



Characterizing and Correcting Hyperion Detectors using Ice- Sheet Images

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Outline

- Ice sheets as a “flat-field” target
- Detector characterization
 - uniformity
 - temporal stability
- Correction strategies
- Corrected images

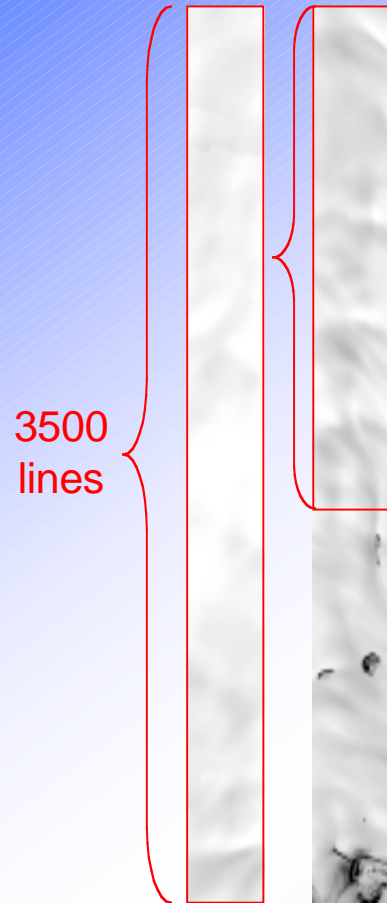


Ice-Sheet Characteristics

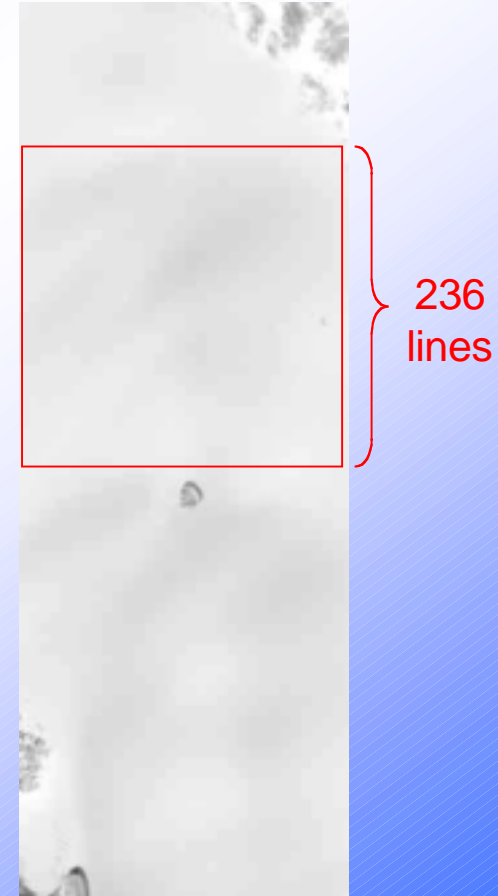
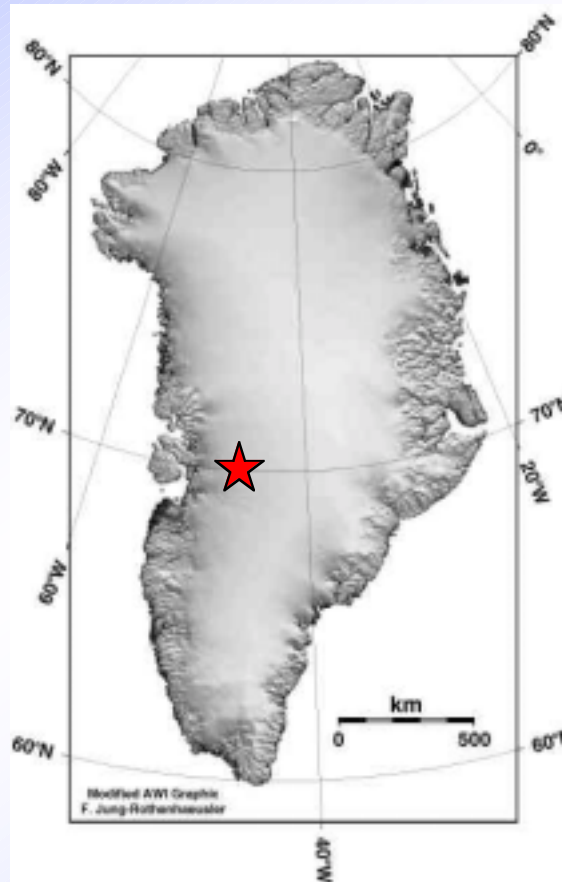
- Nearly monospectral
- Low slope variability
 - 0.001 over 10 km
 - 0.01 over 1 km
- Low reflectance variability
 - Less than 1% over 1 km
 - less than 0.1% over 10 km



Data Used



Day 188
(July 7, 2001)



Day 220
(August 8, 2001)

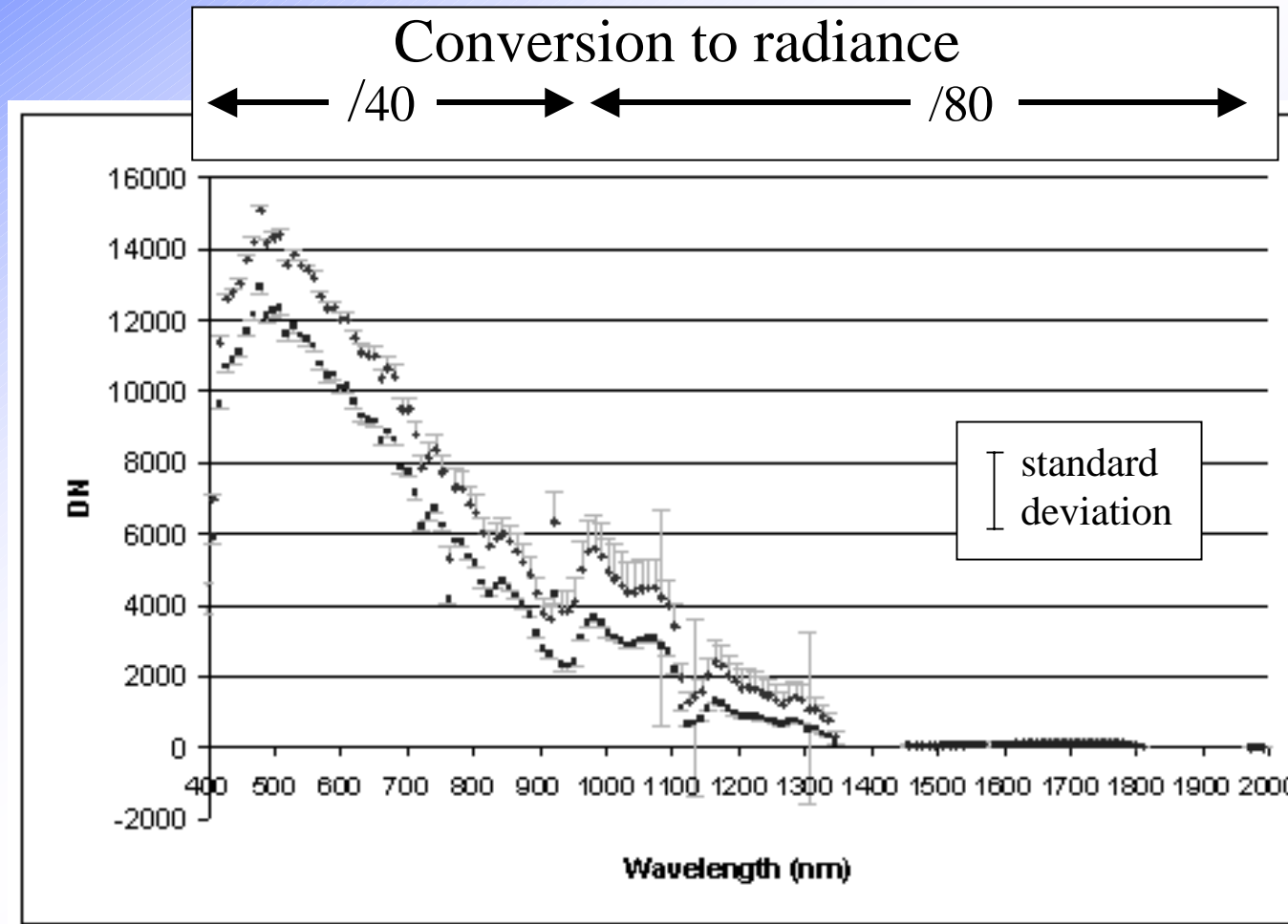


Data Processing

- Level 1a product
 - dark current subtracted
- Use detector units of DN (“scaled spectral radiance”) rather than convert to radiance
- No atmospheric correction
 - Avoid cloudy areas
- Use 147 of 220 bands
 - Omit overlap bands (57-77)
 - Omit water vapor bands (121- 130 and 167-181)
 - Omit low reflectance bands (1-4 and 177-220)



Scaled Spectral Radiance



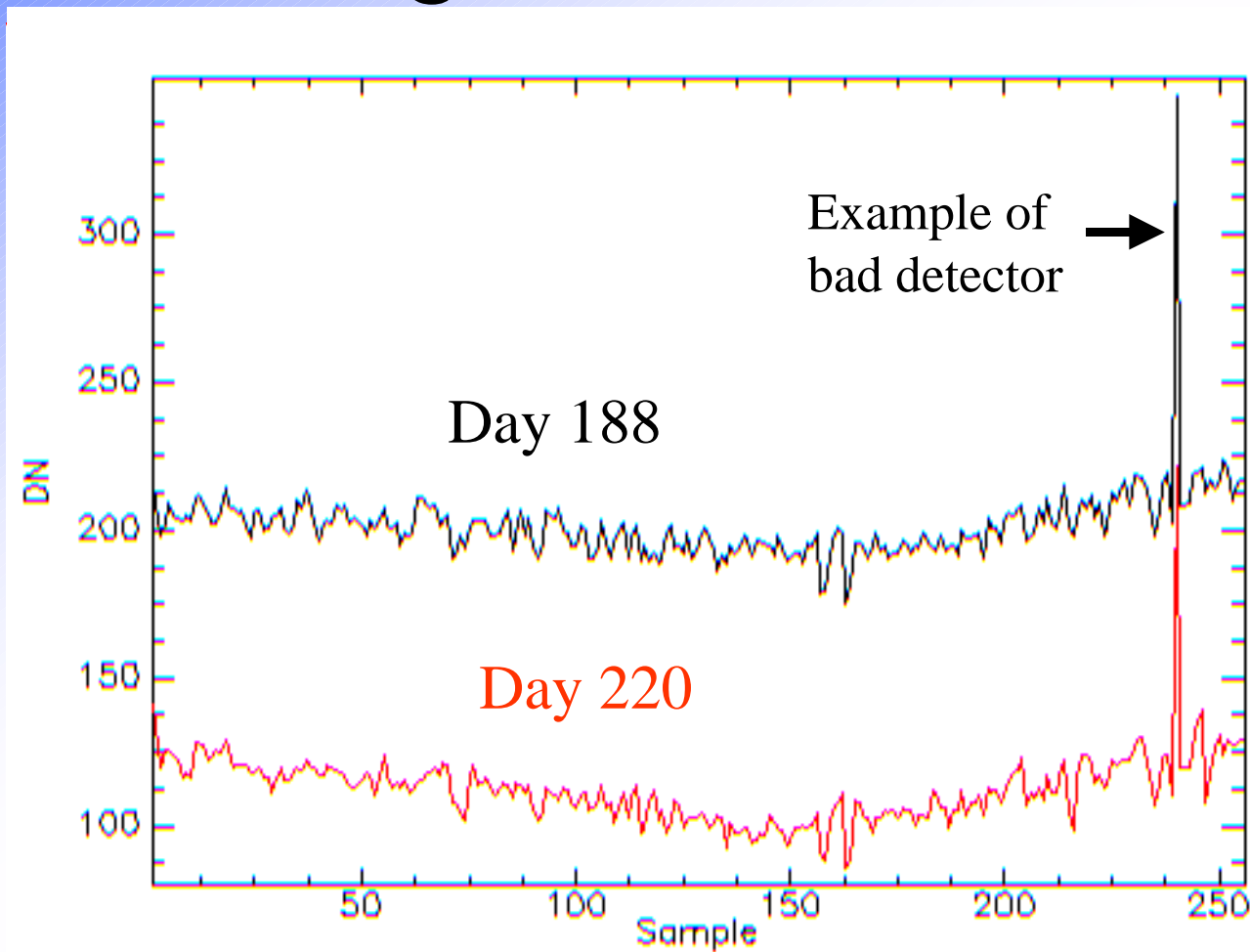


Averaged Line Profiles

- Average each line along track
 - 3500 lines (day 188)
 - 236 lines (day 220)
- Bad detectors identified by large deviation from mean



Averaged Line Profiles





Bad Detectors

- Only 6 (or 7) found in over 60,000 detectors (256 pixels x 220 bands)
 - Band/pixel
 - 56/147
 - 94/82
 - 99/81
 - 116/127
 - 119/240
 - 120/240
 - 165/148 (day 188 only)
- Bad detectors corrected by neighbor interpolation



Error Quantification

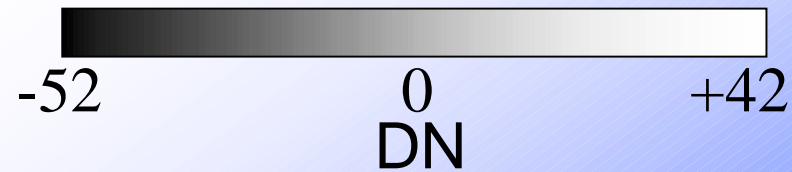
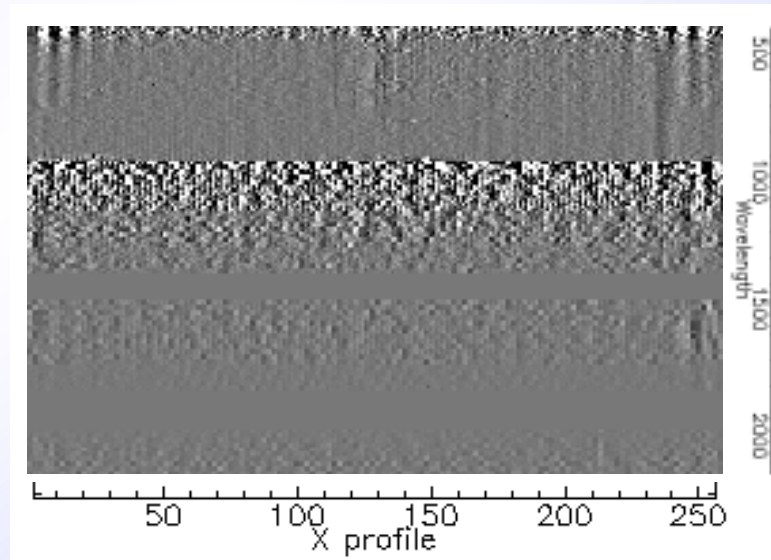
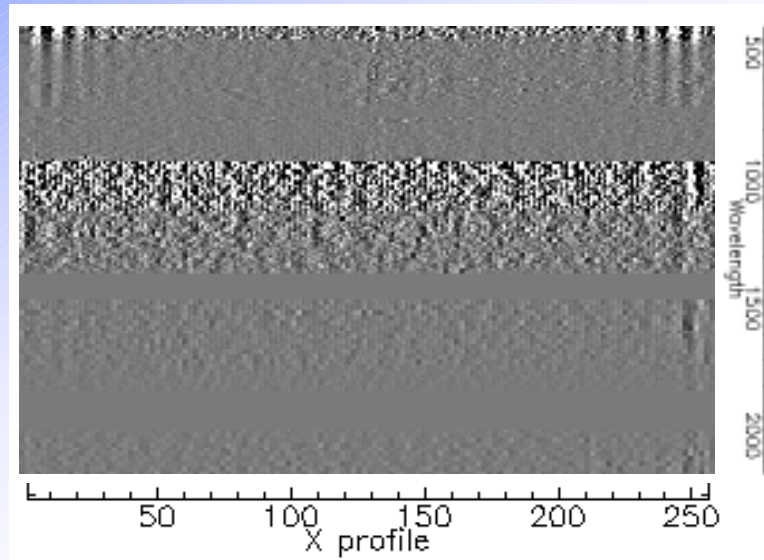
- Fit cubic spline through Averaged Line Profiles
- Assume spline is the correct profile
 - spatial variability should be smooth
- Difference spline values from Averaged Line Profiles
 - performed independently for each spectral band



Detector Array Errors

Day 188

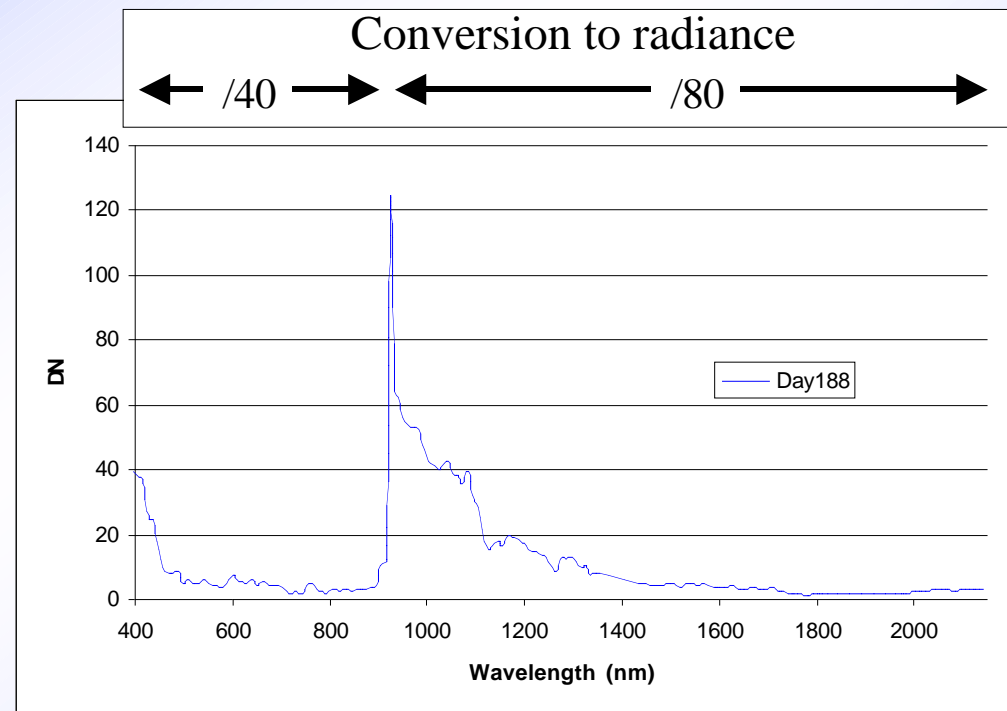
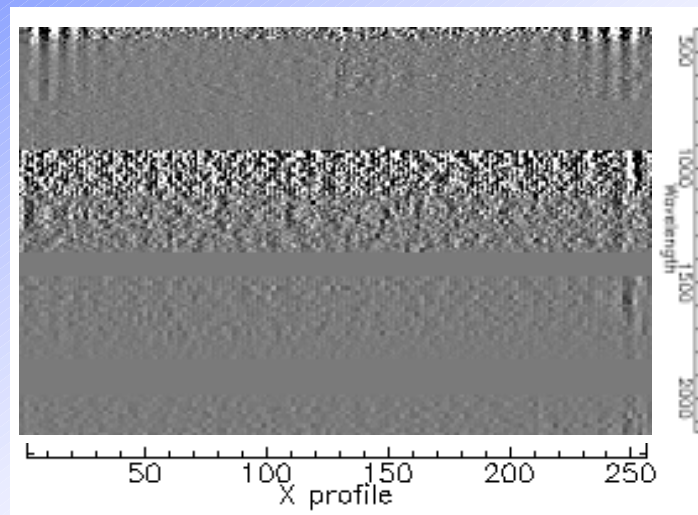
Day 220





Error Variance

Day 188

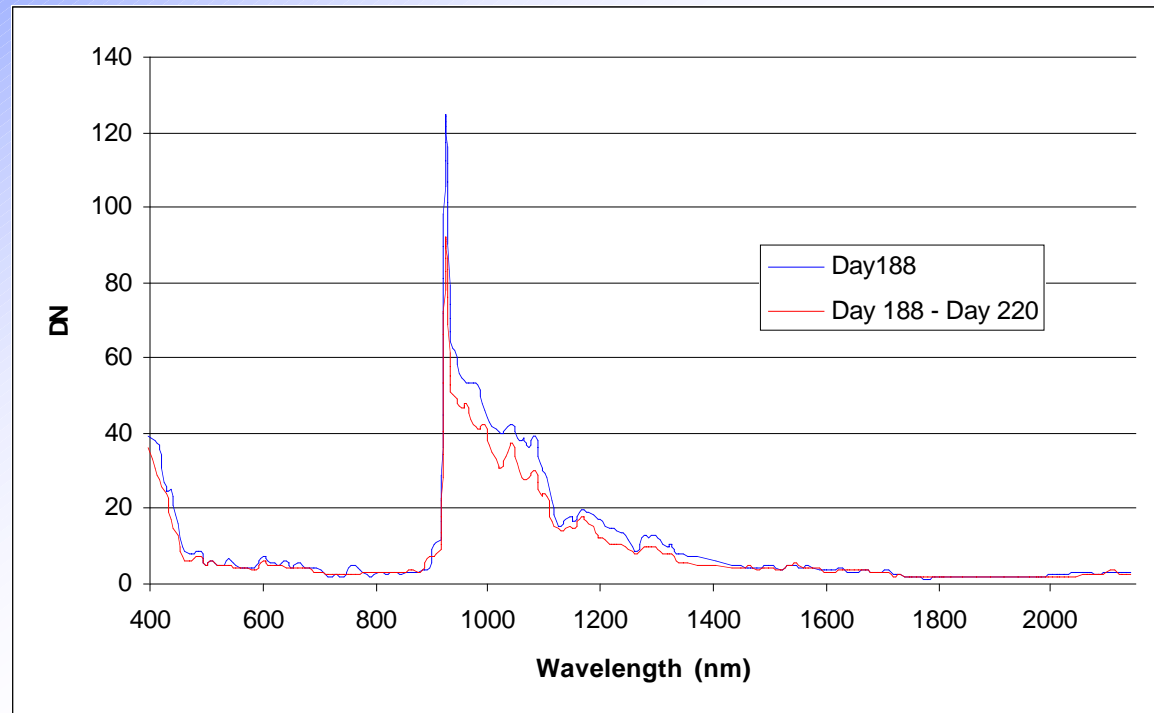


Variance of 256 error samples for each spectral band

Variance for Day 220 nearly identical to Day 188



Temporal Stability of Variance



Errors at one time \neq Errors at another time

Error variance over time = Error variance at one time



Error Stability

- Spectral error variance for Day 220 nearly identical to Day 188
- Error difference (Day 188 - Day 220) also appeared similar
 - detector errors do not appear stable in time

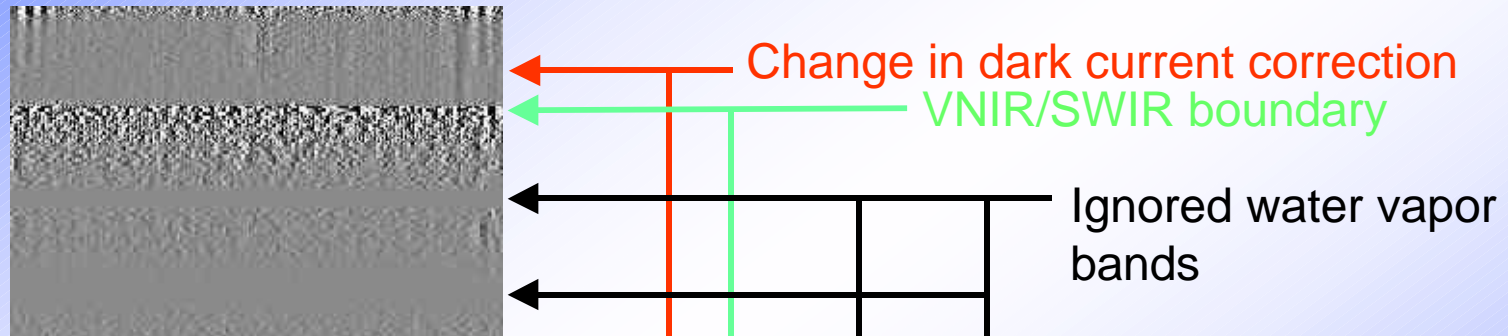


Validity Check

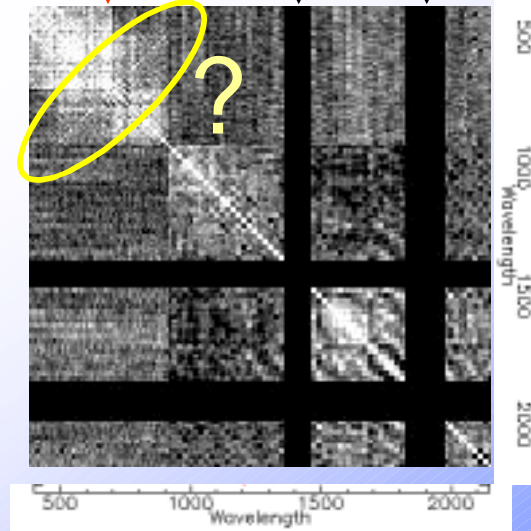
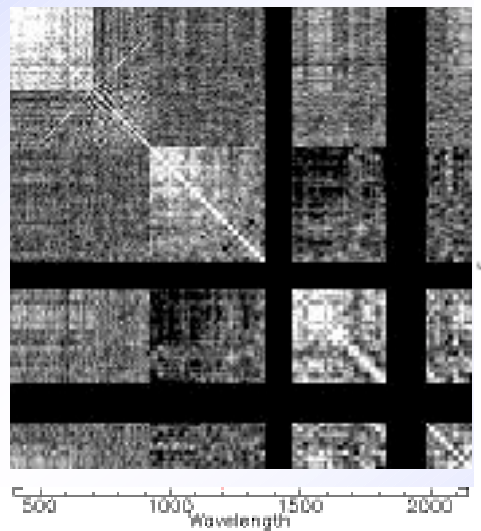
- Day 188 was split into two images, 1750 lines each
- Same error variance calculations performed
- Same error variance results returned



Spectral Cross-Correlation of Errors



Day 188



Day 220

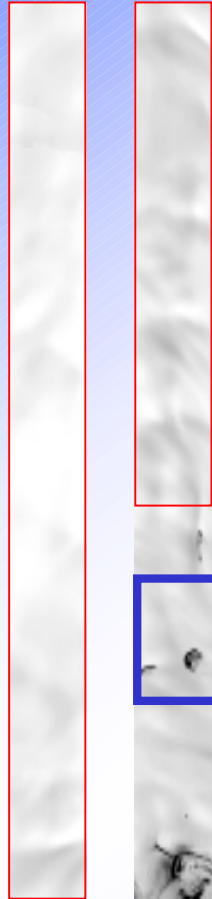


Error Correction

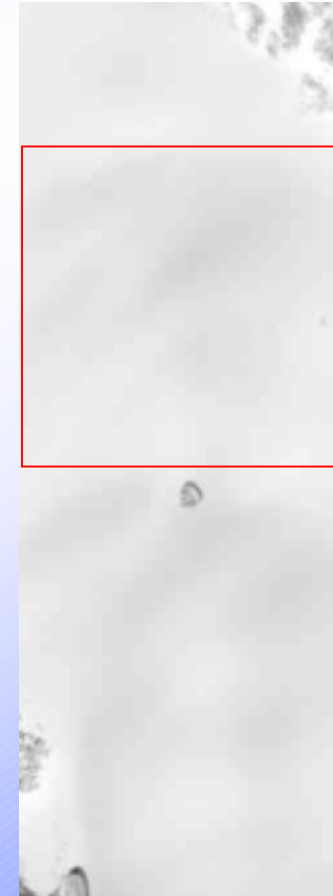
- Method I: error subtraction on a pixel-by-pixel basis
 - artifacts noticed almost immediately outside test area
- Method II: ratio adjustment
 - degrades rapidly for reflectances different than those used to determine ratio
- Temporal variability suggests Method I is preferable



Correction Test



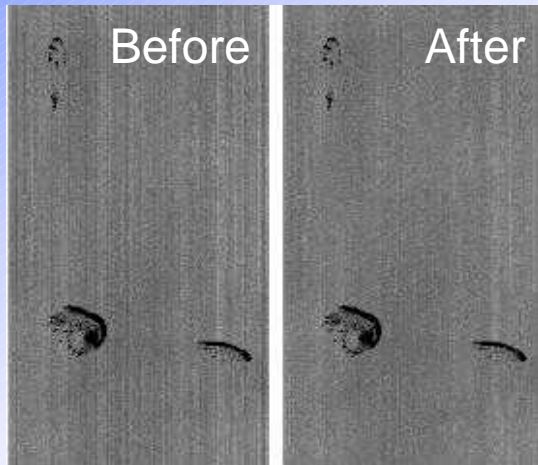
Day 188
(July 7, 2001)



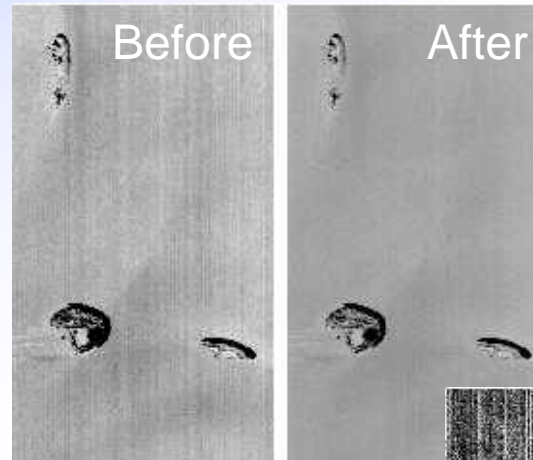
Day 220
(August 8, 2001)



Corrected Image

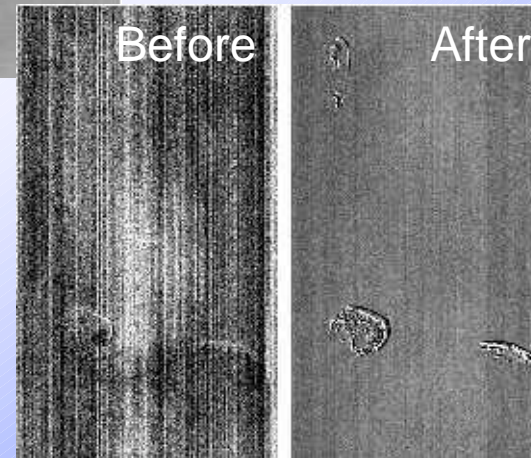


Nearby region (526 lines)
corrected for detector errors
(Band 80 shown)



MNF band 4

MNF components
show significant
reduction in noise



MNF band 11



Conclusions

- Ice sheets are excellent bright “flat field” targets
- Hyperion detector error varies across the array and in time
 - up to 40 DN (VNIR) and 120 DN (SWIR) at the shorter wavelengths
 - VNIR and SWIR errors decrease with increasing wavelength
- Radiance precision beyond these levels is very difficult
 - correction must be customized for each scene