Landsat Image Services Powered by ArcGIS

The Landsat image services and ChangeMatters web application were built using ArcGIS to provide fast and easy access to Landsat data.

Management of Large Imagery Collections

Large collections of imagery can be tricky to manage. It is important to provide maximize accessibility to the information, yet also minimize the impact on hardware infrastructure, network bandwidth and data redundancy. The source for the Landsat image services are the Global Land Survey (GLS) dataset, consisting of countless individual Landsat scenes. Each scene consists of 5-7 separate geoTIF images, one for each band, along with a metadata file.

Using ArcGIS Desktop, we created a set of 4 source mosaic datasets within the geodatabase, one for each epoch of data. This provides an image catalog that includes the metadata, and we defined what image processing to apply when the image is accessed. Typical image processes include extracting specific bands, clipping the imagery to footprints, enhancing the appearance of the imagery, re-projecting and mosaicking the resulting image together.

Overviews were created for scales greater than 1:1,500,000. These overviews represent only a fraction of additional data volume, but greatly improve performance when accessing the data at smaller scales.

From the source mosaic datasets, separate mosaic datasets were generated to represent the different Landsat image services. Many of these image services were

defined as 'derived' mosaic datasts, which pull from the different 'source' mosaic datasets specific bands of data. Others, such as the Normalized Difference Vegetation Index (NDVI) image service or different date comparison image services are defined as reference mosaic datasets. Reference mosaic datasets are created from the 'derived' mosaic datasets and add one or more functions to an existing mosaic.

Mosaic datasets simplify the management of large collections of images. This methodology results in a significant saving in data storage and pre-processing. If the data had to be pre-processed it would have required hundreds of terabytes of storage and many months of processing, even if split over many machines.

Dissemination of imagery information

The Landsat image services show how easy it can be to disseminate a large collection of image data to anyone who needs access. After creating the mosaic datasets, they were published as image services using ArcGIS Server. In addition, we utilized the ArcGIS Server image extension for dynamic mosaicking and on-the-fly processing. Client applications to ArcGIS Online can request multiple, different imagery products that are served quickly because all of the work is being performed by the server accessing the original datasets. Online images services enable users to quickly access, visualize and analyze the imagery through the web, without requiring the images to be downloaded or the imagery products to be pre-generated.

Visualization of Image Service Information

People worldwide can use Landsat image services in ArcGIS Desktop, ArcGIS Online and Web applications. The ChangeMatters application was built using the ArcGIS API for Flex and consumes the Landsat image services. This provides an interactive way to visualize the different services and roam through the imagery. The server performs the required on-the-fly processing directly from the original source images. The maps and applications that connect to the services can also define aspects such as the time period of the imagery, projection and re-sampling methods to be used. Additionally the applications can also define the compression for transmission, enabling use of the image services over low-bandwidth Internet connections.

Analysis of Image Service Information

The creation of multiple services from the data source simplifies the analysis of the imagery because different band combinations can be easily access for different applications, such as forestry or urban planning, that gain specific information from the different bands. Image services, such as NDVI, are an example of using on-the-fly processing to provide faster access to imagery analysis. Users within the applications can view the imagery as a single virtual image, but also query the services and order the imagery based on specific attributes or lock the image services to specific scenes to enable more specified analysis. Such analysis can be done using ArcGIS Desktop (requires V10.0SP2) Spatial Analyst, which can perform more advanced analysis such as supervised and unsupervised classification of the imagery. Geoprocessing tools within

ArcGIS can also be used to query the imagery and automate the process of attributing polygons with values such as changes in the NDVI index values.

The services also allow users to export subsections of imagery. Although limits are imposed on the maximum size of these exports, they can be equivalent to a single landsat scene. As for all client requests the applications that export imagery can define not only the bands to be exported but the spatial reference system and the sampling method to be applied to reduce loss of image fidelity.

Additional Technical Efforts

Due to the NoData values along the edges of the image the data was compressed using Lossless LZW compression to reduce the data volume about 2.5x, but without changing any of the data values to ensure no loss of data fidelity. Pyramids of each image were also created to enable faster access at smaller scales. Since analysis will not be applied on these pyramids, they were JPEG compressed so adding only xxx% (3%) to the data volume.