

Esri Developer Summit

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Change Detection using the Python Raster Function

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Background: change detection

- **Land cover change detection**
 - Deforestation, urban crawl, impervious surface, ice cap, etc...
 - Can be detected in image
- **Example**
 - Search “change matters esri”
 - Search “global forest change”

Background: raster function

- A recipe of processing in XML or JSON understood by ArcGIS
 - See all functions: [search](#) “what are the functions used by a raster or mosaic dataset”
 - Can be chained together
- On-the-fly processing
 - How possible? Process your screen not whole image.
- Where to use?
 - Mosaic dataset
 - Preview before saveAs

Basics of python raster function

- Why
 - ArcGIS ships with built-in raster functions
 - You want your python object to participate in that processing pipeline
 - Adapter – wrap your python into raster function
- How to write one?
 - Search “github esri raster function” (<https://github.com/Esri/raster-functions>)
 - Writing image processing algorithms using the python raster function
 - 5:30 – 6:30 PM | Demo Theater 3

Demo 1, Entropy

- What is entropy
 - $E = \text{sum}(p * \log_2(p))$, where p is histogram
 - Measure complexity, or texture
 - http://scikit-image.org/docs/dev/auto_examples/filters/plot_entropy.html
- It is useful, because...
 - Different land cover has different texture



Demo 2: Normalized Burn Ratio (NBR)

$$\text{NBR} = (\text{NIR} - \text{SWIR}) / (\text{NIR} + \text{SWIR})$$

NIR light: 700 to 1,100 nanometers

- Plants (chlorophyll in leaves) reflect near infrared light strongly
- AFTER FIRE: less plants, less chlorophyll to reflect NIR → NIR decrease

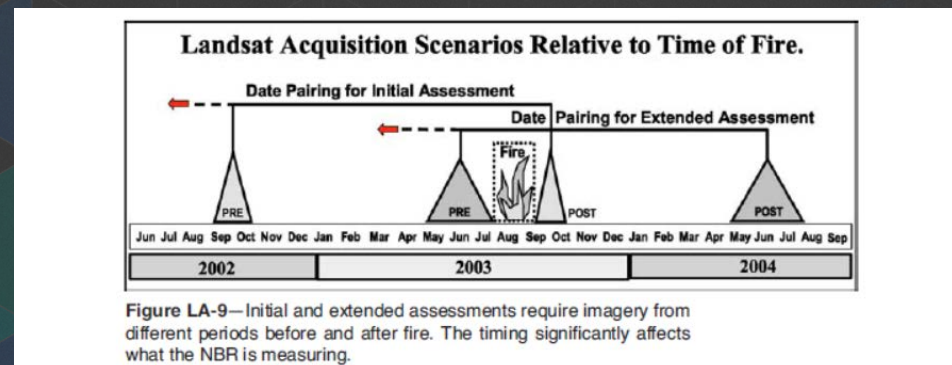
SWIR light: 1,100 to 3,000 nanometers

- Water absorbs shortwave infrared light
- AFTER FIRE: less moisture in soil, less absorption of SWIR → SWIR increase

NIR & SWIR respond the most to burning; the changes is greatest in magnitude comparing to other bands
Measuring the relative changes in NIR & SWIR → distinguish burned area from unburned areas

Differenced Normalized Burn Ratio (ΔNBR)

$$\Delta\text{NBR} = \text{NBR}_{\text{prefire}} - \text{NBR}_{\text{postfire}}$$



Courtesy of Zou Yi
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Demo 3, Block change detection

- Major challenges

- Image registration
- Shadows
- Angle of camera
- Reflection
- Moving objects (vehicles...)



- Methods

- Color differences
 - Luminance effects elimination, color models, band statistics...
- Texture differences
 - Pixel entropy, edge information...

Use python raster function on ArcGIS server

- Install 3rd party libraries on server
- Upload .py and .rft.xml to \ArcGIS\Server\resources\Raster\Functions\System
- Call as well-known raster function (avoid built in names)

Questions?

- Hua Wei
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- For more info on Python Raster Function
 - *Writing image processing algorithms using the python raster function*
 - 5:30 PM – 6:30 PM
 - Demo Theater 3