Drone assisted TTN deployment and mapping in remote areas

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Who am I

Luka Mustafa - Musti (MEng)

- electronics, telecoms, hardware hacking, ...
- Institute IRNAS Rače
- Shuttleworth Foundation Fellow
- University College London: PhD student

Also active in :

- HAM radio S59DXX
- wlan slovenija

SHUTTLEWORTH FELLOW

UCL

wlanslovenija

RADIOKLUB ŠTUDENT S59DXX

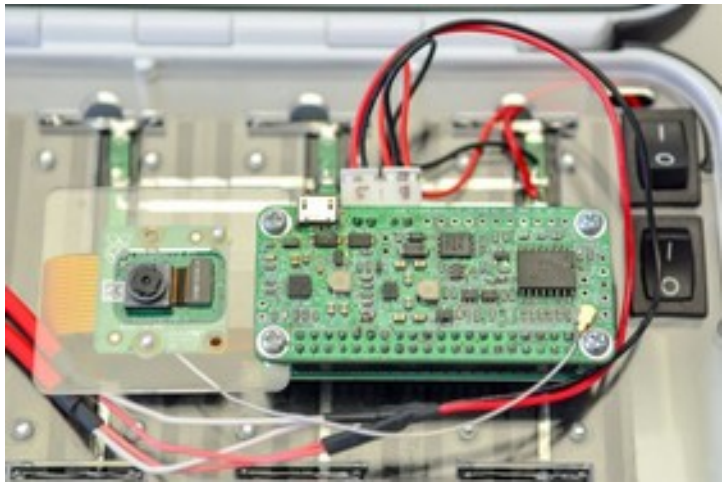
We build future-proof hardware!

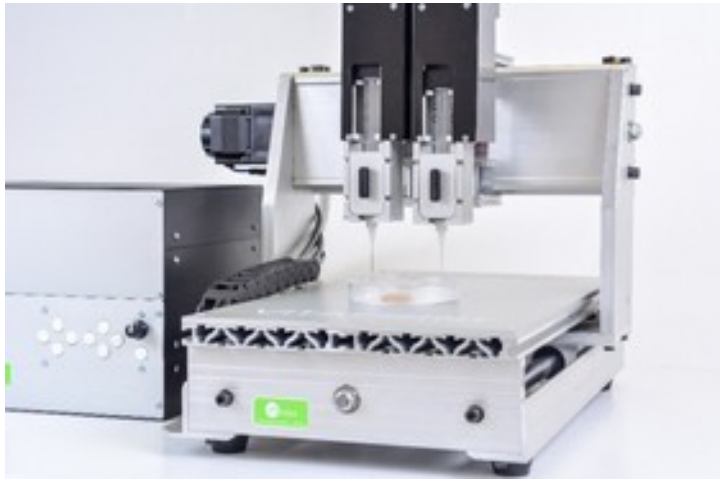
Research & Development

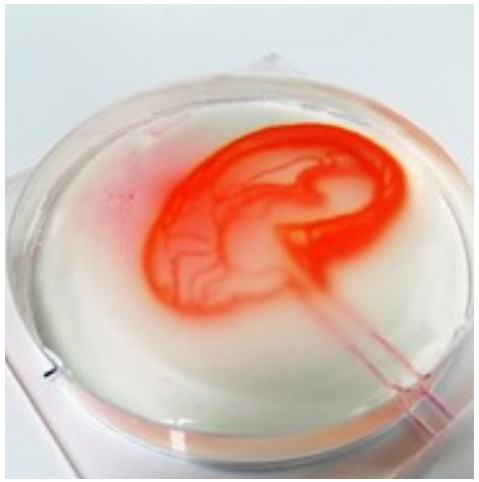
Prototyping & manufacturing

We work together to rapidly develop well-tailored and cost-effective solutions for industry and science.

Projects

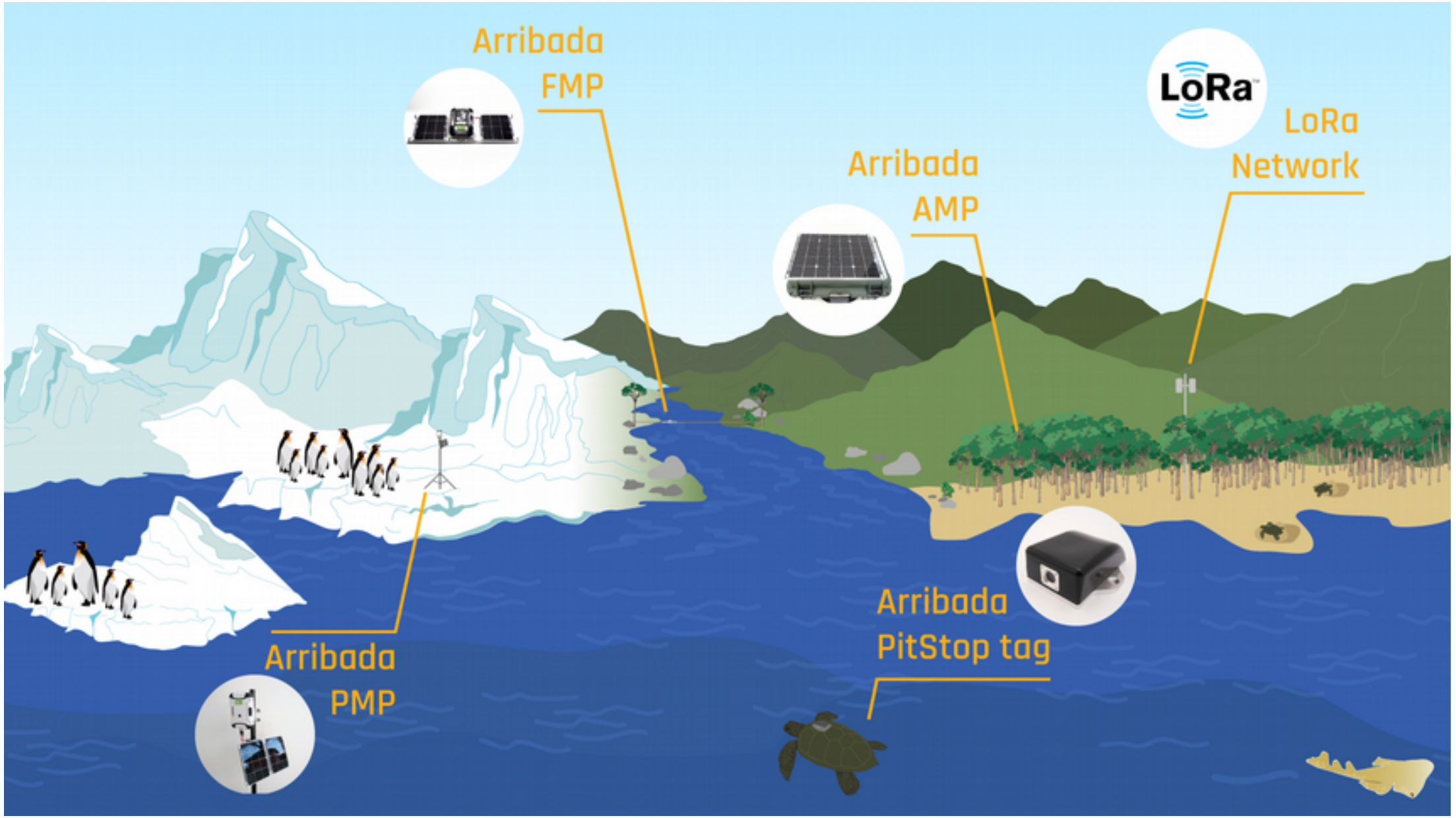




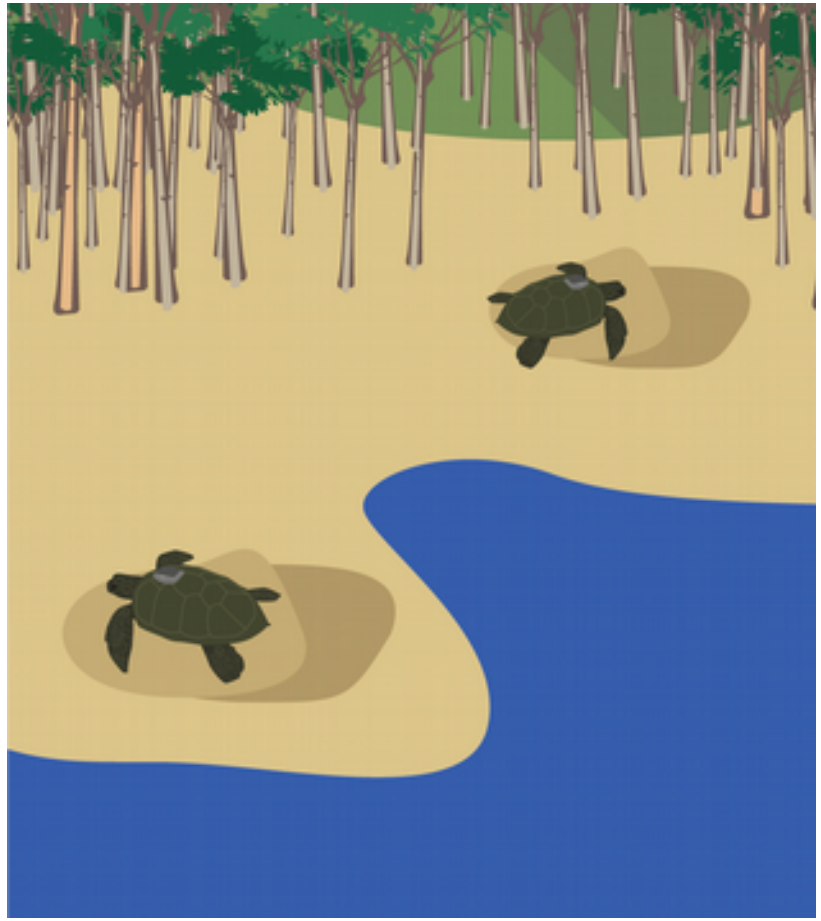


Animal conservation technology

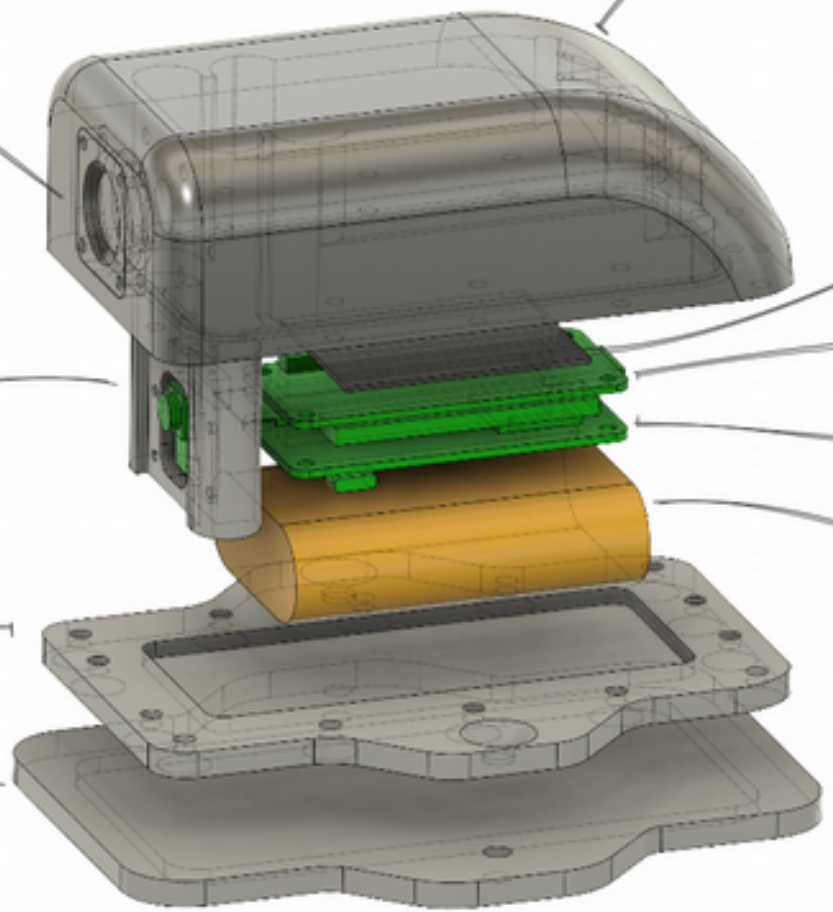
- Working with ARRIBADA initiative on open source conservation


Arribada
FMP
LoRa
LoRa
Network
Arribada
AMP
Arribada
PMP
Arribada
PitStop tag

Arribada Turtle PitStop tags



Arribada PitStop-C tag



enclosure - suitable for deep sea 50 bar / 500 m

camera lens - clear aperture for camera

wireless charging - charge a sealed device

Raspberry Pi Zero W - main processor for video recording

camera - efficient camera mounting system

PiRa zero - advanced power scheduling IoT circuit with LoraWAN

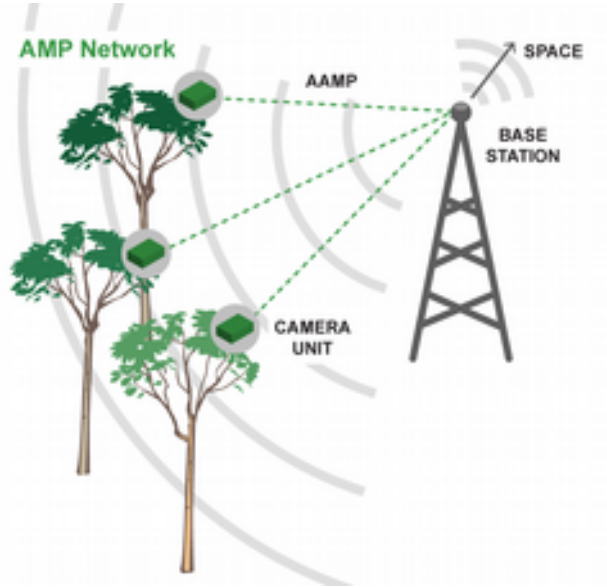
lid - simple opening for servicing, attachment points for base plate

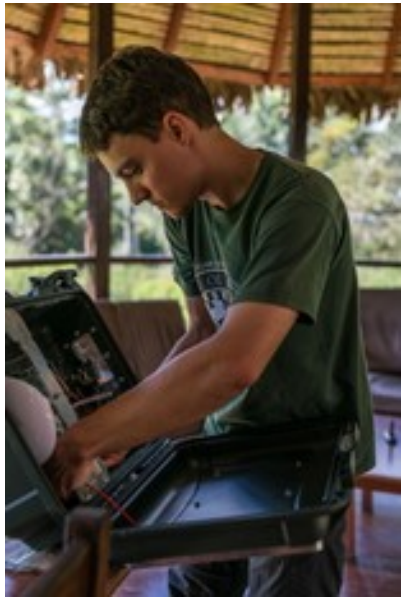
battery pack - 2 x 18650 LiPo cells

base plate - designed for optimal mounting on Green Sea Turtles

Developed by rnas for ARRIBADA initiative using cutting edge technologies by THE THINGS NETWORK resin.io Voltaic

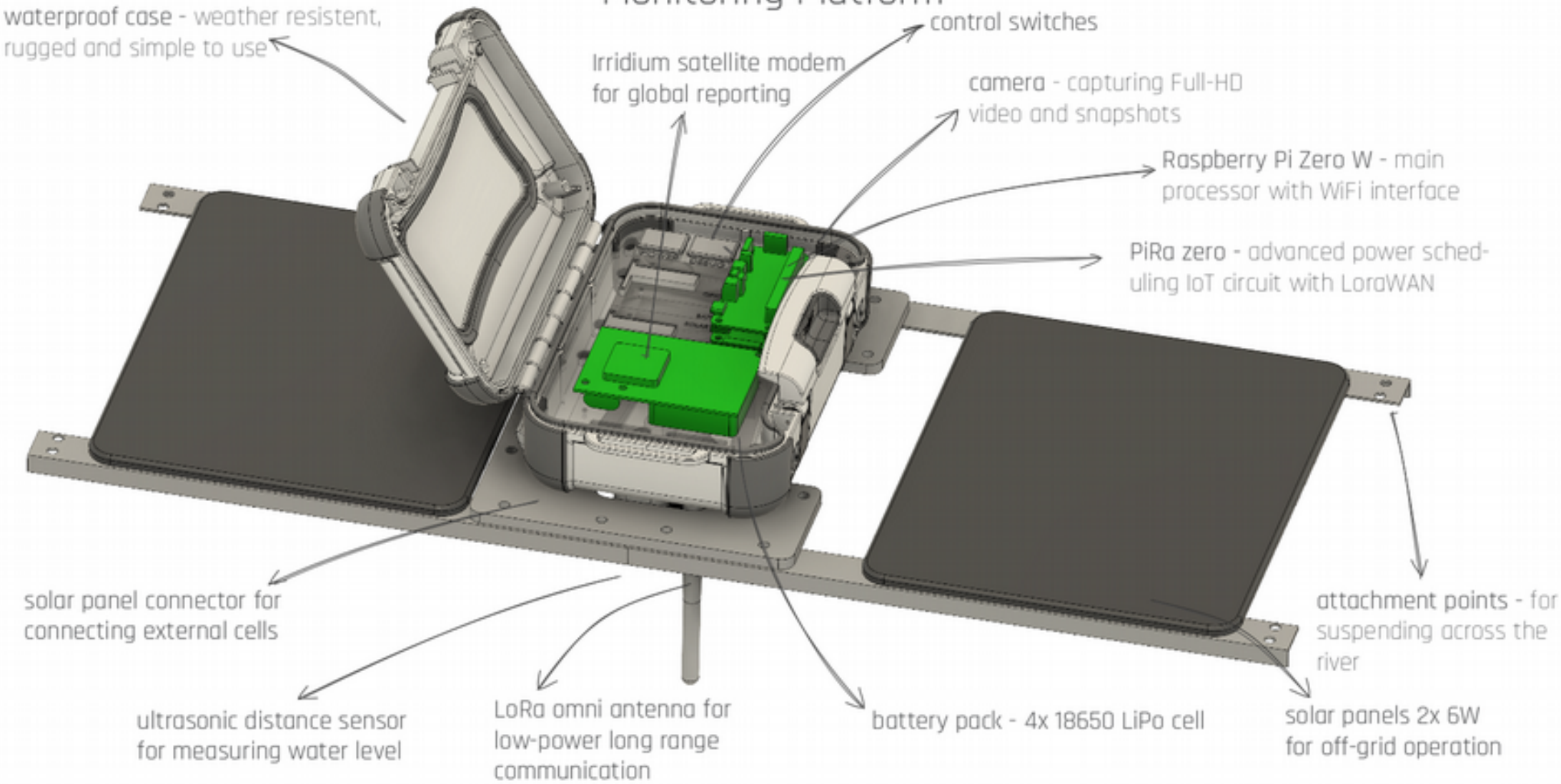
Arribada AMP in Peru





Arribada FMP for Madagascar

Arribada Freshwater Monitoring Platform



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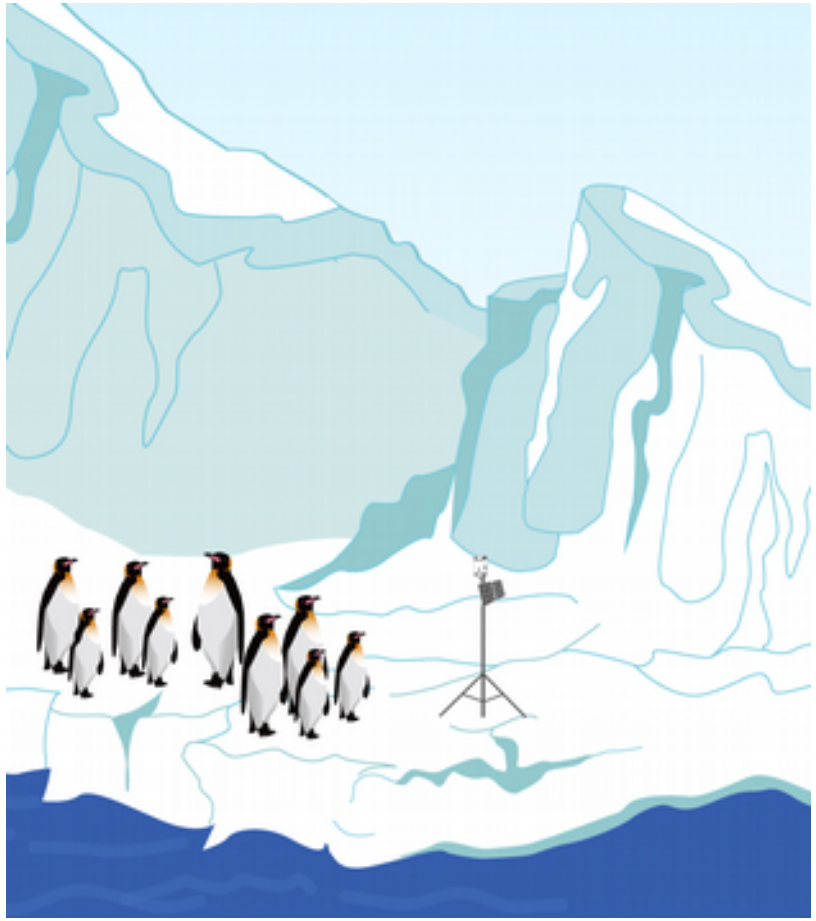
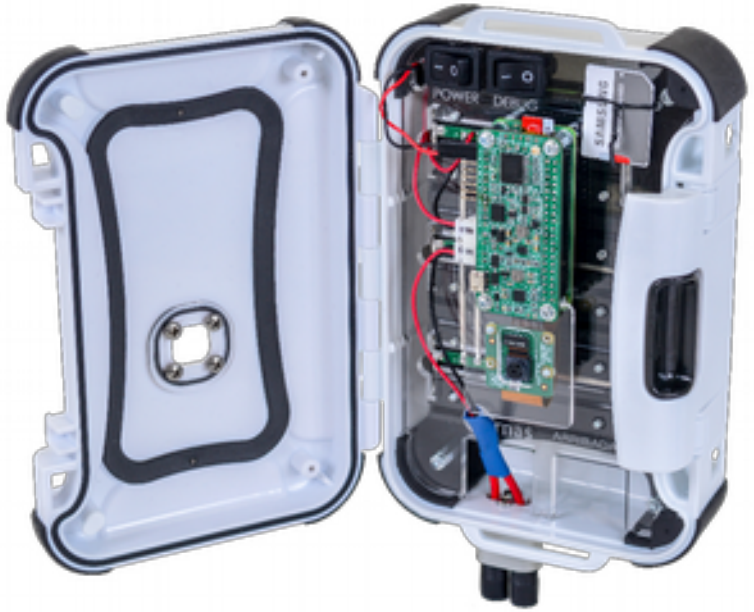
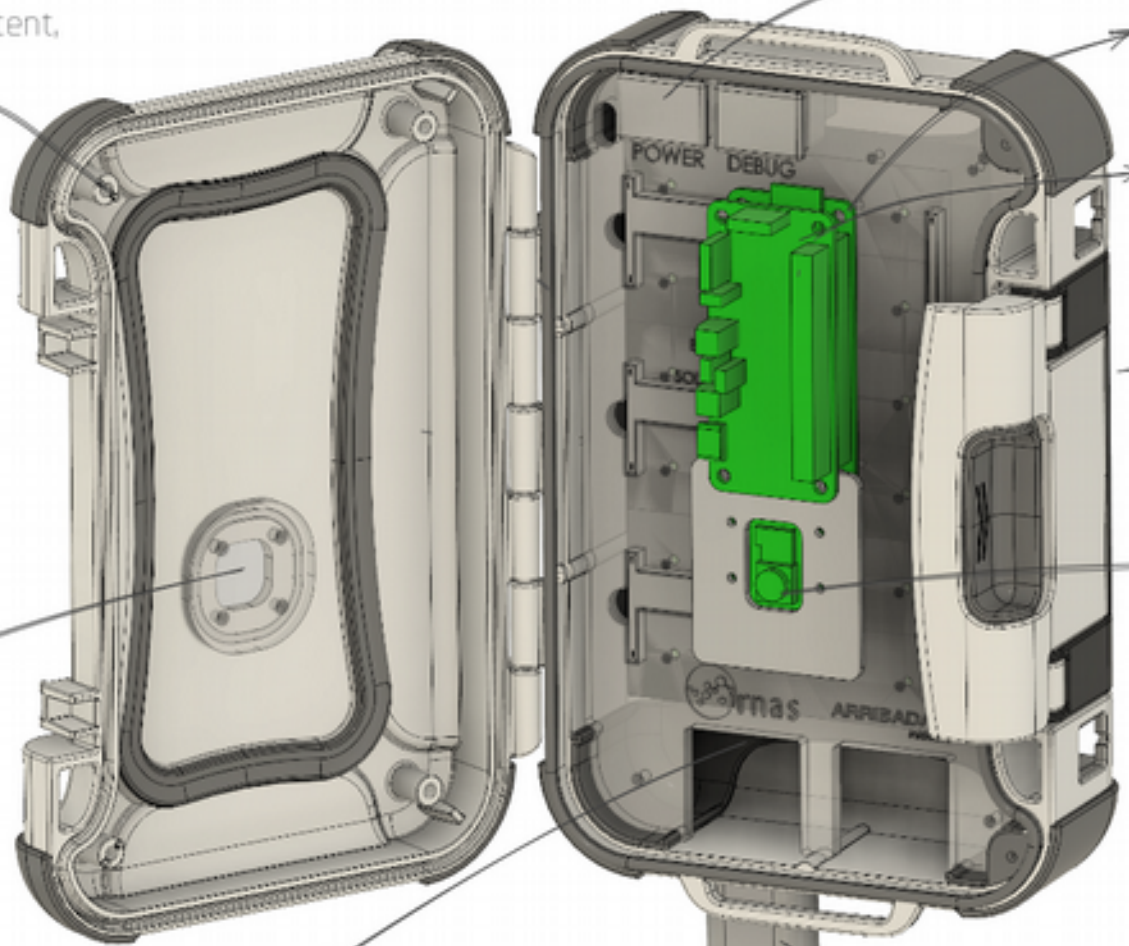
Arribada PMP for Antarctica





Arribada Penguin Monitoring Platform



waterproof case - weather resistent, rugged and simple to use

control switches

Raspberry Pi Zero W - main processor for video recording

PiRa zero - advanced power scheduling IoT circuit with LoraWAN

universal mount with angle adjustment

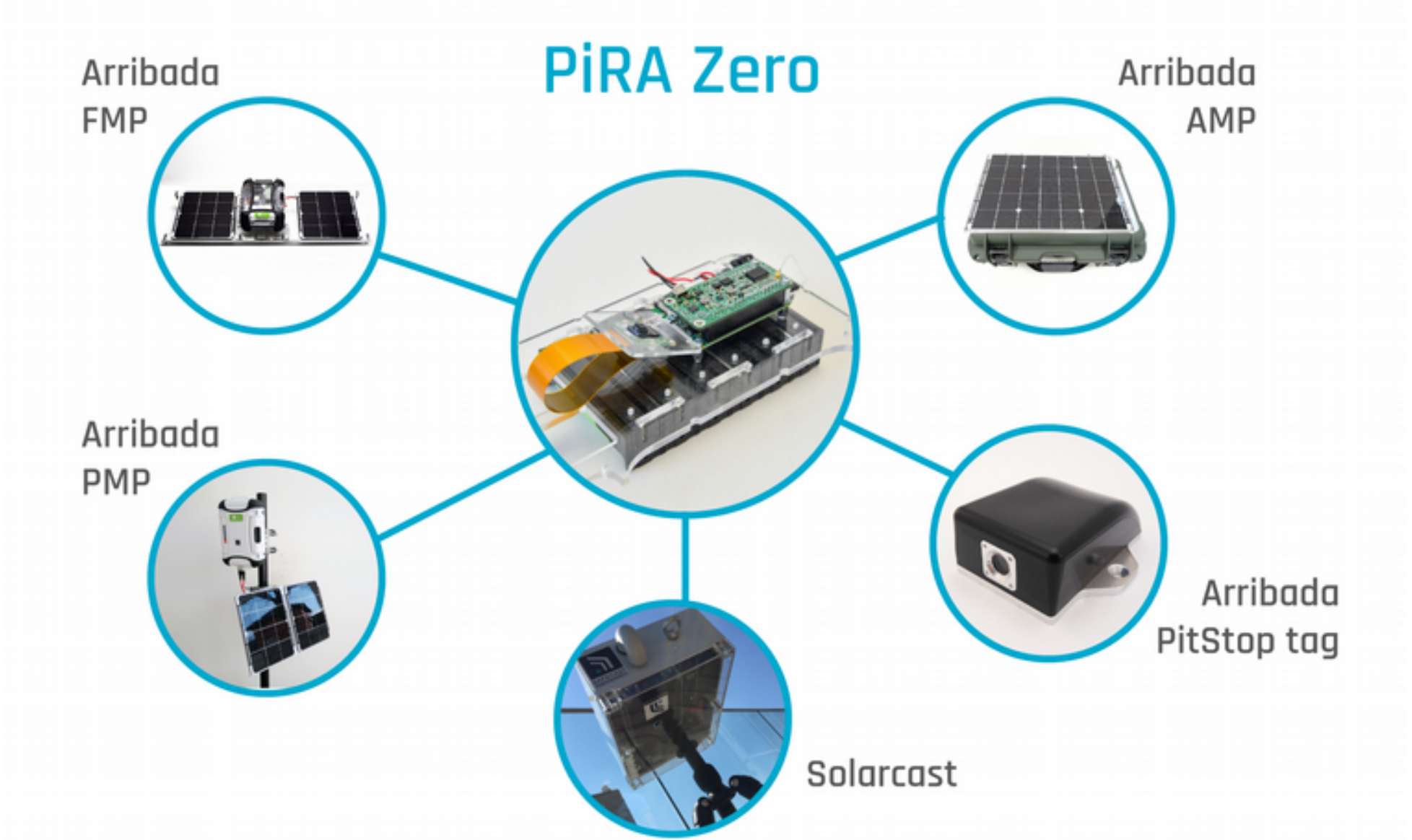
camera - capturing Full-HD video and snapshots

camera window

battery pack - 6x 18650 LiPo cell

solar panel connector for connecting external cells

Developed by rnas for ARRIBADA initiative using cutting edge technologies by Voltaic


PiRA Zero
Arribada
FMP
Arribada
AMP
Arribada
PMP
Arribada
PitStop tag
Solarcast

Key challenges

- Simple and low-cost gear for untrained use
  - Zero-config
  - Simple interface, BLE + phone app or WiFi AP with website
- Real-time information on sensor/tracker operation
  - Know that it works, schedule servicing
  - Schedule collection of large datasets
- Network coverage map
  - Difficult in rain forest and other heavy vegetation
  - Sub-optimal gateway placement
  - Automated way of generating maps

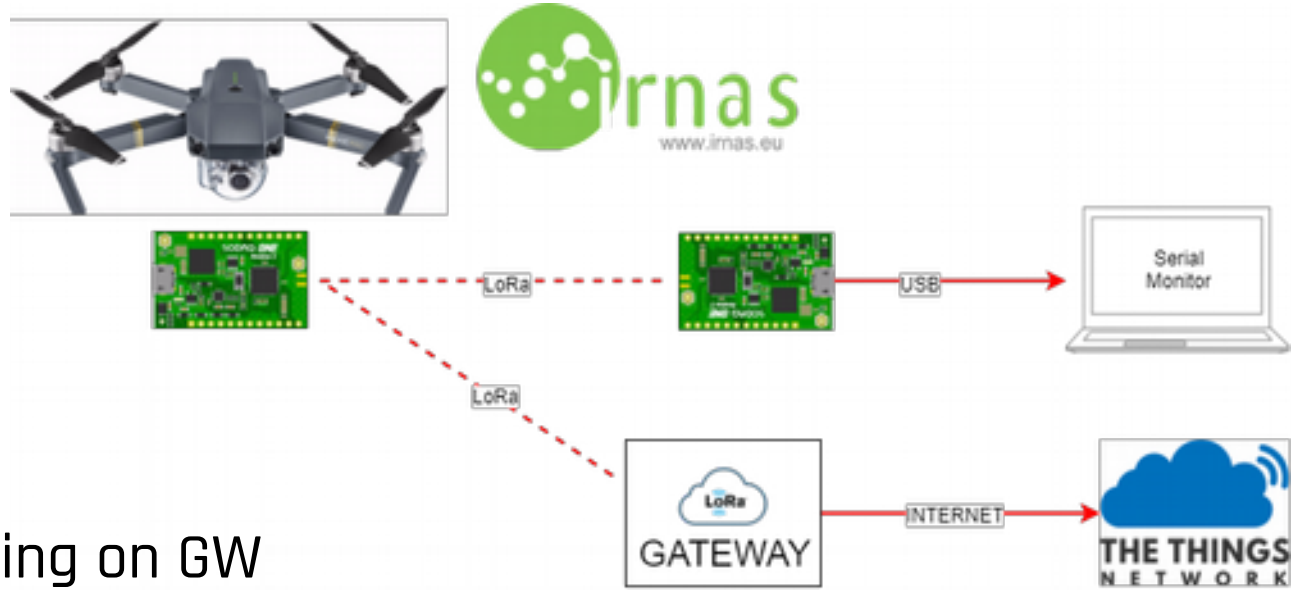
LoRaWAN to the rescue

- Low-cost battery efficient devices
  - SX1276 modules
  - Implemented in sensors of various kinds
- Simple gateways
  - RPi Zero + RAK831
  - WiFi, 3G or other uplink
  - PoE or solar powered
  - Mounted on a building or tree
- Easy to deploy with TTN

Technical unknowns

- What is the coverage of a gateway?
  - TTNMapper for wardriving
    - Hard to repeat, only at ground level
  - RadioMobile for estimating
    - Inaccurate with heavily land cover (vegetation)
    - Inaccurate with gateways with obstructions
- How do I know a device works at a given location
  - 20m up a tree
  - Floating in a pond
  - Swimming in the sea
- How do antennas and devices actually beahve?
  - Repeatable testing required

Mapping setup

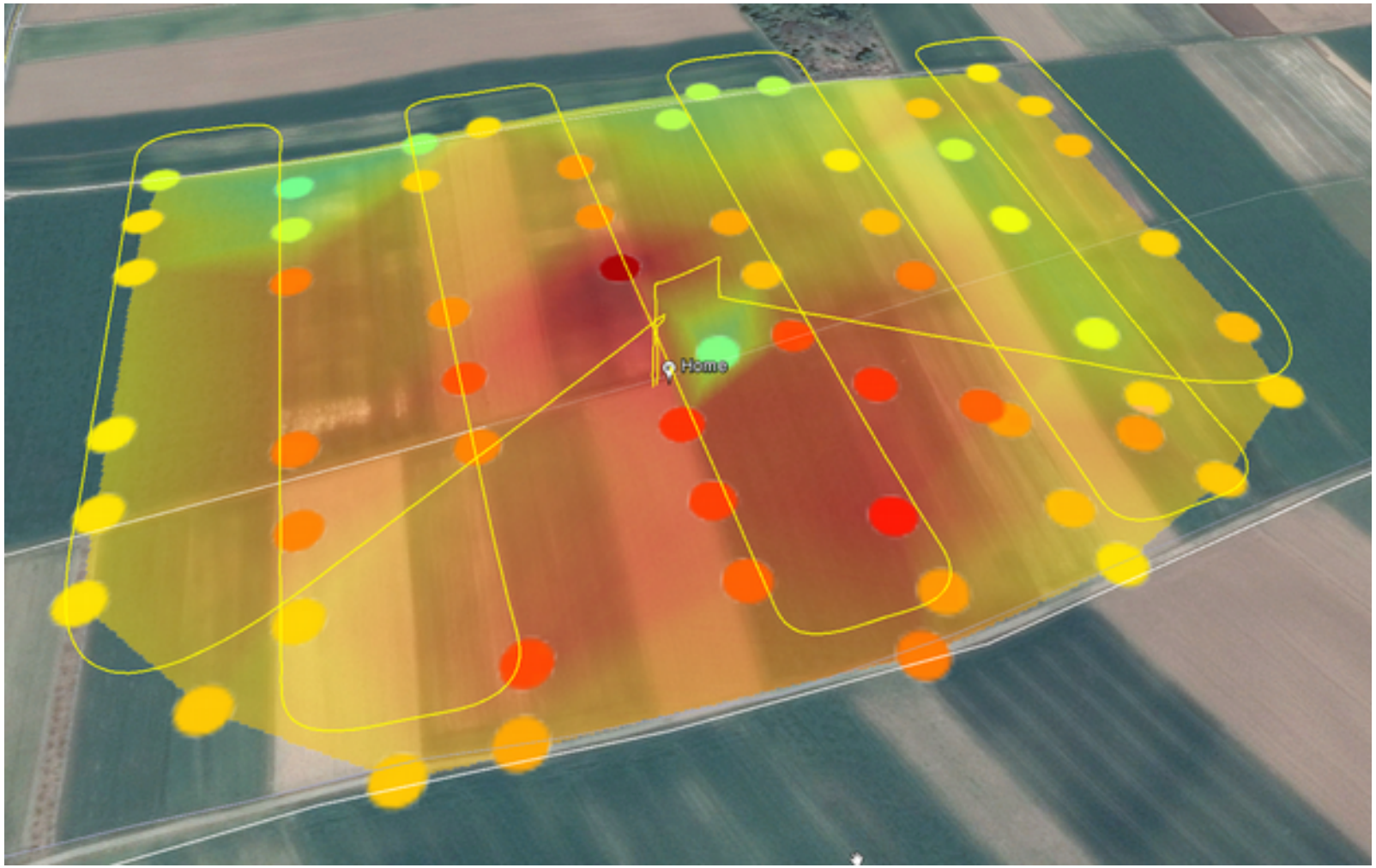


- Online: TTNMapper
  - Operational and useful
- Offline: Device-to-device
  - Under development at IRNAS
  - Simpler with V3 stack for decoding on GW
- Hardware:
  - SodaqOne with GPS
  - DraginoLoraGPS
- Movement:
  - Drive/bike/walk
  - Drone

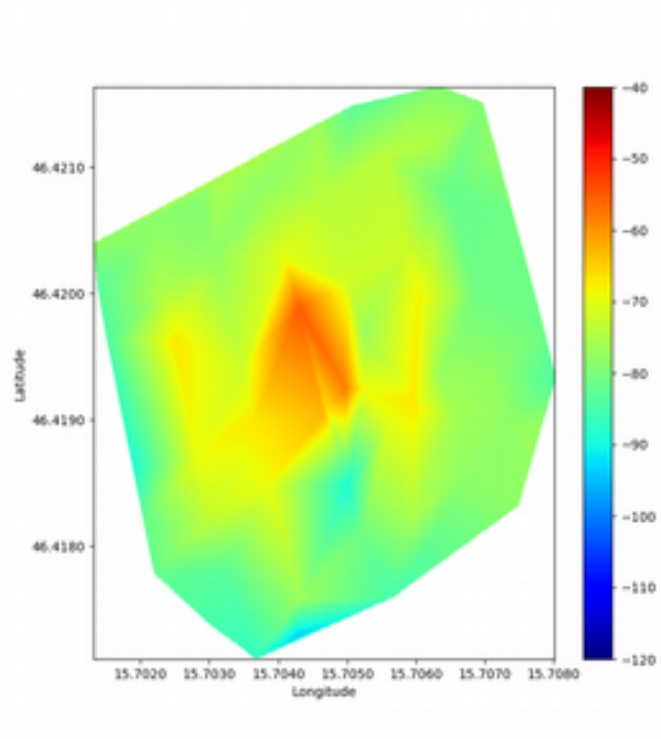
Drone mapping

- TTN Gateway
- Drone (DJI Mavic Pro)
- Litchy (mission planning)
  - Fly in a pattern
- TTNMapper
  - Acquire data
  - Process data
- Google Earth display

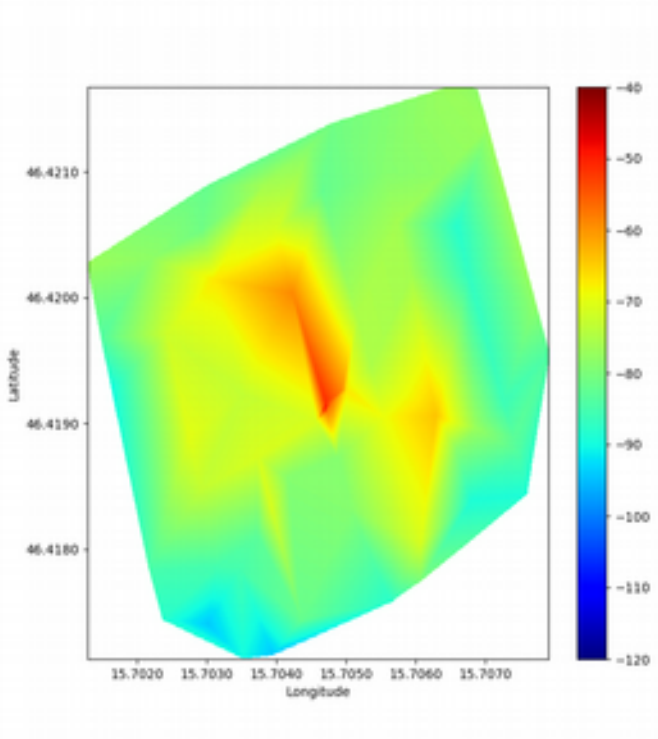
Drone mapping example



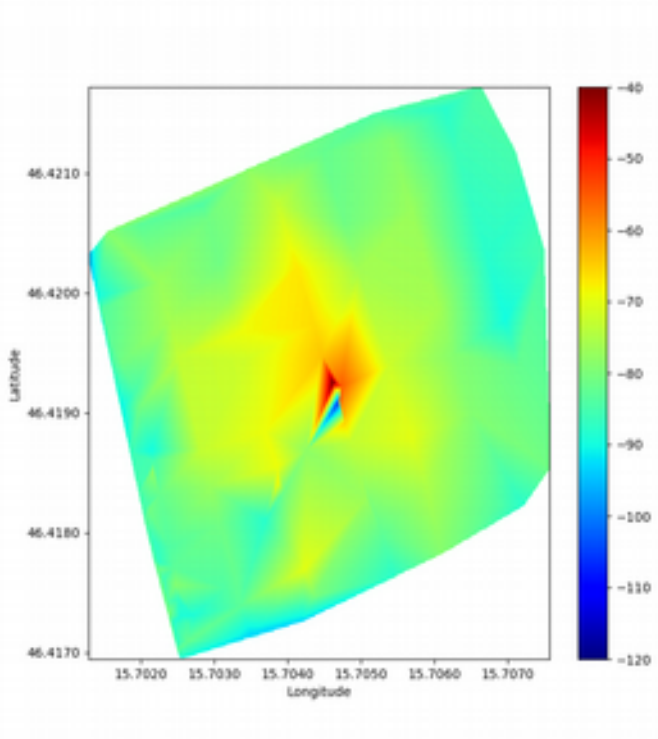
Use-case: Radiation pattern



50m above ground



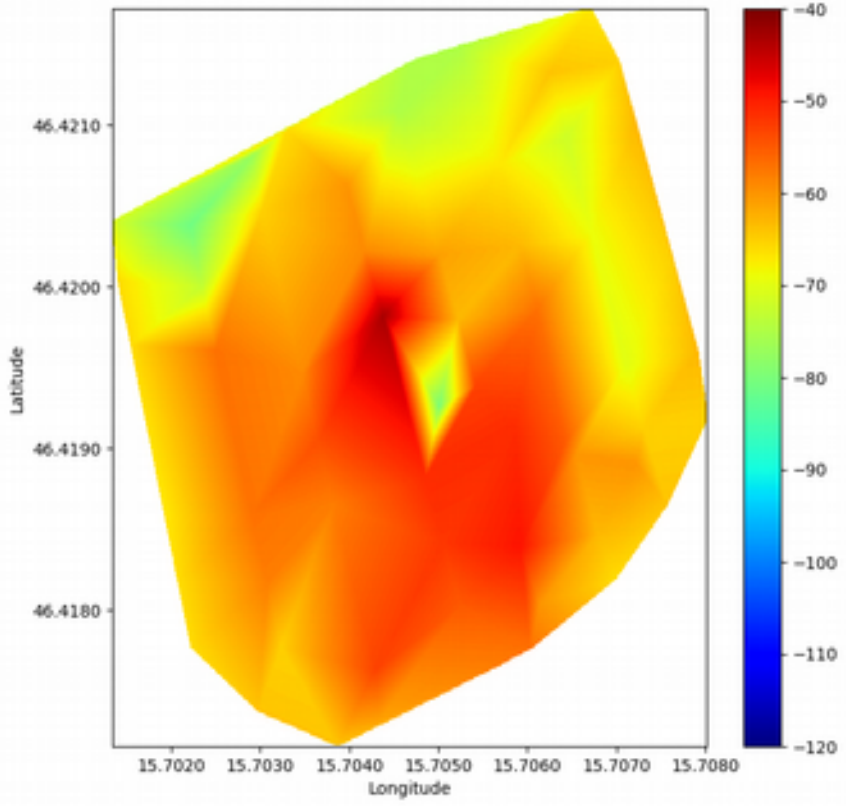
25m above ground

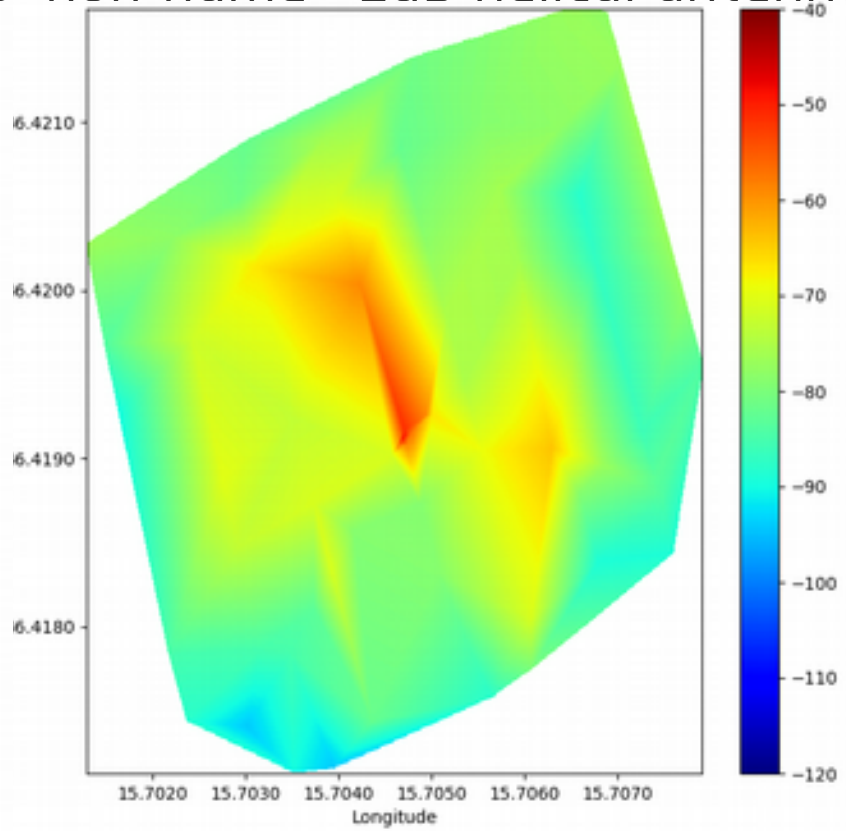


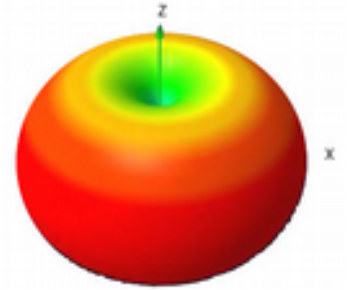
2m above ground

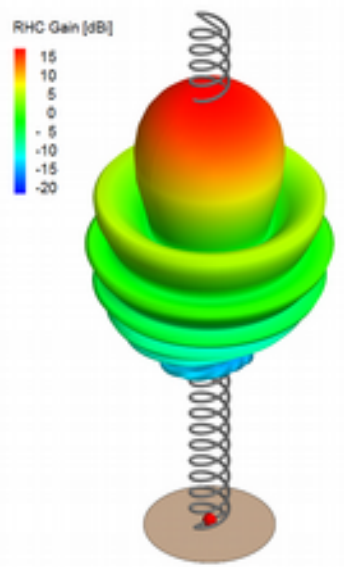
Use-case: Compare antennas

~3dB ANT-8WHIP3H-SMA omni vs non-name ~2dB helical antenna



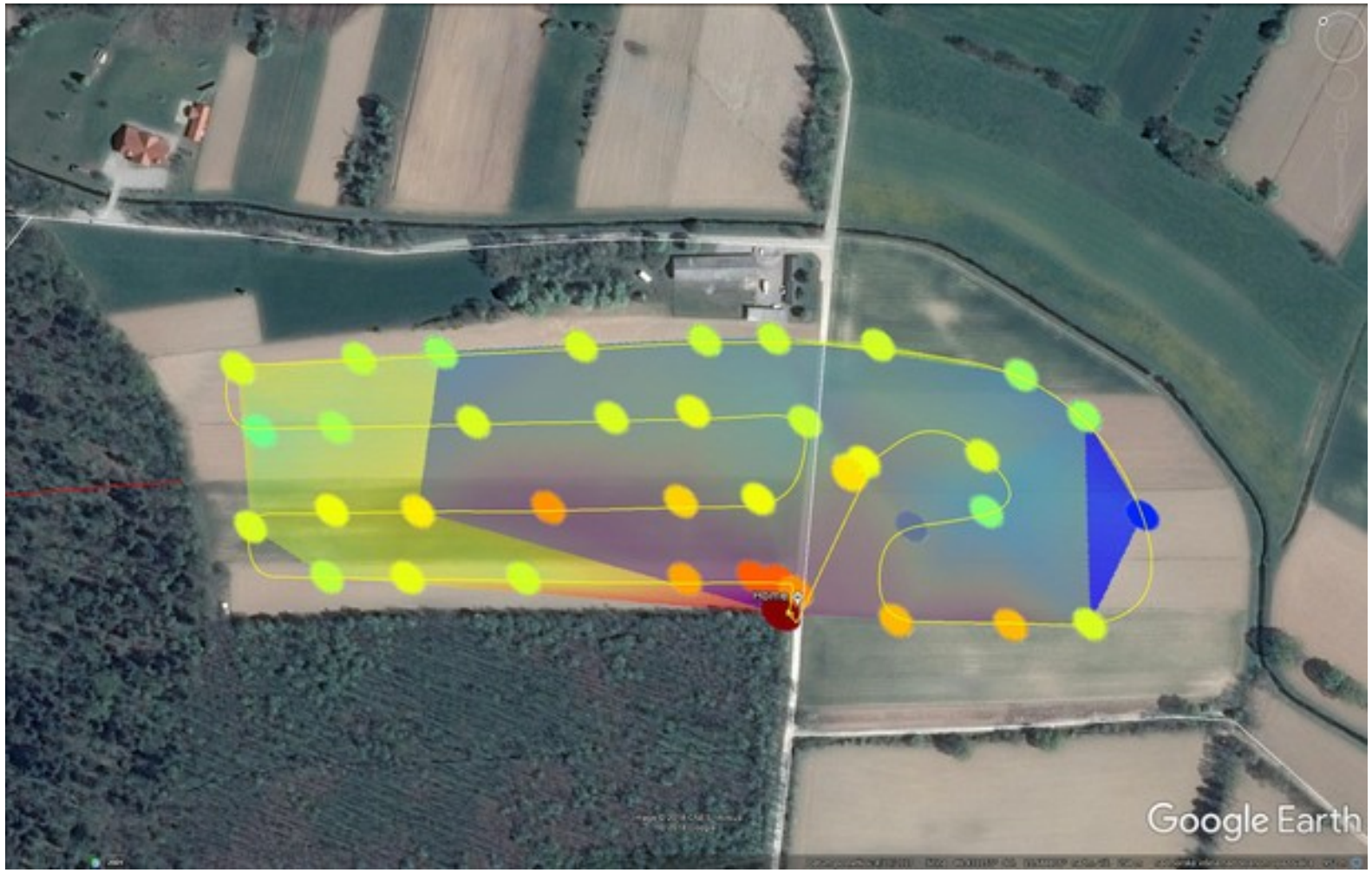




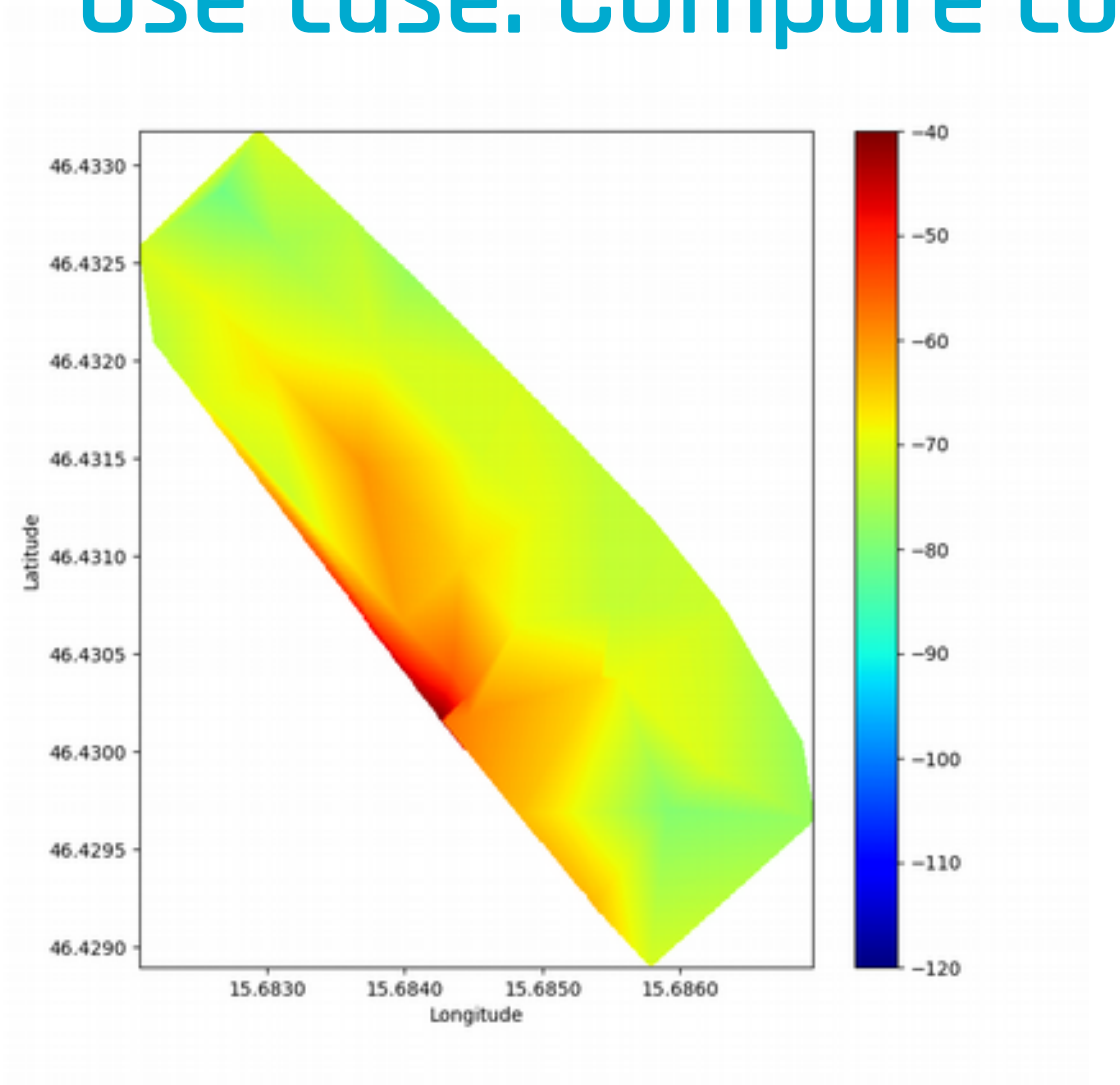


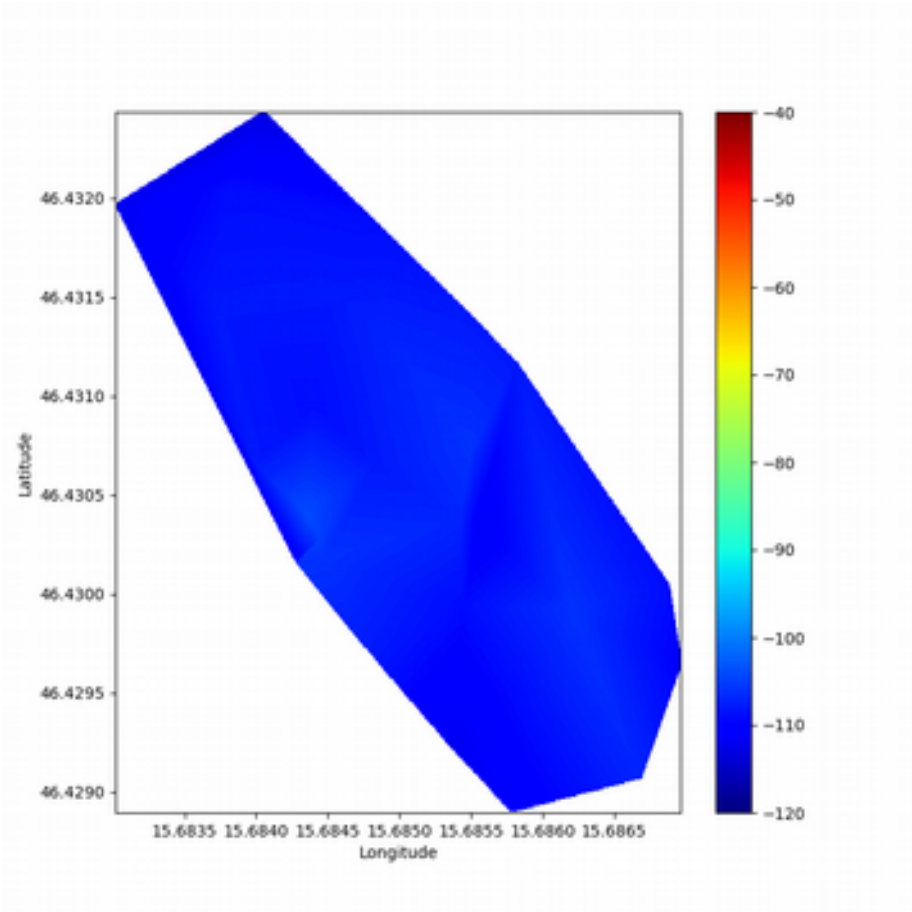

10km to Gateway

Use-case: Forest shadowing



Use-case: Compare coverage of gateways

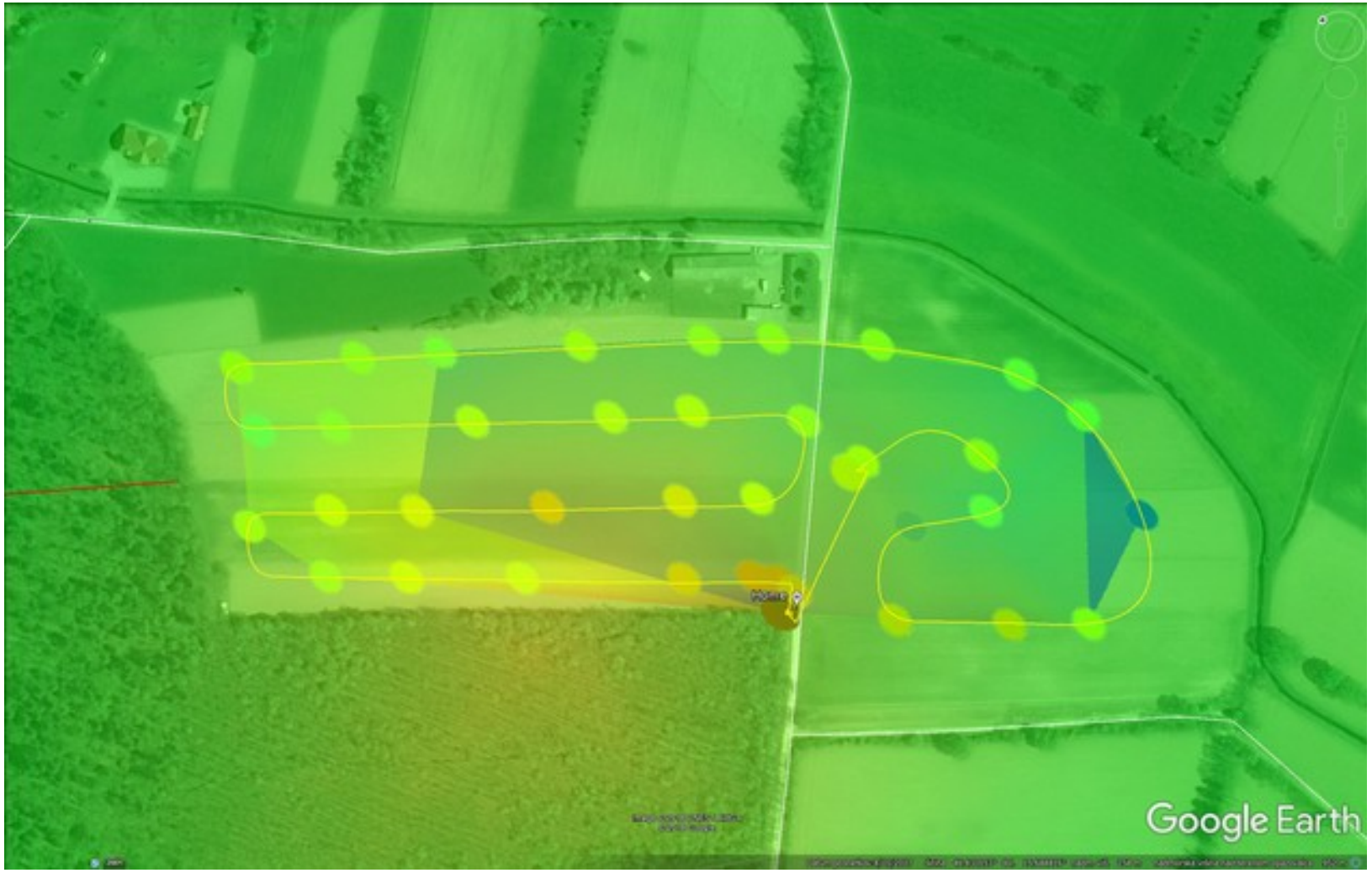




Local GW

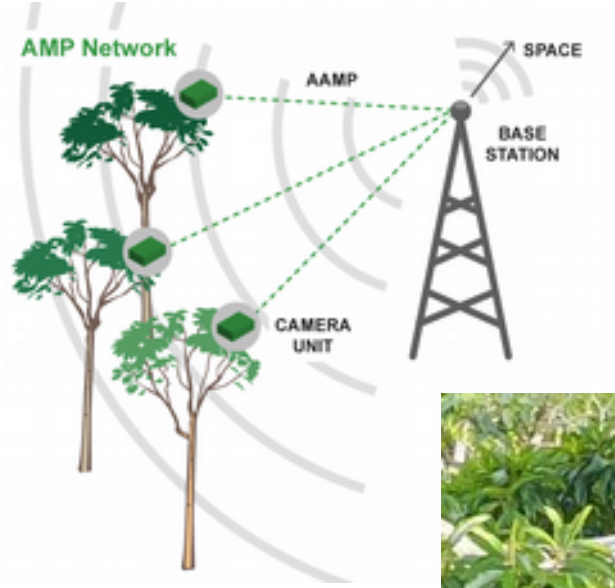
10km from GW

Use-case: Forest shadowing + RadioMobile



Tropical forest: Arboreal monitoring

- Connecting cameras in the trees
- Field-of-view of base-station
- Signal strength at tree-height
  - Hike through the forest
  - Fly the drone to target height
  - Fly close to the cannopy



Principe island: Green Sea turtle monitoring

Principe island: Green Sea turtle monitoring

Experience from on-site work

- Base-station height is limited
  - Highest tree within 100m of nearest power
  - Pole/tower is unlikely
  - Uplink WiFi/3G if lucky, else satellite
- Health/safety limitation
  - Avoid climbing
  - Minimize dependency on specialized team
- Time-effective deployment
  - Useful function performed offline on all devices
  - Connectivity/managament is enhancement

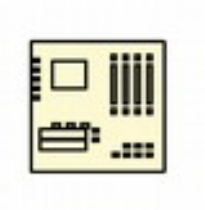
Upcoming projects

- Solar powered TTN Gateway
  - RAK831 + 3G + RPi Zero W
  - 100W solar panel
- PiRa Zero Smart
  - RPi power scheduling
  - BLE interface
  - Simple customized devices
- Offline drone mapping
- Customizable devices

Work with us

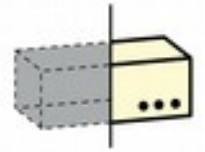
0. Consulting and product conception

1. Experimental testing

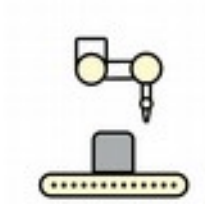


2. Custom electronics design and development

3. Custom mechanical and software design and development



4. Rapid prototyping



5. Manufacturing of products

6. Product testing

Thank you!

Connect

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