DESTRIPING ALGORITHM

FOR IMPROVED SATELLITE-DERIVED OCEAN COLOR PRODUCT IMAGERY

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INTRODUCTION

Types and sources of striping

A. Minor differences in detector calibration and sensitivity
   - Near-infrared
   - No direct relation with detector number
   - Affected by bands.

B. Differences among detector azimuthal and zenith angles
   - Linear dependence on detector.
   - Very strong near Glint areas.
   - Affected reflective bands.
   - [Q. Liu et al, J. Atmos. Oceanic Tech. 36, 2476]

C. Differences in sensor mirror side (MODIS)
   - Alternating values for even – odd scans.
   - Affects reflective bands.
   - Very strong near glint areas.

DESTRIPING ALGORITHM


1. Start with striped image, calculate gradients.
2. Discard “y” gradients in striped, but otherwise smooth regions
3. Poisson reconstruction (with DCT using FFTl) yields approximate destriped image.
4. Split the original image into destriped and striped components

Destriping domain

1. Exclude land, ice, clouds, and high glint pixels.
2. Collect statistics of nd\textsubscript{a}g, gradient magnitude of remaining pixels.
3. Adaptively obtain optimal gradient threshold based on statistics.
4. Define destriping domain via

   \[ \text{Residual-stripped component} \]

5. Apply nonlinear (Gaussian) filter to residual

   \[ \text{Residual filter} \]

   \[ \text{Destriped component} \]

Adaptive adjustment of parameters

A. defining destriping domain

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B. nonlinear filter parameters

1. Nonlinear filter domain is one pixel wide and one scan high.
2. For MODIS bands with mirror striping effect filtering domain height is two scans.
3. For all central pixels in the destriping domain, collect statistics of residual variations within the filtering domain.
4. Obtain optimal nonlinear filter parameter \( n_l \) based on collected statistics

   \[ n_l = \frac{\sum_{i=1}^{N} (y_i - \bar{y})^2}{\sum_{i=1}^{N} (y_i - \bar{y})} \]

   \[ \text{Normalized function} \]

Destriping statistics

1. Before destriping: distribution skewed due to striping artifacts.
2. After destriping: distribution less skewed, smaller standard deviation indicates removal of striping artifacts.
3. Mean is zero both before and after destriping.

CONCLUSIONS

1. Destriping algorithm by Bouali & Ignatov (2014) is very versatile and works very well for larger amplitude striping artifacts in reflective bands.
2. Destriping for Ocean Color should be done on nd\textsubscript{a}g, not the TOA radiances [Mikelsons et al. (2014)].
3. Adaptive adjustment of parameters is essential.
4. Chlorophyll-a, \( K_{d}(490) \) and other nd\textsubscript{a}g-derived products should be obtained from destriped nd\textsubscript{a}g, spectra.
5. Striping may not be completely removed in small clear sky areas separated by sparse clouds.
6. Filling VIIRS bow-tie areas improves destriping data quality.
7. As expected, destriping improves data statistics.

REFERENCES