HabPi: Sending Computers to the Edge of Space

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Outline

1. Introduction
2. HabPi
3. HabPi Flights
4. Roadmap

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Motivation

- The Pellissippi State eclipse team needed practice.
- We needed an inexpensive, extensible payload.
- We wanted a payload simple enough to be assembled by grade-school students.

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HAB Flight Profile

1. Payloads are Staged, Balloon is Filled
2. Release! Balloon assends at a rate of 5 m/s
3. After 1.5 hours of ascent, the balloon bursts (around 40km altitude)
4. Payload parachute back to the ground.
5. (Hopefully) Payloads are recovered.

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HabPi 1 - November 18, 2016

- The first untethered flight of the PSCC/MC Balloon Team
- HabPi payload was constructed by the students of Maryville College
- Released from PSCC Hardin Valley Campus in Knoxville, TN
- Reached an altitude of approximately 30,000 meters
- Came to rest in Pisgah National Forest near Blowing Rock, NC

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HabPi 1 - November 18, 2016

Figure: HabPi 1 in Tree

Parts List

Item	Approximate Cost
Raspberry PI 3 Model B.	$35.00
Sense HAT	$30.00
Raspberry Pi Camera V2	$30.00
32GB Micro SD Card	$15.00
3 $\times$ DS18B20 Digital Thermometers	$9.00
4.7kΩ 1/4 W Resistor	$0.10
30 Row self-adhesive breadboard	$5.00
4400 mAh USB Battery (Cell Phone Charger)	$10.00
20 pack of Male/Female Jumper Wires	$3.00
300mm Ribbon Cable for Pi Camera	$2.00
Total	**$139.10**

Table: Parts List

Payload Box

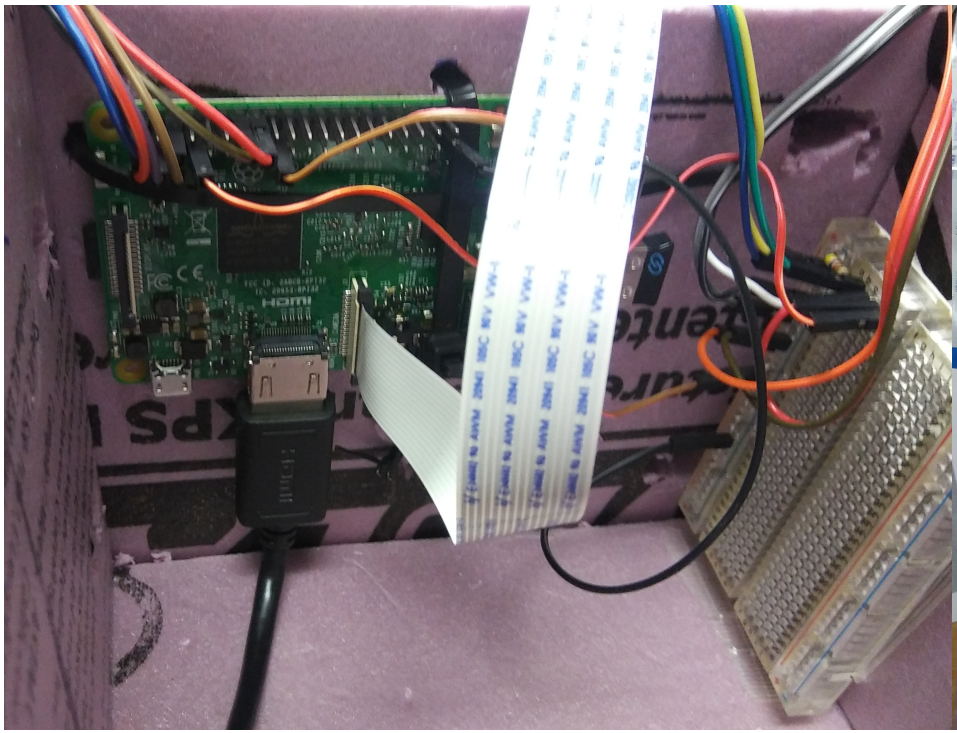

Figure: Payload Interior

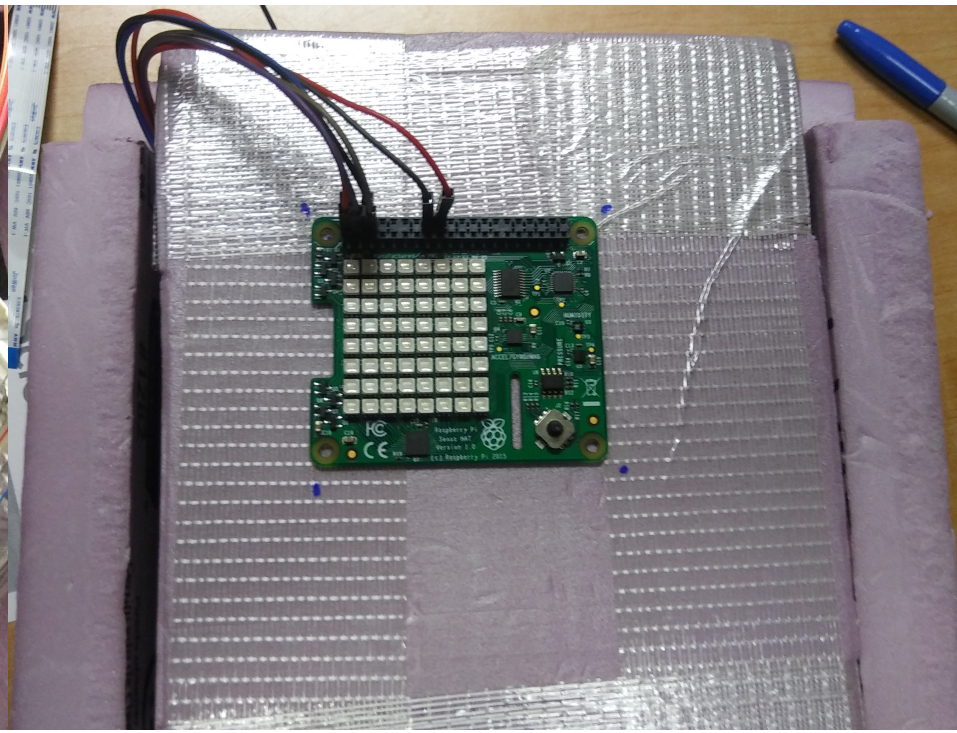

Figure: Payload Top

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HabPi Software

- Creates an access point with a configurable network for wireless data access
- Provides a simple user interface using the SenseHat
- Creates a time-labeled data directory under `/home/pi/habpi/data`
- Executes experiments contained in `/home/pi/habpi/experiments`

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Raw Temperature Data

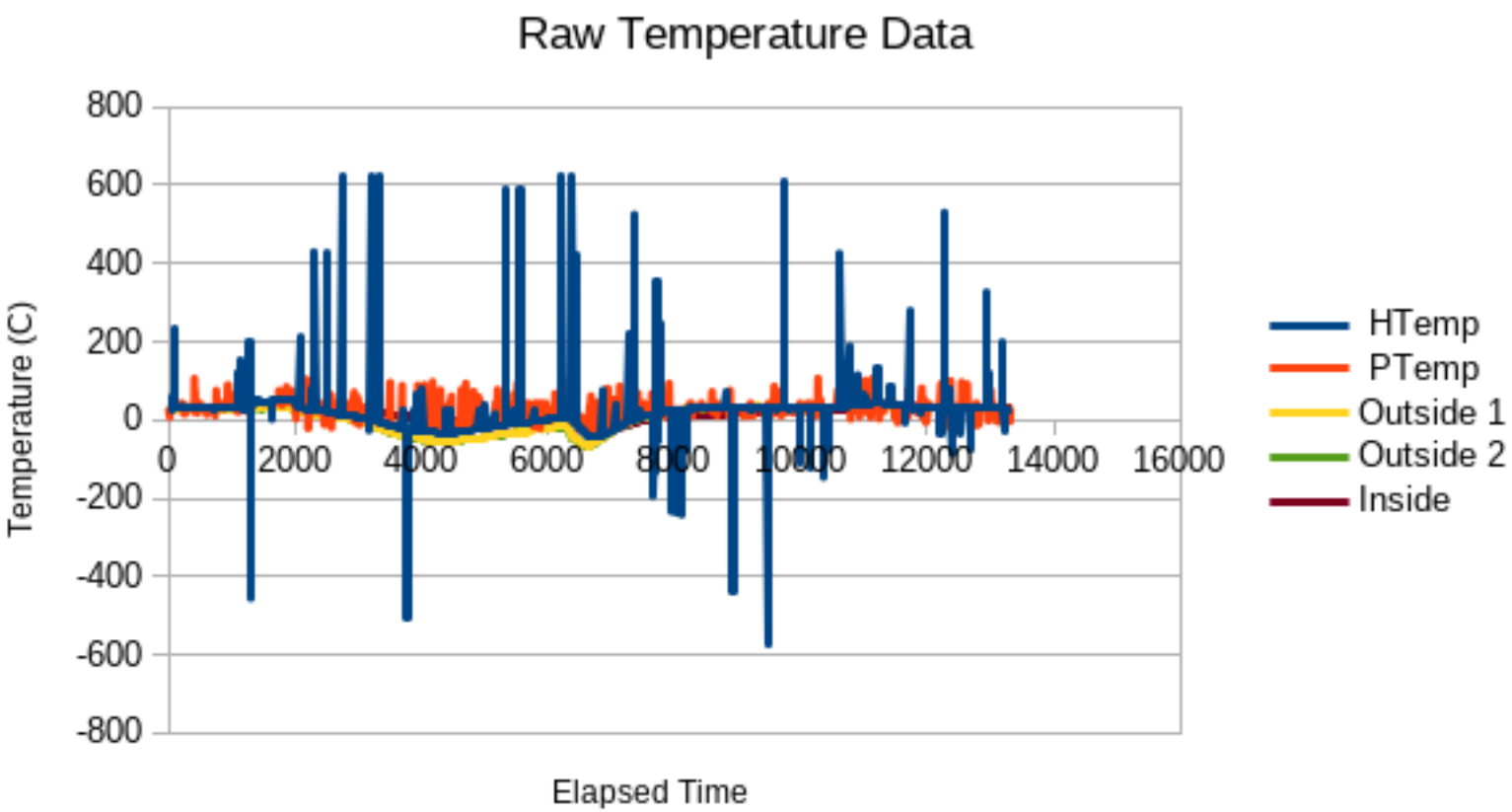


Figure: Raw Temperature Data

1-Wire Data

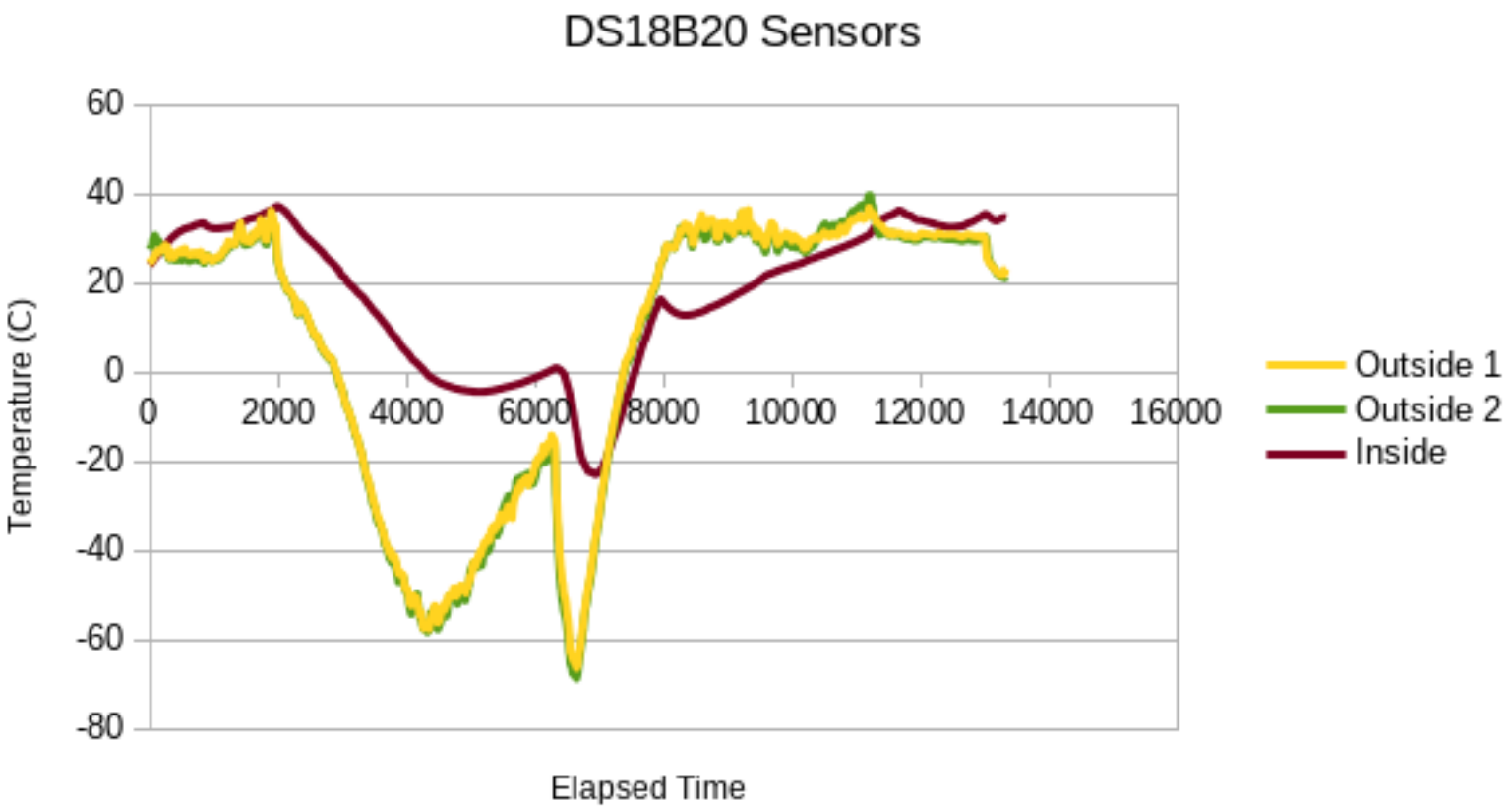


Figure: DS18B20 Temperature Data

Smoothed Temperature Data

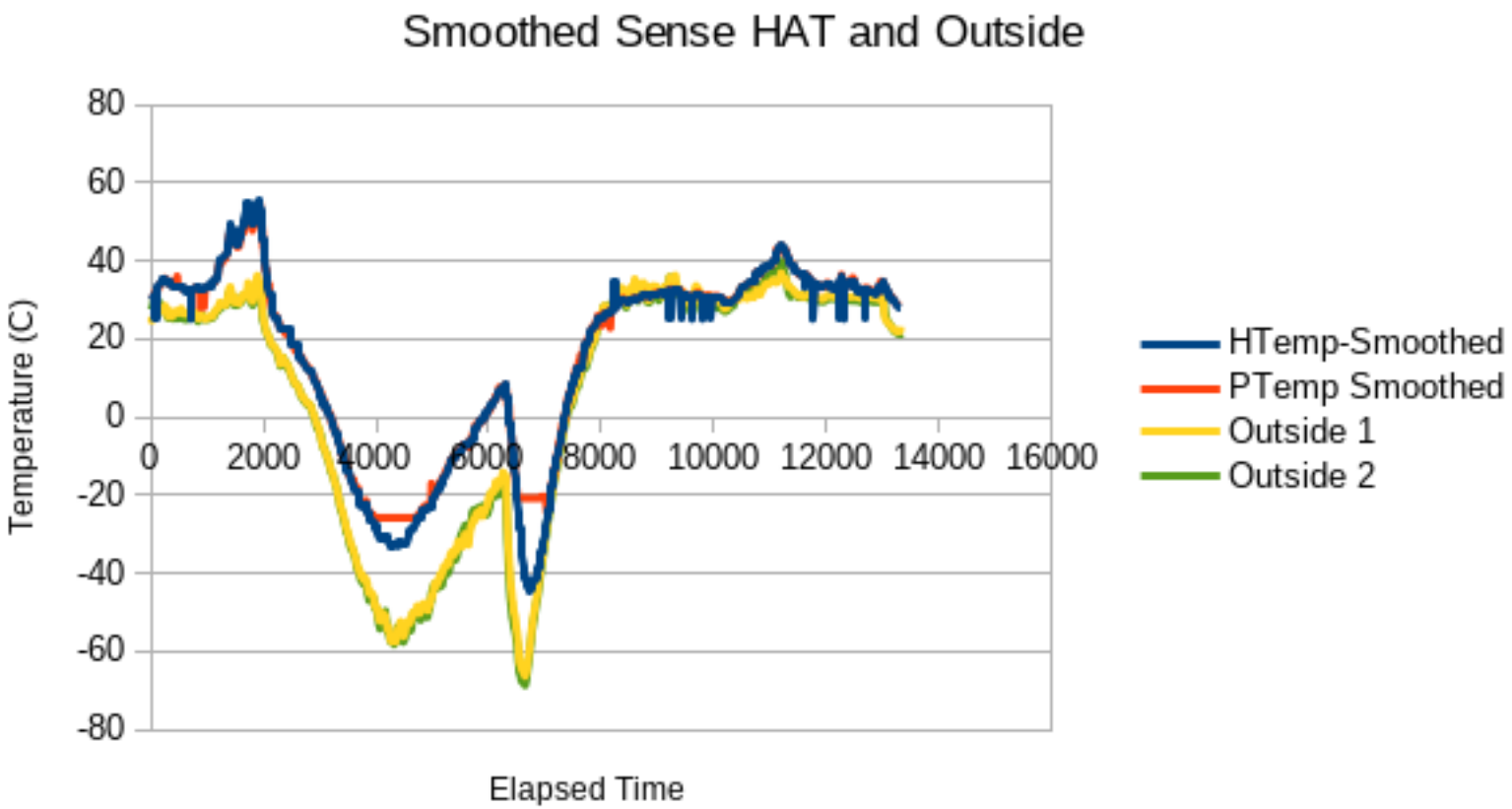


Figure: Smoothed Temperature Data

HabPi 2 - March 19, 2017

- Reference HabPi device built by Robert Lowe
- Released from Russell Springs Kentucky
- Reached an Altitude of 42,000 Meters
- Recovered near New River, TN

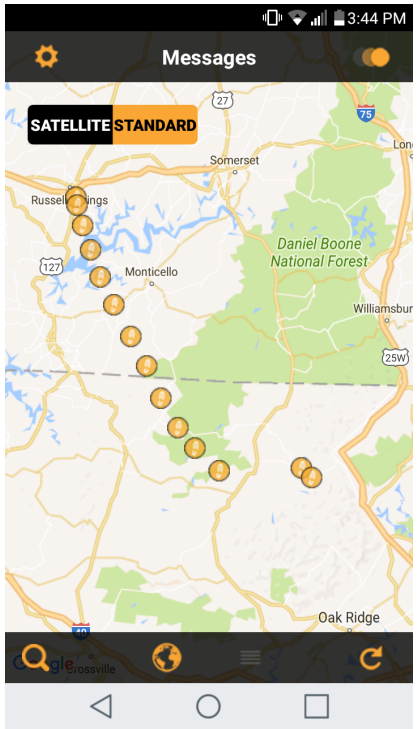
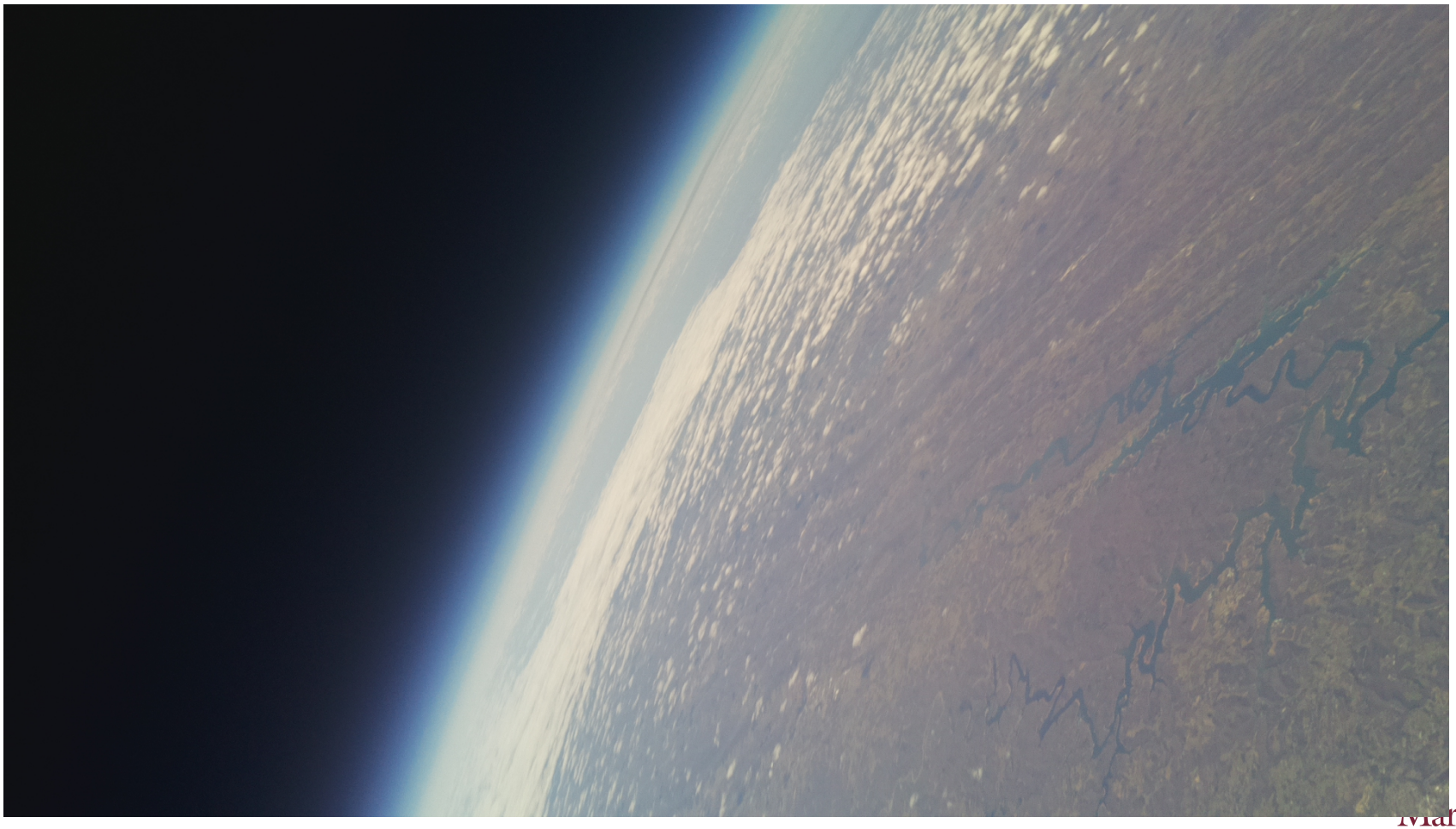


Figure: HabPi 2 Spot Tracker

HabPi 2 - March 19, 2017

HabPi 2 - March 19, 2017



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HabPi 2 - March 19, 2017

HabPi 2 - March 19, 2017

HabPi 3 - May 13, 2017

- 3 HabPi Payloads constructed by students from Concord Christian School
- 1 HabPi Payload constructed by BSA Troop 255
- Released in Sunbright TN
- Reached an Altitude of 27,000 Meters
- Flew through restricted air space at low altitude

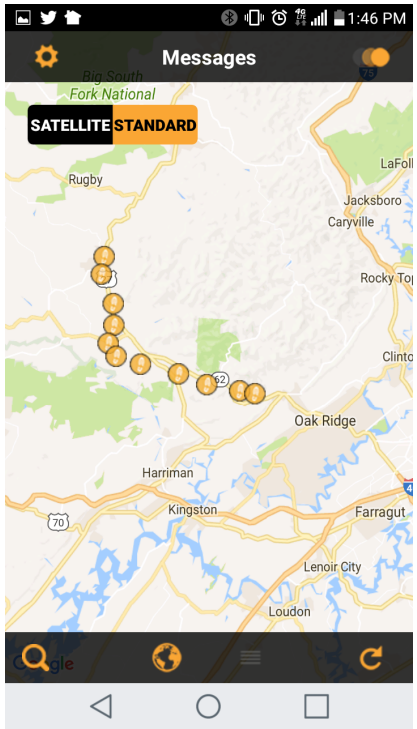

Figure: HabPi 3 Spot Tracker

HabPi 3 - May 13, 2017

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HabPi 3 - May 13, 2017

HabPi 3 - May 13, 2017

HabPi 4 - July 18, 2017

- Constructed by students in the ARC ORNL Summer Institute
- First HabPi to carry adequate battery power for download
- Released from Pellissippi State Community College
- Reached an Altitude of 27,000 Meters
- Recovered lying neatly beside a farm road

Figure: Linda

HabPi 5 - October 7, 2017

- First flight of a revised HabPi payload
- Released from Athens, TN
- Reached an Altitude of 25,000 Meters
- Recovered from a power line in Knoxville, TN
- Successful test of wireless data download

Figure: HabPi 5 - Peak Altitude

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Roadmap

2018-2019 Create a teacher's manual for HAB flight in general, with HabPi payload construction.

2019 Develop classroom activities using HabPi technologies.

2019 Host pilot workshops with gradeschool educators.

2020-2021 Begin regular flights of student constructed payloads.

Figure:

`http://github.com/pngwen/habpi`

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