July 28, 2022

TRENDS IN AERIAL DATA RESOLUTION AND DELIVERY

FOR ASPRS EGLR 2022 SUMMER CONFERENCE

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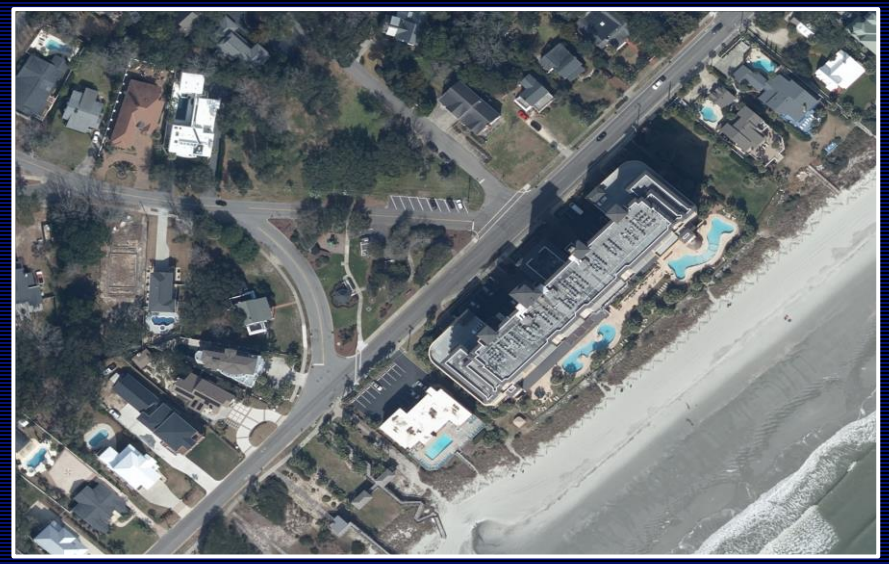
INCREASING IMAGERY RESOLUTION

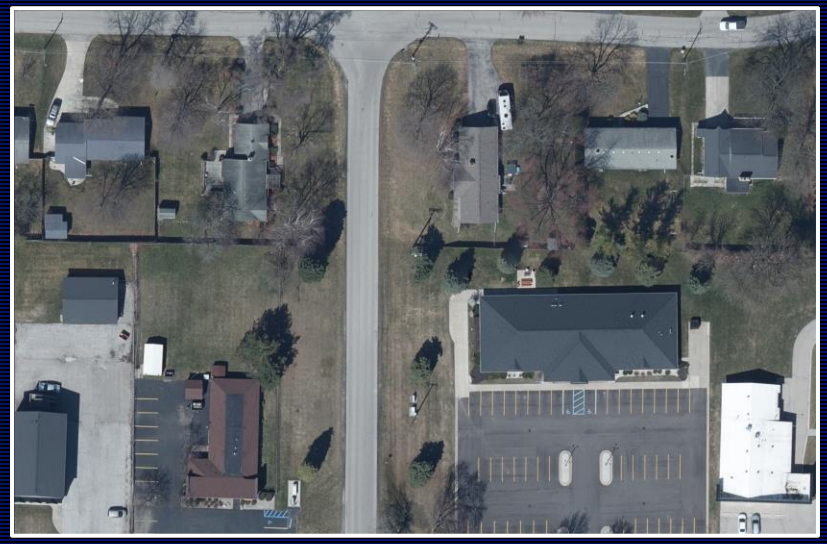
- Typically sought/provided GSDs:
  - 1990s: 6” – 2’
  - 2000s: 6” – 1’
  - 2010s: 3” – 1’
  - 2020s: 3” – 6”
- **3” GSD is becoming the new 6” as the most widely sought at County/City level**
- USDA NAIP – still doing 60cm/2’ standard w/ some 30cm/1’ (HxIP)
  - Will hopefully move to higher resolution, e.g., 1’ GSD standard
  - Technology is there, need to abandon limitation to pushbroom cameras
  - Cost for 1’ GSD has come down significantly
  - Better match to Statewide imagery capture
- USDA NRI/SLI “spot shot” program – still doing 6” GSD– can move to 3”- 4”
  - Technology is there and cost has come down
  - Better interpretation of crop/land use detail

12”



6”

4”



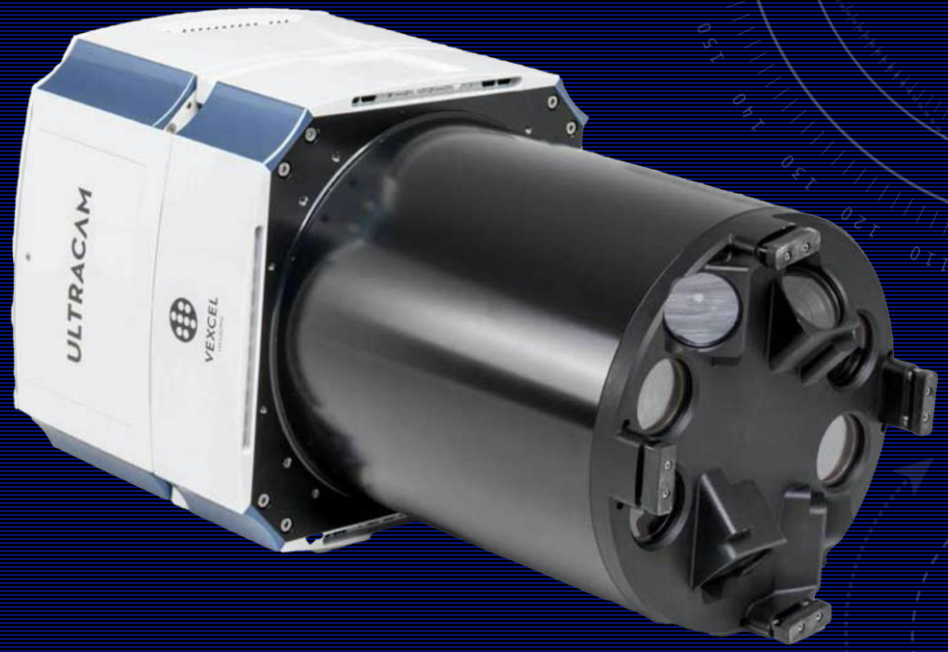
3”

PREVIOUS LIMITATIONS ON SUB 4” IMAGERY USE

- Cost (>$ 250/sq. mi.) and time (9-12 mo. for average County)
- Excessive feature lean – esp. large city/tall structure areas
- Class B airspace access over larger City/Airport areas
- Image blurring w/ some digital camera technologies (e.g., FMC limitation)
- File size – ~ 1.3 GB/sq. mile (3-band imagery)

ENABLING TECHNOLOGIES / ADVANCEMENTS

- New generation digital frame cameras (e.g., Vexcel UltraCam M3/M4)
  - Higher resolving power (2-4 micron)
  - Larger image format (28k-50k across track)
  - Higher flying heights (up to 2x)
  - Reduced feature lean
  - Reduced Class B airspace
- Electronic forward motion compensation (FMC)
  - Built into current gen. of both frame and pushbroom cameras
  - Adjusts for movement of scene relative to camera during capture
  - Adaptive motion compensation (all directions)
- Improved airborne GPS/IMU georeferencing/reduced ground control
- Higher quality source DEMS (lidar-based) for image rectification
- Improved image mosaicking capabilities (e.g., distributed processing)
- Improved image structuring / pyramids /caching and compression
- Improved/increased data storage and imaging processing speeds



Above: Vexcel UltraCam M3

3” IMAGERY IMPROVEMENTS & ADVANTAGES

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- Cost down to $130 - 250/sq. mi. for large city/countywide areas
- Time frame reduced to within 4-6 months from capture for countywide areas
- Visibility of utilities, signs, pavement cracks, traffic markings, other small features
- Accuracy increased to within ~ 0.25’-0.5’ RMS
- With stereo capture – support of local surveying/engineering/assessment needs
  - 0.5’ / 1’ DTMs/contours for engineering design
  - Feature detail for ALTA surveys
  - Improved impervious surface features/accuracies
  - Improved change detection and land use mapping

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OTHER CUSTOMIZED ORTHOIMAGERY TRENDS

- 4-band RGB + NIR (vs. just 3-band color)
  - Minimal or no added cost – less than 5%
  - Added file size (25%) no longer an issue
  - Viewing capabilities have been improved
  - Supports automated feature extraction, e.g., impervious surfaces
  - Supports hydro feature mapping – hydro stands out in
- Low-compressed imagery in lieu of full resolution
  - 5X-20X compression factors
  - Minimal or no added cost
  - Image quality change is generally insignificant
  - Supports image hosting and use of areawide image mosaics
- Hosted imagery
  - Various cloud services and interfaces
  - Example – Amazon cloud + ESRI interface
  - Varying imagery structures, e.g., caching
  - Varying nos. of users and degrees of user capability

INCREASING LIDAR RESOLUTION/RETURN DENSITY

- Typically sought/provided PPSMs (points/sq. meter)
  - 2000s: 0.05 – 1 ppsm (1m – 5m NPS)
  - 2010s: 0.5 – 4 ppsm (0.5m – 1.5m NPS)
  - 2020s: 2 – 20 ppsm (0.2m – 0.7m NPS)
- **8 ppsm (USGS "QL1") is becoming the new 2 ppsm (USGS "QL2") as most widely sought**
- > 20 ppsm becoming common for smaller areas and specialized applications
  - Utility corridors
  - Forestlands
  - Solar farms
- Enabling technologies
  - Latest generation lidar systems – 2MHZ, G2 systems, MPiA, terrain tracking, Geiger mode, etc.
  - Improved flight planning capabilities
  - Improved data storage and processing capabilities, e.g., multi-threaded

Above: 20ppsm lidar return

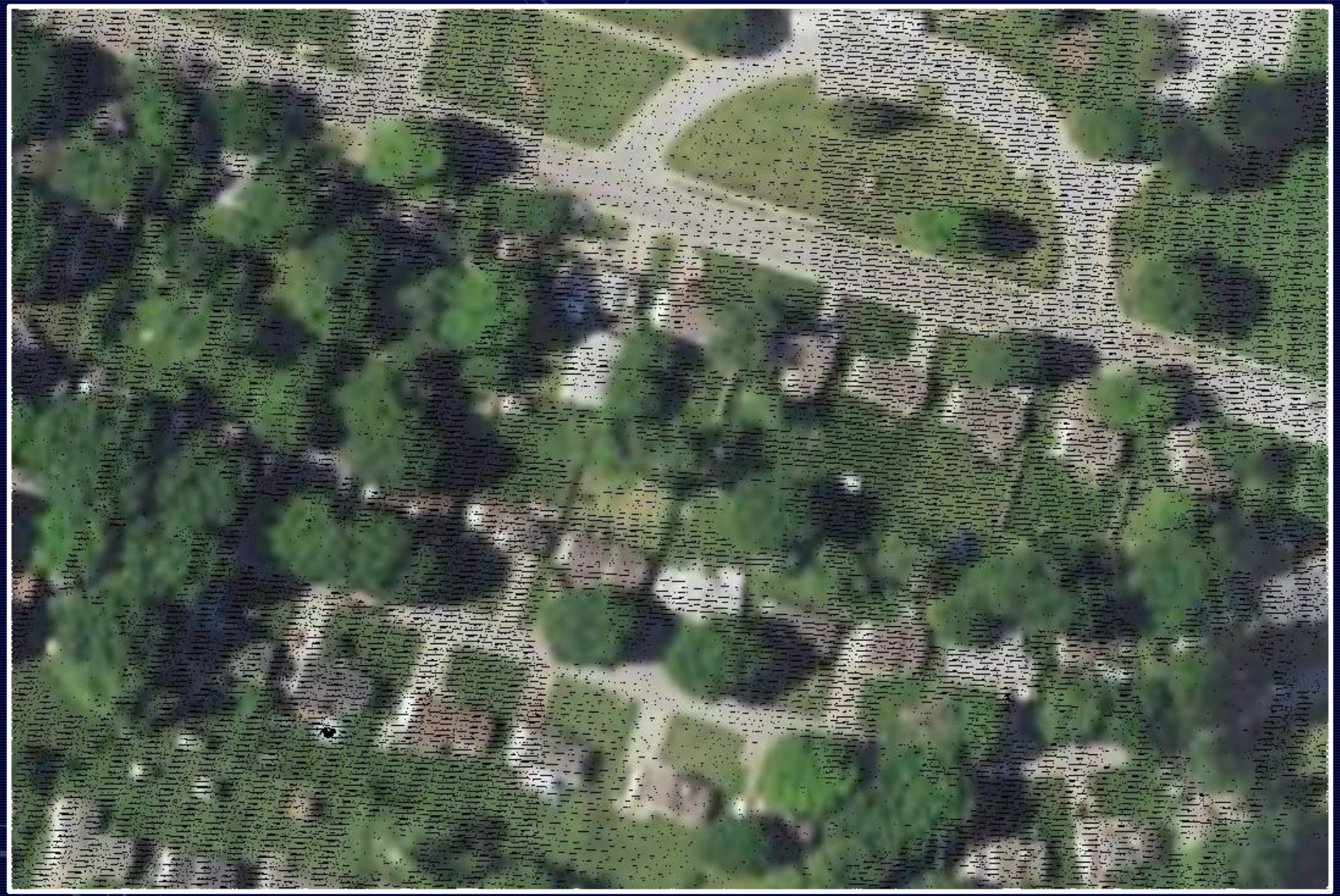
Below: 10ppsm lidar return

INCREASED RETURN DENSITY ADVANTAGES

- Better representation of ground and non-ground surfaces
- Improved feature identification (e.g., breaklines)
- Better support of modeling and feature extraction applications
- Increased ground data for wooded/vegetated areas
- Data quantities still an issue (10s of millions pts/sq. mi.)
- Increased “noise” can be an issue
- Need improvements in processing capabilities

OTHER AERIAL LIDAR TRENDS

- More variation in capture technologies, e.g.,
  - Geiger mode, single-photon
  - Drone-based
  - Corridor-specific
  - Oblique looking
- Increased classification, modeling, extraction of non-ground data
- More reliance on return alone for ground modeling/mapping (less supporting data)
- Increased interest in bathy (below water) and topo/bathy lidar (lead by USGS)
- Increased integration of other geo-data, e.g., colorized lidar
- Increased applications, e.g., forestry, energy, change detection



A sample of colorized lidar

Thank You!

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