# MODIS Terra versus Aqua

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# 1 TERRA VERSUS AQUA

NSIDC distributes MODIS data from both the Terra and Aqua satellites. The Temporal Coverage Tables on the MODIS Data Versions Web page lists the date ranges covered by each satellite. In addition, the differences detailed in the following sections can help you choose which satellite meets your needs and preferences.

## 1.1 Algorithmic Differences

The MODIS snow mapping algorithm utilizes a Normalized Difference Snow Index (NDSI) to differentiate between snow and other features in a scene. The NDSI is a band ratio that exploits the spectral differences between snow in MODIS Band 4 (short-wave infrared) and Band 6 (visible). Because 70 percent of the Band 6 detectors on MODIS Aqua failed shortly after launch, all MODIS Aqua snow products through Version 5 use Band 7 (2.1 µm) instead of Band 6 to calculate the NDSI. In addition, the MODIS test for snow in vegetated areas, which compares a Normalized Difference Vegetation Index (NDVI) with the NDSI, was disabled in these versions because using Band 7 yielded too many false snow decisions.

In 2012 Gladkova et al. published a Quantitative Image Restoration (QIR) technique that restores Aqua MODIS band 6 data to scientific quality. This technique is used starting with Version 6 to produce an intermediate, calibrated radiances product, MYD02HKM_QIR, which is then used as input when generating the Aqua MODIS swath-level snow cover data set. Aside from this step, starting with Version 6, Aqua and Terra utilize the same snow detection algorithm. Additional information is available in the MODIS Snow Cover Products User Guide to Collection 6 and MODIS/Aqua Snow Cover 5-Min L2 Swath 500m, Version 6 documentation.

## 1.2 Orbital Differences

The MODIS instruments on Terra and Aqua image the same area on Earth approximately three hours apart. Observing the entire Earth's surface every 1 to 2 days, these sensors work in tandem to optimize cloud-free surface viewing and provide opportunities to investigate processes that occur on sub-daily time scales. Specifically:

### 1.2.1 Terra

Terra's sun-synchronous, near-polar circular orbit is timed to cross the equator from north to south (descending node) at approximately 10:30 A.M. local time. The following sites have tools to track and predict Terra's orbital path:

- Daily Terra Orbit Tracks, Space Science and Engineering Center, University of Wisconsin-Madison
- NASA LaRC Satellite Overpass Predictor (includes viewing zenith, solar zenith, and ground track distance to specified lat/lon)

### 1.2.2 Aqua

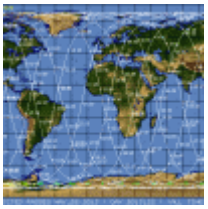
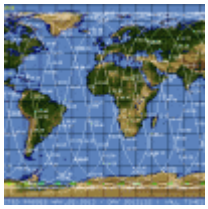
Aqua's sun-synchronous, near-polar circular orbit is timed to cross the equator from south to north (ascending node) at approximately 1:30 P.M. local time. The following sites have tools to track and predict Aqua's orbital path:

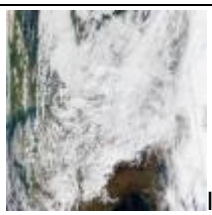
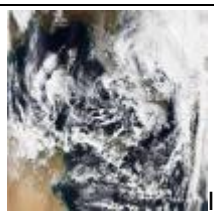
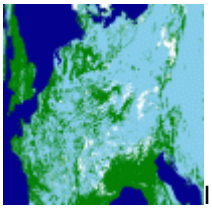
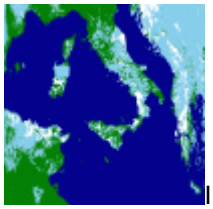
- Daily Aqua Orbit Tracks, Space Science and Engineering Center, University of Wisconsin-Madison
- NASA LaRC Satellite Overpass Predictor (includes viewing zenith, solar zenith, and ground track distance to specified lat/lon)

## 1.3 Coverage Differences

The following examples show differences in coverage between Terra and Aqua over the European Alps on 15 February 2005. The top row shows orbital tracks, the middle row shows visible imagery, and the bottom row shows corresponding Level-2 (swath) snow extent data. Images derived from Aqua data normally appear upside-down due to Aqua's ascending orbit. In this case, the images were rotated 180 degrees for visual comparison with the Terra images. Click the thumbnails for larger images.

Table 1. Terra and Aqua Coverage Differences

| **Terra** | **Aqua** |
|---|---|
|  Sample Terra Orbital Tracks from 15 February 2005 |  Sample Aqua Orbital Tracks from 15 February 2005 |

| | |
|---|---|
|  Image derived from the MODIS/Terra Calibrated Radiances 5-Min L1B Swath 1km product, acquired over the European Alps on 15 February 2005, 10:30 local time. |  Image derived from the MODIS/Aqua Calibrated Radiances 5-Min L1B Swath 1km product, acquired over the European Alps on 15 February 2005, 12:10 local time. |
|  Image derived from the MODIS/Terra Snow Cover 5-Min L2 Swath 500m product (available from NSIDC), acquired over the European Alps on 15 February 2005, 10:30 local time. |  Image derived from the MODIS/Aqua Snow Cover 5-Min L2 Swath 500m product (available from NSIDC), acquired over the European Alps on 15 February 2005, 12:10 local time. |