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Chair on Water-Related Disaster Risk Reduction

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Global Dialogue on Landslide Risk Reduction

OPEN GAPS & CHALLENGES IN LRR

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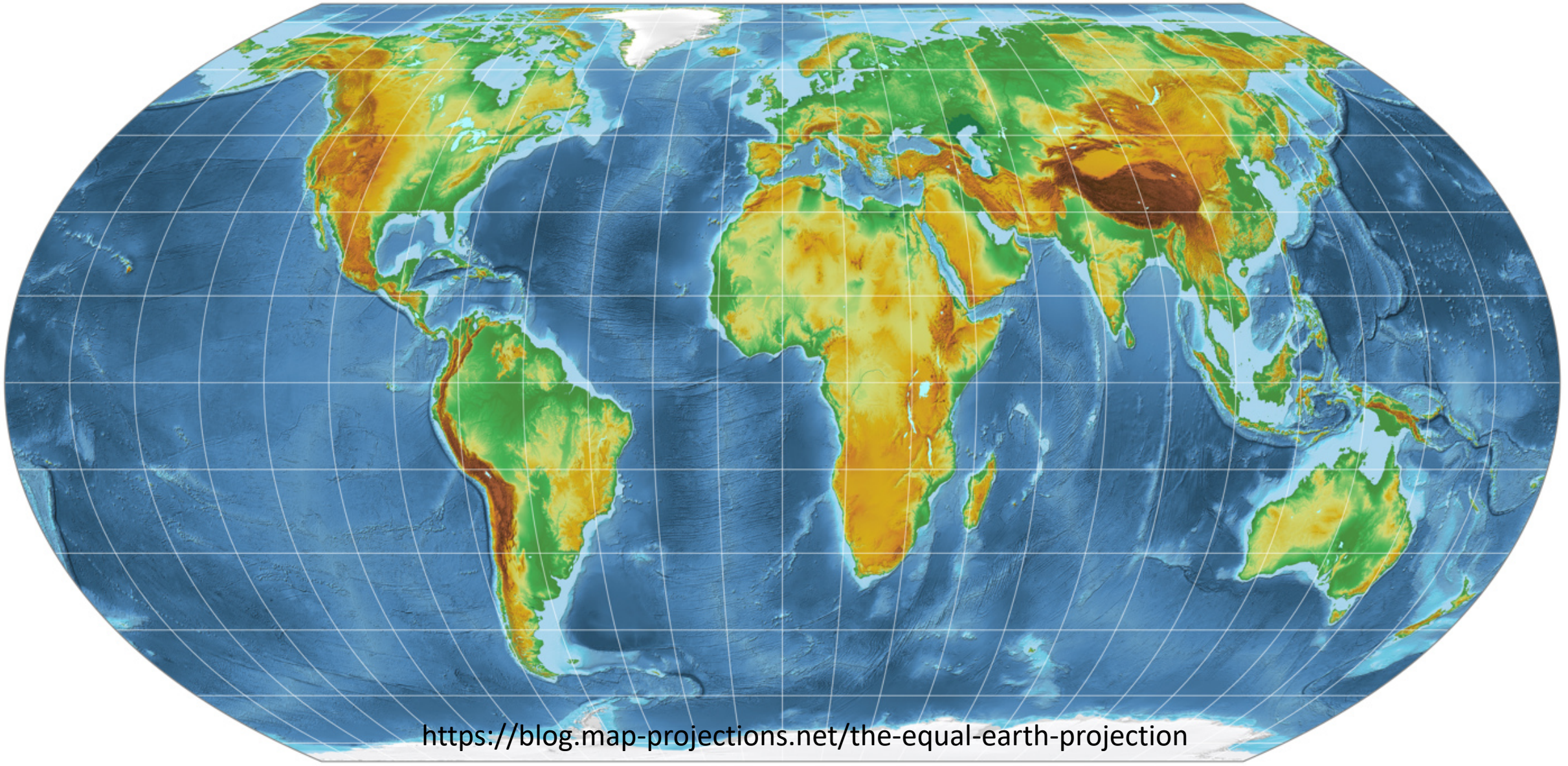

https://blog.map-projections.net/the-equal-earth-projection

MATERIALS & METHODS

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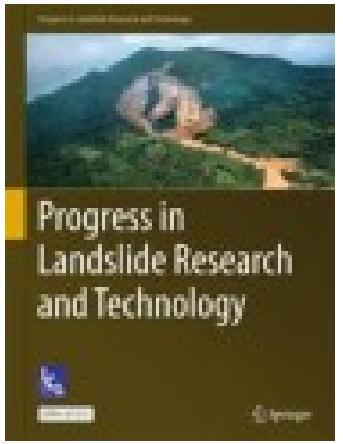
Starting thoughts about LRR:

- We should look at LRR from a global perspective
- What are open/unanswered questions in the field of LRR?
- What are the hot topics in this regard?
- Where we need further research in order to achieve LRR?
- How efforts in LRR support SDGs?



Materials to be used:

- Starting point - already published volumes in the open-access book series Progress in Landslide Research and Technology Vol. 1/1 through Vol. 4/1

Method to be used:

- Gemini Pro 3

EVOLVING LANDSCAPE OF GLOBAL LANDSLIDE RISK GOVERNANCE

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Initiative	Period	Primary Objective	Key Strategic Outcome
Tokyo Action Plan	2006–Onward	Establish the International Programme on Landslides (IPL).	Creation of IPL World Centres of Excellence (WCoEs) and the IPL Global Promotion Committee to coordinate research.
ISDR-ICL Sendai Partnerships	2015–2025	Align landslide science with the Sendai Framework for Disaster Risk Reduction (SFDRR).	Integration of science and technology into global DRR policy; explicit focus on "Underlying Risk Factors."
Kyoto Landslide Commitment (KLC2020)	2020–2030+	Provide a stable, long-term platform for LRR beyond 2025.	Signed by ~90 organizations; launch of the *Progress in Landslide Research and Technology* book series as a central dissemination platform.

The KLC2020 represents a significant escalation in commitment, engaging not only academic institutions but also UN agencies (UNESCO, WMO, FAO, UNDRR) and national governments. The participation of entities like the International Union of Geodesy and Geophysics (IUGG) and the International Union of Geological Sciences (IUGS) underscores the interdisciplinary nature of the challenge, bridging geophysical sciences with applied engineering

EVOLVING LANDSCAPE OF GLOBAL LANDSLIDE RISK GOVERNANCE

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The global discourse on Landslide Risk Reduction (LRR) has undergone a profound transformation over the last two decades, shifting from reactive disaster management toward a proactive, science-driven paradigm of risk governance.

This evolution is necessitated by the increasing intersection of human development with hazardous terrains and the amplifying effects of climate change on geohydrological processes.

The International Consortium on Landslides (ICL), through its pivotal initiatives—the International Programme on Landslides (IPL), the Sendai Landslide Partnerships 2015–2025, and the Kyoto Landslide Commitment 2020 (KLC2020)—has established a robust transnational architecture for addressing these challenges.

The governance of global landslide research is anchored in a series of strategic commitments that have mobilized a diverse coalition of stakeholders. The trajectory from the 2006 Tokyo Action Plan to the KLC2020 illustrates a maturing of the field, moving from networking to concrete, measurable commitments.

AREAS REQUIRING FURTHER RESEARCH

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Research Area	Key Insights from P-LRT Vols	Why it is urgent?
1. Multi-Hazard	Interaction of seismic pore-pressure & rain (Vol 3, 4).	Single-hazard models underestimate risk in tectonic zones.
2. Climate Change	Historical thresholds are failing (Vol 1, 4).	Extreme weather events are outpacing historical data.
3. Tech/IoT	Combining Citizen Apps (Vol 3) with IoT Sensors (Vol 4).	Need cost-effective solutions for developing nations.
4. Infrastructure	Road-induced slides in Himalayas/Andes (Vol 3, 4).	Development is creating new risks faster than we mitigate.
5. Social Factors	The "Last Mile" problem (Vol 1).	Technology works, but communication strategies fail.

AREAS REQUIRING FURTHER RESEARCH

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1. Multi-Hazard Interactions and Cascading Effects

Context & Necessity: Most current models assess landslide risk in isolation (triggered by rain *or* earthquakes). However, research highlights the complexity of "compound disasters" where one hazard preconditions the slope for another.

- **From P-LRT Vol 3 (Matsunami et al.):** Research in **Sri Lanka and Japan** indicates a critical gap in understanding how seismic ground motion affects pore-water pressure. We need further research on how minor earthquakes "prime" slopes to fail during subsequent, even moderate, rainfall events.
- **From P-LRT Vol 4 (Parkash et al.):** In the **Himalayas (India)**, landslide zones often overlap with high seismic activity. There is a lack of integrated models that can simulate the "cascading effect" of earthquake-induced loosening of slope materials followed by monsoon-triggered debris flows.

Research Gap: Developing dynamic susceptibility maps that update in real-time after a seismic event to reflect altered rainfall thresholds.

AREAS REQUIRING FURTHER RESEARCH

2. Climate Change Adaptation: Dynamic Rainfall Thresholds

Context & Necessity: Static rainfall thresholds (e.g., "100mm in 24 hours triggers a slide") are becoming obsolete due to changing climate patterns and extreme weather variability.

- **From P-LRT Vol 4 (General Introduction):** The frequency of "extreme rainfall events" is increasing globally. Research is needed to transition from *historical* statistical thresholds to *predictive* climate-model-based thresholds.
- **From P-LRT Vol 1 & 2:** Early warning systems often fail because they rely on historical data that does not account for the new "intensity-duration" relationship of modern storms.

Research Gap: How to integrate downscaled climate projection models into local Early Warning Systems (EWS) to predict landslides in regions that previously had low historical probability (e.g., new risk zones in non-traditional areas).

AREAS REQUIRING FURTHER RESEARCH

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3. Democratization of Technology: Bridging High-Tech and Low-Cost

Context & Necessity: There is a "technological divide." We have cutting-edge sensors, but they are often too expensive for the developing nations that suffer 80% of fatalities.

- **From P-LRT Vol 4 (OSASI Technos):** There is significant progress in "compact, lightweight, and low-power" IoT sensors for remote mountainous areas (measuring tilt and pore pressure without commercial power).
- **From P-LRT Vol 3 (Abolmasov et al. - MaPLoRds):** Simultaneously, there is a push for **Citizen Science**. The gap lies in validating the accuracy of data collected by non-experts (via apps like MaPLoRds) against professional geotechnical monitoring.

Research Gap: Developing hybrid systems where "Citizen Science" data (crowdsourced via mobile apps) acts as a primary trigger to activate high-precision, energy-intensive professional sensors only when necessary.

AREAS REQUIRING FURTHER RESEARCH

4. Anthropogenic Factors: Infrastructure-Induced Landslides

Context & Necessity: A significant percentage of landslides in developing economies are not purely natural but are triggered by unscientific construction, particularly roads in fragile terrain.

- **From P-LRT Vol 4 (India Mitigation):** Rapid infrastructure expansion in the Himalayas is a major driver of slope instability. Research is often limited to *stabilizing* failed slopes rather than *preventing* failure during the design phase.
- **From P-LRT Vol 3 (Local Road Networks):** The focus on "Local Road Networks" (LSG) highlights that while highways are monitored, rural feeder roads are often neglected data blind spots.

Research Gap: Quantifying the specific impact of "cut-and-fill" road construction techniques on slope stability in Young Glacial Valleys and developing standardized "Green Infrastructure" guidelines for developing nations.

AREAS REQUIRING FURTHER RESEARCH

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5. Social Implementation and the "Last Mile" of EWS

Context & Necessity: Technological capability often outpaces social preparedness. A technically perfect warning is useless if the community does not understand it or refuses to evacuate.

- **From P-LRT Vol 1 (Kyoto Commitment 2020):** A core tenet is "social implementation." Research is needed not just on geology, but on sociology—how communities perceive risk.
- **From P-LRT Vol 3 & 4:** Case studies in **Serbia and India** suggest that technical jargon in warning alerts leads to inaction.

Research Gap: Research into "Risk Communication": How to translate probabilistic technical data (e.g., "70% chance of soil saturation") into actionable, decisive community mandates (e.g., "Evacuate now") without causing "warning fatigue" (false alarms).