Analytics and Machine Learning for Precision Agriculture and Green Infrastructure

Dan Staley

Principal, Arbor Drone LLC

dan@arbordrone.net

https://arbordrone.net

@ArborDrone

arbor drone

tree-d

Powered by Spectrabotics

Agenda

- Precision agriculture & green infrastructure backgrounder – remote sensing only today
- Why analyze these things?
- How we did it
  - What it means
  - Preparation for this impending change
- References, further reading at end
- This presentation on my Research and Education page:
  https://arbordrone.net/analemma-resources

Acknowledgements

- Spectrabotics
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- Arbor Drone ground crew: Payne Jungblut

Precision Ag. & Green Infra. Backgrounder

- Green Infrastructure: food and urban vegetation (built environment ‘constructed landscapes’)
  - Precision agriculture for food, arboriculture & horticulture for built environment
- Precision ag.: Over US$14Bn by 2026, CAGR ~12.5%[1]
- Satellite positioning, seed spacing and depth, big data, remote sensing
  - Remote sensing: plant health, plant counts, pest and disease pressure, irrigation efficiency, time to harvest

Green Infrastructure Backgrounder

- Urban vegetation = Green Infrastructure
- 80% North Americans live in an urbanized area[2]
- **Reduces** urban heat island, air pollution, energy consumption, stormwater runoff[3]
- **Increases** property values, business activity, soil retention[3]
- **Human health benefits**: increased physical activity, faster healing, restoration from stress, increased safety, children better learners, much more[3]

Precision Agriculture Challenges

- Precision ag: food for 9.5B people
  - Per capita grain production decreasing[4]
  - Future climate change may reduce crop yields[5]
- Number of farmers decreasing as urbanization increases, population ages[6]

Urban Green Infrastructure Challenges

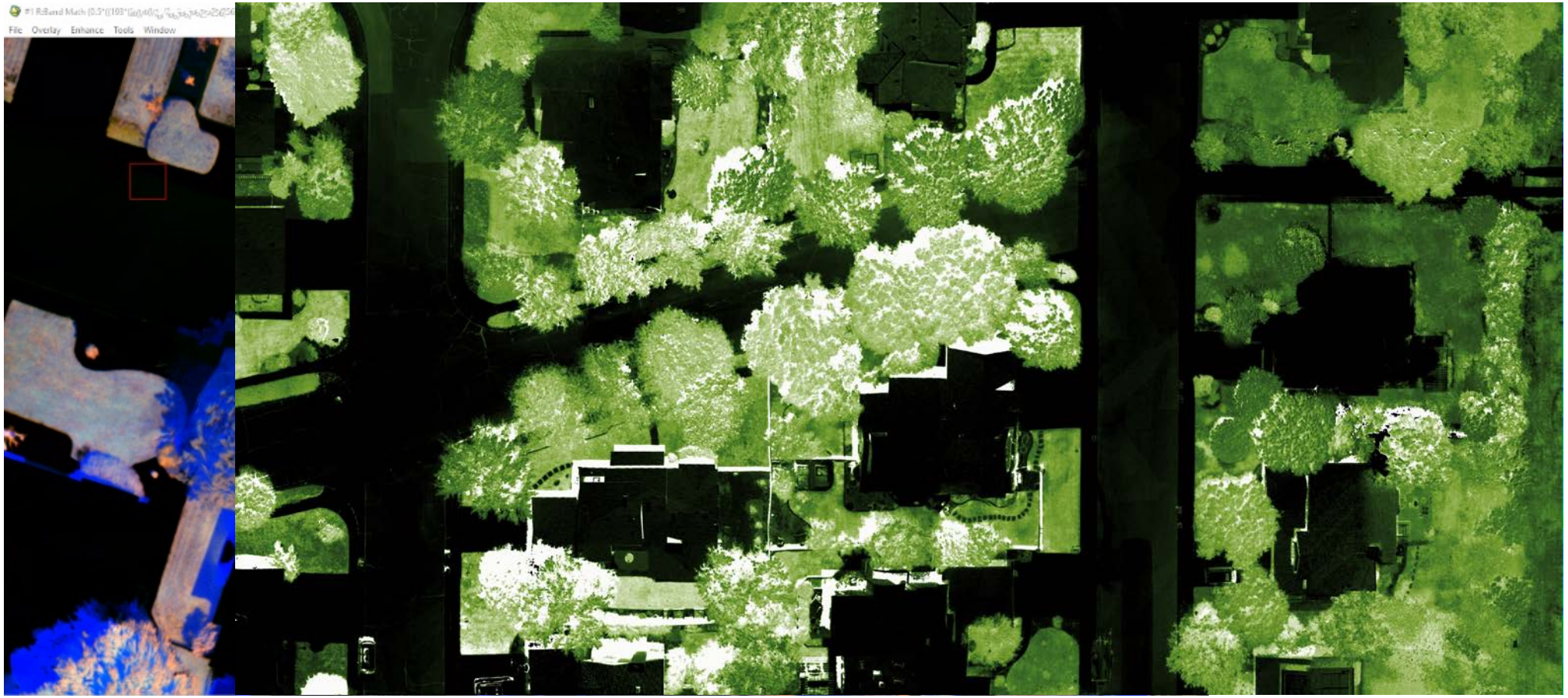
- Green Infra. (GI) decreasing in cities[7]
- Urban Heat Island and increasing frequency of heat waves requires trees for cooling of cities
- Stormwater amelioration by trees and increasing rainfall[8,9]
- Climate change threatens urban tree species[10]

Improving Precision Ag and GI

- Spectral Remote Sensing
  - Minimum 5 bands, hyperspectral still costly
  - Cloud-based platforms ~cannot analyze trees
    - Most common ag Vegetation Index (VI) cannot render trees or large plants (NDVI) – trees saturated
    - Saturates at high Leaf Area Index (LAI)
- ENVI excellent for analysis and has a good library for Vegetation Indices
  - Alternative to “band math” (band math may not be vetted)

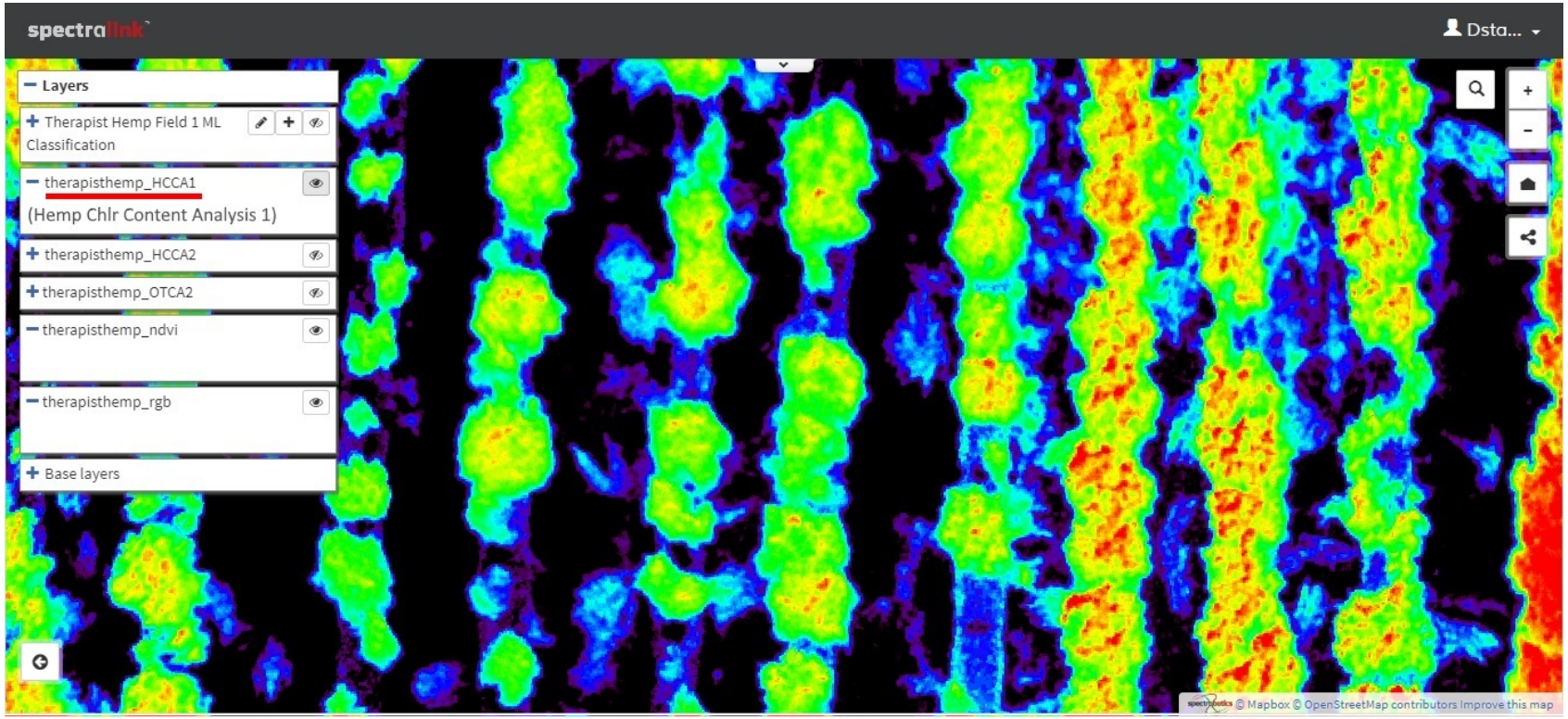
Improving Precision Ag and GI

- Vegetation Indices are not one size fits all



Improving Precision Ag and GI

- Must have a good handle on which Vegetation Indices do what – by species, shadows, weeds, ground covers



Tailor the Output to the Client

- Client may have a different idea of what works for them

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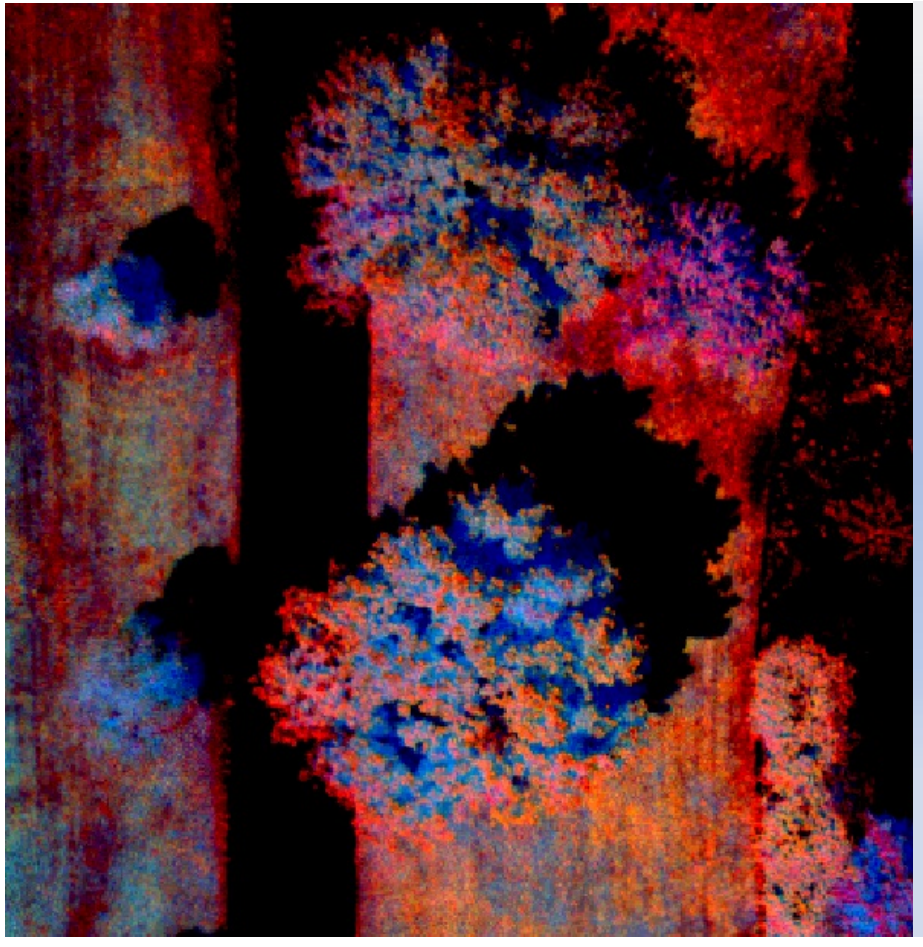
  - Standardize colors for the client
- Knowledge of Vegetation Indices (VIs) invaluable
  - Confounding shadows
    - Color ramp changes (customized to VI)
  - Some VIs handle some urban species better than others
  - You may have to “stack” VIs

Tailor the Output to the Client or the Problem

- You may have to “stack” VIs



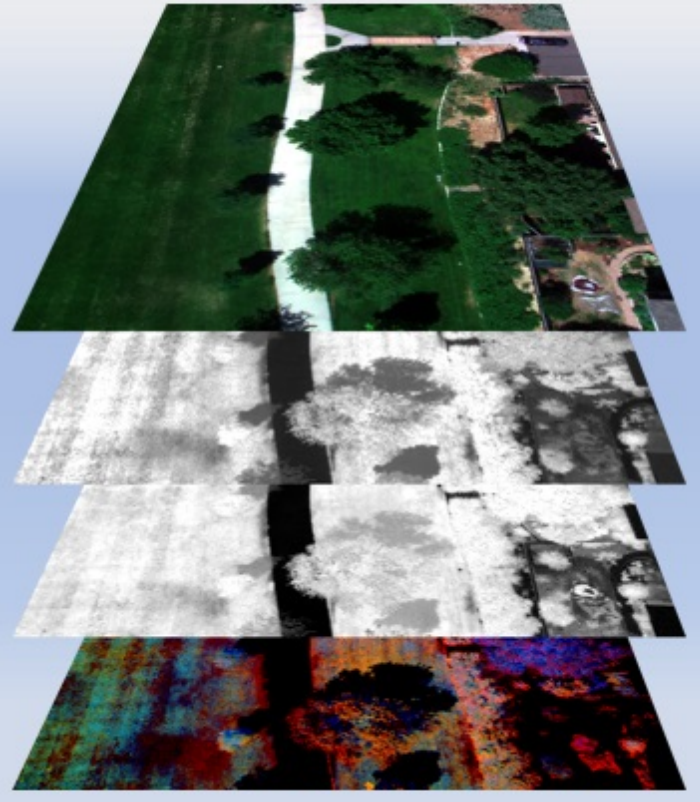
True-Color Composite
(Reference)

Vegetation Index Integration

Leaf Area Assessment Tool
-Brighter Pixels have higher Red and Infrared separation indicating healthy leaf-structures and chemical content.

Leaf Greenness Tool
- Brighter Pixels have higher concentrations of light-absorbing chemicals for Photosynthesis

EAB Indicator Tool



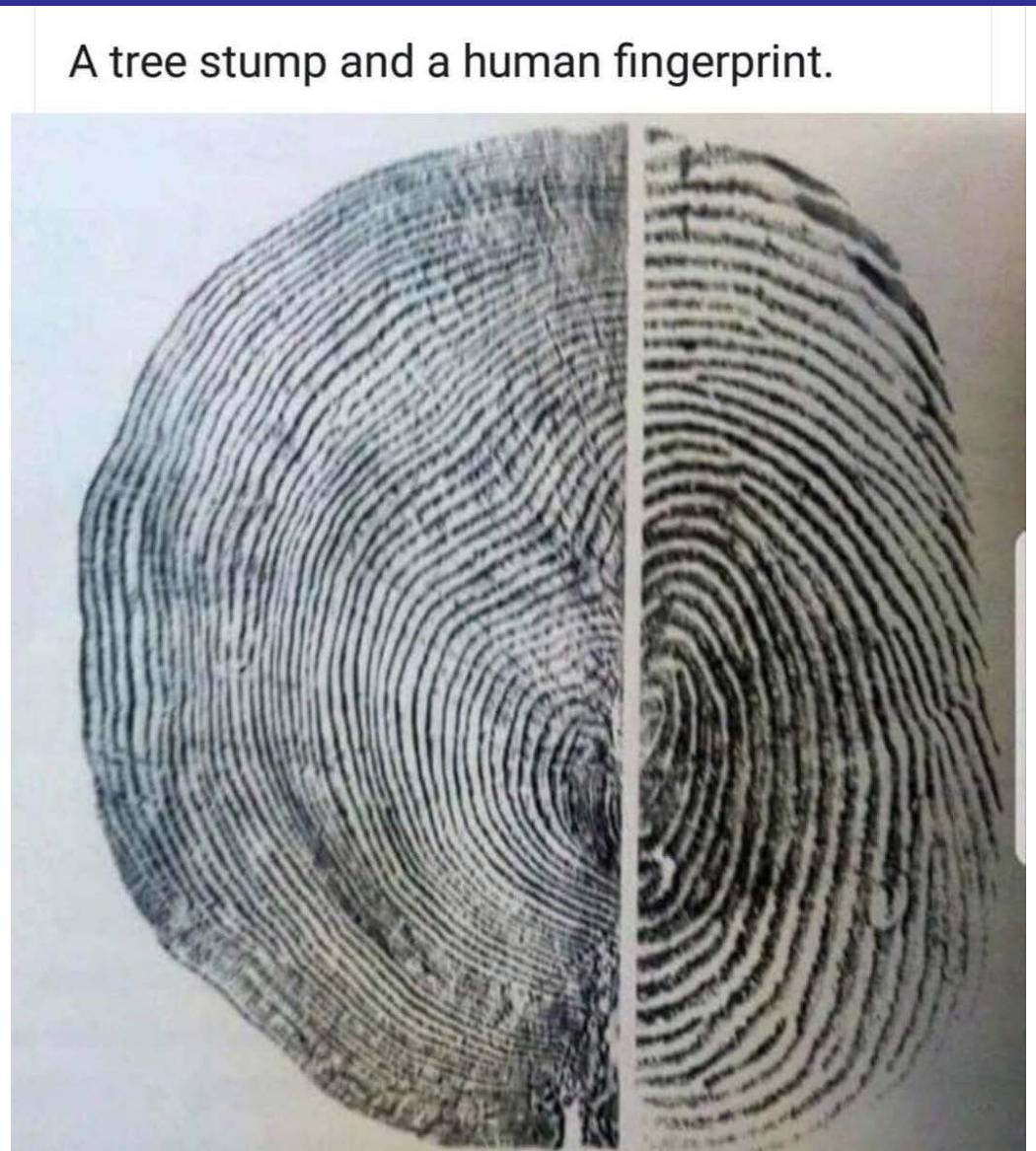
Prepare for the Coming Change

- We spend a lot of time communicating with clients
- Help solve problems
- Know your software, processes to save time and aid client
- Familiarize yourself with agriculture and urban GI challenges
- Taking an extra step helps you, your company, clients
  - People remember

Summary

- More than just software
- Integrating human needs and machine learning
- Early in the game – other person likely doesn’t know what’s possible (maybe you don’t either)
- Wild West – we’re all learning

THANK YOU!



All Presentations and Publications:
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