Day Night Band Denoising

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Project website

https://flissd.github.io/DNB-denoising

Objective

To extend the capabilities of low signal to noise ratio (low SNR) DNB observations by use of novel image denoising methods

Dataset

- Data is collected from SNPP Visible Infrared Imaging Radiometer Suite (VIIRS) day night band (DNB)
- Allows visible band observation of the Earth's atmosphere during nighttime, expanding the potential for cloud detection and retrieval

Method

Data Preprocessing

- Photon-limited noise is approximately Poisson-distributed, but many denoisers assume Gaussian noise
- Variance stabilizing transformations convert Poisson-distributed noise to Gaussian-distributed noise [1]

Denoising Algorithm

- The algorithm attempts to minimize an objective function consisting of a data-fitting term and a regularization term
- Regularization term imparts assumed coherent structure of underlying image
- Presented solution iteratively takes a step to minimize the novel data-fitting term followed by a denoising step using BM3D [2, 3]
- Denoising tuning parameters are inferred from the noisy observations

Conclusion

- The presented denoising algorithm can smooth noise while preserving structure
- The algorithm is sensitive to calibration parameters such as the gain and offset values
- Next steps:
  - How to validate low SNR denoised results?
  - How to mitigate calibration artifacts?

References

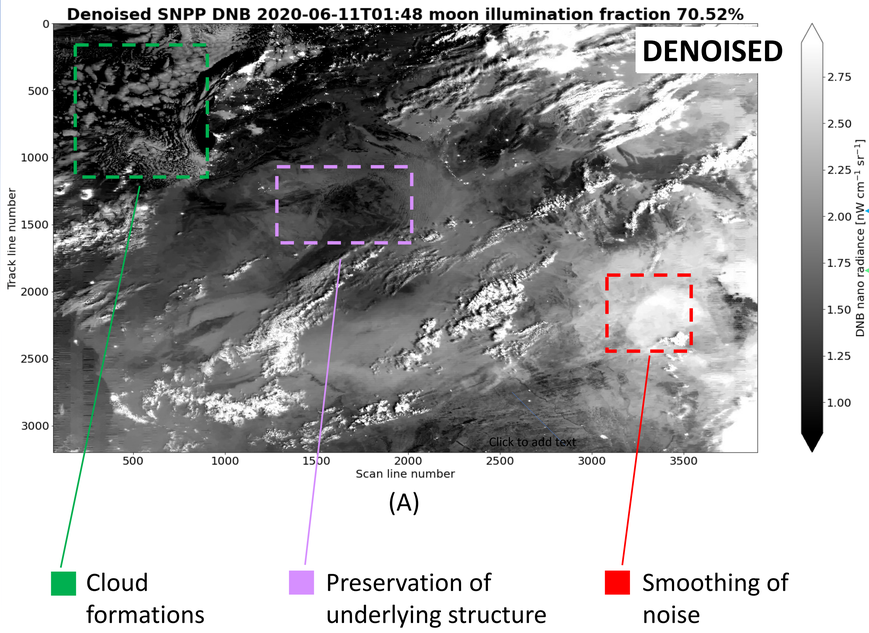
[1] F. J. Anscombe, “The transformation of Poisson, binomial and negative-binomial data,” *Biometrika,* vol. 35, no. ¾, pp. 246-254, 1948.

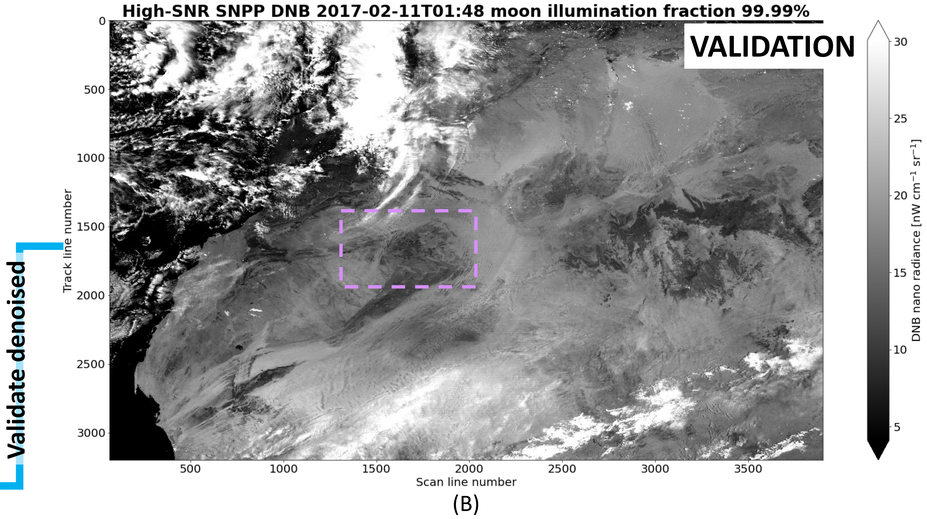
[2] S. V. Venkatakrishnan, C. A. Bouman, and B. Wohlberg, “Plug-and-play priors for model based reconstruction,” in *IEEE Global Conf. Signal Process. And Inf. Process. (GlobalSIP),* 2013, pp. 945-948.

[3] K. Dabov, A. Foi, V. Katkovnik, and K. Egiazarian, “Image denoising by sparse 3-D transform-domain collaborative filtering,” *IEEE Transactions on image processing,* vol. 16, no. 8, pp. 2080-2095, 2007.

Image Index

A) Denoised image at moon illumination fraction 71%
B) High SNR image of same area as (A) at moon illumination fraction 100%
C) Noisy image at moon illumination fraction 71% that is denoised in (A)
D) Denoised image at moon illumination fraction 33%
E) Noisy image at moon illumination fraction 33% that is denoised in (D)





Validate denoised

Noisy to denoised