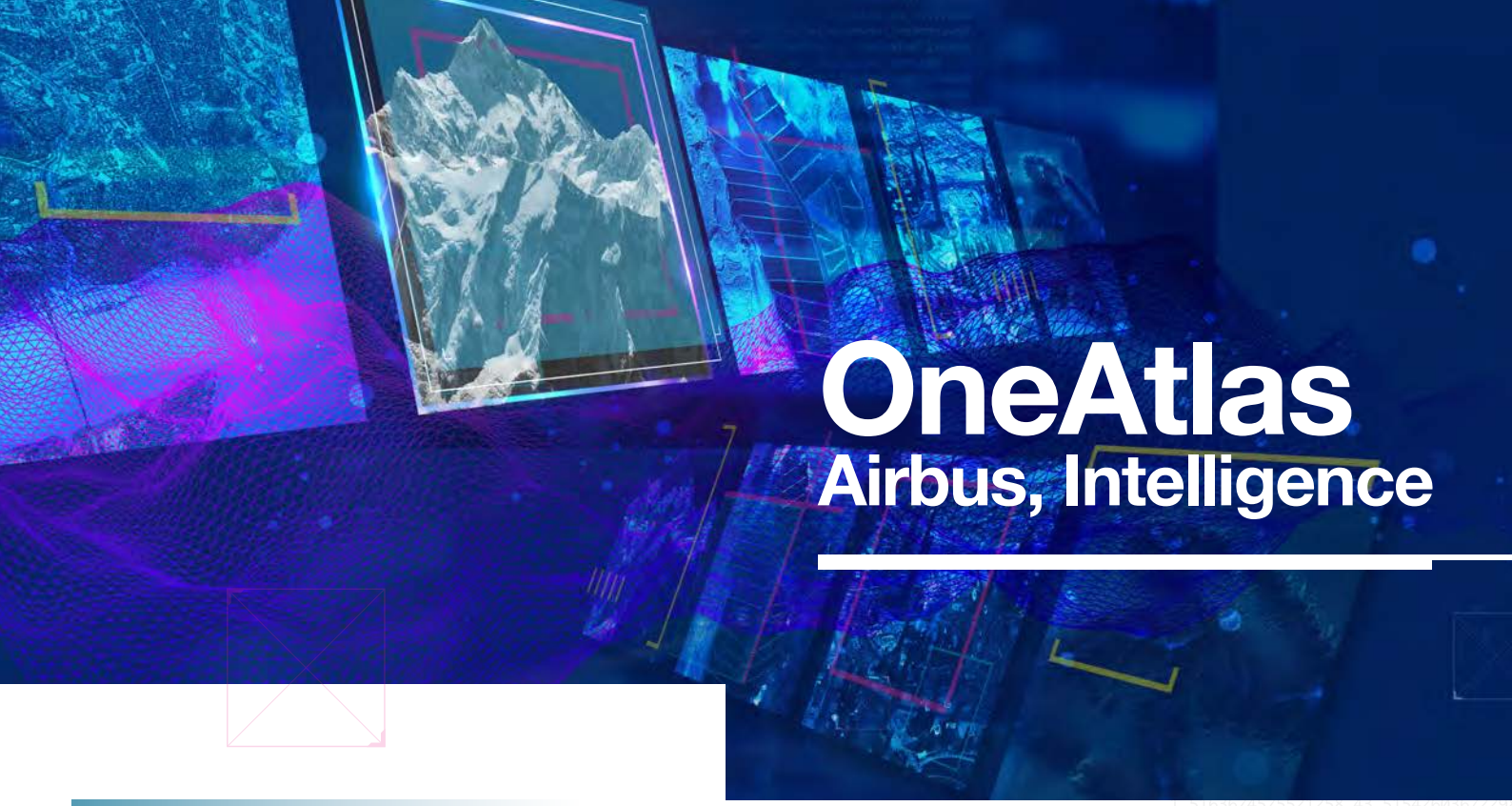


OneAtlas
Airbus, Intelligence

Optical Satellite Image Processing in the Cloud

Airbus Intelligence provides users with access to satellite imagery, innovative geospatial analytics, and industry-specific insights. Image data from the Airbus Constellation of satellites, which includes twin SPOT 6/7, Vision-1, Pléiades, and Pléiades Neo satellites are used to deliver actionable intelligence to a variety of markets around the globe.

Already known for quick processing and delivery of imagery and derived products, the Airbus processing workflow is now even faster – just a few hours after satellite acquisition in many cases – thanks to cloud technology.

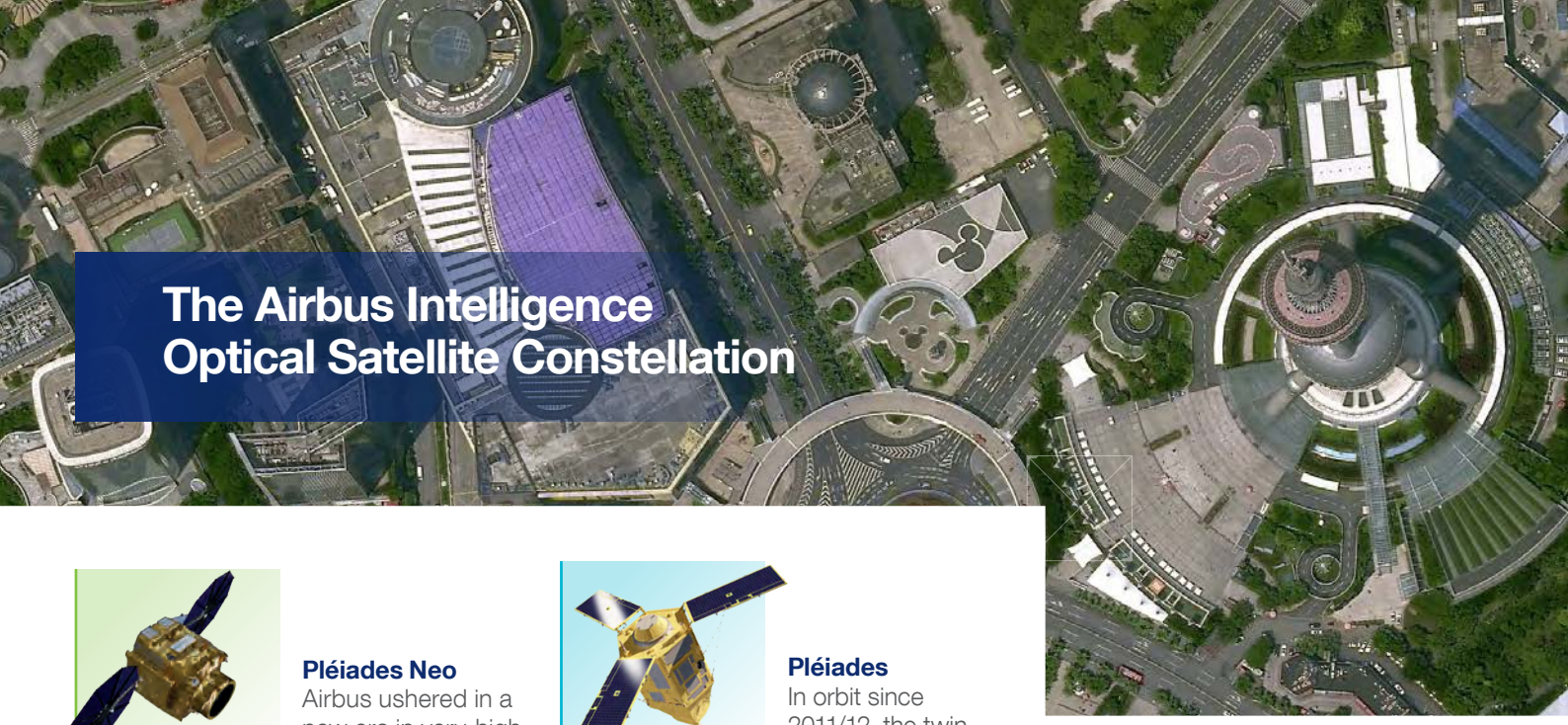
In preparation for the Pléiades Neo era, Airbus redesigned its ground segment, moving Pléiades Neo, Pléiades and SPOT optical image archiving and processing to the cloud. This essentially connects the satellites directly to the cloud where raw imagery is ready for real-time processing of orders placed from anywhere in the world.

New and archived satellite imagery in a variety of processing levels, as well as elevation data, 3D models, and other global data sets are available to customers through the automated OneAtlas platform or through customer service. These products can be delivered via streaming, download, and API in multiple formats for easy integration into your GIS workflows.

The Airbus Intelligence optical imagery catalog encompasses the full Pléiades (50cm), SPOT 6/7 (1.5m) and Pléiades Neo (30cm) data sets now and will include data from Vision-1 (87cm) soon.

For online OneAtlas users, curated cloud-free data are added daily to the easily searchable, subscription-based Living Library, while all images dating back to 2012 are available in the Extended Archive. Customer Service users may call or email a representative for assistance selecting the data set that best fits their needs.

AIRBUS



The Airbus Intelligence Optical Satellite Constellation

Pléiades Neo

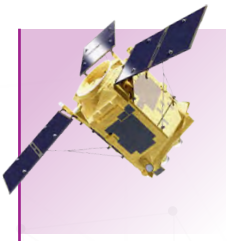
Airbus ushered in a new era in very-high resolution Earth observation in 2021 with the first two launches of the four-satellite Pléiades Neo constellation. Delivering 30cm spatial resolution ideal for accurate large-scale mapping over broad areas, these identical and extremely agile satellites enable rapid acquisition of panchromatic and multispectral data.

- **30cm Ground Sample Distance** (GSD) panchromatic band
- Geolocation accuracy **less than <3.5m**
- **Six multispectral bands** – RGB NIR, plus Red Edge and Deep Blue
- **Intra-day revisit** (twice daily, 46 degrees off-Nadir)
- **2 million square kilometers**/day collection capacity
- **Stereo** and **tri-stereo** same pass acquisitions

Pléiades

In orbit since 2011/12, the twin optical Pléiades satellite constellation delivers 50cm products with a 20km swath to meet the full spectrum of civilian and defence applications. With daily revisit, these satellites are remarkably agile, collecting five acquisition scenarios: Target, Strip Mapping, Tri-Stereo, Corridor, and Persistent Surveillance.

- **50cm product with 6.5m CE90** at nadir geolocation accuracy
- **Four multispectral bands** – Blue, Green, Red and Near-Infrared + Panchromatic bands always acquired simultaneously
- **Stereo** and **tri-stereo** on same pass
- Up to **700,000 km²** of acquisition capacity



SPOT 6/7

Each of these SPOT satellites cover large areas in a single pass at resolutions up to 1.5m, ideal for applications at national and regional scales from 1:250,000 to 1:15,000.

- **1.5m GSD** panchromatic band with 15m CE90 at 30° geolocation accuracy
- **Four multispectral bands** – Pan, Blue, Green, Red, and Near Infrared + Panchromatic band always acquired simultaneously
- **Stereo** and **tri-stereo**
- Up to **6 million km²** acquisition capacity

Vision-1

This high-resolution optical satellite significantly enhances Airbus monitoring capabilities, particularly for defence, security, maritime, and agriculture applications. Vision-1 was placed in orbit with the NovaSAR synthetic aperture radar satellite to open unique opportunities for Opti-SAR applications.

- **0.87m GSD panchromatic band** with <12m CE90 at Nadir absolute geolocation accuracy
- **3.48m multispectral bands** – RGB, NIR
- **Advanced agility** capacity

Since the launch of the original SPOT program in 1986, Airbus has made continued advancements in the development of its satellite and sensor technologies. With each new constellation, the Airbus team has enhanced the spatial resolutions, multispectral range, geolocation accuracy, acquisition capacity, and spacecraft agility.

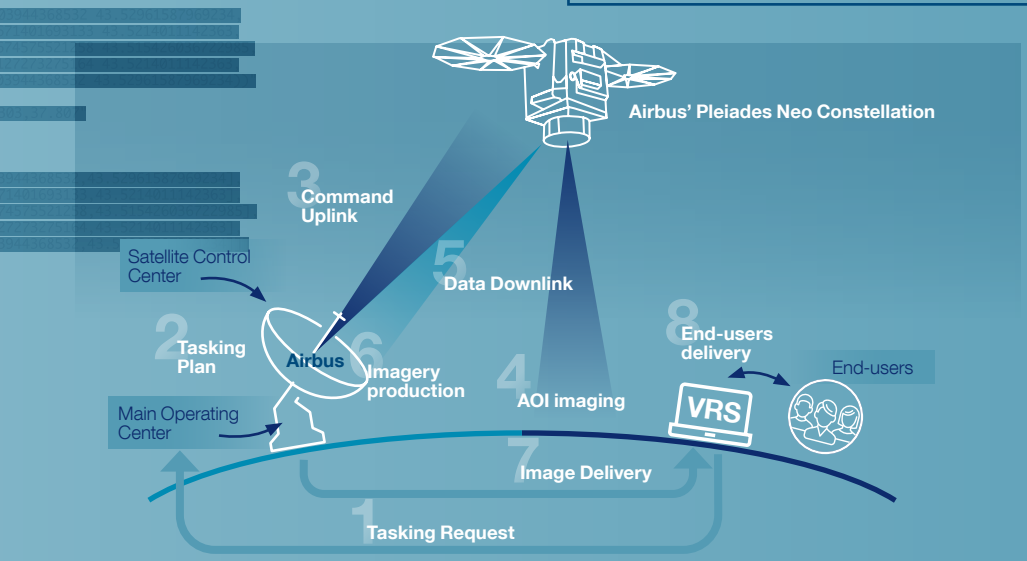
While these technical improvements have elevated Airbus optical satellites to the pinnacle of Earth observation with Pléiades Neo, the ground segment has been continually augmented as well. From acquisition tasking to image processing and product creation to delivery, the entire production chain has been upgraded and streamlined with cloud technology to deliver high-quality image products quickly and efficiently to customers.

Online Customer Tasking

Airbus was the first to offer customers with flexible tasking options. For decades, users have been able to schedule image acquisitions over their areas of interest days, weeks or months in advance. Their selections have been supplemented with latest weather forecasts and automated notifications that allow the user to be informed at each step of their new collection request and to cancel a scheduled collect for a specific day less than 24 hours before hand if cloudy or other poor conditions imperil capture of a quality image.

Today, Airbus has put Tasking orders directly into the hands of end users. Through the intuitive OneAtlas interface, customers may schedule image acquisitions by any of the four optical constellations. Users can select their own tasking parameters and processing options, generally allowing an acquisition order to be placed 24 hours in advance. However, Airbus is now proud to announce the new Pléiades Neo satellites can be scheduled by the user to capture an image in as little as 25 minutes before the satellite passes over a specific AOI.

This direct, short-notice Tasking is ideal for monitoring natural disasters, emergencies, and other rapidly evolving events that have occurred unexpectedly.



Optical Image Processing Options

Pansharpening

Pansharpening is the most common image processing technique applied to Airbus optical satellite data. Each of the four optical constellations captures imagery in a single relatively wide visible band, called Panchromatic, at high or very high spatial resolution. In addition, each sensor captures multispectral data in several narrower discrete wavelengths in visible (RGB) and near-infrared portions of the spectrum at slightly coarser spatial resolution.

Airbus offers a Pansharpening option which combines the spectral content of the multispectral bands with the spatial detail of the panchromatic band. The result is a colorful multispectral image at high or very high GSD pixel depending on the satellite. Most commonly, Pansharpened images are generated as natural color or false-color infrared products.

Customers may also order multispectral images in the three-band combinations of their choice. Of course, for end users with their own image processing capabilities, data sets containing all panchromatic and multispectral bands may also be ordered.

Geometric Correction

Airbus offers three levels of processing to remove geometric distortions from satellite images: Primary, Projected, and Orthorectification. The objective of geometric processing is to improve the geolocation accuracy of x, y, and z points measured in the imagery. Although all imaging sensors rely on onboard sensors, star trackers, and inertial measurement units to geolocate image pixels, some additional processing must occur on the ground to further improve the overall geometric accuracy.

In preparation for the Pléiades Neo constellation, Airbus developed an entirely new global reference database to geometrically correct images acquired by any optical sensor. This database, called Space Reference Points (SRP), contains a worldwide network of 3D ground control points generated by performing a bundle adjustment on the SPOT 6/7 multi-view archive. The accuracy of this new SRP database, used extensively in orthorectification processes, has improved standard geometric correction on Airbus products, up to < 5m CE90.

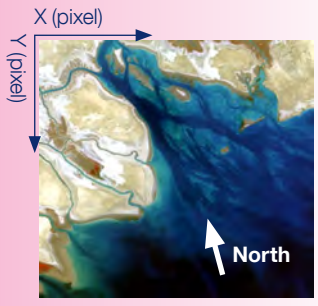
The new SRP database is important because it is now used to geometrically correct all Airbus optical image products. Of critical importance, images from Pléiades Neo, twin Pléiades satellites , SPOT 6/7, and Vision-1 can be aligned to the same reference system, which means they are fully compatible with each other for large, multi-sensor analysis projects, such as time-series change detection. Inter-sensor compatibility is a requirement for analysis involving Artificial Intelligence.

Three levels of Geometric Correction are available:

Primary

Also known as System-Ready, Primary Processing is geometrically very close to the raw image data received from the satellite sensor. These data sets are meant for customers who will perform their own orthorectification or digital elevation model (DEM) creation. Customers receive the sensor model and RPCs to use in performing bundle adjustments and making their own corrections to the data.

(N.B. Not available for Vision-1)



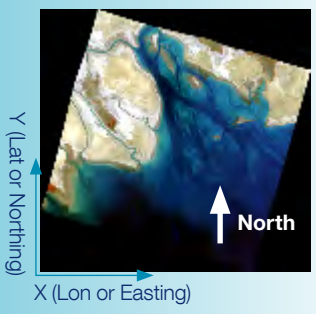
Projected

Referred to as View-Ready, Projected images are mapped on the Earth with a standard reference datum and projection system at a fixed terrestrial altitude. The Default is WGS84/UTM. Like the Primary data sets, Projected images are delivered with sensor models and RPCs for users performing orthorectification with their own GCPs or DEMs. The main advantage of Projected images is they are compatible with GIS environments.

Orthorectification

Sometimes called Map-Ready or Analysis Ready products, Orthorectified images have had geometric distortions removed so the final image has the georeferenced qualities of a map. Airbus applies an automated orthorectification process that uses the new SRP database to remove horizontal and vertical distortions from the data.

Customers ordering orthorectified products may also select from two relief models to project the image onto for proper display of the terrain. The most popular is the SRTM (Shuttle Radar Topography Mission) which is a very smooth data set ideal for nadir images with minimal terrain distortions. The other option is the WorldDEM, which provides more accuracy and is better suited for off-nadir images that experience significant terrain distortion caused by the angle of image acquisition.



On-the-Fly Orthorectification

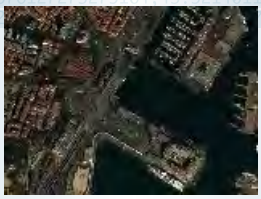
When OneAtlas customers stream data via WMS/WMTS image scenes online, they are seeing On-the-Fly Orthos, which means basic orthorectification has been applied to the raw data files in real time. This gives the customer a good idea of how the final images will appear once they have been fully orthorectified, either by Airbus or by the users themselves.

Massive Orthos

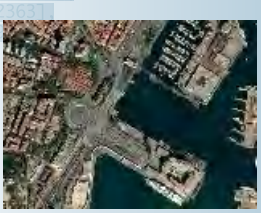
Once the customer has viewed and selected their preferred images online, they may order the final orthorectified image product in their selection of projection system, DEM, and level of radiometric processing. For OneAtlas users, this massive orthorectification is performed in real time on their selected data set for streaming or downloading to their workflow.

Radiometric Processing

Basic



Reflectance



Display

Radiometric correction provides a means to map the recorded pixel values in DN (Digital Numbers) to the measured energy radiated from points on the Earth's surface (surface radiance). A basic radiometric correction provides TOA (Top of Atmosphere) radiance values as received by the sensor in orbit. It also corrects for radiometric effects caused by sensitivity differences among individual detectors that perform the spectral measurements in the satellite sensor, and some sources of electronic noise.

A deeper radiometric correction can also be performed that removes errors which are induced by the impact of the atmospheric transfer. This deeper correction is often known as Bottom of Atmosphere (BOA) or Top of Canopy (TOC) correction.

Correcting for these effects is critical in gaining a true measure of surface reflectance in various electromagnetic spectra. Atmospheric correction is also crucially important for normalizing DN values when creating a large mosaic of, or applying change detection algorithms to, multiple images captured on different dates under varying atmospheric conditions.

Airbus offers four levels of radiometric correction:

Basic Radiometric Processing
Images corrected at this level provide basic TOA radiance values, which includes compensation for non-conformity across the detector array and some sources of electronic noise.

Reflectance Radiometric Processing
This correction equalizes for detector differences and measurement noise as described above, with the addition of partial atmospheric correction to provide reflectance values based on a universal atmospheric model that assumes blue sky conditions without aerosols, sand, haze, and other pollutants.

Display Radiometric Processing
Produced mainly for direct, optimized rendering onscreen and reduced files sizes, it results from the conversion of previous Reflectance product to an RGB 8 bits image, with optimized true color rendering. This conversion is non-reversible.

Surface Reflectance Processing (Based on Project Needs)
This level of processing performs a full correction of atmospheric distortions, including those caused by aerosols, haze, particulates, etc.

Imagery Delivery Formats

Customers have the option of ordering most image products in two different formats – DIMAP and NITF – each with selected levels of data compression and encoding.

DIMAP, or Digital Image Map, is the default data format Airbus developed for imagery and other geospatial products. In use for all image products since 2002, DIMAP is compatible with all third-party image processing and GIS software packages.

In addition to the image data, DIMAP contains metadata for use by the customer in geolocating the image pixels. RPC (Rational Polynomial Coefficient) is a standardized coefficient now used by all satellite image providers to geolocate the pixels in the data set. For more sophisticated users who will process and further enhance the positional accuracy of their own data, DIMAP v2 also contains the Sensor Model information relating to each sensor aboard the various satellites.

DIMAP is available in three compression levels:

- **DIMAP GeoTIFF**
  No image compression (huge files) with the option of either 8- or 16-bit depth.
- **DIMAP JPEG 2000 Optimized**
  Compressed to 3.5 bits per pixel for customers who desire fast download and easy data storage, JPEG 2000 Optimized is a lossy compression function, which means some data is lost and cannot be restored.
- **DIMAP JPEG 2000 Regular**
  Compressed to 8 bits per pixel, this is a lossless technique that retains all the DN values and is reversible for users who want all pixel information and will be performing precise post processing of the data.

NITF, or National Imagery Transmission Format, is a raster data format developed by the U.S. Department of Defense primarily for use by agencies within the Intelligence Community. It was created using a set of standards for DoD-specified exchange and storage of image data. NITF formats are available in two levels of compression – JPEG 2000 Regular and GeoTIFF.

What's Next - Processing Innovations

In addition to satellite imagery, Airbus provides innovative geospatial analytics and industry specific insights to customers, primarily through the OneAtlas platform. The availability of these innovations and more to come – many leveraging AI technology – is made possible by cloud technology.

Storing all satellite image data in their raw data levels in the cloud enables Airbus to harness the massive computing power of that same cloud to perform processing at scales not possible in the past. The benefits of cloud processing are many, but the most important are that Airbus can now apply AI-algorithms to selected images covering large geographic regions and to time-series stacks of multitemporal images spanning decades.

Already available as services on the OneAtlas platform are two of the most common uses for AI-based image processing – Activity Analysis and Monitoring. OneAtlas customers can have automated algorithms analyze images to count automobiles, aircraft, and ships in a specific area or over a large region.

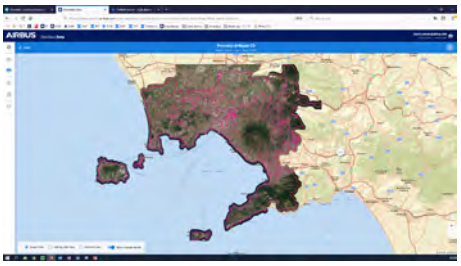
Similarly, OneAtlas allows users to extract a digital map of an area of interest, at scale, to include 12 land classifications that include buildings, roads, parking lots, pavement, driveways, swimming pools, sports fields, railway, water, grassland, forests and bare land. Users can get only the classifications they need even in some of the most challenging areas of the world.

Lastly, OneAtlas offers a Change Detection algorithm that detects man made changes such as buildings, roads, and other features that have been added or removed from a location between the customer-specified time period. Ongoing site monitoring is also possible using AI technology, and Airbus has recently added industry-specific services that alert customers of changes, including Defence Site Monitor, RefineryScanner, and ShaleScanner.

Airbus has developed many AI processing techniques offered via OneAtlas and has also partnered – as noted above – with other developers that want to bring their services to OneAtlas. Airbus has established a rigorous method to test any partner's AI technology, as long as it uses open-source specifications, to create and introduce innovative new image enhancement and processing capabilities on OneAtlas.

Airbus is actively working with several third-party AI developers to introduce new enhanced processing techniques and services in the near future via the OneAtlas platform.

Building and water classifications from the high accuracy digital map analytics service.



Change Detection over the western area of Naples, Italy from 21 May 2016 to 2 Aug 2020.

For more information, visit **oneatlas.airbus.com**

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