

LEBANON CAMERA CLUB

Noise Reduction

Keith Kotay

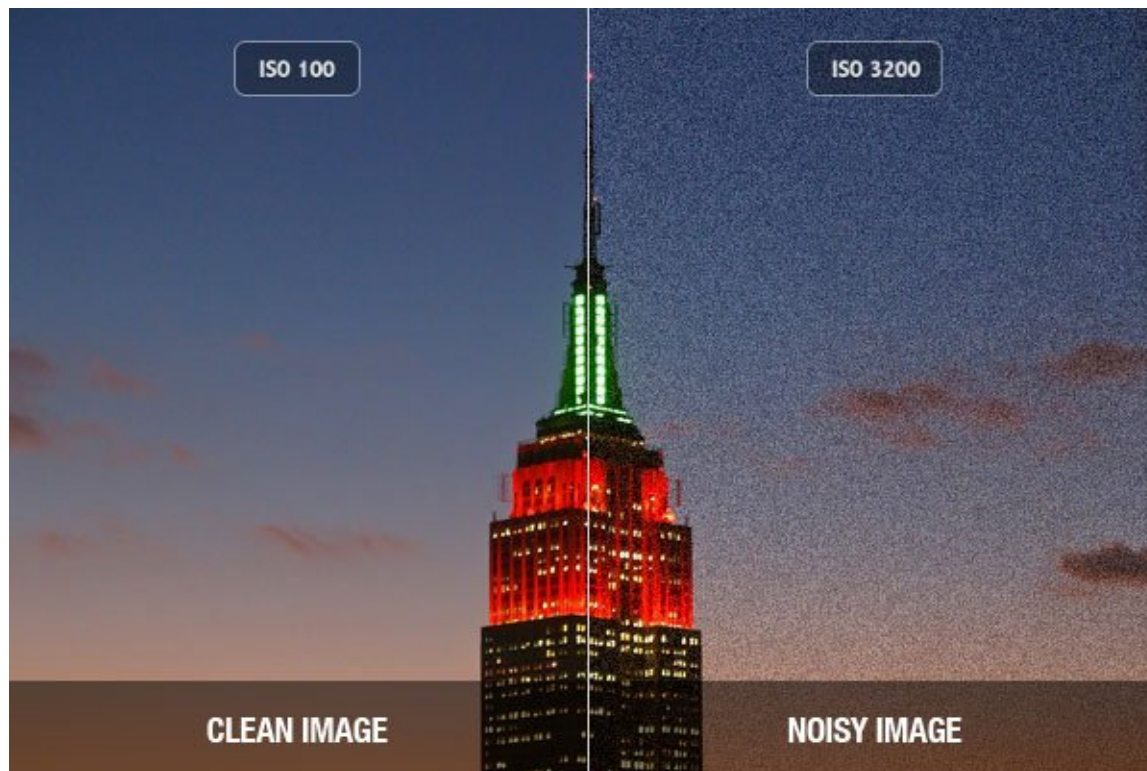
11/5/2024

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Noise Reduction

Introduction

- Image noise
 - ♦ Random variation of brightness or color information
 - Undesirable → obscures detail, lowers contrast, adds rough texture
 - Most noticeable in uniform areas → sky, water, blank walls, etc.

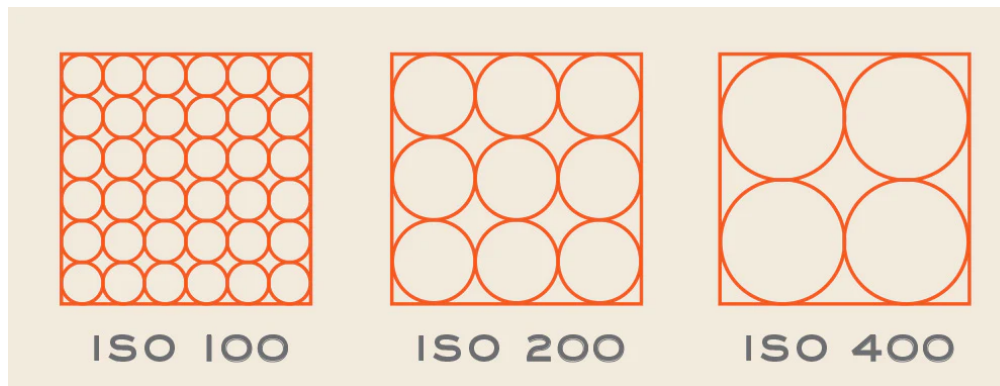


Noise Reduction

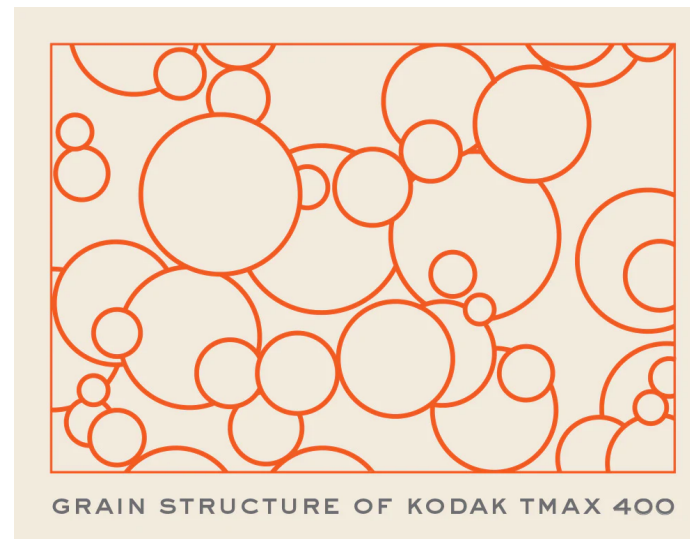
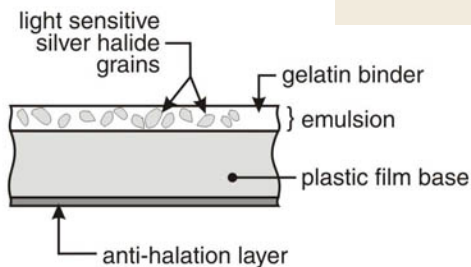
Introduction

Note: Faster film has larger photosensitive silver halide 'grains', which are more likely to undergo chemical transformation when hit by photons.

- Image noise
 - ♦ Random variation of brightness or color information
 - Undesirable → obscures detail, lowers contrast, adds rough texture
 - Most noticeable in uniform areas → sky, water, blank walls, etc.
 - ♦ Film: noisy photos called 'grainy'
 - More prevalent in faster film (higher ISO), and night shots



© Richard Photo Lab



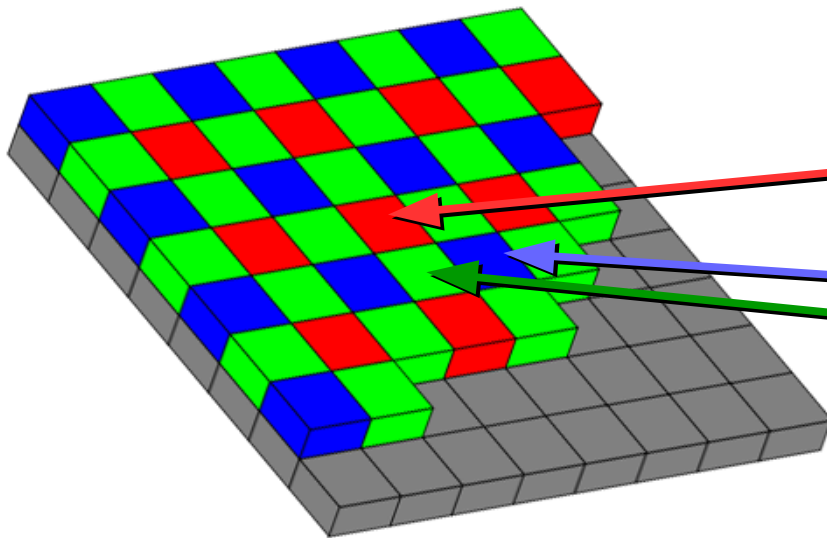
Noise Reduction

Introduction

Note: Pixels are photosensitive sites that convert photons (light) to electrical charge, which can be translated into numbers → bigger number = more light.

- Image noise

- ♦ Random variation of brightness or color information
 - Undesirable → obscures detail, lowers contrast, adds rough texture
 - Most noticeable in uniform areas → sky, water, blank walls, etc.
- ♦ Digital: many sources, can be reduced to some extent
 - Issue: noise reduction reduces detail and sharpness



digital image sensor pixel array

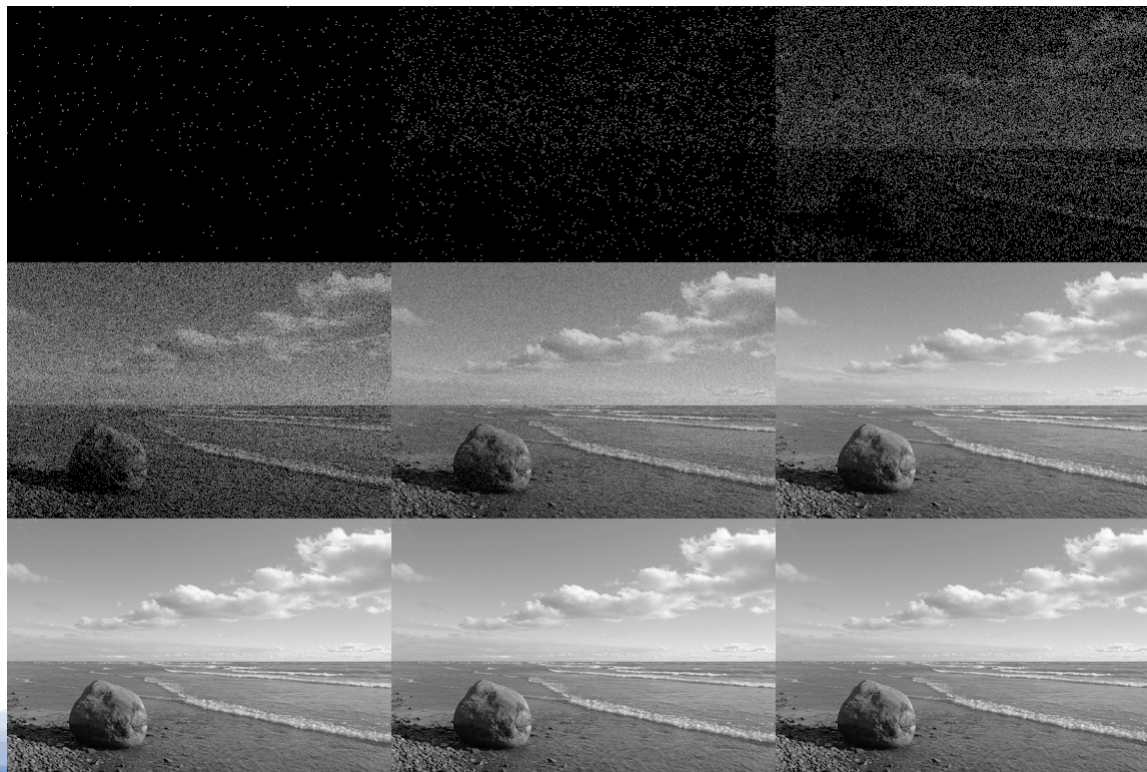


think of pixels as light 'buckets'
which start out empty and are filled
while the shutter is open

Noise Reduction

Digital noise types

- Shot noise
 - ♦ Randomness due to photon distribution
 - Some pixels get hit by more photons than other pixels
 - Film also → not all grains are hit by enough photons to change
 - One of the components of random noise



Noise Reduction

Digital noise types

Note: Electronic noise comes from electronic circuits in the camera. Salt-and-pepper noise (impulse noise) is from faulty pixels or memory errors.

- Random noise
 - ♦ Intensity and color fluctuations above & below actual values
 - Shot noise + electronic noise + salt-and-pepper noise
 - Pattern changes for each exposure, even if settings are the same
 - ♦ Increased by: higher ISO and greater temperature



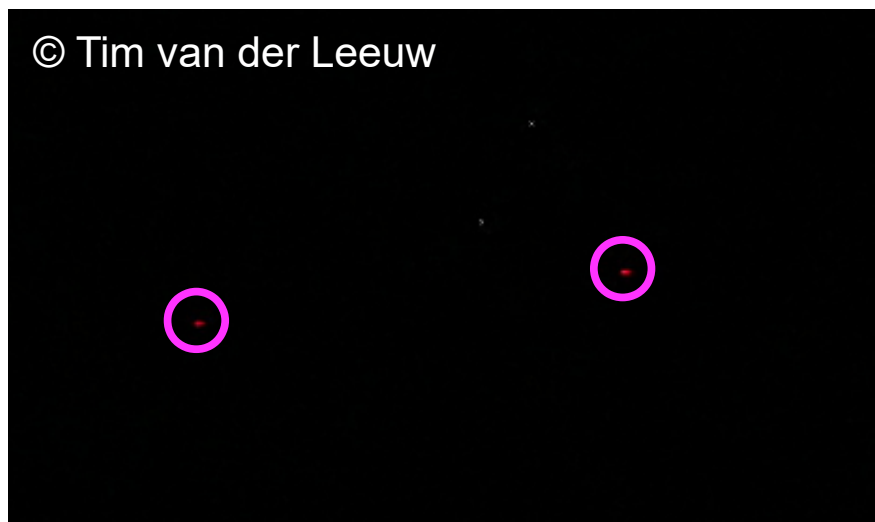
salt-and-pepper noise

Noise Reduction

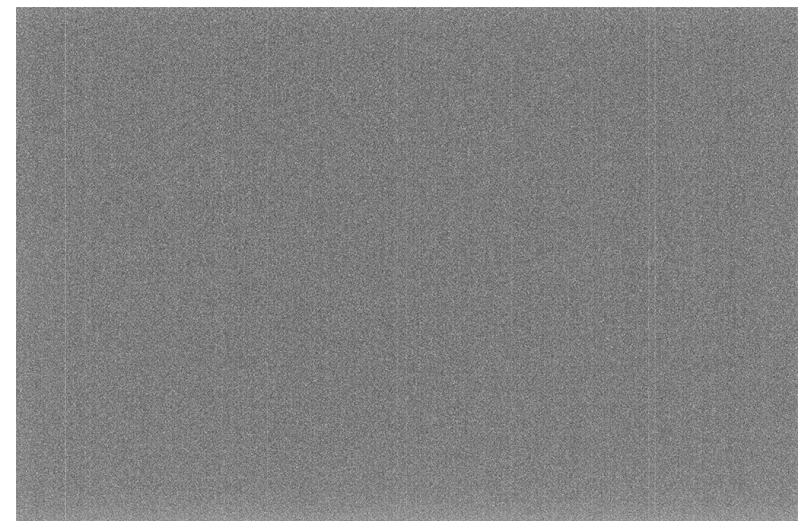
Digital noise types

Note: A “dark frame” is an image taken with no light hitting the sensor (lens cap on). Much of the resulting noise is fixed pattern noise.

- Fixed pattern noise
 - ♦ “Hot” or “dead” pixels → very bright or dark pixels
 - Pixels are damaged and no longer function properly
 - Pattern is repeatable
 - ♦ Individual pixel variation
 - Some pixels are more sensitive than others
 - ♦ Increased by: longer exposures and greater temperature



hot pixels in astrophotograph



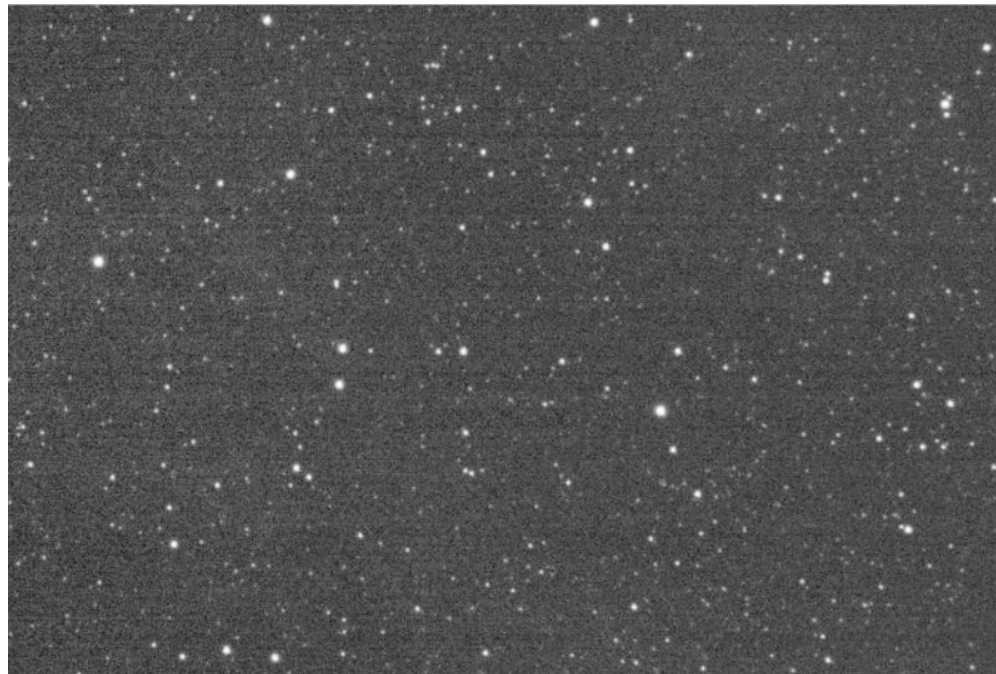
Nikon D300 dark frame image

Noise Reduction

Digital noise types

Note: Some digital cameras are more susceptible to banding noise than others. Many early camera models had noticeable banding noise.

- **Banding noise**
 - ♦ Vertical or horizontal bands in the image
 - Caused by camera reading data from pixels
 - Pattern is repeatable → usually seen in shadow areas
 - ♦ Increased by: higher ISO and image brightening in post



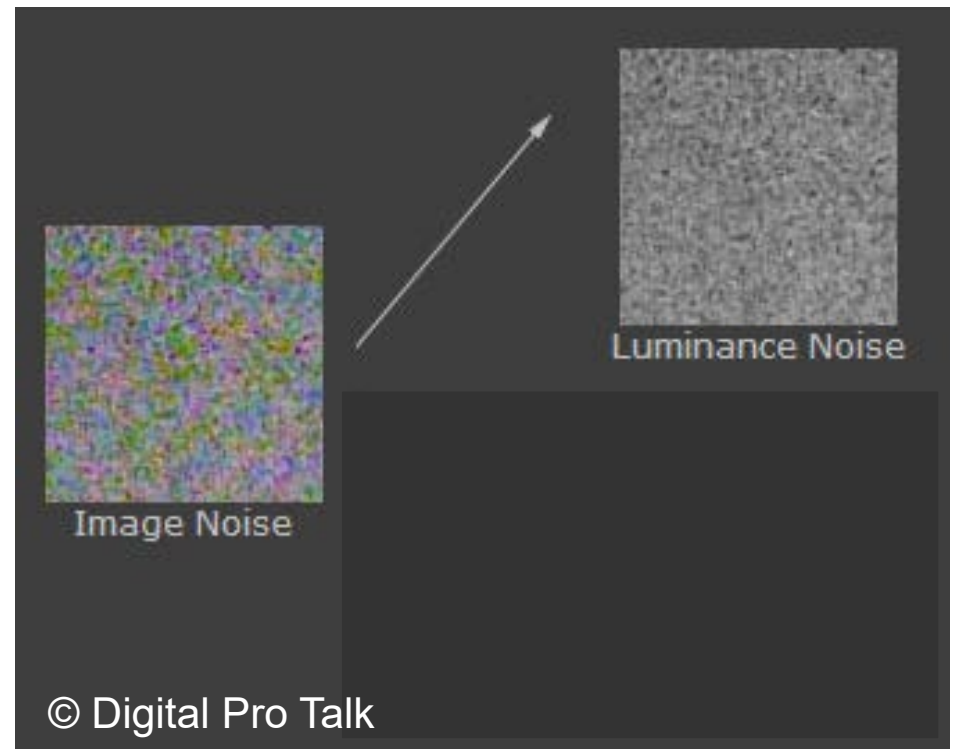
Noise Reduction

Digital noise descriptions

Note: Many noise reduction programs provide separate settings for luminance and chrominance noise.

- Luminance noise
 - ♦ Variations in pixel brightness
 - Grainy blank and white spots
- Chrominance noise (chroma/color noise)
 - ♦ Variations pixel colors
 - Out of place pixel colors

Note: Some cameras have more luminance noise, and other have more chrominance noise.

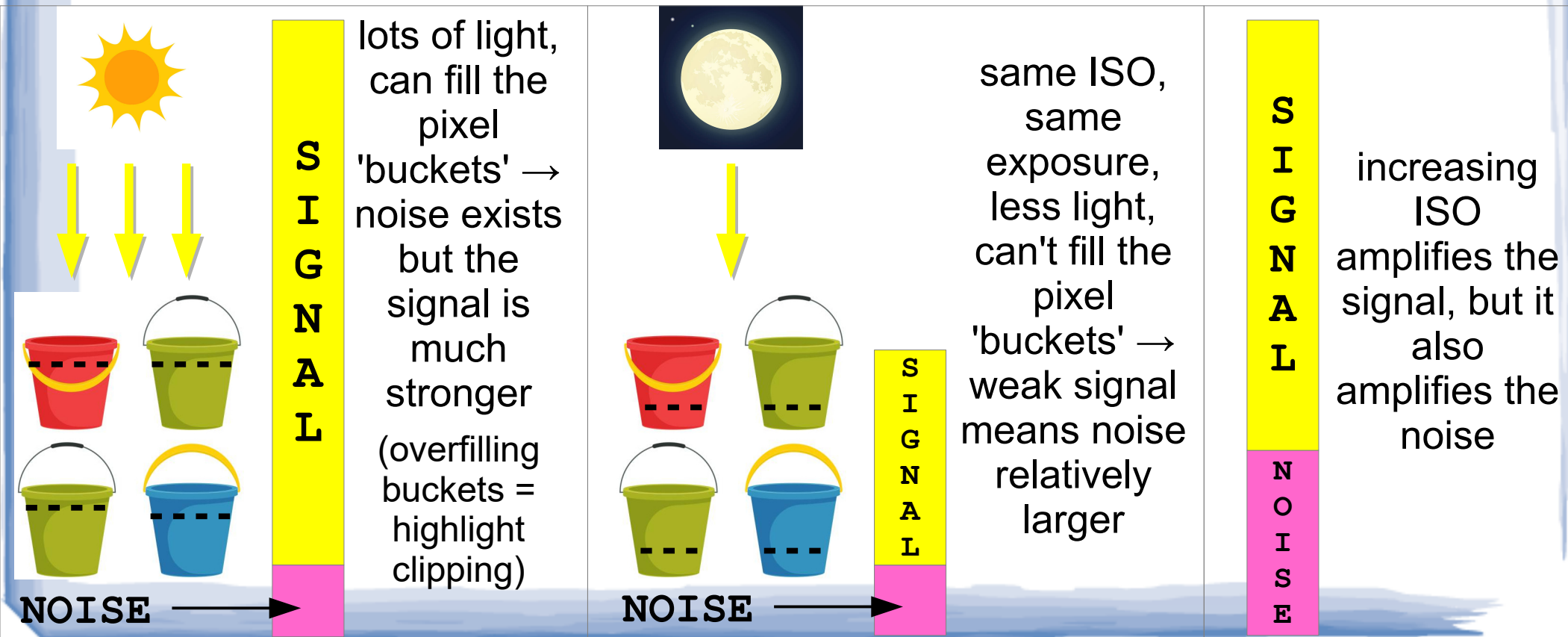


Noise Reduction

ISO

Note: The base sensitivity is usually the lowest ISO value, but some cameras have lower 'extended' ISO values which use base ISO and then processes the image to simulate a lower ISO → lower image quality.

- Measure of sensor sensitivity to light
 - ♦ Sensors have a base sensitivity → usually ISO 100 or 200
 - Increasing ISO → amplifying pixel charge values
 - Amplification also increases pixel deviations → increases noise

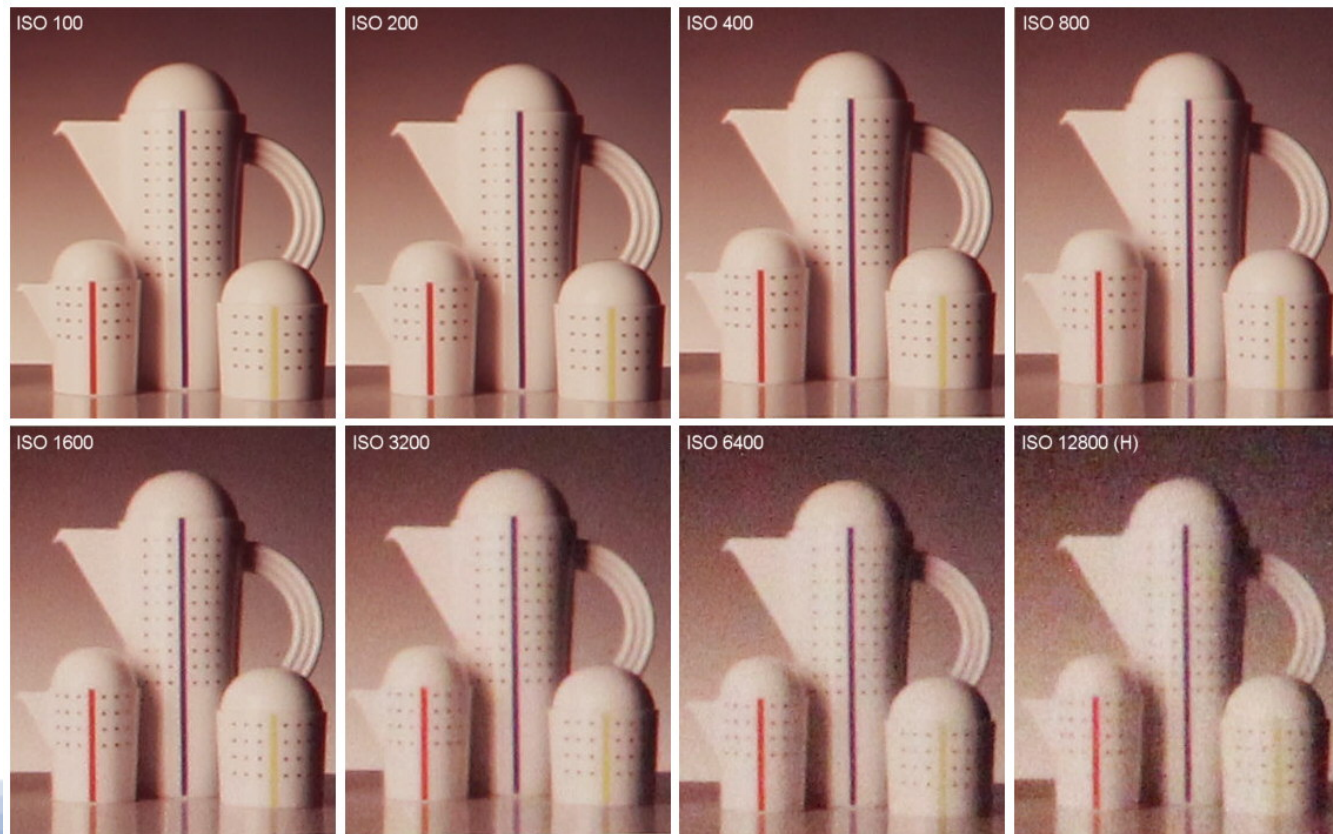


Noise Reduction

Reducing noise

Note: Downsizing an image tends to reduce noise because nearby pixels are combined. So less NR may be needed for competition images.

- Use a low ISO, if possible
 - ♦ Increasing ISO always increases noise
 - ♦ Sometimes you can't avoid high ISO
 - Sports/action photography
 - Shooting at night
 - Astrophotography



Noise Reduction

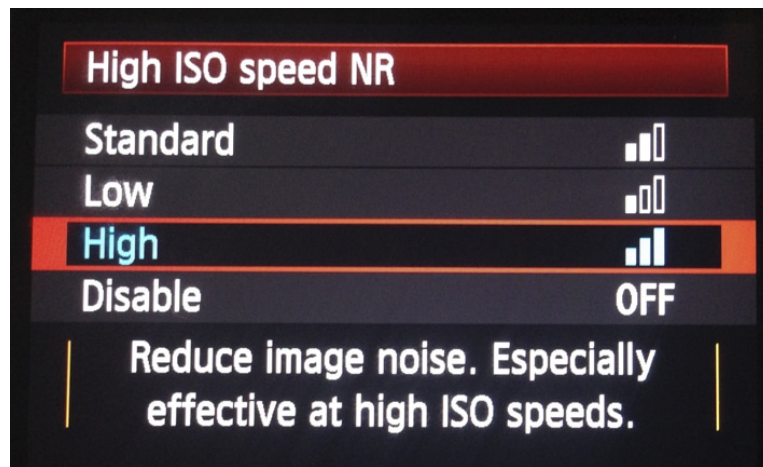
Reducing noise

Note: High ISO NR setting may be communicated to manufacturer's RAW developer application (e.g. Canon DPP, Nikon NX Studio) and applied accordingly.

- In camera NR
 - ♦ High ISO NR

- Camera setup setting, can turn on or off and possibly adjust amount
- Useful for JPEG shooting if you don't plan on editing
- Shooting RAW: may be useless unless using manufacturer RAW app
- In general, it's best to avoid it

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Canon High ISO NR menu



Noise Reduction

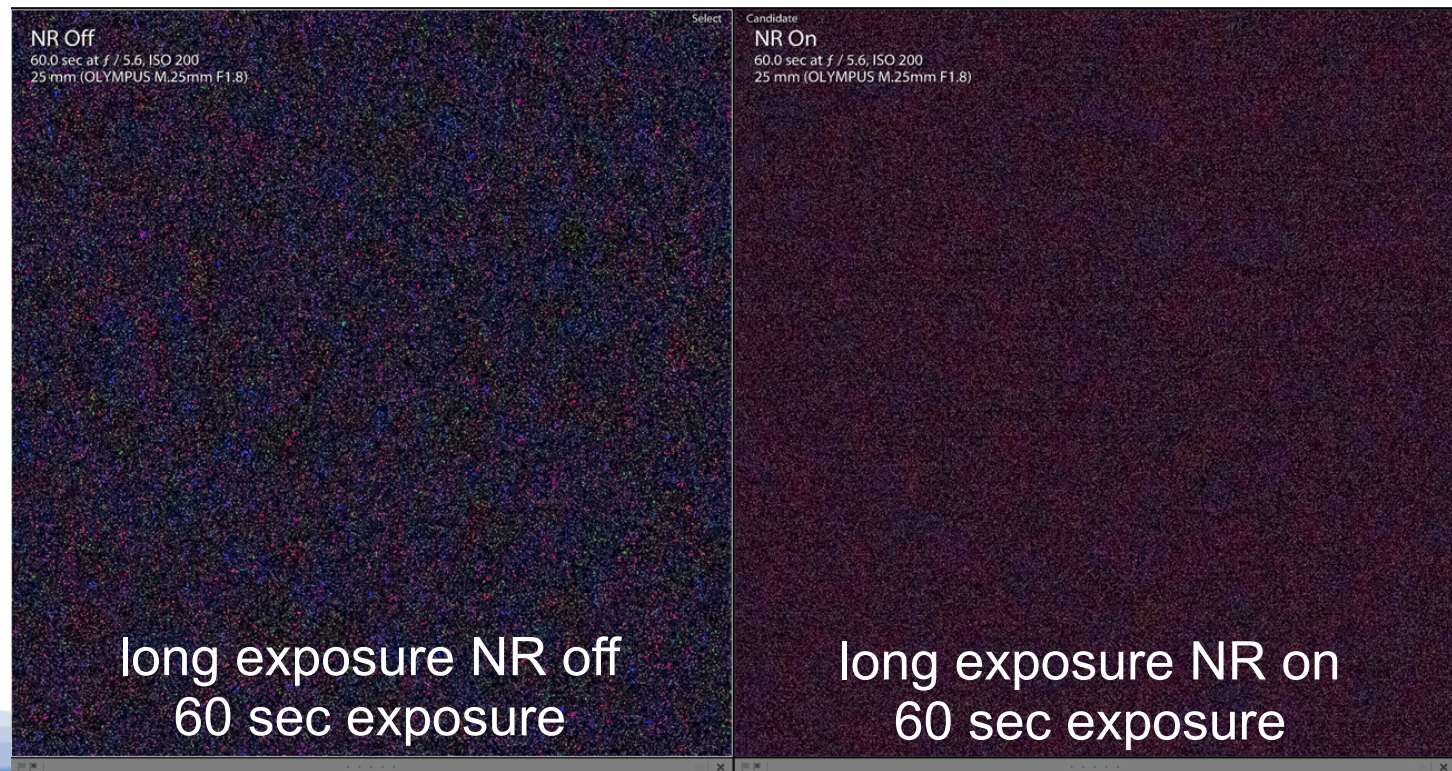
Reducing noise

Note: A dark frame is an image taken without capturing any light. Fixed pattern noise and banding are still present and can be subtracted from the normal image.

- In camera NR

- ♦ Long exposure NR → JPEG only on some cameras

- Camera setup setting, can turn on or off
- If on, applied automatically for long exposures (~1 second or greater)
- Dark frame taken, combined with normal exposure to reduce noise



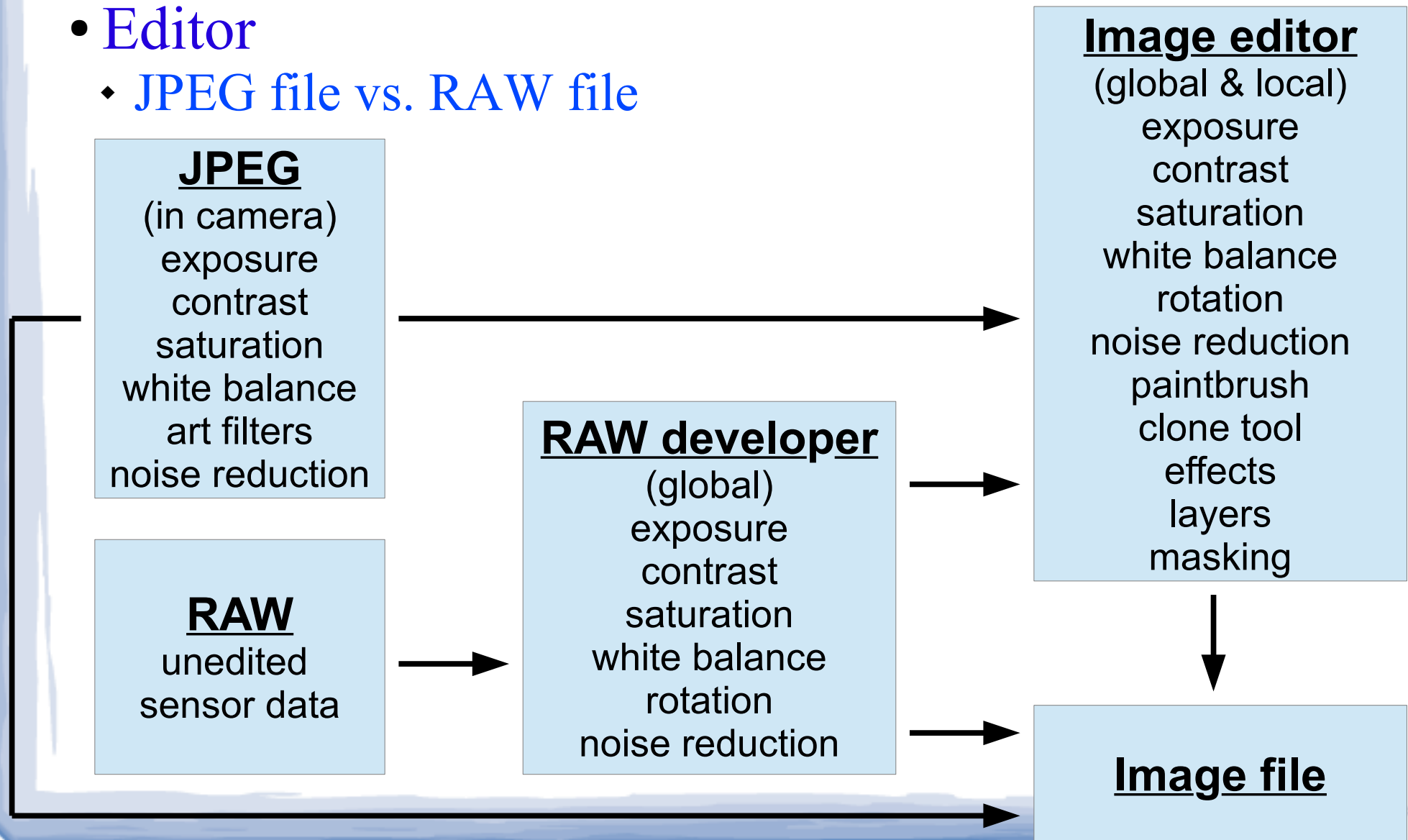
Olympus EM1 mkII
long exposure NR
example

Noise Reduction

Reducing noise

Note: A RAW developer may be integrated in the image editor → Adobe Camera Raw is part of Lightroom, it is controlled through the Lightroom user interface.

- **Editor**
 - ♦ **JPEG file vs. RAW file**

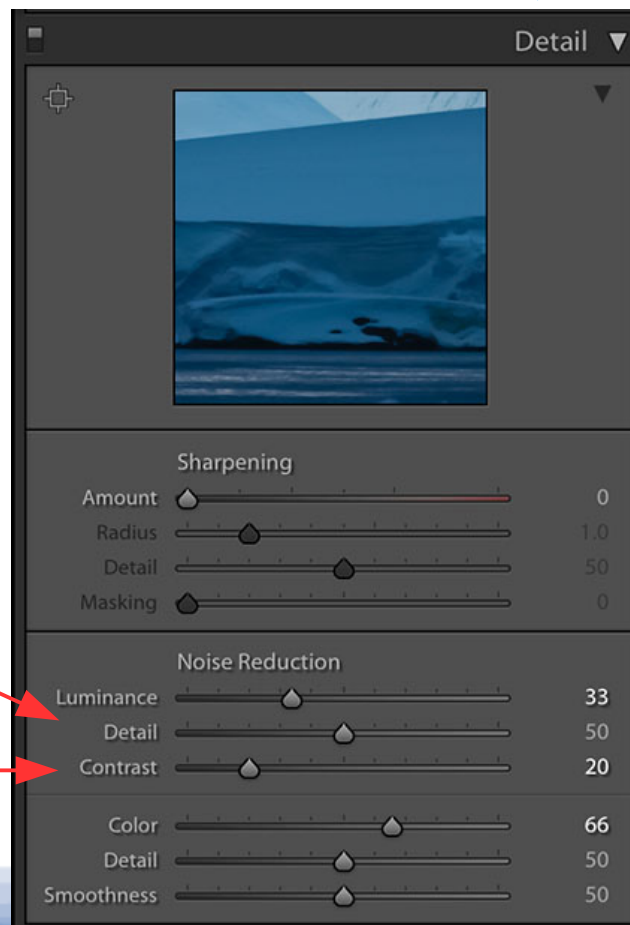


Noise Reduction

Reducing noise

Note: The detail adjustment in noise reduction is for restoring detail removed by noise reduction. It is often just a type of sharpening.

- Editor – RAW developer
 - ♦ Adobe Camera Raw → paid (subscription)
 - Separate luminance and chrominance (color) controls



detail → restores
detail lost in NR

contrast → restores
contrast lost in NR

Note: It is best to view the image at 100% so you can clearly see the effect of the noise reduction.

smoothness →
smooths out color
variations

Noise Reduction

Reducing noise

Note: AfterShot Pro used to be the program Bibble, which was acquired by Corel in 2012. ASP is now integrated into Corel PaintShop Pro.

- Editor – RAW developer
 - ♦ Corel AfterShot Pro → paid (one time)
 - RAW Noise → impulse (salt-and-pepper) noise reduction
 - Perfectly Clear Noise Removal



Noise Reduction

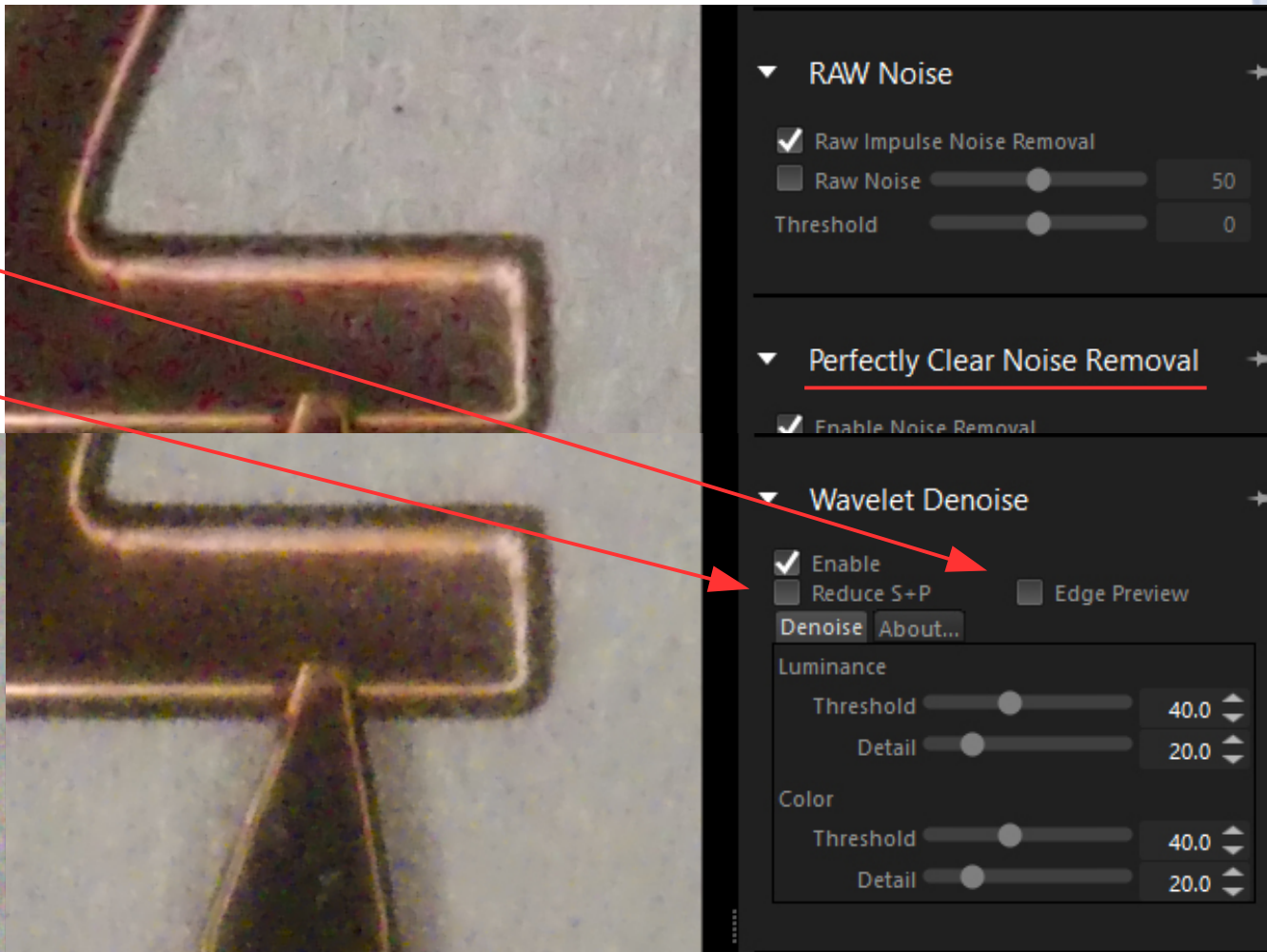
Reducing noise

Note: A wavelet transform is a way of deconstructing a signal so it can be processed more efficiently and then reconstructed. Wavelets are often used to reduce noise.

- Editor – RAW developer
 - ♦ Corel AfterShot Pro → paid (one time)
 - Wavelet Denoise

previews detected edges
(used to adjust params)

reduces salt-and-pepper
noise



Noise Reduction

Note: High detail values can accentuate the noise → image resembles initial photo.

Reducing noise

- Editor – RAW developer
 - ♦ Corel AfterShot Pro → paid (one time)
 - Wavelet Denoise




all images ISO 3200




exposure +1 stop



exp +1, luminance NR 50



exp +1, lum 50 & detail 75,
col 50 & detail 75



exp +1, luminance 50,
color 50



exp +1, color NR 50

Noise Reduction

Reducing noise

Note: Excessive noise reduction can cause artifacts, such as dark spots in bright areas.

- Editor – RAW developer
 - ♦ Corel AfterShot Pro → paid (one time)
 - Wavelet Denoise



all images ISO 3200




exposure +1 stop



exp +1, luminance NR 50



exp +1, luminance NR
100, color NR 100



exp +1, luminance NR 50,
color NR 50



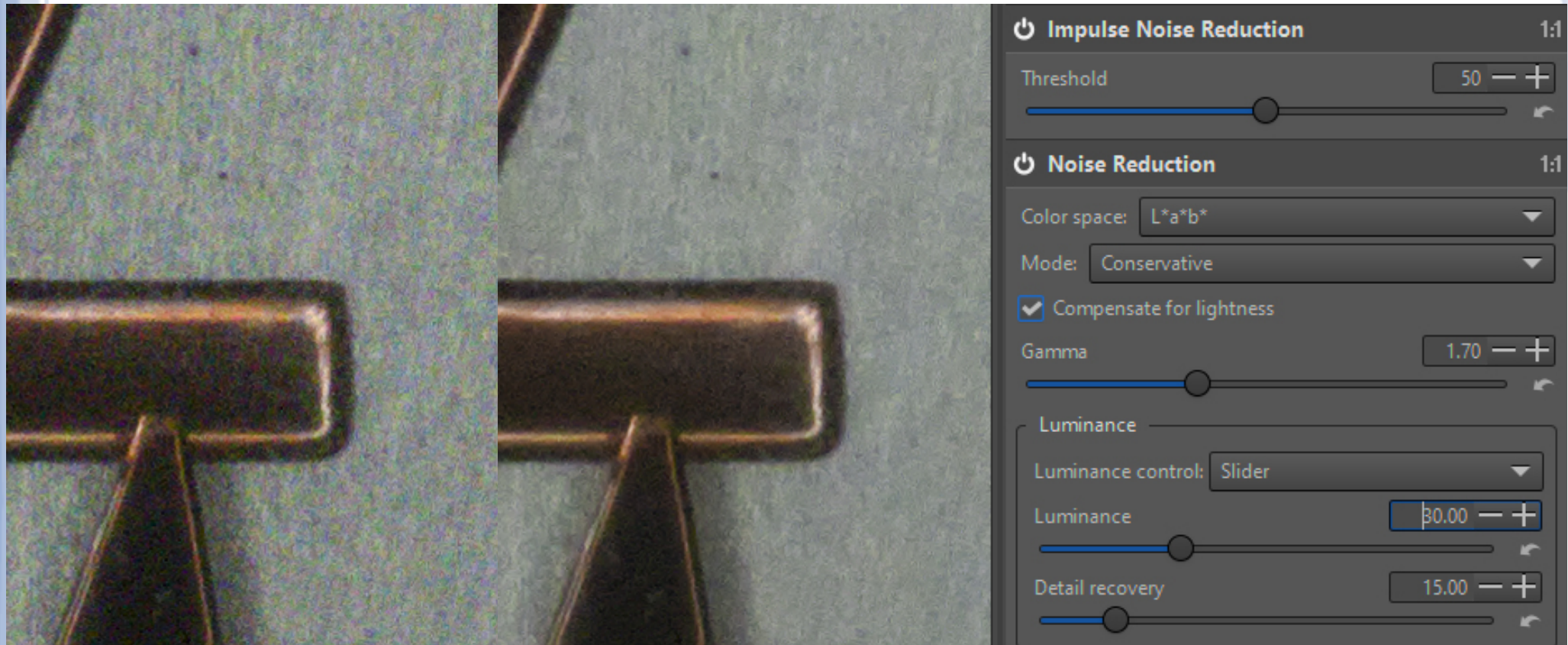
exp +1, color NR 50

Noise Reduction

Reducing noise

Note: A median filter replaces the center pixel of a window (e.g. 3x3 pixels) with the average value for the window, and is done for every window location in the image.

- Editor – RAW developer
 - ♦ RAWTherapee → free
 - Impulse, luminance, chrominance, median filter



includes luminance NR and chrominance NR

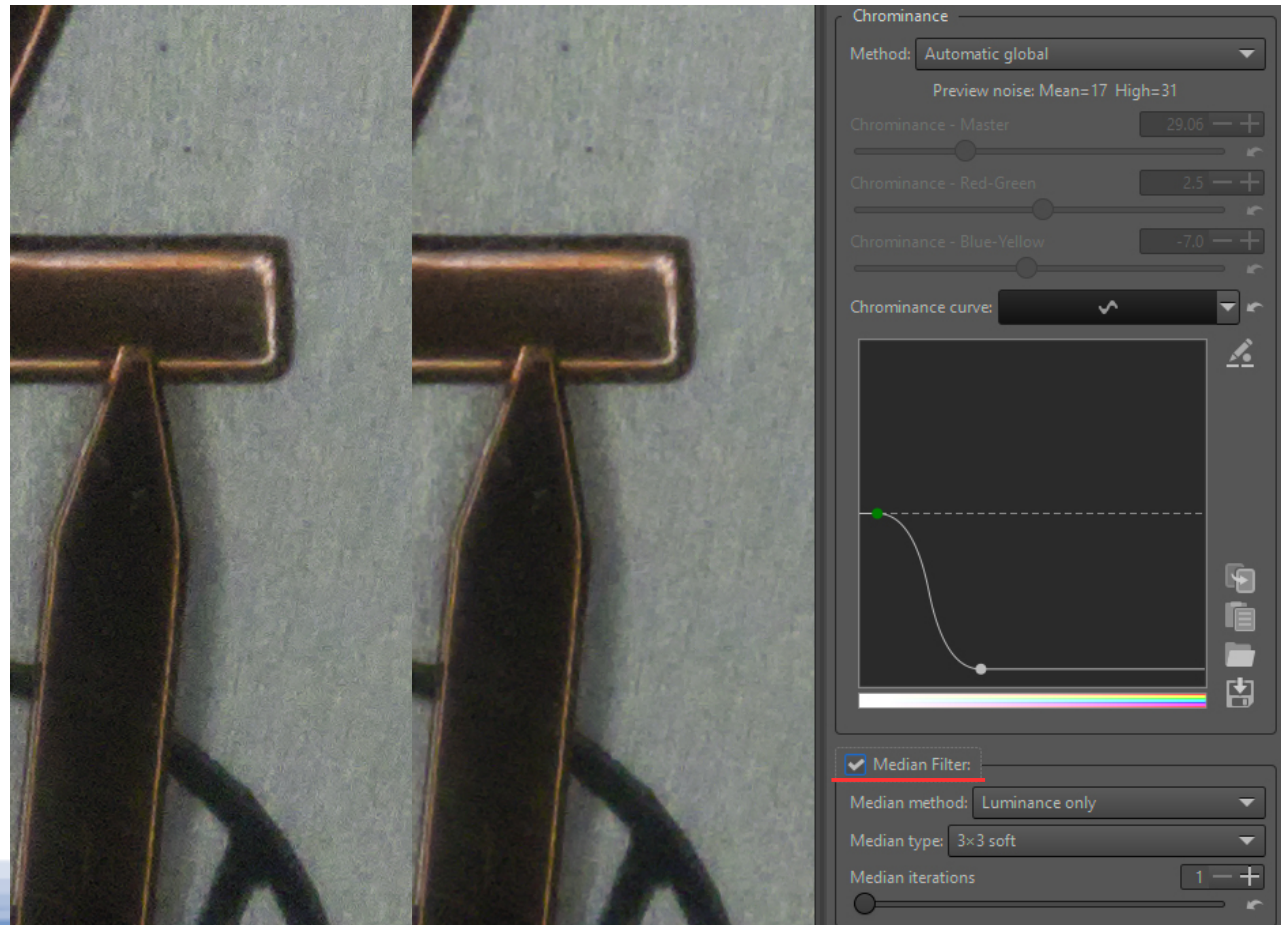
Noise Reduction

Reducing noise

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 - Impulse, luminance, chrominance, median filter

includes luminance
NR and
chrominance NR

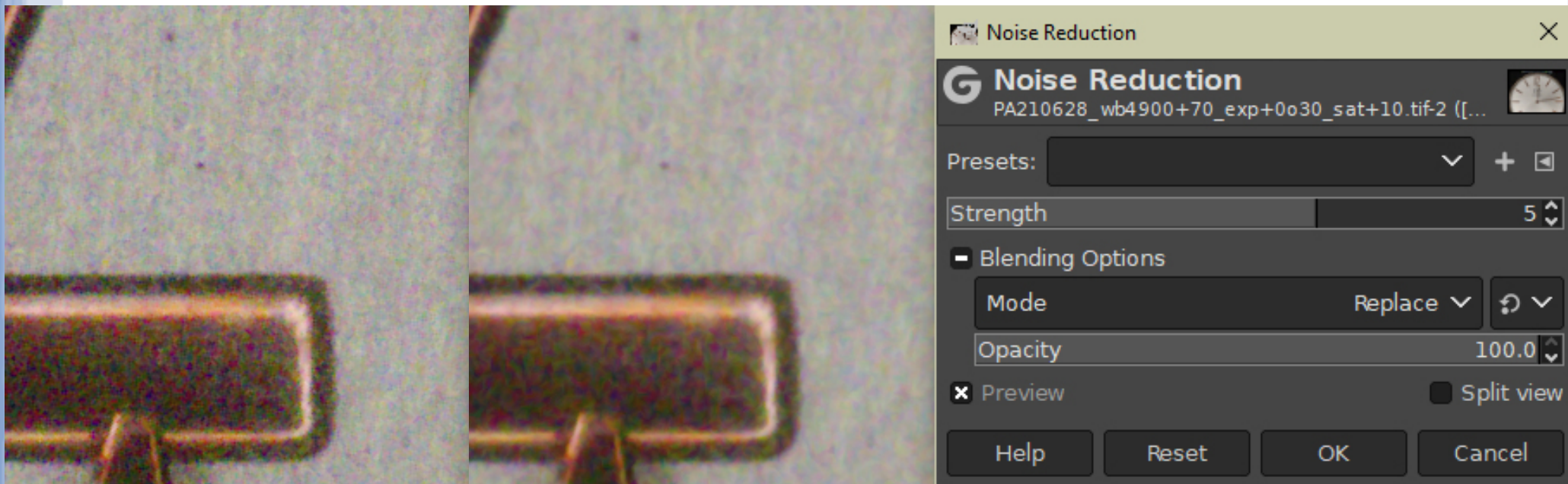


Noise Reduction

Reducing noise

Note: Gimp is a free image editor. It does not process RAW files, so a RAW developer is needed.

- Editor – Image editor
 - ♦ Gimp → free
 - Strength control and blending options (with opacity)

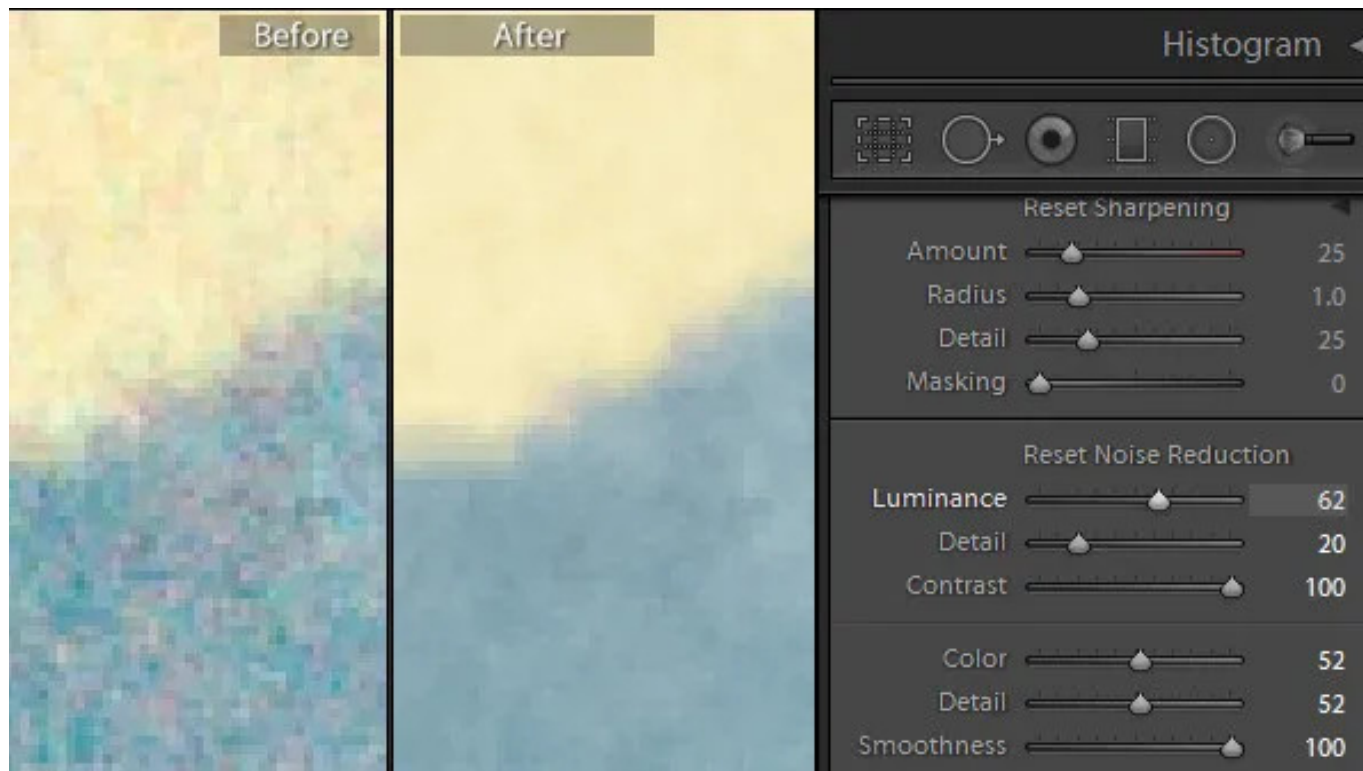


Noise Reduction

Reducing noise

Note: A RAW developer may be integrated in the image editor → Adobe Camera Raw is part of Lightroom, it is controlled through the Lightroom user interface.

- Editor – Image editor
 - ♦ Lightroom → paid (subscription or one time)
 - Separate luminance and chrominance controls

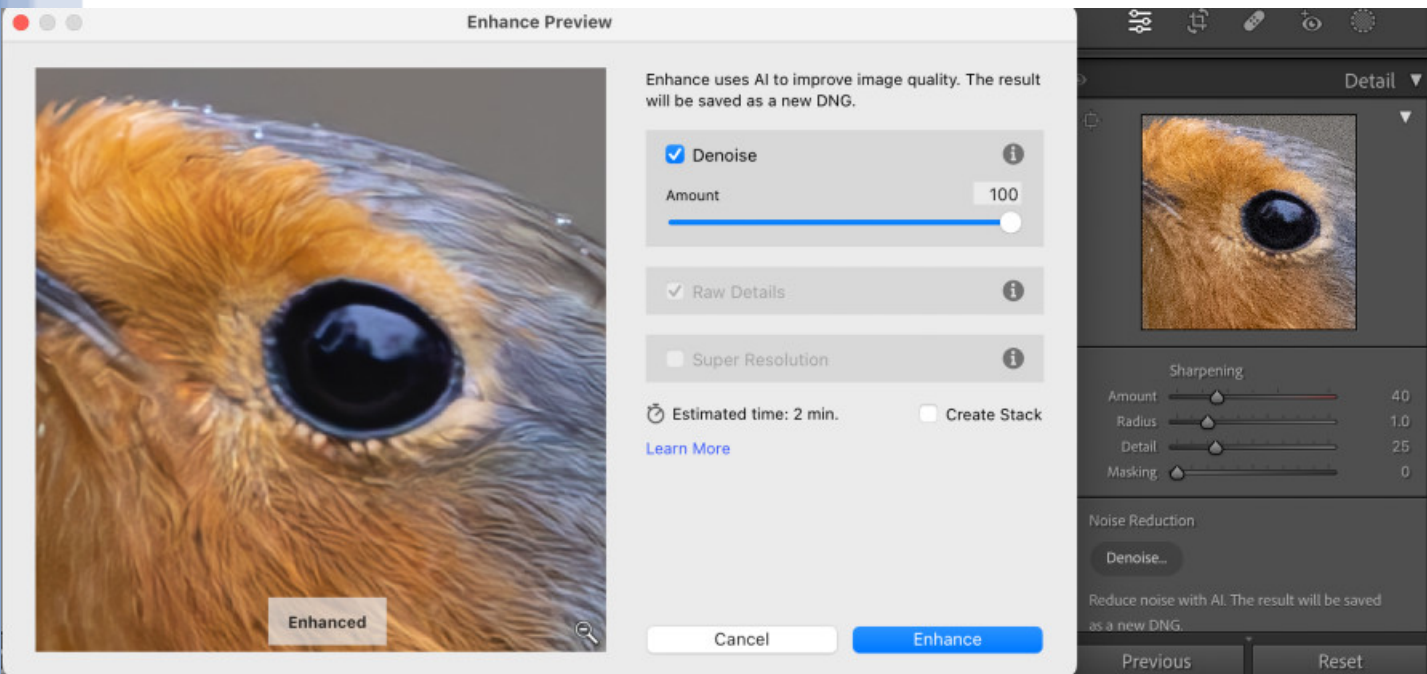
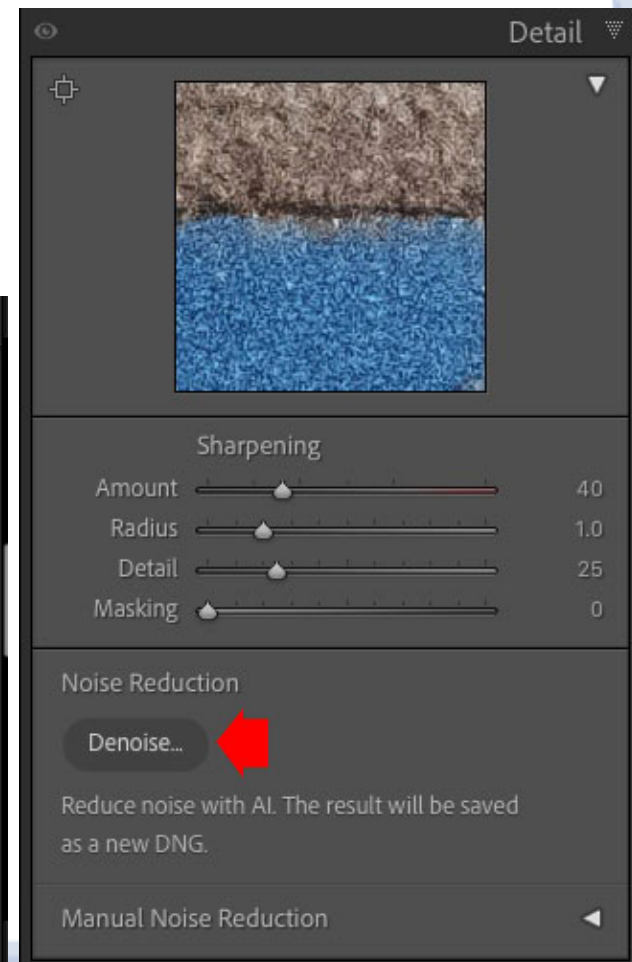


Noise Reduction

Reducing noise

Note: 'AI' stands for 'artificial intelligence' → software has been 'trained' on numerous image examples, and can identify and remove noise while preserving details.

- Editor – Image editor
 - ♦ Lightroom → paid (subscription or one time)
 - Separate luminance and chrominance controls
 - Newer versions have AI denoise



Noise Reduction

Reducing noise

- Editor – Image editor
 - ♦ Corel PaintShop Pro → paid (one time)
 - One Step Noise Reduction → no controls



original image

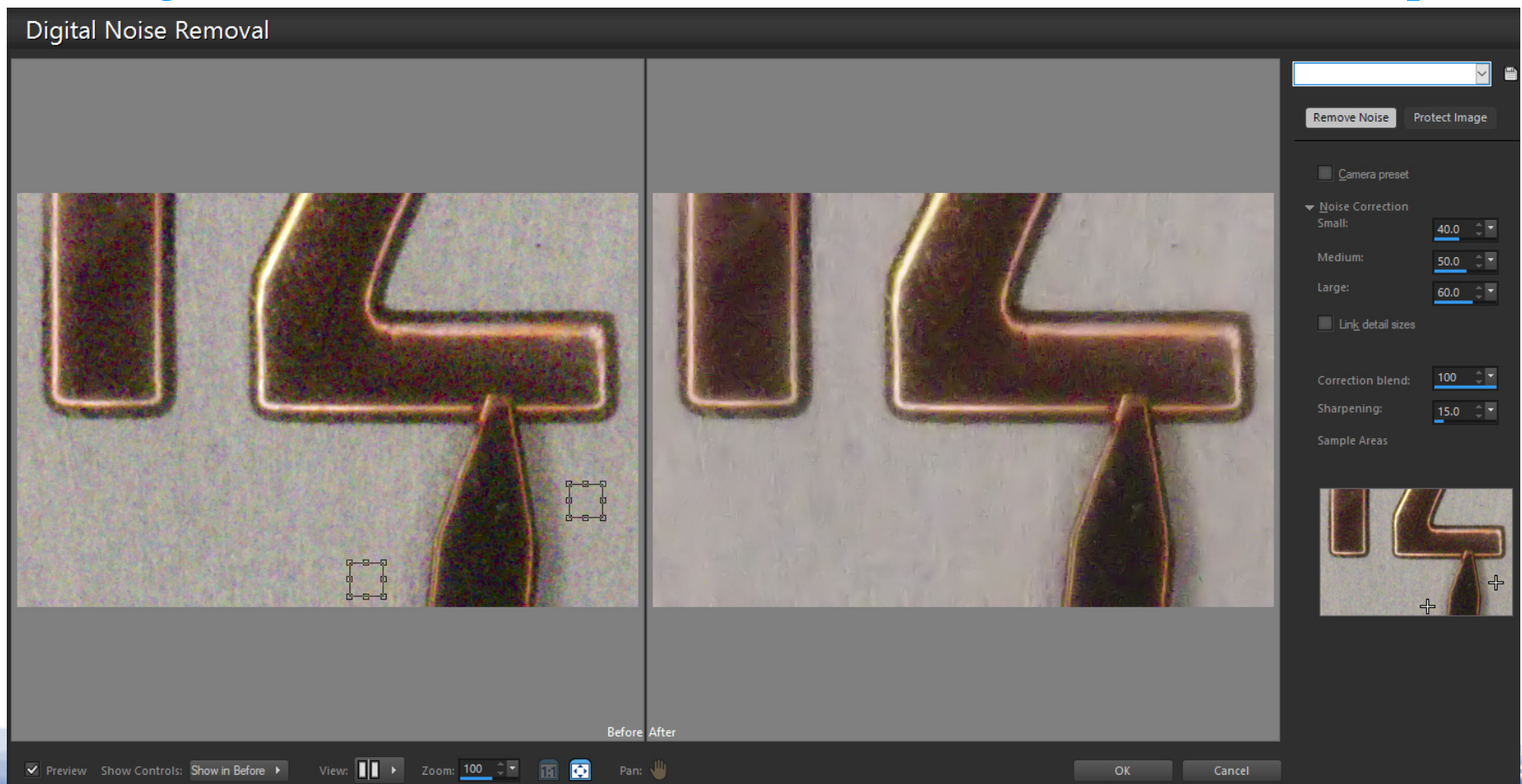


One Step Noise Reduction

Noise Reduction

Reducing noise

- Editor – Image editor
 - ♦ Corel PaintShop Pro → paid (one time)
 - Digital Noise Removal → S, M, L correction + blend + sharpening

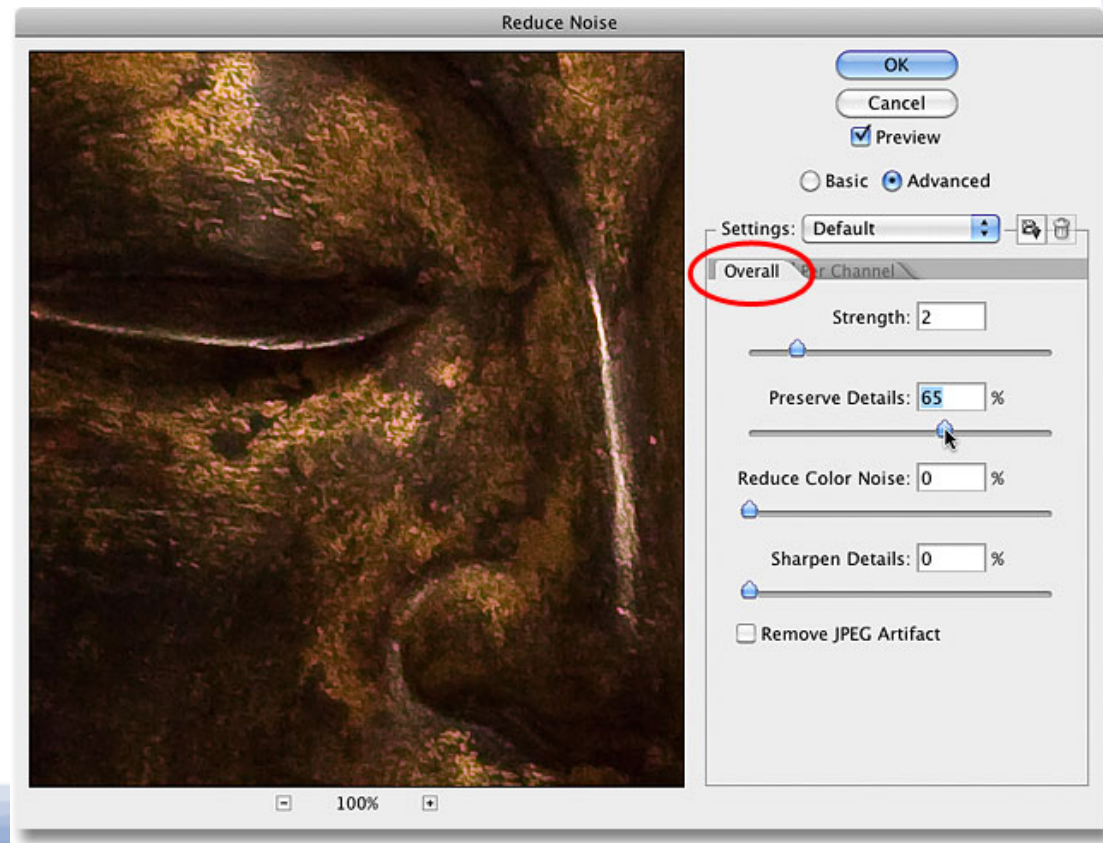
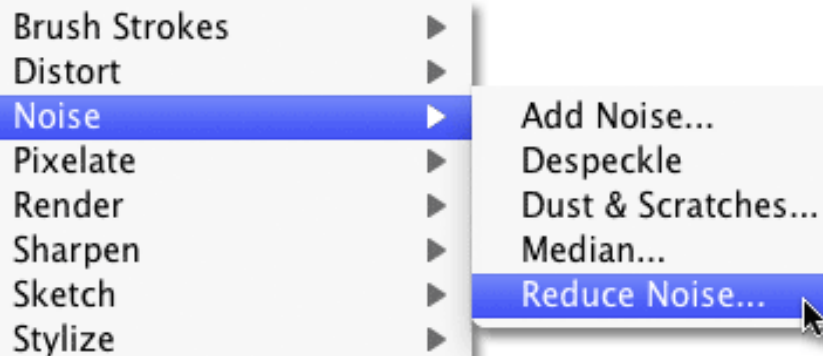


Noise Reduction

Reducing noise

Note: There are many versions of Photoshop. It is impossible to cover all the noise reduction features.

- Editor – Image editor
 - ♦ Photoshop → paid (subscription)
 - Separate luminance and chrominance controls
 - Overall NR and Per Channel NR (can process red, green, and blue separately)

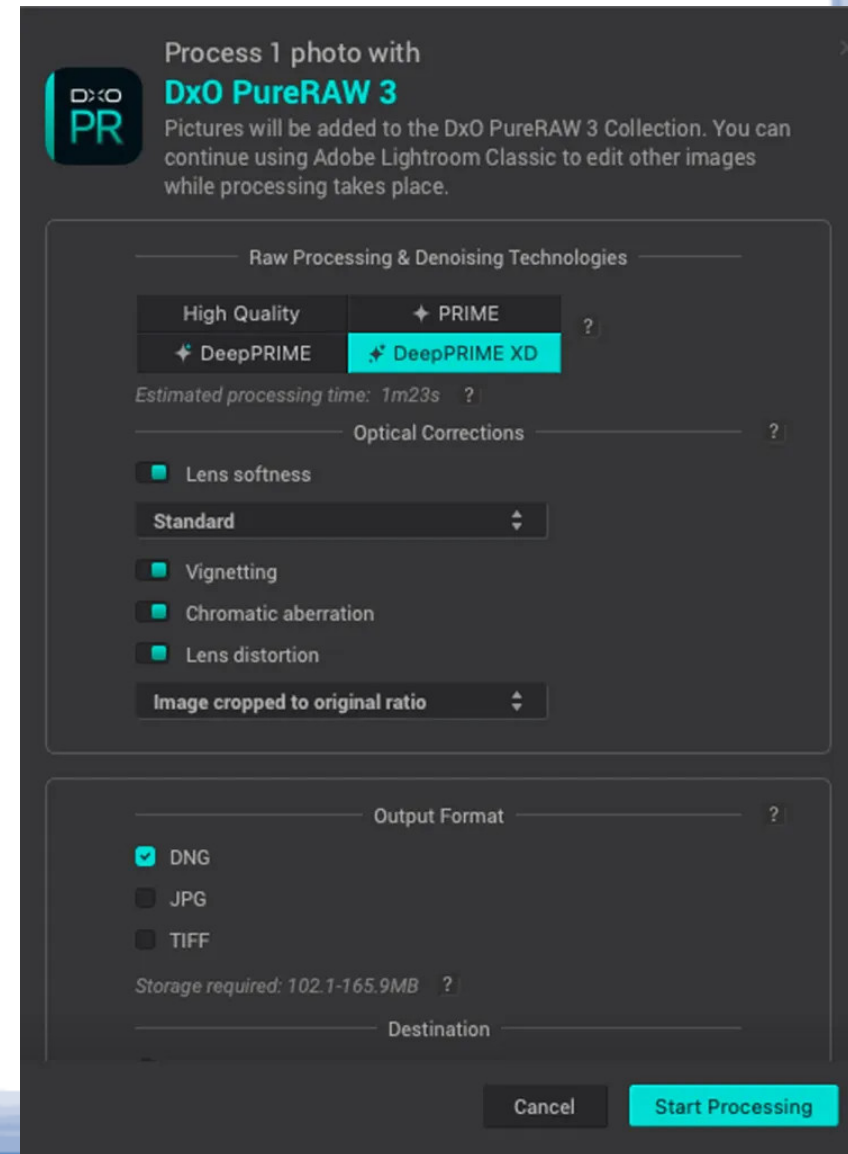
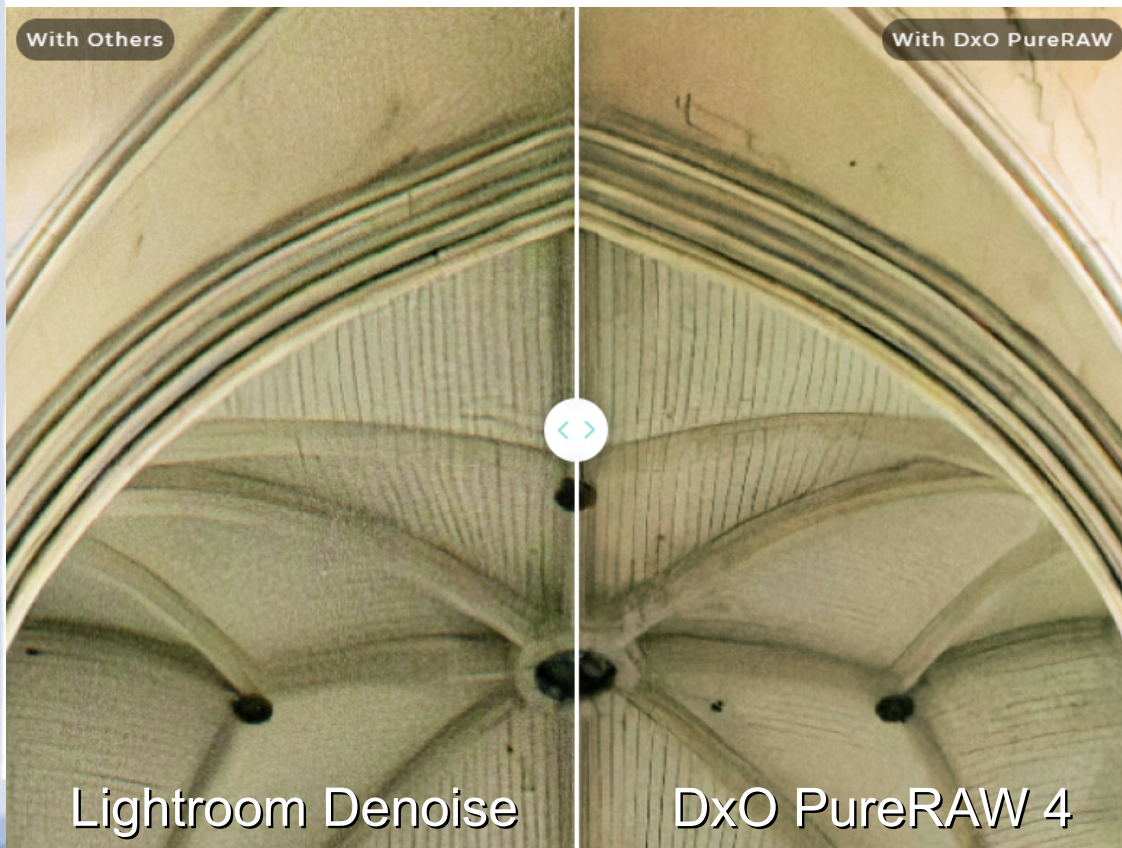


Noise Reduction

Reducing noise

Note: The DxO PureRAW package contains six technologies: lens softness, demosaicing, noise reduction, distortion adjustments, CA reduction, and vignetting correction.

- Editor – Apps & plugins
 - ♦ DxO PureRAW → paid (one time)
 - Standalone or plugin
 - AI noise reduction

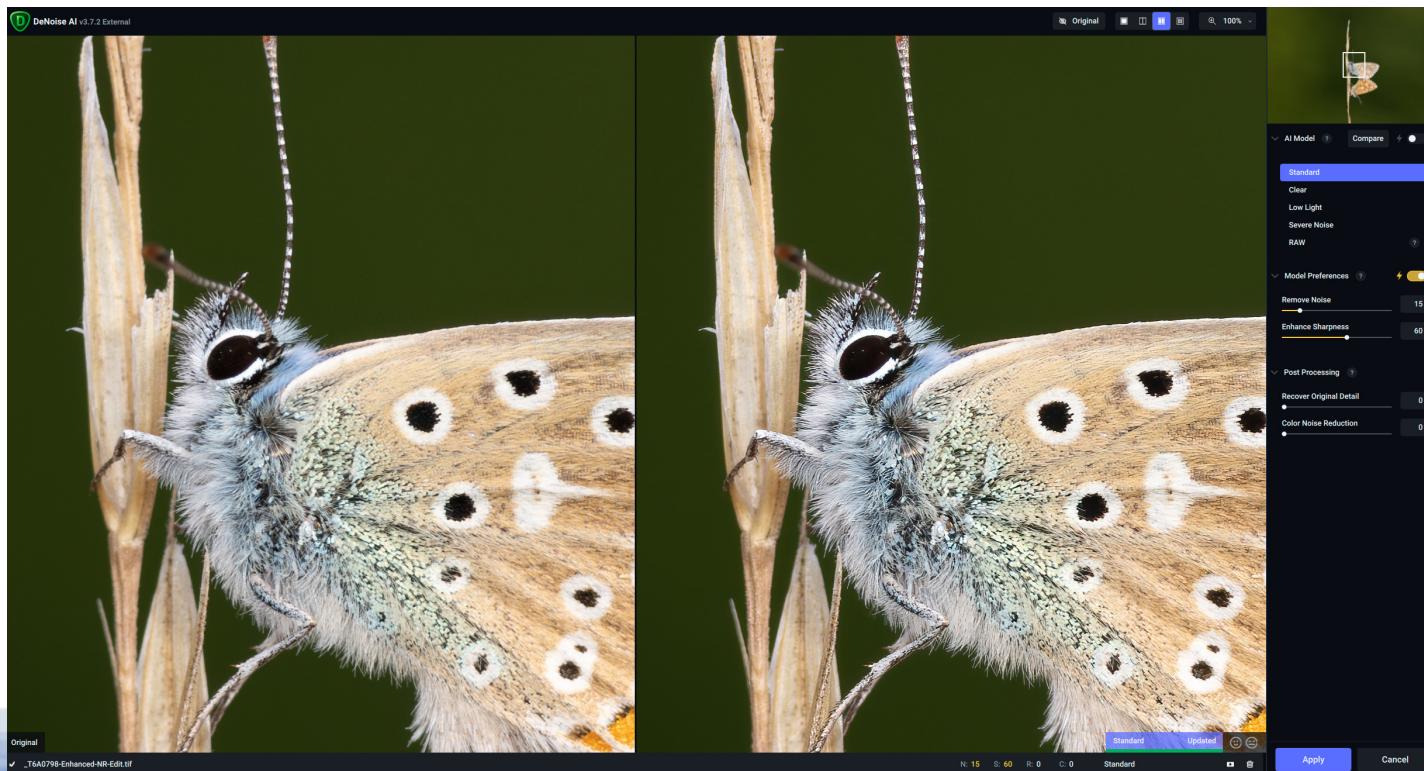


Noise Reduction

Reducing noise

Note: AI NR can result in 'improved' image detail if it can 'recognize' parts of an image and 'reconstruct' features → the issue is whether AI is **replacing** features or not.

- Editor – Apps & plugins
 - ◆ Topaz Denoise AI → paid (one time)
 - Standalone or plugin
 - AIs are trained on image data → useful if your image matches training
 - AI NR can sometimes create artifacts → check your images carefully

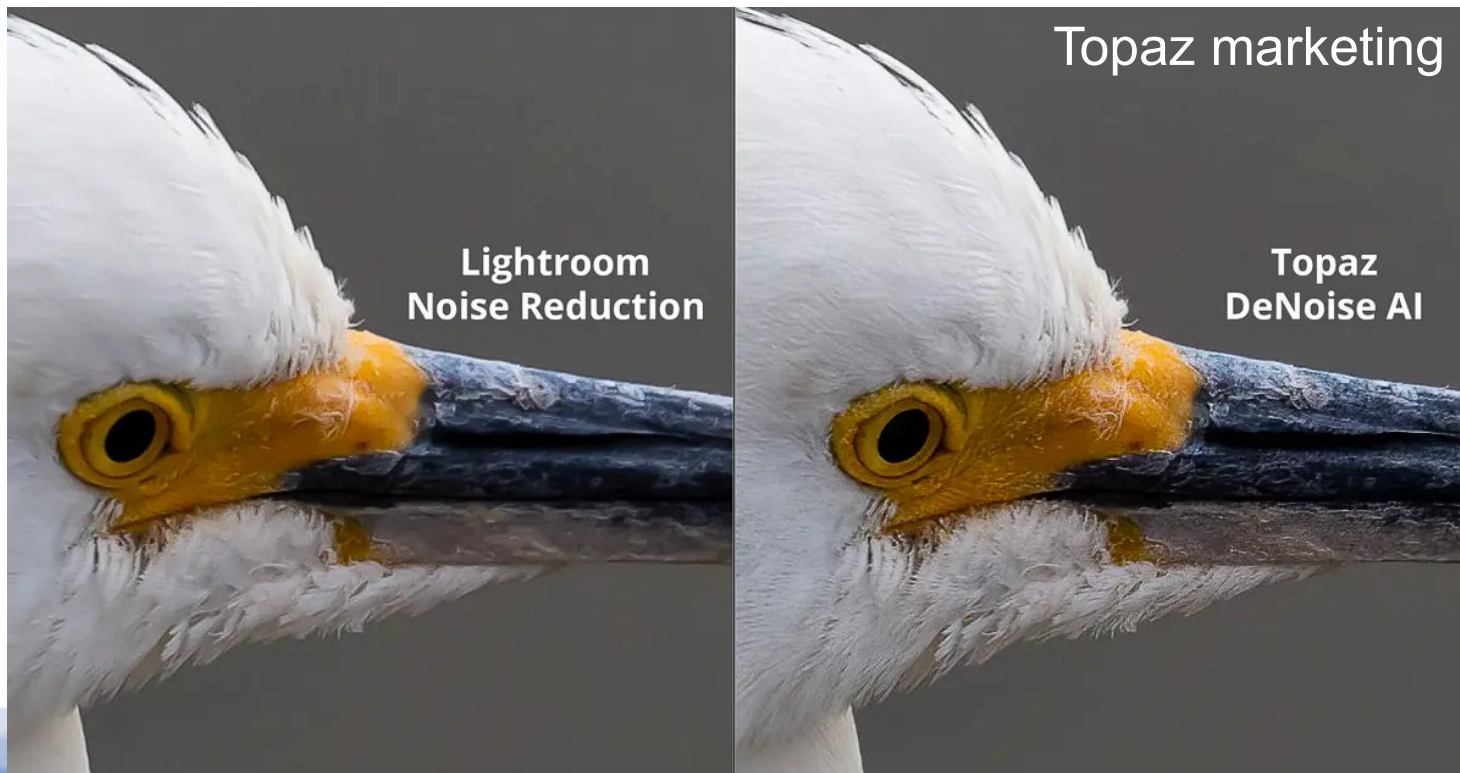


Noise Reduction

Reducing noise

Note: For a comparison of Lightroom Denoise, Topaz Denoise AI, and DxO PureRAW 3 go to amateurphotographer.com/software/adobe-lightrooms-denoise-tool-how-does-it-compare

- Editor – Apps & plugins
 - ♦ Topaz Denoise AI → paid (one time)
 - Standalone or plugin
 - AIs are trained on image data → useful if your image matches training
 - AI NR can sometimes create artifacts → check your images carefully



Noise Reduction

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Lightroom Denoise 100



Lightroom no NR



DxO PureRAW 3



Topaz Denoise AI



Noise Reduction

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