a. Reconstruction with MNN vs. reconstruction with digital baseline
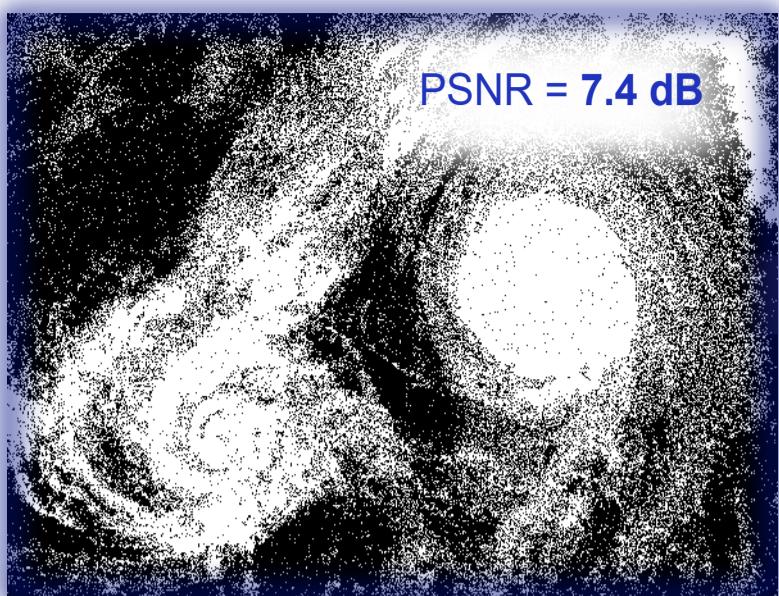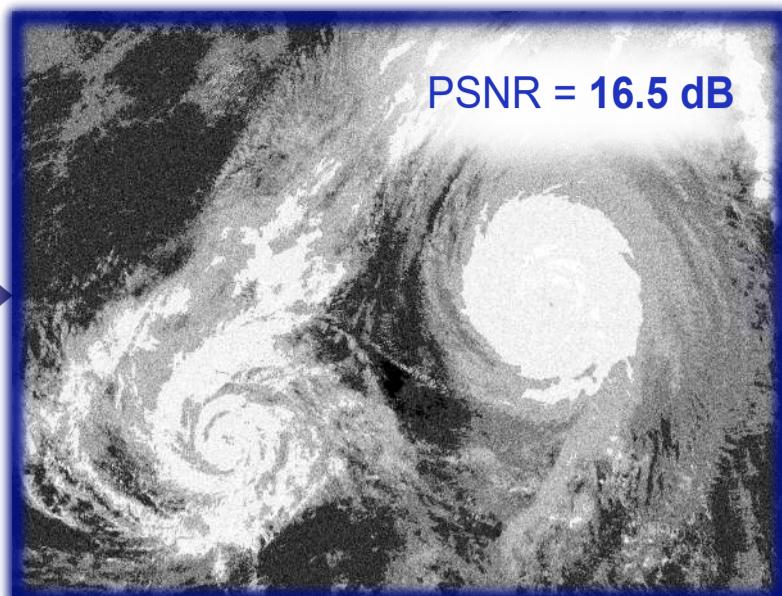
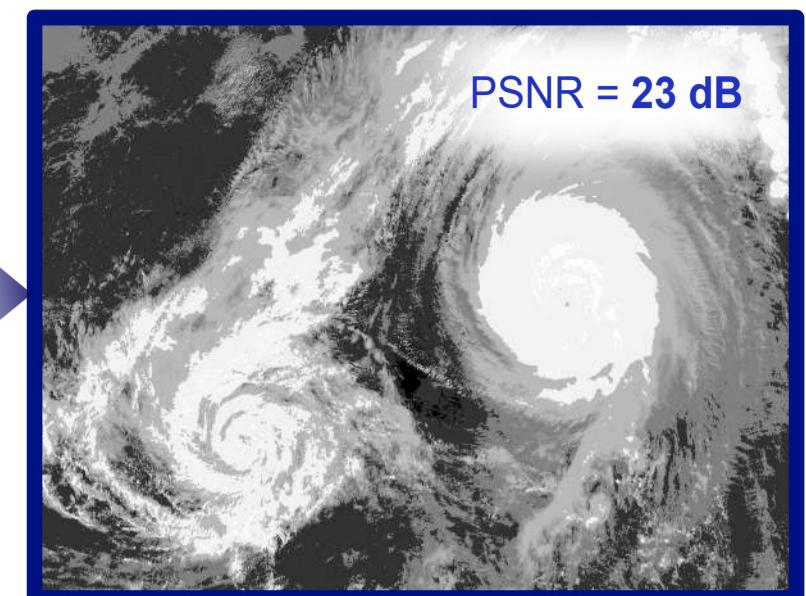i.

1 pass, Local oscillator at 10.4 GHz (main article)

Averaged after 10 passes
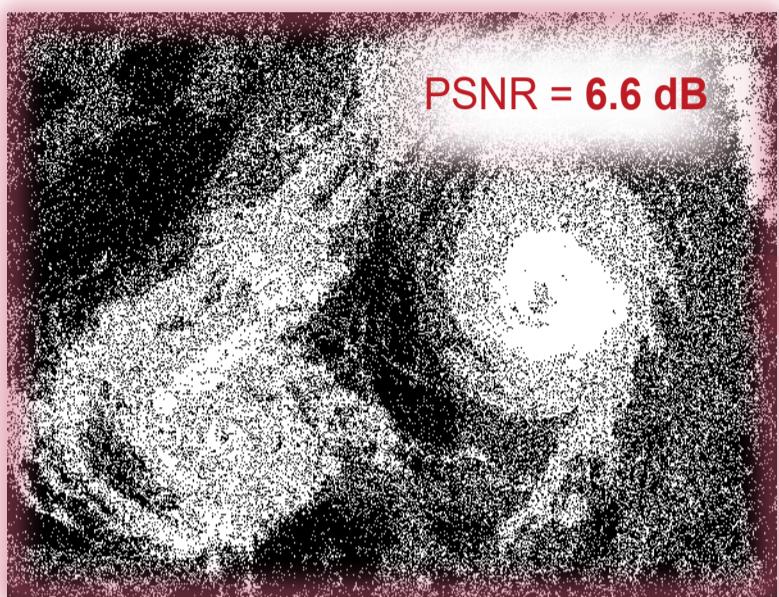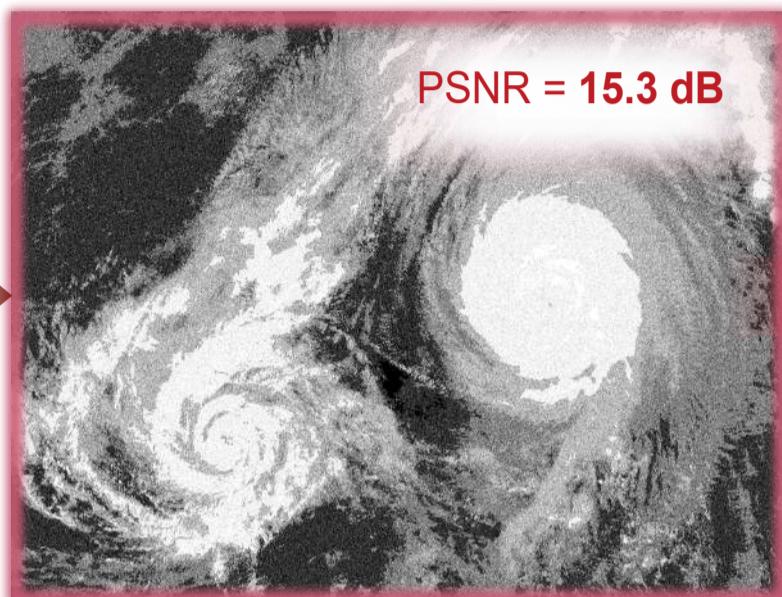
Averaged after `1000 passes

Analog Dithering with MNN

PSNR = **7.4 dB**

PSNR = **16.5 dB**

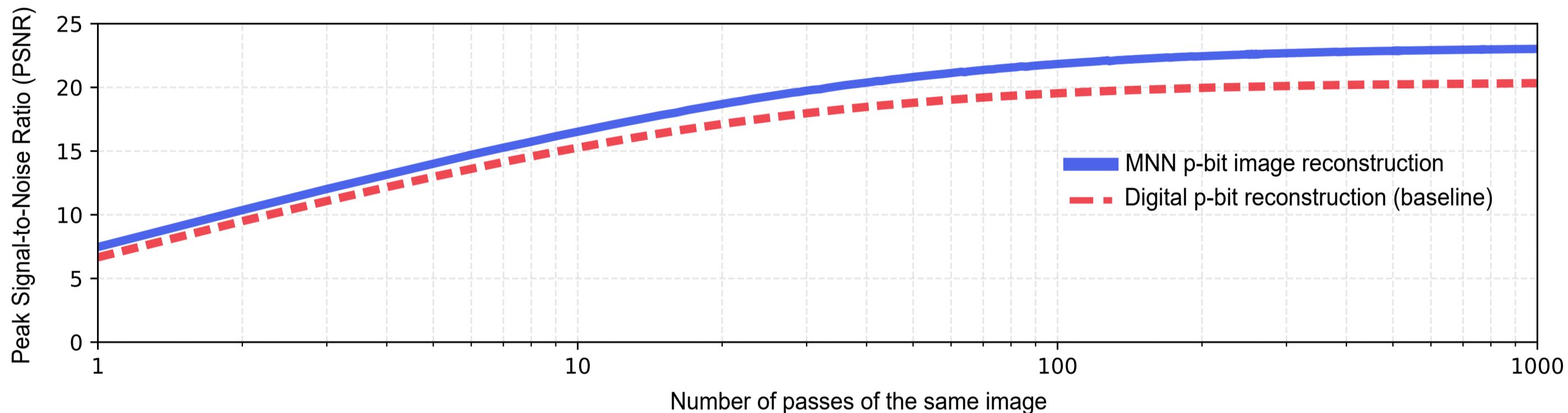PSNR = **23 dB**

ii.

1 pass

Averaged after 10 passes

Averaged after `1000 passes

Dithering with digital baseline

PSNR = **6.6 dB**

PSNR = **15.3 dB**

PSNR = **20.3 dB**
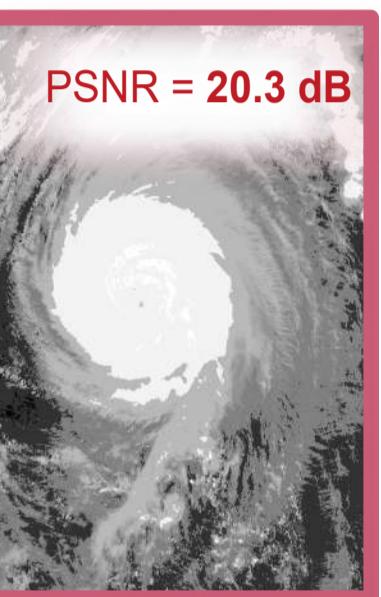
b. PSNR vs number of passes of the same image

Peak Signal-to-Noise Ratio (PSNR)

— MNN p-bit image reconstruction
--- Digital p-bit reconstruction (baseline)

Number of passes of the same image

b.

Reconstructed RGB image after channel-wise dithering

1 pass, Local oscillator at 10.4 GHz

100 passes

PSNR = **7.7 dB**

PSNR = **16.7 dB**
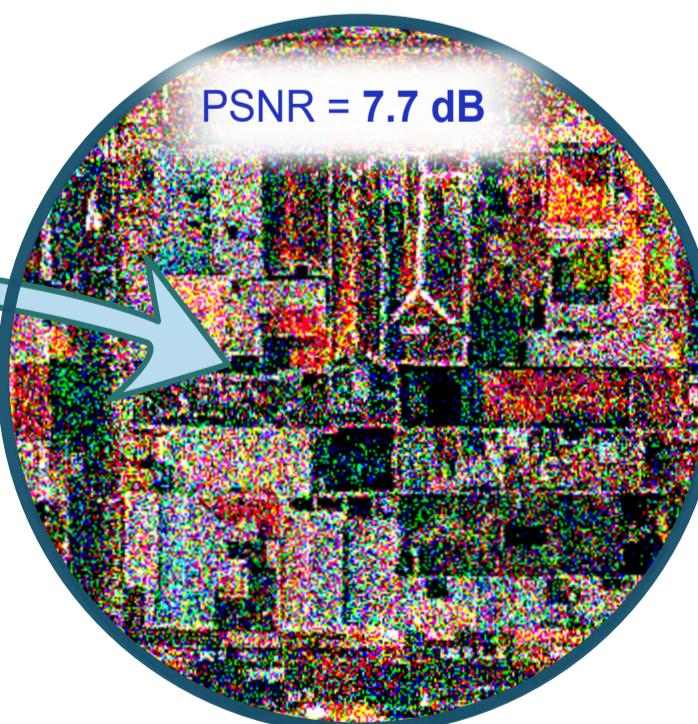
Extended Data Fig 5. Reconstruction improves over repeated MNN passes by averaging probabilistic bits generated using the method in Fig. 5. a, The Peak Signal-to-Noise Ratio (PSNR) rises as more dithered MNN reconstructions are accumulated and the pixel intensities are averaged across repeated passes (**a.i**). Averaging over 1, 10, and 1000 passes demonstrates the expected √N improvement associated with Monte-Carlo denoising: repeated stochastic estimates are averaged to suppress noise and recover the underlying image structure (**a.ii**). **b,** High-resolution RGB satellite images are reconstructed by independently processing the Red, Green, and Blue channels. A single pass produces analog-TV–like Gaussian noise, but repeated transmissions (e.g., 100 passes at 2.4 Gbps from a geostationary satellite) provide Monte-Carlo averaging that yields an efficient, high-fidelity reconstruction.