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

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1. STUDY AREA

- Sub-basin
- Calore Irpino River
- River network
- Railway track

DTM-10m (m)
- 0
- 50
- 100
- 200
- 300
- 400
- 600
- 1400

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

Integrated hydrologic-hydrodynamic 2D HEC-RAS model. Rain-on-grid simulation (direct rainfall modelling approach¹).

- Data collection and elaboration
  A Digital Terrain Model (DTM) of 10 m² 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) 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

- Railway track
- Damage location

Max. water depth (m) - 2D HEC-RAS
- 15
- 0

Flood Extent - River Basin Authority

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


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