ASSESSING HOTSPOTS OF SEDIMENT SOURCES AND RELATED SEDIMENT DYNAMICS THROUGH THE INTEGRATION OF GEOMORPHOLOGICAL DATA, SEDIMENT CONNECTIVITY AND SEDIMENT TRANSPORT MODELLING – THE HOTSED MODEL

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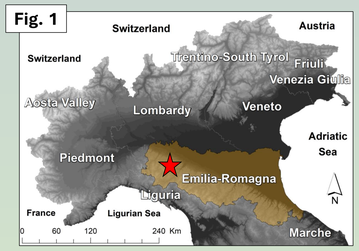
AIM OF THE RESEARCH

This research aims to introduce a novel methodology that integrates geomorphological spatial information derived from a detailed mapping approach with catchment-scale sediment connectivity. Thus, we developed a new GIS-based integrated model named **HOTSED**, designed for assessing potential hotspots of sediment dynamics at watershed scale.

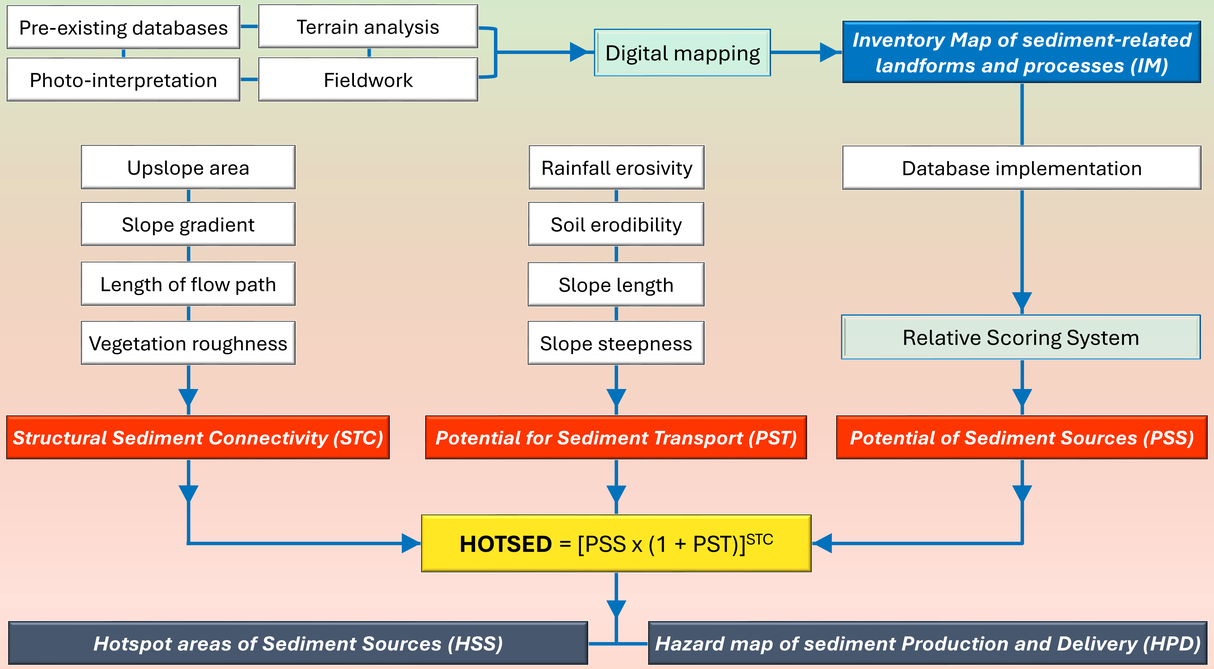
TEST AREA

Fig. 1



HOTSED was applied and tested in the upper Val d'Arda, which is a geomorphologically highly active Mediterranean watershed in the Northern Apennines, Italy (Fig. 1) (La Licata et al., 2023).

METHODOLOGICAL FRAMEWORK



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Cavalli M., Trevisani S., Comiti F., Marchi L., 2013. Geomorphometric assessment of spatial sediment connectivity in small Alpine catchments. Geomorphology, 188, 31-41.

Heckmann T., Cavalli M., Cerdan O., Foerster S., Javaux M., Lode E., Brardinoni F., 2018. Indices of sediment connectivity: opportunities, challenges and limitations. Earth Sci Rev., 187, 77–108.

La Licata M., Bosino A., Bettoni M., Maerker M., 2023. Assessing landscape features and geomorphic processes influencing sediment dynamics in a geomorphologically highly active Mediterranean agroecosystem: The upper Val d'Arda case study (Northern Apennines, Italy). Geomorphology, 433, 108724.

RESULTS AND DISCUSSION

HOTSED relies on a holistic approach, providing a simple and intuitive output resulted from the integration of geospatial information on: i) sediment-related geomorphic features (**IM**, Fig. 2); ii) the potential of these features as sediment sources (**PSS**, Fig. 3); iii) the potential sediment transport (**PST**, Fig. 4); and iv) structural connectivity based on landscape configuration, flow pathways, and land use (**STC**, Fig. 5) (Cavalli et al., 2013). This integration of input data, reflecting both external forcings and intrinsic properties of the system, accounts for both structural and functional aspects of connectivity (Heckmann et al., 2018).

HOTSED allows for the identification of sediment source hotspots (**HSS**, Fig. 6) and the derivation of the "relative hazard" for sediment production and delivery (**HPD**, Fig. 7). Application of **HOTSED** revealed high hazard near main channels, often linked to active landslides overlaid by processes like bank erosion and surficial water erosion. Linear hotspots corresponding to tributary drainages acting as corridor sources were also identified. Moreover, **HOTSED** successfully identified areas prone to store sediments in depositional landforms with low hazard, considering both low geomorphic potential and connectivity.

Fig. 2

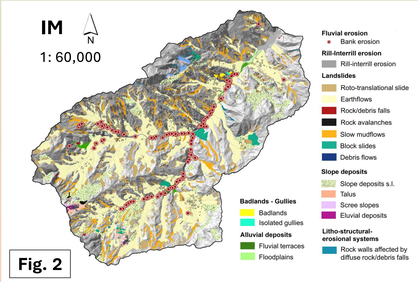


Fig. 3

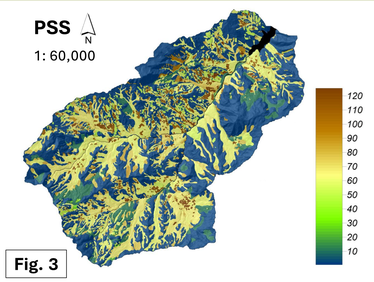


Fig. 4

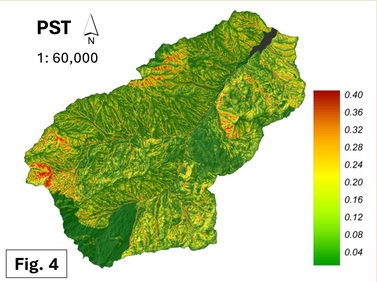


Fig. 5

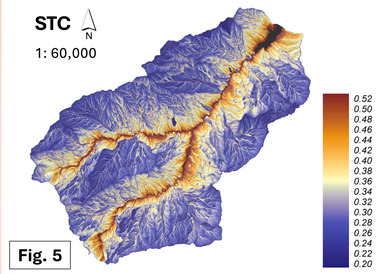


Fig. 6

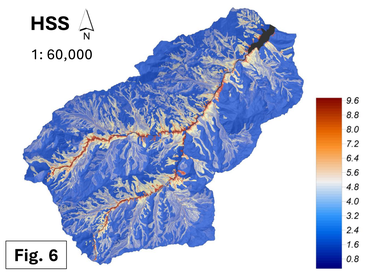
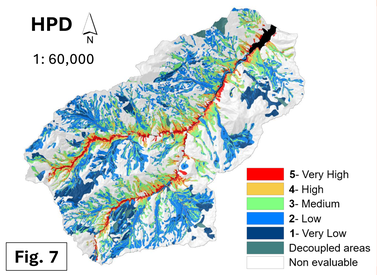


Fig. 7



CONCLUSION

Our conceptual model is generally applicable but proves to be particularly effective in areas characterized by complex and polygenetic geomorphic systems, such as the Northern Apennines. **HOTSED** offers a valuable tool for watershed authorities, providing the methodological framework to support a sustainable watershed management.