Analysis and hindcast simulations of an extreme rainfall event in the Mediterranean area: the Genoa 2011 case

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On November 4th, the city of Genoa, Liguria region capital, was gutted by a torrential rainfall event with about 500 millimeters of rain – a third of the average annual rainfall - fell in 5 hours (between 10 and 15 UTC). Six people were killed. Television footage showed cars floating freely and people wading knee-deep through flooded streets.

Flash flood of the Genoa town center.
Top right corner: the similar event of 1970
Flash Flood Nov. 4th, 2011 – Genova. Synoptic scale
Radar maps from the Italian radar network showing the intense thunderstorm wandering along the Liguria coastline (1-15UTC): White ellipsoid identifies the mostly affected area.
Observed rainfall depth 9-15 UTC

Observed rainfall depth 0-24 UTC
WRF (v 3.3.1) model settings:
domains d01 (dx=dy= 5 km) and d02 (dx=dy= 1km) adopted for WRF simulations

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The grid spacing ranges between 5-1 km should make the model able to resolve explicitly, albeit crudely, many convective processes. More studies have investigated numerical simulations at the so-called “grey-zone” resolution (Gerald, 2007) to understand if convective parameterization is still able to work correctly on those scales. It is still an open question (Yu and Lee, 2010).
Wind field prediction at 10m on November 4th, at 12 UTC, 1 km grid spacing. Panels a) and b) refer to E-E-W and E-E-T settings (28 vertical levels), with IC and BC from IFS model – November 3rd 12 UTC. Panels c) and d) refer to E-E-W and E-E-T settings (28 vertical levels), with IC and BC from IFS model – November 4th 00UTC.
QPF on November 4th, 1 km grid spacing, 28 vertical levels, IC and BC from IFS model (run on November 4th 00UTC). First line: QPF 09-15 UTC on November 4th with panels a) E-E-W and b) E-E-T settings. Second line: daily QPF on November 4th with panels c) E-E-W and d) E-E-T settings.
QPF on November 4th, 0-24UTC, 1 km grid spacing, E-E-T setup with 84 vertical levels and IC and BC from IFS model – November 4th 00UTC. Panels a) refers to $N_t = 25 \times 10^6 \text{ m}^{-3}$, b) to $N_t = 50 \times 10^6 \text{ m}^{-3}$, c) to $N_t = 100 \times 10^6 \text{ m}^{-3}$, and d) to $N_t = 500 \times 10^6 \text{ m}^{-3}$. 
Rain wrapped Tornado/Waterspout taken from Sant' Ilario -GE- looking SW on Nov. 4th at 12.30 PM and 12.35 PM

DRIHM EXPERIMENT SUITES

Experiment Suite 1
Rainfall

Experiment Suite 2
Discharge

Experiment Suite 3
Water Level, Flow & Impact

NWP Multi-model Ensemble
Stochastic Downscaling
Observation Datasets

Hydrological Drainage Model

Pluvial Flooding (from Runoff)

Impact

Hydraulic Open Channel Flow Model

Fluvial Flooding (from River)

Groundwater Flooding
DRIHM MODELS

Meteorologic
- Cb-TRAM (DLR)
- Arome EPS (CNRS)
- Meso-NH (CNRS)
- RainFARM (CIMA)
- COSMO-Model (CIMA)
- WRF-ARW (CIMA)
- PhaSt (CIMA)
- WxFUSION (DLR)
- Rad-TRAM (DLR)
- WRF-NMM (RHMSS)

Hydrologic
- Continuum (CIMA)
- DRift (CIMA)
- HBV (RHMSS)
- RIBS (UPM)
- HYPROM (RHMSS)

Impact
- SISYPHE (HR Wallingford)
- Property Damage (HR Wallingford)

Hydraulic
- MASCARET (HR Wallingford)
- SOBEK-FLOW (Deltarees)
- TELEMAC-2D (HR Wallingford)
- RFSM (HR Wallingford)
- Delft3D-FLOW (Deltarees)
- Inundator (CIMA)
DRIHM Unified Interface Concept
Discussion