

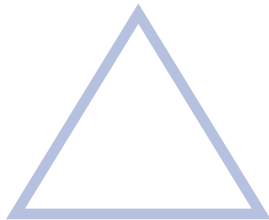
Our journey into open hardware river monitoring

Professor Wouter Buytaert
Imperial College London

Who are we?

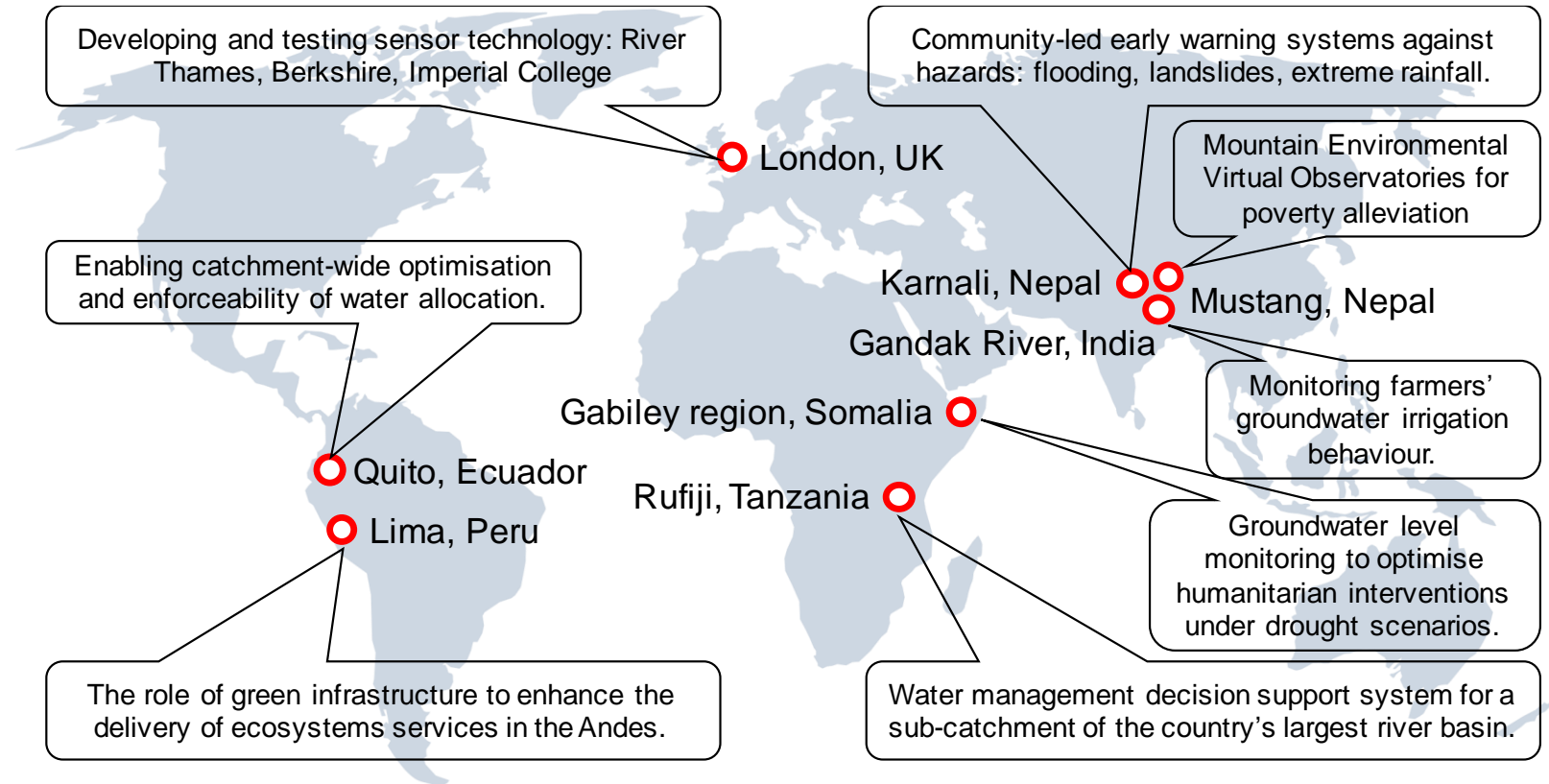
The hydrology and water resources lab @ Imperial

water resources management



hydrological processes

sustainable development



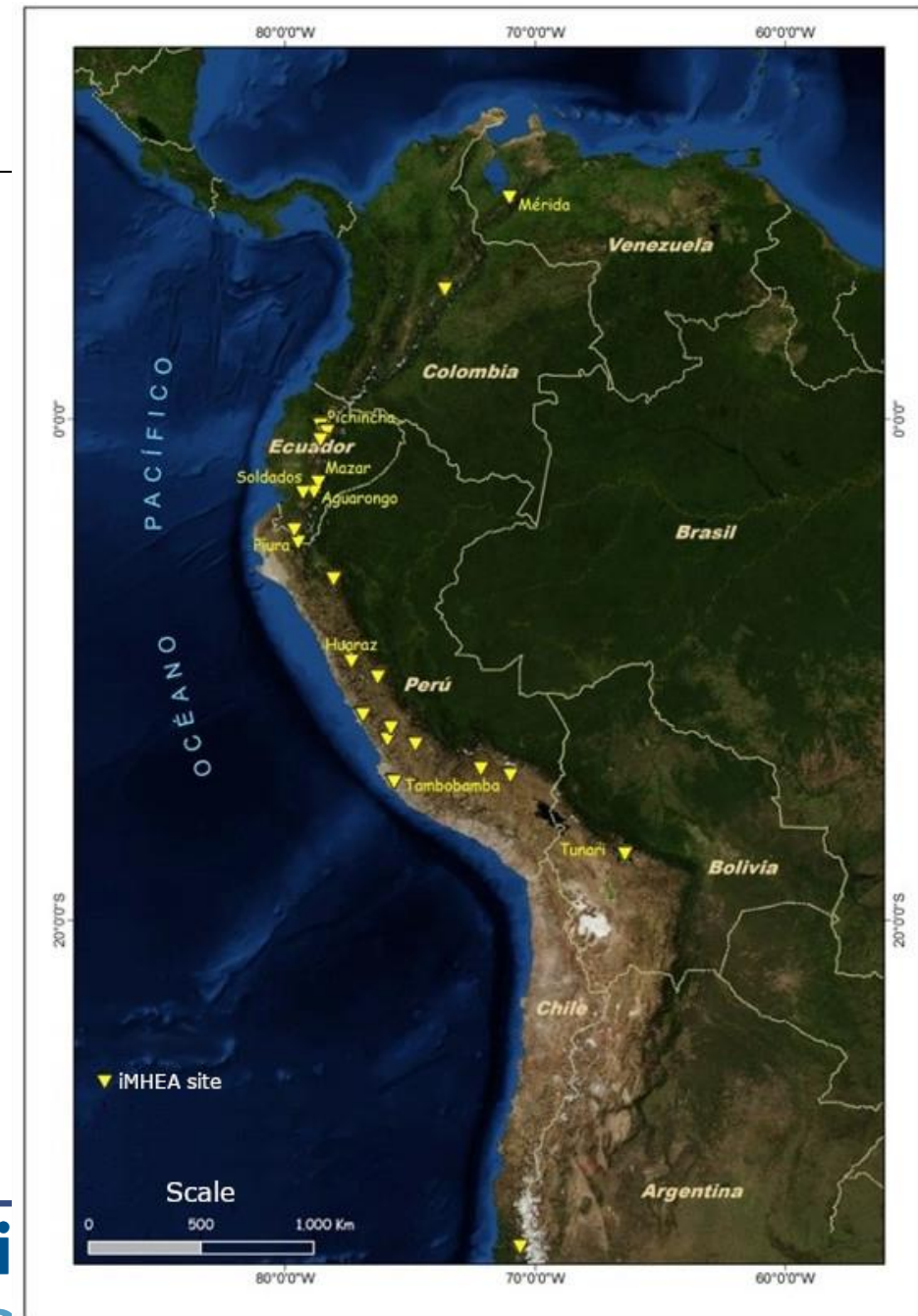
River monitoring in resources-constrained contexts

- Land-use impacts on the hydrological response of mountain catchments in Ecuador and Colombia
- Community-based flood resilience building in Nepal and India
- The impact of melting glaciers on water resource in Peru, Bolivia, and Chile
- Drought early warning in East Africa
- Flood forecasting in Niger, Ghana, and Kenya

...



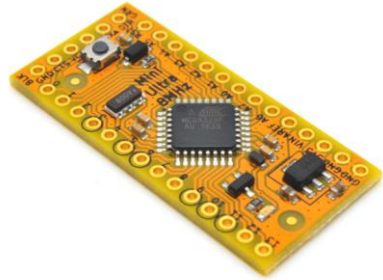
The iMHEA monitoring network



Non-contact methods



Early prototypes



Other sensors

- Lidar
 - Cost-effective
 - Power efficient
 - Rapidly advancing technology
 - Can operate at an oblique angle
 - Long range
- Temperature
- Turbidity
- Precipitation (tipping bucket)
- ...



Garmin LidarLite v3

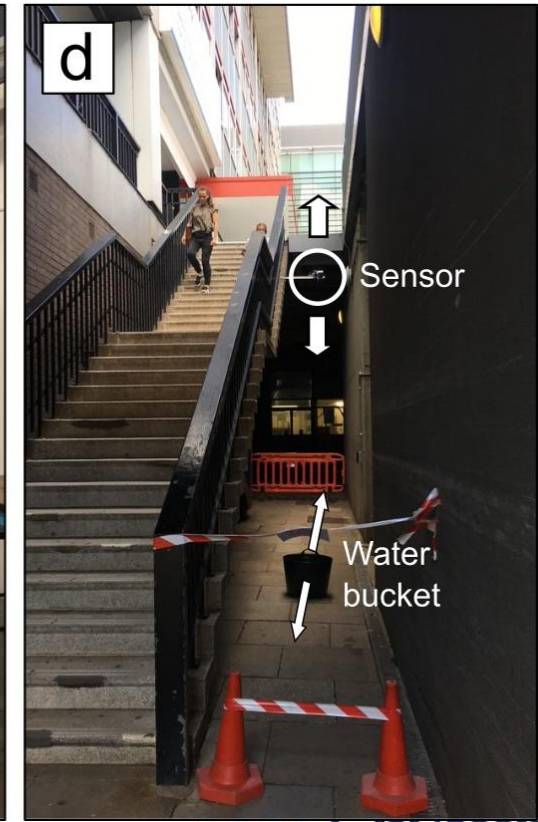
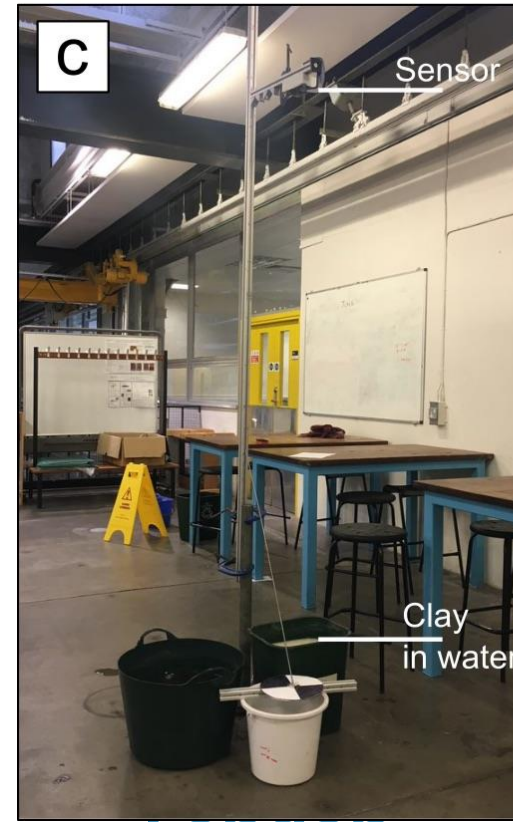
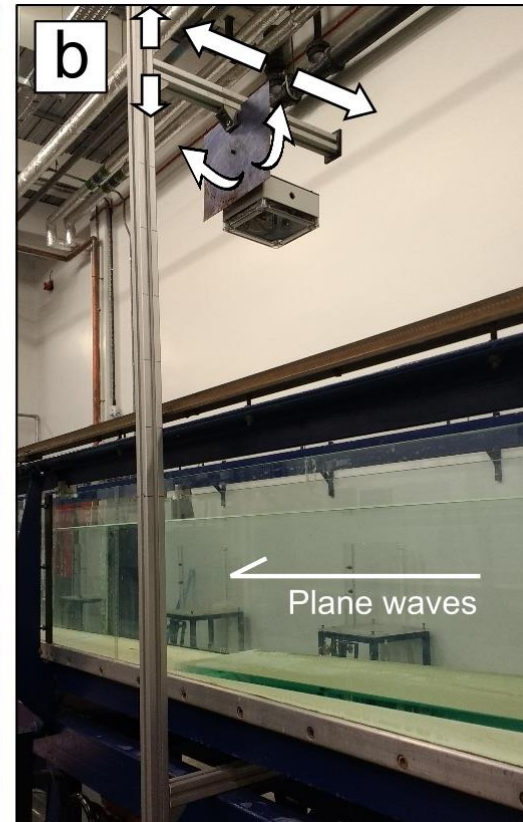
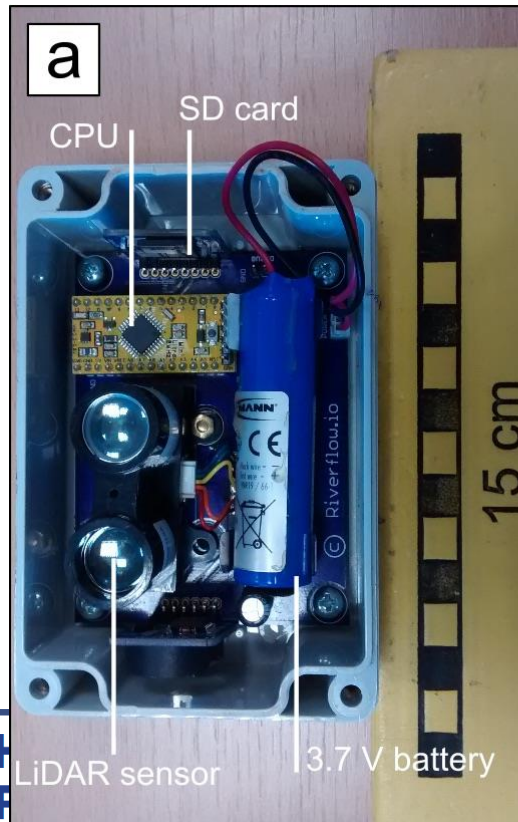


onset

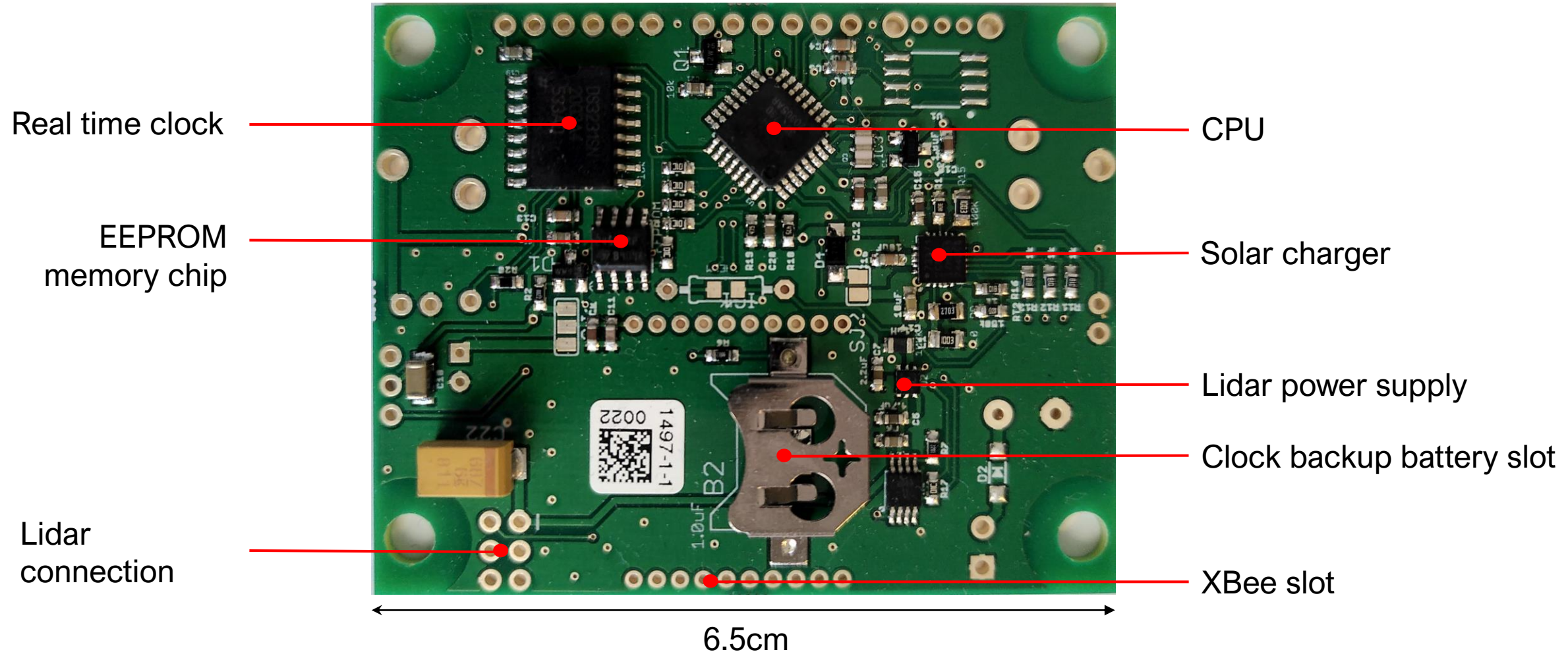


dfrobot.com

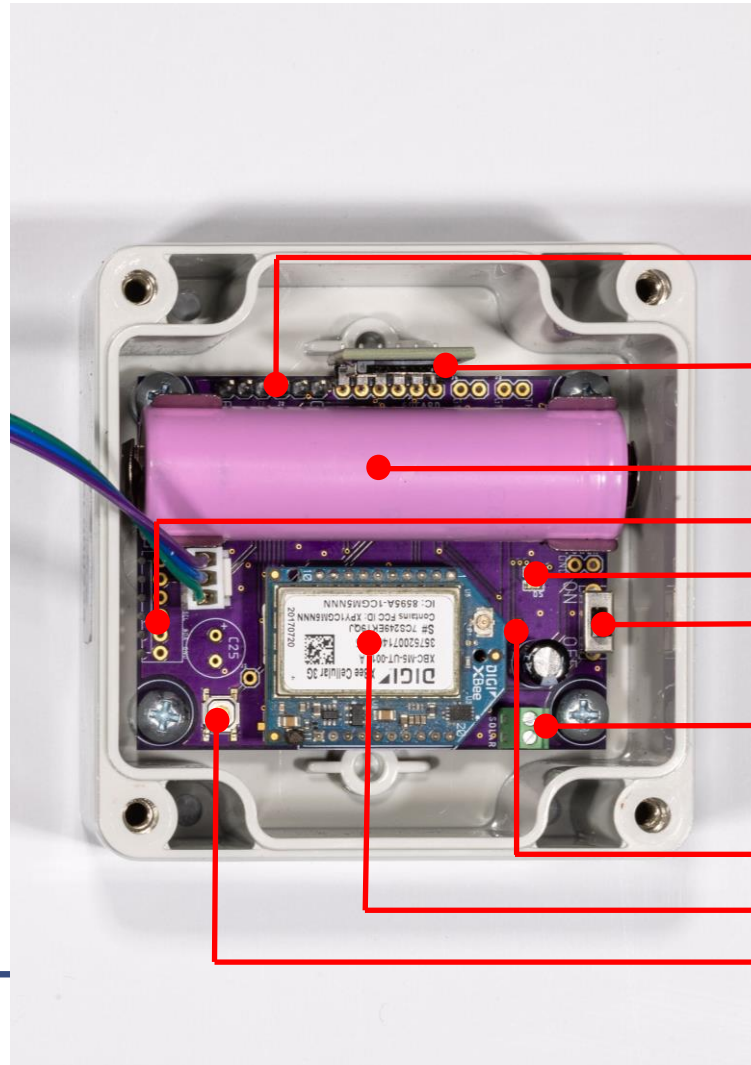
Experiments



Designing and producing our own PCB



Designing and producing our own PCB



FTDI programming port

SD card slot

Battery slot

Sensor connector

Charge LEDs (green, red)

On-Off switch

Solar panel connector

Indicator LED (red)

XBee cellular modem slot

Reset button

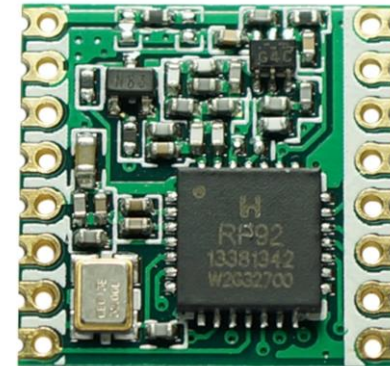
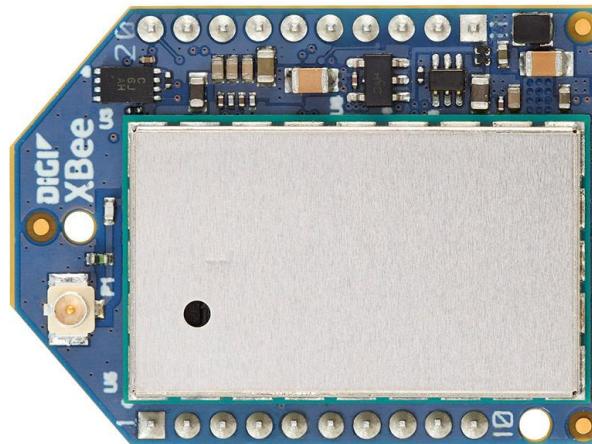
Current technical design

- Atmel Atmega328 processor (8 bit, 8MHz)
- Minicore bootloader
- Xbee slot for Zigbee or Cellular Xbee
- PCB footprint for Lora
- SD card slot
- Solar charger
- EEPROM internal storage
- Flash internal storage
- US or Lidar or other sensor



Logging and telemetry

- XBee Cellular 3G, 4G (LTE-M, Nb-IoT)
- COAP, MQTT
- LoRA
- Thingsboard IoT server, The Things Network



ThingsBoard | Dashboard

riverflow.io:8080/dashboards/c8975270-f9e5-11ec-92fe-c14c3720c783

80%

wouter@riverlabs.uk
Tenant administrator

Realtime - last 30 days

Uganda

RL000282

Realtime - last 7 days

Timestamp ↓	h	t	v
2023-02-06 09:38:00	862	2750	4066
2023-02-06 09:37:00	866	2750	4118
2023-02-06 09:36:00	0	2725	4066
2023-02-06 09:35:00	0	2725	4066
2023-02-06 09:34:00	859	2750	4066
2023-02-06 09:33:00	0	2750	4066
2023-02-06 09:32:00	0	2725	4125
2023-02-06 09:31:00	845	2725	4060
2023-02-06 09:30:00	866	2725	4066
2023-02-06 09:29:00	0	2725	4066
2023-02-06 09:28:00	0	2700	4066
2023-02-06 09:27:00	0	2700	4066
2023-02-06 09:26:00	869	2700	4066
2023-02-06 09:25:00	0	2700	4066
2023-02-06 09:24:00	876	2700	4066

Items per page: 20 21 - 40 of 200

h
t
v

Powered by ThingsBoard 4.3.3.3

Software (firmware)

www.github.com/ICHydro/Riverlabs

Search or jump to... Pull requests Issues Marketplace Explore

ICHydro / Riverlabs Unwatch 1 Star 2 Fork 2

<> Code Issues Pull requests Actions Projects Wiki Security Insights Settings

master 1 branch 0 tags Go to file Add file Code

File	Commit	Time
ICHydro XBee documentation	900db56	10 days ago 26 commits
WMOnode	XBee documentation	10 days ago
docs	XBee documentation	10 days ago
set_clock	adding set_clock.ino	21 days ago
wari	streamlining telemetry sequence to make it more robust to broken con...	25 days ago
.gitignore	Initial commit	11 months ago
LICENSE	Initial commit	11 months ago
README.md	adding WMOnode	last month
_config.yml	Set theme jekyll-theme-cayman	15 days ago

README.md

Riverlabs

This is the code repository for the [Riverlabs](#) suite of sensors.

The Riverlabs sensors use the Arduino bootloader, and the recommended programming environment is therefore the Arduino IDE. To get started with Arduino, we refer to the excellent [Arduino documentation](#).

For specific instructions on each sensor, look in the respective sensor folder.

Our code is based on numerous libraries, examples, and discussion posts from the Arduino community. We do our best to acknowledge and reference all sources of external code and specific solutions. For any improvements, corrections, and other comments, do not hesitate to [get in touch](#).

About

Code for the Riverlabs suite of environmental sensors

Readme MIT License

Releases

No releases published
[Create a new release](#)

Packages

No packages published
[Publish your first package](#)

Environments

1
github-pages (Active)

Languages

C++ 99.4% C 0.6%

Documentation

Documentation for the Riverlabs suite of sensors

Summary: This page gives a concise overview of operating the Riverlabs environmental loggers. Further details can be found in the rest of this documentation

Table of Contents

- Introduction
- Overview and specifications
 - Wari
 - Lidar
- Power considerations
- Programming the loggers
- Telemetry

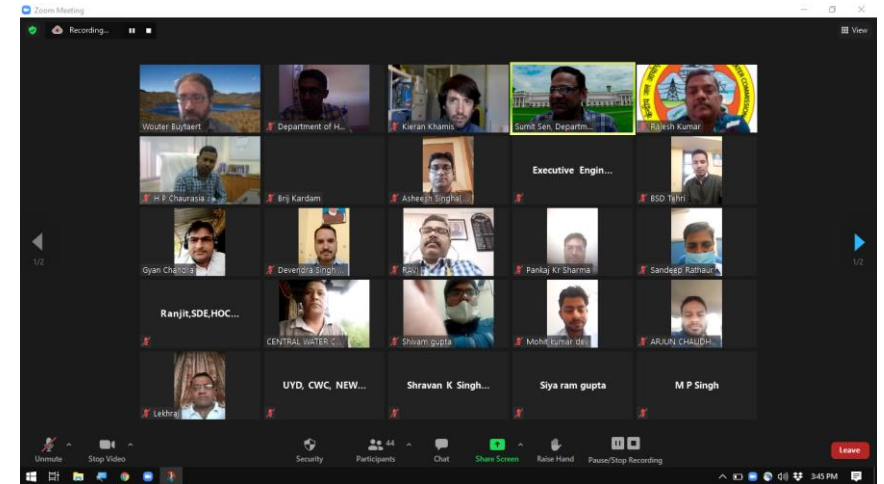
Introduction

The Riverlabs loggers are a series of low-cost environmental loggers based on the Arduino bootloader. This makes them easy to program using with a PC without the need for additional hardware (except for an FTDI cable) or propriety software. It also provides the flexibility to extend and alter them to fit specific applications and workflow.

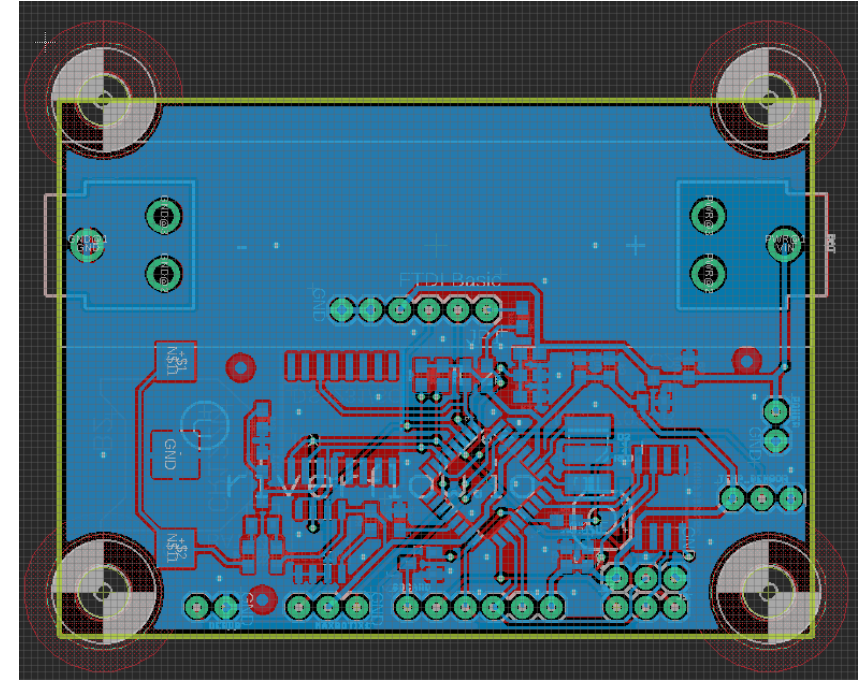
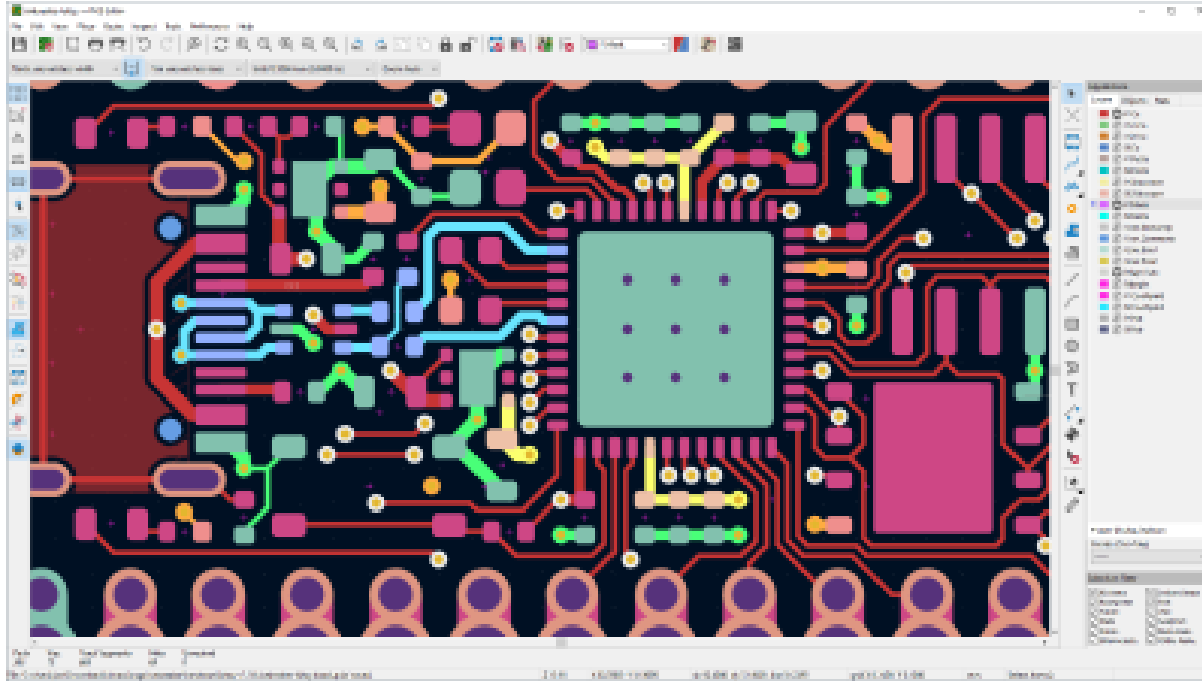
Overview and specifications

Wari

Lidar



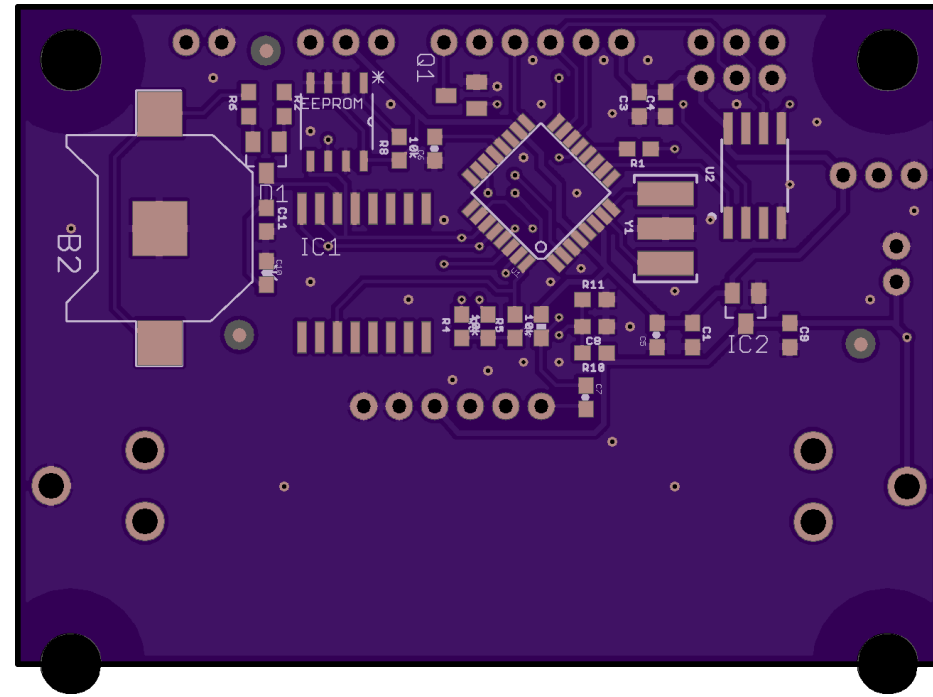
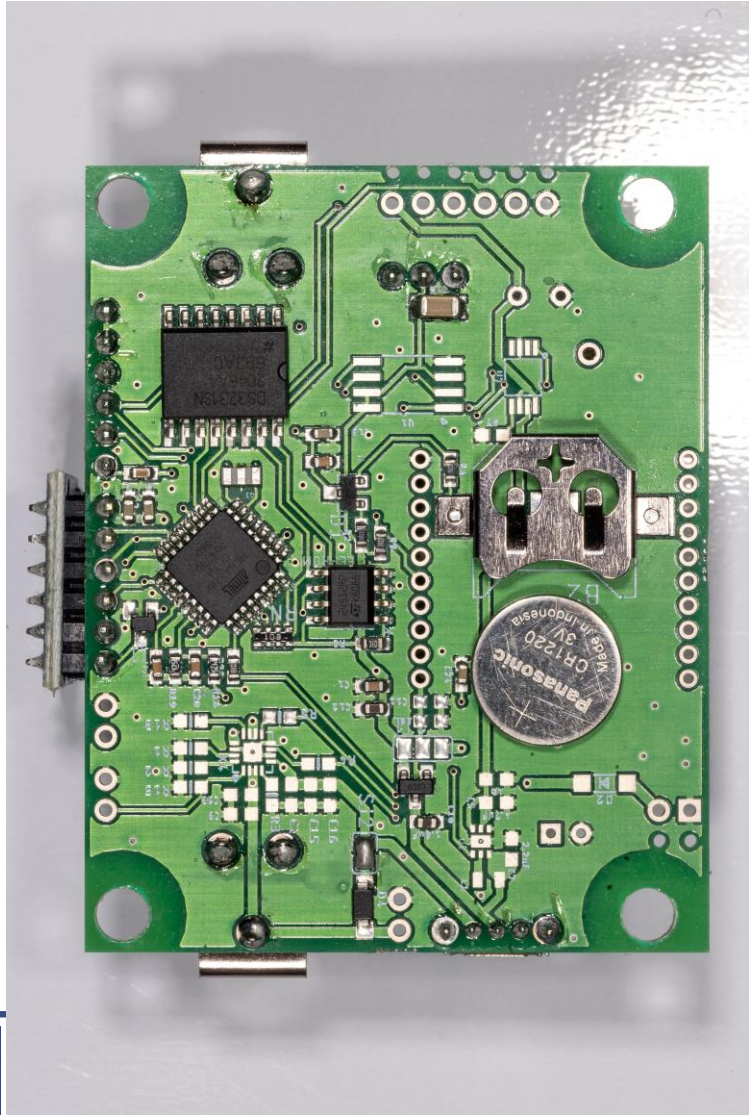
PCB design



Some good tutorials:

- <https://learn.sparkfun.com/tutorials/pcb-basics>
- <https://learn.sparkfun.com/tutorials/designing-pcbs-advanced-smd>

PCB fabrication and assembly



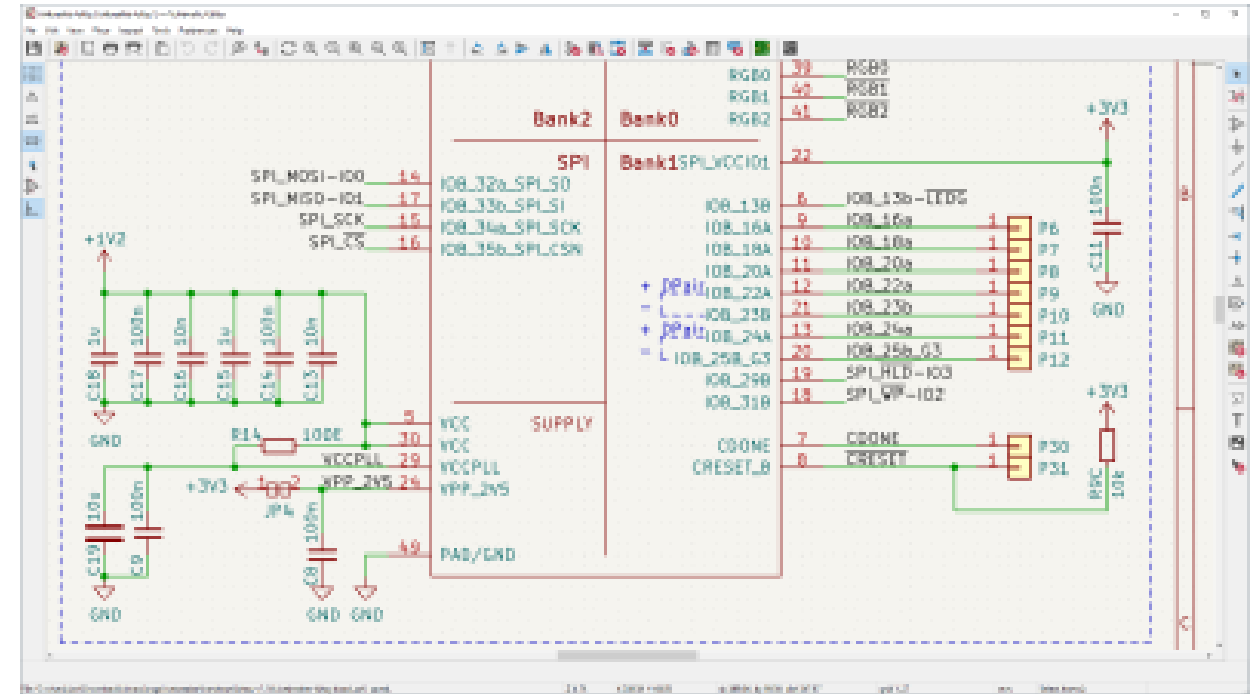
oshpark.com

Tutorials:

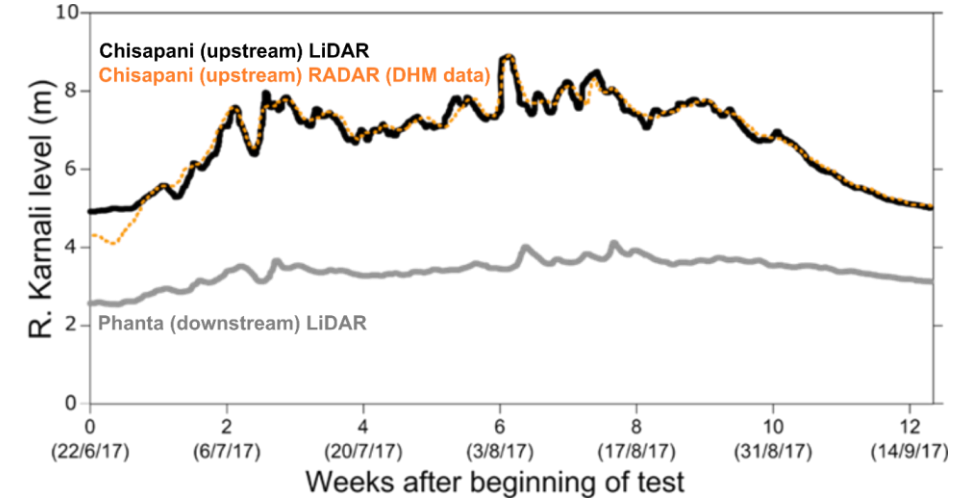
- <https://learn.sparkfun.com/tutorials/how-to-solder-through-hole-soldering>
- <https://www.sparkfun.com/tutorials/category/2>

Software

- Free software
 - KiCad, <https://www.kicad.org/>
 - Fritzing, <https://fritzing.org/>
- Commercial software
 - Fusion 360/Eagle
 - Circuitmaker
 - Altium Designer
 - ...



Early testing: Nepal



Other examples of open source environmental logger software

- Arduino examples -> SD -> datalogger

Example code of a datalogger writing to an SD card

- Arduino examples -> SDFat -> ExFatlogger

Example code of an advanced very high frequency datalogger writing to an SD card
(make sure to install the SDFat library first)

- <https://github.com/EKMallon/UNO-Breadboard-Datalogger>

Code of the Cave Pearl Project, an advanced data logger with lots of technical detail

- <https://envirodiy.github.io/LearnEnviroDIY/>

Code and tutorial to program the EnviroDIY Arduino-compatible datalogger

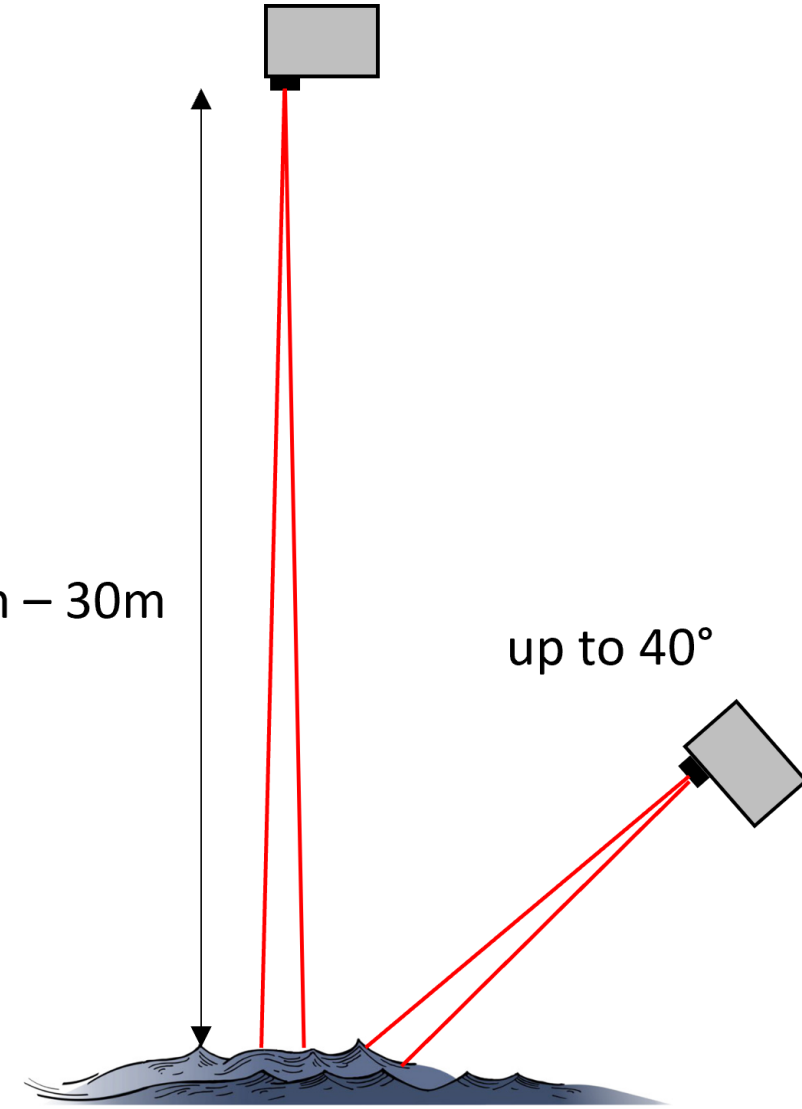
Early testing: Somalia





5cm – 30m

up to 40°



ial College



The Abdus Salam International Centre for Theoretical Physics