Saturation Correction for Nighttime Lights Data Based on the Relative NDVI

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DMSP-OLS

- Defense Meteorological Satellite Program
- Operational Linescan System
- Mainly used for monitoring clouds.
- Later it was found to be capable of monitoring nighttime light for the Earth surface, which is a beautiful accident!



DMSP-OLS Data Download

- URL: https://ngdc.noaa.gov/eog/dmsp.html
- Global DMSP-OLS Nighttime Lights Time Series 1992 - 2013 (Version 4)
 - F1?YYY.v4b_web.cf_cvg.tif
 - F1?YYYY.v4b_web.avg_vis.tif
 - F1?YYYY.v4b_web.stable_lights.avg_vis.tif
 - F1?YYY.v4b.avg_lights_x_pct.tif
- Global Radiance Calibrated Products
 - F1?(-F1?)_YYYYMMDD-YYYYMMDD_rad_v4.avg_vis.tif
 - F1?(-F1?)_YYYMMDD-YYYYMMDD_rad_v4.cf_cvg.tif





Comparison between SNL and RCNL data

	Stable nighttime light data	Radiance calibrated nighttime light data
Orbit	101 minute, sun-synthronous near-polar orbit at an altitude of 830 km	101 minute, sun-synthronous near-polar orbit at an altitude of 830 km
Swath	≈3000 km	≈3000 km
Transit time	≈19:30 (local time)	≈19:30 (local time)
Value	Grey value	Relative radiance value
Spatial resolution	30-arc-second (≈1 km)	30-arc-second (≈1 km)
Radiance calibration	No	Yes
Saturation	Exist in urban center	No
Composit products	Annual	Irregular
Time series	1992-2013	1996/1999/2000/2002/2004/2006/2010

• SNL data needs saturation correction.

• Both SNL data and RCNL data need intercalibration when conducting time series analysis.

Four kinds of ways to correct saturation

Methods	Representative work	Assessment
Utilizing dynamic staellite gain settings	Elvidge et al., 1999; Ziskin et al., 2010	Best, costly, limited images produced.
Regional regression models	Hara et al., 2004; Letu et al., 2010	Simple but not at the pixel scale
Using the RCNL data to correct	Letu et al., 2012	Too many assumptions
Utilizing other kinds of datasets to correct	Cao et al., 2009; Lu et al., 2008	Quite inspiring and promising

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• Linear regression test between SNL and RCNL data in year 2006.



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• Examine the distribution rules of the DNs of the SNL and RCNL data.



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- Unsaturated pixels if DN<50
- Slightly saturated pixels if 50≤DN≤55
- Saturated pixels if DN>55, which were corrected in this work.

Calculating RNDVI

- NDVI=0.004*value-0.1
- real NDVI= $max_{t=1}^{n}NDVI_{t}$
- RNDVI=real NDVI-interpolated NDVI



□ Stl_ndvi
Stl_ndvi
Structure
Structure
RNDVI







Regression formula establishment

- The quadratic function depicts the relationship best
- RNDVI is a better indicator than the real NDVI

	R ²	Coefficient		R ²	Coefficient
RNDVI	0.42	-534.56	NDVI	0.14	77.89
RNDVI ²	0.48	1793.04	NDVI ²	0.08	90.90
RNDVI ⁴	0.29	7554.81	NDVI ⁴	0.04	120.68

Regression formula establishment

 RNDVI might also suffer a "saturation problem" when its value is smaller than -0.4, which should be noted.





Saturation Correction

• Qualitative evaluation of results



Saturation Correction

• Qualitative evaluation of results



Saturation Correction

- Quantitative evaluation of results
- Relationship with the 2006 RCNL image

	2006 SNLImage	Corrected Image
R^2	0.53	0.65
RMSE	30.53	26.39

 Relationship with the GDP (Correlation coefficient 0.8461 and 0.8626 for the 2006 SNL image and corrected image)

Discussion and conclusions

- Different strategies for different degree of saturation
- The effectiveness and deficiency of RNDVI
- Extend the proposed method to other regions and other years

Thank you Q&A