Lidar Pipelines for Immersive and Web3D Visualization

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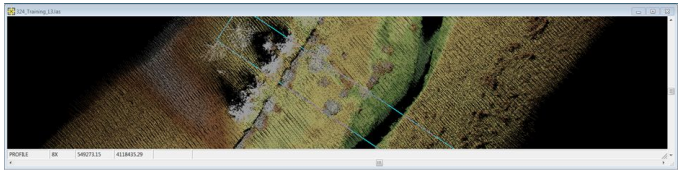
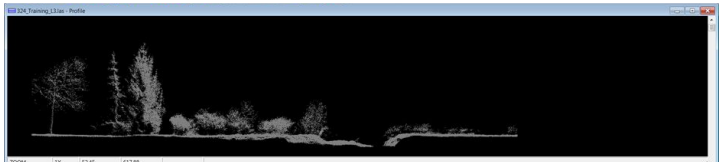
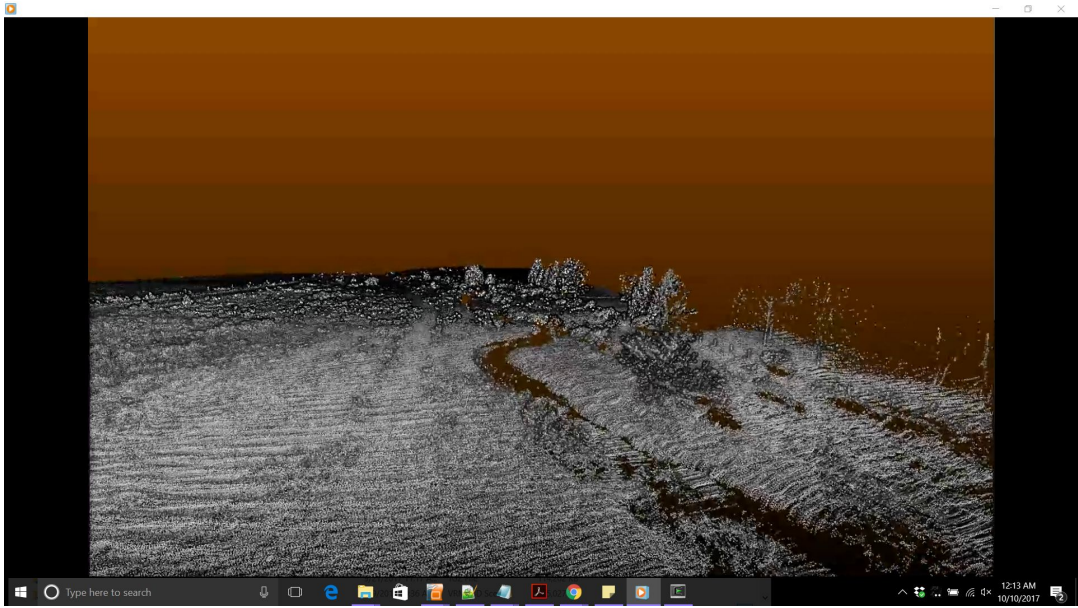
Virginia Tech



SilviLaser 2017



Introduction



General Workflow

1. Acquisition
2. Data Processing
3. Analysis
4. Publishing and Visualization
    a. Immersive 3D
    b. Web3D
5. Future Work

Drone-based Lidar

https://www.youtube.com/watch?v=DO35QIAPrtg&t=256s

YellowScan Puck

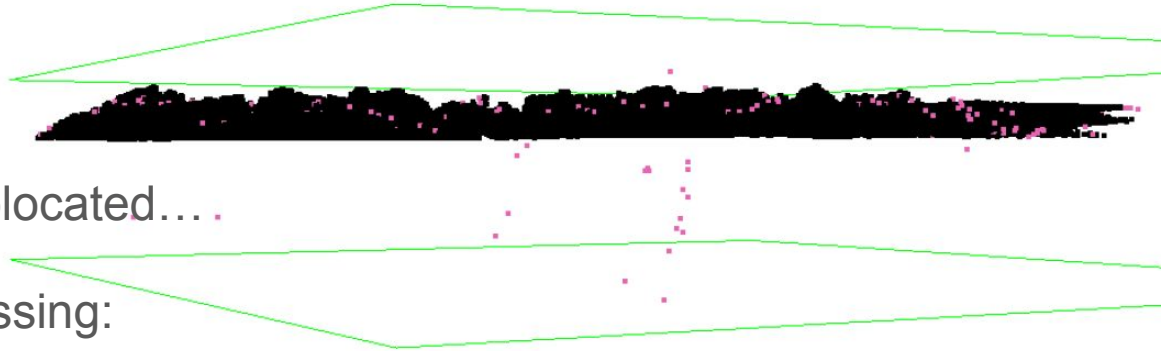
payload

The LiDAR System

- YellowScan® Core System – Mapper
- Integrated w/Vapor35
- Multi-echo LiDAR sensor GNSS RTK + PPK receiver, bi-frequency L1/L2
- Calibrated IMU
- Embedded computer
- Data pre-processing software

- 1 to 2 returns
- ~200 pts/m^2 @ 20 m
- Data recorded to USB stick, includes:
  - IMU and GPS real-time recordings
  - Scanner data

Processing

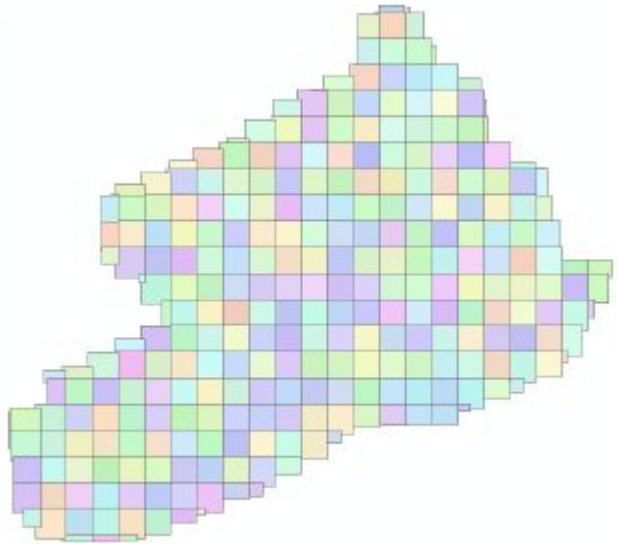


.las files co-registered and geolocated…

Noise removed, tiled for processing:

1. LASTools = > ARCGIS
    a. HTML5: potree

2. LASTools => CloudCompare
    a. X3D
    b. HTML5: X3DOM



Derived Products

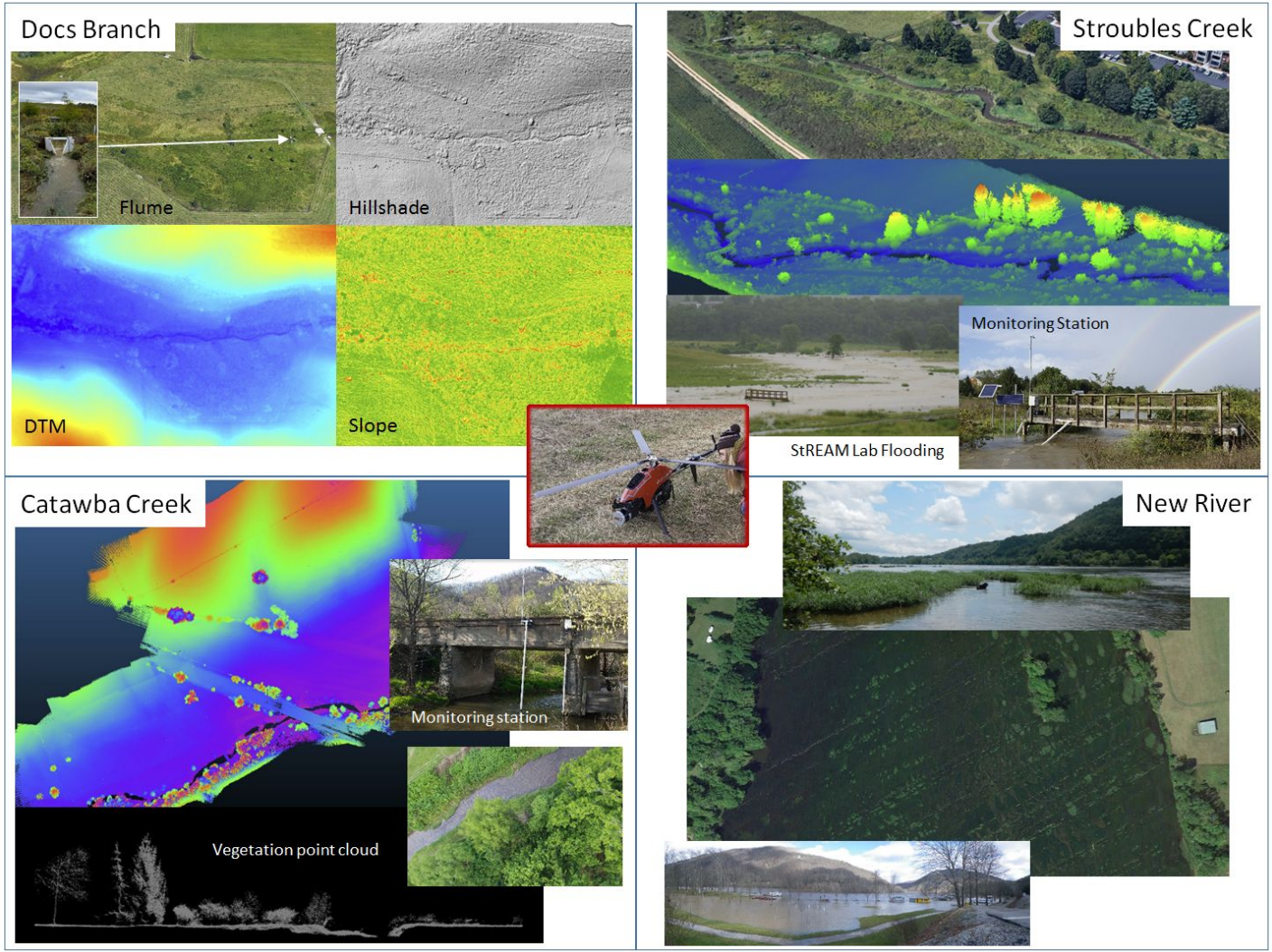
GPS:

DTM (TIN),

Aspect

Slope

CHM



3D Visualization

Rendering essentials:
Colors, Normals, visual mass, lighting, ...

MP4: Movie Fly-throughs w/ CloudCompare

Extensible 3D (X3D): Immersive CAVE @ VT Visionarium,

… HTML5 + Service-based mashups!

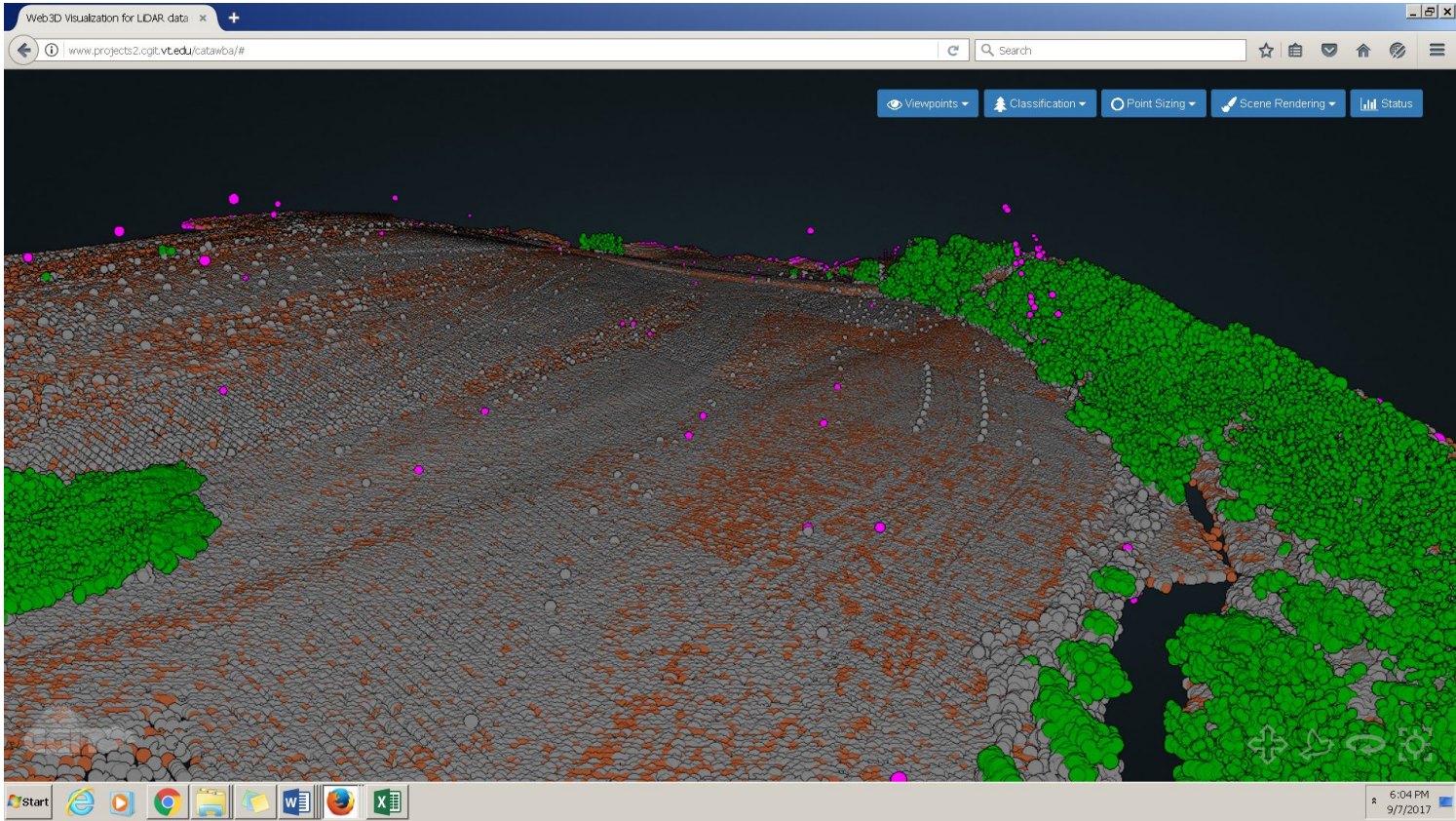
Classified Cloud

Interactive 3D

in HTML5

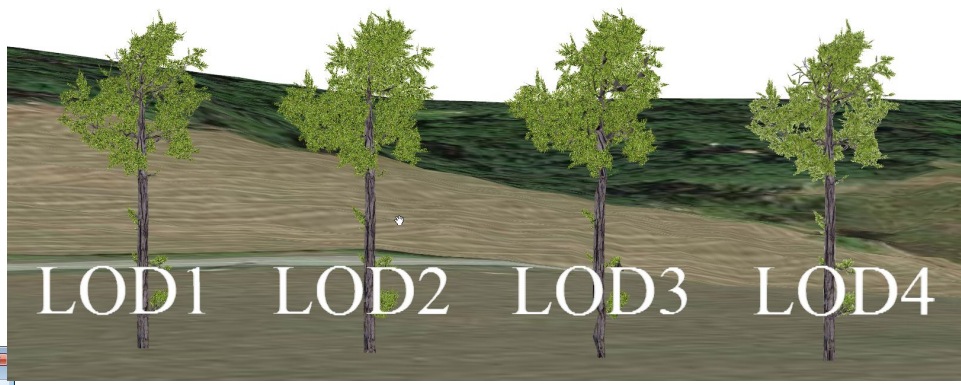
w/ mouse

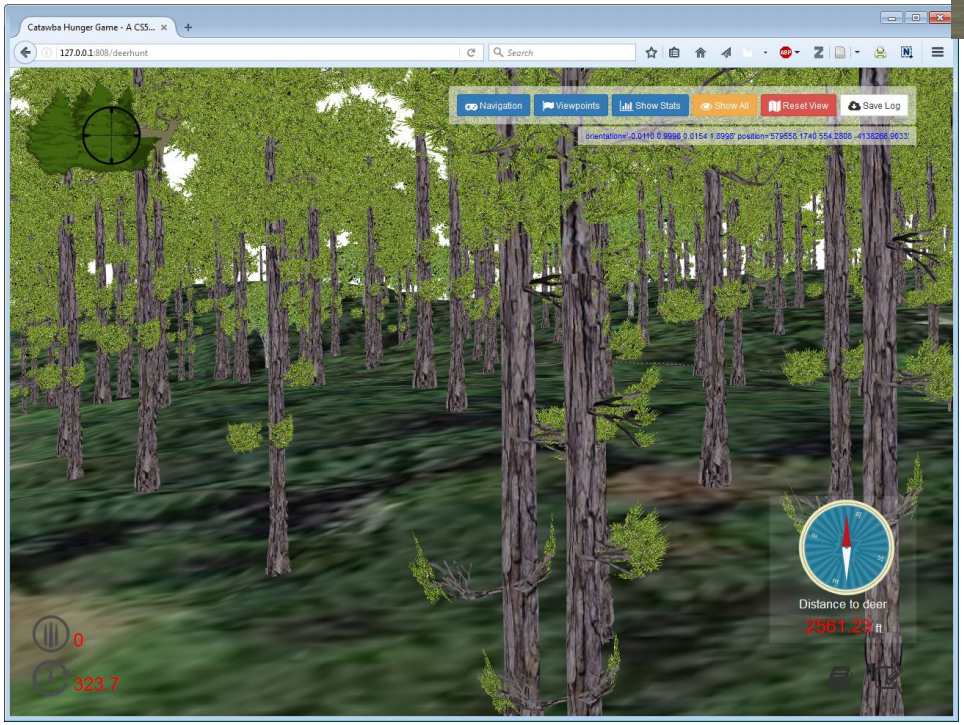
potree



Web3D:
Extensible 3D (X3D)

TIN, Imagery, Tree locations





Haitao Wang, Xiaoyu Chen, Nicholas Polys and Peter Sforza (2017). “A Web3D Forest Geo-Visualization and User Interface Evaluation”. In Proceedings of the 22nd International Conference on 3D Web Technology (Web3D '17). ACM, New York, NY, USA.

Requirements

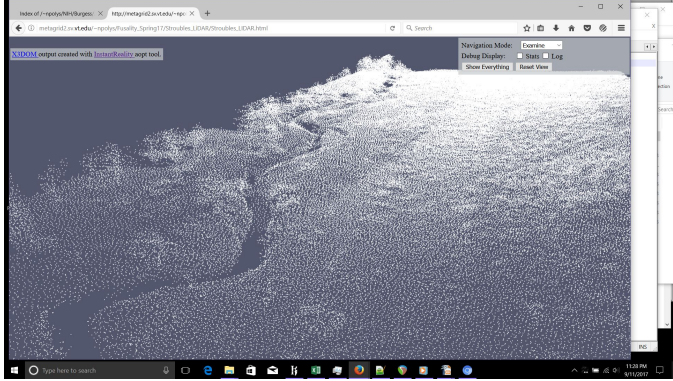
- Metadata Scheme for provenance throughout the lifecycle:
  - Acquisition
  - Transport
  - Processing
- Include points as well as quantitative, categorical, and nominal attributes per point
- A rich visual Palette to render points to visual form (e.g. Web3DS)

Visualization w/ Web3D Standards

- **Extensible 3D (X3D)** is a royalty-free and openly published ISO/IEC Standard developed by the not-for-profit Web3D Consortium [**web3d.org**]
- Metadata can annotate any node
- PointSets make coords, colors, and normals easy, but are not lit, texture-mapped, or collide-able.
  - ParticleSets have been demonstrated to address these
- Surfaces, lines, and points can be compressed
- Full-fledged interactive 3D scenes and webpages via OpenGeospatial Consortium (OGC) Web3D Service

HTML5 + X3D

Using 3D Compression



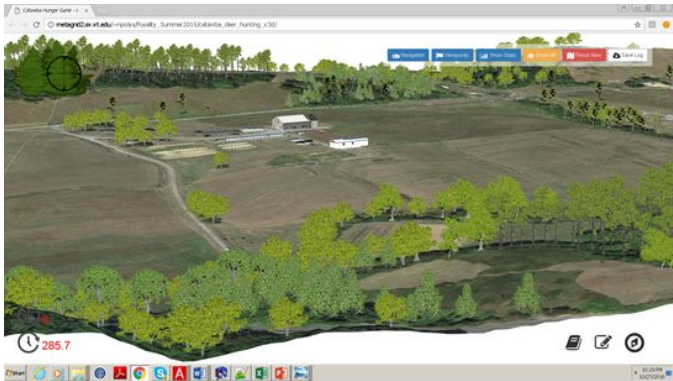
1) 440K points = 23MB.ply , 21MB.x3d

2) Compressed.X3D = 3.4 MB

3) Interaction through Web and WebVR

    - 50-60 fps on laptop

4) Gltf Inline also demonstrated

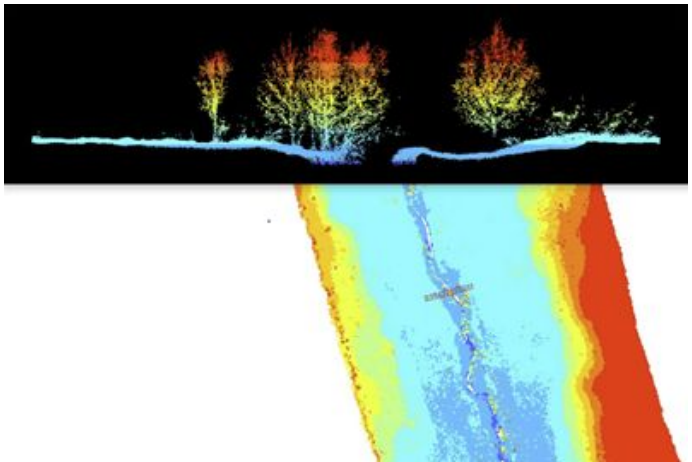


Future Work

Requirements : Durability, Interoperability, Accessibility

Two fronts:

- Standards Advocacy - ISO/IEC standards to support requirements
- Consumer Advocacy - Vendors to support ISO/IEC standards



Thanks

- VT Stream Lab
- Catawba Sustainability Center
- Advanced Research Computing
- Center for Geospatial Information Technology

See Also:

Annual SIGGRAPH Carto BOF -

Polys & Russalesi present
X3D and Web3DS in minutes 8-27
also includes Cesium & ESRI presentations

https://youtu.be/6ttQUhnu4SQ

Join Us~!

Nicholas Polys

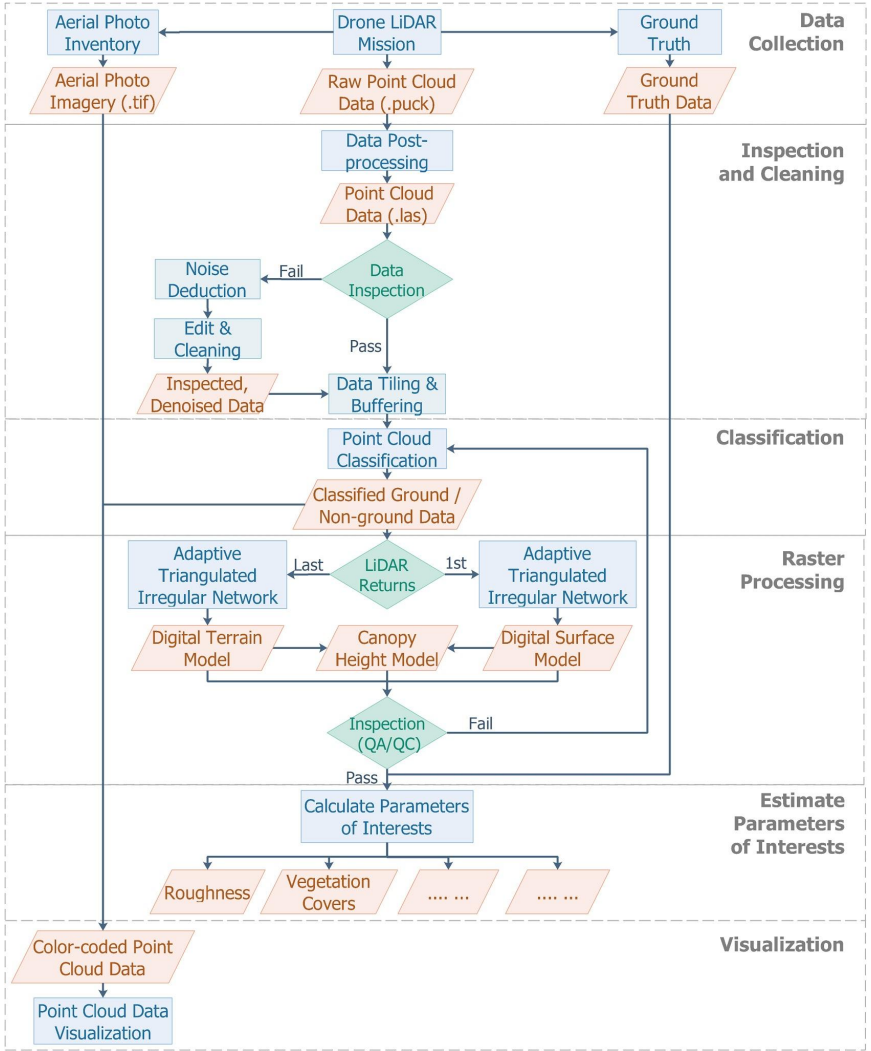
npolys@vt.edu

- **VT NEWs short form:**

- **https://vtnews.vt.edu/articles/2017/07/outreach-dronesatcatawba.html**

long form *(5 min)

- **https://www.youtube.com/watch?v=DO35QIAPrtg&spfreload=5**


Aerial Photo Inventory
Drone LiDAR Mission
Ground Truth
Data Collection
Aerial Photo Imagery (.tif)
Raw Point Cloud Data (.puck)
Ground Truth Data
Data Post-processing
Inspection and Cleaning
Point Cloud Data (.las)
Noise Deduction
Fail
Data Inspection
Edit & Cleaning
Pass
Inspected, Denoised Data
Data Tiling & Buffering
Classification
Point Cloud Classification
Classified Ground / Non-ground Data
Adaptive Triangulated Irregular Network
Last
LiDAR Returns
1st
Adaptive Triangulated Irregular Network
Raster Processing
Digital Terrain Model
Canopy Height Model
Digital Surface Model
Inspection (QA/QC)
Fail
Pass
Calculate Parameters of Interests
Estimate Parameters of Interests
Roughness
Vegetation Covers
....
....
Color-coded Point Cloud Data
Visualization
Point Cloud Data Visualization

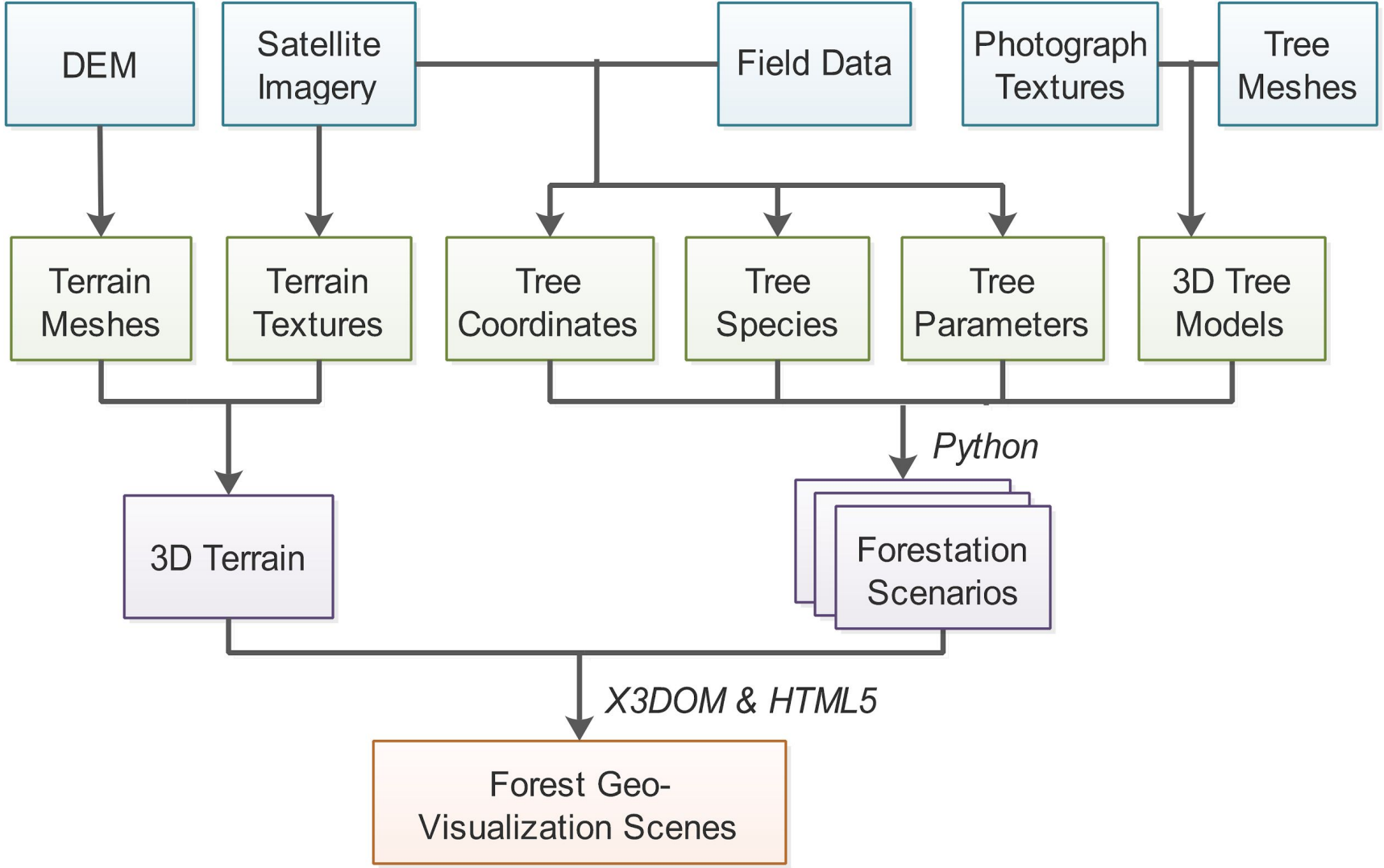
Locations

Catawba Sustainability Center

32 million points, 8 columns

Stroubles Creek & Doc’s Branch

57 million points, 8 columns


DEM
Satellite Imagery
Field Data
Photograph Textures
Tree Meshes
Terrain Meshes
Terrain Textures
Tree Coordinates
Tree Species
Tree Parameters
3D Tree Models
Python
3D Terrain
Forestation Scenarios
X3DOM & HTML5
Forest Geo-Visualization Scenes