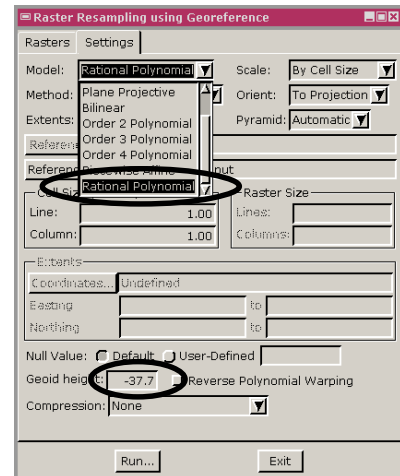# Rational Polynomial Orthorectification of IKONOS/QuickBird Images

You can orthorectify IKONOS Geo Ortho Kit images (from Space Imaging) and QuickBird Ortho Ready Standard Product images (from DigitalGlobe) in the Automatic Resampling process in TNTmips (Process / Raster / Resample and Reproject / Automatic) using a digital elevation model (DEM) and the Rational Polynomial Coefficient (RPC) resampling model. The RPC model uses ratios of cubic polynomials to express the transformation from ground surface coordinates (*latitude*, *longitude*, *elevation*) to image coordinates (*line*, *column*) for the particular input image. The coefficients for the rational polynomial model are supplied in an auxilliary file with each RPC image kit. When you choose the Rational Polynomial option from the Model menu, you are prompted to select the RPC coefficients file, the DEM to use to provide elevation values, and to provide the local geoid height.

IKONOS and QuickBird images are provided with nominal (approximate) georeferencing computed from the source satellite's orbital position and imaging geometry. Although you can orthorectify a nominally-georeferenced image using the RPC coefficients, you can produce a more accurate result by first re-georeferencing the image using accurate, well-distributed, 3D ground control points, such as from a GPS survey. The control points are used to adjust the RPC coefficient values to provide a more accurate location for each image cell. This adjustment provides better registration between the image and the DEM, ensuring that the appropriate elevation value is used for each cell during the rectification. See the color plate entitled *Orthorectification Results for QuickBird* for more information.


**Reference Digital Orthoquarter Quad**
**RPC-orthorectified QuickBird Image**

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 Automatic 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 postings (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.

The Rational Polynomial model is also available in the Georeference process for assessing residual placement errors for ground control points. When you select this model option, you are prompted to select the RPC coefficients file for the image.



The RPC resampling model requires elevation values referenced to the WGS84 ellipsoid. Since most DEM's reference elevations to the geoid, you are prompted to enter the local geoid height to adjust the DEM elevations. You can find the appropriate geoid height of the image center in one of several free geoid height calculators available from http://sps.unavco.org/geoid/ or http://earth-info.nga.mil/GandG/egm96/intpt.htm.
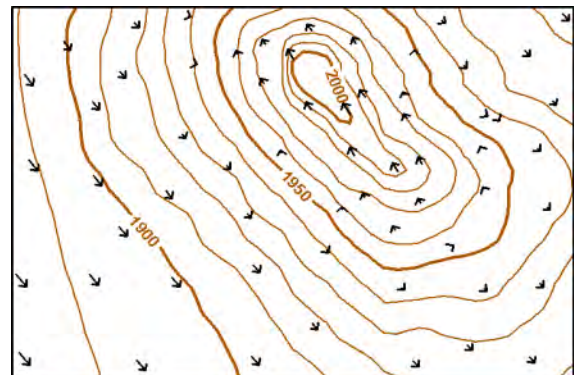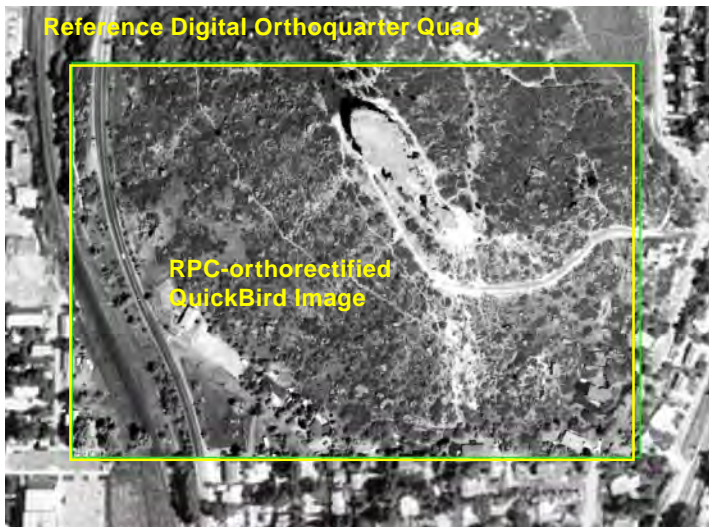


Elevation contour map of the boxed area at left (elevations in meters). Black arrows show the change in position for selected ground features in the georeferenced QuickBird image resulting from the RPC orthorectification. The direction and amount of the position change varies mostly with ground elevation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