# World Wind Structure

You can convert very large images or image collections into tilesets for use in NASA's World Wind using the Auto Mosaic and Export Raster Tilesets processes in TNTmips. Each World Wind tileset overlay consists of a set of uniformly-sized tile files (512 by 512 pixels). Each tile is an image or rendered map of the ground at a predetermined fixed level-of-detail. Each of these tiles is also aligned on a fixed equirectangular (Plate Careé) global grid, so every pixel in every tile at any level-of-detail represents a single fixed ground location. This tiling system is optimized for World Wind's global 3D Earth model, in which higher-resolution tiles are shown in the foreground and lower-resolution tiles in more distant parts of a perspective view. This tiling system enables World Wind to rapidly identify and load only those tiles that are currently in the view and to determine the appropriate level-of-detail to show for each area of the 3D view.

World Wind Level 0: tiles 36 by 36 degrees
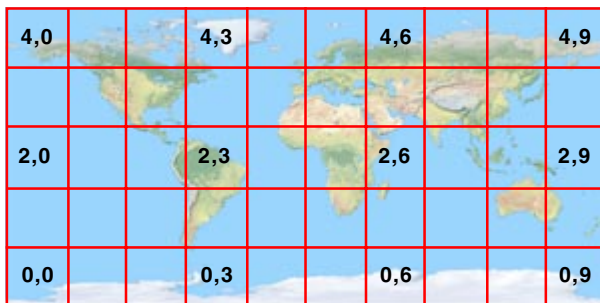
Global tile grid at the lowest World Wind level-of-detail is a 10 x 5 array with each tile covering 36 degrees of latitude and longitude. World Wind uses an equirectangular (Plate Careé) Earth model and a tile size of 512 pixels. Each subsequent level-of-detail doubles the number of tiles in both directions. Tiles are indexed at each level by tile row and tile column number (starting with 0) from the lower left corner of the global grid. The number pairs in the illustration above show the tile column and tile row numbers (X,Y) for selected tiles.

World Wind Tile Reference System

Tiles in the equirectangular (Plate Careé) global grid used in World Wind are aligned to a rectangular grid defined by parallels of latitude and meridians of longitude. The width of the resulting global grid is twice its height. At the lowest (base) level-of-detail this grid consists of a 10 by 5 array of square tiles, each 512 by 512 pixels and covering 36 degrees of latitude by 36 degrees of longitude, as illustrated above. Each subsequent detail level doubles the number of tiles in both directions. Tiles at each level-of-detail are indexed by their horizontal tile row number and vertical tile column number. Tile rows and columns are numbered beginning with 0 at the lower left corner of the global map (unlike Google Maps and Bing Maps, which use the upper left corner as the origin). World Wind tile row and column numbers are shown in the illustration above for selected tiles at the least-detailed level.

Levels-of-Detail (Zoom Levels)

A World Wind tile overlay contains a hierarchy of pre-rendered tiles of different spatial resolution, which can be referred to as levels-of-detail or zoom levels. World Wind uses a numbered sequence of levels-of-detail as shown in the table below. The least-detailed level is level 0, which represents the entire globe with a 10 x 5 array of tiles as previously described and shown in the illustration to the left. Each integer increase in level-of-detail doubles the number of tiles in both the north-south and east-west directions. Because the tile size is fixed, each increase in detail level also reduces the dimensions of the area on the ground represented by one pixel in a tile by a factor of 2, providing increasing visual detail in the tileset at higher levels. (Because World Wind uses a different tile size and tile grid than Google Maps and Bing Maps, levels-of-detail in World Wind do not have the same map scale as the zoom level with the same number in Google Maps or Bing Maps.)

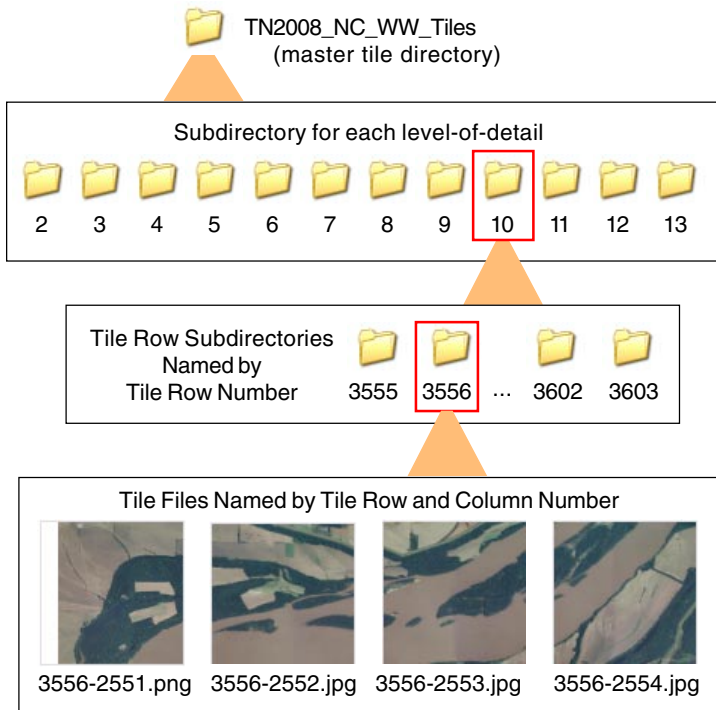| World Wind Detail Level	Pixel Size	Approximate Pixel Size at Equator
0	4.2 arc-min	7.8 km
1	2.1 arc-min	3.9 km
2	1.1 arc-min	2 km
3	32 arc-sec	978 m
4	16 arc-sec	489 m
5	7.9 arc-sec	245 m
6	4.0 arc-sec	122 m
7	2.0 arc-sec	61 m
8	0.99 arc-sec	31 m
9	0.49 arc-sec	15 m
10	0.25 arc-sec	7.6 m
11	0.12 arc-sec	3.8 m
12	0.062 arc-sec	1.9 m
13	0.031 arc-sec	1 m
14	0.015 arc-sec	48 cm
15	0.0077 arc-sec	24 cm

Table showing range of possible pre-rendered, fixed levels-of-detail in a NASA World Wind tileset.

Hierarchical Structure

Tile files for a World Wind tileset are stored in a hierarchical structure of nested folders starting with a directory for each numbered level-of-detail (see illustration on the reverse). Within each level-of-detail directory, the tile files for each tile row are stored in a separate subdirectory named by the four-digit row number (including leading zeros). Individual tile file names are hyphenated, with the four-digit row number followed by the four-digit tile column number. World Wind tilesets created in TNTmips can contain JPEG or PNG tile files, or a mixture of JPEG and PNG files if the Automatic format option was used to create the tileset (see the TechGuide entitled *Tilesets: Tile Image Formats*). Each tile row subdirectory contains all tiles for that row regardless of file format.

World Wind Tileset Directory Structure

TN2008_NC_WW_Tiles
(master tile directory)

Subdirectory for each level-of-detail

2 3 4 5 6 7 8 9 10 11 12 13

Tile Row Subdirectories
Named by
Tile Row Number   3555 3556 ... 3602 3603

Tile Files Named by Tile Row and Column Number

3556-2551.png   3556-2552.jpg   3556-2553.jpg   3556-2554.jpg

Directory structure for a NASA World Wind tileset created in TNTmips using the Auto Mosaic process. The JPEG + PNG format option was used, creating JPEG files for interior tiles and PNG files for edge tiles to provide transparency for non-image areas. This tileset includes World Wind levels-of-detail 2 through 13. Tiles are stored in nested subdirectories, first by level-of-detail number and then by tile row number. Individual tile files are named by tile row and column number.

Using a World Wind Tileset

World Wind loads Internet and local tilesets from its Layer Manager list, which is constructed using information stored in files in configuration directories. TNTmips creates an XML-formated configuration file along with each World Wind tileset ([tilesetname].xml). To add your tileset to the World Wind Layer Manager list, copy this configuration file to the configuration directory for Earth-images. In a default Windows installation the path to this directory is:

    C:\Program Files\NASA\World Wind 1.4\Config\Earth\

World Wind requires that all local tilesets reside under its Data directory, so you must copy your tileset directory ([tilesetname]_Tiles) Data directory in order for World Wind to find and load the tiles. The configuration file created by TNTmips assumes that your local tilesets will reside the Earth\NewLayers subdirectory. In a default Windows installation the path to this directory is:

    C:\Program Files\NASA\World Wind 1.4\Data\Earth\NewLayers\.

Folders, Tiles, and File Size by Detail Level for a Sample World Wind Tileset (1-m Orthoimage Mosaic of a US State)

(see Technical Guide entitled *Tilesets: Understanding Sizes*)

Source image size: **352 GB** (uncompressed)

Image area: 109,185 square kilometers

Tile Size: 512 x 512 Pixels (required)

Tile Formats: JPEG + PNG for edge tiles

Coordinate Reference System:
WGS84 / Geographic (mandatory)

Detail Level	Number of Folders	Number of Tiles	Size on Disk
2*	2	3	106 KB
3	2	5	385 KB
4	2	9	1.5 MB
5	2	16	6 MB
6	4	58	11 MB
7	7	193	25 MB
8	13	687	65 MB
9	25	2,571	207 MB
10	49	9,914	682 MB
11	97	39,117	2.6 GB
12	193	155,786	8.6 GB
13†	386	620,916	25.6 GB

* minimum detail level: minimum level requiring more than one tile to cover the image area

† maximum detail level: pixel size equal to or less than the spatial resolution of the input image; 1 meter in this example for Tennessee

Total Number of Folders: **722**

Total Number of Tiles: **829,275**

Total Size on Disk: **37.7 GB**

Size of World Wind Tileset Structures

The table above shows the number of tiles and stored size by detail level for a World Wind tileset created in TNTmips from statewide, 1-meter color orthoimage coverage of the state of Tennessee. As each higher level-of-detail requires up to 4 times the number of fixed-size tiles than the previous level, high-resolution World Wind tilesets can include millions of tile files and require tens of gigabytes of drive space (see the TechGuide entitled *Tilesets: Understanding Sizes*). The number of tiles in the tileset (and its stored size) depend upon the size of the area depicted, the resolution of the source imagery or map, and the number of zoom levels created for viewing the tileset.