A numerical study of the Livorno 9-10 September 2017 flash flood

Guido Cioni (1,2), Diego Cerrai (3,4), Antonio Ricchi (6,7), Emmanouil Anagnostou (4), Efthymios
Nikolopoulos (4), Sandro Carniel (6), Davide Bonaldo (6), and Marco Borga (5)

(1) Max Planck Institute for Meteorology, Atmosphere in the Earth System, Hamburg, Germany
(guido.cioni@mpimet.mpg.de), (2) Hans Ertel Center for Weather Research (HErZ), (3) Hydrometeorology and Hydrologic
Remote Sensing group, University of Connecticut, Storrs, USA, (4) Department of Civil and Environmental Engineering,
University of Connecticut, Storrs, USA, (5) Department of Land, Environment, Agriculture and Forestry (TESAF), University
of Padova, Italy, (6) ISMAR, CNR (National Research Council), Venezia, Italy, (7) Department of Life and Environmental
Sciences, Marche Polytechnic University, Ancona, Italy

In the night between September, 9th. and 10th. 2017 a Heavy Precipitation Event interested the coastal areas of
Tuscany, Italy. Several pulsating thunderstorms developed over the sea due to a convergence of south-easterly
winds and a fast-moving front of north-easterly winds, following a configuration typical of Heavy Precipitation
Events over the Gulf of Genoa already described in literature. Over 200 mm/2 hours of precipitation were recorded
in the vicinity of Livorno where flash floods occurred the day after and caused 9 casualties. Early estimates of
returning periods for the 12h-accumulated precipitation at several stations yielded values larger than 200 years,
making this one of the strongest Heavy Precipitation Event in this area. Our goal is to describe the event making
use of observation (rain gauges and weather radars) and to verify whether a state-of-the-art Numerical Weather
Prediction model is able to forecast the event.
We use two different models: WRF-ARW and ICON-LEM with similar configurations and a resolution of 1 km.
Both models show a good forecast skill in terms of the localization and magnitude of the precipitation maxima over
the studied region. However, since ICON-LEM performs better than WRF-ARW we employ this model with higher
resolution (150 m) and a LES parametrization of sub-grid scale turbulence to investigate the effect of resolution on
the forecast of the event. In all models, small differences in the modelling set-up cause a visible deterioration of the
forecast. Finally, a different Sea Surface Temperature does not significantly affect the results in terms of intensity,
but only slightly in terms of the localization of the phenomenon.