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Department for International Development

LANDSLIP

LANDSLIde Multi-Hazard Risk Assessment, Preparedness & Early Warning in South Asia: Integrating Meteorology, Landscape and Society

National Stakeholders Workshop and Inception Meeting

Organized jointly with the

20 January 2017, New Delhi, India

KING'S College LONDON

BGS 1835

Geological Survey of India

Italian National Research Council

irpi Research Institute for Geo-Hydrological Protection

PRACTICAL ACTION Technology challenging poverty

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• Welcome & Introduction to Workshop	10.30
• Key note remarks by *Gen N C Vij, Director VIF*	10.35
• Overview of the LANDSLIP Project	10.40
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Co-led by

Bruce D. Malamud

Professor of Natural & Environmental Hazards

Department of Geography, King's College London

Helen Reeves

Director of Science for Engineering Geology

British Geological Survey, NERC

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Grant Dates: 1 November 2016 to 31 October 2020

Funded under the following UK NERC/DFID programme: *Science for Humanitarian Emergencies and Resilience (SHEAR)*

NERC/DFID Grants NE/P000681/1 & NE/P000649/1

1. LANDSLIP CONSORTIUM

The LANDSLIP consortium consists of:

- *9 organizations,*
- *36 physical scientists, engineers, and social scientists*
- *3 countries: India, Italy, UK*

Expertise in:

- *Landslide hazards/disasters*
- *Meteorology*
- *Remote sensing and GIS*
- *Early warning systems*
- *Computational models and Wireless sensors*
- *Multi-hazard frameworks*
- *Resilience, Risk communications and Risk governance*
- *Disaster risk reduction*

1. LANDSLIP CONSORTIUM

KING'S College LONDON	Prof Bruce Malamud 	Prof Mark Pelling 	Dr George Adamson 	Dr Amy Donovan 	+1 PDRA
BGS 1835	Dr Helen Reeves 	Dr Tom Dijkstra 	Dr Claire Dashwood 	Ms Emma Bee 	+1 PDRA + Various
GEOLOGICAL SURVEY OF INDIA	Dr Saibal Ghosh 	Dr Pankaj Jaiswal 	+2 Geoscientists		
AMRITA VISHWA VIDYAPEETHAM	Dr Maneesha Ramesh 	Dr P Venkat Rangan 	Dr Krishnashree Achuthan 	Prof Bhavani Rao 	Ms. Divya P 	Ms. Hemalatha 
irpi	Dr Fausto Guzzetti 	Dr Alessandro Mondini 	Dr Mauro Rossi 	Dr Maria Teresa Brunetti 	Dr Ivan Marchesini 	Silvia Peruccacci 
PRACTICAL ACTION UK & India	Ms Sarah Brown 	Mr KR Viswanathan 	Mr Rajeev Jha 	+ 3 RAs		
Met Office	Dr Joanne Robbins 	Mr Robert Neal 	Dr Rutger Dankers 			
Newcastle University	Dr Rajiv Ranjan 	Dr Philip James 	+ 1 Research Technician			

PDRA = Postdoctoral Research Associate
RA = Research Assistant

Social Scientists & Practitioners | **Physical Scientists**

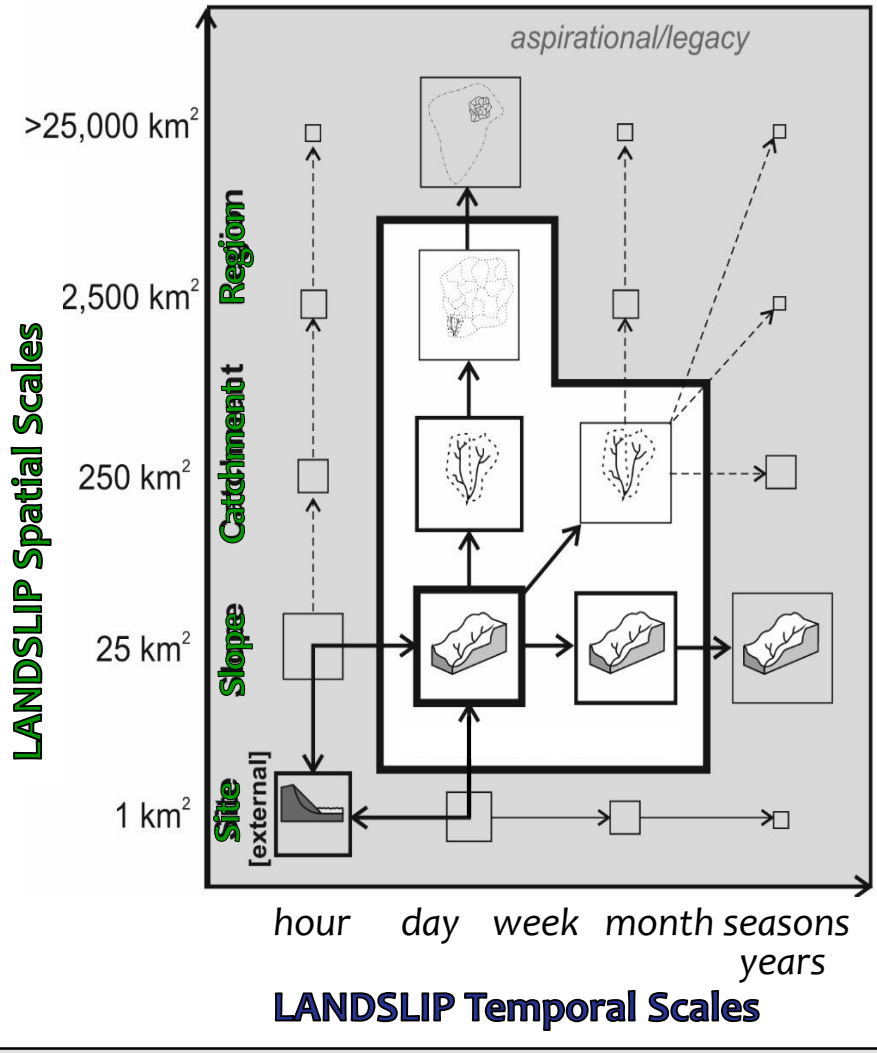
External Advisory Board:
Prof Virginia Murray (UK – Public Health England/Vice-Chair UNISDR Scientific & Technical Advisory Group)
Prof Vinod Menon (India – Founding Member, Indian National Disaster Management Authority)

2. Our vision in LANDSLIP

Design novel and useable methodologies for hydrologically triggered **landslide risk assessments** & robust **landslide multi-hazard early warnings** in **India.**

Spatial scale: slope, catchment & region.

Temporal scale: daily to month.

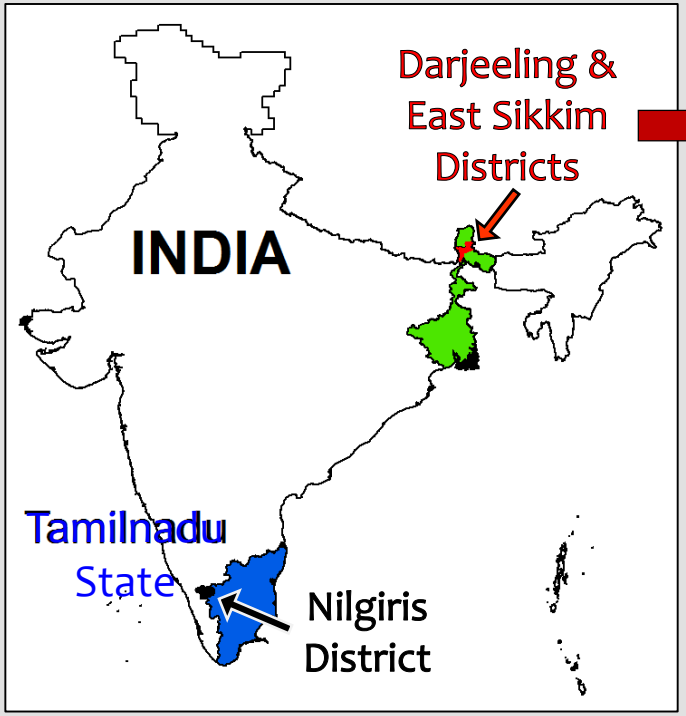


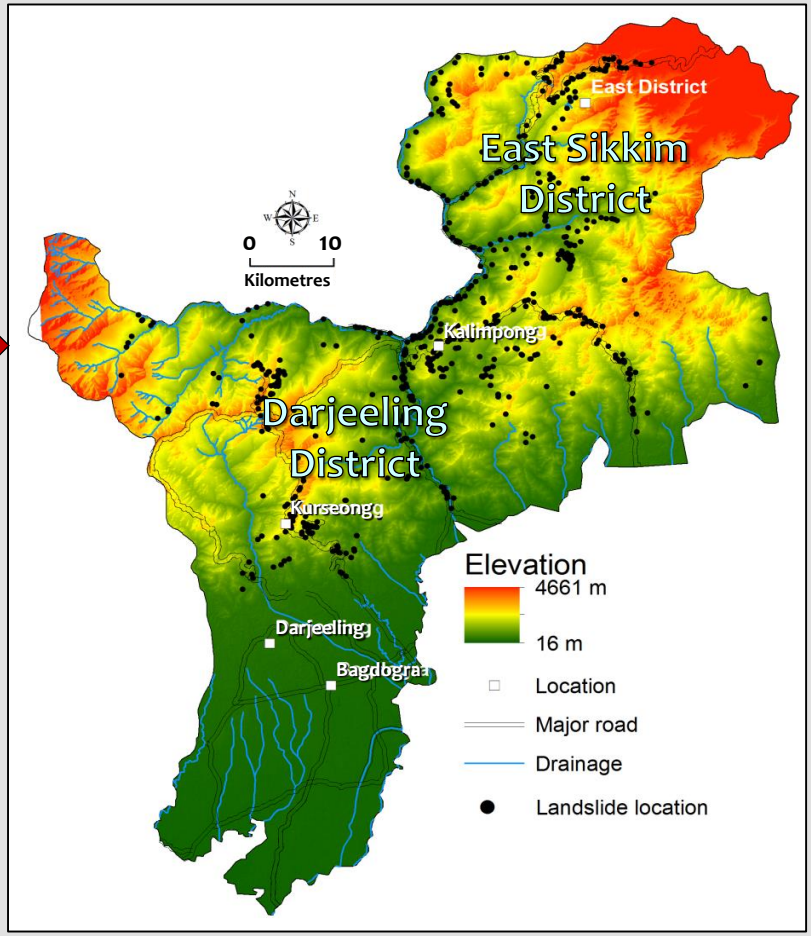
3. LANDSLIP AIMS

- Integrate a novel and useable **landslide risk assessment & Early Warning System (EWS) in a multi-hazard framework** for two pilot study areas in India:
  - **weather regimes**
  - **probabilistic weather forecasting**
  - **landslide domains**
  - **societal factors**
- Co-produce with and deliver to **appropriate stake-holders useful & accessible tailored information.**
- Disseminate **LANDSLIP project knowledge to the broader South Asia region** (particularly India & Afghanistan), ensuring **LANDSLIP's** lasting **legacy.**

4. LANDSLIP PILOT STUDY AREAS

- **Darjeeling & East Sikkim (NE India)**
- **Nilgiris (Tamilnadu, S India)**
- ***Afghanistan*** *(South-South knowledge sharing via workshops)*





4. LANDSLIP Pilot Study Areas

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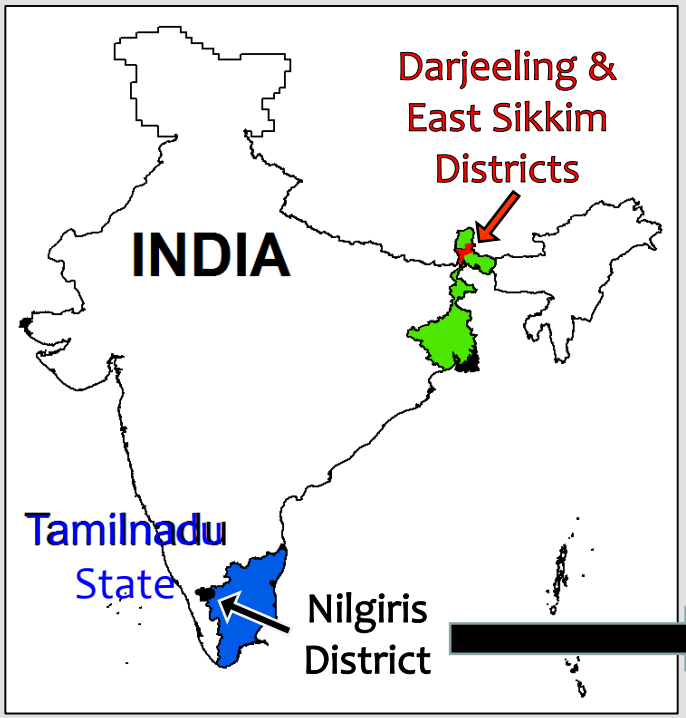

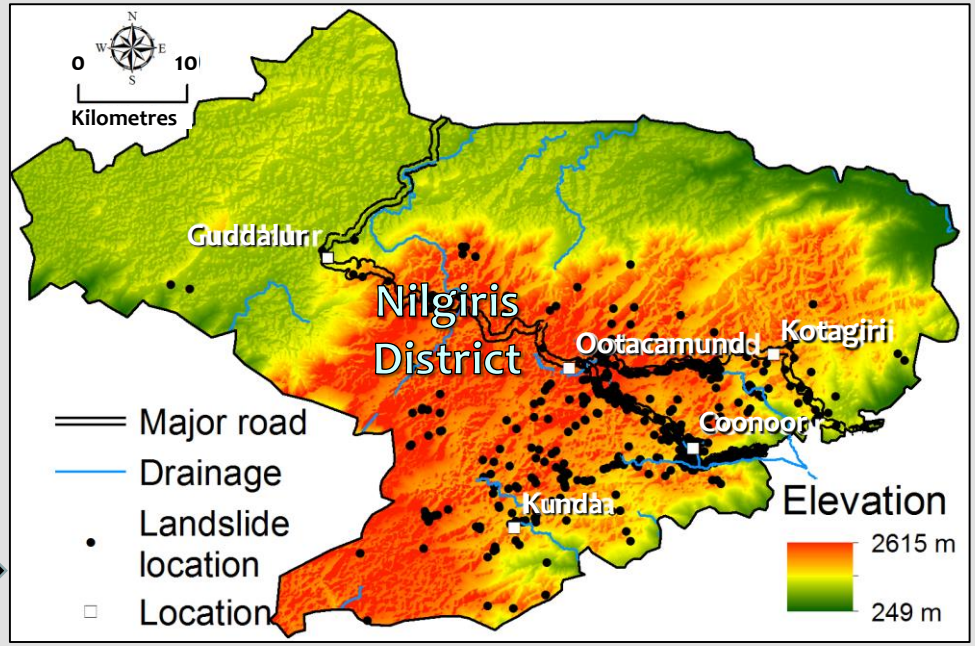

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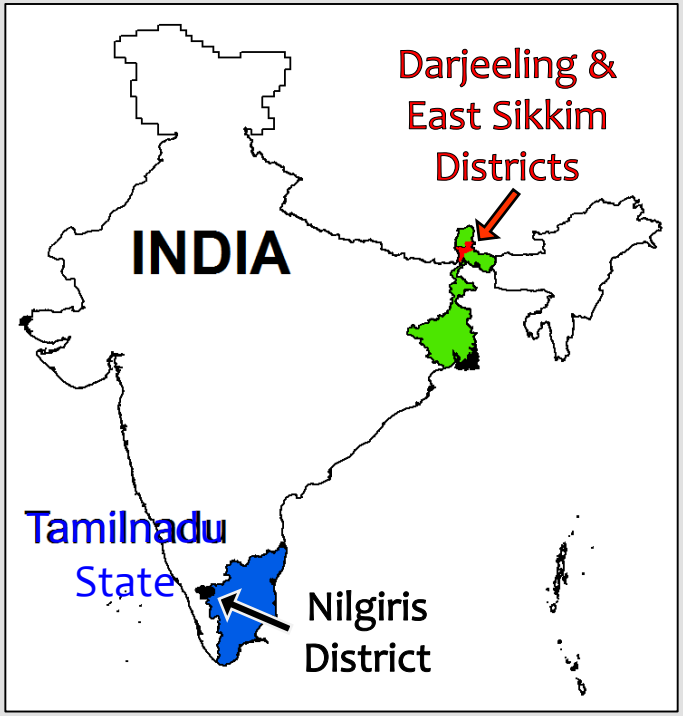
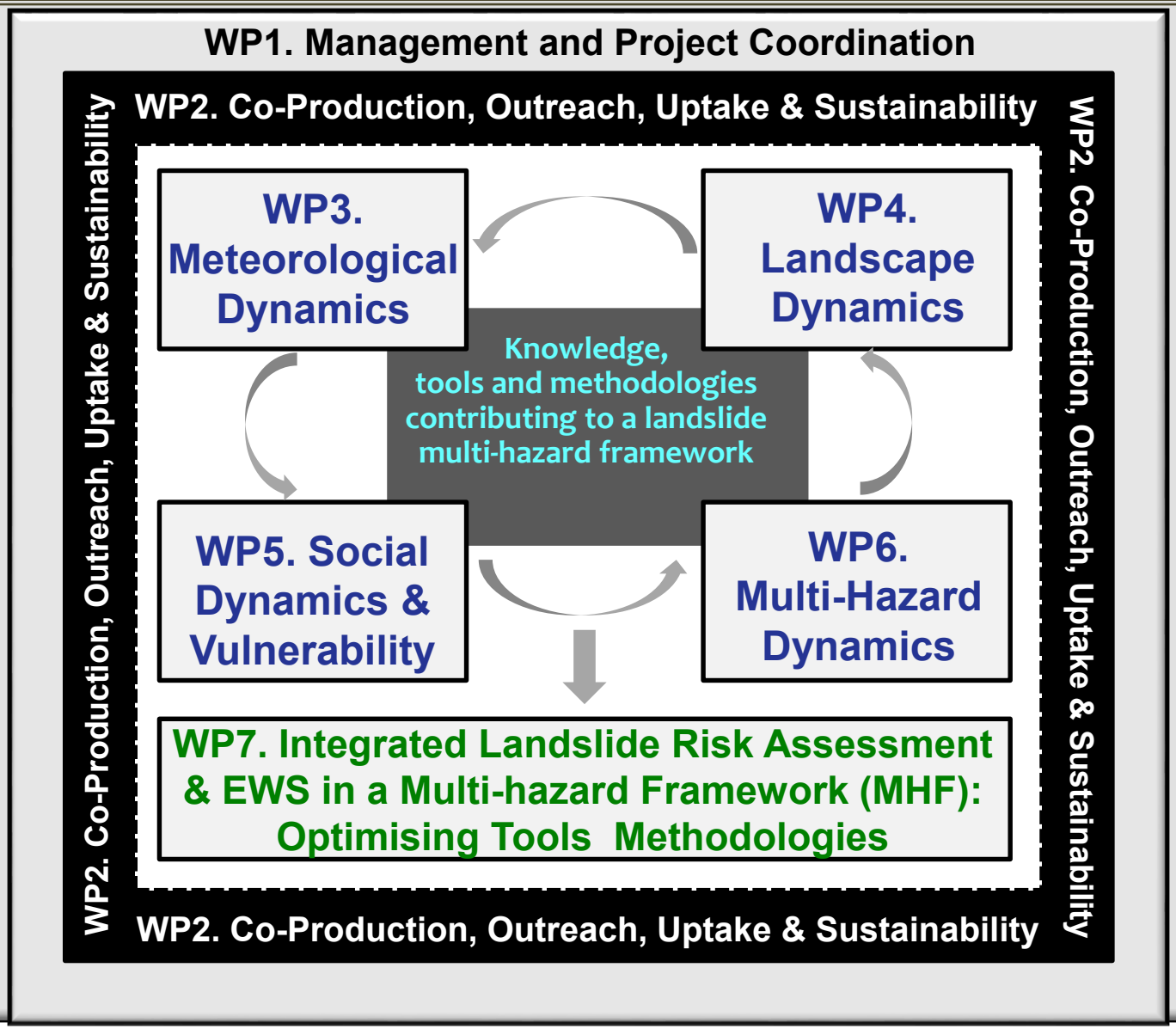


We will also explore *replicability of methodologies developed* for other landslide prone regions such as Uttarakhand

5. LANDSLIP WORKPACKAGE OVERVIEW



WP2 Co-Production, Outreach, Uptake and Sustainability

WP2 Co-Production, Outreach, Uptake & Sustainability	(Task Leads: PA-UK/PA-India)
T2.1	Research **co-production and stakeholder engagement**
T2.2	Share **technical knowledge and build technical capacity**
T2.3	**Information communication** and **outreach**
T2.4	Research into **use and sustainability**

Key Deliverables:

- **Reports:** Product/process co-production & capacity development via workshops.
- Targeted **multi-media material.**
- **Report:** Pathways to **sustainability and legacy.**

WP2 co-production with WP3 to WP7.

Example of Key LANDSLIP-Relevant Stakeholders (* = involved in landslide prevention)

Community & District ⟷ **State** ⟷ **National**

- ***Community based organisations*** *(e.g., Women's self-help groups)*
- ***District Disaster Management Authorities*** *(DDMA)**
- ***Rescue operation units****
- ***Road/rail/public works organisations****
- ***Tea estates****
- ***Village Panchayats*** *(village level administrative body)**

State level...

- ***Department of Homes***
- ***Disaster Management Authority****
- ***Disaster Response Force****
- ***NGOs**** *(e.g., Keystone Foundation, ATREE, Save the Hills, Red Cross)*
- ***Remote Sensing Application centres****
- ***Universities*** *(e.g., AMRITA)*
- ***Police & Fire departments****

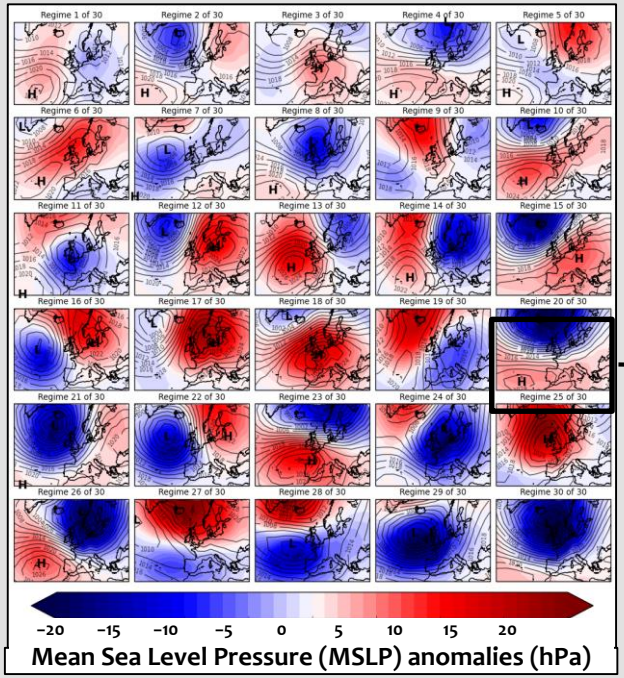
- ***Geological Survey of India (GSI)****
- ***Key ministries*** *(e.g., Ministry of Earth Sciences, Ministry for Science & Technology)**
- ***Response organisations*** *(e.g., National Disaster Management Authority)**
- ***Climate Services Agencies*** *(e.g., India Meteorological Department [IMD], NCMRWF, National Remote Sensing Organisation)**

Yellow = Confirmed Project Partners who will be part of LANDSLIP Stakeholder User Group (SUG)

WP3 Meteorological Dynamics

WP3 Meteorological Dynamics	(Task Leads: MO/CNR/BGS)
T3.1	Review, compare, source **current meteorological data/knowledge**
T3.2	Identify sets of **weather regimes** for South Asia, India & pilot areas
T3.3	Identify list of **weather regimes relevant to increased landsliding in pilot areas**
T3.4	**Weather-based thresholds** for **short-term landslide forecasting**
T3.5	Evaluate **short-term forecasting models** & weather-based thresholds

UK example: 30 representative weather regimes

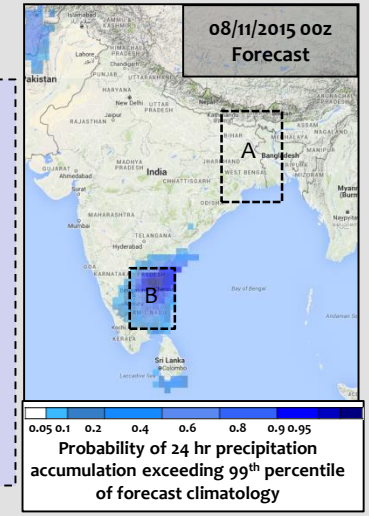


Neal *et al.* (2015) A flexible approach to defining weather patterns & their application in weather forecasting over Europe. *Met App.*

Key Deliverables:

- S Asia: Set of **weather regimes**
- Pilot areas: List of **weather regimes for increased landslides.**
- Pilot areas: Landslide **weather related thresholds.**
- **Peer-review papers.**

Forecast regional precipitation variability over areas of interest within each broad-scale regime

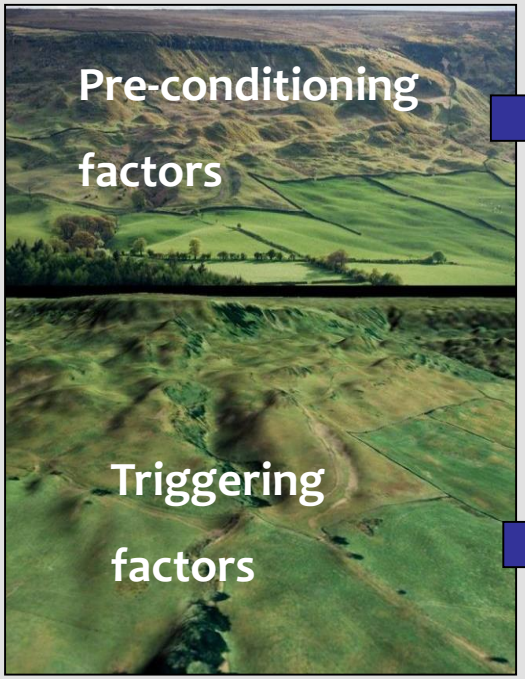


WP4 Landscape Dynamics

WP4 Landscape Dynamics	(Task Leads: GSI/BGS/CNR)
T4.1	Preparation of landslide and other **landscape dynamics thematic data**
T4.2	Use/develop **semi-automatic image processing for landslide inventories**
T4.3	Hazard susceptibility modelling: **landslide types & domains**

Key Deliverables:

- Enhanced **landslide inventories, data** and **thematic maps** in pilot areas.
- Procedure for **landslide monitoring using RS techniques.**
- **Landslide hazard models** for pilot areas delivered as **web-mapping services.**

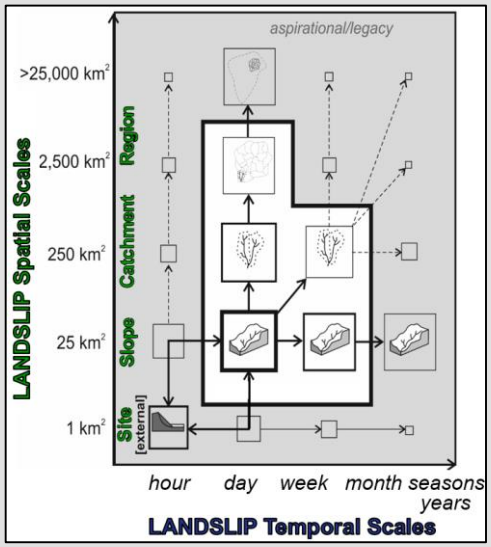


Pre-conditioning factors

- Geology
- Topography
- Quaternary history
- Vegetation change
- Tectonic activity
- Land use
- Antecedent moisture

Triggering factors

- Rainfall
- Changes in water level
- Drought
- Loading/Unloading
- Earthquake



WP5A Social Dynamics & Vulnerability

WP5 Social Dynamics and Vulnerability	(Task Leads: KCL/PA-UK/PA-India/GSI)
T5.1	Source and prepare data on **vulnerability and impact**
T5.2	Map out **institutional landscape**
T5.3	Compile/construct **case histories of impact through human-built systems/policy**
T5.4	Compile **Participatory Vulnerability Capacity Assessments** (PVCA) **and assess gaps**

Key Deliverables:

- **Spreadsheet: Vulnerability and impact data** summary and links
- **Report: Institutional landscape** for landslide risk assessment & EWS.
- **Report:** Landslide related **case histories of impact.**

T5.1 Data on vulnerability & impact:

- **Infrastructure, vulnerability, exposure** data.
- **Socio-economic impacts**

[Recent past landslide-related events, media, peer-review, grey literature, images, interviews, oral histories]

T5.2 Institutional landscapes:

- **Who is responsible for what?**

[Documentary analysis, interviews]

T5.4 Participatory Vulnerability Capacity Assessments (PVCAs)

- **Compile existing PVCAs at local/district levels**
- Work with local stakeholders **to enhance PVCAs.**

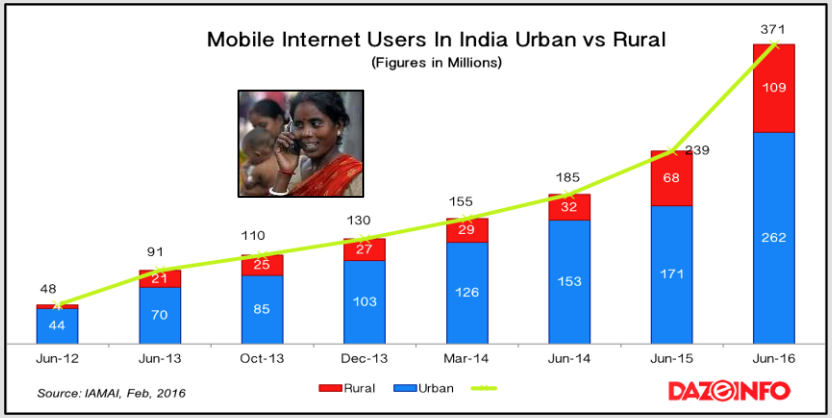
Marapallam landslide, Nilgiris district of Nov. 1999. Slide lead to > 50 casualties

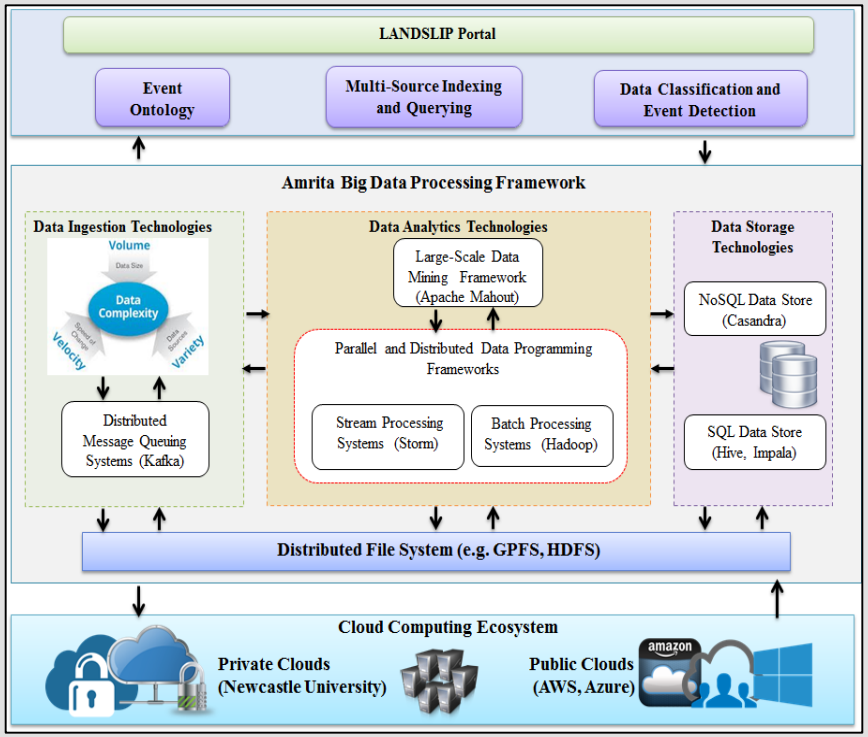
WP5B Social Dynamics & Vulnerability

WP5 Social Dynamics and Vulnerability	(Task Leads: Amrita/NCS)
T5.5	Develop ontology: **social analytic terms related to landslide hazards**
T5.6	Develop multi-source **social platform indexing and querying algorithms**
T5.7	Develop high performance **data classification/event detection algorithms**
T5.8	Develop **mobile phone application**

Key Deliverables *(in collaboration with WP2 stakeholder user group, co-production)*:

- **Index and Report:** Social analytic platform index.
- **Algorithm & report:** Data classification & event detection.
- **SMS protocol & smartphone app.**





LANDSLIP social data analytics framework

WP 6 Multi-Hazard Dynamics

WP6 Multi-Hazard Dynamics	(Task Leads: KCL/Amrita)
T6.1	Collate **case histories** of landslide **multi-hazard cascades/coincidences**
T6.2	**Map potential multi-hazard scenarios**

Landslides can be triggered by many hazards including:

- **Earthquakes**
- **Floods**
- **Storms**
- **Drought**

Landslides can in turn *trigger* or *increase the probability* of other hazards, resulting in multi-hazard cascades.

Key Deliverables:

- **Database: Landslide-related multi-hazards** case histories for pilot study areas.
- **Report:** Table and explanatory text of **potential multi-hazards in pilot areas.**

18 Sep 2011 earthquake induced landslides in Sikkim

Gill & Malamud (2014), Reviewing & Visualizing Interactions of Natural Hazards, *Rev. Geophys.*

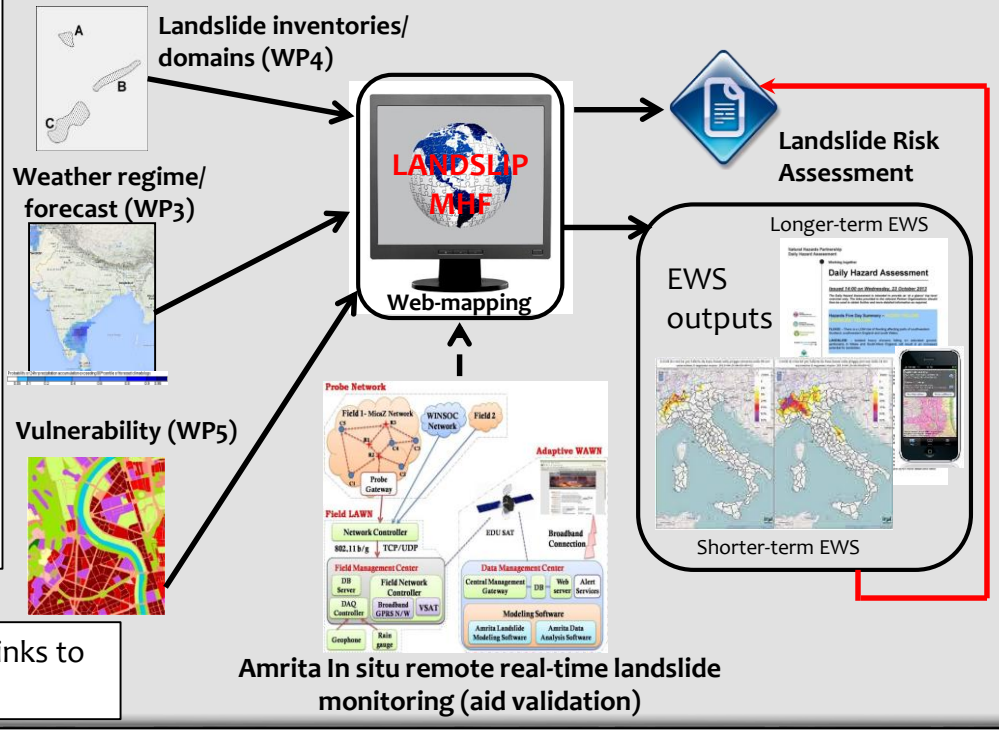
WP7 Integrated Framework

WP7 Integrated Landslide Risk Assessment (RA) and Early Warning System (EWS) in a Multi-hazard Framework (MHF): Optimising Tools & Methodologies (Task Leads: CNR/ BGS/PA/Amrita)

T7.1	**Capture current/emerging technologies** in meteorology, landslide RA/EWS in a MHF
T7.2	Strategic **integration of WP3-WP6 outputs** into landslide RA/EWS in a MHF
T7.3	Conceptualisation/implementation of **computer code** for landslide RA/EWS in a MHF
T7.4	Pilot **web-mapping data access/visualisation** for landslide RA/EWS in a MHF
T7.5	Identify **warning message requirements and dissemination**
T7.6	**Evaluation** of the landslide RA/EWS in a MHF

Key Deliverables *(in collaboration with WP2 stakeholder user group, co-production)*:

- **Computer code** conceptualisation and implementation.
- **Web-mapping tool.**
- **Communication protocols.**
- **Evaluation strategy, legacy protocols & peer-review paper.**



WP7 impact, usability & legacy are key priorities (links to T2.4 "**Research into use and sustainability**").

6. LANDSLIP PROJECT CHALLENGES

- **Landslide forecasting & EWS across different temporal & spatial scales.**
  - Upscaling/downscaling
  - Uncertainty
  - Different stakeholder requirements
- **Addressing stakeholder needs.**
  - Effective, practical and appropriate tools & methodologies for different stakeholders.
  - Clear pathways to improving resilience of stakeholders at risk
  - Ensuring sustainability/legacy
- **Project coordination for effective implementation and delivery of WPs.**
  - Multiple institution types (e.g., government, HE, not-for-profit)
  - Multiple disciplines (e.g., social, meteorology, landslide, computational, DRR)
  - Multiple countries (UK, Italy, India, Afghanistan)

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