LANDSLIP

LANDSLide multi-hazard risk assessment, Preparedness and early warning in South Asia: integrating meteorology, landscape and society

LANDSLIP is a 'research-into-action' project seeking to develop a prototype regional rainfall-induced landslide Early Warning System in two Indian pilot case study areas.

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www.landslip.org

Summary:

About 12.6% of the Indian landmass is prone to landslides. Climate, geomorphology and geology can contribute significantly to an area's susceptibility.

Rainfall is one the main triggers of landslides, and improvements in rainfall forecasting create an opportunity to build resilience to rainfall-induced landslides.

Through advances in interdisciplinary science and the application of this science in practice, LANDSLIP aims to contribute to better landslide risk assessment and early warning.

By working with national and district authorities, these research outcomes will be applied and integrated into disaster risk management and planning, improving preparedness for rainfall-triggered landslides.

Overall aim

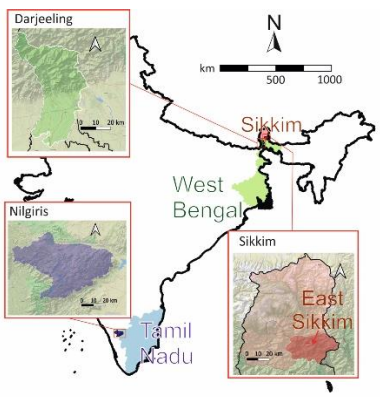
LANDSLIP is contributing to better landslide multi-hazard risk assessment and early-warning, working with national and district authorities for better preparedness to hydrologically controlled landslides and related hazards, on a regional to catchment spatial scale and a daily to 15 day temporal scale in India.

Weather patterns are being identified and correlated to recorded landslide events in the study areas. In addition, landslide susceptibility maps are being created. This will help us to better understand the weather conditions that contributed to landslide occurrences in the past and subsequently inform when and where future potential landslides are most likely to occur.

The project team will work alongside stakeholders including the Geological Survey of India to develop effective applications, evaluation, communication and legacy strategies, so that partners in India will be able to continue to build resilience to rainfall-induced landslides when the project is complete.

LANDSLIP brings together a wide range of expertise and experience from a variety of disciplines. For example, Consiglio Nazionale delle Ricerche, the UK Met Office and the British Geological Survey bring their experience of developing landslide early warning systems in Italy and the UK, Kings College London brings expertise in social science and multi-hazards, Newcastle University brings expertise in social media analytics, and Practical Action and Amrita University bring contextual knowledge and experience of disaster risk reduction in India.

Project case studies



In both of our pilot study areas in India, we are working with community-level organizations.

Both pilot areas experience intense rainfall during the monsoon seasons, which trigger landslides resulting in fatalities and socio-economic impacts.

Components of the Landslide Early Warning System

Meteorological Forecasting

LANDSLIP uses a novel method, developed for the UK by the Met Office, to objectively identify a set of predefined weather patterns. LANDSLIP is applying this method to South Asia for the first time, correlating specific weather patterns (from a set of 30) to landslide events in India using data on location and time of occurrence of historically recorded landslides (see Landscape Dynamics section).

This same landslide data has already been used to estimate daily rainfall thresholds that have triggered landslides in the past. India's National Centre for Medium Range Weather Forecasting provides rainfall forecasts at a range of spatial resolutions (e.g. 4 km over India and 12 km globally), and these are combined with the estimated rainfall thresholds to obtain daily forecasts for landslides over the two test areas.

Probabilistic weather pattern forecasts (forecasts of the likelihood of a weather pattern occurring) are used to identify when there will be a higher risk than normal of landslide occurrence, up to two weeks in advance.

Landscape Dynamics

LANDSLIP is adopting and developing existing methodologies to capture and classify geo-environmental factors and the changes that contribute to landslides. Landslide inventory maps, geological, and geomorphological data have been collected and processed to estimate how susceptible the slopes in the study areas are to slides, debris flows, and rock falls.

These landslide inventory maps are being used to define landslide domains (categories of conditions which shape how landslides occur, such as geological or climatic characteristics), which will aid the characterisation of future landslide events to better understand how different types of landslides will impact communities.

Landslide Forecasting

LANDSLIP combines the meteorological forecasting and landscape dynamics components of the early warning system to develop models for forecasting rainfall-triggered landslides over a daily to 15 day time scale. The models use information about past rainfall-induced landslide events to inform the forecasts.

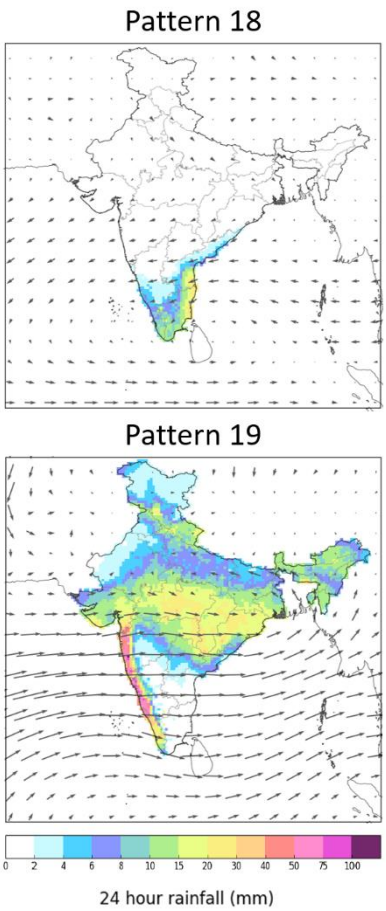
The landslide forecasts will be combined with other tools to create a bulletin of information for District authorities to support them in their decision-making.

Using field surveys and social media sources in both study areas, LANDSLIP are refining the model and its components over the 2019 monsoon season.

Published Papers

Neal *et al.* (2019), Deriving Optimal Weather Pattern Definitions for the Representation of Precipitation Variability over India, *The International Journal of Climatology.*

Mondini *et al.* (2019), Sentinel-1 SAR Amplitude Imagery for Rapid Landslide Detection, *Remote Sensing*, 11, 760.



An example of two contrasting weather patterns from the set of 30 showing mean wind speed and direction at 850-hPa and daily mean rainfall. Weather pattern 18 is a retreating monsoon type and weather pattern 19 is an active monsoon type (Neal et al., 2019).

LANDSLIP Key Events

January 2017: LANDSLIP kick-off meeting in India.

October 2017: visit from the Geological Survey of India to British Geological Survey, Keyworth, UK.

December 2017: second annual partners project meeting and stakeholder workshop, Nilgiris, India.

February 2018: Presentation of the LANDSLIP project at the AOGS–EGU Joint conference, Philippines.

Social Context

Application of scientific approaches to early warning and risk management without understanding the social factors affecting risk and the institutions within which disaster management is operationalised will be ineffective at best and dangerous at worst.

LANDSLIP has mapped the institutional landscape in which a potential landslide early warning system could operate, creating greater understanding of roles and responsibilities in the current DRR system, and how a landslide early warning system could fit in.

LANDSLIP has been engaged in ongoing conversations with District officials and will be working more actively with them in the future to co-develop guidance on useful, understandable, and actionable landslide early warning information.

Social Media

The Global Digital Report 2019 estimates that 57% of India's population have access to the internet, and 42% use social media, with numbers rapidly growing. This presents opportunities to use social media as a significant source of data, but raises the key challenge of the vast volume of data that must be analysed to turn this fire-hose of comments, images, and words into actionable information.

New techniques that can categorise the content and meaning of such data are being developed to process natural language and extract relevant information through computer-based reasoning using vocabularies, relationships, and context.

LANDSLIP is developing a prototype mobile application for research purposes, which could be used in the future to collect or disseminate landslide information from social media platforms.

Multi-Hazards

Landslides rarely occur in isolation and are associated with multi-hazard scenarios. For example, intense rainfall, floods or an earthquake might trigger landslides and wildfire can increase the susceptibility of landslides occurring. Landslides can also trigger other hazards, such as blocking a river and causing a flood.

LANDSLIP is compiling potential scenarios of landslide-related multi-hazards by studying case histories of past events and looking at known potential interactions between hazards.

These potential multi-hazard scenarios will be provided to decision makers to access alongside landslide susceptibility forecasts, so that they can plan for the possibilities of multi-hazard events and build resilience effectively and comprehensively.

Partners

Science for Humanitarian Emergencies and Resilience (SHEAR) is an interdisciplinary, international research programme jointly funded for five years by the UK's Department for International Development (DFID) and the Natural Environmental Research Council (NERC). It aims to support improved disaster resilience and humanitarian response by advancing monitoring, assessment and prediction of natural hazards and risks across sub-Saharan Africa and South Asia. SHEAR is working with stakeholders to co-produce demand-led, people-centred science and solutions to improve risk assessment, preparedness, early action and resilience to natural hazards.