NOAA-21 OMPS Nadir Profiler Straylight Correction using Machine Learning

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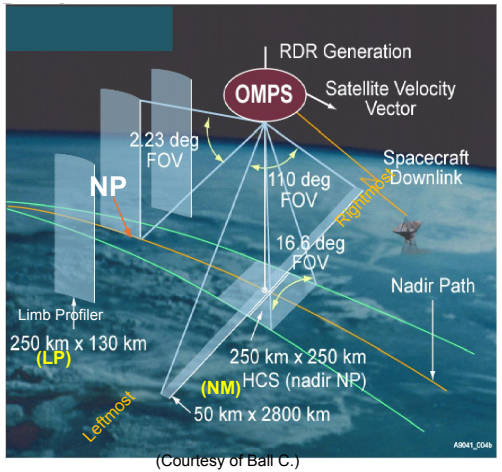
Background

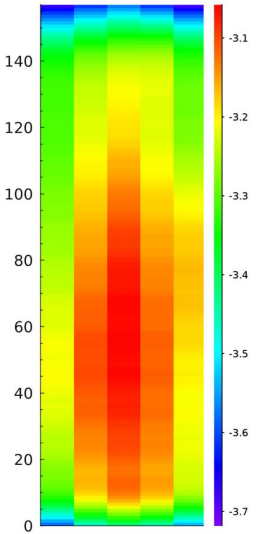
- OMPS Nadir Profiler (NP) on NOAA-21
  - 245-311 nm (5CTx158 channels)
  - 50 km x 50 km at nadir
- Ozone data used to measure pollution, air quality, etc
- NP SL: Spectral SL (always present) and solar intrusion (above ~58 solar zenith, Northern Hemisphere)

SL characterization for OMPS NP is complicated:

- Uncertainties in pre-launch and post-launch radiometric and spectral calibration
- Lack of absolute truth for direct comparison
- SL magnitudes are small (0.5-5%) across the spectral channels
- Strong impact of dark offset errors especially over polar regions



(Courtesy of Ball C.)



Combined SL coeffs over all channels

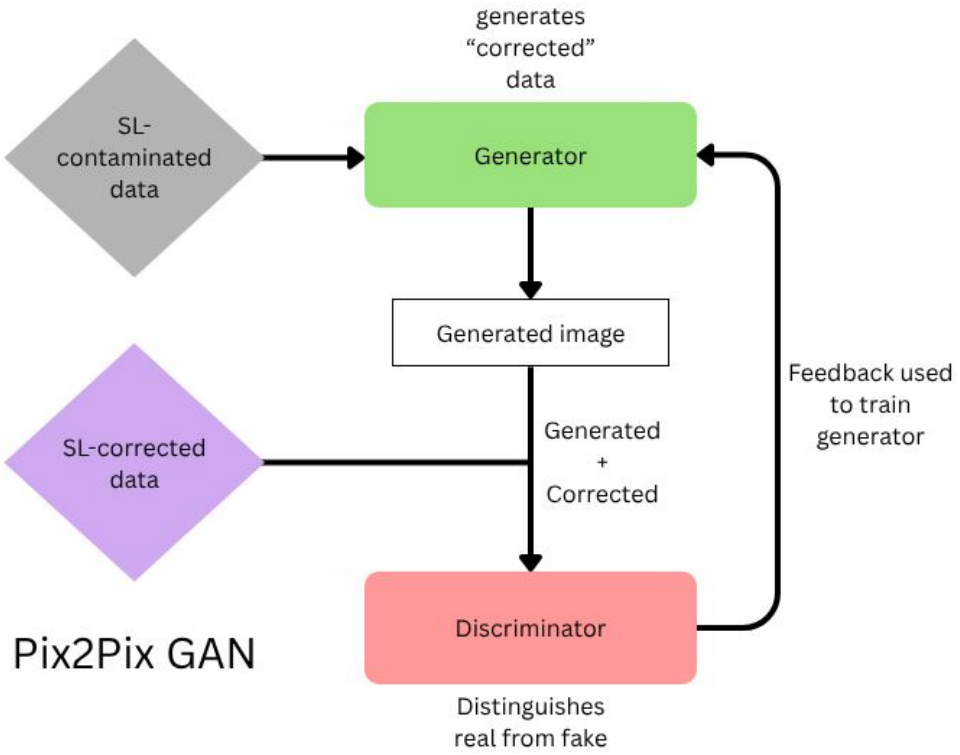
Objective and Obstacles

Objective

- Implement machine learning model to correct SL-contaminated data for NP
- Optimizations to minimize error
  - Relative error increases at ~120 spectral
  - Frequent mode collapse ~140 spectral

Method

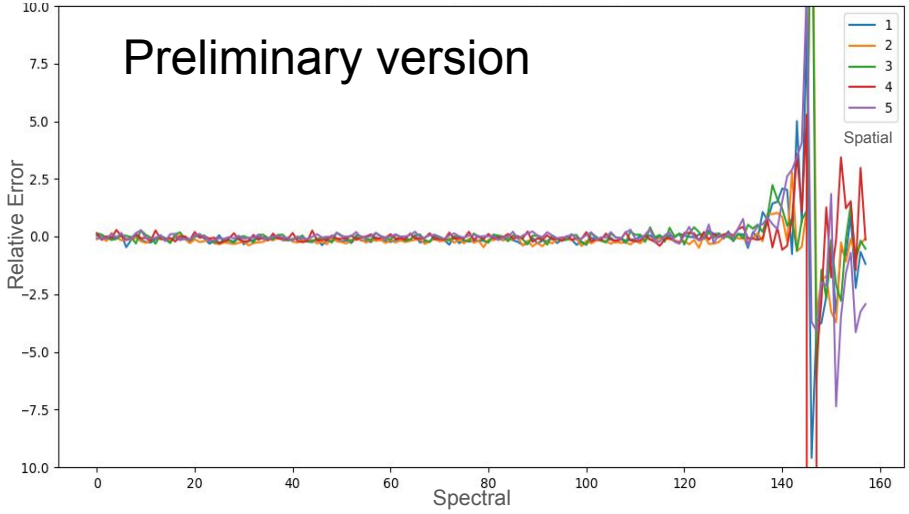
- Pair pre-launch SL-corrected and SL-contaminated data for AI training
- Pix2Pix GAN model
- Optimizing parameters and mathematical operations used by model



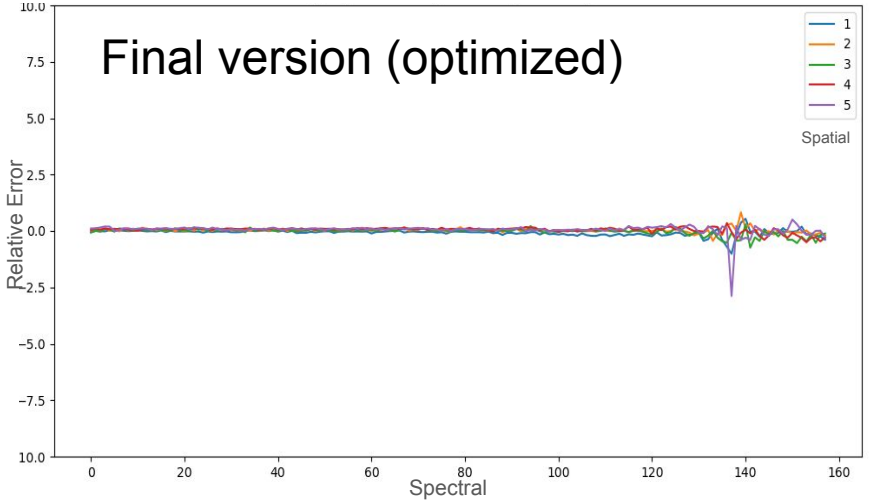
Results

*Relative error calculated by (G/C - 1) x 100
For G = generated and C = corrected

Relative Error* Between Generated and Corrected Images (Spatial 1–5) for SOMPS_j02_d20241013_t0225238_e0226013_b09971



Relative Error Between Generated and Corrected Images (Spatial 1–5) for SOMPS_j02_d20241013_t1215433_e1216208_b09977



- Trained for 200 epochs
- Fails around 138 spectral (~303 nm)
- Consistently high relative error
  - Less error than 500 epochs of the same model

- Trained for 500 epochs
- Adjusted learning rates, math, optimizers
- Error is relatively minimized
- Highest error ~138 spectral on spatial 5