

VIIRS Near Constant Contrast Quick Guide For Imagery Enhancement in AWIPS 2



The NPP polar-orbiting satellite passes twice per day, once around 1:30 pm and again around 1:30 am local time. Its VIIRS instrument has a Day/Night Band (DNB) that is very sensitive to low levels of light and provides unique visible imagery at night. The DNB can detect a broad range of light intensities, ranging from full sunlight in the day down to faint atmospheric glow on moonless nights (the focus here will be on the nighttime imagery). This 8-order of magnitude range in radiance space is difficult to display as an image without losing detail at either end of the radiance scale, so a product called **Near Constant Contrast (NCC)** was developed in order to mitigate enhancement issues by using a model of the sun and moon to convert the DNB radiance values into a reflectance-like value. Doing so reduces the dynamic range from 8 orders of magnitude down to 3, which is much easier to display in AWIPS and other software. **But, beware! The NCC does not provide a true reflectance value like other visible imagery or the DNB Lunar Reflectance product!**

NCC “pseudo-albedo” values vary throughout the lunar cycle. The DNB instrument is sensitive to reflected light from the sun and moon as well as many other sources of emitted light – cities, the aurora, gas flares and fires, lightning, nightglow and even boats! These sources may be 2-3 orders of magnitude brighter than the moon, particularly when the moon is below the horizon when VIIRS is passing overhead. As a result, NCC pseudo-albedo values can vary from -10 to 1000. Most meteorological features of interest have pseudo-albedo values between 0 and 1.5. Side illumination of clouds near the terminator may result in NCC values of 2 or more, like the bright areas in the example at right.

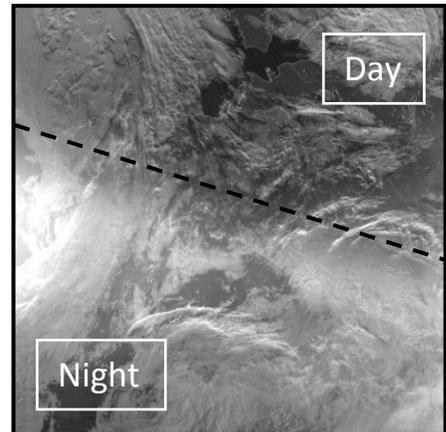


Figure 1. NCC image spanning the terminator. Clouds are clearly seen on both day and night sides.

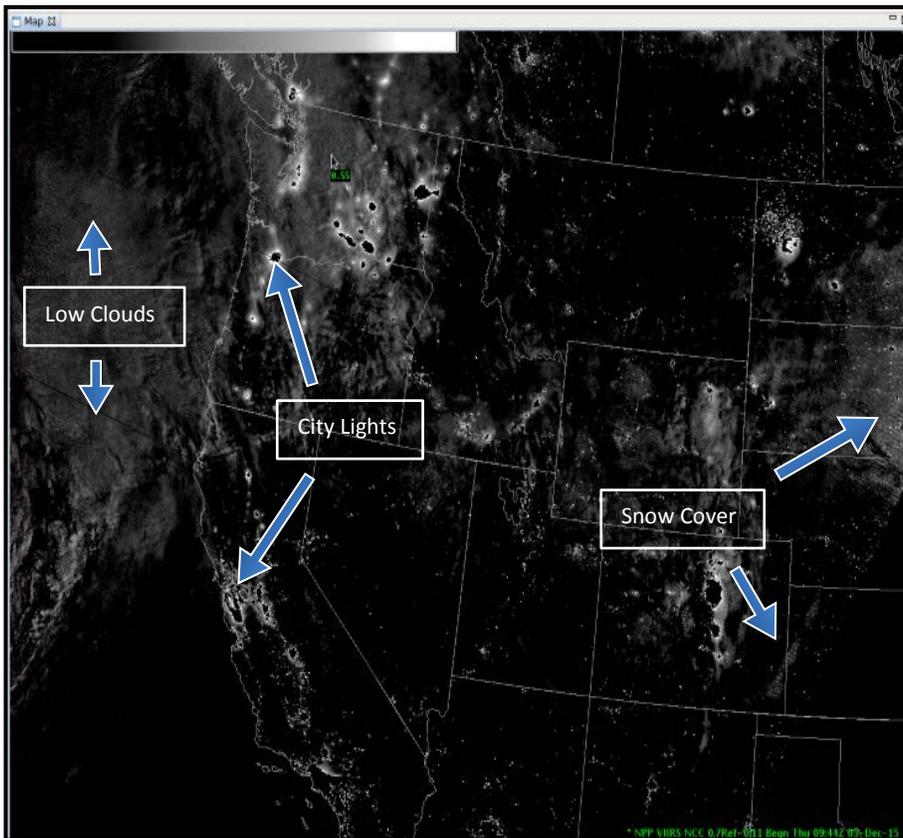


Figure 2. AWIPS-2 screen capture showing how NCC will display by default. This example is from 3 Dec. 2015 when the moon is approximately halfway illuminated. Note how the brightest city lights are black and the clouds are relatively dark - these issues can be fixed by modifying the default color table. (Data courtesy of CSPP from SSEC/CIMSS)

AWIPS 2 scales NCC values from 0 to 1.6 by default. Many clouds are moderately bright while areas where there should be bright city lights are black. These “black” lights have values > 1.6 and are a result of the default color table, as seen in Figure 2. Using the color table editor, change the Colormap size to the maximum 2048 colors. Stretch the values between 0 and 1 by making the top arrow point to the minimum value (0.0), then set the red, green, and blue bars to 0 (black). Set the bottom arrow to a value of 1, and the red, green, and blue values to 255 (white). Click ‘Interpolate.’ Finally set all the values between 1.0-1.6 white, and the result should look like Figure 3.

In Figure 3 below, the city lights now appear white, clouds show up with higher contrast, and the areal extent of the city lights has expanded; this is a natural consequence of stretching the black-to-white over a smaller range of NCC values. Several erroneous lines may have also appeared. This bug will be fixed in a future release. If you zoom in, the lines will disappear with increased resolution. Since the NCC values of features will change with moon phase, we recommend custom-making a color table every time you look at NCC imagery.

The expected NCC values of clouds and city lights change as the phase of the moon changes, and the user will need to modify the color table manually in order to best enhance the features of interest. At full moon, the city lights have their lowest values and occupy the smallest horizontal area, while the clouds are their brightest. So stretching the NCC values from 0 to ~1.2 may work well. As the moonlight decreases, city lights gain larger values and expand horizontally, and clouds become darker. For these lower light conditions, stretching from 0 to ~0.7 may best enhance the clouds. During new moon when there is no moonlight at all, the clouds will be almost invisible and the city lights will dominate the image.

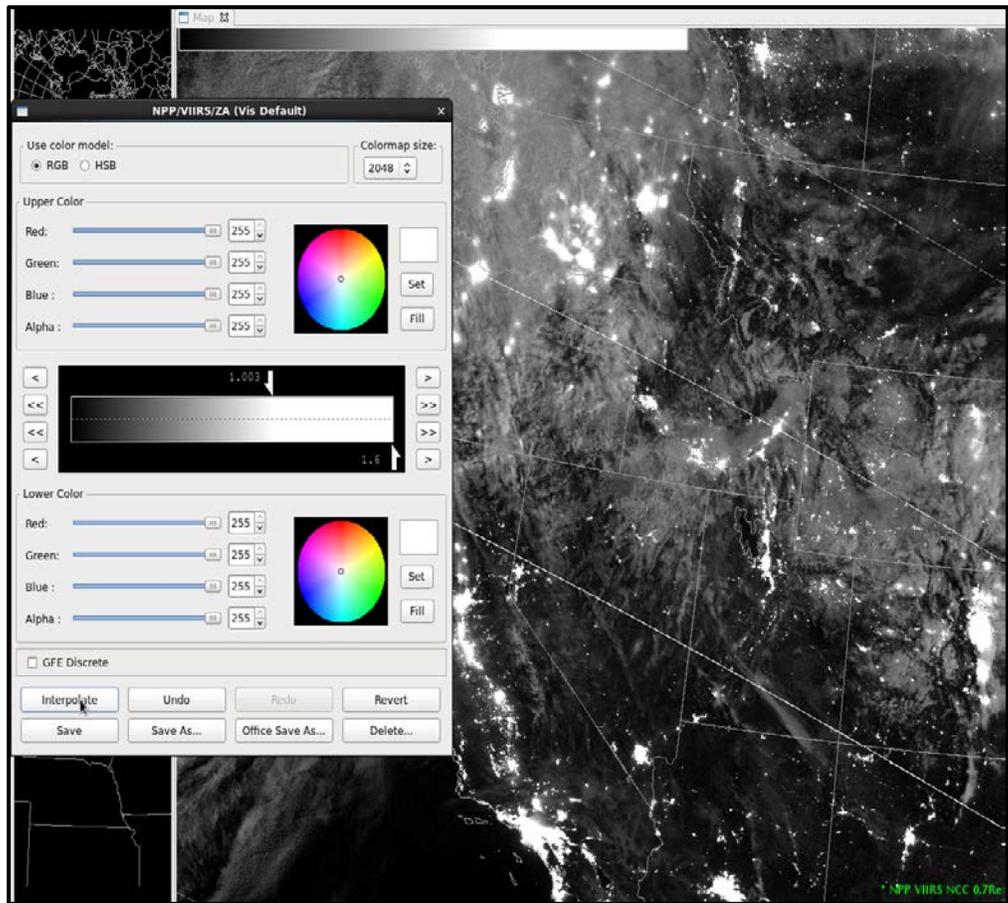


Figure 3. Screen capture of NCC in AWIPS after making the modifications to the color table explained in the text. The color table editor is also shown following the edits. City lights now appear white and clouds are brighter relative to the background. This color table has been provided on the VLab and is called NCC_zero_to_one.cmap. We recommend custom adjusting the color table each time NCC is viewed.

Finally, it should be mentioned that there is effectively no moonlight from 2 days after the last quarter until 2 days after the first quarter in the lunar cycle because the moon is below the horizon at the time of the NPP overpass. During this time, all the nighttime images will look similar to the new moon cases.

Variation with the Lunar Cycle: reflected and emitted source differences and resulting appearances

	Reflected Moonlight (i.e. clouds, snow, ice)	Emitted Light (i.e. cities, fishing boats, gas flares, lightning, aurora, fires)
New Moon	Lowest NCC Values (very dim): illumination primarily by nightglow, cloud tops appear fuzzy	High NCC Values (brighter): significantly brighter than surroundings
Full Moon	Highest NCC Values (very bright): ability to see details in cloud top texture	High NCC Values (bright): proportionally less bright than surroundings