5. Satellite Integrated Landslide Assessment and Alert System (SILAAS)

Aim

SILAAS will develop a state-of-the-art new landslide alert system in India that addresses 'where' and 'when' landslides will occur. It lays its foundation on assessing, modeling, and measuring static and dynamic parameters that control landslide disasters. Landslide inventory will be prepared using object-based image analysis techniques from satellite images and DEM. Landslide inventory will model terrain factors such as lithology, geological structure, slope, soil depth, land use, etc., using bivariate or neural network models to predict spatial occurrence (i.e., where) of landslides. Landslides, mainly the damaging larger ones, have a typical life cycle that may vary from three to four years. In the tertiary stage, the acceleration of landslide movement increases, leading to slope failure. Hence, continuous monitoring of landslide translation, i.e., its kinematic behavior, is required in all stages, but mainly in the tertiary stage, to predict the failure time. Persistent Scatterer Interferometry (PS-InSAR) using Sentinel-1A/1B image stack will generate a deformation time series. The deformation velocity will be inversed using the Fukuzono method, which will provide the failure time (i.e., when). This failure process becomes imminent if there is a triggering event such as high rainfall, which will reduce the friction along the slip surface and thus accelerate the movement. Antecedent rainfall (a combination of actual and forecasted rain)will provide information on water saturation and pore water pressure increase that are vital to accelerating the failure process. Finally, the three crucial components of landslides, i.e., *terrain, trigger, and translation*, will be combined, and district-wise, a landslide alert bulletin will be issued fortnightly for the given area.

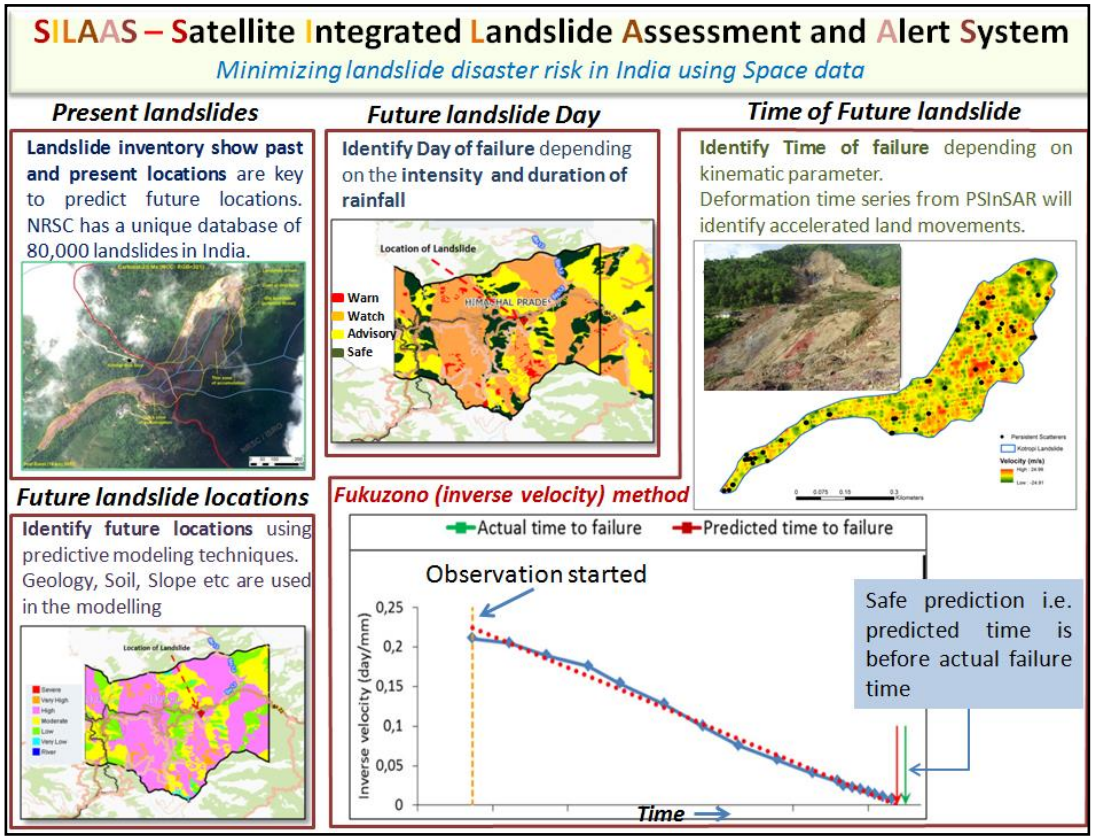
Present status:

1. Proof of concept has been published in a reputed Peer-reviewed journal.
2. Roy, P., Martha, T. R., Khanna, K., Jain, N., & Kumar, K. V. (2022). Time and path prediction of landslides using InSAR and flow model. Remote Sensing of Environment, 271, 112899.
3. The project proposal for upscaling the work to National Level has been submitted to ISRO HQ and reviewed. Final approvals are awaited.

Challenges

1. Landslide displacement time series can have the best frequency of 12 days (over the Indian region) due to the availability of Sentinel-1 data.

2. The landslide displacement time series is linked to the availability of PS points estimated using the MTInSAR method. The PS density may vary depending on the land cover type.
3. The nonavailability of rainfall forecast information.
4. The SILAAS workflow applies to rainfall-induced landslides. Alerts for landslides triggered by extreme rainfall events (e.g., cloud bursts) will be challenging due to the unavailability of specific rainfall forecasts.
5. Landslides caused by earthquakes do not fall under the purview of this application.



Technical Framework of SILAAS