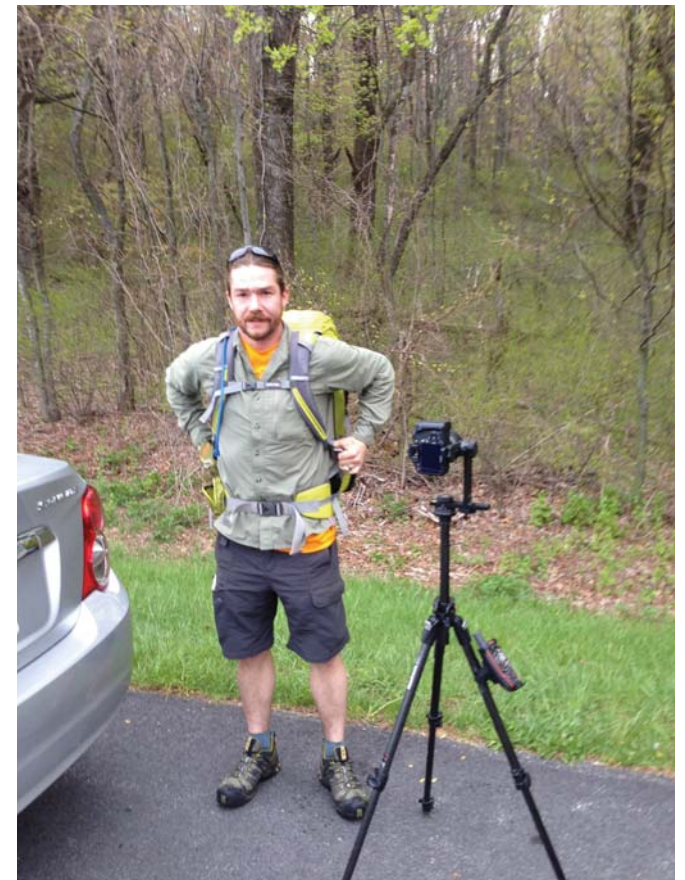


**TERRAIN<sup>360</sup>**

# TERRAIN<sup>360</sup>

## NTSGIS Jan 2017 Agenda

- Introduction to Terrain360
- Why?
- Hardware
- Software
- Notable Place we have Mapped
- Media Coverage
- Accomplishments
- Uses
- Vision
- Questions



# TERRAIN<sup>360</sup>

Introduction

# TERRAIN<sup>360</sup>

## Terrain360 Introduction

- GIS/Spatially Referenced 360° Image & Data Mapping Platform ( think a better version of google streetview)
- To Date mapped 5000+ miles of waterways & 2500+ miles of trails
- Our Passion is to showcase places not easily accessible with ultra high resolution imagery & map data and encourage people to get outside.
- Typically we capture 100's – 1000's of high resolution (130mpx) 360° images per trail or waterway
- Recently added LiDAR to our sensor stack (experimental)



# TERRAIN<sup>360</sup>

Why

# TERRAIN<sup>360</sup>

- Inception 2012 (*Frustrations with existing Streetview*)\
- Love of the Outdoors
- Combine Maps & Photography
- Few players in market

## Challenges to MVP

- Bootstrap Financing
- Software development
- Camera Development
- Creating a capture pipeline to manage massive amounts of data



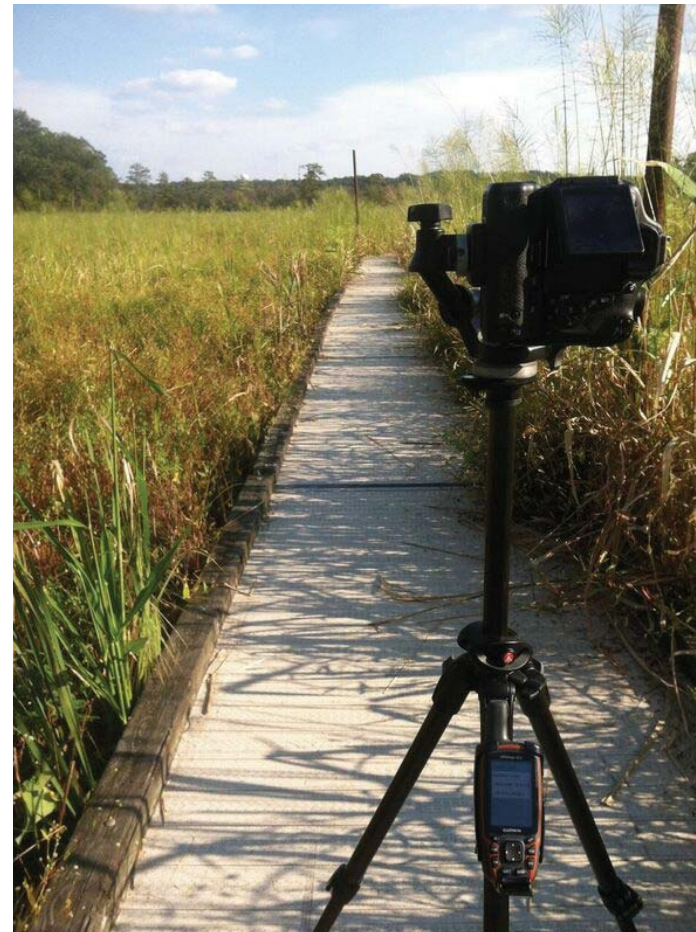
# TERRAIN<sup>360</sup>

Hardware



# TERRAIN<sup>360</sup>

- Mapping “Vehicles”
  - Simple camera & gps on tripod ( long haul backpacking) – very manual
  - Weeks of on board power
  - Simple Garmin GPS
  - Possible upgrades in 2017 include a Pi to control lighting





# TERRAIN<sup>360</sup>

- Mapping “Vehicles”
  - Fat Tire Mapping Trike– Fully automated capture process



- Lithium ion Powered (72 hours of battery)
- On board PC (atom processor)
- Lighting Sensor
- IMU/GPS/Weather Sensors
- Touch Screen
- 5 Canon t5i cameras



# TERRAIN<sup>360</sup>

- Mapping “Vehicles”
  - Custom 16’ Catacraft Boat– Fully automated capture process



- On board Generator
- On board PC i7 SSD
- Lighting Sensor
- IMU/GPS/Weather Sensors
- Touch Screen Controls
- 6 Canon t5i cameras
- VLP-16 Lidar Puck
- Completely weatherproof





# TERRAIN<sup>360</sup>

- Mapping “Vehicles”
  - Custom 13’ Catcraft Boat– Fully automated capture process

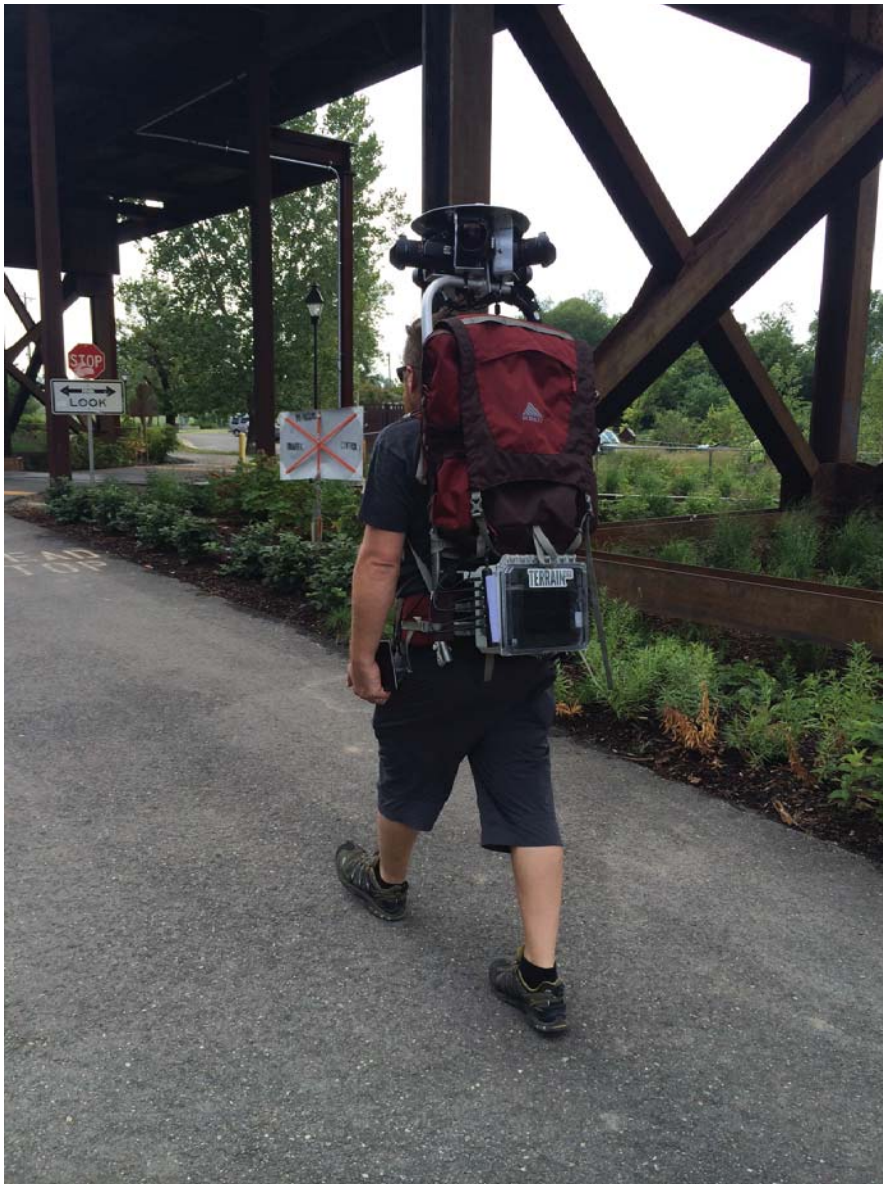


- On board Generator
- On board PC i7 SSD
- Lighting Sensor
- IMU/GPS/Weather Sensors
- Touch Screen Controls
- 5 Canon t5i cameras
- VLP-16 Lidar Puck
- Completely weatherproof



# TERRAIN<sup>360</sup>

- Mapping “Vehicles”
  - Backpack– Fully automated capture process



- Lithium ion (28 hours)
- On board PC i7 SSD
- Lighting Sensor
- IMU/GPS/Weather Sensors
- Touch Screen Controls + iPhone
- 5 Canon t5i cameras

# TERRAIN<sup>360</sup>

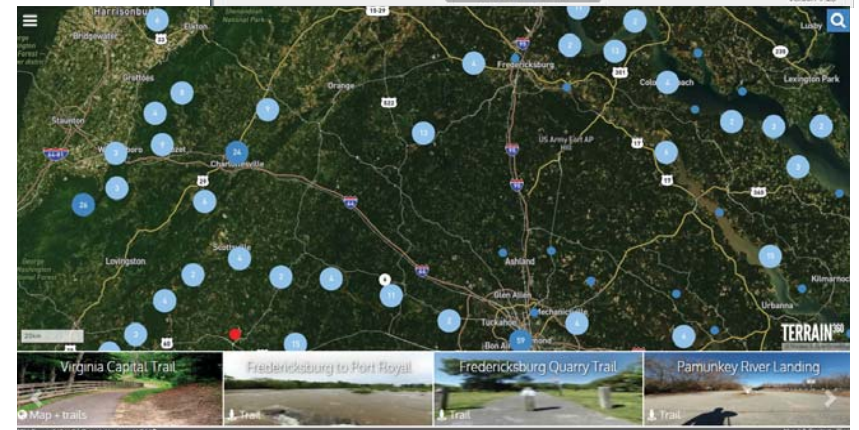
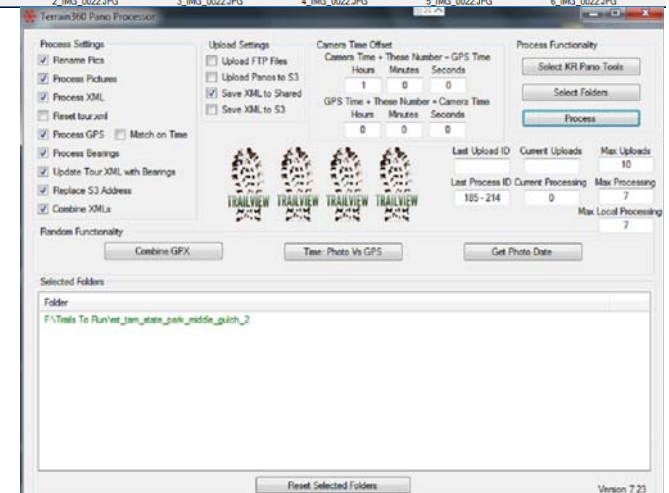
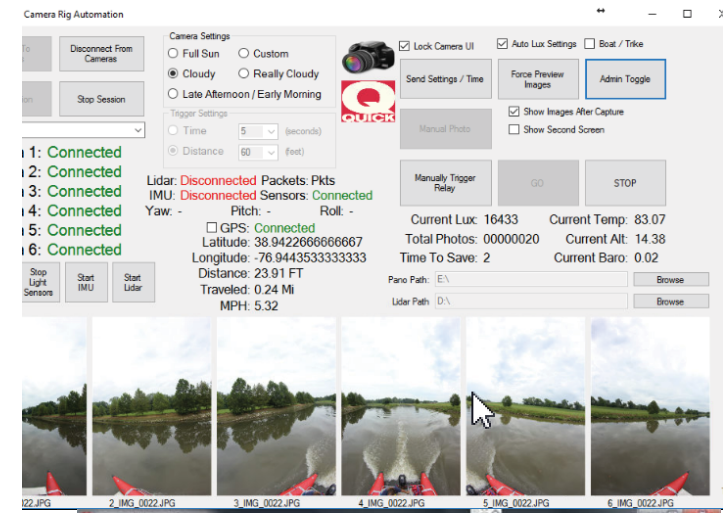
Software



# TERRAIN<sup>360</sup>

## Technology Used

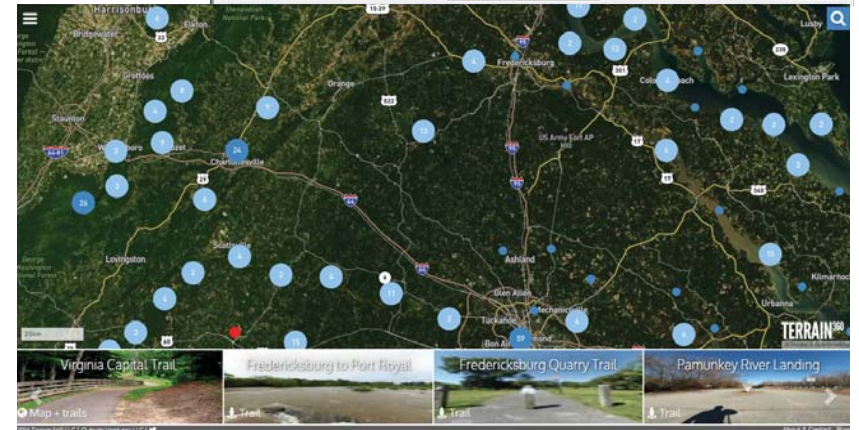
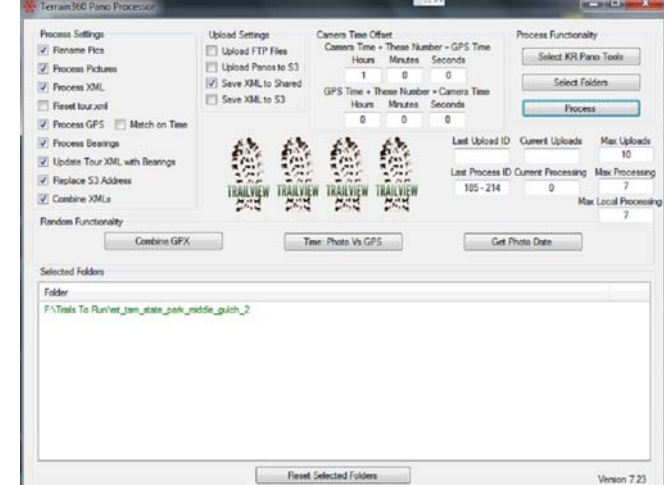
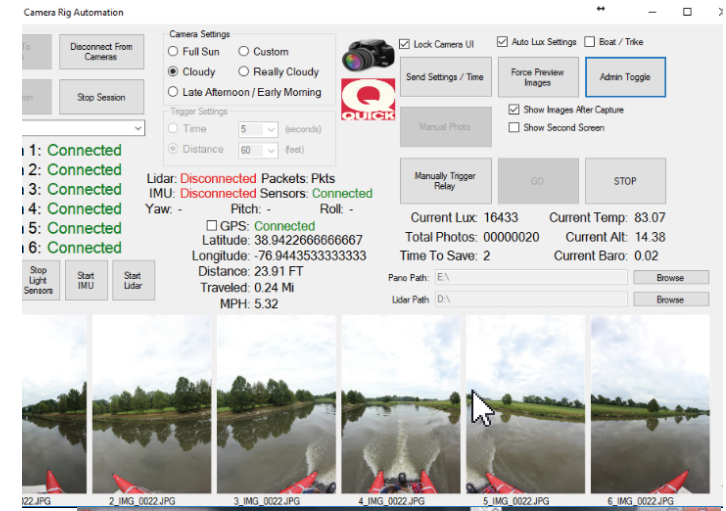
- Custom Data Capturing Application
  - Windows .NET C# App
  - Canon SDK
- Image & Data Processing Application
  - Windows .NET C# App
  - Open CV Image Rendering
  - Spatial > Image matching App
  - AWS Lambda (Structure From Motion)
- Web App and Custom Viewer
  - Laravel PHP + Docker
  - AWS S3 + Cloudfront
  - Mapbox Basemaps
  - PostgresGIS
  - WebGL
  - Three JS, Leaflet JS

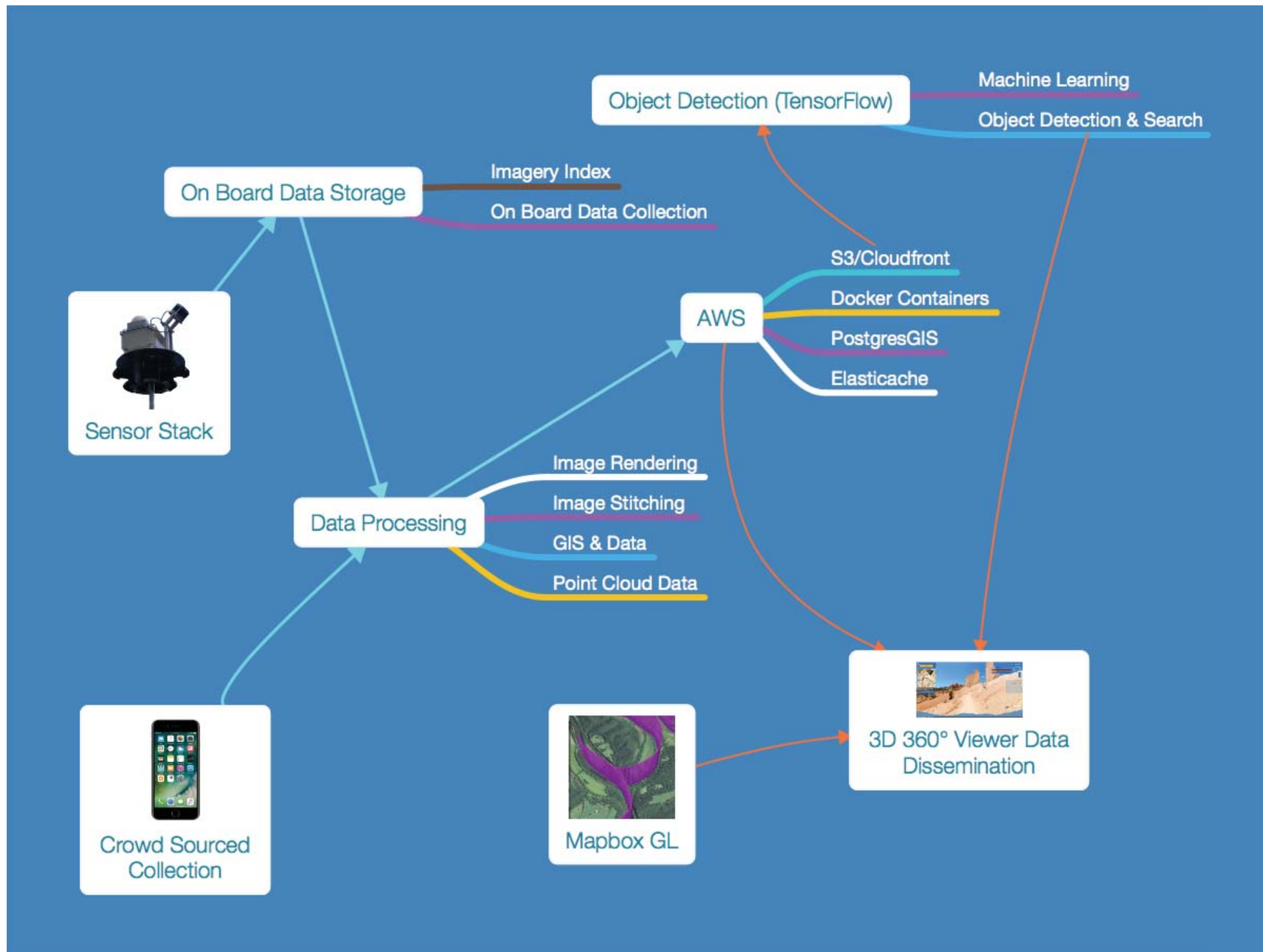


# TERRAIN<sup>360</sup>

## Data Stats

- Images
  - 22 Million original Images
  - 165 Million geo tagged Image objects in AWS S3
- Data
  - 53 TB to date of original image data
  - 140 TB to date image objects (tiles)
  - 100Gb Lidar (experimental)
  - Fun Fact – 3 500GB SSD in field drives exceeded the read/write cycle of 800TB





# TERRAIN<sup>360</sup>

Places We have Mapped





## Appalachian Trail (2013) Springer Mountain





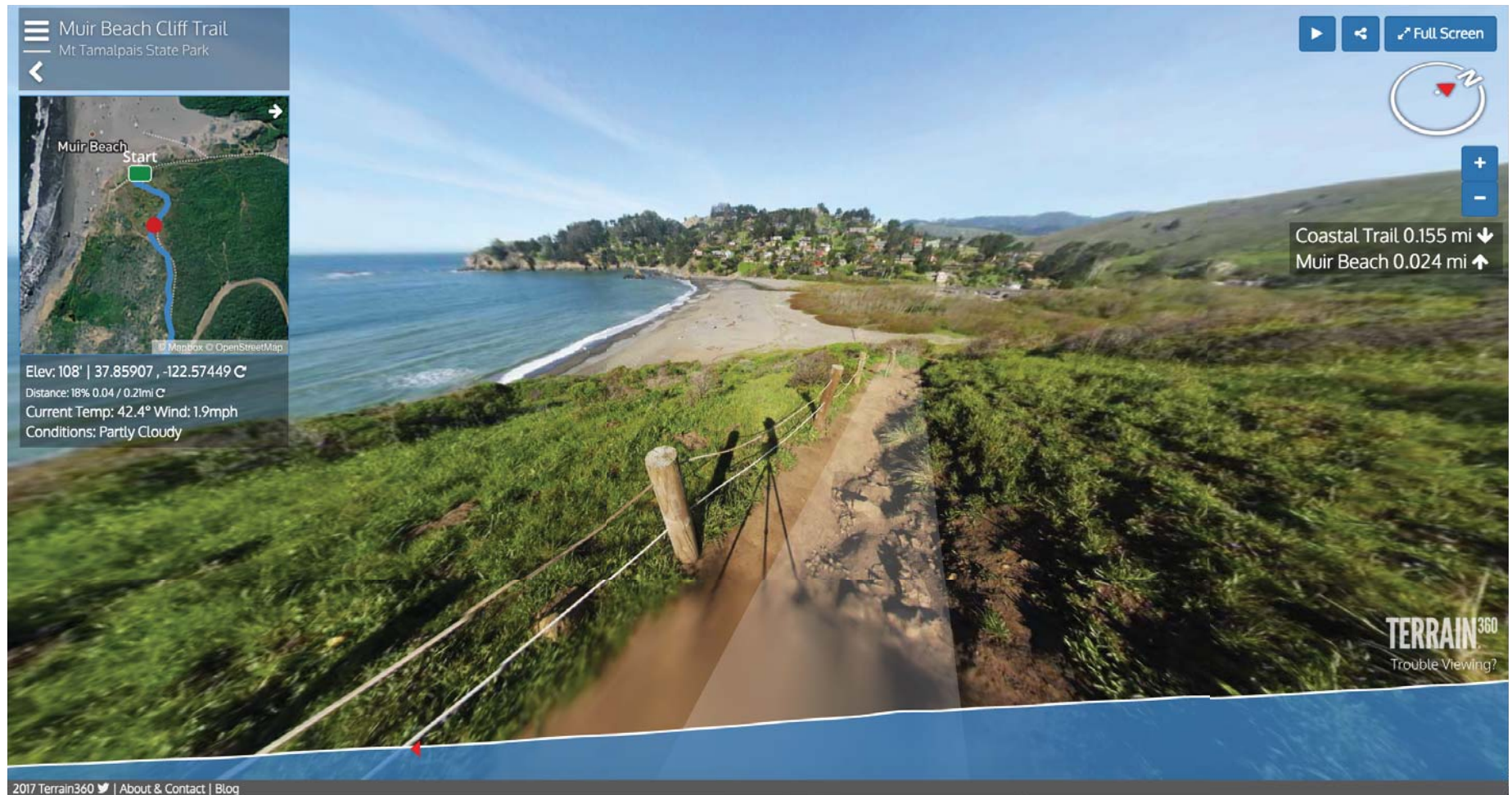
# TERRAIN<sup>360</sup>

## AT over the Potomac River



# TERRAIN<sup>360</sup>

## Mt Tam SP Muir Beach







## Bryce Canyon NP – Queen's Garden





## Bryce Canyon NP Map Page

**Bryce Canyon National Park**  
The Largest Collection of Hoodoos in the World

Birds eye | **Angled** | 2D view | More Info

Hover or click on a section below

Fairyland Canyon Trail	Bryce Canyon City 5.04mi
Hat Shop Trail	2.18mi
Inspiration Point	0.05mi
Navajo Loop Trail	1.48mi
Queen's Garden	0.80mi
Rim Trail	5.75mi
Sunrise Point	0.11mi
Sunset Point	0.06mi
Tower Bridge Trail	0.13mi

Share this map

<https://www.terrain360.com/map/bryce-canyon-national-park>

Embed Width: 800px Embed Height: 600px

Paste this code anywhere on your website:

```
<iframe
src="https://www.terrain360.com/map/bryce-canyon-national-park/embed" scrolling="no"
allowfullscreen="false" frameborder="0">
```

Rim Trail : 7977 ft

Bryce Point Rd

TERRAIN<sup>360</sup>

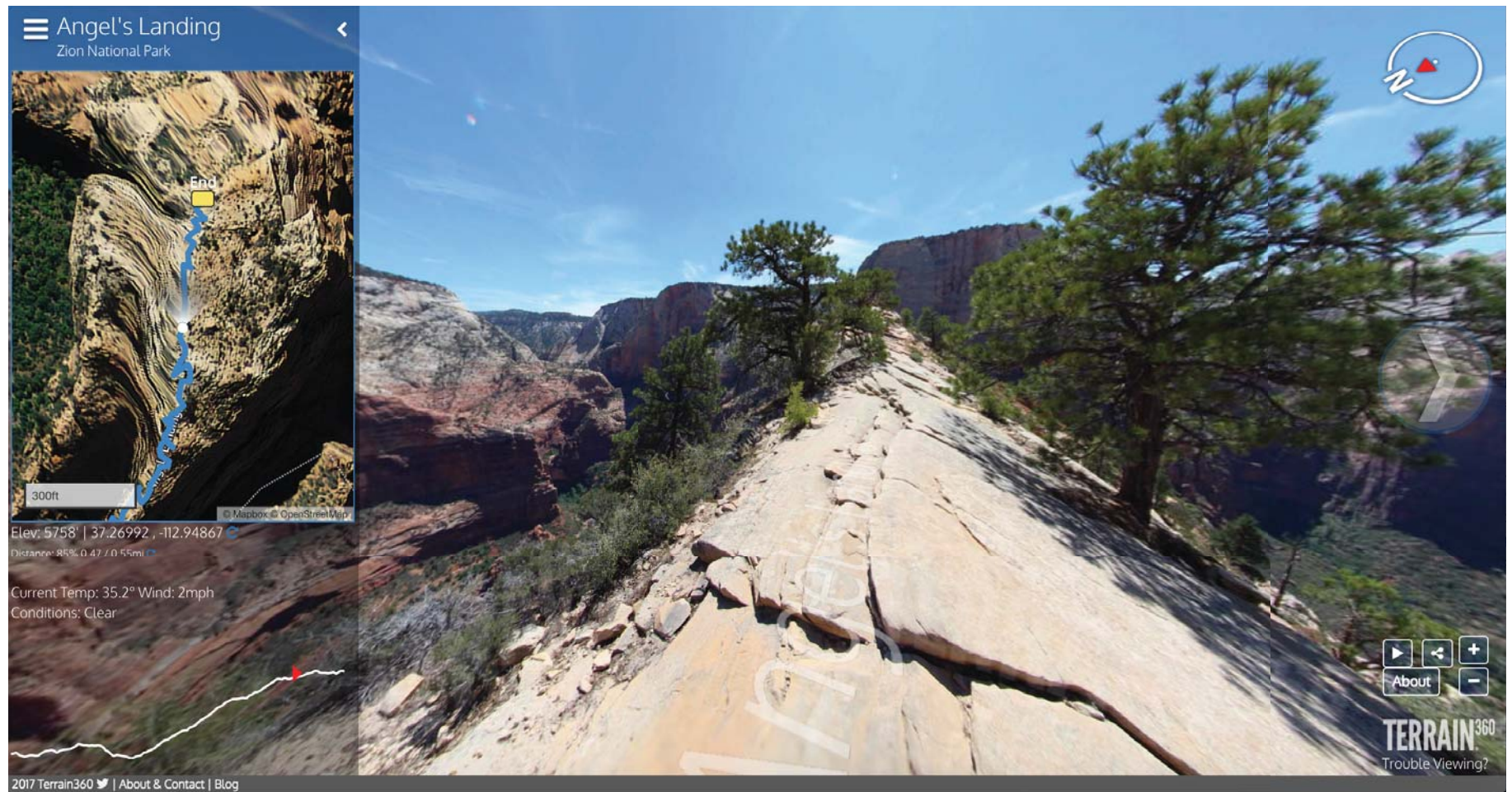
© Mapbox © OpenStreetMap

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## Zion National Park – Angel's Landing





## Captain John Smith Chesapeake NHT - Georgetown



# TERRAIN<sup>360</sup>

Media Coverage

# TERRAIN<sup>360</sup>

- Over 400 Write-ups
- 10+ TV Stories
- 1 TEDx Talk



# TERRAIN<sup>360</sup>

Accomplishments



# TERRAIN<sup>360</sup>

In just 4 years w/limited resources...

- 2000+ miles of trails
- 3500+ miles of waterways
- Highest Quality imagery (120 MP w/ 300MP capability)
- Best In Class All Custom Built 360 Viewer
- 2017- Object & Scene Detection





# TERRAIN<sup>360</sup>

Uses

# TERRAIN<sup>360</sup>

## Terrain360 Uses

- Showcase Places unknown or unseen – Drive awareness
- Encourage Conservation & Appreciation
- Remove fear of visiting
- Trip Planning & Education
- Utilize high-res images for object detection (species detection, foliage density, objects)
- Asset Management
- Detailed change over time assessment (time-machine)
- Partner map sharing (embed, links) all maps open to public



# TERRAIN<sup>360</sup>

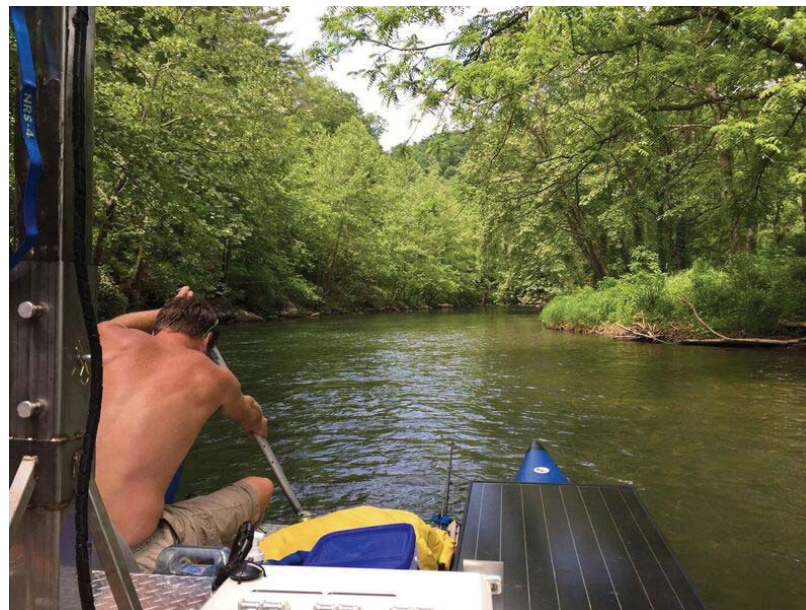
Vision





## **Vision – My Dream For The Platform**

- Real Time 360° + Image Scene, Object & Facial Detection
- Transferable cameras & data capture
- Crowd Sourced Image Gathering– REI Adventure Projects – For large scale image & data collection
- Map all National Scenic Trails (even those with streets), National Parks, State parks, etc. - with hi-res imagery
- Ultimately use Terrain360 to drive conservation policy through education



# TERRAIN<sup>360</sup>

Questions



## Example Links

- <https://www.terrain360.com/map/appalachian-trail>
- <https://www.terrain360.com/map/mt-tamalpais-state-park>
- <https://www.terrain360.com/map/zion-national-park>
- <https://www.terrain360.com/map/bryce-canyon-national-park>
- <https://www.terrain360.com/map/potomac-river-2>
- <https://www.terrain360.com/map/fones-cliffs/visual>
- <https://www.terrain360.com/map/acadia-national-park>
  
- <https://www.terrain360.com/about>