# A new methodology to detect changes in displacement rates of slow-moving landslides using InSAR time series

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## Objective

- Automatically detect and quantify changes in the surface deformation rate of slow-moving landslides.
- Make a spatially distributed velocity change inventory from cumulative deformation time series.

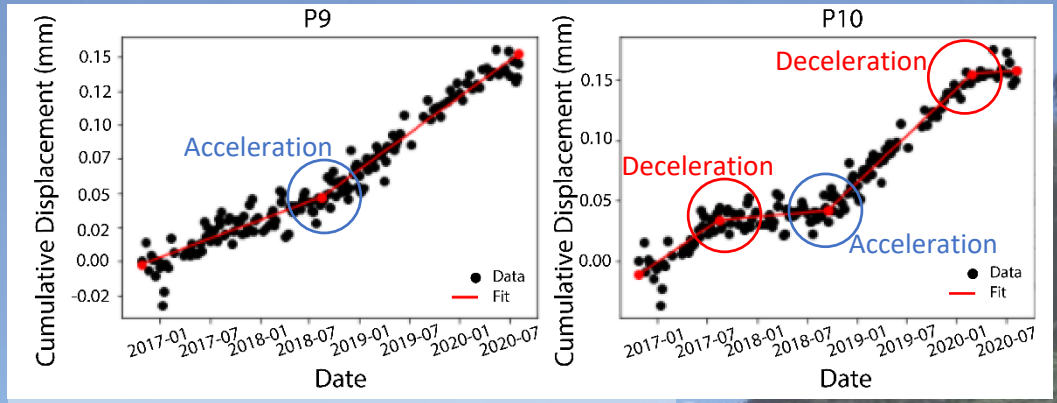
## How do we do this?

- We have a new tool - **AC/DC-INV**.
- Accelerations and/or decelerations are detected by fitting a piecewise linear function to the cumulative deformation time series for each pixel of the InSAR data.

## What do we get?

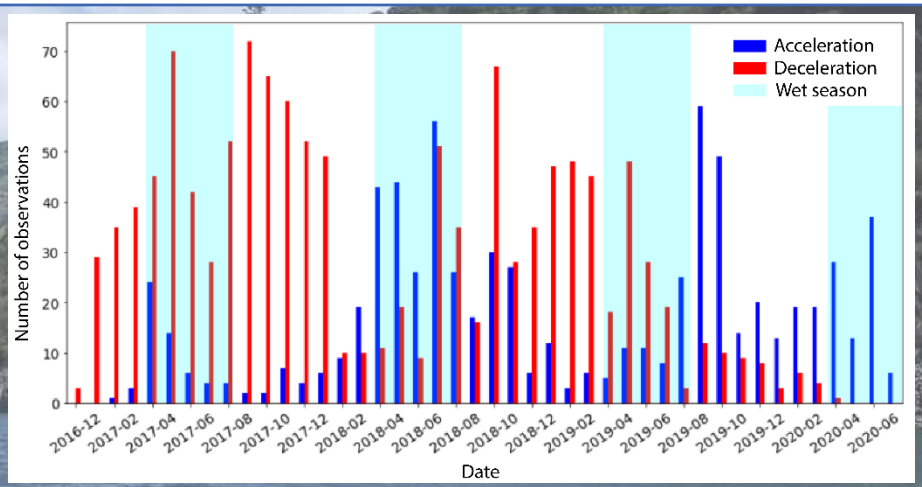
- Detailed inventory of accelerations and decelerations of slow-moving landslides in a regional scale.
- Quantitative information of the location and timing of accelerated/decelerated slope movements. This could be used in regional hazard assessments or early warning systems.

## Landslide accelerations and decelerations




*Cumulative deformation time series from pixels 9 and 10

## Inventory of accelerations and decelerations

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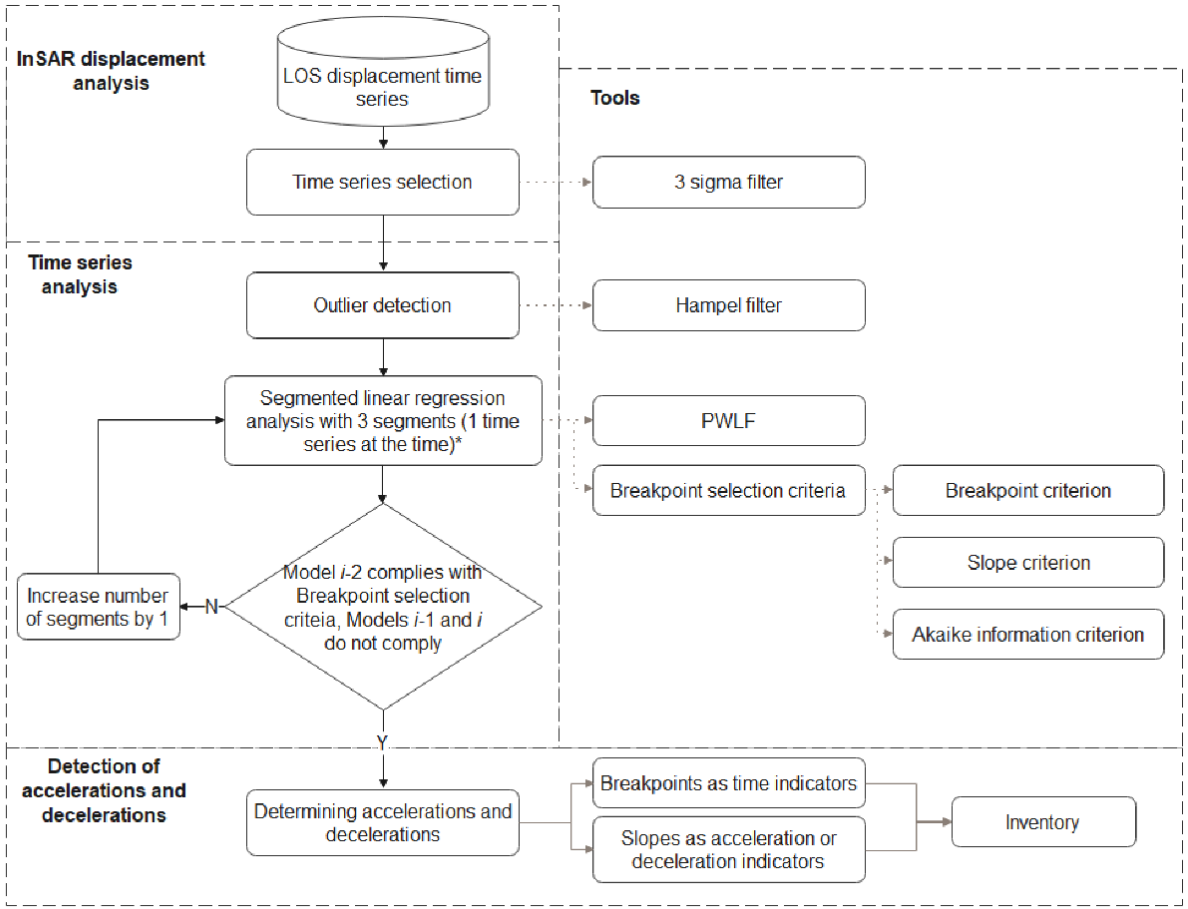
## Methodology




*Note: The segmented regresssion analysis of 1 time series is with *i*-2, *i*-1 and *i* number of segments at the time

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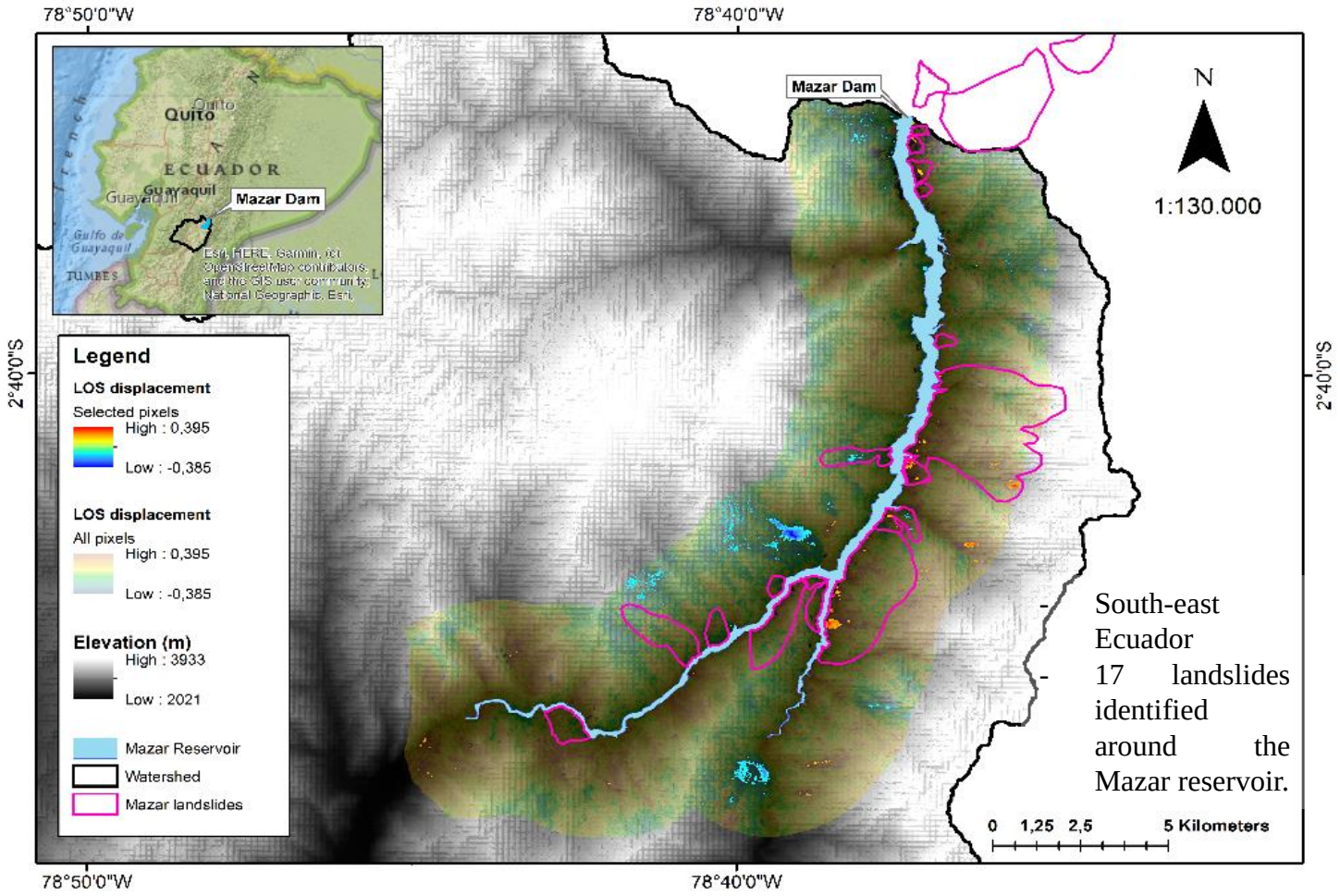
## InSAR displacement analysis




## SAR processing and time series inversion

- Data from Copernicus Sentinel-1 satellites
- InSAR Scientific Computing Environment (ISCE) (Rosen et al., 2012)
- Miami InSAR Time-series software in Python (MintPy) (Yunjun et al., 2019)
- Result:
  - 175.224 pixels available for study in the area around the reservoir
  - 1.580 selected pixels for further analysis

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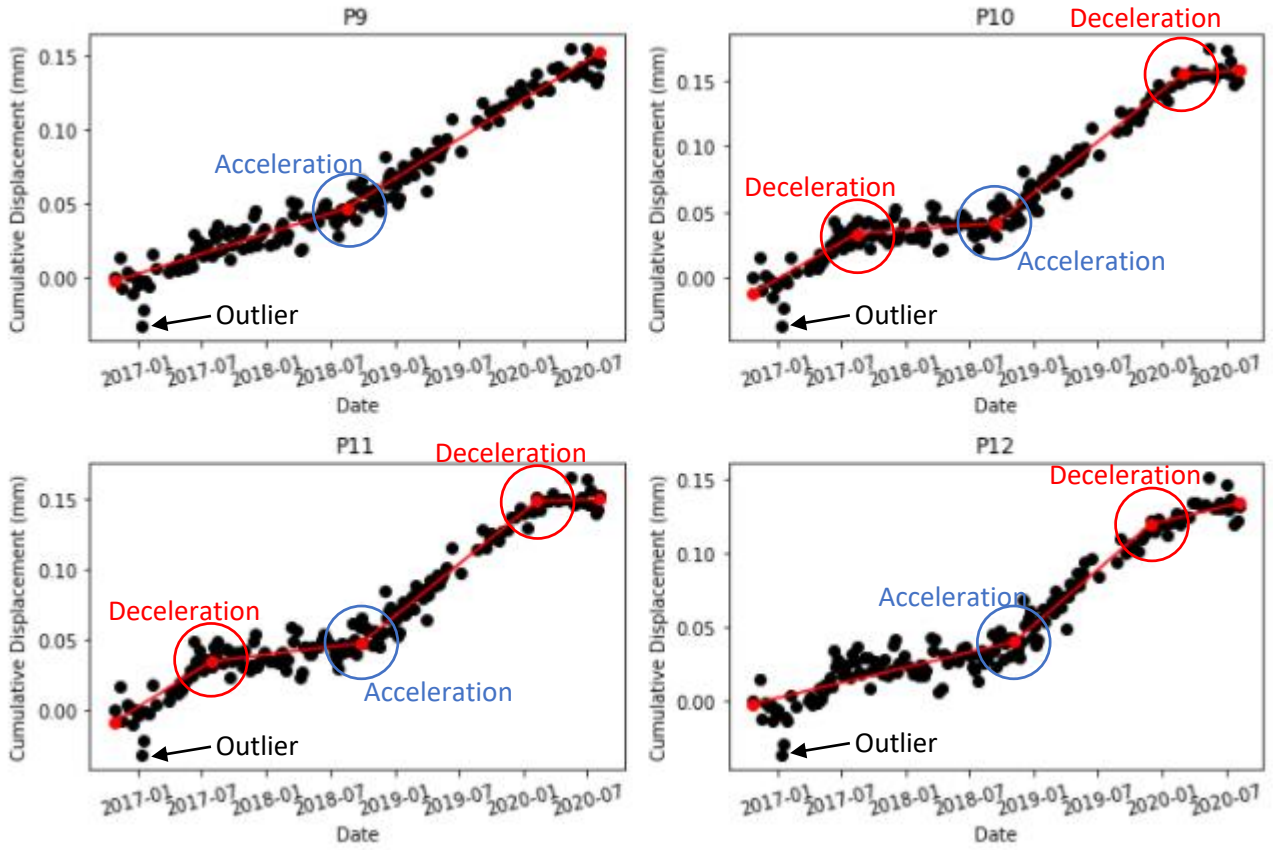
## Time series analysis




1. Detect and replace outliers
2. Fit segmented linear regressions through the cumulative deformation time series.
   - Initiate the process with 1 time series and 3 models, with 2 (*i*-2), 3 (*i*-1), and 4 (*i*) segments, respectively.
   - Evaluate each model with the breakpoint selection criteria.
   - If model *i*-2 complies, and models *i*-1 and *i* do not comply, we accept model *i*-2 and evaluate the next time series.
   - If this is not the case, we add another model with an additional segment and evaluate models with *i*-2, *i*-1, and *i* number of segments.

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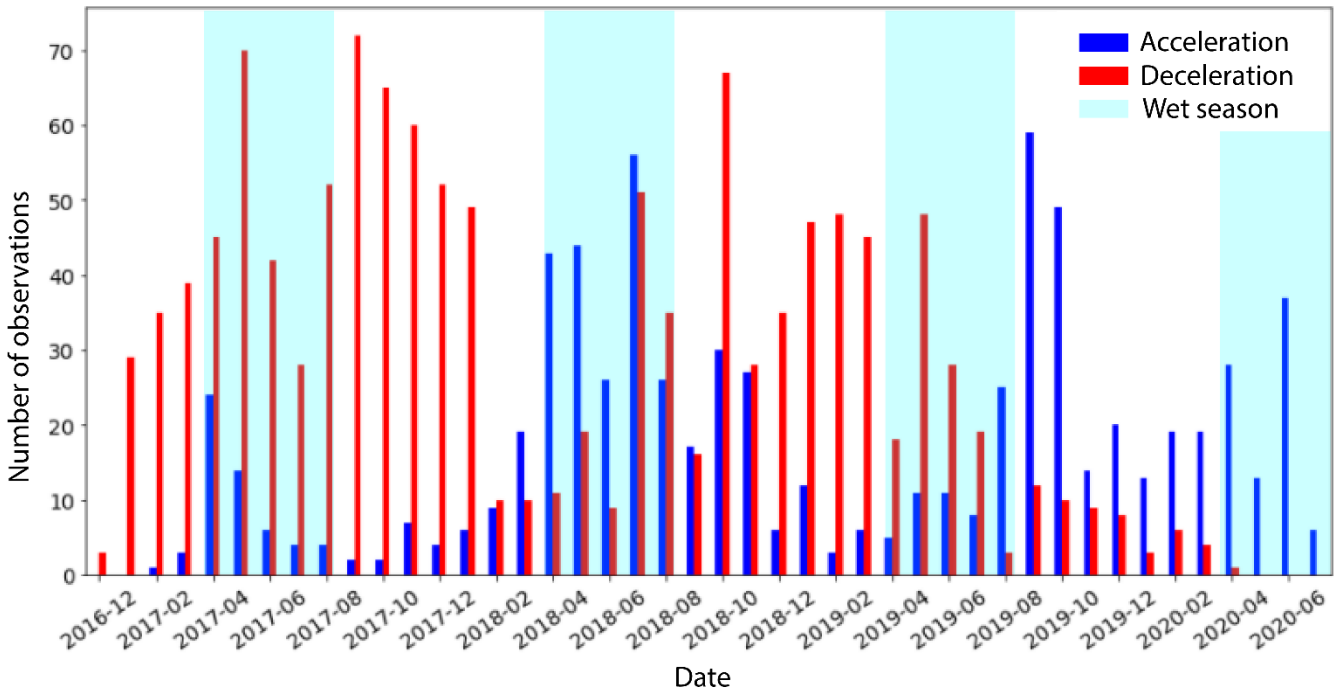
## Detection of accelerations and decelerations




- Location of breakpoints indicate the timing of accelerations and/or decelerations.
- Segments' slopes indicate if the an acceleration or deceleration happened.
- Quantify accelerations and decelerations.
- Make an inventory of changes in displacement rates of slow-moving landslides