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Welcome

To The

Land Processes DAAC Suite of On-line Workshops

LP DAAC Introduction to ASTER Data

Slide 2 – ASTER Workshop

- Specific topics that you will learn about include the purpose of the LP DAAC, the data that are archived and distributed by the LP DAAC, specific characteristics of ASTER data, and the interfaces from which ASTER can be ordered.

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Slide 3 – DAAC Facilities

- NASA Earth Observation data are available from Distributed Active Archive Centers or DAACs.
- The role of each DAAC is to process, archive, document, and distribute data from NASA's past and current research satellites and field programs.
- Each center serves one or more specific Earth science disciplines and provides data products, data information, services, and tools unique to its particular science.
- The LP DAAC archives, processes, and distributes ASTER and MODIS land processes data products and is located at USGS EROS near Sioux Falls, South Dakota.

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Slide 4 – LP DAAC Web Site

- The LP DAAC is one of several discipline-specific data centers within the NASA Earth Observing System Data and Information System.
- Users can find key information about products and services from our Web site. Our home page and News section provides important updates and information for our users.
- The products section provides information on LP DAAC products and links to other product documentation.
- The Get Data section provides links and information on how to order LP DAAC data.
- The Tools section provides information on useful tools that can be used to manipulate LP DAAC data.
- Finally, the User Community section provides examples of how LP DAAC data are being used by our community of users.

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Slide 5 – Types of Data

- The LP DAAC archives, produces, and distributes data from three sensors on-board two satellites, Terra and Aqua.
- The ASTER and one MODIS sensor are part of the payload on Terra, and one MODIS sensor is on-board Aqua.
- There are currently 20 ASTER products and over 60 MODIS products available from the LP DAAC archive.
- These data are available as grid or swath data, and data distributed by the LP DAAC are in the HDF-EOS format. HDF-EOS is a software library that supports the construction of new data structures, including grid, point, and swath.

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Slide 6 – ASTER & MODIS

- Resulting data from the ASTER and MODIS sensors are very different from each other.
- Generally speaking, ASTER data are a higher resolution data measuring frequencies of the electromagnetic spectrum that are useful for geological investigations, and MODIS data are at a moderate resolution and collected for research in global change study.
- With a 60 kilometer by 60 kilometer footprint and a 15-meter resolution for the visible bands, ASTER can be considered for use with a more localized or specific area of interest.
- MODIS is a more general or broad type of data that offers daily coverage of the earth in 250-, 500-, 1000-, or 5600-meter resolution. Please take a moment to notice the differences of these two images.
- Both sensors have been found useful for investigations beyond their intended purpose. For example, ASTER is frequently used for volcano and disaster monitoring, and MODIS data has been used for research in forest degradation and invasive species.

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Slide 7 – Electromagnetic Spectrum

- In addition to the imagery that can be created from ASTER and MODIS data, these data also contain data for use in scientific investigations.
- Remote sensing technology creates images by reading sunlight, and as indicated in this image, only a small portion of sunlight is visible to humans.
- The electromagnetic spectrum includes many other bands of light that the human eye is not able to see. Satellite sensors can record data that is otherwise invisible for use in studying the Earth.
- For example, vegetation appears green to us because plants reflect green light from the visible band. However, vegetation also responds very strongly to light from the infrared band. When changes occur in the physical structure or chemistry of a plant, it may not immediately affect how green the plant looks, but it has a big effect on how infrared light is reflected.
- These data can then be used in scientific investigations to assess crop or forest health.

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Slide 8 – Terra Satellite

- The ASTER sensor is on-board the Terra satellite, which was launched on December 18, 1999.
- In addition to ASTER, the Terra payload includes CERES, MISR, MODIS, and MOPITT sensors.
- The mission of Terra is “to observe and measure how the Earth’s atmosphere, cryosphere, lands, oceans, and life interact.”
- The LP DAAC archives and distributes land processes data collected from the ASTER and MODIS sensors on Terra.

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Slide 9 – ASTER Sensor

- The ASTER sensor is comprised of three subsystems, which are Visible Near Infrared, Short Wave Infrared, and Therma Infrared.
- There are a total of 14 ASTER bands collected by the subsystems, each with a different resolution and location within the electromagnetic spectrum. Please take a moment to familiarize yourself with the bands and resolution associated with each subsystem.
- The ASTER sensor has a 16-day mapping cycle, which would allow coverage for each point on the earth every 16 days.
- However, ASTER data are collected by request for the ASTER Science team and users through the ASTER Data Acquisition Request or DAR Tool.
- More information is available on the DAR Tool through our website or by contacting LP DAAC User Services.

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Slide 10 – Visible Near Infrared

- The Visible Near Infrared subsystem consists of a nadir and backward-looking telescope pair that are used for same orbit stereo imaging.
- This subsystem collects bands 1, 2, 3N, and 3B at a 15 meter resolution.
- The nadir and backward-looking Band 3 data are used to collect the stereo imagery required to create ASTER digital elevation models, the global digital elevation model, and orthorectified ASTER.

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Slide 11 – Thermal Infrared

- The Short Wave Infrared subsystem consists of the pointing module and a single fixed aspheric refracting telescope.
- This subsystem collects bands 4, 5, 6, 7, 8, and 9 at a 30 meter resolution, and the data collected by this subsystem are used to create 5 Level-2 ASTER products.
- These products will be discussed in a few moments.

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Slide 12 – Thermal Infrared

- The Thermal Infrared subsystem consists of the scan mirror and a single fixed telescope.
- This subsystem collects bands 10, 11, 12, 13, and 14 at a 90 meter resolution, and the data collected by this subsystem are used to create 5 Level-2 ASTER products.
- These products will be discussed in a few moments.

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Slide 13 – ASTER Spectral Bands

- The ASTER Spectral Bands graph indicates what are commonly known as “atmospheric windows” compared to the spectral wavelengths that the ASTER sensor is designed to collect.
- The valleys are “dark spots” that certain bands of light have trouble penetrating. The peaks show where light freely travels through the atmosphere between Earth’s surface and a satellite.
- The colors highlight bands in the electromagnetic spectrum used by ASTER to prioritize mineral identification while taking advantage of the window peaks.
- The ASTER instrument is complimentary to the Landsat 7 ETM+ sensor. Both cover similar ranges in the electromagnetic spectrum that are useful and available for monitoring Earth’s surface.
- ASTER has more bands covering certain ranges than Landsat 7 does, because certain features are discernible only in shorter wavelength ranges.
- For example, an identifying peak in the spectral curve of a hydrothermal mineral may occur between 2.150 and 2.250 um. This level of detail is not available in a broader 2.0-2.4 micrometer band.

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Slide 14 – ASTER Data

- Earth Observing System data products are available at various levels ranging from Level 0 to Level 4.
- Level 0 data products are raw Earth Observing System instrument data at full instrument resolution. At higher levels, raw instrument data is converted into more usable parameters and formats that are of interest to the Earth science community. At Level 4, parameters are further refined through the use of models.
- The LP DAAC archives ASTER Level-1A data, which currently amounts to approximately 1.5 million scenes of global coverage.
- When ordering ASTER On-Demand data, users may choose between Level-1, -2, and -3 products, depending on their needs.
- ASTER data may be ordered in an HDF-EOS format or as a GeoTIFF, with the exception of Level-3 products that are only available in the GeoTIFF format.
- Detailed information and user guides for each ASTER product can be found in the Products section of the LP DAAC Web site.

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Slide 15 – Level-1A and -1B

- ASTER Level-1A data are reconstructed, unprocessed instrument data at full resolution, time-referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters that are computed and appended but not applied to the Level 0 data.
- ASTER Level-1B data are data that have been radiometrically calibrated and geometrically co-registered. Level-1B data produced on-demand are distributed in a UTM projection with the WGS84 datum.
- Please take a moment to notice how the ASTER L1A and L1B scenes differ from each other.

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Slide 16 – Level-2 Data

- ASTER Level-2 data products are derived geophysical variables at the same resolution and location as the Level 1 source data.
- ASTER Level-2 data may include bands from one, two, or all of the ASTER subsystems.
- Level-2 data produced on-demand are distributed in a UTM projection with the WGS84 datum.
- Each Level-2 product is described in the Products section of our Web site.

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Slide 17 – Level-2 Data

- ASTER L1B data are corrected for the effects of sun-sensor geometry and atmospheric contamination to produce the Surface Radiance and Surface Reflectance products.
- These atmospherically corrected data provide a basis for estimating the radiation budget of the Earth; improved land surface monitoring across time, space, and sensors; and more accurate retrieval and quantification of surface properties.

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Slide 18 – Level-2 Data

- For the ASTER Brightness Temperature product, radiances from ASTER's thermal bands are changed to temperature in degrees Celsius.
- Uses for Brightness Temperature data include estimating soil moisture, estimating vegetation water content, and detecting thermal anomalies, such as volcano plumes.

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Slide 19 – Level-2 Data

- Emissivity is a measure of how well an object radiates the energy it has absorbed.
- ASTER Surface Emissivity is critical for generating the Surface Kinetic Temperature product, and is also useful for discriminating geologic and land cover features and studying surface energy and water balance.

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Slide 20 – Level-2 Data

- ASTER Surface Kinetic Temperature data provides an estimate of land surface temperature in Kelvin, after accounting for effects such as atmospheric contamination and the emissivity of ground objects.
- This product has many uses, which include detecting thermal pollution, volcano monitoring, and fire mapping.

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Slide 21 – ASTER Level-3 DEM

- Level 3 data products are variables mapped on uniform space-time grid scales.
- LP DAAC ASTER products are available as digital elevation models and orthorectified data.
- The ASTER digital elevation model is a 30-meter DEM that can be produced on-demand from any ASTER Level-1A scene that includes the 3N and 3B bands.
- The data are available in the GeoTIFF format and have a footprint of 60 kilometers by 60 kilometers.

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Slide 22 – ASTER Level-3 GDEM

- The ASTER Global DEM may be ordered in 1 degree by 1 degree tiles in a GeoTIFF format.
- Please see the LP DAAC Web site for the re-distribution policy of these data.

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Slide 23 – ASTER Level-3 Ortho

- The ASTER On-Demand Orthorectified Image products contain imagery transformed from a perspective projection to an orthogonal one.
- An orthorectified image possesses the geometric characteristics of a map, with near-vertical views for every location.
- These products are terrain-corrected, provide radiometrically calibrated radiance, and are mapped to the Universal Transverse Mercator coordinate system.
- Orthorectified data are available in the GeoTIFF format.

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Slide 24 – Applications

- The applications for ASTER data are many, and science investigations using ASTER data include, but are not limited to, climatology, volcanoes, hazards monitoring, the carbon cycle, geology and soils, aerosols and clouds, and hydrology.
- The following applications are examples of current and previous applications for ASTER.
- You may also visit the Community section of the LP DAAC Web site for more information on applications for LP DAAC data.

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Slide 25 – Climatology

- The North American ASTER Land Surface Emissivity Database or NAALSED is a current example of how ASTER data is being used in a land surface climatology science investigation.
- One of the most important Earth System Data Records identified by NASA and numerous international organizations is Land Surface Temperature and Emissivity.
- NAALSED is an investigation that is demonstrating how ASTER can be used to improve surface emissivity estimates.
- The user community is expected to benefit from an improved emissivity product, since currently, they frequently use constant or inaccurate surface emissivities that typically result in large temperature and moisture profile errors, particularly over desert and semi-arid regions.

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Slide 26 – Volcanoes

- ASTER data are very useful for monitoring volcanoes, and the range of ASTER products can be used in different ways.
- This image of Mount St. Helens shows how ASTER Level-1B data can be draped over an ASTER DEM.
- The detailed terrain in the context of surface reflectance can be used to predict where lava is likely to flow if an eruption occurs.
- Prediction and monitoring are further enhanced using ASTER products to map surface geology and measure thermal activity in hot-spots.

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Slide 27 – Hazards

- ASTER from the LP DAAC has been an important data source used to track the occurrence and remediation of natural hazards, including floods and wildfires.
- ASTER products are used by emergency response officials as pre-event, during-event, and post-event data to evaluate damage and make informed public safety decisions.

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Slide 28 – Thank You

- There are several ways to search, order, and browse for ASTER data.
- Information on each of the ordering interfaces, or clients, can be found in the Get Data area of the LP DAAC Web site.
- Each client is unique and tailored to suit the different needs of the LP DAAC user community. These clients will be discussed in greater detail in future workshops.
- For now, please take a moment to view the differences of each client and visit the LP DAAC Web site or contact LP DAAC User Services for more information.

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Slide 29 – Thank You

- Thank you for viewing the LP DAAC Introduction to ASTER data On-Line Workshop.
- We encourage you to continue with our on-line workshops by visiting the Introduction to MODIS Data Workshop for more specific information about the data that is archived, processed, and distributed by the LP DAAC.

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