Heavy Rainfall Identification within the Framework of the LEXIS Project: The Italian Case Study

LEXIS

Large-scale EXecution for Industry & Society

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Heavy Rainfall Identification within the Framework of the LEXIS Project: The Italian Case Study

Paola Mazzoglio[1,2], Antonio Parodi[3], Andrea Parodi[3], Lorenza Bovio[2], Jan Martinovic[4]

[1] Politecnico di Torino (IT); [2] ITHACA (IT); [3] CIMA Research Foundation (IT); [4] IT4Innovations, VSB – Technical University of Ostrava (CZ)

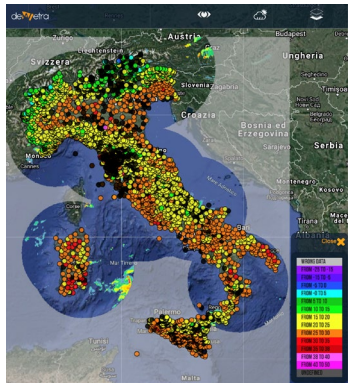
LEXIS (Large-scale EXecution for Industry and Society) H2020 project is currently developing an advanced system for Big Data analysis that takes advantage of interacting large-scale geographically-distributed HPC infrastructure and cloud services [a]. In the framework of LEXIS Weather and Climate Large-scale Pilot, CIMA Research Foundation is running a 3 nested domain WRF (Weather Research and Forecasting) model with European coverage, radar assimilation over the Italian area (innermost domain at 2.5 km grid spacing), and daily updates with 48 hours forecast. WRF data is processed by ITHACA ERDS (Extreme Rainfall Detection System) [b], an early warning system for the monitoring and forecasting of heavy rainfall events. The entire WRF - ERDS workflow was applied to two of the most severe heavy rainfall events that affected Italy during 2020.

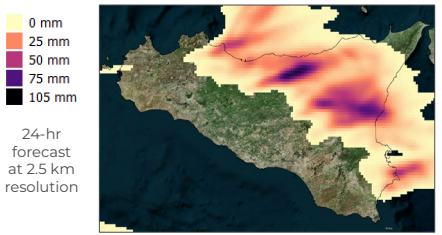
PALERMO – 15th July 2020

An extreme rainfall event affected Palermo (Sicily) during the afternoon of 15th July 2020: more than 130 mm of rain fell in about 2.5 hours, producing widespread damages due to urban flooding phenomena.

The event was not properly forecasted by meteorological models operational at the time of the event, and the Italian Civil Protection did not issue an alert on that area (including Palermo). During that day, only a yellow alert for thunderstorms was issued on northern-central and western Sicily, on a scale from yellow (low) to orange (medium) to red (high). Furthermore, in the afternoon the radar was not measuring due to technical problems.

Within LEXIS, no alert was issued using GFS data due to the severe underestimation of the amount of forecasted rainfall. Conversely, a WRF modelling experiment (three nested domains with 22.5, 7.5 and 2.5 km grid spacing, innermost over Italy) was executed, by assimilating the National radar reflectivity mosaic and in situ weather stations from the Italian Civil Protection Department, and it resulted in the prediction of a peak rainfall depth of about 35 mm in 1 hour and 55 mm in 3 hours, roughly 30 km far apart the actual affected area, thus values supportive at least a yellow alert over the Palermo area.



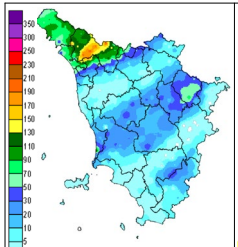


24-hr forecast at 2.5 km resolution

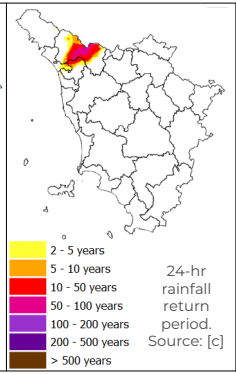
Heavy rainfall alerts provided by ERDS using WRF data as input

TOSCANA REGION – 4th June 2020

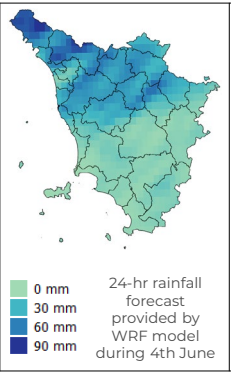
In the northern part of the Region more than 100 mm of rainfall were recorded in 3 hours, corresponding to an estimated return period of about 200 years. The Italian Civil Protection Department issued an orange alert for thunderstorms. Despite the slight underestimation, WRF model was able to properly forecast the spatial distribution of the rainfall pattern. Thanks to WRF data, information about the locations that would be affected by the event were available in the early morning, several hours before the event affected these areas.



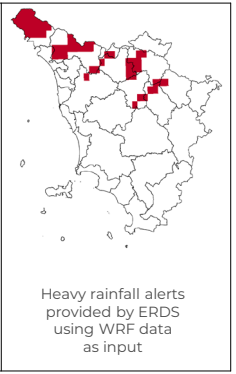
24-hr rainfall depth recorded by rain gauges during 4th June. Source: [c]



24-hr rainfall return period. Source: [c]



24-hr rainfall forecast provided by WRF model during 4th June



Heavy rainfall alerts provided by ERDS using WRF data as input

CONCLUSIONS

Obtained results highlight how improved rainfall forecast, made available thanks to the use of HPC resources, significantly increases the capabilities of an operational early warning system in the extreme rainfall detection. Global-scale low-resolution rainfall forecasts like GFS one are in fact widely known as good sources of information for the identification of large-scale precipitation patterns but lack precision for local-scale applications. Future experiments will include the assimilation of atmospheric data from personal weather stations at the European scale.

CONSORTIUM

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CONTACT

Presenter: Paola Mazzoglio - paola.mazzoglio@polito.it
LEXIS Coordinator: Jan Martinovic - jan.martinovic@vsb.cz
Co-design Manager: Olivier Terzo – olivier.terzo@linksfoundation.com
LEXIS WP7 Lead: Antonio Parodi - antonio.parodi@cimafoundation.org
LEXIS Project Website: www.lexis-project.eu

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