

## **Metadata for the River Surface Reflectance Database (RiverSR) v1.1.0**

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Please cite the associated paper in Geophysical Research Letters (The color of rivers, 10.1029/2020GL088946) and this zenodo database when publishing work using this data or code. Thank you.

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**Table 1.** Metadata associated with the River Surface Reflectance (River SR v1.1.0) database (riverSR\_usa\_v1.1.feather). This database contains USGS Surface Reflectance Tier 1 product for Landsat 5, 7, and 8 in the t Google Earth Engine Catalog over all rivers in the contiguous USA that are about 60 meters wide or greater. The surface reflectance values across bands (red, green, blue, nir, swir1, swir1) represent the median reflectance of pixels detected as high quality water within each image that are within the boundaries of each reach in the NHDplusV2 flowlines database. All Reflectance values are x10,000 as they are in the Tier 1 product. Multiply by 0.0001 to convert to more typical 0-1 reflectance scale.

Column Name	Description	Units
LS_ID	Landsat product identifier (collection 1)	Na
Cloud_cover	% cloud cover of Landsat scene	percent
ID	Reach ID from modified NHDPlusV2	Na
azimuth	Solar azimuth angle from Landsat scene	degrees
cScore	Sum of pixel_qa cloud/cloud_shadow/snow/ice within the reach polygon	Na
date	Date of Landsat scene	YYYY-MM-DD
time	Time of Landsat scene (GMT)	HH:MM:SS
dswe	Median dynamic surface water extent category (1=open water) of reach water mask. Only 1 was collected.	Na
dswe_sd	Std. dev. dynamic surface water extent	Na
elevation	Elevation from MERIT. Minimum of reach water mask	meters
hillshade	Median Hillshade of reach polygon. 0-255 (0=shadowed, 255 = illuminated)	Na
hillshadow	Median hillshadow of reach polygon. Binary (0= shadowed, 1= not shadowed)	Na
hillshadow_sd	Std. dev of hillshadow over reach polygon	Na
path	WRS path of scene	Na
pixelCount	Number of pixels in reach water mask	count
qa	Median pixel_qa of reach water mask	Na
qa_sd	Std. dev. of pixel_qa of reach water mask	Na
Row	Row of WRS scene	Na
sat	Landsat mission 5, 7, or 8	Na
swir1_sd	Std. dev. of surface reflectance of shortwave infrared 1 band over the reach water mask	Na
Zenith	Solar zenith angle from Landsat scene	degrees
date_time	Date and time of Landsat scene collection (UTC)	YYYY-MM-DD HH:MM:SS
month	Month of scene collection (1-12) (UTC)	m
year	Year of scene collection (UTC)	YYYY
hour	Hour of scene collection (1-24) (UTC)	h
season	Northern hemisperhe season of scene collection (Summer, Spring, Winter, Fall): winter = Dec-Feb, spring=March-May, summer=June-Aug, fall=Sept-Nov	Na
decade	5 year interval for grouping (1984-1990, 1990-1995...)	YYYY
count	Number of observations for a given reach 1984-2018	count

<b>max_year</b>	The most recent year of observations for a given reach	YYYY
<b>min_year</b>	The first year of observations for a given reach	YYYY
<b>n_years</b>	The number of years between the min and max year	Na
<b>rn</b>	Row number	Na
<b>red_raw</b>	Uncorrected surface reflectance from the red band over reach water mask	Na
<b>green_raw</b>	Uncorrected surface reflectance from the green band over reach water mask	Na
<b>blue_raw</b>	Uncorrected surface reflectance from the blue band over reach water mask	Na
<b>nir_raw</b>	Uncorrected surface reflectance from the near infrared band over reach water mask	Na
<b>swir1_raw</b>	Uncorrected surface reflectance from the shortwave infrared 1 band over reach water mask	Na
<b>swir2_raw</b>	Uncorrected surface reflectance from the shortwave infrared 2 band over reach water mask	Na
<b>red</b>	Corrected surface reflectance (for Landat 5 and 8) from the red band over reach water mask (See Table 4 for correction coefficients)	Na
<b>green</b>	Corrected surface reflectance (for Landat 5 and 8) from the green band over reach water mask (See Table 4 for correction coefficients)	Na
<b>blue</b>	Corrected surface reflectance (for Landat 5 and 8) from the blue band over reach water mask (See Table 4 for correction coefficients)	Na
<b>nir</b>	Corrected surface reflectance (for Landat 5 and 8) from the nir band over reach water mask (See Table 4 for correction coefficients)	Na
<b>swir1</b>	Corrected surface reflectance (for Landat 5 and 8) from the swir1 band over reach water mask (See Table 4 for correction coefficients)	Na
<b>swir2</b>	Corrected surface reflectance (for Landat 5 and 8) from the swir2 band over reach water mask (See Table 4 for correction coefficients)	Na
<b>ALL band ratios below were calculated with CORRECTED bands not "raw"</b>		
<b>NR</b>	nir/red	Na
<b>BR</b>	blue/red	Na
<b>GR</b>	green/red	Na
<b>SR</b>	swir1/red	Na
<b>BG</b>	blue/green	Na
<b>RG</b>	red/green	Na
<b>NG</b>	nir/green	Na
<b>SG</b>	swir1/green	Na
<b>BN</b>	blue/nir	Na
<b>GN</b>	green/nir	Na
<b>RN</b>	red/nir	Na
<b>SN</b>	swir1/nir	Na

<b>BS</b>	blue/swir1	Na
<b>GS</b>	green/swir1	Na
<b>RS</b>	red/swir1	Na
<b>NS</b>	nir/swir1	Na
<b>R.GN</b>	red/ (green +nir)	Na
<b>R.GB</b>	red/ (green + blue)	Na
<b>R.GS</b>	red / (green + swir1)	Na
<b>R.BN</b>	red / (blue + nir)	Na
<b>R.BS</b>	red / (blue + swir1)	Na
<b>R.NS</b>	red / (nir + swir1)	Na
<b>G.BR</b>	green / (blue + red)	Na
<b>G.BN</b>	green / (blue + nir)	Na
<b>G.BS</b>	green / (blue + swir1)	Na
<b>G.RN</b>	green / (red + nir)	Na
<b>G.RB</b>	green / (red + blue)	Na
<b>G.NS</b>	green / (nir + swir1)	Na
<b>B.RG</b>	blue / (red + green)	Na
<b>B.RN</b>	blue / (red + nir)	Na
<b>B.RS</b>	blue / (red + swir1)	Na
<b>B.GN</b>	blue / (green + nir)	Na
<b>B.GS</b>	blue / (green + swir1)	Na
<b>B.NS</b>	blue / (nir + swir1)	Na
<b>N.RG</b>	nir / (red + green)	Na
<b>N.RB</b>	nir / (red + blue)	Na
<b>N.RS</b>	nir / (red + swir1)	Na
<b>N.GB</b>	nir / (green + blue)	Na
<b>N.GS</b>	nir (green + swir1)	Na
<b>N.BS</b>	nir / (blue + swir1)	Na
<b>GR2</b>	(green + red) / 2	Na
<b>GN2</b>	(green + nir) / 2	Na
<b>BR_G</b>	(blue - red) / green	Na
<b>NS_NR</b>	(nir - swir1) / (red - swir1)	Na
<b>fai</b>	nir - (red + (swir1-red)*((830-660)/(1650-660)))	Na
<b>N_S</b>	nir - swir1	Na
<b>N_R</b>	nir - red	Na
<b>ndvi</b>	((nir - red)/(nir + red))	Na
<b>ndwi</b>	((green - swir1)/(green + swir1))	Na
<b>ndssi</b>	((blue - nir)/ (blue + nir))	Na
<b>gn.gn</b>	((green- nir)/ (green + nir))	Na
<b>hue</b>	Color, or hue, using rgb2hsv	Na
<b>saturation</b>	Saturation using rgb2hsv	Na
<b>bright</b>	Brightness using rgb2hsv	Na
<b>bright_tot</b>	Total brightness (red + green + blue + nir)	Na
<b>dw</b>	Dominant wavelength	nanometers
<b>hexcolor</b>	Hexadecimal color using rgb function	Na
<b>chroma_x</b>	x coordinate in chromaticity	Na

<b>chroma_y</b>	y coordinate in chromaticity	Na
<b>chroma_z</b>	z coordinate in chromaticity	Na
<b>hue_angle</b>	angle from white point through xy coordinates in chromaticity	degrees
<b>mean_SR</b>	(red + green + blue + nir/4)	Na
<b>flag</b>	Manual flagging of poor data. Currently includes several reaches with significant topographic shadow that our current algorithm did not detect (Colorado and Santa Anna Rivers) as well as the most downstream end of the Colorado River which is typically not flowing.	Na

**Table 2.** Metadata associated with the modified NHDplusV2 centerlines (nhdplusv2\_modified\_v1.0.shp). This file can be joined with the RiverSR database by the “ID” column to assign geometries to the reflectance data. Centerlines were modified to achieve reaches that were ~2km on average by joining short reaches. More information on NHDplusV2 can be found at...

([https://nctc.fws.gov/courses/references/tutorials/geospatial/CSP7306/Readings/NHDPlusV2\\_User\\_Guide.pdf](https://nctc.fws.gov/courses/references/tutorials/geospatial/CSP7306/Readings/NHDPlusV2_User_Guide.pdf)) (<https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus>).

nhdplusv2\_polygons.shp has only the ID column and its geometry.

Column Name	Description	Units
ID	New reach ID from joining small reaches in NHDplusv2	Na
toID	ID of downstream reach	Na
LENGTHKM_	Length of new reach	kilometers
LvIPtID	levelPath (or mainstem) ID of new reaches	
Hydrsq_	Hydrosequence of new reaches	Na
COMID	Original reach ID from NHDplusV2. If reaches were joined, the most downstream COMID was joined to the new ID	Na
<p>ALL other columns are data from NHDplusV2 and attributes associated with the COMID (or most downstream point of the new reach). Column names were truncated from their original names for shapefile reading and writing. More info on additional attributes can be found in the NHDplusV2 manual.</p> <p><a href="https://nctc.fws.gov/courses/references/tutorials/geospatial/CSP7306/Readings/NHDPlusV2_User_Guide.pdf">https://nctc.fws.gov/courses/references/tutorials/geospatial/CSP7306/Readings/NHDPlusV2_User_Guide.pdf</a></p> <p><a href="https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus">https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus</a></p>		

**Table 3.** COMID\_ID is a table of the original NHDPlusV2 reach COMIDs that were joined to form new reach IDs.

<b>Column Name</b>	<b>Description</b>	<b>Units</b>
COMID	Original reach COMID	na
ID	New reach ID	na

**Table 4.** Polynomial coefficients for correcting Landsat 5 and 8 to 7 based on a 2<sup>nd</sup> order polynomial regression of ordered quantiles of all reflectance measurements from rivers in the contiguous USA. The equations is;  $\rho_{corrected} = a\rho^2 + b\rho + c$ , where  $\rho$  = surface reflectance measured by Landsat (5 or 8),  $abc$  are the polynomial coefficients shown below, and  $\rho_{corrected}$  is the surface reflectance normalized to Landsat 7.

<b>Band</b>	<b><i>a</i></b>	<b><i>b</i></b>	<b><i>c</i></b>
<i>Correct Landsat 5 (to 7)</i>			
<b>blue</b>	7.28E-06	0.9781	3.0184
<b>red</b>	-1.20E-05	1.0438	-46.6908
<b>green</b>	-2.23E-05	0.9964	-24.8700
<b>nir</b>	-6.92E-05	1.1227	-55.6598
<b>swir1</b>	2.66E-04	0.7072	8.9740
<b>swir2</b>	2.65E-04	0.7265	6.1006
<i>Correct Landsat 8 (to 7)</i>			
<b>blue</b>	-9.21E-05	1.0259	59.7216
<b>red</b>	-3.04E-05	0.9971	46.2292
<b>green</b>	-4.25E-05	0.9949	49.2675
<b>nir</b>	-1.86E-04	1.2754	84.9931
<b>swir1</b>	-9.46E-05	1.0315	25.1120
<b>swir2</b>	-3.58E-05	0.9498	14.8144