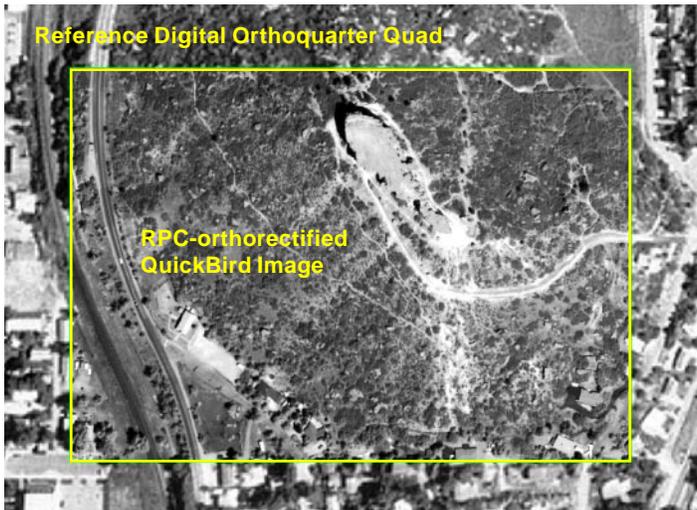# Rational Polynomial Orthorectification

The Image Resampling process in TNTmips allows you to orthorectify an image that has rational polynomial coefficients (RPCs) that define an empirical orthorectification model. The RPC model is a coordinate transformation that relates row and column positions in the unrectified image to latitude and longitude using terrain elevation values, so the rectification requires an accurate elevation raster (DEM) covering the image area. You can rectify an ortho-ready satellite image that has an RPC model supplied by the vendor and stored as coefficients in an auxiliary file. You can also use the Georeference process in TNTmips to *compute* an RPC model for any aerial or satellite image using 3D control points and an elevation raster (see the Technical Guide entitled *Compute Rational Polynomial Model for Orthorectification*).

The RPC resampling model requires elevation values referenced to the WGS84 ellipsoid. Since most DEMs have elevations referenced to the geoid, a correction for the geoid height relative to the ellipsoid is required and must be entered in the Geoid Height field in the Resample Image window. You can use one of several on-line geoid height calculators to find the geoid height for the image area:
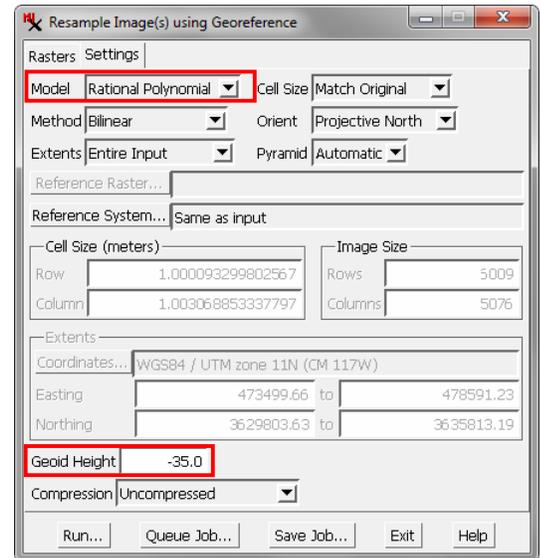
http://earth-info.nga.mil/GandG/wgs84/gravitymod/egm96/intpt.html
http://sps.unavco.org/geoid/
http://www.ngs.noaa.gov/cgi-bin/GEOID_STUFF/geoid03_prompt1.prl

Ortho-ready satellite images are provided with approximate georeference information computed from the satellite's orbital position and the imaging geometry. Although you can orthorectify an image with its original georeference, you can produce a more accurate result by first re-georeferencing the image using well-distributed 3D control points and the Rational - Predefined transformation model (see the TechGuide entitled *Georeferencing Orth-Ready Images for Rational Polynomial Orthorectification*).
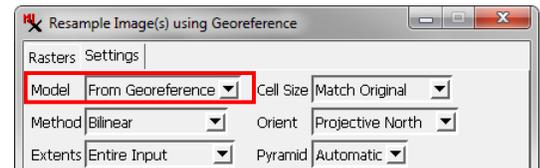
(continued)

For images that have not been georeferenced using the Rational - Predefined or Rational - Computed models, choose Rational Polynomial from the Model menu in the Resample Images window. You should also enter an appropriate value in the Geoid Height field (see text).

For images that have been georeferenced using the Rational - Predefined or Rational - Computed models you can use the default From Georeference model and enter an appropriate value in the Geoid Height field (see text).
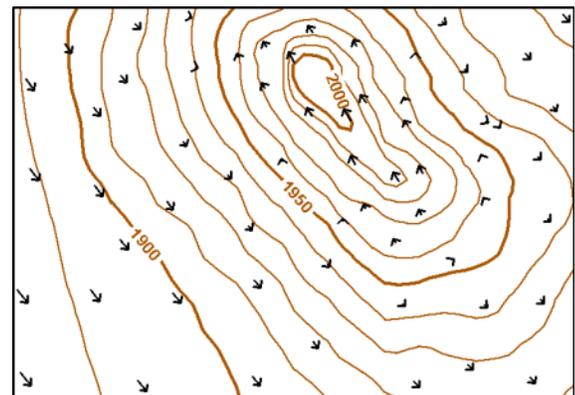

The View-In-View box in the illustration above shows a small portion of a QuickBird panchromatic image of Castle Rock, Colorado (ground resolution 0.7 meters) orthorectified in the Image Resampling process using Rational Polynomial Coefficients adjusted with accurate 3D ground control points. The ground width of the box is 490 meters and topographic relief in the scene is about 160 meters. A DEM with 10-meter cell size was used in the rectification. A digital orthophoto with 1-meter resolution (USGS Digital Orthoquarter Quad) is shown surrounding the box. Note the excellent positional match of features along the boundary between the two images. QuickBird scene and control point data provided courtesy of Digital Globe.

Elevation contour map of the boxed area at left (elevations in meters). Black arrows show the change in position for selected ground features in the georeferenced QuickBird image resulting from the RPC orthorectification. The direction and amount of the position change varies mostly with ground elevation in this local area. The largest position change is about 15 meters in the southwest corner of the area.

If you choose to rectify an ortho-ready image with its original georeference, select the image or image bands on the Raster tabbed panel in the Resample Images window, then choose the Rational Polynomial option from the Model menu on the Settings tabbed panel (see illustration at the top of the previous page). You are then prompted to choose the text file containing the RPC model coefficients and the DEM raster to use for the rectification. The Geoid Height field is activated so you can enter the appropriate geoid height value. Other resampling parameters can be set as you choose, just as you would for any other image resampling operation.

When you create an RPC model in the Georeference process using the Rational - Computed model, or re-georeference an ortho-ready image using the Rational - Predefined model, the resulting RPC coefficients are automatically saved as part of the georeference subobject. When you select such an image in the Image Resampling process, the RPC coefficients are read directly and you are prompted to choose a DEM covering the image area. In this case you can use the From Georeference option on the Model menu, and the Geoid Height field is activated for you to enter a value.

For more information see the tutorial entitled *Orthorectification Using Rational Polynomials*.