Change Detection Techniques

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- Mas 1999. Vol. 20, no. 1, 139-152
- Lu et al. 2004. Vol 25, no. 12, 2365-2407

Why Detect Changes?

- LULCC
- Forest & vegetation change
- Forest mortality, defoliation, & damage assessment
- Deforestation, regeneration, and selective logging
- Wetland change
- Forest fire and fire-affected area detection
- Landscape change
- Urban change
- Environmental change, drought monitoring, flood monitoring, coastal marine environmental change, desertification, and detection of landslide areas
- Crop monitoring, shifting cultivation monitoring, road segments, and change in glacier mass balance and facies
- Others…

Products of Change Detection

- Change area and rate
- Spatial pattern of change
- Change trajectories
- Accuracy assessment of change detection results

Change-Detection Considerations

- Precise geometric registration
- Radiometric normalization/calibration
- Phenology, soil moisture, sun angles (select images of similar solar days)
- Image complexity of the study area and mixel effects (use images of similar spatial resolutions)
- Compatibility of images from different sensors
- Classification and change detection schemes (application oriented – change/non-change vs change directions)
- Change detection methods
- Ground truth data
- Analyst's skill and experience
- Time and cost restrictions

Radiometric Calibration/Normalization

1. Absolute correction/calibration:
   - Converting from DN to ground reflectance (or radiance) using atmospheric models

2. Relative normalization:
   - Based on regression or histogram matching techniques to register the radiometric signals of one image to another.

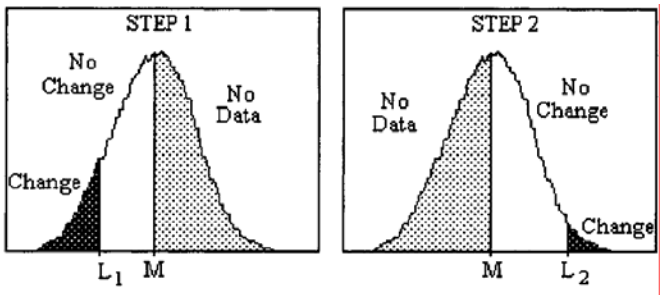
Is radiometric calibration/normalization necessary in change detection?

Change Detection Techniques

Techniques	*Specific Methods*	*Lu et al. 2004*	*Mas 1999*
Algebra (Image Enhancement)	• Image differencing	√	√
	• Vegetation index differencing	√	√
	• Change vector analysis	√	X
	• Image regression	√	X
	• Ratioing	√	X
Transformation (Image Enhancement)	• Selective principal component analysis (SPCA)	X	√
	• PCA	√	X
	• Tasselled Cap (KT)	√	X
	• Gramm-Schmidt (multi-date KT)	√	X
	• Chi-square	√	X
Classification	• Direct multi-date unsupervised classification	√	√
	• Post-classification change differencing	√	√
	• Unsupervised change detection	√	X
	• Expectation maximization (EM)	√	X
Advanced Models	• Li-Strahler reflectance model	√	X
	• Spectral mixture model	√	X
	• Biophysical parameter method	√	X
GIS	• GIS + Remote Sensing	√	X
	• GIS	√	X
Visual analysis		√	X
Image Enhancement + Post-Class Comparison	• Hybrid change detection	√	√

Determining Threshold Values in Image Enhancement Change Detection Methods

- Ground truth data
- Sensitivity analysis identifying the threshold value that produces the highest accuracy (K-hat)



L_1: Threshold level of the lower tail of the distribution; M: Mean;
L_2: Threshold level of the higher tail of the distribution.

Results (Mas 1999)

Table 5. Comparison of the performances of the change detection procedures.

Change detection procedure	Change no change level		From-to change level	
	Kappa	Global accuracy	Kappa	Global accuracy
Band 2 differencing	0.4100	80.40	–	–
Band 4 differencing	0.2210	73.90	–	–
NDVI differencing	0.3981	81.84	–	–
SPCA band 2	0.4155	82.05	–	–
SPCA band 4	0.2222	73.20	–	–
Multi-date classification	0.2850	80.71	0.3886	61.78
Post-classification comparison	0.6191	86.87	0.7070	82.41
Masking + post-classification comparison	0.4201	84.52	0.6414	79.58

- Post-classification is the best.
- Band 2 is better than Band 4 in change detections.

Summary (Lu et al. 2004)

- Red band is better for single band CD
- Band ratio is better than single band CD
- CVA and NDVI are better for multi-band CD