

RPC File Format for Cartosat-1

RPCs give the relation between ground and image coordinates. The ground coordinates ranges for latitude is $[-90, +90]$, longitude is $[0, 360]$ degrees and height in meters. The following section gives the description of meaning of each parameter provided in RPC file.

Each scanline number can be expressed as a function of ground coordinates in terms of ratio of cubic polynomials. The constant term in the denominator is taken as 1. So for a given scanline number, we have

$$s = \frac{P_1(X, Y, Z)}{P_2(X, Y, Z)}$$

where,

$$\begin{aligned} P_1(X, Y, Z) = & a_1 + a_2Y + a_3X + a_4Z + a_5YX + a_6YZ + a_7XZ + a_8Y^2 + a_9X^2 \\ & + a_{10}Z^2 + a_{11}XYZ + a_{12}Y^3 + a_{13}YX^2 + a_{14}YZ^2 + a_{15}Y^2X + a_{16}X^3 + a_{17}XZ^2 \\ & + a_{18}Y^2Z + a_{19}X^2Z + a_{20}Z^3 \end{aligned}$$

$$\begin{aligned} P_2(X, Y, Z) = & b_1 + b_2Y + b_3X + b_4Z + b_5YX + b_6YZ + b_7XZ + b_8Y^2 + b_9X^2 \\ & + b_{10}Z^2 + b_{11}XYZ + b_{12}Y^3 + b_{13}YX^2 + b_{14}YZ^2 + b_{15}Y^2X + b_{16}X^3 + b_{17}XZ^2 \\ & + b_{18}Y^2Z + b_{19}X^2Z + b_{20}Z^3 \end{aligned}$$

$$b_1 = 1$$

Similarly each pixel number can also be expressed as a function of ground coordinates in terms of ratio of cubic polynomials. Here also we take the constant term in the denominator as 1. So for a given pixel number, we have

$$p = \frac{P_3(X, Y, Z)}{P_4(X, Y, Z)}$$

where,

$$\begin{aligned} P_3(X, Y, Z) = & c_1 + c_2Y + c_3X + c_4Z + c_5YX + c_6YZ + c_7XZ + c_8Y^2 + c_9X^2 \\ & + c_{10}Z^2 + c_{11}XYZ + c_{12}Y^3 + c_{13}YX^2 + c_{14}YZ^2 + c_{15}Y^2X + c_{16}X^3 + c_{17}XZ^2 \\ & + c_{18}Y^2Z + c_{19}X^2Z + c_{20}Z^3 \end{aligned}$$

$$\begin{aligned} P_4(X, Y, Z) = & d_1 + d_2Y + d_3X + d_4Z + d_5YX + d_6YZ + d_7XZ + d_8Y^2 + d_9X^2 \\ & + d_{10}Z^2 + d_{11}XYZ + d_{12}Y^3 + d_{13}YX^2 + d_{14}YZ^2 + d_{15}Y^2X + d_{16}X^3 + d_{17}XZ^2 \\ & + d_{18}Y^2Z + d_{19}X^2Z + d_{20}Z^3 \end{aligned}$$

$$d_1 = 1$$

X, Y, Z are the normalized object space coordinates i.e normalized latitude, longitude and height respectively. s and p are the normalized scanline number and pixel number between (-1,+1). The normalization of the coordinates can be done as follows

$$X = (\phi - O_\phi) / S_\phi, Y = (\lambda - O_\lambda) / S_\lambda, Z = (h - O_h) / S_h,$$

$$s = (S - O_s) / S_s, p = (P - O_p) / S_p$$

$O_\phi, O_\lambda, O_h, O_s, O_p$ are the mean values for latitude, longitude, height, scanline number and pixel number respectively while $S_\phi, S_\lambda, S_h, S_s, S_p$ are the scale factor values for latitude, longitude, height, scanline number and pixel number respectively. The above values are filled in RPC file as follows

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LINE_OFF:     $O_s$  pixels
SAMP_OFF:     $O_p$  pixels
LAT_OFF:      $O_\phi$  degrees
LONG_OFF:     $O_\lambda$  degrees
HEIGHT_OFF:   $O_h$  meters
LINE_SCALE:   $S_s$  pixels
SAMP_SCALE:   $S_p$  pixels
LAT_SCALE:    $S_\phi$  degrees
LONG_SCALE:   $S_\lambda$  degrees
HEIGHT_SCALE:  $S_h$  meters
LINE_NUM_COEFF_1:  $a_1$ 
LINE_NUM_COEFF_2:  $a_2$ 
LINE_NUM_COEFF_3:  $a_3$ 
LINE_NUM_COEFF_4:  $a_4$ 
LINE_NUM_COEFF_5:  $a_5$ 
LINE_NUM_COEFF_6:  $a_6$ 
LINE_NUM_COEFF_7:  $a_7$ 
LINE_NUM_COEFF_8:  $a_8$ 
LINE_NUM_COEFF_9:  $a_9$ 
LINE_NUM_COEFF_10:  $a_{10}$ 
LINE_NUM_COEFF_11:  $a_{11}$ 
LINE_NUM_COEFF_12:  $a_{12}$ 
LINE_NUM_COEFF_13:  $a_{13}$ 
LINE_NUM_COEFF_14:  $a_{14}$ 

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LINE_NUM_COEFF_15: a_{15}
LINE_NUM_COEFF_16: a_{16}
LINE_NUM_COEFF_17: a_{17}
LINE_NUM_COEFF_18: a_{18}
LINE_NUM_COEFF_19: a_{19}
LINE_NUM_COEFF_20: a_{20}
LINE_DEN_COEFF_1: b_1
LINE_DEN_COEFF_2: b_2
LINE_DEN_COEFF_3: b_3
LINE_DEN_COEFF_4: b_4
LINE_DEN_COEFF_5: b_5
LINE_DEN_COEFF_6: b_6
LINE_DEN_COEFF_7: b_7
LINE_DEN_COEFF_8: b_8
LINE_DEN_COEFF_9: b_9
LINE_DEN_COEFF_10: b_{10}
LINE_DEN_COEFF_11: b_{11}
LINE_DEN_COEFF_12: b_{12}
LINE_DEN_COEFF_13: b_{13}
LINE_DEN_COEFF_14: b_{14}
LINE_DEN_COEFF_15: b_{15}
LINE_DEN_COEFF_16: b_{16}
LINE_DEN_COEFF_17: b_{17}
LINE_DEN_COEFF_18: b_{18}
LINE_DEN_COEFF_19: b_{19}
LINE_DEN_COEFF_20: b_{20}
SAMP_NUM_COEFF_1: c_1
SAMP_NUM_COEFF_2: c_2
SAMP_NUM_COEFF_3: c_3
SAMP_NUM_COEFF_4: c_4
SAMP_NUM_COEFF_5: c_5
SAMP_NUM_COEFF_6: c_6
SAMP_NUM_COEFF_7: c_7
SAMP_NUM_COEFF_8: c_8
SAMP_NUM_COEFF_9: c_9
SAMP_NUM_COEFF_10: c_{10}

SAMP_NUM_COEFF_11: c_{11}
SAMP_NUM_COEFF_12: c_{12}
SAMP_NUM_COEFF_13: c_{13}
SAMP_NUM_COEFF_14: c_{14}
SAMP_NUM_COEFF_15: c_{15}
SAMP_NUM_COEFF_16: c_{16}
SAMP_NUM_COEFF_17: c_{17}
SAMP_NUM_COEFF_18: c_{18}
SAMP_NUM_COEFF_19: c_{19}
SAMP_NUM_COEFF_20: c_{20}
SAMP_DEN_COEFF_1: d_1
SAMP_DEN_COEFF_2: d_2
SAMP_DEN_COEFF_3: d_3
SAMP_DEN_COEFF_4: d_4
SAMP_DEN_COEFF_5: d_5
SAMP_DEN_COEFF_6: d_6
SAMP_DEN_COEFF_7: d_7
SAMP_DEN_COEFF_8: d_8
SAMP_DEN_COEFF_9: d_9
SAMP_DEN_COEFF_10: d_{10}
SAMP_DEN_COEFF_11: d_{11}
SAMP_DEN_COEFF_12: d_{12}
SAMP_DEN_COEFF_13: d_{13}
SAMP_DEN_COEFF_14: d_{14}
SAMP_DEN_COEFF_15: d_{15}
SAMP_DEN_COEFF_16: d_{16}
SAMP_DEN_COEFF_17: d_{17}
SAMP_DEN_COEFF_18: d_{18}
SAMP_DEN_COEFF_19: d_{19}
SAMP_DEN_COEFF_20: d_{20}