



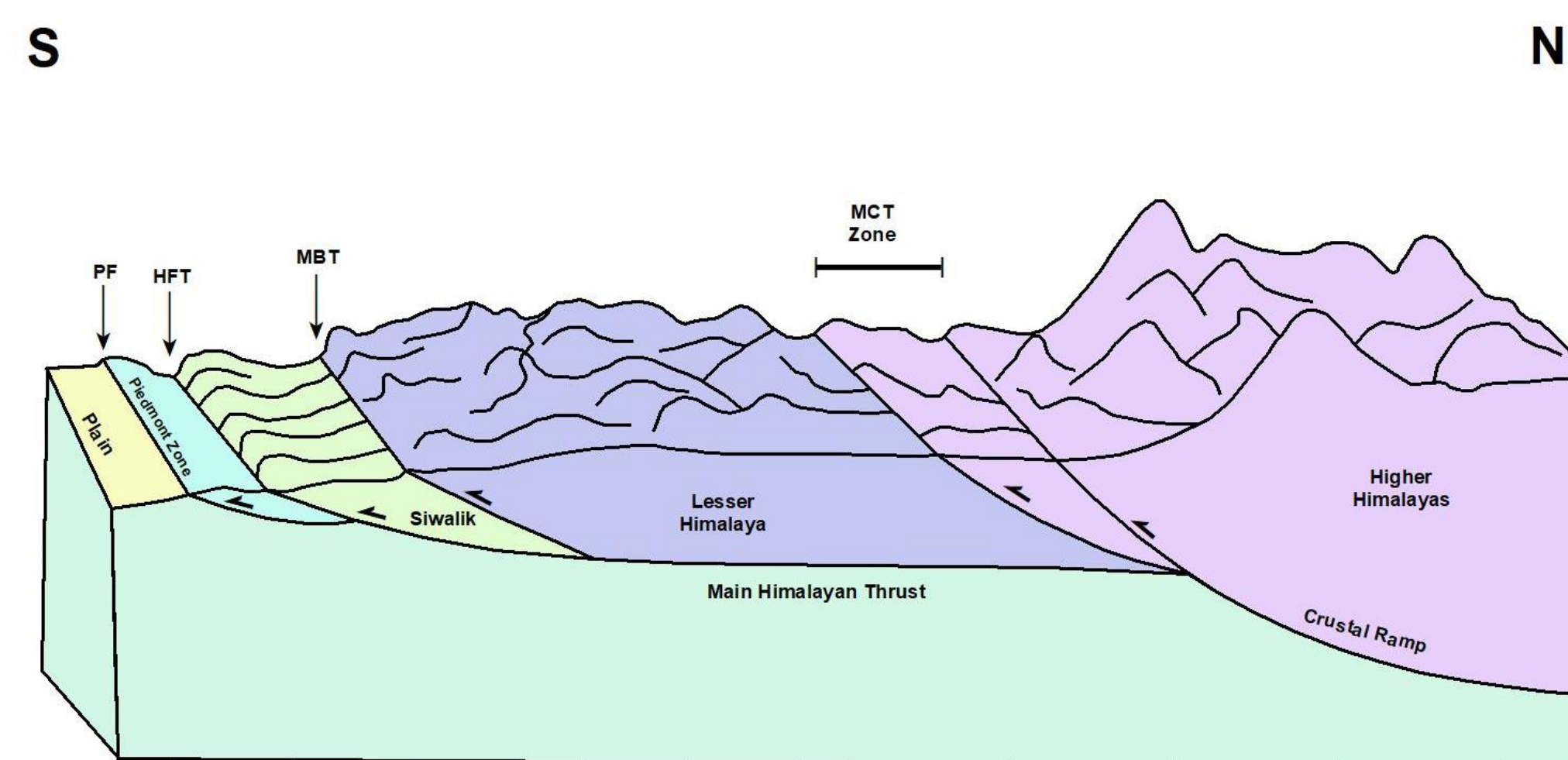
Geomorphic Signatures of the Neotectonic Activity in Haridwar-Kotdwar Region, Northwestern Himalaya, India

Abhishek Kralia and Mahesh Thakur
Centre of Advanced Study in Geology, Panjab University, Chandigarh, India



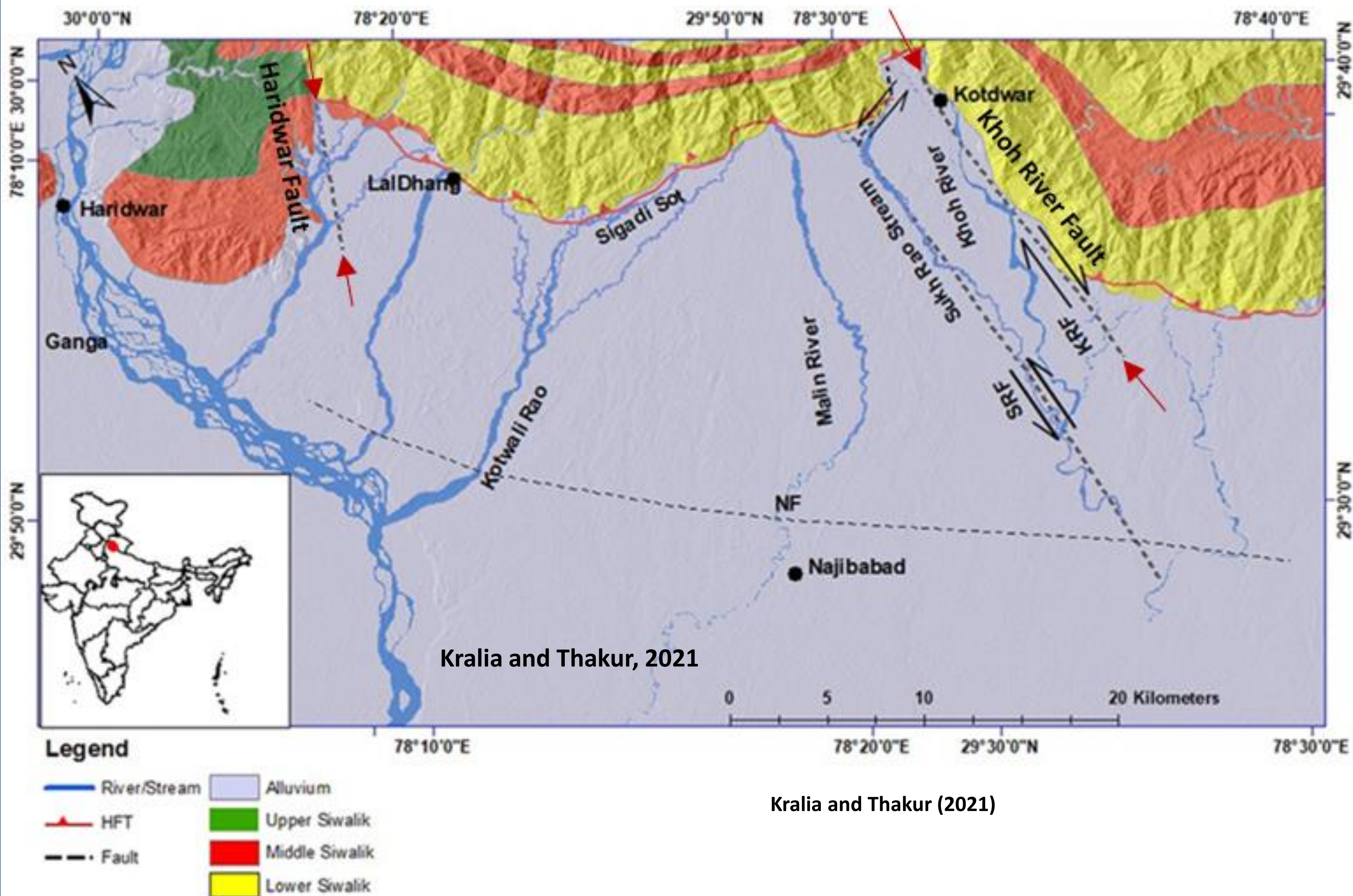
Introduction

Himalayan tectonic deformation is south verging and the Himalayan deformation front have been shifting towards the South. The major Himalayan thrusts include South Tibetan Detachment, Main Central Thrust, Main Boundary Thrust and Himalayan Frontal Thrust. The Himalayan Frontal Thrust is the most active Himalayan structure which consumes most of Himalayan deformation now. Himalayas have been extensively studied but the Himalayan piedmont zone have largely been unexplored, as the Himalayan deformation front have been shifting towards the south, its manifestations can be seen in the Himalayan piedmont zone. In this study we are identifying the deformation in the Himalayan piedmont zone caused by the blind thrust which manifests itself as upwarping, migration of rivers etc. which along with two strike-slip faults i.e. Khoh River Fault and the Haridwar Fault and the Himalayan Frontal Thrust makes this area a tectonically active block and a potential seismic Hazard.



Study Area and Geology

The Study area lies in the Northwestern Himalaya, Uttarakhand, India and is bound by the Ganga River in the West and Khoh River in the east. Tectonically it is bound by the Ganga Tear Fault in the west and the Khoh River Fault in the east. The Himalayan Frontal Fault marks the northern boundary of the area and the Najibabad Fault bounds it towards the South



NNE-SSW Trending Left Lateral Haridwar Fault offsets the Himalayan Frontal Thrust Sinistrally by ~9 Km
N-S Trending Khoh River Fault (KRF), offsets the HFT dextrally by ~12 Km. The path of Khoh River is controlled by KRF

Geomorphic Signatures of Khoh River Fault

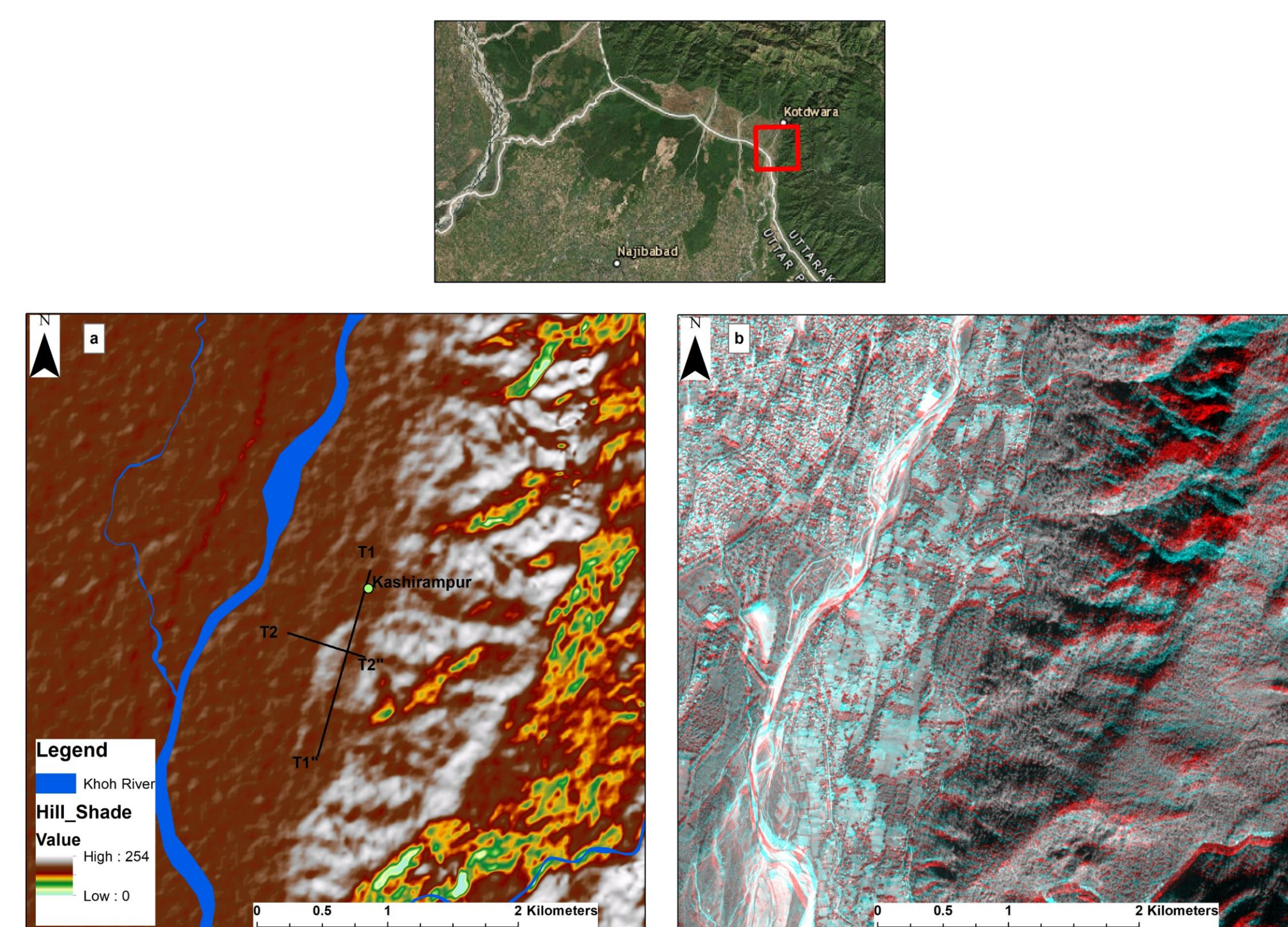


Fig: Uplifted terrace due to KRF (a) DEM of the Khoh River, showing terrace which is uplifted ~50 meters, (T1-T1' and T2-T2' are elevation profiles taken along the uplifted terrace to show the upliftment Fig. 18) (b) CARTOSAT-1 anaglyph showing the uplifted terrace corresponding to the neotectonic activity along the KRF.

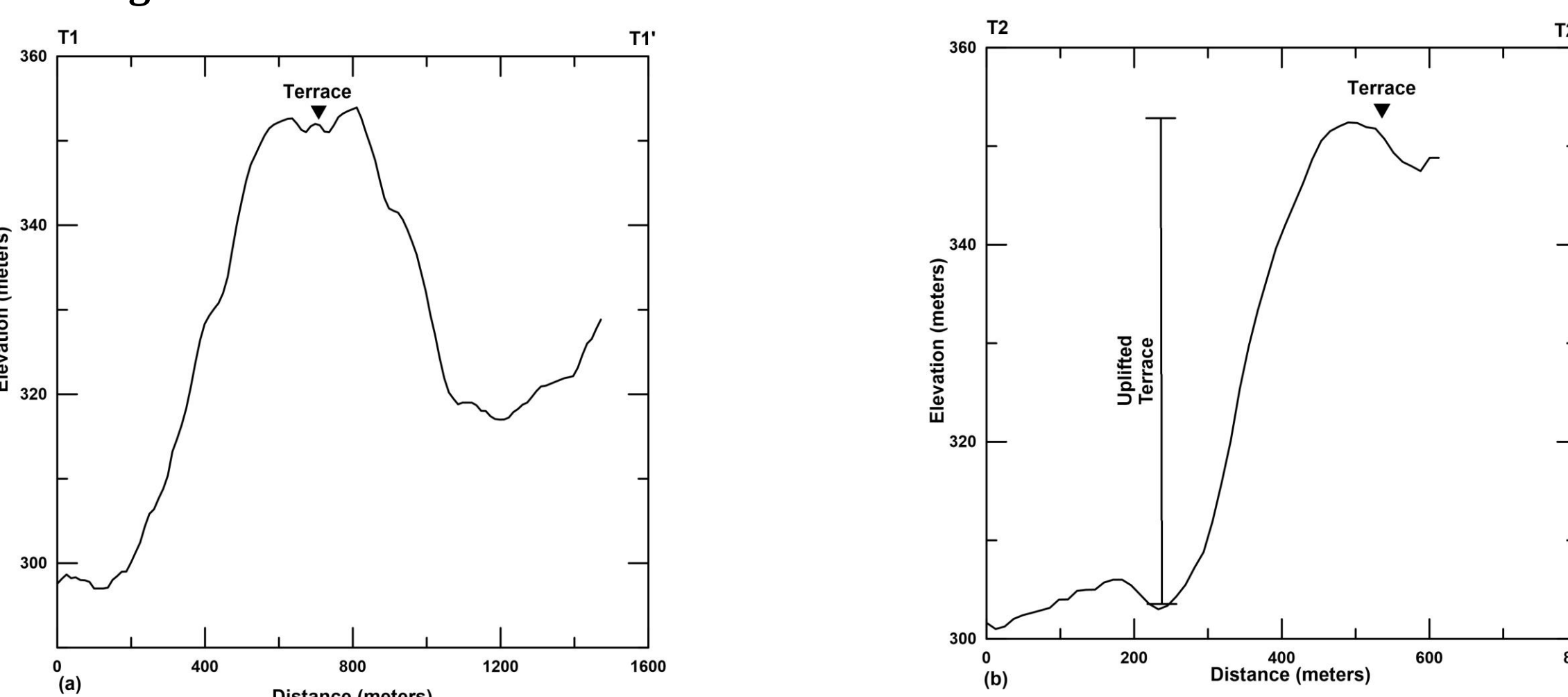
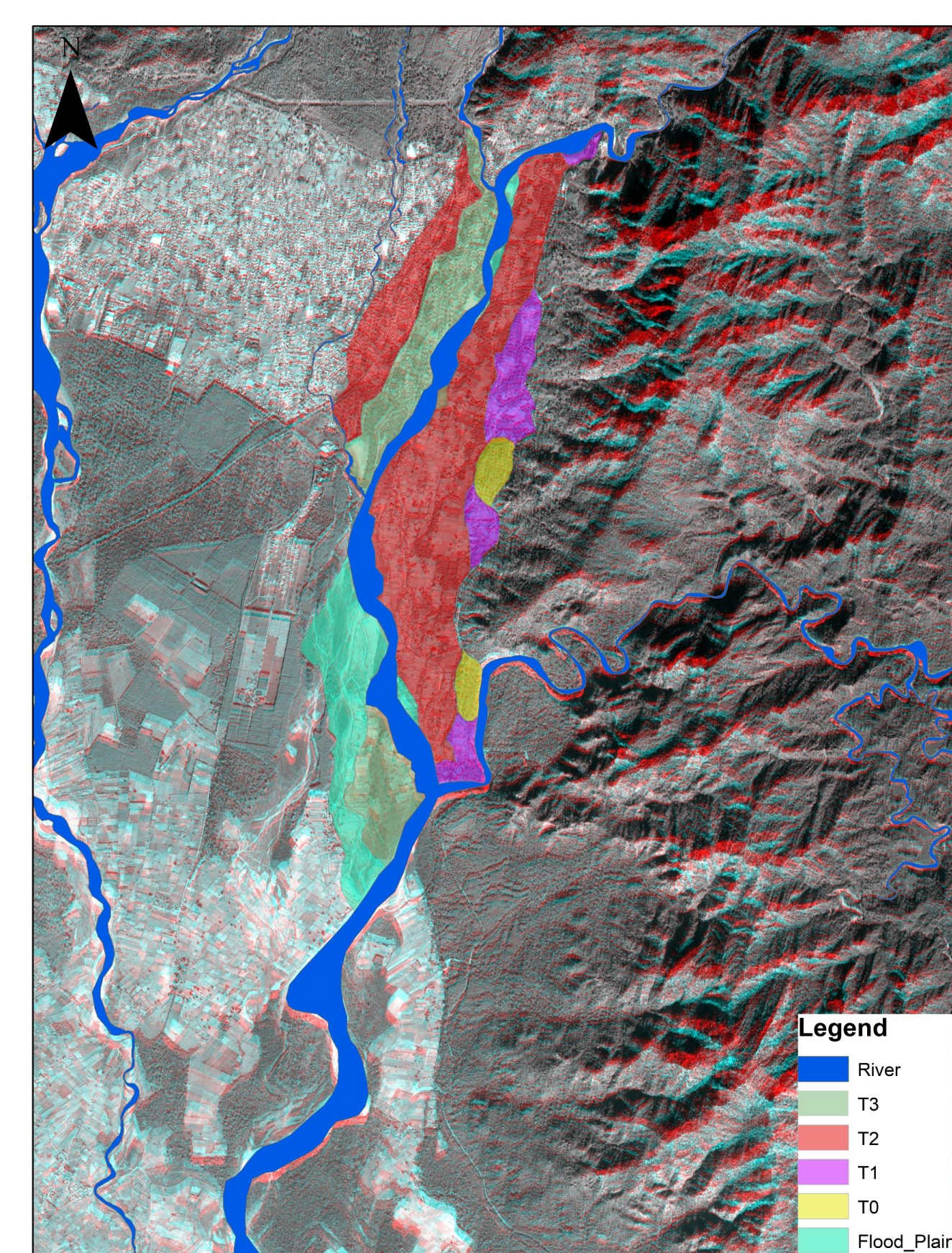
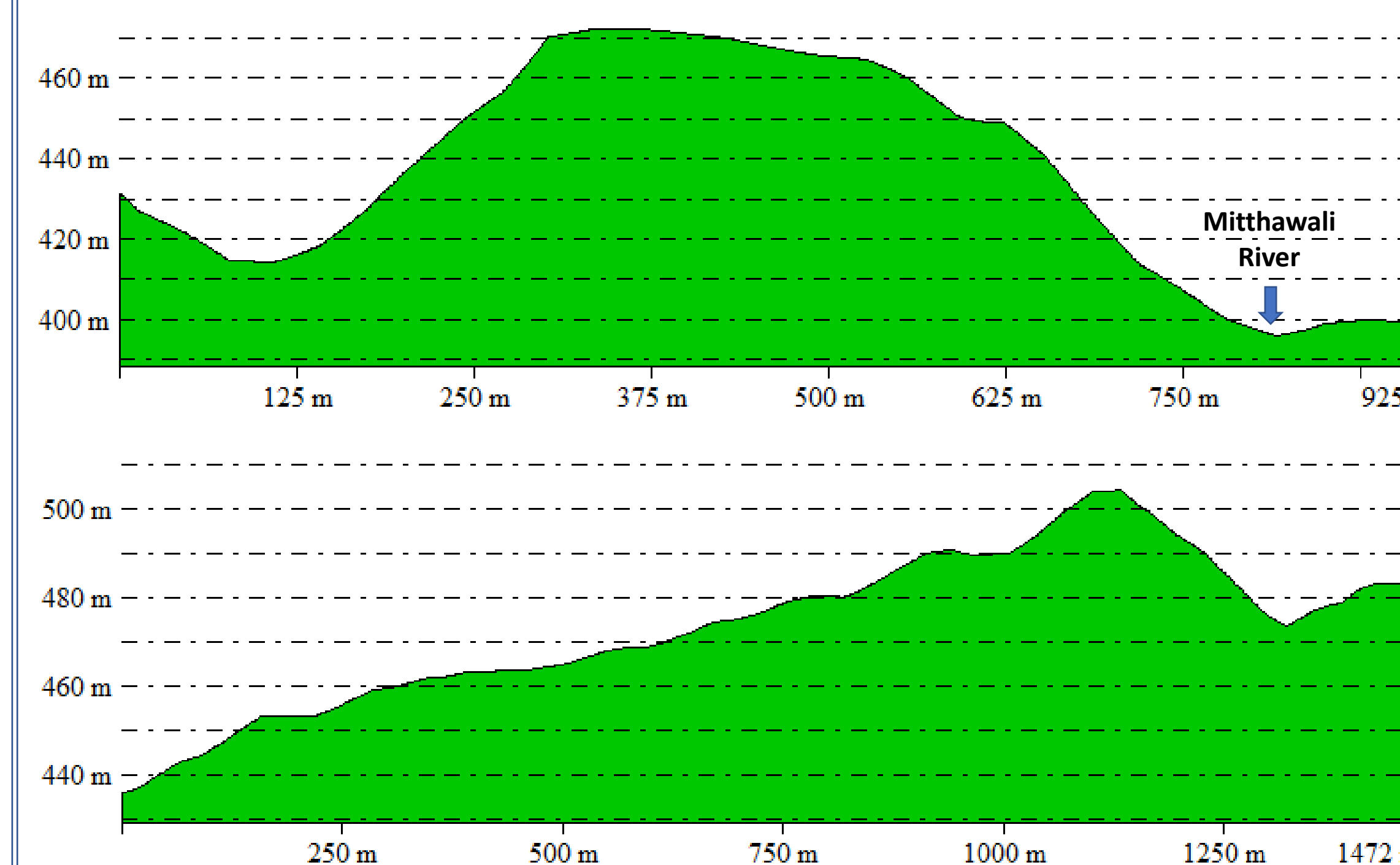
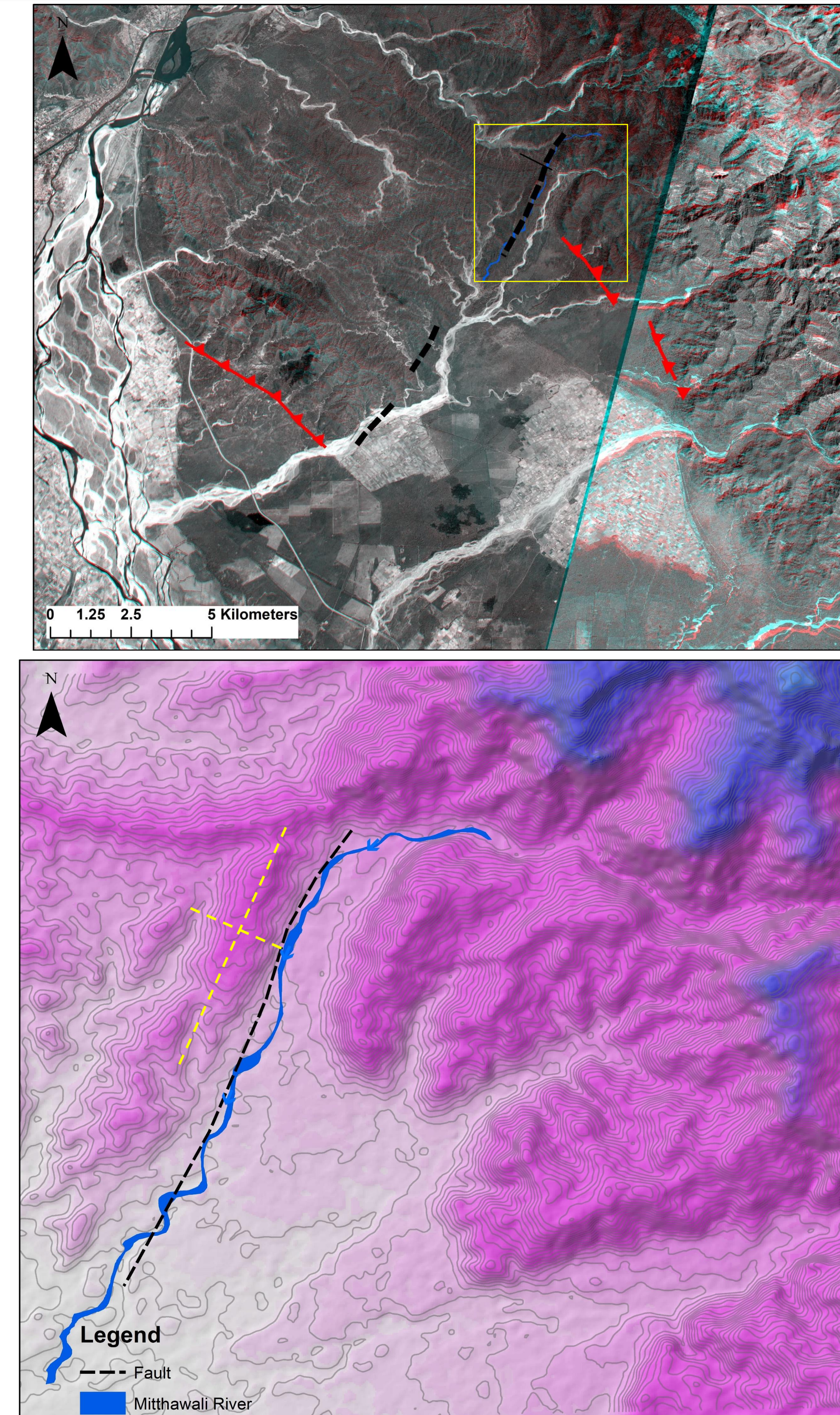


Fig: T2-T2' (E-W) elevation profile of the uplifted terrace (b) T1-T1' (N-S) elevation profile of the uplifted terrace. There is an upliftment of ~50 meters.



River Terraces of the Khoh River, the river course is tectonically controlled by the Khoh River Fault which offsets the Himalayan Frontal Fault by ~12 Km

Geomorphic Signatures of Haridwar Fault



Tectonic Activity in the Piedmont Zone

Himalayan piedmont is considered to be inactive but the Haridwar-Kotdwar piedmont zone shows signature of tectonic activity, which is visible as knee turn bending of rivers flowing through the piedmont zone, the blind thrust in the piedmont zone of this area is named as Najibabad Fault (NF). The rivers flowing through this has been victims of the upwarping caused by the NF. The Malin River has migrated twice in last 4 decades, the Gradient Length Anomalies calculated along the four rivers shows upliftment's along the zone where the rivers cross the NF.

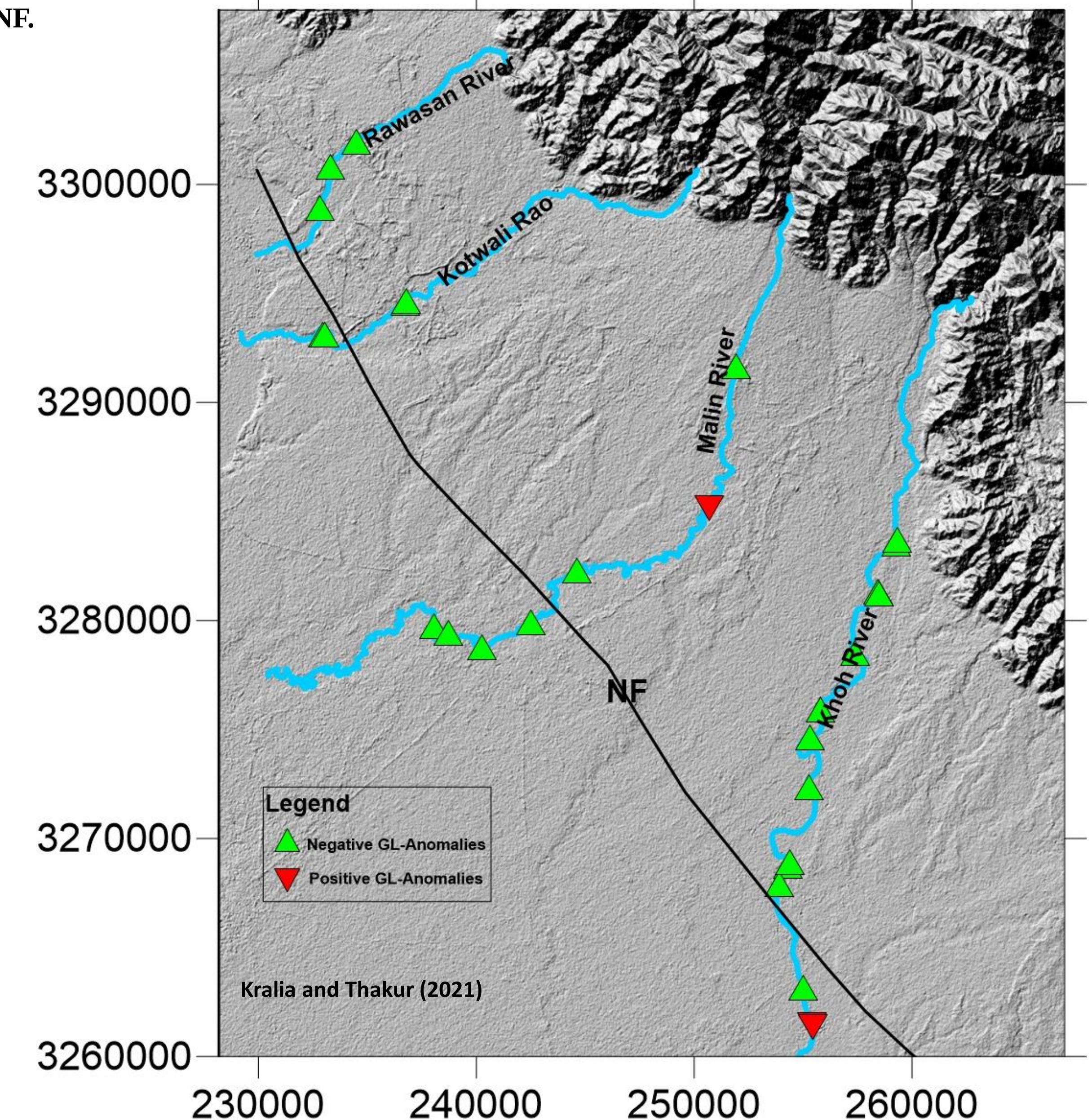


Fig: GL anomalies calculated for the four rivers in the piedmont zone. The green triangles are negative anomalies indicating an upliftment and red triangles are positive anomalies indicative of upliftment or erosion (map projection UTM, zone 44N).

Conclusions

- The Region is surrounded by faults from all four boundaries.
- Haridwar Fault and Khoh River Fault towards west and East of the region are tectonically active which are conspicuous through the uplifted terraces.
- The Himalayan Frontal Fault is the most active structure in the Himalayan regime bounds the region towards the north and the Najibabad fault is the next emergent fault which is also active and has been causing the migration of the rivers.
- This scenario makes this a fault bound region and a potential seismic hazard in future.

References

Kralia, A., Thakur, M., Geomorphic mapping and investigation of the uplifted piedmont zone between Haridwar and Kotdwar, Indo-Gangetic Plain, India, Applied Computing and Geosciences, Volume 9, 2021, 100047, <https://doi.org/10.1016/j.acags.2020.100047>.