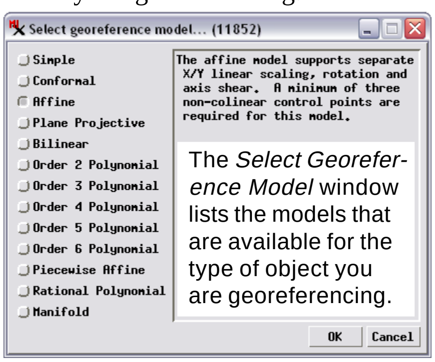
Georeference

Choosing a Model

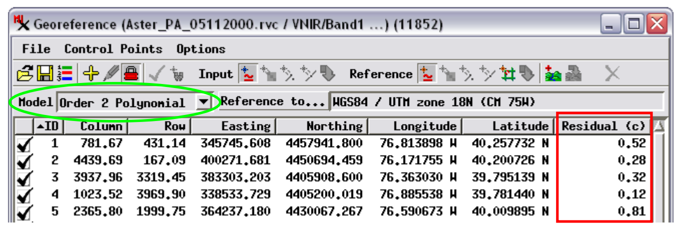
In the georeference process you can choose from a number of mathematical models to compute control point residuals and judge the fit of individual points. These models are coordinate transformations that relate the spatial distribution of control points in object coordinates to their distribution in reference (map) coordinates. Models of varying mathematical complexity are provided to account for different types of spatial distortion that may be present in the object you are georeferencing. Simpler mathematical models may be used to account for relatively uniform distortion, such as shrinkage of a paper map prior to scanning or tilt distortion in an aerial image acquired at an oblique angle to the ground. More complex models can partially compensate for non-uniform, spatially-varying distortion within an aerial or satellite image such as can be introduced by the optics of an imaging system or by terrain effects (relief displacement). The minimum number of non-colinear control points needed to compute a particular residual model increases with the mathematical complexity of the model, as shown below. You must enter at least one more than the minimum number of points for the current model in order for the Georeference process to automatically determine the best global fit of control point object and map coordinates and compute residuals for individual control points.

If the object you have selected to georeference does not have an existing georeference subobject, you are automatically prompted to select a model to use initially for georeferencing. The *Select georeference model* window (see illustration to the right) lists the models that are available for the type of object you are georeferencing. Simpler models requiring fewer control points are shown at the top of the list. This window provides a brief explanation of each model to aid you in selecting one that is appropriate for your spatial object. The available models are also listed in the table at the bottom of this page. The options for Simple and Implied georeference are described in the Technical Guide entitled *Georeference: Simple and Implied*.

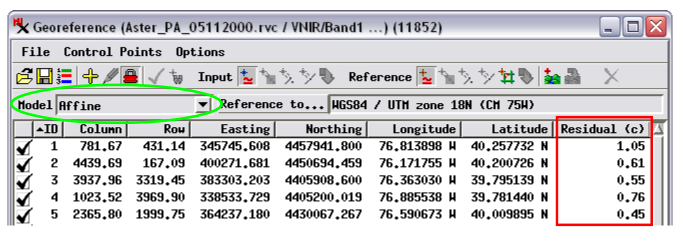


The *Select Georeference Model* window lists the models that are available for the type of object you are georeferencing.

After the initial setup sequence, the current model is shown in the Model menu above the control point list in the Georeference window. You can use this menu to change residual models at any time as you create or edit the control points and note the effect on control point and overall residual values (see illustration below). Your last choice of model is saved with the georeference subobject so that the correct model is set if you reopen the object in the Georeference process. The saved model is also used in the Automatic Resampling and Geometric Warping processes when you use the default selection *From Georeference* from the Model menu in these processes.



A more complex georeference model may account for internal distortion within the spatial object you are georeferencing better than a simpler model. In this example of an ASTER satellite image, the Order 2 Polynomial model (above) provides a better fit (lower control point residual values) than the simple Affine model (below). Only 5 out of 14 control points are shown in these illustrations.



Models Supported	Minimum Non-colinear Points / Description	
Conformal	2	Supports uniform scaling and rotation and thus will not change the object geometry.
Affine	3	Supports separate linear scaling factors in the X and Y directions, as well as rotation and axis shear.
Plane Projective	4	Intended for oblique imagery where distortion due to both sensor optics and relief displacement are minimal.
Bilinear	4	Models lens distortion where not enough control points can be located for higher-order polynomial models.
Polynomials: Order 2 Order 3 Order 4 Order 5 Order 6	 6 10 15 21 28	Polynomials may be used to model various types of non-uniform distortion. To ensure mathematical stability it is recommended that at least twice the minimum number of control points be defined.
Piecewise Affine	3	Assumes control points are correctly located in both object and map coordinates; no best fit or residuals are computed. Creates a triangular mesh using the specified control points, with each triangle having its own affine model derived from its vertices. The mesh may be extrapolated to the edges of the object. Individual distorted control point locations only affect the immediately surrounding triangles.
Rational Polynomial		Uses coefficients provided with the image to compensate for sensor orientation and optics. Requires selection of a DEM raster and geoid height at the image location to correct for distortion due to topography.
Manifold	3	Allows an image to be projected onto a 3D manifold mesh. The user may specify 3D control points and breaklines. A typical use is to georeference scans of geological cross-sections.