

## *Atmospheric Correction (including ATCOR)*

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The data obtained by optical satellite sensors with high spatial resolution has become an invaluable tool for many groups interested in studying, managing, developing, and protecting our population, environment, and resources. Unfortunately, satellite images are often obscured by atmospheric effects like haze as a result of conditions in the atmosphere at the time the image was captured.

The objective of atmospheric correction is the elimination of atmospheric and terrain effects to retrieve physical parameters of the earth's surface, including surface reflectance, ground visibility and temperature. Such correction is especially important in cases where multi-temporal, multi-sensor or multi-condition images are to be compared and analyzed.

### *Module Prerequisites*

The Atmospheric Correction (including ATCOR) module is an add-on to Geomatica. It requires Geomatica Core or Geomatica Prime as a pre-requisite.

### *Workflows*

The Atmospheric Correction (including ATCOR) module provides several workflows that allow you to perform various types of atmospheric correction and includes ATCOR technology from DLR:

#### Top-of-the-Atmosphere reflectance

The Top of the Atmosphere Reflectance workflow is the most basic of the Atmospheric Correction (including ATCOR) workflows. The workflow converts pixel values to physical reflectance, as measured above the atmosphere. It normalizes images based on radiance values and image acquisition times, using only the required image information.

#### Haze removal and cloud masking

The Haze Removal workflow allows you to calculate water and cloud masks for the input scene, and remove haze from images before performing atmospheric correction, thematic classification, or creating a mosaic.

This workflow generates an image containing raw DN values (scaled radiance) that have been corrected for haze. The output also includes all the pre-classification masks (haze, cloud, and water).

#### Ground reflectance atmospheric correction

The ATCOR Ground Reflectance workflow allows you to calculate the reflectance values at ground level to remove atmospheric effects in satellite imagery, preparing the images for analysis under different atmospheric conditions. The workflow generates a reflectance image at ground level, corrected by atmospheric (aerosol type and water vapor) and terrain effects.



When running the ground reflectance workflow, users also have the ability to output value-added products, including:

- Soil-Adjusted Vegetation Index (SAVI): uses the red and near-infrared bands to measure the density and vigor of green vegetation by attempting to eliminate the reflectivity of the ground beneath the canopy
- Leaf-Area Index (LAI): calculates the green-leaf density
- Fraction of Absorbed Radiation (FPAR): calculates the amount of photosynthetically active radiation absorbed by plant canopy
- Surface Albedo: calculates wavelength-integrated surface reflectance
- Absorbed Solar Radiation: calculates the shortwave solar radiation absorbed by the surface

#### Surface temperature atmospheric correction

The ATCOR Surface Temperature workflow takes an input thermal band in scaled radiance (raw DN values), a DEM and terrain derivatives, and, optionally, a visibility map to generate a surface temperature map of the thermal image. This workflow currently supports only Landsat 4 TM, Landsat 5 TM, and Landsat 7 sensors.

When running the Surface temperature workflow, users have the ability to optionally output the following energy balance components:

- Thermal flux difference: calculates the difference between the emitted atmospheric radiation and the emitted surface radiation
- Ground heat flux: calculates the exchange rate of energy between the Earth's surface and the underground
- Latent heat: calculates the exchange rate of stored heat energy between the air and the Earth's surface. Latent heat flux is measures the amount of energy needed to change matter from one state to another (from solid to liquid to gas).
- Sensible heat: calculates the exchange rate of excess heat energy between the air and the Earth's surface. Sensible heat flux measures the amount of energy needed to change air temperature.
- Net radiation: calculates the difference between absorbed and emitted shortwave and longwave radiations



## *Supported Sensors*

- ALI
- ALOS Avnir-2
- Aster
- CBERS-4
- Deimos-1
- Deimos-2
- DMC
- FASat-Charlie
- Formosat-2
- Gaofen-1
- Gaofen-2
- Geoeye-1
- Ikonos-2
- IRS-1A
- IRS-1B
- IRS-1C
- IRS-1D
- IRS-P6
- Kazeosat-2
- KOMPSAT-2
- KOMPSAT-3 / 3A
- Landsat-4 MSS
- Landsat-5 MSS
- Landsat-4 TM
- Landsat-5 TM
- Landsat-7 ETM+
- Landsat-8
- OrbView-3
- PeruSAT-1
- PlanetScope
- Pleiades
- QuickBird
- RapidEye
- Resourcesat-2
- SAC-C
- Sentinel-2
- SPOT-1
- SPOT-2
- SPOT-3
- SPOT-4
- SPOT-5
- SPOT 6
- SPOT 7
- Thaichote (THEOS)
- Triplesat
- Worldview-2
- Worldview-3
- Worldview-4
- ZY-3
- ZY3-2



## *Atmospheric Correction (including ATCOR) in Geomatica Focus*

The Atmospheric Correction (including ATCOR) workflows, which are accessed from the **Analysis** menu, allow you to perform each of the available operations using the minimum amount of information required, while also allowing you to execute further radiometric corrections such as calculating ground reflectance or surface temperature. Each workflow runs independently; information provided in one workflow is automatically applied to the other workflows.

The atmospheric correction window provides access to several workflows:

- The TOA Reflectance workflow: computes a Top-of-Atmosphere reflectance image
- The Haze Removal workflow: creates coarse classification masks for cloud and water masking, and performs haze removal
- The ATCOR Ground Reflectance workflow: performs atmospheric correction of satellite images
- The ATCOR Surface Temperature workflow: performs atmospheric correction of thermal imagery

### **Spectral Plot**

The spectral plot panel is linked to the atmospheric correction panel directly, at the final setup stage, so you can see the changes in the spectral signatures based on changes made in the ATCOR parameters. This enables users to better choose correct parameters prior to running the full correction process.

## *Spectral Reflectance Plot in Geomatica Focus*

A critical part of validating the accuracy of the reflectance correction process is to compare the reflectance signatures computed from different image pixels (samples) with the library spectra of a similar feature. For example, you can compare the reflectance signature computed from a pixel of a pine tree in an image with the library signature for pine trees. You can establish confidence that you have a good correction applied by sampling a variety of features (pixels).

The Spectra Reflectance Plot tool, found under the **Layer** menu in Focus is specially designed to work with layers that are reflectance data. The plot and the tools are linked to the currently selected image in the Focus tree list.

You can plot reflectance spectra with an interactive graph tool that allows you to validate the results of your atmospheric correction by comparing the values to those from a spectral library.

## **Atmospheric Correction (including ATCOR) Functions**

With a license for the Atmospheric Correction (including ATCOR) package the following functions can be executed either independently or sequentially via an EASI™ or Python™ script. They may also be available in the Algorithm Librarian in Geomatica Focus and the PCI Modeler.

- ATCOR – Calculate atmospheric and terrain correction
- ATCOR\_T – Atmospheric correction for thermal imagery
- DN2TOA – Calculate top of atmosphere reflectance



- FPAR – Calculates fraction of absorbed photosynthetically active radiation
- HAZEREM – Remove haze from satellite imagery
- LAI – Calculates leaf area index model value
- MASKING – Create cloud, haze and water masks from satellite imagery
- SAVI – Calculates Soil Adjusted Vegetation Index
- SPECL – Calculate spectral classification from ground reflectance data
- TERSEUP – Generate terrain derivatives, in preparation for atmospheric correction

*Note: The ATCOR models are incorporated into the Geomatica product under license from Deutsches Zentrum für Luft-und Raumfahrt e.V. (German Aerospace Center). These models are covered by German Patent P 41 02 579.2.*

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