

Keith Peterson | Product Manager

FEBRUARY 2020

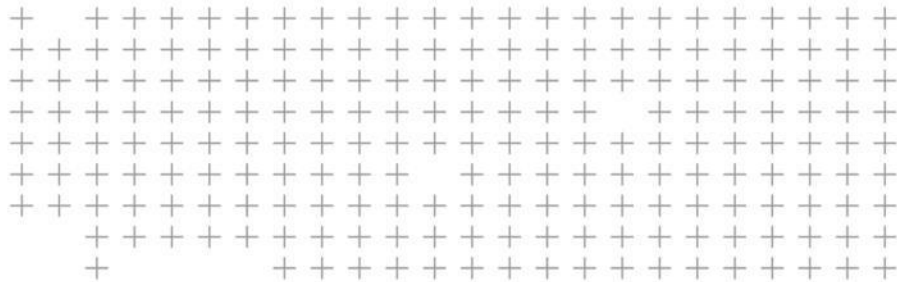
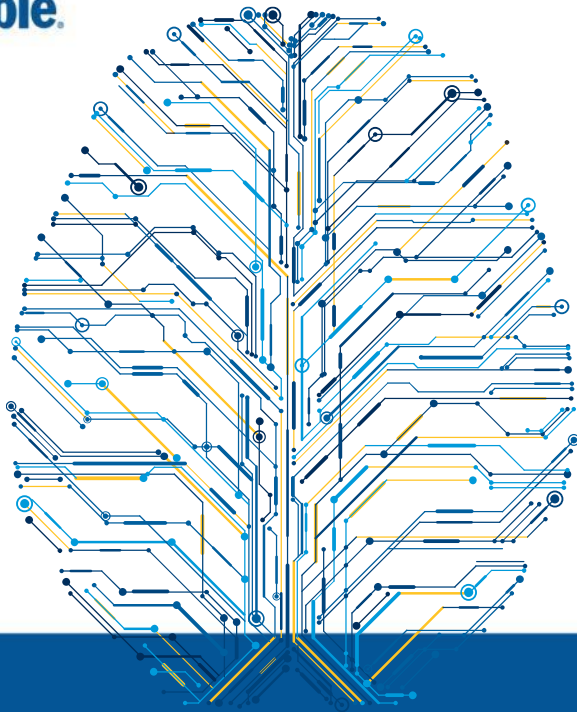
Trimble eCognition: What's new & how much AI is under the hood?



Outline



- Who we are
- What's new in version 9.5
- Customer stories
- eCognition resources
- eCognition & AI
- Outlook – what's next?
- Discussion



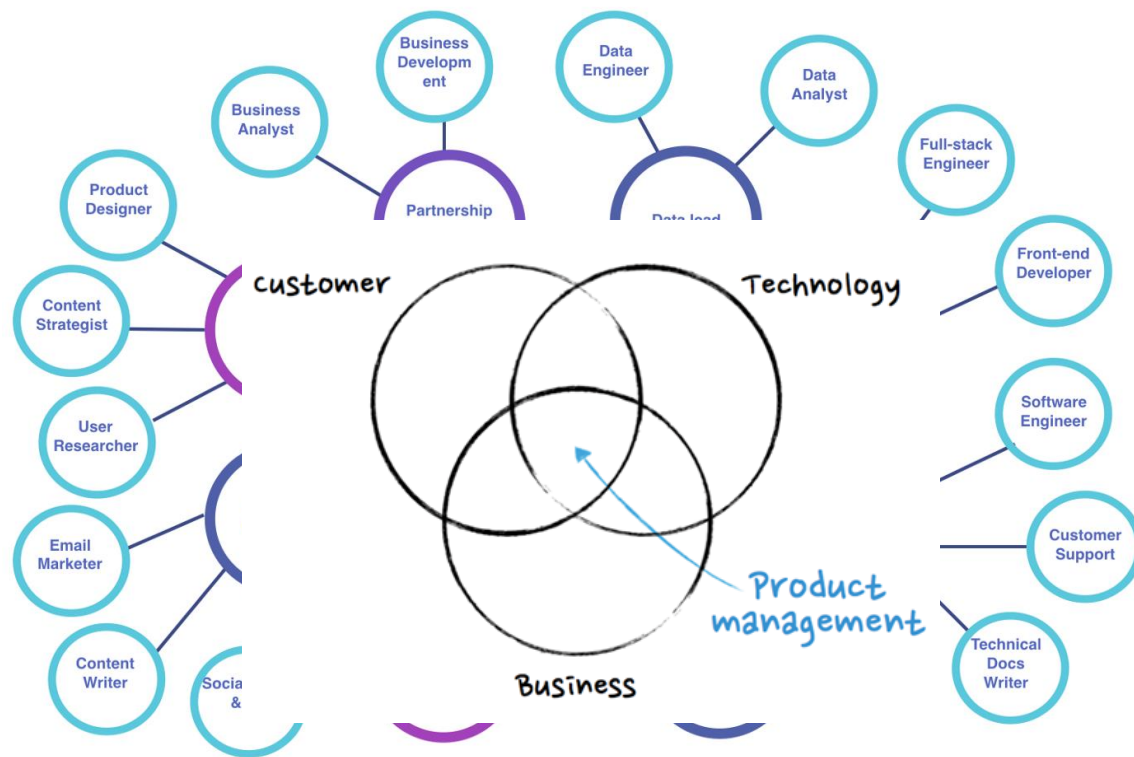
Who we are

eCognition Product Manager

- Keith Peterson
 - Trimble eCognition Product Manager
 - Bachelor's degree in Geography (U of Vermont)
 - Master's degree in Geographical Information Science & Systems (U of Salzburg)
 - 15 years experience in GIS & Remote Sensing industry. Have been working with eCognition for 10 years as a commercial customer & for Trimble.



What Does a Product Manager Do?

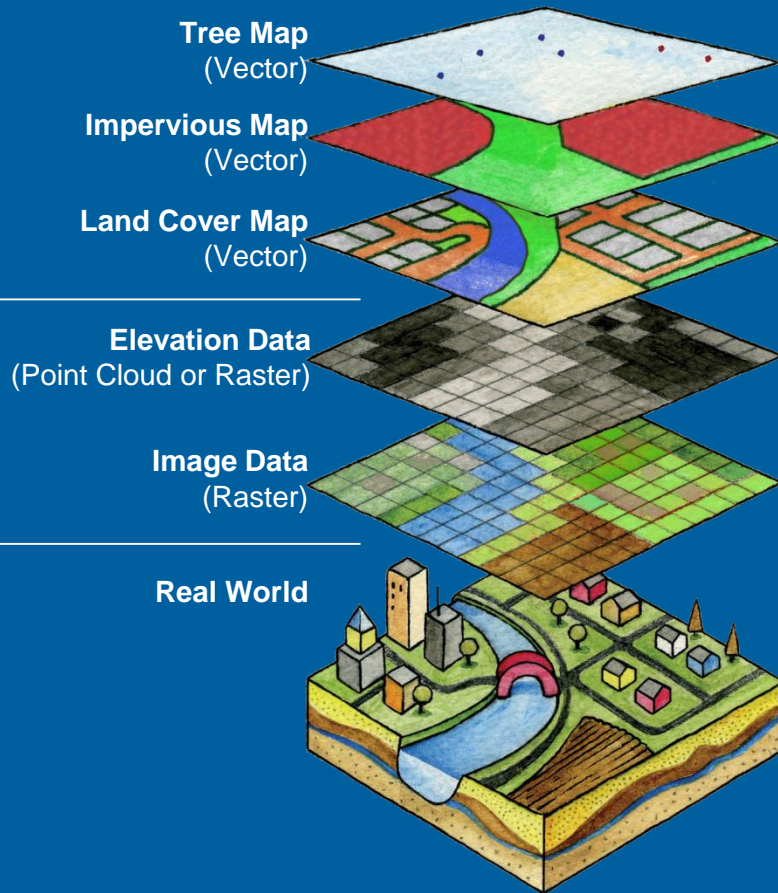


The Idea

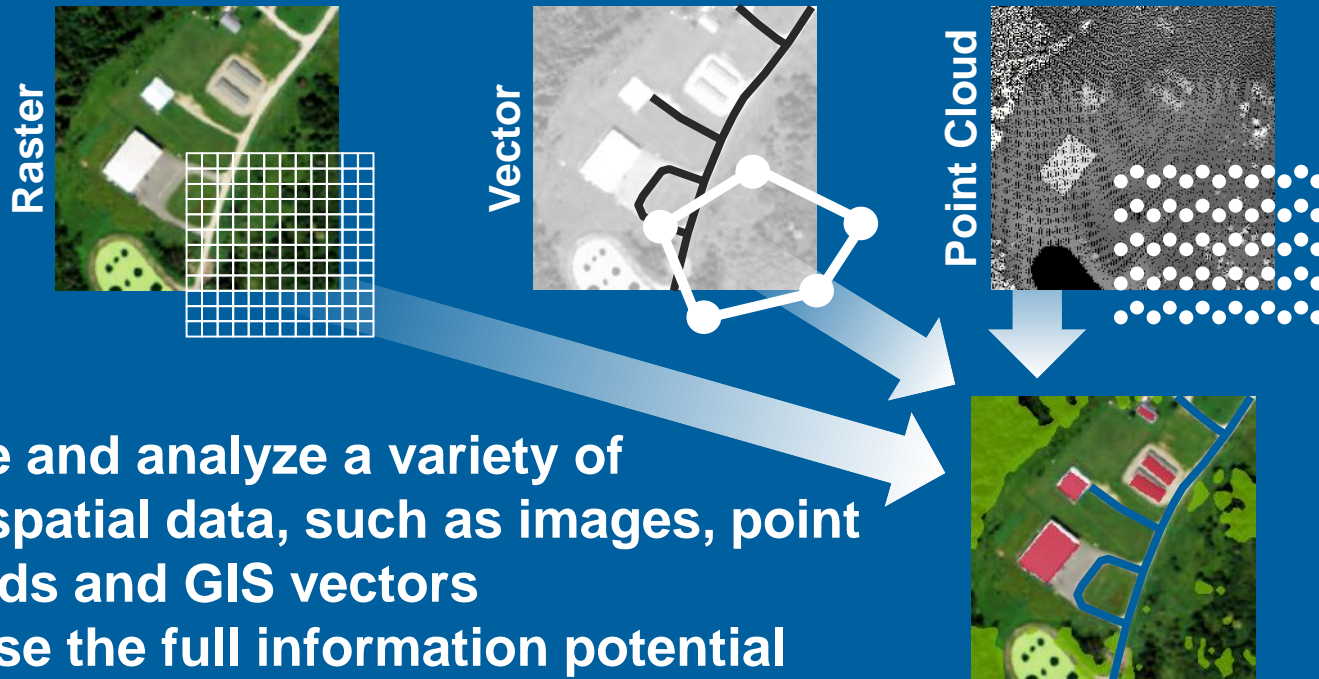
Transform Data to Information



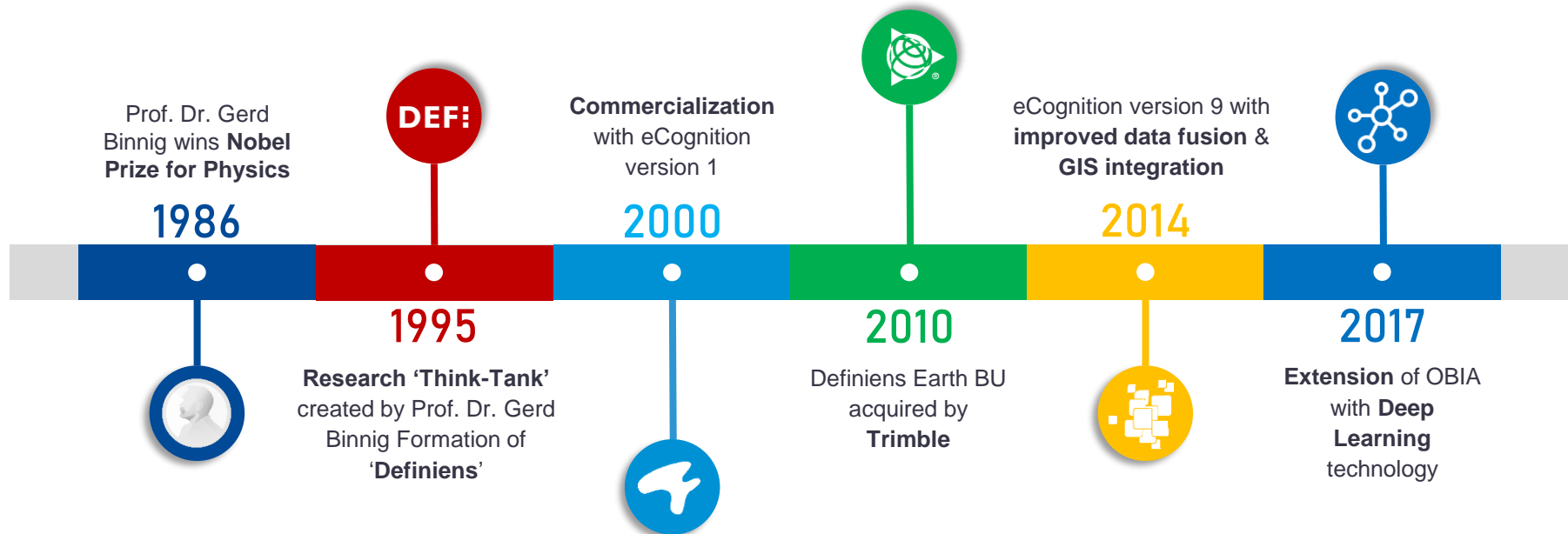
- Information Extraction
- Change Detection
- Object Recognition

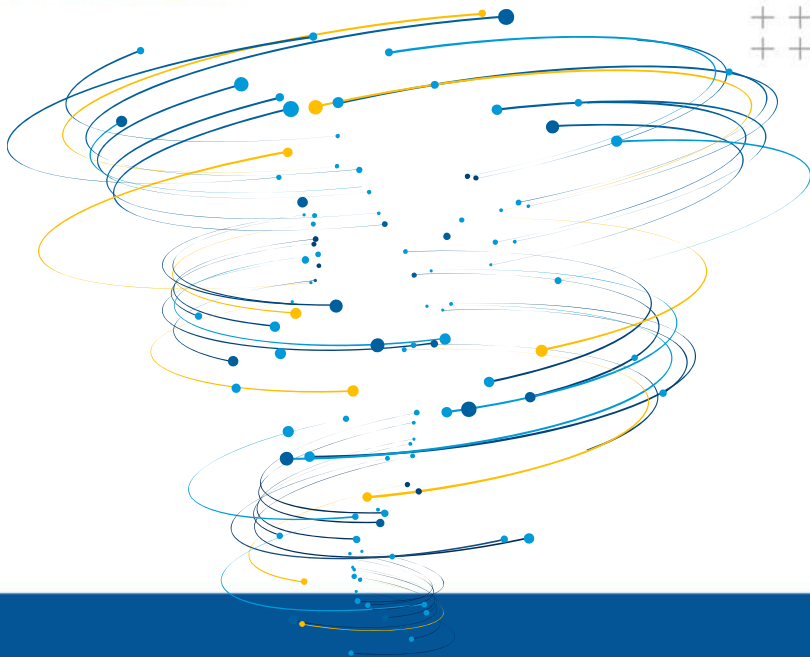
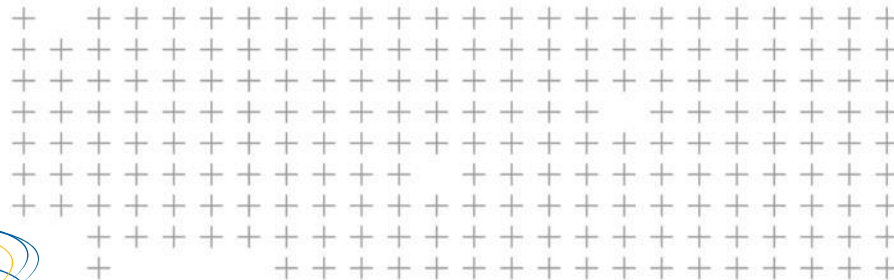


Unique eCognition Feature: Data Fusion



eCognition Milestones





Highlights in Version 9.5

eCognition Suite v9.5 Highlights

- **Boosted Point Cloud Operability**

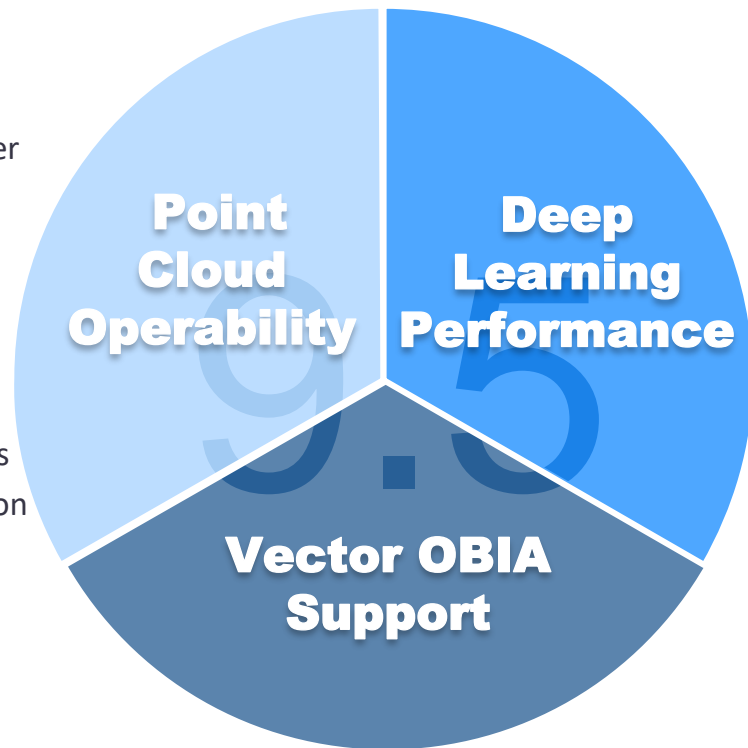
New point cloud resampling algorithm for increased processing speed through the reduction of oversampling in dense regions
Enriched data fusion with the support of raster display in the 3D Viewer

- **Improved Deep Learning Performance**

Deep Learning algorithms extended to support batch normalization
New advanced sample manipulations help automating production workflows

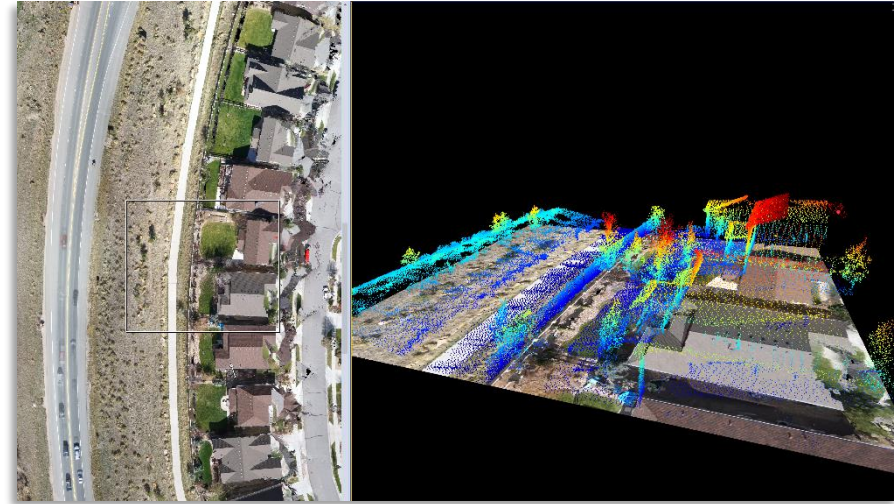
- **Extended Vector OBIA Support**

Region support for vector algorithms offers clear performance benefits
New features & algorithms allow more flexible processing exclusively on vector domain
Possible to calculate statistics in the vector domain, to shrink polygon vectors & to access layer values and object class under point vectors



Boosted Point Cloud Operability

- Point cloud operability has been boosted on two fronts:
 - Improved functionality - raster layers can now be displayed within the 3D viewer to enrich data fusion & aid rule set development
 - Increased processing speed - a new point cloud resampling algorithm is available to reduce the oversampling of points in dense regions



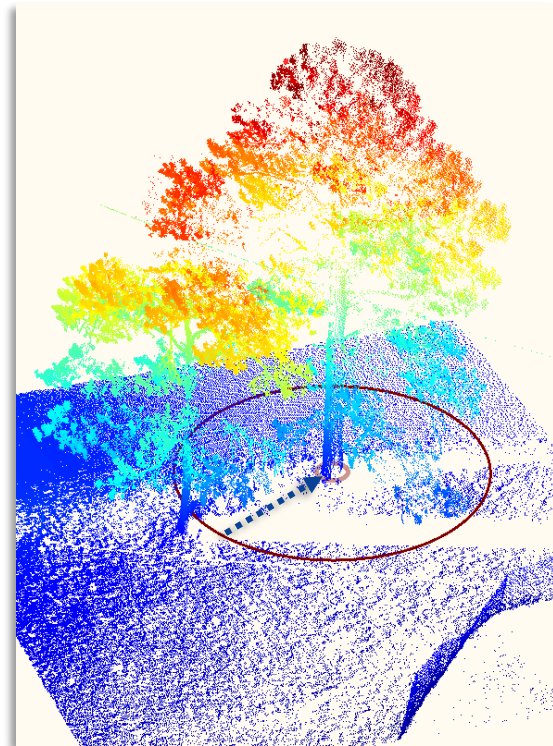
Improved Deep Learning Performance

- Deep Learning & convolutional neural network (CNN) performance continues to improve:
 - eCognition's Deep Learning algorithms have been expanded to support models using batch normalization leading to speedier and more robust learning
 - New advanced sample manipulations help automating production workflows



Extended Vector OBIA Support

- We continue to grow the pallet of vector analysis tools and capabilities:
 - Region support for vector algorithms offers clear performance benefits. Such regions can now be conveniently generated based on vector domains.
 - New features & algorithms allow more flexible processing exclusively based on vector domains. It is now possible to:
 - Calculate statistics in the vector domain
 - Shrink polygon vectors
 - Access layer values & object class under point vectors





Summary

- eCognition 9.5 adds a series of tools & features to improve productivity with boosted performance and increased data fusion: **raster-point cloud fusion** in 3D viewer, **batch normalization** support for Deep Learning, point cloud **resampling** algorithm & **region** support for **vector domains**

Ordering, Availability, and Resources

eCognition Suite 9.5.1

- **Release Date:** 10 December 2019
- **Who's eligible?**
All users with a valid maintenance contract as of December 10th, 2019
- The current version of the software is available via eCognition.com → **Download Current Version**
- Get the **Free Trial** & learn more about Trimble eCognition on <http://www.eCognition.com>
- Visit the **eCognition Community** – currently a new Community platform is being constructed & will be available soon



eCognition Customer Stories

Use Cases & Application Fields

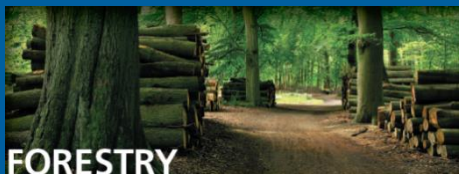
Use Cases



Fields of Use



URBAN



FORESTRY



AGRICULTURE

Fields of Use



Forestry

- Forest monitoring
- Agro-forestry analysis



Urban

- Urban landscape analysis
- Utilities management



Agriculture

- Crop analyses
- Individual plant identification (Oil Palm Application)



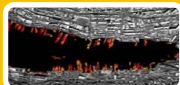
Land cover

- General LC mapping
- Change detection



Marine

- Offshore oil spill detection
- Seafloor mapping



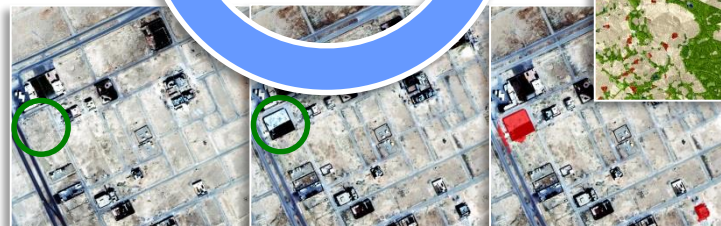
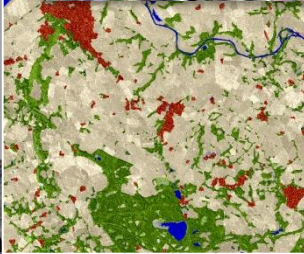
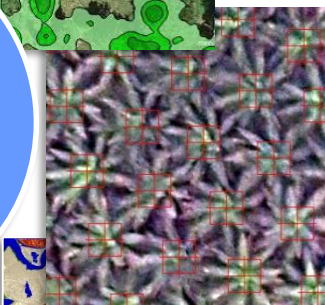
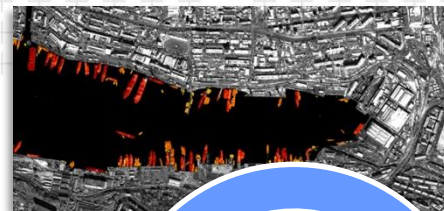
Defense & Security

- Natural disasters
- Asset monitoring



Oil & Gas

- Digital petrography
- Pipeline monitoring/ planning



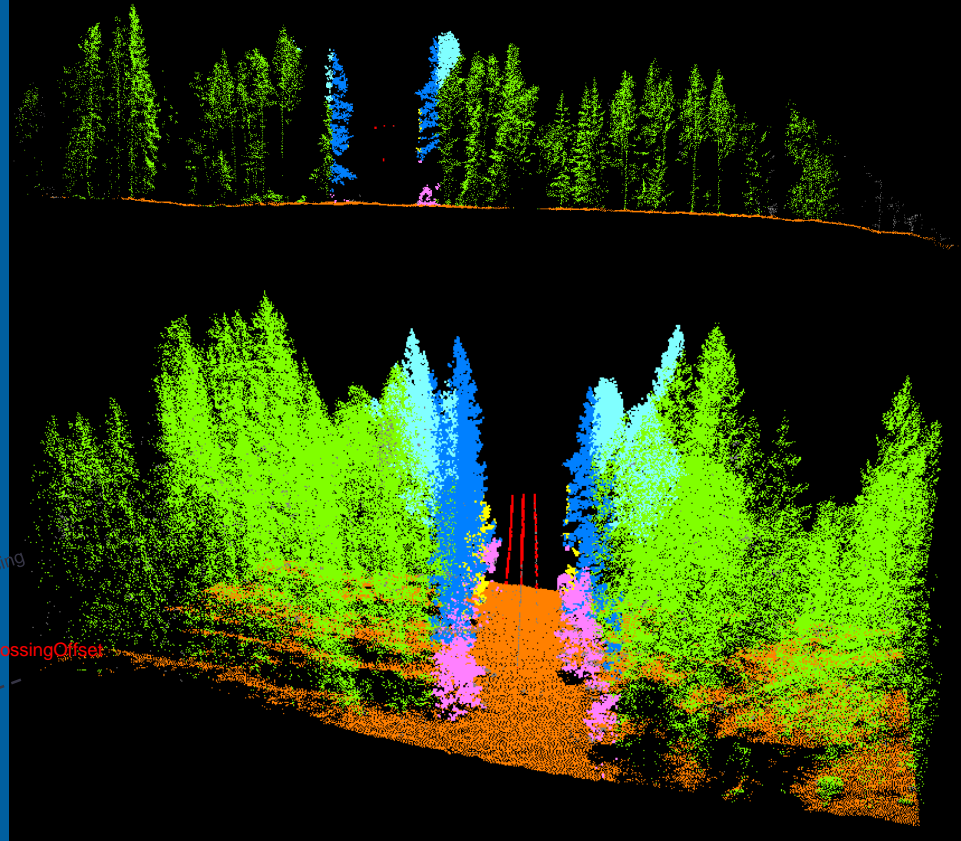
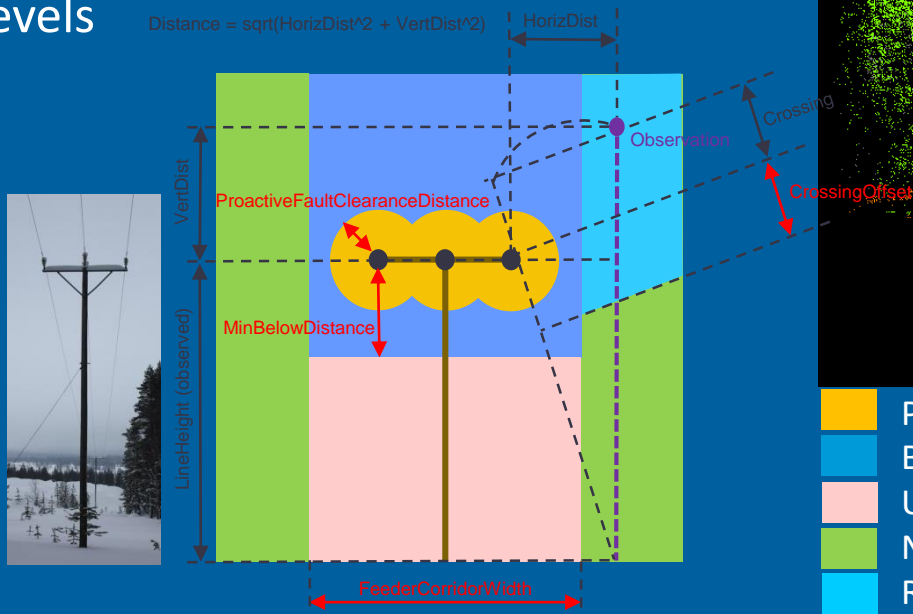
Feature
Extraction

Change
Detection

Vegetation Enchroachment

Automatically detect vegetation
within user defined distance of a
power line & classify into various risk
levels

$$\text{Distance} = \sqrt{\text{HorizDist}^2 + \text{VertDist}^2}$$

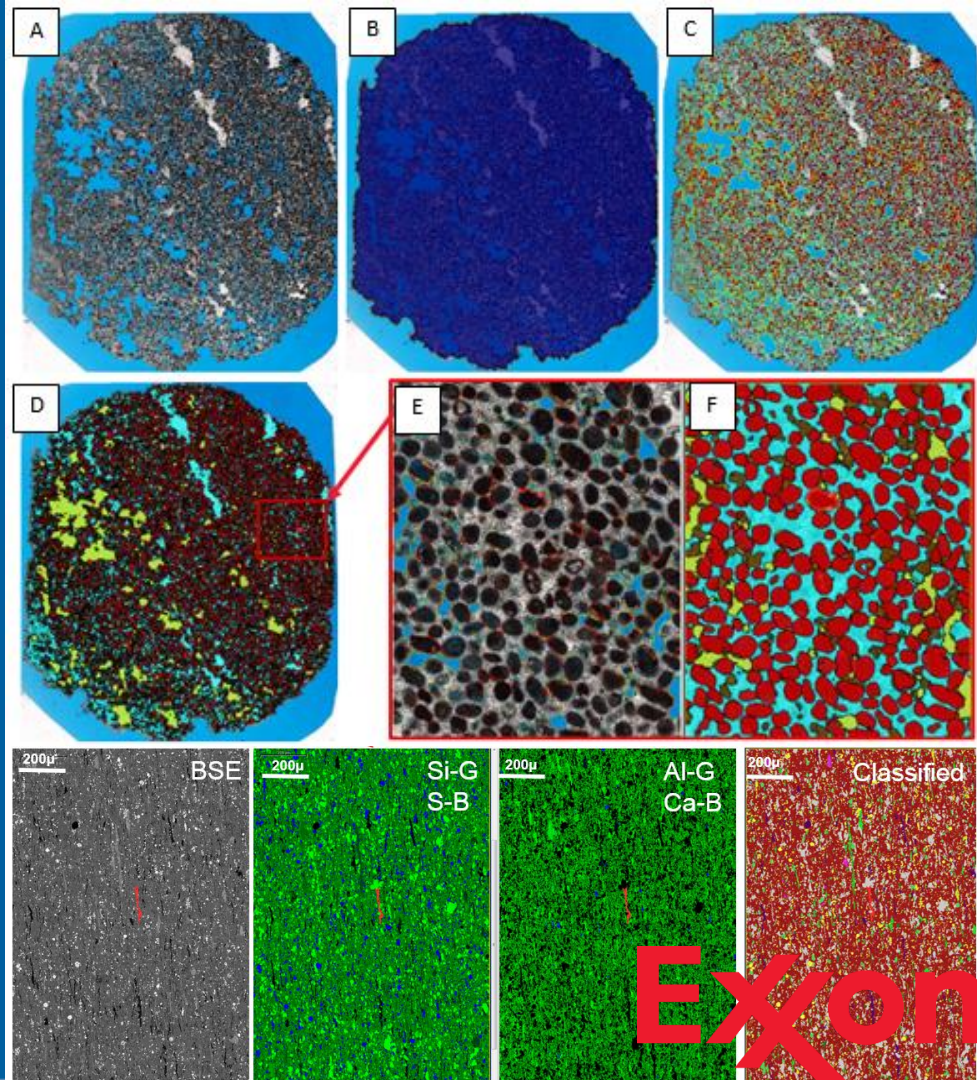


- Pro-Active Fault Clearance
- Branch Removal
- Underlying Vegetation
- Neighboring Forest
- Risky Tree (when falling)

Quantitative Digital Petrography

“A new method of computerized object-based image analysis (QDP) that relies on a predefined rule set to enable rapid, **automated** thin section quantification with only **minor** human interaction...”

(Antonia Buono)



New York
Philadelphia
Austin
Detroit
Washington, D.C.
Baltimore
Portland
Tampa
Pittsburgh

University of Vermont
Spatial Analysis Lab

[illegible]

UAV Wetland Mapping

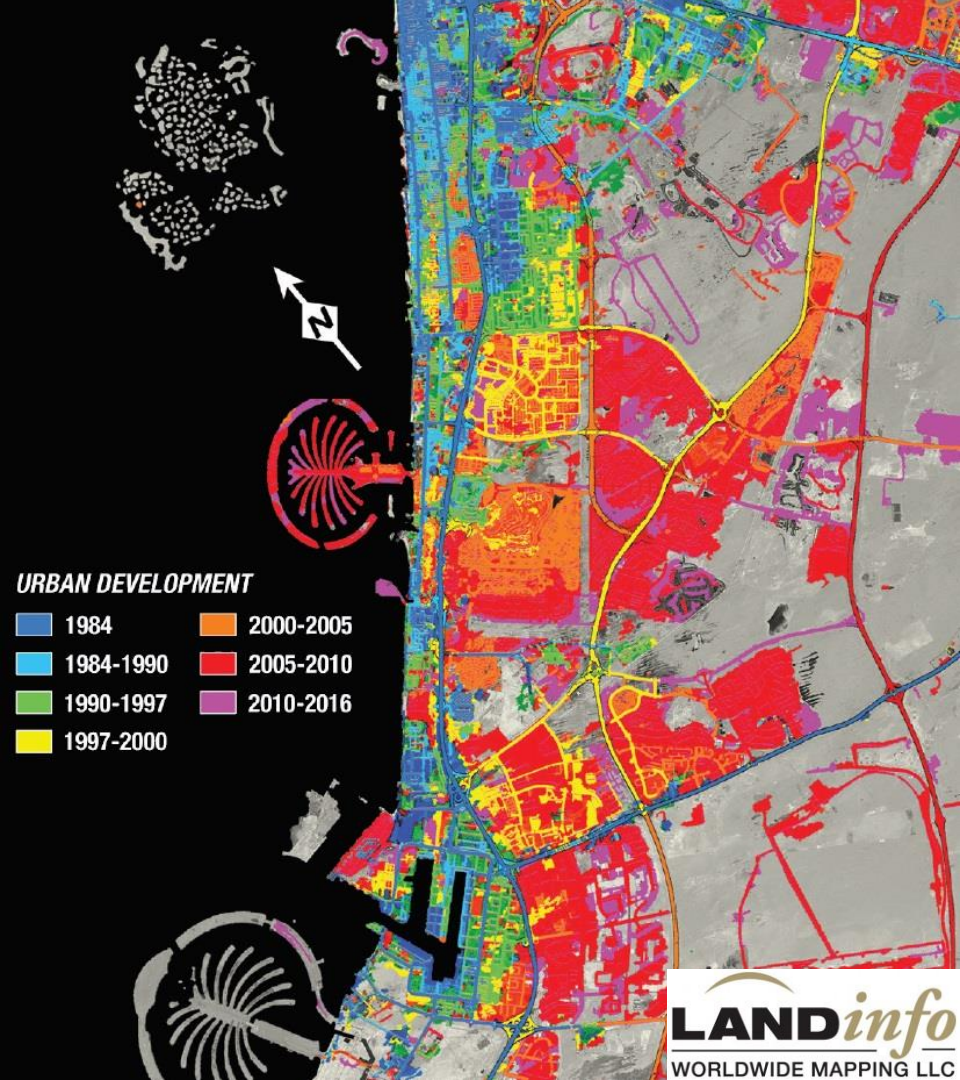
“Unlike traditional image-processing methodologies, OBIA software can handle the **high spectral variance** and subtleties of the **hyperspatial** data”.
(Dr. Whitney Broussard III)



Urban Growth Monitoring

“Road networks and how they have changed can enhance the story of a region’s growth... With this information, the National Geographic Society can incorporate the city’s road expansion into their other metrics and develop a **deeper understanding** of Dubai’s urban growth”.

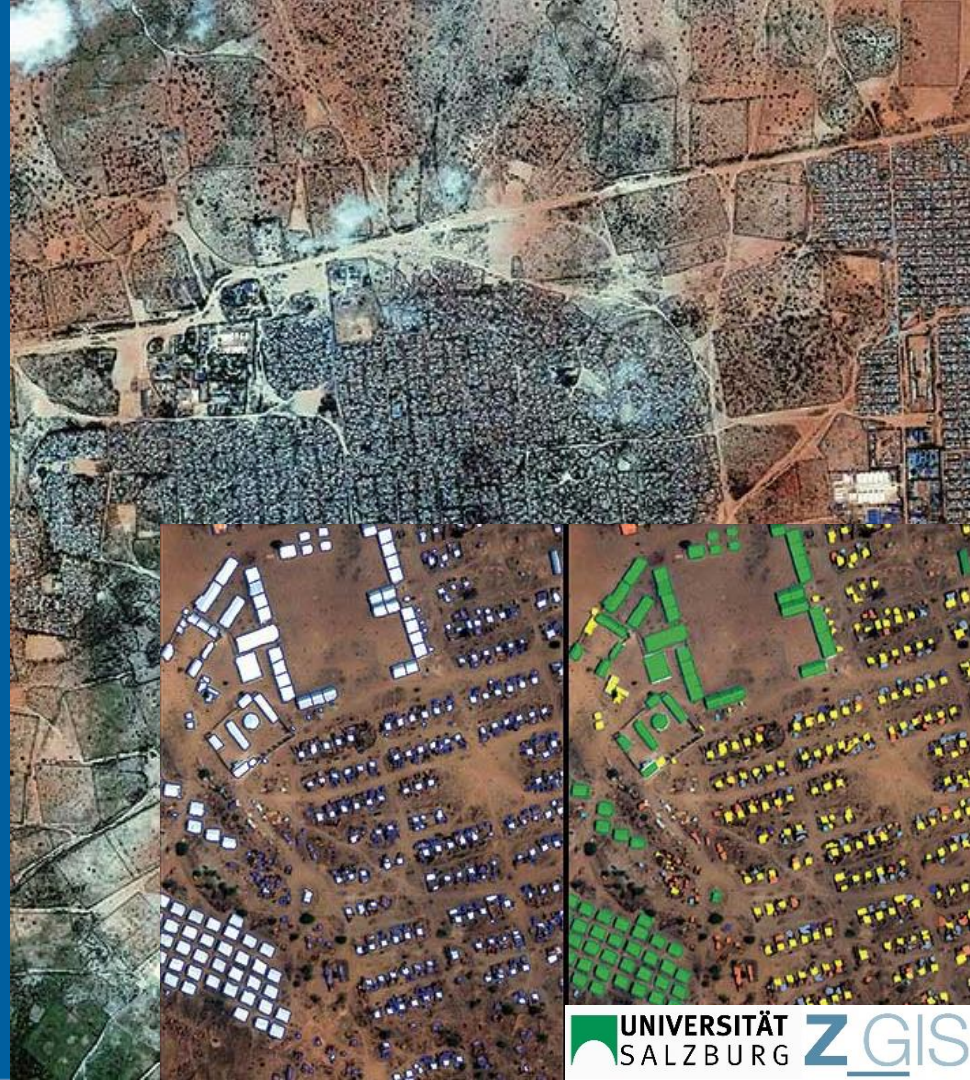
(Chris Lowe)



Humanitarian Aid Support

“Because crises can produce rapid changes in populations, it’s essential to be able to develop accurate data quickly and to repeat the measurements as needed...Once we capture a particular area then we try to do **recursive monitoring**. It’s important to have tools that we can use to **repeat our analysis and not start from scratch**”.

(Dr. Stefan Lange)



Monitoring Economic Health

“The rooftop materials in Sri Lanka are variable enough that they can be distinguished using high-resolution satellite imagery and OBIA technology and, most importantly, provide **economic intelligence** ... Unlike most projects that focus on the ‘pixels,’ this project was unique in that the World Bank wanted the **statistics** and **realworld analytics** based on the **classifications**”.

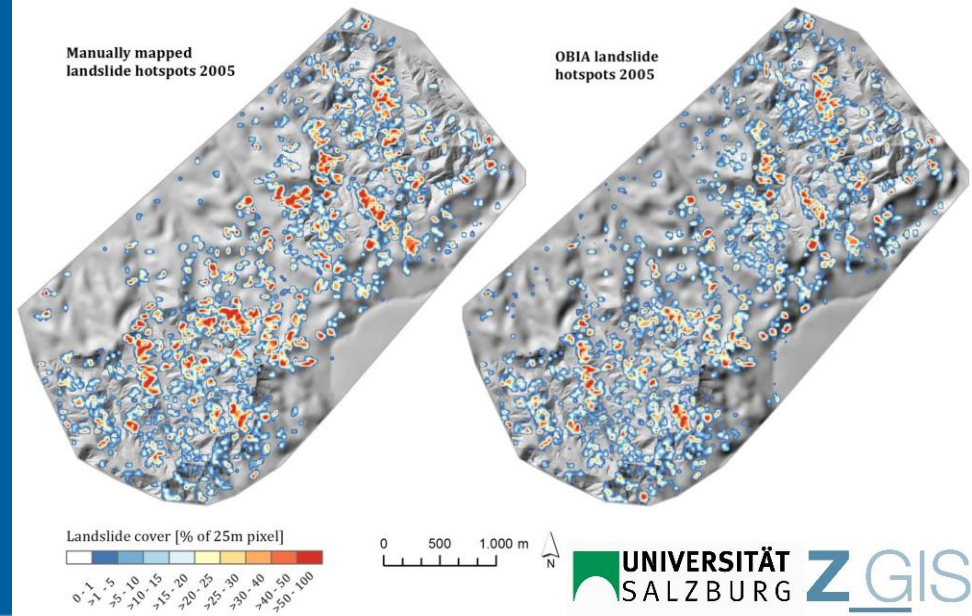
(Nick Hubing)



Landslide Monitoring

“Semi-automated approach for identifying and mapping landslide-prone “hotspots” based on historical and recent aerial photography... The eCognition approach was considerably faster, more consistent, more objective, and it was easily repeatable.”

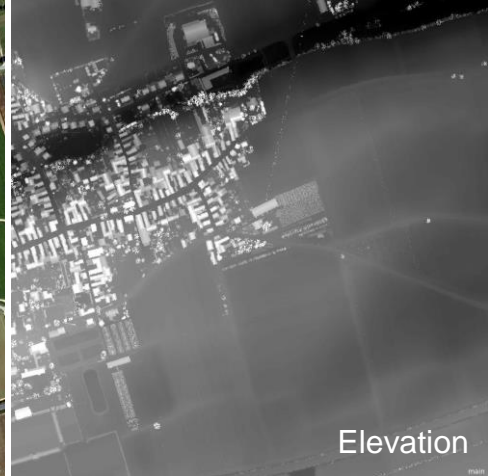
(Daniel Hölbling)



Cadastral Change Detection

“eCognition allows us to **automate** time-consuming workflows. Change detection of cadastral buildings (land survey register) with eCognition can be **standardized** and the effort for visual image interpretation and comparison in the field can be **optimized**.”

(Rhineland-Palatinate Survey and Geodetic Data Office)



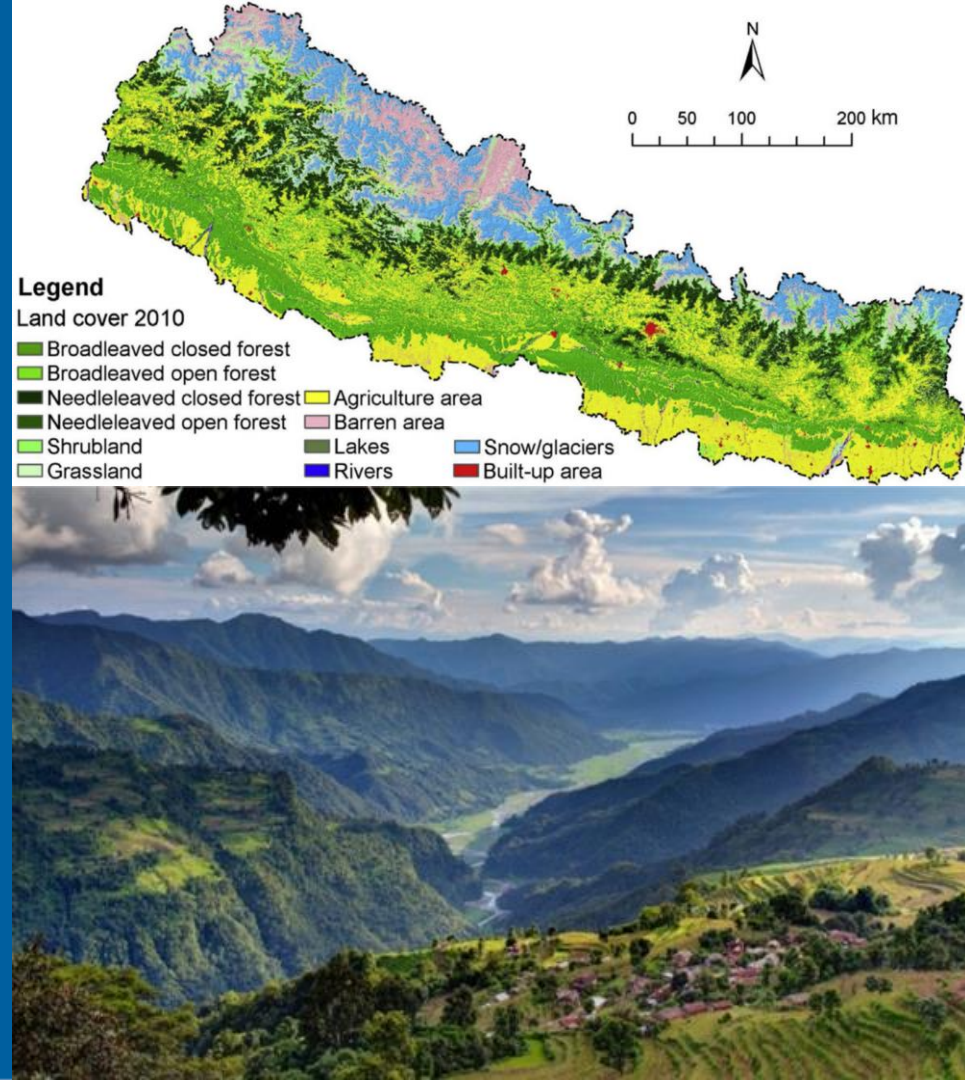
Rheinland-Pfalz
LANDESAMT FÜR VERMESSUNG
UND GEOBASISINFORMATION

- Building
- Building (changed)
- Building (new)
- Building (unchanged)
- Vegetation
- Forest
- Low Vegetation
- Shrubs

Land Cover Mapping

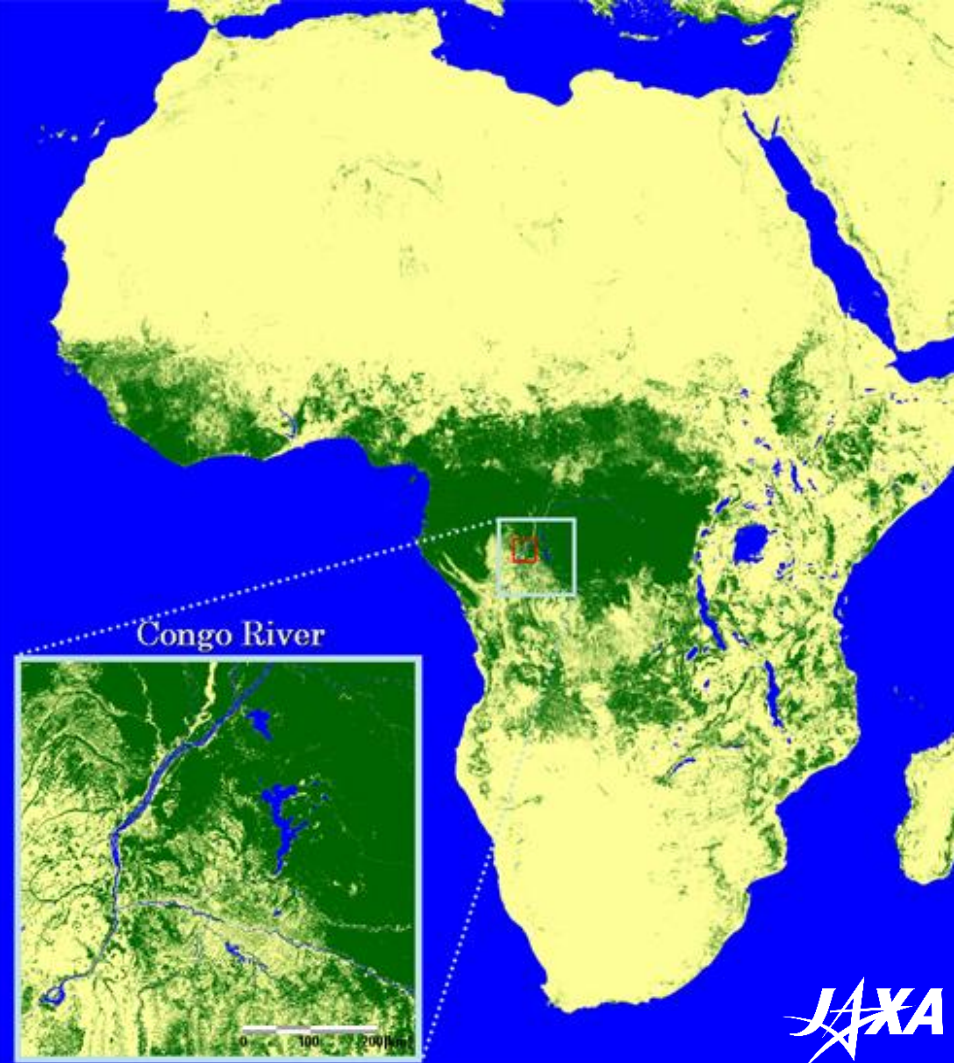
“Land cover and its change analysis across the Hindu Kush Himalayan (HKH) region is realized as an urgent need to support diverse issues of environmental conservation. This study presents the **first** and most **complete** national land cover database of Nepal...”

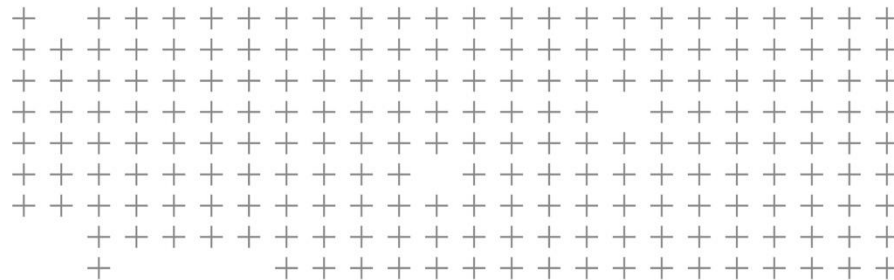
(Journal of Environmental Management: *Development of 2010 national land cover database for the Nepal*)



Global Forest Mapping

The Japan Aerospace Agency (JAXA) automated global forest cover mapping based on data from the ALOS PALSAR sensor (L-band, 10 m). 86,000 scenes were processed within the framework of a forest carbon tracking & monitoring project to prevent deforestation.





eCognition Resources

Information & Help Resources



Website
www.eCognition.com



User Guides



YouTube &
Social Media



Community



Blog



Support & Training

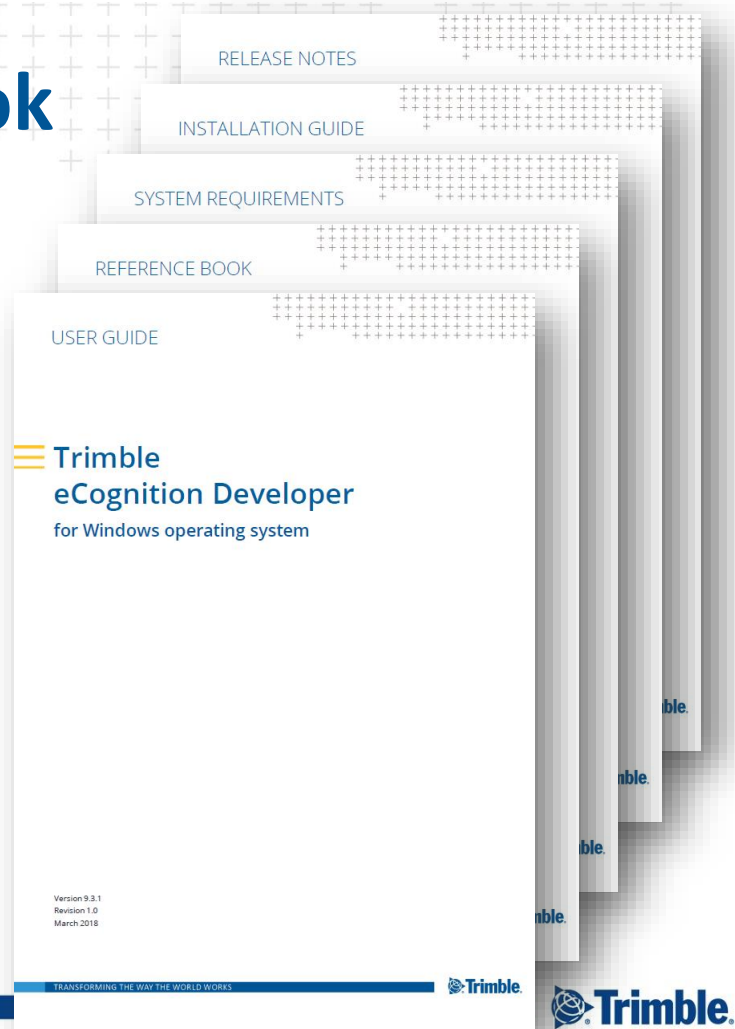


Webinars



User Guide & Reference Book

- Automatically installed with software
- User Guide acts as an operating manual
- Reference Book acts as an encyclopedia
- Can be accessed directly from software via the Help menu
 - Also available in the install folder with additional documents
 - Installation Guide
 - Release Notes
 - Supported Connectors & Drivers
 - System Requirements
- [ONLINE HELP](#)





eCognition Webinars

Trimble Geospatial Webinar Portal



- Google “Geospatial Webinars” or <https://geospatial.trimble.com/webinars-home>
- Regular eCognition Webinars available
- 3 Categories:



STARTING POINT

Discover new Products or Versions



ELEVATE YOUR SKILLS

Hearing how others using Trimble



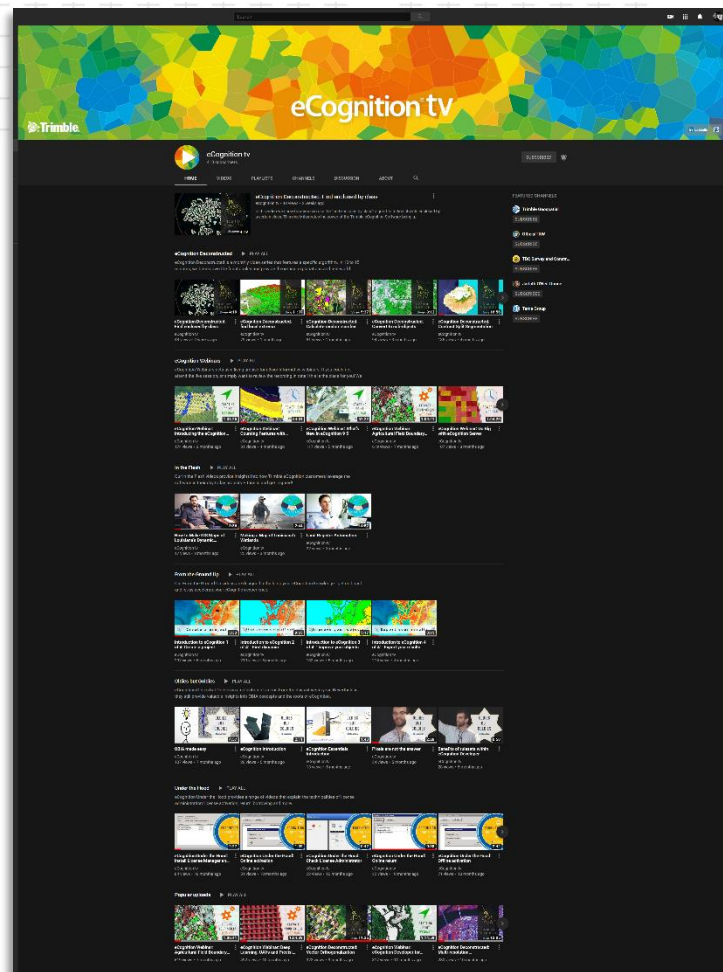
POWER HOUR

Advanced Workflows and Demos



eCognition tv

- **eCognition Deconstructed** is a monthly video series that features a specific algorithm. In 10 to 15 minutes, we breakdown the functionality and provide theoretical explanations and real-world examples of how it can be applied within a rule set
- **eCognition Webinars** acts as a living archive for all our informative webinars. If you could not attend the live session, or simply want to review the recording in detail this is the place for you!
- **eCognition Oldies but Goldies** is a collection of videos from the days of yesteryear. Nevertheless, they still provide valuable insights into OBIA concepts and the roots of eCognition
- **eCognition Under the Hood** provides a range of videos that explain the technicalities of license administration: license activation, return, borrowing and more
- And More ...





eCognition Blog

- New eCognition blog
<https://ecognition.blog/>
 - News, articles, events...

Home eCognition Contact Support

Mapping the Future for 5G with LiDAR
by Keith Peterson • February 25, 2019

Latest Posts

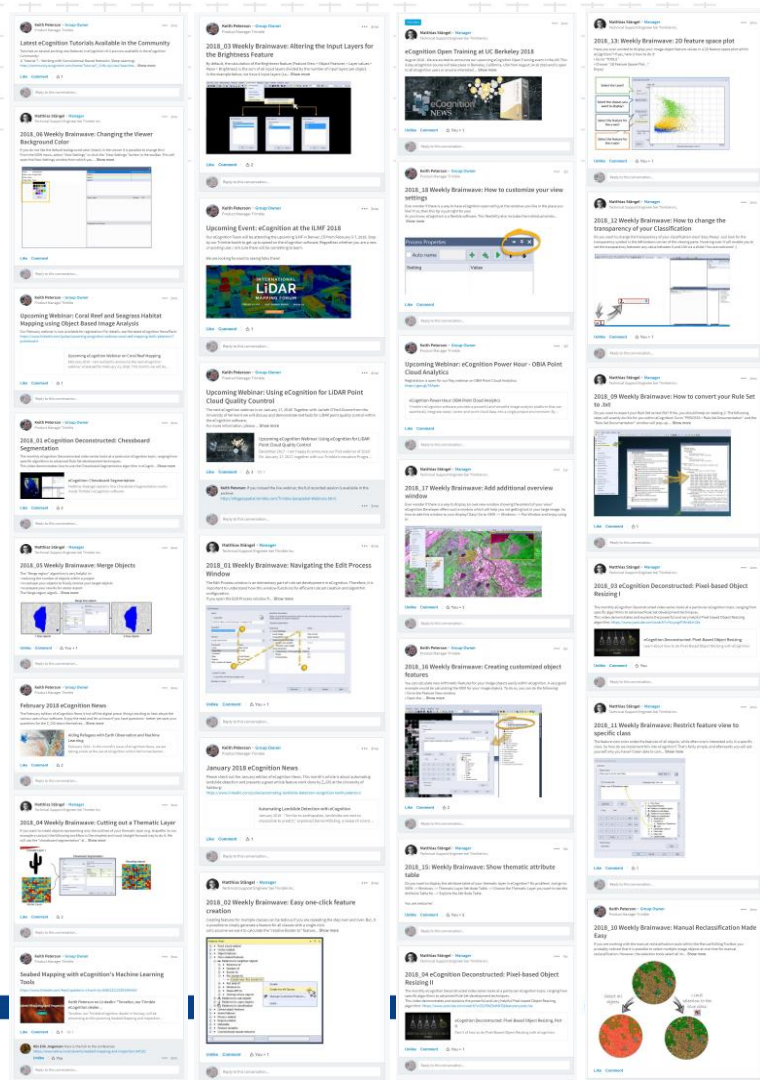
eCognition Workshop: Data Science Meets OBIA
The eCognition Team is excited to announce the upcoming workshop "Data Science Meets OBIA: eCognition Developer". The 2-day course will explore the fields of machine learning and OBIA in more detail and a basic understanding of eCognition and rule set development. It's...
by Keith Peterson • January 16, 2020

Trimble eCognition Oil Palm Application 2.0
The long awaited moment for our eCognition Oil Palm Application customer's is here! We released version 2.0 earlier this week and it is full of new functionality, improved detection accuracy and a great modern UI. The Trimble eCognition Oil Palm Application 2.0 offers...
by Keith Peterson • November 19, 2019



eCognition Social Media

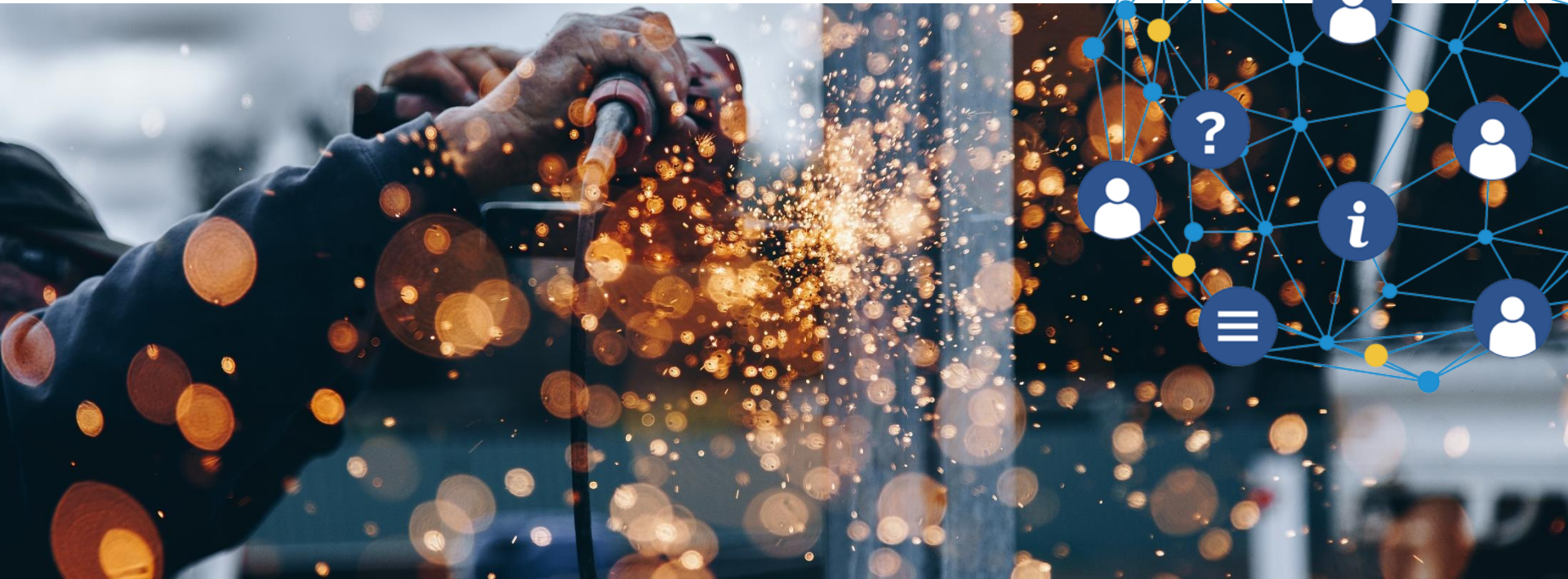
- eCognition LinkedIn Group
 - “eCognition Brainwave” (weekly tips)
 - News & Hot Topics





The eCognition Community

- We are working on a new Community





eCognition Support

- Submit ticket via the Support Portal
- Or, via email:
Support@eCognition.com



[eCognition - Help Center](#) > [Submit a request](#)

Submit a request

Your email address *

Subject *

Description *

Please enter the details of your request. A member of our Trimble support staff will respond as soon as possible.

Entitlement ID *

The Entitlement ID is a 23-30 character long string required for license activation and provided to customers within the Entitlement email.

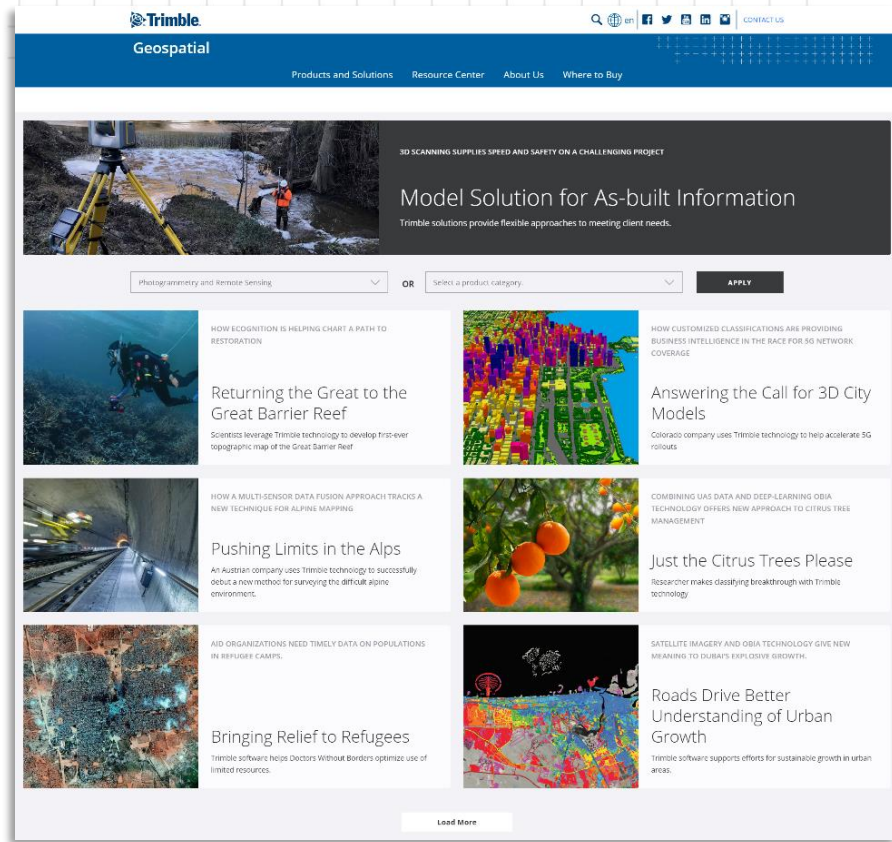
Attachments

 [Add file](#) or drop files here



eCognition Case Studies

- Trimble Geospatial Customer Stories Portal
 - Google “Geospatial Customer Stories” or <https://geospatial.trimble.com/resource-center/customer-stories>
 - PDF Documents
 - Highlighting customer and partner success with eCognition products



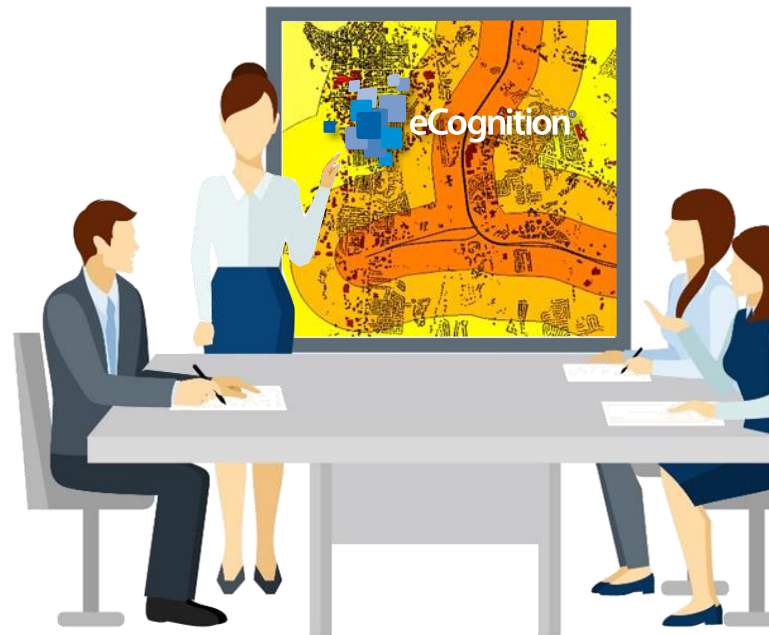


eCognition Training



- Instructor-led training
 - Open-trainings
 - On-site customer trainings
 - eCognition Developer – Fundamentals
 - eCognition Developer – Analysis Strategies
 - eCognition Architect – Fundamentals
 - eCognition – Custom

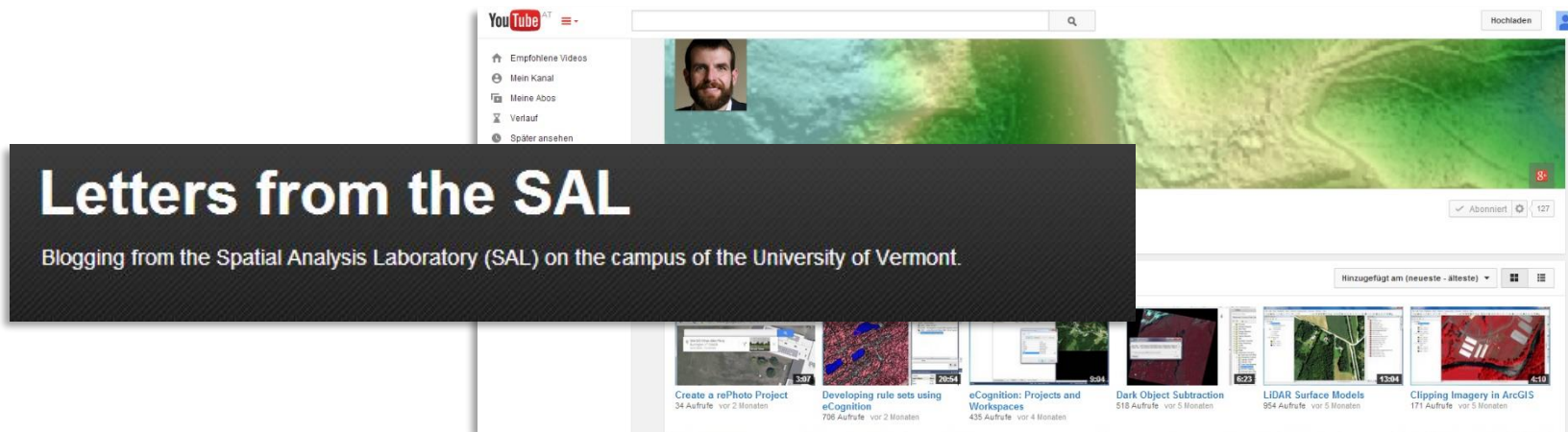
→ eCognition_Training@trimble.com

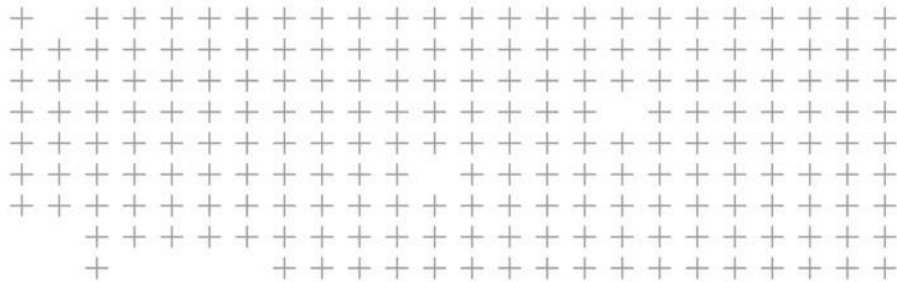




Outside Blogs

- Useful 3rd party sources of information:
 - YouTube channel from Jarlath O'Neil-Dunne
 - Letters from the SAL blog
 - <http://letters-sal.blogspot.de/>

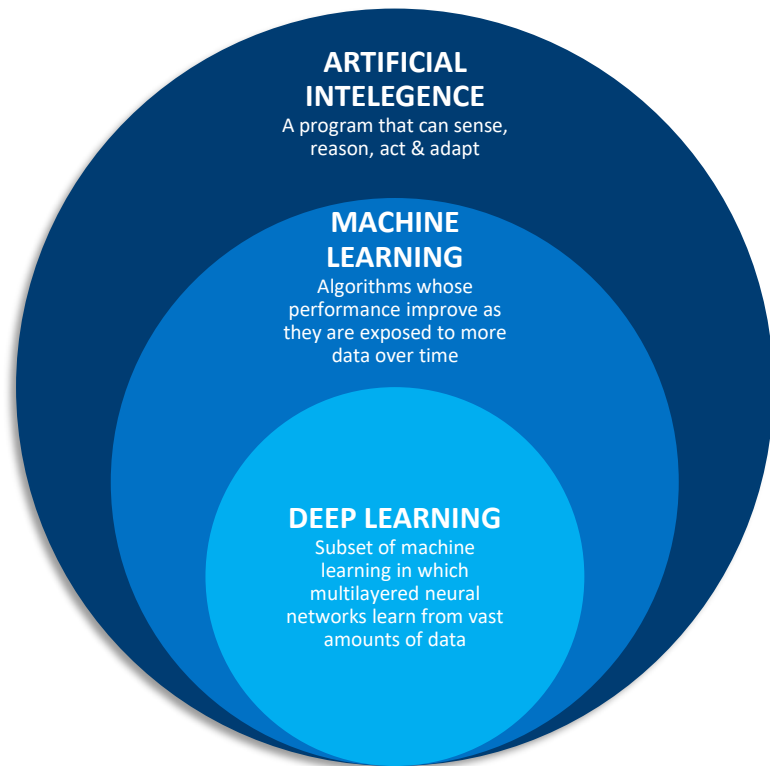




eCognition & AI

The Who's Who of AI

- **AI** - any technique that enables computers to mimic human “cognitive” functions, using logic, if-then rules, decision trees & machine learning (including deep learning)
- **ML** – a subset of AI that includes abstruse statistical techniques that enable machines to improve at tasks with experience (including deep learning)
- **DL** – the subset of machine learning composed of algorithms that permit software to train itself to perform tasks, image recognition, by exposing multilayered neural networks to vast amounts of data



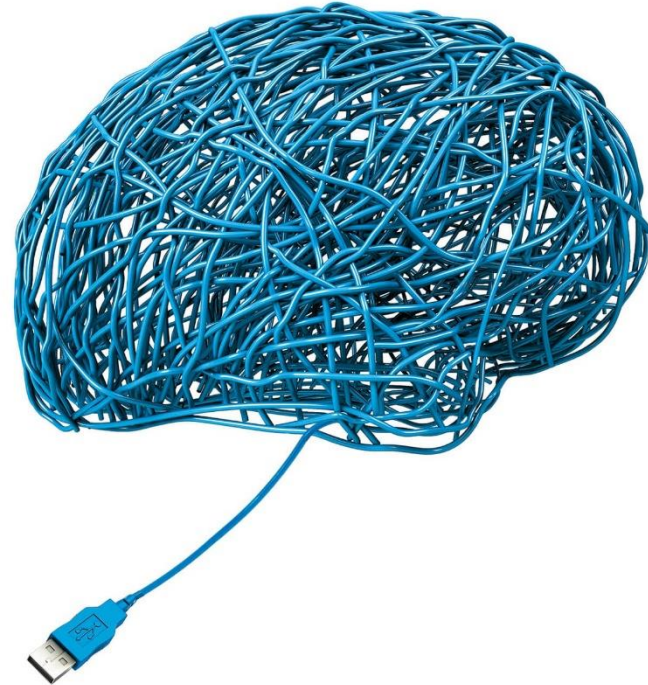
The Human Algorithm

- “Over the last few decades biologists have reached the firm conclusion that the man pressing the buttons [...] is also an algorithm.”

(Yuval Noah Harari – *Homo Deus*)

- “Humans are algorithms that produce [...] copies of themselves.”

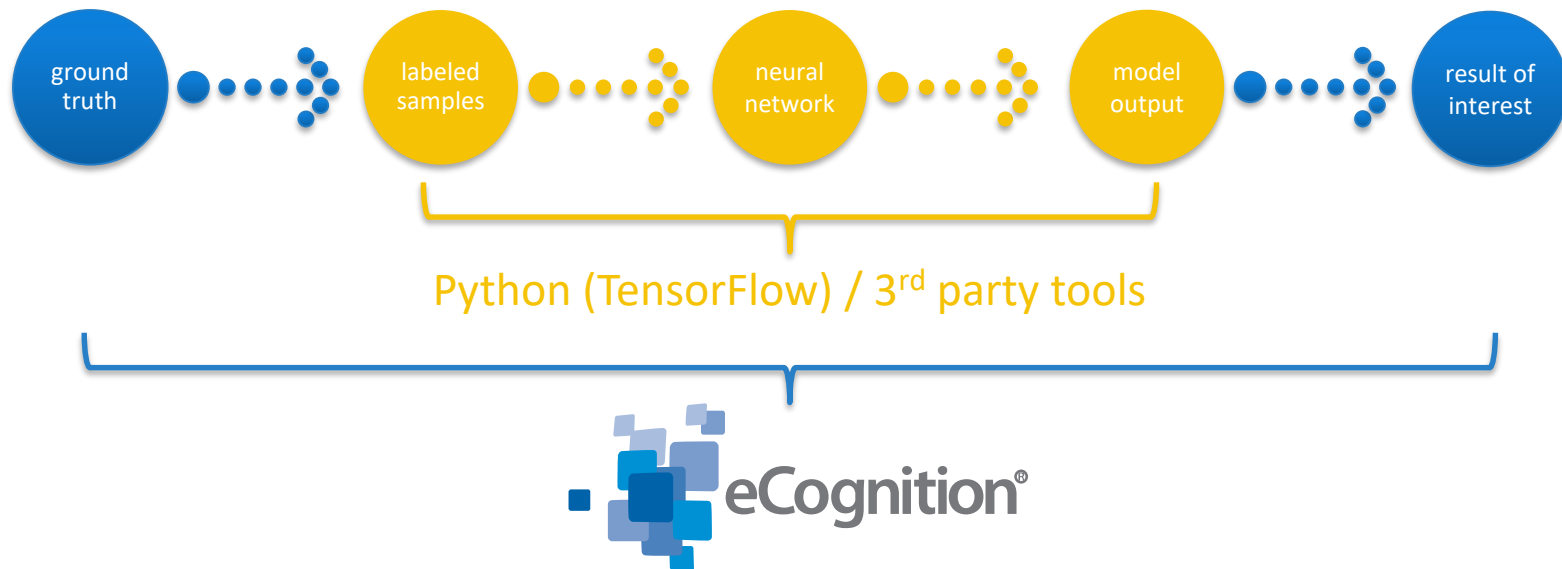
(Yuval Noah Harari – *Homo Deus*)



AI in eCognition

- eCognition provides tools for mimicing the human visual interpretation process
 - Rules to apply cognitive logic → knowlege-based classification
 - Membership functions in class descriptions (fuzzy logic)
 - Conditions in process domains (AND, OR, AND/OR)
 - Typical algorithms: assign class, classification...
 - Machine learning → supervised/ unsupervised
 - Typical algorithms: classifier (KNN, SVM, RF, CART), cluster analysis
 - Computer vision → Template Matching
 - Deep learning → Google TensorFlow (CNN)

End-to-end processing with eCognition



CNN – How does it work in eCognition?

Collect Sample Data

✖ generate labeled sample patches

Manage Sample Space(s)

✖ delete sample space
✖ merge labeled sample spaces
✖ split labeled sample space
✖ shuffle labeled sample patches

Create Model

✖ create convolutional neural network

Train Model

✖ train convolutional neural network

Apply model

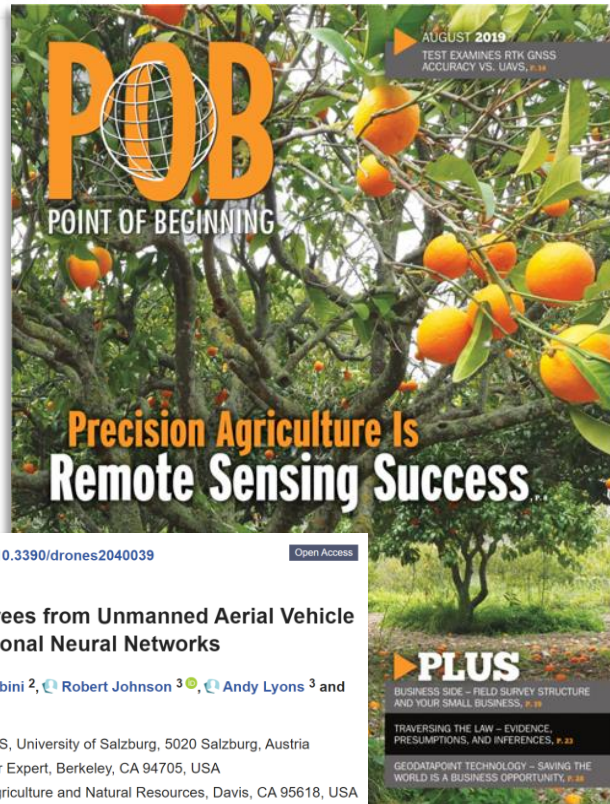
✖ apply convolutional neural network

Manage model

✖ save convolutional neural network
✖ load convolutional neural network
✖ convolutional neuronal network accuracy

Combining Deep Learning & OBIA

- Research by Csillik et al. 2018:
Identification of Citrus Trees from Unmanned Aerial Vehicle Imagery Using Convolutional Neural Networks
- eCognition webinar
→ see **eCognition tv**



18, 2(4), 39; <https://doi.org/10.3390/drones2040039>

Open Access

Article

Identification of Citrus Trees from Unmanned Aerial Vehicle Imagery Using Convolutional Neural Networks

by [Ovidiu Csillik](#)¹, [John Cherbint](#)², [Robert Johnson](#)³, [Andy Lyons](#)³ and [Maggi Kelly](#)^{3,4,*}

¹ Department of Geoinformatics, Z_GIS, University of Salzburg, 5020 Salzburg, Austria

² UAV/Remote Sensing Subject Matter Expert, Berkeley, CA 94705, USA

³ University of California Division of Agriculture and Natural Resources, Davis, CA 95618, USA

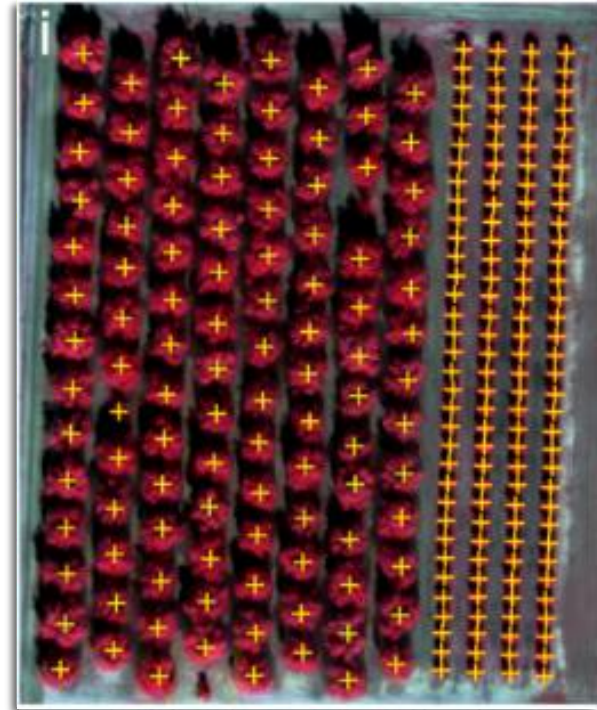
⁴ Department of Environmental Sciences, Policy and Management, University of California, Berkeley, CA 94720, USA

* Author to whom correspondence should be addressed.

Received: 24 October 2018 / Accepted: 14 November 2018 / Published: 20 November 2018

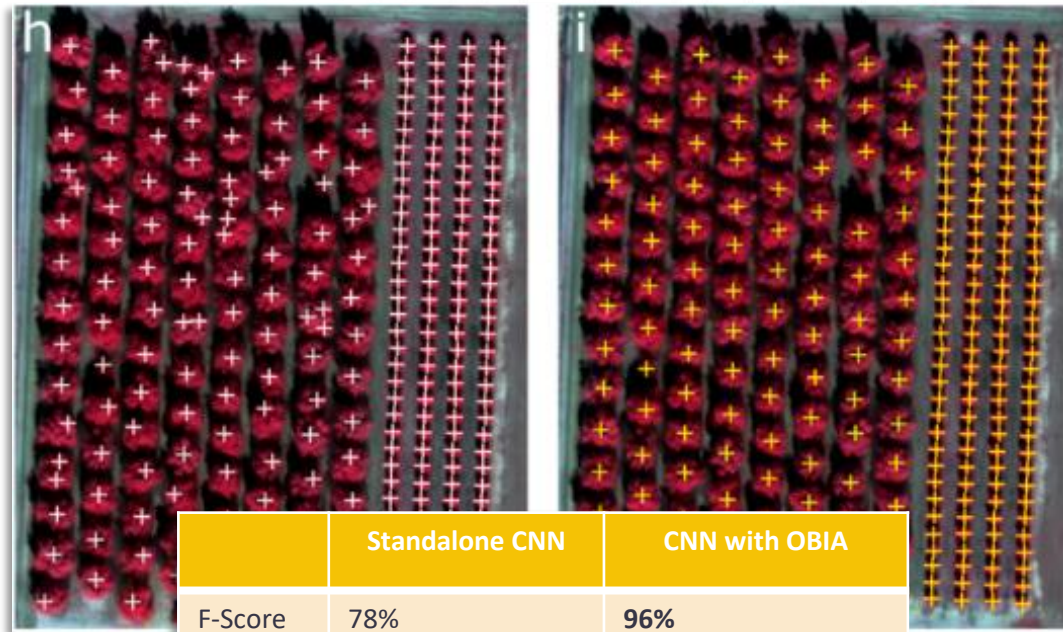
Taking CNN to the Next Level

- Heatmap created by eCognition CNN algorithm – probability values 0-1
- Smoothed heatmap to reduce noise
- Trees identified using threshold of 0.5
- Vectorized result – problem with multiple crown detection for large trees
- Segmentation of smoothed heatmap & NDVI layer using SLIC superpixels of sizes $> 40 \times 40$ pixels
- Identification of multiple crown detections
- Single hit per tree computed
- Final CNN-OBIA result



CNN-OBIA Results

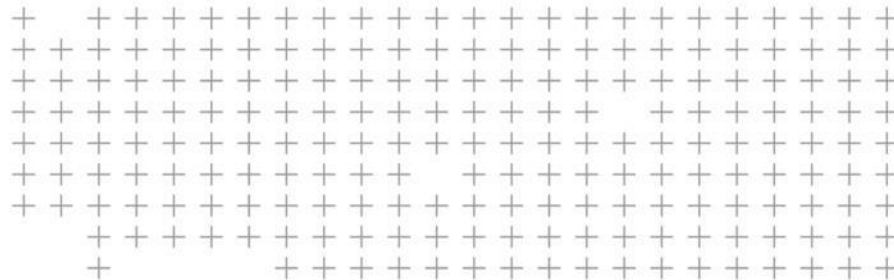
- The results after refinement (h) were a better match to the ground reference sample (i)
- “By combining an object-based post-processing approach for the CNN results of tree detection, the accuracy of the results was improved significantly” (Csillik et al 2018).



	Standalone CNN	CNN with OBIA
F-Score	78%	96%
Precision	65%	95%
Recall	98%	98%

Image Analysis is More than AI

- eCognition is **more** than just AI, because EO data interpretation is more than AI
 - Adrea Baraldi: “There is no meaning in numbers”
 - Jarlath O’Neil-Dunne: “What I used to love about eCognition was that it enabled us to bring together point cloud, vector, and raster data without all the pesky transformation.
What I love about it now is how it gives us access to multiple feature extraction approaches.
AI is not the future, AI combined with existing approaches is.”



Release Overview – where have we been & where are we going?

eCognition Releases 2014 & 2015

eCognition Suite 9.0

- **Major release** with new features and improvements
- **Native Vector Handling** (Improved integration of GIS techniques into Remote Sensing workflows)
 - Vector visualization
 - Vector related attributes
 - Vector boolean operations
 - Vector smoothing
 - Vector orthogonalization
 - Vector integration
- **Template Matching** (Extends OBIA with Computer Vision based object detection to improve classification results)
 - Template Matching Algorithm
 - Template Editor Dialog
- **JPEG2000 Support** (Faster turnaround times for projects using newest remote sensing products)
- **Trusted Storage** (Secure & online based license management)
- 20 bug fixes
- **Release date: 28th March 2014**

eCognition Suite 9.0.1

- **Maintenance release** with small improvements
- Windows 8.1 support
- **Virtual Machine support (License Server)**
- Native 64-bit edition of Image Proxy
- Improved vector layer support (GeoJSON files)
- PNG world file support
- Improved mouse navigation in Viewer
- 22 bug fixes
- **Release date: 11th June 2014**

eCognition Suite 9.0.2

- **Maintenance release** with new features
- **Template Matching Phase 2:**
 - Rotation invariance Template Matching
 - Generation and utilization of template masks
 - Rectangular-shaped templates support
- **Application Development Improvements**
 - Permanently visible and configurable toolbar & tooltips for widgets
 - New window to show and edit ruleset processes
 - New dialog to insert multiple process domain conditions
- Trimble Data Market Place plugin
- Unsupervised classification support
- Improved vector export (feature list support)
- Migration of Documentation to Authoring Tool „Madcap Flare“
- 30 bug fixes
- **Release date: 7th October 2014**

eCognition Suite 9.0.3

- **Maintenance release** with bug fixes
- 6 bug fixes
- **Release date: 16th December 2014**

eCognition Suite 9.1

- **Major release** with new features and improvements
- **Multi-Core MRS Segmentation** (40-50% performance improvement of typical RS rulesets; Max = 4 cores)
- **Native Vector Handling Phase 2** (Better utilization of GIS-data in image analysis workflows → Vector buffering/Vector context/Vector conversion)
- **Re-usable Sample Statistics** (Flexible & robust Supervised Classification via combine, extend and transfer ground truth data from various locations)
- **Trimble MX2 support** (Enhanced mobile mapping support)
- **Packaging and Installation of Customized Applications** (easier roll out and commercialization of eCog-based apps)
- **Application Development Improvements**
 - Process loop debugging (Breakpoints)
 - Enhanced Widgets and Data Viewing capabilities to create eCognition Apps
- 54 bug fixes
- **Release date: 23th April 2015**

eCognition Suite 9.1.1

- **Maintenance releases** to fix bugs
- **New Version Notification** (Informs users – not license owner – about new releases)
- 3 bug fixes (major bug fix: multi-core issue)
- **Release date: 21th May 2015**

eCognition Suite 9.1.2

- **Maintenance release** with new features
- **Customer Feedback Program** (Collects information about computer hardware and used eCognition algorithms & UI elements → base for further PM decisions)
- **License Borrowing** (Trusted Storage based license borrowing to use SW without network access)
- **Out of MNT Notification** (Informs user – not license owner – about MNT status)
- **Application Development Improvements** (vertical separator, resizable window, etc.)
- **Windows 10 support**
- 19 bug fixes
- **Release date: 16th September 2015**

eCognition Suite 9.1.3

- **Maintenance releases** with minor improvements
- New JPEG2000 driver (Lizardtech)
- 12 bug fixes
- **Release date: 18th December 2015**

2014

2015

eCognition Releases 2016 & 2017

eCognition Suite 9.2



- **Major release** with new features and improvements
- **Extended Multi-Core Processing Capabilities** - utilize up to 8 cores to complete projects faster than before
 - multiresolution segmentation
 - template matching
 - layer arithmetics
 - feature calculations
- Advanced Data Support - reduce time taken in converting data
 - JPEG2000 (JP2)
 - MrSID (SID)
 - LasZIP (LAZ)
- Enhanced Native Vector Handling - more intuitive and complete solution based on GIS data within eCognition
- 30 bug fixes
- **Release date: 11th April 2016**

eCognition Suite 9.2.1



- **Maintenance releases** with bug fixes
- 10 bug fixes
- **Release date: 11th August 2016**

eCognition Suite 9.3



- **Major release** with new features and improvements
- **Point Cloud analysis enhancements** (automated classification algorithm, tutorials for typical RS use cases, fully SDE integration)
- **Point Cloud viewing enhancements** (TopDown & 3D -Viewer)
- **Image analysis enhancements** (Deep Learning, Superpixel Segmentation, Memory page compression)
- High-DPI display support
- **Release date: 26th September 2017**

2016

2017

eCognition Releases 2018 & 2019

eCognition Suite 9.3.1



- **Maintenance release** with bug fixes and improvements
 - Deep Learning Enhancements:
 - Monitoring/Query of CNN models
 - **GPU support to increase performance**
 - TF v1.4 support
 - Point Cloud OBIA Enhancements:
 - PCL field editing & custom field support to increase CNL flexibility
 - Extended LAS field support to use all PCL features (without waveform)
 - Full LAS export support to include all PCL field information
 - **Release date: 16th March 2018**

eCognition Suite 9.3.2



- **Maintenance release** with bug fixes
 - Critical Bug Fixes
 - Support Windows 10 update 1803 for Server processing
 - Create temporary point cloud from image objects
 - Minor Bug Fixes:
 - Calculate Random Number for image objects
 - Manual Editing – object splitting tool
 - **Release date: 18th June 2018**

eCognition Suite 9.4



- **Major release** with new features and improvements
 - **New UI for data management & visualization**
 - Support quick project creation through drag & drop
 - GIS-like data visualization tools: View Settings & Source View windows for faster development
 - **New Algorithms for Enhanced Usability**
 - Out-of-the-box algorithms for easier development
 - Algorithms to help new users
 - **3D Vector Support**
 - Support 3D vector files for analysis
 - Visualization of 3D vectors supported in 3D viewer with point clouds
 - **Release date: 12th November 2018**

eCognition Suite 9.5



- **Major release** with new features and improvements
 - **Boosted Point Cloud operability**
 - Point cloud resampling for faster processing
 - Increased data fusion support in 3D viewer – raster display with point cloud
 - **Improved Deep Learning Processing**
 - Batch normalization support for CNN
 - New sample manipulation for production workflows
 - **Extended vector OBIA support**
 - Region support for vector domain
 - Vector buffer shrinking
 - Vector domain statistical calculations
 - Increased data fusion between vector points, image objects and layer values
 - **Release date: 12th July 2019**

eCognition Suite 9.5.1

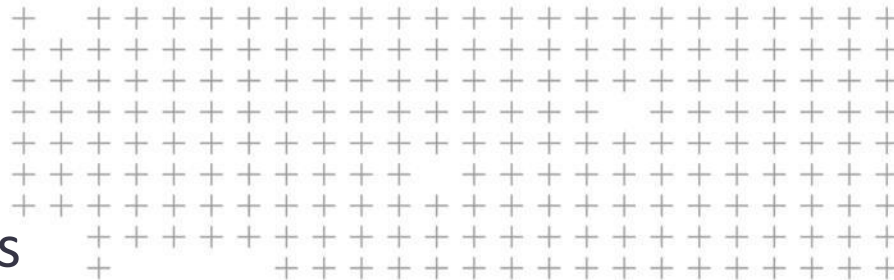


- **Maintenance release** with bug fixes and improvements
 - License Server Update:
 - FlexNet licensing security update
 - Minor Bug Fixes:
 - Template display
 - CNN sample size/ format
 - CNN shuffle sample patches
 - Thematic raster export
 - **Release date: 10th December 2019**

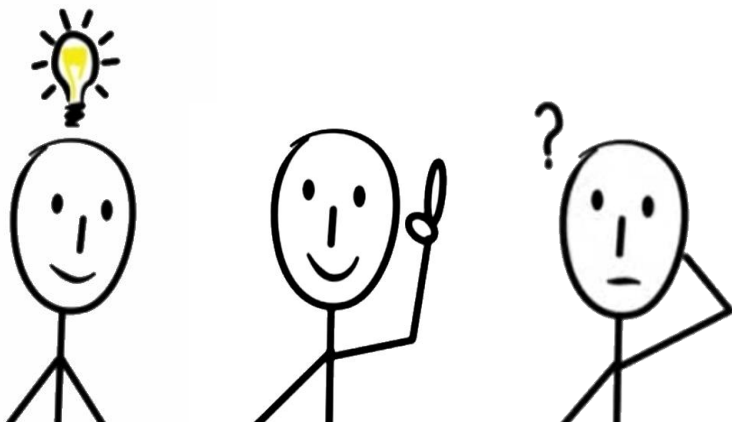
What's
Next?

2018

2019



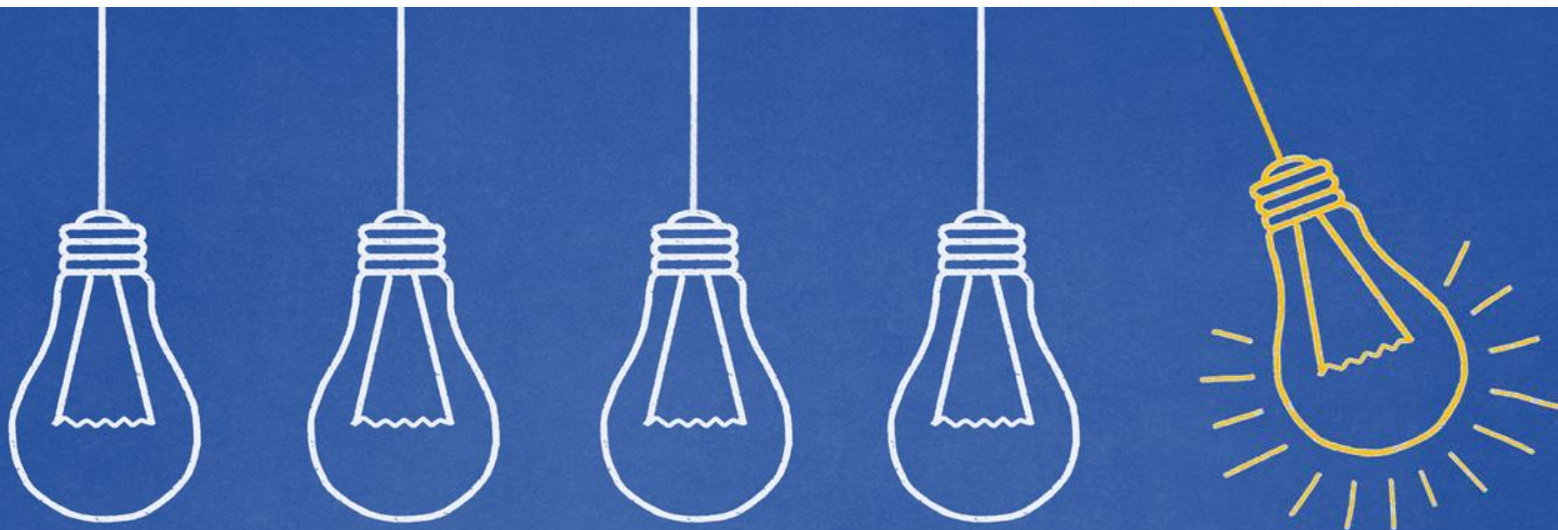
✦ Ideas | Feedback | Questions



Open Discussion

Thank you for listening

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