CAPELLA AUTOMATED CHANGE MONITORING

THE CHALLENGE

Organizations responsible for understanding activities and changes across a broad portfolio of locations face an immense monitoring challenge. The volume, size, and distribution of sites, in addition to difficult or dangerous access conditions, makes remote sensing an appealing way to efficiently gain critical insights into what is happening on the ground. Many remote sensing methods, however, suffer from key drawbacks. Manned and unmanned aircraft don't have the range and revisit required to meet ongoing monitoring requirements. Optical satellite imagery is obscured by cloud cover or darkness for extended periods of time—particularly in certain seasons and geographies. Simply put, organizations don't have the ability to consistently and reliably monitor large numbers of assets, facilities, and geographies.

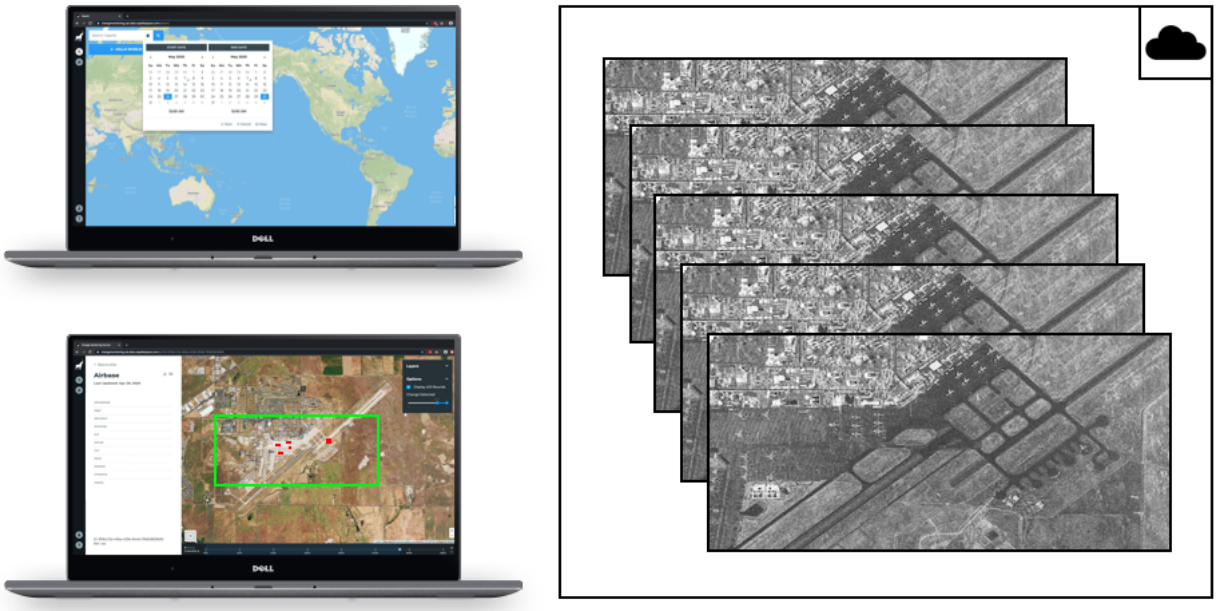

Figure 1: Capella Automated Change Monitoring allows a user to select an area of interest and monitoring period (top left). Capella collects, processes, and runs change detection algorithms on SAR data, leveraging cloud computing and storage (right). Users explore and annotate results through a user interface or use an API to bring results into other systems for data fusion (bottom left).

AUTOMATED CHANGE MONITORING SOLUTION

Satellite-based synthetic aperture radar (SAR) is an ideal data source for consistent monitoring due it its all-weather, day and night imaging capability. The combination of Capella's high resolution, high cadence SAR constellation along with the European Space Agency's (ESA) Sentinel-1 SAR satellites provides an ideal solution for both large-area monitoring and precise measurement of change. Many organizations, however, don't have or don't want to devote the technical expertise and infrastructure to quickly and effectively make use of these rich, reliable information sources.

Capella Automated Change Monitoring brings efficient, large-scale site monitoring into reach for organizations with varying levels of geospatial expertise. This service combines the reliability of SAR with global change detection analytics to create a powerful tool for gaining insights and deriving actionable information. Capella Automated Change Monitoring is conveniently delivered through a web application, where analysts can immediately set up sites for monitoring and gain insights, and an associated Application Programming Interface (API), which allows organizations an ability to bring results into other systems for data fusion.

Data collection and storage

Significant software development and engineering expertise is required to continually gather and prepare time-series data for change monitoring. The Capella service gathers new and historical SAR imagery of a customer's areas and time periods of interest from Capella's proprietary constellation and ESA's Sentinel-1 SAR satellites. Imagery is securely stored in the cloud for ready access, analysis, and distribution.

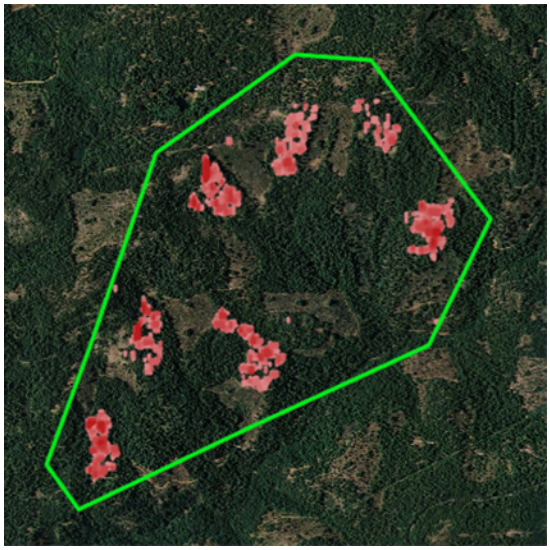

Figure 2: Capella Automated Change Monitoring results, derived from SAR, showing timber harvesting activity in red.

Image pre-processing

Calibration, noise reduction, terrain correction, and other pre-processing is critical to ensuring relevant analytic results. Capella's data science and engineering teams have created sensor-specific methods to reliably produce analysis-ready data into a multi-temporal change detection pipeline.

Change detection analytics

Capella Automated Change Monitoring allows for the rapid acquisition of meaningful insights about land and infrastructure or the assessment of activity levels and patterns of life. Capella uses an ensemble of algorithms on the intensity and phase of short and long time series stacks of SAR data. Information on the extent, timing, and confidence of detected changes is surfaced within the user interface and API. Capella continues to make improvements and additions to the available analytics over time for alerting, identification and quantification of changes.

Figure 3: Capella Automated Change Monitoring results, derived from SAR, show a 95% confidence (red shading in left image) of change over the course of a one-year monitoring period. Right optical image validation pair shows before (top) and after (bottom) states of the location of interest with the red circle emphasizing the large vehicle that was positioned on the site for an extended period.

Results exploitation, distribution, and ongoing monitoring

Capella's web console is a powerful way to view change detection results and distribute these to other applications and team members that will take action. A user is able to view a list or map of all sites under monitoring and prioritize by the quantity of change at a given site, recency of analytics processed, or user defined favorites. Users can keep notes on sites with developing changes and view original SAR and optical reference imagery, as available.

Importantly, for advanced organizations, results, imagery, and metadata can be exported individually or accessed in bulk by a well-documented API for incorporation into other applications and systems.

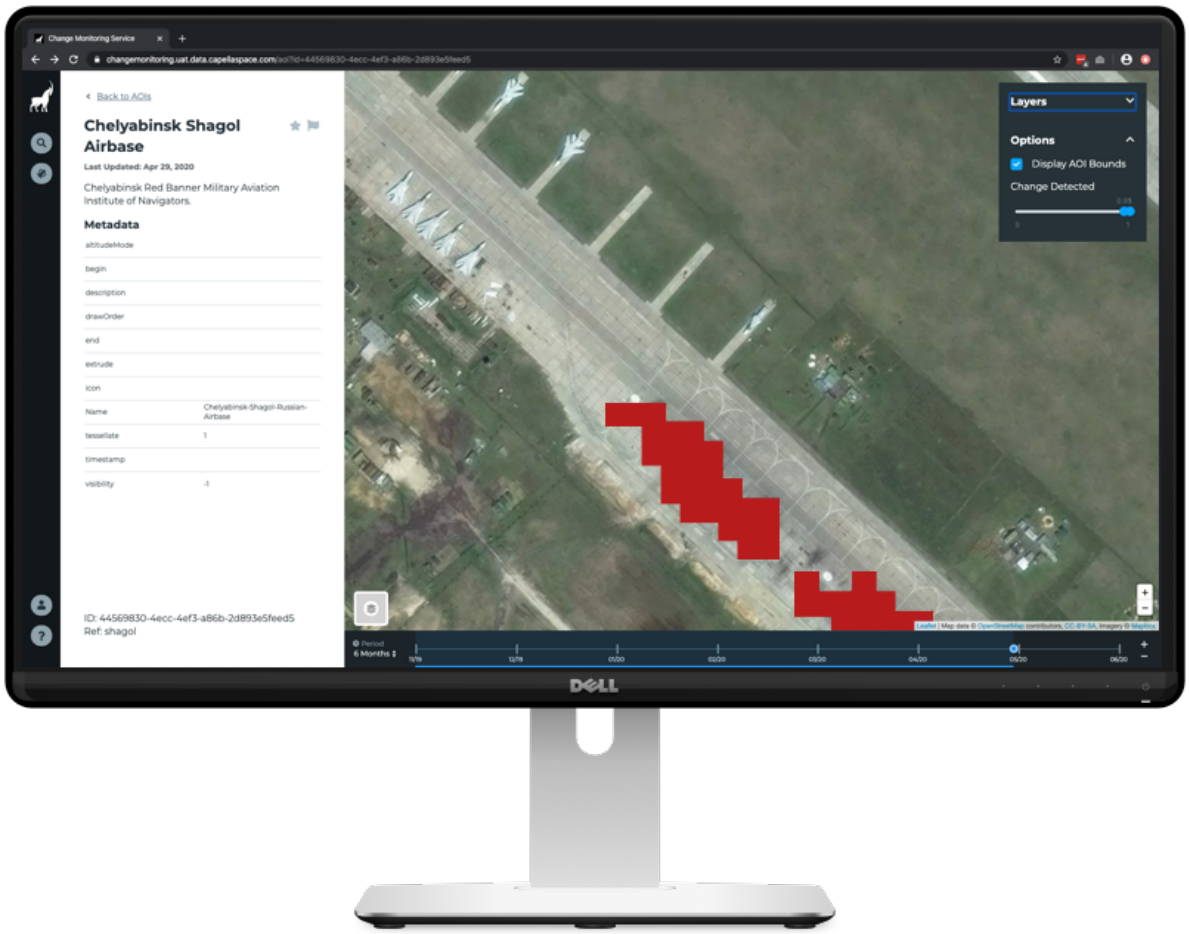

Figure 4: Capella Automated Change Monitoring results, derived from SAR, shown within the web application. Red shading denotes a 95% confidence of change over the course of the activity monitoring period, indicating a high likelihood of aircraft movement at this location.