How To:
Use The Background Enhancement Tool

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Wavesharp 2 - Using the Background Enhancement Tool

Introduction

Wavesharp 2 contains a Background Enhancement Tool which offers with user an opportunity to bring faint objects such as planetary moons into visibility. This section of the user guide will provide a concise how-to summary for using the Background Enhancement Tool. The tool contains a variety of controls which perform two primary functions; firstly, extracting the faint object from the background, and secondly, adjusting the final brightness and extent of the extracted faint object. Both of these functions have three primary controls which allow the user flexibility in reaching a desired final image.

For this how-to we will start with a sharpened and denoised image of Saturn containing 7 moons of varying brightness. The example image was sharpened, denoised and color corrected using the appropriate Wavesharp 2 tools for these purposes. They are shown in Figures 1a and 1b for completeness. However, the details of how to operate the Background Enhancement Tool (BET) are not dramatically affected by the choice of these processes.

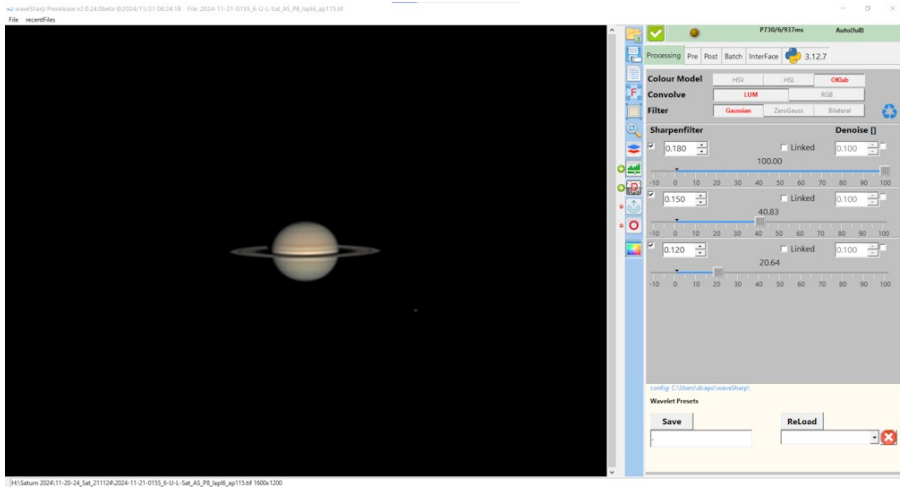

Figure 1a: Main Wavesharp Panel and Wavelets settings for the example image.

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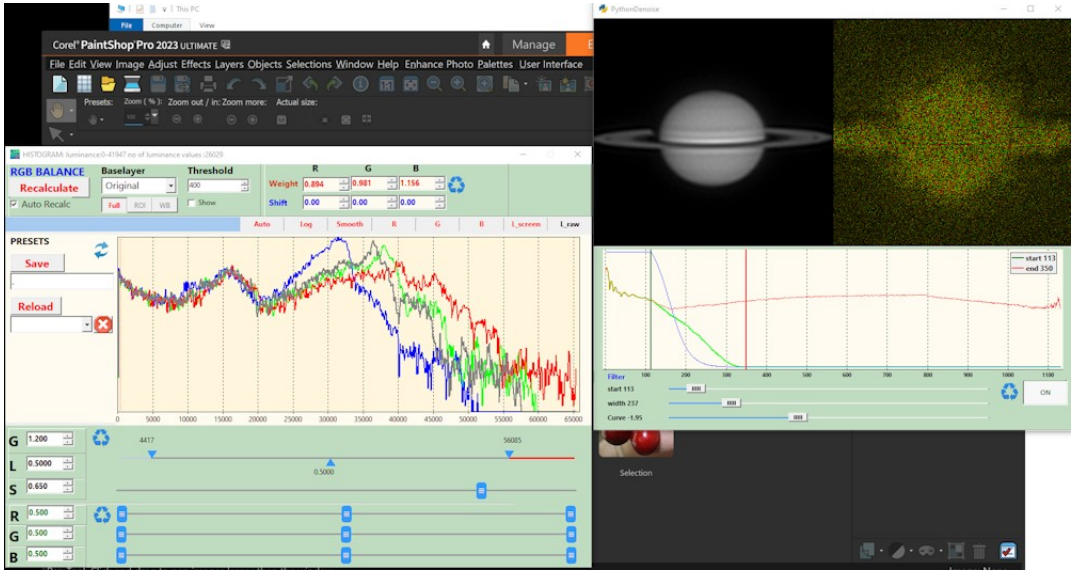

Figure 1b: Histogram and Denoise settings for the example image.

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Launching the BET

Figure 2 shows the location of the icon which launches the BET (marked with the white arrow). Selecting the BET with this icon launches the tool window shown to the right as a green control box. This tool box can be moved around the screen to a convenient location for the user. To move the tool right-click the top of the tool window and then move as needed with your mouse.

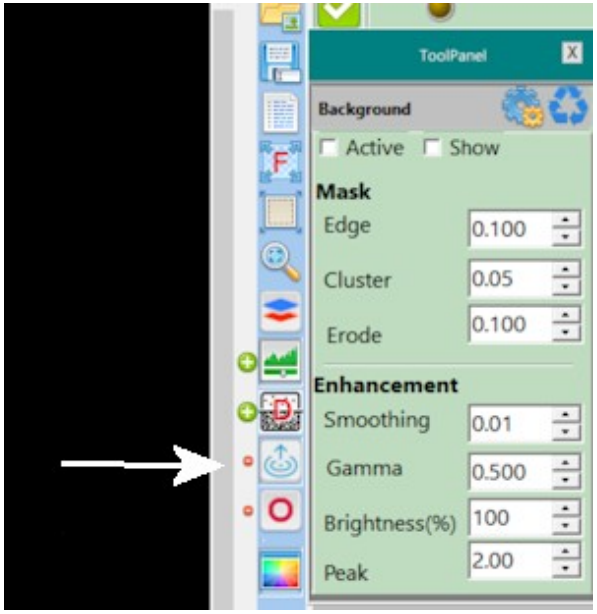

Figure 2: The BET Control Window

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Figure 3 shows our example image and the tool box controls in a convenient position and will be used in the following example of how to use the tool to bring up the moons currently invisible in the image.

The banner of the BET contains two common icons in the Wavesharp 2 software.  The recycle icon on the right allows the user to reset the BET to the default values shown in Figure 2. The gear wheel on the left opens the advanced features in the tool which will be covered in a later section.

To activate the BET, select the “Active” toggle box in the upper left side of the window directly below the banner.

Notice that the BET contains two primary sections. Mask and Enhancement The controls are presented in the basic order in which they are applied to the image, however, lots of minor adjustments can be performed as image processing continues. Therefore the user should explore the behavior of each control as you progress. The Mask controls are normally used in conjunction with the “Show” toggle box in the upper right-hand side of the window checked. The Enhancement controls will generally be adjusted with the “Show” toggle in the unchecked position.

Figure 3: Starting point for using the BET

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Adjusting the Mask

Examine Figure 4 in which we have now checked both active and show. Saturn has taken on a greenish hue indicating that it neither part of the background nor will it be affected by any of the settings in the BET. Notice along the top a series of red “clusters” have appeared. These are common and represent the small artifacts that occur along the perimeter of a sharpened image stack.

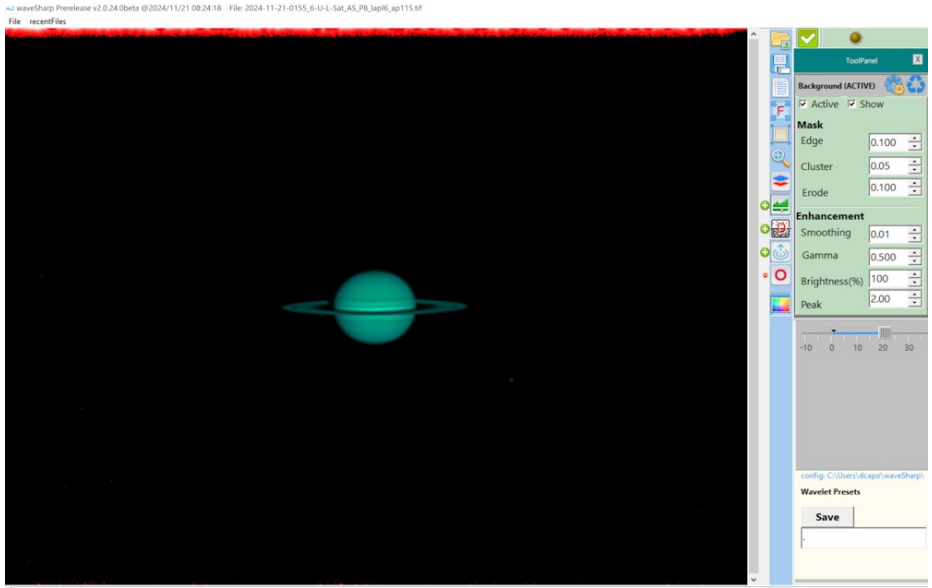

Figure 4: Select Active and Show to being moon extraction.

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At this point, we have an opportunity to examine the advanced feature currently available in the BET. Selecting the gear wheel, drops an extension to the BET containing the Trim function. The numerical entry (px) allows the user to remove these edge artifacts from consideration. Normally, these edge artifacts will be eliminated by the normal operation of the BET. However, in those cases for which this does not occur, the trim function will remove the excess clusters. Note: For those imagers dealing with field rotation in their image sets it will be important to be sure that no such edge artifacts are present in images planned for use in animations as these edges will not remain parallel to the edges of the FOV in the final animations. The trim feature is particularly useful in these case. Figure 5 shows the same image as Figure 4 but with the Trim feature set to 25 px.

We'll leave the trim feature set at 0 px for the remainder of this how-to so as to provide a better look at the opportunity provided by the BET.

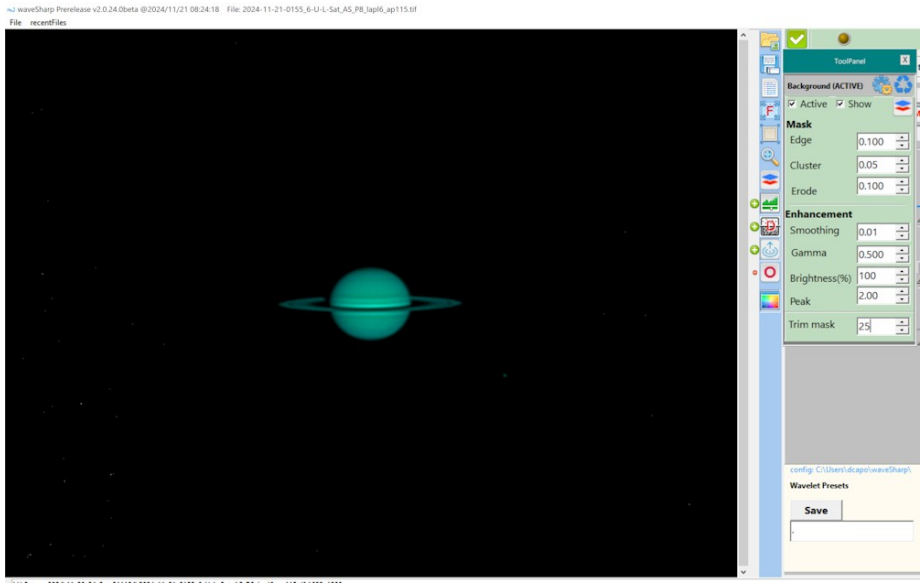

Figure 5: Removal of the edge artifacts with the trim feature set at 25 px.

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Bringing the moons into visibility begins with the Edge setting. We'll begin by seeing the dramatic change that occurs with just a small increase in the edge parameter. In Figure 6 we see the mask created by setting the Edge to just 0.003. Notice that the bulk of the image area has turned a bright red. Regions in red are identified as background. Notice that Saturn is not considered background nor are any of Saturn's moons that can now be clearly seen at the center of regions not background.

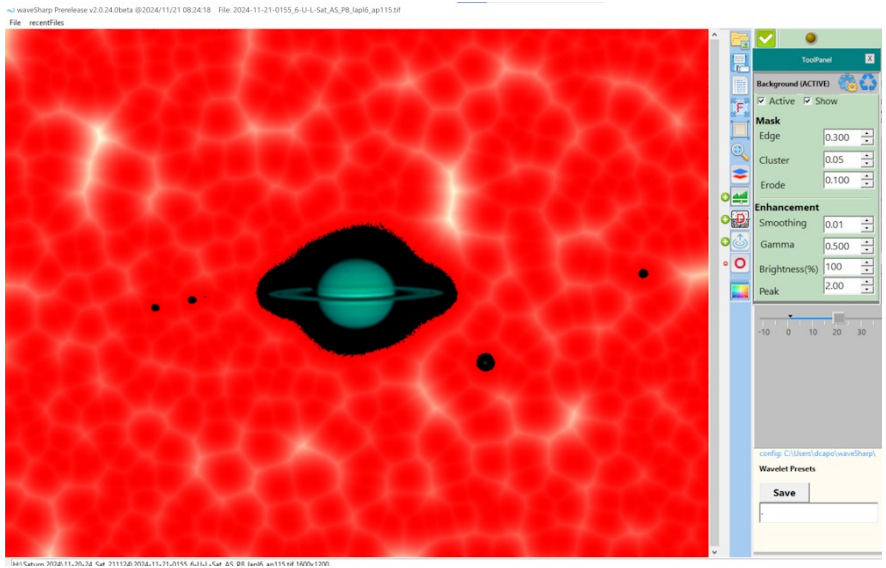

Figure 6: Edge set to 0.003.

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With such a large amount of the area surrounding Saturn identified as non-background we will have difficulty in extracting moons close to Saturn's limb or rings. Continuing to increase Edge will move the boundary closer to Saturn and increase the opportunity for close-in moons to be extracted. In Figure 7 notice the impact of making a large increase in Edge, this time to a value of 8.000. By turning off the Show toggle you can see very quickly that a value of 8.000 results in the very tips of Saturn's rings becoming part of the designated background which has deleterious effects on the image.

For this example image a good value for the Edge parameter is about 2.500 as shown in Figure 8. Notice that the moon Titan below and to the left of Saturn is still considered part of the base image and not the background. This means that any of the Enhancement tools applied to the background will NOT be applied to Titan. We'll return to this item shortly.

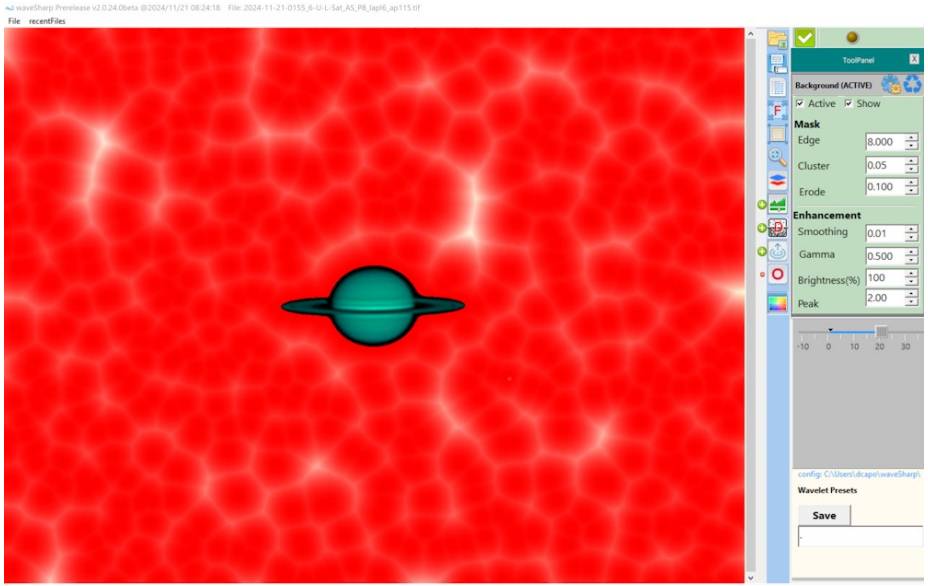

Figure 7: Edge parameter set to 8.000 yields a very close crop to Saturn but begins to impact the tips of both rings.

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Having found a reasonable value for the Edge parameter it is now time to clearly bring the moons forward from the background so they can be processed separately. This task is accomplished using the cluster parameter. In Figure 9 the result of making an initial change in Cluster to a value of 0.55 gives you an immediate idea of what is happening.

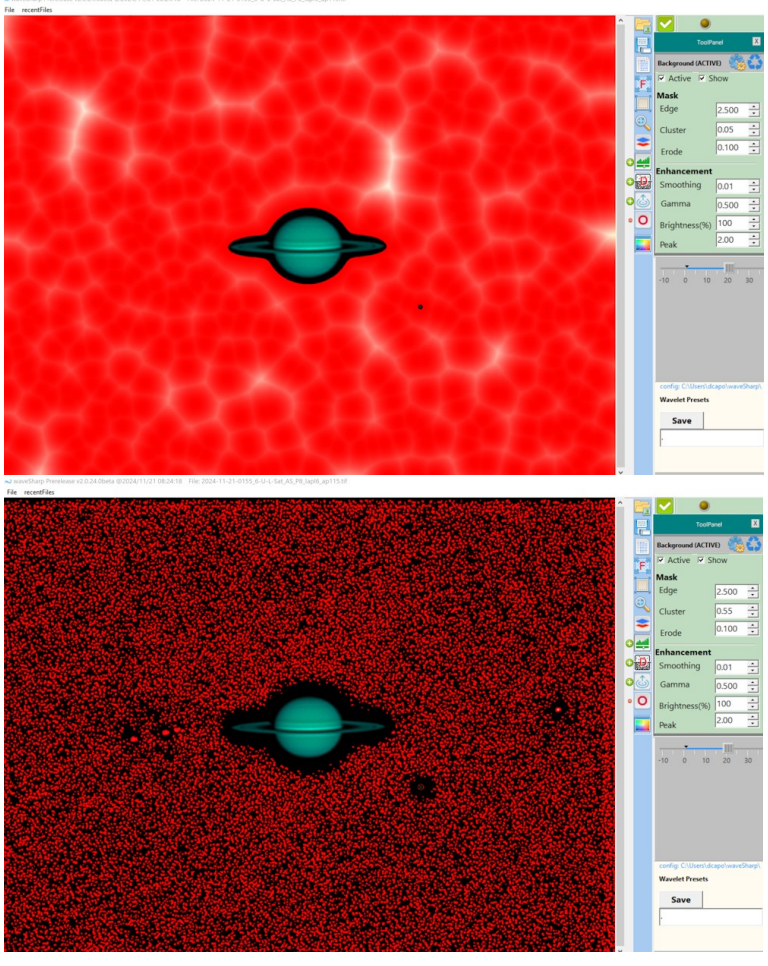

Figure 9: Increasing Cluster from the default value to 0.55 starts to remove the background mask in the image (red).

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The user continues to increase Cluster until the bulk of the background is black and only the moons remain part of the background. Figure 10 shows the image with Cluster set to 1.00.

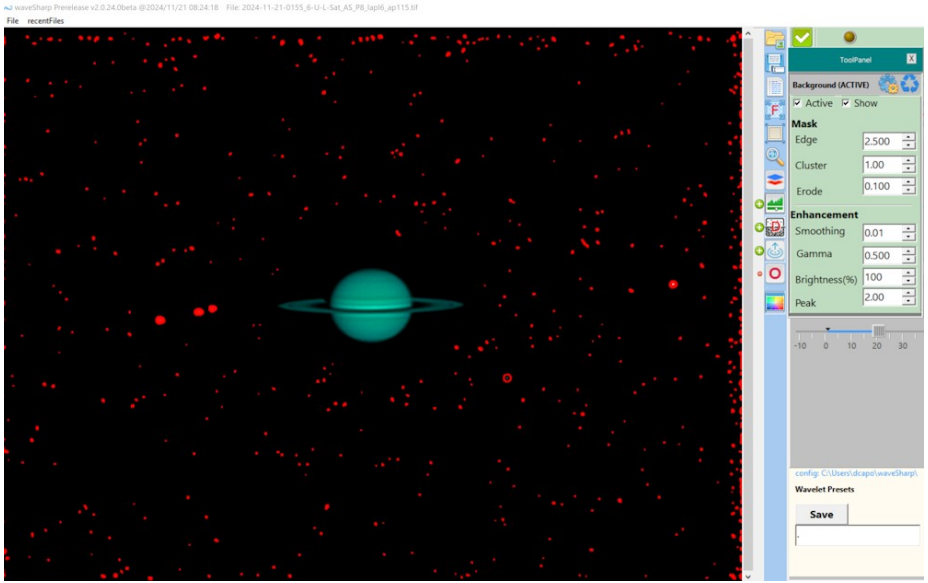

Figure 10: Cluster set to 1.00 as removed the bulk of the background and clearly shows the five moons.

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While it is possible to completely remove all of the background using the Cluster input, this approach will often result bloated moons. To avoid this, we apply the erode tool to scrub the remaining background clusters and refine the selection of the moons themselves. At this point it is important to notice that Titan now has a background ring surrounding it. This combination of (or similar) parameters allows Titan to remain in the base image and yields natural color for the moon. It does however inform the choice for the enhancement parameters to follow. For now, let's bring the Erode parameter to a value of 0.250 and see the final result of the Mask process in Figure 11a.

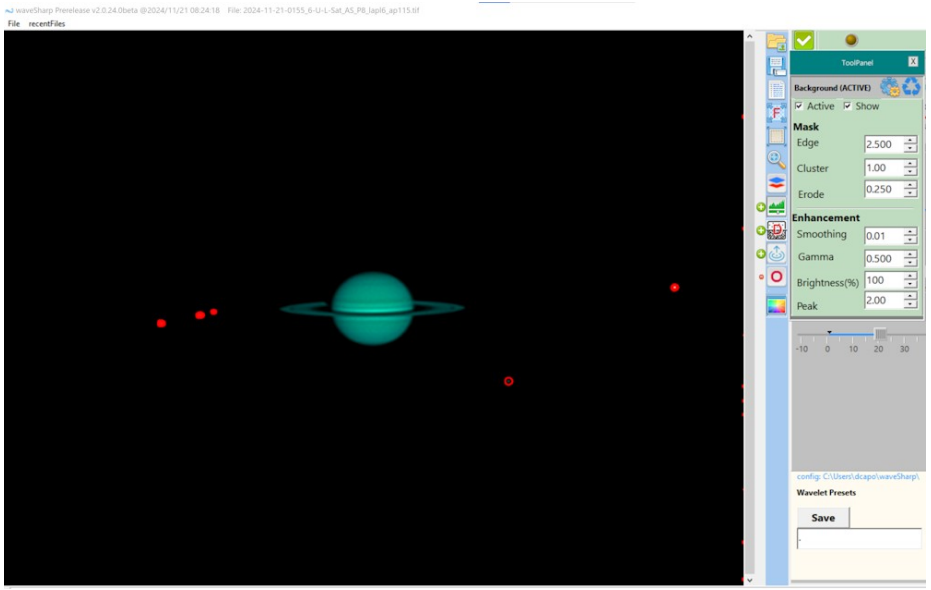

Figure 11a: Setting erode to a value of 0.250 leaves only the fainter moons identified as part of the background with Titan remaining in the base image as evident by the hole in Titan's mask (ring).

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In the final section of the how-to guide, we'll set up parameters that leave Titan in the background and see how the enhance parameters must change as a result. These figures will be labeled 11b, 12b, etc so that a comparison can be made by the user with these initial settings.

First, let's understand the operation of the enhancement controls.

Enhancement Tool Section

In order to refine the appearance of the fainter moons and give them the correct relative brightness compared to Saturn and Titan it is necessary to turn off the Show setting by unchecking the box. The resulting image is shown in Figure 12a. As you can see in the example image at this point only Titan and Rhea both on the right are visible. We now use Gamma and Peak to bring the other moons into visibility and refine their appearance.

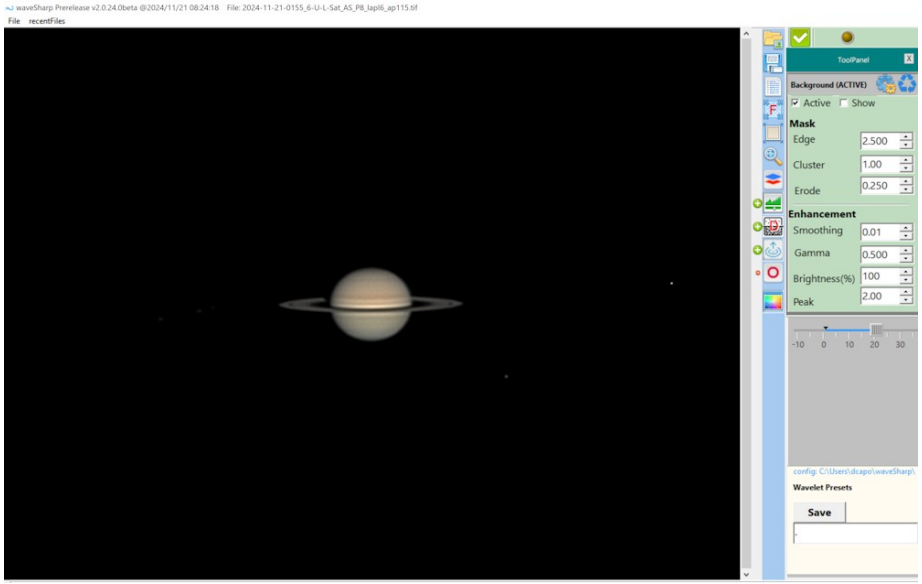

Figure 12a: Turning off Show by unchecking the box yields the current state of the image.

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As you might expect, we can drop the Gamma setting from the default value of 0.500 to the lowest value possible 0.001 and bring the faintest moons into view. The result is shown in Figure 13a

A couple of serious issues are clearly evident in Figure 13a: Firstly, Titan is nearly the faintest moon in the image (a result of leaving it in the base image); Secondly, each of the moons brought up from the background are larger than Titan (with the exception of Enceladus on the left) which is also no a desired outcome. We correct these deficiencies using a combination of Peak and Brightness. There are hundreds of possible combinations but Figure 14a shows the result of setting Peak to 3.50 and lowering the Brightness to a value of 45. This yields moons that appear more natural in comparison with Titan which was left in the base image.

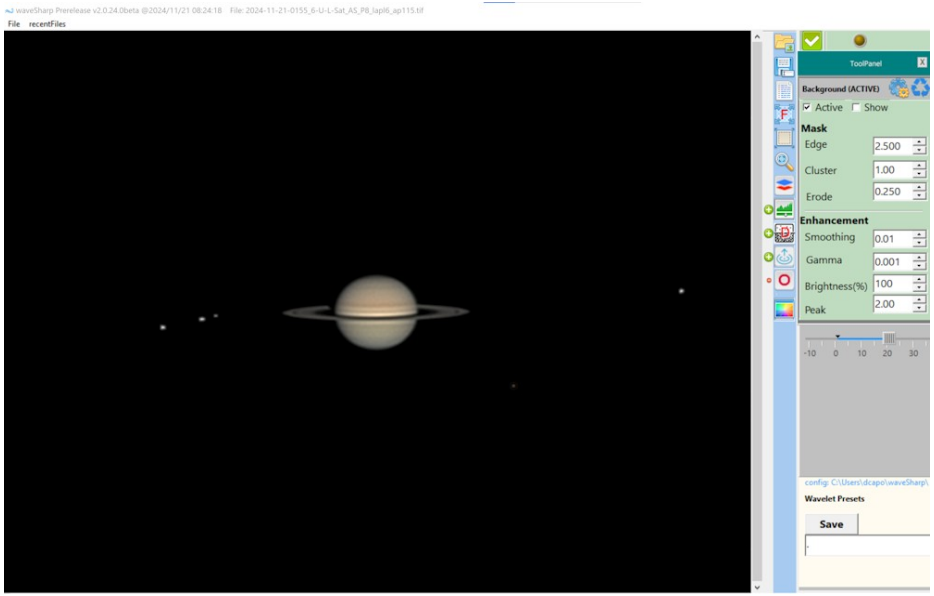

Figure 13a: Dropping Gamma to the lowest setting brings the fainter moons into view.

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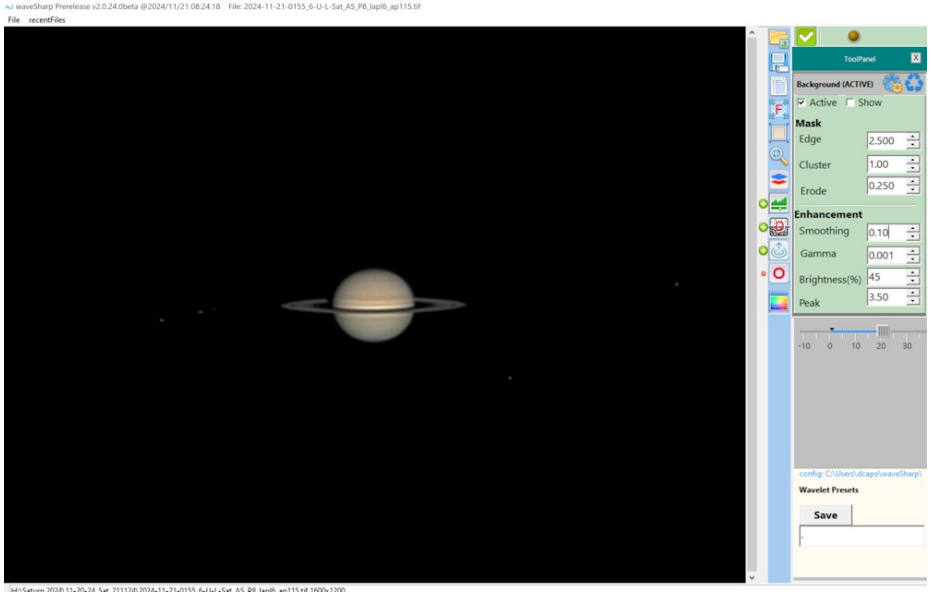

Figure 14a: Peak and Brightness are adjusted to ensure the extracted moons match the overall brightness and shape of other moons in the image.

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Alternative Processing Example – Leaving Titan in the Background

Return to Show checked and examine the result of increasing Edge sufficiently to keep Titan fully in the background. In Figure 11b this is shown by having chosen a value of Edge at 4.500. Notice a slight impact on the ring tips shown by the red dots at either end of the rings. Developing this feature much beyond this level results in bright spots forming in the final image at the ends of the rings. This degree of effect generally yields no impact in the final image. The advantage to keeping Titan in the background is that now all the moons comes into view at their correct relative brightnesses which I find easier to merge into a believable image. The disadvantage is that Titan will have lost it's natural color.

Continuing to process is similar manner as before yields the following resulting steps.

Figure 11b: Setting Edge to 4.500, now leaves Titan fully in the background.

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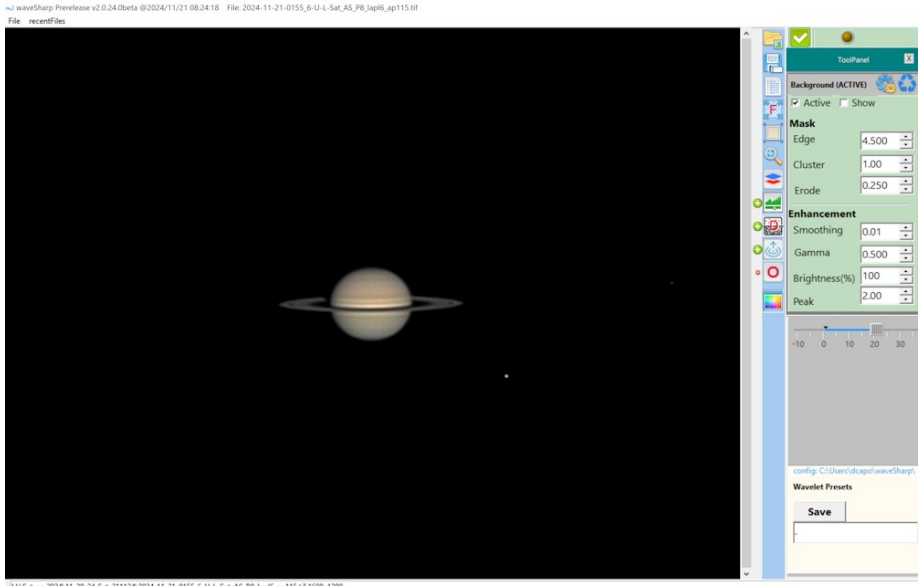

Figure 12b: Erode at 0.250 Show unchecked.

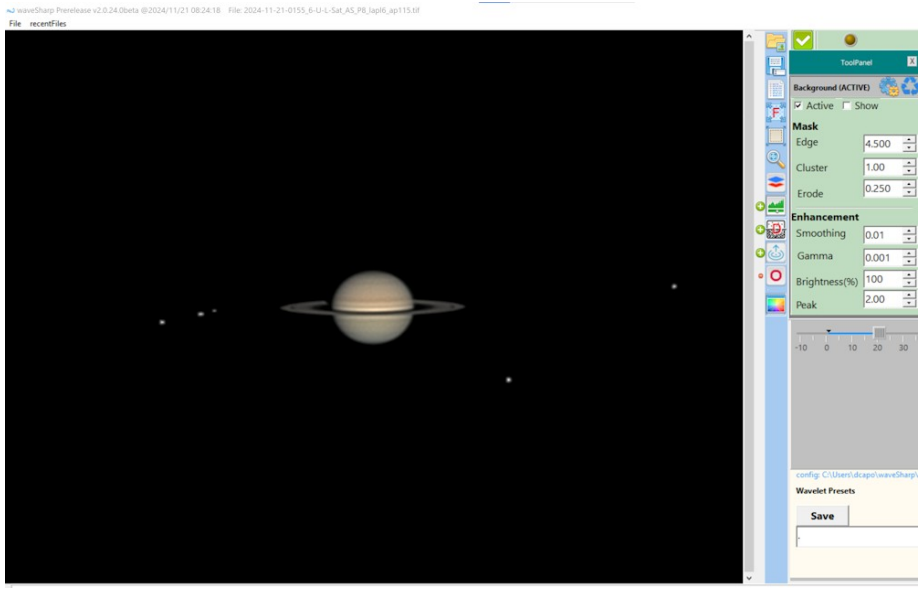

Figure 13b: Gamma dropped to 0.001

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Figure 14b: Set Peak to 3.50 and decrease brightness to 60% yields this result.

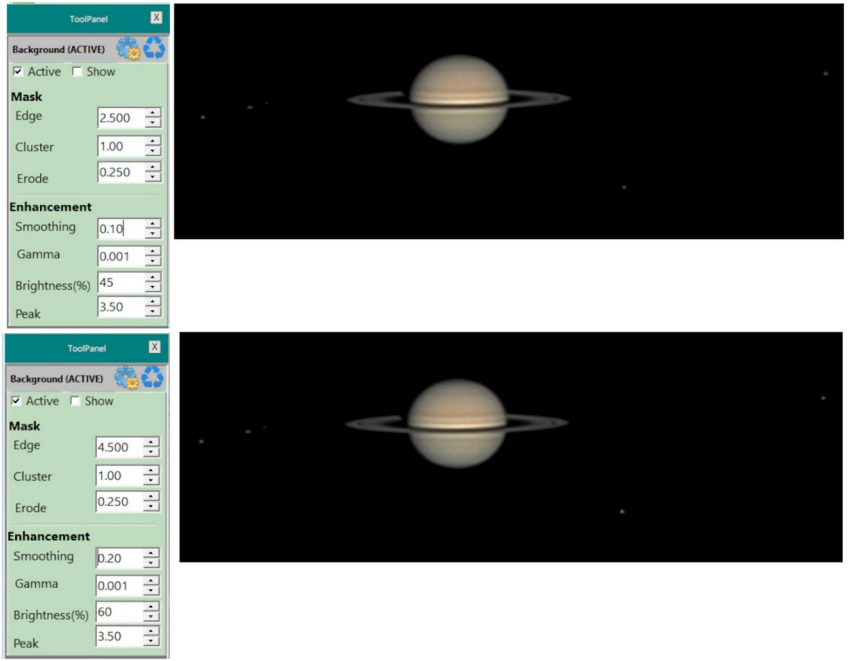

Figure 15: Side by side comparison of the two approaches described in this how-to.