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Cloud-Based LiDAR Visualization and Exploitation

ASPRS - 2015
Patrick Collins

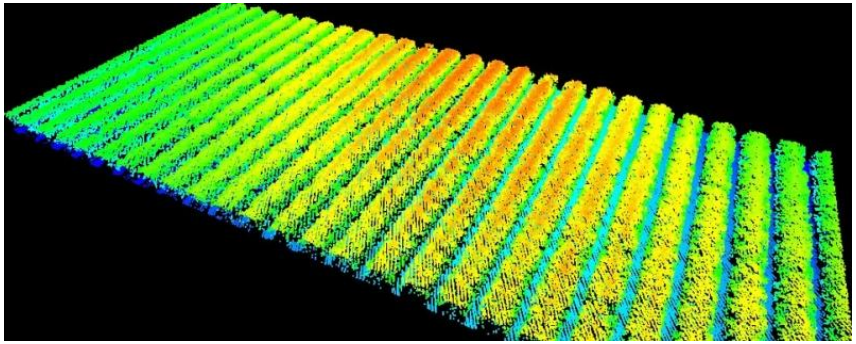
LiDAR is a Growing Industry

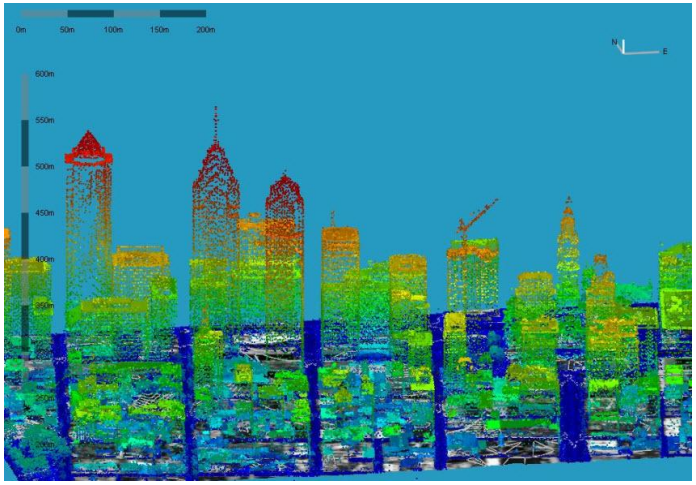
Expected to grow to over $550 million dollars by 2018*

- Reduced cost for acquisition and analysis
- More businesses getting into LiDAR development and services

LiDAR is uniquely solving complex problems across industries

- Advanced Driver Assistance Systems (ADAS)
- Offshore Wind Measurement
- Forest and Crop Assessment / Management
- Urban Planning and Development





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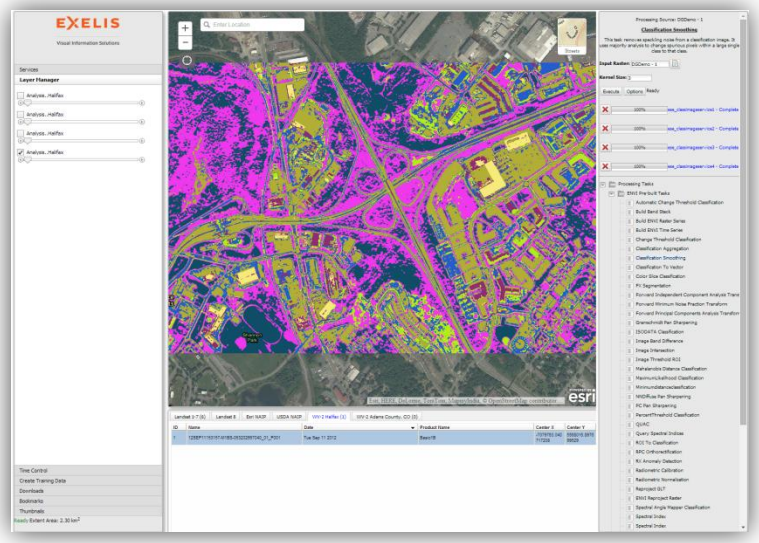
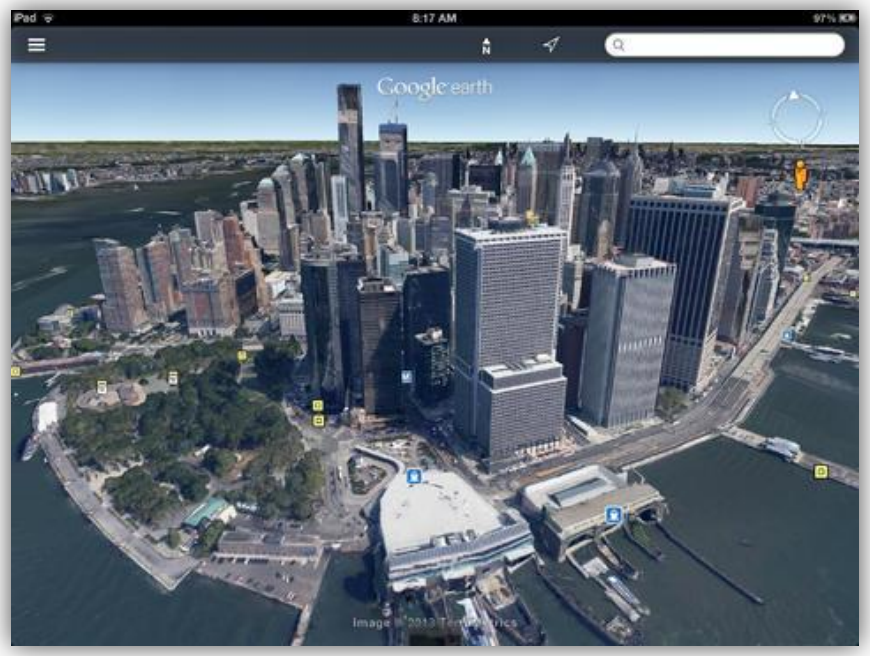
* LiDAR Market by Components (INS, Laser, GPS/GNSS, Camera, MEMS), Product Types (Airborne, Mobile, Terrestrial), Applications (Corridor Mapping, Forestry, Mining, Topographic Surveying, Volumetric Mapping) - Global Forecasts and Analysis 2013 – 2018

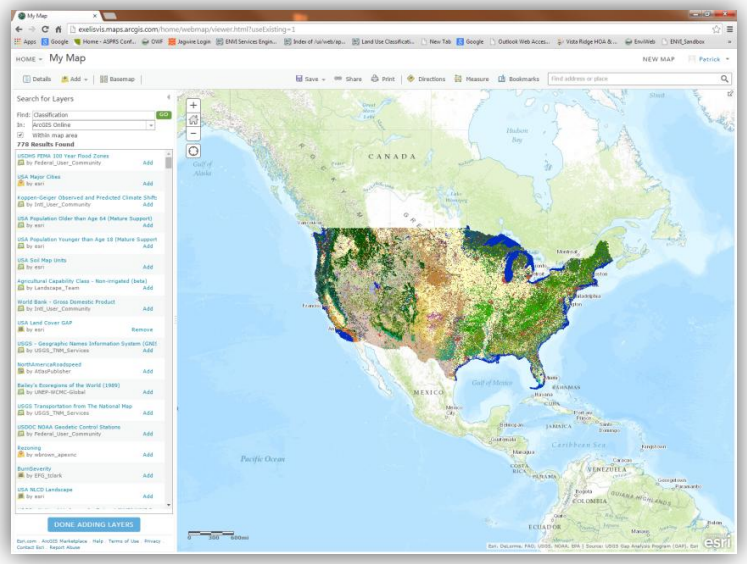
Web GIS is a Growing Industry

Companies are building robust online visualization and analysis communities

- Google Earth™
  - Visualization of imagery, building models
- Esri®
  - Sharing of data layers and maps
- Exelis
  - Advanced web-based analytics







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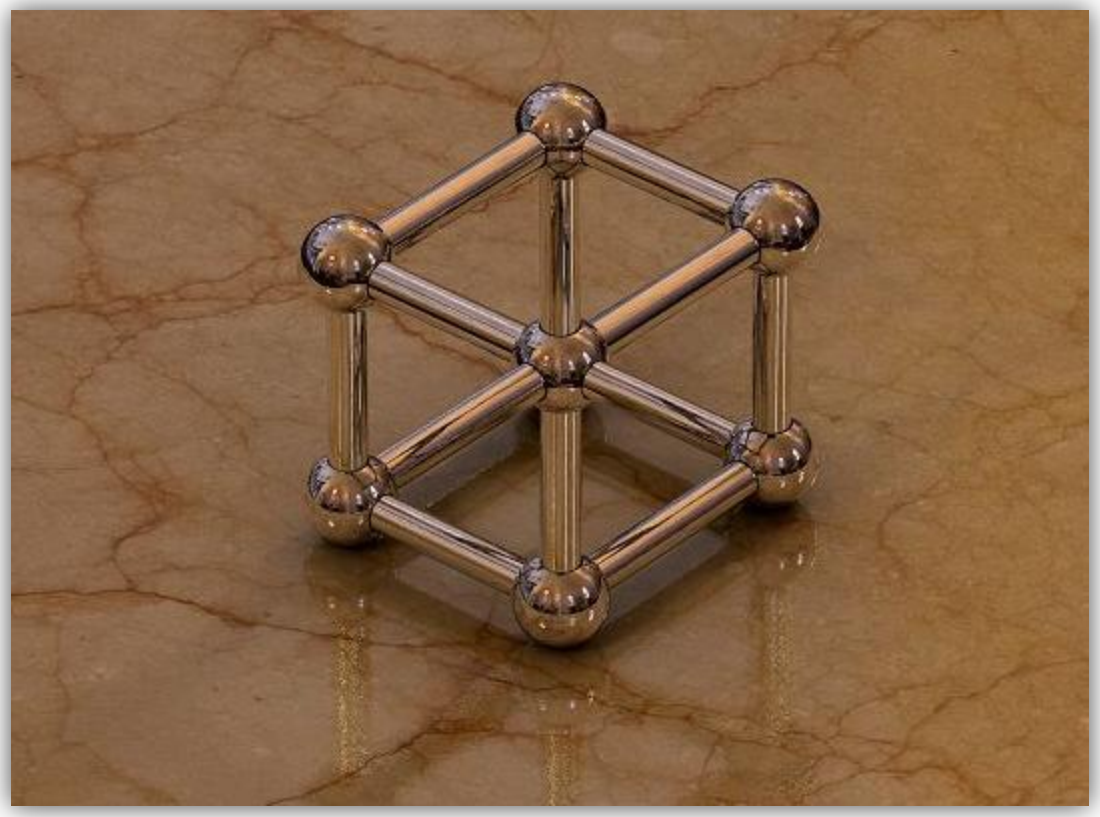
The Art of the Possible

Consumers of web GIS want easy and intuitive solutions

- Many non-traditional users
- Apps and interfaces should be easy to use
- Making something **possible** does not necessarily make it **easy**



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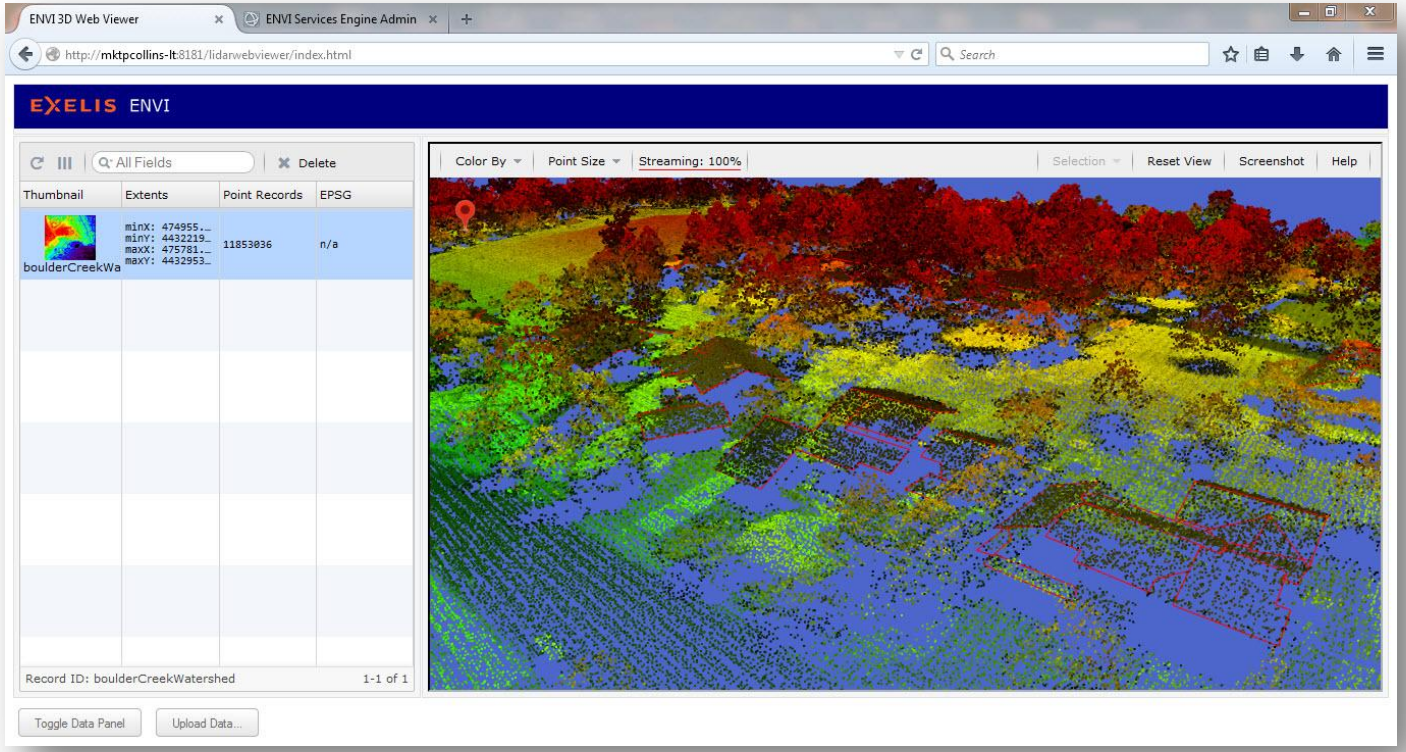
What we've done

Created a WebGL viewer that consumes LiDAR point clouds through a browser

> Visualization of streaming LiDAR from ENVI Services Engine

Enabled automated building feature extraction via http://REST protocols

> FX routines pulled from ENVI LiDAR and enabled as Services Engine tasks



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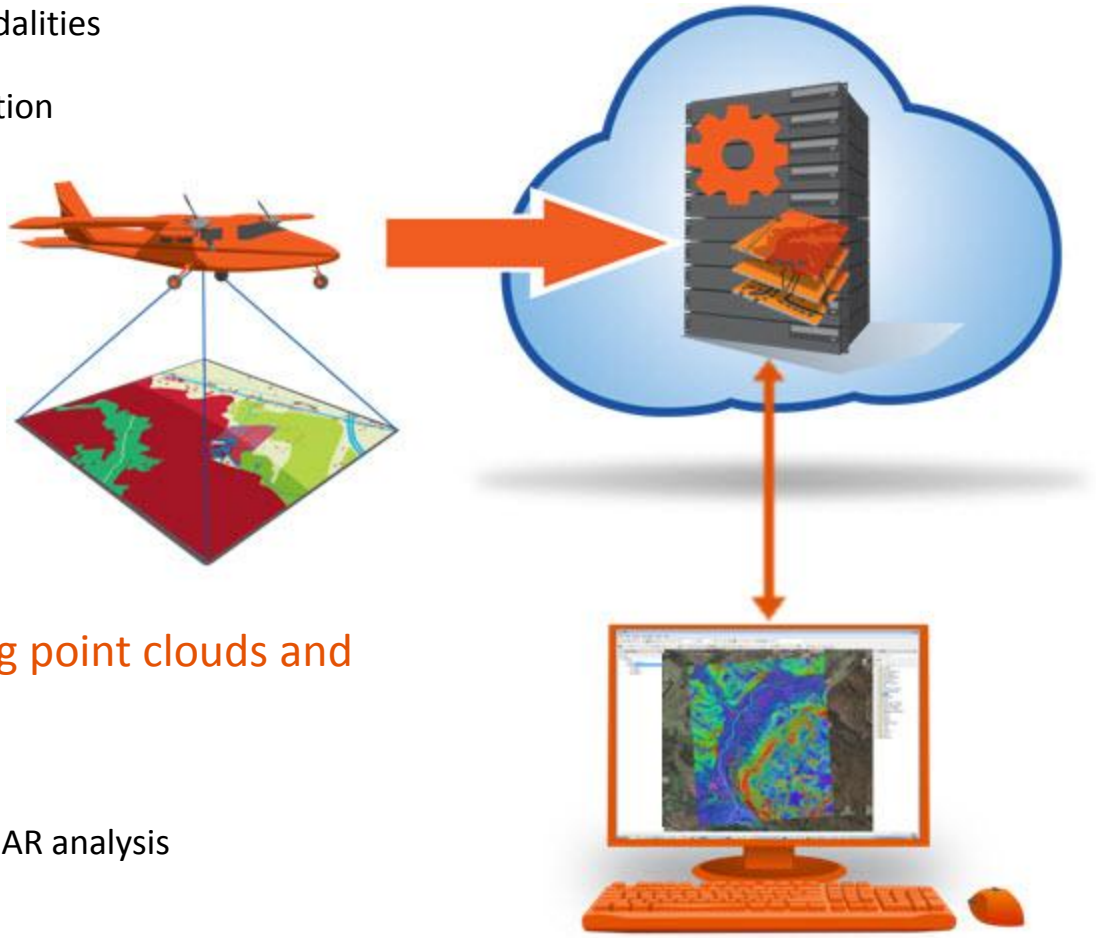
Basic Architecture

ENVI Services Engine provides data streaming and analysis capabilities

- Ingest and display of multiple data modalities
- LiDAR-specific data ingest and preparation
- Hosting of analysis capabilities
  - ENVI
  - IDL
  - C++
  - Java



WebGL Viewer consumes streaming point clouds and enables analysis calls

- Provides the user experience
- Leverages http:// Rest calls to call LiDAR analysis

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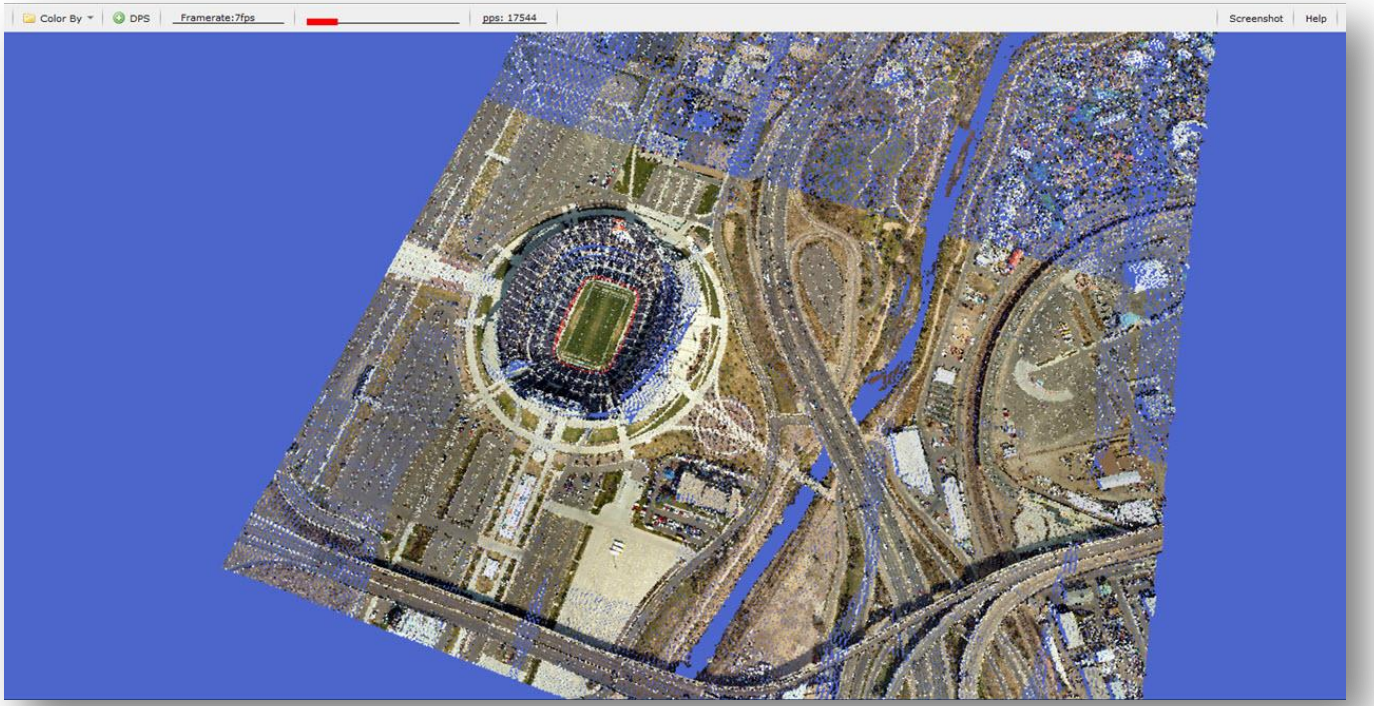
LiDAR Provides Unique Challenges

Cloud-based visualization and exploitation of LiDAR is different than most traditional GIS modalities

- Size of LiDAR datasets
- LiDAR data needs to be massaged prior to dissemination
- User wants desired information without having to do the ‘heavy lifting’
- User wants fast results

We’ll look at two aspects of cloud-based LiDAR from two angles

- Visualization
  - Make it Possible
  - Make it Easy
- Exploitation
  - Make it Possible
  - Make it Easy



Data courtesy of Merrick®

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Web-based LiDAR visualization – make it possible

What are some technical considerations when visualizing LiDAR on the web?

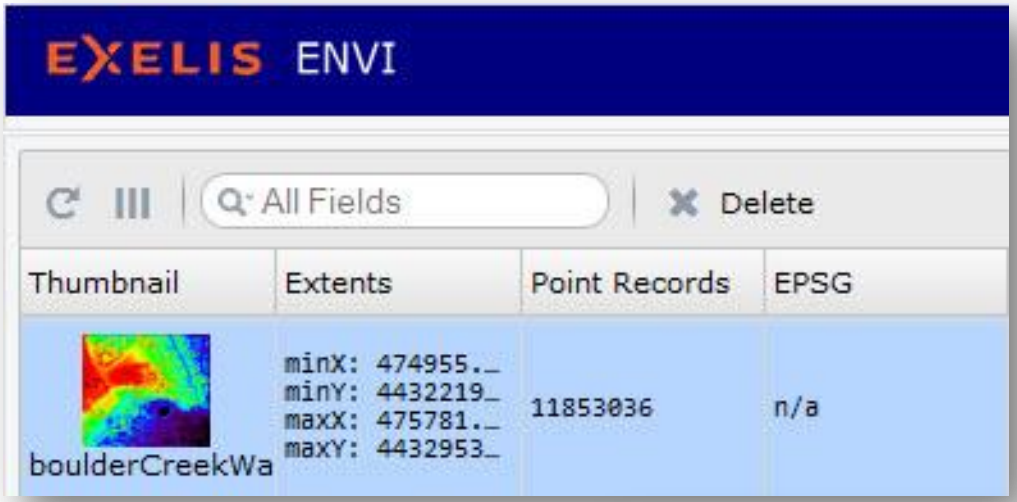
- Size of LiDAR datasets
- Data preparation
  - Pre-processing IDL task bins data into a quadtree structure
- Choosing the right viewer technology
  - JavaScript / WebGL

```
PRO lidarPreProcessor, INPUT_LIDAR_URI=fileList, $
                       INPUT_BASE_NAME=baseName, $
                       INPUT_LEVELS=levels, $
                       OUTPUT_NUMBER_OF_POINTS = outputNumPoints, $
                       OUTPUT_EPSG = outputEPSG, $
                       OUTPUT_DIRECTORY = outputDirectory, $
                       OUTPUT_BASENAME = outputBasename, $
                       OUTPUT_DATA_RANGE = outputDataRange

  COMPILE_OPT idl2

  ;ESE should prevent this from being called, but
  ;just in case
  if N_Elements(fileList) eq 0 then begin
    !server.Error, 'Required parameter INPUT_LIDAR_URI is not defined'
  endif

  print, 'Starting lidar processing'

  localFileArgument = ""
  firstFileDirectory = !null
  foreach file, fileList do begin

    fileFromURL = !server.URLtoFile(file)

    ;!server.URLtoFILE returns a list of 1 element
    ;make sure to scalarify, it is okay to index
    ;0 on a scalar
    fileFromURL = fileFromURL[0]
```

Web-based LiDAR visualization – make it easy

What are some UI/UX considerations when visualizing LiDAR on the web?

- Don’t stream the entire dataset!
  - Load resolution levels based on user perspective for better performance
- Make the interface intuitive
  - Zooming, panning, selecting data, and running analysis
- Allow users to upload their own data for visualization / analysis
  - Automatic data prep



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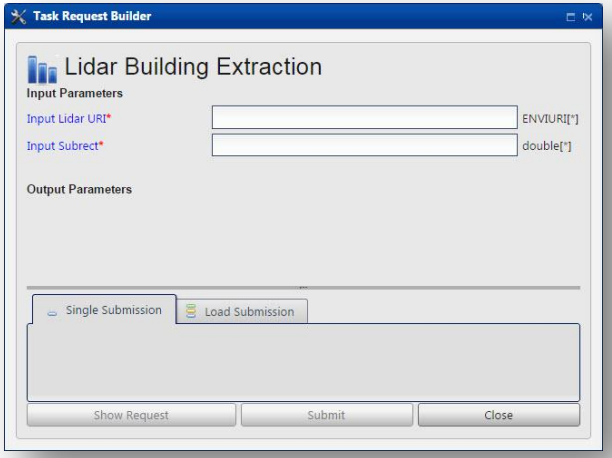
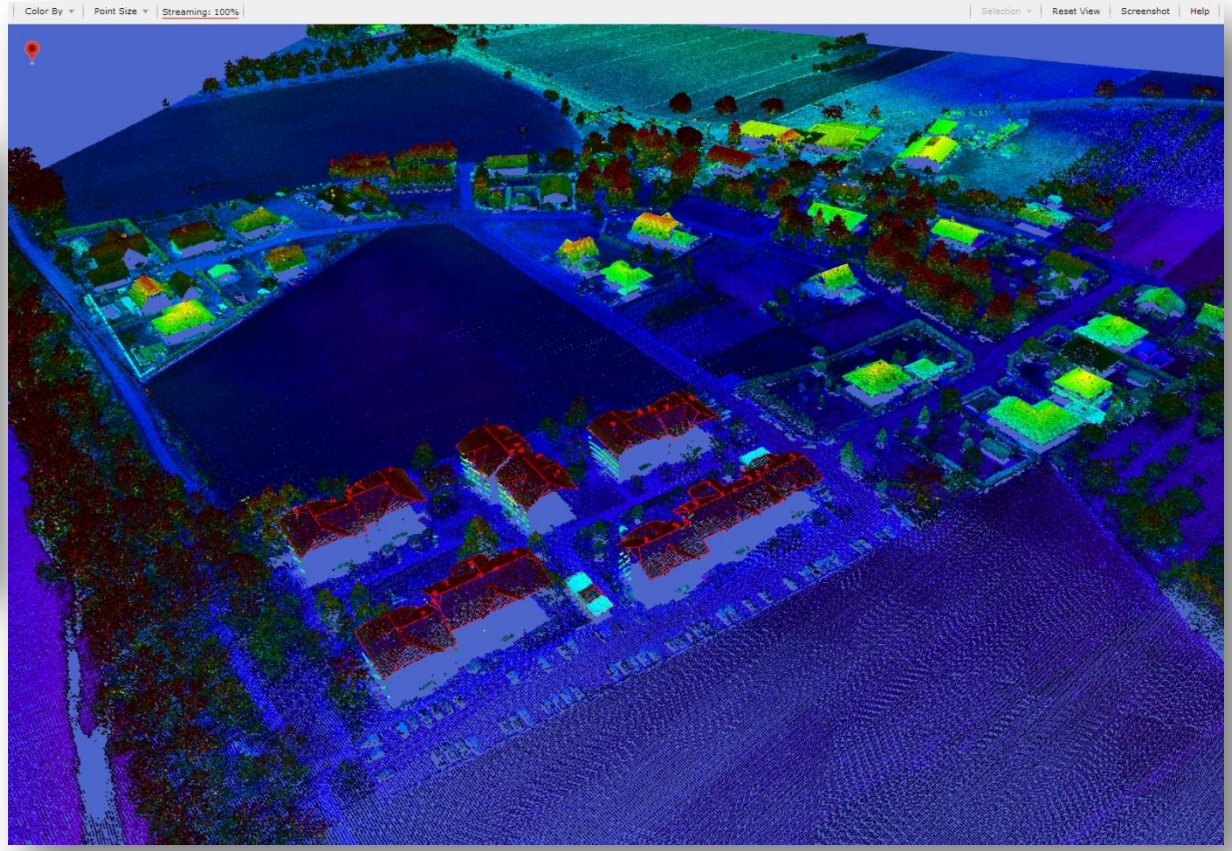
Web-based LiDAR exploitation – make it possible

What are some technical considerations when analyzing LiDAR on the web?

- Requires data subset, data URI, and any required parameters
  - Coordinates sent to the LiDAR task on the server
- Building extraction task written in IDL and leverages the ENVI LiDAR API
- Extracted features saved as shapefile and streamed via the server





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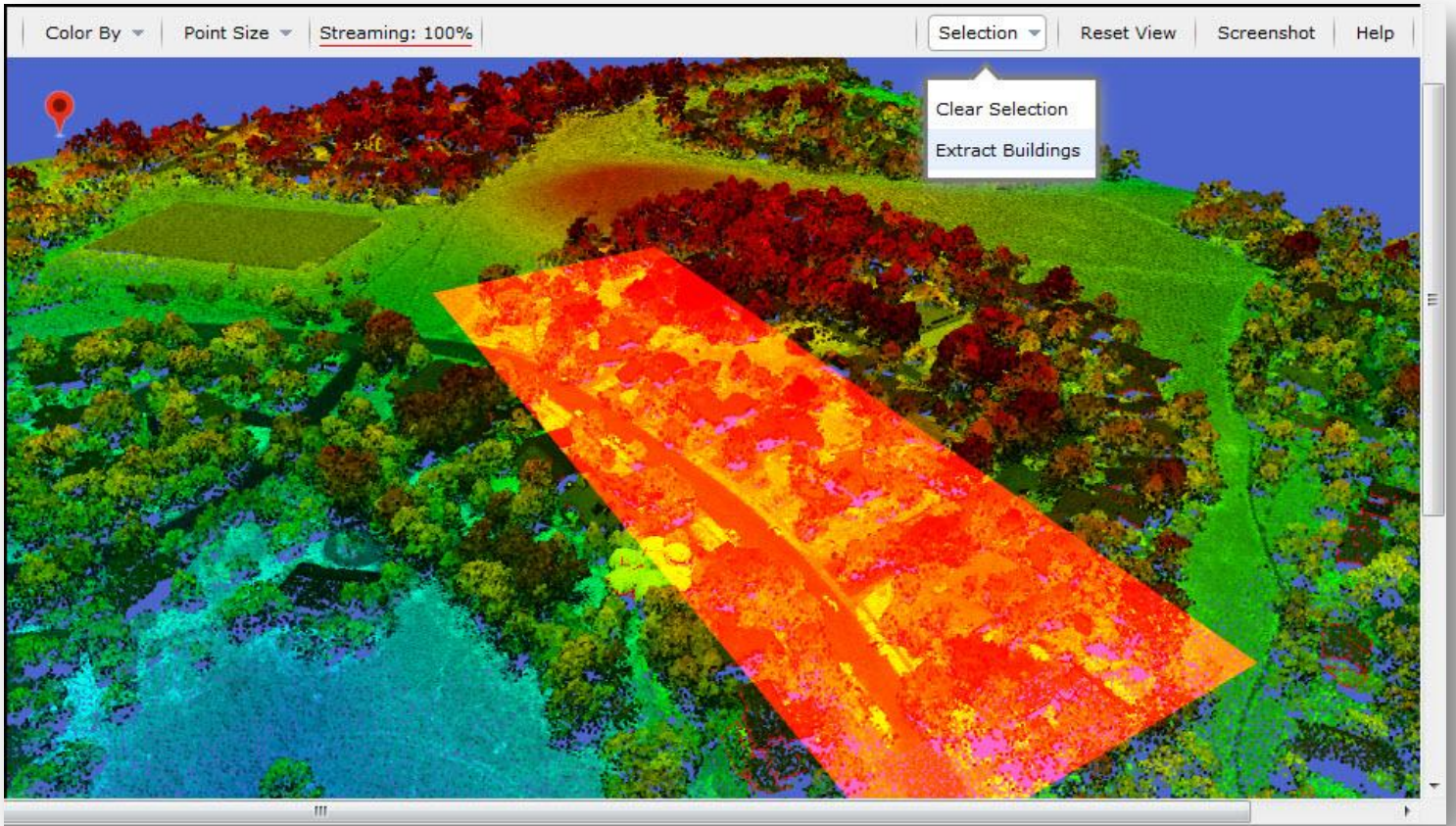
Web-based LiDAR exploitation – make it easy

What are some UI/UX considerations when analyzing LiDAR on the web?

- Enable the user to select a subset of the data
- Simple buttons for clearing selection and extracting buildings
- Future improvements - extraction status, ability to download shapefile, more tasks



What does this all mean???

Web-based LiDAR visualization and exploitation will help drive the growth of the industry

- The ability to stream and analyze LiDAR point clouds via the web is a reality
  - ENVI Services Engine combined with the 3D Web Viewer
- Organizations can create simple applications that leverage server technology to display and exploit LiDAR point clouds
- The ENVI LiDAR API contains automated extraction tasks for buildings, elevation data, power lines, trees, and more
- Custom routines can be designed to extract almost anything from a LiDAR point cloud
- The key becomes designing user interfaces that are simple and that solve specific problems within a specific industry