Effect of Filters on Landscape Images
After a Full-Spectrum IR Conversion

Someone with normal vision can see colors from violet (about 360nm, nanometers) to deep red (about 680nm). We cannot see ultraviolet radiation (UV, 10nm to 360nm) or above 680nm (infrared, IR). The range for IR extends from 780nm to 1000nm (1mm).

Panchromatic B&W film can record some of the UV range so we need to use a UV filter to cut out some of the UV light. Since it does not normally record above about 650nm we do not need an IR filter. Different films may record a little differently from each other within the visible spectrum.

But a sensor can start to record from UV at about 300nm through IR at about 1000nm (1mm). This range is inherent in common silicon based sensors.

A full-spectrum digital sensor has no color filter array (a Bayer or X-Trans CFA) and does not block infrared (IR) or ultraviolet (UV) light. The Monochrome Imaging Services technical article Full-Spectrum IR shows graphically how different color filters in the CFA behave. Note that the red, green and blue filter curves overlap and transition gradually so that some wavelengths can affect two or three of the red, green or blue (RGB) colors. But all of the CFA filters allow some IR or UV to pass through.

To record the normal spectrum of visible light we need to remove some of the UV and IR radiation. Digital sensors commonly have two filters on top of the CFA. If they are removed we need to use a cut filter on the lens to restore normal imaging for the visible range. Cut filters block light over a narrow boundary rather than abruptly at their intended cutoff.

In this article you will see what happens with different filter combinations on Sony A7 II with a full-spectrum digital conversion (no UV, IR or CFA). The effects of filters in a monochrome image can be very subtle depending on the scene, time of day and the weather. If there is little or no UV or IR present in the scene the differences will only show up in the visible portion of the spectrum. UV might be more likely to be seen in distant landscapes and IR in warmer daylight or where an incandescent heat source is present.

Regardless of the color of light we perceive in the scene, without the CFA the monochrome sensor just sees luminosity. It records the intensity of the light reaching each sensor element indiscriminately. To modify the balance of colors we need to add our own filters.

The camera's B&W conversion doesn't know that the Bayer array or the other filters have been removed. It proceeds to convert what it thinks is an RGB image in the conventional manner. It will end with a pink-magenta tint. You can override that by setting the camera to produce a B&W JPEG despite the fact that the JPEG is useless due to the compromised resolution. Don't save the JPEG. Just keep the raw file. Then convert the raw file to DNG using Monochrome2DNG and you can use your usual raw conversion program to create a JPEG or TIFF.

Since this is a mirrorless camera and you are already looking at the results on your LCD screen or in the viewer, you don't have to guess how the images are going to end up looking.

This is the scene from a camera with a Bayer array.

The remaining images are from the A7 II (m). All were exposed at aperture priority with at EC+1 so the shutter speeds give us an idea of the exposure adjustment needed to achieve a normal exposure.

This image used no filters at all so it may include wavelengths from 300-1000nm. 1/1000

The remaining images will show the effect of blocking some of that radiation.

With only a UV filter there is a slight change with the range now limited to about 360-1000nm. 1/1000

A UV-IR cut filter the range is limited to 360-680NM. 1/800 (0.3 stops)

This is the normal range for visible light. But neither end of the range is cut off abruptly.

A green filter alone can accept visible light as well as some light in the IR range. 1/320 (1.7 stops)

But adding a cut filter eliminates the much of green IR portion of that light. 1/250 (2 stops)

A red filter alone can also accept some light in the IR range. 1/320 (1.7 stops)

But adding a cut filter will eliminate much of the IR portion of that light. 1/160 (2.7 stops)

An IR filter will eliminate the wavelengths from the visible spectrum. 1/125 (3 stops)

But adding a cut filter will eliminate a lot of the IR portion of 700nm light as well. ½ (9 stops)

An R72 IR filter was used to block light below 720nm. There are many other versions of IR filters to work with specific ranges of the IR spectrum. The blocking occurs over a narrow range close to 720nm.