

iSPEX 2:

Deployment and Operation



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776480.

DDQ | innovative
mobile projects



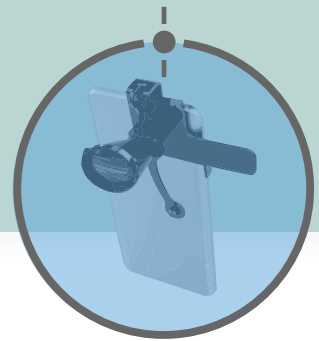
Universiteit Leiden

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iSPEX 2

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SYSTEM DESCRIPTION

iSPEX 2 is a device for measuring air and water quality on the user's smartphone. It has two components, namely a hardware add-on and a software application.

This document describes these components, how they are installed on the user's smartphone, how they are used to obtain data, and how the data are uploaded to the MONOCLE backend service.



SYSTEM INSTALLATION

The iSPEX 2 software application (app) and hardware add-on are provided and installed separately. The application needs only be installed once per smartphone, while the add-on is installed and removed at the beginning and end, respectively, of every session.



INSTALLING THE iSPEX 2 APPLICATION

Applications have been developed for the Android and iOS operating systems (OS). Both versions are still in beta mode for a limited release. This means users cannot yet install them independently.

First, the user must determine which OS they have.

All Apple iPhone series smartphones use iOS. The app is available for iPhone 6S (2015) and more recent devices.

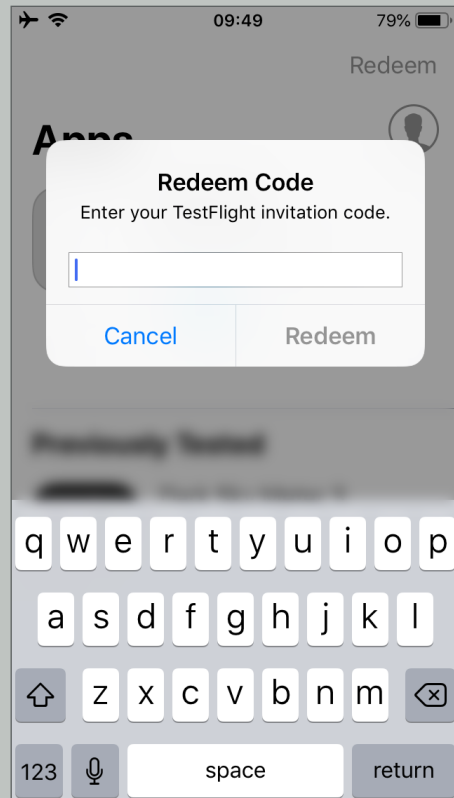
Virtually all smartphones by other manufacturers, including but not limited to Asus, Fairphone, Google, HTC, Huawei, Nokia, OnePlus, OPPO, Samsung, Sony, and Xiaomi are Android-based. This can be confirmed by looking for the “Google Play” app, which is automatically installed on Android devices.

IOS INSTALLATION

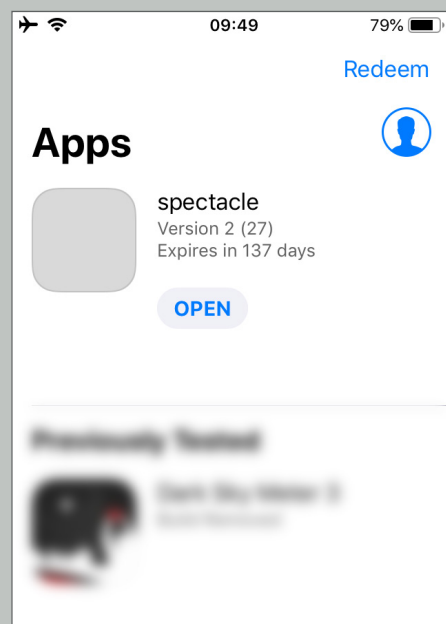
The iOS beta programme is run through Apple's TestFlight service. This is a closed beta, meaning the user must first ask the developer for access.

Please follow these steps for installation:

1. On your iPhone, install TestFlight from the App Store.
2. Open the Testflight app and log in.
3. In the Testflight app, click "Redeem" (top right corner) and enter the code sent to you by the developer.



4. In Testflight, a header titled "Apps" should have appeared, which lists the "spectacle" app. Install this and open it with the button that appears next to it.



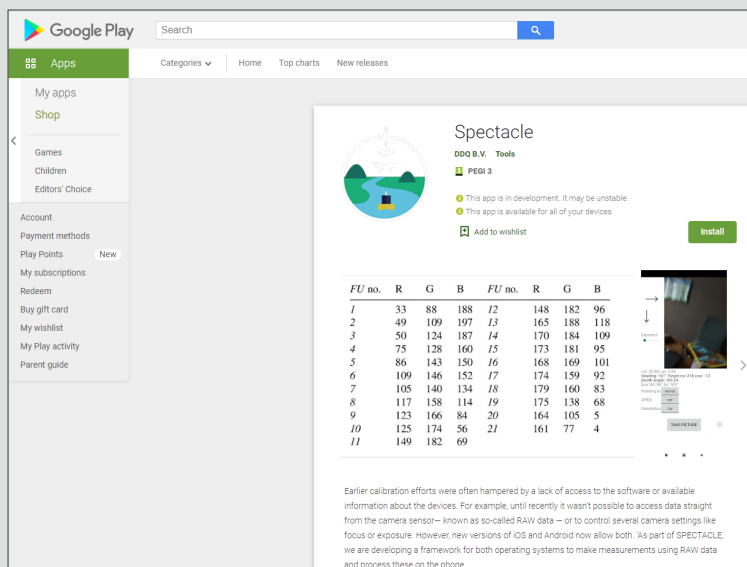
ANDROID INSTALLATION

The Android beta programme is run through Google Play. It is an open beta, meaning anyone can participate. The app can be installed from this link: <https://play.google.com/store/apps/details?id=nl.ddq.android.spectacle>

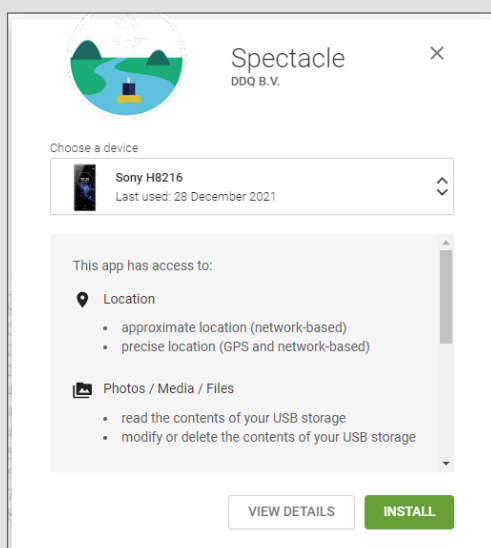
The app can be installed from your computer or from your smartphone.

Android installation from a computer

1. Open the installation link in your web browser (Chrome, Firefox, Edge, Safari, etc.):
<https://play.google.com/store/apps/details?id=nl.ddq.android.spectacle>
2. Install the app using the green “Install” button.



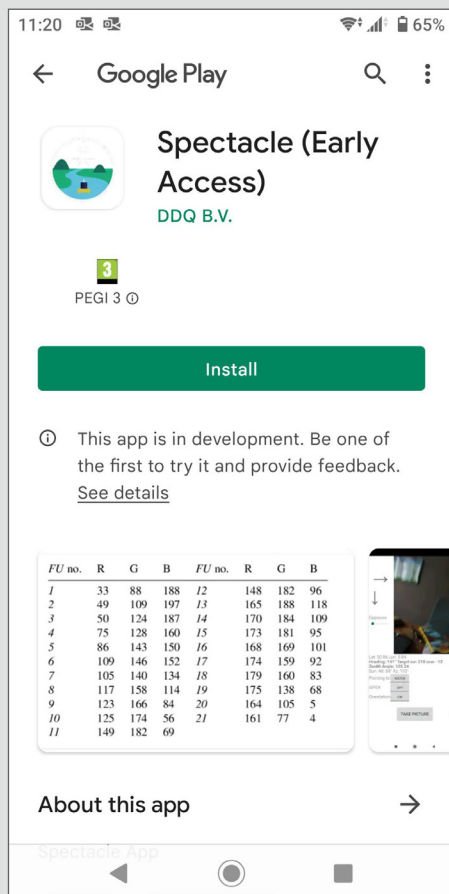
3. Select the device you wish to install the app on from the dropdown menu, and click the green “Install” button.



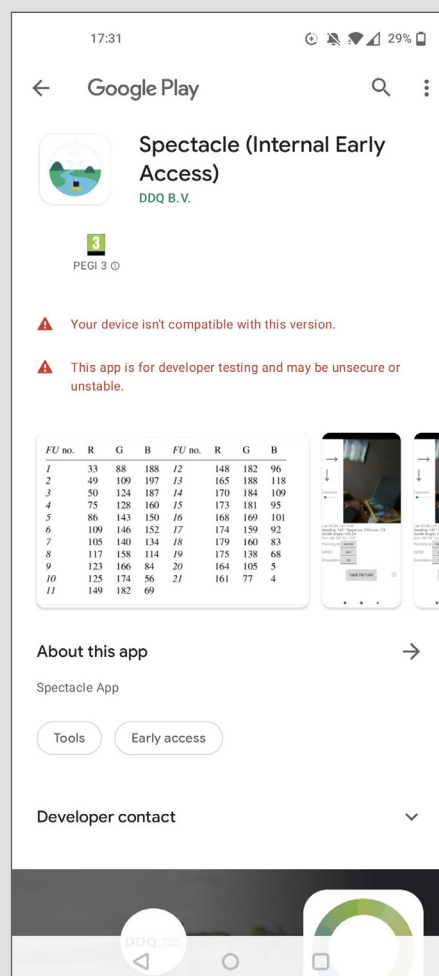
4. The app will now automatically be downloaded and installed on your selected device.

Android installation from a smartphone

1. Open the installation link in your web browser (Chrome, Firefox, etc.):
<https://play.google.com/store/apps/details?id=nl.ddq.android.spectacle>



2. Click the green “Install” button near the top of the screen.



3. The app will now automatically be downloaded and installed on your device.

INSTALLING THE iSPEX 2 ADD-ON

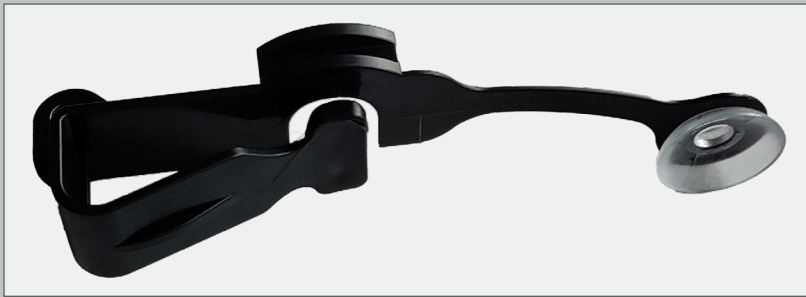
Parts

The iSPEX 2 add-on consists of three parts. First make sure you have all three.



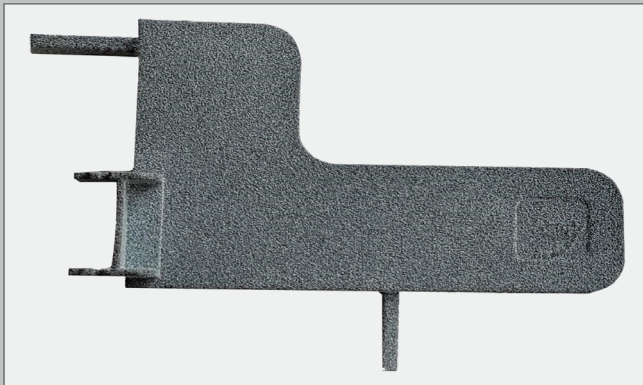
1. Optical tube.

Please make sure the barcode is present at the bottom.



2. Smartphone clip.

The clip and tube may already be attached when you receive the add-on.

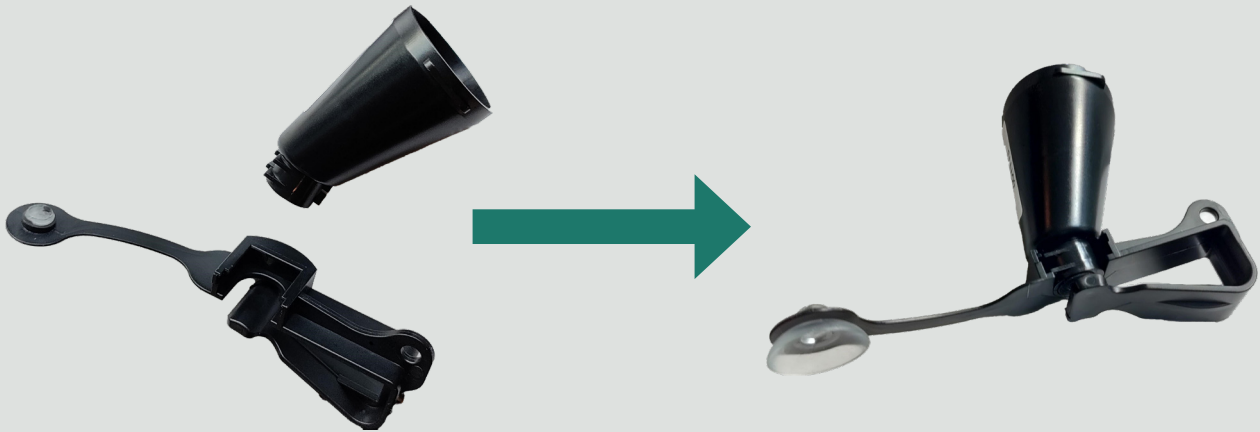


3. Smartphone backplate.

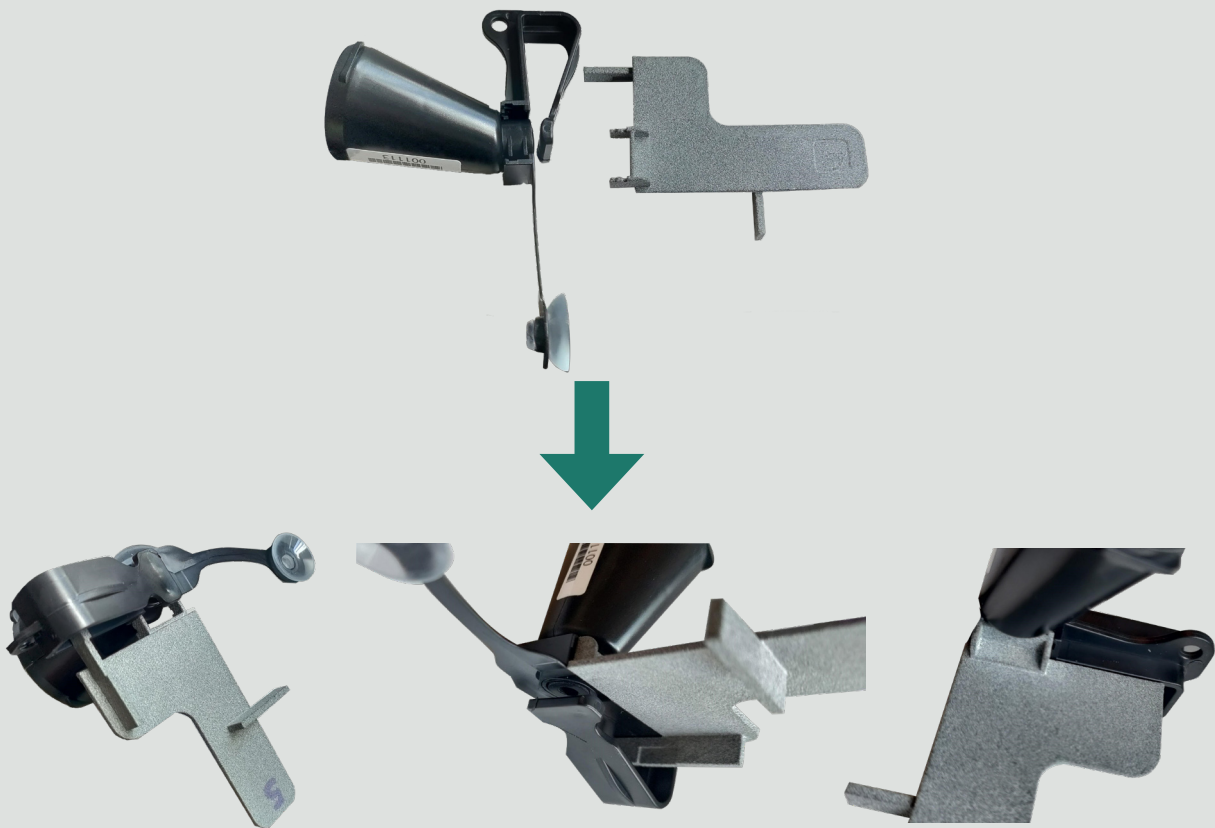
There is a unique backplate for every smartphone model, so make sure to select the one suitable for your device. The sticker on the front side indicates the appropriate model.

Assembly

1. Combine the tube and clip. The tube should slide smoothly into the clip. Apply force until it stops moving. There is no clicking noise.



2. Combine the tube-clip and backplate. Make sure the backplate is oriented correctly. Apply force until it fits snugly into place. There is a clicking noise when this happens.



3. To swap backplates for another smartphone, simply pull the current backplate out (tilting it sideways makes this easier) and redo step 2 with the new backplate.

Installation on a smartphone



1. If you have a smartphone cover or case, remove it.
2. Take your smartphone in one hand and the iSPEX 2 add-on in the other. If this is not possible, use a table or similar surface to lay the smartphone on.



3. Slide the top right corner of your smartphone into the smartphone clip. You may need to use your other hand to slightly open the clip, especially for thicker smartphones.

4. Slide the iSPEX 2 add-on over your smartphone until the bars on the top and left sides fit snugly.



5. Gently press the suction cup on the back of the smartphone until it is firmly attached.
6. Gently move the smartphone back and forth to ensure the add-on is firmly attached. If the add-on appears to rotate or slide off, start again.

SYSTEM CHECK

BEFORE HEADING INTO THE FIELD

1. Make sure you have assembled your iSPEX 2 add-on with the correct backplates, or are bringing the parts for your smartphone and know how to assemble it in the field.
2. Ensure you have the iSPEX 2 app installed on your smartphone.
3. Check the iSPEX 2 app is functioning correctly - try taking a test photograph, of anything, before leaving.
4. Make sure your smartphone has enough battery power left (at least 20% is recommended).
5. If you are conducting water reflectance measurements, make sure you have a grey card with you. A standard 18% grey card, which is readily available online or from photography stores, should be used. A card the size of a postcard or bigger is sufficient.

IN THE FIELD

1. Check that iSPEX 2 is properly installed on the smartphone (see previous instructions).
2. Make sure you are standing in a position with a clear view of the water or sky you want to investigate.
3. Ensure you are standing in a position where you can move your arms up-down and around freely without hitting an obstacle or a person.
4. Try not to drop your smartphone.
5. After taking measurements, keep the app open (this can be in the background) until you reach a stable WiFi connection.



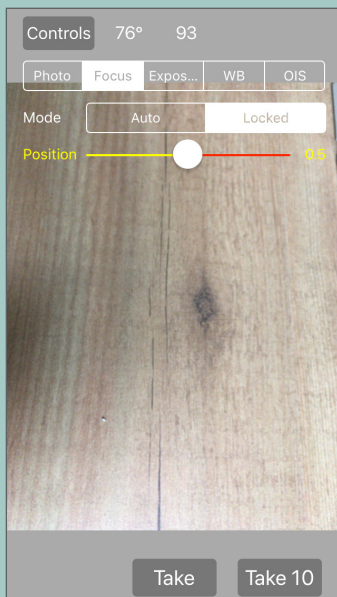
MEASUREMENTS

GENERAL

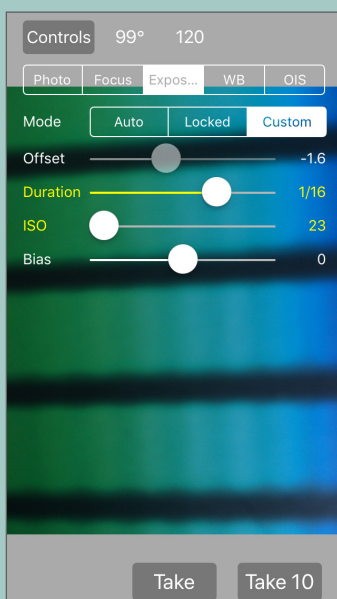
iOS



1. Open the iSPEX 2 app on your device.

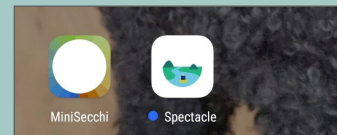


2. Click the top left "Controls" button, then go to "Focus", click "Locked" and drag the circle all the way to the right.

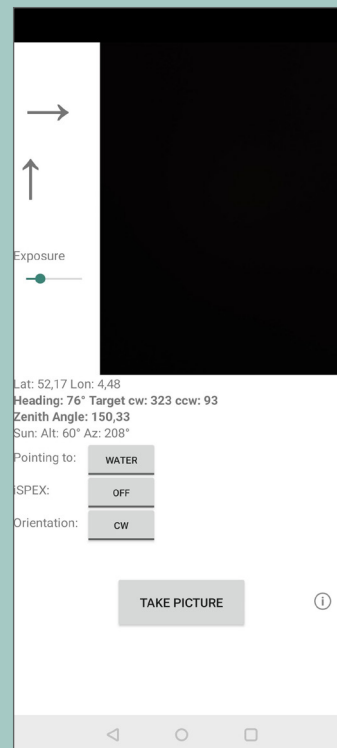


3. Go to the "Exposure" menu, click "Custom" on the top right, then drag "ISO" all the way to the left. Then drag "Duration" slowly to the right until an image of what you are observing appears.

Android



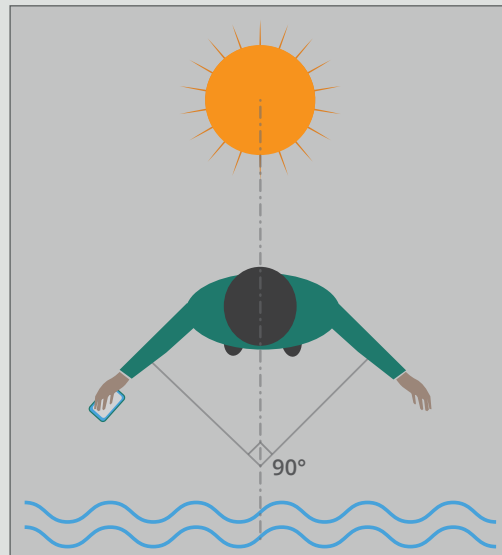
1. Open the iSPEX 2 app on your device.



2. Drag "Exposure" slowly to the right until an image of what you are observing appears.

WATER: REMOTE SENSING REFLECTANCE

1. Find an unshaded patch of water. You must not be able to see the bottom. There should be a clear view of the water itself and the sky above it. Measurements are best done on a fully clear or fully overcast day.
2. Orient yourself so the sun is behind you and the water roughly in front of you. Do not get too close to the water, for your safety.
3. Get your grey card ready, for example under your arm, or around your neck.
4. **Android:** Press the “iSPEX” button until it says “ON”.
5. With the sun directly behind you, hold your arms out straight in front of you and move them back equally to form a square corner.
6. Pick the direction of the arm with the clearest view of the water and sky. Now face this angle.
7. Fine tune your angle using the app:
 - a. **iOS:** There are two numbers in the top left of the screen. Move around a little until the right-most number is as close to 135 as possible.
 - b. **Android:** Press the “Orientation” button for CW (clockwise) or CCW (counterclockwise), depending on which direction you chose. Now move around a little, following the horizontal arrow at the top, until you are at the right angle.
8. With an outstretched arm, point the smartphone downwards.
 - a. **iOS:** Slowly point downwards until the number in the top left of the screen is as close to 67 degrees as possible.
 - b. **Android:** Slowly follow the vertical arrow downwards until you are at the correct angle.
9. Fine-tune the exposure (**iOS:** “Duration” slider; **Android:** “Exposure” slider) until you see a clear, but not saturated, spectrum in the preview window.
10. Take an image (**iOS:** “Take”; **Android:** “Take picture”).
11. Without moving the smartphone, put the grey card into its field-of-view as shown in the image. Hold it as horizontally as possible.
12. Fine-tune the exposure (**iOS:** “Duration” slider; **Android:** “Exposure” slider) until you see a clear, but not saturated, spectrum in the preview window.
13. Take an image (**iOS:** “Take”; **Android:** “Take picture”).
14. Put the grey card away again.
15. **Android:** Press the “Pointing to” button until it says “SKY”.
16. Keeping your arm stretched, move your smartphone up.
 - a. **iOS:** Move up until the top-left number is 33 degrees.
 - b. **Android:** Follow the vertical arrow up until you have finished.
17. Fine-tune the exposure (**iOS:** “Duration” slider; **Android:** “Exposure” slider) until you see a clear, but not saturated, spectrum in the preview window.
18. Take an image (**iOS:** “Take”; **Android:** “Take picture”).



You have now taken the three measurements required for a water reflectance measurement.

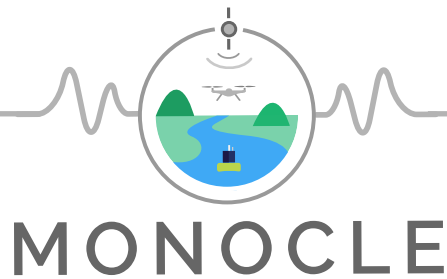
DATA UPLOAD

Data are automatically uploaded to the MONOCLE backend if a stable internet connection is present.

This can happen in the field over a mobile data connection (3G, 4G, 5G), though take note of your service provider's charges for mobile data.

It can also happen at home over a WiFi connection.





MONOCLE creates sustainable in situ observation solutions for Earth Observation (EO) of optical water quality in inland and transitional waters.

MONOCLE develops essential research and technology to lower the cost of acquisition, maintenance, and regular deployment of in situ sensors related to optical water quality. The MONOCLE sensor system includes handheld devices, smartphone applications, and piloted and autonomous drones, as well as automated observation systems for e.g. buoys and shipborne operation. The sensors are networked to establish interactive links between operational Earth Observation (EO) and essential environmental monitoring in inland and transitional water bodies, which are particularly vulnerable to environmental change.

Other MONOCLE observation solutions include:



FreshWater Watch



Hypersectral Radiometer (HSP1)



iSPEX2



KdUINO



MapEO Water



Mini-secchi disk



So-Rad



WISPstation

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