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Understanding the impacts of extreme hydro-meteorological events on railway infrastructure

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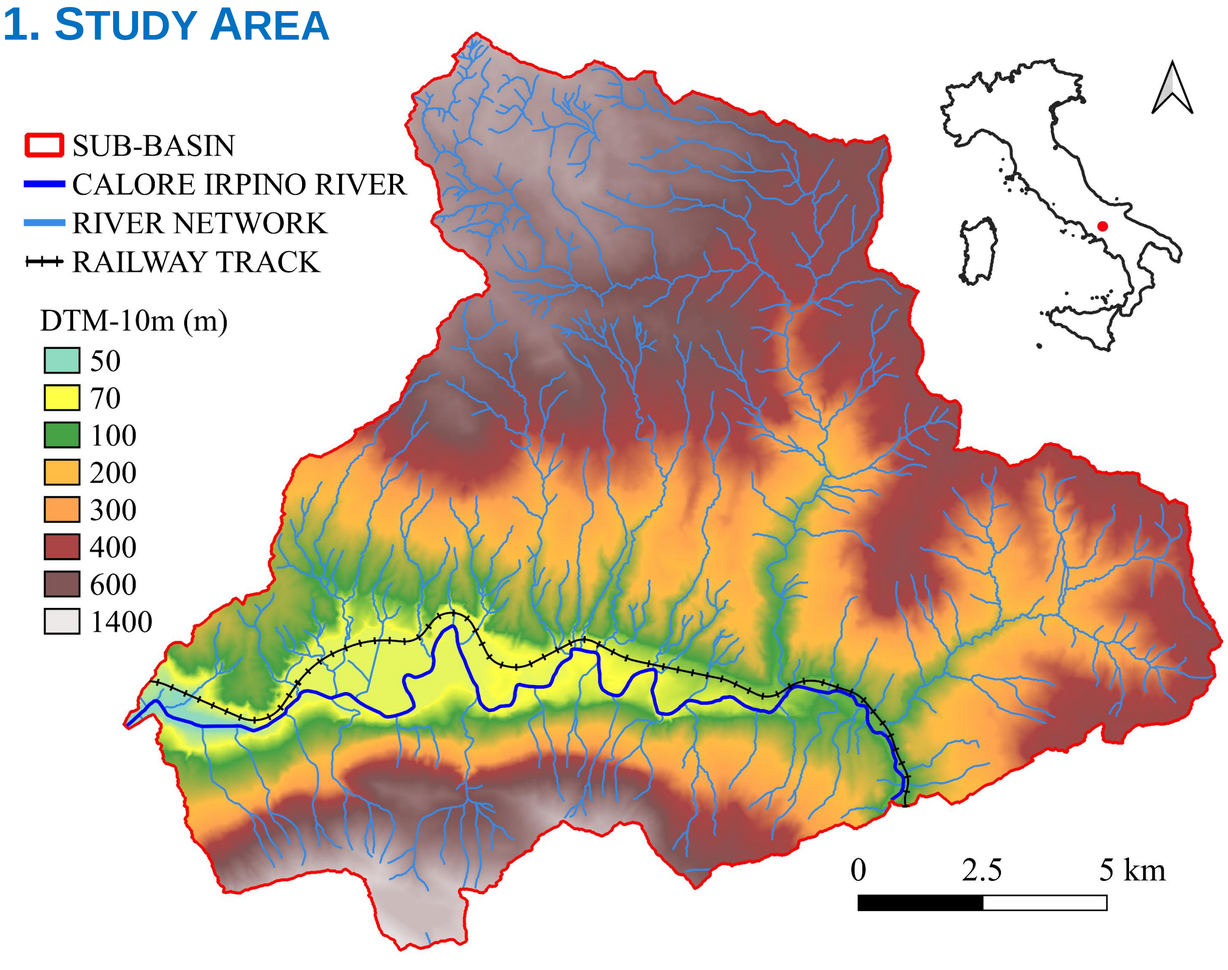
1. STUDY AREA



Portion of the Calore Irpino River basin in the Benevento province of Campania region, Southern Italy. The railway track, which belongs to the Napoli-Bari route, suffered performance failures and intense damages due the extreme hydro-meteorological event of 14th–15th October 2015.

2. MATERIALS AND METHODS

HEC-RAS
US Army Corps of Engineers

Integrated hydrologic-hydrodynamic 2D HEC-RAS model.
Rain-on-grid simulation (**direct rainfall modelling approach**[1]).

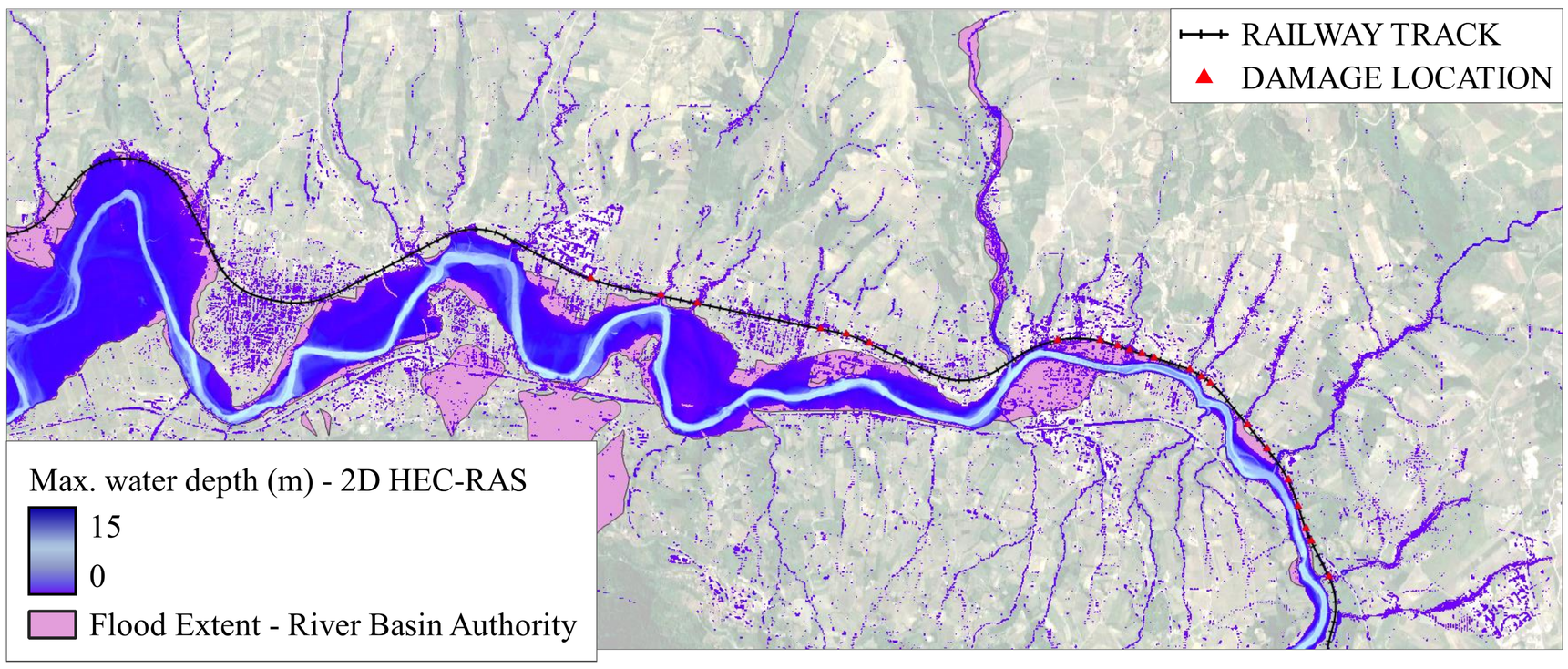
- **Data collection and elaboration**

A Digital Terrain Model (DTM) of 10 m[2] is analyzed in QGIS for the sub-basin delineation. The DTM-10m is merged with a DTM of 1 m from the Italian Ministry of Environment, mainly covering the floodplain, and a 2D computational mesh with cell size 20-5 m is created in HEC-RAS.

- **Selected storm and effective rainfall**

The simulated rainfall event lasts from 08:00 pm, 14th October, to 07:00 am, 15th October 2015. Precipitation data from 11 rain gauges operated by the regional Civil Protection Department are interpolated with the Thiessen Polygon approach in HEC-RAS. The transformation of rainfall to flood runoff is made in HEC-RAS with the Soil Conservation Service (SCS)[3] curve number (CN) method, which assigns to different areas in the computational domain a CN dimensionless value (ranging from 0 to 100) based on soil type, land use, vegetation cover and antecedent moisture conditions.

3. RESULTS



The direct rainfall modelling allows to individuate the tributary creeks along which rapid flows may occur, with possible damage, which are not included into the River Basin Authority flood hazard maps[4].

Possible sources of damage are

- flooding of railway embankment, with earth erosion,
- track flooding due to flow level rising,
- track flooding by overland flow,
- damage of retaining walls due to infiltration,
- pressurization of culverts and small bridges.

4. PRELIMINARY CONCLUSIONS

- A case study approach is adopted to investigate the cause-and-effect relations between hydro-meteorological hazards and railway damage.
- We distinguish between flood events (i) related to river overflow, and (ii) directly linked to heavy rainfall (that generate hydraulic instability effects on slopes).
- With the direct rainfall modelling approach in 2D HEC-RAS, we identify not only the railway sections intersecting with flooded areas, but also potential damage sources caused by direct rainfall, which are not currently incorporated into official hazard maps.
- We validate the numerical results against the recorded historical damages.

REFERENCES

1. Costabile, P., Costanzo, C., Ferraro, D., Barca, P.: Is HEC-RAS 2D accurate enough for storm-event hazard assessment? Lessons learnt from a benchmarking study based on rain-on-grid modelling. Journal of Hydrology 603, (2021).
2. Tarquini S., Isola, I., Favalli, M., Mazzarini, F., Bisson, M., Pareschi, M.T., Boschi, E.: TINITALY/01: a new Triangular Irregular Network of Italy. Annals of Geophysics 50, 407–425 (2007).
3. Soil Conservation Service (SCS). National Engineering Handbook; Section 4, Hydrology (NEH-4). U.S. Department of Agriculture: Washington, DC, USA (1985).
4. Trigila, A., Iadanza, C., Lastoria, B., Bussettini, M., Barbano, A.: Dissesto idrogeologico in Italia: pericolosità e indicatori di rischio - Edizione 2021. ISPRA, Rapporti 356/2021 (2021).

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