

Identification and characterization of extraordinary rainstorms in Italy

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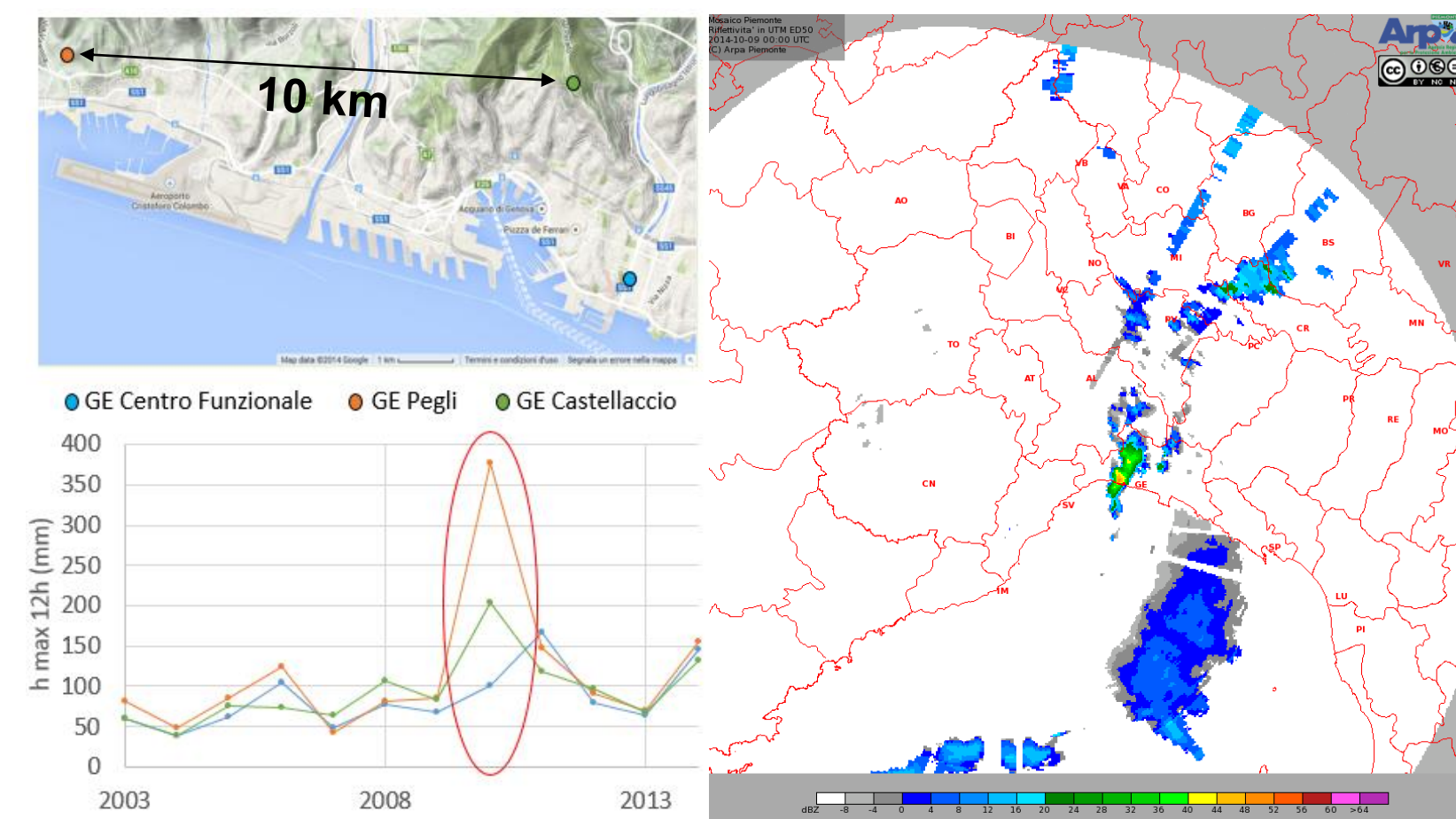
The problem

Despite its generally mild climate, Italy, as most of the Mediterranean region, is prone to the development of severe rainfall events with “extraordinary” rainfall intensities. The main triggering mechanisms of these events is nowadays quite well known, but more research is needed to transform this knowledge in directions to build updated rainstorm hazard maps at the national scale. Moreover, a precise definition of “extraordinary” events is still lacking. Until now, the lack of a unique dataset of rainfall extremes has made the above task difficult to reach.

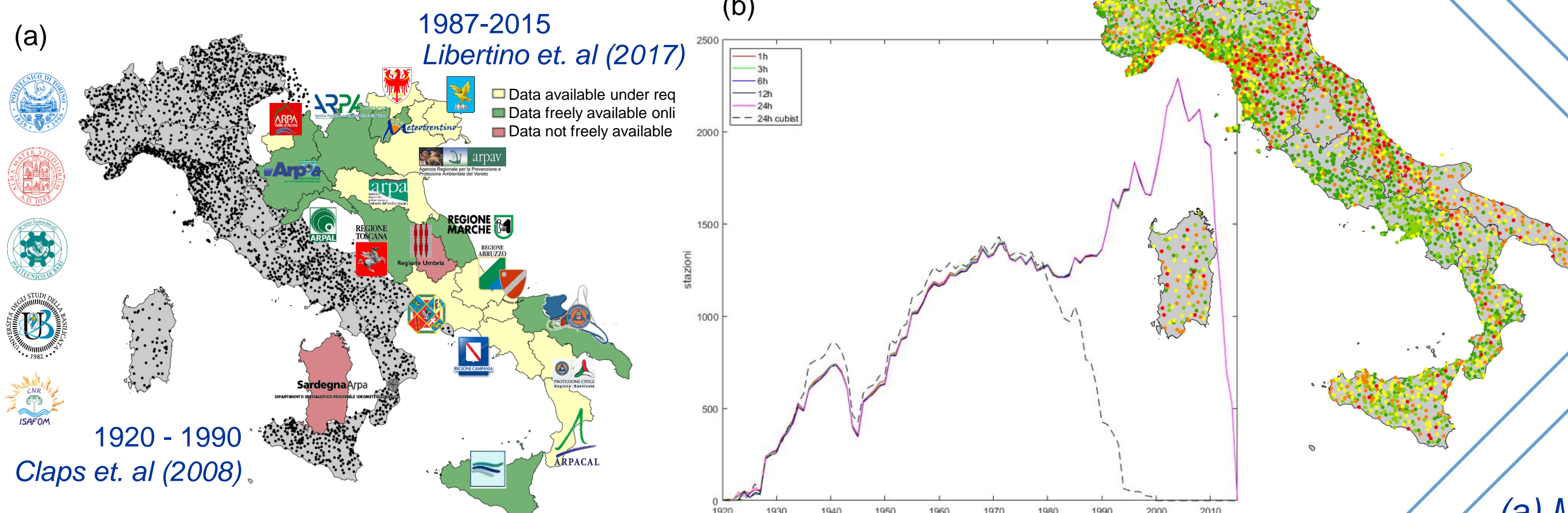
MAIN OBJECTIVES:

- Development of an updated consistent database of annual maximum rainfall in Italy
- Analysis of the distribution of extreme rainfall in Italy
- Preliminary assessment of the need to consider a separate “super-extreme” population of events

Problems of spatialization dealing with localized “extraordinary” rainfall amounts: the Genova 2010 case.

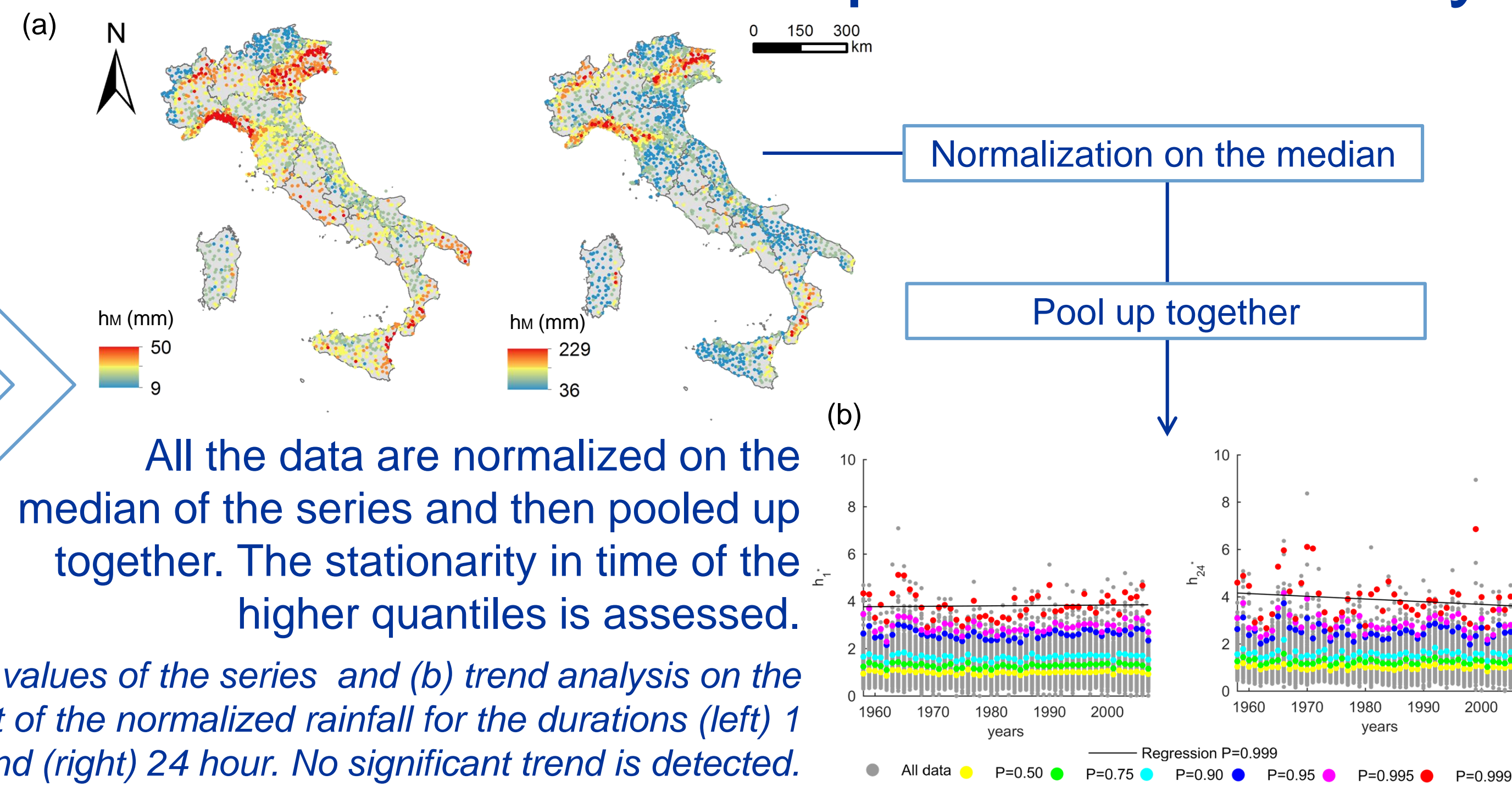


Data from 21 local authorities are cleaned and merged to develop an updated dataset of annual maximum rainfall depth for 1-3-6-12-24 hours durations.



(a) Considered datasets, data providers and data availability. (b) Number of rain gauges per year. (c) Spatial distribution of the rain gauges.

Normalization and temporal stationarity

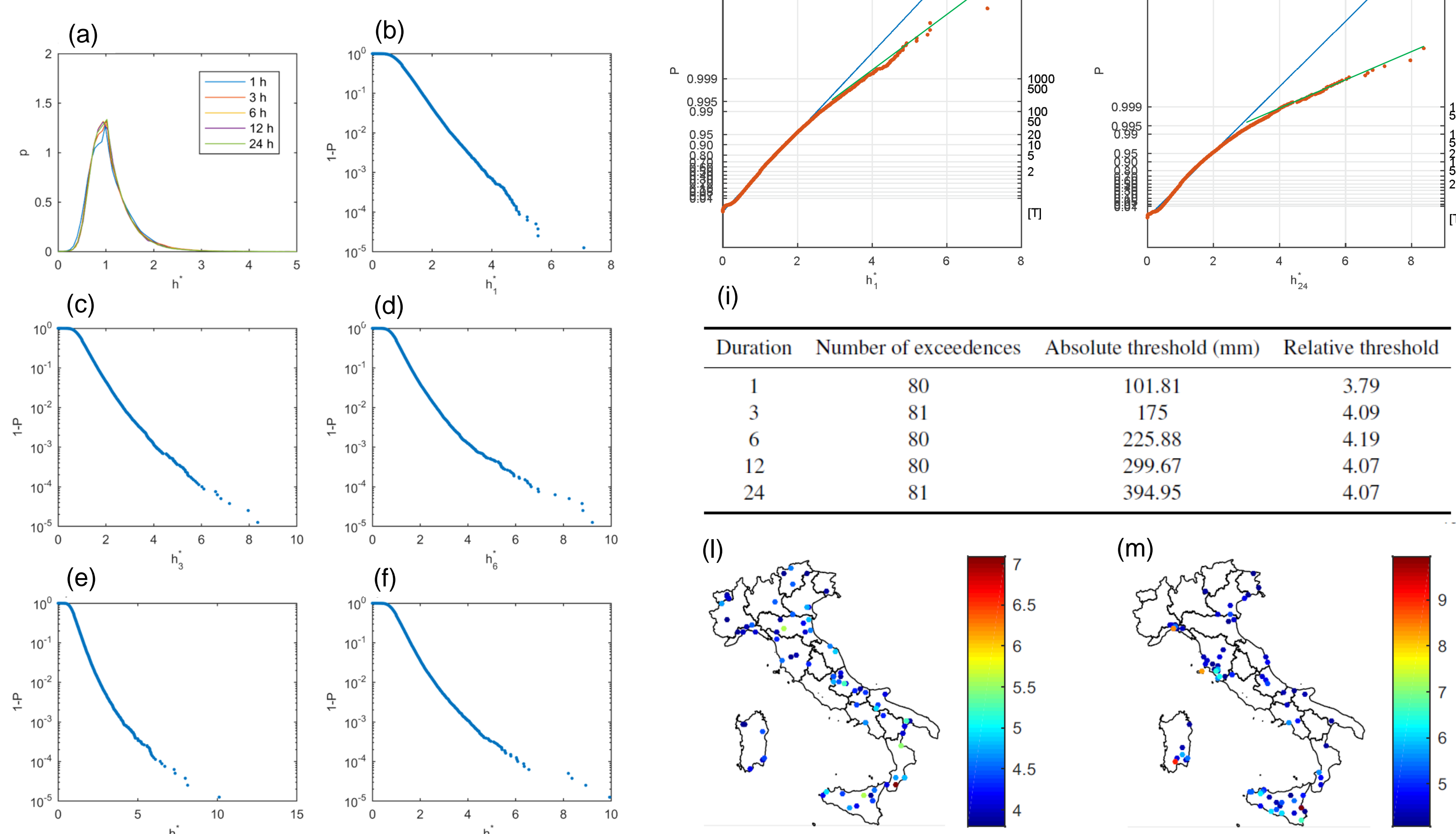


All the data are normalized on the median of the series and then pooled up together. The stationarity in time of the higher quantiles is assessed.

(a) Median values of the series and (b) trend analysis on the dataset of the normalized rainfall for the durations (left) 1 hour and (right) 24 hour. No significant trend is detected.

Analysis and thresholds

The distribution of the normalized values is analysed and the effects of some thresholds is explored.



(a) Empirical PDFs for the 5 durations and empirical frequency of exceedances (1-P) for durations from (b) 1 to (f) 24 hours. Normalized values on Gumbel probability plot for durations (g) 1 and (e) 24 hours. (i) Threshold values related to a cumulative probability of 1/1000 overall. Normalized values over-1/1000 threshold for durations (g) 1 and (e) 24 hours.

References

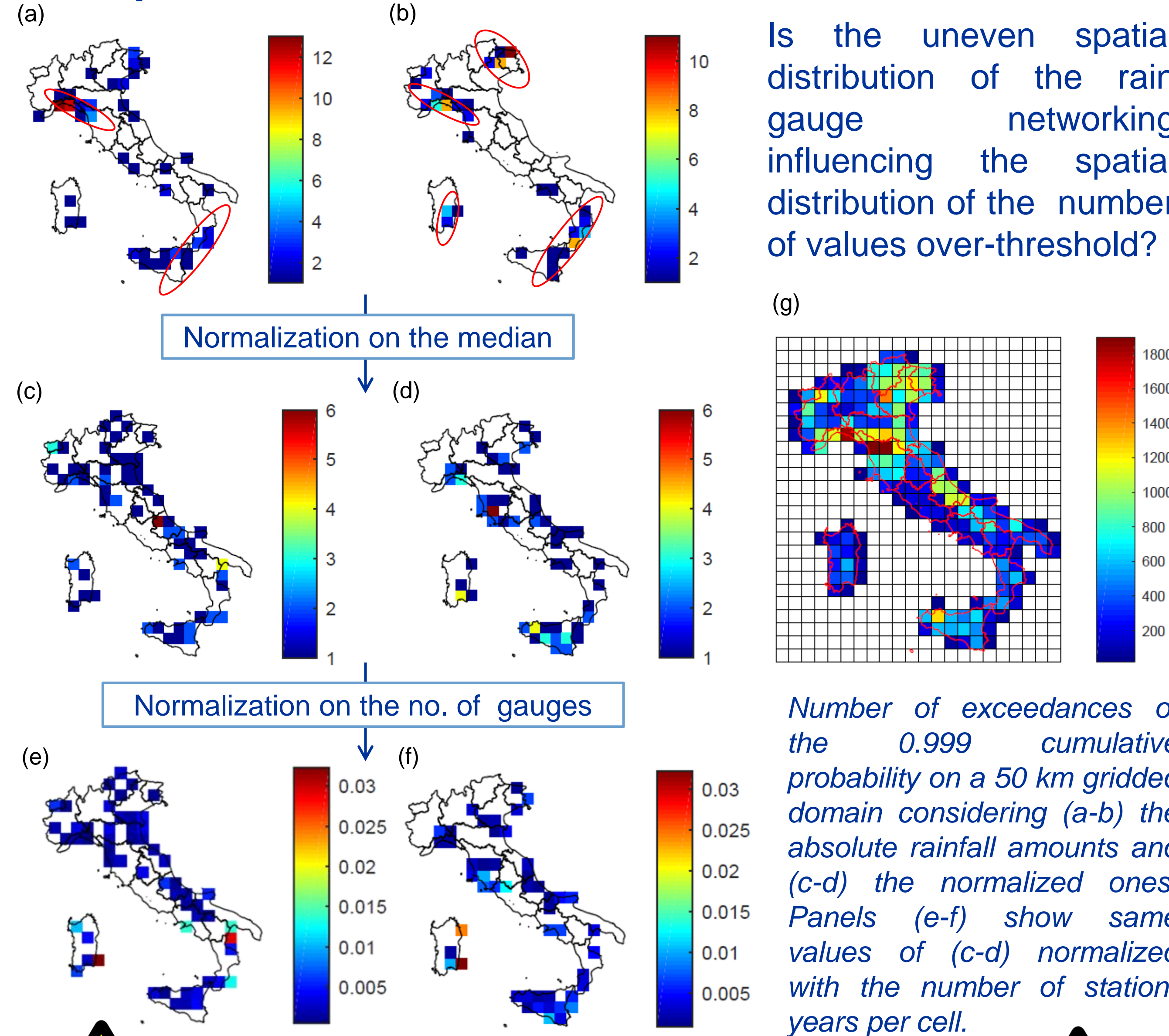
Claps, P., Barberis, C., De Agostino, M., Gallo, E., Laguardia, G., Laio, F., Miotto, F., Plebani, F., Vezzù, G., Viglione, A. and Zanetta, M. (2008), Development of an information system of the Italian basins for the CUBIST project. In: EGU General Assembly 2008, Vienna.

Kouroutzoglou, J., Flocas, H. A., Keay, K., Simmonds, I. and Hatzaki, M. (2011), Climatological aspects of explosive cyclones in the Mediterranean. Int. J. Climatol., 31: 1785–1802. doi:10.1002/joc.2203

Libertino, A., Ganora, D. and Claps, P. (2017), Assessment of the hazard related to extraordinary rainstorms in Italy [under submission].

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Spatial distribution of the extremes



Is the uneven spatial distribution of the rain gauge networking influencing the spatial distribution of the number of values over-threshold?

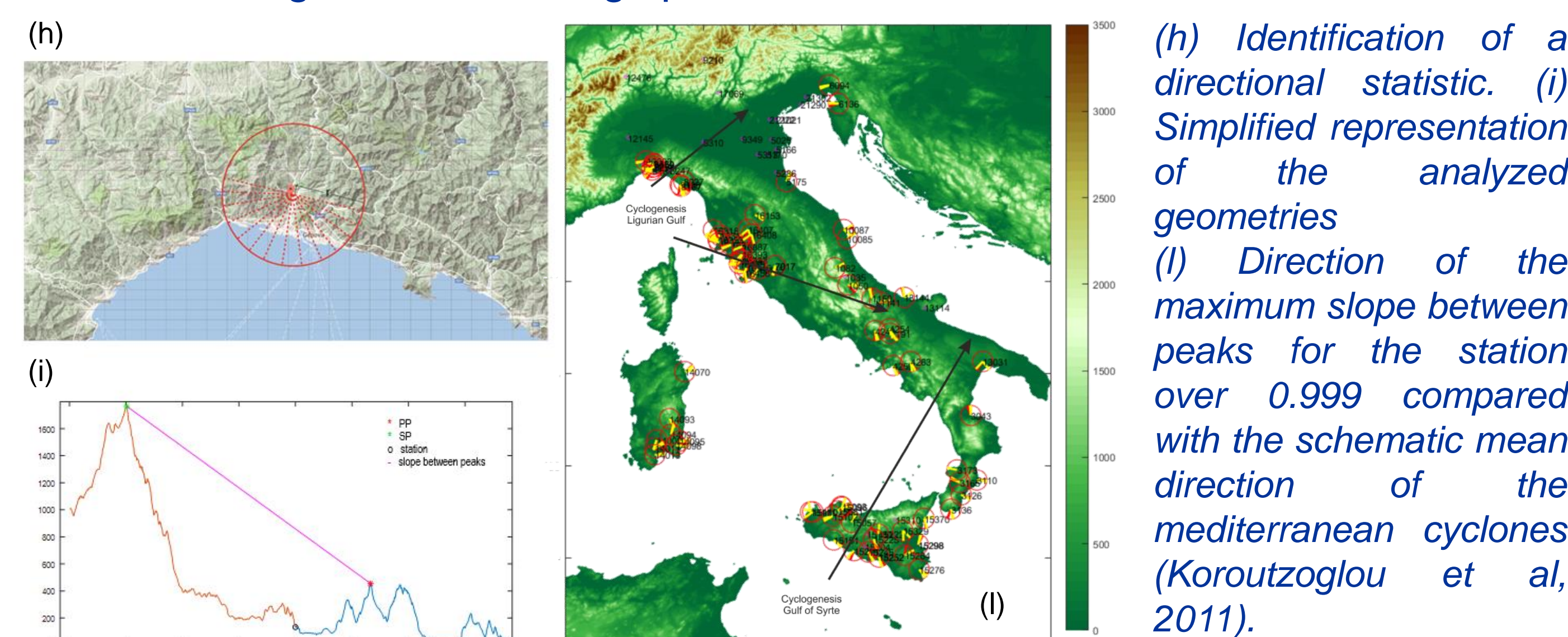
Number of exceedances of the 0.999 cumulative probability on a 50 km gridded domain considering (a-b) the absolute rainfall amounts and (c-d) the normalized ones. Panels (e-f) show same values of (c-d) normalized with the number of station-years per cell.



OPEN ISSUES and FUTURE DEVELOPMENTS



Definition of morphologic directional indices possibly correlated to the past events to integrate the missing spatial historical information.



(h) Identification of a directional statistic. (i) Simplified representation of the analyzed geometries. (l) Direction of the maximum slope between peaks for the station over 0.999 compared with the schematic mean direction of the mediterranean cyclones (Kouroutzoglou et al, 2011).