Inter-annual river pattern change detection using machine learning

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27 May 2022, EGU22-4418, GM5.1
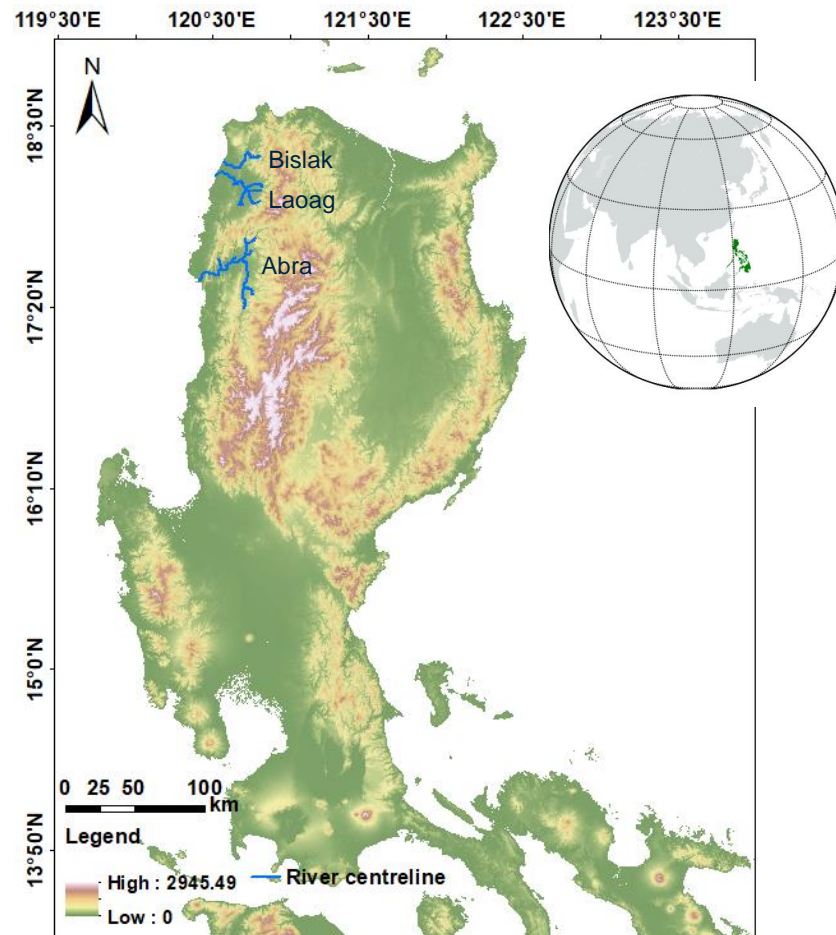
Sharing is encouraged

Study Area

West Luzon, the Philippines:
- ❖ Mean catchment precipitation: 74.4 mm/10-days
- ❖ Temperature: 25 - 31℃

- ➢ Bislak River (L: 39 km, MW: 375 m)
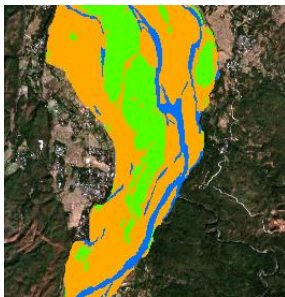- ➢ Laoag River (L: 47 km, MW: 580 m)
- ➢ Abra River (L: 82 km, MW:2626 m)

L: main channel length; MW: mean width.

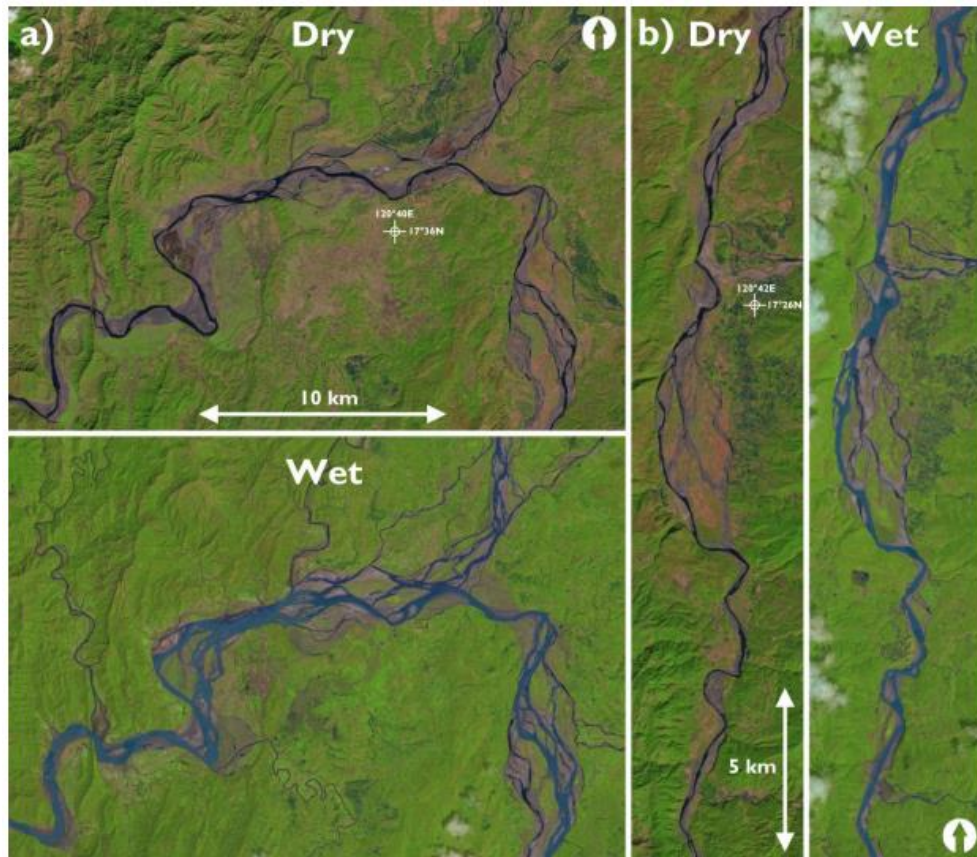# Example: Abra River, Luzon, the Philippines

Issues:

➤ Seasonality (dry/wet)
➤ Dynamics of water, bars and vegetation
➤ Channel settings and landforms
➤ Sub-reach behaviours

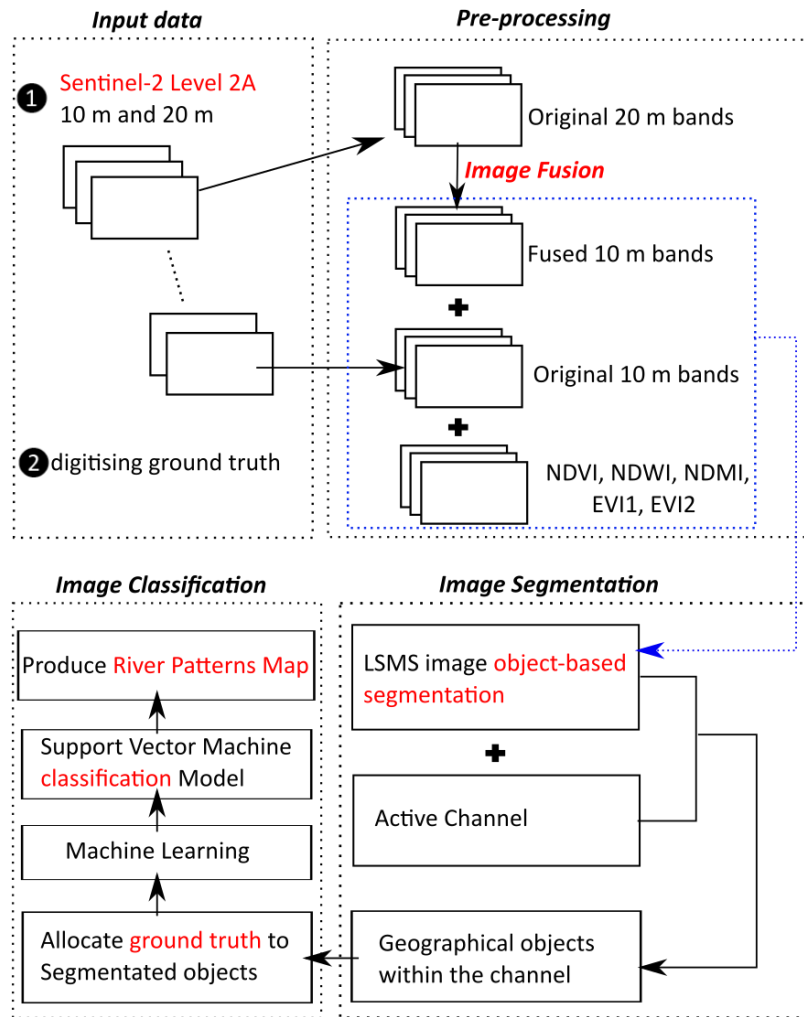

Legend
- water
- bars
- vegetation

0   1.25   2.5
            km

Workflow

- Data:
  Sentinel-2 L2A imagery, digitised ground truths
- Image downscaling:
  Area to Point Regression Kriging (ATPRK)
- Objects segmentation:
  Large Scale Mean Shift (LSMS)
- Machine learning classification:
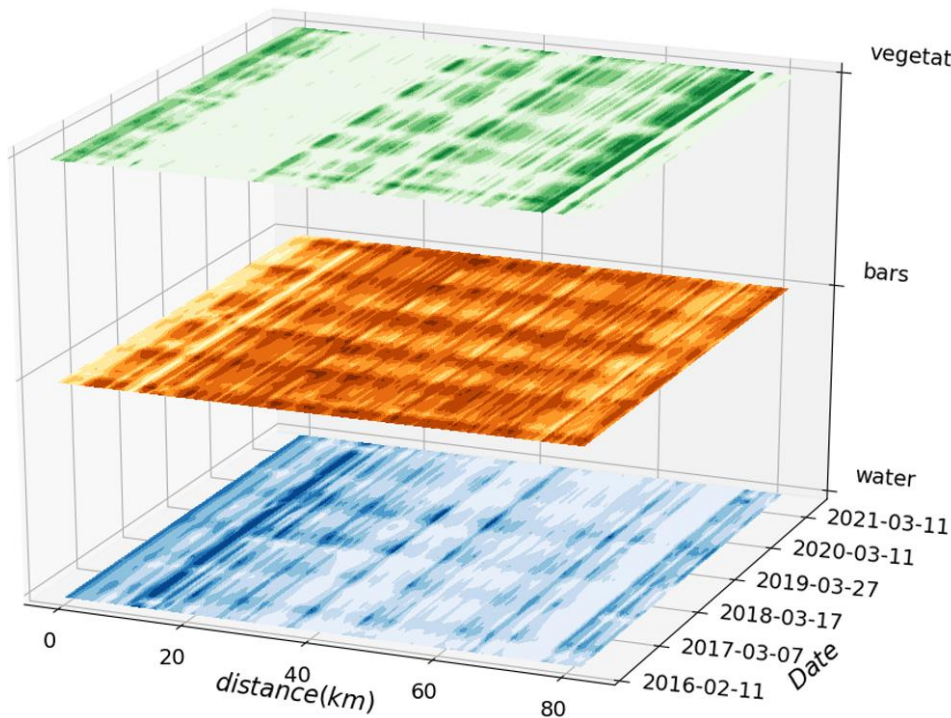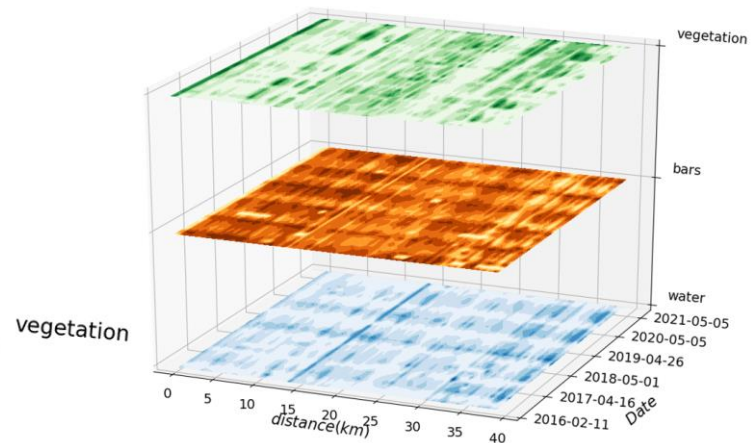 Support Vector Machine (SVM)
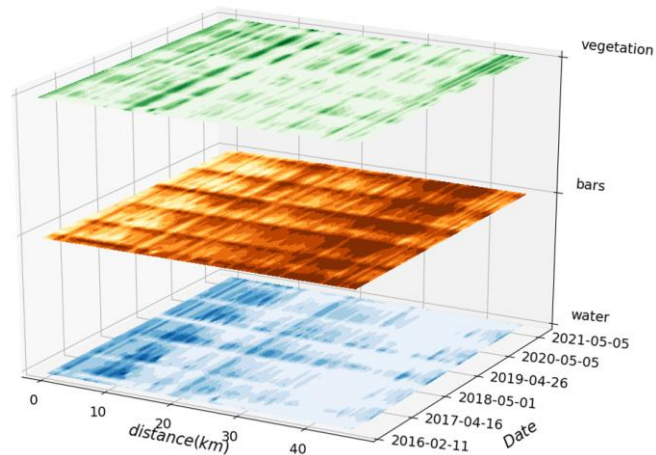
Classification results

Spatial-temporal landforms proportion change of Abra River

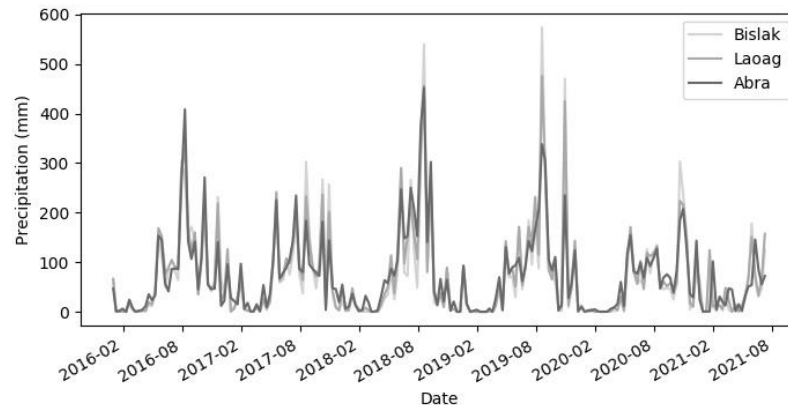Spatial-temporal landforms proportion change of Bislak River

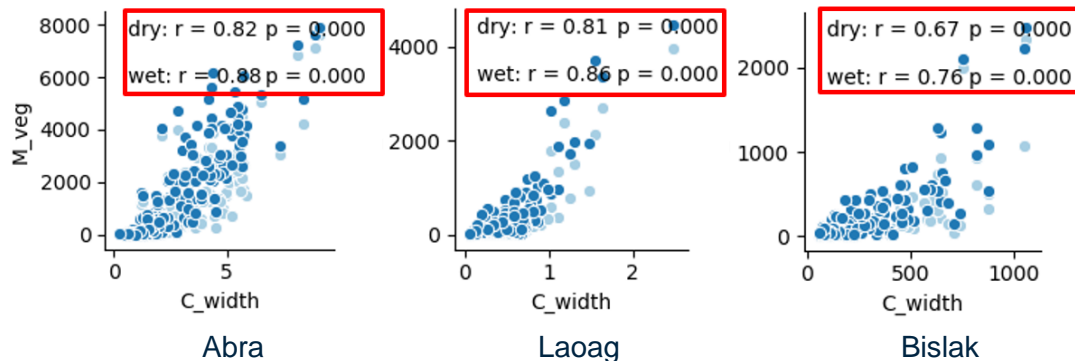Spatial-temporal landforms proportion change of Laoag River

Variations in seasons

- Dry season:
  the continuous period with precipitation <100 mm/10-days
- Wet season:
  the period between two dry periods

Channel width- vegetation correlations in 3 rivers

dry: r = 0.82 p = 0.000
wet: r = 0.88 p = 0.000

Abra

dry: r = 0.81 p = 0.000
wet: r = 0.86 p = 0.000

Laoag

dry: r = 0.67 p = 0.000
wet: r = 0.76 p = 0.000

Bislak

## Correlation coefficients in 3 rivers

- ❑ Geomorphological relationships vary from dry season to wet season

- ❑ Channel width controls dynamics of three landforms
  - channel scale is a factor driving correlation coefficients between vegetation area and channel width

Sub-reach investigation

15 Sub-reaches in the Abra River defined by:
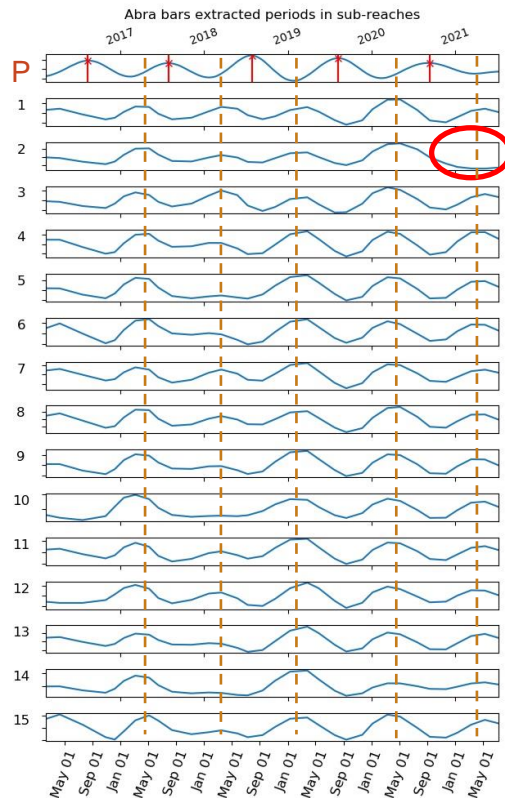
- water frequency
- confinement
- confluences

Landforms within the sub-reaches were extracted for temporal analysis.
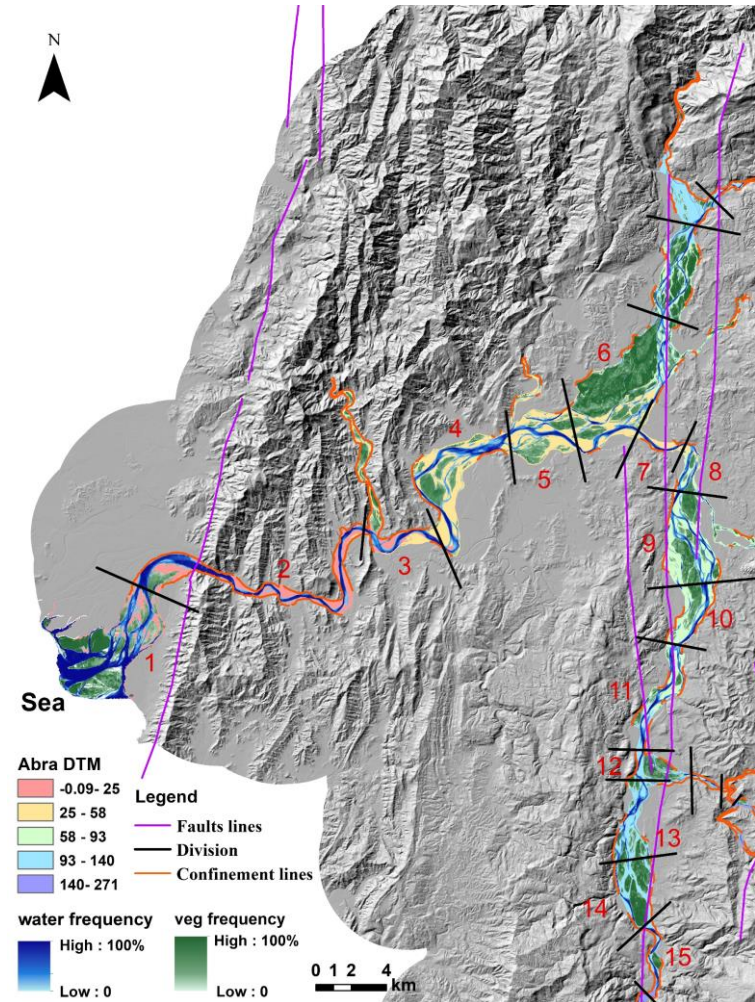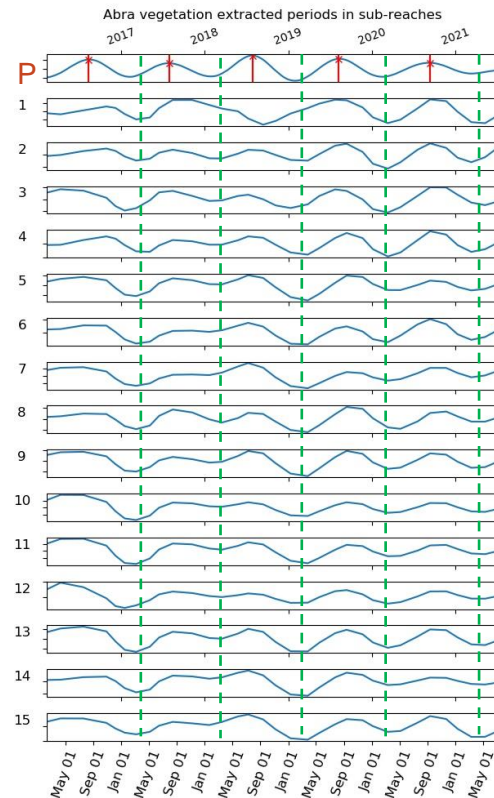
❖ -Water and vegetation areas are both in phase with precipitation (P); sediment bar areas are in anti-phase with precipitation (P)

❖ -Periodic consistency in patterns may reflect extreme events and/or human disturbance (red circle)
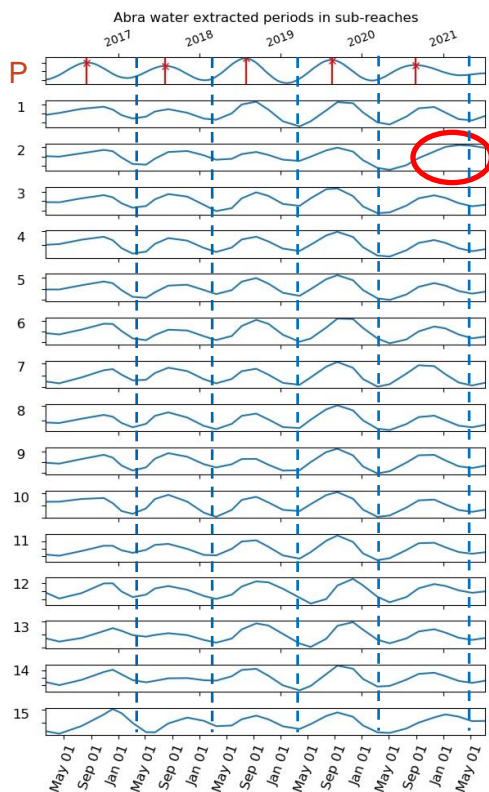
Conclusions

1. The processing workflow to classify river channel landforms is shown to be efficient and accurate in the three studied rivers

2. Seasonality in precipitation controls the temporal behaviour of the water, bars and vegetation; spatial variation is controlled by channel width

3. Signal decomposition helps to identify the causes of changes in water, bars and vegetation areas

4. Spatial-temporal analysis will further improve our understanding of geomorphological changes

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🙂 Thank you!

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