_BME280_Library. You install all libraries via the LIBRARY MANAGER, confirming also the installation of any dependencies:
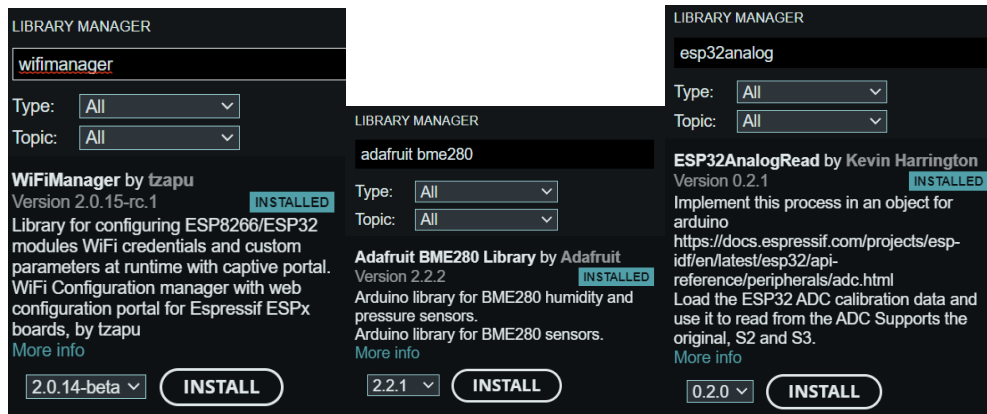

In the source code it is necessary to set the domain to TMEP.cz (or any other address of your choice), where the data from the weather station will be sent. If you don't have an account on TMEP.cz, just create one:

- Open https://www.tmep.cz, click on "My Account" on the upper right.
- Under "Register", fill in your email and password, submit and then log in with your detail
- Click on "Add sensor", fill in the name and domain, select "Temperature, humidity and pressure" in "Sensor type", copy the value for "Domain for sending values and save the sensor.
- Fill in the copied "Domain for sending values" in config.h.

Now that you know the domain to which you will send the measurements, edit the program source code and put the desired address in the *serverName* definition line between the quotes:

```
String serverName = "DOMENA.tmep.cz";
```
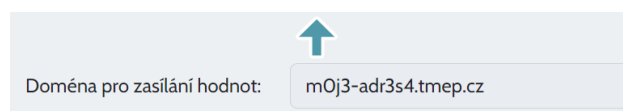

Finally, flash the program to the development board. After the program has been successfully loaded, you can disconnect the board from the computer and disconnect the programming converter from the board:

```
Output
Writing at 0x000cac68... (73 %)
Writing at 0x000d0865... (76 %)
Writing at 0x000d69e0... (78 %)
Writing at 0x000dcd09... (81 %)
Writing at 0x000e314c... (84 %)
Writing at 0x000e959e... (86 %)
Writing at 0x000efa84... (89 %)
Writing at 0x000f59ab... (92 %)
Writing at 0x000fba8f... (94 %)
Writing at 0x001036f1... (97 %)
Writing at 0x00109ea1... (100 %)
Wrote 1034128 bytes (612649 compressed) at 0x00010000 in 17.8 seconds (effective 465.9 kbit/s)...
Hash of data verified.

Leaving...
Hard resetting via RTS pin...
```

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8) Setting up the weather station's Wi-Fi connection

Plug the power supply into the board - either via a programmer, USB-C connector or a charged battery. At this point you should be able to connect (e.g. from your mobile phone) to a Wi-Fi network:

AP: **LaskaKitMeteo**
Password: meteostation

This is the network that the board transmits, if the AP where the weather station should be connected to is not configured or if is not in range.

When you connect to the "LaskaKitMeteo" AP, either the settings page will open automatically, or load "http://192.168.4.1" in your web browser and you will be taken to a signpost similar to this one:
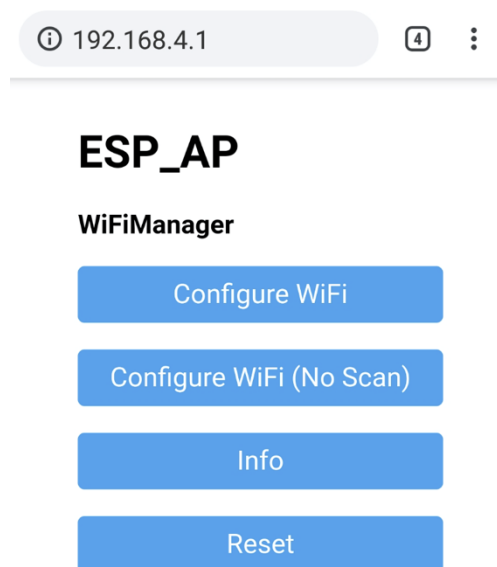

Configure Wi-Fi and select one of the available networks or manually fill in the SSID and then the password to connect to the intended access point. Then save the values. If the AP is in range, then a measurement should come up immediately to the domain you chose on TMEP.cz. If you already want to connect the station to Wi-Fi and you have the external antenna option, then you need to have it connected - the signal difference is abysmal and without it you may not scan the intended network and be able to connect to it.

If you don't see the measurements on TMEP, then you can look in its administration to debug the incoming values for a specific sensor. There you can see if something is coming to the server and from what IP address.

After the final placement of the weather station, you can have the service delete the existing stored measurements so that you have a clean history without values that don't belong there.

This completes the preparation and you can start the final assembly including the radiation shield, bracket, external antenna and solar panel.

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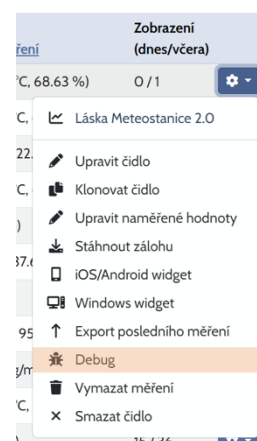
Assembling a box with electronics

Let's get to building the box! Before you can screw board in, there are a few things that need to be done one at a time:

1. Connect the battery to the board to the connector marked BATTERY - in the photo it is the one on the left.
2. Plug the USB-C connector into the bottom so that the cable from it goes inside the box and plug it into the board into the connector marked SOLAR - in the photo on the right.
3. You can now insert the board into the box carefully so that the cables   from the connector and battery fit snugly inside.
4. If you have an external antenna, push its IPEX connector through the   bottom hole in the box and plug it into the connector on the development board.
5. The BME280 sensor is already connected to the board and you can screw it into the box with two M2.2x5 screws (the shortest ones).

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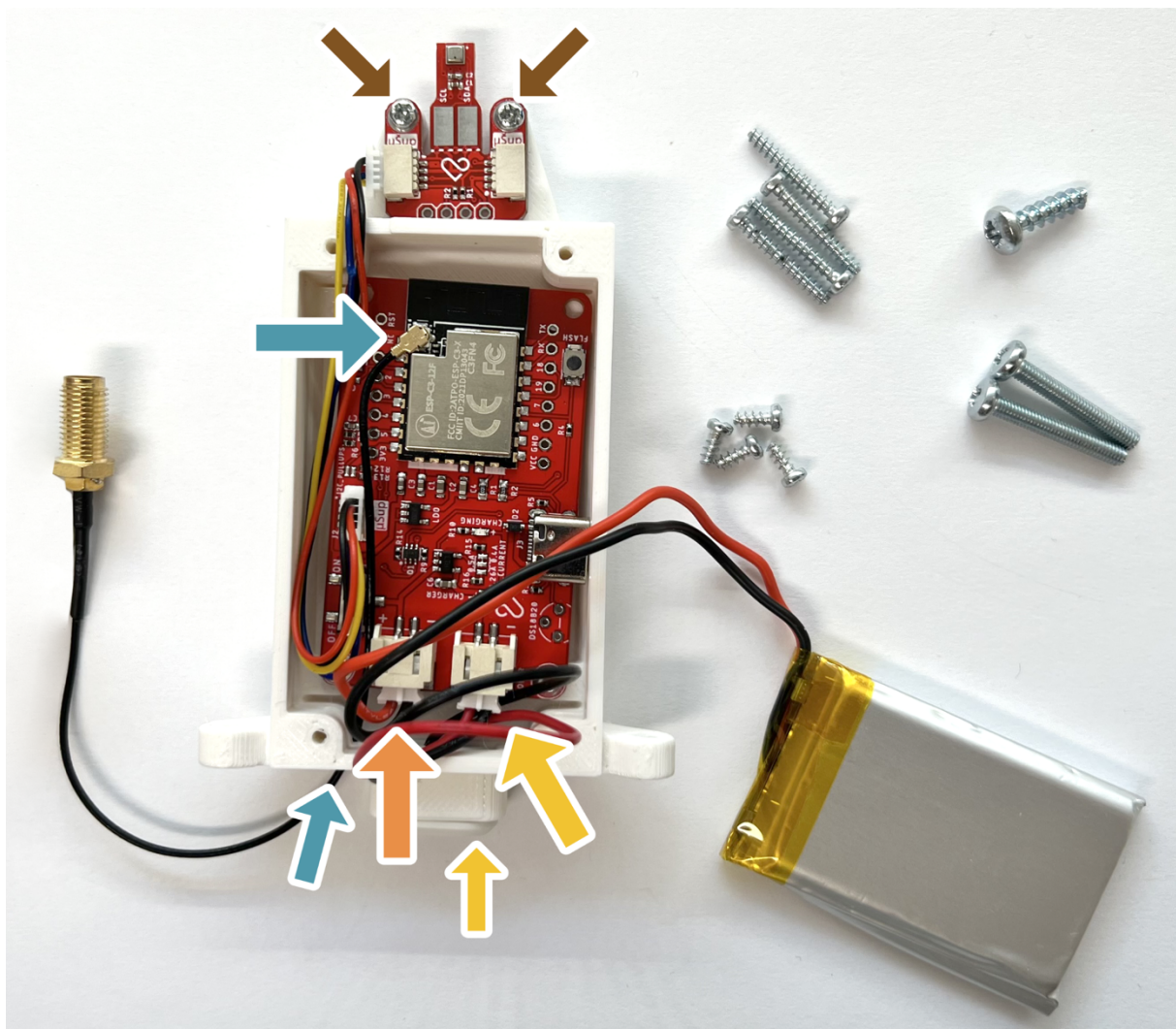
Screw the development board into the box with four M2.2x5 screws.
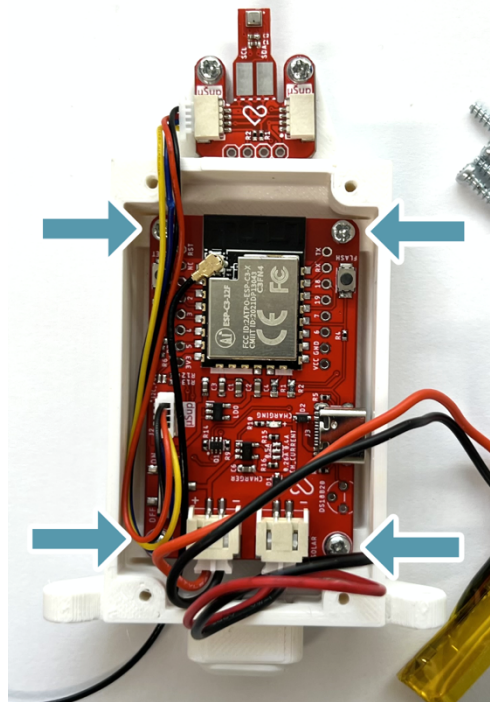
Prepare to close the box - carefully place the cables and battery inside on top of the development board so that nothing sticks out. When you close it, which will happen in the next step, the **cables leading to the sensor must be in the hole designed for them (they are outside in the photo and the hole where they need to go is marked here)**, otherwise you will pinch them and may irreversibly damage them! But don't worry, we have plenty of our µŠup cables in stock if it comes to worst :)

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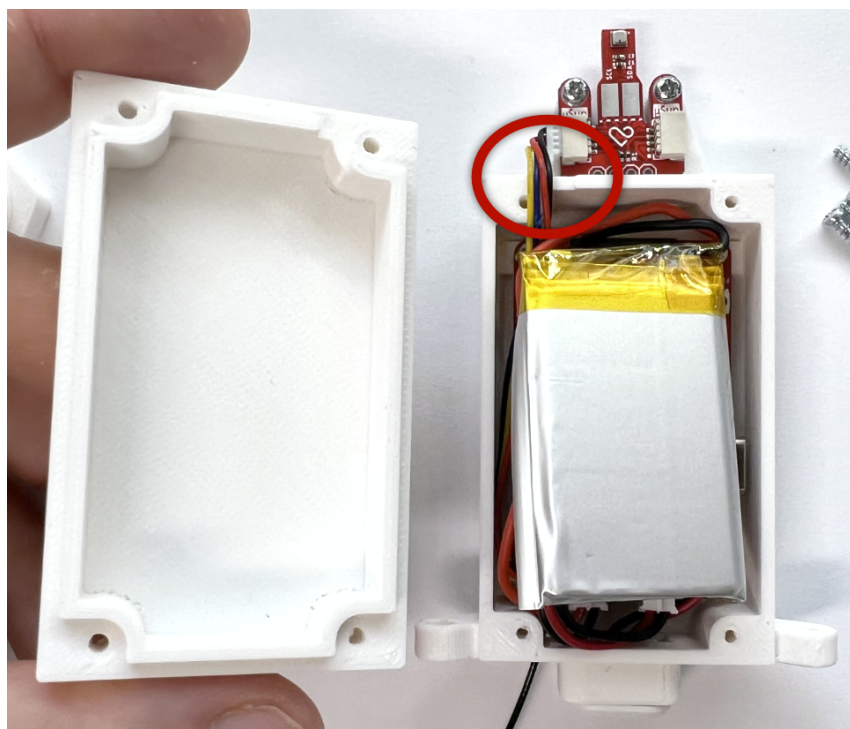
When you are closing the box with the top printed part, check that all cables are in and not pinched anywhere.
Be especially careful with the cable leading to the sensor - it belongs in a prepared hole where it fits nicely:
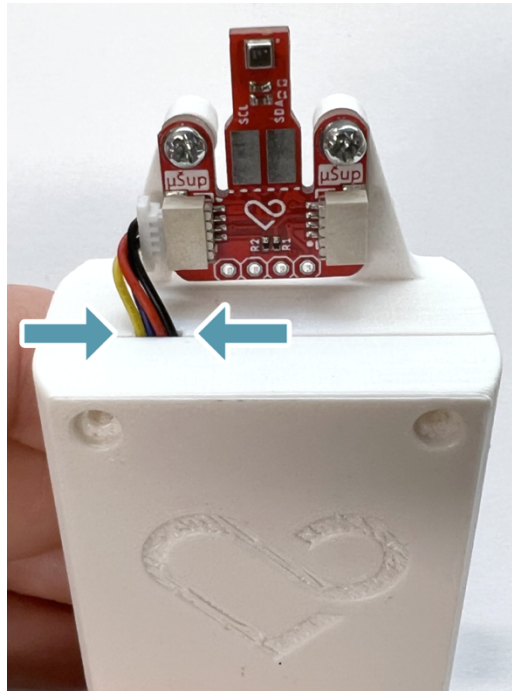
Screw the cap with four M2.2x16 screws.

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Solar panel mounting method

Decide if you want to place the solar panel on the radiation shield or if you want to attach it elsewhere (separately, e.g. on the wall). The separate mounting option is better - you can simply hide the radiation shield in the shade in a place where the readings will be less affected by solar radiation and perhaps radiant heat. In that case, you don't have to modify the radiation shield in any way and you can use the wall bracket that came with the solar panel.

In case you want to place the solar panel on the radiation shield, you will need to drill a hole 3.2mm for an M3.5x12 screw similar to the one shown in the photo on the left radiation shield:

A template is between the 3D printed parts to easily determine the center:

It is easier to drill the hole now, before connecting the radiation shield to the box and bracket, which we will do in the next step.

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Assembling the shield, box with board and holder

Insert the electronics box into the radiation shield as shown. A 3D printed bracket will come on top of it, where you can place a connector to the Wi-Fi antenna (if you have an external antenna).
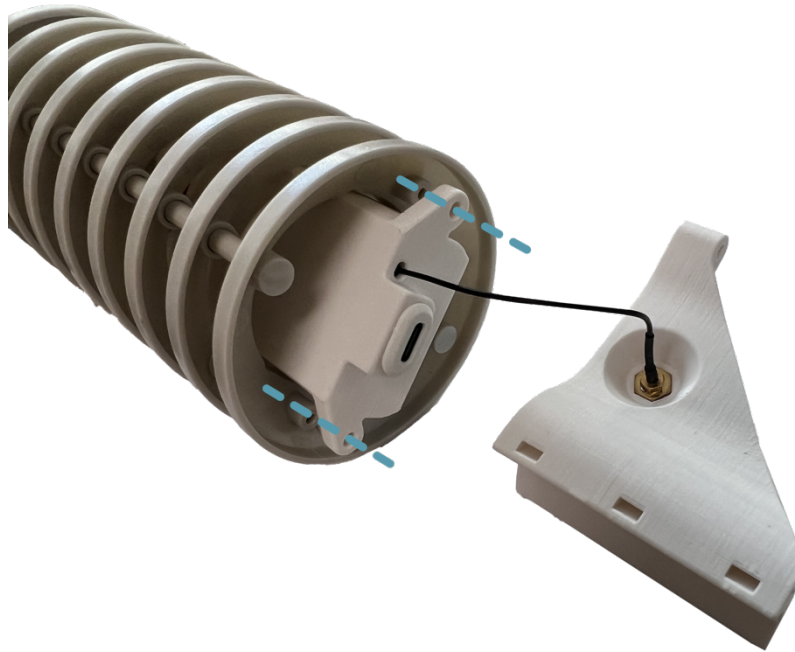
Align the holes of the radiation shield, electronics box and bracket. Then connect them with two M3x20 screws. Screw the Wi-Fi antenna (if you have this version of the weather station) onto the connector with the washer as shown.

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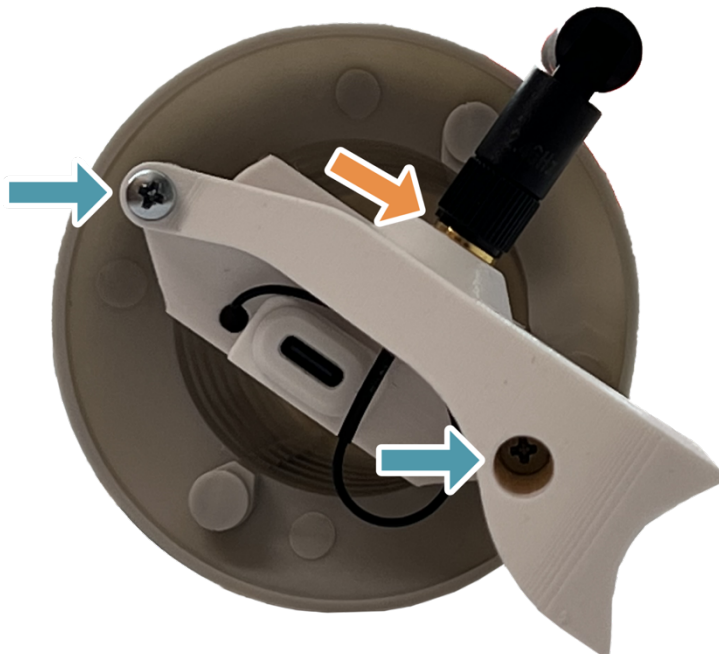
Are you putting together a variant where the solar panel will be placed outside the radiation shield? **Congratulations**, you've finished the build!

The weather station is secured to the mounting bracket with three ties. Where to place it? Check out the Useful tips at the end!

Use the supplied dowels to attach the solar panel bracket to a suitable location. Finally, connect the solar panel via the USB-C connector to the electronics board and you can start enjoying the readings.

Are you going to put the solar panel on the radiation shield? Then continue with the instructions.

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Putting a solar panel onto the radiation shield

If you have chosen this option and have drilled the hole according to the template (see instructions two pages back), now add the solar panel to the radiation shield.

Unscrew the original wall bracket from the solar panel to remove it as in the following picture and prepare the following three 3D printed parts:

Insert a 3D printed washer over the hole in the radiation shield and a threaded part over it. Screw both into the radiation shield with an M3.5x12 screw.

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Insert the last 3D printed part as shown in the picture into the hole in the solar panel instead of the original wall   bracket:
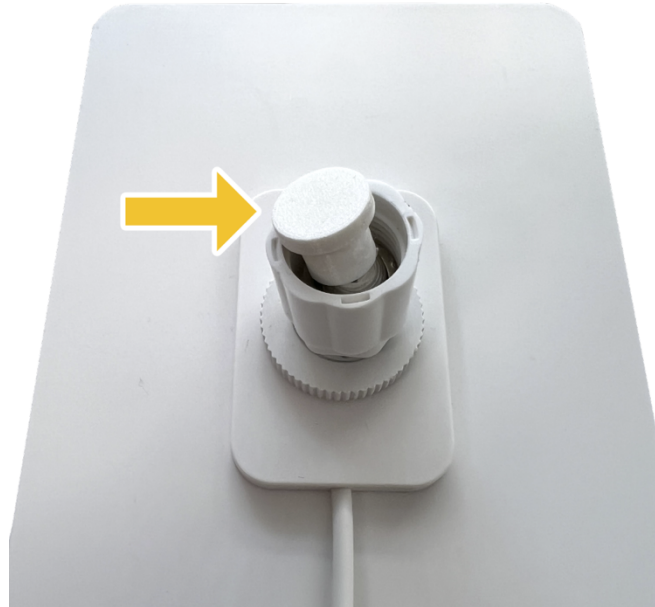
Now you can screw the solar panel onto the counter piece that you screwed onto the solar panel in the previous step. **Congratulations**, your build is complete!

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Useful tips

- If you have the chance, place the weather station 1.2 - 2m above, for example, a grassy area away from the house and in the shade. This will ensure the most accurate measurement.
- When placing the weather station, avoid places where radiant heat could be generated - facade, asphalt.
- Thanks to the solar panel, the battery of the weather station is recharged when needed, so the weather station should be positioned and the solar panel should be rotated so that as much light as possible falls on the solar panel, and at the same time the solar panel casts a shadow on the electronics housing (if it is placed on the radiation shield) to avoid a large heating of the housing by sunlight. Therefore, a better option is the one where the solar panel is not placed on the radiation shield, but separately.

Printable parts

The necessary file for printing all parts can be found in our repository here: https://github.com/LaskaKit/Weather_Station_Mini/tree/main/3D.

Parts are printed in the position in which they are stored.

Recommended print settings

- **Material:** PETG
- **Colour:** White (for maximum reflectivity of possible sunlight)
- **Filling:** 20% GRID
- **Layer height:** 0.2 mm (0.15 or variable layer height can be used for a smoother appearance)

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