A conceptual approach on optimising lead time for the forecasting of landslides using remote sensing systems

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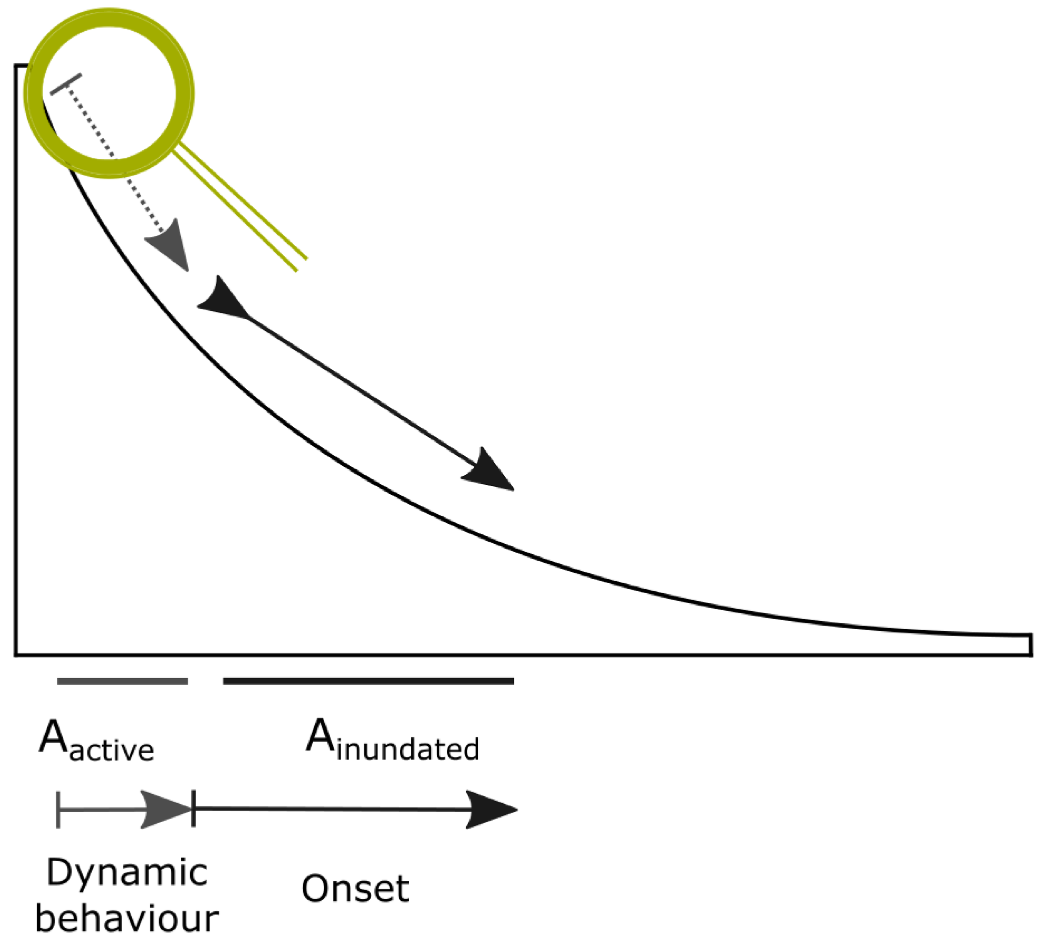
Motivation



Many post-event studies successfully demonstrated the capabilities of multispectral sensors to investigate landslide process evolution[1].

In this study we present a new conceptual approach to evaluate the capabilities of different multispectral sensors for an optimisation of lead time for pre-event landslide studies and the saving of lifes. Our goal is to use it as an aid for a practical guide to systematically select eligible sensors based on their temporal aspects. There is the need to have improved understanding for the extension of lead time before the hazard strikes.

Monitoring & Early Warning

Time matters.

The UNISDR[2] defines an early warning system as the capacity to provide effective warning information in time to take action to reduce or avoid risk and prepare for response. Here, the adjective 'early' implies all events which can be detected before they take place. But the reference of a time scale is not included. To our understanding the temporal element is a crucial factor in EWS and every concept should consider a temporal component. We follow the UNISDR definition and include this missing reference. In an EWS all components of time are driven by the speed of the natural process itself. This process determines all time components: the onset of ground motion, its acceleration and the onset of a hazardous process with the final impact. As a consequence, the speed of the natural process drives the forecasting window. This is in comparison to the technological domain, which drives the computation time.

Process time [t]

Monitoring

one observation	two observations	near-real-time observation

The systematic and repeated observation over a specific object or area[3]. It provides insights into long-term behaviour and short-term response to triggers and perturbations. The overall understanding of the study site is continuously improved and a threshold for the acceleration excess can be defined. It is a key component for a sound landslide EWS.

Forecasting window

Warning time

The start of a massive acceleration and defined threshold exceedance.

A process becomes predictable, the start of the forecasting window is opened.

Lead time

A time interval between the warning and the onset of the forecasted event[4].

The greater the lead time, the greater the countermeasures and reactions that can be taken prior to the event.. With a reduction in warning time, the lead time can be extended.

For a landslide EWS to be successful, mitigation and response measures must be within the lead time window.

Reaction time

Time to respond and take measures to mitigate a hazardous event.

Summary

At the end what matters is time. Therefore we postulate a new conceptual approach on the optimisation of lead time for EWS incorporating the reference of a time scale. The natural process dictates all time components; consequently this also influences the behavior of technical components as well. This approach targets the temporal components of the natural process for landslide investigation and examines available systems on their ability to comply why the time frame.

Knowledge and critical selection of available data sources and applied technologies decrease the warning time. This increases the lead time, therefore the reaction time until a landslide occurs. Finally this enables the application of more extensive response measures for landslide events.

Outlook

There is the need for a better understanding of temporal components of natural processes with respect to their speed and duration. This goes along with an improved technological understanding and categorisation into different classes of landslide velocity[5]. Set together, a practical toolbox will be created to allow the EWS practitioner selecting the most appropriate remote sensing data available. Preliminary results on the practical application by digital image correlation of optical multispectral images have been tested with three different methods. Please see our display on preliminary results of digital image correlation, EGU2020-16982 in session NH3.8.

References

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