EGU 2020 *Sharing Geoscience Online*

Session Geomorphology 4.3: **Land cover dynamics and geomorphic processes in hillslope environments: from data acquisition to modelling and management practices**

Forest change as a proxy for landslide occurrence – a Sentinel-2 based spatio-temporal landslide detection approach for two test sites

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Study Areas

South Tyrol, Italy

- Approx. 7,400 km²
- 64% of area above 1500 m, only 4% below 500 m
- 531.178 inhabitants (ASTAT, 2018)

Longnan Admin. Area, China

- Approx. 24,000 km²
- Elevation range 550-4187 m
- 2.7M inhabitants

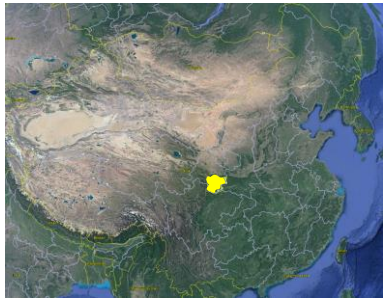


Figure 3: Longnan Administrative Area

Hazard potentials:

- **Floods**, **mass movements** and **avalanches** are well known phenomena in population (Natural Hazard Report 2017)
- Most widespread landslide types: **rock falls**, **debris flows**
- shallow landslides favoured by **forest cutting** and **urbanization** (roads, human settlements) (Piacentini et al., 2012)

Figure 1: Landslide at Klausen in October 2018 (Landesfeuerwehrverb. Südtirol)

Figure 2: Landslide in Gadertal in October 2018 (Freiw. Feuerwehr St. Martin in Thurn)

- **One of four most active landslide and debris flow regions** in China (Scheidegger and Ai, 1987)
- Combination of **earthquakes**, **high relative relief**, **steep slopes**, **strongly seasonal (monsoonal) climates** and widely distributed **thick loess and argillitic rocks** (Bai S., 2011)
- Severe landslide triggering events:
  WenChuan earthquake, 2008
  Jiuzhaigou earthquake, 2017

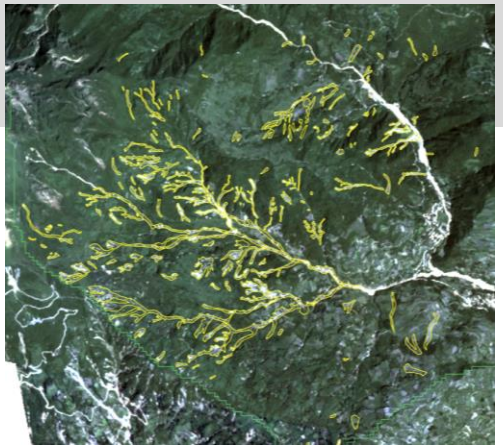
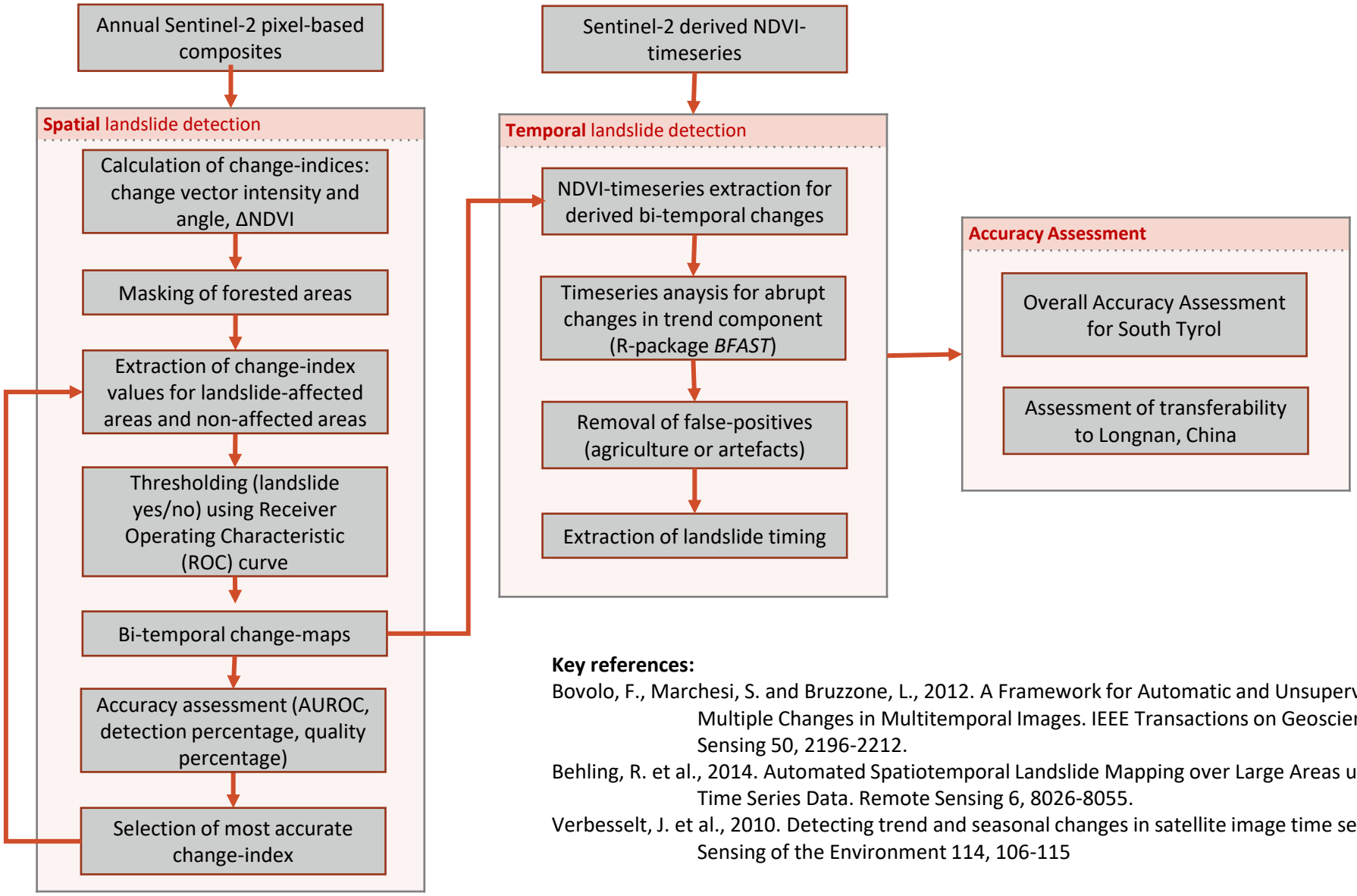


Figure 4: Landslides and debris flow at Wangtoutou, Longnan (imagery: Planet)

General Workflow



Key references:

Bovolo, F., Marchesi, S. and Bruzzone, L., 2012. A Framework for Automatic and Unsupervised Detection of Multiple Changes in Multitemporal Images. IEEE Transactions on Geoscience and Remote Sensing 50, 2196-2212.

Behling, R. et al., 2014. Automated Spatiotemporal Landslide Mapping over Large Areas using RapidEye Time Series Data. Remote Sensing 6, 8026-8055.

Verbesselt, J. et al., 2010. Detecting trend and seasonal changes in satellite image time series. Remote Sensing of the Environment 114, 106-115

Results: Spatial landslide detection

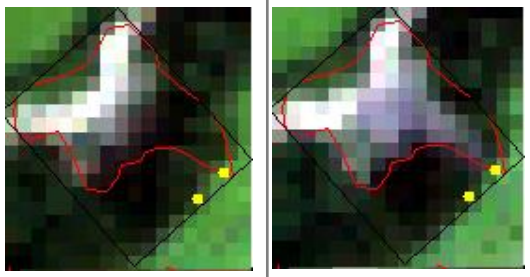
Bi-temporal spatial landslide detection

input

Sentinel-2 pixel-based composites (PBC)

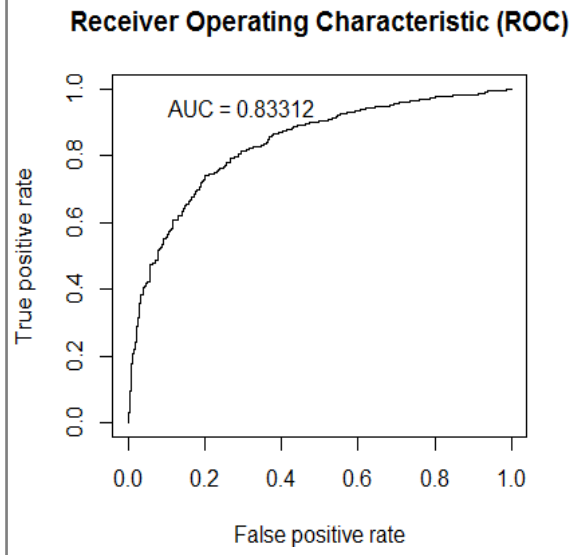
processing

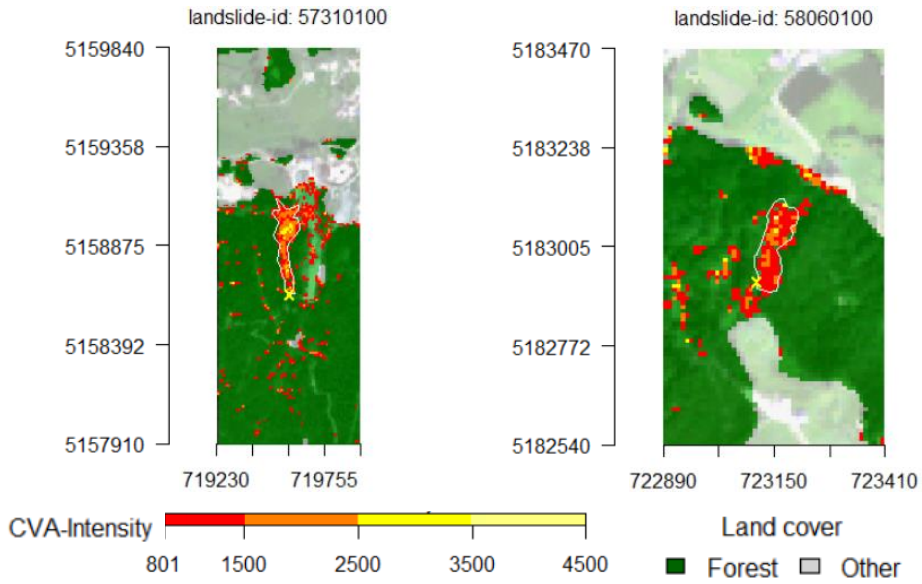
PBC_pre	PBC_post	Thresholding (landslide yes/no) using Receiver Operating Characteristic (ROC) curve on bi-temporal change indices	Results of spatial landslide detection



2016

2017



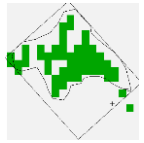


Results: Temporal landslide detection

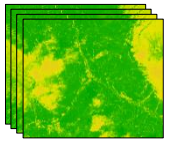
Temporal landslide detection

input

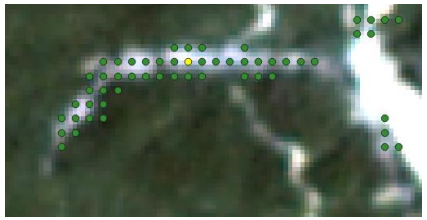
Change-pixels derived from bi-temporal change-detection



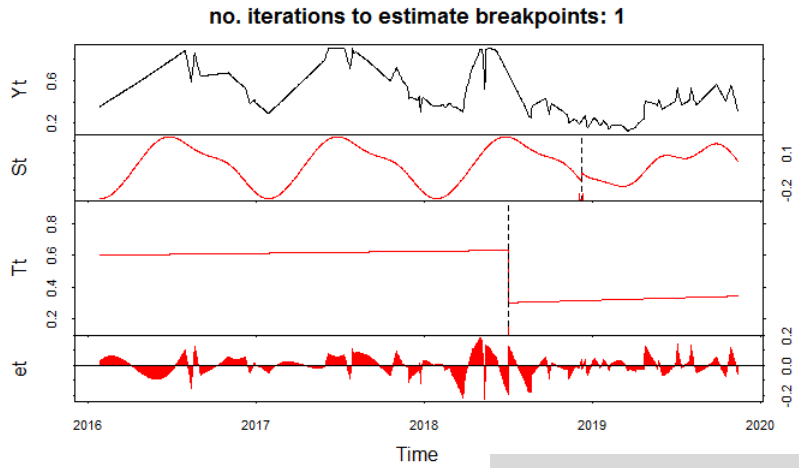
Sentinel-2 derived NDVI-timeseries



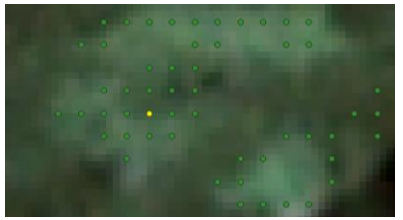
processing



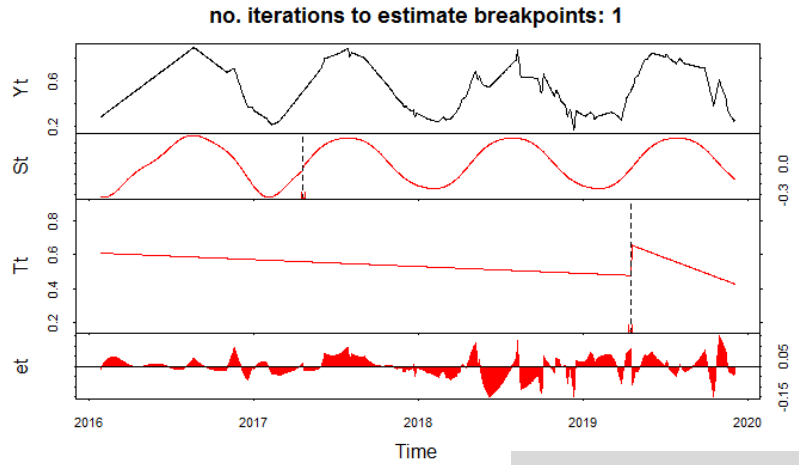
Landslide-affected pixels (indicated with green points). The pixel at the yellow point is chosen for display below



Breakpoint (with fall) in trend-component in 2018



Pixels not affected by landslides, but received as false positives in the spatial detection approach



No breakpoint with fall in trend-component

Verbesselt, J. et al., 2010. Detecting trend and seasonal changes in satellite image time series. Remote Sensing of the Environment 114, 106-115

Thank you for your interest!

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Information on Dragon4 project:
http://www.eurac.edu/en/research/projects/Pages/projectdetail4315.aspx