Developers of a cutting-edge solution (IoTree) that provides early detection of pests attacking trees.

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The Pain

It's not just ISIS Tunisia has to fight, there's the weevil killing its date palms

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UNIVERSITY OF CALIFORNIA, RIVERSIDE

UCR | Today

Is Palmageddon Coming to [illegible]rnia?

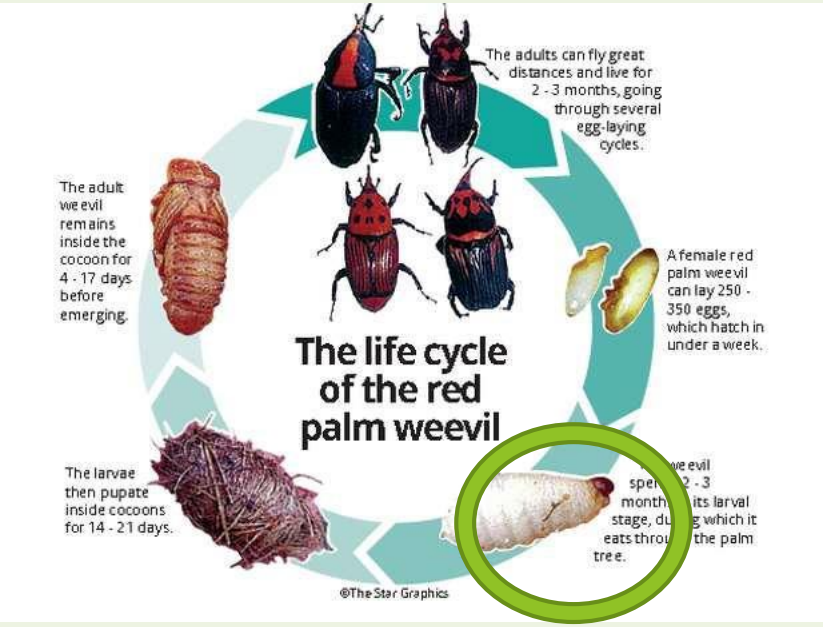
Symposium set for Oct. 26 to talk about an invasive weevil that threatens California's palm trees

By Sean Nealon On OCTOBER 19, 2016

RIVERSIDE, Calif. (www.ucr.edu) — A palm tree-killing insect that is already established in San Diego County and likely to spread will be the subject of a research symposium Oct. 26 just outside San Diego.

The Palm Weevil

- Flying insect which **lays its eggs inside palm trees**.
- The larvae, emerging from the eggs, **feeds on the core of the tree** and **evolves inside it**, causing the tree to eventually collapse.
- The palm tree, does not show any signs of distress, until few months later, the treetop collapses. At this point, it is too late to save the tree.



How BIG is the threat?

Red palm weevil

Coconut Palms
Oil Palms
Canary Palms
Dates Palms

South American palm weevil

Coconut Palms
Oil Palms

African palm weevil

Market Potential

- Ornamental palms: Public gardens, private gardens and cities.
- Date palms: 125 M yielding trees.
- Oil palms: 2.1 B yielding trees
- Coconut palms: 1.5 B yielding trees.

What is the current best practice ?

Spray and Pray…. periodic spraying (or other methods of applying pesticides) of **ALL** trees and keeping a close eye, hoping to salvage the tree once detected (in most cases its too late for that)

IoTree – In tree Sensing

- Low-energy sensor, easily attached to **every tree ,** provides early detection of the Red Palm Weevil larvae in its early stages.
- Cloud based services sending an alert directly to the plantation with specific tree ID.
- **A platform for additional tree borer insects detection or other precision agriculture applications.**

➢US Provisional Patent Application No. 62/313,987

"A System and Method for Detecting the Existence and Activity of Vermin and Larvae in Trees and Plants"

Why is the Early detection so attractive ?

Clearly, an early, targeted detection is the only effective answer to the weevil problem, for the following reasons:

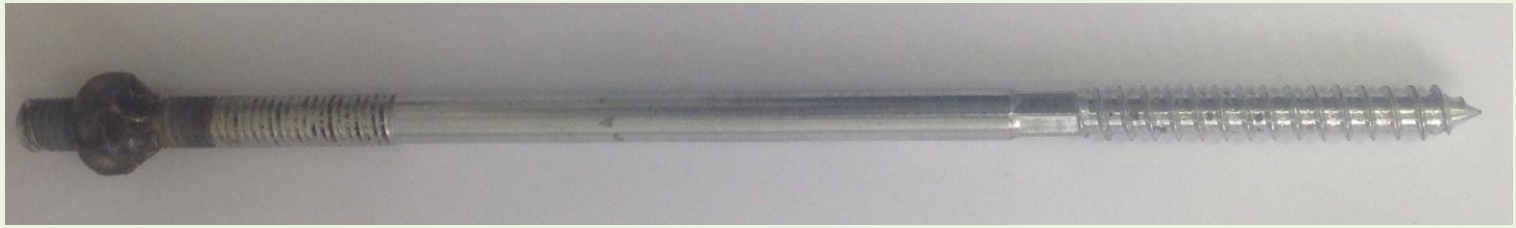
- Reduce the cost, increase the revenues
- Preserving pesticide efficiency
- Saves the trees
- Environmental protection

Detection Challenges

- No visible marks of red palm weevil (RPW) attack on tree
- Various palm tree types (date, ornamental, coconut, oil)
- Tree **height** and **diameter** varies much from **young** to **adult** trees
- Tree **plantation environment** varies from **quiet desert** to **bustling city**
- **Other animals** and especially insects may be active around and in the tree (e.g., longhorm)

Tree Coupling

- The tree coupling is important as it is the physical element which carries the vibrations caused by the larvae to the seismic sensor
- After rigorous experimenting we have decided on the coupling device – which is a drilling screw in varying dimensions.
- The various solutions were evaluated according to the following parameters -
  - Performance
  - Ease of installation
  - Price and availability



Hardware

- The IoTree sensor uses a proprietary hardware design which includes analog circuitry alongside digital computation capabilities.
- The board is comprised of 4 main sections –
  - Analog seismic sensor
  - Microcontroller – an ARM Cortex M4 core based microcontroller with embedded analog peripherals
  - Communication – a WiFi/LoRa interface (installation dependent) which carry alerts, calibration data and firmware updates to/from the device
  - Energy – the device is battery operated and backed up by small solar panel keeping a positive energy balance all year round.

Hardware

Algorithm Goals

- Early detection of RPW larva in the palm tree
- Discrimination between RPW signals to other animals signals or man made noises
- Automatic adaptation of algorithm to different tree size and tree environment
- Low complexity and low resources algorithm to allow minimum power requirement

The Algorithm

- The forte of the IoTree lies in its detection algorithm – finalized after long period of lab and field testing, evaluation of years of experiments conducted by various academic and independent researches
- The algorithm result is determined after running the signal acquisition and DSP in the sensor itself and verification/overruling of the algorithm cloud server to compensate for local environmental changes which influence large number of trees

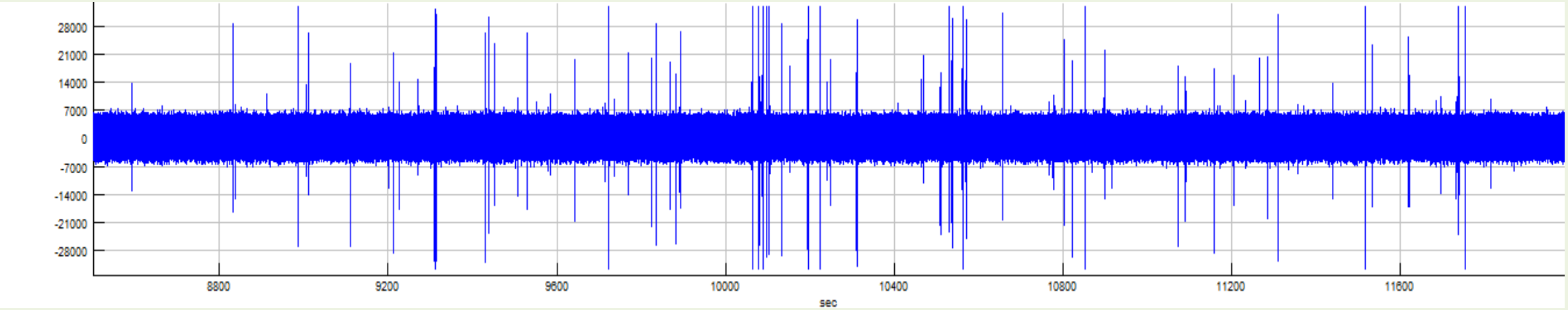
Algorithm Innovation

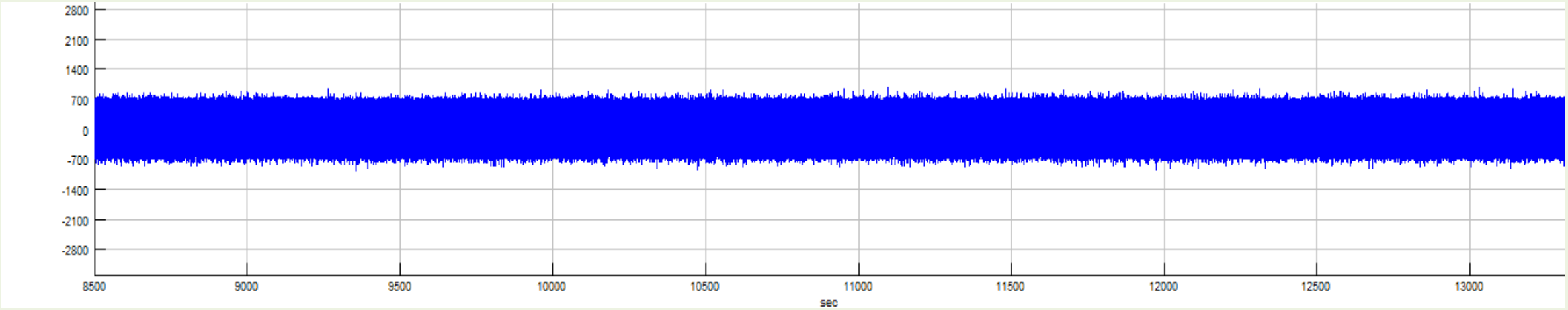
- Sensitivity to RPW signal “footprint” even in low SNR environment
- Discrimination between RPW signals and other “noise” signals
- Adaptation to tree size and environment
- High accuracy detection of infected and clean palm trees

Algorithm Verification Process

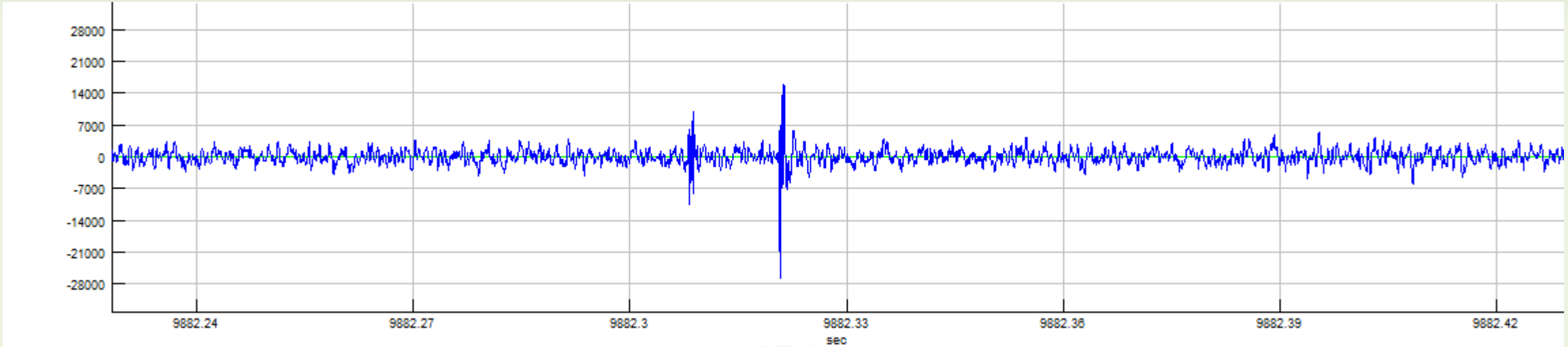
- In order to verify the algorithm validity we completed the following procedures –
  - Four field trials, each with 10-15 trees, in which the trees were cut
  - Continuous lab testing with two trees – reference and infected
  - Additional opportunistic testing – i.e., Hotel Daniel in Herzeliya
  - On going testing in Eden experimental farm

Algorithm Verification Process





RPW Signal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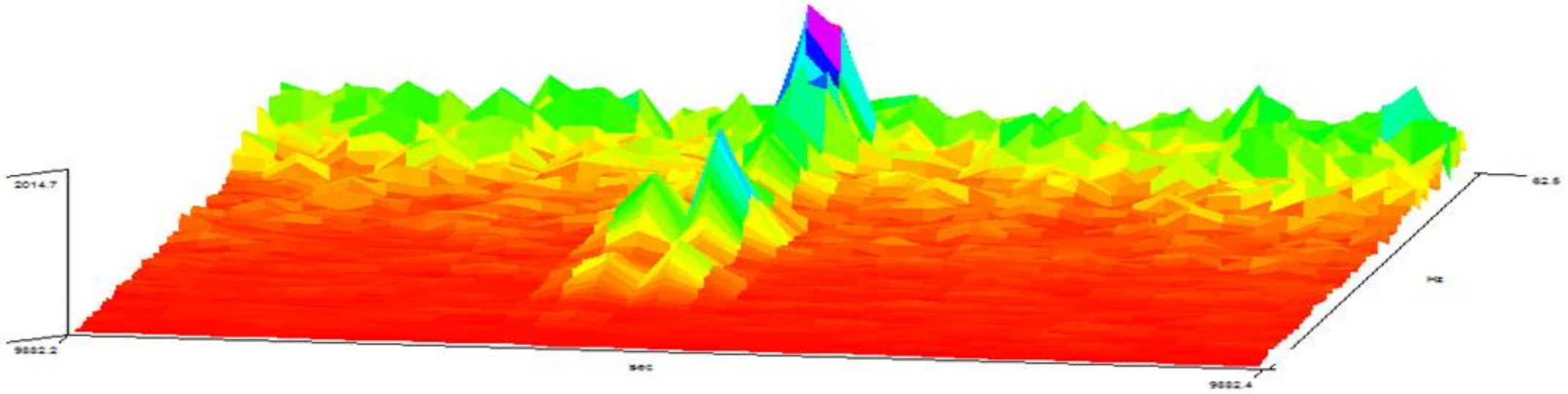
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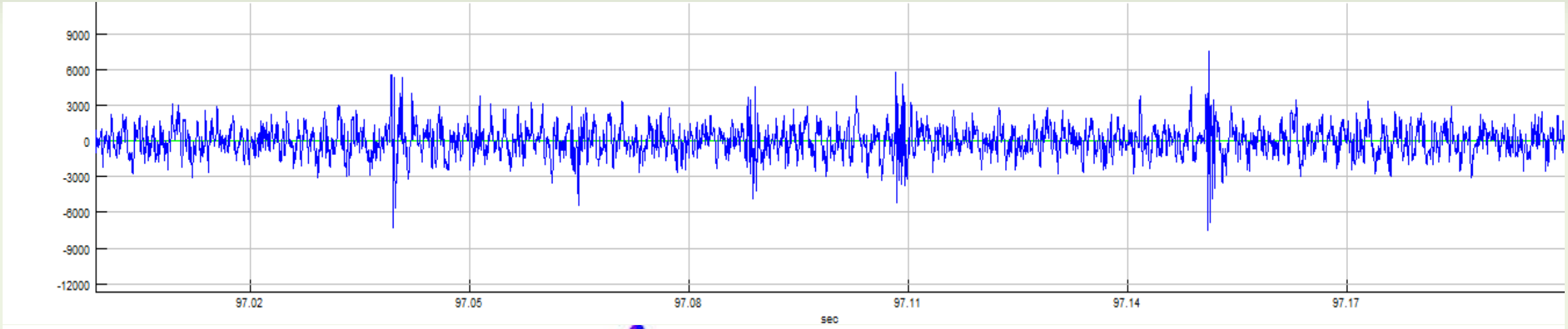
RPW Signal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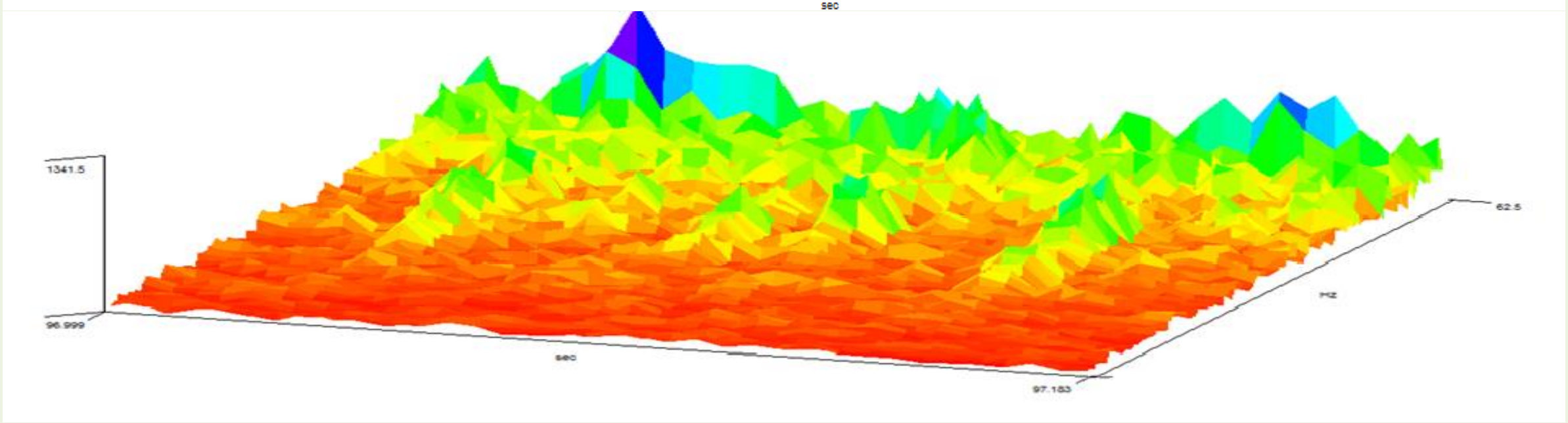
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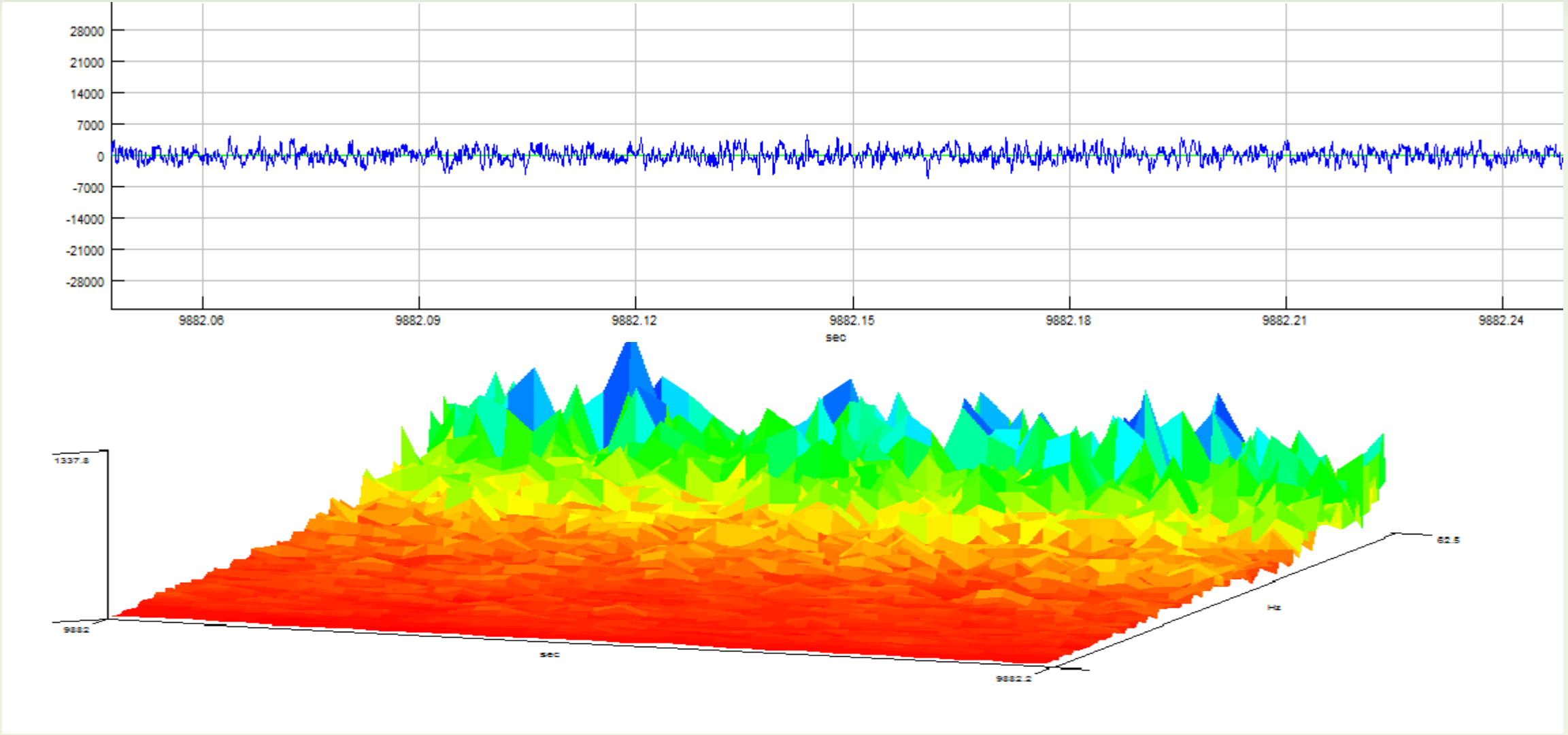
Noise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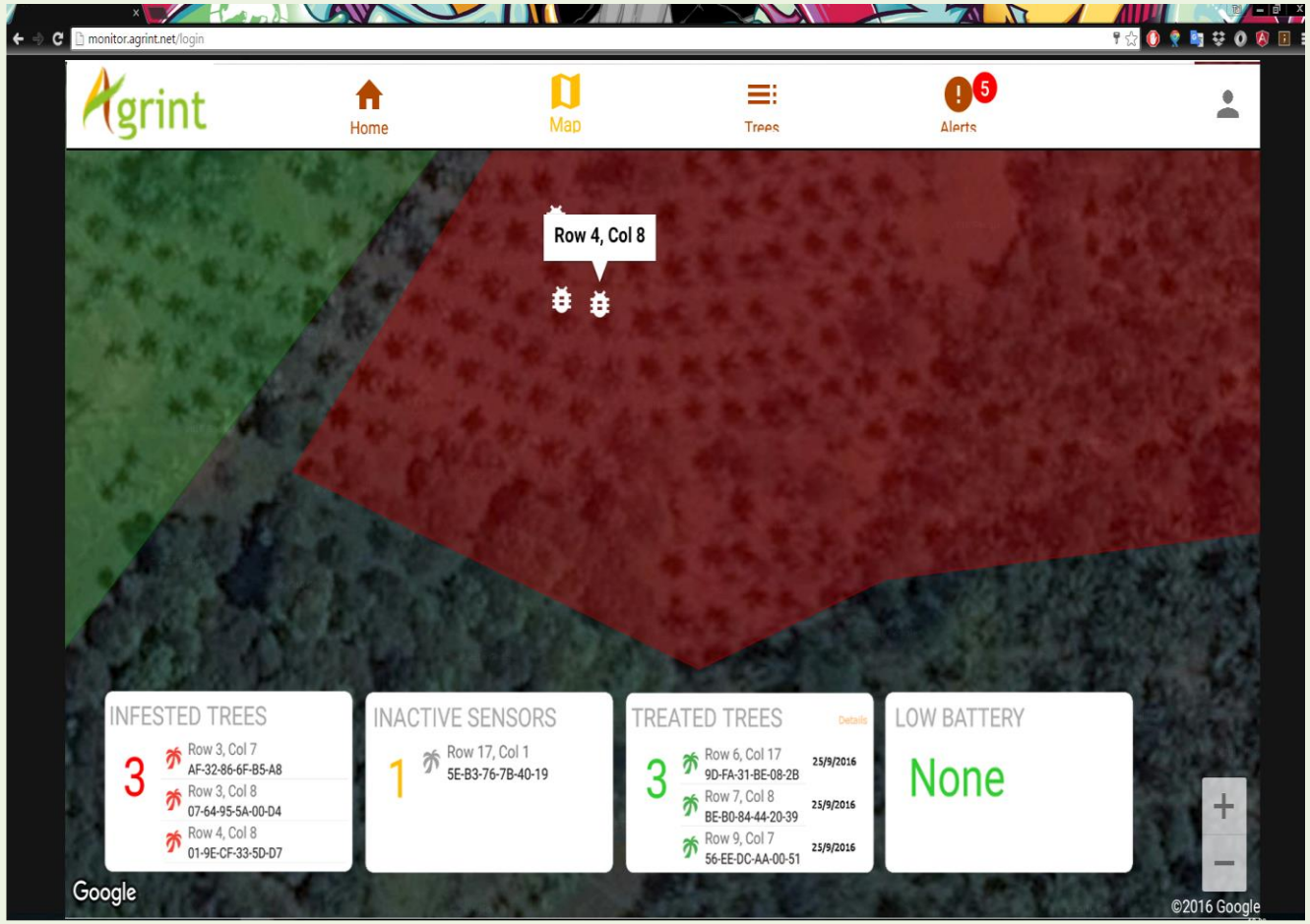
Cloud Services

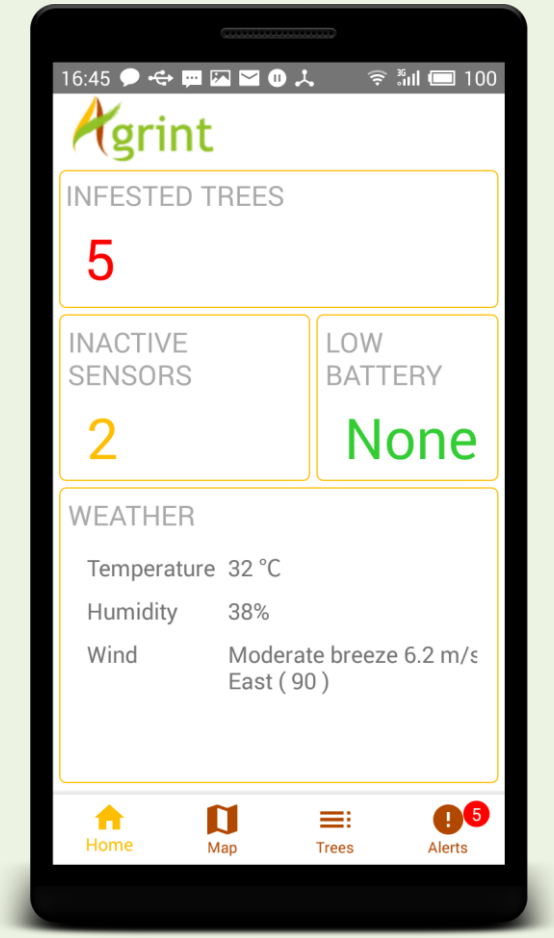
- Core of the IoTree solution is based on Microsoft's AZURE platform, with world wide redundant deployment and extensive feature set, which allows us to create a robust computational service
- The cloud service takes part in every aspect of the solution – algorithm

Mobile Application

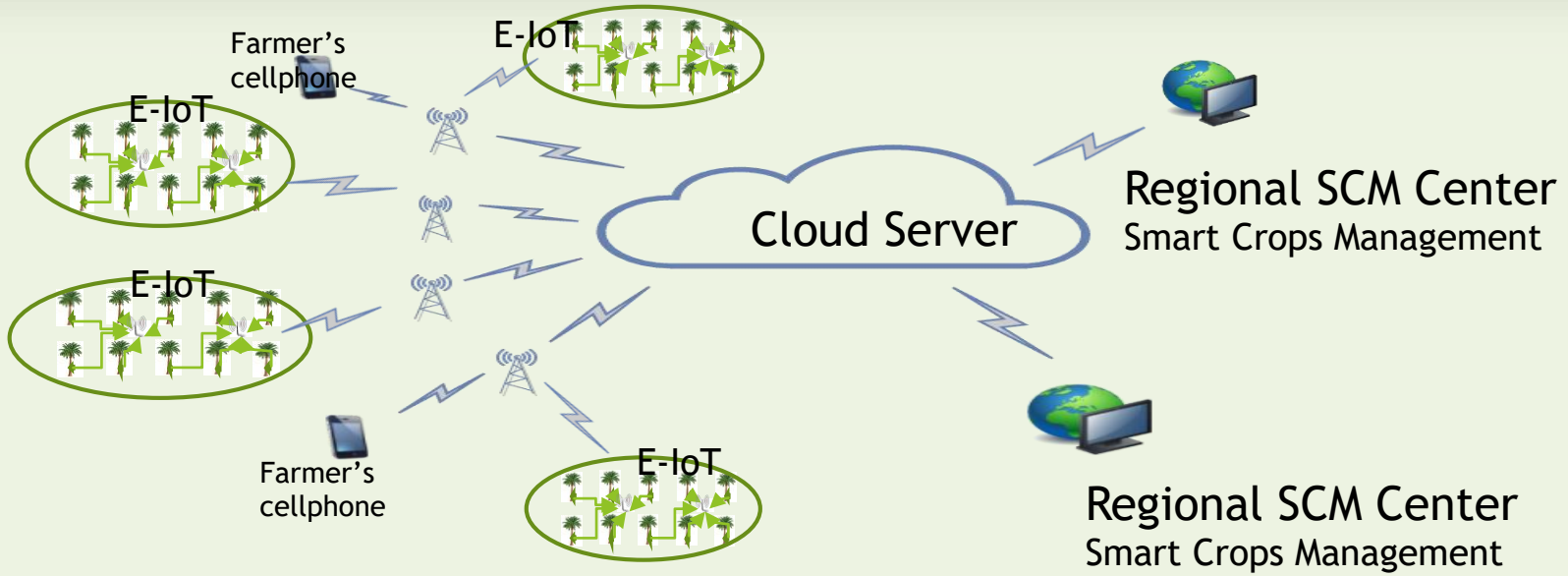
- An easy to use mobile application is available for two use-cases –
  - Installation
    - The app. walks-through the IoTree installation and deployment phase
    - Main focus is on “inventory” aspects of the installation – mainly unique identification of a specific tree’s location, for future plant orientation.
  - On-going monitoring
    - Red-Palm-Weevil alerts are pushed immediately, so that relevant measures can be taken
    - Past records, alerts and treatments are easily accessed for tighter plant control

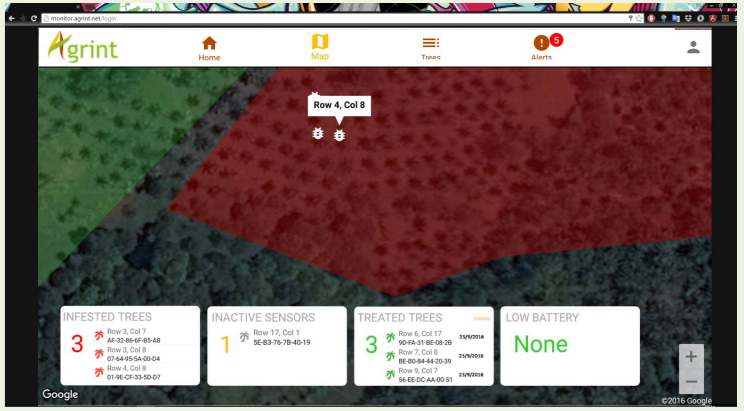
Mobile Application

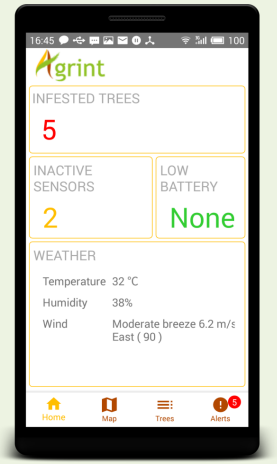




IoTree solution







Who are we?

- Founded in 2016 (after one year of development in the “garage”)by group of experts in the field of sensors and communications.
- 10’s of years of experience in product delivery
- Strong R&D expertise in the field of sensors and communications in the military industries.
- True passion for the challenge

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Thank you