ATOM-GLOF
Adaptive Operational Intelligence Framework for Cascading Himalayan Hazard Systems

Research Summary

ATOM-GLOF frames glacial lake outburst flood intelligence as an operational latency problem in a coupled cryosphere-hydrology-seismic system. The platform proposes a hybrid sensing, causal inference, and physics-surrogate architecture to reduce time to situational understanding across cascading Himalayan hazard systems.

Observability gap:
Existing early warning systems over-index on lake level and post-onset hydrological signals. The missing layer is continuous pre-breach structural and kinematic insight.

Seismic triggers and cascading hazards:
Ice avalanches, rockfalls, and slope failures can initiate displacement waves, breach erosion, debris entrainment, and downstream flood cascades.

Interaction-driven amplification:
Hazard intensity is shaped by moraine geometry, lake volume, breach timing, debris load, valley confinement, and downstream exposure.

Operational latency:
Classical flood solvers frequently exceed the evacuation window. ATOM-GLOF treats latency as a first-class systems constraint from sensing through alerting.

Adaptive environmental intelligence:
The architecture combines InSAR, SWOT, selective ground radar, causal reasoning, and physics-certified surrogates to update risk as conditions change.

Socio-hydrological interaction and resilience:
Risk is shaped by exposure, road dependency, communication reliability, and institutional coordination, not hydrodynamics alone.

Disclaimer:
This framework is exploratory, research-oriented, and intended for interdisciplinary discussion and iterative validation.