Change detection processing chain dedicated to Sentinel data Time Series. Application to forest and water bodies monitoring

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SPOT 5 (Take 5 Initiative) and Test sites for water bodies and forest monitoring

La Victoria (Colombia)
Novo Progresso (Brasil)
Waku Kungo (Angola)
Poyang (China)
1. Context

Test site 1. Magdalena River, La Victoria (Colombia) Water bodies monitoring and floods risk in Magdalena River, La Victoria (Colombia)

Hydrological component - Flooded frequency evaluation, using ALOSPalsar information

Source: El Colombiano, 2011. Magdalena River Flood hazard in April 2011. Puerto Nare place flooded

Source: Carlos Florez, Identification and mapping of Colombia wetlands. An Ecosystem Approach. Carlos Flórez. Humboldt Biodiversity Research Institute, Colombia, 2015
1. Context

Test site 2. Lake Poyang (China), Time series Water bodies monitoring

Poyang lake: a monsoon lake with important water height variations

January 2011
Water height = 9 m

June 2010
Water height = 20 m

Source: Yesou et al, ESA Dragon Initiative for Poyang Lake Water Monitoring.
The study of change detection in Time Series Analysis is possible using Holder means in multi spectral and SAR images from new missions.

⇒ Hölder means

Generalized Hölder Mean, or “power mean”:

$$M_n[x, y] = \sqrt[2]{\frac{x^n + y^n}{2}}$$

Hp (T) is continuous and monotonic increasing in p for $-\infty < p < \infty$
Test site 2. Magdalena River, La Victoria (Colombia), Time series Water bodies monitoring

SPOT (Take 5) Time series Data. Product Level 2A.
→ Test site 1. Magdalena River, La Victoria (Colombia) First Results for Water bodies monitoring and floods risk in Magdalena River, La Victoria (Colombia)
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The Holder Means method, present significant results for time series classification too, here we present our first results in this area.
water bodies (yellow color)
Flooding Areas (red color)
forest areas (green color),
urban areas and mineral exploitation areas (purple color).

LULC in La Victoria (Colombia, derived of Time Series Analysis of SPOT (Take 5) Data
1. Contexte

Test site 2. Lake Poyang (China), Time series Water bodies monitoring

2. Method

SPOT (Take 5) Time series Data. Product Level 2A.

3. First results

4. Summary
Test site 3. Waku Kungo (Angola), Time series Water bodies monitoring

SPOT (Take 5) Time series Data. Product Level 2A.
Test site 3. Waku Kungo (Angola) Lake Poyang (China), First Results for Time series Water bodies monitoring

In figure 1 we can detect the time series cut trees change detection areas (deforestation). We show in RGB composition for a better discrimination of cut trees areas.

In Figure 2, these water bodies monitoring results are principally affected by time series bare soil spectral values and cloud coverage of 2015/09/07.
Our algorithm showed very robust performance on several test sites:

- In Poyang Lake (China), La Victoria (Colombia) we have extracted temporal change mainly for water bodies (water extent) and floods areas.

- For Novo Progresso (Brasil) and Waku Kungo (Angola) we have performed the change detection in water bodies and forest, using time series of SPOT (Take 5) project, Sentinel-1 and Sentinel-2 images.
At this point, we can foresee the option of fusion of Holder means analysis derived from optical-radar data, for better results in temporal change detection applications. This option allows to improve performance when the optical imagery has a high clouds cover. Holder method in Long Time Data Series also has further applications for forest fire, LULC, etc.