Reflection Removal in Adobe Camera Raw

Clever use of non-generative AI

Tanya Riseman, Jan 16, 2025. SSCC

Idea: Remove reflections (and haze) from photos taken through large windows. (Adobe intends to extend the use cases.)

A snapshot that is ruined by reflections from a glass window (left), the photo with the reflections removed (center), and the reflection itself (right) of a backyard garden.

Reflection Removal

It's in the camera raw module of the beta version of Photoshop 2026.
It might become available in Lightroom as well.
Only works for certain raw files for now - not jpg.

Long blog entry
https://blog.adobe.com/en/publish/2024/12/12/removing-window-reflections-adobe-camera-raw

Directions:
https://helpx.adobe.com/camera-raw/using/remove-reflections.html

An academic paper
Removing Reflections from RAW Photos

Eric Kee, Adam Pikielny, Kevin Blackburn-Matzen, Marc Levoy

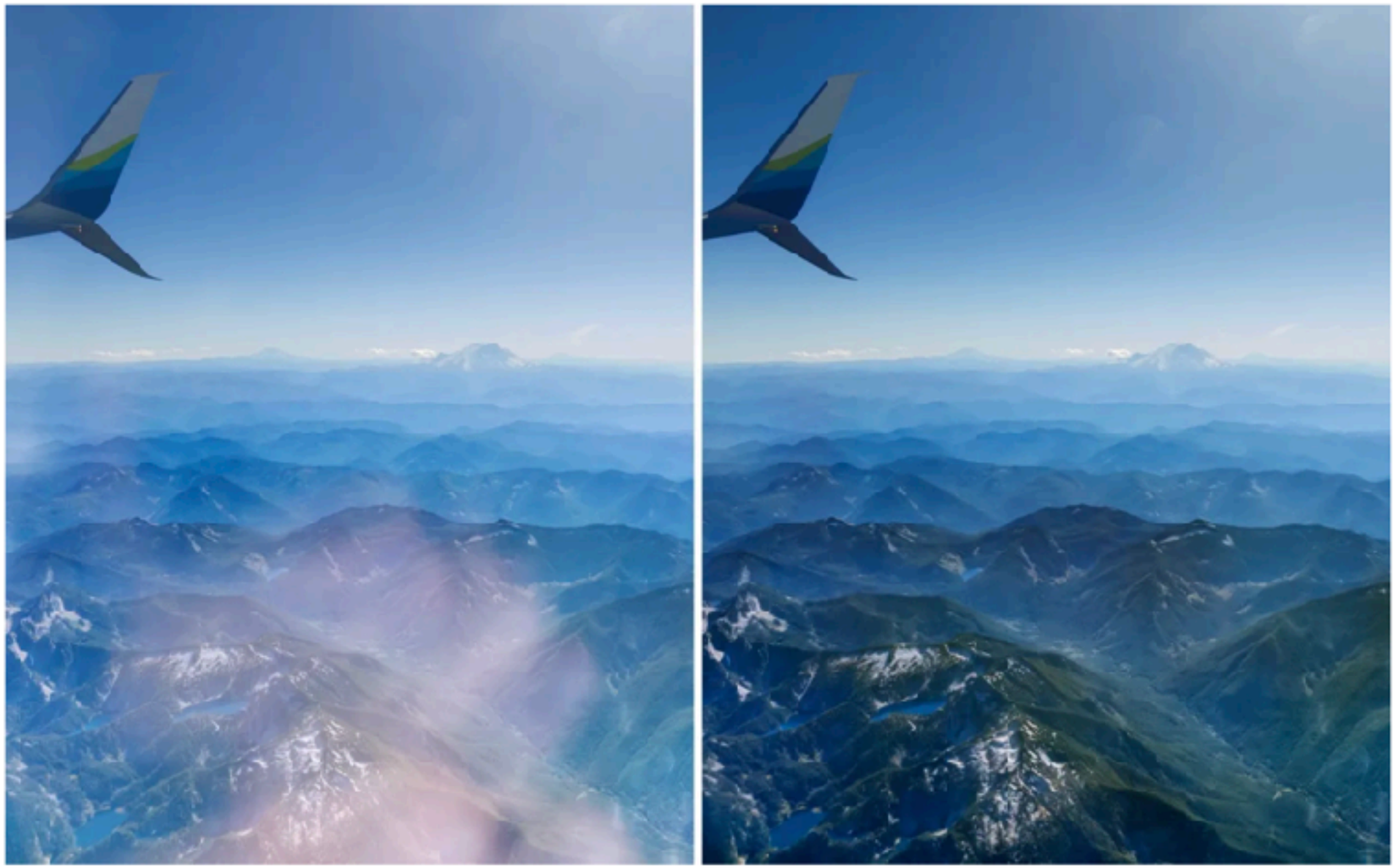
https://doi.org/10.48550/arXiv.2404.14414

Is this a rare problem? Yes and kind of no.

Indeed, we often give up taking a unique photo that we expect will be ruined by a reflection. So while few of the photos in our collections might contain unwanted reflections, this is mainly because we passed up many creative opportunities.



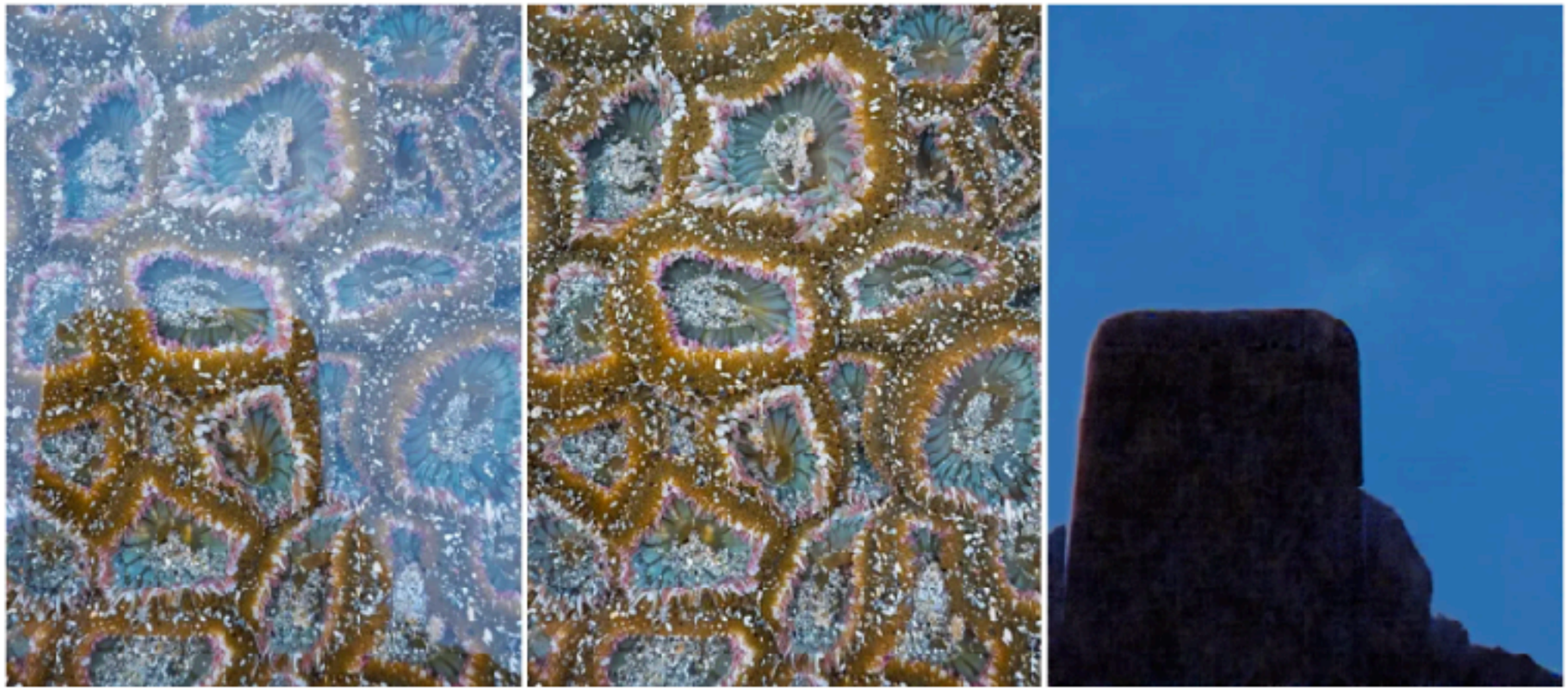
Dehazes from the reflection image, a dirty window, and from real haze in the atmosphere.



Mount Rainier and other volcanos of the Pacific Northwest photographed through an airplane window. In this case, removing the reflection also attenuates the effect of atmospheric scattering, which is a form of reflection.

Also works with reflections off water.

Check out the phone/camera in the removed reflection image.



Here's an unexpected use: photographing a tidepool along the California coast. It's hard to take a picture like this without your camera (or smartphone) being reflected in the water surface.

How is this done? (Nerd alert)

The technology is powered by AI, but it's not generative AI.

They “trained” an AI model with hundreds of thousands of fake photos created using two photos, one of which is intended image (A) and the other intended background reflection (B). Since the researchers already know the correct answer (A), they then tell the computer program whether it found the correct image from the composite fake photo. So the program gets better with practice and feedback.

BUT the resulting AI model/program is still super slow at removing reflections because it needs to think hard.

One of our training examples. Ordinary photographs of an outdoor scene and an indoor scene are added together to form a simulated image (right) polluted by reflections. Our Reflection Removal model learns to separate the third image into the first and the second, with the two original images serving as ground truth.

Researchers also took hundreds of real photos through windows (mixture images M). Then they placed a black material behind the glass and took a second photo of just the reflection (contextual images c) or simultaneously captured the reflection using the secondary front camera (selfie) on a mobile device.

Removing Reflections from RAW Photos

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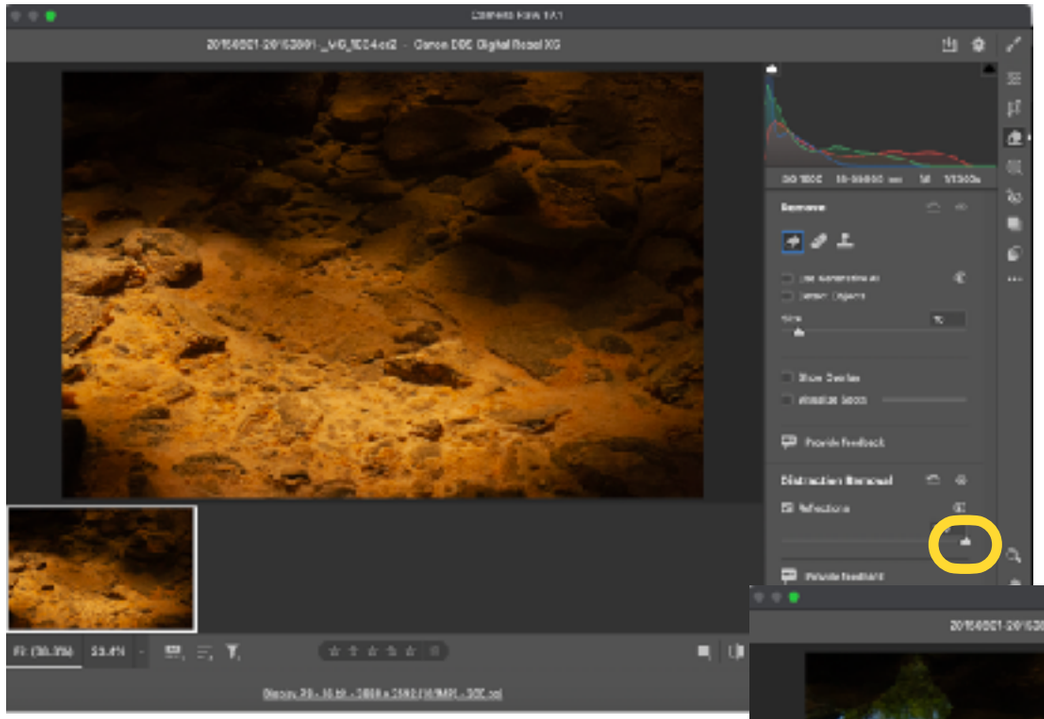
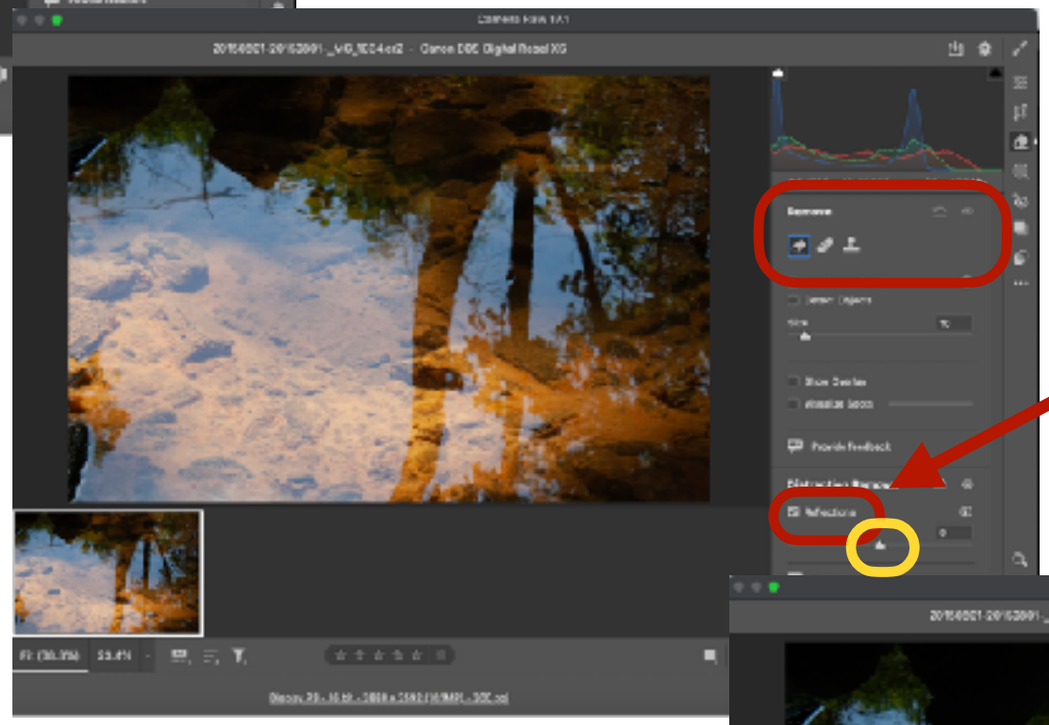
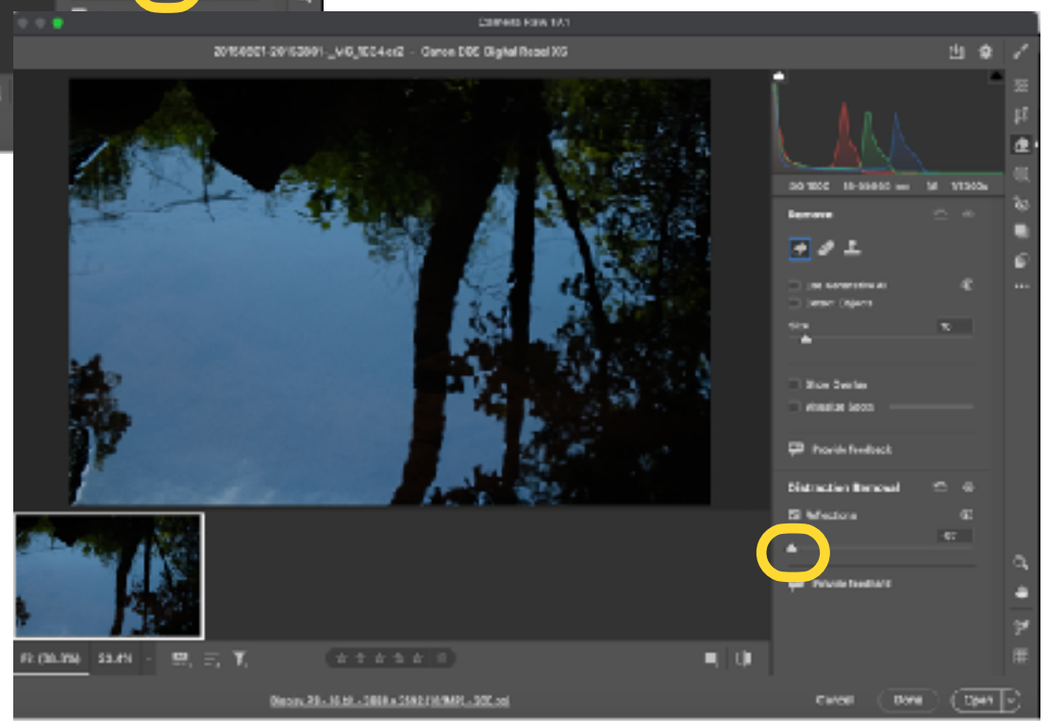
I don’t have many good window reflection photos to share.



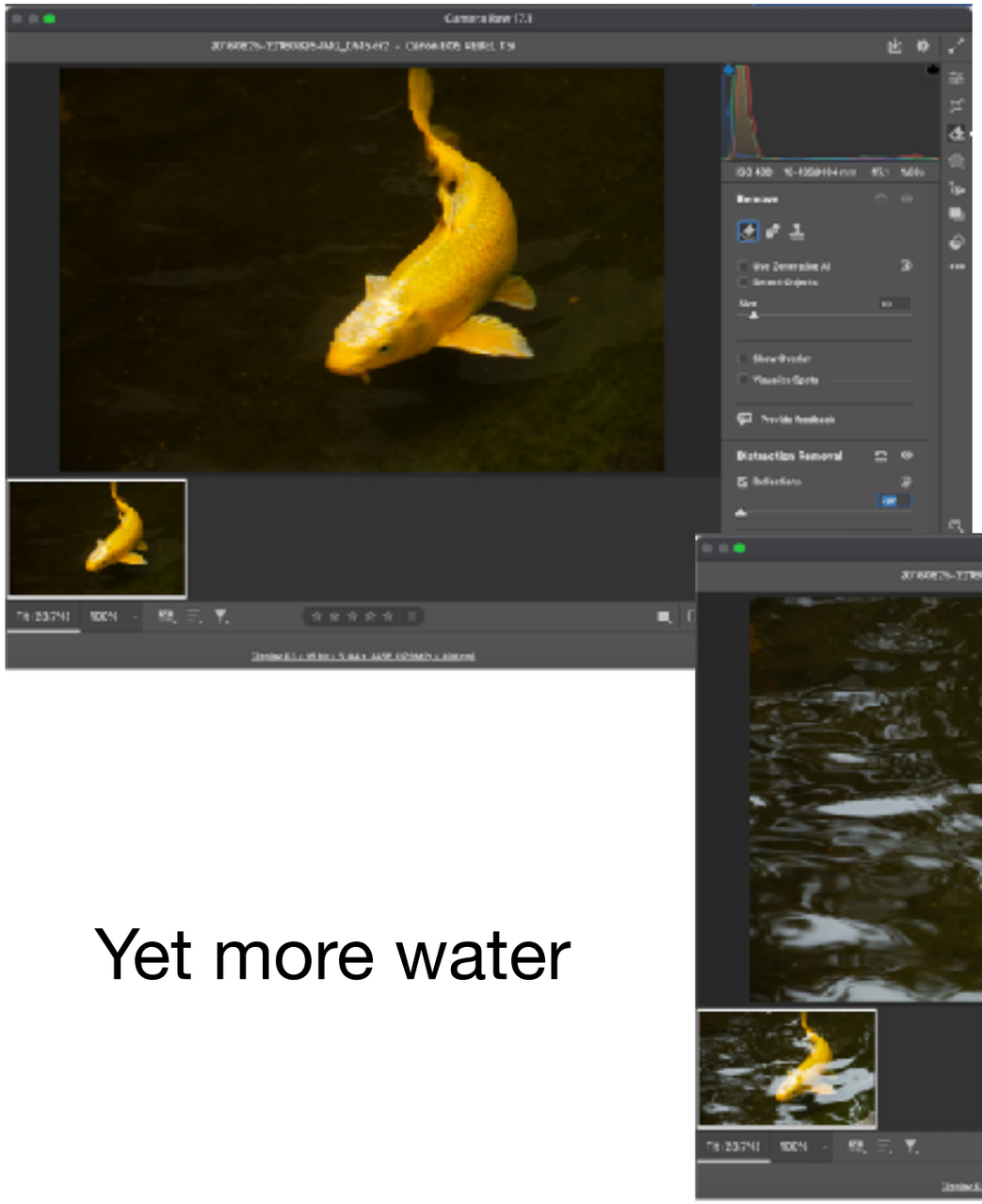


One click!



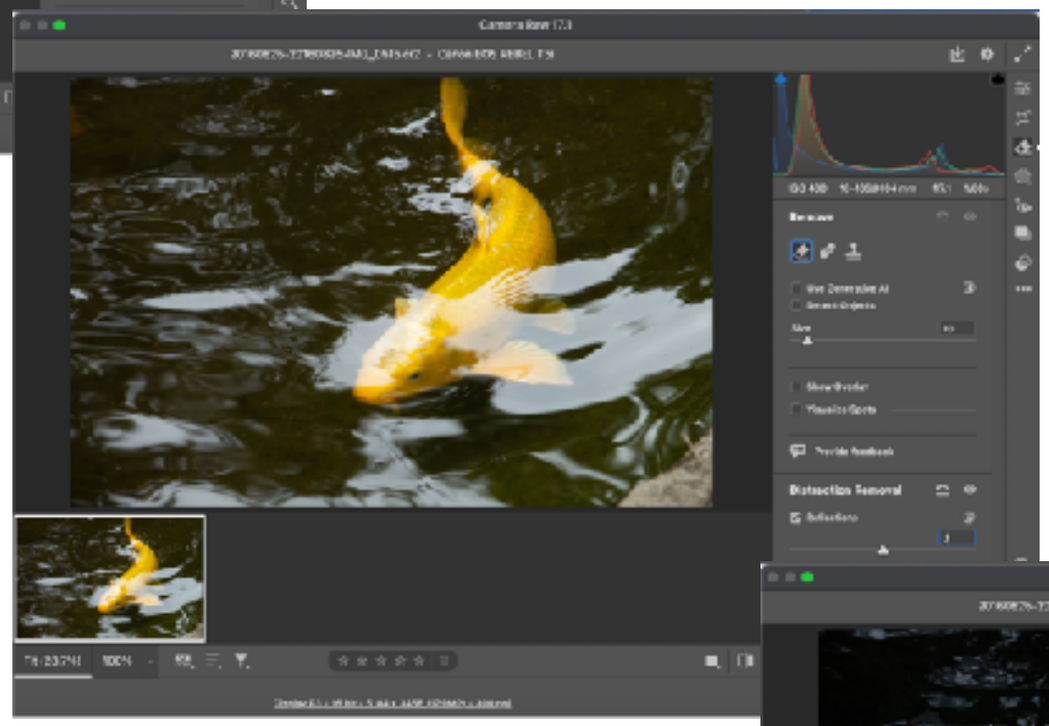
More water

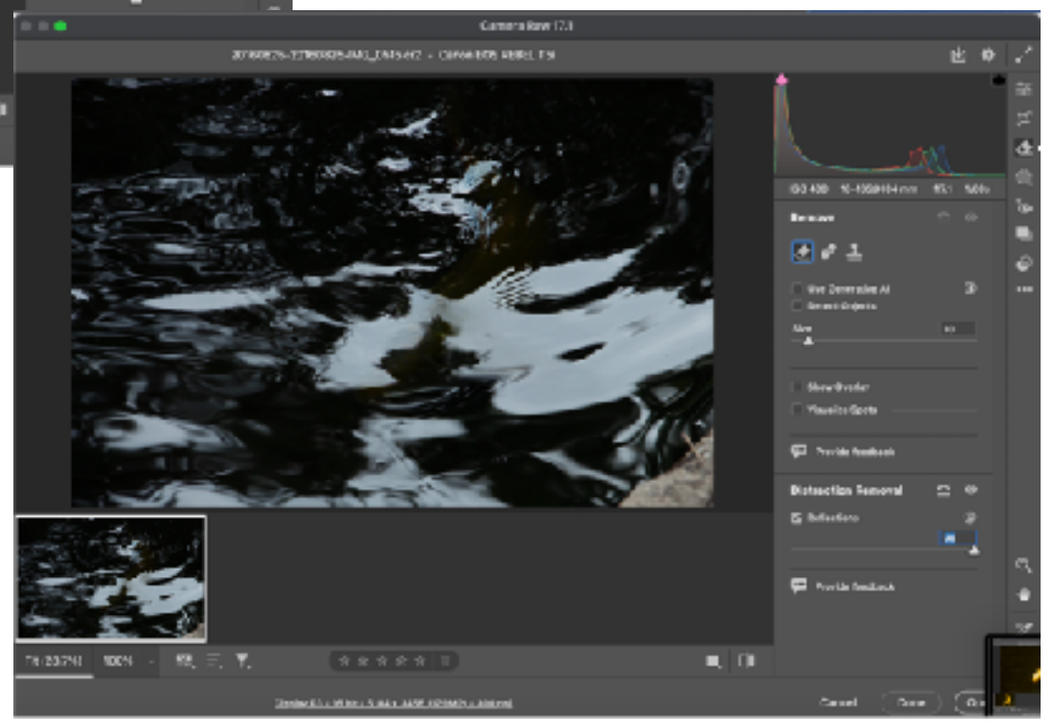
Move the slider (yellow) to mix in however much reflection you want.

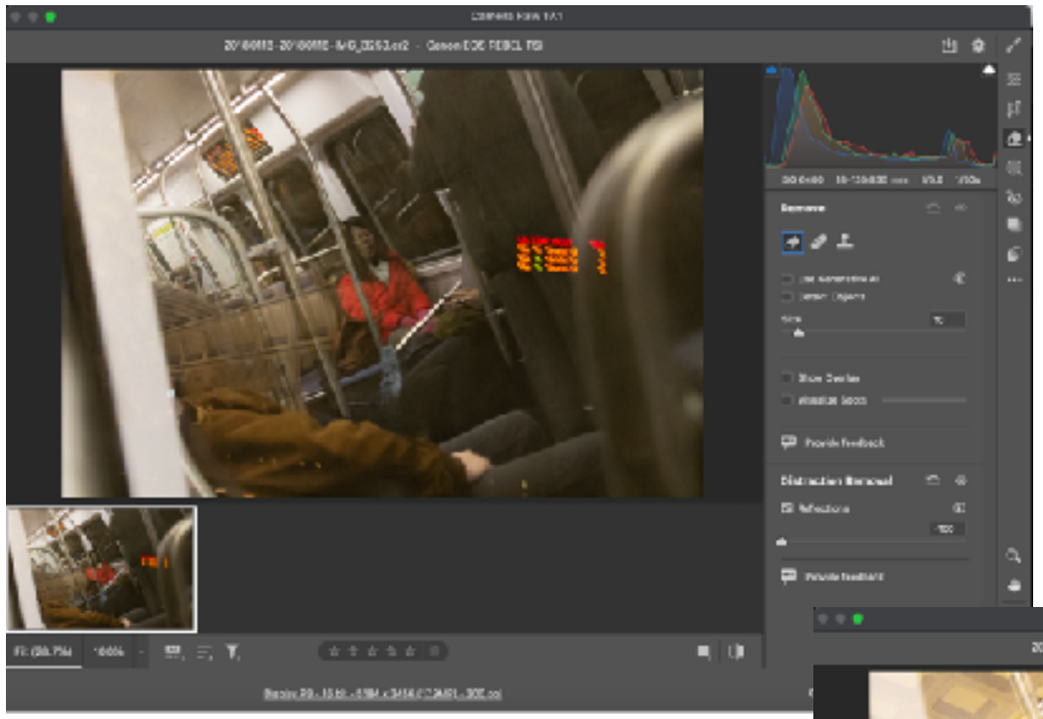


Works amazingly well this ripplely water

Yet more water



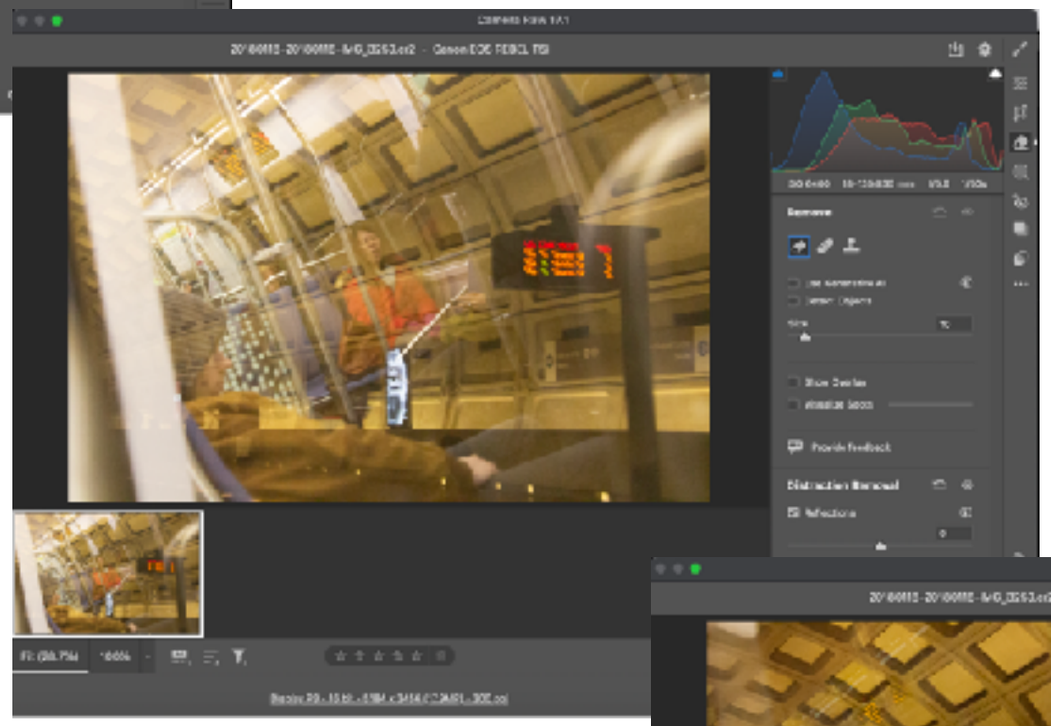


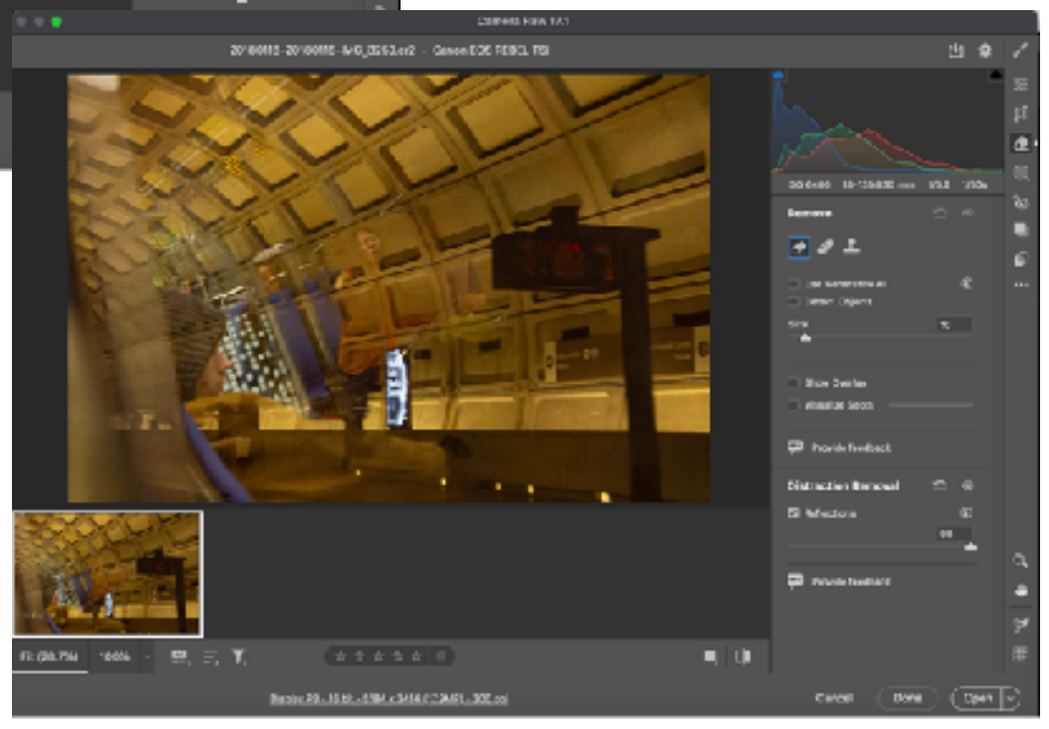


Too hard!

If you can’t figure it out,

you can’t expect the program to either.





If completely impossible, it just makes the reflection image totally black.

Calculation time: 41 seconds
on Macbook Air, 2020 with an M1 chip, 16GB of RAM

Calculation time: 1 minute, 10 seconds
on Macbook Air, 2020 with an M1 chip, 16GB of RAM

Hum. The paper says a preview takes only 5s on a MacBook or iPhone 14 Pro.

Conclusions

Super cool

Very impressive results

Extremely niche for a generalist program like Camera Raw/Lightroom

Super slow

Is it worth the electricity?